# SOUTH AFRICAN REVENUE SERVICES (SARS)

# PROPOSED HATFIELD GARDENS OFFICE

**SPECIFICATION AND SCHEDULES**

**FOR**

**PRIME DIESEL GENERATOR**

**SECTION C: STANDARD SPECIFICATION**

**INDEX**

**1 DIESEL ENGINE**

**2 FUEL STORAGE**

**3 ALTERNATOR**

**4 GENERATOR REGULATION**

**5 GENERATOR PROTECTION**

**6 GENERATOR CONTROL**

**7 INTERCONNECTING CABLES**

**8 EARTHING**

**9 EXHAUST SYSTEMS**

**10 INLET & DISCHARGE LOUVRES**

**11 RECIPROCATING I.C ENGINES – NOISE AND VIBRATION CONTROL**

**12 TOOLS AND SPARES**

**13 GENERATOR ENCLOSURES**

1. Diesel Engine
   1. General Requirements of the Diesel Engine

The engine shall comprise a multi-cylinder unit constructed to BS 5514 or ISO 3406, supplied with all auxiliaries necessary for operation including, where applicable, turbo-charging and charge air cooling equipment.

Construction shall facilitate on-site maintenance and repairs, including a barring facility if appropriate, and access to and removal of pistons and connecting rods. The engine a/c generator unit shall be mounted on a common, rigid bed-plate supported on spring-type anti-vibration mountings. Means for lifting and moving the set into position shall be provided.

The engine shall be direct fuel injected and in conjunction with turbo charging.

The engine shall be suitable for operation using fuel oil to BS2869, DIN 51 601 or as specified. Fuel filters with water drips shall be incorporated in the lift pump supply system feeding the injector pumps.

The engine shall include the following components but not limited to:

1. Dry type combustion air filters
2. Lubricating and fuel oil filters
3. Coolant and lubricating oil circulating pumps
4. High pressure fuel injection pump and fuel solenoid
5. Heavy duty electric starter motor c/w24DC electric starting control system
6. Set mounted generator and regulator to charge starting batteries when set is running
7. Engine driven pusher type radiator fan
8. Coolant flow thermostat and bypass system and water jacket heater
9. Electronic governor for speed control to BS 5514 Class AO
10. Sensor switches to initiate automatic shutdown for engine fail to start, low oil pressure, high coolant temperature and engine overload conditions
11. Set mounted oil pressure gauge, coolant temperature and rpm gauge.

The engine alternator set will be close coupled (flange mounted) with flexible couplings between engine and alternator. The engine/alternator unit will be mounted on a duplex skid base by bonded mounted rubbers in semi shear. Provision should be made in base frame for:

* 1. Grouting of frame
  2. Lifting (slinging) of complete unit.

The rotating system shall be dynamically balanced to reduce vibration to a minimum.

* 1. Engine Speed

The maximum nominal operating speed of the engine together with the nominal generator output frequency, shall meet the requirements specified.

The engine speed governing system shall be selected in accordance with BS 5514:Part4, to meet the tolerance values specified.

Means of manual adjustment of engine speed to + 5% from the nominal speed under all specified load conditions shall be provided at the control panel.

An engine overspeed prevention device shall be incorporated in the speed control system in accordance with BS 5514:Part6 (ISO 3046/6).

* 1. Engine Rating

The engine shall be capable of continuous operation as defined in BS 5514:Part1. The rating shall include both full load and 110% full load.

* 1. Engine Lubrication

A complete engine lubrication system shall be provided, including a large capacity sump incorporated within the base plate. The sump shall be fitted with oil pumps with filters on the suction and delivery sides. A bypass pressure relief valve shall be fitted in the pump delivery. Galvanised steel or GRP drip-trays shall be fitted to collect spillage.

The lubrication system shall provide automatic continuous lubrication of all moving parts without manual intervention. Ancillary equipment shall include:

1. oil cooler
2. level dipstick
3. filler cap
4. crankcase breather pipe or outlet
5. manual lubrication facility for priming
6. drain pipe to drain sump, with easy access in draining operations.

