DBN26/02/01: DEPARTMENT OF JUSTICE: VULAMEHLO MAGISTRATE COURT: REPAIRS & RENOVATIONS OF OFFICE BUILDING: COMPLETION CONTRACT

VOLUME 2 (C): RETURNABLE DOCUMENTS

TECHNICAL SPECIFICATION

FD HEATING, VENTILATION AND AIR-CONDITIONING SYSTEMS

CONTENTS

FD 01 SCOPE

This specification covers the general repair and maintenance of heating, ventilation and air-conditioning systems, which include the following:

(a) Room air-conditioning units with air cooled condensers
(b) Refrigeration pipework
(c) Fans and attenuators
(d) Electric motors
(e) Air filters
(f) Canopies and grease eliminators
(g) Duct work
(h) Air terminals
(i) Noise and vibration
(j) Painting and cleaning
(k) Labelling and identification.

This specification also addresses the training of
- User Client and associates, and
- Maintenance staff.

This specification shall form an integral part of the repair and maintenance contract document, and shall be read in conjunction with the additional and particular specifications compiled as part of this document.

This specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

FD 02 STANDARD SPECIFICATIONS

FD 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall deemed to form part thereof:

FD 02.01.01 SABS and other specifications and codes

SABS 046	-	Copper tube manufacturing code of practice
SABS 0400	-	The applications of building regulations
SABS 0103	-	The measurement and rating of environmental noise with respect to annoyance and speech communication
SABS 0139	-	The prevention, automatic detection and extinguishing of fire in buildings
SABS 0140	-	Identification colour marketing
SABS 0142	-	Code of practice for the wiring of premises
SABS 0147	-	Refrigerating systems, including plants associated with air-conditioning systems
SABS 0173	-	Installation, testing and balancing of duct work
SABS 630	-	Decorative high-gloss enamel paint for interior and exterior
SABS 763	-	General coating thickness
SABS 1238	-	HVAC duct construction standards
Act 103	-	National Building Regulations and Building Standard Act, 1977 (Act No 103 of 1977) as amended

FD 02.01.02 Department of Public Works Specifications

OW 371	-	Specification of materials and methods to be used (Fourth revision, October 1993)
STD.PWD.VIII	-	Standard specification for refrigeration services

FD 02.01.03 Occupational Health and Safety Act of 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) shall be adhered to.

FD 02.01.04 Manufacturers' specifications, codes of practice and installation instructions

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

FD 02.01.05 Municipal regulations, laws and by-laws

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

FD 03 VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS

The following additional general specifications and requirements shall be read in conjunction with this specification and shall be adhered to unless otherwise specified in the Particular Specification.

FD 03.01 GENERAL REPAIR AND INSTALLATION REQUIREMENTS

(a) All materials and equipment supplied and installed shall be new and of high quality and manufactured to the relevant specifications, suitable for providing efficient, reliable and trouble-free service.

(b) All work shall be executed in a first-class workman-like manner by qualified tradesmen.

(c) All equipment, component parts, fittings and materials supplied and/or installed, shall conform in respect of quality, manufacture, test and performance to the requirements of the applicable current SABS specifications and codes, except where otherwise specified or approved by the Engineer in writing.

(d) All materials and workmanship which, in the opinion of the Engineer, is inferior to that specified for the work will be condemned. All condemned material and workmanship shall be replaced or rectified as directed and approved by the Engineer.

(e) The Contractor shall submit a detailed list of the equipment and material to be used to the Engineer for approval before placing orders or commencing installation.

(f) All new equipment, materials and systems shall be installed and positioned such as to not impede on access routes, entrances and other services. The Contractor shall coordinate these items taking other services and equipment into account.

(g) All control equipment and serviceable items shall be installed and positioned such that they will be accessible and maintainable.

(h) The Contractor shall make sure that all safety regulations and measures are applied and enforced during the repair and construction periods to ensure the safety of the public and User Client.

(i) Repair work shall be programmed in accordance with Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures, to ensure the shortest possible down-time of any service and the least inconvenience to the User Client and public. The Contractor shall make sure that the necessary notifications and notices are timeously put into place for these activities.

FD 03.02 TESTING OF REFRIGERATION PIPING AND EQUIPMENT

(a) All new refrigerant pipe installations shall be thoroughly tested to be sure that they are absolutely tight. Nitrogen must be used to pressure test the system at 1,5 times the working pressure. A pressure-reducing valve must be used to set the test pressure. A leak test must be carried out on the entire system.

(b) All new refrigerant pipe installations shall be vacuum pumped by means of a suitable vacuum pump. An absolute pressure of 2500 micron must be reached. Allow the system to stand under vacuum for a minimum of 12 hours. If no noticeable rise in pressure has taken place after 12 hours, the system may be charged.

(c) The dryness of the refrigeration system shall be indicated by an approved moisture indicator.

(d) Should moisture be present, the system shall be leak tested and the leak repaired. Should no leak be present, the system shall be flushed with dry nitrogen and vacuum pumped again as described above.

(e) If the completed system complies with all the Specifications and passes the test and inspection, it can be approved and the Contractor may be instructed to recharge the system with the correct refrigerant and refrigerant charge.

(f) Under no circumstances shall the refrigerant piping/installation be purged.

FD 03.03 REFRIGERANTS

(a) No CFC refrigerant shall be used in new installations.

(b) Equipment still running on CFC shall be maintained until such time that a leak occurs or the system has to be decanted. The system shall then be converted to a compatible HCFC or HFC as described in the Montreal Protocol and recommended by the compressor manufacturer.

(c) Any CFC refrigerant that has to be discharged, shall be decanted by means of an approved reclaiming system, and not discharged to the atmosphere. Should the Contractor not comply with this requirement, full action shall be taken contractually and statutory against him.

(d) Any refrigeration system not supplied with three-way service valves, shall be provided with Schreuder type service valves. These valves shall be installed on both suction and discharge lines of the compressors. Tap-o-line valves shall not be fitted or used on the systems.

(e) In the event of an electrical motor burn-out in a hermetic or semi-hermetic compressor, a burn-out drier shall be used. Purging only is prohibited. The burn-out drier shall be installed and removed as per the manufacturer's instructions.

(f) No synthetic components or solutions shall be used to repair leaks in refrigeration piping, on coils or evaporators. Only approved gas welding shall be used. Should the leak be of such nature that repair is not possible, the item should be replaced.

FD 03.04 FANS AND ATTENUATORS

FD 03.04.01 General

(a) Requirements under this heading apply to fans that are not integral parts of complete units supplied by recognised suppliers. Selected fans shall be such that the operating point is as close as possible to maximum efficiency.

(b) Fan motors selected must be capable of supplying not less that 10 % above the specified air quantity without overloading.

(c) The system resistance must be calculated and the fan selected to meet the required static pressure, taking into consideration the site altitude, system air temperature and air density at which the system duty shall be met. The selection must be submitted to the Engineer for approval before ordering the equipment.

(d) Belt drives shall be designed for a minimum overload of 25 % and not less than two matched belts may be used. Belts shall be selected and installed according to BS 790.

(e) Pulleys shall be of the adjustable speed taper-lock type and shall be accurately keyed to the shafts and aligned before the system is put into operation.

(f) Belt guards shall be supplied in accordance with Occupational Health and Safety Act, No 85 of 1993. The guards shall have an expanded metal front and shall allow oiling and the use of a tachometer without removal of the guard.

(g) Bearings shall be selected for a minimum life expectancy of 200 000 hours at the given duty.

(h) Lubrication points shall be readily accessible and shall be extended to the outside to permit lubrication without removal of the fan. Fan shafts shall be suitably protected from rust and corrosion.

FD 03.04.02 Axial flow fans

(a) Axial flow fans shall be in-line direct-driven type with the motor mounted inside the fan housing.

(b) Fans shall be of the multi-bladed aerofoil type of a non-ferrous construction. The number of blades vary according to the application. The fans shall be provided with adjustable blade pitch indexed to permit field adjustment.

(c) Fan casings shall be constructed of hot-dip galvanized mild steel with a minimum thickness of 3 mm and mild steel galvanized flanges on each side drilled for connections to matching flanges on ducting.

FD 03.04.03 Sound attenuators

(a) Sound attenuators shall be installed in the positions indicated on the drawings and shall be selected to provide the noise criteria levels as specified. All sound attenuators shall be products of an accredited manufacturer who publishes selection data on these products. Data shall be submitted to the Engineer for approval before ordering.

(b) Metalwork shall be galvanized steel and acoustic insulation shall be non-combustible material, properly bonded and covered so as not to permit particles to be eroded by air moving over it.

(c) Sound absorbing lining material shall have a density not less than 48 kg/m^3 and thickness of not less than 50 mm.

FD 03.05 CANOPIES AND GREASE ELIMINATORS

(a) Kitchen canopies shall be connected to the extract fan by means of cuts of which the joints and seams are of the welded or soldered construction and shall be watertight. Cleaning openings shall be provided at such intervals on the ducting that the inside of the ducting can be reached for cleaning purposes. The fan shall be provided with a cleaning access door, as well as a drain point at the bottom.

(b) Fire dampers, operated with fusible links, shall be provided in each air outlet connection and shall form an integral part of the canopy construction.

(c) Lights shall be fitted into the canopy by the manufacturer. Access to the tube for tube replacement shall be through the face of the fittings without the use of tools.

(d) Grease filters shall contain a series of vertical baffles to change the direction of the air flow and efficiently divert grease particles out of the air stream by centrifugal action. Each filter bank shall contain a condensate trough and removable grease storage container.

FD 03.06 ELECTRIC MOTORS

(a) All electric motors shall be of one make, unless integral with the equipment, and shall not operate in excess of 1500 r/min unless previously approved by the Engineer for specific reasons. Motors, unless otherwise specified, shall be 380 volt, three-phase, 50 hertz for all sizes from and including 0,37 kW upwards. Smaller motors may be 220 volt, single-phase, 50 hertz.

(b) All motors shall be totally enclosed, fan-cooled and have metric frame dimensions. Motors shall be quiet in operation to the full acceptance of the Engineer.

(c) Three-phase motors shall all be squirrel cage induction type, special high torque motors being used on high inertia loads such as centrifugal fans, where otherwise excessively large motors, necessary to overcome driven equipment inertia, cause operation BHP to be less than 70 % of motor nameplate kW.

(d) Starting methods for three-phase motors shall be as follows:

Motors up to 5,5 kW	-	DOL
Above 5,5 kW	-	Star-delta started, provided that the starting current does not exceed three times the full load amps.

(e) Single-phase motors shall be capacitor started, induction run type with built-in manual reset overload protection.

(f) Nameplate rating of electric motors shall be at least 15 % larger than the required driven equipment brake drive losses duly accounted for, on motors below 15 kW. On larger motors a 10 % margin shall suffice.

(g) All switch panels shall have a phase failure and low voltage protection with automatic reset adjustable to a maximum period of 10 minutes.

FD 03.07 DUCT WORK

(a) This specification covers the air distribution system as shown on the drawings. Duct work shall be manufactured in accordance with the standard specification for air-conditioning duct work, SABS 1238. Duct work shall be erected in accordance with the code of practice for the installation, testing and balancing of duct work, SABS 0173.

(b) Fittings such as elbows, parallel flow branches, branch connections, off-sets and transitions shall be manufactured and installed in accordance with the SMACNA standards.

(c) All ducting shall be sufficiently airtight to ensure economical and quiet performance of the system, and joints shall be suitably sealed in accordance

with the relevant SMACNA standard with suitable non-combustible filler compound.

(d) The Contractor shall provide all hangers and supports which are to be hot-dip galvanized after fabrication to SABS 193. No explosive fasteners to the building structure shall be allowed, only approved expanding bolts or clamps are permissible.

(e) The duct work shall be connected to the air terminals by means of flexible ducting. Flexible ducting shall be coated fibreglass fabric with a mineral base. Flexible ducting shall be installed with "easy" bends of not less than one duct diameter centre line and shall be supported to SMACNA specification to ensure that the ducting does not kink. The length of the flexible duct shall be kept to a minimum and shall not exceed lengths of 1200 mm.

FD 03.08 AIR TERMINALS

(a) Air distribution shall be effected by means of the supply air grilles as indicated on the drawing. The finish of the grilles shall be epoxy powder-coated, the colour of which shall be advised and approved by the Engineer. Supply air grilles shall be of the double deflection type, consisting of two rows of individually adjustable aerofoil section vanes, front vanes horizontal rear vanes vertical, all vanes housed in a surrounding fixing flange with neat mitred joints in the corner.

(b) Supply air grilles shall be of steel construction and shall be provided with burglar bars. The inner section will be only accessible from above and the face plate of the grille is fixed from above. No screws or fixing devices are accessible from below.

(c) Supply grilles are supplied with a plenum box with spigot and connected to the spigot on the ducting by means of flexible ducting.

(d) Transfer grilles shall be of steel construction and be provided with burglar bars. Standard door grilles may be installed with a burglar bar assembly in between.

FD 03.09 AIR FILTERS

FD 03.09.01 General

(a) Provide and install air filters in the positions as indicated on the drawings.

(b) Filters shall be standard products of a reputable manufacturer regularly engaged in the manufacture of the particular filter. The manufacturer shall submit evidence to the satisfaction of the Engineer that the filters have been tested by an independent authority and that they meet the minimum arrestance, efficiency and dust holding capacity.

(c) Filters shall be tested in accordance with ASHRAE test standard 52 - 76.

(d) A Megnahelic gauge calibrated from zero to 500 Pa shall be installed, connected with copper tubing to static pressure tips complete with isolating valves.

FD 03.09.02 Primary filters

(a) Primary filters shall, unless otherwise stated, be washable on woven polyester material, pleated to provide an extended surface with a dust spot efficiency of minimum 40 % and an arrestance of 85 %.

(b) Media shall be firmly held in place by rustproof wire screens to maintain pleat strength and spacing.

(c) Media and support screens shall be continuously bonded into aluminium support.

(d) Frames shall be folded to form a robust media support frame. The bonding between media and frame shall be continuous to prevent leakage.

(e) Each filter shall be provided with a factory made holding frame, constructed of not less than 1,0 mm thick galvanized mild steel provided with suitable seals and quick release spring type clips to securely hold the filter cell in place without permitting leakage of air.

(f) The holding frames of multiple cell filter banks shall be suitably joined and sealed so as to prevent leakage of air between the frames.

FD 03.10 LABELLING AND IDENTIFICATION

All equipment shall be labelled and identified using black Traffolite labels with 10 mm high white lettering on the labels. Labels will be secured using epoxy base glue.

The identification number used on these labels shall correspond with the equipment number on the complete inventory list.

FD 03.11 NOISE AND VIBRATION

(a) Particular care shall be taken in the selection, application and installation of all equipment used to ensure that the equipment will operate below the required noise level for public areas of NC 35 and with the least vibration possible, all to the satisfaction of the Engineer.

(b) Equipment shall be mounted on vibration isolators of the correct type and selection depending on deflection requirement and vibrating frequency.

