ANNEXURE B: GENERATOR TECHNICAL SPECIFICATION

SECTION 1 – GENERAL

1. Intent of Document

The specification is intended to cover the complete installation of the standby generator The minimum equipment requirements are outlined, but do not cover all the details of design and construction. Such details are recognised as being the exclusive responsibility of the contractor.

In all cases where a device or part of the equipment is referred to in the singular, it is intended that such reference shall apply to as many devices as are required to complete the installation.

2. Scope of Work

2.1 **1x 1250KVA** open set generators with changeover panel.
2.2 The existing generators change over including controllers to be upgraded.
2.3 Distribution boards.
2.4 LV cabling.
2.5 LV terminations.
2.6 Earthing.
2.7 Cable ladders.
2.8 Dummy load for on-site testing for all generators
2.9 As built drawings.
2.10 Trenching
2.11 Minor Building works

3. Maintenance and Guarantee

The installation and equipment supplied under this contract shall be guaranteed and maintained for a period of twelve months (12-month guarantee) from the date of acceptance by SABC in all respects and commissioned for continuous service. The bid price shall include the above, which will entail call outs during and after hours.
A separate five-year maintenance and service contract shall be priced separate in the bill and shall commence after the warranty period expires.

4. Relevant Standards and Specifications

4.1 General

4.1.1 All material and equipment supplied and / or installed under this Contract shall be new and of good quality and shall comply with the requirements laid down in the latest editions of the relevant SABS, BS or IEC Specifications and their amendments (if any) and the requirements of this specification. The workmanship and finish of work shall be of high standard throughout and to the satisfaction of the Engineer/SABC.

4.1.2 Before the commencement of manufacture a full set of drawings showing all details of equipment, wiring (single line diagram) and layouts shall be submitted to the Engineer for approval.

4.1.3 All calculations, designs, documentation and drawings shall be submitted to the Engineer prior to the procurement, manufacture or construction of any part of the plant

5. Laws, Regulations and Standards

The work shall be carried out strictly in accordance with the specifications and all material and equipment supplied shall comply with the following laws and regulations where applicable:

The cost of complying with the requirements of this clause shall be deemed to be included in the rates.

5.1 The latest version of the "Code of Practice for the wiring of Premises" SANS 10142-1: 2003 as amended.
5.2 The Occupational Health and Safety Act (No 85 of 1993) as amended.
5.3 The general safety regulations of 1986.
5.4 The construction regulations of 2003.
5.5 The "Electrical Supply By-Laws and Regulations" of the Supply Authority.
5.6 The local Fire Office Regulations.
5.7 The regulations of Telkom.
5.8 Specifications indicated in the detailed generator specification.

5.9 Additional Standardized Specifications

NO	DESCRIPTION	DETAILS
1	Hot-dip (galvanised) zinc coatings heavy duty	SABS 763 – 1988
2	National colour standards for paint	SABS 1091
3	Rotating electrical machines (Parts 1 to 18) (Applicable to low voltage motors)	SABS IEC 60034
4	Electric welded low Carbon steel pipes for aqueous fluids (ordinary duties)	SABS 719
5	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V)	SABS 1507 : 1990
6	The selection, handling and installation of electric power cables of rating not exceeding 33 kV	SABS 0198 Parts 1-12
7	Induction motors Part 2: Low-voltage three-phase standards motors	SABS 1804-2 :2001
8	Induction motors Part 1: IEC requirements	SABS 1804-1 :2001
9	Code of Practice for the wiring of premises	SABS 0142-1 :2006 (SANS 10142-1: 2006)
10	Low voltage switchgear and control gear assemblies Part 1 : Requirements for type-tested and partially type-tested assemblies	SABS 1473-1 (SANS 60439 – 1 : 2004)