The capacity of the sump together with the type, grade and consumption rate of the lubricating oil shall be as specified or as otherwise approved.

All screws, studs, etc., except those of a less diameter than ¼” (6mm) shall be of “Unified Form”. To facilitate subsequent oil change the sump drain plug is to be extended beyond base frame and terminated with head plug and with plug painted red.

All grease points to be provided with nipples of the hexagon slide on type, painted red and extended clear of guard frames where necessary.

* 1. Engine Water Cooling System

Coolant ducts shall be incorporated within the cylinder heads. Cooling fluid shall be circulated by means of a pump mounted on the engine. A thermostatically controlled valve shall be provided in the cooling system to assist rapid heating up of the water in the engine jacket when starting from cold, and to provide temperature control when the engine is running.

For operating in ambient temperatures below 10°C an electric immersion heater shall be fitted, and connected to the normal mains supply. The immersion heater shall be automatically disconnected when the engine starts.

The cooling system shall comprise a closed circuit, engine mounted radiator with integral fan. The radiator fan shall be either directly driven from the engine or driven by an electric supply, and shall be sized to accommodate resistance of ductwork, louvres and attenuators forming the installation.

The radiator shall carry a label stating the radiator and engine cooling capacity.

* 1. Generator Room Cooling

The contractor shall provide details of radiant heat output from the engine, exhaust system and generator.

* 1. Auxiliary drives

All auxiliary drives and moving parts shall be fully guarded in accordance with BS 1649.

* 1. General Engine Starting Requirements

The engine starting system shall be capable of starting and running the engine at a steady cranking speed appropriate to the particular engine requirements for satisfactory ignition.

* 1. Electric Motor Starting

The engine shall be started by means of electric starter motor(s) mounted on the engine flywheel housing. Where two motors are utilized for starting, each motor shall be capable of providing the required starting duty at the lowest ambient temperature specified.

The starter motors shall be mechanically and electrically disconnected when the engine fires or when the starting sequence is de-energized.

The electric start system shall be capable of being operated from the main control panel and/or any other position as specified.

The starting system shall have sufficient capacity to initiate three starting cycles.

* 1. Starter Batteries

Starter batteries shall be of the type and capacity specified. The batteries shall be contained within a purpose made corrosion-resistant frame with timber cover located close to the engine. Leads between batteries and engine shall be protected against physical damage.

The batteries shall have ample capacity to give a minimum of 3 consecutive starts in quick succession.

Battery charging equipment shall be of the constant potential type, with monitoring instrumentation type as specified, and shall be automatically disconnected during engine starting. When the engine is running the battery charging shall be by the engine driven alternator.

Provision for hand starting

Provision shall be allowed for hand starting and a starting handle shall be provided. Where applicable, barring facilities and tools shall be provided.

1. Fuel Storage

A fuel oil daily service tank shall be provided by the contractor and shall be set mounted as specified.

The capacity of the service tank shall be as specified in the Specification.

The fuel tank shall be manufactured and installed to comply with the requirements of BS 799: Part 5.

The tank shall be supplied complete with all necessary pipe work, valves, connections, and shall be clearly marked with the type of fuel oil to be used.

The daily service tank shall incorporate:

1. fill opening and filler pipe extension
2. oil strainer
3. filler cap
4. vent pipe
5. dial-type contents gauge (graduated in litres)
6. connections for engine leak-off return pipe
7. drain valve and hose connection
8. float switch for overfill alarm
9. float switch for low level alarm.

Audio visual alarm provisions shall be made on the main control panel.

The contractor shall supply and install all necessary fire protection systems as specified.

1. Alternator

The Alternator shall be of the salient pole, brushless type and shall be short circuit proof.

The generator shall be continuously rated in accordance with BS 5000 : Part 99, and shall be capable of providing 110% of full load for one hour in any twelve hour period.

