public works
& infrastructure

Department:
Public Works and Infrastructure
REPUBLIC OF SOUTH AFRICA

SPECIFICATIONS

&

BILLS OF QUANTITIES

DEPARTMENT OF JUSTICE
PIETERMARITZBURG HIGH COURT

INSTALLATION OF A GENERATOR

PROJECT CODE: 056689

ELECTRICAL INSTALLATION

JULY 2023

INSTALLTION OF A GENERATOR
DEPARTMENT OF JUSTICE
WCS056689

AT

PIETERMARITZBURGH HIGH COURT

CONSISTING OF:

ELECTRICAL WORK

REGIONAL OFFICE: Department of Public Works: DURBAN
Private Bag x54315
DURBAN
4000

PART 1: GENERAL

NOTICE TO TENDERERS

1. The tenderer for the principal electrical contract shall submit additional information regarding the installers of the Specialist Electrical Installations (Parts B and C) together with the returnable enclosed with the tender enquiry documents
2. The Electrical Contractor shall submit the schedules of information for each installation with his tender.
3. Failure to compile / return the schedules may disqualify the Tender as it will not be possible to adjudicate the offer.
4. Drawings accompany this tender and will form part of this Specification.

PART A: GENERAL ELECTRICAL INSTALLATIONS

PART 1: GENERAL

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1 TESTS

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 installations will be inspected and the Contractor shall make good, to the satisfaction of the Representative/Agent, any defects which may arise.

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 installations at completion.

2 MAINTENANCE OF INSTALLATIONS

With effect from the date of the First Delivery Certificate the Contractor shall at his own expense undertake the regular servicing of the installation during the maintenance period and shall make all adjustments necessary for the correct operation thereof.

THE NORMAL CONTRACTUAL FREE MAINTENANCE AND GUARANTEE PERIOD INCLUDED IN THIS CONTRACT SHALL BE 12 MONTHS.

If during the said period the installations is not in working order for any reason for which the Contractor is responsible, or if the installations develops defects, he shall immediately upon being notified thereof take steps to remedy the defects and make any necessary adjustments.

Should such stoppages however be so frequent as to become troublesome, or should the installations otherwise prove unsatisfactory during the said period the Contractor shall, if called upon by the Representative/Agent or the Director-General, at his own expense replace the whole of the installations or such parts thereof as the Representative/Agent or the Director-General may deem necessary with apparatus specified by the Representative/Agent or the Director-General.

3 REGULATIONS

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

a) The latest issue of SANS 10142: "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 amended,

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 NOTICES AND FEES

The Contractor shall give all notices required by and pay all necessary fees, including any connection and inspection fees, which may be due to the local Supply Authority.

On production of the official account, only the net amount of the fee charged by the Supply Authority for connection of the installation to the supply mains will be refunded to the Contractor by the Department.

5 SCHEDULE OF FITTINGS

In all instances where schedule of light, socket outlet and power points are attached to or included on the drawings, these schedules are to be regarded as forming part of the specification.

6 QUALITY OF MATERIALS

Only materials of first class quality shall be used and all materials shall be subject to the approval of the Department. Departmental specifications for various materials to be used on this Contract are attached to and form part of this specification.

Wherever applicable the material is to comply with the relevant South African Bureau of Standards, specifications, or to British Standard Specifications, where no SABS Specifications exist.

Materials wherever possible, must be of South African manufacture.

7 CONDUIT AND ACCESSORIES

The type of conduit and accessories required for the service, i.e. whether the conduit and accessories shall be of the screwed type, plain-end type or of the non-metallic type and whether metallic conduit shall be black enamelled or galvanised, is specified in Part 2 of this specification.

Unless other methods of installation are specified for certain circuits, the installation shall be in conduit throughout. No open wiring in roof spaces or elsewhere will be permitted.

The conduit and conduit accessories shall comply fully with the applicable SABS specifications as set out below and the conduit shall bear the mark of approval of the South African Bureau of Standards.

a) Screwed metallic conduit and accessories: SABS 1065, parts 1 and 2.

b) Plain-end metallic conduit and accessories: SABS 1065, parts 1 and 2.

c) Non-metallic conduit and accessories: SABS 950

All conduit fittings, except couplings, shall be of the inspection type. Where cast metal conduit accessories are used, these shall be of malleable iron. Zinc base fittings will not be allowed.

Bushes used for metallic conduit shall be brass and shall be provided in addition to locknuts at all points where the conduit terminates at switchboards, switch-boxes, draw-boxes, etc. Draw-boxes are to be provided in accordance with the "Wiring Code" and wherever necessary to facilitate easy wiring.

For light and socket outlet circuits, the conduit used shall have an external diameter of 20mm. In all other instances the sizes of conduit shall be in accordance with the "Wiring Code" for the specified number and size of conductors, unless otherwise directed in part 2 of this specification or indicated on the drawings.

Only one manufactured type of conduit and conduit accessories will be permitted throughout the installation.

Running joints in screwed conduit are to be avoided as far as possible and all conduit systems shall be set or bent to the required angles. The use of normal bends must be kept to a minimum with exception of larger diameter conduits where the use of such bends is essential.

All metallic conduits shall be manufactured of mild steel with a minimum thickness of 1,2mm for plain-end conduit and 1,6mm in respect of screwed conduit.

Under no circumstances will conduit having a wall thickness of less than 1,6mm be allowed in screeding laid on top of concrete slabs.

Bending and setting of conduit must be done with special bending apparatus manufactured for the purpose and which are obtainable from the manufacturers of the conduit systems. Damage to conduit resulting from the use of incorrect bending apparatus or methods applied must on indication by the Department's inspectorate staff, be completely removed and rectified and any wiring already drawn into such damaged conduits must be completely renewed at the Contractor's expense.

Conduit and conduit accessories used for flame-proof or explosion proof installations and for the suspension of luminaires as well as all load bearing conduit shall in all instances be of the metallic screwed type.

All conduit and accessories used in areas within 50 km of the coast shall be galvanised to SABS 763.

Tenderers must ensure that general approval of the proposed conduit system to be used is obtained from the local electricity supply authority prior to the submission of their tender. Under no circumstances will consideration be given by the Department to any claim submitted by the Contractor which may result from a lack of knowledge in regard to the supply authority's requirements.

8 CONDUIT IN ROOF SPACES

Conduit in roof spaces shall be installed parallel or at right angles to the roof members and shall be secured at intervals not exceeding 1,5m by means of saddles screwed to the roof timbers.

Nail or crumpets will not be allowed.

Where non-metallic conduit has been specified for a particular service, the conduit shall be supported and fixed with saddles with a maximum spacing of 450 mm. The Contractor shall supply and install all additional supporting timbers in the roof space as required.

Under flat roofs, in false ceilings or where there is less than 0,9m of clearance, or should the ceilings be insulated with glass wool or other insulating material, the conduit shall be installed in such a manner as to allow for all wiring to be executed from below the ceilings.

Conduit runs from distribution boards shall, where possible terminate in fabricated sheet steel draw-boxes installed directly above or in close proximity to the boards.

9 SURFACE MOUNTED CONDUIT

Wherever possible, the conduit installation is to be concealed in the building work; however, where unavoidable or otherwise specified under Part 2 of the specification, conduit installed on the surface must be plumbed or levelled and only straight lengths shall be used.

The use of inspection bends is to be avoided and instead the conduit shall be set uniformly and inspection coupling used where necessary.

No threads will be permitted to show when the conduit installation is complete, except where running couplings have been employed.

Running couplings are only to be used where unavoidable, and shall be fitted with a sliced coupling as a lock-nut.

Conduit is to be run on approved spaced saddles rigidly secured to the walls.

Alternatively, fittings, tees, boxes, couplings etc., are to be cut into the surface to allow the conduit to fit flush against the surface. Conduit is to be bedded into any wall irregularities to avoid gaps between the surface and the conduit.

Crossing of conduits is to be avoided; however, should it be necessary purpose-made metal boxes are to be provided at the junction. The finish of the boxes and positioning shall be in keeping with the general layout.

Where several conduits are installed side by side, they shall be evenly spaced and grouped under one purpose-made saddle.

Distribution boards, draw-boxes, industrial switches and socket outlets etc., shall be neatly recessed into the surface to avoid double sets.

In situations where there are no ceilings the conduits are to be run along the wall plates and the beams.

Painting of surface conduit shall match the colour of the adjacent wall finishes.

Only approved plugging materials such as aluminium inserts, fibre plugs, plastic plugs, etc., and round-head screws shall be used for fixing saddles, switches, socket outlets, etc., to walls, wood plugs and the plugging in joints in brick walls are not acceptable.

10 CONDUIT IN CONCRETE SLABS

In order not to delay building operations the Contractor must ensure that all conduits and other electrical equipment which are to be cast in the concrete columns and slabs are installed in good time.

The Contractor shall have a representative in attendance at all times when the casting of concrete takes place.

Draw-boxes, expansion joint boxes and round conduit boxes are to be provided where necessary. Sharp bends of any nature will not be allowed in concrete slabs.

Draw and/or inspection boxes shall be grouped under one common cover plate, and must preferable be installed in passages or male toilets.

All boxes, etc., are to be securely fixed to the shuttering to prevent displacement when concrete is cast. The conduit shall be supported and secured at regular intervals and installed as close as possible to the neutral axis of concrete slabs and/or beams.

Before any concrete slabs are cast, all conduit droppers to switchboards shall be neatly spaced and rigidly fixed.

11 FLEXIBLE CONNECTIONS FOR CONNECTING UP OF STOVES, MACHINES, ETC.

Flexible tubing connections shall be of galvanised steel construction, and in damp situations of the plastic sheathed galvanised steel type. Other types may only be used subject to the prior approval of the Department's site electrical representative.

Connectors for coupling onto the flexible tubing shall be of the gland or screw-in types, manufactured of either brass or cadmium or zinc plated mild steel, and the connectors after having been fixed onto the tubing, shall be durable and mechanically sound.

Aluminium and zinc alloy connectors will not be acceptable.

12 WIRING:

Except where otherwise specified in Part 2 of this specification, wiring shall be carried out in conduit throughout. Only one circuit per conduit will be permitted.

No wiring shall be drawn into conduit until the conduit installation has been completed and all conduit ends provided with bushes. All conduit to be clear of moisture and debris before wiring is commenced.

