

### General Instructions

- 1- **Standards:** All material and equipment supplied by the manufacturer/supplier shall be new and in all respects conform to the high standard of engineering design and workmanship, perform and function as herein specified and fully meet the specifications requirements of the latest standards of International Elektrotechnical Commission and or VDE, BSS.

- 2- **Climatic Conditions :** All equipment supplied shall withstand, without developing any defect the following climatic conditions:

|                             |   |       |
|-----------------------------|---|-------|
| Maximum ambient temperature | = | 45° C |
| Minimum ambient temperature | = | 4° C  |
| Relative humidity           | = | 80 %  |

- 3- **Drawings & Data:** Three sets of dimensioned drawings, plans, foundations and elevation & technical data of supplied equipment shall be furnished to the Consultant well before arrival of DG sets at site. The technical data must show the characteristic curves, setting ranges, reference standards, installation details etc. for, circuit breaker, meter, relay, switches, etc. Single line diagrams and control wiring diagrams, internal connections etc. shall be provided.

- 4- **Factory Tests:** The set shall be tested at manufacturer's factory as specified by the standards to be followed. Before commissioning of each DG set all field tests shall be performed by manufacturer's engineer at site in the presence of consultants and certified result in triplicate shall be submitted before and after test runs of the DG set on-load.

The witnessing of tests by the Consultant or Owner's engineer shall not absolve the manufacturer/supplier from his responsibility for the proper functioning of DG set and all attachments, accessories etc. as per guarantee to be furnished by the supplier/manufacturer on placing of order.

- 5- **Installation & Operation Manuals:** Two copies of manufacturer's installation and operating manuals of the diesel generator and control panels etc. shall be furnished with the delivery.

## TECHNICAL SPECIFICATIONS

The following diesel generator sets are required for this hospital:

- 1- One 550KVA for lighting and power in the hospital and
- 2- One 100 KVA for essential equipment and lighting in OTs ,ICUs, and laboratories

Each of the above DG sets shall be complete with:

- Diesel engine
- Alternator
- Skid mounted diesel tank
- Auto Mains Failure Panel with auto transfer switch
- Control panel with all controls for diesel engine and alternator.

### **Diesel Engine:**

Rating & Type: Each diesel engine shall be 1500 RPM 4 cylinders four stroke direct injection, turbo- charged, water cooled and shall comply to the latest international standards and develop to deliver prime power as stated above at 0.8 power factor. The radiator and fuel tank shall be set mounted.

Lubricating System: The lubricating system shall be of the full pressure circulation type complete with full flow lubricating oil filters with replaceable elements and a lubricating oil heat exchanger. Filtering system shall be equipped with spring loaded by-pass valve as an insurance against stoppage of lubricating oil circulation in the event of the filters becoming clogged.

Cooling System: The engine shall be water cooled with geared water pump. The cooling system shall be pressurized and equipped with a heavy duty radiator mounted integral with the set and cooled by a reverse flow fan, keeping the coolant temperature up to 50 degree centigrade. The coolant temperature shall be controlled by means of one or more thermostats. A fan cool and hand protection guard shall be fitted.

Fuel Supply System: Fuel shall be supplied to the engine from set mounted fuel tank which in turn will get fuel from day tank by gravity. The injection pump and injectors shall be easily removable and replaceable for servicing purposes. The engine shall be equipped with a built-in gear type engine driven fuel transfer pump capable of lifting fuel against a head of 250cm for supplying fuel through filters to the injection pump at constant pressure. The fuel system shall be equipped with easily replaceable fuel filter elements.

Air Supply System: A heavy duty engine-mounted air intake cleaner with replaceable filters shall be provided for the engine. The air intake system shall be equipped with turbo charger for optimum combustion and fuel economy.

**Speed Control:** The engine governor shall be solid state electronic having external droop adjustment. The governor shall be capable to provide speed control within (+)

(-) 0.25 % of rated speed, so that frequency fluctuation at the output of the alternator shall not be more than 2 %. The electronic governor complying to BS 5514 Part 4 or Barber Colman system or equivalent shall be provided.

**Exhaust System:** The exhaust system shall be complete with a dry type exhaust manifold with flanges, flexible exhaust expansion connections, exhaust pipes and **domestic** silencer. The silencer shall be fitted with a drain plug at its lower end to permit evacuation of condensed humidity. Appropriate type insulation at least 10mm thick shall be provided for the exhaust pipe through out its length.

