

Annex-A

TECHNICAL SPECIFICATION

FOR

SUPPLY, INSTALLATION, TESTING AND COMMISSIONING

OF 0.4kV (2,000kVA) DIESEL GENERATOR

1.0 SCOPE

This specification covers the requirements of design, manufacture, delivery testing, installation and commissioning of **0.4 kV, 3phase, 50 Hz, 2,000 kVA, 1,600 eW, Generator set.**

2.0 SITE CONDITIONS

- 2.1 Ambient Temperature: Maximum 55°C Minimum -5°C
- 2.2 Relative Humidity: Around 60% at maximum Temperature
- 2.3 Altitude: Around 1000 M above MSL.

3.0 ELECTRICAL SUPPLY PARTICULARS

- 3.1 System Voltage (Normal): 0.4kV
- 3.2 No. of Phases: 3
- 3.3 Frequency: 50 c/s
- 3.4 Auxiliary supply: 24 V D.C. supplies for D.G Set starting Motor.

4.0 STANDARDS

The Diesel Generating set and accessories shall conform to the requirements of Iraq Standards some of are listed below: -

- a. BS: 649 - Diesel Engines for general purposes
- b. IS: 4722 - Electrical performance of rotating electrical Machinery.
- c. IS: 2516 - Air Circuit Breaker
- d. BS 5000 , IS 1460, ISO 8528, BS 5514, ISO 3046

5.0 Guarantee period:

Contractor shall written guarantee identifying the owner against defective materials and workmanship for a period of one or 1000h actual operation after acceptance.

ENGINE:

Engine: direct injection, water cooled engine, 16 cylinders, and 4 strokes, rated at 1500 rpm

RPM, conforming to ISO 3046 / BS 5514 has the following specifications:

- PT fuel pump, Electronic governor
- Emission: low fuel consumption
- Mechanical unit injector
- Holset turbocharger with low temperature after cooler, pulse tuned exhaust Manifold, stainless steel exhaust flexible connections
- Radiator or heat exchanger, coolant inhibitor,
- Plate type lube oil cooler

- Outboard after coolers

Full flow paper element filters - fuel, lube oil and by-pass

- Dry type replaceable paper element air cleaner with restriction indicator
- Flywheel housing & flywheel to suit single / double bearing alternator
- Hole set flexible coupling for double bearing alternator
- Starting motor – Electric, battery charging alternator
- Microprocessor based gen set Controller PC
- First fill lube oil & coolant inhibitor Full Authority Electronics,
- Residential Silencers.

ALTERNATOR:

Alternator 2,000 kVA at 1,500 RPM, 0.4kV, 3 phases conforming to Iraq Standards.

The Alternator is brushless alternator. The alternator has the following features

- Permanent Magnet
- 4 pole
- Class 'H' insulation
- Salient pole revolving field
- Double bearing
- PMG standard
- Voltage regulation $\pm 0.5\%$
- IP: 23 Enclosures
- Digital AVR is inbuilt in PCC.

GENSET CONTROLS - is a microprocessor based generator set Monitoring, metering, protection and control system.

It shall offer advanced levels of functions for reliability and optimum gen set Performance.

The control system shall have easy servicing capabilities that allow system parameters to be interrogated, monitored and adjusted with a PC.

Features:

- Digital governing
- Digital voltage regulation
- Protection for true alternator O/C protection
- Analog/ digital AC output metering
- Battery monitoring system to sense and warn against a weak battery condition
- Digital alarm and status message display
- Gen set monitoring: Displays status of all critical engines and Generator set functions
- Smart starting control system: Integrated fuel ramping to limit black smoke and Frequency overshoot
- Advanced serviceability

- Network capability

MOUNTING ARRANGEMENT:

Engine and alternator are mounted on a common MS fabricated base frame.
Water proof and sound proof enclosure noise level outside DG room shall not be more than 70 dB at distance 1.5m from outside of DG enclosure

FUEL TANK:

Daily built-in fuel tank.