Unless otherwise specified in Part 2 of this specification or indicated on the service drawings, the wiring of the installation shall be carried out in accordance with the "Wiring Code". Further to the requirements concerning the installation of earth conductors to certain light points as set out in the "Wiring Code" , it is a specific requirement of this document that where plain-end metallic conduit or non-metallic conduit has been used, earth conductors must be provided and drawn into the conduit with the main conductors to all points, including all luminaires and switches throughout the installation.

Wiring for lighting circuits is to be carried out with 2,5mm² conductors and a 2,5mm² earth conductor. For socket outlet circuits the wiring shall comprise 4mm² conductors and a 2,5mm² earth conductor. In certain instances, as will be directed in Part 2 of this specification, the sizes of the aforementioned conductors may be increased for specified circuits. Sizes of conductors to be drawn into conduit in all other instances, such as feeders to distribution boards, power points etc., shall be as specified elsewhere in this specification or indicated on the drawings. Sizes of conductors not specified must be determined in accordance with the "Wiring Code".

The loop-in system shall be followed throughout, and no joints of any description will be permitted.

The wiring shall be done in PVC insulated 600/1000 V grade cable to SABS 150.

Where cable ends connect onto switches, luminaires etc., the end strands must be neatly and tightly twisted together and firmly secured. Cutting away of wire strands of any cable will not be allowed.

13 SWITCHES AND SOCKET OUTLETS

All switches and switch-socket outlet combination units shall conform to the Department Quality Specifications which form part of this specification.

No other than 16A 3 pin sockets are to be used, unless other special purpose types are distinctly specified or shown on the drawings.

All light switches shall be installed at 1,4m above finished floor level and all socket outlets as directed in the Schedule of Fittings which forms part of this specification or alternatively the height of socket outlets may be indicated on the drawings.

14 SWITCHGEAR

Switchgear, which includes circuit breakers, iron-clad switches, interlocked switch-socket outlet units, contactors, time switches, etc., is to be in accordance with the Departmental Quality Specifications which form part of this specification and shall be equal and similar in quality to such brands as may be specified.

For uniform appearance of switchboards, only one approved make of each of the different classes of switchgear mentioned in the Quality Specifications shall be used throughout the installations.

15 SWITCHBOARDS

All boards shall be in accordance with the types as specified, be constructed according to the detail or type drawings and must be approved by the Department before installation.

In all instances where provision is to be made on boards for the supply authority's main switch and/or metering equipment the contractor must ensure that all requirements of the authorities concerned in this respect are met.

Any construction or standard type aboard proposed as an alternative to that specified, must have the prior approval of the Department.

All bus bars, wiring, terminals, etc., are to be adequately insulated and all wiring is to enter the switchgear from the back of the board. The switchgear shall be mounted within the boards to give a flush front panel. Cable and boxes and other ancillary equipment must be provided where required.

Clearly engraved labels are to be mounted on or below every switch. The working of the labels in English and Afrikaans, is to be according to the lay-out drawings or as directed by the Department's representative and must be confirmed on site. Flush mounted boards to be installed with the top of the board 2,0m above the finished floor level.

16 WORKMANSHIP AND STAFF

Except in the case of electrical installations supplied by a single phase electricity supply at the point of supply, an accredited person shall exercise general control over all electrical installation work being carried out.

The workmanship shall be of the highest grade and to the satisfaction of the Department.

All inferior work shall, on indication by the Department's inspecting officers, immediately be removed and rectified by and at the expense of the Contractor.

17 CERTIFICATE OF COMPLIANCE

On completion of the service, a certificate of compliance must be issued to the Department's Representative/Agent in terms of the Occupational Health and Safety Act, 1993 (Act 85 of 1993).

18 EARTHING OF INSTALLATION

Main earthing

The type of main earthing must be as required by the supply authority if other than the Departments, and in any event as directed by the Department's representative, who may require additional earthing to meet test standards.

Where required an earth mat shall be provided, the minimum size, unless otherwise specified, being 1,0m x 1,0m and consisting of 4mm diameter hard-drawn bare copper wires at 250mm centres, brazed at all intersections.

Alternatively or additionally earth rods or trench earths may be required as specified or directed by the Department's authorised representative.

Installations shall be effectively earthed in accordance with the "Wiring Code" and to the requirements of the supply authority. All earth conductors shall be stranded copper with or without green PVC installation.

Connection from the main earth bar on the main board must be made to the cold water main, the incoming service earth conductor, if any and the earth mat or other local electrode by means of 12mm x 1,60 mm solid copper strapping or 16 mm^2 stranded (not solid) bare copper wire or such conductor as the Department's representative may direct. Main earth copper strapping where installed below 3m from ground level, must be run in 20 mm diameter conduit securely fixed to the walls.

All other hot and cold water pipes shall be connected with 12mm x 0,8mm perforated for solid copper strapping (not conductors) to the nearest switchboard. The strapping shall be fixed to the pipework with brass nuts and bolts and against walls with brass screws at 150 mm centres. In all cases where metal water pipes, down pipes, flues, etc., are positioned within 1,6m of switchboards an earth connection consisting of copper strapping shall be installed between the pipework and the board. In vertical building ducts accommodating both metal water pipes and electrical cables, all the pipes shall be earthed at each distribution board.

Roofs, gutters and down pipes

Where service connections consist of overhead conductors, all metal parts of roofs, gutters and down pipes shall be earthed. One bare 10mm^2 copper conductor shall be installed over the full length of the ceiling void, fixed to the top purlin and connected to the main earth conductor and each switchboard. The roof and gutters shall be connected at 15m intervals to this conductor by means of 12mm X 0,8mm copper strapping (not conductors) and galvanised bolts and nuts. Self-tapping screws are not acceptable. Where service connections consist of underground supplies, the above requirements are not applicable.

Sub-distribution boards

A separate earth connection shall be supplied between the earth busbar in each sub-distribution board and the earth busbar in the Main Switchboard. These connections shall consist of bare or insulated stranded copper conductors installed along the same routes as

the supply cables or in the same conduit as the supply conductors. Alternatively armoured cables with earth continuity conductors included in the armouring may be utilised where specified or approved.

Sub-circuits

The earth conductors of fall sub-circuits shall be connected to the earth busbar in the supply board in accordance with SABS 0142.

Ring Mains

Common earth conductors may be used where various circuits are installed in the same wire way in accordance with SABS 0142. In such instances the sizes of earth conductors shall be equivalent to that of the largest current carrying conductor installed in the wire way, alternatively the size of the conductor shall be as directed by the Engineer. Earth conductors for individual circuits branching from the ring main shall by connected to the common earth conductor with T-ferrules or soldered. The common earth shall not be broken.

Non-metallic Conduit

Where non-metallic conduit is specified or allowed, the installation shall comply with the Department's standard quality specification for "conduit and conduit accessories".

Standard copper earth conductors shall be installed in the conduits and fixed securely to all metal appliances and equipment, including metal switch boxes, socket-outlet boxes, draw-boxes, switchboards, luminaires, etc. The securing of earth conductors by means of self-threading screws will not be permitted.

Flexible Conduit

An earth conductor shall be installed in all non-metal flexible conduits. This earth conductor shall not be installed externally to the flexible conduit but within the conduit with the other conductors. The earth conductor shall be connected to the earth terminals at both ends of the circuit.

Connection

Under no circumstances shall any connection points, bolts, screws, etc., used for earthing be utilised for any other purpose. It will be the responsibility of the Contractor to supply and fit earth terminals or clamps on equipment and materials that must be earthed where these are not provided.

Unless earth conductors are connected to proper terminals, the end shall be tinned and lugged.

19 MOUNTING AND POSITIONING OF LUMINAIRES

The Contractor is to note that in the case of board and acoustic tile ceilings, i.e. as opposed to concrete slabs, close co-operation with the building contractor is necessary to ensure that as far as possible the luminaires are symmetrically positioned with regard to the ceiling pattern.

The lay-out of the luminaires as indicated on the drawings must be adhered to as far as possible and must be confirmed with the Department's representative.

Fluorescent luminaires installed against concrete ceilings shall be screwed to the outlet boxes and in addition 2 x 6mm expansion or other approved type fixing bolts are to be provided. The bolts are to be ¾ of the length of the luminaires apart.

Fluorescent luminaires to be mounted on board ceilings shall be secured by means of two 40mm x No. 10 round head screws and washers. The luminaires shall also be bonded to the circuit conduit by means of locknuts and brass bushes. The fixing screws are to be placed ¾ of the length of the fitting apart.

Earth conductors must be drawn in with the circuit wiring and connected to the earthing terminal of all fluorescent luminaires as well as other luminaires exposed to the weather in accordance with the "Wiring Code".

Incandescent luminaires are to be screwed directly to outlet boxes in concrete slabs. Against board ceilings the luminaires shall be secured to the brandering or joists by means of two 40mm x No. 8 round head screws.

PART 2: INSTALLATION DETAILS

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12	ELECTRICAL INSTALLATION
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20	LIGHTNING AND EARTHING INSTALLATION
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22	DISTRIBUTION BOARDS AND CIRCUITING
23	SCHEDULE OF CABLES, CONDUIT AND WIRING
24	BONDING TRAYS, JUNCTION AND DRAW BOXES
25	BUILDING WORK

1 CABLE SLEEVE PIPES

1.1 Where cables cross under roadways, other services and where cables enter building, the cables shall be installed in ribbed, flexible, 100 ø high density polyethylene pipes.

1.2 The ends of all sleeves shall be sealed with a non-hardening watertight compound after the installation of cables. All sleeves intended for future use shall likewise be sealed.

2 NOTICES

The Contractor shall issue all notices and make the necessary arrangements with Supply Authorities, the Postmaster-General SA, Transport Services, Provincial or National Road Authorities and other authorities as may be required with respect to the installation.

3 ELECTRICAL EQUIPMENT

All equipment and fittings supplied must be in accordance with the attached quality specification (Part 3 of this document), suitable for the relevant supply voltage, and frequency and must be approved by the Department's representative.

4 DRAWINGS

4.1 The drawings generally show the scope and extent of the proposed work and shall not be held as showing every minute detail of the work to be executed.

4.2 The position of power points, switches and light points that may be influenced by built-in furniture must be established on site, prior to these items being built in.

5 BALANCING OF LOAD

5.1 The Contractor is required to balance the load as equally as possible over the multiphase supply, at each distribution board and at the main low tension switchboard.

5.2 Test readings are to be submitted in writing to the Department's Representative for their comments and approval.

6 SERVICE CONDITIONS

All plant shall be designed for the climatic conditions appertaining to the service.

