

# PART 2

GENERAL GENERATOR TENDER  
SPECIFICATION



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# 2 PART A – STANDBY DIESEL GENERATOR

## 2.1 GENERAL

- 2.1.1 The specification covers the supply, delivery, complete installation and commissioning on site in full working order of the complete standby plant (standby diesel generators & fuel system, and bulk fuel storage tanks where specified).
- 2.1.2 Full particulars, performance curves and illustrations of the equipment offered must be submitted with the tender. Tenderers may quote for their standard equipment complying with the specification and any deviation from the specification must be fully detailed.
- 2.1.3 All generator sets shall be fully automatic i.e., shall start when any one phase of the mains supply fails and shall shut down when normal supply is re-established. The generator sets shall be capable of delivering the specified output continuously under the site conditions without overheating.
- 2.1.4 The client will provide a plant room for open sets or a concrete slab for enclosed sets as shown on the drawings included in the detailed specification.
- 2.1.5 Tenderers must confirm that the space is sufficient for the installation of the generator set, fuel tank and the control board and shall indicate the proposed layout of their equipment on the site plan.
- 2.1.6 The tenderer must furnish a detailed description and illustration of the equipment offered and must complete the technical schedules as indicated in Part 3: Project Specific Specification.
- 2.1.7 Failure to submit any of the information asked for may disqualify the tenderer.
- 2.1.8 In the absence of a compulsory site visit, the tenderer shall ensure that they have satisfied themselves of the prevailing site conditions. No claims in this regard will be entertained.
- 2.1.9 The tenderer will allow for any items not specifically mentioned in the BOQ, but which are obviously required for the successful completion of the job.
- 2.1.10 Where a serious omission is noted by the Contractor, they will communicate their concerns to the Engineer as soon as they become aware of such an omission.
- 2.1.11 Where a Contractor intends to deviate from this specification, they will communicate their intention to the Engineer. Such deviation will only be allowed at the discretion of the Engineer. Where no such notice of deviation is received from the tenderer, it will be assumed that their offer meets all requirements of this specification.
- 2.1.12 The complete Generator Installation shall satisfy all National and Local Laws, Standards and By-Laws as applicable to the area where the installation is to take place.
- 2.1.13 The installation shall be carried out in strict accordance with the current Rules and Regulations of OHSA Act 85 and the local Fire Regulations.
- 2.1.14 An Electrical Certificate of Compliance (COC) shall be issued by the Contractor upon completion of their work.
- 2.1.15 Where the installation is in a hazardous environment, all relevant SANS codes shall apply. The Contractor will be provided with the relevant Hazardous Area Classification by the Engineer. They will ensure that they install equipment that is correctly rated for the area.
- 2.1.16 Equipment shall be installed so as to ensure that:
- Inspection, Maintenance, Cleaning & Replacement is Easy to Perform & at Minimum Cost
  - Safe Operation Under Site Conditions is Ensured

- 2.1.17 All Client enforced safety standards shall at all times be observed and adhered to by the Contractor. All site personnel will be required to attend the Client's safety induction training. The Contractor will accordingly provide for this in their submission.
- 2.1.18 Where a Contractor is barred from site by the Client appointed safety personnel, no claim for standing time will be entertained.
- 2.1.19 The Contractor will at all times maintain and keep up to date a safety file and present it on demand, for inspection, to the Engineer or the Client's Safety Officer.

## **2.2 INSTALLATION**

- 2.2.1 Except for those items specifically excluded, tenderers must include for the complete installation and wiring of the plant in running order.

## **2.3 WARNING NOTICES**

- 2.3.1 Tenderers must include in their tender for all notices that are required under the safety acts applicable to the area in which the installation is carried out.

## **2.4 DRAWINGS**

- 2.4.1 The successful tenderer must, within two weeks after receipt of an order submit detailed drawings and wiring diagrams of the plant and switchgear.

## **2.5 GUARANTEE**

- 2.5.1 The successful tenderer will be required to guarantee the complete plant for a period of 12 months from the date it has been taken over by the client in running order.
- 2.5.2 If during this period the plant is not in working order or not working satisfactorily owing to faulty material, design or workmanship, the contractor will be notified and immediate steps shall be taken by them to rectify the defects and/ or replace the affected parts on site, at their own expense.

## **2.6 OPERATIONAL INSTRUCTION**

- 2.6.1 After completion of the installation and when the plant is in running order, the successful tenderer will be required to instruct an attendant in the operation of the plant, until they are fully conversant with the equipment and handling thereof.

## **2.7 TESTS**

- 2.7.1 Factory Acceptance Tests (FAT) are to be carried out at the supplier's premises, before the generating set is delivered to site, at which time a representative of the client will be present to ensure that the generator set complies with the specification and delivers the specified output. As such the supplier must arrange a load bank rated at 110% of the Generator output.
- 2.7.2 Site Acceptance Test (SAT) are to be carried out once the supplier has completed, tested and fully commissioned the standby plant, at which time a representative of the client will be present to witness the SAT and sign off acceptance. The SAT will include a full mains failure test.
- 2.7.3 The supplier must allow for the diesel required to complete all pre-testing, commissioning, FAT and SAT.

