SPECIFICATION FOR SINGLE PHASE DIESEL GENERATOR SET

CONTENTS

SPECIFICATION FOR SINGLE PHASE STANDBY DIESEL GENERATOR SET

1.0 GENERAL

This section of the specification describes and specifies requirements for the supply, delivery, installation, testing and commissioning of diesel generator set and handing over in approved working order and providing service and maintenance during the Defects Liability Period as specified thereafter for the period stated in the Condition of Contracts.

The set shall comprise a diesel engine directly coupled to a single phase alternator with auxiliary equipment as further described below and shall be capable of maintaining a continuous output of not less than the KVA specified in this Tender at 0.8 lagging power factor, 240 volts, single phase, 2 wire, 50 Hz supply under the operating conditions specified hereafter and within a guaranteed range of frequency and voltage fluctuations after making full allowance for all internal losses and power consumed by ancillaries.

The operating conditions shall be:

(a) Total baromatic pressure : 750 mm Hg.

(b) Air temperature : 40 deg. C

(c) Relative humidity : 95%.

The generator set offered must be approved by Jabatan Kerja Raya, Semenanjung Malaysia for use in Peninsular Malaysia and must be supplied by the supplier registered with Jabatan Kerja Raya, Semenanjung Malaysia. The installation, testing and commissioning shall be strictly in accordance with the recommendations of the registered supplier unless otherwise directed by the S.O.'s Representative.

Both the alternator and the engine must be provided with name plates bearing serial numbers, ratings and other relevant data. In addition, name plate bearing the registered supplier's name and address and date of commissioning shall also be provided.

Tenderer shall submit together with his tender catalogues and literatures describing the generator set, lead acid battery and its charger offered in addition to filling in Appendix A (Schedule of Technical Data and Guarantee) to this specification.

2.0 ENGINE

The engine shall be multi cylinder, vee/in line configuration, 4 stroke, naturally aspirated, air cooled or water cooled with fan and radiator, instant starting and in general compliance with BS 5514 as minimum requirements. Engine speed shall be 1500r.p.m

and capable of producing continuously the service power not less than that required by the alternator for the generation of the specified output under the specified operating conditions. The engine shall be able to withstand an overload of 10% for 1 hour in any period of 12 hours consecutive running.

Engine base mounting shall be fabricated steel channel base frame complete with spring type vibration damper which shall be supplied together with the generator set by the registered supplier.

3.0 **LUBRICATING SYSTEM**

The engine shall be complete with enclosed force-feed lubricating system by gear type oil pump with full flow replaceable paper element type oil filter. Oil pan shall be of the sump type.

4.0 **EXHAUST SYSTEM**

The engine shall be provided with a suitable exhaust system capable of carrying exhaust gases from the engine and dissipate them to the atmosphere as quickly and silently as possible. The piping and fitting shall have minimum thickness of 3 mm and shall be suitably protected from corrosion by application of heat resistant paint.

A suitable flexible connections shall be made between the section of piping fixed to the engine and the piping fixed to the building structure.

The exhaust system shall incorporate an efficient residential type silencer of the absorption-type capable of reducing the exhaust noises of the engine to an acceptable level. Silencer shall be supplied together with the generator set by the registered supplier. Exhaust piping inside the Generator Room shall be fully lagged with minimum 20 mm thick asbestos rope which in turn sheathed with tin foil. Silencer shall be lagged with minimum 35 mm thick fibre glass section. Where the exhaust pipe which passes through the wall, a metal thumble guard shall be installed.

5.0 **RADIATOR AIR DISCHARGE**

Unless otherwise dictated by room design engine radiator discharge air shall be directed outdoors through an approved discharged duct that connects the engine radiator to an opening in an external wall. The duct shall be as short as possible. A length of flexible duct shall be provided between the radiator and the fixed air discharge duct. The Electrical Contractor shall provide an aluminium automatic self- opening and self-closing shutter complete with aluminium frame to be mounted on the wall opening.

The automatic shutter shall be self-closing when the engine is not in operation. When the engine starts the shutter shall be opened outwards by air discharged from the radiator. The automatic shutter system shall be so designed as to keep the noise level to a minimum.

In the case of an air-cooled engine, air discharge ducting system complete with aluminium automatic shutter as above shall be provided.