Insulation to windings shall be rated Class 'F' as a minimum standard. Temperature monitoring of the stator windings shall be provided. Temperature rise of alternator shall be in accordance with BS 2613, Class ‘E’ Insulation. The alternator shall provide the required continuous rated output at .0.8 pf. At 380/220 volts 3 phase 4-wire or 220 volts 1 phase 2- wire at 1500 Rpm. Waveform between line and neutral shall be sufficiently near the sine curve to restrict circulating current to a reasonable level when neutral is ground.

The generator shall be capable of developing the rated output during the load duty cycle over the ambient temperature range specified.

Enclosure class of the generator shall conform to the ambient conditions specified.

The generator shall be self cooled by means of an integral shaft mounted fan over the ambient air temperature range specified.

* 1. Coupling

The alternator to be directly coupled to the engine by means of flexible coupling and a spigotted flanged ring fitted between the units to ensure permanent alignment.

1. Generator Regulation

The automatic voltage regulation shall be capable of maintaining the limits on phase voltage within the tolerances specified. The voltage limits and recovery times shall be held over the load duty cycles specified.

Regulator components shall be contained within an enclosure mounted on the generator, the enclosure shall be isolated from any vibration forces transmitted from the generator.

The Contractor shall supply all ancillary electrical / electronic equipment associated with the operation of the voltage regulator, for both single and parallel operation of generators.

Where links are necessary to remote switchboards and/or control panel, the Contractor shall supply all necessary terminations in his equipment.

The generator output waveform shall comply with the requirements of BS 4999 : Part 40, with respect to harmonic content.

1. Generator Protection

The generator shall be protected against all types of excess current that will damage the generator electrical system.

Earth leakage protection shall be provided by means of a 'core balance' residual current device. The restricted earth fault protection level shall be capable of being varied over the range 0.3 amps to 10 amps.

The Sub-Contractor shall provide all auxiliary equipment necessary for monitoring the electrical parameters utilized in the protection systems.

1. Generator control
   1. General Requirements

The Contractor shall provide all equipment necessary for the starting/control/shut-down procedures for the diesel generator system specified.

* 1. Radio Interference Suppression

The generator/regulator system shall be equipped to comply with the requirements of BS 800, BS 1597, in respect to limits of radio interference.

* 1. Control Panel Location

The Control panel shall be a totally enclosed steel cubicle. A hinged door on the panel face shall be provided for access to all components. The Contractor shall submit full dimensions of the control panel in the Specification Data Sheets.

The engine control and protection system panel shall be set mounted.

* 1. Control Panel Construction

The control panel shall be manufactured from best quality mild steel plate of 2mm minimum thickness, and formed in a folded and welded construction. Prior to final painting, the panel shall be suitably treated against corrosion. Back plates shall be removable and secured by bolts and shake proof washers. Doors shall be flush fitting and suitably braced to prevent distortion and whip. Doors shall be capable of being lifted off hinges and shall be fitted with locks.

The complete panel enclosures shall comply with IP 51 (BS 5490) as a minimum standard unless a higher standard is specified.

Paint finishes shall be in full gloss stove enamel to BS 4800 colours, unless a particular finish is specified.

Where the equipment standard finish differs from the above the Sub-Contractor shall record details of the paint finish and colour in the Specification Data Sheets.

Cables or conduit entry shall be via removable plates at the top and bottom of the panel. Means for lifting the control panel shall be provided.

* 1. Control Panel Equipment

All facilities provided within the control panel shall be as specified.

The control panel shall be complete with all necessary equipment and facilities to control, and monitor the diesel generator under the conditions of operation specified. Control relays shall be of the plug-in dust proof type.

Contractors shall comply with BS 5424: Part 1. Transfer switches shall comply with the requirements specified. Busbars shall be fully shrouded. Power and control components shall be located within separate sections of the panel. Power and control circuits shall be segregated from each other within the panel. All wiring shall be arranged in the form of suitably supported looms and/or run in slotted PVC trunking. Wiring shall be PVC to BS 6231, for low voltage circuits.

