

TICEL BIO PARK II	
INTERNATIONAL COMPETITIVE TECHNO COMMERCIAL TENDER VOLUME 3 TECHNICAL SPECIFICATION	
SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF DIESEL GENERATOR SETS AND ALLIED WORKS IN CONSTRUCTION OF LABORATORY COMPLEX – TICEL BIO PARK – II AT TARAMANI, CHENNAI-113(3 BASEMENTS +G+12 UPPER FLOORS)	
DUE DATE FOR SUBMISSION: ON OR BEFORE 03/02/2012 at 16.00 Hours	
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<u>JANUARY 2012</u>	

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SECTION –I

SCOPE AND GENERAL INFORMATION

1.0.0 INTENT OF SPECIFICATION:

- 1.1.0 This specification intends to cover the Engineering, Manufacture, Fabrication, Assembly, Test and Inspection at works, arranging all transportation and delivery to site (duly packed), transit insurance, Erection, Testing, Commissioning and Handing it over to Clients.
- 1.2.0 This specification also makes it easy for the contractor for arranging and obtaining approval/clearance from all statutory authorities, for the installation of plant and machinery and render all assistance and services required in this regard.
- 1.3.0 It is also not the intent to completely specify all the design and construction therein. nevertheless, the equipment and installation shall conform to high standard of Engineering Design and workmanship in all respect and shall be capable of performing continuous satisfactory operation and acceptable to the Client.

2.0.0 GENERAL INFORMATION:

- 2.1.0 Location of the DG buildings, general arrangement of DG set, bus duct for the connection of Gen set output to the MV panel, Lay out location of terminal points and scope of work have been indicated in the drawings enclosed within this tender sheet.

2.2.0 **SITE DATA**

- 2.3.0 For information regarding site condition, approaches, climatological data etc. appropriate clause of this tender document and the conditions thereof are given below in the detailed specifications & Drawing.

Technical Specification-Mechanical.

Technical Specification-Electrical.

- 2.4.0 In case of conflict among sections, subsections, documents, drawings the same shall be referred to the Client whose decision shall be final and binding to the contract. In any case the best advantages shall go to the Client.

2.5.0 SYSTEM DESCRIPTION:

- 2.5.1 The need for an independent, reliable, standby AC source arises when the main power supply (from EB) fails for safe and smooth running of the units and other essential services required for safety and plant maintenance during prolonged failure of AC supply. The Standby Generating Set supply the full voltage with in 10 seconds of failure of EB Supply and all the Loads connected.
- 2.5.2 For safe and normal operation of the LAB facility and other essential allied services in the event of failure of the normal utility power system, it provides for 100% power for the following systems.

- a. Computer Nodes and Equipments
- b. AC Plant.
- c. Internal Lighting.
- d. Water supply pumps
- e. AHU's
- f. Lifts & Equipments

2.6.0 **SCOPE:**

- 2.6.1 This sub section covers the design, performance, manufacturing, construction features and testing requirements of one (1) No. Compression ignition diesel engine, with all accessories including daily service fuel tank.
- 2.6.2 In the plant under supply, the diesel generating set will be considered as a single unit and the contractor shall guarantee the performance and satisfactory operation of each set until the end of warranty period, and shall also remain responsible to provide all technical and commercial services as well as replacement of parts as necessary during the warranty period.
- 2.6.3 The DG plant components shall be reputed make. It is not the intent to completely specify all details of design and construction herein. Nevertheless, equipment and construction shall conform in all respects to high standard of Engineering Design and workmanship and shall be capable of performing in a manner acceptable to the Client.

2.7.0 **CODES AND STANDARDS**

- 2.7.1 The Design, Manufacture, Shop Testing, Erection, Testing and Commissioning of Diesel Engine shall conform to the latest revisions of the following:

IS-1000	:	Method of tests for IC engines Pt. I to XII
IS-10002	:	Performance requirements for constant speed IC (diesel) Engines for general purpose
BS-5514	:	Reciprocating international combustion engines: Performance
ASME.PTC 17	:	Performance test code for reciprocating IC engines.
IS-2825	:	Codes for unfired pressure vessels
IS-3589	:	Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal size).
DEMA	:	(Diesel Engine Manufacture's Association) Standards.

2.8.0 PERFORMANCE REQUIREMENT:

- 2.8.1 The performance of the D.G. sets, torsional; vibration, workmanship etc.shall be in accordance with the proper standard. The contractor shall be responsible for the proper torsional vibrational design for the combined engine generator set, including any extension shaft required. No harmful torsional vibrational stresses shall occur within 10% above or 20% below rated speed indicated in data specification sheet.
- 2.8.2 The engines shall be dynamically balanced to keep the vibrational level as low as possible during the running of the engine and hence transmit minimum unbalanced forces to the foundation. Critical speed of the assembly shall be sufficiently away from the rated speed of the engine.
- 2.8.3 The noise level at one meter from the engine and its various components shall be limited to acceptable level.
- 2.8.4 The engine shall be capable of starting up and being loaded under emergency conditions when there is no power supply to the installation within 10 seconds.
- 2.8.5 The tolerance for compression pressure, peak pressure, mean effective pressure shall be + 2.5%.
- 2.8.6 The engine shall be so designed that there shall be no diesel block during operation of the engine at any condition.
- 2.8.7 All parts subjected to substantial temperature variations shall be designed and supported to permit free expansion and contraction without resulting in leakage, excess clearance, harmful distortion or misalignment.

SECTION II**(TECHNICAL SPECIFICATION – MECHANICAL)****1.0.0 DESIGN AND CONSTRUCTION:****1.1.0 Diesel Engine**

1.1.1 The net brake horse power of the engine at rated continuous operation speed and shall be suitable to the rated standby electric kilowatt rating of the engine generator. Net brake horsepower is defined as the horsepower that the fully debated bare engine can deliver minus the power required by all accessories.

1.1.2 Continuous capacity available for the load shall be exclusive of the power requirement of auxiliaries of the diesel engine and after correction for altitude, ambient temperature and humidity of specified environmental conditions. The engine shall be capable of continuous operation and at least 5000 hours of operation before any major overhaul. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run. Fuel consumption of the engine generator shall be substantiated by means of manufacturer's published curves. The engine shall accept full load within 10 seconds from the receipt of signal to start.

1.1.3 The engine shall be high speed diesel oil, four stroke, and multicylinder, turbo-charged, air cooled compression ignition with direct mechanical fuel injection system. The engine shall be manufacture's standard model for the intended service, shall be designed to applicable code requirements and also be designed in accordance with the DEMA standards in addition to other standards specified therein. definition and ratings shall be in accordance with DEMA standards. A flexible coupling shall be installed between the generator and the engine fly wheel. Suitable removable guard shall be mounted over the flywheel and coupling.

1.2.0 Engine instrumentation:

1.2.1 Engine instrumentation shall include the following:

- Lube oil pressure gauge
- Lube oil temperature gauge
- Water pressure gauge
- Water temperature gauge
- Tachometer
- Hour meter
- RS 485 Protocol for BMS connectivity

The instrumentation panel shall be mounted on the engine frame with suitable absorber to prevent vibration.

1.3.0 Engine protection devices:

1.3.1 The following engine protection and automatic shut down facilitates shall be provided.

- Low lube oil pressure
- High water temperature
- High lube oil temperature
- Over speed shut down

1.3.2 Engine wiring shall be high quality, heat resistant ,insulated, stranded copper conductor wiring shall be protected with suitable woven loom protection and shall be isolated from high temperature engine parts. Wiring for alternating current power circuits protected by rigid or flexible conduit.

1.4.0 **BATTERY STARTING SYSTEM**

1.4.1 The battery systems of the generator set shall consists of lead acid/maintenance free batteries and an automatic constant voltage charger unit, for the engine starting motor and control circuit of the diesel generator sets.

1.4.2 The capacity of the batteries shall be sufficient for the starting requirements.

1.4.3 The batteries and automatic charger unit shall be installed beside generator control panel devices and alarm indicator lamps.

1.4.4 The input of the system shall be of single phase 220 V, 50 Hz, and output of the system shall be 24V DC.

1.5.0 **ENGINE COOLING SYSTEM:**

1.5.1 The engine cooling system shall be radiator water cooled system. The radiator assembly shall be mounted on the common bedplate. The radiator fan shall be driven off the engine as its auxiliary with multiple fan belts. When half the belts are broken, the remaining belts shall be capable of running the fan. Cooling water shall be circulated by means of a centrifugal type auxiliary pump of suitable capacity driven by the engine in closed circuit. The engine cooling system shall include one or more spin on type engine water filters, which shall treat the coolant and prevent corrosion and scale deposits inside thee cooling system. A rigid guard shall enclose both top and sides of all moving parts between engine and radiator. The radiator shall be fitted with a close fitting venture shroud of type and capacity recommended by engine manufacturer.

1.6.0 AIR INTAKE AND EXHAUST SYSTEM:

- 1.6.1 An air cleaner /silencer shall be furnished as recommended by the engine manufacturer. air cleaners shall be dry type with replaceable elements.
- 1.6.2 Engine exhaust outlets shall be coupled to the exhaust silencers by means of an adequately sized section of stainless steel corrugated flex, and shall decrease the exhaust noise level to 70 DB measured at 1meter away from exhaust end flexible connector shall be flanged at both ends formatting to the engine and exhaust system.
- 1.6.3 The exhaust pipe shall be covered by fiberglass with 50 mm thickness, 24 kg/m³ density and will be sheeted by 24 SWG aluminum sheets.
- 1.6.4 A residential grade exhaust silencer shall be provided exhaust silencer shall be sized to limit exhaust back pressure to acceptable values .the exhaust silencer shall be double wall construction and shall have a high temperature anticorrosion coating uniformly on the outside surface.

1.7.0 FUEL SYSTEM

- 1.7.1 The fuel shall be gravity fed from the day/service tank to the engine driven fuel pump. The fuel tank shall be mounted adjacent to the engine at suitable height as recommended by the engine manufacturer. The fuel system shall be equipped with a fuel filter having replaceable elements which may be easily removed from their housing for replacing without breaking any fuel connections or disturbing the fuel pumps or any other parts of the engine.
- 1.7.2 The fuel tank shall be welded steel construction and of capacity equal to 12 hrs fuel consumption at full load. The tank shall be complete with floor mounted supports, level indicators, inlet, outlet, over flow connections, air vent and drain plug and piping to the engine fuel pump.
- 1.7.3 Fuel piping from fuel tank to engine shall be with 25 mm ID MS "C" class pipe with a suitable valve to regulate the flow, the return oil from the injectors /fuel pump shall be let into the tank top through another 19mm ID MS"C" class pipe. a wire braided flexible hose of suitable connection shall be provided for connection between engine and pipe line.

1.8.0 Lubricating oil system:

- 1.8.1 Forced feed lube oil system shall be employed for positive lubrication. Necessary lube oil filters shall be provided, located suitably for convenient servicing.

1.9.0 Anti vibration mounting:

- 1.9.1 Suitable vibration mounting shall be employed for mounting the unit so as to minimize transmission of vibration to the structure. The isolation efficiency achieved shall be clearly indicated.

1.10.0 Piping work:

1.10.1 MS piping of adequate size shall be used for lube oil, exhaust and fuel oil piping. The pipe work shall be inclusive of all fittings and accessories such as valves, bends, reducers, elbows, flanges, flexible connections necessary connections etc.the installation shall cover clamps, supports etc .required for completing the work. All MS pipe shall be heavy class. for measurement purposes the length of run shall include all the accessories and fittings excluding valves/silencer .those runs forming part of factory assembly on the engine shall however be excluded.

1.11.0 Main and Crank-Pin Bearings:

1.11.1 Removable precision type which shall fit without scarping or shims.

1.12.0 Cylinder Liners:

1.12.1 Replaceable close grained alloy iron liners, heat treated for proper hardness and of the wet or dry type.

1.13.0 Engine Access:

1.13.1 Engine shall be arranged for convenient inspection and maintenance of crank and main bearings.

1.14.0 Governing System (Over Speed Protection)

- i. The governor shall be suitable for operation without external power supply, and shall provide adequate speed control in the event of failure of electrical motorized system. The governor shall be provided with a motor operated speeder gear for remote adjustment of generator frequency.
- ii. A mechanical over speed trip devices shall be provided to automatically shut-off fuel in case the speed exceeds 110% of the rated value. The trip shall also be manually operable for an emergency stop.
- iii. The generator characteristics shall be suitably chosen.

1.15.0 SCOPE, TERMINAL POINTS AND EXCLUSION:**1.16.0 SCOPE OF SUPPLY:**

1.16.1 The scope of supply under this specifications in a shall be as below .items not mentioned but required to make the system, complete reliable and efficient shall be deemed to included in the scope and shall be furnished without any extra cost.

1.16.2 One no. of 2000 KVA diesel generator consisting briefly of:

- a. diesel engine, mounted on vibration damping pads complete with integral air intake and exhaust manifold ,speed regulation system, fuel injection system, lubricating oil system, jacket and lube-oil cooling system, along with all necessary coolers, filters, valves, piping, fittings etc.
 - b. AC generator along with brushless excitation system, automatic voltage regulator and protection system.
 - c. Coupling between engine and generator.
- 1.16.3 Electrical starting complete with DC starter motored batteries and battery charger.
Engine cooling water systems using radiator cooling method complete with pipes, valves, and fittings etc. authorities shall provide only intermittent makeup to the engine radiator. Tentative analysis of cooling water has been furnished under appendix 1 of this section.
- 1.16.3 Complete instrumentation, interlocks and controls with necessary annunciation and indication for startup, supervision and safe operation of the DG set and its auxiliaries.
- 1.16.4 Engine exhaust duct/piping, complete with silencer, metal expansion bellow etc. engine air intake duct /piping and intake filter completed in all respects.
- 1.16.5 Complete DG plant piping, valves, fitting and ducting with necessary supporters and hangers. Complete equipments and component support as required.
- 1.16.6 Foundation bolts ,nuts ,leveling plates ,shims, flanged valve at terminal points shall be provide with counter flanges together gasket, bolts etc.
- 1.16.7 The desired normal output at site referred to at the alternator terminals and the machines operating under the ambient conditions shall be 2000KVA at 0.8 power factor at 415V. the engine shall be capable of producing the maximum continuous output under the most adverse combination of temperature, pressure and humidity at site and when required 10% greater output for a period of 1 hour in every 12 hours.
- 1.16.8 The engines shall be derated in accordance with standard for the difference in site condition from standard conditions.
- 1.16.9 The diesel generator sets shall be housed in the substation building and shall be provided with mechanical exhaust ventilation system by means of wall mounted axial flow fans .fresh air shall be taken outside atmosphere and system shall be desired to maintain adequate ventilation.
- 1.17.0 **TERMINAL POINTS:**
- a. Electric power
 - b. Equipment grounding
 - c. Engine exhaust
 - d. Engine air intake

1.18.0 UTILITIES AVAILABLE:

- 1.18.1 Electric power will be made available at 415VAC.
- 1.18.2 Any other voltage, if required for this system shall have to be arranged by the contractor.
- 1.18.3 The contractor shall furnish power requirements for the above in this bid.
- 1.18.4 Water for engine cooling system shall be made available.

1.19.0 PERFORMANCE GUARANTEE:

- 1.19.1 All the equipment covered under this specification shall be guaranteed for successful operation for a period of 12 months from date of commissioning.

1.20.0 INSPECTION & TESTING:

- 1.20.1 The testing of the different equipments and components shall be carried out as per relevant standards.
- 1.20.2 The tests required for diesel engine have been described under this specification.
- 1.20.3 The manufacturer shall conduct all tests and inspections required to ensure that the equipment furnished shall conform to the requirements specified in this specification. The details for the particular tests shall be submitted to the purchaser for approval before conducting the tests. The purchaser's representative shall be given full access to all tests. The contractor shall intimate the purchaser well in advance so that if desired, his representative can witness the test.

1.21.0 PERFORMANCE TEST:

- 1.21.1 Performance test for the equipment shall be carried out in accordance with applicable standards and shall include but not limited to the following types:
 - a. Fundamental tests on complete DG set along with AMF panel, DG, DB etc.
 - b. Transient voltage dip test for worst starting requirement shall be done.
 - c. load test for the set with AMF panel, up to full load at 0.8 pf for a duration of 6 hours.
 - d. Exhaust system back pressure test at full load.
 - e. Fuel consumption at full load.
- 1.21.2 Tests shall be preferably being conducted with actual drive being furnished.
- 1.21.3 Reports and test certificates of the above tests shall be conducted to the concerned authority.
During the tests the contractor shall establish the following:
 - a) Performance of all instruments, protection and interlock circuits associated with DG sets shall be established and listed.
 - b) Automatic startup of sets in case of AC power failure shall be established.
- 1.22.0 **DYNAMIC BALANCING TEST:**
- 1.22.1 All rotating components and the assembly of the equipments shall be subjected to the dynamic balancing test if asked for the data specification sheet.

1.22.2 All driver motors where applicable, shall be tested as per standard. Type test shall be conducted on motors, if specified.

1.22.3 After installation, complete system offered may be subjected to testing at field also by the client. If the performance at field is not found to meet the requirement, then the equipment shall be rectified by the contractor without any extra cost.

1.23.0 FINAL ACCEPTANCE:

1.24.0 After all the tests are successfully complete and after the purchaser is satisfied that the installation is functioning as intended, a taking over certificate shall be provided by the contractor. The guarantee period shall be counted from the date of final acceptance subject to the fulfillment of other responsibilities by the contractor which otherwise survive by terms and conditions of the contract.

1.25.0 SPARES:

1.25.1 The tendered shall provide a list of recommended spares along with spare part no. required for 3 years of reliable operation and maintenance of the DG set.

1.26.0 TOOLS AND TACKLE:

1.27.0 The contractor in his proposal will indicate a list of special tools and tackles which may be required for maintenance, overhaul and replacement of various equipment to be supplied under this contract in the form of this enclosed contract. Order for the tools and tackle may be placed simultaneously or otherwise at the option of the authority.