6.0 **FUEL SYSTEM.**

The engine shall be capable of operating on 'Class A' fuel to B.S 2869. The fuel pump shall be of the gear type complete with governor and throttle and capable of fuel delivery to injectors under all power conditions of the engine. The pump shall be self-adjusting for wear and fuel viscosity. Fuel filter shall be of heavy duty, replaceable and paper element type.

7.0 **ENGINE GOVERNING.**

The governing accuracy of the engine shall be in accordance with B.S. 5514 part 4, 'Class A1'. The speed droop shall be less than 5%.

8.0 **ENGINE INSTRUMENTATION**

The engine shall be complete with all instruments and gauges necessary or desired for its proper operation, service and maintenance. The instruments and gauges shall be of the flush-mounting on the metalclad panel and shall include but not limited to the following:-

(a) Elapsed hours running meter.

(b) Lubricating oil pressure gauge

(c) Cooling water temperature gauge.

(d) Tachometer.

(e) DC ammeter.

(f) DC voltmeter.

9.0 **ALTERNATOR AND EXCITER**

The alternators shall be of screen protected, drip-proof, revolving fields, salient pole type, directly coupled to the

engine and fitted with an exciter to comply in all respects to B.S 4999 and B.S 5000.

Insulation shall conform to B.S 2757 Class 'F'.

The rotor or armature shall be of one piece, four pole type with lamination pressed and keyed to the shaft.

The stator shall be of the multiplicity type for high or low voltages. Damper windings shall be provided in the pole faces.

The alternator shall be continuously rated not less than the manufacturer's rated KVA specified at 0.8 power factor lagging when wound for 240 volts, single phase, 2-wire, 50 Hz supply.

10.0 **VOLTAGE REGULATION**

The voltage regulation shall be of solid state transistor amplified type capable of providing voltage regulation Grade VR 2.21 of B.S 4999 part 40.

The alternator, when driven its rated speed and operating with its normal excitation control system, shall be capable of maintaining the voltage under steady state conditions within + 2.5% of rated voltage for all loads between no-load and rated load at rated power factors. Following transient changes the voltage shall restored to within these limits in less than 10 seconds.

When alternator, driven at rated speed and giving its rated voltage on no load under its normal excitation control system is switched on to a symmetrical load which would absorb 60% of rated current at rated voltage at a power factor between 0.4 and zero lagging, the initial voltage drop shall be limited to 15% of rated voltage and the voltage shall recover to at least 97%

of rated voltage in less than 1.5 seconds. The transient rise in voltage after a sudden rated load rejection at rated power factor and constant speed shall not exceed 20%.

Normal voltage shall be variable by means of voltage trimmer within +5% of rated voltage.

11.0 **VOLTAGE WAVEFORM**

The voltage waveform shall approximate closely to a sine wave both at no load and full load with a lagging power factor of 0.8 and shall not exceed the limits as stated in B.S 4999 part 40.

12.0 **STARTING SYSTEM.**

The engine shall be fitted with electric starting system with a 12/24 volt heavy duty lead acid battery of sufficient capacity to provide a minimum of six (6) successive abortive starts of the engine without recharging. The minimum cranking period for each abortive starts shall be 15 seconds.

The battery shall be connected to the starter motor starting and stopping circuit complete with indicating or signal devices. Capacity of the lead acid battery shall be as recommended by the battery manufacturer for particular make and model of the generator set offered by the Tenderer plus that required to operate the d.c indicating, tripping and control circuits. Proof of this shall be provided by the Tenderer. Battery shall be housed in a rack or crate located beside the generator set and covered on top by a removable wooden cover with sufficient ventilation.

The engine shall be fitted with a DC battery charging alternator of sufficient capacity and rating complete with regulator and cut-off relay. DC ammeters and DC voltmeters shall be provided and included in the engine instrumentation.

The starter motor for the engine shall be automatic type to be controlled by the automatic starting and stopping system.

Furthermore, the engine shall be capable of starting manually from cold without difficulty. Starting handle shall be provided.

In the event of more than one generator sets are installed then each engine shall be provided with its own lead acid battery and

battery charging alternator as above.