Wiring for control circuits shall be carried out in flexible PVC cable to BS 6500. Wiring within the panel shall conform to the special requirements specified. All wiring within the control panel shall be identified by means of coded ferrules fitted to each end of the cable; the coding shall be identified on the schematic wiring diagram.

All control panel wiring shall be terminated at suitable rail mounted terminal boards located for easy access. Terminals shall utilise a spring clamp arrangement to prevent damage to wire ends.

Control circuit wiring shall be protected by fuses in accordance with BS 88. A main earth terminal bar shall be fixed within the control panel and positioned to facilitate connection of external wiring.

All indicating lamps shall be of the LED type and shall be mounted on the front face of the panel.

All indicating meters shall be 96mm scale, industrial grade performance to BS 89/IEC 51. Scales shall be chosen for ease of reading and interpolation throughout the scale range.

Where timers are utilized in the protection and control circuits, each timer shall have a readily adjustable setting range incorporated in the timer module.

All control switches shall be mounted on the front face of the panel and shall be of the rotary type. All push buttons shall be mounted on the front face of the panel. Audible alarms shall be located on the front face of the control panel with a muting facility fitted in an adjacent position. All switches, push buttons and indicator lamps shall be identified by means of permanently fixed labels manufactured from engraving laminate. Alternatively, push buttons shall be permanently engraved with the appropriate legend.

The front face of the control panel shall be illuminated with easily replaceable maintained luminaire. The illumination shall be provided glare free and shall not produce reflection from the glass fronted instruments.

The panel shall include but not limited to:

1. 3 phase kwh meter with cyclometer register
2. Breaker, auxiliary fuses, incoming and outgoing terminals
3. Frequency meter
4. Line volts with common selector switch
5. Amps per phase with common selector witch
6. Amps voltage trimmer rheostat and adjustable quadrature control.
7. Engine start push button
8. Engine stop push button
9. Main load switch shall be moulded case circuit breaker type
10. Battery trickle charge ammeter
11. Where applicable fuel day service tank pump failure alarm
12. Hand-auto-test switch
13. Circuit breaker tripped indicator
14. Protection to trip the circuit breaker and shut down engine on high water temperature (HWT), and low oil pressure (LOP).
15. Warning lamps for shut down (LOP and HWT) or visible trip/resets.
16. All relays and times shall be 11 pin plug in type and shall be secured against vibration.
17. Overload and external short circuit to trip the circuit breaker and not shut down the engine. Internal alternator faults shall trip the circuit breaker and shut down the engine.

**6.6 Remote Alarms**

The Contractor shall supply and install a remote alarm panel for the diesel-alternator system. The panel shall be installed in the location as indicated on the drawings. The panel shall be of sheet steel construction with fascia suitable for wall mounting. Alarms shall be of sheet steel construction with fascia suitable for wall mounting. Alarms shall comprise the following:

###### Load on normal supply - Green

###### Load on emergency supply - Red

###### Genset in prime mode - Green

###### Low fuel level - Amber

###### Engine start failure - Red

###### Low oil pressure - Red

###### High engine temperature - Red

###### Engine over speed - Amber

###### Engine under speed - Amber

###### Overvoltage - Amber

###### Under voltage - Amber

The Contractor shall supply and install multi-core PVC/SWA/LSF to BS 6724 control cabling between the

AMF/Changeover Panels and the remote alarm panel.

* 1. Automatic mains fail sets

1. In coming mains circuit breaker
2. Mains by pass switch – suitable in
3. Mains and alternator changeover contactors electrically and mechanically interlocked.
4. Audible time delays on load “Pick-up” and for engine “Run-on” after mains restoration.
5. Interconnecting Cables

The Contractor shall supply, install and terminate all interconnecting wiring between the diesel generator set, control panels, monitoring indication positions and supply change over switch within the main LV panel.

All wiring shall be capable of withstanding contamination by diesel fuel, lubrication oil; and shall be of the size and type, and rating consistent with the environmental conditions experienced at the site.