1.28.0 DATA AND CURVES:

1.28.1 All civil data for design and preparation of equipment foundation by the client.

1.28.2 Generator curves and characteristics:

- a) DC and SC characteristics
- b) V curves
- c) Capability curves
- d) Generator transient and sub-transient reactance.
- e) Generator losses, fixed and variables.
- f) Communication non-interference test curves.
- g) All other necessary curves for the generator, exciter, AVR and Auxiliaries.

1.28.3 Characteristic curves for diesel engines.

- a. Performance test curves and test certificates for all equipment as per the requirement of technical specification.
- b. Bill of material for pipes, valves, and instruments.
- c. Generator relay setting calculations

- d. Any other data/curve deemed necessary by the purchaser.

1.29.0 WRITE UP, MANUAL AND LEAFLETS:

- a. Write up on operation, control and monitoring of the DG plant.
- b. Write up on specific features of equipment, if any.
- c. Replacement parts list with ordering information.
- d. Leaflets and catalogues .etc.covering equipment features.

1.29.1 Information, tools and plants, instruction, drawings and all other relevant data regarding erection and commissioning of the supplied plant.

1.29.2 Detailed instruction manuals for equipment supplied presenting the basic categories of information in a comprehensive manner, shall be submitted for the approval of the client.

- i. Instruction for erection
- ii. Instruction for precommissioning checkup, operation.
- iii. Write up on controls and interlocks provide.
- iv. Recommended inspection points and periods of inspection
- v. Schedule of preventive maintenance
- vi. Ordering information for all necessary parts
- vii. Recommendation for type of lubricants along with the specifications and brand names for various suppliers, lubrication points and lubrication replacement schedule.

1.29.3 The information shall be organized in a logical and orderly sequence. a general description of the equipment including significant technical characteristic shall be included to familiarise operating and maintenance personnel with the equipment

1.29.4 Necessary drawings and /or other illustrations shall be included or copies of appropriate certified drawings shall be bound in the manual .Tests, adjustment and calibration information as appropriate shall be included and shall be identified to the specific equipment. Safety and other warning notices and installation ,maintenance and operating calculations shall be emphasized.

1.29.5 A parts list shall be included showing part nomenclature, manufacturer's part number and or/other in formations necessary for accurate identification and ordering of replacement parts.

1.29.6 Instruction and part list shall be securely bound in durable folder.

1.29.7 If a standard manual is furnished covering more than the specific equipment purchased, the applicable model parts and other information necessary for the specific equipment shall be clearly identified.

- 1.29.8 The instruction manual shall include the list of spare parts that have been procured along with the equipment.
- 1.29.9 The instruction manual shall include the list of all special tools and tackles furnished with complete drawing and instructions for the use such tools and tackles.
- 1.29.10 In addition to the above drawings/documents ,foundation details and any other information deemed necessary during detailed engineering shall also be furnished to the client.

1.30.0 DEVIATION:

- 1.30.1 In case the proposal has deviation from the specification or an alternative offer is made which the contractor thinks to be superior to what is asked for and price of which is comparable, the contractor in his proposal shall indicate clearly such deviations item wise in the annexure enclosed price deviations shall also be indicated .in case of absence of much deviation sheets, in the proposal it will be presumed that the offer is strictly as per the specification. Also in case of absence of any price implication against any item for which the technical deviation has been taken by the contractor, it will be taken for granted that such technical deviations will have no reflection in the quoted price.

2.0 VENTILATION AND ACOUSTIC SYSTEM

The scope of work covers fabrication, supply, erection, testing and commissioning of ventilation, exhaust and acoustics for the DG room comprising of acoustic treatment for walls and ceiling, fresh air fans if required, fresh air fan attenuators, radiator exhaust attenuator and fresh air attenuator.

The scope shall include design and installation of efficient acoustic treatment to the DG sets as well as to the building in such a manner that the sound levels with all the D.G sets operating will be within 75 dBA at 1.5 meters from the DG sets and less than 45 dBA at the nearest boundary of the site during night time and less than 55 dBA at nearest boundry of the site during day time. The nearest site boundary is approximately about 12 Mtrs away. As such it is planned to install fresh air sound attenuators through which fresh air is drawn by means of the fans of the DG sets. The exhaust from the radiator will be through the radiator attenuators. It is planned to install propeller fans, for intake of cool air in to the room to maintain room temperature. The fans are provided with attenuators. The entire wall of the room is acoustically treated with 100mm thick insulated panels. There will be suspended ceiling with acoustically treated panels. It is required that the pipe, duct opening has to be thoroughly sealed. The doors for the DG room are in the purview of the contractor. The fresh air / exhaust fan attenuator and the radiator exhaust / fresh air attenuator shall be provided with MS powder coated louvers to prevent water entry into the same.

Civil works such as opening in the walls, foundation works will be organized through other agencies. However, MS framework for the fans and attenuators as per the drawings will be in the scope of the contractor. Cabling for the fresh air fans which will be operated only when the set is not running to provide cool air into the room will be done by others.

The successful contractor has to ensure that the entire job is done in a good workmanship manner and the work not complying to the specifications and quality will be rejected by Engineering Consultant / Client.

The tenderers shall have the facility for good sheet metal fabrication at their works and shall have done similar works earlier.

The contractor has to depute a qualified site engineer for the site meetings to receive instructions from Engineering Consultant / Client as and when required.

2.1 SHEET METAL WORK

All ducts if required shall be fabricated from galvanized sheet steel conforming to IS: 277. The coating of zinc shall conform to Class VIII. Flanges and stiffeners used in duct sections shall be rolled steel angles. All nuts, bolts and washers shall be of zinc-plated steel and all rivets shall be galvanized or made of aluminum alloy. Self-tapping screws need not be used. Gaskets shall be of 3 mm neoprene rubber and shall be leak proof. Only new, clean and bright sheets without watermarks shall be used. Engineering Consultant / Client reserves the right to reject the sheets not meeting the requirements.

2.2 RECTANGULAR DUCTING

Duct construction shall follow IS: 655. Thickness of sheets for rectangular duct shall be as follows:

MAXIMUM SIZE OF THE DUCT IN MM	MINIMUM SHEET THICKNESS IN MM
750 mm and below	0.83
752 mm to 1500 mm	0.80
1501 mm to 2250 mm	1.00
2251 mm and above	1.25

The fabrication of the ducting including details of transverse joint connections, bracing, seems etc., for longitudinal joints etc., will be generally as per IS: 655. The ducts should be rigid and should have very minimum leakages.

Only angle iron flanges shall be used for all transverse joints and GS sheet flanges are not acceptable. The angle iron flanges shall be painted with two coats of primer and black enamel paint.

All ducts shall be supported on Factory made GI supports using threaded rods and slotted channels using anchor fasteners. The span of the supports shall not exceed 1.5 m. All civil works including drilling, chipping, grip bolting and other related works will be within the scope of the DG contractor. Stiffening angles shall be fixed to the sides of the duct by riveting. Flanged joints shall be used at intervals not exceeding 1800 mm using angle iron of size not less than 40 x 40 x 3 mm. Flanges shall be welded at corners first and then riveted to duct. All flanged joints must have 6 mm felt lining between flanges.

All joints shall be made air tight with proper packing gaskets and all interior surfaces shall be smooth. Bends shall be made with radius not less than one half the width of the duct or with properly designed inside curved vanes. Inspection doors shall be provided to permit access to the radiator fan / heat exchanger etc. as required.

Duct connections to the radiator shall be made by inserting a heavy fire resistant flexible double canvas of 150mm length. The sleeve shall be securely banded and bolted to the duct and radiator casing.

Where sheet metal ducts or sleeves terminate in woodwork, tight joints shall be made by means closely fitting heavy flanged collars.

All ducts shall be totally free from vibration under all conditions of operation.

All exposed ducting inside the DG room shall be painted with primer followed by 2 coats of synthetic enamel paint of approved colour.

2.3 INSULATION WORK

The scope of this section comprises supply and application of insulation for attenuators and the wall/Ceiling panels.

Resin bonded fiber mat is used for insulating the attenuators and the panels and shall have a density not less than 24 kg / cum and a thermal conductivity not greater than 0.029 k-cal hr / sq.m / deg.c / m at 20 deg. C. Fibre glass shall be in the form of blankets. Alternatively rock wool of density 64 kg/cum. shall be used.

The Consultants / Owners or their authorized representatives reserve the right to peruse the weights, dimensions etc. of the insulation material supplied. Samples of all insulation material specified in various forms shall be submitted by the successful contractor. Engineering Consultant / Client shall have the right to reject all supplies which do not conform to the specifications and to the samples so approved.

2.4 SOUND ATTENUATOR

The attenuator shall be fabricated using 18 G (1.25 mm) thick galvanized steel sheet as per the sizes indicated. The flanges shall be fabricated out of 50 x 50 x 6 mm thick MS angles. The attenuator duct and the angle frame shall be treated with zinc chromate primer and painted with two coats of approved synthetic enamel paint. The attenuator leaves shall be fabricated using GI sheet metal frames fabricated again out of 18 G sheet. The 100 mm thick leaves shall be packed with 2 layers of 50mm thick fiber-glass of density 24 kg/cum or Rock wool of 64 kg/cum density. The insulation shall be covered with RP tissue and sandwiched between 1 mm thick GI perforated sheets. The sheet shall have minimum 20% free area. Only pop rivets shall be used for joining the perforated sheet to the frames. The spacing of the leaves shall be as indicated in the drawings and shall be rigidly supported. Whenever the height exceeds 1500 mm intermediate support has to be provided at the middle. The attenuator leaves shall also be in two layers and the height of each attenuator leaf shall not exceed 1500mm. The duct casing shall not be fabricated using multiple sheet joints. The sound attenuator shall be factory fabricated and shall be offered for inspection to the owners and consultants prior to the site.

2.5 ROOM WALL AND CEILING INSULATION

The insulation shall be done using acoustic panels. The panels shall be of suitable size to have uniform section throughout to have proper aesthetic having a thickness of 100mm. The panels shall be fabricated using 1.25 mm thick GI sheet metal channels and angels. 100mm thick fiber glass or Rock wool in 2 layers each of 50 mm thick shall be used. The insulation shall be sandwiched between a layer of 1 mm thick perforated GI sheet one side (front face) and RP tissue on the other side (back side facing the wall/ceiling). The perforated sheet shall be riveted to the frame using pop rivets. The wall shall be painted with 85 / 25 grade bituminous primer having a density of 1.5 kg / sq.mt. Before fixing the panels. The panels will held on to the wall using special sheet metal GI 1 sections. Drawings indicating the fixing details shall be submitted for approval before the work is started. The 'I' sections shall be secured to the wall using fasteners. In case of ceiling, suspenders are to be fabricated out of steel channels and angles. The panels will slide through the 'I' sections and as such no screws will be visible from the room

2.6 AXIAL FLOW FAN:

Fan shall be complete with motor, motor mount, belt driven (or direct driven) and vibration isolation type, suspension arrangement as per approved for construction shop drawings.

- a. **Casing:** Shall be constructed of heavy gage sheet steel. Fan casing, motor mount and straightening vane shall be of welded steel construction. Motor mounting plate shall be minimum 15 mm thick and machined to receive motor flange. An inspection door with handle and neoprene gasket shall be provided. Casing shall have flanged connection on both ends for ducted application. Support brackets for ceiling suspension shall be welded to the casing for connection to hanger bolts. Straightening vanes shall be aerodynamically designed for maximum efficiency by converting velocity pressure to static pressure potential and maximum efficiency by converting velocity pressure potential and minimizing turbulence. Casing shall be bonderized, primed and finish coated with enamel paint.
- b. **Rotor:** Hub and blades shall be cast aluminum or cast steel construction. Blades shall be die – formed aerofoil shaped for maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Fan blades mounting on the hub shall be statically and dynamically balanced. Extended grease leads for external lubrication shall be provided. The fan pitch control may be manually readjusted at site upon installation, for obtaining actual air flow values, as specified and quoted.
- c. **Motor:** Shall be energy efficient squirrel – cage, totally enclosed, fan cooled, standard frame, constant speed, continuous duty, single winding, suitable for 415-10% volts, 50 cycles, and 3-phase AC power supply, provided with class F insulation. Motor shall be specially designed for quiet operation .The speed of the fans shall not exceed 1000 rpm for fans with impeller diameter above 450mm, and 1440 rpm for fans with impeller diameter 450 mm and less. For lowest sound level, fan shall be selected for maximum efficiency or minimum Hp. Motor conduit box shall be mounted on exterior of fan casing and lead wires from the motor to the conduit box shall be protected from the air stream by enclosing in a flexible metal conduit.
- d. **Drive:** The fan shall be provided through belt drive with adjustable motor sheave and standard sheet steel belt guard with vented front for heat dissipation. Belt shall be oil – resistant type.
- e. **Vibration Isolation:** The assembly of fan and motor shall be suspended from the slab by vibration isolation suspension of rubber in –shear type.
- f. **Accessories:** The following accessories shall be provided with all fans.
 - i) **Outlet cone for static pressure regain.**
 - ii) **Inlet cone**

Section III

TECHNICAL SPECIFICATION (ELECTRICAL)

SPECIFICATION FOR GENERATOR, AMF PANEL BATTERY CHARGER PANEL

1.0.0 GENERATOR AND EXCITATION SYSTEM:

1.1.0 The DG sets shall be required to operate during emergency conditions for maintaining essential services. For safe and smooth running of facility and other essential allied services in the event of failure of normal utility power system the emergency diesel generator system caters to these loads thru corresponding circuit, breaker with assistance of auto main failure panel.

1.2.0 The generator shall be complete with exciter, AVR and all auxiliaries

1.3.0 Specific requirement of generator:

1. Generator continuous output rating : 2000 KVA
2. Power factor : 0.8 LAG
3. Overload capability for 1 hour in 12 consecutive hrs. of operation, : 10%
4. Rated voltage : 415 V
5. Rated frequency : 50/S
6. Number of phase : 3
7. Winding connection : WYE
8. Maximum ambient temperature : 50 deg c
9. Type of insulation for Armature windings: The alternator starter windings shall be of class "H" insulation but temperature rise limited to that of class "B" insulation. Accordingly, the capacity of alternator shall be designed and quoted for meeting out the required performance for continuous operations :
10. Type of enclosure : screen protected
11. Permissible variation of voltage for proper
Operation at rated KVA, rated speed and power
Factor : $\pm 5\%$
12. Permissible variation of frequency for
Satisfactory operation at rated KVA,
Power factor and voltage. : $\pm 5\%$
13. Method of neutral grounding : solidly grounded.
14. Rated speed : 1500 RPM.

- 1.4.0 The transient reactance of generator should be as low as possible consistent with the need to limit voltage drop on sudden application of load.
- 1.4.1 All parts of the generator and accessories shall be designed to withstand all electrical, mechanical and other stresses that may be experienced during operation, including short circuit and over speed conditions.
- 1.4.2 The line and neutral ends of each phase winding of the generator shall be brought out on six suitably located terminals. the contractor shall provide suitable terminating arrangement for connecting the terminals to the machine ones the terminals shall be suitably enclosed to prevent short circuits by rodents etc.suitable cable glands shall be provided on the enclosure i.e. Cable terminal box to facilitate entry of the above cables. The space inside the terminal box should be adequate to accommodate current transformers of the rating indicated in the enclosed drawing.
- 1.4.3 A suitable adopter box shall be considered in addition to generator terminal boxes. The bidder's scope shall cover supply and installation of same. The degree of protection and fault level withstand of this box shall be same as that if generator terminal box.
- 1.4.4 Suitably rated 240V single phase heaters shall be provided in the lower parts of the stator frame. The KW rating of the space heaters shall be indicated. The connections, for the space heaters shall be brought out to a separate terminal box. when the generator is running, the space heaters shall be cut out automatically .two nos .diametrically opposite grounding terminals with clamps shall be provided on the generator suitable for minimum 65*10 mm² mild steel strips
- 1.5.0 **EXCITATION SYSTEM:**
- 1.5.1 The excitation system shall be either of the following types:
- A compound wound main exciter directly connected to the shaft and mounted on the end opposite to the diesel engine. Brush gear assembly shall be readily accessible for inspection and maintenance
 - Rectifier type excitation system.
- 1.5.2 Class B insulation shall be used for the armature and field windings of the exciter.
- 1.5.3 The response ratio of the excitation system shall be not less than 0.50.
- 1.5.4 The excitation system shall be so designed and/or protected that harmful over voltages cannot occur at the main exciter commutator due to combined effect of maximum exciter field current and machine over speed.
- 1.5.5 The exciter shall be provided with two Nos. diametrically opposite grounding terminals with clamps made with 50 X 6 mm. mild steel strips.

1.6.0 VOLTAGE REGULATOR:

1.6.1 The generator shall be capable of operation over a range of $\pm 5\%$ of the rated voltage. A voltage regulator shall be supplied complete with cross current compensation preferably of the static type. The regulator shall be supplied complete with voltage adjusting rheostat, all accessories and alarm contacts for successful operation including mounting and wiring. The voltage drop from no load to full load shall not exceed 3%.

1.7.0 BATTERY AND BATTERY CHARGER:

1.7.1 This specification is intended to cover the design manufacture and delivery of the following complete with all accessories:

- i. Battery and battery charger for DG plant equipment and services to be supplied under this specification.
- ii. One set of battery and battery charger for the DG set.
- iii. First filling of electrolyte with 10% extra and all necessary accessories for above battery set
- iv. Special tools, as required for erection and maintenance.

1.8.0 BATTERY:

1.8.1 Each of the DG sets shall be provided with one (1) set of 24 V or suitable voltage grade DC battery to cater the starting requirement of the DG set .besides this all the components ,mounted in side of AMF panel shall be supplied from DC battery.

1.8.2 The bidder shall compute the ampere hour capacity at suitable discharge rate based on the above duty and furnish the calculation with this bid. the minimum ambient temperature shall be 10 deg.c.the minimum voltage at the end of the load cycle shall not be less than 1.8 volts per cell. The batteries shall be storage type as specified. The cells shall be lead acid type with plates or tubular positive plates. Each cell shall be in a suitable leak proof container with sealed cover vent plug and filler cap shall be provided in the cover. Separators between plates shall permit free flow of electrolyte. Cell posts shall be sealed against electrolyte creep age. Cell terminal posts shall be provided with connector clamps, bolts, nuts.cell terminals shall be lead alloy reinforced with copper core inserts of adequate current carrying capacity and complete with acid resistant connecting straps bolts and nuts. Sufficient sediment space shall be provided so that the cells will not have to be cleaned out during normal life. Electrolyte normal level and lower level shall be indicated. The battery shall be shipped uncharged with the electrolyte shipped in separate container.10% extra electrolyte shall be furnished to compensate for spillage during transit and erection in non returnable container. Rated life of each battery shall be at least three years.