7 SWITCHES AND SOCKET OUTLETS

The installation of switches and socket outlets must conform to clause 13 of Part 1 of this specification.

8 LIGHT FITTINGS AND LAMPS

8.1 The installation and mounting of luminaries must conform to clause 19 of Part 1 of this specification.

8.2 All fittings to be supplied by the Contractor shall have the approval of the Department. Incandescent lamps shall bear the approved mark of the S.A.B.S. and shall have the British light centre length.

9 EARTHING AND BONDING

The Contractor will be responsible for all earthing and bonding of the installation. The earthing and bonding is to be carried out strictly as described in clause 18 of Part 1 of this specification and to the satisfaction of the Department's representative.

10 MAINTENANCE OF ELECTRICAL SUPPLY

All interruptions of the electrical supply that may be necessary for the execution of the work, and subsequent repair and maintenance will be subject to prior arrangement between the Contractor and the user Department and the Department's representative.

11 EXTENT OF WORK

11.1 The work covered by this contract comprises the complete electrical installation and handing over in working order, as per this specification, including the supply and installation of all panels, equipment and accessories that accompany this installation. The following electrical elements are to be carried out under this contract:-

1 Identify the main panel for the High Court, the MV Equipment, the Transformers and also the installation of a Generator to this Main Distribution System. The contractor must provide a detailed design methodology, with drawings, schematics and also a safe workable solution for an installation of a generator to this installation. The contractor will take full responsibility for this design, installation and commissioning of this installation. The contractor must have medium and high voltage switching experience and competency certificates. The contractor will be working on the main LV panel of the High Court to replace breakers with new motorized ACB, modified to fit onto the same panels with axillary contacts, electrical/mechanical interlocks, replace breakers/isolators, spray paint panel and modify. **This installation must be done over weekends and complete in totality, no disruptions during normal working days/hours.**

2 The contractor must identify all circuits/ breakers, if any discrepancy, the drawings must be revised and agreed by the Representatives before any changes are done. Distribution Board must be wired correctly, load balanced and a danger sign on the door. All circuits must be labelled on the main panel, with a clear label to identify cable sizes, fault levels and supply sizes. On the MV Board and LV Board special labels to be read as follows: Switch on T1 or T2, not both. Generator connected to the Bustie. The load meter must be installed immediately to monitor the loads at this facility before gen. installation

3 Supply, install, commission and maintain a 500kVA Diesel generator/alternator installations with a 1000litre base tank (By a specialist sub-contractor). The generator will be placed on a new plinth, position will be shown on site and the plinth must carry this load. Allow for new sleeves on the plinth. Install a 1000litre day tank on a 1m tank stand (3CR12 material), on a new plinth, with a bund wall 1.6 x 1.6 x 0.5m high. The bunded area must be constructed with bricks, floors concreted and the area including the walls must be fibre glass lined. Allow for an open and close valve on the bottom of this wall as per fire department request with a pit.

4 Install sensing cables from the LV Panel to the generator i.e. T1 & T2. In the event any transformer fails, the generator will start up and energize those circuits. Main cables from the LV Board to the generator, the cable will run on cable ladders/trunking, the route will be agreed on site by the contractor & the Engineer. The cables running though the wall must be cored professionally.

5 The contractor to provide fire extinguisher and signage's at the generator. The contractor must install an open/close valve at the bunded wall. Install a tap at the generator from the nearest water installation. Install a sump just outside the bund wall, below the shut off valve. Install a fuelling point at the lowest point of the existing face brick wall, it will be shown to the contractor during installation. Contractor must perform any other task related to this work to obtain compliance by the Fire Chief of this Municipality.

6 Install of pump between base tank and day tank with all the related valves.

7 Tracing of circuits, spray-painting of distribution boards & numbering of circuits. All the distribution boards that are supplied via the generator in this

entire facility must be identified with RED. Panels must be painted RED and labelled as Essential.

8 Service, maintain and testing of MV switchgears, and transformers at this facility.

9 Installation of earthing and testing with a certificate by a specialist contractor.

10 Building related work and installation as per our Civil/Structural Engineer scope and installation methodology listed on the BOQ with certificates.

11 The service provider must comply to the Municipal Guidelines and the Department of Environmental Affairs with to emissions and noise. Make provisions to Consult with these departments and comply with the guidelines.

11.2 Tenderers shall arrange to inspect the site and familiarise themselves with the conditions on site. Full allowance shall be made as no extras shall be entertained for ignorance of site installations and conditions and location.

12 ELECTRICAL INSTALLATION

12.1 Allow to work in close cooperation with the Main Contractor, provide all required information materials and equipment to be built into the works as the work progresses

12.2 Provide suitable supervision on site at all times. Institute quality control and ensure that all workmanship is first class.

12.3 The installation of the new panel is to be carefully co-ordinated with the Client Representative to allow that this work is effected timeously.

13 MAIN LOW TENSION SWITCHBOARD

13.1 Repairs and upgrade of the existing main LV Board, must conform to the relevant fault levels and standards. Make sure fault levels are cascaded, check upstream.

14 STANDBY EMERGENCY PLANT

14.1 A 500 kVA (700Amp) 0.85 P.F. outdoor type standby diesel generating set installation complete with sensing output supply panel and battery charging circuitry will be supplied and installed by a specialist Contractor under this contract. This generator will be installed at the Pmburg. High Court, on a new plinth. It will be a unit in an enclosure with complete sound attenuation. The engine **will be a Volvo, Cummins, Perkins, Caterpillar, John Diere, Mtsubishi, Leroy Somer, Scania or Deutz.** The alternator **will be a Stamford, Meralli or Gen Power.** The controllers **Deep Sea, Loverto or Circom**

14.2 The sound attenuation of the outdoor unit shall comply with Municipal noise criteria for residential areas and the levels specified in this specification and shall be carried out under this Contract.

14.3 The Electrical Contractor shall supply, install, connect and test the cable and earth wire to the Standby Diesel Unit complete with the reference cable interconnecting the main changeover panel, mounted on the generator

14.4 Install a fuel filtration system, it must continuously filter the diesel fuel 24/7 365 days in 10 minute cycles, removing suspended particles of effective diameter. It will be installed in-between the day tank & the base tank to filter the fuel even when the genset is not operating. It must separate all water from the fuel tank, **mechanically, automatically** (not manually) drain water in the open, removable in a suitable position. It must meet the "General Effluent Standard" required to be disposed into the Municipal drain and sewer system.

15 CABLES

15.1 The Contractor shall supply and completely install all distribution cables as indicated on the drawings, listed in the Schedule of Cables, and measured in the Bill of Quantities.

15.2 The storage, transportation, handling and laying of the cables shall be according to first class practice, and the contractor shall have adequate and suitable equipment and labour to ensure that no damage is done to cables during such operations.

15.3 The cable trenches shall be excavated to a depth of 0,9m deep below ground level and shall be 450mm wide for one to three cables, and the width shall be increased where more than three cables are laid together so that the cables may be placed at least two cable diameters apart throughout the run. The bottom of the trench shall be level and clean and the bottom and sites free from rocks or stones liable to cause damage to the cable.

15.4 The Contractor must take all necessary precautions to prevent the trenching work being in any way a hazard to the personnel and public and to safeguard all structures, roads, sewage works or other property on the site from any risk of subsidence and damage.

15.5 In the trenches the cable shall be laid on a 75mm thick bed of earth and be covered with a 150mm layer of earth before the trench is filled in.

15.6 The laying of cables shall not be commenced until the trenches have been inspected and approved. The cable shall be removed from the drum in such a way that no twisting, tension or mechanical damage is caused and must be adequately supported at intervals during the whole operation. Particular care must be exercised where it is necessary to draw cables through pipes and ducts to avoid abrasion, elongation or distortion of any kind. The ends of such pipes and ducts shall be sealed to approval after drawing in of the cables.

15.7 Backfilling (after bedding) of the trenches is to be carried out with a proper grading of the material to ensure settling without voids, and the material is to be stamped down after the addition of every 150mm. The surface is to be made good as required. This work to be carried out by the Main Contractor.

15.8 On each completed section of the laid and jointed cable, the insulation resistance shall be tested to approval with an approved "Megger" type instrument of not less than 2000V for low tension cables.

15.9 Earth continuity conductors are to be run with all underground cables constituting part of a low tension distribution system. Such continuity conductors are to be stranded bare copper of a cross-sectional area equal to at least half that one live conductor of the cable, but shall not be less than $4mm^2$ or more than $70mm^2$. A single earth wire may be used as earth continuity conductor for two or more cables run together, branch earth wires being brazed on where required.

16 CONDUIT AND WIRING

16.1 Conduit and conduit accessories shall be black enamelled/galvanised screwed conduit or black enamelled/galvanised plain end conduit in accordance with SABS 162, 763 and 1007 respectively.

16.2 All conduits, regardless of the system employed, shall be installed strictly as described in the applicable paragraphs of clauses 4 to 8 of Part 1 of the specification.

Wiring of the installation shall be carried out as directed in clause 9 part 1 of this specification.

16.3 Where plain end conduit is offered all switches and light fittings must be supplied with a permanent earth terminal for the connection of the earth wire.

16.4 Lugs held by switch fixing screws or self-tapping screws will not be acceptable.

17 LIGHTING INSTALLATION

17.1 The Electrical Contractor shall refer to the drawings for the project whereon the lighting layouts have been shown.

17.2 Lighting outlets are shown having letters which form the key to luminaire types to be installed at each outlet.

17.3 For recessed mounted luminaries at each outlet, allow to terminate the conduit and wiring in a 5 amp socket outlet mounted in a 100 x 50 extension surface mounted box, in the roof void adjacent to the luminaires.

17.4 Allow to install, connect and test the luminaries detailed in this specification and as shown on drawing.

17.5 All recessed luminaries shall be supplied with a 3 metre cabtyre flexible cord complete with a 5 ampere plugtop.

17.6 Provide annular rings of tempered masonite for all recessed mounted downlighters (fluorescent or incandescent) to be placed behind the ceiling material to protect the ceiling from the springs securing the luminaire.

17.7 The complete luminaries inclusive of fluorescent lamps, control gear and lamp holders shall be guaranteed for a period of twelve (12) months from date of handover (incandescent lamps excluded).