13.0 **FUEL SUPPLY SYSTEM**

13.1 **FUEL TANK**

A fuel tank having a capacity for a minimum of 6 hours continuous operation at full load or 1000 litres capacity whichever is larger supported by suitable angle irons to permit gravity feed to the engine pumps, shall be supplied and installed within the Generator Room at a location to be agreed by the S.O.'s representative. The fuel tank shall be fabricated from 2.5 mm thick mild steel sheet construction, not galvanised but painted inside and outside with oil resistant prime and externally finished with undercoat and topcoat.

A dial type level indicator calibrated in litres shall be provided.

A breather is to be provided. The breather opening must be adequate to vent gases and air from the fuel tank without back pressure. The fuel pump suction line shall pick fuel about 30 mm from the bottom of the fuel tank complete with fuel strainer. The fuel return line shall be so located so as to allow separation of the fuel and vapour or gases in the expansion space above the normal fuel level and shall be pointed away from the breather and suction area.

A drain valve complete with padlock shall be provided at a low point in the fuel tank in an accessible location to allow periodic removal of water condensation and sediment.

If more than one generator sets are installed in the Generator Room, a common fuel tank may be used unless otherwise specified. However, the common fuel tank shall be of sufficient capacity, or otherwise specified elsewhere, to run the generator sets simultaneously for a minimum of 6 hours continuous operation at full load.

A full tank of fuel shall be supplied by the Electrical Contractor under this Contract at the time of handing over. Fuel required to carry out all tests including work test and site tests shall be supplied by the Electrical Contractor and shall be additional to the full tank of fuel mentioned above.

13.2 **FUEL TRANSFER SYSTEM**

Fuel transfer system for transferring fuel from drums into the fuel tank shall be supplied and installed. The fuel transfer system shall consist of hand operated pump installed in parallel with an electric motor-driven pump. A filler pipe shall be installed from the inlet point of the fuel tank to the outlet point of the fuel transfer pumps. A suitable length of flexible transparent oil resistant hose shall be connected from the inlet of the fuel pumps for off-loading from drums.

The fuel transfer pumps shall be installed as close to the fuel tank as possible but the exact location shall be decided by the S.O.'s representative on site.

The electric motor driven pump shall be of the self-priming type and shall have sufficient suction lift to deliver a transfer rate of 50 litres per minute. The electric motor driven pump shall be suitable for operation from single phase, 240 V, 50 Hz supply. Wiring in galvanised steel conduit from the electric starter point on nearby wall to the electric motor-driven pump shall be carried out by the Electrical Contractor.

13.3 **FUEL SUPPLY PIPING**

Fuel piping and plumbing shall be of black iron pipe or 'steam' pipe. The diameter of the pipe shall be as recommended by the generator set supplier. Seamless synthetic rubber flexible hose shall be used for connection to the engine fuel inlet and return outlet. Care must be taken to keep the number of bends to a minimum.

Feeding fuel pipe from the fuel tank shall be with a shut-off valves near the fuel tanks for maintenance purposes. Facilities shall be provided to padlock the shut-off valves in open position. The padlock used shall be approved by the S.O.'s Representative. Overflowing fuel from the engine shall be fed back to the fuel tank by means of fuel pipe complete with check valve near the fuel tank.

Keys alike shall be provided for the padlocks used for shut-off valves of the fuel feeding pipe and the padlocks used for drain valves of the fuel tank.

Fuel pipes where required to be distinguished from pipelines of other services shall be brown as a basic identification colour in compliance with B.S 1710.

14.0 **PROTECTIVE DEVICES**

The generator set shall be provided with protective devices to provide warning and automatic shut-down under the following conditions:-

(a)	Low oil pressure	-warning and trip.
(b)	High jacket water temperature	-warning and trip.
(c)	Over speed	-trip
(d)	Low fuel level (1st.stage)	-warning
(e)	Low fuel level (2nd.stage)	-trip.

The low oil pressure warning and shut-down and the high jacket water temperature warning and shut-down protective devices shall be set at the manufacturer's recommended pressures and temperature respectively. The overspeed shut-down protective devices shall also be set at the speed recommended by the manufacturer.

Under any of the above conditions, a common alarm bell of 250 mm diameter installed at the control panel shall sound. In addition, indications lamps showing operation of each engine protective devices shall also be provided.

The Electrical Contractor shall arrange for simulation tests of the above on completion of the generator set erection.