- 1.9.0 The bidder shall furnish along with the bid, his proposed layout of the battery racks to suit the space available.
- 1.10.0 **CONTROL OF DIESEL GENERATOR SETS AND AUTO MAIN FAILURE PANEL:**
- 1.10.1 Tenderer shall carefully study the following equipment concerning the control of the diesel generator set and the AMF panel consistent with these requirements. **Microprocessor control system shall be used for control and protection of the entire system of the AMF operation even though ordinary type of relays are mentioned some where in the specification.**
- 1.10.2 The diesel generator set will be normally at rest when the utility AC power supply is available from normal utility power source and in case of any emergency or any preplanned shutdown by the authority , the diesel generator set shall be started as follows:
- 1.10.3 On failure of normal utility AC supply, an impulse will start from the bidder's AMF panel, from this point onwards, all the bringing up to rated speed and voltage shall take place automatically without the help of any operator or any other bidder's equipment. Contractor shall provide all the necessary accessories required for this purpose of automatic starting involving various stages of operation in the engine auxiliary systems.
- 1.10.4 It shall be possible to start the engine manually through a push button mounted on AMF panel. The selection of automatic /manual start shall be done by suitable selector switches to be provided by bidder on AMF panel. Tender shall note that in access for manual starting by push buttons, except for the start everything else shall be automatic.
- 1.10.5 As soon as the diesel generating set reaches its rated speed and the generator its rated voltage contractor shall permit the closing of 415 V generator breakers.
- 1.10.6 The client will provide the circuit breakers on his switch gears; the diesel generator supplier shall supply and install all the necessary control cable for interconnection between the AMF panel and the circuit breaker cubicles.
- 1.10.7 Three attempt starting facility for the set shall be provided and in case the diesel engine fails to start and reach speed within the 3 successive commands it shall be disconnected and locked out automatically
- 1.10.8 It is not necessary for tenderer to offer any device to trip the DG set when the main station supply is restored. This will be done manually when necessary by means of push buttons on the diesel control panel.
- 1.10.9 The diesel generator and the associated circuit breaker shall be tripped under the following abnormal conditions.

Mechanical abnormal conditions :

- i. Over speed of diesel engine set
- ii. High jacket water temperature
- iii. Low lubricating oil pressure
- iv. Lube oil temperature high
- v. Cooling water temperature high
- vi. Exhaust gas temperature high

Electrical abnormal conditions:

- i. Failure of DC control supply
- ii. Excitation failure
- iii. Engine trip due to generator fault

1.10.10 Tenderer shall include all the sensing devices on the diesel set and relays, contactors, indication lamps, push buttons etc.on the MAF panels to achieve the above tripping conditions on 110V ungrounded system.

1.10.11 Window type annunciations shall be supplied by mounted on each AMF panel to give visual and audible indication of anyone or more of the following trouble:

- i. DG set over speed
- ii. High jacket water temperature trip
- iii. Low lube oil pressure trip
- iv. Lube oil temp.high
- v. Cooling water temp.high
- vi. Exhaust gas temp.high
- vii. Storage tank oil level low/high
- viii. Day tank oil level low/high
- ix. Failure to start of the engine after preset time
- x. Engine air intake filter choked
- xi. DG set on
- xii. General winding temp.high
- xiii. General bearing temp.high
- xiv. Excitation failure
- xv. Earth fault trip
- xvi. Differential relay operated

- xvii. Under voltage
- xviii. Over voltage
- xix. Reverse power relay
- xx. Over current relay operated
- xxi. Instantaneous O/C relay operated
- xxii. DG set tripped
- xxiii. General winding temp.very high
- xxiv. General bearing temp.very high
- xxv. Master trip relay operated(mech)
- xxvi. Master trip relay operated(elect)
- xxvii. 24 V DC, system failure
- xxviii. lube oil level low
- xxix. cylinder head temp high

Each annunciation system shall be provide with

- i. One push button for acknowledging the audible alarm
- ii. One push button for resetting the visual indication after the fault has been cleared
- iii. One push button for testing the illuminated transparencies.

- 1.10.12 On the occurrence of a fault the audible alarm shall be sounded and the appropriate window shall light up. the audible alarm will be silenced by pressing the” acknowledge” push button. The visual indication shall however persist until the relevant fault contact has been reset after which the visual indication can be rest by the reset push button.
- 1.10.13 Tender shall include all the sensing devices at the diesel set for the above alarms and the accessory relays/contactor/timer at the AMF panel.
- 1.10.14 The AMF panel shall be provided with equipment including but not limited to the following instruments and accessories: (item no.i to viii expect iv & vi shall be combined meter with RS 485 Modubus Protocol)
- i. 1 No. ammeter with selector a switch
 - ii. 1 No. voltmeter with the selector switch

- iii. 1 No. frequency meter
- iv. 1 No.DC ammeter
- v. 1 No.I kilo watt meter
- vi. 1 No.DC voltmeter
- vii. 1 No.KWH meter
- viii. 1 No KVAH meter
- ix. Push buttons, indicating lmaps,contractors,timer
- x. Annunciation system complete with facia window
- xi. Under freq. relay .
- xii. Instantaneous .O/C relay (50)
- xiii. Time delayed O/C relay (51 V)
- xiv. Reverse power relay (32 G)
- xv. Relay of differential protection (87)
- xvi. Earth fault relay(51 G)
- xvii. Under voltage relay (27)
- xviii. Over voltage relay(59)

1.10.15 All the cable entries to the panels shall be from the bottom. Tenderer shall include necessary gland plate with cable glands in his scope of supply. All the control accessories, push buttons, indicating instruments and indicating lamps as per relevant scheme drawing will be mounted on the AMF panel. All the internal wiring shall be carried out by 660 volts grade, PVC insulated copper wire of across section not less than 2.5 mm.the wiring shall be identified at both ends by means of plastic ferrules. Copper grounds bus of suitable size shall be provided inside the panel. The AMF panel shall be supplied with 2 nos. grounding terminals with clamps suitable for 50 mm x 6 mm strip conductor The tenderer shall include an adopter box completed with bus bar etc at the generator terminal box for mounting current transformers.

- i. Bus bar shall be of adequate rating, PVC sleeved.
- ii. 3 CTs of 2 core 2500/1 30 VA, CL-1 and 5P 20 will be used for the differential protection, metering and other protection purpose.
- iii. The neutral side terminals shall be terminated after forming the neutral in terminal box .one CT of single core 2500/1 A,20 VA,CL5P) Type will be used for the earth fault protection and shall be mounted inside the neutral terminal box.

- iv. The PT for generator operation, metering, protection and AVR are located at emergency switchgear of owner and all necessary interconnection shall be in the scope of the bidder
- 1.10.16 The panel shall contain or have mounted on it the generator voltage regulator, field breaker and associated control switches and indicating lamps. It shall be tested for the following:
- i. Mechanical tests on the components
 - ii. High voltage withstand test.
 - iii. For power requirement and wiring 2 kV 50 c/s .AC between phases and Phase to ground for 1 minute.
 - iv. For control equipment and wiring 1000v, 50 c/s AC between poles and between pole and between live parts and ground for 1 minute.
 - v. Leads from all the sensing devices and instruments to which bidder's cables will be connected shall be neatly brought to terminal blocks. The terminal block shall be properly identified.
- 1.11.0 **PERFORMANCE REQUIREMENTS:**
- 1.11.1 The diesel generator and accessories shall be designed to meet the performance requirements as per the relevant specification.
- 1.11.2 The unit shall be capable of delivering continuously at the generation terminals a net output of 2000 KVA at 0.8 pf. within invisible exhaust. The net output shall be obtained after necessary debating of engine due to site conditions and unit auxiliary power requirements have been taken into consideration.
- 1.11.3 The unit shall be capable of a peak output of 105% in excess of the rated output for the a period of one hour out of a total of 12 consecutive hours of operation, without exceeding permissible temperature limits and with a fairly visible exhaust.
- 1.11.4 **Items of guaranteed performance:**
- 1.11.5 The items of performance shall be guaranteed by tenderer in respect of the diesel generator unit and the auxiliaries when operating under the specified site conditions,.
- Net electrical output
 - 10% overload for one hour charger without overheating or showing signs of undue stress and within specified frequency variation.
 - Generator efficiency at **25%, 50%, 75% & 100%. load**

- Voltage regulator response
- Excitation at full load and under specified variation of voltage and speed.

1.12.0 BATTERY AND BATTERY CHARGER:

1.12.1 This specification is intended to cover the design manufacture and delivery of the following complete with all accessories:

- v. Battery and battery charger for DG plant equipment and services to be supplied under this specification.
- vi. One set of battery and battery charger for the DG set.
- vii. First filling of electrolyte with 10% extra and all necessary accessories for above battery set
- viii. Special tools, as required for erection and maintenance.

1.13.0 BATTERY:

1.13.1 Each of the DG sets shall be provided with one (1) set of 24 V or suitable voltage grade DC battery to cater the starting requirement of the DG set .besides this all the components ,mounted in side of AMF panel shall be supplied from DC battery.

1.13.2 The bidder shall compute the ampere hour capacity at suitable discharge rate based on the above duty and furnish the calculation with this bid. the minimum ambient temperature shall be 10 deg.c.the minimum voltage at the end of the load cycle shall not be less than 1.8 volts per cell. The batteries shall be storage type as specified. The cells shall be lead acid type with plates or tubular positive plates. Each cell shall be in a suitable leak proof container with sealed cover vent plug and filler cap shall be provided in the cover. Separators between plates shall permit free flow of electrolyte. Cell posts shall be sealed against electrolyte creep age. Cell terminal posts shall be provided with connector clamps, bolts, nuts.cell terminals shall be lead alloy reinforced with copper core inserts of adequate current carrying capacity and complete with acid resistant connecting straps bolts and nuts. Sufficient sediment space shall be provided so that the cells will not have to be cleaned out during normal life. Electrolyte normal level and lower level shall be indicated. The battery shall be shipped uncharged with the electrolyte shipped in separate container.10% extra electrolyte shall be furnished to compensate for spillage during transit and erection in non returnable container. Rated life of each battery shall be at least three years.

1.13.3 The bidder shall furnish along with the bid, his proposed layout of the battery racks to suit the space available.

1.14.0 **BATTERY CHARGERS:**

1.14.1 The battery chargers shall be solid state electronic type using silicon rectifiers and complete with all switches, fuses, contactors, and instruments. The battery charger shall be suitable for 415 volts \pm 10%, 3 phase, 50 Hz supply or 240V, 1 phase, 50 Hz AC supply. The charger shall have fully automatic voltage regulation and electronic current limiting. The voltage regulation shall be within 1% for a 0-100% load variation and 10% voltage variation on the AC side. Cooling shall be by means of natural convection. The battery charger shall be housed in a side of the AMF panel. The instruments, switches and lamps shall be flush /semi-flush mounted on the front of AMF panel since the charger panel shall be located inside the control panel. The battery charger shall be constant voltage type with dual provision of float charging and boost charging. The float charging voltage shall be 2.15 volts per cell. The float charger shall furnish the continuous DC load as well as float charge its associated battery. The boost charging voltage shall be about 2.75 volts/cell. Necessary blocking diode shall be provided so that boost charging voltage does not appear at the load terminals. The battery charger shall recharge the completely discharged battery to full capacity in 3 hours. The charger will have 10% excess capacity.

1.15.0 **WIRING:**

1.15.1 The contractor shall furnish and install all wiring for the equipment instruments and devices located on or within the battery charger system. The wiring shall be completed in all respects so as to ensure proper functioning of control, protection and metering schemes. All spare contacts of relays and switches shall be wired up to terminal block. Fuses and links shall be provided for isolation of individual control circuits from bus wires without disturbing other circuits. All fuses shall be link or cartridge type HRC fuses. Screw-on type fuses shall not be acceptable. Wiring shall be done with 2.5 sq. mm. stranded copper conductor, flexible PVC insulated switchboard wire. Each wire shall be identified at both ends with wire designation in accordance with contractor's wiring diagram. Interlocking type plastic ferrules shall be used for identification. All wire terminations shall be made with crimping type connections. Wire shall not be spliced between terminal points. Wherever practicable, wiring shall be accommodated on the sides of the cubicles. sharp tight bends shall be avoided. Wiring shall be neatly bunched in grouped by nonmetallic cleats or bends. each group shall be adequately supported along its run to prevent sagging and strain on the termination.

1.13.1 TERMINAL BLOCKS:

1.13.2 Multiway terminal blocks completed with necessary binding screws and washers for wire connections and plastic marking strip for terminal identification shall be furnished for terminating the panel wiring and outgoing cables. The terminals blocks shall be grouped according to circuit functions and shall have at least 20% spare terminals. Power and control terminals shall be clamp/stud type suitable for termination of at least 2 nos.copper cables of the specified size per terminal. Not more than 2 wires shall be connected to any terminal. if necessary a number of terminals shall be hampered together to provide wiring points. Adjacent rows of terminal bocks shall be spaced not less than 100mm apart. the bottom of terminal blocks shall be spaced at least 200 mm above the cable crutch of incoming multi core cables.

1.16.0 ACCESSORIES:

1.17.0 The following accessories shall be furnished for the batteries.

- i. One (1) connector bolt wrench
- ii. One (1) hydrometer syringe
- iii. One(1) thermometer with specific gravity correction scale
- iv. One (1) electrolyte level test tube.

The charger shall be completed with the standard accessories including but not limited to the following:

- i. Solid state surge protectors on the AC and DC sides.
- ii. AC failure alarm relay.
- iii. DC time delayed low voltage relay.
- iv. Ground detection alarm for positive and negative leads.
- v. Manual float voltage adjust potentiometer
- vi. DC ammeter and voltmeter

SECTION - IV**GENERAL REQUIREMENT OF LT BUSDUCT:****SCOPE:**

The specification covers the technical requirements of design, manufacture, test at works, supply, installation, testing & commissioning of 415V LT, Non-segregated phase, air insulated bus ducts and accessories for efficient and trouble free operation

The bus duct shall be erected from Transformer to Main MV Panel, Main MV Panel to Rising mains as shown in the enclosed drawings.

STANDARDS:

The equipment covered by this specification shall unless otherwise stated, be designed, Constructed and tested in accordance with the latest revisions of relevant Indian standards and shall conform to the regulations of local statutory authorities.

IS: 2147 – degree of protection provided by enclosures.

IS: 8623 (part II) – particular requirements for bus Trunking system

GENERAL:

The bus duct shall be metal enclosed self cooled, Non-segregated, indoor/outdoor type as required and shall include as Standard manufactured components, all straight lengths, elbows, phase change-over boxes, Termination chambers flexible joints. It shall be the responsibility of the contractor to manufacture the bus duct to suit the terminal flange arrangements of the transformer; LT Switchgear & DG control Panel.

CONSTRUCTION:

The bus duct enclosure shall be duct and vermin proof rectangular in cross section and shall be fabricated out of M.S angle and 14 SWG CRCA sheets. It shall be rigid and robust in Construction and shall be treated to prevent any possibility of corrosion.

The bidder shall furnish the external treatment process for approval (10 years life guarantee to be provided) and would be subjected for stage inspection and approval.

Joints in the enclosure shall be bolted and shall be provided with neoprene gaskets. All retaining Catches, screws, bolts and nuts etc. shall be nickel plated. Ends of bus duct connecting to Transformers; LT ACBS shall be provided with flange connectors and flexible.

The bus duct shall be designed to keep enclosure losses to a minimum due to temperature rise. Provision shall be made for the expansion and contraction due to temperature variations. Enclosures shall be with louvers and designed in such a way to have Dust & Vermin proof. Design of expansion joints shall be subjected to approval.

Whenever required necessary phase crossover chambers shall be included the bus duct enclosure shall provide a protection of not less than IP 4X as per IS: 2147. Inspection openings of sufficient size shall be made on the enclosures to facilitate inspection/maintenance of supports and bus bar joints.

BUSBARS:

The bus bars shall be air insulated and made up of high conductivity COPPER, with high purity. The bus bars shall have a continuous current rating as Mentioned in the Technical particulars and shall have fault withstand capacity as specified in the Schedule of Quantities. The bus bars shall be TP & N, the cross section of the neutral bus being equal to the cross Section of the phase bus bar.

Bus bars shall be identified with red, yellow, blue and black colour tape bands appropriate places and at terminations

The bus bars shall be suitably supported at appropriate intervals with SMC/FRP material to withstand the electro-mechanical stresses during short circuit.

End terminations shall be provided with necessary flexible connectors for bus expansion and contraction.

Appropriate electrical clearance shall be provided between phase, neutral and body as per IS and to withstand temperature rise and electrical stress.

The bus supports shall be of the material as indicated in the Technical particulars.

The bus bars shall be fixed in the supports in such a way to allow for free movement of conductor due to thermal variation, without creating mechanical stresses proof shall be provided .Bolted type bus bar rigid joints shall be considered for connecting successive bus bars of its same phase. Bolted type splice plate, HTS zinc plated bolts and nuts with washers, shall be used to achieve an efficient joint.

Joining method shall be as per international practice and the manufacturer should submit proof, customer may call for testing to verify.

Bidder shall submit calculation for selection of bus bars , support insulator spacing, for approval.

EARTHING:

The bus duct enclosure shall be earthed by a continuous COPPER earth bar size as specified in BOQ, running on both side of the enclosure throughout the entire length of the bus duct.

PAINTING:

Care shall be taken in workmanship and selection of materials to prevent the occurrence of any form of damage of corrosion. Bus duct enclosure shall be prepared, primed, filled and painted to the highest standards. All items shall be cleaned and deburred after fabrication and welding is complete. External surfaces shall be filled and rubbed down as necessary to obtain a perfectly flat smooth surface, free from blemishes and imperfections and the whole shall be painted with under coats followed by coats of power coated paint and desired shade after duly heated for rust prevention and applying two coats red oxide metal primer and the sheet metal work shall be passivated prior to other process mentioned. The purchaser shall indicate the exterior colour later and the interior of the enclosure shall be painted matt black. The bus bars shall be painted matt black.