17.8 A Schedule of luminaries is provided.

18 LIGHTING SWITCHES

18.1 Supply, install, connect and test lighting switches wherever shown on drawings; the switches shall be similar to 20 Ampere "Classic Range" equal and approved manufacture and 0.5 PF rating; where surface installation is required they shall be of the industrial galvanised metal clad type: Where flush mounted they shall be set into pressed metal boxes with overlapping pressed metal cover plates to Architect's choice. Provide similar boxes and conduit for AC unit switches and fan heater isolators.

18.2 Light and AC unit switches to be mounted 1350mm to the centre of the box from F.F.L. or as otherwise instructed on site to suit the existing installation.

18.3 Where mounted in partition walling they shall be the mullion type complete with metal cover plate to Architect's choice.

18.4 The luminaries and area lighting situated outside shall be switched by a Photocell unit set to switch in, when the ambient illuminance falls to approximately 70 lux and to switch off when the ambient illuminance rises to approximately 35 lux. The photo cell switches shall embody time delay circuiting to obviate cyclic switching in changeable weather conditions. The photo cell unit shall switch the respective lighting contactors circuits which in turn switch on the outdoor luminaire.

19 SINGLE PHASE SWITCHED SOCKET OUTLET

19.1 The switched socket outlets shall be of the standard round three pin, shuttered type, rated at 16A/250V and shall comply with SABS 164 – 1992 as amended and shall bear the SABS mark.

19.2 The plastic insulation around each pin socket shall be raised to protrude through the cover plate which shall be punched with three separate holes for the three pin sockets. The cover plates fed from normal mains power shall be white.

19.3 The terminal screws of the live and neutral sockets shall be recessed so that inadvertent contact with the earth conductor will be impossible when the wired switched socket outlet is pushed back into the wall mounted conduit box during installation.

19.4 The switched socket outlet shall be controlled by means of a white piano type lever which matches those of the light switches.

19.5 The switched socket outlets fed off diesel generator power shall have a "D" shaped earth pin and the plastic insulation around each pin socket shall be red. The cover plates for those switched socket outlets with "D" shaped earth pins, mounted in cobuit boxes shall also be red.

20 LIGHTNING AND EARTHING INSTALLATION

20.1 Employ a Specialist Lightning and Earthing Installation Contractor who shall supply and install all the required conductors and earthing rods required in accordance with SABS 042. He shall test all earth circuits and provide resistance readings and certificates.

21 SCHEDULE OF DISTRIBUTION BOARDS

In addition to clause 14 and 15 of Part 1 of this Specification the following shall also be applied to switchboards required for this service.

The contractor will upgrade the existing LV Board, upgrade breakers to motorized, replace breakers, repairs to panels and also spray to RED.

The following types of switchboards are required for this service; scheduled as follows:

1	Main Distribution Panel	Upgrade main distribution board at High Court, upgrade breakers and labels

22 DISTRIBUTION BOARDS AND CIRCUITRY

The Electrical Contractor shall refer to the switchboard single line diagrams/ drawing and main line schematic whereon the respective switchboards have been detailed complete with equipment circuitry wiring, circuit breakers, earth leakage units, isolators and fault levels etc.

The circuitry must tie up with the respective lighting, power, geysers, fume cupboards, air conditioning circuits etc as indicated on the layout drawings.

23 SCHEDULE OF CABLES CONDUIT AND WIRING

23.1 Supply, install, connect and test the following cables, trunkings, conduit and wiring:

From	To	Size and Type
Main Panel	Generator	1 x 185mm² 4-core PVC cable and 1 x150mm² earth wire in 1 x 160mm underground sleeve

24. BONDING TRAYS, JUNCTION AND DRAW BOXES

a, All junction, trays, draw boxes, etc., must be accessible approved and generally not exposed in finished spaces and clear of other trades. Where necessary, re-route conduits or make other arrangements for concealment as approved. Support tray, junction and draw boxes independently to building structure with no weight bearing on boxes, trays, conduits etc.

b. Where drawing in of wires not included under these specifications, provide draw boxes in horizontal conduit runs every 30 metres and in accordance with the Code of Practice.

c. Outlet boxes for light fittings recessed in hung ceilings shall be accessible through the opening created by the removal of the light fitting.

25. BUILDING WORKS

25.1. The contractor to conform to the relevant work processes and concrete methodology. All tests will be witnessed including compaction. Require certificates for concrete, paving, civil works.

25.2. The painting, epoxy of floors, coring through walls/floors must be done professionally and of a very high quality/standards. This will be monitored on site.

PART 3: QUALITY SPECIFICATION FOR MATERIALS AND EQUIPMENT OF ELECTRICAL INSTALLATIONS

CLAUSE	DESCRIPTION
1	C1 CONDUIT AND CONDUIT ACESSORIES
2	C2 WIRING CHANNELS, DUCTING & POWER SKIRTING
3	C3 PVC –INSULATED CABLES 600/ 1000 V GRADE
4	C4 GLANDS FOR PVC –INSULATED CABLES
5	C5 CABLE TERMINATIONS AND JOINTS
6	C6 WIRING TERMINALS
7	C8 USWITCHED AND SWITCHED SOCKET OUTLETS
8	C9.1 TUBULAR FLOURESCENT LUMINAIRES FOR INTERIOR
9	C9.2 BULLHEAD LUMINAIRES FOR INTERIOR AND EXTERIOR USE
10	C11 EARTH ELECTRODES
11	C12 SWITCHBOARDS (Up to 1kV)
12	C14 MOULDED-CASE CIRCUIT BREAKERS
13	C15 EARTH LEAKAGE RELAYS
14	C16 CURRENT TRANSFORMERS
15	C18 TRIPPLE POLE ON-LOAD ISOLATORS
16	C19 TIME SWITCHES AND PHOTOCELLS
17	C20 CONTACTORS
18	C21 INDOOR SURGE ARRESTORS
19	C22 STANDARD PAINT SPECIFICATION

SECTION C1
C.1 CONDUIT AND CONDUIT ACCESSORIES

1. GENERAL

This section covers the requirements for conduit and conduit accessories for general installations under normal environmental conditions.

The type of conduit and accessories required for the service, i.e. whether the conduit and accessories shall be of the screwed type, plain-end type or of the non-metallic type and whether metallic conduit shall be black enamelled or galvanised, is specified in Part 2 of this specification. Unless other methods of installation are specified for certain circuits, the installation shall be in conduit throughout. No open wiring in roof spaces or elsewhere will be permitted.

The conduit and conduit accessories shall comply fully with the applicable SANS Specifications as set out below and the conduit shall bear the mark of approval of the South African National Standards.

(a) Screwed metallic conduit and accessories: SANS 1065 parts 1 and 2.
(b) Plain-end metallic conduit and accessories: SANS 1065 Parts 1 and 2.
(c) Non-metallic conduit and accessories: SANS 950

Bushes used for metallic conduit shall be brass and shall be provided in addition to lock nuts at all points where the conduit terminates at switchboards, switch-boxes, draw-boxes, etc.

Only one manufacture of conduit and conduit accessories will be permitted throughout the installation.

All metallic conduits shall be manufactured of mild steel with a minimum thickness of 1,2mm for plain-end conduit and 1,6mm in respect of screwed conduit.

2. SCREWED CONDUIT

2.1 Conduits shall comply with SANS 1065 and shall bear the SANS mark.

2.2 All conduit shall be heavy gauge, welded or solid drawn, hot-dip galvanised or black enamelled, screwed tube.

2.3 Galvanised conduit shall be hot-dipped inside and outside in accordance with SANS 32 & 121.

2.4 All conduit ends shall be reamed and threaded on both sides and delivered with a coupling at one end and a plastic cap on the other end.

3. METAL CONDUIT ACCESSORIES

All metal conduit accessories shall be of malleable cast iron or pressed steel with brass bushes in accordance with SANS 1065. Alloy or pressure cast metal accessories or zinc base alloy fittings are not acceptable. All fittings whether galvanised or black enamelled, shall be fitted with brass screws.

4. CIRCULAR TYPE BOXES

4.1 The boxes shall be of the long spout pattern, manufactured of malleable cast iron or pressed steel and stove enamelled jet black or galvanised as required. The two cover fixing holes shall be diametrically opposite each other, drilled and tapped at 50mm centres.

4.2 Junction, draw-in and inspection boxes shall be of adequate size and shall be supplied with heavy gauge metal cover plates.

4.3 Boxes shall comply with SANS 1065.

5. SWITCH BOXES AND SOCKET OUTLET BOXES

5.1 All switch boxes and socket outlet boxes shall be manufactured of pressed galvanised steel of at least 1mm thickness. All boxes shall be fitted with the necessary lugs to suit standard flush mounted switches and socket outlets manufactured in accordance with SANS 1085.

5.2 Light switch boxes shall be 100 x 50 x 50mm with two 20mm knockouts on the sides, one 20mm knockout on the top, bottom, side and back.

5.3 Socket outlet boxes shall be 100 x 100 x 50mm with two 20mm knockouts each on the top, bottom, sides and back.

5.4 Switch and socket outlet cover plates shall comply with SANS 1084.

6. FLEXIBLE CONDUIT

Flexible steel conduit and adaptors shall comply with BS 731, part 1 where applicable. Flexible conduit shall be of galvanised steel construction and in damp areas of the plastic sheathed galvanised steel type. Flexible conduit shall only be used as specified and shall then be installed in accordance with par. 5.4.4 of SANS 10142.

7. PLAIN-END METALLIC CONDUIT

7.1 As an alternative to the threaded conduit, plain-end (unthreaded) metallic conduit with accessories may be used under the conditions stated in the Department's standard specification for "INSTALLATION AND TERMINATION OF CONDUITS AND CONDUIT ACCESSORIES", par. 3 of Section BI.

7.2 Unthreaded conduit shall be manufactured of mild steel with a minimum thickness of 1,2mm and shall comply with SANS 1065.

7.3 Bending and setting of conduit shall be done with the correct apparatus recommended by the manufacturer of the conduit.

7.4 The Contractor or Supplier shall be responsible for obtaining the approval of local authorities for the use of this system.

7.5 All conduit and accessories used in areas within 50 km of the coast shall be hot-dip galvanised to SANS 32 & 121. In inland areas electro-galvanised or cadmium-plated accessories will be accepted.

8. NON-METALLIC CONDUIT

Non-metallic conduit shall comply fully with SANS 950 and shall be installed in accordance with Appendix C of the same specification as well as the Department's standard specification for "INSTALLATION AND TERMINATION OF CONDUITS AND CONDUIT ACCESSORIES", par. 4 of Section BI.

