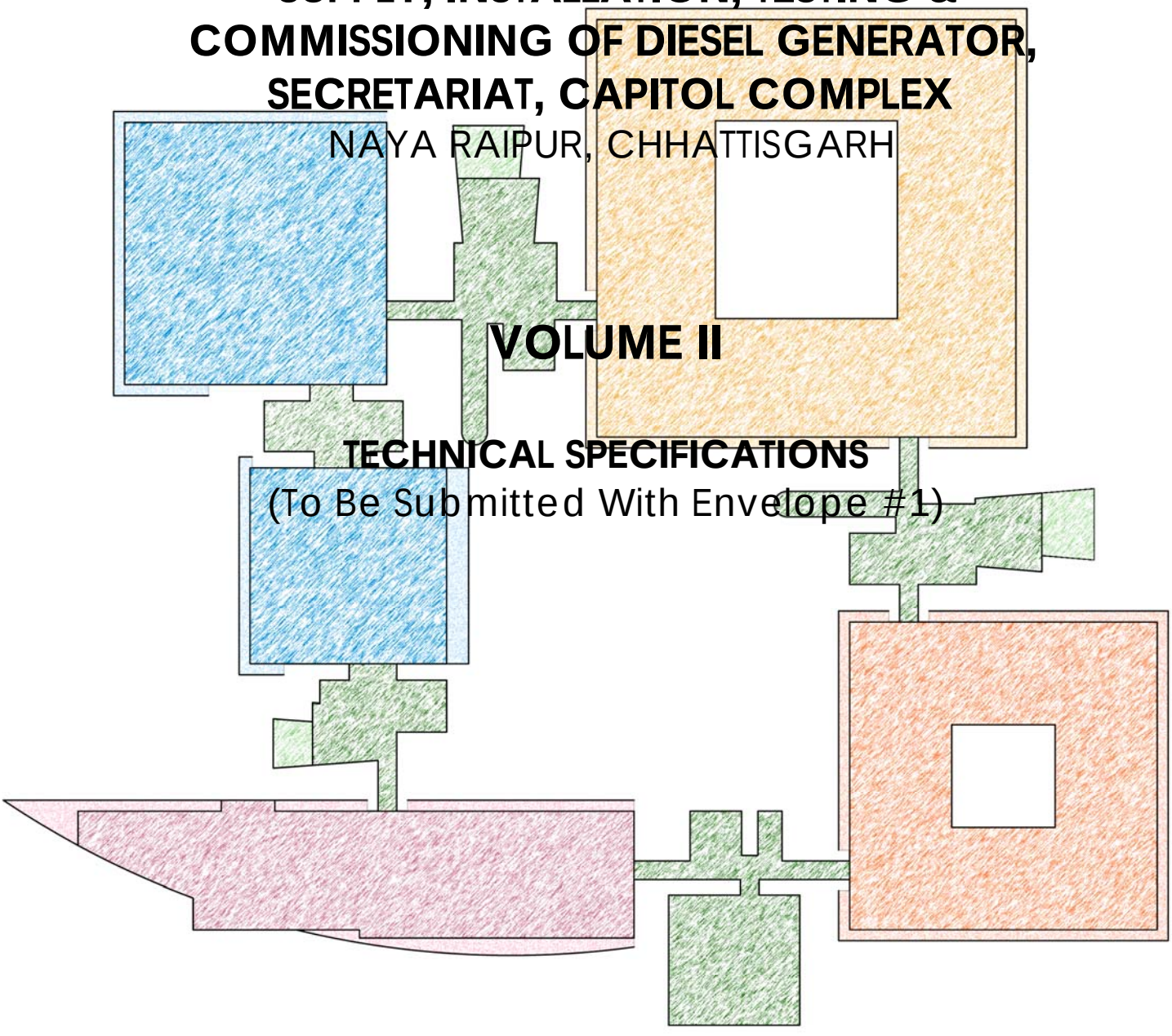
NAYA RAIPUR DEVELOPMENT AUTHORITY

TENDER

FOR

SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF DIESEL GENERATOR, SECRETARIAT, CAPITOL COMPLEX

NAYA RAIPUR, CHHATTISGARH



VOLUME II

TECHNICAL SPECIFICATIONS

(To Be Submitted With Envelope #1)

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architecture & environment

TECHNICAL SPECIFICATIONS - DIESEL GENERATOR SET WITH ACOUSTIC CANOPY

1 GENERAL :

1.1 SCOPE :

This general specification together with the equipment sheets and attachments defines the minimum requirements the design, performance, inspection, testing and supply diesel engines for general industrial purposes.

1.2 The construction, design and rating of the diesel engine shall meet fully, the requirements of the specified driven machine and the Vendor shall select and provide the requisite ancillaries and controls with the diesel engine for its safe and satisfactory operation.

1.3 No deviations or exceptions from this specification shall be permitted without the written approval of the purchaser. Intended deviations supported by reasons there of shall be separately listed by the vendor and submitted with the bid for the consideration of the Purchaser.

1.4 Compliance with this specification shall not relieve the vendor of the responsibility of furnishing equipment and accessories of proper design, materials and workmanship to meet the specified operating conditions.

1.5 This general specification supplements the specific requirements contained in the attached equipment data sheets. In the event of any contradiction between the two, the information contained in the latter shall govern.

1.6 Other attachments of the Material Requisition from a apart of this specification.

1.7 TERMS AND DEFINITIONS:

1.7.1 The Net Calorific value of fuel is defined as the heat resulting from the complete combustion of a unit quantity of fuel oil and air, without condensation of the water vapor. A net calorific value of 9,720 Kcal/Kg (As per IS : 1460 Rev.2) shall be considered while declaring the fuel consumption and for testing purposes.

1.7.2 The unit of horse power as defined in this specification is the metric horse power equivalent to 4,500 n-Kg/Min. The horse power in F.P.S. system is equal to 1.014 metric horse power.

1.7.3 Other terms used in this specification or in the equipment data sheets are as defined in the latest edition of British Standard-5514.

2 STANDARD OPERATING CONDITIONS :

2.1 The standard operating conditions shall be defined in the latest edition of B.S.-5514 unless otherwise mentioned specifically in the equipment data sheet.

3 RATED POWER OUTPUT AND SPEED :

3.1 The diesel engine rating shall be the net output in brake horse power, which the engine is capable of delivering continuously at the stated crank shaft speed under the conditions specified under Clause 2.0 above, provided the engine is maintained in good operating condition and is serviced / overhauled regularly as per the schedules laid down by the Manufacturer.

3.2 No negative tolerance shall be allowed on the diesel engine rating specified by the Vendor in the equipment data sheets.

3.3 The engine shall be capable of satisfactorily providing an output 10 percent in excess of the continuous rating defined above, at the same speed for one hour in any period of 12 hours consecutive running i.e. the engine shall be prime rated and continuous duty engine.

3.4 The normal power requirement of the engine driven radiator fan or the coolant pump and the battery charging dynamo shall be clearly stated for the engine which is so equipped.

3.5 Unless otherwise specified in the equipment data sheets, the site rating of the engine shall be worked out considering the duration's specified under the latest edition of B.S.-5514 and the power absorb by all the engine driven ancillaries shall also be deducted.

4 DESIGN & CONSTRUCTION :

4.1 GENERAL :

4.1.1 The Diesel engine offered shall be of the regular production models of the manufacturer for industrial applications and already type tested either at the manufacturer's works or outside. The type test report shall be furnished to the purchaser for his review if so desired.

In case the proposed engine model has not been type tested, vendor shall furnish with the offer, a reference list of its existing industrial installation and at least three of these engines, should have completed, 5,000 houses of running at site.

4.1.2 Unless otherwise specified in the equipment data sheets, the diesel engine shall be provided with class A2 governing as per the latest edition of B.S. 5514.

4.1.3 The "Cyclic irregularity" of the diesel engine for direct coupling to an electric generator, "angular deviation of p73 A.C. generators " driven by diesel engine for parallel operation, and the "engine governor speed droop characteristics ", shall be restricted to the values specified under the latest edition of B.S.-5514.

4.1.4 In case diesel engines are required to drive generators in parallel, the governor fuel injection pumps provided should have identical characteristics and the speed-load curves shall be made available to the purchaser's inspector for his scrutiny and approval prior to load testing. The vendor shall maintain proper record for such curves to ensure additional diesel engines if required in future with identical characteristics, could be made available to the purchaser. A set of the said curves shall also be furnished to the purchaser.

4.1.5 The vendor shall be responsible for carrying out torsion analysis of the dynamic system as specified in the latest edition of British Standard-5514. The results in the fork of a report shall be submitted to the purchaser for scrutiny and reference, if desired.

4.1.6 Vendor shall provide the flexible exhaust connections to connect the engine exhaust to the exhaust piping. The connection should be able to with stand the temperature and pressure generated by the exhaust gases. **The required size of the exhaust piping and flexible connection should be clearly specified by the vendor. The size chosen should be able to release the peak quantity of smoke that can generate with out any problem. The exhaust piping shall be fully insulated with 12. 5 mm thick resin bonded fibre glass rigid boards having 48 kg / cub.mtr density, covered with RP tissue paper & 36 G perforated Aluminium sheet.**

4.1.7 If specified, the common base plate for mounting the diesel engine and the driven equipment as well as the flexible coupling, shall be supplied by the vendor.

4.1.8 Vendor shall indicate in the bid, the ISO Noise Level rating of the diesel engine with the offered exhaust silencer/s.