## 2.8 ENGINE

- 2.8.1 The engine must comply with the requirements laid down in SANS 8528 and must be of a solid injection, compression ignition type, running at a speed not exceeding 1500rpm. The engine must be amply rated for the required electrical output of the set, when running under the site conditions.
- 2.8.2 The starting period for either manual or automatic switching on until taking over the specified load by the generating set shall not exceed 10 seconds. The tenderer shall specify the initial one-step load capability of the generating set.
- 2.8.3 The engine shall be capable of delivering an output of 110% of specified output for one hour in any period of 12 hours consecutive running, in accordance with SANS 8528.
- 2.8.4 Curves furnished by the engine maker, showing the output of the engine offered against the speed, for both intermittent and continuous operation, as well as fuel consumption figures must be submitted with the tender.
- 2.8.5 Engines shall be of the multi-cylinder, compression ignition type, water-cooled, naturally aspirated or turbocharged, cold starting, rated for continuous heavy-duty operation and having overload capacity of overcome transient heavy motor starting as specified.
- 2.8.6 Engine speed shall be 1500 rpm. A reduction gearbox shall not be used.
- 2.8.7 The cylinders shall be fitted with interchangeable liners and carried in individual galvanised water jackets.
- 2.8.8 The engine shall be fitted with replaceable valve seat inserts and valve guides made of suitable material.
- 2.8.9 The engine installation shall be of neat appearance and all water, lubrication oil and diesel oil lines, filters and stopcocks shall be leak free.
- 2.8.10 All engine flexible or rigid piping, which is not heat resistant, shall be adequately protected against damage by radiant heat. Engine wiring shall be silicon rubber insulated, and moving parts must be well protected.

### LUBRICATION

- 2.8.11 Lubrication of the main bearings and other important moving parts shall be a force-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.
- 2.8.12 Full flow fine filters with replaceable elements capable of 250 hours running without attention shall be fitted and arranged for easy access and maintenance.
- 2.8.13 An oil pressure gauge shall be fitted. Separate sensors for the oil pressure gauge and low oil pressure cut out system shall be fitted.
- 2.8.14 Recommended oil types shall be indicated on the engine by means of suitable labels.

### FUEL SYSTEM

- 2.8.15 The fuel injection equipment must be suitable for operation with commercial brands of diesel fuel normally available in the country [max. 500ppm].
- 2.8.16 The electronic governor controlled fuel injection pump(s) and injectors shall be arranged for easy access and maintenance. An engine mounted fuel feed (lift) pump shall be fitted.
- 2.8.17 A micro filter with replaceable elements suitable for the full flow rate of the injection pump(s) and rated for 500 hours running time without attention, shall be fitted between the lift and injection pump(s) and shall be arranged for easy access and maintenance.
- 2.8.18 An additional heavy-duty primary filter (sludge filter) of the washable screen mesh type shall be fitted in the fuel line between the fuel tank and lift pump. The filter bowl shall serve as a water trap. Interconnecting fuel piping shall be copper and shall be neatly run from the sludge filter to the other parts of the fuel system.
- 2.8.19 All piping shall be securely fixed by means of saddles and clamps.

- 2.8.20 The Sub-Contractor shall allow for all inter connecting fuel piping between the Bulk fuel tank and the header tanks in the Plant room. The header tank, pumps and all inter connecting piping will form part of this Contract.

#### **COOLING**

- 2.8.21 The engine must be a water-cooled type, with a built-on heavy duty, tropical type radiator.
- 2.8.22 All air ducts for the cooling of the engine are to be allowed for. The air shall not be allowed to re-circulate in the plant room and an air duct shall be supplied from the radiator face to discharge louvres in the plant room wall.

#### **GOVERNOR**

- 2.8.23 The speed of the engine shall be controlled by a governor in accordance with SANS 8528 if not otherwise specified in the detail specification. When the initial one-step load is suddenly switched on or full load off the temporary speed variation shall not exceed 10%. The permanent speed variation shall not exceed 1% of nominal engine speed. The governor shall be electronic.

#### **DERATING**

- 2.8.24 The engine must be derated for the site conditions as set out in the detail specification.
- 2.8.25 The derating of the engine shall be in accordance with the engine manufacturers derating curves. Copies of these derating curves or tables must be included with the tender response.

#### **AIR FILTERS**

- 2.8.26 The engine shall be fitted with high efficiency cartridge type air filters suitable for 500 hours running without attention. The filters shall be complete with differential pressure service indicators.

#### **STARTING AND STOPPING**

- 2.8.27 The engine shall be easily started from cold, without the use of any special ignition devices, under summer as well as winter conditions.
- 2.8.28 Tenderers must state what arrangements are provided to ensure easy starting in cold weather.
- 2.8.29 The electrical circuits for heaters shall be taken from the control panel and must be protected by a suitably circuit breaker.
- 2.8.30 Besides the automatic starting and stopping, provision must be made on the control board for manual starting and stopping of the set.
- 2.8.31 The automatic control shall make provision for three consecutive starting attempts of 10 seconds with 10-second intervals. Thereafter the set must be switched off and the start failure relay on the switchboard must give a visible and audible indication of the fault.