The painting process shall be using a seven-tank phosphating system with primer coating within 4 hours of phosphating and two coats enamel Powder Coating.

The painting process shall be pre approved by the Consultant / Owner. Painting shall be subject to inspection before assembly.

TYPE TESTS

The bidder shall furnish two copies of type test certificate along with bid for the following.

- a. Short time current
- b. Temperature rise test.

INSPECTION AT MANUFACTURER'S WORKS.

Fully assembled busducts shall be offered for inspection at works with prior intimation. Materials shall be dispatched to site only after issuing inspection clearance by the representative of purchaser /consultants, Following routines tests shall be conducted on the bus duct.

Stage inspection during fabrication

Corrosion test

Paint inspection

Physical verification check

Rubber gasket test.

Megger Test.

Power frequency HV Test.

Mill volt drop test on Rigid and expansion joints.

Temperature Rise Test.

DRAWINGS

After award of the order, the manufacture shall submit the following documents for approval.

General arrangement showing the plan, elevation, different views, detailed typical cross section of bus duct, details of expansion joint, termination arrangement at both ends, bus bar arrangements, erection details with necessary supports.

Tests certificates, if needed,

Complete technical particulars of the components of busduct Commissioning and maintenance instruction for the bus duct.Design calculations. Bidder shall furnish a cross section of the bus ducts showing the following along with the bid

- a. Size of Enclosure
- b. Size of Bus bars.
- c. Type of Bus support and spacing.

SECTION - V

GENERAL REQUIRMENT OF SCRUBBER

PLANT DESCRIPTION

The facility basically a software park houses a Captive Power Plant [DG] to act as standby against eventual power failure. The captive power plant comprise of Three Generators, each of capacities **2000 KVA**. The Generators use HSD as the prime fuel. It is known that since the particulate matters + the quantitative SOx emissions in the flue gases across the DG is more the installation of scrubber is warranted mainly to neutralize the acidic emission and also the particulates.

Though a complete combustion is ensured by the destruction of hydro carbons the Sulphur presence accounts of Sulphur Oxides resulting on account of oxidation due to combustion. SOx being an acidic emission tends to cause air pollution around the immediate vicinity. Again an important pollutant need to be addressed.

PROPOSED SET UP

Though there are a few options available for the neutralization of SOx emissions, considering the operational constraints a wet gas cleaning [Scrubbing] arrangement is proposed to be inducted in the present set up, most importantly without causing any operational lacunae to the existing set up.

The proposed set up shall house a gas scrubber [Wet Scrubber] with two stage distribution of spray arrangement on strategic locations, operating on counter flow arrangement with demisters / entrainment separators. This scrubber shall dose / spray alkaline medium [NaOH] at requisite concentration to neutralise the eventual acidic emissions [SOx based] generated. The resultant clean air / gas coming out of the scrubber shall be exhausted through a vent. Exhaust from the generator engines shall have a static pressure of 2-3 inches of Hg . The proposed system is basing on the above head availability to overcome the possible pressure drop which could occur across the proposed scrubber. Necessity of an additional suction blower is not warranted. It may be noted that packed bed towers offer more pressure drop which induces the induction of a suction blower to overcome the pressure drop.

Thus the set up shall house a wet scrubber with complete re-circulation system with due standbys and a direct venting for exhausting the gases across the scrubber.

PROPOSAL BASIS

Plant Data

No. of Generators	-	1 + 2 (Future) Nos. (Total 3 Nos.)
Capacity of Generator	-	2000 KVA

- ◆ The fuel firing rate of the above generator is such that at full load the likely flue gas generation is estimated to be 16500 m³/hr @ 500°C / DG.
- ◆ The flue gas exit velocity is around 21 m/sec.
- ◆ The proposed gas cleaning system, each scrubber, in line with the above consideration shall be designed to handle a flow rate of 3x16500=49500m³/hr.
- ◆ Innovative two stage distributors and spray nozzles strategically positioned for effective neutralization of the acidic emissions and to have reduced pressure drop in the overall system.
- ◆ Scrubber internals shall be of stainless steel conforming to SS-304 or 316.
- ◆ Non-Corrosive, High Performance Vertical Glandless Pump of UHMWPE make is considered for the scrubber water re-circulation. All piping shall be conforming to HDPE / U-PVC.
- ◆ More than corrosion, erosion problem rules out the usage of stainless steel and hence a most suitable non-metallic scheme is suggested.
- ◆ The proposed FGD arrangement could be housed in an overall span of 4 mtrs x 5 mts linear scale... However depending on the site conditions the orientation of the individual equipment could be altered as the proposed system being a custom built one.
- ◆ The overall tonnage of the FGD system shall be 14 tonnes / scrubber [On site constructed basis inclusive of all accessories]
- ◆ Importantly the FGD is designed to comply with the emissions norms prescribed by the statutory authorities and the governing guidelines.

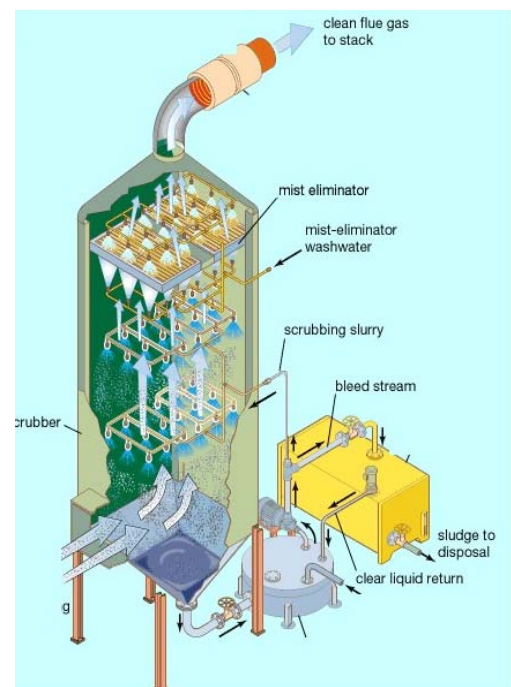
PROCESS DESCRIPTION

The basic operating principle along with the design considerations made with respect to the available plant data is explained in detail in the following lines:-

Operating Principle

Scrubber uses the natural process of re-circulating water decontaminating air - essentially the same process that occurs during a rainstorm, but made more efficient by technology and engineering.

1. Flue gas is passed through the scrubber using either negative or positive pressure, created from a fan on either upstream or downstream from the scrubber unit. [In the proposed case the scrubber is intended to be on delivery side].



2. The gas stream enters the scrubber unit near the bottom and travels up [Counter Current] through the spray distribution section (where the contaminants are actually separated from the gas).
3. The gas stream is vigorously exposed to the scrubber solution, through a demister assembly [Entrainment Separator] (to remove the liquid droplets from the exiting gas).
4. The clean gas stream is then discharged either to the atmosphere or routed back through the original process.

During operation the gas / fumes flows upward through the packed bed while scrubbing liquid flows down over the packing material. The counter-flow design principle offers optimal mass transfer.

The scrubber unit as explained earlier shall be installed at the delivery of the exhaust with a tapping taken from the existing exhaust ducts duly connected with an isolation damper. Importantly the scrubber is designed considering the requirement of direct exhaustion of the gases through the scrubber without inducing any back pressure in the event of any failure in the re-circulation system.

Besides the scrubber unit shall house the re-circulation system for atomized fine spray of the neutralizing medium through anti corrosive vertical glandless pumps, coupled with due interlocks / annunciators. There shall be a raw / make up water line provision for the scrubber re-circulation system. The dosing of alkali [Caustic] shall be done through dosing mechanisms and once reaching the set TDS of more than 1600 PPM the water could be discharged in total to the STP or to main drains.

EQUIPMENT

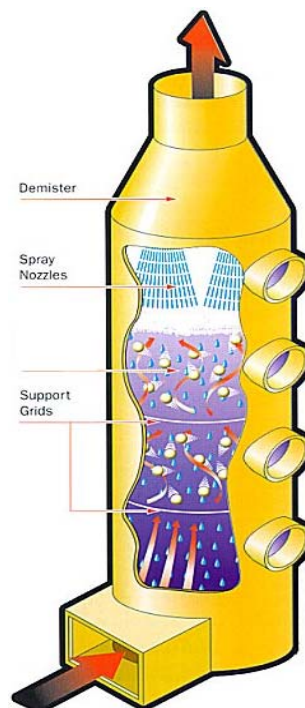
01. GENERATOR EXHASUT

EXISTING

No modification is warranted but for the insertion of a damper with due by pass for any emergency. A tapping shall be taken from the existing outlet to form the inlet for the proposed gas cleaning system. This proposal is being made with the consideration that the inlet connections to scrubber shall be made by M-GEN, however the individual exhaust duct length not exceeding 8 mtrs.

02. WET SCRUBBER

Flue gas from the ID fan outlet shall be passed through wet scrubber to control particulate and gaseous emissions. Wet scrubber is a cylindrical vessel with an array of liquid (alkaline medium) spraying nozzles through a distributor at the top of the scrubber with spraying arrangements at different elevations for effective contact of both the mediums. There shall be packing grids positioned to ensure thorough contact of the gas and water and to have reduced pressure drop. Gas and water are maintained in a counter flow path to increase the efficiency of scrubbing. The complete inner surface of the scrubber shall be lined with acid proof tiles or Metalising with aluminium for protection against corrosion. The very idea of selecting this scrubber with partial spray and packed column out of different options available is owing to the following criteria.



- Low pressure drop
- Operational / maintenance ease.
- Back Washing not required owing to the trappment of particulates collected in the bottom of the scrubber itself.

Material of construction	-	IS 2062
Gas inlet temperature	-	500 °C (max)
Gas outlet temperature	-	80 to 90 °C
Inside Lining	-	Acid Proof Tiles [or] Metalising
Scrubber Internals	-	Stainless steel –SS304/SS316
Water circulation rate	-	30 m3/hr

**** The Photo is only a simulated version actual may change depending on the site requirements**

The scrubber shall have ladders and inspection platforms suitably positioned at the right elevation and location.

03. SCRUBBER RECIRCULATION SYSTEM

Vertical Glandless pump with due stand bye is considered for the scrubber water re-circulation. The tank shall be an integral part of the scrubber itself. It may be noted that since the particulate carryover being less, and only the neutralization occurs in the scrubber system, the sludge generation is expected to be very less. The tank shall have manholes and inspection doors for operational / maintenance ease. The tank shall also be inside lined completely with acid proof tiles of adequate thickness for protection against corrosion. The tank shall have compartments with filters for filtering the scrubbed water and the filtrate alone shall be re-circulated.

Beside a small alkali dosing tank shall also form a part of the proposal.

Tank material of construction	-	IS2062 with FRP lining
Tank capacity	-	6000 Lits – Maximum
Pump MOC	-	UHMWPE
Pump flow rate	-	30.0 m3/hr
Pump delivery pressure	-	15 mlc
Pump motor rating	-	7.5 HP
No.of Pumps	-	2nos [1w + 1 s].

The complete interconnecting piping and the re-circulation system shall be of HDPE with PP valves and fittings. The HDPE lines shall be properly supported with structures taken from the scrubber end itself.

04. VENT / CHIMNEY

Scrubbed gases from the system shall be exhausted through a vent directly positioned over the scrubber itself. The effective height of the vent from the ground level shall be matching with the plant requirements. The Vent shall be installed in compliance with the TNPCB requirements. Given the consideration that the scrubber is intended to be installed on the top of the building, the exhaust elevation shall be a minimum of 8 mtrs from the top of the building [inclusive of the scrubber height]

05. ELECTRICAL & INSTRUMENTATION

An operating panel with SFU's, starters, push button switches is considered under the scope. The complete cabling within the system boundary is resting with M-GEN. However the incomer to the panel shall have to be provided by the customer.

MCC and operating panels shall be provided with all the above proposed instruments and controls. Panel shall have required starters with protection relays and ON/ OFF push buttons.

MCC and operating panels shall be provided for the proposed systems. Panel shall have starters with protection relays and ON/ OFF push buttons.

The complete panel along with panel instruments shall be flame proof complied.

BATTERY LIMITS

- | | | | |
|-----|----------------------------------|---|-----------------------------|
| 01. | ELECTRICITY
Power supply | - | Inlet to Panel |
| 02. | RAW WATER
Water | - | Inlet to tank. |
| 03. | SCRUBBER WATER
Scrubber Water | - | Outlet of tank. |
| 04. | ALKALI DOSING
Alkali | - | Inlet of alkali dosing tank |

SECTION VI
ANNEXURESTECHNICAL DATAENGINE AND ALTERNATOR

S.No.	DESCRIPTION	To be filled by the vendor
1	Make of engine	
2	Model	
3	Bore X stroke mm	
4	Displacement LTR	
5	Length overall mm	
6	Height overall mm	
7	Width overall mm	
8	Compression ratio	
9	Engine BMEP Kpa	
10	Engine BHP W/O Fan	
11	Rating KVA	
12	Unit dry WT KGs	
13	Fly wheel housing	
14	Governor	
15	Battery/make/volts/capacity/nos	
16	Make of alternator	
17	Class of insulation for winding	
18	Rated voltage	
19	Efficiency of alternator	
20	Alternator Rating	

AIR INTAKE SYSTEM

S.No.	Description	To be filled by the vendor
1	Intake manifold temp deg c	
2	Intake manifold PR Kpa	
3	Intake air flow M3/min	
4	Max.Allowable restriction clean	
5	Element Kpa	
6	Air cleaner element	
7	Filtration	
8	No. of filters	
9	Dust removable efficiency %	

Exhaust system

S.No.	Description	To be filled by the vendor
1	Max.static weight on exhaust connection KGs	
2	Max.allowable system back pressure KPa	
3	Heat rejection to exhaust KW	
4	Manifold Temp. deg.C	
5	Stack temp deg.c	
6	Gas flow M3/MIN	
7	CO gms/hrs	
8	NOx gms/hrs	
9	Sox gms/hrs	

Noise data

S.NO	Description	To be filled by the vendor
1	Engine exhaust air noise in dbA at a. 100% load b. 90% load c. 80%load d. 70%load e. 60%load	
2	Engine mechanical noise in dbA at a. 100% load b. 90% load c. 80%load d. 70%load e. 60%load	

ALTERNATOR

S.No.	DESCRIPTION	To be filled by the vendor
1	Frame	
2	Rating in KVA	
3	Rating in KW	
4	Power factor	
5	No: phase	
6	Frequency in Hz	
7	Speed in rpm	
8	Rated voltage in V	
9	Voltage variation in %RV	
10	Rated full load current	
11	Enclosure as per IS 4691	
12	Cooling as per IS 6362	
13	Mounting as per IS 2253	
14	Altitude MSL	
15	Ambient in deg C	
16	Insulation Stator	
17	Insulation Rotor	
18	Temperature Rise IS 12802-Stator	
19	Temperature Rise IS 12802-rotor	
20	Governing Standards	
21	Resistance Ohms @ 20 deg C-Min Stator	
22	Resistance Ohms @ 20 deg C	
23	Resistance Ohms @ 20 deg C	
24	Resistance Ohms @ 20 deg C	
25	Excitation type	

26	Rectifier bridge type	
27	Rotor Current in DC Amps-No load	
28	Rotor Current in DC Amps-Full load	
29	Exciter overload capacity	
30	Excitation current in DC amps-no load	
31	Excitation current in DC amps-full load	
32	AVR type	
33	Voltage Regulation	
34	System Response time	
35	TVD when 100% load is applied	
36	Wave form distortion	
37	Short Circuit Ratio	
38	Unsaturated Direct axis synchronous reactance	
39	Unsaturated Direct axis transient reactance- X_d'	
40	Unsaturated Direct axis sub transient reactance- X_d''	
41	Unsaturated quadrature axis synchronous reactance- X_q'	
42	Unsaturated quadrature axis sub transient reactance- X_q''	
43	Negative sequence reactance- X_2	
44	Zero sequence reactance- X_0	
45	Time constant-Transient current- $T'd$	
46	Time constant –sub transient current - $T''d$	
47	Time constant- $T'do$	
48	Armature time constant – T_a	
49	Efficiency @ fullload@0.8 pf	
50	efficiency@3/4 fullload@0.8 pf	
51	Efficiency @1/2 fullload@0.8pf	
52	Stator winding and connection	
53	Terminal markings	
54	Damper winding	
55	Overload capacity	
56	Sustained short circuit	
57	Unbalanced load permitted	
58	Impregnation	
59	Protection against moisture dust	
60	Paintings	
61	Bearings-DE	
62	Bearings-NDE	
63	Lubrication	
64	Over speed	
65	Direction of rotation	
66	Cooling air in m ³ /min	
67	Moment of inertia-KGm ²	
68	General dimension arrangement	
69	Weight	

VII. RECOMMENDED MAKES OF EQUIPMENTS

1. Generator Engine	-	CATERPILLER / CUMMINS/ PERKINS / MTU / MITSUBISHI	
2. Generator Alternator	-	STAMFORD/ KATO / LEROY SOMER / CATER PILLER /	
3. Miniature Circuit Breakers	-	MERLIN GERIN / L&T HAGER /ABB/Siemens	
4. Air circuit breaker	-	SIEMENS /L&T/ABB /SCHNEIDER/ GE(M-PACT)	
5. Moulded Case Circuit Breaker	-	SCHNEIDER /SIEMENS/ABB/ L&T / GE(SPECTRA)	
6. LT Contactors	-	SIEMENS / L&T / SCHNEIDER TELEMECHANIQUE (FRANCE)	
7. L.T. Cables	-	FINOLEX / GEMSCAB / CCI / UNIVERSAL /KEI / POLYCAB	
8. Protection Relays and Auxiliary Relays	-	ALSTOM / ABB / CSPC/ L & T / SCHNEIDER	
9. Instruments(Digital)	-	CONZERV / L& T / CADEL	
10. CTs / PTs	-	KAPPA/ PRAGATHI/INSTRANS/ AE / PRAYOG/ INDCOIL	
11. Control Switch / Indication Lamp/	-	SIEMENS / TEKNIC / KAYCEE / L&T/ MG	Push Button
12. Annunciation Windows	-	MINILEC / PROCON / ALAN	
13. Cable Termination Kits	-	RAYCHEM / BIRLA 3M	
14. Cable Glands	-	COMET / PRABHAT / STANDARD METAL INDUSTRIES	
15. Cable Trays & Accessories	-	PROFAB / TECHNOFAB/	