4.2 ENGINE STARTING:

4.2.1 Diesel engines shall be capable of starting without the use of cold starting aids so long the ambient temperature at the site is not below 4^{O} C.

4.2.2 Where the diesel engine is specified / offered with battery starting arrangement, the starter motor shall be capable of starting the engine without having to disengage the driven machine with the help of a clutch. Where the diesel engine is equipped with a dual starter the synchronizing switch and the corresponding wiring / connection with the starter motor shall be provided by the vendor.

In case of diesel engines driving fire water pumps, besides the engine mounted dynamo and voltage regulator, the Vendor shall also provide automatic battery charging equipment suitable for taking power from an alternating current power source and mounted on a free standing type of a panel.

The battery charger if specified in the equipment data sheet, shall be capable of delivering a current equal to 100 percent of the 20 hour discharge rate of the battery and also equipped with charging rate selector device.

4.2.3 Where the diesel engine is specified / offered with compressed air starting, the Vendor shall also provide the air compressor driven by a diesel engine / electric motor and equipped with necessary instruments and controls as specified in the equipment data sheets.

The air receiver supplied by the vendor shall provide batteries and battery charging equipment (see clause B. above) for operating the electrical controls of the diesel engine.

4.2.4 If as specified in the data sheets, the diesel engine is required to start / stop automatically, the vendor shall provide the necessary controls (automatic-cum-manual) in the engine panel and the interconnecting wiring and piping from the panel to the engine and starting equipment. A pilot lamp shall be provided in the line side of the starting equipment circuit to indicate that the controller is in the automatic position. In the event the engine does not start after three attempts have been made, the controller shall stop all further cranking and operate the audiovisual alarm. A D.C. motor driven per lubrication pump with timer suitably inter-locked with the starting system shall be provided by the vendor. Whenever the unit is arrange for automatic shut down, a running period time set for a specific time interval, shall be provided.

4.3 ENGINE COOLING:

4.3.1 When radiator cooled engines are offered, the diesel engine shall be provided with a radiator for mounting on the common base plate, complete with the suction / blower fan, temperature control valve and a radiator guard.

4.3.2 Where the engine cooling is achieved by closed circuit cooling water system, the vendor shall provide the complete jacket water (primary water) circuit, heat exchanger with the make-up tank and its piping, as well as the raw water (secondary water) circuit including but not limited to the following :

4.3.2.1 Raw water pump with driver, unless the raw water is required to be obtained from the discharge of the pump driven by the diesel engine.

4.3.2.2 Raw water piping (prefabricated) and fittings, as specified in the equipment date sheets.

4.3.2.3 Instruments and controls as specified in the equipment data sheets.

4.4 ENGINE FUEL SYSTEM :

4.4.1 A fuel float (surge) tank if recommended by the manufacturer, shall be supplied with the diesel engine along with its interconnecting piping / hoses.

4.4.2 The daily service fuel tank shall be equipped with as air breather, shielded level gauge, strainer and a hand hole of not less than 150 mm diameter, besides the required fuel connections and a drain plug. The capacity of tank shall be as specified in the equipment data sheets.

4.4.3 The inside surfaces of the fuel tank and the float tank shall be coated with Enamel Red or Black of I.C.I. or its equivalent and the outside surface to be given two coats of the oil resistant primer paint. Both the fuel tank and the float tank, shall be hydrostatic tested at a pressure not less than 0.35 kg /Cm^2.

4.4.4 Electrically operated diesel transfer pump to transfer diesel from barrels to day tank shall also be provided.

5 INSPECTION & TESTING :

5.1 The inspector representing Purchaser shall have entry to the plant while and wherever work for the equipment is being performed.

5.2 The vendor shall have the responsibility of providing purchaser's inspector with all requisite facilities / equipment for carrying out satisfactory testing.

5.3 The diesel engines shall be tested in the presence of purchaser's inspector in accordance with the latest edition of B.S. -5514 or any other equivalent standard as agreed to with the purchaser before the finalization of order.

5.4 The routine load and fuel consumption test shall be of the following duration :

5.5 Unless otherwise specified, 10% overload provision shall be kept while setting the fuel stop for the site running.

5.6 The hydrostatic test certificates for the heat exchanger / intercoler , fuel tanks and other pressure vessels shall be furnished to the purchaser's inspector for his review and approval at the time of load testing of the diesel engine.

5.7 The engine control panel/s after assembly and wiring, shall be functionally tested in the presence of the purchaser's inspector.

6 PREPARATION FOR SHIPMENT :

6.1 Immediately upon completion of all tests and inspections, all exposed machined surfaces shall be cleaned and coated with a suitable rust preventive by the vendor and the unmachined surface shall be painted by at least two coats of red oxide primer.

6.2 Diesel engines shall be transported assembled as far as possible.

6.3 All untapped opening shall be provided with 4mm thick metal closures with full rubber gaskets and bolted by not less than 4 bolts. All connections including those for instruments, instrument leads, lubricating oil and the like shall be identified with securely attached tags indicating the type of connection, the instrument or the line description as applicable.

6.4 The equipment shall be crated for domestic / export shipment as specified in the data sheets considering for storage at job site for at least 6 months. Lifting load-out, and handling instructions shall be securely attached to the exterior of the largest packing in a well marked weather proof container. Upright position lifting points, weight (including packing and dimensions shall be clearly identified with item no., serial no., package no., and the names of the equipment.)

7 PROPOSAL :

7.1 Proposals shall be accompanied with completely filled in Data Sheets. The vendor shall not use his own data sheets.

7.2 The proposals must include a specified statement that all equipment is in accordance with the purchaser's specifications.

7.3 Any deviation / change in the required in the specifications of the equipment shall be clearly brought out by the vendor, giving reasons for such deviations, atleast one week prior to the stipulated date for issue of the corrigendum.

7.4 Rating (HP) curves for the diesel engine for different duties and their interpretation as per the applicable standard, shall accompany the proposal.

7.5 The drawings and data as listed under "prints with Quote" on the vendor data requirement sheet attached with this specification, shall be provided.

7.6 The vendor shall include in the proposal for carrying out supervision of the installation and commissioning of diesel engine/s offered indicating per item rates, no. of specialists proposed to be deputed, completion time and a list indicating nature and quantity of consumable/ tools required and any other terms.

7.7 All tenders are strongly advised to visit & inspect the on-going wroks/ site to examine all site conditions & constraints. Any changes, required by the Tenderer, in the executed civil/ structural work / core cutting required shall be done by the tenderer (with prior approval from the architect / consultant) at his own cost. All such changes required shall be indicated by the tenderer while submitting his bid.

8 SCOPE :

8.1 This specification define the requirements of design, manufacture, testing and supply of self excited emergency generator complete with automatic voltage regulator, control panel, generator breaker and other accessories as specified in the material requisition.

8.2 Unless otherwise specified the emergency generator shall be supplied complete with

a) Brush less excitation system complete with AVR.

b) Electric panel including control cubicle and associated auxiliary devices, relay panel and generator breaker battery and charger (unless otherwise specified).

c) Air inlet and outlet for generator cooling (inlet shall be oriented to suit local plant layout).

d) Lifting arrangement for the machine.

e) Foundation frame complete with foundation bolts and base frame.

f) Lube oil system integral with the prime mover lube oil system.

g) Spares for commissioning

h) Any other part / accessories not specifically mentioned above but considered necessary for safe and reliable operation.

9 CODES AND STANDARDS :

Unless they are in variance with the clause of this specification the diesel engine driven generator and their components shall comply with the latest edition of the applicable standards listed below :

IS : 22534 Designation for type of construction and mounting arrangement of rotating electrical machines.

IS : 46914 Degree of protection providing by enclosures of rotating electrical machinery.

IS : 47284 Terminal marking of rotating electrical machines.

IS : 71324 Guide for testing 3 Ph. sysn. Machines.

IS : 54224 Turbine type generators.

IS : 48894 Methods of determination of efficiency of rotating electrical machines.

IS : 12714 Insulating materials for Electric machinery and apparatus in relation to their thermal stability service, classification of

IS : 47224 Specification for rotating electrical machines.

IS : 25164 A.C. Circuit breakers.

Other codes shall be : AS2789, BS4999, BS5000, DIN6271, EGSA101P, IEC34/1, IS4722, ISO3046/1, ISO8528, NEMAMG1-22, SAEJ1349.

10 PERFORMANCE REQUIREMENTS :

10.1 Operative Conditions :

Generators shall be suitable for operating satisfactorily in humid and corrosive atmosphere found in pump house. Service conditions shall be as specified in the data sheet. The generator shall operate satisfactorily under sudden load application. Generator rating indicated in the data sheet shall be the net output of the set after accounting for all auxiliaries for the prime mover and generator.

10.2 Transient Voltage performance

The dip or rise in system voltage load variations is dependent on the leakage voltage drop of the machine which shall be kept to the minimum.

In case of sudden application of full load at rated power factor the voltage drop shall not exceed 15% of the rated voltage. The rated voltage shall be restored within 0.5 to 0.8 second depending on the size of the machine.

10.3 Voltage Regulation

The voltage regulation of the machine shall be within +/- 2 % of the nominal voltage under following conditions :

a). Between no load and nominal load with p.f. of 0.8 lag to unity.
b). With the machine cold or warm.
c). At a speed drop of approximately 3% of the nominal speed.

10.4 Voltage setting range :

The generator terminal voltage shall be adjustable with a continuously variable potentiometer. The adjustment range shall be +/- 5% of the nominal voltage with a possible extension to +/- 10%.