NO	DESCRIPTION	DETAILS
11	Safety of distribution boards	SABS 1765
12	Earthing of low-voltage (LV) distribution systems	SABS 0292 :2001
13	Cable standard	SANS 1507 (Part 1-3) Electric cables with extruded solid dielectric insulation
14	Low voltage switchgear and control gear assemblies Part 1: Type-tested and partially type-tested assemblies	SABS IEC 60439-1 :
15	The design and installation of an earth electrode	SABS 0199 :1985
16	Earth rods and couplers	SABS 1063 :1998
17	Low voltage switchgear and control gear assemblies Part 2: Particular requirements for busbar trunking systems (busways)	SABS IEC 60439-2:
18	Low Voltage Switchgear and Control Gear Part 1: General Rules	SABS IEC 60947-1
19	Low Voltage Switchgear and Control Gear Part 2: Circuit Breakers	SABS IEC 60947-2
20	Low Voltage Switchgear and Control Gear Part 3: Switches, disconnectors switch-disconnectors and fuse-combination units	SABS IEC 60947-3
21	Low Voltage Switchgear and Control Gear Part 4: Contactors and motor-starters Section 1: Electromechanical contactors and motor-starters	SABS IEC 60947-4-1
22	Steel, cast iron and copper alloy flanges, tables 10/3, 25/3 or 64/3	BS 4505-1969
23	Specification General requirements for rotating electrical machines. Part 133	BS 4999
24	Specification for Acceptance tests for centrifugal, mixed flow and axial pumps – Part 2. Class B tests	BS 5316
25	Classification of insulating materials	IEC 60085
26	Occupational Health & Safety Act (Act 85 of 1993)	OHS Act

6. Drawings and Documents

6.1 Drawings and Information Provided:

The Engineer shall produce cable schedules and such drawings necessary to adequately document the installation for the Contractor. Three prints of each drawing shall be issued to the Contractor.

6.2 As Built Drawings

The Contractor shall be required to mark up these schedules and drawings with the “as built” information and return one print to the Engineer with all “as built” information entered thereon.

6.3 Information to be submitted by the successful bidder in respect of Control Panels

The successful bidder shall submit three paper prints of each of the following drawings, in respect of the Control Panels to the Engineer for approval prior to manufacture:

6.3.1 Outline and general arrangement drawings, showing main overall dimensions and construction details.
6.3.2 Wiring diagrams.
6.3.3 Schematic line diagrams.

Prints of the following shall be supplied by the successful Bidder in respect of each of the final As Built layouts of the Control Panels:

6.3.4 Outline and general arrangement drawings of the DB’s.
6.3.5 Wiring diagrams
6.3.6 Schematic line diagrams.

Note: Where contradiction occurs between the Detailed Technical Specification and the General Technical Specification, preference shall be given to the Detailed Technical Specification.

SECTION 2 – TECHNICAL INFORMATION

1. Conduit

Galvanised conduit bearing the SANS mark of approval must be used for surface mounting on concrete slab and soffits walling.

2. Cables Specification

2.1 All cables shall have stranded copper conductors and shall be of the PVC/PVC/SWA/PVC type, 600/1000V grade. Cables with aluminium conductors are unacceptable.
2.2 The cables shall be armoured with a single layer of galvanised steel wire.
2.3 All cables shall bear the SANS mark of approval and shall have colour coded PVC insulated conductors.

3. Numbering

The contractor shall fit a cable number at each cable gland. The cable number shall be in accordance with the cable number indicated on the respective cable schedules. The cable numbers shall be equal to the type manufactured by Bowthorpe Hellerman or similar approved.

4. Glands

All cable glands shall be suitable for use in highly corrosive locations and equal or similar to the CCG Posi guard and Posi seal types.

5. Trenches

Cables installed in trenches shall be installed in accordance with the General Technical Requirements. The electrical contractor shall carry out the excavation and backfilling of cable trenches. Cable trenches shall have a minimum depth of 600m.

6. Measurement

Cable quantities given in the Schedule of Quantities and Cable Schedules have been measured against scaled drawings. It is the contractor's responsibility to measure the exact cable lengths before purchasing / installing cables. All cables will be subject to re-measure by the engineer once installed.

7. Installation

All LV cables shall be installed as specified. The installation shall be carefully planned to reduce the number of cable crossings to a minimum.
The following different types of installations shall be employed:

7.1 On cable trays and ladders
7.2 Inside sleeves in excavated cable trenches

8. Laying of cables in trenches

When laying cables in trenches excavated in soft or hard rock or containing sharp stones, rocks or other items most likely to injure cables, the following precautions shall be taken:

8.1 Before laying the cables all rocks, stones, etc shall be removed from the bottom of the trench. The floor of the trench shall be evenly covered with a layer of sifted backfill or sand to a level which is 75mm above the highest unevenness of the trench. The cost of this work shall be included in the contractor's price. The laying of cables shall not be commenced until the trenches have been inspected and approved. The cable shall be removed from the drum in such a way that no twisting, tension or mechanical damage is caused, and must be adequately supported at short intervals during the entire operation. Particular care must be exercised where it is necessary to draw cables through pipes and ducts to avoid abrasion, elongation or distortion of any kind. The ends of such pipes and ducts shall be sealed in an approved manner after drawing in of cables.