Main power cables shall be of the size and type specified in the Schedules of Quantities and/or drawings and shall be provided by the Electrical Sub-Contractor.

1. Earthing

The Contractor shall supply and install the complete earthing system including all earthing tape, bars, etc, associated with the diesel generator installation.

1. exhaust systems
   1. General

The exhaust system for each engine shall form a continuous unique path from the engine to the termination position. Inspection and cleaning doors shall be provided at changes of direction and at the base of the vertical stacks.

The selection, sizing and fixing on site of all sections comprising the exhaust system, including the silencers, shall be suitable for the installation specified.

Flexible, gas tight joints shall be provided between engines and the exhaust system to permit thermal expansion and to prevent vibration transmission from the engine.

The exhaust system shall be adequately supported throughout the length of its run with spring hangers as necessary or specified. Where the system is run within the confines of the building and wherever else specified, appropriate thermal insulation material shall be applied to the pipework and silencers to limit surface temperature to 55°C completed with embossed aluminium cladding.

Drain points for the removal of condensate shall be provided at the lowest point of the exhaust system.

A weather cowl shall be provided to prevent rain from entering the exhaust outlet.

* 1. Engine Silencers

Silencers shall be incorporated in the exhaust system to maintain the external noise levels specified.

* 1. Exhaust Piping – Purpose Made

Exhaust systems shall be fabricated from carbon steel pipe to BS 3601, with dimensions to BS 1600, for installations up to and including DN 600, welded or flanged and of standard wall thickness to provide adequate internal corrosion allowance.

Over 600mm bore the exhaust system dimensions shall be calculated in accordance with BS 4076, Specification for steel chimneys, and the installation shall be fabricated from steel plate to BS 4360, Grade 43EE.

External corrosion allowance shall be made for fully exposed flues, i.e. those uninsulated and not metal clad.

The pressure loss through the exhaust system shall not exceed the value recommended by the manufacturer.

Flexible bellows type connections shall be fitted between the engine exhaust manifold and the exhaust system.

Expansion devices shall be low pressure rating suitable for corrosive atmosphere and temperature up to 520°C with pipe guides provided on either side of each expansion device. Devices shall be corrugated bellows type with internal sleeves of Incoloy 825 or similar, installed with maximum ‘cold draw’.

Expansion devices shall be located midway between anchor points, firmly fixed to the building structure and positioned as specified. Anchor clamps shall be lined with high density insulating material to minimize heat transfer to the structure at those points (e.g. foam glass).

Exhaust piping shall be so supported that no vibration is transmitted to the building structure and be clear of all structural elevates to prevent heat transfer and possible combustion.

Silencers shall be incorporated into the exhaust system to control noise transmission from the engine room as specified.

The exhaust system shall terminate with an efflux cone section and conical or dished cowl to exclude rain, snow and/or particulate matter.

The base of any vertical section of the exhaust piping shall have a tee pocket and welded-in tundish of mild steel, tapped for and provided with a 19mm carbon steel drain-pipe extended to near floor level without causing obstruction to personnel or operations.

The low point of the horizontal section of the exhaust system shall similarly have a tee pocket, tundish and drain pipe splay cut at bottom or lower ends.

Before insulation all exhaust piping shall be wire-brushed clean of rust, scale, etc, and cleaned of grease and oil and painted with one full coat of silicone aluminium heat-resisting paint.

The exhaust system shall be insulated throughout its complete length with 100mm thickness mineral wool rigid sections, applied in two layers, secured with wire ties or metal bands.

Flanges shall be installed for 75mm either side of the joint faces to the same thickness as the piping. Aluminium cladding shall be 1.2mm thickness embossed style.

* 1. Exhaust Piping – Double Skin

Double skin exhaust pipe systems shall comprise a stainless steel inner liner and aluminium steel outer casing with the annular space filled with thermal insulation.

The system shall be complete with all bends, tees, expanders, nuts, bolts and washers, fixings and supports, guys and terminals.

The system and the jointing systems shall be suitable for a maximum internal pressure of 15kPa and for the exhaust gas temperature.