#### **STARTER BATTERY**

- 2.8.32 The set must be supplied with a new fully charged maintenance free lead-calcium type battery, or suitable alternative. Lead-acid batteries will not be considered.
- 2.8.33 The battery must have sufficient capacity to provide the starting torque stipulated by the engine manufacturer, and for at least six consecutive starting attempts. The battery must be housed on a suitable acid resistant tray or stand. Battery terminals shall not be easily accessible by non-technical personnel.

#### **EXHAUST SYSTEMS**

- 2.8.34 Exhaust systems, to suit the layout of the plant room as shown on the drawings shall be supplied and installed. These systems shall be designed for "Residential areas" to limit the exhaust noise and air pollution to a minimum.

- 2.8.35 An effective exhaust silencing system of the residential type is to be provided to limit the noise level to approximately 65dBA @ 7 metres from the exhaust outlet or as specified in the detailed specification.
- 2.8.36 The exhaust pipe must be flexibly connected to the engine to take up vibrations transmitted from the engine, which may cause breakage. The exhaust pipe and silencer inside the plant room must be lagged to reduce heat and noise transmission.
- 2.8.37 The Sub-Contractor shall include the necessary high and low frequency exhaust silencers, piping, expansion pieces, rain-caps, supports etc., to complete the installation in its entirety. Special care shall be taken to avoid the blackening of the façade.
- 2.8.38 The system components within the confines of the plant room and ventilation shaft shall be effectively lagged and clad with an approved material to reduce the amount of heat dissipated into the plant room to a minimum.
- 2.8.39 The exhaust pipes shall terminate in accordance with the requirements of the local authority. The route to be followed by the exhaust pipes is shown on the drawings.

## **2.9 ALTERNATOR**

- 2.9.1 The alternator shall be of the self-excited brushless type, with enclosed drip-proof housing, and must be capable of supplying the specified output continuously with a temperature rise not exceeding class H as laid down in SANS 8528 part 3 for rotor and stator windings. The alternator shall be capable of delivering 110% of the specified output for one hour in any period of 12 hours consecutive running. Windings shall be fully impregnated for tropical climate and must have an oil resistant finishing varnish.

### **ALTERNATOR PROTECTION**

- 2.9.2 On the switchboard, a multi-pole circuit breaker with instantaneous short circuit trips and thermal overload trips must be installed for protection of the alternator against short circuit and overload.

### **REGULATION**

- 2.9.3 The steady state voltage regulation must not exceed  $\pm 1\%$  of nominal voltage specified between no load and full load with the power factor between unity and 0.8 lagging and within the driving speed variation of 4.5% between no load and full load.

### **PERFORMANCE**

- 2.9.4 Following the application of 70% of full load or the initial one step load capability of the engine, the transient voltage shall not exceed 15% and will recover to the nominal voltage within 500ms.
- 2.9.5 The excitation system shall be designed to promote rapid voltage recovery following the sudden application of the load. The voltage shall recover to within 2½% of the steady state within 300 milliseconds following and application of full load and the transient voltage dip shall not exceed 15%.

### **OUTPUT VOLTAGE**

- 2.9.6 The set shall have a site output as set out in the detail specification.

## **2.10 OPERATION SELECTOR**

- 2.10.1 A four-position selector must be provided on the control panel marked “AUTO”, “MANUAL”, “TEST” and “OFF”.
- 2.10.2 With the selector on “AUTO”, the set shall automatically start and stop according to mains supply being available or not.

- 2.10.3 With the selector on “TEST”, it shall be possible to start and stop the set with the push buttons but the running set shall **not** be switched to the load, UNLESS the mains supply fails during this test, in which case the set will be switched to the load.
- 2.10.4 With the selector on “MANUAL”, the set must take load when started with the push button, but it must not be possible to switch the set onto the mains or the mains onto the running set.
- 2.10.5 With the selector on ”OFF”, the set shall be completely disconnected from automatic and manual controls for cleaning and maintenance of the engine.

## 2.11 BY PASS SWITCH AND COMBINED MAINS ISOLATOR

- 2.11.1 Refer to PART 3 – Project Specific Specification to see if this is required.
- 2.11.2 The switchboard must be equipped with a manually operated on-load by-pass switch, which shall either connect the incoming mains to the automatic control gear or directly to the outgoing feeder. In the latter position the automatic control gear, including the changeover gear, shall be isolated for maintenance purposes.
- 2.11.3 It is required that the bypass switch isolator be mechanically isolated from the automatic control gear preferably in the lower portion of the switchboard cubicle.

## 2.12 BATTERY CHARGING

- 2.12.1 Whilst the set is stationary, the engine battery shall be charged via a battery charger mounted in the Control Panel.
- 2.12.2 The charger shall be suitable for the AC mains with a maximum voltage variation of approximately 10% and a maximum frequency deviation of approximately 3 Hz.
- 2.12.3 The charger shall be of the constant voltage type with current limiting facilities. Output voltage shall be kept within 1% of the float charge voltage designed for maximum charge conservation and maximum life of battery. The charger shall be suitably sized to supply any standing load on the battery plus a charging current, which will recharge a fully discharged battery in less than 8 hours.
- 2.12.4 The ripple content in the output of the charger shall be less than 2%.
- 2.12.5 The battery charger shall be equipped with the following additional equipment:
  - Mains input isolator and fuse in the AC input supply.
  - HRC fuse in DC positive output lead of the charger.
  - One flush mounted voltmeter for indication of battery voltage.
  - One ammeter for indication of battery charging current.
- 2.12.6 A low voltage alarm with a two-second time delay and visible indication. The low voltage alarm shall activate the hooter.
- 2.12.7 If auxiliary batteries are supplied for the control equipment, the auxiliary charger shall comply with the above.
- 2.12.8 An engine driven alternator must be provided for charging the battery during operation of the set.