10.5 Harmonic Content

The maximum permissible deviation from the sine wave shall be 5%. The harmonic content of the voltage shall be less than 3% measured between phases off load and up to nominal rating for a power factor of 0.8 lag to unity and with symmetrical distortion free consumers in circuit.

10.6 Frequency limits

The Generator shall be suitable for continuous operation at rated load for frequency variation of +/- 3% of rated value in addition the vendor shall furnish the short time under-frequency operating limits.

10.7 Overloads :

The generator shall be capable of withstanding without injury the effect of a 10% overload for one hour (to be factory tested)

10.8 Short Circuit Conditions :

The generator shall be capable of withstanding without damage, a three phase, a line to line, line to earth or two line to earth short circuit for a period of 3 seconds when

operating at rated speed and with an excitation corresponding to 5% over voltage at no load.

10.9 Parallel operation :

Generator sets shall be suitable for parallel operation amongst themselves, or with other generating sets or with other sources (Grid supply) at operating voltage and under load conditions up to rated value. **The set shall be provided with Electronic governor system.**

10.10 Excitation support system

Excitation system shall be provided with short circuit support equipment (Series compounding) to maintain three times the rated current for three seconds in case of short circuit to ensure proper fault clearance in outgoing feeders.

11 DESIGN AND CONSTRUCTION :

11.1 The generator design shall meet the requirement specified in data sheet and shall be suitable for the site conditions specified therein.

11.2 The generator shall be mounted on a common base frame together with the prime mover unless otherwise agreed. The generator shall be provided with necessary lifting hooks and two earth terminals for connection to main earth grid.

11.3 The generator winding shall be class "B" insulation with temperature limitation for class "B" the windings and overhangs shall be braced to withstand the short circuit forces. For machines rated 1000 KW and above shall have six no. RTDs suitably distributed in stators winding.

11.4 The stators windings shall be brought out to six insulated terminals in two separate terminal boxes. The alternator shall, therefore, be provided with three separate terminal boxes i.e. for the line and neutral stators connections and for control connections. The terminal box for the line terminals shall have sufficient space for the termination of cable size specified in data sheet. The neutral box shall in addition to space for neutral earthing cable have sufficient room for current transformers used for protection of generator. Star connection shall be formed in the neutral side terminal box. The terminal box for control cables shall contain properly marked terminals for all internal equipment e.g. embedded temperature detectors etc. All terminals shall be stud type. The terminal boxes shall be complete with lugs and double compression cable glands. Current transformers shall be as specified in data sheet.

11.5 All parts and accessories shall be suitable to withstand stresses due to over speed / overload / short circuit conditions specified.

11.6 Bearings shall be double shielded and relubricated. Grease in the bearing enclosure shall provide additional lubrication to bearing as well as provide sealing against dust and moisture.

11.7 The generator shall be air cooled unless otherwise agreed generator enclosure shall be as specified in data sheet.

11.8 The direction of rotation of the rotor of the machine shall be compatible with that of the prime mover. A clear indication of the direction of rotation shall be given on either end of the machine.

11.9 Space heaters shall be installed within the enclosure, location and max. surface temperature of the heaters shall be such that no damage can be caused to any insulation. Heaters shall suitable for operation on a single phase 240V AC supply unless otherwise specified.

A suitable double pole switch shall be mounted on or adjacent to the stators frame or enclosure for the manual switching off of the heaters.

11.10 Field winding shall have class "F" insulation with excellent electrical and mechanical properties. The field winding shall be capable of operating at a field voltage of 125% of rated load field voltage for at least one minute starting from stabilized temperatures at rated conditions.

11.11 All cabling on the generator set skid shall be in GI cable trays/ conduits. All cables shall be identified close to their termination point. Double compression type cable glands shall be used for cable termination.

11.12 A rating plate of corrosion resistant material shall be fixed on the generator frame and shall give the following information:

a) Manufacturer's name.
b) Serial Number, Type and frame reference
c) Rated output in MVA & MW
d) Rated power factor, frequency and voltage
e) Rated stators current and speed in Rev. / Min.
f) Class of insulation
g) Phase rotation (CW or CCW)
h) Customer's indent no.
i) Year of manufacture
j) Weight rotor and stators in KG.

12 EXCITATION SYSTEM :

The generator shall be provided with brush less type solid state excitation system with automatic voltage regulator. The excitation system shall include the automatic voltage regulator, AC exciter and rotary rectifier. The field of the exciter shall be fed from the stators winding through a suitable transformer and AVR. AC Voltage generated in the AC exciter shall be rectified by the rotary rectifier assembly and fed to the main field circuits. The rotor windings of the AC exciter, the rectifier assemble, main field winding of the generator and other accessories on rotor part shall be rigidly fastened to the shaft and the connection with different items shall be anti-loosening type.

The exciter capacity shall be at least 20% more than the maximum requirement at any time. The exciter winding shall be insulated with class "F" insulation.

Automatic solid state voltage shall be provided with the following features as a minimum.

- Under frequency protection.
- short circuit protection.
- Manual voltage control switch with adjuster.
- Cross current compensation for parallel operation.
- Voltage build up circuitry.
- Stators current limited.
- Field current limited.

The Current and potential transformers required to feed the AVR from the generator terminal shall be adequately rated.

13 SYSTEM OPERATION

The emergency generator set shall normally be in an unattended area. The Control system shall operate in fail safe mode and shall include all controls and protection necessary for the safe operation of the package. The generator set shall function as per one of the following schemes:

- Auto main failure scheme (AMF).
- Manual start in service mode.
- Manual test mode.

14 GENERATOR CONTROL PANEL :

14.1 The Local generator control panel for the generator set shall comprise of the following unless otherwise specified in the attached data sheet.

(a) Automatic Voltage Regulator.

(b) Protection and metering equipment's.

(c) Indicating instruments.

(d) Local breaker for DG set (Siemens / Schnneider / L & T)

(e) Control gear for generator set auxiliaries.

Any other accessory require to make the generator set operational as a package shall be included in scope of supply. If required the generator control panel shall be split into various functional sections viz. protection, metering and control, regulation etc.

The generator breaker shall also be part of the control panel unless otherwise specified. The breaker rating shall be as specified in the drawing. The protective relays in the Gen. Control panel shall act to trip this breaker on fault conditions unless otherwise specified. This breaker also serves the purpose of local isolation.

All motor starters for generator set auxiliaries shall be DOL type.

Unless otherwise specified , the DC control supply required for relays , controls, closing/tripping of generator breaker, annunciation circuit and for any other purpose shall be met by a DC system consisting of battery and battery charger of suitable capacity to be supplied by the generator set manufacturer . The battery shall be sized for two hours load cycle a maximum. Battery charger shall be of the constant voltage type with current limiting feature and facilities for automatic and manual, normal and quick charging of batteries. Charger shall be sized for boost charging of batteries with 10 to 14 hours.

14.2 The panel shall be free standing , metal enclosed, dust and vermin proof type with a hinged door and having a degree of protection IP 54 as per IS:51 as per IS:2147 unless otherwise specified . Power and control equipment shall be segregated inside the panel as far as practicable. The maximum light of the operation handle/switches shall not exceed 1000 mm. and the minimum height not below 300 mm. All hardware shall be corrosion resistant and bolts, nuts and washers shall be made of galvanized zinc passivated of cadmium plated high quality steel. Unless otherwise specified the panel shall be suitable for bottom cable entry. Necessary glands shall be provided with the panel.

All auxiliary devices for control, indication, measurement and alarm such as push buttons control/selector switches, indicating lamps, metering instruments, annunciation's etc. shall be mounted on the front door of the panel. Adequate

number of potential free contacts shall be provided in the control panel for any remote control, monitoring of the generator set.

14.3 All switches shall be load - break, heavy duty type. All fuses shall be non-deteriorating HRC cartridge pressure filled, link type. The contractor shall be air-break type having AC-3 duty rating. Thermal overload relays shall be three element, positive acting, ambient temperature compensated type with adjustable setting range and built in protection feature against single phasing. All indicating instruments shall be moving iron, flush mounting type and of 96 mm x 96 mm square pattern. All control / selector switches shall be rotary back connected type having a cam-operated contact mechanism with knob type handle. "STOP" push buttons shall be stay put type.

14.4 Wiring for power, control and signaling circuits shall be done with PVC insulated copper conductors having 660 / 1100 V grade insulation. Minimum size of control wires shall be 2.5 mm "ELEMEX" type terminals shall be acceptable for wires up to 10mm^2 size and for conductors larger than 10 mm^2 bolted type terminals with crimping lugs shall be provided. A minimum of 10% spare terminals shall be provided on each terminal block.

14.5 An adequately sized earth bus shall be provided in the panel for connection to the main earth grid. All non current carrying metallic parts of the mounted equipment's shall be earthed. Doors and movable parts shall be earthed using flexible copper connections.

14.6 Engraved nameplates shall be provided for all devices mounted on the front of the panel. Nameplate or polyester adhesive stickers shall be provided for each equipment mounted inside the panel.

14.7 Where ever synchronising panel is asked, it is a panel including incoming breakers as per number of D.G. sets, outgoing breaker of same numbers (unless specified for some other qty as per boq), including auto start / auto load sharing relays. The outgoing breakers shall be always on (MDO type) as EDO breaker for D.G. set incomer and SEC incomer shall be provided in main panels of client. On –Off controlling signals for these breakers shall be from D.G. set AMF / synchronising panel for which necessary relays shall be provided. Also control cabling from D.G. set to D.G. set panel to breakers of client main panel shall be scope of D.G. set supplier. D.G. set supplier shall clarify necessary relays / contactors to be provided in client L.T. panel for control of SEC and D.G. incoming breakers.