8.2 The cable shall be covered with a 150mm layer of sifted backfill of sand. All trenches shall be backfilled with damp soil, in layers not more than 150mm thick. Each layer shall be individually compacted in order to obtain the same degree of permeability as that of the surrounding undisturbed soil.

8.3 A distance of 300mm shall exist between instrumentation and power cable.

*Tenderers are to note that **Pickable Material** shall mean: -*
ground or rock that can be loosened by handpick and includes hard shale, compact ouklip and boulders from 75mm in diameter up to 0.03m² in volume.

9. Laying of cables into existing concrete cable trenches.

New cables installed in concrete cable trenches must be secured to existing cable ladders, and metal covers must be reinstated after cables have been installed.

10. Cable Ladder

10.1 Cable ladders shall be OL76 (2mm thick) Cable Ladder as supplied by O-Line or similar approved. All nuts and bolts must be galvanised.

10.2 Wherever possible all cable racks shall be installed in a vertical orientation to prevent accumulation of spillage and dust. Adequate space being provided behind the rack for the fixing of nuts and cable ties, etc. GTS

10.3 Cable racks shall be fixed to the building structure by means of stand-off galvanised supports at approximately two metre intervals, and also at the ends (joints) of each fabricated length.

10.4 Each run of cable rack shall be bonded across all sections and be electrically continuous throughout. Where the electrical continuity cannot be guaranteed, a continuous bare copper conductor shall be provided for each run of cable tray and each section shall be bonded to this conductor. In addition, all cable racks shall be bonded to the switchboard to which the cables it carries are connected.

10.5 Cables on cable trays and ladders shall be neatly laid on the ladders and strapped to the ladders/trays at 1200mm intervals. A minimum of a half cable diameter space shall be allowed between cables.

11. 400v Motorised Air Circuit Breakers

SABC has standardizing on ABB 400V motorised ACB's. Therefore, the ACB's indicated on drawings must be ABB or similar approved.

12. Existing Electrical Installation

Bidder must note that the existing installation in Mahikeng is in operation 24 hours a day and no interruption of broadcasting services will be allowed. Before any equipment is disconnected and new equipment connected, the contractor will have to obtain acceptable time slots from the SABC.

13. Remote Monitoring System

13.1 The new generator must be equipped with remote monitoring system.
13.2 The system must be able to support multi-set generator system
13.3 The system must provide real time instrumentation & control, event log and automatic system alerts. These must be sent to different users via email and SMS. The system should be viewed on smart phone, tablet or computer.
13.4 Each device can be set to view only or able to control the system remotely.
13.5 The controller should be able to log all the event or changes done by each user.

14. Earthing

The complete Electrical Installation shall be earthed and bonded as required by the Code of Practice

15. Generator Change over Panel

The contractor will be responsible for liaison with the supplier regarding programme, submission of workshop drawings, inspections at the factory, taking delivery, unpacking, placing in position and assembling, where required. Final connections to all Control Panels, testing, preparation of legend cards and commissioning shall be carried out by the contractor.

The fault levels are indicated on the schematic diagram. It is the responsibility of the distribution board manufacturer to select current limiting type circuit breakers and select suitable downstream switchgear to ensure that the fault levels indicated will be achieved.

The Control Panels manufacturers shall ensure that distribution boards are correctly sized in order that they may be fitted within the allocated spaces as indicated on the drawings.

15.1 Battery Charger

15.1.1 The changeover panel shall contain battery charger for charging each of the 24V DC Engine Starting batteries.

15.1.2 Each of the Engine Starting batteries will consist of 2 x 12V DC 200Ah batteries in parallel.

15.1.3 The 24V battery chargers shall be of the fully automatic type and shall consist of an air-cooled transformer, silicon bridge rectifier, fuses and switching arrangement. All equipment shall be suitably rated and designed to automatically deliver a trickle or boost charge as determined by the battery voltage. The boost charge in amps shall not exceed 20% of the rated battery capacity but must not be less than 10Amps.

15.1.4 A constant trickle charge facility is not acceptable. The charger shall switch off automatically when the battery is fully charged.

15.1.5 The charger must be provided with a Voltmeter indicating the battery voltage. This instrument must be mounted on the control panel door.

15.2 Battery Charger

15.2.1 The changeover panel shall contain battery charger for charging each of the 24V DC Engine Starting batteries.

15.2.2 Each of the Engine Starting batteries will consist of 2 x 12V DC 200Ah batteries in parallel.

15.2.3 The 24V battery chargers shall be of the fully automatic type and shall consist of an air-cooled transformer, silicon bridge rectifier, fuses and switching arrangement. All equipment shall be suitably rated and designed to automatically deliver a trickle or boost charge as determined by the battery voltage. The boost charge in amps shall not exceed 20% of the rated battery capacity but must not be less than 10Amps.