## 2.13 STARTING AND STOPPING DELAY

- 2.13.1 When the utility supply is interrupted on one or all phases, the voltage sensors shall initiate the starting cycle. A 0–15 second adjustable start delay timer shall be provided to prevent start up on short power interruptions.

- 2.13.2 A stop delay timer is required to keep the set running for a period of 0–5 minutes, adjustable, after the main supply returns. After changing back to the utility supply a 0–5 minute timer shall be provided to keep the set running for a cooling down period at no load before stopping.

## 2.14 SYSTEM OPERATION (AMF OPERATION ONLY)

- 2.14.1 The system shall automatically start up and initiate the changeover following mains failure and shall reverse the changeover on the restoration of the mains power, and shall shut down the set automatically.
- 2.14.2 An adjustable timer of 0 to 60 seconds (set at 15 seconds) to adjust the time between mains failure and the initiation of the start-up cycle shall be provided.
- 2.14.3 If the mains should be restored during the preset time delay, the start-up cycle shall not proceed.
- 2.14.4 A Start Process Timer shall initiate the starting of the engine after the required time delay following mains failure. The timer shall initiate three starting attempts of approximately 15 seconds each.
- 2.14.5 After three unsuccessful starting attempts, the "Start Failure" alarm shall be initiated.
- 2.14.6 After voltage build up, the changeover contactor to the generator supply shall be activated.
- 2.14.7 Upon restoration of mains supply, an adjustable timer of 0 60 seconds (set at 15 seconds) shall be activated. If at the preset time delay, the mains power is still present the changeover contactor shall connect the mains supply to the outgoing circuits.
- 2.14.8 Should one or more the engine protective devices become operative and shut the engine down, the automatic restoration of mains supply shall nonetheless take place when the mains supply returns. To prevent hunting of the contactors the restoration of the changeover contactor shall be initiated after the protective device has operated and shut the engine down.
- 2.14.9 The control equipment shall be battery operated, either from the engine starting battery or from auxiliary batteries.
- 2.14.10 The control equipment shall be designed to operate satisfactorily under both battery boost charge conditions and a partially discharged battery after 3 starting attempts with the charger supply disconnected.
- 2.14.11 The control system shall be capable of sending SMS and Email notifications to preset cellular phones and email addresses in the event of startup.
- 2.14.12 A time-stamped event log for all generator operations shall be accessible via the substation HMI (to be provided) and a web-portal, either in ACSA's intranet or the generator manufacturer website.

## 2.15 MAINS FAIL SIMULATION KEY SWITCH

- 2.15.1 A main supply failure simulation key switch with TEST and NORMAL positions must be installed in the switchboard. In the TEST position, the set must be operated as if mains had failed, i.e. start and take load.

## 2.16 COUPLING

- 2.16.1 The engine and alternator must be directly coupled by means of a high quality flexible coupling for double bearing alternators or a flexible plate supplied by the alternator manufacturer in the case of single bearing alternators.

## 2.17 FUEL TANK

- 2.17.1 The tank shall have sufficient capacity to run the engine on full load for a **period of 48 hours**. A 110% catch tank shall be installed under the fuel tank if floor standing or as required by local authorities.

- 2.17.2 The tank shall be fitted with a suitable filter, a full height protected sight glass calibrated in percentage, shut off valve and low-level alarm at 30%, giving an audible and visible signal on the switchboard, via an HMI interface.
- 2.17.3 For sets rated at more than 100kVA, an electrically operated pump with a suitable length of oil resistant hose must be supplied, for filling the fuel tank from 200 litre drums or as required by the detailed specification. For smaller sets, a manually operated wing pump is to be supplied.
- 2.17.4 The inter-connecting fuel piping shall consist of black steel and connection to vibrating components shall be flexible tubing. A water trap shall be provided in the fuel pipeline between the tank and engine. A drain valve must be fitted to the underside of the fuel tank.

**NOTE:**

~~Refer to Project Specific Specification (PART 2) to confirm if Bulk Fuel tanks apply.~~

## 2.18 BASE FRAME

- 2.18.1 The engine and the alternator of the set shall be built together on a common base-frame, of simplex/duplex type. For set mounted panels a Duplex frame will be preferred, consisting of a heavy-duty inner frame on which the alternator and engine are secured with an outer floor-standing frame between which purpose made anti-vibration mountings in "V" formation is mounted. The Panel will be mounted on the floor-standing frame. The Simplex type base frame will consist of a heavy-duty steel frame on which the alternator and engine are securely fitted with floor standing spring type anti-vibration mountings. The set must be placed directly on the concrete floor / plinth. A drip tray must be fitted under the engine. The tray must be large enough to catch a drip from any part of the engine.