15 PAINTING, PACKING AND TRANSPORT:

15.1 All metal surfaces shall be thoroughly cleaned of scale, rust and grease etc. prior to painting. Cleaned surfaces shall be given two coats of primer and prepared for final painting. Final finish shall be free from all sorts of blemishes.

15.2 The equipment shall be shipped to site suitably packed to prevent any damage. Each package shall have labels to show purchaser's name, purchase order and equipment no. suitable lifting lugs etc. shall be provided and lifting points shall be clearly marked on the package. Packing shall be suitable for storage at site for a minimum period of 6 months.

16 TESTS AND INSPECTION :

The owner or his authorized representative may visit the works during manufacture of equipment to assess the progress of work as well as to ascertain that only quality raw materials are used for the same. He shall be given all assistance to carry out the inspection.

Detailed test procedure along with the facilities available at vendors works shall be furnished along with the bid Owner's representative shall be given minimum four weeks advance notice for witnessing the final testing. Test certificates including test records and performances curves etc. shall be furnished by the vendor.

Tests

Equipment shall be tested to conform to the appropriate standards and the following tests shall be conducted in the presence of purchaser's:

Functional tests, continuity tests and high voltage test on control panel to establish the performance called for in the specification.

Power frequency voltage test on switch gear and mechanical / electrical operational check.

Routine tests for alternator as per IS : 4722.

Over speed test (1.2 times the rated speed for 2 minutes)

Transient response tests for sudden application and rejection of loads of 25%, 50%, 75% and 100% of rated capacity.

Wave form test (type test results are acceptable)

Phase sequence test.

Vibration test

Noise level test.

Dimensional and alignment test.

String test.

17 ACOUSTIC ENCLOSURE

17.1 CONSTRUCTION DETAIL :

This specification covers the design, construction features, manufacture and performance of Acoustic Enclosures. Acoustic Enclosure should be thoughtfully crafted. Contractor has to submit Δt calculation, sound attenuation calculation, G.A. drawing, and only after getting approval from consultant, the fabrication work shall be start.

The Enclosure enables should reduce noise level up to 75 dbA at 1 mtr. Distance under free field condition.

Acoustic Enclosure should comprises / incorporates of following:

1.0 Structure / Profile is made out of export quality CRCA Sheet Steel.

2.0 The roof, Side-walls, integral partition and doors are all made out of export quality CRCA sheet steel.

3.0 The Acoustic Enclosure is natural cooled & maintain temperature difference with Air Ambient of 5 degree Celsius. If require necessary option for articulated ventilation are also to be require suitable to site condition.

4.0 The sound absorption material is selected from either mineral wool / glass fibre of relevant thickness and density to meet the performance.

5.0 The enclosure construction should provide sufficient space to access for maintenance work.

6.0 Space to be required for control panel for suitably mounted inside the enclosure and enclosure door is provided with panel viewing window should be made from double (toughened) glass and sealed with neoprene rubber gasket.

7.0 Separately space is required for fuel tank with arrangement for re-filling, level switch, Air vent, drain, supply & return connection should be provided with in the enclosure.

8.0 The enclosure is required to complete with arrangement for power cable connection for load and mains supply, Integral-Residential Exhaust Silencer, Suction Louvers, Discharge Louvers, Openable and lockable doors with air tight neoprene rubber gasket, lifting arrangement and 2 Nos. of Light point with ON/OFF switch. Also require 1 No. of 15A Power Plug Socket along with 16A switch.

17.2 SUMMARY :

-	Base	:	Suitable Heavy duty MS Channel Section
-	Structure	:	MS CRCA 1.6-2.0 mm thick
-	Doors	:	MS CRCA>1.0mm thick.
-	Out side cover	:	CRCA Sheet>1.0mm thick
-	Insulation	:	Mineral Rock wool. (Density : 48 Kg./ m^3)
-	Inside cover	:	Perforated sheet
-	Air Inlet & Air Outlet	:	Louvers with special Sound Reductions Dampers. The vender to specify relations between fresh air requirement for engine cooling, Turbo charger

and alternator -vs air inlet louvers and air outlet - vs outlet louvers arrangement .

- Construction : Modular

18. FUEL PIPING

Scope

The scope of this section comprises the supply and laying of pipes, pipe fittings and valves. Testing and balancing of all HSD piping required for the complete installation as shown on the drawings. All piping inclusive of fittings and valves shall follow the applicable BIS codes.

1. Pipes shall be MS class "B" and fittings shall be welded type fittings conforming to relevant BIS codes. All jointing in the pipe system shall generally be by welding flanges, unless otherwise mentioned or directed at site. All welding shall be done by qualified welders and shall strictly conform to BIS code of procedure for manual metal arc welding of mild steel.
2. All pipes and their steel supports shall be thoroughly cleaned and given on primary coat of red oxide paint before being installed. All welded piping shall be subject to the approval at site.
3. Threaded joint fittings shall be malleable casting of pressure rating suitable for the piping system. Fittings used on welded piping shall be of the wieldable type.
4. Tee-off connections shall be through equal or reducing tees other wise ferrules welded to the main pipe shall be used. Drilling and tapping of the walls of the main pipes shall not be resorted to.

MOTORS AND PUMPS

SCOPE

This specification covers the design, manufactures and testing of three phase medium voltage squirrel cage induction motors.

STANDARDS

Unless they are at variance with the clauses of this specification, the squirrel cage induction motors and their components shall comply with the latest applicable Indian standards listed below. Where Indian standards do not exist, the relevant IEC, British or German (VDE) standards shall apply.

2.1 IS – 325 Three phase induction motors.

2.2 IS – 1076 Preferred numbers.

2.3 IS – 1231 Dimensions of three phase, foot mounted induction motors.

2.4 IS – 1271 Insulating materials for electric machinery and apparatus in relation to their therminal stability in service, classification of.

2.5 IS – 2148 Flame proof enclosures of electrical apparatus.

2.6 IS – 2223 Dimensions of flange mounted AC Induction motors.

2.7 IS – 2253 Types of construction and mounting of motors.

2.8 IS – 2254 Dimensions of vertical shaft motors for pumps.

2.9 IS – 2968 Slide rails for electric motors, dimensions of.

2.10 IS – 4029 Guide for testing three phase induction motors.

2.11 IS – 4691 Degrees of protection provided by enclosures for routing electrical machinery.

2.12 IS – 4722 Specification for rotating electrical machines.

2.13 IS – 4728 Terminal marking for rotating electrical machinery.

2.14 IS – 4889 Methods if determination of efficiency of rotating electrical machines.

2.15 IS – 6362 Methods of cooling for rotating electrical machines.

2.16 IS – 6381 Constructions and testing of electric apparatus with type of protection ‘e’.

2.17 IS – 7389 Pressurized enclosure of electrical equipment for use in hazardous area.

2.18 IS – 7816 Guide for testing insulation resistance of rotating machines.

2.19 IS – 8223 Dimensions and output ratings for foot mounted rotating electrical machines with frame numbers 355 to 1000.

2.20 IS – 8289 Specification for electrical equipment with type of protection 'n'.

2.21 IS – 8789 Values of performance characteristics for three phase induction motors,

2.22 IS – 9283 Motors for submersible pump sets.

2.23 IS – 9628 Specification for three phase induction motors with type of protection 'n'.

2.24 IS – 12075 Mechanical vibration of rotating Electrical Machines.

2.25 IS – 12065 Permissible limits of noise level for rotating electrical machines.

2.26 IS – 12802 Temperature rise measurement of rotating electrical machines.

2.27 IS – 13529 Guide on effects of unbalanced voltages on the performance of three phase cage induction motors.

2.28 IS – 13555 Guide for selection and application of three induction motors for different types driven equipment.

3. OPERATING CONDITIONS

3.1 Ambient Conditions

Motors shall be suitable for operating satisfactorily in humid and corrosive atmosphere found in Refineries, Petrochemical complex, fertilizer and metallurgical plants. Service conditions shall be as specified in the data sheets. If not specifically mentioned therein, a maximum ambient temperature of 40^{o} C and an altitude not exceeding 1000 meters above mean sea level, shall be taken into consideration.

3.2 **Frequency and Voltage Variations**

Unless otherwise agreed motors shall be designed for continuous, satisfactory operation at rated output under the following conditions :

a) The terminal voltage differing from its rated value by not more than +/- 6 %, or
b) The frequency differing from its rated value by not more the +/- 3 % or
c) Any combination of (a) and (b).

3.3 **Starting**

Unless otherwise specified motors shall be designed for direct –on-line starting. Motors shall be designed for re-acceleration under full load after a momentary loss of voltage with the residual voltage being 100% out of phase.

Minimum locked rotor thermal withstand time at rated voltage shall be 10 seconds under cold conditions and 8 seconds under hot conditions. The starting time of the motor shall be less than the hot thermal withstand time (time t_E in case of increased safety motors) to permit application of conventional bimetal relays or thermal release against locked rotor and overload conditions.

Unless otherwise specified, all motors shall be suitable for starting under specified load conditions with 75 percent of the rated voltage at the terminals.