(c) Anti-vibration connections shall be used on duct work where it joins vibrating equipment such as fans and air-conditioning units.

(d) Suitable sound attenuating devices shall be incorporated within the duct work to reduce airborne noise to acceptable levels as specified.

(e) The subcontractor shall provide sound level data to the Engineer on the completion of the installation detailing the noise levels in NC level for each separate area. No measurement shall be taken closer than 1 metre from any outlet.

FD 03.12 PAINTING AND CLEANING

(a) No untreated metal surfaces shall be allowed on the project. Items which are not galvanized or similarly protected against rust and corrosion shall be painted as detailed below. No equipment, hangers, brackets, etc, shall be delivered to

site in unprotected condition; they shall be factory coated with an approved zinc-rich prime coat before being despatched.

(b) Painting shall comprise the following consecutive processes. Thoroughly clean, descale and degrease all surfaces, apply one coat of approved zinc-rich primer and one coat of universal undercoat, and finish off with two coats of quality high-gloss enamel. Final finish shall be to the full approval of the Engineer.

(c) Items with galvanized finish, such as cable trays, need not be painted but shall be properly cleaned with suitable galvanized iron cleaning fluid. Where galvanized finish is painted, it shall be primed with a calcium plumbate primer.

(d) It is not a requirement to paint duct work, conduits or pipework installed in roof voids and shafts, where they are not visible, if they are galvanized. Items as mentioned above shall be properly cleaned and painted as specified above.

(e) Visible sections of the inside of ducting through grilles shall be painted matt black after degreasing and priming as specified above.

(f) Plant and equipment shall be painted with the relevant colour in accordance with SABS.

FD 03.13 SELF-CONTAINED AIR-CONDITIONING UNITS

(a) The self-contained packaged unit shall be a fully catalogued product and documentation shall include performance curves and selection tables.

(b) Self-contained room air-conditioning units consist of unit casing, compressor, evaporator and fan, condenser and fan, refrigerant pipework with expansion device and the relevant controls. The condenser unit shall form an integral part of the unit or be separate for split applications.

(c) Unit casings shall be of sheet metal construction with a baked enamel finish to give a corrosion resistance. Units shall be suitably insulated to ensure quiet operation.

(d) Evaporator fans shall be of the double inlet centrifugal type with integral motor or belt-driven. The fan assembly shall be isolated from the unit by means of rubber mounts and the unit shall operate without vibration.

(e) Condensate trays shall be manufactured of non-corrosive materials and shall be insulated and condensate shall be piped to the nearest drain point.

(f) Washable WP 77 filters shall be provided and installed behind the inlet grille and shall be easily removable.

(g) Compressors shall be of the hermetically sealed dome type with crankcase heaters and suitable vibration isolators.

(h) Condenser coils shall be copper tubes with aluminium fins for inland use. Condenser fans shall be propeller fans or of the centrifugal type.

(i) Refrigerant piping shall be installed and repaired as specified in FD 03.

FD 04 AS-BUILT INFORMATION AND OPERATING AND MAINTENANCE MANUALS

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals and system data sheets.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

The Contractor shall allow for the required equipment and facilities to establish the correct as-built information.

All information shall be recorded and reproduced in electronic format, as well as three sets of hard copies to be supplied to the Department.

Over and above what is specified in Additional Specification SB: Operating and Maintenance Manuals, the operating and maintenance manual to be compiled shall be structured to include at least the following:

(a) System description

Complete system description and the working of the plant.

(b) Commissioning data

Complete commissioning, test and inspection data of plant.

(c) Operating data

(i) Plant running check list and frequency of servicing required;
(ii) Safety precautions to be implemented;
(iii) Manual and automatic operation;
(iv) Maintenance duties and logging required;
(v) Lubricating oils and service instructions;
(vi) Pre-start checklist for each system;
(vii) Starting and stopping procedures.

(d) Mechanical equipment

(i) Description of all major items with the make, model number, names, addresses and telephone numbers of the suppliers, manufacturers or their agents;
(ii) Design capacities of all equipment, including selection parameters, selection curves, capacity tables, etc;
(iii) Manufacturers' brochures and pamphlets;
(iv) Schedule of spares with part numbers recommended to be held as stock.

(e) Maintenance instructions

(i) Schedule of maintenance particulars, frequency of services and replacements;
(ii) Trouble-shooting guide;
(iii) Part number of all replacement items and spares;
(iv) Capacity curves of pumps, fans and compressors;
(v) Serial numbers of all items of equipment.

(f) Electrical equipment

(i) Schedule of equipment, indicating manufacturer, type, model number, capacity and addresses and telephone numbers of suppliers;
(ii) Maintenance instructions;
(iii) Manufacturers' brochures and pamphlets;
(iv) Complete as-built circuit diagrams and diagrammatic representation of interconnections of all electrical equipment.

(g) Instrumentation and control

(i) Description of each control system;
(ii) Schedule of control equipment indicating manufacturer, type, model number, capacity and addresses and telephone numbers of suppliers;
(iii) Maintenance instructions;
(iv) Manufacturers' brochures and pamphlets.

(h) Drawings

(i) Paper prints of all as-built mechanical and electrical drawings;
(ii) Wiring diagrams framed behind glass shall be mounted adjacent to each relevant control panel.

FD 05 TRAINING OF OPERATORS FOR THE OPERATION OF THE INSTALLATION AND EQUIPMENT

In addition to the requirements of Additional Specification SD: General Training, the Contractor shall allow and provide for additional training of the HVAC maintenance staff as specified and set out in this specification. The objective of this training will be to ensure that the following is achieved:

(a) Understanding of equipment;
(b) High plant operating efficiencies to reduce operating costs;
(c) Reduce the maintenance cost of the plant to an acceptable level, and maintain the cost at this level in so far as they are affected by the operating conditions;
(d) Prevent the maloperation of the plant and its associated equipment.

In the event of the designated staff not achieving the set goals the Contractor shall be responsible to ensure that such personnel attend an approved maintenance course as available from the Department or manufacturer.

The Contractor shall, in collaboration with the Engineer, ensure that the maintenance personnel be re-evaluated on an annual basis by means of a set examination, to ensure the upkeep of skill level and knowledge.

The evaluation and training course to be utilised for the evaluation of the HVAC maintenance staff shall include at least the following:

(a) Equipment and component recognition;

(b) Emergency procedures to be followed in the event of power failure, water shortage, and accidents related to refrigerator systems;

(c) Safety precautions to be followed and implemented;

(d) The identification, reporting and recording of faults and operation of equipment;

(e) The logging of boiler plant operation, readings and setting;

(f) In the event of plant running on ammonia, the full SAIRAC course on handling ammonia as refrigerant shall be attended by the maintenance staff.

FD 06 LOGGING AND RECORDING PROCEDURES

The Contractor shall under this repair and maintenance contract institute a logging and recording system as part of his maintenance control plan as defined in Additional

Specification SA: General Maintenance. This shall consist of a log and record book which shall be utilised to log and record all operations, faults, system checks, breakdowns, maintenance visits, inspections, etc.

The logbook shall be kept in a safe place at the maintenance section and shall only be utilised by the boiler house supervisor, the Contractor and the Engineer. A copy of the monthly entries and recordings into this logbook shall be submitted by the Contractor together with this monthly report to the Engineer.

The logbook shall be structured to include at least the following:

(i) Daily inspection and maintenance actions;
(ii) Monthly inspection and maintenance actions;
(iii) Six-monthly inspection and maintenance actions;
(iv) Breakdown reports;
(v) Statutory inspection and test comments and reports.

The Contractor shall also institute an attendance register, which shall be kept in a safe place at the maintenance section. This register shall be completed by all persons visiting the relevant plants, including:

(a) Contractor and maintenance personnel;
(b) Inspectors;
(c) User Client and associates;
(d) Engineer.

This register shall state the date, time-in, time-out, name, company and reason for visit. A copy of the register shall be submitted by the Contractor together with his monthly report.

On completion of repair work and/or the installation of new equipment the plant and equipment shall be put into operation after all tests and adjustments have been carried out to the satisfaction of the Engineer. Where new plant is installed the Contractor shall run and operate the system for a period of time specified by the Engineer and train the staff of the User Client to operate and maintain the system. This operation shall be done strictly in accordance with Clause SC 11 of the Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

Logging of the operation of the installations shall commence immediately upon start-up.

The Contractor shall submit a full commissioning report as per attached commissioning data sheet.

FD 07 TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK

On completion of repair work the Contractor shall prior to recommissioning test the plant and its equipment. This operation shall be done strictly in accordance with Clause SC 08 of Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

Except where otherwise provided in the Contract, the Contractor shall provide labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out such tests. Arrangements for these tests shall be made by the Contractor and he shall give at least 72 hours written notice to the Engineer before commencing the test.

In the event of the plant or installation not passing the test, the Employer shall be at liberty to deduct from the Contract amount all reasonable expenses incurred by the Employer or the Engineer attending the repeated test.

Whenever any installation or equipment is to be operated for testing or adjusting as provided for above, the Contractor shall operate the entire system for as long a period as may be required to prove satisfactory performance at all times in the occupied space served by that system for up to twenty-four hours a day continuously until the certificate of practical completion of repair work is handed over.

The Contractor shall provide all labour and supervision required for such operation and the Department may assign staff as observers, but such observation time shall not be counted as instruction time.

After complete installation of the system all equipment shall be tested, adjusted and readjusted until it operates to the satisfaction and approval of the Engineer.

The Contractor shall submit certificates of tests carried out to prove the performance of all equipment, as well as certificates obtained from all the relevant authorities and statutory bodies, etc.

The Contractor shall only utilise Departmentally approved inspection authorities for all inspections and tests to be conducted. This will be done and approved in writing among the relevant parties.

FD 08 QUALITY ASSURANCE SYSTEM

The Contractor shall institute an approved quality assurance (QA) system, which shall be submitted to the Engineer for his approval. The records of this QA system shall be kept throughout the duration of the Contract and be submitted to the Engineer at regular intervals as required.

FD 09 COMMISSIONING AND RECOMMISSIONING OF PLANT AND INSTALLATION

FD 09.01 GENERAL

On completion of repair work and/or the installation of new equipment the plant and equipment shall be put into operation after all tests and adjustments have been carried out to the satisfaction of the Engineer. Where new plant is installed the Contractor shall run and operate the system for a period of time as specified by the Engineer and train the staff of the User Client to operate and maintain the system. This operation shall be done strictly in accordance with Clause SC 11 of Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

Logging of the operation of the installations shall commence immediately upon start-up.

The Contractor shall submit a full commissioning report as per attached commissioning data sheet.

FD 09.02 RECOMMISSIONING OF PLANT AND ANCILLARY EQUIPMENT

On completion of repair work the Contractor shall recommission the plant and its equipment. This operation shall be done strictly in accordance with Clause SC 11 of Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures. This operation shall also be carried out strictly in accordance with the manufacturer's specification and shall be witnessed by the Engineer.

Recommissioning checks to be carried out shall be categorised under the following headings:

(a) Mechanical checks
(b) Electrical and control checks.

On completion of repair work the Contractor shall recommission the plant and its ancillary equipment. This operation shall be done strictly in accordance with the manufacturer's specification and shall be witnessed by the Engineer. This shall include but not be limited to the following:

(a) All required recommissioning mechanical checks

(i) Check system for leaks;
(ii) Check rotation of all fans;
(iii) Check mountings of all equipment.

(b) All required recommissioning electrical and control checks

(i) Check all wiring connections for tightness and repair any hot connections.

(ii) Check that all electrical equipment have been properly reconnected in accordance with the manufacturer's specification.

(iii) Perform and record all required electrical insulation tests on equipment.

(iv) Check and test all controls with main circuits isolated.

(v) Check all motor-driven equipment for correct rotational directions.

(vi) Check and test the operation of all indication and warning lights.

(vii) Check, set, record and readjust all equipment control and set points in accordance with manufacturer's specification.

(viii) Run all motor-driven equipment for a period to ensure free movement and correct operation. Feed pumps only to be operated for a short interval to check rotation.

FD 09.03 COMMISSIONING AND COMPLETION OF REPAIRS

On completion of the recommissioning checks the Contractor shall proceed with the commissioning. This operation shall be done strictly in accordance with Clause SC 11.02 of Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures. This operation shall also be carried out in accordance with the manufacturer's specification and shall include but not be limited to the following for the different types of equipment:

FD 09.03.01 Self-contained air-conditioning unit

(a) Check evaporator and condenser pressures and superheat.

(b) If the unit needs charging, find leak, decant, repair leak and recharge unit.

(c) Check fans, fan speed control and fan motors.

(d) Check entering and leaving air temperatures over evaporator coil.

(e) Check operation of all safeties:

(i) LP cut-out pressure
(ii) HP cut-out pressure
(iii) Low on-coil thermostat
(iv) Set point of oil pressure safety
(v) Oil pressure trip.

(f) Check anti-recycle timer.

(g) Check all running amps of fans and compressors.

(h) Check compressor unloading mechanism if applicable.

(i) Complete commissioning data sheet.

FD 09.03.02 Ventilation system

(a) Check fans, fan speed control and fan motors.

(b) Check running amps of fans.

(c) Check pressure drop over filters.

(d) Check air quantity over filters or canopy face velocity.

(e) Check outlet air quantities.

The Contractor shall visit, inspect, test and readjust the plant during the 30-day period following the recommissioning to ensure the correct functioning of the plant and its associated equipment.

FD 10 GUARANTEE OF INSTALLATION AND EQUIPMENT

The Contractor shall provide and obtain guarantees from the manufacturer(s) and/or supplier(s) to the effect that each piece of new equipment supplied and installed under the repair contract, will comply with the required performance and will function as part of the complete system.

All new equipment, including the complete new installations and the systems as a whole, shall be guaranteed for a period of 12 (twelve) months commencing on the day of issue of a certificate of completion for repair work of the installation.

FD 11 MAINTENANCE TOOLS AND SPARES

Each maintenance workshop shall be equipped with the necessary maintenance tools and spares as required by the specific type of plants and installation for the daily operation and maintenance of the plant. At the start of the repair and maintenance contract the Contractor shall make an inventory of the existing tools and spares in the presence of the User Client, and any shortfall or damaged tools and spares shall be replaced with new. All replacement tools and spares shall be as specified by the boiler and equipment manufacturers. These tools and spares shall be kept in a lockable room or cabinet of which the maintenance supervisor and the Contractor shall carry keys. The Contractor shall on a monthly basis take stock of these items in the presence of the maintenance supervisor and shall record and report to the

Engineer. Any shortfall shall be replaced by the Contractor as part of his responsibility under this Contract.