16.	Battery Charger	-	CHAABBI/SABNIEF/CALDYNE / DUBAS/AMAR RAJA
17.	Battery	-	AMCO / CHLORIDE / STANDARD / EXIDE AMAR RAJA
18.	AMF/SYNCHRONIZING PANEL	-	(IF DG MANUFACTURER HAS THEIR OWN MANUFACTURING UNIT FOR PANELS OR TIE-UP WITH REPUTED ANUFACTURERS CAN SUBMIT THEIR CREDENTIAL FOR APPROVAL. APPROVAL WILL BE GIVEN BASED ON THE CREDENTIAL BY ARCHITECT/ CLEINT. ONLY APPROVED FIRMS SHALL BE PERMITTED FOR MANUFACTURING THE PANELS.)
19.	Fuel Oil Tank and Connected Works		CREDENTIAL OF THE FIRM SHALL BE SUBMITTED FOR APPROVAL
20.	Ventilation System		CREDENTIAL OF THE FIRM SHALL BE SUBMITTED FOR APPROVAL
21.	Scrubbers and Connected Works		CREDENTIAL OF THE FIRM SHALL BE SUBMITTED FOR APPROVAL

NOTE:

1. **The Successful Tenderer shall submit test reports for all the materials/equipments.**
2. **If any make is not in accordance with the tender specification it will not be accepted even if the make is indicated in the above List.**
3. **The client / Engineering Consultant have reserve to select any of the make specified above.**
4. **The origin of equipments shall be India/USA/Europe/Japan/Singapore.**

SECTION – VIII

SUPPLY & INSTALLATION OF DIESEL STORAGE TANKS AND ACCESSORIES PIPING ,PIPE FITTINGS AND ACCESSARIES FOR DIESEL DISTRIBUTION

CONTENTS

1. SCOPE OF TENDER
2. CODES AND STANDARDS
3. SCOPE OF WORK
4. DESIGN REQUIREMENTS
5. DOCUMENTS TO BE FURNISHED
6. LIST OF APPROVED MAKERS
7. REFERANCE DRAWINGS

1.0 SCOPE OF TENDER:

GENERALSCOPE:

The scope of this tender comprises the supply, erection, testing, commissioning of Diesel storage tanks and accessories, Pipe, Pipe fittings, instruments, bolt & nuts, Gaskets and valve package confirming of these specification and in accordance with requirement of drawing and of the schedule of quantities. Integration of each unit is to be completely assembled with all interconnecting equipment and systems, piping and internal field installation from the utility production boundaries as indicated by consultant and owner. Preparation of submission drawing in required copies to be submitted to all government agencies inclusive of CCOE (Chief Controller of Explosives) office and getting all approvals and clearance from government and statutory authorities. All charges payable to Statutory Authorities such as CEIG/Explosive Dept. etc are to be borne by the tenderer.

Supply, fabrication erection and commissioning of diesel storage tank with all safety accessories, supply and erection of diesel unloading pump and transfer pump, piping from this storage yard to utility point day tank and to the diesel tank in DG Set as per process requirement and specification and Indian standards and as per rules and regulation of Chief Controller of Explosive Dept and The Petroleum Act 1934 and The petroleum Rules2002 amended by 2005 and as detailed in the scope of work and tender document BOQ.

The scope under this tender shall include but is not limited to the Designing the layout Installation of Piping ,pipe rack and supports structural where ever necessary to support the piping and other accessories and system, Installation, pre commissioning, commissioning and painting as per code and standards, specification given by Consultant /Owner authorized engineer. Preparation of submission drawing in required copies to be submitted to all government agencies inclusive of CCOE (Chief Controller of Explosives) office and obtaining necessary approvals from various Government statutory authorities , Boards and councils and Chief Controller of Explosives Dept wherever applicable.

For laying piping and supporting all services from the source to the boundary point marked by Ticel enable to connect and the Piping routings are to be designed as per requirement and site conditions as indicated in the layout drawing and as per statutory rules and regulations but in such a way with out affecting the loading in the main structures and other process piping and equipments. All routings and support fabrication are to be got approved from Consultant /Owner authorized engineer before executing in the site

The required civil foundation for the support structure for tank, pump, piping and Pipe rack shall be executed by different agency. Safety fencing as per statutory rules and regulations shall also be executed by different agency. The detail design drawing for required foundation and fencing detail shall be supplied by the contractor.

This specification covers the technical requirements and essential particulars for the Design, supply, fabrication, and inspection, erection, testing and cleaning of storage tanks and piping systems as covered in the specification, documents and drawing. The CONTRACTOR shall demonstrate that the piping satisfies the requirements of the specifications and applicable codes.

No deviations or exemptions from this specification shall be permitted without the written approval of the Purchaser Client/ OE / EC. Intended deviations supported by reasons shall be separately listed by the vendor and submitted with the bid for the consideration of the purchaser.

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 and startup conditions.

Vendor is requested to highlight if any of the requirements of CCOE any other regulatory agency is not met and they could provide a BOM and cost as optional item as part of their submittal. These may include a change to the present BOM if it does not meet the intent of the CCOE/PESO regulations.

A . PLANT ENVIRONMENT

Maximum ambient air temperature	: 50°C
Minimum ambient air temperature	: 15°C
Maximum daily average ambient air temperature	: 40°C
Maximum yearly average ambient air temperature	: 32°C
Maximum Wet bulb Temp	: 28.5°C
Maximum humidity	: 100%
Maximum wind pressure	: 150 kg f/sq.m.
Altitude above M.S.I.	: ≤1000 m
Earthquake	: Zone-II (IS: 1893-2002)C

Utilities

The following shall be made available by the PURCHASER ONLY FOR TESTING AND COMMISSIONING & CONTINUOUS OPERATION OF THE EQUIPMENT:-

Electricity

Power	: 415v ± 10%. 50 Hz ± 5%.
High efficiency	: IS – 325 – 1996
Electrical Motor	: Energy efficient as per IEEMA Std. / 19- 2000 with efficiency norm 2.

Note : For Field instruments. Sub Contractor to Step down to 24V DC for safety reasons.

Water:

High quality of water for testing and commissioning of equipment and systems as per requirement shall be arranged by Vendor.

2.0 CODES AND STANDARDS:

2.1 The installation and system required for storage of DEISEL, shall comply with all currently applicable statutory, regulations and safety codes in the locality where the equipment will be installed. The system shall also conform to the latest editions of the codes and standards listed in the clause 2.2. below and other applicable standards. Nothing in this specification shall be construed to relieve the CONTRACTOR of his responsibility.

2.2 The equipment and work under the contract conform to the following standards/codes.

- (a) Indian regulations of Chief Inspector of explosives.
- (b) Applicable standard
 - (I) IS10987-1992:Code of practice for design, fabrication, testing & installation of underground /above ground horizontal cylindrical steel storage tanks for petroleum products
 - (II) IS: 800 - Code of practice for use of Structural Steel in General Building Construction
 - (ii) IS: 226-1975 Structural steel (Standard Quality)
 - (iii) IS: 1239 & IS: 3589 - Seamless or Electrically Welded Steel pipes for Water, Gas and Air systems.
 - (iv) IS 2062 –Carbon steel Plates
 - (v) IS1367 (Part 1 to 13) - Technical supply conditions for threaded Fasteners
 - (vi) IS 6044-1972: Code of Practice for Liquefied (Part II) Petroleum Gas Storage installation
- (c) American National Standards Institutes (ANSI) code "Power Piping" - ANSI B31.1 and all other associated ANSI standards
- (d) American National Standard Institute (ANSI) code "Chemical Plant and Petroleum Refinery Piping "ANSI B31.3 and all other associated ANSI standards:ANSI / ASME: 31.4
- (e) Manufactures Standardization Society (MSS) USA standard practices.
- (f) American Society for Testing Materials (ASTM) specification.
- (g) NFPA 30-2000 designed in accordance with NFPA 30 [45], Classification -Methanol - Class 1B Flammable Liquid
- (h) American Society of Mechanical Engineers (ASME) codes.
- (i) Pipe Fabrication Institute (PFI), USA Standards
- (j) The Petroleum Act 1934 along with The Petroleum Rules 2002
- (k) The installations shall also be in conformity with all applicable state laws and the Bye laws and requirements of Local authority in so far as these become applicable to the installation. Where ever this specification calls for a higher standard of material and or workmanship than those required by any of the above regulations and standards, then this specification shall take precedence over the said regulations and standards where ever drawings and specification require some thing which will violate the regulations, the regulations shall govern

3.0 SCOPE OF WORK:

General:

The scope under this tender is covering to Designing, Supply of storage tanks, pipe and pipe fittings, valves, Gaskets and supports structural, Installation, pre commissioning, painting as per code and commissioning of piping system for Diesel piping unloading and transfer from diesel storage yard to plant use as per technical specification and codes and standards and also as per rules and regulation stipulated by chief general inspector of explosive dept.

1. DIESEL STORAGE AND PIPING

The scope under this tender covers Designing, Supply of piping and pipe fittings, valves, Gaskets and supports structural, Installation, pre commissioning, painting as per code and commissioning of piping system for Diesel piping unloading and transfer from diesel storage yard to plant use as per technical specification and codes and standards and also as per rules and regulation stipulated by chief general inspector of explosive dept.

Diesel Tank

Diesel tank of 25KL horizontal cylindrical type to with stand maximum pressure of 1.0 kg/cm² in IS 2062 MOC mild steel plates with safety accessories with complete supporting structure, **under ground storage tank**, flanged nozzles, manhole Vent valve with Box trap over flow valve, isolation valves and drain Valve shall be provided and IS10987-1992:Code of practice for design, fabrication, testing & installation of underground / horizontal cylindrical steel storage tanks for petroleum products and as per rules and regulation of Chief controller of Explosive Dept. Fabrication, Transportation, insurance, Unloading at site, Installation, Testing & Commissioning of HSD tank suitably designed for Underground installation as per enclosed drawing. Tank to be suitably fabricated with stiffeners, necessary accessories such as outlet, inlet, manhole, Aluminium dipstick, bolts, nuts and necessary brackets on the tank for holding turn buckle etc. complete all as per approved design/drawing and as per rules and regulation stipulated by chief control of explosive dept and The petroleum Rules 2002 amended by 2005.

Capacity : **25KL (or) 30 KL as required by TICEL**
Quantity : **1 No.**

Suggested Material of Construction

Shell / Endplate : IS2062. Thickness minimum 6 MM for Shell and End plates
Supports : C.S.
Vertical/ horizontal : Horizontal cylindrical
Type of Construction : DOUBLE WALLED Horizontal cylindrical
Accessories : Shut-off valves, Vent valve, drain valves etc.,
Painting : 2 coats of Epoxy primer and 2 coats of epoxy paint.
Test Certificates : Hydraulic test, and radiographic test as per standards and Chief Controller of Explosive dept rule and regulations To be Furnished.

TRANSFER PUMP

Type	:	CENTRIFUGAL STAGE PUMPS /ROTARY GEAR PUMPS
Capacity flow	:	5CMH
Total Head	:	30 MWC
Speed RPM	:	2990
Shaft	:	EN9/SS 304
Casing	:	CS/CI /CF 8M
Impeller	:	CI
GEARS	:	Alloy steel surface hardened Spur/helical gears
Coupling	:	Direct
Gland	:	Mechanical Seal
Base Frame with FRP coating	:	To be provided
Qty	:	1 working +1Standby
Make	:	KIRLOSKAR /KSB FOR CENTRIFUGAL STAGE PUMPS

1. This tank area additionally Grounding is to be done for protecting DIESEL from accidental ignition resulting from static discharge. Grounding is required for lighting systems, pipe racks, pumps, vessel, filters, and all other equipment near and potentially within range of Petroleum vapor. Unloading Hoses Bonding by making a connection between a grounded object can be intended to dissipate static electricity generated during fluid transfer.

2. Sprinkler piping,/fire hydrant piping point to be installed exclusively for this tank yard as per CCOE Norms

3. Fire extinguisher Alcohol Resistant Aqueous Film Forming Foam (AR-AFFF) with 6% foam proportioning (with water) equipment is advised for use on methanol fires.

4. Proper earth pit as per electrical code & rules to be installed with in the yard Contractor can decide the no of pits based on their design however minimum Two nos is to be installed .

5. Proper fencing to be done as per statutory rules and CCOE Norms is included this contract scope.

6. Inside the yard all mechanical, electrical & control instruments jobs as per statutory rules and CCOE Norms is under diesel vendor scope of works except yard lighting. Yard lighting poles also to be installed outside the yard and done by electrical vendor. A POWER CABINET with isolator for total requirement of power for the YARD equipment will be given by electrical vender. From this cabinet a separate panel to be installed with individual cable & isolator and control circuit for equipment and controls shall be done by Diesel vendor. This panel circuit construction and component material are to be get approved from our electrical consultant

7. CONTROL SYSTEM

For Diesel transfer to process the below said control, instrumentation with level sensor, indicating and control instrument, valve and accessories are to installed

1) When the tank level reaches high , feed incoming valve gets closed & LAH starts.

2) When tank level reaches low, LAL starts & discharge pump stops.

3) When level reaches high -high >80% of volume of tank -LAHH starts.

All measuring and controlling instruments for Flow , Level, Pressure, temperature of fluids, electricity etc shall be having adequate compatibility for BMS system where ever applicable in the plant . Selection of such type and model instruments and systems are to be only considered.

GENERAL SCOPE OF WORK

1. The scope of this section covers supply, laying, testing and commissioning of storage tank vessel and piping intended. The tender drawings enclosed depict the schematic layout for all system and the same should not be treated as working drawings.
2. Loading and unloading of equipments. Handling of logistics for all equipments from CONSULTANT/ CLIENT Stores to utility buildings are under contractors Scope
3. All tools and tackles consumables and other material pertaining to the scope of work shall be under contractors Scope.
4. The system shall be designed to optimize the flow and pressure requirement for all the utilities and shall be laid in accordance with the prevailing Indian and international design and safety standards and as above ground preferably to avoid mishaps during in event of leakage. Any modification or update can be done only after getting the prior authenticated approval from CONSULTANT/ CLIENTTEAM .Vendor is requested to highlight if any of the requirements of CCOE any other regulatory agency is not met and they could provide a BOM and cost as optional item as part of their submittal. These may include a change to the present BOM if it does not meet the intent of the CCOE regulations
5. Electricity power and Water shall be arranged by the owner for execution of this contract.
6. Security shall be arranged by the contractors for their material storage.
7. A work place shall be ear marked by CLIENT with in the site. Contractor has to construct their own site office cum stores for keeping their men and material in tact.
8. A qualified safety supervisor shall be appointed by the contractor for coordination and safety supervision of site activity during the contract period. Contract employees are required to adopt safety gadgets (viz, safety belt while working at height, safety shoes & goggles) during work period.
9. Well qualified site engineer and skilled man powers shall be appointed by the contractor for coordination of all activities of this contract. Work permit hot permit, height permit and other approval for execution is to be obtained on day to day basis
10. All statutory registrations and regulations, standards and procedures given by CONSULTANT/ CLIENTTEAM are to be followed by the contractors.
11. Contractor has to arrange for additional resource at no extra cost to complete the schedule on time and has to be flexible for minor deviation as per C request on mutual understanding
12. Green coloured jacket with contractor's name appearing on the back is to be provided to all contract employees.
13. Contractor shall co-ordinate with the OEM at all point of time during erection, testing & commissioning of the equipments.
14. Only CONSULTANT/ CLIENT TEAM approved fittings, stores and spares, tools and tackles are to be procured and used. All tools and are tested for safety and got approved by Site engineer in charge.
15. Electrically connect the equipment to the Main Electrical supply panel with cabling, suitable earthing and other electrical safety appliances, control panel and instruments as per P&I, layout, standards and procedures given by manufacturer &supplier CONSULTANT/ CLIENT TEAM
16. Any instruments for commissioning activity are under contractor scope.
17. Chilled water piping and connected fitting, accessories are to be insulated as per specification and data given in this tender document. Insulation material selections are under contractor scope and got prior approval before execution.

18. In general the contractor will be responsible for all commissioning of the installation with the support of the others contractors (compressors, dryers, cooling towers, chillers, pumps, heat exchanger, electrical parts). All supporting documents, guidance, procedure to interlink the production and distribution of compressed air, cooling water, chilled water shall be obtained from manufacturer/Architect CONSULTANT/ CLIENT when ever and where ever need.
19. All tools and tackles are to be get inspected and certified by the CONSULTANT/ CLIENT Safety and Engineer in-charge.
20. All scaffolding, elevators, cranes for lifting the men and material to the elevations are to be arranged by Contractor and the scheme shall be get approved from the CLIENT Safety and Engineer in-charge.

SUBMITTALS

Submit shop drawings and product data in accordance with the following:

- Submittals shall include:
 - Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, electrical characteristics and connection requirements.
 - Product Data:
 - Provide literature, which indicates dimensions, weights, capacities, ratings, Pump performance, gauges and finishes of materials, electrical characteristics and connection requirements.
 - Submit sound power level data for fan unit outlet, inlet and casing radiated at rated capacity and specified pressure.
 - Submit electrical requirements for power supply including wiring diagrams for interlock and control wiring, clearly indicating factory installed and field installed wiring.
 - Submit performance and vibration test results of the fan for review prior to any air handling unit shipment to the jobsite.
 - Submit electrical requirements for power supply including wiring diagrams for interlock and control wiring, clearly indicating factory installed and field installed wiring.
 - Submit performance and vibration test results of the fan for review prior to any air handling unit shipment to the jobsite

Warranties: Special warranties specified in this Section.