Motors shall be designed to allow the minimum number of consecutive starts indicated below :

TABLE – I

Starts	**Min no. of consecutive starts**
No of consecutive start-ups with initial temp. of the motor at ambient level (cold)	3
NO of consecutive start-ups with initial temp. of the motor at full load operating level (hot).	2

3.4 **Direction of Rotation**

Motors shall be suitable for their direction of location. In case unidirectional fan is provided for motors, direction of rotation for which the motor is designed shall be permanently indicated by means of an arrow. A painted arrow shall not be acceptable. directional arrow should be manufactured from corrosion resistant material. When a motor is provided with bi-directional fans, a double headed arrow should be provided.

4. PERFORMANCE

4.1 Motors shall be rated for continuous duty (SI) unless otherwise specified.

4.2 The starting current (as % rated current) shall not 600% for motors upto and including 75 KW and 550% for motors above 75 KW subject to tolerance.

4.3 Starting torque and minimum torque of the motor shall be compatible with speed torque curve of the driven equipment under specified operating conditions. For heavy duty drives such as blowers, crushers etc. high starting torque motors shall be provided. In case where characteristics of driven equipment are not available while selecting the motor, minimum starting torque shall be 110% of rated value for motors upto 75KW and shall be 90% of rated value for motors above 75 KW.

4.4 The pull out torque at the rated voltage shall be not less than 175 percent of the rated load torque with no negative tolerance. Unless otherwise agreed, the pull out torque shall not exceed 300 percent of the rated load torque.

In case of motors driving equipment with pulsating loads (e.g. reciprocating compressors) the minimum value of pull out torque at 75 percent of the rated voltage shall be more than the peak value of pulsating torque and the current pulsation shall be limited to 40%.

4.5 The minimum value for product of efficiency and power factors for motors rated upto and including 37 KW shall be as per IS – 8789.

The minimum value for product of efficiency and power factors of 2 pol, 4-pole, and 6-pole motors rated above 37 KW shall be as given below.

Rated Output	**Product of efficiency and power factor at rated load (minimum)**		
	2-POLE	**4-POLE**	**6-POLE**
45 KW	0.82	0.80	0.79
55 KW	0.82	0.80	0.79
75 KW	0.82	0.80	0.80
90 KW	0.82	0.80	0.80
110 KW	0.86	0.80	0.80
125 KW	0.86	0.80	0.80
160 KW	0.86	0.81	0.80
180 KW	0.86	0.83	0.80
200 KW	0.86	0.83	0.80

Efficiency and power-factor figures for motors having synchronous speeds of 750 r.p.m. and below, shall be as agreed between the purchaser and manufactured.

5. GENERAL REQUIRMENTS AND CONSTRUCTIONAL DETAILS

5.1 Windings

a) Insulations and bracing

Unless otherwise specified in the data sheet motors shall be provided with class 'B' insulation as a minimum. In case of motors with class 'F' insulation the permissible temperature rise as measured by resistance method above the specified ambient temperature shall be limited to those specified in the applicable Indian standards for class 'B' insulation.

The winding shall be tropicalized. The windings shall preferably be vacuum impregnated. Alternately the windings shall be suitably varnished, baked and treated with epoxy gel for operating satisfactorily in humid and corrosive atmospheres.

Windings shall be adequately braced to prevent any relative movement during operation and in this respect, particular care shall be taken for the stator windings of direct-on-line starting squirrel cage motors. Insulation shall be provided between coils of different phases which lie together. Core laminations must be capable of withstanding burnout for rewind at 400^{o}C with out damage or loosening.

In case of motors driving equipment with pulsating loads, special attention shall be paid to the joints of rotor bars and end rings to avoid premature failure due to induced fatigue stresses.

b) Phase Connections

The windings shall be connected in delta. However, for motors rated 2.2 KW and below, star connection may be accepted.

If star- delta starting is required, this will be specified in the data sheet and the motor windings shall be fully insulated for delta connection.

c) Winding Terminations

The ends of the windings shall be brought out into a terminal box. They shall be terminated by means of terminals mounted on an insulating base made of no-hygroscopic and non-flammable material.

All motors shall be with six terminals and suitable links to connect them in star or in delta except for motors rated upto and including 202 KW which my be accepted with three terminals.

All terminals shall be adequately designed. Line terminals shall be thoroughly insulated from the frame with material resistant to tracking.

Anti-loosening, anti-vibration type of terminals shall be provided in case of increased safety (Type 'e') and non-sparking (Type 'n') type of motors.

d) Terminal Box and Cable Entries

Unless otherwise specified, the terminal box shall be located on the right hand side as viewed from the driving (coupling) end. It shall be rotatable in steps of 90^{o} to allow cable entry from any direction.

The terminal box shall be of sturdy construction and large enough to facilities easy connection of the cables. Terminal box cover shall be provided with handles to facilitate easy removal.

An adequately sized earth terminal shall be provided in the motor terminal box for termination of the forth core of specified cables.

The terminal box shall be provided with cables lugs and entries for suitable cables glands corresponding to the number and size of specified cable. Nickel glands shall be supplied along with the motor for mentioned cable sizes.

Equipment and accessories provided shall confirm to the hazardous area classification and the environmental conditions wherever required as specified in the motor data sheet.

Unless otherwise specified the terminals, cable lugs, terminal box, cable entries and cable glands shall be suitable for the cable sizes as specified below for 2 pole, 4 pole or 6 pole motors :

Motor rating upto and including	**Sizes of phase conductor (mm^2)**
2.2 KW and below	4 Al./2.5 cu
3.7 KW	6 Al./4.0 cu
5.5 KW	10 Al./6.0 cu

7.5 KW	10 Al./6.0 cu
9.3 KW	16 Al./10.0 cu
11.0 KW	16 Al./10.0 cu

NOTE : Cable sizes motors having synchronous speeds 750 rpm and below shall be as agreed between the purchase and manufacturer.

Cable Type

Cables used are of 650/1100 V grade aluminium conductor, XLPE insulated, PVC extruded inner sheath, armoured with overall PVC sheath for conductor cross- sections of 35 mm^2 & above. However for cables upto & including 16 mm^2 cross-section cables used may be with copper or aluminium conductor as indicated in the data sheet.

The terminal box shall be capable of withstanding internal short circuit conditions without danger to personnel or plane from the emission if hot gases or flame or due to excessive disfortion or damage o the terminal enclosure.

e) Phase Marking

appropriate phase markings as per IS : 4728 shall be provided inside the terminal box. The marking shall be non-removable and indelible.

5.2 Motor Casting and Type of Enclosure

Motors for use in safe areas shall be normal industrical degree of motor enclosures including terminal boxes and bearing housing shall be IP 55 as per IS : 4691.

Motors for use in hazardous areas (Zone 1 or Zone 2) shall have type of protection Ex(d) Or Ex(e) or Ex (n) as specified in the data sheet and shall meet the requirements of applicable Indian standards. Ex(d) type of motors shall have a BIS marking on the name plate.

Motors for outdoor use shall be suitable for installation and satisfactory operation without any protective shelter or canopy. Motor casing shall be provided with a suitable drain for removal of condensed moisture except in case of flameproof motors.

Vertical motors with downward shaft shall be provided with fully covering rain canopies. Vertical motors with upward shaft e.g. on fin-fan coolers, shall be

adequately protected, (such as cowls/canopies) against ingress of water into the enclosure or the bearing housing even when standing still for long periods of time. Motors designed to handle external thrust from the pump shall be supplied with a thrust bearing at the non-driving end.

All internal and external metallic parts which may come into contact with cooling air, shall be of corrosion resistant material or appropriately treated to resist the corrosive agents which may be present in the atmosphere. Screws and bolts shall be hot dip galvanized or zing passivated to protect against corrosion.

Unless otherwise agreed, motors shall have standard frame size for various output ratings as stipulated in IS : 1231.

5.3 Bearing and Lubrication

Motors shall have grease lubricated ball or roller bearings. In all cases, the bearings shall be chosen to provide a minimum L-10 rating life of 5 years, (40 000 hours) at rated operating conditions. (The L-10 rating life is the number of hours at constant speed that 90% of a group of identical bearings will complete or exceed before the first evidence of failure). Unless otherwise specified the bearing shall be adequate to absorb axial thrust produced by the motor itself or due to shaft expansion. Vertical motors shall be provided with thrust hot liquids where the driven machine operates at high temperatures, bearings shall be cooled by a shaft mounted fan. This shall ensure efficient ventilation of the bearing and disperse the heat transmitted from the driven object by conduction or convention. For motors operating in hazardous areas fans shall be of an anti-static non-sparking material.

Bearing shall be capable of grease injection from outside without removal of covers with motors in the running conditions. The bearing boxes shall be provided with necessary features to prevent loss of grease or entry of dust or moisture e.g. labyrinth seal. Where grease nipples are provided, these shall be associated, where necessary, with appropriately located relief devices which ensure passage of grease through the bearing. Pre-lubricated sealed bearings may be considered provided a full guarantee is given for 4 to 5 years of trouble-free service without the necessity of re-lubrication.

5.4 Cooling System

All motors shall be self ventilated, fan cooled. Fans shall be corrosion resistant or appropriately protected. They shall be suitable for motors rotation in either direction without affecting the performance of the motor. If this is not possible

for large outputs, it shall be possible to reverse the fan without affecting the balancing of the motor.

5.5 Rotor

The rotor shall be of squirrel cage type, dynamically balanced to provide a low vibration level and long service life for the bearings. The accepted values of peak to peak vibration amplitudes for a motor at rated voltage and speed on a machined surface bedplate with the motor leveled and with a half-key or coupling fitted shall not exceed those given in IS-12075. Die cast aluminium rotors for motors in hazardous areas may be accepted provided the same are type tested and approved by competent authorities.