The tools and spares to be carried shall include, but not be limited to at least the following:

(a) Tools

(i) Electric welding (arc welder)
(ii) Oxy-acetylene welding set
(iii) Soldering iron
(iv) Pipe cutter
(v) Swaging tool set
(vi) Flaring tool set
(vi) Leak detector (electronic or leak torch or Spectro light)
(vii) Vacuum pump
(viii) Service valve ratchet
(ix) Refrigerant reclaim unit
(x) Flow measuring hood
(xi) Pitot tube
(xii) Vacuum gauge
(xiii) Digital thermo anenometer
(xiv) Hygrometer
(xv) Tung tester
(xvi) Coil comb
(xvii) Multimeter
(xviii) Amp meter
(xix) Combination spanner set
(xx) Combination socket set
(xxi) Allen keys
(xxii) Screwdriver set
(xxiii) Drill set
(xxiv) Drilling (arc welder)
(xxv) Pop rivet gun
(xxvi) Tab and die set
(xxvii) Three-jaw gear pulley
(xxviii) Hacksaw
(xxix) Level
(xxx) Bench vice
(xxxi) Assorted files
(xxxii) Tape 5 m
(xxxiv Torch.

(b) Spares

It is recommended that essential parts be maintained in inventory. Essential parts are those parts used frequently in responding to routine and urgent work requests. Consider the accessibility to spares and the time it takes to obtain them. The goal is to avoid stockpiling parts, as well as to avoid being without a needed part. The following parts are regarded as essential spares:

(i) Schreuder valves
(ii) Relevant refrigerants
(iii) Relevant refrigeration compressor oil
(iv) Filter/dryers
(v) Expansion valves
(vi) Filter sets
(vii) Relevant V-belts
(viii) Lubricants and greases.

FD 12 REPAIR WORK TO INSTALLATION SYSTEMS AND EQUIPMENT

FD 12.01 GENERAL

At the start of the repair and maintenance contract all the systems, installations and equipment shall be repaired as specified in the Particular Specification. This repair work shall include but not be limited to the specified Particular Specification details.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve. The said repair work shall be executed in accordance with the relevant codes of practice, standard, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and particular specifications included in this document.

The repair work items shall be listed in tabular form in the Particular Specification with all relevant details, such as capacity, size, manufacturer, model number, etc.

All repair work shall be executed within the approved period for repairs to be agreed at the start of the Contract period. All new equipment, materials and systems shall be furnished with a written guarantee of a defects liability period of 12 months from date of issue of a certificate for completion of the repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over to the satisfaction of the Engineer.

Repair work items shall be categorised for the following installations:

(a) Ventilation systems including canopies
(b) Self-contained air-conditioning units.

FD 12.02 VENTILATION SYSTEMS

(a) Replace fresh air intake screen.
(b) Inspect and clean all duct work and canopy.
(c) De-rust, neutralise and touch up paint work on ducting and canopy.
(d) Check tightness of all securing bolts.
(e) Replace all canvas collars with new.
(f) Replace all filters.
(g) Check bearings of fan motors and lubricate.
(h) Check whether all duct supports are still in position and replace missing supports.
(i) Check duct work for leaks and repair defects.
(j) Replace all joint seal and gaskets with new.
(k) Check all fire dampers for correct operation and reset.
(l) Clean fan blades and check for unbalance.
(m) Check fans, speed control and fan motor.
(n) Check running amps of fan.
(o) Reseal penetrations through roof.

FD 12.03 SELF-CONTAINED AIR-CONDITIONING UNITS

(a) Clean air intake screen.
(b) Replace filters.
(c) De-rust, neutralise and touch up paintwork.

(d) Replace canvas collars.
(e) Clean housing, ensure all panels are properly secured and door panels close properly.
(f) Check setting and operation of all pressure switches, reset if required.
(g) Check setting and operation of all safety switches, ie LP and HP switches, oil pressure switch.
(h) Check setting and operation of thermostats.
(i) Check timers and reset if required.
(j) Check operation of seven-day timer.
(k) Check running current of fans and compressor and settings and operation of overloads.
(l) Check tightness of all electrical terminals.
(m) Ensure operation of local and remote isolators.
(n) Check condition of all cables and whether cables are neatly strapped and reposition and strap if required.
(o) Ensure correct operation of emergency stop.
(p) Carry out a leak test on all refrigeration piping and components inclusive of evaporator and condenser.
(q) All leaks shall be repaired. Should a leak on a component be of such a nature that it cannot be repaired, the component shall be replaced. The procedure to follow is as set out in FD 03.
(r) The superheat setting of the thermostatic expansion valve shall be checked and adjusted if required (setting approximately 8 °C).
(s) The filter dryer shall be replaced.
(t) Check compressor vibration mounts.
(u) Test oil acidity.
(v) Check refrigerant charge sight glass being clear or flashing.
(w) Check moisture indication being dry.
(x) Clean condensate tray and test drainage operation.
(y) Clean evaporator and condenser blades and check unbalance.
(z) Replace suction line insulation.
(aa) Check all service valves for full operation, replace caps if missing.

FD 13 MAINTENANCE TO INSTALATION AND EQUIPMENT

FD 13.01 GENERAL

Monthly maintenance responsibilities for each installation including all units and components as specified, shall commence with commencement of the Contract. A difference shall be made in payment for the maintenance prior to and after practical completion of repair work.

Maintenance responsibilities of the completed installation shall commence upon the issue of a certificate of practical completion for repair work, and shall continue for the remainder of the 36-month contract period.

This part of the Contract shall include:

(a) Routine preventative maintenance;
(b) Corrective maintenance; and
(c) Breakdown maintenance,

as defined in Additional Specification SA: General Maintenance, for the specified installations described under FD 01 of this specification.

The maintenance work to be performed and executed shall be done strictly in accordance with Additional Specification SA: General Maintenance, and as specified in Particular Specification PFD and this specification.

The said maintenance work shall be executed in accordance with the relevant codes of practice, statutory regulations, standards, regulations, municipal laws and by-laws and the manufacturers' specifications and codes of practice.

The maintenance schedules and frequency shall be developed under the maintenance control plan to be instituted by the Contractor, as specified in Additional Specification SA: General Maintenance.

All new equipment, components and materials supplied and installed under the maintenance contract shall be furnished with prescribed manufacturer's guarantees.

The maintenance work and items are to be categorised by the Contractor for each maintenance activity under the following headings:

(a) Ventilation systems
(b) Self-contained air-conditioning units.

The Contractor shall be remunerated monthly, based on his performance, for maintaining the complete installation in a perfect functional condition.

FD 13.02 DEFINITION AND QUALIFICATION OF ACTIONS

FD 13.02.01 Daily maintenance actions

Daily actions are the responsibility of the User Client. These checks are to be performed by staff responsible of the facility. The self-contained air-conditioning units and ventilation systems should run during working hours and/or continuously. The status of these systems can thus be monitored by observation on a daily routine.

(a) Ventilation systems:

- Are the systems running and is the operation quiet?
- Is the kitchen hood removing vapour from the kitchen?

(b) Self-contained air-conditioning units:

- Does the unit perform and maintain temperature?
- Is the temperature in the areas concerned satisfactory?
- Is the condensate drain working properly?

These daily checks shall be logged at the facility, ie by the kitchen manager and the maintenance personnel.

FD 13.02.02 Monthly maintenance actions

TABLE FD 13.02.02/1: VENTILATION SYSTEMS

REFERENCE NUMBER	ACTION
V-1	Inspect air intake for blockages
V-2	Check all accessible duct work for leakages, damages, and damages supports
V-3	Clean filters
V-4	Check electric motor running temperature
V-5	Check electric connections for tightness
V-6	Check operation of relief air grilles and check that they are not blocked
V-7	Check for motor noise and check bearings
V-8	Check for leaks on canvas collars

TABLE FD 13.02.02/2: SELF-CONTAINED AIR-CONDITIONING UNIT

REFERENCE NUMBER	ACTION
S-1	Clean filters, replace if required
S-2	Inspect air intake and discharge for blockages
S-3	Check all refrigerant, drainage pipes for damaged and leaks
S-4	Check sightglass: clear or flash gas
S-5	Carry out visual inspection of condenser coil for blockages and correct operation of fans
S-6	Carry out visual inspection of evaporator coil for blockages and correct operation of supply fan
S-7	Check enclosure for damages
S-8	Check electric motor running temperatures
S-9	Check electric connections for tightness
S-10	Test thermostat and control operation
S-11	Clean condensate tray and test drainage for proper operation
S-12	Check cooling and heating cycle

Note: The monthly actions shall include the activities of the daily maintenance actions.

FD 13.02.03 Biannual maintenance actions

TABLE FD 13.02.03/1: VENTILATION SYSTEMS

REFERENCE NUMBER	ACTION
V-1	Inspect air intake for blockages
V-2	Check all accessible duct work for leakages, damages, and damages supports
V-3	Clean filters
V-4	Check electric motor running temperature
V-5	Check electric connections for tightness
V-6	Check operation of relief air grilles and check that they are not blocked
V-7	Check for motor noise and check bearings
V-8	Check for leaks on canvas collars
V-9	Clean fan blades and check for unbalance
V-10	Clean exterior casing
V-11	Clean all grilles
V-12	De-rust, neutralise and touch up paint work
V-13	Check vibration mounts of fan and tightness of mounting bolts

TABLE FD 13.02.03/2: SELF-CONTAINED AIR-CONDITIONING UNITS

REFERENCE NUMBER	ACTION
S-1	Clean filters, replace if required
S-2	Inspect air intake and discharge for blockages
S-3	Check all refrigerant, drainage pipes for damages and leaks
S-4	Check sight-glass: clear or flash gas
S-5	Carry out visual inspection of condenser coil for blockages and correct operation of fans
S-6	Carry out visual inspection of evaporator coil for blockages and correct operation of supply fan
S-7	Check enclosure for damages
S-8	Check electric motor running temperatures
S-9	Check electric connections for tightness
S-10	Test thermostat and control operation
S-11	Clean condensate tray and test drainage for proper operation
S-12	Check filter/dryer
S-13	Check superheat and functioning of expansion valve
S-14	Check operation of HP and LP switch
S-15	Check operation of controllers
S-16	De-rust, neutralise and touch up paint work
S-17	Check cooling and heating cycle
S-18	Clean evaporator and condenser coil chemically
S-19	Clean all filter frames and seals
S-20	Check fan motor and compressor current
S-21	Check and test overload settings
S-22	Lubricate all bearings

Note: The above biannual actions include the activities of the monthly maintenance actions.

HVAC COMMISSIONING DATA SHEET - AIR CONDITIONING UNITS

INSTALLATION: .....

A/C MAKE : .....

Model number :	Inside unit		
	Outside unit		
Serial number :	Inside unit		
	Outside unit		
Voltage :			
Starting amps :			
Running amps :			
		COOLING	HEATING
System discharge gauge pressure: (kPa and running)			
System suction gauge pressure: (kPa and running)			
Condenser : cooling medium inlet temperature:			
Condenser : cooling medium outlet temperature:			
Evaporator : air inlet temperature:			
Evaporator : air outlet temperature:			
Room dry bulb temperature after 1 hour A/C operation:			
Ambient dry bulb temperature:			

COMMISSIONED BY:

....
PRINT SIGNATURE

.....
DATE

CONSULTANT:

....
PRINT SIGNATURE

.....
DATE

PARTICULAR SPECIFICATION

PJC CONVENTIONAL FIRE FIGHTING EQUIPMENT

CONTENTS

PJC 01 SCOPE

(a) This specification covers the particulars of the repair and renovation work to the conventional fire fighting equipment installation at the Potchefstroom DHA offices. This Particular Specification shall be read in conjunction with Technical Specification JC: Conventional Fire Fighting Equipment, and all additional and technical specifications compiled as part of this document, in particular the following Additional Specifications:

SA: General Maintenance
SB: Operating and Maintenance Manuals
SC: General Decommissioning, Testing and Commissioning Procedures
SD: General Training

The intended repair and renovation work to this installation will restore the existing installation to a safe, efficiently functional system that complies with all statutory regulations and applicable standards, in the process repairing all defects and shortfalls. Monthly maintenance responsibilities for each installation shall commence with access to the site. A difference shall be made in payment for renovation prior to and after practical completion of repair work. On completion of the repair work, the completed installation shall be maintained and serviced by the Contractor for the remainder of the 36-month Contract period.

(b) The scope of work consists of facilities as listed below of the Department of Home Affairs situated in the North West province, which forms part of the repair and maintenance contract for the fire fighting equipment installation. The piped fire water reticulation network to the equipment, such as hydrants and hose reels, are dealt with under and form part of the plumbing and drainage repair and renovation contract.

(i) Installation B: Building Wet Services

PJC 02 GENERAL DESCRIPTION OF INSTALLATION

The various buildings on the sites are generally fed by means of a site reticulation network which feeds the fire fighting equipment such as hose reels and hydrants.

The buildings are also equipped with fire extinguishers.

PJC 03 TECHNICAL DETAILS OF EXISTING INSTALLATION

At the time of compilation of this document the existing installation consisted of the equipment listed below:

PJC 03.01 FIRE FIGHTING EQUIPMENT

BUILDING DESCRIPTION	NUMBER OF FIRE PROTECTION EQUIPMENT							
	FHR	4,5 kg DCP	9 kg DCP	6,8 kg CO_2	FH	Fire Eng.	KS CO_2	2,5 kg DCP
Potchefstroom DHA	1	2	1		2			

PJC 04 STATUS OF EXISTING INSTALLATION

At the time of compilation of this document the status of the equipment and installation was briefly as described below.

PJC 04.01 LAST SERVICE

The fire fighting equipment was last serviced a long time ago.

PJC 04.02 OTHER

Equipment is generally in a fair condition, but do require attention and servicing. There is a shortage of equipment in the whole building.

(i) Fire equipment not sufficient
(ii) Fire extinguishers kept at undesignated areas
(iii) Equipment ill-serviced
(iv) Signage not clear enough

PJC 05 DETAILS OF REPAIR AND SERVICE WORK

The following work shall form part of the intended repair work to the fire fighting equipment. This work shall be done in accordance with the relevant regulations, codes, specifications and Technical Specification JC: Conventional Fire Fighting Equipment.

The description of the repair work included as set out below shall be read in conjunction with the Bill of Quantities and Technical Specifications.

PJC 05.01 GENERAL DESCRIPTION OF REPAIR WORK

PJC 05.01.01 The Contractor shall at the start of the Repair and Renovation Contract inspect the items, systems, equipment and installations listed below. This inspection shall include the establishing of any defects, leaks, conditions, damages, shortfalls, repairs required, details of existing equipment, suitability of equipment for the purpose it serves, etc. The Contractor shall report back to the Engineer in writing on all the above and the following items. No repair work shall commence prior to approval by the Engineer.

(a) Correlation of all fire fighting equipment;
(b) Last service record;
(c) Inventory list of all equipment;
(d) Compliance with present governing regulations;
(e) Accessibility to equipment;
(f) Dynamic water pressure under flow conditions of equipment;
(g) As-built information.