Also Warranties for all OEM and sub vendors supplied materials spares, accessories such as valves, gauges to be confirmed by the contractor. Required documents are to be produced along with all as build drawings and submittals

LICENSING:

The contract scope is to be getting the approval and statutory clearance at various stages from preliminary to final for filling and operation of the system and where ever applicable from Govt authorities , local bodies /Fire dept/, Chief controller of Explosive DEPT for the system to be installed from preliminary approval to start construction and final approval for operation

STAGE I

Preparation of Layout/ construction drawing as per requirement of rules and regulation of Chief Controller of Explosive Dept and The petroleum Rules 2002 amended by 2005 , Follow Up, obtaining approval for construction purpose from where ever applicable statutory Government authority

STAGEII

Preparation and submission of final license application including test certificates, safety certificate and clearance certificate form local statutory body and Chief Inspector General of Explosive Dept follow up and license for operation

Preparation of submission drawing in required copies to be submitted to all government agencies inclusive of CCOE (Chief Controller of Explosives) office. Any additional input is required in addition to the detail given in the tender, technical specifications to meet the rules and regulations, vendors has to fulfill the same

All liaison work for installation, commissioning and for continuous operation of the system is part of the vendor's scope which will include the following and also any other regulatory requirement, if needed.

ALSO

- Prior approval for construction from CCOE
- Test/certification of tank under Rule 126 by Competent Person
- Certification for Safety under Rule 130 by Competent Person
- No-Objection-Certificate from Dist Authority (a pre-condition for grant of licence by CCOE
- Licence from CCOE

TIME LIMIT:

It is very important that Contractor has to give their plan and tentative schedule stage wise timeline for achieving clearances along with this tender. However the time limit shall exceed maximum 5 Months overall inclusive of all licenses

OPERATION AND MAINTENANCE DATA

Provide comprehensive O&M manuals including product specific information and recommended spare parts list and costs. Two hard bound binders and two electronic versions (CD's) shall be provided to the Owner within 60 days following receipt of purchase

QUALIFICATIONS

Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five (5) years documented experience, which issues complete catalog data on total product.

DELIVERY, STORAGE AND HANDLING

All material brought from the manufacturing place in INDIA to the site. Price for packing, forwarding, handling and insurance all are included in the quoted price.

If the material is imported outline separately in proposal the following costs

All special packing, sealing, export crating, other necessary equipment protection provisions and all associated paperwork and documentation costs to prepare product for shipping, and include the shipping costs and insurance costs for F.O.B. nearest port to CHENNAI, India. Insurance coverage to include extended coverage for shipping from said port to the job site.

GUARANTEE/WARRANTY

- All equipment and space conditions shall be tested after carrying out necessary adjustments and balancing to establish the equipment ratings and indoor space conditions. At least four sets of readings shall be taken daily for each item tested and submitted in the form shown separately. Instruments required for testing, shall be furnished by the Contractor.
- All equipment shall be guaranteed for the specified ratings plus/minus 3% tolerance.
- All equipment and the entire installation shall be guaranteed against defective materials and workmanship for a period of 18 (EIGHTEEN) months from the date, the equipment and installation are handed over.
- Performance Guarantee the equipment as specified to meet the operating conditions, capacity and performance requirements for a period of 18 (EIGHTEEN) months after final acceptance. If either the system or components fail to meet operating requirements or if failure of any part occurs during the guarantee period, rework or replace the affected work promptly to meet the Contract Document requirements at no cost to the Owner.
- Subsequent to acceptance, the Owner reserves the option to request a performance test throughout the warranty period.
- Based on no performance test, warranty shall extend for 18 (Eighteen) months from date of initial operation. If a performance test is made and the equipment meets its guarantee, the warranty shall be as above. If unit fails to meet its guaranteed performance, then warranty shall extend two years from date of acceptance of modified unit.
- Equipment, Material and Workmanship Warranty: Supplier/Manufacturer to clearly outline in the proposal the standard warranty terms and conditions for their product(s). At a minimum, warranty shall include parts, labor and travel/lodging costs to the project site. Also provide terms and conditions of any extended warranties that are offered, and the associated premiums.
- Pass through all OEM materials equipment guarantee/warranties.
- Supplier shall furnish a guarantee statement with the proposal that confirms they have a support services organization that can be at the project site (Chennai, India) within 24 hours of a service request call.

MATERIAL & COMPONENTS:

Selection of Materials:

Material shall be best approved quality obtainable and unless otherwise specified they shall conform to the respective India standard s specifications, materials, tool certificate for all equipment and system supplied shall be provided

Samples of all materials shall be as per the list of approved brand manufactures which shall be get approved before placing the order and the approved samples shall be deposited with the owner when claimed. For purchases coming under contractor's scope a blank copy of the order to be pleaded on the supplier shall be furnished by the contractor

1. TANK& PIPE

For Fabrication of Tank materials to be utilized shall be IS 2062 carbon steel plate

For Pipe materials to be utilized shall be as under:

- a. For **DIESEL SERVICE** sizes up to 150 mm dia : MS HEAVY 'C' Class ERW Pipes BLACK /GALVINISED as per IS 1239 - 79 Part-I. Pipe coat bituminous wrapping of minimum 4mm thickness to be given for corrosion resistance

OPERATING PRSSURE : MAX.10.0 KG/SQ.CM

OPERATING TEMPERATURE : MAX 98 DEG.C

NOMINAL PRESSURE RATING: # ANSI 150

GASKET FACING : # RF / # FF

PIPE JOINT 40& ABOVE : BUTT WELDED

DRAIN 40& ABOVE : BUTT WELDED

VENT 25& BELOW : SOCKET WELDED

PRESSURE GAUGE :15NB SOCKET WELDED

TEMP. CONNECTION : 3/4" FLANGED

MAINTENACE JOINT ALL : FLANGED

COVERING CODE : ANSI / ASME 31.3

1. LINE TO LINE JOINT : 15-40mm SOCKET WELD
50-400mm BUTT WELD
 - FULL PENETRATION & 10%
 - ALL ROOT RUN TO BEEXAMINED BEFORE SUBSEQUENT RUNS by DYE PENETRANT TEST
2. LINE TEST PRESSURE:-
 - HYDRAULIC TEST :1.5times of operating pressure.
 - HOLDING TIME : Minimum 8hours
 - NO LEAK
 - NO LOSS OF PRESSURE

The following manufacturing tolerance s shall be permitted on tubes and sockets.

THICKNESS

- i) Light tubes butt welded : + Not limited - 5 percent
- ii) Medium and Heavy tube : + Not limited - 7 percent butt welded
- iii) Medium tubes seamless : + Not limited - 10 percent

For sizes up to 40 mm NB, socket weld fittings shall be used. For sizes from 50 mm NB up to 150 mm NB, butt weldable Carbon steel fittings shall be used, which shall have a wall thickness equivalent to the pipe thickness. All bends shall be of seamless constructions and butt welded bends and reducers will not be accepted.

2. PIPE FITTINGS :

Elbows, Tees, Couplings, Caps, Hex nipples, Bushings etc

Size Range : 1/2" TO1 1/2"
 Type : Socket weld
 Dimension : ANSI B 16.11
 MOC : Forged Carbon Steel
 Pressure Rating : 3000, psi

For sizes up to 40 mm NB, socket weld fittings shall be used. All bends shall be of seamless constructions and butt welded bends and reducers will not be accepted. For sizes up to 150 mm NB, butt weldable wrought steel fittings shall be used, which shall have a wall thickness equivalent to the pipe thickness.. For higher diameters fabricated bends, fabricated from the parent pipe shall be used. The bend should have a minimum of 4 sections with a radius equal to approximately 1.5 times the diameter.

3. **Flanges** shall be slip-on carbon steel with plain face conforming to IS 6392-1971. All bolts & nuts shall be carbon steel and gaskets shall be 3 to 6 mm reinforced rubber Gaskets.
4. **Butterfly Valves:** All valves shown in the drawings for piping for sizes above 50 mm shall be wafer type butterfly valves. The valves should be suitable for mounting between flanges drilled to IS 6392 Table 10 to 20. The valve body shall be cast iron. Body liner shall be integrally molded and bonded to the body. The material shall be Buna-N Rubber. This body liner shall provide seating to the valve disk and "Gasket Joint" with mating pipe flanges. The valve disk material shall be Stainless steel or Ductile (SG) Iron with Electroless Nickel Coating. The valve stem shall be high tensile stainless steel (AISI 410). The Valve Stem shall be sealed properly using 'O' rings. All valves up to 200 mm NB shall be provided with flow control levers. Valves of 250 mm NB and above shall be provided with gear operated levers. The valve should have a pressure rating of ANSI 150.

Butterfly Valve

SIZE	: 50MM & ABOVE
FLUID HANDLED	: N2 GAS /COMPRESSED AIR
MANUFACTURER	: KSB/ AUDCO /INTERVALVE/ADVANCE
Material of Construction	
a)Body	: Cast Iron to BS EN:1561
b) Disc	: Stainless Steel BS:970 Part 4
c) Screw	: Stainless Steel
d) Seat	: EPDM Ends Sandwiched between ASA. 150 flanges
Working Pressure	: 10 bar
Working Temperature	: 70 °C
Type of Operation	: Hand Lever Operated

5. Ball Valve :

All valves for shut-off purposes for sizes below 50 mm shall be ball valves. The valve body and body connector shall be carbon steel as per ASTM A216-WCB, the ball and stem shall be stainless steel SS 304/316. The seats and stem packing shall be PTFE. All Valves shall have socket weldable ends, in 2/3 piece construction and the central portion could be bolted out for maintenance. All valves should be supplied in full bore construction. The valves should have a pressure rating of ANSI 150.

Ball Valve

SIZE	: 40MM & BELOW
FLUID HANDLED	: N2 GAS COMPRESSED AIR
MANUFACTURER	: KSB/ AUDCO/INTERVALVE/ ADVANCE
Material of Construction	

- a) Body : ASTM A351GrCF8
- b) Ball : AISI316 /Stainless Steel BS:970 Part 4/ ASTM A351GrCF8
- c) Seat : VERGIN PTFE
- d) Stem : AISI316
- e) Stem Seal : 35% Carbon filled PTFE
- f) Body Seal : VERGIN PTFE

Working Pressure : 10 bar
 Working Temperature : 70 °C
 Type of Operation : Hand Lever Operated

6. **Check Valve:** Check Valves shall be dual plate check valves, wafer type sleep-on construction. The valve body shall be carbon steel as per ASTM A216-WCB, . The valve disk shall be aluminium - bronze plate, SS 316 inch pins & pins and springs rubber seal and should be rated for a pressure rating of ANSI 150.
7. **“Y” Strainers:** “Y” Strainers shall be provided with fabricated Hot DIP GALVANIZED body only. The strainers shall have a removable bronze mesh with 500micron for straining out dirt in the fluid stream. The strainer mesh could be dismantled and cleaned without disturbing the strainer connections on the pipe line. All strainers shall be flanged type only.
8. **Air Vents :** Box type with flame arrester type manual air vents shall be provided at all high points in the piping and also at locations where there is a likelihood of air locking.
9. **Drain Valves :** Drain Valves should be provided at all low points in the diesel /methanol piping system with proper safety collecting and locking system The valve sizes shall be as under :
 Pipe size upto 300 mm NB :25 mm NB Ball valve
10. **Pressure Gauges :** Pressure Gauges shall be “**Bourdon**” type with a minimum dial size of 100 mm dia. The range shall be selected to suit the application and location of the gauges. All gauges shall be provided with a gun metal plug type gauge cock and capillary connections to prevent system fluctuations. Pressure gauges shall be provided at locations shown in the pipe schematic drawings.

11. **PRESSURE REDUCING VALVE**

Pressure relief valves are provided to keep the pressure in the line below a given value within the reasonable limits in the downstream side of the pipeline when the pressure builds up beyond the design value. Pressure reducing valves shall be of high pressured type of specified sizes. The valves should be suitable for mounting between flanges and threading connections also. The valve body shall be of bronze / SS as specified. The valve shall be of spring loaded, direct operation, metallic diaphragm type, as required for the particular usage. The pressure reducing valves should be manufactured in conformance with ASA- 150,300,600,800,900 and 1500, or to BS10- table –D,E,F,H or DIN- ND-16 & ND-40.

12. LEVEL SENSORS

Level sensor shall consist of control unit, preamplifier and one full insulated probe-mounted vertically or two part insulated probe mounted from tanks side wall adjustable switching system for pump control application, the same to be housed in stove enamel painted cast aluminium weather proof suitable for black panel / wall mounting etc.,

The enclosure of probes shall be manufactured with SS316 material. The least count of the central unit with amplifier should be +/- 0.10mm for response value of 30 seconds.

13. LEVEL INDICATORS

A level control system with electronic level probes is mounted on the face of the reservoir. The top two level sensors provide the ON-OFF signal for the transfer pumps. A third level sensor enunciates a low level alarm condition to the paging system and a fourth sensor enunciates an alarm to the paging system and stops the pumps from operating.

14. PUMPS

General requirements:

The pumps shall be. **CENTRIFUGAL STAGE PUMP** design and followed necessary codes as per DIN 24255/ ISO 2858 /API 610/IS2148 Kirloskar /KSB/ARMSTRONG

OR ALLOY STEEL ROTARY GEAR PUMPS - TOSAHCO /ROTODEL

The pump suction/discharge chamber (base) shall be in CS as per requirement. Motor stool, and pump shaft coupling shall be constructed of cast Steel .The impellers, pump shaft, diffuser chambers, outer discharge sleeve, impeller seal rings, and seal ring retainers shall be constructed of cast steel /SS/Bronze. The pump impellers shall be secured directly to the pump shaft by means of a spline shaft arrangement for model of the lower sizes, and the pump impellers shall be secured to the shaft by a split cone and nut for higher sizes. The shaft journal and chamber bearings shall be Tungsten Carbide and Ceramic/Bronze. All pumps shall be equipped with a high temperature cartridge mechanical seal assembly with Tungsten Carbide/Carbon or Tungsten Carbide seal faces mounted in stainless steel components. The shaft seal shall be of the cartridge design.

The Rotary gear pumps shall be constructed in such a way to ensure trouble free performance and simple construction of alloy steel surface hardened by nitriding or any another advance methodology for smooth friction free operational Spur/helical gears supported by anti friction bearings ,horizontal foot mounted rotary gear pumps.

- a) The specified range shall lie on the stable portion of the head characteristic curve. This is applicable in case of parallel operations of pumps only.
- b) For a high pressure pump, a reflux valve shall be connected on the delivery side and a pressure relief valve installed in pumping main outside pump house. Need for surge control devices verified.
- c) Fluid passages : All the liquid passages in the casing and the impeller which are inaccessible to machining shall be finished to smooth surface as far as possible.

- d) Drainage plugs : Tapped drain holes with plugs shall be provided for draining the fluid that may drip from the sealing arrangement. The sealing arrangement shall be sufficiently deep to provide for sufficient quantity of packing to prevent leakage of air.
- e) Lantern ring : In case, where a lantern ring is used in a stuffing box, it shall be sandwiched between rows of pickings and shall be easily removable.
- f) Casing : Casing shall be of robust construction and tested to withstand 15. times the shut-off pressure or twice the rated pressure whichever is higher.
- g) Impeller: The impellor shall be properly balanced along with any other un-machined rotating parts on proper balancing equipment so as not to cause any vibrations.
- h) Shaft : The shaft shall be finished to close tolerance at the impeller coupling, pulley and bearing diameters. The impeller, pulley and shaft sleeves shall be firmly secured to the shaft by keys or nuts of both.
- i) Shaft couplings: Shaft couplings, where provided, shall be properly aligned and firmly secured to the shaft by keys or nuts on both.
 - i) The size of the shaft shall be calculated on the basis of the maximum combined shear stress. This shall not exceed 30 % of the elastic limit in tension or 18% of the ultimate tensile strength.

The next higher standard size of shaft in accordance with the relevant standard shall be chosen.
 - ii) The design of the shaft shall also be taken into consideration the critical speed of the shaft which shall differ from the actual working speed by at least ten percent on either side.
- j) Bearings : The bearings should be designed for a minimum life of 20,000 hours or 40,000 hours as required. The bearing housings be designed in such a manner that no liquid being pumped should enter the housing.
- k) The bearing may be ball, roller or sleeve bearings. In the latter case, some sort of thrust bearings are necessary. If sleeve bearings are used, they are to be machined for close running fit. The bearings shall be so designed as to take up the necessary radial load as well as the net hydraulic axial thrust. Bearings shall be lubricated properly.
- l) Where there is a possibility of fluid entering the bearing the pump shall be provided with suitable preventive arrangements for example., deflectors.
- m) Stuffing Boxes: The stuffing boxes shall be extra deep and provided with a cooling water jacket if so required. In addition, provision for tapping off the leakage liquid shall also be make. The packing materials employed shall be suitable for withstanding special conditions such as temperature, corrosion due to the fluid being handled etc. wherever possible, suitable mechanical seals may be used.

- n) **Base plates:** The base plates which accommodates the pump and the prime mover, when provided shall be rigid so that alignment is not affected under normal working conditions.
- o) **Prime mover:** the prime mover shall be of a such capacity a provide, under working site conditions a power which is more then maximum power required by the pump at any point in the specified range should be a specific margin be required by the customer in the power of the prime mover, he should go advise the manufacturer for obtaining the proper recommendations.
- p) **Name plate:** Every pump shall have a name plate indicating:
- i) Name and address of the pump manufacturer.
 - ii) Type, size and serial number of the pump and
 - iii) Speed, total head, capacity and corresponding pump input for the duty point.

MATERIAL OF CONSTRUCTION

Components	All CAST STEEL IS1570 GR .40C-8
Casing	Cast Steel
IMPELLER	Cast Steel
IMPELLER WEAR RING& BUSH	Cast Steel
SHAFT	Steel
Shaft Sleeve	SS410
Sleeve NUT	SS410
GLAND/ MECHANICAL SEAL	MECHANICAL SEAL

Control Cabinet

The controller shall be mounted in a control cabinet with an IP 54 enclosure of suitable rating (or specified optional cabinet) with the keypad and display screen mounted through the outdoor. The control cabinet shall include circuit breakers for each pump and the control circuit and control relays for alarm functions.