5.6 Shaft Extension

Motors shall be provided with a single shaft extension with key-way and full key. Motor shaft shall be sized to withstand 10 times the rated design torque.

5.7 Lifting Hook

All motors except for fractional horse power motors shall be provided with lifting hooks of adequate capacity

5.8 Earth Terminals

Two earth terminals located preferably on diametrically opposite points shall be provided for each motors. Unless otherwise specified, the size of each earth stud shall be as given below :

Motor Rating	**Stud size**
Upto and including 3.7KW	6 mm
5.5KW to 30 KW	10 mm
Above 37KW	12 mm

Necessary nuts and spring washers shall be provided for earth connection.

An additional earth terminals shall be provided inside the terminal box as stated in 5.1

6 MISCELLANEOUS ACCESSORIES

6.1 Anti-Condensation Heaters

All motors rated above 30KW shall be provided with 240 V anti-condensation heaters, sized and located so as to prevent condensation of moisture during shut-down periods. Motors rated 30 KW and below shall be provided with anti-condensation heaters if specified in the requisition. Motors meant for humid location such as cooling tower fans, sump pump motors etc. shall be provided with space heaters irrespective of the motor rating in the motor data sheet. The heaters shall permanently remain 'ON' when the motor is not in service and as such shall not cause damage to the windings.

The heater leads shall be brought out to separate terminal box of the same specification and grade of protection as the main power terminal box excepting that the cable glands provided shall be suitable for two core 4 sq. mm aluminium conductor, armoured cable or 3 x 2.5 sq. mm. copper conductor armoured cable.

A warning label with indelible red inscription shall be provided on the motor to indicate that the power line and the heater supply shall be isolated before carrying out any work on the motor.

6.2 Name Plates

A stainless steel name plate manufactured from series 300 stainless steel and as required under specification IS-325 shall be provided on each motor. In addition to the motor rating plate a separate motor plant equipment number plate shall be fixed in a readily visible position. This number shall be indicated in the data sheets attached with purchase requisition.

Additional information as stipulated in applicable Indian standards shall be included in the name plate for motors meant for use in hazardous atmospheres as per IS:13408

7. NOISE LEVEL

The permissible noise level shall not exceed the stipulations laid down in IS – 12065.

8. MOTOR VIBRATIONS

Motor vibrations shall be within the limits of IS – 12075 unless otherwise specified for the driven equipment.

9. CRITICAL SPEEDS

The first actual critical speed of stiff rotors shall not be lower than 125% of the synchronous speed. For flexible rotors this shall be between 60% and 80% of the synchronous speed; the second actual critical speed shall be above 125% of the synchronous speed.

10. PAINTING

Internal and external parts of the casing and all metal parts likely to come in contact with the surrounding air shall be protected with anti-acid paint that will resist the particular ambient condition.

All external surfaces shall be given a coat of epoxy based paint.

11. INSPECTION AND TESTING

The vendor shall allow purchaser or his authorized representative to visit the works during manufacture of motors to assess the progress of work as well as to ascertain that only quality raw material is used for the same. He shall be given all assistance to carry out the inspection.

The vendor shall give at least 4 weeks advance notice to the purchaser, regarding the date of testing to enable him or his representative to witness the tests.

The motors shall be tested in accordance with IS : 325 and IS : 4029. Type test including any specific test to ascertain compliance with these specification shall be carried out on one sample from each KW rating and frame size. Routine tests shall be carried out on all motors. In addition measurement of vibration and noise level (if desired) shall form a part of route tests.

Test on completely assembled motor shall be carried out in the presence of purchaser or his representative. The result shall be tabulated and signed by both vendor and purchaser or their representatives. Though the motors shall be accepted on the basis of the satisfactory result of the test at the works, it shall not absolve the vendor from liability regarding the proper functioning of the motor coupled to the driven equipment at site.

19 TECHNICAL DATA FOR EQUIPMENTS :

A. PRIME MOVER FOR D.G. SET

1.	Prime mover	Cummins / Cater pillar / Perkins
2.	Qty, required	One No. for each alternator.
3.	Service	Prime mover for generating set.
4.	Horse power	To be indicated by vendor
5.	RPM	1500 RPM
6.	Type	Radiator cooled set.
7.	Flywheel	Required
8.	Vibration damper	Required
9.	Fuel pump air cleaner	Required
10.	Fuel pump	Required
11.	Radiator	Required
12.	Oil filter, fuel filter etc.	Required
13.	Lub oil pump	Required
14.	110 V DC V electrical system	Required
15.	Safety controls	Required
16.	Silencer	Required
17.	Coupling	Required
18.	Instrument panel consist of :	
a)	Starter switch	Required

b)	Lub. oil temp. gauge	Required
c)	Water temp. gauge	Required
d)	Oil pressure gauge	Required
e)	Meter	Required
f)	Tachometer	Required
19	Fuel tank	Required
20	Battery charger	Required
21.	Engine testing	
a)	At shop	Required
b)	At site	Required
22.	Tool kits	Required
23.	Literature	Required

a) Operation & maintenance manual
b) Parts catalogue/list

Note :

1. The engine HP. should be selected so as to achieve required KW rating to be generated considering derating of engine due to altitude, temp. humidity etc.

2. The engine test shall be witnessed by the client's representative.

ALTERNATOR

DATA SHEET - B

1.	Make	:	Leroy Somer / Stamford
2.	Rating	:	1000 KVA
3.	Power factor	:	0.8
4.	Rated voltage	:	415 V
5.	Voltage regulation	:	As required
6.	Rated current	:	To be specified by vendor
7.	Speed	:	1500 RPM.
8.	Frequency	:	50 Hz.
9.	Field current at rated output and power factor	:	to be specified by vendor
10.	Field voltage at rated output and power factor	:	to be specified by vendor
11.	Method of excitation and regulation	:	Self
12.	Class of insulation	:	A) Starter - b with temp.rise of Cl. B B) Rotor - --- do ------
13.	Degree of protection	:	Screen protected, drip proof.
14.	Base plate	:	The Engine & alternator shall be mounted and alignedon a common base plate fabricated from steel.
15.	Control Panel AMF	:	Consist of 1. ACB with O/L, E/F and shunt trip releases – static type releases

2. On/off indicator.
3. Auxiliary switch.
4. Ammeter & Voltmeter with assessors
5. KWH meters with CTs.
6. Over voltage relay
7. Under Voltage relay
8. Reverse & Forward Power relay.
9. Over & Under frequency Relay
10. KVA meter
11. Frequency meter.
12. Annunciation windows.
13. LED Lamp indicator.

16.	Change over switch	Synchronising and load sharing panel – with 5 incoming feeders – 1600A / 3 buscouplers – min 2500A and 4 outgoing feeders– 2 nos 2000A / 1 nos 2400 A / 2 nos 3200A which shall be all ACB with static releases. Each feeder shall have communicable trevectometer with RS485 port. Provision of D.G. control / and protection panel parameters shall also be transmitted to BMS. All switchgears shall be of schneidder / Siemens / L & T make.

20 TECHNICAL SPECIFICATION FOR SYNCHONIZATION

20.1 POWER & ENERGY MANAGEMENT SYSTEM (PLC & LLSM & IO & POWER MONITOR):

Power & Energy Management Architecture mainly consist of following component:

(1) Auto DG Synchronization/Start system

(2) Auto DG Load sharing system

(3) Auto Non-Critical Load Shedding system

(4) Auto Power monitoring system

(5) Auto Stand By All breaker Interlock system

The above all operation shall be act as a one unit system operation. To employ these all operation one shall be deploy adequate automation system along with SCADA and Programmable logic Controller with Input out put and Power analyzer.

(1) AUTO DG SYNCHRONIZATION/START SYSTEM

All 6 No 1000KVA DG set & 2 Nos. 500KVA shall be operated from . In case of failure of MSEB supply any DG Set shall be start automatically and Based on Power requirement System shall judicially decide weather next DG Set required or not. The same Logic shall be applicable in reverse order when Power demand decreases system shall stops access DG set from Operation.

After success fully startup of One DG set to make parallel operation of Other DG set with the first one start synchronization of DG set. For synchronization operation one has to select source and reference DG set from DG set matrix through SCADA graphic screen. Also close automatically appropriate breaker through Breaker Matrix. Synchronization of any DG set shall be achieved through Line-Line synchronization Module.

There shall be different mode for Achieve synchronization like Auto/Semi auto/Permissive (Test Mode). These entire modes shall be programmable through Line to Line synchronization module

Auto Mode:

During this mode Total operation of synchronization will be carried out automatically through Line to Line Synchronization module till close the tie breaker

Semi Auto:

Only Parameter matching can be done through SCADA but tie breaker shall be closed by Line to Line synchronization module

Permissive (Test Mode):

During this mode total operation shall be carried out automatically by Line to Line synchronization module, when synchronization criteria meet Line to line synchronization module will be issue an indication command but tie breaker will not close. This mode shall be used for Testing/Commissioning purpose

(2) AUTO DG LOAD SHARING SYSTEM

When necessary DG sets are running without trouble under synchronization mode then equal distribution of active and reactive Load sharing shall be required. This load sharing shall be achieved through specially employed Line to Line synchronization Module.

(3) AUTO NON-CRITICAL LOAD SHEDDING SYSTEM

When total system draw power through DG set and any DG set fail then to prevent cascade tripping of DG set system one has to employ Load shedding system for Non Critical load.