PJC 05.01.02 The general scope of work at the time of going on tender is defined as follows:

(a) Replacing of irreparable damaged, missing and unsuitable fire fighting equipment;
(b) Servicing and overhauling of all fire hose reels and fire hydrants;
(c) Servicing and recharging of all fire extinguishers;
(d) Replacing of missing and damaged fire extinguisher brackets;
(e) Replacing damaged fire hose reel cabinets;
(f) Supply and installation of additional fire hose reels, hydrants and extinguishers where necessary, in accordance with the requirements of SABS 0400;
(g) Servicing and overhauling of fire booster connections;
(h) Compilation of fire plan for each site;
(i) Compilation of inventory list with all relevant details and an identification system to all equipment.

PJC 05.02 REPAIR WORK TO FIRE FIGHTING EQUIPMENT

The repair work to this installation shall include, but not be limited to at least the following items. Any items, components or installations not detailed in this specification but found to be defective or inoperative during the inspection and report phase, shall be repaired or replaced as instructed by the Engineer.

(a) Service and repair all existing fire hose reels and hydrants.
(b) Service and recharge all fire extinguishers.
(c) Install new fire booster connection including pressure gauge.
(d) Supply and installation of additional hydrants and hose reels.
(e) Supply and installation of additional fire extinguishers including wall brackets.
(f) Replace missing and damaged hose reel and fire extinguisher cabinets.
(g) Replace perished and missing fire hoses and fire nozzles.

PJC 06 MEASUREMENT AND PAYMENT

All new building work and repair work to existing structures and buildings resulting from repairs to the conventional fire fighting equipment as scheduled, shall be done in accordance with the Specifications for the structural and building section included elsewhere in this Tender Document. The costs of such building and repair works shall be deemed to be included in the tendered rates for the applicable items scheduled in this section.

PJC 06.01 INSPECTION AND REPORT ON EXISTING INSTALLATIONS ..... Unit: item

The tendered sum shall include full compensation for the inspection and written report on all items, systems, components, equipment and installations, including the establishment of any defects, leaks conditions, damages, shortfalls, structural soundness, repairs required, details of existing equipment and suitability of the equipment for the purpose it serves.

PJC 06.02 AS-BUILT INFORMATION AND OPERATING AND MAINTENANCE MANUALS ..... Unit: set

The tendered sum shall include full compensation for the compilation and submission of inventory lists and operating and maintenance manuals in accordance with Additional Specification SB: Operating and Maintenance Manuals.

The tendered sum shall also include full compensation for all equipment necessary to establish the exact position and level of underground services, as well as the recording of all information on electronic drawing format.

PJC 06.03 ISOLATION, STRIPPING, DISMANTLING AND REMOVAL OF EXISTING FIRE FIGHTING EQUIPMENT ..... Unit: number

The tendered rates shall include full compensation for the isolation, stripping, dismantling and removal of irreparable damaged, broken or unsuitable fire hydrants, fire hose reels and fire extinguishers, including all valves, cabinets, mounting brackets, streamers, etc, as well as removal off site and/or storage of all removed items mentioned above.

PJC 06.04 SUPPLY AND INSTALLATION OF FIRE HYDRANTS ..... Unit: set

The tendered rate shall include full compensation for the supply, delivery, positioning, installation, testing, commissioning and hand-over of fire hydrants, including all necessary pipework, cabinets, cupboards, valves, brackets, fittings, bends and the reinstating of existing surfaces such as walls, floors, ceilings, etc.

The tendered rate shall also include full compensation for the supply, delivery and positioning and fixing of all fire signage as required by regulation.

The tendered rate shall also include full compensation for the labelling with identifying tags and recording of details of all equipment.

PJC 06.05 SUPPLY AND INSTALLATION OF FIRE HOSE REELS ..... Unit: number

The tendered rate shall include full compensation for the supply, delivery, positioning, installation, testing, commissioning and hand-over of fire hose reels, including all necessary pipework, cabinets, cupboards, valves, brackets, fittings, bends and the reinstating of existing surfaces such as walls, floors, ceilings, etc.

The tendered rate shall also include full compensation for the supply, delivery and positioning and fixing of all fire signage as required by regulation.

The tendered rate shall also include full compensation for the labelling with identifying tags and recording of details of all equipment.

PJC 06.06 SUPPLY AND INSTALLATION OF FIRE EXTINGUISHERS ..... Unit: number

The tendered rate shall include full compensation for the supply, delivery, positioning, installation and hand-over of the fire extinguishers, including all necessary brackets, backboards, etc.

The tendered rates shall also include full compensation for the supply, delivery, positioning and fixing of all fire signage as required by regulation.

The tendered rate shall also include full compensation for the labelling with identifying tags and recording of details of all equipment.

PJC 06.07 SERVICING, CLEANING AND REPAIR OF FIRE HYDRANTS ..... Unit: number

The tendered rate shall include full compensation for the repair or replacement of damaged, broken, leaking or corroded pipework and fittings, main hydrant seals, quick coupling catches, shaft ends for right-angle hand wheel type hydrants, streamers, hose nozzles, valve steam seals, fire cupboard doors and locks, damaged, missing or shortfall fire signage, etc.

The tendered rate shall also include full compensation for the labelling with identifying tags and recording of details of all equipment.

PJC 06.08 SERVICING, CLEANING AND REPAIR OF FIRE HOSE REELS ..... Unit: number

The tendered rate shall include full compensation for the repair or replacement of damaged hose drums, mountings and shut-off valves, replacement of damaged or missing 30 m hoses, hose nozzles, shut-off valve wheel handles, hose drum seals where leaks occur, gland packing and gaskets of shut-off values, repainting of deteriorated paintwork, replacement of fire cupboard doors and locks, damaged, missing or shortfall fire signage, etc.

The tendered rate shall also include full compensation for the labelling with identifying tags and recording of details of all equipment.

PJC 06.09 SERVICING, CLEANING, RECHARGING AND REPAIR OF FIRE EXTINGUISHERS ..... Unit: number

The tendered rate shall include full compensation for the repair or replacement of all damaged, faulty or missing discharge hoses and nozzles, pressure gauges, operating instructions, the recharging of discharge cylinder to required capacity for DCP, water and foam extinguishers, and the recharging of CO_2 extinguisher to capacity, repair, resealing of CO_2 discharge mechanism, checking, servicing and repairing of activation mechanisms, replacement of water and foam extinguishers that have corroded cylinders, replacement of DCP, water or foam content of extinguishers, the replacement of fire cupboard and cabinet doors and locks, damaged, missing or shortfall fire signage, brackets and backboards, etc.

The tendered rate shall also include full compensation for the labelling with identifying tags and recording of details of all equipment.

PJC 07 DETAILS OF MAINTENANCE WORK

PJC 07.01 GENERAL

The Contractor shall be responsible for the complete maintenance of all the equipment, components, installations and systems forming part of this repair and renovation contract for this installation. The Contractor shall strictly adhere to Additional Specification SA: General Maintenance, and Technical Specification JC: Conventional Fire Fighting Equipment, with regard to the maintenance period, obligations, responsibilities, actions and activities, etc, which shall also include the following maintenance actions:

(a) Routine preventative maintenance. A guideline to the required actions is provided in Technical Specification JC. The actions will not be limited to these guidelines, but shall include all additional actions, work, materials, etc, necessary to maintain this installation at an acceptable level.

(b) Corrective maintenance as described and defined in Additional Specification SA: General Maintenance.

(c) Breakdown maintenance as described and defined in Additional Specification SA: General Maintenance.

For this particular installation a fatal breakdown shall be defined as any equipment, systems and installations prohibiting fire fighting to any area of the complex as a whole.

Emergency breakdown shall be defined as a failure of equipment, components and systems of this particular installation.

AUTOMATIC FIRE DETECTION DETECTION SYSTEM SPECIFICATION

STANDARD TECHNICAL SPECIFICATION

All equipment, pipes and fittings and electrical equipment shall conform to the Standard Technical Specification. Where the Standard Specification is contradicted by the Detailed Technical Specification, the Detailed Technical Specification shall apply.

DETAILED SPECIFICATION

1.0 SCOPE OF WORK

The Contract, as detailed in these Specification Documents and the accompanying Drawings, comprises of the manufacture, supply, transport and delivery, hoisting, installation, testing, setting in operation, leaving in complete working order, and guarantee of the entire fire detection system and, except so far as the contract otherwise provides, the provision of all labour, materials, contractor's equipment and everything, whether of a temporary or permanent nature required in and for such manufacture, supply, offloading, hoisting, installation, testing, setting in operation, leaving in complete working order, guarantee so far as the necessity for providing the same is specified in or reasonably to be inferred from the contract.

1.1 DESCRIPTION OF SYSTEM

The fire detection system shall be analogue addressable fire detection and alarm system.
The fire control panel shall be installed at positions shown on the Engineer's drawings. The main panel shall be installed by the main entrance.
Addressable optical smoke detectors shall be installed in all offices and corridors as shown on the Engineer's drawings.
Addressable heat detectors shall be installed in the kitchens as shown on the Engineer's drawings.
The smoke detectors and heat detectors shall be connected together using a fire retarded cable.
The fire retarded cable shall be installed in a metal or galvanised conduit.
Manual fire call points shall be installed at all building exits and or passages as shown on the Engineer's drawings.

1.2 DESIGN STANDARDS

The Automatic Fire Detection System Installation shall be in compliance with OHS act, PW336, Local fire regulations, Regulations of the local electrical and gas supply authorities, National Building Regulations Act No 103 of 1977, SANS and the Department of Public Works General Electrical and Mechanical specifications Part A, Part B and Part C and all other relevant regulations and specifications.

1.3 AUTOMATIC FIRE DETECTION SYSTEM

The automatic fire detection system to be installed shall be analogue addressable system. The automatic fire detection system shall be installed according to EN54, BS5839, SANS 10139 and PW336.

1.3.1 Fire detectors

Each room/office of the buildings to be covered shall be fitted with either a smoke or a heat detector. In offices, smoke detectors will be installed. In areas where smoke is occasionally present, e.g. kitchens, heat detectors will be installed.
The heat detectors shall be spaced at 5.3m apart while smoke detectors shall be spaced at 7.5m each.

1.3.2 Fire control panels and fire zones

There shall be a fire control panel by the main entrance of each building and mimic panels will be installed in areas where there are more than two entrances.
Each zone shall have a maximum of 20 field devices. The devices in each zone shall be wired in a 'loop' such that they will be able to communicate with the fire control panel from two sides. Each zone shall have 2 line isolators.

1.3.3 Manual call points

Red manual "call" points will be installed at all exits and corridors at not more than 45m apart.

1.3.4 Conduits and wiring

Metal conduits shall be used for all installations of the automatic fire detection system. A fire retardant cable will be used in the installation.

1.3.5 Strobe lights

Basement parking, building corridors and building entrances/exits shall be installed with red strobe lights to act as a visual fire alarm.

1.3.6 Sirens and sounders

Smoke detectors and heat detectors fitted with base sounders shall be installed in corridors, staircase landings and lobbies to act as sound alarms in the event of a fire. The base sounders shall have a minimum of 103dBA at 1m.

1.3.7 Generator room

The Generator room shall be fitted with two types of heat detectors because of the nature of fires that can happen. The Generator room shall be fitted with a radiation type and rate of rise of temperature heat detectors.
A fire wall must be built around the Generator room.

Department:
Public Works
REPUBLIC OF SOUTH AFRICA

SPECIFICATION

FOR THE

SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF UNINTERRUPTED POWER SUPPLY

AT

VULAMEHLO MAGISTRATE COURT

DUDUDU

ELECTRICAL ENGINEER

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AUGUST 2014

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SPECIFICATION FOR THE SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF UNINTERRUPTED POWER SUPPLY

SECTION 1 – GENERAL

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SECTION 1 – GENERAL

1. Intent of Document

The specification is intended to cover the complete installation of the uninterrupted power supply. 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. Standards and Codes

Refer to clause 1 of Section 2 of this document for the relevant standards and codes.

All equipment shall be Y2K compliant.

3. Scope of Work

Supply, delivery, installation and commissioning of the complete uninterrupted power supply specified in this document.

The plant room will be provided by other trades and the contractor shall ensure that the space allowed is sufficient for the installation of the UPS and that the ventilation of the plant room is adequate. If any changes to the design have to be made the contractor must inform the consulting engineer in writing.

4. Ambient Operating Conditions

a) Ambient Temperature: 27°c
b) Relative Humidity: 55%
c) Altitude: 464M

5. Site Information

The site is at Vulamehlo Magistrate Court, Indududu A, Dududu, KwaZulu-Natal (P77 Dududu Main, Road, Scottburgh, 4180)

GPS Coordinates: 30°11'38.10"S, 30°36'41.63"E

6. Co-ordination

Due to the nature of the installation, a fixed sequence of operation is required to properly install the complete uninterrupted power supply. The work shall be closely scheduled in order not to delay the entire project.

The contractor shall familiarise himself with the requirements of the other trades and shall examine the plant and specification covering each of these sections.

The space requirements shall be carefully checked with the other trades to ensure that he equipment can be installed in the proper sequence in the space allocated.

7. Test Certificates and Inspections

The following tests are to be carried out :

(a) After completion of the works and before first delivery is taken, a full test will be carried out on the installation for a period of sufficient duration to determine the satisfactory working thereof. During this period the installation will be inspected and

the contractor shall make good, to the satisfaction of the Representative/Agent, any defects which may arise.

(b) The Contractor shall provide all instruments and equipment required for testing and any water, power and fuel required for the commissioning and testing of the installation at completion.

(c) Test reports of both tests as specified under (a) and (b) are to be submitted to the Department.

8. Guarantee and Maintenance

The Contractor shall guarantee the complete plant for a period of twelfth months after first delivery has taken place.

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 him to rectify the defects and/or replace the affected parts on site at his own expense.

The Contractor shall maintain the plant in good working condition for the full twelfth month period to the final delivery of the installation. However, should the Contractor fail to hand over the plant in good working order on the expiry of the specified twelfth months, the Contractor shall be responsible for further monthly maintenance until final delivery is taken.

During this period the contractor will undertake to arrange that the plant be inspected at regular intervals (whatever number of visits the contractor deems necessary to fully maintain the equipment) by a qualified member of his staff who shall: -

(a) Check the mechanical soundness of all parts

(b) Check and adjust all the output and control values of the system (voltage, frequency, control voltages, etc.)

(c) Take control measurements on the major system components and record these measurements.

(d) Replace all defective components.

(e) Service batteries.

(f) Check ventilation UPS equipment.

(g) Clean all equipment and/or rooms as required.

(h) Provide 24 hour standby maintenance and repair service at all times, including statutory holidays.

Note: At each visit, which shall be arranged in advance with the client's representative, a record of maintenance carried out shall be kept. The time and date of visits shall be entered in a logbook, which shall be kept in the plant room.

9. Materials and Workmanship

(a) The work throughout shall be executed to the highest standards and to the entire satisfaction of the Representative/Agent who shall interpret the meaning of the Contract Document and shall have the authority to reject any work and materials, which, in his judgement, are not in full accordance therewith. All condemned material and workmanship shall be replaced or rectified as directed and approved by the Engineer.