Captive gas-tight cleaning doors shall be provided at changes of direction and at the base of vertical stacks.

Where the system passes through building open or enclosed internal spaces the surface temperature shall be restricted to 55 degrees celcius, by additional insulation and covering where necessary.

The system shall include purpose-made adaptors for connection to the engine exhaust and to the flexible and expansion fittings.

The system shall comply with BS 4543: Part 3.

1. inlet and discharge louvres

Details of air resistance values and dimensions of all louvers (including acoustic louvres) shall be submitted in the tender specification data sheets.

Louvres shall incorporate attenuation in order to achieve the noise levels specified.

External louvres shall be provided, complete with all necessary fixings and manufacturer’s fixing instructions.

Louvers shall be fixed by the Main Contractor.

* 1. General Requirements

Air intake and discharge points shall be protected from ingress of moisture and dust by framed and shaped weather proof louvres.

The space immediately behind or below louvres shall be ‘tanked’ and adequately drained to remove deposits of moisture.

Any ductwork immediately behind an intake or exhaust louvre shall be properly prepared and painted on all internal surfaces with epoxy resin or bitumastic paint for a length from the louvre equal to the louvre height, duct length or to the next equipment item, whichever is the lesser. The bottom side of the ductwork connection shall slope downwards towards the louvre.

Louvre free area shall not be less than 50% of the total area of opening and overall be matched to airflow requirements of the engine.

Louvres shall be suitable for building into a structural opening, or fixing to substantial groundings.

Galvanised wire bird screens shall be fitted to the inner face of all louvres with provision made for removal for cleaning. Screens shall extend over the full face of the louvre and be of 10mm mesh size. All fixing clips , screws and washers shall be hot dip spun galvanized.

Adequate size closed-ends drain gutter sections at the bottom of each louvre section with an outlet branch piped to the nearest gulley or discharge on an adjacent roof as applicable shall be provided.

* 1. Steel Louvres

Frame and blades shall be fabricated from galvanized mild steel sections and sheet with cut edges repaired with cold galvanized solution.

Galvanized steel louvre assemblies shall normally be bolted together. If welding methods of assembly are used the galvanizing shall be reinstated immediately on completion of welding.

Where specified galvanized steel external louvres shall be etch-primed and a painting system applied having a five-year minimum warranty against colour fade, deterioration of surface finish, peeling and flaking. Colour to BS 4800, shall be as specified.

* 1. Aluminium Louvres

Frames and blades shall be fabricated from aluminium alloy extruded sections. Finish shall be as specified.

Aluminium alloy louvre assemblies shall be inert gas shielded arc welded, or bolted or riveted together.

* 1. Acoustic Louvres

Units shall be as specified and of specialist manufacture. Performance figures for both sound reduction and air passage pressure drop shall be available.

Louvres shall have a rigid casing housing double skin blades with plain top surfaces and shaped, perforated undersides to achieve maximum attenuation. Infill material shall be odourless, non-hygroscopic, non-toxic, and non-combustible, not decompose, not support fungoid life nor attract vermin or rodent attack, packed in sealed plastic film containers. Blades shall be positioned to provide weather protection. Acoustic performance shall be as specified. The whole assembly shall be protected against corrosion.

1. RECIPROCATING I.C Engines – noise and vibration control
   1. Noise Control

The specified sound pressure level measured 1m from the exhaust discharge shall not be exceeded.

The sound pressure levels due to the combined effect of exhausts, machinery and background noises shall not exceed the values indicated at the locations specified.

The parts of the exhaust system downstream of a silencer and inside the engine room, or in ducts with other services, or in ducts with duct covers opening into occupied areas, shall have insulation at least 50mm thick covered with sheet steel of specific weight 1 0-12kg/sqm. The sheet steel sections shall be cut out at supports and expansion joints only and all joints shall be rivetted or made with self-tapping screws. The insulation shall be as for acoustic louvres.