15.2.4 A constant trickle charge facility is not acceptable. The charger shall switch off automatically when the battery is fully charged.

15.2.5 The charger must be provided with a Voltmeter indicating the battery voltage. This instrument must be mounted on the control panel door.

15.3 Change Over Panel

15.3.1 The switchboard / control panel must provide for the control, metering and switching of the diesel alternator sets. The switchboard will incorporate all the switchgear, control equipment and load busbars specified.

15.3.2 This section covers the design, manufacture and works testing of a switchboard/control panel for the automatic change over and control of the 400/230V 50Hz diesel generating sets.

15.3.3 Control equipment must provide advanced synchronizing functionality for diesel generating sets that include non-electronic and electronic engines.

15.3.4 Control of the sets will be undertaken by means of Programmable Deep-Sea series 8610 Controllers or similar approved, and the

control system must offer the end user maximum flexibility, reliability and ease of operation.

15.3.5 The hardware of the controllers must comprise inputs and outputs which are galvanically isolated from the C.P.U. (Central Processing Unit) input and output circuits.

15.3.6 The switchboard will consist of a section for each generator, arranged with a Common Control section in the centre of the switchboard and the generator switching and control panels on either side of the Common Control section

15.3.7 The switchboard will be manufactured from 2mm cold rolled sheet steel and will be of folded construction. Each section of the switchboard will be physically separated from adjacent sections and suitable barriers will be provided between control and switchgear sections of each panel.

15.3.8 Prior to epoxy painting, all sheet steel must be thoroughly de-rusted and primed with two coats of zinc chromate etching primer.

15.3.9 All internal chassis plates must be galvanised steel

15.3.10 The panel shall be fully labelled, and a wiring diagram shall be installed in each plant room, mounted on the wall in a wooden frame with removable Perspex protective cover.

16. Sections of the Switchboard

Generator Control and Switching	Control selectors and LCD Display	Control Functions and Equipment
Instrumentation	Front STOP/RESET, MANUAL, AUTO and START push buttons	Monitor under/over generator volts, over current, under/over generator frequency, under speed, over speed, charge fail, emergency stop, low oil pressure, high engine temperature, fail to start, low/high DC battery volts, fail to stop, generator short circuit protection
Generator Volts L1-N, L2-N, L3-N	Electronic engine capability	ROCOF & vector shift
Generator Volts L1-L2, L2-L3, L3-L1	RS485 remote communications	Automatic hours run balancing of generator sets
Generator Amps L1, L2, L3	Back-lit LCD 4-line text display	Dead bus sensing
Generator Frequency Hz	Voltage measurement	Direct communication from the module to the governor and AVR
Generator kVA L1, L2, L3, Total	Configurable inputs number of ports (9)	Volts & frequency matching.
Generator kW L1, L2, L3, Total	Configurable outputs number of ports (5)	Alarm message with SMS.
Generator pf L1, L2, L3, Average	Automatic start	If first generator failed on start-up or during operation the second generator shall start automatically.
Generator kVAr L1, L2, L3, Total	Manual start	KW and KVAr load sharing with multiple generators.
Generator KWh	Audible alarm	Refuel day tank automatically when at 50%, when at 30% send low fuel

Generator Control and Switching	Control selectors and LCD Display	Control Functions and Equipment
		alarm. When level reach 90% refuelling must stop and when at 100% a second stop signal must be sent including full fuel alarm. Day tank fuel gauge to be calibrated on site and tested.
Generator KVAh	LED indicators	
Generator KVArh	Engine history event log	
Generator Phase Sequence	Engine protection	
Synchroscope Display	Configurable alarm timers	
Engine Speed RPM	Configurable start & stop timers	
Engine Oil Pressure	Automatic load transfer	
Engine Temperature	Magnetic pick-up	
Plant Battery Volts	LCD display scroll, lamp test, mute functionality, and breaker control	
Engine Hours Run		
Number of Start Attempts		
Maintenance Display		
Engine ECU diagnostics information via industry standard CAN interface		
Enhanced metering via CAN when connected to an electronic engine		

17. Switchgear

The following switchgear for switching and protection of each generator must be provided:

17.1 Triple-pole draw out type air circuit breaker complete with electronic overload and short circuit protection. This breaker will be suitable for remote electrical operation and will be equipped with a spring charging motor as well as closing and tripping coils.