(b) All work shall be executed in a first-class manner by qualified tradesman.

(c) The Contractor shall warrant that the materials and workmanship shall be of the highest grade, that the equipment shall be installed in a practical and first-class manner in accordance with the best practices and ready and complete for full operation. It is specifically intended that all material or labour which is usually provided as part of such equipment as is called for and which is necessary for its proper completion and operation shall be provided without additional cost whether or not shown or described in the Contract Document.

(d) The Contractor shall thoroughly acquaint himself with the work involved and shall verify on site all measurements necessary for proper installation work. The Contractor shall also be prepared to promptly furnish any information relating to his own work as may be necessary for the proper installation work and shall co-operate with and co-ordinate the work of others as may be applicable.

(e) All components and their respective adjustment, which do not form part of the equipment installation work, but influence the optimum and safe operation of the equipment shall be considered to form part of, and shall be included in the Contractor's scope of works.

(f) All control equipment and serviceable items shall be installed and positioned such that they will be accessible and maintainable.

(g) The Contractor shall make sure that all safety regulations and measures are applied and enforced during the installation and guarantee periods to ensure the safety of the public and the User Client.

(h) The Contractor is to include for all scaffolding required to complete the work required.

10. Brochures

Detailed brochures of all equipment offered shall be presented together with the tender documents.

11. Submittals

The following information must accompany the tender documents

(a) The information requested in the schedule of information.

(b) A paragraph by paragraph schedule of compliance with detailed description of any deviations from this specification.

(c) If alternative systems are offered, a clear description of the operating characteristics and special features of the equipment along with a motivation for offering the alternative.

(d) Descriptive and illustrated brochures and other information pertaining to the inverter and ventilation equipment and switchgear.

(e) The proposed layout as stated.

(f) Arrangement of batteries.

(g) A sample test report as stated.

(h) The circuit diagram requested.

(i) The information requested.

(j) Tenderers shall submit a list of successful installations completed in the Republic of South Africa.

SPECIFICATION FOR THE SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF UNINTERRUPTED POWER SUPPLY

SECTION 2 – EQUIPMENT REQUIREMENTS

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1. QUALITY, STANDARDS AND REGULATIONS

All material and equipment supplied for this contract shall be new and the best of their respective kind. All new materials and equipment supplied, shall comply fully with the requirements laid down in the specification. The whole of the works shall be executed in accordance with best practice and to approval of the engineer. The equipment shall comply with the latest issues of the following standard specifications:

1.1 South African Bureau of Standards

SABS 150	Insulated wire.
SANS 1091	Colour standards for paint.
SANS 0142	Wiring code of practice.
SANS 1474	UPS units.

1.2 Regulations and Rights of Engineer

Apart from any other authority, which the engineer may have in terms of the contract, he shall have the right to set the standard and to accept or reject part of the specified equipment depending on the quality of material and workmanship offered.

The contractor shall be notified if the quality of such materials and/or workmanship is not acceptable. In such an event, the contractor shall replace the specific part or repair it to the satisfaction of the engineer, all at the cost of the contractor. Such an instruction shall not exempt the contractor from any of his obligations in terms of the contract.

The installation shall be erected and carried out in accordance with:

a) The Basic Conditions of Employment Act and the Machinery and Occupational Safety Act of 1983, as amended.

b) The local Municipality by-laws and Regulations as well as the regulations of the local Supply Authority.

c) The local Fire regulations.

d) The Regulations of the Department of Posts and Telecommunications.

e) The Standard Regulations of any Government Department or public service company where applicable.

In addition the contractor shall at his cost issue all notices in respect of the installation to the local authorities, and shall exempt the client from all losses, costs or expenditures which may arise as a result of the contractor's failure to comply with the requirements of the regulations enumerated above.

It shall be assumed that the contractor is conversant with the above-mentioned requirements. Should any requirements, by-law or regulation, which contradicts the requirements of this document, apply or become applicable during erection of the installation, the contractor shall immediately inform the engineer of such a contradiction. Under no circumstances shall the contractor carry out variations to the installation in terms of such contradictions without obtaining the written permission to do so from the engineer.

2. UNINTERRUPTED POWER SUPPLY (UPS)

2.1 Definitions

(a) UPS shall denote the complete UPS unit with associated controls, remote alarm panel and batteries and any accessories required by the system for its successful operation.

(b) Power Converter Module shall denote a rectifier, battery charger, inverter, electromechanical by-pass switch and manually operated by-pass switch.

(c) Rectifier shall denote that portion of the converter module containing the equipment and controls to convert the incoming AC power to regulated DC power required by the inverter.

(d) Inverter shall denote that part that converts the DC supplied by the rectifier to AC satisfying the load requirements.

(e) Electro-mechanical by-pass static switch shall denote a by-pass system provided break free switching from inverter to mains operation and vice versa.

(f) Battery charger shall denote that portion of the power converter module containing the equipment and controls to convert the incoming AC power to precisely regulated DC power required for battery charging.

(g) Critical load denotes the load as presented to the UPS by the computer or other load requiring constant supply and associated circuits and apparatus.

(h) Mean-Time-Between-Failure (MTBF) shall denote an overall MTBF of the UPS as a complete system.

(i) A system failure shall denote any interruption to, or degradation of the critical load bus voltage or frequency beyond the limits set forth herein.

(j) Efficiency shall denote the ratio of real output power (kW) to real input power (kW) with the UPS operating at a defined load power at the defined power factor, the battery fully charged and with nominal input voltage.

2.2 System Requirements (The Required Input and Output Voltages Are Detailed In Part 2 Of This Specification)

(A) Input to the UPS

(a)	Input voltage	:	400/231V ± 10%
(b)	Frequency	:	50Hz ± 4%
(c)	System	:	3 phase 4 wire with operative earth conductor, supplied from utility network or standby generator set. Refer to detail specification.
(d)	Power factor		Not less than 0,8 lagging.
(e)	Max starting current:		10 times full load current for not more than ½ a cycle with rectifier soft starting facility.

(B) Output to Load

(a)	Rating	:	Refer to detail specification.
(b)	Output voltage	:	Refer to detail specification.
(c)	Frequency	:	50 Hz ± 0,5 Hz.
(d)	System	:	1 phase 2 wire or 3 phase 4 wire with operative earth conductor. Refer to detail specification.
(e)	Voltage regulator	:	± 10% maximum deviation of steady state voltage recovering to within 5% in less than 50 ms and to within 1% less in that 100 ms.

(f) Frequency stability : Normally automatically synchronised to mains frequency if the latter is within 50 Hz ± 2% (adjustable window) Runs free at 50 Hz ± 0,5 Hz at any load when mains is out of limits.

(g) Harmonic content : Less than 4% total distortion.

(h) Amplitude modulation : Less than 2%

(C) Overall Performance

Efficiency (overall) : 80 - 85%

(D) Ambient Operating Conditions

Refer to Section 1, General – Clause 5

(E) System Description

The system shall consist of a static UPS complete with the following components:

(a) Rectifier/charger.

(b) Inverter.

(c) Battery.

(d) Automatic electronic no-break bypass circuit and switch.

(e) Separate manual bypass switch.

(f) Protective devices and measuring equipment.

(g) The required controls and necessary equipment.

(h) A self monitoring system with digital readout by means of which all critical functions can be checked.

The system shall be capable of providing an uninterrupted supply to the load with the output characteristics as specified for a minimum period of 30 minutes during a total mains failure (i.e. normal mains and standby generator supply failure). The batteries shall be rated at an AC load power factor of 0,8 lagging.

The complete system, including all controls shall be designed in such a way that the failure of any one vital central component will NOT cause a complete system failure. If necessary such a failure must be avoided by connecting the load directly to the mains by means of the bypass switch.

The UPS shall operate satisfactorily synchronous with the mains supply even under severe conditions of up to 100% unbalanced load.

The UPS shall be amply rated to carry the stated full load current. The UPS shall furthermore be capable of withstanding the following overloads.

Static Overloads: 100% of full load continuously.
125% of full load for 5 minutes.
150% of full load for 2 minutes.
165% of full load for 1 second with inductive decay after initial equipment switch on surge current.

Dynamic Overload : 300% for less than 5 msec.
1000% for less than 1 msec.

All component parts, cables and other connections shall be amply rated to withstand the overloads stated and maintain the input voltage at the load within the tolerances stated.

The equipment shall be designed for the maximum operating efficiency. The efficiency shall be determined when the system is delivering full load at 0,8 power factor with the batteries fully charged. The load required by the auxiliary equipment (controls, alarms, etc). electronic switches and cabinet fan shall be included in he determination of overall efficiency. A typical test report clearly showing how the efficiencies are calculated, shall be submitted with the tender.

It shall be the responsibility of the successful tenderer to ensure satisfactory operation of the complete system for the load to be supplied. It is, therefore, essential that the tenderer acquaint himself fully with typical load conditions before the tender closing date.

All cabinets containing thyristors shall be adequately screened and earthed to prevent direct radio frequency radiation.

Tenderers shall submit with their tenders a schematic diagram showing :

Input circuit breakers.
System busbars.
Rectifiers.
Batteries.
Inverters.
Electronic switches.
Bypass circuit.
Detour circuit.
Fuse protection.
Output circuit breakers.
Oscillator.
Power supply circuits to oscillator, alarms, controls, etc.
Battery isolator.

(F) Inverter Oscillator

The inverter shall contain an oscillator capable of operating and maintaining the inverter output frequency as specified. The inverter oscillator shall be capable of frequency synchronisation and phase locking to the mains (or standby generator) power source frequency. When operating as a slave to the mains or standby power and a failure occurs in the slaving signal, the invertor oscillator shall automatically revert to a free running state and maintain the specified limits. All changes in output frequency to free run or synchronise shall be gradual to suit the load requirements.

(G) Rectifier

The UPS shall have its own rectifier and rectifier transformer which shall operate satisfactorily from the mains or standby supply.

The rectifier shall be of the solid state type providing full wave rectification of the input voltage suitably regulated to suit the input requirements of the inverter. Where necessary, a high grade DC filter shall be utilised to limit the output ripple to within acceptable levels for the inverter input. Current limiting features shall be provided to protect the rectifier. The current limiting settings shall be variable for final adjustment on site.

Voltage free contacts shall be provided for the malfunction alarms of the rectifier.

An input monitoring circuit shall be provided for the rectifier. This circuit shall switch off the rectifier when the r.m.s. value or frequency of the input voltage falls below present values.

The necessary protection circuitry shall be provided to switch off the rectifier if any one of the rectifier phases should fail, thus presenting an unbalanced load to the incoming supply.

The output of the rectifier shall be connected in parallel to the battery and inverter.

The rectifier shall have over temperature protection. Temperature sensing probes shall be placed on the thyristor housing, thyristor mounting, or on the heat sink close to the thyristor. The sensing of the off coming air temperature alone is not acceptable.

Tenderers shall take into account the possible effects of harmonics that may be present on the input supply due to non-sinusoidal waveforms at the rectifier input, phase commutation, the effect of reactance during phase commutation etc. The input voltage monitoring circuits of the rectifiers shall be adequately filtered and buffered to ensure reliable load control and to prevent continuous on-off switching of the rectifiers.

For three phase units each of the three rectifier transformers shall have a different primary to secondary phase displacement in order to minimise the harmonics generated by the rectifiers.

(H) Inverter

The inverter shall be adequately protected against any excessive overload or short circuits that occur in the load. Reactive current limiting or other methods shall be employed to render the thyristors short circuit proof. The successful tenderer shall replace any thyristors or any inverter components at his own expense if these should be damaged.

The necessary feedback and control circuits shall be incorporated to ensure satisfactory operation separately or in synchronisation with the mains supply under all conditions of dynamic load variations, stated overloads, severe unbalanced conditions and high operating temperatures. The thyristor bridge shall contain the necessary auxiliary circuitry to ensure satisfactory operation.

The output of the inverter shall be connected in parallel with the thyristor switch output.

Each inverter shall have over temperature protection similar to the over temperature protection for the rectifier.

A discharge device shall be provided across the D.C. input to the inverter, which will discharge any capacitors in the inverter module when it is switched off.

(I) Battery charger

The battery charger shall be a solid state, constant voltage type providing full wave rectification of the input voltage with the output regulated to an accuracy as specified. A high grade D.C. filter shall be utilised to limit the output ripple to the stated tolerance. Current limiting features shall be provided. The value of the current limit setting, shall be in accordance with the maximum allowable charging current that the batteries can withstand.

The maintained voltage on float charge shall be such as to give maximum life to the batteries whilst maintaining the maximum charge conservation and minimising gas formation and water loss. The optimum float charge voltage shall be specified by the battery manufacturer but is expected to be approximately 2,23 volts per cell. The voltage shall be kept within ± 0,5% of the nominal value for all loads from no load to the full rated battery charger current when supplying the full output with batteries discharged.

(J) Computer rooms/office UPS installation

The rectifier shall be equipped with 2 independent over voltage shutdown contacts for maximum charger security.

The battery charger shall be designed to charge the batteries to 90% of its fully charged capacity within 14 hours and to 100% capacity within 20 hours.

The battery charger shall be capable of boost charging the batteries to 2,6 volt per cell. The boost facility shall be manually operated.

The battery charger shall be provided with a current limiting circuit.

The current limit setting shall be variable for easy adjustment on site.

The necessary voltage free contacts for the alarms and battery charger failures shall be allowed for in the tender price.

The battery charger shall have over temperature protection similar to the protection specified for the rectifier.

The battery charger shall have circuitry to inhibit the charging of batteries from the standby generator. This circuitry shall be activated by normally open contacts on the generator control panel. The interconnecting cables will be supplied and installed as part of this contract.
NOTE: This requirement is only applicable for UPS systems above 200kvA

(K) Battery

The battery capacity shall be sufficient to provide full load for the specified time. The capacity shall be rated at a maximum specific gravity of 1,245 at 25 C and correctly filled.

Tenderers shall state the discharge capacity of the battery after 10 hours of charge and the battery voltage at its terminals under various conditions. The inverter shall switch off on low battery voltage.

The battery cells shall be of the maintenance free type.

The batteries shall give satisfactory service for a minimum period of 3 years. Tenderers shall state the maximum expected lifetime of the batteries and motivate their statement, and provide a statement by the battery manufacturer supporting this and stating that the charger offered is suitable for the battery.

The cells must be mounted in a matching steel cabinet or in the same cabinet as the control equipment. The vented type cells should be mounted on a wooden stand, consecutively, numbered with positive and negative terminals clearly marked in a ventilated battery room.

The batteries shall be complete with cell inter-connectors and row inter-connectors. The output terminals shall be robust and adequately dimensioned for the output cable terminations.

The inter-connectors between cells and shall be made in a manner giving the lowest volt drop and maximum resistance to corrosion.

All connections to cells must consist of flexible cable to avoid mechanical stress at the cell terminals.