15.0 **CONTROL PANEL**

A generator set control panel housing control switches and buttons, relays, timers, indicating lights, indicating instruments, selector switches, alarms, etc. shall be supplied and installed. The control panel shall be cubicle construction suitable for floor standing fabricated from sheet steel of not less than 2 mm thickness of similar construction as for generator switchboard as described hereinafter.

It shall form part of the generator switchboard which may form part of the main switchboard as indicated in the Drawings.

All control wiring shall be not less than 1.5 sq. mm section insulated with PVC and shall be properly labelled with number sleeves.

The following facilities shall be incorporated as minimum

requirements:-

(a) Indication lamps showing operation of each engine protective devices.

(b) A lamps test button.

(c) Alarm bell indicating operation of each engine protective devices with `Alarm Silence' button.

(d) `Start' and `Stop' push buttons.

(e) Self-latching mushroom head type 'Emergency Stop' button (One to be provided at the control panel and another one in the vicinity of the generator set to be decided on site).

16.0 **GENERATOR SWITCHBOARD**

The generator switchboards shall be of the self-contained cubicle type, free standing floor mounted, metalclad, flush fronted suitable for front and rear access housing switchgear and controlgear, protective relays, meters, indicating lamps, cable terminating boxes, and all other necessary items of equipment whether specified hereinafter or on the Drawings or not, suitable for operation on a 240 V, 1 phase, 2 wire, 50 Hz system with solidly earthed.

Unless otherwise specified elsewhere, the generator switchboards shall be in general compliance with BS 5486 Part 1 and capable of withstanding without damage fault condition of not less than 10 MVA at 240 volts for 1 second.

The frame work of the switchboard shall be fabricated from rolled steel sections and shall be self-supporting when assembled, uniform in height and depth from front to back. The rigid construction shall be designed to withstand without any sag, deformation or warping, the loads likely to be experienced during normal operating, maintenance or maximum fault conditions.

The front shall be provided with covers/doors of box formation.The rear shall be provided with hinged removable doors of box formation. The rear doors shall be of double-leaf type with rebated edges and each leaf should preferably not be wider than 450 mm. Each leaf of door shall have 1 1/2 pairs of approved hinges. The door shall be fitted with approved type of surface- mounted espagnolette or cremone bolts complete with approved locking device operated by a satin chrome lever handle at the centre fixing. The top and sides shall be of removable

panels. All panels, covers and doors shall be fabricated from sheet steel of thickness not less than 2 mm and so constructed as to provide a clear, flush and pleasing appearance. The panels, covers and front doors shall be secured to the enclosure by means of chrome type of screws with cylindrical knurled head complete with retaining clips. Welded cross struts shall not be used.

The generator switchboard shall be dust and vermin proof. All covers and doors shall be provided with grummets and seals to exclude dust and dirt. Louvres shall be provided at the sides and back for adequate ventilation.

The whole cubicle shall undergo de-rusting treatment, followed by anti-rust treatment and with the exterior be finished semi-gloss enamel grey and interior finished matt white.

Busbars shall be tinned hardrawn high conductivity copper of adequate rectangular cross section to carry continuously the rated normal current at a rated frequency of 50 Hz with a temperature rise in accordance with the requirements of BS 159. Busbar sizes shall be as specified in the Drawings. However if not specified, then the busbar rating shall be base on the current density of not more than 1.5 A/sq.mm. Busbars shall be arranged and rigidly mounted on non-hygroscopic insulators so as to withstand any mechanical forces to which they may be subjected under the maximum fault conditions. Where multiple parallel bars are used, they shall be separated by tinned copper spacers at a spacing equals to bar thickness.

The main busbars shall be run for the full length of the generator switchboard without reduction in size and shall be arranged in the horizontal plane and in the order of phase and Neutral from back to front. In each panel, connections shall be the phase and Neutral from left to right, viewed from the front

of the panel. The neutral busbar shall be of full size and full length as that of the phases. Tinned copper earthing bar of 6mm x 25mm cross section shall run to the full length at the base of the generator switchboard.

Busbars shall be identified with standard colour code Red, or Yellow, or Blue, Black and Green at appropriate points to distinguish the phases, neutral and earth respectively.

Connections from busbars to the switchgears shall be effected by means of copper bars or copper insulated conductors and shall be identified by means of coloured plastic sleeving or painting in accordance with the standard colour code. All connections

shall be made up with bronze or other copper alloy bolts and nuts utilizing tension washers on both outer faces.