Constant speed engines shall be fitted with two-stage exhaust noise silencers. The peak attenuation of the first stage shall be at the firing frequency of the manifold to which the exhaust is attached, with a drop in attenuation 1 octave each side of this frequency not exceeding 5dB. It shall be as close to the manifold as possible.

The attenuating characteristic of the second stage shall be complementary to the first and -shall cause the spectrum of the exhaust noise at the point of discharge to approximate to the NR specified within +/-5 dB over the range of frequencies emitted.

Where there is no restriction in plant space, the second stage attenuator shall be fitted not less than 10 pipe diameters from the first and shall be followed by a tail pipe 10 pipe diameters long. The second stage shall be located in the engine room if the tailpipe passes through occupied spaces.

Where an exhaust system runs with less than two bends between the flexible bellows connection at the manifold and the point of exit from the plant room, a second bellows connection, similar to the first, shall be located just before the point of exit.

* 1. Vibration Control

The parts of the exhaust system in the engine plant room shall be suspended from spring hangers. The spring hangers shall allow unstressed expansion of the exhaust system without significant changes in hanger loads or excessive deflections of the flexible connections.

The isolation efficiency of spring hangers at engine rotational speed (or firing frequency if this is lower ) shall not be lower than:

1. 90% when the basic support is a ground slab or retaining wall, or,
2. 96% when the basic support is a suspended slab, a column or part of a steel frame type structure.

The isolators shall be suitable for the ambient temperature and metal contact temperature specified.

Supports for tail pipes passing through occupied spaces shall include pads or bushed washers to prevent metal contact between the parts of the support fixed to the tail pipe and the parts fixed to the structure.

Supports for tail pipes passing through occupied spaces shall include vibration isolators with efficiencies of not less than 90% at the firing frequency of the manifold to which the tail pipe is connected.

The isolators shall be suitable for the ambient temperature and metal contact temperature specified.

Intervals between spring hangers shall be chosen to give adequate structural support without causing resonance of the supported length at the manifold firing frequency or the engine rotational frequency.

Vertical sections of tail pipes shall be supported at floor slabs, and be guided between as necessary to avoid resonance. Horizontal sections, where not shown otherwise, shall be run close to junctions of walls and floors.

1. tools and spares
2. 1 set long term spares for engine, alternator and control panel (including relays and timers) to be supplied with the set.
3. 1 set of tools as follows:
   1. 1 – Set of recommended tools
   2. 1 – Toolbox
   3. 1 – Grease gun hexagon head fitting
   4. 1 – Battery hydrometer
4. generator enclosures
   1. General

The enclosure shall be completely sound proof and vermin – proof, removable from the set and shall be constructed of 3CR12 stainless steel of equally approved of a material of thickness of 1.6mm.

The enclosure shall allow easy access to the Engine, alternator, radiator, fuel, oil caps and control cubicle for maintenance purposes.The foors shall be flush with the rest of the canopy and be of the side opening type. A minimum of four doors is to be provided, two in each side.

Door locks shall be of Achor Minor type CS75 and the hinges miner type CS as supplied by Laurson Brothers Rosslyn or equally approved.Diesel fuel level indicator and alternator rating plate shall clearly visible with the door open. The silencers shall be mounted with in the enclosure.

* 1. Design

The enclosure shall be designed to be weather proof and sound proof.Perforated steel sheet shall be fitted over all the insulation material inside the canopy, rubber seals on the doors shall be equal and or similar to rubber pinch weld wind lace steel shall be of 3CR 12 or equal and approved.

Roof of the enclosure shall be designed and constructed for proper drainage of water.A battery operated fluorescent lamp fitting and its associated On/Off switch shall be provided to illuminate the control panel.

The canopy shall be completely proof, shall be constructed such that the maximum noise level generated by the under any load conditions shall not exceed 60 dba measured in any direction at a distance of 7 metres from the center of the generator.

The terminals for cables shall be brought out to entry box out die the canopy mounted at the rear of the canopy. This cable entry box shall have a suitable gland for mains, load and generator cables.