9. EARTH CLAMPS

Earth clamps shall consist of copper strips at least 1,2mm thick and not less than 12mm wide secured with a brass bolt, nut and washer and shall be so constructed that the clamp fit firmly to the conduit without any additional packing.

SECTION C.2

C.2 WIRING CHANNELS, UNDERFLOOR DUCTING AND POWER SKIRTING

1. WIRING CHANNELS

1.1 GENERAL

1.1.1 The channels shall be manufactured of rolled sheet steel.

1.1.2 The minimum thickness of the sheet steel shall be:

(a) 1,6mm for ribbed channels with a maximum width of 42mm.

(b) 2,5mm for unribbed channels with a maximum width of 42mm.

(c) 1,2mm for channels with a width in excess of 42mm.

1.1.3 The channels shall be finished as follows:

(a) In coastal areas (under all installation conditions)	Hot-dip galvanised to SANS 32 & 121 or epoxy powder coated
(b) Cast in concrete	Pre-galvanised
(c) False ceiling voids	Pre-galvanised
(d) Vertical building ducts coated	Hot-dip galvanised to SANS 32 & 121 or epoxy powder
(e) Surface mounted in plant rooms, substations, service tunnels, basements	Epoxy powder coated or electro galvanized
(f) Damp areas, exposed to weather underground runs in contact with earth	Hot-dip galvanised to SANS 32 & 121 or epoxy powder coated
(g) Undercover industrial applications	Hot-dip galvanised to SANS 32 & 121 or epoxy powder coated

1.1.4 The above-mentioned finishes shall apply unless specified to the contrary or approved - by the Department. Hot-dip galvanised ducts shall be cold galvanised at all joints. sections that have been cut and at places where the galvanising has been damaged. Powder coated ducts shall likewise be touched up at joints, cuts and damaged portions using methods recommended by the manufacturer of the channels.

1.2 Cover Plates

1.2.1 All channels shall be supplied with cover plates.

1.2.2 Channels up to 127mm wide shall have snap-in cover plates of metal or PVC.

1.2.3 For channels wider than 127mm only metal cover plates shall be used.

1.2.4 The finish of steel cover plates shall be the same as the finish of the channels.

1.3 Accessories

All accessories i.e. hangers, brackets etc. shall be purpose made and in general have the same finish as the channels.

1.4 Wiring Supports

Wiring supports shall be provided in order to prevent the wires falling out when cover plates are removed.

2. UNDERFLOOR DUCTING

2.1 General

2.1.1 The dueling shall be manufactured of 2mm thick rolled sheet steel or rectangular tubing. Galvanised steel shall be used or shall be epoxy coated after manufacture.

2.2 Outlets

2.2.1 Outlets shall be provided on a modular basis in the dueling to accommodate pedestal or recessed socket units. Tapped holes shall be provided to fix the pedestal units to the dueling.

2.2.2 Draw boxes at junctions of perpendicular ducts shall have removable barriers for wiring and shall be provided with a heavy gauge cover plate.

2.3 Pedestals

2.3.1 Pedestals shall be manufactured of die-cast aluminium or pressed steel.

2.3.2 The finish of pedestals shall be epoxy powder coating of an approved colour.

3. POWER SKIRTING

3.1 General

3.1.1 The channel and cover shall be manufactured of 1mm thick rolled sheet steel.

3 1 2 The channel and cover shall be epoxy coated after manufacture.

3.2 Outlets

3.2.1 Outlets pre-punched on a modular basis shall be provided to accommodate socket outlets or future socket outlets.

3.2.2 In addition to standard lengths, covers of 250mm length shall be provided for installation on building module lines

SECTON C3

C.3 PVC-INSULATED CABLES 600/1 000 V GRADE

1. GENERAL

This section covers the requirements for PVC-insulated cables for general installations under normal environmental conditions.

2. CONSTRUCTION

2.1 Cables shall be manufactured in accordance with SANS 1507, shall come only from fresh stocks, and shall be constructed as follows:

(a) Unarmoured cables PVC-insulated/PVC-sheathed

(b) Armoured cables PVC-insulated/PVC-bedded/armoured/black extruded PVC outer sheath

(c) Single core cables PVC-insulated/unsheathed

2.2 The conductors shall be of high conductivity annealed stranded copper and the cores may be shaped or circular.

2.3 The insulation shall be general purpose PVC, 600/1 000V Grade.

2.4 The bedding shall consist of a continuous impermeable sheath of PVC extruded to fit the core or cores closely and in the case of multi-core cables, to fill the interstices between the cores.

2.5 Where armouring is specified it shall consist of one layer of galvanised steel wire in the case of multi-core cables and nonmagnetic metallic wire in the case of single core cables. Aluminium strip or tape armouring is not acceptable.

2.6 Where specified, an earth continuity conductor shall be provided in the armouring in accordance with SANS 1507.

3. PVC-SHEATHED ALUMINIUM-COVERED CABLES

3.1 Aluminium-covered cables shall comprise PVC-insulated copper conductors protected by an aluminium foil tape screen and a PVC sheath.

3.2 Cable ends shall be made off with compression glands fitted with a neoprene ring to seal the end.

3.3 Aluminium sheathed cable shall be installed on surface only using matching saddles installed at suitable intervals to prevent sagging.

3.3 Where exposed to sunlight, the cable shall have a stabilised black outer sheath.

4. LENGTHS

Cable shall be manufactured and supplied in one length to the lengths specified unless these lengths exceed a standard drum length in which case a ruling shall be obtained from the Department.

5. TESTS

At the option of the Department, acceptance tests shall be carried out on production runs of the cable in accordance with SANS 1507.

SECTION C4
C.4 GLANDS FOR PVC-INSULATED CABLES

1. Glands to be used for terminating PVC/PVC/SWA/PVC cables shall be of the adjustable type.
2. Glands shall be suitable for general purpose 600/1 000 V Grade cable with steel armouring.
3. The glands shall be made of nickel-plated cadmium plated or in coastal area bronze or brass.
4. The glands shall consist of a barrel carrying a cone bush screwed into one end and a nickel-plated brass nipple carrying a nickel-plated brass or a heavy galvanised steel locknut screwed into the other end. The galvanising shall comply with SANS 32 & 121.
5. Non-watertight glands must be easily converted to watertight glands by means of a waterproofing shroud and inner seal kit. On the cable entry side of the barrel a concave groove shall be provided to accommodate the top rim of the waterproofing shroud.
6. The shrouds shall be made of non-deteriorating neoprene or other synthetic rubber, and shall be resistant to water, oil and sunlight. The shrouds shall fit tightly around the glands and cable.
7. Glands shall be provided with ISO threads and shall be suitable for the specified cable sizes.
8. Flameproof glands shall comply with SANS 808, Groups 1, 2a and 2b.
9. Suitable accessories shall be provided with glands to be used on ECC armoured cables to facilitate a bolted lug connection of the earth continuity conductors. Grooves cut into the barrel or cone bush to accommodate the earth continuity conductors are not acceptable.

10. For unarmoured cables the cone bush and compression ring of the gland shall be replaced with a synthetic rubber compression bush and ring to provide the required grip on the outer sheath of the cable.

SECTION C5
C.5 CABLE TERMINATIONS AND JOINTS

1. HEAT-SHRINKABLE MATERIALS

1.1 General

1.1.1 Heat-shrinkable materials may only be used in exceptional circumstances with the written permission of the Department.

1.1.2 The complete kit shall be packed in a container that is marked for the type of cable insulation and construction as well as the voltage range for which the materials are suitable.

1.1.3 An illustrated set of instructions for the installation of the materials shall accompany every kit.

1.1.4 The joints and terminations shall make minimal, if any, use of insulating or stress relieving tapes. The use of electrical stress control and insulating tubing that is heat-shrunk onto the termination or joint, is preferred above other methods.

1.1.5 The materials shall comply with VDE 0278 and the supplier shall be called upon to confirm this aspect before acceptance of the materials or installation.

1.1.6 The heat-shrinkable and other materials used for the terminations and joints shall be of a high quality and shall retain their electrical and mechanical properties without deterioration.

1.2 Terminations with Heat-Shrinkable Materials

1.2.1 Terminations shall be made of a material that gives lasting protection against ultraviolet radiation.

1.2.2 The cores of all cables terminated outdoors and the cores of 3,3 kV and higher voltage cables terminated indoors, shall be completely covered with a shrunk-on protective layer against surface tracking, ultraviolet radiation and weathering.

1.2.3 Outdoor terminations shall be designed to prevent flashover under wet or contaminated conditions and to ensure additional mechanical strength. This shall be achieved with shrunk-on insulating spacers and rain shields.

1.3 Joints with Heat-Shrinkable Materials

1.3.1 The electrical continuity of all the conductors, screens and armouring shall not be impaired by the joints and the earth continuity shall be accomplished within the joints, i.e. no external earth continuity conductor that will be subject to corrosion, is acceptable. The joints shall be completely covered by a watertight sheath to prevent corrosion.

1.3.2 In the case of joints in cables with an outer PVC anti-electrolysis sheath, the joints shall be subject to the same electrical insulation test as the outer sheath of the cable.

2. RESIN FILLED JOINTS

2.1 The resin filled joint kit shall comprise a self sealing plastic mould of high mechanical strength having sufficient connector space.

2.2 The exact amount of cold hardening resin shall be provided in a two-compartment plastic bag.

2.3 The resin shall have absolute minimum shrinkage.

2.4 The mould and resin shall be completely waterproof and non-hygroscopic and shall be resistant to ultraviolet radiation.

2.5 Joint kits shall be of "SCOTCHCAST", "CELLPACK" or similar

3. CABLE JOINTS BOX

3.1 Cable joint boxes shall be manufactured of die cast aluminium material for normal conditions or glass fibre reinforced thermosetting compound where exposed to corrosive conditions.

3.2 The lid shall provide an absolute moisture barrier.

3.3 Boxes shall contain 2. 3 or 4 entries as required.

3.4 Unused entries shall be sealed with watertight blanking plugs.

3.5 Earth continuity shall be maintained through the box by means of the material of the box in the case of aluminium boxes or by means of earth straps and studs in the case of glass fibre reinforced boxes.