Precautions shall be taken to prevent overheating through hysteresis and Eddy current losses.

All secondary wiring shall be of not less than 1.5 sq.mm. section insulated with PVC and shall be fixed securely without strain by cleats of the compression type. All secondary wiring shall be properly labelled with number sleeves. Flexible protective conductor of not less than 2.5 sq. mm section insulated with PVC shall be fixed securely between the lids, doors, cover plates etc. with electrical equipment attached to them and the main cubicle to ensure continuity of the protective circuits.

All switchgear, controlgear, indicating and measuring instruments, measuring transformers, protective relays etc. provided shall comply with the relevant specifications stated elsewhere. Overcurrent protective relays with inverse definite minimum time characteristics of induction disc type shall be provided. Instantaneous earth fault protective relay of attracted armature type with current setting from 10% to 40% shall be provided. All protective relays shall be provided with hand reset drop flag indicators.

One number anti-condensation heater shall be installed for every two (2) panels at the generator switchboards. Each heater shall be complete with automatic thermostat, control switch and indicating lamp.

A tools compartment of sufficient size shall be provided at the base of the generator switchboard for storage of tool kit used for the generator set. The door for tools compartment shall be hinged type complete with lockable handle with keys.

Engraved labels with white lettering on a black background made of laminated materials shall be provided and fastened on the front panels of each and every switchgear and items of equipment. Wording shall be clear and coincide and shall be approved by the S.O.'s Reperesentative.

Rubber mat of width 1000 mm and thickness 5 mm shall be provided in front of the generator switchboard. It shall extend to the full length of the generator switchboard.

17.0 **EARTHING SYSTEM**

Independent earthing system shall be provided for each generator set. Earthing to earth Resistance not exceeding one Ohm shall be effected by 3 mm x 25 mm copper tape and 16 mm diameter copper

jacketed steel core rods. The copper jacket shall be of minimum thickness 0.25 mm and shall be permanently bonded to the steel core to ensure that the copper jacket and steel core are not separable. Earth chambers and covers used for earthing rods shall be reinforced concrete type. Each generator set earthing point shall be identified by permanent label legibly marked with the words 'GEN-SET EARTH' permanently fixed to the point of connection of every earthing conductor and the earth electrode.

Four (4) sets of earthing test results duly certified by the Electrical Contractor's chargeman shall be submitted to the S.O.'s Reperesentative before commissioning of the generator set.

18.0 **WORKING DRAWING**

Within three weeks after award of the Tender or such shorter period as may be required by the S.O.'s Representative, the Electrical Contractor shall submit to the S.O.'s Representative, for his approval of the following working drawings:

(a) Details of the layout of the generator set, fuel tank, generator switchboard, foundation, mounting of radiator air discharge duct, fuel piping etc. in the Generator Room provided,

(b) Details of the layout and schematic wiring of the generator switchboard and generator set control panel,

(c) Relative locations of earthing points for the generator set with respect to the Generator Room.

The drawings submitted are to be modified if necessary as requested by the S.O.'s Representative and resubmitted for final approval.

It is to be understood, however, that approval of the drawings will not exonerate the Electrical Contractor from any responsibility in connection with the work.

19.0 **WORKS TEST**

Prior to installation at site the generator set shall be load tested at various percentage of the rated KVA of the generator set offered. The test shall be carried out in the presence of the

S.O.'s Reperesentative or his representatives. During this testing it should have maintained the highest possible standards for voltage regulation, frequency regulation, shock load pick up and other characteristics. The generator set shall be tested at rated power factor for the following loads and periods:-

(a) 50% rated KVA - one hour.

(b) 75% rated KVA - one hour.

(c) 100% rated KVA - three hours.

(d) 110% rated KVA - one hour.

For the purpose of this tests, dummy loads supplied by the Electrical Contractor or supplier may be used. Certified results as per Appendix C (Generator set Test Results) to this specification shall be provided for all readings. Every 15 minute readings of fuel consumption, lubrication oil temperature and pressure, cooling water temperature and engine speed governor trails according to B.S 5514 shall be carried out.

The above tests may be carried out at the workshop of the generator set supplier. However, if the tests are to be carried out outside Peninsular Malaysia, the Electrical Contractor shall bear the cost of food, accommodation, transport and travelling expenses and all Government approved allowances for two Electrical Engineers to witness the tests.