17.2 Suitable ratio five-amp current transformers.

17.3 Set copper busbars rated for 1,67A per millimetre square operation. The busbars will be identified in phase colours.

The following ABB switchgear for switching and protection of the main incomer must be provided:

17.4 Three-pole draw out type air circuit breaker complete with electronic overload and short circuit protection. This breaker will be suitable for remote electrical operation and will be equipped with a spring charging motor as well as closing and tripping coils.
17.5 Suitable ratio five-amp current transformers.
17.6 Set copper busbars rated for 1,67A per millimetre square operation. The busbars will be painted in phase colours.
17.7 Programmable power meter (KVA, KWH, Kvar, V, I,pf, etc).

The following switchgear for switching and protection of the feeders must be provided:

17.8 Triple-pole draw out type air circuit breaker complete with electronic overload and short circuit protection. This breaker will be suitable for remote electrical operation and will be equipped with a spring charging motor as well as closing and tripping coils.
17.9 Suitable ratio five-amp current transformers.
17.10 Set copper busbars rated for 1,67A per millimetre square operation. The busbars will be painted in phase colours.
17.11 Programmable power meter (KVA, KWH, Kvar, V, I,pf, etc).

17.12 Testing

The control panels must be fully tested and the following control conditions must be simulated:

17.12.1 Automatic Starting and Stopping of the Generators as described in clause 5.
17.12.2 Manual Control of the Generators.
17.12.3 These tests must be witnessed by an SABC representative.

17.13 Standards

The switchboard/control panel will be built to the following standards:

17.13.1 <u>Control Circuit Wiring and Terminals</u>

a. All control wiring will be undertaken in stranded copper conductor having a minimum cross-sectional area of 1,0mm².
b. All control wiring will present a neat appearance and will be suitably braced, placed in trunking, clipped to prevent vibration. Connections to equipment on swing doors will be so arranged to give a twisting motion and not a bending motion to the conductor.
c. All panel and equipment terminals, labels etc., will be completely accessible after the wiring and cabling has been completed.
d. All wires will be marked at both ends with an approved type of marking device identifying the conductor which corresponds to the circuit diagrams. Interlocking type ferrules with permanent

black letters impressed on a white or yellow background will be used.

e. All auxiliary terminals will be accessible from the front of the control board and all terminals will be mounted at a minimum height of 200mm above the gland plate.
f. All terminals will be suitable for use with crimped lugs.
g. Terminal blocks will be made from non-tracking insulating material and have a minimum clearance of 13mm between the connection point and earthed metal. Terminals where pressure is applied to the insulating moulding when tightening the connections will not be used.
h. After completion, the wiring will be tested to withstand a test voltage of 1000V for two minutes.
i. All busbars and cable connections will be pressure tested to withstand a test voltage of 2500V for two minutes.

17.13.2 Fuses

a. All fuses will be of the high breaking capacity type in accordance with IEC/EN60269-1.
b. All fuses will be so connected that the live wire terminal is at the top.
c. Each set of fuses will be provided with an engraved label, fixed to the panel adjacent to the fuses, inscribed with the fuse number and rating.

17.13.3 Instruments

All instruments will comply with the following standard unless otherwise stated.

Instruments	BS89
Instrument scales	BS3693
Indicating electrical instruments	I.E.C.51

17.13.4 Contactors: All contactors will comply with the requirements of I.E.C.947-4-1.

17.13.5 Control Switches

Control switches will be of the rotary action air break type, suitable for controlling alternating or direct current loads.

17.13.6 Control Relays

Control relays will be of the totally enclosed plug-in type with contacts suitable for the current making, carrying and breaking conditions of the associated equipment.

17.13.7 Busbars and Busbar assemblies

In accordance with SABS IEC 60439 and SABS 1473 Part 1, all bus-bar assemblies and mountings must have been tested by the NETFA test facility and the switchboard manufacturer must be approved to manufacture switchboards in accordance with this standard.

Fault Level - The board and its equipment shall be rated to operate on a 400V 3phase 4 wire system having an asymmetrical prospective fault level of 50 kA or as contained in the detailed specification of the Electrical Installation.

18. Generators

18.1 Engines

18.1.1 General

The engine must comply with the requirements as laid down in BS 5514 (ISO 3046), and must be of the atomised injection, compression ignition type, running at a speed not exceeding 1500 r.p.m. The engine must be amply rated for the required electrical output of the set, when running under the site conditions. The starting period for either manual or automatic switching-on until the taking over by the generating set, in one step, of a load equal to the specified site electrical output, shall not exceed 15 seconds. This must be guaranteed by the Bidder.