Control cabinet shall include the following, but not be limited to:

1. Motor protection
2. Dry run protection
3. Bus communication
4. 2X 24 character LCD display
5. Pump Fault Lights – A Red light for fault indications
6. Visual Alarm
7. Pump Elapsed Time Meters
8. Manual Operation

The entire packaged pumping system shall be mounted on a Hot Dipped Galvanized MS or POWDER COATED MS fabricated skid. The control cabinet shall be mounted in one of the following ways depending on the size of the cabinet.

ACCESSORIES FOR PUMPS :

- a) Oil lubricator with oil level indicator if the pump is lubricated.
- b) Flanged ball valve/Gate valve on suction side if there is positive suction.
- c) Flanged ball valve/Gate valve on delivery side.
- d) Flanged horizontal/vertical check valve on delivery side.
- e) Pressure relief valve.
- f) Pressure gauge (for delivery pipe)
- g) Float switches or automatic level operated control switch.
- h) Base plate.
- i) Foundation bolts and nuts.

Plumbing

The suction and discharge manifolds shall be fabricated of Hot Dipped Galvanized MS or SS. Both manifolds shall be designed to attach to the system piping at either end of the manifold. Delivery manifold shall include a pressure gauge. The suction manifold shall have as standard a pressure switch or pressure sensor to detect low suction pressure or a float switch to prevent dry running. The discharge manifold shall include a pressure transducer with a 4-20mA output. The pressure transducer shall be factory installed and wired.

Isolation valves shall be installed on the suction and discharge of each pump. A check valve shall be installed on the discharge of each pump (optional on the suction side for suction lift applications).

The system shall include a diaphragm type pressure tank sized by the system manufacturer.

All systems shall be factory tested for performance and hydrostatic tested to 20 bars. Verified Factory Performance Tests and Witness Factory Performance Tests shall be provided by the system manufacturer

Pump Test :

Pump tests are made to determine the following :

- (b) The discharge against the specified head when running at the rated speed under specified suction lift or head.
- (c) The power absorbed by the pump at the pump shaft (BP) under the above specified conditions and
- (d) Efficiency of the pump under the above specified conditions.

The pump has to be tested at manufacturers works and a test certificate furnished before supply and tested at site after installation as per procedure as per clause 13 of 5120 – 1968.

Pump Installation :

Installation:

Certain precautions must be observed in planning a pump installation and during the erection period. Some of these point will now be considered.

Piping : Both the suction and discharge lines should be independently supported so as no strains will be thrown on the casing such strains may cause distortions and rubbing.

The suction line should be as short and straight as possible. Any elbows should have large radii. For pumps operation with suction lifts no valves other than a foot –valve should be placed in it. Generally, the diameter is made one or two sizes larger than the pump flange size. All these precautions insure the maximum available suction head on the pump. When an oversize line is used an eccentric reducer which is horizontal at top is placed between it and the pump flange size.

It is very important to have the suction line airtight and to avoid high spots at which dissolved gases or air might separate out and destroy the vacuum. After piping is installed and the pump is running all joints should be inspected with a flame, as air leakage will draw the flame to the opening. The same method can be used to determine leakage through the packing box, the eccentric reducer is used at the suction flange to avoid high spot at which the air might collect. The inlet end of the suction line i.e., submergence should be 1 to 2 m below the minimum water level of the pump (not less then 1 m) to prevent air from being drawn into the pipe with the water.

It is desirable to have as long a length of straight piping between the elbow and suction flange as possible to even out the flow of the water as it enters the pump. The pump should be placed to secure the greatest possible suction head and yet to be available for inspection and repair work.

A check valve and gate/ball valve are usually placed in the discharge line. The gate valve is used to regulate the flow and the check valve prevents backflow into the pump which might cause it to operate like a turbine and perhaps be damaged on account of over speed. The check valve is placed between the gate valve and the pump so that it may be inspected or rewired without emptying the discharge line.

Foundation : The foundation should be heavy to reduce vibrations and should be rigid to avoid any twisting or misalignment. A space of 2 to 4 cm is allowed between the base plate and top of the foundation which is filled with grouting to secure a uniform load distribution.

When the grouting had dried the base plate should be drawn down evenly to avoid springing it. After this has been done the shaft is finally aligned both radially and axially with the driver by means of shims or wedges so that it turns freely. If the shaft is not properly aligned there will be vibration and excessive wear on the bearings, packing and wearing rings.

Pump Operation:

Trail operation : The operation of centrifugal pump is quite simple and safe. There are relatively few valves and the pump will not be damaged even if the discharge valve is closed for short periods of time.

Starting : The pump must be primed before it will deliver any fluid. Failure to prime the pump may cause the wearing, rings, rub and seize or the shaft may be scored at the packing boxes. During starting it is wise to have the vent cock in the casing open slightly to remove any dissolved air in the water.

It is best to have the discharge valve set so that the least load is thrown on the driver when the pump is started. The valve should be opened gradually to avoid throwing a large sudden load on the driver and to prevent a sudden surge in the discharge line. The discharge valve should be fully open when starting mixed flow or propeller pumps because the brake horse power will then be a minimum.

Running : When the unit is running it requires very little attention beyond occasionally checking to see that

- (a) the journal and thrust bearings are running cool and have a sufficient supply of oil.
- (b) the packing is adjusted to permit a slight leakage to cool and lubricate it, and
- (c) the water is flowing to the water seal of the suction gland to prevent air from leaking in.

Shutting Down : When shutting down, the discharge valve should be in the same position as when starting up by closing the discharge valve gradually so that less power is dropped from the line and any sudden pressure surges in the pipe system are avoided.

Inspection and Maintenance : Manufacturer supply instruction books which give directions for the operations for the operation and maintenance of each pump. The following information is general.

The wearing ring clearance should be checked as they will increase with time and thus cause a decrease in efficiency. The frequency of the inspection will depend upon the liquid handled. If the liquid contains gritty materials or is corrosive, inspection may be made monthly, but if clear water is pumped it may be sufficient to check them annually. A general rule is to replace the rings when the clearance has increased 100 percent above the original.

The packing should be replaced after it becomes hard and tends to score the shaft. When the packing is being replaced the finish of the shaft sleeves should be examined for smoothness. It is essential that the lantern ring be placed directly under the water inlet when putting in the new packing to insure a circulation of the water and a satisfactory seal. The packing should be gradually compressed with the pump running. It should not be compressed too much as local heating of the shaft and consequent misalignment will result. A slight leakage will insure proper lubrication and cooling.

If the base is not too rigid the shaft alignment should be checked occasionally when the pump is at a temperature corresponding to running conditions. This must be done with the packing removed. At the same time the clearance of the journal bearings should be checked for wear.

The oil should be changed as required band at that time inspected for the presence of water. If water appears in the oil the pump casing should be examined to find the leak.

Guarantee of Performance:

- a) The pumps shall be guaranteed by the manufacturer/supplier against defects in material and workmanship under normal use and service for a period of at least one year from the date of dispatch.
- b) Guarantee of performance : the supplier shall indicate the working range of the pump and the efficiency of the pump shall be guaranteed at a specified point of rating only and shall not be guaranteed to cover the performance of the pump under conditions varying there from nor for a sustained performance for any period of time. If the purchaser so desires, the manufacturer shall guarantee the non-overload of the prime mover for variations in the head in the working range. In the case of pumps where acceptance tests cannot be conducted on the liquid for which the pump is designed, the manufacture shall indicate the liquid performance of the pump based on the results of the tests conducted by him on the pump with water as indicated under 13 and interpolated as explained under 14 (IS 5120) . however, in these cases, the manufacture shall guarantee for the performance of the pump with water for the specified range.
- c) Tolerance : A tolerance of ± 2.5 percent shall be permissible on discharge. However, for small discharge up to 9000 litres per minute, a tolerance of ± 2.5 percent or +24 liters per minute which ever is higher is allowed. While the negative tolerance 2.5 percent is maintained.

The pump efficiency shall be not less than the specified valve by more than 2.5 percent. This tolerance may be raised to 5 percent in case the prime mover does not get overloaded.

Information to be furnished by the supplier along with tender

1. Pump type.
2. Discharge in liters per second.
3. Head in meters.
4. Suction pipe size in mm dia.
5. Delivery pipe size in mm dia.
6. Power at shaft in Kw.
7. Speed in revolution per minute.
8. Required NPS in meters.
9. Performance curves.
10. Materials of construction.
 - i. Casing – CAST STEEL
 - ii. Casing ring – CAST STEEL
 - iii. Impellers – CAST STEEL
 - iv. Impeller wearing rings and bush CAST STEEL /GM
 - v. Shaft – steel
 - vi. Shaft sleeves – SS410
 - vii. Gland – CAST STEEL /GM
 - viii. Sleeve nuts – SS/GM

11. Recommended :

- i. Suction pipe size in mm dia.
- ii. Delivery pipe size in mm dia.
- iii. Weight of the pump in Kg.
- iv. Any special instruction for installation, operation and maintenance use of special tools.

12. Sealing arrange :

13. Recommended spares for 2 years service and cost.

14. Prime mover – all information corresponding to the particular in the item for satisfactory performance of the pump.

SCOPE OF WORK –DATA SHEET**DIESEL/ LPG/CO2/ARGON STORAGE & TRANSFER SYSTEM**

SI. No	DESCRIPTION	TENDERER'S DATA	REMARKS
A	STORAGE TANK		
1	Under ground/Above ground		
2	SIZE		
3	Horizontal/Vertical HORIZONTAL DISHED END/ FLAT END VERTICAL FLAT ROOF/ CONICAL ROOF		
4	IS standard CONFIRMED TO		
5	MOC		
6	THICKNESS Horizontal SHELL END PLATE VERTICAL SHELL BOTTOM ROOF		
7	STIFFNERS/SUPPORTS		
8	NOZZLE DETAIL Manhole/Inlet/Outlet/Overflow/vent/Drain/level /safety/Indicators/Others		
9	NOZZLE -MOC		
10	TEST PRESSURE Atmospheric/Hydro Pressure test		
11	STAGE TEST (DURING FABRICATION) Magnetic particle test /Radiography / Dye penetrate/Ultrasonic		
12	LEVEL CONTROLLER/INDICATOR Manual/AUTOMATIC-DIGITAL		
13	PROTECTIVE COATING/PAINTING		
14	EARTHING		
15	TURN BUCKLE/Additional support		
16	HANDRAIL/LADDER/PLATFORM		
17	SAFETY VALVE		
B	PUMPS- UNLOADING/TRANSFER		
1	PUMP TYPE		
2	CAPACITY FLOW in LPS		
3	HEAD MTRS		
4	POWER KW		
5	MOTOR KW		

6	RPM		
7	MOC CASING IMPELLOR IMPELLOR WEAR RINGS SHAFT SHAFT SLEEVE GLAND SLEEVE NUT		
8	GLAND/ MECHANICAL SEAL		
9	SUCTION NOZZLE		
10	DISCHARGE NOZZLE		
11	PERFORMANCE CURVE SHAFT POWER in Kw REQUIRED NPS in MTRS		
12	COUPLING		
13	PRIME MOVER DATA POWER VOLTAGE FREQUENCY FRAME DETAIL INSULATION IS STANDARD STARTER		
14	BASE FRAME		
15	Oil lubricator with oil level indicator		
16	CONTROL PANEL		
17	MAKE		
C	UNLOADING HOSE		
	TYPE/ MOC		
	SIZE : DIAMETER/LENGTH		
	MAKE		
D	SAFETY		
1	NITORGEN BLANKETTING		
2	FIRE HYDRANT/SPRINKLER/ ALARM /SAFETY SYSTEM- Fire extinguisher /Eye washer/ Shower/		
3	PERSONAL PROTECTIVE EQUIPMENT		
E	VALVES		
	TYPE		
	MOC		
	CLASS / PRESSURE RATING/		
	END CONNECTION		
	STANDARD		
	MAKE		

F	PIPING-PIPE& PIPE FITTING		
	MOC		
	CLASS/SCHEDULE		
	STANDARD		
	MAKE		
G	SUPPORTS		
H	CIVIL REQUIREMENT		
I	ELECTRICAL REQUIREMENT		
	POWER/LIGHTING		
J	INSTRUMENT CONTROL		
	APPROVALS /NOC/LICENSE		
1	Test certificate of tank under rules126 by competent person		
2	Certification for Safety under rules130 by competent person		
3	NOC FROM DISTRICT AUTHORITY FIRE/POLICE/HEALTH/VILLAGE OFFICER/THASILDAR/REVENUE OFFICER/DISTRICT MAGISTRATE/ANY OTHER APPROVING STATE/CENTRAL GOVERNMENT AUTHORITY AS PER RULES AND REGULATIONS		
4	LICENSE FROM CCE/PESO		
5	DLII LICENSE FROM REVENUE/STATE EXCISE DEPT		
6	SLOPE LICENSE		
7	ANY OTHER APPROVALS /NOC from GOVERNMENT AUTHORITY AS PER RULES AND REGULATIONS		
	TIME SCHEDULE		
1	Preparation of drawing & getting approval from CCOE NAGPUR		
2	TANK FABRICATION & TESTING,SUPPLY OF ALL MATERIAL		
3	ERECTION OF TANK		
4	SUPPLY OF PUMP & OTHER ACCESSSARIES		
5	PIPING		
6	RULE -126&130Certification		
7	NOC		

8	EXPLOSIVE LICENSE		
9	DL2 LICENSE		
10	SLOPE LICENSE		
11	ANY OTHER TASK		
	COMMERCIAL		
1	PRICE		
	SUPPLY INSTALLTION DIESEL STORAGE &TRANSFER INCLUDING GETTING APPROVAL/ NOC/LICENSE		
	SUPPLY INSTALLTION METHANOL STORAGE &TRANSFER INCLUDING GETTING APPROVAL/ NOC/LICENSE		
	TAXES		
	TOTAL		
	EXCLUSIONS (PI Mention)		
	ADDITIONAL SCOPE (PI Mention)		
2	PAYMENT TERMS ATL STANDARD TERMS-		
3	WARRANTY ATL STANDARD TERMS -18MONTHS From the date of Commissioning		
4			

3.2 SCOPE OF ERECTION OF EQUIPMENT & INTER CONNECTING PIPING:

1. On Award of Contract, the Contractor should prepare and submit for approval detailed shop drawings indicating the tank vessel position, Layout pipe routing, levels, tapping points, riser points etc. as per rules and regulation of Chief controller of Explosive Dept and The petroleum Rules 2002 amended by 2005, Pipes shall be installed in a workmanship manner in accordance with the approved shop drawings. Pipes shall be aligned parallel to walls and ceiling and all drops shall be plumb. The pipe routing shall follow the approved drawings and wherever necessary the pipes could be rerouted under the instructions of the Engineer / Site In-charge to accommodate site conditions and avoid interference with other services.
2. Wherever specified all pipe connections to vibrating machineries like Pump sets etc., shall be provided with flexible connections. The flexible connections shall be fabricated out of SS Bellows and be provided with flanged end connections.
3. All pipes shall be properly supported from roofs, walls, etc., vertical risers shall be supported at all floor casting with Rigid MS Channels and rubber pads OR similar resilient material shall be provided between the floor and the support channel. . Where light weight roofing are provided, the pipe supports should be provided from the floors and as directed by the Engineer in-charge.

4. All pipes shall necessarily be clamped to the pipe supports with specially made pipe clamps. The clamps shall be made out of mild steel and painted with a coat of primer and final coat of black enamel paint. The clamps should take into account any lateral moment of the pipes owing to temperature variations and in no case the clamps should induce stresses on the pipe and supports.
5. For insulated pipes, an interposing insulating member made out of extra rigid Polyurethane Foam having a density of 64 Kg/cum. shall be provided between the pipe and the clamp. This RPUF member shall be properly contoured to suite the pipe..
6. Pipe supports shall be made out of structural steels with sections selected to suite the dia and weight of pipe being supported. The supports shall be painted with a primer coat of red-oxide and finished painted with two coats of black enamel paint. The pipe support spacing shall be as under:

PIPE SIZE	SUPPORT SPACING HORIZONTAL RUN	SUPPORT SPACING VERTICAL RUN
Upto 15 mm	1.25 Mts.	1.80 Mts.
20mm to 25 mm	2.00 Mts	2.50 Mts
32 mm to 125 mm	2.50 Mts	3.00 Mts
150 mm and above	3.00 Mts	3.00 Mts

7. Additional supports shall be provided at Bends, Valves etc., Supports structures could be fixed on to the walls and concrete ceilings using Anchor Fasteners. Ready-made supports like “**Hi-Tec**” could also be used
8. All pipe joints shall be welded construction, unless otherwise specified. However, flange joints shall be provided as mentioned below. All pipes below 40 mm NB shall have socket welding using fillet welding. Pipes 50 mm NB and above shall have butt welding using butt weldable fittings. In this case the welding edges shall be properly “V” Grooved before welding. All pipe cuttings shall be carried out using Hacksaw OR pipe cutting tools. If in case, Gas cutting is utilised care should be taken to properly finish the edges so that the edges are smooth and are without any burs. Flange joints shall be provided at the following positions.
 - a. Pair of flanges for isolation of equipment like condensers etc., for de-scaling.
 - b. Mating flange for equipment flange connection.
 - c. Matting flange for valves, strainers etc.,
 - d. Pair of flanges at every 50 Mtrs. continuous run of pipe.
 - e. All drain pipes shall be installed pitched @ 2% towards the drain points. Only GI or PVC Pipes shall be used for drain piping.
9. GI Pipes whenever welded, the welded portions should be immediately finished by painting the same with zinc chromate primer.
10. When pipes are buried underground, both insulated and un-insulated pipes shall be painted with one coat of hot bitumen 80/25 at 2.5 Kg/sqm and wrapped with 6 mm thick Tar felt and the joints properly glued.
11. All pipes shall be laid and tack welded in position with all flanges, valves, etc., after inspection and approval of the layout by the Engineer in-charge, only then full welding could be carried out. Please note, to reduce down time, pipes could be offered for inspection in sections.

12. WRAPPING OF CONCEALED GI PIPES

Cleaning

Pipe surfaces shall be thoroughly cleaned and dried before tape is applied and shall be free of dirt, grease and rust scale or other foreign matter. The pipe shall be cleaned mechanically.