22.0 **COMMISSIONING TEST**

On completion of plant erection, tests on completion shall be carried out. Tests in the generator set shall comprise starting, stopping and running on load. Simulation tests on the operation of the protective device shall also be carried out. All fuel, instruments and labour necessary for the tests shall be provided by the Electrical Contractor. All protective relays shall be tested and calibrated by the TNB or by competent Services Engineer with special right to test electrical equipment issued by Director General of Electrical Supply Department, Malaysia. Four (4) sets of these test results duly certified shall be submitted. The Electrical Contractor shall pay all costs incurred in connection with these tests.

23.0 **SERVICE AND MAINTENANCE**

Under this contract, the Electrical Contractor shall provide and carrying out comprehensive service and maintenance of the generator set, its control panel and the generator switchboard during the Defects Liability period in accordance with Appendix D (Schedule of Services and Maintenance) to this specification as minimum requirement.

The Electrical Contractor shall supply all the consumable materials except the fuel as and when required for the comprehensive service and maintenance of the generator set, its control panel and generator switchboard.

The Electrical Contractor shall provide a service and maintenance record book for each generator set and control panel being serviced and maintained. Details of service, maintenance and repair carried out shall be entered by the Electrical Contractor into this book for checking purposes. The record book shall be kept in the Generator Room.

In addition, a full report in duplicate of each service and maintenance carried out and the condition of the generator set and control panel shall be forwarded to the S.O.'s Reperesentative. This report shall be countersigned by responsible Government Officer of the client department.

24.0 **RECOMMENDED SPARES**

The Tenderer shall complete Appendix D (Schedule of Recommended Spares) to this specification and submit together with his Tender. This Schedule should contain the price and delivery period of each item of the spares recommended. The Tenderer shall also recommend the quantity for each item to be stored for purpose of maintenance. The prices of these shall not be included in the total Tender Price and the purchase of all or any of these spares listed shall be at the option of the S.O.'s Reperesentative. These prices shall be valid for acceptance up to the end of the Defects Liability Period.

All spares shall be properly packed and labelled in a suitable manner to prevent deterioration during prolonged storage in tropical climate.

23.0 **ITEMS TO BE SUPPLIED ON COMPLETION**

23.1 **AS INSTALLED DRAWING**

Within three calender months after the practical completion of the project, One set of true to scale negatives (155/165 gm/sq.m, ISO size AO or A1) and four sets of prints for each of the following drawings shall be submitted:-

(a) Site plan.

(b) Installation of generator set.

(c) Location layout of earthing points with respect to the Generator Room.

(d) Layout and schematic control wiring of the generator set control panel.

(e) Layout and schematic wiring of the generator switchboard.

(f) Any other drawings deemed necessary by the S.O.'s Representative for record and maintenance purposes.

All drawings submitted by the Electrical Contractor shall be properly stencilled and shall have at the lower right hand corner the Electrical Contractor's name and address, date of commissioning, scale, drawing number (to be obtained from S.O.'s Reperesentative), titles and the following particulars:

JABATAN KERJA RAYA
CAWANGAN ELEKTRIK

Contract No: .....
Tender No: .....

Each of the above four sets of prints shall be filled in a stiff cover ring file together with the manuals stated hereinafter.

In addition to the above sets of prints submitted, one set of the following prints shall be framed up in the Generator Room:

(a) Location layout of earthing points with respect to the Generator Room.

(b) Layout and schematic control wiring of the generator set control panel.

(c) Layout and schematic wiring of the generator switchboard.

23.2 **MANUALS**

The Electrical Contractor shall provide four sets of the following manuals and documents for each generator sets installed:

(a) Installation manual

(b) Operation manual

(c) Service and Maintenance Manual

(d) Parts List

(e) Product data and catalogue of equipment

(f) Test certificates and test results

Only original copies of the above manuals and documents shall be accepted. Each of the four sets submitted shall be filed in a stiff cover ring file together with the as-installed drawings.

The following particulars shall be printed on the cover of each file:

(a) Name of project.

(b) Tender Number.

(c) Contract Number.

(d) Name, address and telephone number of the Electrical Contractor.