## 2.19 SWITCHBOARD

- 2.19.1 A switchboard must be supplied for the set and is to incorporate all equipment necessary for control and protection of the generating set, the automatic change over, battery charging equipment and fuel management system.
- 2.19.2 The switchboard shall be a totally enclosed unit and shall consist of steel panels, and shall be vermin and dust proof.
- 2.19.3 The switchboard shall consist of a power section and control panels housed in physically separated compartments.
- 2.19.4 The steelwork of the boards must be thoroughly de-rusted, primed with zinc chromate and finished with two coats of signal red enamel or baked epoxy powder coating.
- 2.19.5 Suitable rated terminals must be provided for all circuits. Where cable lugs are used, these shall be crimped. Screwed terminals shall prevent spreading of the strands.
- 2.19.6 All equipment, connections and terminals shall be easily accessible. The front panels shall be hinged and fixed in position by BARKER NELSON or similar catches. A chromium plated handle with lock shall be fitted to the front panel.
- 2.19.7 All wiring shall have each wire fitted with a cable or wire marker of approved type and the numbering of these markers must be shown on a wiring diagram of the switchboard.
- 2.19.8 The automatic control and protection control equipment shall be mounted on a separate easily replaceable small panel freely available in R.S.A. The automatic control shall be microprocessor based and shall be programmable, unless otherwise specified. The manufacturer shall guarantee the availability of compatible exchange control units for at least 10 years.
- 2.19.9 All equipment on the switchboard, such as contactors, isolators, busbars, etc. shall have ample current carrying capacity to handle at least 110% of continuous full load alternator current without overheating.
- 2.19.10 Wiring between hinged panels shall be in flexible lumes.

- 2.19.11 Special attention shall be paid to complete and correct labelling of all equipment. Suitable engraved "IVORENE" or similar plates with white letters against a black background shall be used and shall be fixed by means of brass bolts and nuts. Self-tapping screws or glue will not be accepted. All equipment mounted either internally or externally shall be suitably labelled.
- 2.19.12 Where equipment is mounted close together such as single pole circuit breakers or instrument fuses; they may be designated by a number and described on a chart mounted inside the board behind a transparent protective cover.
- 2.19.13 The colour of insulated conductors supplying AC power to any equipment shall correspond with the phase colour of the supply and black for the neutral. All other conductors shall be wired according to a consistent colour code different from the AC power, to identify the function. These codes shall be clearly indicated on the wiring diagrams.
- 2.19.14 Cable gland support brackets shall be fitted at the bottom of the switchboard not less than 300mm above the room floor level for all incoming and outgoing power cables.
- 2.19.15 Busbars where applicable, shall be solid copper of sufficient cross section to carry the currents in the various sections of the switchboard with a maximum density of 1.3 A/mm<sup>2</sup>. The neutral busbar shall have the same cross sectional area as the phase busbars. Busbars shall be covered with heat shrinkable material coloured according to the phase colours.
- 2.19.16 The rating and fixing of the busbars shall be capable of withstanding fault currents of at least 30kA (unless otherwise specified). Complete drawings of the switchboard showing equipment layout, circuit diagrams and mechanical details shall be prepared and submitted in triplicate for approval prior to manufacture.
- 2.19.17 Upon completion of the switchboard and control system, the Engineer shall be informed so that they may inspect the switchboard in the factory prior to dispatch.
- 2.19.18 All sundries necessary for erection and commissioning of the board shall be supplied under this Contract.
- 2.19.19 The main outgoing air circuit breakers in the control panels shall be fully compatible (with regards to closing time, protection, etc.) with the synchronising equipment as specified in Part 3 or as indicated on the drawings. The Sub-Contractor shall provide complete details of the air circuit breakers offered.

#### **AIR CIRCUIT BREAKERS**

- 2.19.20 The air circuit breakers to be supplied as part of the Contract shall conform to the general requirements as listed below:
- 2.19.21 The circuit breakers shall be metal clad and shall comply with BS 4752 and IEC 157.
- 2.19.22 The circuit breaker shall be horizontally withdrawable and shall be a self-contained unit of the dead front type, allowing maintenance and tests to be carried out without having to remove the circuit breakers from the withdrawal mechanism.
- 2.19.23 The unit shall contain the necessary mechanical interlocks to prevent:
- Access to "LIVE" terminals when the circuit breaker is withdrawn.
  - The withdrawal or insertion of the unit, when the circuit breaker is in the closed position.
  - Closing of the circuit breaker following an automatic trip condition without resetting the mechanism.
- 2.19.24 Adjustable thermal overload releases shall be provided to suit the required current range. In addition, instantaneous magnetic short circuit trips, which are adjustable, shall be fitted. The tripping devices shall be direct acting. The delay adjustment shall be bypassed with an instantaneous making current release when the circuit breaker is closed to prevent the delay timer from operating when the circuit breaker is closed on a fault.
- 2.19.25 The air circuit breakers shall be of the quick make and quick break type with a stored energy spring assisted operating mechanism provided with:

- A trip free mechanical hand operated closing mechanism.
- A manually operated mechanical trip mechanism suitably protected to prevent inadvertent tripping.
- A positively driven mechanical device to provide ON/OFF/TRIP indication. This indication shall be clearly visible with the circuit breaker in position.