18.1.2 Rating

The set shall be capable of delivering the specified output continuously under the site conditions, without overheating. The engine shall be capable of delivering an output of 110 % of the specified output for one hour in any period of 12 hours consecutive running in accordance with BS 5514.

18.1.3 De-Rating

The engine must be de-rated for the site conditions as set out in the Specification 1500 metres above sea level.

The de-rating of the engine for site conditions shall be strictly in accordance with BS 5514 of 1977 as amended to date. Any other methods of de-rating must have the approval of the SABC and must be motivated in detail. Such de-rating must be guaranteed in writing and proved by the successful Bidder at the site test.

18.1.4 Starting and Stopping

The engine shall be fitted with an electric starter motor and be easily started from cold, without the use of any special ignition devices under summer as well as winter conditions.

The engine must be fitted with electrical heater to keep the engine warm. The electrical circuit for such heaters shall be taken from the control panel, and must be protected by a suitable circuit breaker.

18.1.5 Starter Battery

The set must be supplied with a fully charged lead-acid type battery, complete with necessary electrolyte. The battery must have sufficient capacity to provide the starting torque stipulated by the engine makers. The battery capacity shall not be less

than 120 Ah and shall be capable of providing five consecutive start attempts from cold and thereafter a six attempt under manual control of not less than 20 seconds duration each. The battery must be of the heavy duty “low maintenance” type, housed in a suitable battery box. An automatic battery charger to be supplied to keep in a fully charged state. The electrical circuit for the battery charger shall be taken from the control panel, and must be protected by a suitable circuit breaker.

18.1.6 Cooling

The engine may be either of the air- or water-cooled type. In the case of water-cooling, a built-on heavy duty, tropical type pressurised radiator must be fitted.

For either method of cooling, protection must be provided against running at excessive temperatures. The operation of this protective device must give a visual and audible indication on the switchboard. Water-cooled engines shall in addition be fitted with low water cut-out and low water warning switches, installed in the radiator, to switch the set off in the event of a loss of coolant. The protection shall operate in the same way as the other cut-outs (e.g. low oil pressure). All air ducts for the cooling of the engine are to be allowed for. The air shall be supplied from the cooling fan cowling/radiator face to air outlet louvers in the plant room wall.

18.1.7 Lubrication

Lubrication of the main bearings and other important moving parts shall be by forced feed system. An automatic low oil pressure cut-out must be fitted, operating the stop solenoid on the engine and giving a visible and audible indication on the switchboard.

18.1.8 Fuel Pump

The fuel injection equipment must be suitable for operation with the commercial brands of diesel fuel normally available in South Africa.

18.1.9 Fuel Tank

A 900L stainless steel fuel tank shall be installed at plant rooms link to the existing underground tank with approved seamless steel pipes from the bulk tank.

Supply and install main pipe from the bulk tank to each day tank including electric solenoid valve and pump for each tank. The piping & pump shall be sized to replenish the day tank while the generator is running at full load.

A water trap shall be fitted in the fuel pipeline from the day tank to the engine.

The tank shall be fitted with a suitable filter, a full height gauge glass, “low fuel level” alarm, giving an audible and visible signal on the switchboard as well as a low-low fuel level cut-out.

An automatic electrically operated pump to refuel the day tank from the main tank shall be fitted.

The fuel lines should not be made of copper as there is a risk of oxidation due to condensation.
The sulphur content in the fuel can also have a negative effect on the copper.

The interconnection fuel piping shall consist of seamless steel pipe and the connection to vibrating components shall be in flexible tubing with armoured covering.

18.1.10 Governor

The speed of the engine shall be controlled by a governor in accordance with class A2 of BS 5514 of 1977 if not otherwise specified in the Technical Specification.

The permanent speed variation between no load and full load shall not exceed 4,5% of the normal engine speed and the temporary speed variation shall not exceed 10%. External facilities must be provided on the engine, to adjust the normal speed setting by ± 5% at all loads zero and rated load.

18.1.11 Flywheel

A suitable flywheel must be fitted, so that lights fed from the set will be free from any visible flicker.

The cyclic irregularity of the set must be within the limit laid down in BS 5514 of 1977.

18.1.12 Exhaust Silencer

It is essential to keep the noise level as low as possible. An effective exhaust silencing system of the residential type must be provided.