SECTION C6

C.6 WIRING TERMINALS

1. Terminal bodies and screws shall be of non-corrosive metal, enclosed in fire resistant, moulded plastic insulating bodies. Terminal bodies or screws shall not project beyond the insulating material and shall afford suitable protection against accidental contact by personnel and against short circuits and tracking.
2. The construction of the terminal block and mounting rail shall be such as to ensure a firm and positive location of the terminal blocks. It shall be possible to add additional terminal blocks within the terminal sequence without having to disconnect or dismantle the terminal strip. The terminal blocks shall be held in position by means of standard end clamps.
3. It shall be possible to intermix terminals of various sizes, i.e. for different sizes of conductors, whilst utilising the same mounting rail. Where smaller terminal blocks occur adjacent to larger terminal blocks, suitable shielding barriers shall be inserted to cover the terminals that might otherwise be exposed.
4. The terminal bodies and clamping screws shall be so constructed as to ensure that conductors are not nicked or severed when the clamping screws are tightened. Screws shall not come in direct contact with the conductors.
5. Terminals shall be sized and rated to match the conductors that are connected to them.
6. Each terminal block shall have provision for clip-in numbering or labelling strips to be installed, together with protective, clear caps over the sheet

SECTION C8

C.8 UNSWITCHED AND SWITCHED SOCKET-OUTLETS

1. GENERAL

This section covers the requirements for unswitched and switched socket-outlets for use in general installations under normal environmental conditions.

2. FLUSH AND SURFACE MOUNTED SWITCHED SOCKETS

2.1 All switched socket-outlets shall be suitable for mounting in 100 x 100 x 50mm or 100 x 50 x 50mm boxes, shall comply with SANS 164.

2.2 Switches shall be of the tumbler operated microgap type rated at 16A, 220/250V.

2.3 Terminals shall be enclosed for safe wiring.

2.4 Contacts shall be of silver material.

2.5 Safety shutters shall be provided on live and neutral openings.

2.6 The yoke strap shall be slotted to allow for easy alignment

2.7 The covers of surface mounted switched socket shall have toggle protectors.

2.8 Miniature circuit-breakers shall be used in lieu of a switch where specified.

2.9 Where 13A flat pin switched socket-outlets are specified, these shall comply with BS 1363.

3. WATERTIGHT SWITCHED SOCKETS

3.1 The housing of watertight switched sockets shall be of galvanised cast iron or die cast aluminium with watertight machined joints.

3.2 The switch shall have a porcelain base and a quick-acting spring mechanism and shall be rated at 16A. 220/250V.

3.3 The ON/OFF positions shall be clearly marked on the switch housing.

3.4 The socket openings shall be rendered watertight by means of a gasketed cover plate which is screwed onto the body of the unit. The cover plate shall be secured to the body of the unit by means of a chain.

4. UNSWITCHED SOCKET-OUTLETS

4.1 Unswitched socket-outlets shall only be used in the case of 5A, 220/250V, 3-pin socket-outlets intended for the connection of recessed light fittings installed in false ceilings.

4.2 The socket-outlets shall have shuttered live and neutral openings.

1.3 The socket-outlets shall be suitable for installation in pre-punched wiring channels. deep round conduit boxes, 100 x 50 x 50mm or 100 x 100 x 50mm boxes.

5. THREE-PHASE SWITCHED SOCKET-OUTLETS

5.1 Three-phase switched socket-outlets shall have 5 pins, one for each phase, neutral and earth. The current rating shall be as specified in the Detail Technical Specification.

5.2 The units shall be interlocked to prevent switching on if the plug top is not installed.

5.3 The units shall be supplied complete with plug top.

5.4 The live terminals shall be shrouded and shall be completely safe when the plug top is removed.

5.5 Samples shall be submitted to the Department for approval prior to the installation.

6. SHAVER SOCKETS

6.1 Shaver sockets shall comprise a double wound isolating transformer rated at 20 VA.

6.2 A three hole system shall be provided to provide for 115 V or 230V systems and also to cater for various types of shaver plugs.

6.3 Insertion of a shaver plug shall automatically switch on the unit by energising the primary side of the isolating transformer. Removal shall switch it off.

6.4 The unit shall be protected against overload by a thermal overload device.

6.5 The unit shall comply with BS 3052.

SECTION C9

C.9 LUMINAIRES FOR INTERIOR AND EXTERIOR APPLICATIONS

C.9.1 TUBULAR FLUORESCENT LAMP LUMINAIRES FOR INTERIOR APPLICATIONS

1. SCOPE

This specification covers the requirements for fluorescent luminaires using tubular fluorescent lamps for general indoor use. The types of luminaires covered are open-channel, industrial, decorative and recessed types and includes luminaires with one or more lamps with standard wattage ratings as specified in the project specification. Luminaires for use in special applications or atmospheres are not included in this specification. .

2. GENERAL

2.1 To promote work creation in South Africa, the luminaire should preferably be manufactured within the Republic of South Africa and should have a local content of at least 50%.

2.2 If the luminaire offered is of foreign origin, full specifications on technical performance and quality must be submitted and full reasons shall be given why the unit had to be imported.

2.3 A sample luminaire shall be provided for evaluation and approval by the Electrical Engineer prior to installation.

2.4 Luminaires, associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, diffusers, mounting brackets, etc. and shall be delivered to site in a protective covering.

2.5 Lamps shall be delivered separately.

3. STANDARDS

The following standard specifications of the South-African National Standards shall apply to this luminaire specification:

3.1	SANS 1119:	Interior luminaires for fluorescent lamps.
3.2	SANS 1250:	Capacitors for use with fluorescent and other discharge lamp ballasts.
3.3	**SANS 890:**	**Ballasts for fluorescent lamps.**
3.4	SANS 1464:	Safety of luminaires.
3.5	SANS 1479:	Glow starters for fluorescent lamps.
3.6	IEC 400:	Lamp holders for tubular fluorescent lamps.
3.7	SANS 1041:	Tubular fluorescent lamps for general service.
3.8	SANS VC 8031:	Coatings applied by the powder-coating process.
3.9	SANS 783:	Baked enamels.
3.10	SANS 10142:	The wiring of Premises

Any standard referred to in the above specifications.

4. PHYSICAL AND ENVIRONMENTAL REQUIREMENTS

4.1 AREAS OF APPLICATION: The luminaires are intended for standard indoor use in buildings under the control of the Department of Public Works.

4.2 FIXING: The luminaires shall be suitable for mounting in or against ceilings as described in the project specification.

4.3 ENVIRONMENTAL: Unless otherwise specified in the detail specification the luminaires shall be suitable for operation in ambient temperatures between -10°C and +25°C.

4.4 SAFETY: The luminaire shall bear the SANS 1464 safety mark.

4.5 NOISE: Noisy ballasts will not be accepted and shall be replaced at no cost to the Department. All ballasts shall comply with the requirements of the latest edition of SANS 890. Part 1.

5. GENERAL TECHNICAL REQUIREMENTS

5.1 GENERAL

5.1.1 Tubular fluorescent lamp luminaires shall comply fully with SANS 1119 and all amendments as well as the additional requirements of this specification. Luminaires shall bear the SANS mark, or at least have a SANS Certificate of Compliance.

5.1.2 The Department reserves the right to have samples of luminaires offered tested by the SANS for compliance with SANS 1119. If a sample luminaire is found not to comply with SANS 1119 the cost of such tests shall be borne by the Tenderer.

5.2 CONSTRUCTION

5.2.1 A luminaire shall consist of a ventilated body manufactured of cold rolled sheet steel not less than 0,8mm thick, suitably braced or stiffened to prevent distortion. The body shall be of sufficient strength for the mounting of the entire luminaire.

5.2.2 The luminaire shall be designed to accommodate the control gear, wiring, lamp holders and, where applicable, the diffuser and reflectors. It shall be possible to reach the control gear without disconnecting wiring or removing the luminaire.

5.2.3 Except for mounting holes and/or slots and the required openings in air-return luminaires. the back of the body channel shall be closed over the full length of the luminaire.

5.2.4 Suitable knockouts shall be provided in the rear of the luminaire body for wire entry.

5.2.5 All components, including screws, bolts and nuts utilised in the construction of the luminaire or fixing of its components, shall be corrosion proof. Cadmium plated or stainless steel materials are preferred.

5.3 INTERNAL WIRING

5.3.1 Luminaires shall be completely wired internally. Conductors shall be protected with grommets where they pass through holes in the body.

5.3.2 The wiring shall be totally metal enclosed to prevent any possible contact with live components while changing lamps.

5.3.3 The conductor insulation shall be rated to withstand the temperature inside the luminaire body without deterioration.

5.3.4 The wiring shall terminate on a suitable terminal block having screw down plates bearing on the wires. Terminals where screws bear down directly on wires will not be acceptable.

5.3.5 An earth terminal, welded to the luminaire body, shall be provided. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal by means of a crimped lug.

5.4 LAMP HOLDERS

Lamp holders shall preferably be of the telescopic spring-loaded type. Where twist-lock type lamp holders are provided, the mounting of the holders shall be able to accommodate the tolerances experienced in the length of lamps and in the manufacture of luminaires.

5.5 CONTROL GEAR

5.5.1 The control gear, ballasts, capacitors and starters shall be designed and manufactured to suit the control circuitry adopted. All luminaires shall operate on a switch-start basis.

5.5.2 Ballasts shall comply with SANS 890 and SANS 891, suitable for operation on 220V to 250V, 50Hz supplies.

5.5.3 Ballasts shall further be suitable for the particular luminaire to ensure that the thermal limits specified in paragraph 3.5 of SANS 1119 are not exceeded.

5.5.4 Starters shall comply with SANS 1479 or with BS 3772 if it is not covered by SANS 1479. Starters with metal cans shall contain integral earthing facilities to earth the can upon insertion.

5.5.5 Starters shall be accessible from the outside of the luminaire, and the replacement of the starter shall not necessitate the removal of lamps.

5.6 CAPACITORS

Capacitors shall comply with SANS 1250. The power factor of each complete fitting shall be corrected to at least 0,85.

5.7 LAMPS

5.7.1 Fluorescent lamps shall be suitable for the control circuitry used. Lamps shall comply with SANS 1041.

5.7.2 If no colour is specified in the Detail Technical Specification, the light colour shall correspond to colour 2 (4 300K) of SANS 1041.

5.7.3 Lamps of the same colour shall be provided for an entire installation unless specified to the contrary.

5.7.4 There shall be no visible flicker in the lamps and lamps shall readily strike when switched on. Faulty lamps or ballasts shall be replaced at no cost to the Department.