23.3 **TOOLS**

A complete set of tools comprising of the following item as minimum complete with proper lockable tools kit(s) shall be provided for each generator set installed:

(a) 200 mm adjustable wrench

(b) 165 mm combination pliers

(c) Feeler gauge set (0.10, 0.15, 0.25, 0.30, 0.40 mm)

(d) 125 mm and 200 mm screw drivers

(e) 800 mm ball pein hammer

(f) Combination spanners set (6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 19, 22, 24, 27, 30, 32 mm)

(g) Bihexagon socket set (10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 24, 27, 30, 32 mm)

(h) Reversible ratchet

(i) 125 mm and 250 mm extension bars

(j) Hexagon head allen key set(1.5, 2, 2.5, 3, 4, 5, 6, 8 mm)

(k) Other special tools necessary for normal maintenance of the generator set.

If the generator set is manufactured in Imperial Units then the above shall be supplied in imperial Units.

25.4 **SAFETY SIGNS AND DEVICES**

The following items shall be supplied and installed in the Generator Room:

(a) One no. 9 Kg dry powder fire distinguisher for A,B,C class of fire complete with pressure gauge, discharge hose with nozzle and wall bracket.

(b) One no. shock treatment card.

(c) One No. `BAHAYA' sign.

(d) One No. `DILARANG MASUK' sign.

(e) One No. `DILARANG MEROKOK' sign.

(f) 300 mm x 150 mm `BILIK JANAKUASA' sign.

APPENDIX A
SCHEDULE OF TECHNICAL DATA AND GUARANTEE

(A) DIESEL ENGINE

1)	Make	: .....
2)	Country of manufacture	: .....
3)	Model No.	: .....
4)	No. of cylinders	: .....
5)	Arrangement of cylinders	: .....
6)	No of strokes	: .....
7)	Rated R.P.M.	: .....
8)	Service Power	: .....
9)	Speed Regulation (No load to full load)	: .....
10)	Rotation	: .....
11)	Fuel Consumption	
	i) at full load	: .....
	ii) at 75% load	: .....
	iii) at 75% load	: .....
12)	Type of lubrication oil filter	: .....
13)	Type of fuel filter	: .....
14)	Method of cooling	: .....

APPENDIX A
SCHEDULE OF TECHNICAL DATA AND GUARANTEE

15) Type of vibration dampers : .....

(B) STARTING SYSTEM

1) Starting Equipment : .....

a) Rated KW : .....

b) Rateed voltage : .....

c) Breakaway current : .....

d) Mean cranking current : .....

2) Batteries

a) Make : .....

b) Country of manufacture : .....

c) Type : .....

d) Model No. : .....

e) Battery AH at 5 hourrate : .....

f) Battery voltage : .....

g) Rated voltage per cell : .....

h) Amp on discharge to 0.85 VPC for 90 seconds : .....

i) Amp on discharge to 0.65 VPC for 1 second : .....

APPENDIX A
SCHEDULE OF TECHNICAL DATA AND GUARANTEE

3) DC Battery Charging Alternator

a) Make : .....

b) Country of manufacture : .....

c) Type : .....

d) Rated output voltage : .....

e) System Voltage : .....

f) Rated current : .....

(C) FUEL SUPPLY SYSTEM

1) Fuel Tank : .....

a) Thickness : .....

b) Dimensions (LxWxH) (mm) : .....

c) Capacity (litres) : .....

2) Manual Fuel Transfer Pump

a) Make : .....

b) Country of manufacture : .....

c) Model : .....

3) Electric Fuel Transfer Pump

a) Make : .....

b) Country of manufacture : .....

c) Model : .....

d) Rated Voltage : .....

e) Rated KW : .....

APPENDIX A
SCHEDULE OF TECHNICAL DATA AND GUARANTEE

f) Transfer Rate (litre/min) : .....

(D) ALTERNATOR

1) Make : .....

2) Country of manufacture : .....

3) Model No. : .....

4) Wiring Connection : .....

5) Rated voltage : .....

6) Rated Frequency : .....

7) Rated KVA at 0.8 p.f. : .....

8) Rated current : .....

9) Voltage regulation

i) No load to full load at 0.8 p.f. lagging : .....

ii) No load to full load at unity p.f. : .....

iii) Steady state : .....

10) Insulation Class : .....

APPENDIX A
SCHEDULE OF TECHNICAL DATA AND GUARANTEE

11) Brush or brushless type : .....