The exhaust pipe shall be installed in such a way that the expulsed exhaust fumes will not cause discomfort to the public/employees. The exhaust pipe must be flexibly connected to the engine to take up vibrations transmitted from the engine, which may cause breakage. The exhaust piping and silencer shall be lagged to reduce the heat and noise transmission into the plant room and shall be protected against the ingress of driving rain at 45° to the horizontal. The exhaust pipe must extend 0,5m above the roof gutters. It must be secured by flanges both sides of the wall at the point of exit. These flanges must be clamped to the wall with bolts through the wall.

18.1.13 Accessories

The engine must be supplied complete with all accessories, air and oil filters, 3 instruction manuals, spare parts lists, the first fill of all lubricating oils, fuel, etc.

The engine shall be capable of starting from cold in winter conditions, and should be provided with a dual pre-heating system, separately wired, supplied from both normal and

backup supplies (not smaller than 2kW each), acceptable to the Engineer.

An electronic speed governor of class A1 as stipulated by BS 5514 shall be provided.

The engines shall be rated (prime capacity) to operate at 1,500 metres above sea level (Mahikeng), capable of driving the alternators to the capacity as specified.

18.1.14 Alternators

The alternators shall comply with the requirements of BS 5000, Part 3.

The alternators shall be of the self-excited brushless (Stamford/Leroy) type, capable of supplying the specified output continuously with a temperature rise not exceeding the limits laid down in BS 5000 for rotor and starter windings.

The alternator shall be capable of delivering an output of 110% of the specified output, for one hour in any period of 12 hours consecutive running

The alternators shall be self-regulated, the inherent voltage regulation not exceeding ± 2,5% of the nominal voltage at all loads with the power factor between unity and 0,8, and within the driving speed variations of 4, 5% between no load and full load.

The alternator shall be designed for rapid voltage recovery following sudden application of full load or motor starting currents. The voltage shall recover to within 2,5% of the steady state within 300 Ms following the application of full rated load, with the transient voltage dip not exceeding 18%.

The engine and alternator must be directly coupled by means of a high-quality flexible coupling, equal and similar to the “HOLSET” type.

18.1.15 Plant Ratings

The Standby Plant ratings shall apply under the following load/site conditions:

Power factor	0,8
Altitude above sea level	1500m above sea level
Maximum ambient temperature	30°C averages
Relative humidity at maximum	80% Average

18.1.16 Protection Equipment and Indicators

Provide a start attempt limit, limiting the number of start cycles to six attempts, thereby avoiding the batteries from being run down, should the engine fail to start or should the alternator fail to generate power for any reason.

Provide a speed sensing switch to isolate the starters after the engine has attained speed during the start cycle. In series with the speed sensing switch, provide an oil pressure switch, again

to isolate the starter when the engine oil reaches operational pressure during the starting of the plant.

While the plant is in its stop cycle, the oil pressure switch shall delay engaging of the starters, until the engine has come to rest and the oil pressure has dropped completely. The above switches shall prevent the starters engaging while the engine is still rotating.

Provide engine over and under speed protection with short delay before shutting down the plant.

Provide low and high (adjustable) alternator voltage protection.

Other protective devices shall include:

a. Set not in "auto" mode
b. Single Common Alarm Output but shall have individual potential free contacts for
c. High engine temperature
d. Low battery voltage
e. Start sequence failure alarm
f. Over-speed
g. Under-speed
h. Low fuel level
i. Battery earth fault
j. Generator "Run"
k. Mains failure

The above devices shall operate indicator lamps, sound the alarm and shut down the plant, except as otherwise indicated.

SECTION 3 – SCHEDULES OF TECHNICAL INFORMATION

1. GENERATOR PARAMETERS

The following information shall be supplied in full and in all respects for each plant and shall be submitted together with the bid

1.1 Engine 1250 KVA

NO	ITEM	REMARKS
1.	Manufacturer's Name	
2.	Manufacturer's model No. and year of manufacture	
3.	Continuous sea level rating after allowing for ancillary equipment in kW	
4.	Percentage de-rating for site conditions, in accordance with BS 551.4 a) For altitude b) For temperature c) For humidity d) Total de-rating	
5.	Net output on site in kW	
6.	Nominal speed in r.p.m.	
7.	Number of cylinders	
8.	Fuel consumption of the complete generating set on site in l/h of alternator output at : a) Full load b) ¾ load c) ½ load NOTE : A tolerance of 5% shall be allowed above the stated value of fuel consumption.	
9.	Make of fuel injection system.	
10.	Capacity of fuel tank in litres	
11.	Is gauge glass fitted to tank?	
12.	Is electric pump for filling the fuel tank included?	
13.	Method of starting	
14.	Voltage of starting system	
15.	Method of cooling	
16.	Type of radiator if water-cooled	
17.	Type of heater for warming cylinder heads	