Oil and grease, if present on the pipe surface should be removed by using a suitable solvent and clean rag. The use of dirty, oily rags should not be permitted.

Field Application of tape

The tape shall be wrapped in accordance with the manufacturers recommendations in a manner that shall meet the adhesion requirement. During application, care shall be taken to ensure that there are no air pockets or bubbles beneath the tape.

The tape should be wrapped with an overlap of 50% for TEES. The first wrapping shall be done individually. The tape may be cut if required to suit the profile. There shall be two layers of tape wrappings. The first layer is to be wrapped on the pipe directly after cleaning the pipe surface. The second layer is to be applied over the first layer. The second layer should also be wrapped with 50% overlap.

13. All the systems supplied by CONTRACTOR or supplied by OTHERS but indicated to be in the scope of work of piping CONTRACT, defined in scope of work, shall be erected by CONTRACTOR as per the drawing.
14. Necessary connections from the existing header to be properly taken care by the contractor.
15. If at the terminal connections or at connections to in-line specialties, the supply of counter flanges is by others, the same shall be erected by the CONTRACTOR.
16. Necessary gaskets and fasteners are included in CONTRACTORS scope of supply, unless otherwise excluded.
17. All valves, strainers, flow meters, flow indicators and other in-line specialties if warranted or included at a later date during execution of the contract which are supplied by others but form a part of the piping systems erected by the CONTRACTOR shall be installed by the CONTRACTOR to render the systems complete within his terminal points. CONTRACTOR shall perform necessary internal machining of pipe for installing orifices, flow nozzles, straightening vanes etc., if warranted.
18. Fabrication and erection of pipe supports including shoes, guides, stops / anchors, clips, cradles, hangers, turnbuckles, supporting fixture brackets, cantilever struts, etc.
19. OWNER'S piping drawings indicate dimensioned layout of piping. While these have been laid out taking care to avoid interference with structural steel, cable trays, sanitary sewers, manholes, etc., and other piping and equipment, certain interference would still exist. It is expected that these interference would be minor in nature. The CONTRACTOR shall modify prefabricated piping and reroute the piping to avoid any field interference. These minor modifications shall be done at no extra cost to the OWNER.

3.3 Testing :

CONTRACTOR'S scope of supply for fabrication, erection, cleaning, testing and commissioning of the piping systems installed by him shall include the following:

All machinery, crane, equipment, tools and tackles as required for transportation, handling, fabrication and erection.

All equipment and materials as required for cleaning, flushing, blowing out and testing of the piping systems. These shall include but not limited to pumps and compressors with prime movers; instruments; pipe work with supports, valves, strainers and other specialties, blanks plugs, spool pieces, dummy plates, electrical accessories etc.

Services of erection Superintendent, supervisors and foremen, fitters and riggers, welders, gas cutters, grinder, transport and crane operators and other skilled and unskilled labourers.

- a. Pipes after full welding is completed shall be hydraulically tested, without giving connections to the equipment. Pipes could be tested in sections and after testing the ends should be capped. No insulation or painting for the pipes shall be carried out before the hydraulic testing is completed and approved by their Engineer in-charge.
- b. All pipes shall be tested for hydraulic pressure as under :
 - i) **Two times** the hydraulic head of the pump plus the gravity head due to expansion tank or cooling tower.
 - ii) **Two and half times** the shut-off head of the pump whichever is higher.

In both the above cases the system should hold the pressure for 24 hours without any drop. The Pressure testing and pressure reading should be inspected and approved by the Engineer in-charge. Any defects or leakage found during pressure testing shall be rectified and tests re-conducted..

- c. Arrangements for pressure testing like provision of hydraulic pump, pressure gauges etc., shall be organized by the Contractor. Necessary water shall be provided by the Owners.
- d. After completion of Pressure testing the entire water should be drained off by the Contractor without affecting the Premises. Further, when the piping is completely over the Contractor should flush the entire piping at least three times before commissioning, so that, the piping system is free from dirt, millscale etc.,

FABRICATION STAGE TESTING:

WELDED INSPECTION

The welding joint shall satisfy not to have any defects such as crack , incomplete penetration and fusion , undercuts , rough surfaces , burns blow holes & porosity etc. beyond permissible limits as mentioned in the standards

The mechanical characteristics of the welded joints shall be as in IS:823

All welded are to be DP tested/ Magnetic particle tested and Radiography test to be done for 10% of the total Joints

For piping Applicable standard: ANSI / ASME: 31.3

STAGE INSPECTION

During the stage Of fabrication Contractor shall prepare test specimen for Non destructive test or destructive test depending of up on the pressure rating specified and other all relevant specification to meet the requirement of service as per quality assurance plan mentioned by the Owner /Engineer.

The test specimens are to be tested at reputed test laboratories /Govt Approved Institution at contractor 's cost for every buildings and every service of pipe lines (MINIMUM 3 SAMPLES)

All welders are to be qualified by a test as per quality assurance plan mentioned by the Owner /Engineer

TEST CERTIFICATES AND REPORTS:

The following test certificates shall be submitted to the OWNER / ENGINEER for review.

For materials supplied by the CONTRACTOR

Dimensions

Hydrostatic and other pressure test.

Reports on visual examination.

The construction shall comply with the requirements of ANSI CODE FOR PRESSURE PIPING; ANSI / ASME B 31.3:

5. Measurements :

The pipes, for payment purposes, shall be measure as under :

- a. The pipe lengths specified in the BOQ shall deemed to be inclusive of all fittings like Bends, Elbows, Reducers, Flanges, Pipe Nipples for instruments etc., Pipe Supports, clamps etc., These will not be measured separately and paid for. The pipes shall be in unit length round off to the nearest centimeter and measured along the centre line of the pipe and fittings. The center line distances between flanges of valves, strainers etc., shall not be measured. The rates quoted shall also be inclusive of necessary painting as specified.
- b. All valves, strainers etc., shall be measured per unit in each size and paid for. The price quoted shall deemed to be inclusive of mating flanges, gaskets, net, bolts etc.,
- c. All Pressure gauges complete with sockets, gauge cock etc., shall be measured per unit.
- e. All air vents, drain valves shall be measured per unit.

4.0 DESIGN REQUIREMENTS:

4.1 While site routing of piping, the following requirements shall be taken into account by CONTRACTOR.

4.1.1 All piping shall be routed so as to avoid interference with other pipes and their hangers and supports, electrical cables, structural members, equipments etc. Adequate clearances shall be ensured with respect to the above to accommodate pipe movements.

4.2 Drains, vents, etc. wherever not located on OWNER'S piping layout drawings shall be suitably located by CONTRACTOR as may be warranted by site conditions.

4.3 The design, layout and supporting of all temporary pipe work as required for erection, cleaning, flushing, blowing out, testing and commissioning of the piping systems installed by the CONTRACTOR is the responsibility of the CONTRACTOR.

- 4.4** Drawings in general are made to scale. The CONTRACTOR shall use dimensions and grades relevant at site based on SURVEY and Site Conditions ground levels as it exists.

4.5 PIPING TECHNICAL SPECIFICATIONS

PIPING MATERIAL a) MILD STEEL - BLOCK/GALVANISED AS PERIS 1239 HEAVY / IS 3589 FOR DIESEL SUPPLY WITH 6.25-mm WALL THICKNESS Or 'C' CLASS THICKNESS

b) FOR UNDER GROUND: Carbon steel A 106 Gr B, Sch 40 /Sch 80, Seamless Butt welded to 36.10 Non IBR Quality above ground and Schedule 80 underground. Pipe coat bituminous wrapping of minimum 4mm thickness to be given for corrosion resistance

Max OPERATING PRESSURE	:	MAX. 15.0 KG/SQ.CM
OPERATING TEMPERATURE	:	MAX. 300 DEG.C.
NOMINAL PRESSURE RATING	:	# ANSI 150 / # ANSI 300
GASKET FACING	:	# RF / # FF
PIPE JOINT 40& ABOVE	:	BUTT WELDED
DRAIN 40& ABOVE	:	BUTT WELDED
VENT 25& BELOW	:	SOCKET WELDED
PRESSURE GAUGE	:	10NB SOCKET WELDED
TEMP. CONN ALL	:	3/4" FLANGED
MAINTENACE JOINT ALL	:	FLANGED
COVERING CODE	:	ANSI / ASME 31.3
2. LINE TO LINE JOINT	:	15-40mm SOCKET WELD 50-400mm BUTT WELD - FULL PENETRATION & 10% - ALL ROOT RUN TO BEEXAMINED BEFORE SUBSEQUENT RUNS by DYE PENETRANT TEST
2. LINE TEST PRESSURE:-	:	
HYDRAULIC TEST	:	1.5times of operating pressure.
HOLDING TIME	:	Minimum 8hours - NO LEAK - NO LOSS OF PRESSURE

The following manufacturing tolerance s shall be permitted on tubes and sockets .

THICKNESS

- | | | |
|----------------------------|---|---------------------------------------|
| i) Light tubes butt welded | : | + Not limited - 5 percent |
| ii) Medium and Heavy tube | : | + Not limited - 7 percent butt welded |
| iii) Medium tubes seamless | : | + Not limited - 10 percent |

FLANGES

Flanges shall be slip-on Carbon steel with raised face conforming to ANSIB16.9. All bolts & nuts shall be carbon steel and gaskets shall be 3 to 6 mm CAF reinforced asbestos Gaskets or spiral wound steel gasket Spirajet make . INSIDE THE STORAGE YARD ALL SIZES OF VALVES JOINT IS TO BE FLANGE JOINT

ITEM	NOM.SIZE	GENERAL DESIGN	STANDARDS	MATERIAL
DIESEL PIPE	15-20	SMLS.PIPE	HEAVY	IS 1239
	25-150	ERW.PIPE	HEAVY	IS 1239
	Above 200	ERW.PIPE	6.35 THK.	IS 3589
NITROGEN PIPE	15-25	SMLS. PIPE	Sch.80	A 106 Gr. B
	32-200	SMLS. PIPE	Sch.40	A 106 Gr. B
	Above 200	Smls.pipe	10 THK.	A 106 Gr. B
ELBOW	15-40	SW #3000 Smls.	B 16.11	A 105
	50-200	BW Sch.40 Smls.	B 16.9	A234 WPB
REDUCER	15-40	SW#3000 Smls.	B 16.11	A 105
	50-200	BW Sch.40 Smls.	B 16.9	A234 WPB
TEE	15-40	SW#3000 Smls.	B 16.11	A 105
	50-200	BW Sch.40 Smls.	B 16.9	A234 WPB
FLANGE	15-200	SORF #150	B 16.5	A 105
GASKET	15-200	3 mm THK.	B 16.5	SPIRAGET RING TYPE
FASTENERS			IS:1363 & IS:1364	IS:1367 CL.6 4/4

NOTES :-

1. Covering Code : ANSI / ASME 31.3
2. Line to Line Joint : 15 – 40 mm Socket Weld or Seal Weld or Screwed.
50 – 200 mm Butt Weld.
- Full Penetration & 10% Radiography for U/G. & A/G Lines.
- All Root Run To Be Satisfactory On D.P. Examination Before Subsequent Runs.
3. Line Test Pressure Hydraulic Test : 1.5 Times of Design Pressure.

Holding Time : 2 Hours (or) Engineers Approval.
- No Leak
- No Loss of Pressure

1 GENERAL

- a) For steel pipe line, welded construction shall be adopted unless specified otherwise .

- b) Hangers and supports shall be capable of carrying the sum of all concurrently acting loads They shall be designed to provide the required supporting effects and allow pipe lines movements as necessary. Approval to the type of hangers and components for all piping selected by contractor shall be obtained from the owners / engineer before commencement of work.
- c) All piping system shall be capable of withstanding the maximum pressure arising from any condition of testing (as stipulated) and operation including water hammer effects.
- d) While erecting field run pipes, the contractor shall check the accessibility of valves, instrument, tapping points, and maintain minimum head room requirements and other necessary clearance from the adjoining work areas.
- e) Modification of prefabricated pipes, if any, shall have to be carried out by the contractor at no extra charge to the owner / engineer.
- f) All pipe lines shall be given proper slopes towards the drain point.
- g) External and internal attachment to piping shall be designed so as not to cause flattening of pipes of excess localised stresses.
- h) All pipe lines shall be identified by means of colour bands and direction arrows in consultation with the engineer.

2 END PREPARATION

- a) For steel pipe, end preparation for butt welding shall be done by machining / flame cutting.
- b) for tees, lateral, mitre bends and other irregular details cutting templates shall be used for accuracy.

3 PIPE JOINTS

- a) In general pipes having sizes 50 mm and over shall be joined by butt welding, pipe having 40 mm size of less shall be joined by socket welding / screwed joints shall have tapered thread and shall be assured to leak tightness without using any sealing compounds.
- b) Flanges Joints shall be used for connection to vessels, equipments, flanged valves and also on straight lengths of pipe line at strategic points to facilitate erection and subsequent maintenance work.

4 OVER GROUND PIPING

- a) Piping to be laid over ground shall be supported on supports. support detail shall have to be approved by the owner / engineer.

5 PAINTING

Above ground pipes shall be coated with one coat of red oxide primer and two (2) coats of synthetic enamels of colour as per IS standard of Colour codes. The pipe line surface shall be manually cleaned off rust / mill scales by wire brush, carborandium tips etc., Use of wipping hammer, emery paper shall be done to clean pitted area.

The primer coat dry film thickness shall be 30 micron per coat. The finished coat dry film thickness shall be 35 micron per coat.

The Pipe Supports should be coated with 2 coats of Red Oxide primer with 2 Coats of Synthetic Enamel Paint.

All pipes are to be colour coded as per the client's requirement.

6.COATING & WRAPPING

Wherever underground pipes laid the same shall have to suitably coated and wrapped other than stainless steel pipes as per section E.05 coating and wrapping in fire protection system.

7.WELDING

- a) Before welding, the ends shall be cleaned by wire brushing, filing or grinding. Each weld - run shall be cleaned of slag before the next run is welded.
- b) Welding at any joint shall be completed uninterrupted. If this cannot be followed for some reason the weld shall be insulated for slow and uniform cooling
- c) Welding shall be done by manual oxy-acetylene or manual shielded metal arc process.
- d) As far as possible welding shall be carried out in flat position. If not possible welding shall be done in a position as close to flat position as possible.
- e) The root of butt joints shall be such as to achieve full penetration with the complete fusions or root edges. The weld projections shall not exceeds 3 mm inside the pipes.
- f) On completion of each run crated weld irregularity, slag etc., shall be removed by grinding or chipping.
- g) During the process of welding, all movements, shocks, vibrations or stresses shall be carefully avoided in order to prevent weld cracks.
- h) At least 10% of all the welded joints shall be radiographically tested and half of the joints radiographic shall be field joints.
- i) All Valves size from 20mm NB shall have flanged end connections with drilled holes conforming to IS: 1538.
- j) PIPE SUPPORTS: (Anchor Block)

The Pipe supports to be designed and erected as per site condition. The materials to be used shall be IS: 2062 with suitable Anchoring & Clamps wherever required. The Pipe Supports should be coated with 2 coats of Red Oxide primer with 2 Coats of Synthetic Enamel Paint.

5.0 DOCUMENTS TO BE FURNISHED ALONG WITH QUOTATION

1. A brief background of the company detailing the address of the company, production facilities, date of incorporation, production capacity and range of products, details of in house design facilities, particulars of foreign collaboration in the product range, no. of employees, details of approval of the facilities by any established third party inspection agencies such as Lloyds, BV,EIL etc., ISO certification and exports of products to other countries.
2. A list of clients along with details of capacity of similar units in and around Chennai.

DOCUMENTS TO BE FURNISHED ON SUPPLY OF SYSTEM

MANUALS

3copies of manuals shall be submitted duly indexed with complete technical data sheet of each piece of equipment installed .The manual shall be well bounded and shall contain the following.

1. Table of contents
2. Design data / standards
3. "As Built" drawings
4. Manufacturers catalogues installation and maintenance brochures.
5. Spare part list.

6.0 ACCEPTED MAKE OF MATERIALS

- | | |
|--|--|
| 1. G.I. & M.S. Pipes and Carbon Steel Pipes. : | TATA / ZENITH / JINDAL |
| 2. GI & MS Pipe Fittings & Stainless Steel Fittings : | SHIVANANDA /LLOYD, GENERAL ENGG |
| 4 Flanges : | ECHJAY /GEN. ENGG /SKANDER |
| 5. Valves, Globe valves, Ball & slam shut off valves : | AUDCO INDIA LIMITED / ANIL/FLOCON,
ADVANCE/ FISHER /LEADER |
| 6. Gripp Bolts : | HILTI / FISCHER |
| 7. Pressure Gauges/Temp. Gauges : | WAREE/FIEBIG/RADIX / MASSIBNS - DIGITAL |
| 8. Flow Meter / Tantalizer : | Fluidyne / Kent |
| 9. Motors : | SIEMENS / ABB / KIRLOSKAR. |
| 10. Level Controller /Pressure Controller : | IDAS MARKETTING/SRIDHAN INTERNATIONAL/
J.N.MARSHALL/TOSHNIWAL BROS. |
| 11. Gasket : | CHAMPION |
| 12. Wielding Electrodes : | ADVANI OERLIKON |
| 13. Bolts & Nuts : | GKW/Mahendra/ GENERAL/ . |
| 14. CENTRIFUGAL STAGE PUMPS : | KSB/ KIRLOSKAR/ ARMSTRONG |
| 15. FLAME PROOF MOTORS : | SIEMENS/NGEF/KIRLOSKAR |

16. METERING UNIT	:	KENT/CROWN MEASUREMENTS/TOSHNIWAL
17. FLAME PROOF STARTERS	:	SIEMENS / L & T /
18. AIR COMPRESSORS	:	KEASER / ATLASCAPCO/LG/INGERSOLLRAND
19. AIR MOISTURE TRAP	:	SPIRAX
20. PRESSURE REDUCING VALVE	:	HONEY WELL/ADVANCE
21. STRAINER	:	LEADER/PROCEEDYNE
22. Diesel / FO TRANSFER GEAR PUMPS	:	TOSAHCO /ROTODEL
23. MAGNETIC FLOAT SWITCH	:	TECH TROL/ TOSHNIWAL/ SHRIDHAN