(4) AUTO POWER MONITORING SYSTEM

Full fledge Power Monitoring shall be required for Total system. Power Analyzer shall be employ to all three transformers and subsequent out going from main Bus. Detail high speed power monitoring shall be required for each DG set. Each End user feeder shall be monitored with Power monitor. These all Power monitor and Analyzer shall be connected to master CPU through high speed network

(5) AUTO STAND BY ALL BREAKER INTERLOCK SYSTEM

In case of failure of main control system Minimum system operation shall be carried out through another PLC which will take care of Operation all three DG set and transformer. So one can operate the system without trouble.

20.2 GENERAL SPECIFICATIONS

This specification has been developed to establish minimum requirements for a solid-state Programmable Controller designed to provide high reliability in industrial applications. The internal wiring of the controller is to be fixed, with the logic functions it must perform in a given application to be programmed into its memory. The controller shall be supplied with the CPU, input/output scanner, inputs, outputs, memory, power supply, and all power and interface cables necessary to function as a complete and operable Programmable Controller system.

The objective of the Programmable Controller will be to improve reliability, maintainability, and efficiency by reducing operating costs and downtime.

The specification shall be followed in accordance with the contract and all areas of questions or noncompliance shall be submitted to the purchaser for review and approval.

20.2.1 SERVICE

The supplier shall provide operating instruction manuals with adequate information pertaining to the following:

A. System specifications

B. Electrical power requirements

C. Application considerations

D. Assembly and installation procedures

E. Power up procedures

F. Troubleshooting procedures

G. Programming procedures

H. Explanation of internal fault diagnostics

I. Shut down procedures

J. Recommended spare parts list

In cases where the programming is done by the supplier, the supplier shall provide a copy of all working programs on 3 1/2 inch floppy disks or Compact Disk as well as a printed program listing.

The supplier shall provide a network of field sales and support personnel located in key cities throughout the United States and internationally. The supplier shall also provide a field service department with experienced representatives stationed in major cities with the capability to provide telephone consultation, prompt on-site service, and field replacement stock.

The supplier shall provide product application assistance by trained and experienced engineers to assist the customer with program and system development through telephone consultation and on-site check-out, debug, and start-up assistance.

The supplier shall provide a customer training program designed to teach the customer's personnel in the understanding and application of the programmable controller. The training program shall include training manuals and "hands-on" programming experience on a Programmable Controller of a type similar to that provided by the supplier.

The supplier shall have the capability to conduct on-site training programs at a location provided by the customer.

The supplier shall be capable of providing troubleshooting software.

20.2.2 GENERAL REQUIREMENT FOR POWER MONITOR & SOFTWARE SYSTEM

1 Load profiling measures and records energy usage to:

- Determine load factor
- Identify peak demand period(s)
- Correlate consumption with facility

2 Cost Allocation measures and records energy usage to:

- Allocate energy costs by:
- Department
- Process
- Facility
- Verify utility bills
- Analyze alternate energy rates

3 Power Quality Monitoring measures, displays, records, trends and alarms on power quality parameters like:

- Harmonics
- Voltage excursions

4 Demand Management limits demand using:

- Peaking or co-generator control
- Load interlocking
- Load shedding
- Load trimming

5 Emergency Load Shedding preserves system stability during sudden loss of a power source **by:**

- Determining system topology
- Evaluating the lost source and remaining loads - Shedding loads in less than 100 msec.

Preserving critical loads or avoiding total shutdown due to unforeseen loss of power sources.

6 Power System Control maintains power quality by controlling:

- Load tap changers
- Generators
- Capacitor banks
- Filter banks
- Managing system voltage, power factor or harmonics.

7 Distribution System Monitoring senses, displays, records, trends and alarms on power systems information like:

- Power flow

- System topology
- Equipment status
- Showing distribution system behavior.

20.2.3 AN ENGINEERED SYSTEM SHALL TYPICALLY INCLUDE THE FOLLOWING:

- System architecture and hardware selection
- Material procurement
- Design, assembly and testing of control enclosures
- System programming and configuration
- System integration and testing
- Start-up assistance
- Extensive system documentation

A self-contained, high-performance power management tool, the Power monitor shall offer many innovative features, including built-in monitoring, archival, analysis, and control capabilities:

20.2.4 REAL - TIME POWER PARAMETERS

The Power monitor shall be capable of monitoring either single or three phase systems in real time, providing users with a host of fast and accurate information about their electric power.

20.2.5 OSCILLOGRAPHY

It shall have fast sampling rate (180 samples/cycle at 60Hz under all operating conditions), the Power monitor shall provides simultaneous capture of oscillograms.

20.2.6 HARMONIC ANALYSIS

The Power monitor scrutinizes your power system harmonics by measuring percent distortion, magnitude and relative phase angles. It likewise performs harmonic calculations, such as TIF, %THD, K-factor, Crest factor and compliance check to IEEE-519.

20.2.7 CONNECTIVITY

The Power monitor boasts plug-in communication cards that cover a broad variety of different networks, including RS-232, Remote I/O, Device Net and Ethernet The Ethernet communication card even includes a built-in HTML web page for Internet read access of all critical Power monitor data. Finally, the Power monitor features

extensive analog and digital I/O with four self-powered status inputs and two form C ANSI C37.90 output relays.

The Power monitor shall have the ability to monitor single and three-phase systems in real time, just like the Power monitor. Unlike other energy management devices, however, the master module mounts easily into existing 1/2 or 1 space MCC bucket, eliminating the need for an external enclosure.

The display shall also fits into existing 4" ANSI cutouts. The result—lower installation costs for both new and retrofitted applications.

Every Power monitor shall come standard with a native RS-485 communication port that supports the DF-1/Modbus half-duplex slave protocol. Device Net, Ethernet, Control Net™, Remote I/O and RS-232 options likewise allow information access over a variety of networks, "from the shop floor to the top floor."

20.2.8 POWERFUL AND INTUITIVE SOFTWARE

Software shall have ability to effectively manage energy usage is only as good as your ability to manage your power, monitoring data.

1 Energy Software

Energy Software shall combines data communication tools, client-server software, and advanced web technology to allow users to efficiently and effectively manage energy use. An installed Energy Server allows clients to view energy information using a simple web browser over a wide area network.

2 Power Software

Power shall be a stand-alone software package based on Active X technologies that allows you to configure and view power monitoring hardware in conjunction with communication driver package for PLC. Through Power software, you can configure and view power monitoring devices in the field or on the plant floor, via your PC. Within minutes of completing the easy and intuitive installation of the software, you can begin monitoring your power, viewing log files, analyzing harmonic data and capturing oscillograms. Additionally, as an OPC/DDE server, Power Software can be closely integrated with other HMI/MMI/SCADA packages, and other products like Microsoft® E x c e l or Microsoft Visual Basic Application.

20.3 Information to be furnished by the Tenderer:

The tenderer shall furnish all such essential technical information as are required for proper assessment of the equipment offered including filled up data sheets as asked

for in the tender. The successful tenderer will have to furnish complete technical data of he equipment covered under the equipment specification.

- Panel manufacturer shall be an authorised OEM or approved manufacturer of the approved and finally selected switchgear & control gear manufacturer.

- Manufacturer shall have to furnish CPRI test certificate of similar panel board and busduct for rating upto 3200 amp. Capacity.

- Manufacturer should have in house sufficient manufacturing facility of electrical panel boards as well as automation system. Also adequate qualified and experience personnel are required. Manufacturer has to submit detail company profile furnishing all the details.

- Manufacturer shall be an authorised system house / solution provider of one of the approved PLC manufacturer with an endorsement stating the proficiencies of the same in automation of power and energy management system.

- Solution provider shall be in the business of panel manufacturing and automation work for minimum period of 5 years.

- Solution provider must have supplied at least 3 PLC based systems with twin industrial computer based MMI package for D.G / Turbine / Grid synchronizing application.

- Bidder / Manufacturer must have executed minimum 3 no. of similar type of works worth Rs. 100 lacs.

Bidder / manufacturer / solution provider has to submit all relevant details / documents / papers for all above requirements. If any bidder fails to comply with the above requirement or not furnishing the details will be liable to reject.

21.0 FACTORY ACCEPTANCE TEST

Client, his consultant and their authorized representative shall have the right to inspect and test or get inspected and tested the goods at the works of the Seller or its sub suppliers any time during manufacture and prior to dispatch and to inspect within a reasonable time after arrival of goods at the ultimate destination and during and after erection, testing and commissioning. The goods shall not be deemed accepted until after the said inspection, testing and commissioning and signing of the Acceptance Certificate. Failure to make any inspection of or payment for or acceptance of goods shall in no way impair client's right to reject non-conforming goods or to avail itself of any other remedies to which UCJ/NRDA may be entitled, notwithstanding client's knowledge of the nonconformity, its substantiality in the case of its discovery. In the event of failure of Seller to remove the rejected goods within the time allowed, client shall have the right to dispose of the same at the seller's risk and cost. During the time the rejected goods lie with client awaiting removal by the seller, they will so lie at the seller's risk. All goods rejected by client after receipt at the destination shall be removed by the seller within a reasonable time allowed by client, not exceeding 30 (thirty) days at seller's expense and risk.

The Seller will permit client's Inspectors, Consultant and their authorized representatives free access during normal working hours to his works, godown, storage or loading spot etc. and will give them all necessary assistance to perform their task including free use of all accessories, testing and control instruments. The seller shall ensure that the same facilities are granted by his sub-suppliers.