- 2.19.26 Provision shall exist for the addition, if required, of a supply side under voltage release.
- 2.19.27 The complete circuit breaker and its electrical and mechanical constituents and accessories shall be from a standard product range of a single original supplier.
- 2.19.28 A description and illustration of the circuit breaker as well as trip curves, operating manuals and rupturing test certificates shall be provided.
- 2.19.29 Circuit breakers shall be derated if necessary to compensate for the following environmental factors:
- Maximum ambient air temperature in excess of 40°C or the daily average ambient air temperature in excess of 30°C. This is especially important with regard to the type of enclosure in which the circuit breaker is to be installed.
  - Height above sea level.
  - Operational duty cycle and estimated loading.
- 2.19.30 The Sub-Contractor shall state the type and operating characteristics of air circuit breakers offered.
- 2.19.31 In addition, the Sub-Contractor shall state operating characteristics required of air circuit breakers which will be supplied and installed under the electrical contract, as far as they will be affected by the automatic controls initiated by the generator control system.

#### **EARTHING**

- 2.19.32 A solid copper earth bar of at least 40mm x 10mm shall be fitted in the switchboards to which all non-current carrying metal parts of the switchboard shall be bonded.
- 2.19.33 The neutral point of the system must be solidly connected to this bar. Suitable terminals must be provided on the earth bar for connection of the main earth conductors, which will be supplied and installed by others or as specified in the detailed specification.
- 2.19.34 The outer casing of the alternator, the engine and all parts of the base frame shall also be earthed to this bar.
- 2.19.35 The star point (neutral) of the generator shall be earthed to the earth bar.
- 2.19.36 The size of the earth conductors shall comply with the Code of Practice for the Wiring of Premises, SANS 10142 as amended.
- 2.19.37 All earth conductors shall be individually bolted to the earth bar

#### **THE FOLLOWING EQUIPMENT IS REQUIRED IN THE BOARD:**

- 2.19.38 One flush mounted 96mm square dial voltmeter, scaled, indicating the alternator voltage.
- 2.19.39 One flush mounted voltmeter selector-switch with 6 metering and one off position, connecting the voltmeter to phase and neutral and phase to phase.
- 2.19.40 One flush mounted 96mm square dial indicating the alternator frequency.
- 2.19.41 An hour meter with cyclometer counter, reading the number of hours the plant has been operating. The smallest figure on this meter is to read 1/10<sup>th</sup> of an hour.
- 2.19.42 One set of fuses or CB's for potential circuits of the meters.
- 2.19.43 Flush mounted 96mm square dial maximum demand ammeters for measuring the alternator current, scaled to suit complete with necessary current transformer with resettable pointer.
- 2.19.44 One isolator for the mains isolation (check detailed specification for requirement).

- 2.19.45 Automatic – change over control equipment (check detailed specification for requirements).
- 2.19.46 One circuit breaker for alternator protection against overload and short circuit conditions (check detailed specification for requirement).
- 2.19.47 One four-position operation selector switch.
- 2.19.48 Two push buttons or one key switch marked “Start” and “Stop”, for manual starting and stopping the set.
- 2.19.49 Battery charging equipment as specified, complete with flush mounted ammeter and voltmeter.
- 2.19.50 Relays with re-set pushes as specified, for engine protection and warning.
- 2.19.51 Fault indicating lights.
- 2.19.52 Mains fail simulation key switch.
- 2.19.53 Switch for fuel pump.
- 2.19.54 Warning hooter.
- 2.19.55 By pass switch.
- 2.19.56 Test pushbutton to test all indicator lamps.
- 2.19.57 Suitable terminals for incoming main and alternator cables, for the outgoing feeder and for the earth connection.
- 2.19.58 Any other equipment necessary for the correct and safe operation of the installation.

#### **PROTECTION AND ALARM DEVICES**

Relays with reset push buttons are required to give a visible and audible signal and stop the engine when any of the protective devices operate.

- 2.19.59 Protection must be provided for high engine temperature, low lubrication oil pressure, over-speed / under-speed, start failure, low water level, overload, low fuel, battery charger fail, faulty switch position, emergency stop and abnormal voltage.
- 2.19.60 A potential free common alarm contact for remote monitoring must be supplied, unless otherwise specified in the detailed specification.

## **2.20 REMOTE MONITORING**

- 2.20.1 Voltage free, N/O alarm contacts from all the major protection devices shall be wired to a separate terminal box in the control board. All wiring and terminals shall be clearly identified in accordance with the relevant wiring diagrams.
- 2.20.2 All outgoing wiring from this terminal box shall be done by the BMS contractor.
- 2.20.3 A comprehensive BMS system may be installed and all alarms shall be presented in the format of MODBUS or SNMP protocol to the BMS system as well as hardwired normally closed contacts of the critical alarm.
- 2.20.4 Event logs, Critical Alarms, Generator Parameters (e.g. Engine RPM, Fuel Level, Alternator Voltage, etc.) and other critical information must be accessible from the Main Substation HMI and a user-level access-controlled web-portal.

## **2.21 MAINTENANCE**

- 2.21.1 The tender is inclusive of all breakdown maintenance, 24-hour emergency callout and four preventative maintenance visits during the first 12 months calculated on standby use of the generating set, <sup>in</sup>cluding consumables such as oil and filters. A fully priced pro-forma maintenance agreement must be submitted with

the tender, catering for four preventative visits per annum and 24-hour emergency callout facility. The number of bona-fide service technicians employed by the tenderer will be stated in the tender response.