The tenderer shall describe the method of removal and replacement of a faulty cell.

The battery shall be complete with a battery fuse isolator capable of breaking the full load current drawn by the inverter. These battery fuse isolators shall be installed in the inverter unit room or cabinet.

Terminal posts should be effective for the expected lifetime of the battery and should be effective even if the cell is overfilled.

The battery may be resistance grounded through 5000 ohm to 10000 ohm for the purpose of ground fault.

Tenderers shall submit full details with dimensioned drawings of the batteries offered.

Tenderers shall submit the calculations and motivations complete with curves supporting the selection of a specific battery cell.

All cabling for the battery shall be installed on PVC cable trays and fitted to the satisfaction of the engineer.

(L) Automatic by-pass switch

An integral automatic bypass switch shall be provided to transfer the critical load without break to the mains should the UPS unit fail. The latter unit shall simultaneously be disconnected from the critical load bus. This transfer shall, however, be inhibited if the mains is out of synchronism with the UPS output. Retransfer to the UPS output shall be on a manual or automatic command. This switch must have a cover fitted screwed to the panel so as to make the operating of this switch impossible without having first removed the cover. This switch cover must also have the following words etched in white with a red background mounted on or adjacent the cover: CAUTION : BYPASS SWITCH ONLY : ONLY TO BE OPERATED BY QUALIFIED PERSONNEL

The static switch should prevent "hunting" and after trying unsuccessfully to switch a maximum of three times the static switch should be inhibited from further switching.

3. CONSTRUCTION OF CUBICLES AND SWITCHBOARDS

All the converter equipment shall be housed in totally enclosed, free standing, floor mounted cubicles, designed top provide adequate ventilation for the equipment.

All cubicles shall be rigid with suitably braced doors providing front access.

- All cubicles shall be vermin proof.

All equipment shall be mounted on the metal framework suitably arranged to provide safe operation and ease of access. Fuses and switchgear in particular should be safely accessible even under load conditions.

All power bridges, filters and other major components both in the inverter and rectifier, shall be completely withdrawable to facilitate rapid repair and/or replacement. The method of withdrawal shall be such that a complete module can be extracted in the operating condition so that checks and measurements may be made while in operation and access to all components facilitated.

All electronic printed circuit cards shall be of a good quality and shall be easy and simple to interchange.

All auxiliary power supplies shall be duplicated and shall be connected so as to operate in parallel redundancy. At least two primary sources of power shall be provided for each of the power supplies in the system.

Flexible wires shall not be soldered directly onto terminals but shall have a crimped tab, which is soldered onto a terminal or post. The wire wrapping technique shall be employed for electronic circuits where possible.

The front panel alarms shall be clearly and adequately marked in both official languages. A single line mimic layout of the switchgear shall be provided on the front of the cubicles providing a graphic display of the circuitry of the equipment involved.

All input and output power cables shall be terminated using approved cable glands, onto a cable gland support bracket. The cable conductors shall terminate at the connecting busbars or shall be connected directly to the appropriate switchgear. All power cables shall be properly numbered with wrap around cable markers with punched figures to identify cables at each termination point.

4. INSTRUMENTATION AND CONTROLS

All the required instrumentation as indicated on the drawings shall be provided.

Supply and install all the necessary controls for the operation of the system. Facilities shall be provided for controlling the rectifier, switching the inverter on, switching the inverter output to the synchronous motor/alternator and controlling the bypass thyristor switch circuit.

All control switching of the rectifier and inverter as well as the bypass operation shall be pushbutton initiated.

Standard electronic equipment from overseas manufactures shall not be accepted if not duly protected with transsorbs and metal oxide varistors in power supplies and external communication lines. Standard electronic equipment not internally protected with transsorbs or MOV's may be protected externally by means of transsorbs and MOV's mounted on klippon type terminals. All external communication and remote power supply lines shall be protected by means of transsorbs and MOV's of sufficient rating mounted on klippon type terminals.

5. ALARMS

All alarms shall be of the tell tale type with memory features e.g. a flashing light indicates a fault coupled with an audible alarm. The pressing of the appropriate button shall cancel the audible alarm and allow the alarm lamp to burn continuously until the fault is removed.

The following minimum alarm conditions shall be monitored on the equipment:

(1) Normal
(2) Mains failure
(3) Inverter failure
(4) Shutdown imminent
(5) Load on mains
(6) Overload
(7) Charger fails

Where required a remote panel must be supplied and installed. The alarms indicated must duplicate all the alarms indicated on the UPS control panel. In addition a buzzer must be provided. Any alarm occurring must sound the buzzer to draw attention. An alarm accept pushbutton to silence the buzzer must be provided.

Provision shall be made on all the alarms mentioned above to be remotely monitored. Normally open contacts shall be supplied at the converter for each alarm for this purpose. The contacts shall close under an alarm condition.

6. VENTILATION

All equipment racks shall be positioned in logical fashion on the floor in a configuration, which will ensure proper ventilation

Each cubicle containing heat-generating equipment (thyristors, transformers electronic circuitry, filters, etc) shall, where necessary, have extraction ventilation fans mounted on the top of the cubicle to assist air circulation. These fans shall be fed from the output distribution panel of the uninterrupted power supply.

7. QUALITY ASSURANCE

The manufacturer shall be responsible for the performance as specified herein and to prove such performances to the satisfaction of the engineer. Except as otherwise specified, the supplier must utilise facilities acceptable to the engineer.

8. DRAWINGS

As soon as possible after the awarding of the contract, the successful tenderer shall at his expense submit to the engineer for approval, three prints of:

(1) All general arrangement drawings.

(2) Detailed dimensioned drawings of all plant and equipment.

(3) Complete wiring diagrams and block schematic diagrams.

At the same time a list of all equipment designations, labels, etc. in both official languages shall be submitted for approval.

The approval of drawings shall not relieve the successful tenderer of his liability to carry out work in accordance with the terms of the contract.

On completion of the contract, a complete set of transparencies of all drawings of a quality acceptable to the engineer shall be handed to the engineer at the expense of the successful tenderer. These final drawings shall include:

(1) A proper and accurate as-made wiring diagram of the complete installation showing circuit numbers, terminal strip numbers and conductor colours.

(2) A schematic diagram clearly showing functions and component values. A material list showing make, model and characteristics of all components of the control equipment and switchgear is to be included.

(3) Fully dimensioned as-made physical layout drawing of the equipment, batteries and ventilation equipment.

(4) A detailed schedule of all wiring.

The contract shall be deemed incomplete until all drawings have been received by the client.

9. INSTRUCTION OF OPERATOR AND MANUALS

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 he is fully conversant with the equipment and handling thereof.

Three (3) copies of maintenance, fault-localising and operating manuals together with the drawings required shall be handed over to the engineer.

10. TESTS

The complete testing including the provision of test facilities, instruments, dummy loads and switchgear at the manufacturer's premises in the Republic of South Africa shall form part of this contract. If the factory tests cannot be performed in the RSA, the client may, at his discretion and own cost, decide to attend tests at the supplier's overseas factory. Tenderers shall not allow for this.

For the test in the manufacture's premises the client shall be notified four weeks in advance in order that a representative can be sent to witness these tests.

10.1 Battery tests

(1) The output voltage of the battery unit (i.e. all the cells making up one battery) shall be tested with the incoming supply removed.

(2) The full rated load for the battery shall then be connected to it. The voltage shall be measured at 5 minute intervals for the duration discharge period.

(3) The batteries shall be left to recharge. The voltage shall be checked after 14 hours with the load and incoming supply removed as well as with the load connected but incoming supply removed.

(4) When fully recharged, the voltage and specific gravity of every cell shall be measured with the incoming supply removed.

(5) The circulating A.C. current through and the A.C. voltage across the batteries shall be measured when the rectifiers are on with the battery discharged and fully charged.

10.2 Oscillator tests

(1) Frequency within tolerances at all loads.

(2) Parallel redundancy.

(3) Auto automatic synchronisation for connection of the synchronous motor/alternator to mains via the thyristor switch.

An electronic frequency counter shall be used to measure the frequency.

10.3 Rectifier tests

(1) Output voltage of rectifiers at no load and full load with batteries charged and not charged.

(2) Current limit, both for mains failure and return to mains.

(3) Switch off value mains input monitor.

(4) Sequential switch on for return to mains.

(5) Soft start circuits.

10.4 General

Ammeters will not be acceptable to prove the above items. A wave analyser and a recording oscilloscope will be required. Photographs shall be taken of the oscillograms by the contractor in the presence of the engineer.

The overall efficiency of the complete uninterrupted power supply shall be proved to be within the specified limit at full load and at no load.

The overcurrent protection mechanisms of the A.C.B. shall be proved by current injection (either primary or secondary)

The bypass and detour circuits shall be proved.

All alarms, indications and control functions shall be proved.

The test instruments provided shall in all cases be of high quality and suitable to be able to adequately assess the quantities being measured and the equipment being tested. All instruments shall be calibrated by a testing laboratory approved by the National Calibration Service of the CSIR. The test equipment remains the property of the successful tenderer.

At the completion of the tests, a full test report shall be submitted by the contractor to the engineer in triplicate.

Continuously adjustable dummy loads of a rating suitable to comprehensively test the UPS shall be provided by the contractor as well as any temporary cables required for the connection of the dummy load to the UPS on site.

11. CABINET

The contractor shall supply and install a metal cabinet with lockable doors of sufficient size to house all operating and maintenance instructions, drawings, spares, tools, etc.

12. SCHEMATIC DIAGRAM

A schematic diagram of the complete system shall be mounted in a suitable place and shall be resin encapsulated.

13. AUXILIARY EQUIPMENT

Tenderers shall make all allowances for plant required (i.e. hoists, cranes, trolleys, etc.) ensuring positioning of the equipment in the UPS room.

14. UPS POWER PLUG OUTLET

All UPS power plug outlets must be of the red non-standard 3-pin type with the earth pin not earthed to the plug baseplate to facilitate the installation of a single earth connection earthing system. Each socket outlet must be provided with a red plug top.

Each socket outlet must be labelled with an engraved label indicating the power circuit number to which it is connected.

15. DISTRIBUTION WIRING

All sub-distribution wiring circuits must be wired as follows:

15.1 Mains power plug circuits

4 mm^2 PVC/copper in red and black conductors and a 2,5mm^2 bare copper earth.

15.2 UPS power plug circuit

4 mm^2 PVC/copper in blue and black and a green PVC insulated 2,5mm^2 earth wire.

The black neutral conductors must be clearly labelled at each end as follows: "UPS" or "OKT"

15.3 UPS Earthing

The main earth bar must be connected to the insulated earth bar of the UPS via a removable copper link bar.

All UPS boards must have insulated earth bars, separately earthed to a clean 1,2m earth spike be means of 70mm^2 insulated earth to obtain at least one ohm at the UPS board.

SPECIFICATION FOR THE SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF UNINTERRUPTED POWER SUPPLY

SECTION 3 – SCHEDULES OF TECHNICAL INFORMATION

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SECTION 3 – SCHEDULES OF TECHNICAL INFORMATION

1. SYSTEM PARAMETERS

1.	Net output power of inverter system	kVA
2.	Power factor for which the system is rated	Lagging
3.	Nominal input voltage	Volts
4.	Maximum input voltage tolerated	Volts
5.	Minimum input voltage tolerated	Volts
6.	Maximum input frequency deviation tolerated	Hz
7.	Maximum and minimum input power factor at rated KVA	kVA
8	Maximum harmonic input tolerated for successful operation	%
9	Nominal output voltage	Volts
10	Steady state output voltage regulation	Volts
11	Dynamic output voltage regulation:	
(a)	Step load of 25% between 10% and 100% of full load	%
(b)	150% overload for 1 sec	%
(c)	Input voltage step variation of ± 15%	%
12	Time for voltage recovery to steady state:	
(a)	25% step load	ms
(b)	100% step load	ms
(c)	150% step load for 1 sec and then returned to 100%	ms

13.	Relative output phase angles at 100% unbalanced load (in degrees)	Degrees
14.	Maximum harmonic content of output voltage	%
15.	Overload capacity	
(a)	One hour	%
(b)	One minute	%
(c)	Ten seconds	%
(d)	One second	%
(e)	Five msec	%
(f)	One msec	%
16.	Total input required with batteries charged for rated full load	KVA
17.	Total input required at full load and and battery discharged	KVA
18.	Allowable temperature rise across equipment at input air temperature of:	
(a)	25 °C	°C
(b)	30 °C	°C
(c)	32 °C	°C
(d)	35 °C	°C
(e)	40 °C	°C
19.	Heat dissipation under normal full load Running conditions:	
(a)	Converter	KW

(b)	Battery		KW
20.	Efficiency of the complete UPS system	1.0p.f.	0.8p.f
(a)	Full load	%	%
(b)	80% load	%	%
(c)	75% load	%	%
(d)	65% load	%	%
(e)	50% load	%	%
(f)	40% load	%	%
21.	R.M.S. value of the A.C. current component through the batteries for:		
(a)	Discharged battery		Amp
(b)	Charged battery		Amp
22.	R.M.S. value of the A.C. voltage component through the batteries for:		
(a)	Discharged battery		Volts
(b)	Charged battery		Volts
23.	Total number of cubicles		
24.	Total floor space required		m^2
25.	Dimensions of cubicle in mm		W
			H
			L

2. BATTERY CHARGER

1.	Type	
2.	Output voltage for trickle charge	Volts
3.	Steady state regulation of output voltage trickle to full load	± %
4.	Output voltage for input voltage fluctuation	
(a)	± 10%	%
(b)	± 15%	%
5.	Ripple content (%)	%
6.	Current limit value	Amp
7.	Input voltage at which battery charger switches off	
(a)	Maximum	Volts
(b)	Minimum	Volts
8.	Maximum switch on inrush current	Ampere
9.	Battery charger overload protection (type)	
10.	Efficiency	%
11.	How is the effect of harmonics on input voltage minimised ?	