12) Automatic Voltage Regulator

a) Make : .....

b) Country of manufacture : .....

c) Type : .....

d) Model : .....

e) Minimum voltage set : .....

f) Maximum voltage set : .....

(E) GENERATOR SWITCHBOARD

1) Manufacture : .....

2) Dimensions (LxWxH) (mm) : .....

3) Thickness od sheet steel used : .....

(F) MISCELLANEOUS

1) Name and Address of Generator Set Supplier : .....

2) Weight of complete generator set (Kg.) : .....

3) Overall dimensions of complete generator set (LxWxH) (mm) : .....

4) Air Circuit Breaker

a) Make : .....

b) Country of manufacture : .....

c) Type : .....

APPENDIX A
SCHEDULE OF TECHNICAL DATA AND GUARANTEE

d) Model : .....

e) Rated voltage : .....

f) Rated Current : .....

g) Short time rating for 1 sec. : .....(KA)

5) Moulded Case Circuit Breaker

a) Make : .....

b) Country of manufacture : .....

c) Type : .....

d) Model : .....

e) Rated voltage : .....

f) Rated Current : .....

g) Rupturing Capacity (KA) : .....

(F) MISCELLANEOUS (contd.)

6) Automatic Changeover Contactor

a) Make : .....

b) Country of manufacture : .....

c) Model : .....

d) Rated voltage : .....

e) Rated Current : .....

f) Frequency : .....

APPENDIX C
SCHEDULE OF SERVICE AND MAINTENANCE

Item	Description	Enery month	6th month	12th month
A	**Lubrication System**			
A.1	Check lubricating oil level, replenish if necessary	*	*	*
A.2	Change lubricating oil filters, half-yearly or 250 hours whichever occur first		*	*
A.3	Check hydraulic governor oil level replenish if necessary		*	*
A.4	Change hydraulic governor oil level 12th month or 1500 hours whichever occur first			*
A.5	Visual inspection for indication of unusual conditions	*	*	*
B	**Fuel System**			

APPENDIX C
SCHEDULE OF SERVICE AND MAINTENANCE

B.1	Check operation of fuel transfer pumps	*	*	*
B.2	Change fuel filters half-yearly or 250 hours whichever occur first		*	*
B.3	Visual inspection for indication of fuel leaks	*	*	*
B.4	Check and clean air intake filters	*	*	*
B.5	Change air intake filters	*	*	*
C	**Cooling System**			
C.1	Check coolant level, replenish if necessary	*	*	*
C.2	Check conditions of hose and connections	*	*	*
C.3	Change coolant and coolant filters		*	*
C.4	Check and clean radiator	*	*	*
C.5	Check conditions of fan belts, tension if necessary	*	*	*

Item	Description	Enery month	6th month	12th month
D	**Electrical System**			
D.1	Check battery electrolyte lvel and specific gravity,replenish if necessary	*	*	*
D.2	Check the condition of the battery charging alternator	*	*	*
E	**Alternator**			
E.1	Check ad clean vent screenss	*	*	*
E.2	Check and grease the bearings		*	*
F	**Generator Set Control Panel**			

APPENDIX D
SCHEDULE OF RECOMENDED SPARES

F.1	Inspect and service the control system, meters, appearance etc.	*	*	*
F.2	Check the indicator lamps, replace if necessary	*	*	*
F.3	Check and test the operation of protective devices for the generator set:	*	*	*

(1) High temperature - warning and trip
(2) Low oil pressure - warning and trip
(3) Overspeed - trip
(4) Low service fuel level (1st stage) - warning
(5) Low service fuel level (2nd stage) - trip
(6) Low bulk storage fuel level - warning

G. **General**

G.1	Run the generator set without load for 30 minutes	*	*	*
G.2	Run the generator set on load	*	*	*

The Tenderer shall submit this Schedule of Spares Recommended by him. The prices for these spares shall not be included in the total Tender Price and the purpose of all or any of the spares listed shall be at the option of the S.O.'s Representative. These prices shall be valid for acceptance up to the end of Defects Liability Period of the project.

Item	Description and Part No.	Quantity	Unit Rate	Price

APPENDIX D
SCHEDULE OF RECOMENDED SPARES

Delivery Period: .....Weeks

Total Price: ==========

Tarikh: .....

.....
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APPENDIX D
SCHEDULE OF RECOMENDED SPARES