# PART 4

EQUIPMENT / CONTRACT SCHEDULES OF  
INFORMATION



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Engineers ©**

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## 4

## PART A - EQUIPMENT SCHEDULES OF INFORMATION

### 4.1 SCHEDULE OF EQUIPMENT / SUPPLIER OFFERED (800 KVA DIESEL GENERATORS X 2)

#### ENGINE INFORMATION (800KVA GENERATORS)

1	Manufacturers name:
2	Country of origin and year of manufacture:
3	Manufacturers type No:
4	Continuous sea level rating after allowing for ancillary equipment: a) in b.h.p. b) in kW
5	Percentage derating for site conditions, in accordance with SABS ISO 8528 a) for altitude: b) for temperature: c) for humidity: d) Total derating:
6	Nett output on site in kW:
7	Nominal speed in r.p.m.
8	Number of cylinders:
9	Strokes per working cycle:
10	Strokes in mm:
11	Initial one step load capability in kWe:
12	Cylinder bore in mm:
13	Swept volume in cm <sup>3</sup> :
14	Mean piston speed in m/min:
15	Compression ratio:

### ENGINE INFORMATION (800KVA GENERATORS)

---

16 Cyclic irregularity:

---

17 Fuel consumption of the complete generating set on site in 1/h.  
“Load” is the specified nominal kWe rating:

a) 100% load :

b) 50% load:

c) 25% load:

**NOTE:**

*A tolerance of 5% shall be allowed above the stated value of fuel consumption*

---

18 Make of fuel injection system?

---

19 Capacity of fuel tank in litre?

---

20 Is gauge glass fitted to tank?

---

21 What method for filling the fuel tank is included?

---

22 Method of starting the engine:

---

23 Voltage of starting system:

---

24 Method of cooling?

---

25 Type of radiator if water-cooled:

---

26 Type of heater for warming cylinder heads:

---

27 Capacity of water heater in kW:

---

28 Method of protection against high temperature:

---

29 Method of protection against low oil pressure:

---

30 Method of protection against low water level:

---

31 Type of governor:

---

32 Speed variation in %

a) Temporary:

b) Permanent:

---

**ENGINE INFORMATION (800KVA GENERATORS)**

---

33 Minimum time required for assumption of full load in seconds:

---

34 Recommended interval in running hours for:

- a) Lubricating oil change:
  - b) Oil filter element change:
  - c) Decarbonising:
- 

35 Type of base offered:

---

36 Can plant be placed on solid concrete floor?

---

37 Are all accessories and ducts included?

---

38 Is engine naturally aspirated?

---

39 Are performance curves attached?

---

40 Diameter of exhaust pipe:

---

41 Noise level at tail of exhaust pipe in dB (A):

---

42 BMEP (4 stroke) at Continuous rating (kPa):

---

43 % Load acceptance to SABS ISO 8528, with 10% transient speed variation:

---

**ALTERNATOR (800KVA GENERATORS)**

---

1	Manufacturers name:
2	Country of origin and year of manufacture:
3	Manufacturers type No:
4	Normal speed in r.p.m.
5	Terminal voltage
6	Sea level rating kVA at 0.8 power factor
7	Derating for site conditions in %
8	Input required in kW for site kVA output required
9	Method of excitation
10	Efficiency at 0.8 p.f.:
	a) 100% load
	b) 75% load
	c) 50% load
11	Maximum permanent voltage variation in %
12	Transient voltage dip on full load application in %
13	Voltage recovery on full load application in milli-seconds
14	Is alternator brushless?
15	Class of insulation of windings
16	Is alternator tropicalised?
17	Symmetrical short circuit current at terminals in Amps
18	Type of coupling
19	Number of bearings

---

**SWITCHBOARD / CONTROL PANEL INFORMATION (800KVA GENERATORS)**

---

1	Manufacturers name:
2	Country of origin and year of manufacture:
3	Is board floor mounted?
4	Finish of board
5	Make of volt, amp, and frequency meters:
6	Sea level rating kVA at 0.8 power factor:
7	Scale range of voltmeters:
8	Scale range of ammeters:
9	Ratio of current transformers:
10	Make of hour meter:
11	Range of cyclometer:
12	Smallest unit shown on counter (Item 11):
13	Make and type of circuit breaker:
14	Rating of circuit breaker in Ampere and fault level in kA:
15	Setting range of overload trips:
16	Setting range of instantaneous trips:
17	Make of changeover equipment:
18	Make of voltage relay:
19	Is control and protection equipment mounted on a small removable panel:
20	Type of control equipment:

---

**DIMENSION INFORMATION (800KVA GENERATORS)**

---

1	Overall dimensions of set in mm :	L =..... W =..... H =.....
	Panel if separate from genset:	L =..... W =..... H =.....