6. PHOTOMETRIC DATA

Photometric data sheets of the luminaire as prepared by a laboratory that complies with SANS requirements, shall be submitted with the luminaire.

7. TECHNICAL INFORMATION

The Tenderer shall include full technical particulars regarding the luminaire offered with the tender.

8. CHANNEL LUMINAIRE

8.1 Channel luminaires shall consist of a ventilated, enclosed channel body with one or more lamps as specified in the project specification. The channel body shall house the ballast, capacitor, terminals and internal wiring.

8.2 Provision shall be made for the addition of reflector wings and/or diffusers.

8.3 Three sets of mounting slots and knock-outs suitable for mounting onto standard round conduit boxes and/or 20mm diameter conduit pendant rods, shall be provided in the rear of the channel, one in the centre and one approximately one sixth from each end.

8.4 A knockout suitable for a 20mm diameter conduit entry shall be provided at each end of the channel. The distance between the back of the luminaire and centre of the knockout shall be approximately 25mm.

8.5 The knockouts shall be positioned on the centre line of the channel.

8.6 The body channel shall incorporate a removable cover acting as a reflector, manufactured of cold rolled steel, not less than 0,8mm thick, designed and mounted to completely cover the interior of the body channel and its contents and extending over the full length of the luminaire up to the lamp holders.

8.7 The reflector shall be firmly held in position with a latching device consisting of knurled, coin slot, captive screws. Plastic, used as a spring mechanism, is not acceptable as a fixing device for reflectors. The action of the latching device shall not deteriorate due to use and/or ageing.

9. INDUSTRIAL LUMINAIRES

9.1 Industrial type luminaires shall consist of a basic channel luminaire fitted with detachable side reflectors.

9.2 The reflectors shall be manufactured of cold rolled steel, not less than 0,8mm thick.

9.3 The reflectors shall be designed to improve the downward light output ratio and decrease the upward light output ratio to a value of less than 2%.

10. DECORATIVE LUMINAIRES

10.1 Decorative luminaires shall incorporate an injection moulded prismatic acrylic diffuser or a high-grade optical reflector covering the entire reflecting surface of the luminaire.

10.2 The diffuser shall be hinged or easily removable for maintenance and lamp replacement. Optical reflectors shall be hinged.

10.3 Decorative luminaires with diffusers shall be constructed and so installed to prevent the ingress of dust and insects.

10.4 Highly polished reflectors shall be protected and carefully handled and to prevent fingerprints showing on the surface.

10.5 Surface mounted luminaires on suspended ceilings shall be arranged to suit the grid and shall fit tightly against the ceiling.

11. RECESSED LUMINAIRES

11.1 Recessed luminaires shall be suitable for mounting in the ceiling structure specified in the project specification.

11.2 The attachment of the prismatic diffuser or reflector shall be similar to that specified in paragraph 10 above.

11.3 The djffuser or reflector shall fit flush with the ceiling and the only visible portion shall be the reflector or diffuser.

11.4 Should the luminaire be so designed that a surrounding frame is visible, then this frame shall be manufactured of anodised aluminium. The frame shall form a neat trim with the ceiling. The comers of the surrounding frame shall be mitred and reinforced.

12. LOW-BRIGHTNESS LUMINAIRES

12.1 The luminaire shall be provided with an aluminium louver with V-shaped longitudinal vanes and extruded stepped cross-shielding plates.

12.2 Louvers shall be constructed from high purity aluminium (99,98%), chemically brightened and anodised.

12.3 The total Light Output Ratio (LOR) shall be 62% or better. In the plane between 60 and 90 (from the vertical), the LOR shall be below 3%.

13. LOW GLARE LUMINAIRES

13.1 The luminaire shall be provided with a die-formed, bright anodised high-purity aluminium (99,98%) louver with parabolic reflecting surfaces in both directions.

13.2 The total LOR shall be 62% or better. In the plane between 60 and 90(from the vertical), the LOR shall be less than 1,3%

14. LUMINAIRES FOR USE IN AREAS WITH VISUAL DISPLAY TERMINALS

14.1 The luminaire shall have anodised specular louvers to provide the brightness control required for this type of application.

14.2 At angles between 60 and 90 (from the vertical) the luminance shall not exceed 200cd/m2.

14.3 At the above angles the LOR shall be less than 0,6%. At angle between the vertical and 60 the LOR shall be 61% or better.

SECTION C9.2

C9.2 BULKHEAD LUMINAIRES FOR USE WITH COMPACT FLUORESCENT OR TUNGSTEN FILAMENT LAMPS FOR INTERIOR AND EXTERIOR APPLICATIONS

1. SCOPE

This specification covers the requirements for bulkhead type luminaires, using compact fluorescent or tungsten filament lamps, for general indoor and outdoor use. The types of luminaires covered are decorative round, rectangular or square surface-mounted and recessed types and include luminaires with one or more lamps with standard wattage ratings as specified in the project specification. Luminaires for use in special applications or atmospheres are not included in this specification.

2. GENERAL

2.1 To promote work creation in South Africa, the luminaire should preferably be manufactured within the Republic of South Africa and should have a local content of at least 50%.

2.2 If the luminaire offered is of foreign origin, full specifications on technical performance and quality must be submitted and full reasons shall be given why the unit had to be imported.

2.3 A sample luminaire shall be provided for evaluation and approval by the Electrical Engineer prior to installation.

2.4 Luminaires. associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, diffusers, mounting brackets, etc. and shall be delivered to site in a protective covering.

2.5 Lamps shall be delivered separately.

3. STANDARDS

The following standard specifications of the South-African National Standards and the International Electrotechnical Commission shall apply to this luminaire specification:

3.1 SANS1119: Interior luminaires for fluorescent lamps. Note: The latest amendments whereby luminaires with compact fluorescent lamps are covered, shall apply.

3.2 SANS 1250: Capacitors for use with fluorescent and other discharge lamp ballasts.

3.3 SANS 890, IEC 920 & IEC 921: Ballasts for fluorescent lamps.

3.4 SANS 1464: Safety of luminaires.

3.5 SANS 1479: Glow starters for fluorescent lamps.

3.6 IEC 400: Lamp holders for tubular fluorescent lamps.

3.7 SANS 1041, IEC 81 & IEC 901: Tubular fluorescent lamps for general service.

3.8 SANS 1247: Coatings applied by the powder-coating process.

3.9 SANS 783: Baked enamels.

3.10 SANS 10142: The wiring of Premises

3.11 SANS 56:Incandescent lamps

3.12 Any standard referred to in the above specifications.

4. PHYSICAL AND ENVIRONMENTAL REQUIREMENTS

4.1 AREAS OF APPLICATION: The luminaires are intended for standard indoor and exterior use in buildings under the control of the Department of Public Works.

4.2 FIXING: The luminaires shall be suitable for mounting against ceilings or walls as described in the project specification.

4.3 ENVIRONMENTAL: Unless otherwise specified in the detail specification the luminaires shall be suitable for operation in ambient temperatures between -10°C and +45°C.

4.4 SAFETY: The luminaire shall bear the SANS 1464 safety mark.

4.4 NOISE: Noisy ballasts will not be accepted and shall be replaced at no cost to the Department. All ballasts shall comply with the requirements of the latest edition of SANS 890, Part 1 or IEC 920 and IEC 921.

5. GENERAL TECHNICAL REQUIREMENTS

5.1 General

5.1.1 Compact fluorescent lamp luminaires shall comply fully with SANS 1119 and all amendments as well as the additional requirements of this specification. Luminaires. which bear the SANS mark, are preferred. Luminaires shall at least have an SANS Certificate of Compliance.

5.1.2 The Department reserves the right to have samples of luminaires offered tested by the SANS for compliance with SANS 1119. If a sample luminaire is found not to comply with SANS 1119 the cost of such tests shall be borne by the Tenderer.

5.1.3 Luminaires for tungsten filament lamps shall not materially differ from those for compact fluorescent lamps, but shall be capable of dissipating the extra heat generated without deterioration in the luminaire materials.

5.2 Construction

5.2.1 A luminaire shall consist of a ventilated body manufactured from die-cast aluminium. The body shall be of sufficient, strength for the mounting of the entire luminaire.

5.2.2 The luminaire shall be designed to accommodate the control gear, wiring, lamp holders, the diffuser and reflectors. It shall be possible to reach the control gear without disconnecting wiring or removing the luminaire.

5.2.3 Except for mounting holes and/or slots, the back of the body shall be closed over the full extent of the luminaire.

5.2.4 Suitable knockouts shall be provided in the rear of the luminaire body for wire entry.

5.2.5 All components, including screws, bolts and nuts utilised in the construction of the luminaire or fixing of its components, shall be corrosion proof. Cadmium plated or stainless steel materials are preferred.

5.2.6 The luminaire shall, as an option, be available with a high-pressure die-cast aluminium skirt, which shall be designed in such a way that it covers the base completely when mounted. The skirt shall be mounted onto the body by means of at least three screws

5.3 Internal wiring

5.3.1 Luminaires shall be completely wired internally. Conductors shall be protected with grommets where they pass through holes in the body.

5.3.2 The wiring shall be totally metal enclosed to prevent any possible contact with live components while changing lamps.

5.3.3 The conductor insulation shall be rated to withstand the temperature inside the luminaire body without deterioration.

5.3.4 The wiring shall terminate on a suitable terminal block having screw down plates bearing on the wires. Terminals where screws bear down directly on wires will not be acceptable.

5.3.5 An earth terminal, welded to the luminaire body, shall be provided. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal by means of a crimped lug.

5.4 Lamp holders

Lamp holders shall be of the type suitable for the relevant compact fluorescent or general lighting service lamp. The following standard lamps and lamp holders shall apply:

5.4.1

LAMP	HOLDER	LAMP	HOLDER
7W PL	2G11	13W PLC	G24d-1
9W PL	2G11	16W 2D	GR10q
11W PL	2G11	18W PLC	G24d-2
60/100E GLS	E27, porcelain		

5.5 Control gear

5.5.1 The control gear, ballasts, capacitors and starters shall be designed and manufactured to suit the control circuitry adopted. All fluorescent luminaires shall operate on a switch-start basis where external starters are employed.

5.5.2 Ballasts shall comply with SANS 890 & SANS 891, or IEC 920 & IEC 921 as applicable and shall be suitable for operation on 220V to 250V, 50Hz supplies.