Unless specifically stated to the contrary in the order, all expenses relevant to the preparation and performance of testing, inspection and preparation of any test reports or certificates shall be borne by the Seller

The sellers shall carry out tests related to performance tests as described in the specifications and specified in the order. All such performance tests shall be at supplier costs. Supplier shall also provide all the tests certificates and documents as demanded by the Inspector for his satisfaction that the order has been executed as per PO specifications. All such certificates, documents in original shall be submitted to the Client before dispatch of material. The goods shall be dispatched from suppliers shop only after written confirmation from clients/ or its authorized representative.

22.0 DRAWING AND DOCUMENTS

The vendor, on award of work, shall submit the following drawing and documents to GGL / Consultant.

1.	Technical Specifications	:	4 sets
2.	G.A./ Foundation Drawings (specifying point load & size of foundation)	:	4 sets
3.	Tests Certificates	:	1 + 3
4.	O & M Manual	:	2 sets
5.	List of Spare Parts	:	3 sets
6.	Design Qualification Report	:	4 sets
7.	Preventive maintenance schedule	:	3 sets
8.	Any Other documents as per requirements	:	4 sets

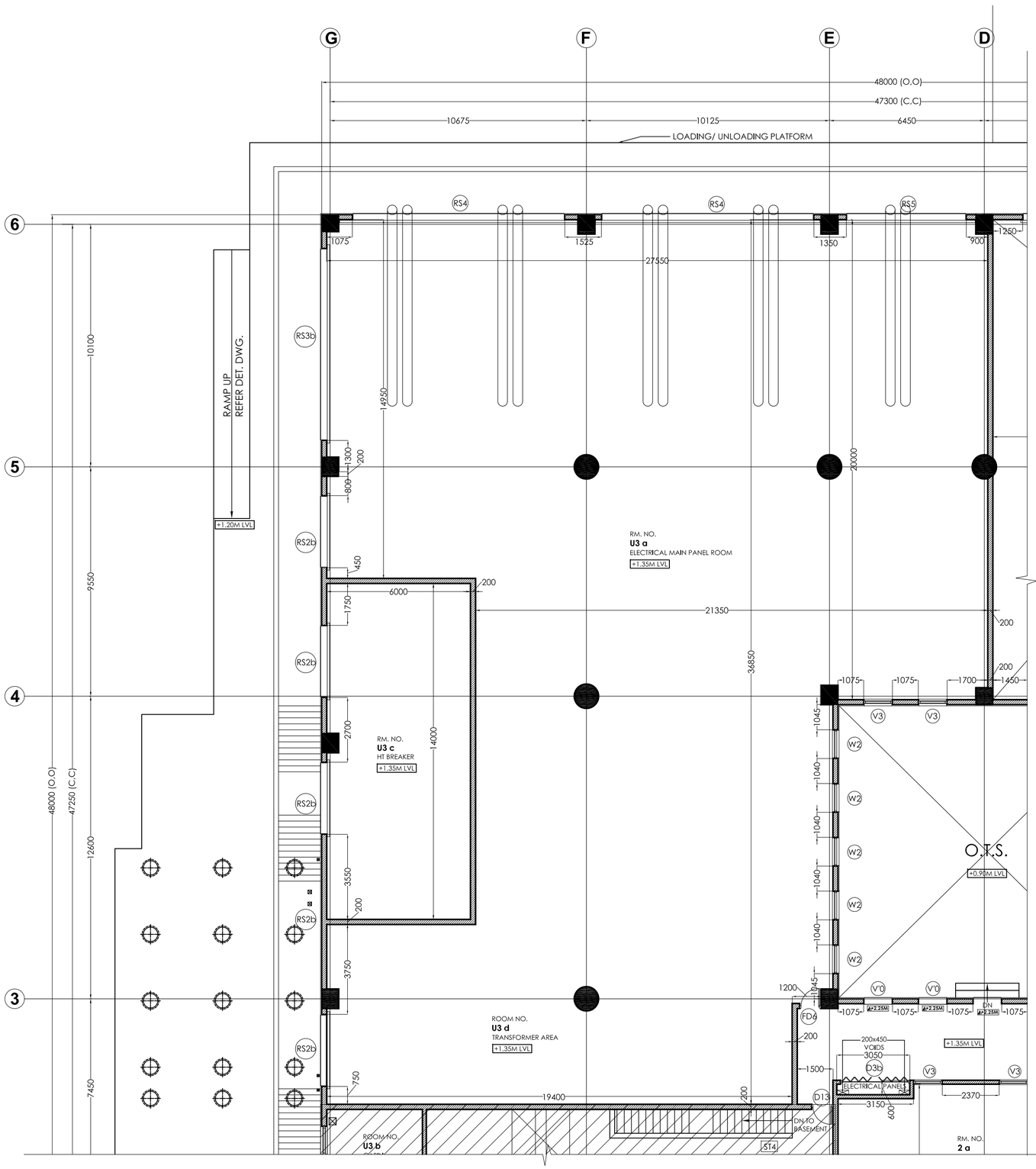
23.0 TERMS OF PAYMENT:

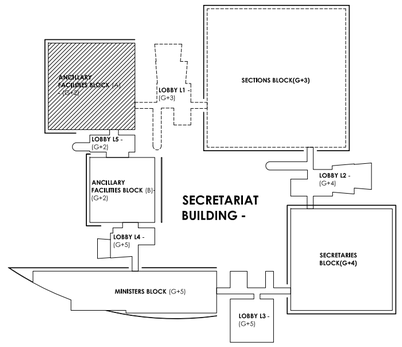
The terms of payment shall be as follows:

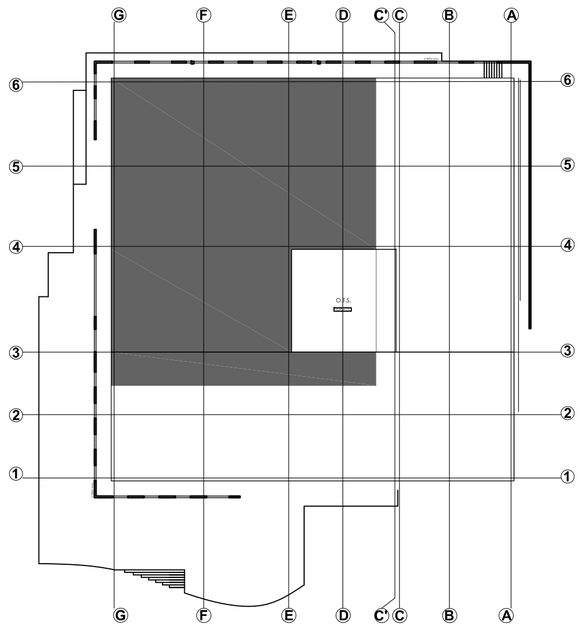
a. 15% advance against receipt of bank guarantee (in approved proforma) for equivalent amount.
b. 5% on approval of shop drawings.
c. 55% after delivery of all equipments at site.
d. 10% after testing and commissioning at site and receipt of performance bank guarantee (in approved proforma) for equivalent amount valid for 36 months.
e. The balance 15% shall be paid on satisfactory completion of each quarter of annual maintenance & operations contract to be paid in 12 equal installments due every 3 months for the next three years.

24.0 STATUTORY APPROVAL:

The unit supplied shall be duly approved as per latest IS / IEEE / CPCB etc norms and regulations which ever applicable. The supplier shall submit all the documents along with all the dispatch documents.







KEY PLAN : ANCILLARY BLOCK A

NOTE : ACTUAL SITE CONDITIONS/ CONSTRAINTS TO BE VERIFIED THROUGH SITE INSPECTION.

GENERAL NOTES

No	DESCRIPTION
	ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED DO NOT SCALE THIS DRAWING ANY DISCREPANCY IN THIS DRAWING BE BROUGHT TO THE IMMEDIATE NOTICE OF THE ARCHITECTS THIS DRAWING IS A COPYRIGHT AND MUST NOT BE USED, DISCLOSED OR REPRODUCED IN ANY FORM WITHOUT EXPRESS PERMISSION OF UTTAM C. JAIN ARCHITECTS & PLANNERS

REFERENCES

No	DESCRIPTION

REVISIONS

No	DESCRIPTION	DATE

COPIES SENT TO

No	DESCRIPTION	DATE
1	S.E. (PW), NRDA (for tender purpose)	18/11/09

DRAWING ISSUED BY

UTTAM C JAIN
ARCHITECT

SHANGHVI & ASSOCIATES
STRUCTURAL CONSULTANT

TRANS ENERGY ELECTRICAL CONSULTANTS
ELECTRICAL CONSULTANT

DNYANESH G. BHAVE
PLUMBING & FIRE FIGHTING CONSULTANT

DIKSHIT CONSULTANTS & ENGINEERS PVT. LTD.
LANDSCAPE CONSULTANT

KISHORE D. PRADHAN
LANDSCAPE CONSULTANT

NAYA RAIPUR DEVELOPMENT AUTHORITY
CLIENT

TITLE **SECRETARIAT BLDG, CAPITOL COMPLEX, NAYA RAIPUR**

ANCILLARY BLOCK 'A' GROUND FLOOR PLAN
DESCRIPTION

NORTH

DATE 18 NOV 09
DEALT BY SAVIN
CHKD BY CUJ
SCALE 1:200
350/CCR/2006
INDEX

TENDER DRAWING
REMARKS

ST 139/T39
DRG.NO.

ST

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