---

2 Is plant room adequate for the installation of the set and panel?

---

3 Overall mass in kg:

---

**BATTERY INFORMATION (800KVA GENERATORS)**

---

1	Manufacturers name:
---	---------------------

---

2	Country of origin:
---	--------------------

---

3	Type of battery:
---	------------------

---

4	Voltage of battery:
---	---------------------

---

5	Number of cells:
---	------------------

---

6	Capacity in A.h.:
---	-------------------

---

7	Type of battery housing:
---	--------------------------

---

## 4.2 SCHEDULE OF EQUIPMENT / SUPPLIER OFFERED (200 KVA DIESEL GENERATOR)

### ENGINE INFORMATION (200KVA GENERATOR)

1	Manufacturers name:
2	Country of origin and year of manufacture:
3	Manufacturers type No:
4	Continuous sea level rating after allowing for ancillary equipment: a) in b.h.p. b) in kW
5	Percentage derating for site conditions, in accordance with SABS ISO 8528 a) for altitude: b) for temperature: c) for humidity: d) Total derating:
6	Nett output on site in kW:
7	Nominal speed in r.p.m.
8	Number of cylinders:
9	Strokes per working cycle:
10	Strokes in mm:
11	Initial one step load capability in kWe:
12	Cylinder bore in mm:
13	Swept volume in cm <sup>3</sup> :
14	Mean piston speed in m/min:
15	Compression ratio:
16	Cyclic irregularity:

### ENGINE INFORMATION (200KVA GENERATOR)

---

17 Fuel consumption of the complete generating set on site in 1/h.  
“Load” is the specified nominal kW rating:

- a) 100% load :
- b) 50% load:
- c) 25% load:

**NOTE:**

*A tolerance of 5% shall be allowed above the stated value of fuel consumption*

---

18 Make of fuel injection system?

---

19 Capacity of fuel tank in litre?

---

20 Is gauge glass fitted to tank?

---

21 What method for filling the fuel tank is included?

---

22 Method of starting the engine:

---

23 Voltage of starting system:

---

24 Method of cooling?

---

25 Type of radiator if water-cooled:

---

26 Type of heater for warming cylinder heads:

---

27 Capacity of water heater in kW:

---

28 Method of protection against high temperature:

---

29 Method of protection against low oil pressure:

---

30 Method of protection against low water level:

---

31 Type of governor:

---

32 Speed variation in %

- a) Temporary:
  - b) Permanent:
- 

33 Minimum time required for assumption of full load in seconds:

---

**ENGINE INFORMATION (200KVA GENERATOR)**

---

- 34 Recommended interval running in hours for:
- a) Lubricating oil change:
  - b) Oil filter element change:
  - c) Decarbonising:
- 
- 35 Type of base offered:
- 
- 36 Can plant be placed on solid concrete floor?
- 
- 37 Are all accessories and ducts included?
- 
- 38 Is engine naturally aspirated?
- 
- 39 Are performance curves attached?
- 
- 40 Diameter of exhaust pipe:
- 
- 41 Noise level at tail of exhaust pipe in dB (A):
- 
- 42 BMEP (4 stroke) at Continuous rating (kPa):
- 
- 43 % Load acceptance to SABS ISO 8528, with 10% transient speed variation:
-

**ALTERNATOR (200KVA GENERATOR)**

---

1	Manufacturers name:
2	Country of origin and year of manufacture:
3	Manufacturers type No:
4	Normal speed in r.p.m.
5	Terminal voltage
6	Sea level rating kVA at 0.8 power factor
7	Derating for site conditions in %
8	Input required in kW for site kVA output required
9	Method of excitation
10	Efficiency at 0.8 p.f.:
	a) 100% load
	b) 75% load
	c) 50% load
11	Maximum permanent voltage variation in %
12	Transient voltage dip on full load application in %
13	Voltage recovery on full load application in milli-seconds
14	Is alternator brushless?
15	Class of insulation of windings
16	Is alternator tropicalised?
17	Symmetrical short circuit current at terminals in Amps
18	Type of coupling
19	Number of bearings

---

**SWITCHBOARD / CONTROL PANEL INFORMATION (200KVA GENERATOR)**

---

1	Manufacturers name:
2	Country of origin and year of manufacture:
3	Is board floor mounted?
4	Finish of board
5	Make of volt, amp, and frequency meters:
6	Sea level rating kVA at 0.8 power factor:
7	Scale range of voltmeters:
8	Scale range of ammeters:
9	Ratio of current transformers:
10	Make of hour meter:
11	Range of cyclometer:
12	Smallest unit shown on counter (Item 11):
13	Make and type of circuit breaker:
14	Rating of circuit breaker in Ampere and fault level in kA:
15	Setting range of overload trips:
16	Setting range of instantaneous trips:
17	Make of changeover equipment:
18	Make of voltage relay:
19	Is control and protection equipment mounted on a small removable panel:
20	Type of control equipment:

---

**DIMENSION INFORMATION (200KVA GENERATOR)**


---

1 Overall dimensions of set in mm : L =..... W =..... H =.....  
 Panel if separate from genset: L =..... W =..... H =.....

---

2 Is plant room adequate for the installation of the set and panel?

---

3 Overall mass in kg:

---

**BATTERY INFORMATION (200KVA GENERATOR)**


---

1 Manufacturers name:

---

2 Country of origin:

---

3 Type of battery:

---

4 Voltage of battery:

---

5 Number of cells:

---

6 Capacity in A.h.:

---

7 Type of battery housing:

---

**4.3 EQUIPMENT NOT LISTED ABOVE**

Tenderer to list any additional equipment / supplier not detailed above:

**ADDITIONAL  
EQUIPMENT**

---

Product:

---

Manufacturer:

---

---