**Starting System:** The electric starting of the engine shall be manual- cum- automatic by means of a push button for manual start and automatic from an Auto Mains Failure panel. The starting system shall consist of 24 V d.c. a starter motor, heavy duty 24 V lead acid battery housed in a tray mounted on a stand on the side of the set. An engine driven charging alternator with built-in rectifier and controls shall charge the batteries while the engine is running. A suitable trickle charger fully automatic and connected to the main supply shall be housed in the control panel or separately on the wall, for keeping the batteries in fully charged condition when the set is not running.

**Protections:** An automatic shut down protective system with signaling shall be provided to shut down the engine in the event of:

- Engine over-speed
- Low lubricating oil pressure
- High cooling water temperature.

A complete protection shall be provided to shut-down the system and arrange to energize alarm located within the generator room and to trip the generator's circuit breaker.

### **Alternator:**

The alternator shall be drip-proof construction and screen protected. It shall be revolving field brushless type with adapter and flexible coupling for direct connection to the engine at the flywheel. The alternator's (generator's) essential data is given below:

|                     |                            |
|---------------------|----------------------------|
| No. of phases       | 3                          |
| Winding connections | Star with grounded neutral |
| Net rated output    | 550 KVA and 100 KVA        |
| Voltage             | 415V 3 phase               |
| Power Factor        | 0.8                        |
| Frequency           | 50 Hz                      |
| Insulation clause   | F or H                     |
| Voltage regulation  | (+) (-) 1.5%               |

Voltage Regulation: The exciters shall be permanent magnet type. An electronic automatic voltage regulator shall be provided to control voltage regulation from no load to full load including hot to cold variation and load power factor between 0.8 lagging to unity shall be within (+) (-) 1.5% of nominal voltage. The voltage build up shall be in positive and rapid manner even when the machine is connected to its load circuit. The line to line voltage waveform shall be at least to the requirements of BS2613 or its latest revision. The total harmonic content shall not exceed 3 %. The radio interference suppression shall be at least to BS800 or its latest revision. The generator shall be fitted with field suppression system that eliminates any source of diode failure resulting from high inductive load.

Generator Protections: The generator protections shall include:

- Over-current
- Short circuit
- Earth fault
- Over-voltage

The protections shall ensure tripping of the main circuit breaker, stopping of the diesel engine and sounding an alarm signal in fault conditions. The required number of current transformers with class C accuracy shall be provided.

Control Board Instruments: The following instrumentation and control switches shall be provided:

- Ammeter with phase selector switch
- Voltmeter with phase selector switch
- KW meter for 3-phase 4-wire system
- KWH meter for 3-phase 4-wire system and balance and unbalanced loads
- Frequency meter
- Battery voltmeter and charging meter
- Start stop push switches
- Emergency stop push
- Hour counter

**Auto Mains Failure Panel:**

The auto mains failure panel and auto-transfer switch shall be floor mounting cubical type and shall have following features:

On failure of electric supply or on fall of supply voltage below 70% of rated voltage a signal shall be generated to the start system of the genset whereby the engine is started and on coming up to the rated speed and voltage the auto change-over switch is activated to switch on the generator supply to the system in about 15 seconds time. On resumption of normal supply the auto mains failure panel shall immediately switch ON to normal supply and after a lapse of prescribed time interval the genset shall be stopped.

One volt meter for generator supply and other for normal supply shall be provided.

**Spare Parts List:** The supplier of the DG sets shall include in his offer the following spare parts for each of the 550 KVA and 100 KVA DG sets to be imported or from ready stock and shall quote firm prices individually :

|  |         |
|--|---------|
| Oil filter elements                        | 12 Nos. |
| Air filter elements                        | 12 Nos. |
| Fuel filter elements                       | 12 Nos. |
| Fuel filter strainer                       | 6Nos.   |
| Set of belts for crankshaft pulley         | 1 No.   |
| Set of belts of charging alternator drive. | 2 No.   |
| Thermostat                                 | 2 Nos.  |
| Fuse set (Control panel)                   | 3 Nos.  |
| Field circuit diodes                       | 6 Nos.  |

**Testing & Commissioning:** The above specified diesel generator set will be installed by a contractor under separate contract. The supplier of diesel generator set shall provide required assistance and before testing and commissioning check the entire work and report any short coming to the consultant or Owners engineer.

The supplier of DG set shall get the testing and commissioning performed by the manufacturer's trained engineer after certifying that the installation by contractor had carried out the installation that is acceptable to the manufacturer's standards.

**Training:** The hospital's supervisor and operators shall be trained by the suppliers commissioning engineers for a suitable period of time so that the operation of their supplied set is ensured to be handled by them satisfactorily.