3. OSCILLATOR

1.	Type of oscillator (RC, crystal, etc.)	
2.	Stability:	
(a)	With oscillator supply fluctuation	± %
(b)	Temperature variation	± °C
(c)	Number of power supplies in parallel redundancy	
3.	Number of batteries from which oscillator is fed	
4.	Minimum time synchronise to mains frequency	sec

4. INVERTER

1.	Maximum continuous power output (kVA)	KVA
2.	Nominal output voltage	Volts
3.	Maximum harmonic content	%
4.	Nominal input voltage:	
(a)	Maximum	Volts
(b)	Nominal	Volts
(c)	Minimum	Volts
5.	Input current at full load	Ampere
6.	Input power factor at full load	Lagging
7.	Efficiency at full load	%
8.	Overload protection	

5. STATIC SWITCH

	Does switch comply to clause 3.2.2.12	
1.	Describe electronic switch	
2.	Minimum power factor at which switches will operate satisfactorily	
3.	How does switch derive operating signal ?	
4.	Maximum break time for switchover	ms

6. BATTERIES

1.	Manufacturer	
2.	Country of origin	
3.	Type	
4.	Type No	
5.	Total number of cells	
6.	Number of cells per inverter	
7.	Battery voltage (float conditions)	Volts
8.	Battery voltage (Boost charge)	Volts
9.	Capacity (rated for time required)	Ah at
		Hrs
10.	Battery time offered under load conditions specified in Clause 2.17 Part 2) and (Clause 3.2.2.5 (Part 3)	Minutes
11.	Maximum output current	Ampere

12.	Cell voltage under float conditions	Volts
13.	Cell conditions under boost conditions	Volts
14.	Cell voltage at start of discharge and full inverter load	Volts
15.	Cell voltage at end of discharge period	Volts
16.	Expected lifetime of batteries	Years
17.	Time to charge to 90% capacity	Hrs
18.	Total time to charge to 100% capacity	Hrs
19.	Material of supporting framework	
20.	Finish of framework	
21.	Dimensions of each cell	W
		H
		L
22.	Design of positive plate of cell	
23.	Rating of fused isolator	Ampere
24.	Cell configuration	

7. SYSTEMS ABOVE 200kVA

1.	No of shelves	
2.	No of rows/shelves	
3.	No of tiers/shelves	
4.	Shelf length	
5.	Shelf height (incl. Batteries)	

NOTE : ALL BATTERY CALCULATIONS INCLUDING CURVES SHALL BE INCLUDED IN THE TENDER

8. DETAILS OF MANUFACTURE OF UPS

1.	Manufacturer	
2.	Address	
3.	Country of origin	
4.	Make or trade name of equipment	
5.	Manufacture's type no.	
6.	Is tenderer an accredited agent ?	YES/NO
7.	Furnish details of maintenance and repair service facilities which can be rendered.	

Department:
Public Works
REPUBLIC OF SOUTH AFRICA

SPECIFICATION

FOR THE

SUPPLY, DELIVERY AND INSTALLATION OF ONE 150kVA EMERGENCY GENERATOR SET

AT

VULAMEHLO MAGISTRATE COURT

DUDUDU

ELECTRICAL ENGINEER

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AUGUST 2014

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SPECIFICATION FOR THE SUPPLY DELIVERY AN INSTALLATION OF EMERGENCY GENERATOR SET/S

SECTION 1 – GENERAL

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SECTION 1 – GENERAL

1. Intent of Document

The specification is intended to cover the complete installation of the generator plant. 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. Standards and Codes

Al work and equipment shall be in accordance with the requirements of BS5514 and shall comply with the Occupational Health and Safety Act, No 85 of 1993 and current regulations of all other codes applicable to this work.

All equipment shall be Y2K compliant.

3. Regulations

The installation shall be erected and tested in accordance with the following Acts and regulations:

a) The latest issue of SABS 0142: "Code of Practice for the Wiring of Premises",

b) The Occupational Health and Safety Act, 1993 (Act 85 of 1993) as amended,

c) The Local Government Ordinance 1939 (Ordinance 17 of 1939) as amended and the municipal by-laws and any special requirements of the local supply authority,

d) The Fire Brigade services Act 1993 Act 99 of 1987 as amended,

e) The National Building Regulations and Building Standards Act 1977 (Act 103 of 1977) as emended,

f) The Post Office Act 1958 (Act 44 of 1958) as amended,

g) The Electricity Act 1984 (Act 41 of 1984) as amended and

h) The Regulations of the local Gas Board where applicable.

4. Scope of Work

Supply, delivery and installation of the complete emergency generator set specified in this document.

The plant room will be provided by other trades and the contractor shall ensure that the space allowed is sufficient for the installation of the generator set and that the ventilation of the plant room is adequate.

5. Co-ordination

The standby generator room will be provided under this contract. This will include for construction of all foundations, plinths, openings, rebates, etc., required by the Contractor for the installation of the plant and equipment. A detail of all such foundations, plinths, openings, rebates, etc. Must be supplied with his tender.

The Contractor shall co-ordinate his program with the Civil, Structural, Electrical and Building Contractor. His installation rates shall include for such "first fixing: of plant as may be required, and for returning at a later stage to complete the installation when the other Contractor's has completed their operations, were necessary.

Delays due to lack of co-ordination between the Contractor's shall not form a basis for claims be the Contractor of this Contract.

6. Test Certificates and Inspections

The following tests are to be carried out:

(a) At the supplier's premises, before the generating set will be delivered to site Representatives of the Department may be present during the test to satisfy them that the generating set complies with the specification and delivers the specified output. The test must be carried out in accordance with BSS 5514, Part 2 and 3. The Department must be timeously advised of the date for the test.

(b) After completion of the works and before first delivery is taken, a full test will be carried out on the installation for a period of sufficient duration to determine the satisfactory working thereof. During this period the installation will be inspected and the contractor shall make good, to the satisfaction of the Representative/Agent, any defects which may arise.

(c) The Contractor shall provide all instruments and equipment required for testing and any water, power and fuel required for the commissioning and testing of the installation at completion.

(d) Test reports of both tests as specified under (a) and (b) are to be submitted to the Department.

7. Guarantee and Maintenance

The Contractor shall guarantee the complete plant for a period of twelfth months after the first delivery has taken place.

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 him to rectify the defects and/or replace the affected parts on site at his own expense.

The Contractor shall maintain the plant in good working condition for the full twelfth month period to the final delivery of the installation. However, should the Contractor fail to hand over the plant in good working order on the expiry of the specified twelfth months, the Contractor shall be responsible for further monthly maintenance until final delivery is taken.

During this period the contractor will undertake to arrange that the plant be inspected at least once per month by a qualified member of his staff who shall: -

(a) Report to the Officer-In-charge, keeping the maintenance records, and enter into a log book the date of the visit, the tests carried out, the adjustments made, and any further details that may be required.

(b) Grease and oil moving parts, where necessary.

(c) Check the air filter and, when necessary, clean the filter and replace filter oil.

(d) Check the lubricating oil and top-up when necessary.

(e) After the plant has run one oil change for the number of hours stipulated by the manufacturers, drain the sump and refill with fresh lubricating oil. The reading of the hour meter on the switchboard will be taken to establish the number of hours run by the plant.

Under this heading only the cost of the actual oil used, shall be charged as an extra on the monthly account.

(f) Clean the lubricating oil filter and/or replace the filter element at intervals recommended by the engine manufacturer, the cost of a new filter element to be charged as an extra on the monthly account.

(g) Check and when necessary adjust the valve settings and the fuel injection equipment.

(h) Check the battery and top-up the electrolyte when necessary.

(i) Test-run the plant for 0,5 hour and check the automatic starting with simulated faults on the mains, the proper working of all parts, including the electrical gear the protective devices with fault indicators, the changeover equipment and the battery charger. Make the necessary adjustments.

(j) Report to the Department and to the Contractor on any parts that become unserviceable through fair wear and tear, or damaged by causes beyond the control of the Contractor.

The Contractor on receiving the report, shall immediately submit a detailed quotation for the repair or replacement of such parts to the Department.

(k) Advise the Department when it has become necessary to de-carbonise the engine and submit a quotation for this service.

(l) Top up the water of the radiator, if applicable.

(m) Clean the plant and its components.

8. Materials and Workmanship

(a) The work throughout shall be executed to the highest standards and to the entire satisfaction of the Representative/Agent who shall interpret the meaning of the Contract Document and shall have the authority to reject any work and materials, which, in his judgement, are not in full accordance therewith. All condemned material and workmanship shall be replaced or rectified as directed and approved by the Engineer.

(b) All work shall be executed in a first-class manner by qualified tradesman.

(c) The Contractor shall warrant that the materials and workmanship shall be of the highest grade, that the equipment shall be installed in a practical and first-class manner in accordance with the best practices and ready and complete for full operation. It is specifically intended that all material or labour which is usually provided as part of such equipment as is called for and which is necessary for its proper completion and operation shall be provided without additional cost whether or not shown or described in the Contract Document.

(d) The Contractor shall thoroughly acquaint himself with the work involved and shall verify on site all measurements necessary for proper installation work. The Contractor shall also be prepared to promptly furnish any information relating to his own work as may be necessary for the proper installation work and shall co-operate with and co-ordinate the work of others as may be applicable.

(e) All components and their respective adjustment, which do not form part of the equipment installation work, but influence the optimum and safe operation of the equipment shall be considered to form part of, and shall be included in the Contractor's scope of works.

(f) All control equipment and serviceable items shall be installed and positioned such that they will be accessible and maintainable.

(g) The Contractor shall make sure that all safety regulations and measures are applied and enforced during the installation and guarantee periods to ensure the safety of the public and the User Client.

(h) The Contractor is to include for all scaffolding required to complete the work required.

9. **Imported Content**

This equipment will not be subject to fluctuations in the rate of exchange.

However, should the Contractor choose to be protected against fluctuations in the rate of exchange on imported equipment, the following conditions will apply:

a) The Materials Offered Ex-Import (Annexure A), which forms part of this tender document, must be completed by the Contractor.

b) Any fluctuations in the rate of exchange will be for the account of the Government and shall be calculated from a date seven (7) days prior to the date of the Contractor's tender to a date seven (7) days after receipt by the Contractor's bank of the negotiable bill of lading or the exporter's invoice, provided this latter date is not later than 30 days after the date of payment. Thereafter, fluctuations in the rate of exchange shall not be for the account of the Government.

10. **Brochures**

Detailed brochures of all equipment offered shall be presented together with the tender documents.

11. **Submittals**

The following information must accompany the tender documents

(a) Full particulars, performance curves and illustrations of the equipment offered, must be submitted with the Tender.

(b) The design of the control system to comply with the requirements for automatic starting, stopping, interlocking and isolation as specified.

(c) Curves furnished by the engine makers, showing the output of the engine offered against the speed, for both intermittent and continuous operation as well as fuel consumption curves when the engine is used for electric generation

The successful Tenderer must, as soon as possible after receipt of the order, submit detailed drawings and wiring diagrams of the plant and the switchgear. One diagram shall be contained in a metal pouch on the side of the switchboard.

SPECIFICATION FOR THE SUPPLY DELIVERY AN INSTALLATION OF AN EMERGENCY GENERATOR SET

SECTION 2 – EQUIPMENT REQUIREMENTS

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SECTION 2 – EQUIPMENT REQUIREMENTS

1. Engine

1.1 General

The engine must comply with the requirements as laid down in BS 5514 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 Tenderer.

Turbo-charged engines will only be accepted if the Tenderer submits a written guarantee that the engine can deliver full load within the specified starting period.

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.

1.3 De-Rating

The engine must be de-rated for the site conditions as set our in the Technical Specification, Section 3 of this document.

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 Department and must be motivated in detail. Such de-rating must be guaranteed in writing and proved by the successful Tenderer at the site test.

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.

Tenderers must state what arrangements are provided to ensure easy starting in cold weather. Full details of this equipment must be submitted. In the case of water cooled engines, any electrical heaters shall be thermostatically controlled. The electrical circuit for such heaters shall be taken from the control panel, and must be protected by a suitable circuit breaker.

1.5 Starter Battery

The set must be supplied 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 three consecutive start attempts from cold and thereafter a fourth attempt under manual control of not less than 20 seconds duration each. The battery must be of the heavy duty "low maintenance" type, house in a suitable battery box.

1.6 Cooling

The engine may be either of the air of water cooled type. In the case of water-cooling, a built-on heavy duty, tropical type pressurised radiator must be fitted. Only stand-by sets that are water cooled shall have electric heaters.

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 on the switchboard. Water-cooled engines shall in addition be fitted with a low water cut-out switch, 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.

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.

1.8 Fuel Pump

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

1.9 Fuel Tank

A fuel tank shall be installed in the plant room. The tank shall have sufficient capacity for standby sets to run the engine on full load for a period of 12 hours. The fuel tank shall be a free standing type should a base mounted tank be inadequate.

A water trap is fitted in the fuel pipeline from the 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 electrically operated pump with sufficient length of oil resistant hose to reach 2m beyond the door shall be supplied, for each set for filling the fuel tank/s from 200 litre drums.

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

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.

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.

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. 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.

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.

2. Alternator

2.1 General

The alternator shall be of the self excited brush less type, with enclosed ventilated drip proof housing and must be capable of supplying the specified output continuously with a temperature rise not exceeding the limits laid down in BS 5000 for rotor and stator 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.

Both windings must be fully impregnated for tropical climate and must have an oil resisting finishing varnish.

2.2 Regulation

The alternator must preferably be self-regulated without the utilisation of solid state elements. The inherent voltage regulation must not exceed plus or minus 5% of the nominal voltage specified, at all loads with the power factor between unity and 0,8 lagging and within the driving speed variations of 4,5% between no-load and full load.

2.3 Performance

The excitation system shall be designed to promote rapid voltage recovery following the sudden application of the load. The voltage shall recover to within 5% of the steady state within 300 mili-seconds following the application of full load and the transient voltage dip shall not exceed 18%.

2.4 Coupling

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

3. Switchboard

3.1 General

A switchboard must be supplied and installed to incorporate the equipment for the control and protection of the generating set and battery charging.

The switchboard must conform the specification as set out in the following paragraphs.

3.2 Construction

The switchboard shall be a totally enclosed, floor mounted unit, fabricated from steel panels, carried on and-substantial angle iron framework.

The board shall be flush fronted and all equipment to be mounted behind the front plate, on suitable supports.

All equipment, connections and terminals shall be easily accessible from the front. The front panels may be either hinged or removable and fixed with studs and chromium-plated cap nuts. Self tapping screws shall be used in the construction of the board.

All pushbuttons, pilot lights, control switches, instrument and control fuses, shall be mounted on hinged panels with the control wires in flexible looms.

The steelwork of the boards must be thoroughly de-rusted, primed with zinc chromate and finished with two coats of signal red quality enamel, or a baked powder epoxy coating.

Suitably rated terminals must be provided for all main circuits and the control and protection circuits. Where cable lugs are sued, these shall be crimped onto the cable strands. Screw terminals shall be of the type to prevent spreading of cable strands. All terminals shall be clearly marked.

For the control wiring, each wire shall be fitted with a cable or wire marker of approved type, and numbering of these markers must be shown on the wiring diagram on the switchboard. Control wiring shall be run in PVC trunking. The trunking shall be properly fixed to the switchboard steelwork. Adhesives shall not be acceptable for the fixing of trunking or looms.

The automatic control and protection equipment shall be mounted on a separate easily replaceable small panel with printed circuits. The equipment shall mainly be the "solid state" type. After mounting the equipment on the panel, the rear of this panel shall be sealed with epoxy-resin. However, other proven control systems may also be considered, but must be described in detail.

All equipment on the switchboard, such as contactors, isolators, busbars, etc., shall have ample current carrying capacity to handle at least 110% of the alternator full load current.

3.3 Protection and Alarm Devices

All switchboards shall be equipped with protection and alarm devices as described below.