NO	ITEM	REMARKS
18.	Capacity of heater in kW	
19.	Method of protection against high temperature	
20.	Method of protection against low oil pressure	
21.	Type of governor	
22.	Speed variation in % a. Temporary b. Permanent	
23.	Minimum time required for as assumption of full load in seconds	
24.	Recommended interval in running hours for : a. Lubricating oil change b. Oil filter element change c. Decarbonising	
25.	Type of base	
26.	Can plant be placed on solid concrete floor?	
27.	Are all accessories and ducts included?	
28.	Is engine naturally aspirated?	
29.	Are performance curves attached?	
30.	Diameter of exhaust pipe	
31.	Noise level at tail of exhaust pipe in dBA	
32.	BMEP (4 stroke) at continuous rating (kPa)	
33.	% Load acceptance to BS 5514, Part 4, with 10% transient speed drop	

1.2 Alternator (1250KVA)

NO	ITEM	REMARKS
1.	Maker's name and model no.	
2.	Country of Origin and year of manufacture	
3.	Type of enclosure	
4.	Nominal speed in r.p.m.	
5.	Number of bearings	
6.	Terminal voltage	
7.	Sea level rating kVA at 0,8 power factor	
8.	De-rating for site conditions	
9.	Input required in kW	

NO	ITEM	REMARKS
10.	Method of excitation	
11.	Efficiency at 0,8 power factor and: a) Full load b) ¾ load c) ½ load	
12.	Maximum permanent voltage variation in %	
13.	Transient voltage dip on full load	
14.	Voltage recovery on full load application in milli-seconds	
15.	Is alternator brushless?	
16.	Class of insulation of windings	
17.	Is alternator tropicalized?	
18.	Symmetrical short circuit current at terminals in Ampere	
19.	Type of Coupling	

1.3 Switchboard

NO	ITEM	REMARKS
1.	Maker's Name	
2.	Country of Origin	
3.	Is board floor mounted?	
4.	Finish of board	
5.	Make of volt, amp, and frequency meters	
6.	Dial size of meters in mm	
7.	Scale range of voltmeter	
8.	Scale range of ammeters	
9.	Ratio of current transformers	
10.	Make of hour meter	
11.	Range of cyclometer counter	
12.	Smallest unit shown on counter (Item 11)	
13.	Make/ Manufacturer of circuit breaker	
14.	Type of circuit breaker	
15.	Rating of circuit breaker in Amp and fault level in kA	
16.	Setting range of overload trips	
17.	Setting range of instantaneous trips	
18.	Make of change-over equipment	
19.	Make of voltage relay	

NO	ITEM	REMARKS
20.	Is control and protection equipment mounted on a small removable panel?	
21.	Type of control equipment	
22.	Make of mains isolator	
23.	Type of indicators for protective devices	
24.	Is battery charging	
25.	Are volt- and ammeters provided for charging circuit?	
26.	Is the alarm hooter of the continuous duty type?	
27.	Rating in Amps of : a. Change-over equipment b. Mains on load isolator c. By-pass switch d. Circuit breaker to outgoing feed	
28.	Is manufacture of switchboard/control panel to be sub-let?	
29.	If yes, state name and address of specialist manufacturer	

1.4 Battery

NO	ITEM	REMARKS
1.	Maker's Name	
2.	Country of Origin	
3.	Type of battery	
4.	Voltage of battery	
5.	Number of cells	
6.	Capacity in cold crank amp	

1.5 Dimensions 1250KVA Generator set

NO	ITEM	REMARKS
1.	Overall dimensions of set in mm	
2.	Overall mass	
3.	Is the generator room adequate for the installation of the set?	

1.6 Spare Parts and Maintenance Facilities

NO	ITEM	REMARKS
1	Approximate value of spares carried in stock for this particular diesel engine and alternator	

2	Where are these spares held in stock	
3	What facilities exist for the servicing of the equipment offered	
4	Where are these facilities available	

1.7 Warranty

NO	ITEM	REMARKS
1	12 months warranty on delivery of generator set.	
2	12 months warranty after commissioning and acceptance of generator set by client.	
3	Any other warranties please state.	

1.8 Delivery

NO	ITEM	REMARKS
1	Delivery period in weeks	