BATTERY:

Set of 4 Nos.12 Volts for DG set, uncharged maintenance free batteries with leads and terminals.

6.0 DIESEL ENGINE

The Diesel Engine specifications shall be as follows: -

- | | | |
|------|---|------------------------------------|
| 6.1 | Type: 4 cycles, V type, Turbo charged and after cooled. | |
| 6.2 | Rating : Continuous at 55° C ambient, 95% RH & according Iraq atmospheres and pressure. | |
| 6.3 | No. of Cylinders | : 16 |
| 6.4 | No. of strokes | : 4 |
| 6.5 | BHP | : 2,300 kVA for 2,000 kVA DG set |
| 6.6 | RPM | : 1,500 |
| 6.7 | Overload rating | : As per BS 5514 |
| 6.8 | Type of governing | : Electronic as per BS 649 |
| 6.9 | Maximum speed
on a change
Of load up to 20% | : Not more than 2% Variation |
| 6.10 | Type of fuel | : Diesel |
| 6.11 | Fuel consumption | : low fuel consumption |
| 6.12 | Type of starter: - As per the Manufacturer recommendation. | |
| 6.13 | Type of Engine : Radiator – fan cooled – fan to be driven
Cooling By the engine shaft. | |
| 6.14 | Type of coupling to
Generator | : Direct through flexible coupling |

7.0 ALTERNATOR

The alternator shall be double bearing, revolving field type conforming to IS: 4722 as per specifications given below: -

- | | | |
|----|------------------------|--|
| a. | Rated voltage | : 0.4KV |
| b. | Rated KVA | : 2,000 kVA under site conditions |
| c. | Rated power factor | : 0.8 |
| d. | No. Of phases | : 3 |
| e. | Frequency | : 50Hz. |
| f. | Type of stator | : Star connected Connection |
| g. | Percentage regulation | : +/- 5% |
| h. | Type of excitation | : Brushless, Self-regulated and separately
Excited, |
| i. | Insulation class | : Class H for stator and rotor |
| j. | Type of enclosure | : Screen protected drip proof – IP23 |
| k. | Alignment | : Flex plate/Flywheel spigot |
| l. | Over speed capability | : 150% for 30 sec |
| m. | Wave form | : Less than 3% deviation |
| n. | Paralleling capability | : Standard with adjustable voltage drop |
| o. | Voltage | : 0.4KV |
| p. | Voltage regulation | : Less than 1% |
| q. | Voltage adjustment | : $\pm 5\%$ |

8.0 AMF WITH AUTO SYNCHRONISING FACILITY AND LOAD SHARING RELAY DEVICE.

a. Incomers and Outgoings

8.1 The electronic Microprocessor based AMF module shall contain the following Control and monitoring features.

- Automatic/manual start-stop engine control with programmable safety Shutdowns and associated flashing LED indicators for low oil pressure, High coolant temperature, over speed, over crank /rest Periods
- Cycle cranking adjustable 1-60 second crank/rest periods.
- Cool down timer - adjustable 0-30 minutes.
- Energized to run or shut shown fuel control system.
- The control panel shall have metering and measuring features like,
 - * Total real power
 - * Total reactive power
 - * % of rated power
 - * Power factor (average)
 - * Total energy output
 - * Real power each phase
 - * Total apparent power
 - * Power factor each phase
 - * Total reactive energy output
 - * Phase selector switch
 - * Auto starts / stops control
 - * Cycle crank and cool down timer
 - * Digital DC Voltmeter
 - * Tachometer, Hour meter
 - * Emergency stop push button
 - * Engine control switch for

- * Auto, Start / run, off / reset, stop
- * Engine speed adjust potentiometer
- * Voltage adjust potentiometer
- * Digital oil pressure and water temp gauge
- * Shutoffs with visual indicators for:
- * Low oil pressure
- * High water temperature
- * Over speed
- * Over crank
- * Low coolant level
- * System diagnostic codes
- * Programmable protective relays

- a. LCD digital readout for Engine oil pressure, Coolant temperature, Engine RPM, System DC volts, Engine running hours, Generator AC volts, AC Amps and frequency.
- b. Engine control switch
- c. Ammeter voltmeter phase selector switch.
- d. Emergency stop push button.
- e. Voltage adjustable potential meter.
- f. Speed adjust potential meter.
- g. Protective relay functions.
 - Over voltage
 - Under voltage
 - Over frequency
 - Under frequency
 - Over current
 - Reverse power

The scope also includes all necessary components which are required for full filament of the system for Auto start, Auto synchronization and load sharing.