A circuit breaker and an adjustable current limiting protection relay must be installed for protection of the alternator. The protection relay shall be of the type with inverse time characteristics. The relay shall cause contactor to isolate the alternator and stop the engine.

Protection must be provided for overload, high engine temperature, low lubricating oil pressure, over speed, start-failure, and low water level.

Individual relays with reset pushed are required, to give a visible signal and stop the engine when any of the protective devices operate. In the case of manual operation of standby sets, it shall not be possible to restart the engine.

The indicators and re-set pushes must be marked in both official languages respectively.

"OVERLOAD"	"OORLAS"
"TEMPERATURE HIGH"	"TEMPERATUUR HOOG"
"OIL PRESSURE LOW"	"OLIEDRUK LAAG"
"OVER-SPEED"	"OORSPOED"
"START FAILURE"	"AANSITFOUT"
"LOW WATER LEVEL"	"LAE WATERVLAK"

In addition two relays with reset pushes must be fitted giving and audible and visible signal when:

(a) The fuel level in the service tank is low. The reset push of this relay must be marked "FUEL LOW" - "BRANDSTOF LAAG".

In addition, a low-low level sensor must be provided. At this level the engine must stop to prevent air entering the fuel system.

(b) The battery charger failed. The reset push of this relay must be marked "CHARGER FAIL" - "BATTERYLAAIER FOUTIEF".

This is also applicable to the engine driven generator/alternator.

All relays must operate an alarm hooter. A pushbutton must be installed in the hooter circuit to stop the audible signal, but the fault indicating light on the control panel must remain lit until the fault has been rectified.

An on/off switch is not acceptable. After the hooter has been stopped, it must be re-set automatically, ready for a further alarm.

The hooter must be of the continuous duty and low consumption type. Both hooter and protection circuits must operate from the battery.

Potential free contacts from the alarm relay must be brought down to terminals for remote indication of alarm conditions.

A test pushbutton must be provided to test all indicators lamps.

3.4 Manual Starting

Each switchboard shall be equipped with two pushbuttons marked "START" and "STOP" for manual starting and stopping of the set.

3.5 Battery Staring Equipment

Each switchboard shall be equipped with battery charging equipment.

The charger shall operate automatically in accordance with the state of the battery and shall generally consist of an air-cooled transformer, a full wave solid state rectifier, and the necessary automatic control equipment of the constant voltage system.

The charger must be fed from the mains. An engine driven alternator must be also a provided for charging the battery while the set is operational. Failure of this alternator must also activate the battery charger failure circuit.

3.6 Switchboard Instruments

Each generating set shall have a switchboard equipped as follows:

(a) One flush square dial voltmeter, reading the alternator voltage, scaled as follows:

(i) 0-300V for single phase generators.
(ii) 0-500V for three phase generator. In this case a six position and off selector switch must be installed for reading all phase and phase to neutral voltages.

(b) A flush square dial combination maximum demand and instantaneous ampere meter for each phase, with resettable pointer suitably scaled 20% higher than the alternator rating. A red arc stripe above scale markings from 0-20A and a red radial line through the scale at full-load current shall be provided. These instruments shall be supplied complete with the necessary current transformer.

(c) One flush square dial vibrating type frequency meter, indicating the alternator frequency.

(d) A six digit running hour meter with digital counter, reading the number of hours the plant has been operating. The smallest figure on this meter must read $^{1}/_{10}$ hour.

(e) Fuses or m.c.b.'s for the potential voltage circuits of the meters.

(f) One flush square dial ampere meter suitably scaled for the battery charging current.

(g) One flush square dial voltmeter with a spring loaded pushbutton or switch for the battery voltage.

3.7 Marking

All labels, markings or instructions on the switchgear shall be in both official languages.

3.8 Earthing

An earth bar must be fitted in the switchboard, to which all non-current carrying metal parts shall be bonded.

The neutral point of the alternator must be solidly connected this bar by means of a removable link labelled "EARTH" "AARD". Suitable terminals must be provided on the earth bar for connection of up to three earth conductors, which will be supplied and installed by others.

3.9 Operation Selector Switch

A four position selector switch must be provided on the switchboard marked "AUTO", "MANUAL", "TEST" and "OFF" - "AUTO", "HANDBEHEER" "TOETS" and "AF".

With the selector on "AUTO", the set shall automatically start and stop, according to the mains supply being available or not.

With the selector on "TEST", it shall only be possible to start and stop the set with the pushbuttons, but the running set shall not be switched to the load.

With the selector on "MANUAL", the set must take the load when started with the pushbutton, but it must not be possible to switch the set on to the mains, or the mains onto the running set.

With the selector on "OFF", the set shall be completely disconnected from the automatic controls, for cleaning and maintenance of the engine.

3.10 Automatic Change-over System

A fully automatic change-over system must be provided to isolate the mains supply and connect the standby set to the outgoing feeder in case of a mains failure and reverse this procedure on return of the mains.

3.11 By-pass Switch and Main Isolator

The switchboard shall be equipped with an on-load isolator to isolate the mains and 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 main contractors, shall be isolated for maintenance purposes. It shall not be possible to start the engine except with the selector switch in the "TEST" position.

It is required that this by-pass switch and mains isolator be mounted away from the automatic control gear, in a separate compartment either on the side or in the lower portion of the switchboard cubicle, and that the switches operated from the front of the compartment.

3.12 Start Delay

Starting shall be automatic in event of a mains failure. A 0-15 second adjustable start delay timer shall be provided to prevent start-up on power trips or very short interruptions.

3.13 Stop Delay

A stop delay with timer is required for the set, to keep the set on load for an adjustable period of one to sixty seconds after the return of the mains supply, before changing back to the supply. An additional timer shall keep the set running for a further adjustable cooling period of 5 to 10 minutes at no-load before stopping.

4. Installation

Except for the supply of the incoming mains cable and outgoing feeder cables, the tenderer must include for the complete installation and wiring of the plant in running order, including the connection of the incoming cable and outgoing feeder cables.

The connecting of the cable and control cabling to the generator and the control terminals in the LV board remains the responsibility of the tenderer.

5. Warning Notices

Notices, in both official languages, must be installed in the plant rooms.

The contents of these notices are summarised below.

(a) Unauthorised entry prohibited.

(b) Unauthorised handing of equipment prohibited.

(c) Procedure in case of electric shock.

(d) Procedure in case of fire.

The successful tenderer must consult the Occupational Health and Safety Act 83 of 1993 and get approval of the wording from the Department's representative, prior to ordering the notices.

Lettering must be black on a yellow background.

Notices (a) must be installed outside next to the entrance of the plant room and (b-d) inside the plant room.

In the plant room, a clearly legible and indelible warning notice must be mounted in a conspicuous position.

The motive shall be made of a non-corrodible and non-deteriorating material, preferable plastic, and must read as follows:

DANGER: This engine will start without notice. Turn selector switch on control board to "OFF" before working on the plant.

GEVAAR: Hierdie masjien sal sonder waarskuwing begin loop. Draai keuseskakelaar op beheerpaneel na "AF" voordat aan die masjien gewerk word.

6. Construction

The engine and alternator of the set shall be built together on a common frame, which must be mounted on a skid base on anti-vibration mountings. The set must be placed direct on the concrete of the generator room. 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.

The frame must be of the 'DUPLEX' type.

7. Operation

The set is required to supply the lighting and power requirements in the case of a mains power failure.

The set shall be fully automatic i.e. it shall start when any one phase of the main supply fails or get switched and shall shut down when the normal supply is re-established. In addition it shall be possible to manually start and stop the set by means of pushbuttons on the switchboard.

The automatic control shall make provision for three consecutive starting attempts. 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.

To prevent the alternator being electrically connected to the mains supply when the mains supply is on and vice versa, a safe and fail proof system of suitably interlocked contactors shall be supplied and fitted to the changeover switchboard.

SPECIFICATION FOR THE SUPPLY DELIVERY AN INSTALLATION OF AN EMERGENCY GENERATOR SET

SECTION 3 – TECHNICAL SPECIFICATION

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SECTION 3 – TECHNICAL SPECIFICATION

1. General

Supply, deliver, install, commission, test and maintain an emergency generating set at Vulamehlo Magistrate Court, Dududu, KwaZulu-Natal.

This installation must comply fully with all the sections and drawings of this document. This technical specification is supplementary to the Equipment Requirements, Section 2, and must be read together where they are at variance the Technical Specification shall apply.

2. Site Information And Conditions

2.1 Location

The site is at Vulamehlo Magistrate Court, Indududu A, Dududu, KwaZulu-Natal (P77 Dududu Main, Road, Scottburgh, 4180)

GPS Coordinates: 30°11'38.10"S, 30°36'41.63"E

2.2 Site Conditions

The following site conditions will be applicable and equipment shall be suitably rated to develop their assigned rating and duty at these conditions.

a)	Height above sea level	: 464 meters
b)	Maximum ambient temperature	: 38 °C
c)	Maximum ambient humidity at lowest temperature	: 55 %

3. Output And Voltage

After the de-rating factors for the engine and generator due to site conditions have been taken into account, the set must have a site output and voltage as follows: -

No load voltage	:	400/230 Volt
Rating	:	150 kVA
Power at 0,8 power factor	:	120 kW
Frequency	:	50Hz
Fault Level	:	10kA.

4. Switchboard/Control Panel Unit

All switch- and control gear shall be rated for a fault current level of 10kA.

The switchboard/control panel unit shall be a free standing floor mounted type, which shall be installed in the plant room.

5. Cables

The contractor will be responsible for all electrical cable connections associated with the complete generating set installation.

The following cables will be supplied, installed and terminated at the Switchboard by others. Adequate provision shall be made for the termination of these cables at the Switchboard:

DB fed	PVC PVC SWA PVC Cable
DB1 Ess	185 mm²

6. Engine

A sump drainpipe must be fitted with a shut-off valve placed in a convenient position outside the base frame to facilitate drainage.

Recommended oil types must be indicated on the engine, or base frames, by means of suitable labels.

All engine instruments shall have clear markings on the faceplates, indicating the normal operating zone(s), maximum and minimum allowable values/limits and danger zone(s).

The flywheel shall be covered by approved hoods.

7. Alternator

The Alternator shall be of the low harmonic type.

8. Load Acceptance

The generator set shall be capable of accepting 75% of the specified site electrical output 10 seconds after the starter motor is energised and the remaining 25%, 5 seconds thereafter, i.e. 100% load acceptance shall not exceed 15 seconds.

9. Generator Room

The size of the plinth will be 4000 mm wide x 7000 mm long x 500 mm high.

10. Alarms

The successful tenderer must pay particular attention to the requirements of the alarms as described in the Equipment Requirements, Section 2.

One alarm hooter and red light shall be supplied and installed on the outside wall of the generator room in the position as shown on the drawing in this specification.

The hooter shall consist of an electronic unit similar and equal to a "Klaxon" - type SY2/725 hooter with a continuously rated output and 110 db at a distance of 2 metres, and shall be IP55 weatherproof rated.

The warning light shall consist of a 40W flashing red light, which shall be mounted on a galvanised steel frame together with the hooter.

The hooter and light shall be switched on or off simultaneously after initiation or cancellation of an alarm condition. The supply and installation of the wiring between the control board and the alarm unit forms part of this contract.

The successful tenderer must ensure that the hooter control circuit resets automatically after cancellation due to a low fuel condition or battery charger failure, but the visible fault indication must remain, i.e. should the operator continue to run the set, the hooter must sound, should any other condition develop.

A remote alarm panel shall be supplied and installed by the contractor in the control room. This shall be of surface mounting, enamelled sheet metal (colour to approval), minimum depth construction, and shall incorporate a flashing red pilot alarm light, adjustable electronic sounder, and a silence push button. The silence button shall not switch off the pilot light - this shall only be switched off when the alarm is reset at the Generator Panel.

A 2,5mm² x 4-core PVC SWA PVC cable will be supplied, installed and terminated by others between the Generator Panel and the Charge Office. The Contractor shall connect this cable at both ends and shall supply and install all switch gear relays, etc. to ensure satisfactory operation of the Remote Alarm Panel.

11. Remote Control Generator Switch

A Remote Control Generator "ON/OFF/AUTO" switch will be supplied and installed by others in the Police Station Charge Office, and a 2,5mm² x 4-core PVC SWA PVC cable will be supplied and installed by others between the Charge Office and the Generator Panel.

The contractor shall connect this cable at both ends, and shall supply and install all switch gear, relays, etc. to ensure satisfactory operation of the remote control switch.

12. Fuel Drip Tray

A drip tray approximately 100mm deep shall be mounted below the fuel tank and must be large enough to collect any fuel that drips from the tank accessories. The drip tray shall be manufactured from black mild steel. The thickness of the drip tray sheet steel shall not be less than 2mm.

13. Completion Time

The Generator Set is required to be commissioned in conjunction with the building contract.

14. Inform

The successful tenderer shall inform the Engineer when the set is ready for installation.

15. Fuel Supply Tank

The fuel tank shall be a free-standing type, which shall be installed in the plant room. The tank shall have sufficient capacity for the generating set to run the engine on full load for a period of 12 hours.

A drip tray approximately 100mm deep shall be mounted below the fuel tank and must be large enough to collect any fuel that drips from the tank accessories. The drip shall be manufactured from black mild steel with a thickness of not less than 2mm.

SPECIFICATION FOR THE SUPPLY DELIVERY AN INSTALLATION OF AN EMERGENCY GENERATOR SET

SECTION 4 – SCHEDULES OF TECHNICAL INFORMATION

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SECTION 4 – SCHEDULES OF TECHNICAL INFORMATION

1. Engine

NO	ITEM	REMARKS
1.	Manufacturer's Name	
2.	Country of Origin	
3.	Manufacturer's model No. and year of manufacture	
4.	Continuous sea level rating after allowing for ancillary equipment : a) In b.h.p. b) In kW	
5.	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	
6.	Net output on site in kW	
7.	Nominal speed in r.p.m.	
8.	Number of cylinders	
9.	Strokes per working cycle	
10.	Stroke in mm	
11.	Cylinder bore in mm	
12.	Swept volume in cm^3	
13.	Mean piston speed in m/min	
14.	Compression ratio	
15.	Cyclic irregularity	
16.	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.	
17.	Make of fuel injection system.	
18.	Capacity of fuel tank in litres	
19.	Is gauge glass fitted to tank?	
20.	Is electric pump for filling the fuel tank included?	
21.	Method of starting	
22.	Voltage of starting system	

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

2. Alternator

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 tropicalised?	
18.	Symmetrical short circuit current at terminals n Ampere	
19.	Type of Coupling	

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.	Ration of current transformers	
10.	Make of hour meter	
11.	Range of cyclometer counter	
12.	Smallest unit shown on counter (Item 11)	
13.	Make 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	
20.	Is control and protection equipment mounted on a small removable panel?	
21.	Type of control equipment	

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

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	

5. Dimensions

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	

6. Deviation from the Specification as An Alternative (State Briefly)

NO	DESCRIPTION

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	