13.0 DOCUMENTATION

As a part of the equipment supply, following documents shall be supplied for Our/Owners approval/records.

Records

- a. General arrangement drawing of the diesel generating set, engine Outline dimensions and list of Accessories.
- b. Layout of the diesel generating Sets along with recommended Size and type of D.G enclosure
- c. Schematic & wiring diagram for gen set
- e. Routine test certificate on engine 2 for gen set
- f. Routine test certificate on alternator 2 for gen set

- g. Routine Test Certificate on VCB and Relays 2 for gen set
- h. Routine Test Certificate of control Panel 2 for gen set
- i. Operating instruction chart 2 for gen set
- j. Instruction Manual 2 for gen set
- k. Spare parts list 2 for gen set

14.0 PACKING

The diesel engine, alternator, control panel etc. shall be suitably packed for Shipment to site by road. A complete list of parts (Packing list) shall be furnished

15.0 SPARES

A recommended list of spare parts (for one year operation) of the unit shall be submitted along with the bid.

16.0 PREFERRED MAKES

- a. Engine –CATERPILLAR/ CUMMINS/VOLVO or Equivalent
- b. Alternator - STAMFORD/LEROY SOMER/MARATHON or Equivalent
- c. Control Fuses - GE CONTROLS/SIEMENS/C & S
- f. Battery – Approving type

17.0 ASSEMBLY AND INSTALLATION

Components shall be assembled in factory over the trailer foundation prepared from other agencies.

The necessary fuel and exhaust piping shall be installed as per Bill of quantity. While The fuel piping shall be carried out using medium gauge (class B) MS Pipes, and Approved makes of fittings, the exhaust piping shall be fabricated out of Medium gauge pipes of required diameter. The exhaust gas line shall be insulated up to height 2.5M above the floor level. **The pressure loss through Exhaust system does not exceed the value recommended by the manufacturer.**

Silencers in the exhaust system to maintain the external noise level specified by the manufacturer.

The D.G. set shall be installed over the Anti-vibration mounts and the alignment shall be carried out. The alignment shall be well within the limits specified by the manufacturer. The installation of cabling and earthing up to the control panel shall be carried out and this shall comply with the statutory requirements. Any improvement Modification called for the electrical inspectorate shall be carried out

18.0 FIELD TESTING

After the assembly the unit shall be tested in the presence of the client. The following tests shall be conducted on the engine and alternator.

- a. Full load test for 8 hours
- b. Over loading test on engine as per standards

- c. Fuel & Oil consumption checks
- d. Determining efficiency
- e. Meager test on alternator
- f. Checking regulation
- g. Testing of control wiring.
- h. Any other tests as may be required to satisfy the Owner/Electrical inspectorate of the performance of the Unit.

19.0 CONFORMATION SCHEDULE OF TECHNICAL SPECIFICATION

Required UNDP specification in Annex: B

20.0 VIBRATION CONTROL

The complete generator assembly shall be isolated on static deflection

UN housed spring-neoprene in series isolator with non-skid neoprene pads.

Start-up and shut down rocking restraint snuffers shall be provided at four

Corners of base frame.

All fuel line pipes shall be cushioned with a layer of harnesses and neoprene pad

At attached points. All pipe work and engine silencers shall be suspended on static

deflection spring-neoprene in-series hangers. Detail calculation and proposal for

justifying the size and provision shall be provided for consultant Review prior to the installation.