5.5.3 Ballasts shall further be suitable for the particular luminaire to ensure that the thermal limits specified in paragraph 3.5 of SANS 1119 are not exceeded.

5.5.4 Starters shall comply with SANS 1479 or with BS 3772 if it is not covered by SANS 1479. Starters with metal cans shall contain integral earthing facilities to earth the can upon insertion.

5.5.5 Starters shall be accessible from the outside of the luminaire, and the replacement of the starter shall not necessitate the removal of lamps.

5.5.6 The luminaire reflector shall act as the gear/mounting tray and shall be manufactured from sheet steel at least 0,7mm thick. The gear tray shall preferably be white epoxy powder coated after all the cut-outs and holes have been made on the tray. The tray shall be mounted to the body of the luminaire by means of screws and the tray shall be provided with a hole through which the screw head can pass plus a slot of the same width as the screw thickness so that the tray can be removed without removing the screws completely.

5.5.7 The gear tray shall be equipped with the components suitable for the luminaires specified in the project specification.

5.6 Capacitors

Capacitors shall comply with SANS 1250. The power factor of each complete fitting shall be corrected to at least 0,85.

5.7 Lamps

5.7.1 Fluorescent lamps shall be suitable for the control circuitry used. Lamps shall comply with the applicable clauses of SANS 1041 and, where it does not apply, the lamps shall comply with IEC 81 or IEC 901.

5.7.2 If no colour is specified in the Detail Technical Specification, the light colour shall correspond to colour 2 (4 300K) of SANS 1041.

5.7.3 Lamps of the same colour shall be provided for an entire installation unless specified to the contrary.

5.7.4 There shall be no visible flicker in the lamps and lamps shall readily strike when switched on. Faulty lamps or ballasts shall be replaced at no cost to the Department.

5.7.5 The following standard lamps shall be used for the purposes of this specification:

PL lamps:	7W, 9W AND 11W
PLC Lamps:	13W
2D Lamps:	16W
GLS Lamps:	60 and100W

5.8 Diffuser

5.8.1 The diffuser shall consist of a high-impact resistant ultra-violet stabilised acrylic moulding. The diffuser shall be either transparent or opaque as described in the project specification. Where transparent diffusers are required, these shall be moulded with internal prismatic refractors and the outer surface shall be smooth.

5.8.2 The diffuser shall be mounted to the body by means of an external mounting ring and at least three screws, which should preferably not pass through the diffuser body as well. A silicon sponge gasket which fits into a groove on the diffuser shall be used to allow breathing of the luminaire whilst prohibiting the ingress of insects.

6. PHOTOMETRIC DATA

Photometric data sheets of the luminaire as prepared by a laboratory that complies with SANS requirements, shall be submitted with the luminaire.

7. TECHNICAL INFORMATION

The Tenderer shall include full technical particulars regarding the luminaire offered with the tender.

SECTION C11

C.11 EARTHING ELECTRODES

1. GENERAL

This section covers uncoated, coated and metal clad circular rod electrodes intended to provide an earth in soil for electrical and lightning arrestor systems.

2. CATEGORY AND TYPE

2.1 Only the following type of earth rods shall be used:

1(a) - Solid copper.
1(b) - Solid stainless steel.
2 (a) - Solid steel with bonded copper protection.
2 (b) - Solid steel with plated copper protection.
2 (c) - Solid steel with a shrunk-on copper jacket.
3 - Solid steel with a shrunk-on stainless steel jacket.
4 - Galvanised steel.

2.2 Bare aluminium is not acceptable as an electrode material.

2.3 All rods shall be solid and of circular cross section with length as specified in the Detail Technical Specification.

2.4 The nominal diameter of the earthing rods shall not be less than 16mm unless the rods are specified for placing in pro-drilled holes in which event the minimum nominal diameter shall not be less than 12mm.

3. COUPLINGS AND CONDUCTOR CLAMPS

3.1 Earthing electrodes shall be provided with (n-1) couplings where n = number of rods supplied.

3.2 Rods designed for coupling by means of external sleeves shall be provided with an adequate quantity of hydrocarbon or silicon grease to be applied to the coupling before the joint is made.

3.3 Rods designed for coupling by means of internal pins or splines shall be provided with thin-walled tubes and hydrocarbon or silicon grease to seal the joint.

3.4 Conductor clamps shall be provided to suit the type and size of rods provided and the type and size of conductor specified in the Detail Technical Specification.

3.5 The material of the clamps shall be electrolytically compatible with the rod and conductor materials.

3.6 Where brazed or welded connections are specified, the supplier of the rods shall stipulate at least two types of metals which are compatible with the rod and conductor materials.

3.7 An adequate number of driving caps or bolts shall be supplied with the rods to protect the ends of the earthing rods whilst being driven into hard soil.

SECTION C12

C.12 SWITCHBOARDS (Up to 1 kV)

1. GENERAL

1.1 Scope

This section covers the manufacturing and testing of flush mounted, surface mounted and floor standing switchboards for general installations in normal environmental conditions and for system voltages up to 1 kV.

1.2 Size

All switchboards shall be of ample size to accommodate the specified switchgear and provide space for future switchgear. For every 4 (or part of 4) 5kA circuit-breakers on a switchboard, space for an additional 5kA circuit breaker shall be allowed unless future space requirements are dearly specified. For circuit breakers above 5kA, this factor shall be 15%. The clearance between adjoining switchgear openings shall be as specified in par. 6.2.

1.3 External Dimensions

The maximum allowable height of free standing switchboards is 2,2m. Cubicle type boards may be up to 2,4m high if they can be fully dismantled into individual cubicles. Where, due to space restrictions, a board exceeds 2,4m in height, equipment not normally requiring access, shall be installed in the top section, enabling equipment normally requiring access to be installed lower down in the board. All other specified external dimensions for switchboards shall be strictly adhered to. If the clearances specified in par. 6.2 cannot be adhered to as a result of restricting external dimensions, the Contractor shall obtain the approval of the Department before manufacturing the switchboards.

1.4 Moisture and Vermin

All switchboards shall be rendered moisture proof and vermin proof and shall be adequately ventilated. Refer to par. 4.10 and 4.11.

1.5 Load Balance

The load shall be balanced as equally as possible across multiphase supplies.

2. CONSTRUCTION OF FLUSH MOUNTED SWITCHBOARDS

2.1 Standard

Flush mounted switchboards shall comply fully with SANS 1765. Unless the depths of the switchboards are specified, the depths shall be determined in accordance with par. 6.

2.2 Expanded Metal

Where switchboards are to be built into 115mm thick walls, expanded metal shall be spot-welded to the rear of the bonding trays. The expanded metal shall protrude at least 75mm on each tray side to prevent plaster from cracking.

2.3 Knock-outs

Knock-outs shall be provided in the top and bottom ends of each switchboard tray to allow for the installation of conduits for the specified and future circuits. Knock-outs shall be provided for an equal number of 20mm and 25mm dia. conduits.

2.4 Panel

Front panels shall have machine punched slots for housing the specified and future flush mounted switchgear. The distance between the inside of the closed doors and the panel shall not be less than 20mm. No equipment may be mounted on the panel unless the panel is permanently hinged to the switchboard frame.

2.5 Fixing of Front Panels

The front panel shall be secured to the architrave frame by means of 6mm studs and chromium-plated hexagonal domed nuts, hank nuts or captive fasteners. Alternatively the panel may be secured to the architrave frame by means of two pins at the bottom and a latch or lock at the top of the panel. Self-tapping screws will not be allowed. All front panels shall be provided with a minimum of one chrome plated handle.

2.6 Door Handles and Catches

Switchboard doors shall be equipped with handles and catches. Locks shall only be provided when specified. In all cases where lockable doors are required and in all cases where the switchboard doors are higher or wider than 450mm, handles consisting of a push-button-and-handle combination with spring loaded catch or rotary handle-and-catch combination shall be installed. Switchboard doors smaller than 450mm in height and width may be equipped with spring loaded flush mounted ring type latches. Square key operated catches are not acceptable unless specified.

3. CONSTRUCTION OF SURFACE MOUNTED SWITCHBOARDS

3.1 Standard

Surface mounted switchboards shall comply with SANS 1765.

3.2 Switchboard Tray

Surface mounted switchboards shall be equipped with a 1,6mm minimum sheet steel reinforced tray suitably braced and stiffened to carry the chassis, door and equipment. Lugs to secure the switchboard to a vertical surface shall be provided.

3.3 Construction

All joints shall be welded or securely bolted. The tray shall be square and neatly finished without protrusions. The front tray sides shall be rounded with an edge of at least 20mm to accommodate flush doors.

3.4 Chassis

A sheet steel chassis for the mounting of equipment shall be bolted to the tray and shall comply with the requirements of par. 6.1 and 6.3.

3.5 Front Panel and Door

The front panel and door shall comply with par. 2.4 to 2.6 above. Doors shall fit flush in the tray when closed.

3.6 Dimensions

Unless the depth of the switchboards is specified, the dimensions shall be determined in accordance with the requirements of par. 6.2 and 6.3.

4. CONSTRUCTION OF FREE STANDING SWITCH BOARDS

4.1 Framework

A metal framework for free standing switchboards shall be manufactured from angle iron. channel iron or 2mm minimum folded metal. A solid U-channel base frame, sufficiently braced to support all equipment and span floor trenches and access holes shall be provided. Switchboards shall be of cubicle design with 2mm side panels forming divisions between cubicles. The maximum allowable cubicle width is 1,5m. (Refer also to par. 4.7). Joints shall be non-continuously butt-welded. Welds shall be ground smooth and the joint wiped with plumber's metal in order to provide a smooth finish. Switchboards wider than 2m shall be fitted with screwed eye-bolts attached to the framework to facilitate loading and transportation of the board.

4.2 Rear and Side Panels

The rear panels shall be removable and shall be manufactured from 2mm minimum sheet steel. The panels shall have returned edges which are recessed in the frame or which fit over lips on the switchboard frame. The panels shall be secured to the frame by means of studs and chromium-plated hexagonal domed brass nuts or hank nuts or captive fasteners equal or similar to "DZUS" or "CAMLOC". Where switchboards are intended for installation in vertical building ducts or against walls, the rear and side panels may consist of a single folded sheet which is either bolted or welded to the frame or which forms part of the folded metal frame.

4.3 Front Panels

4.3.1 The front panels of floor standing switchboards shall preferably be hinged except where flush mounted equipment prevents this. Alternatively, panels shall be secured by means of the methods described in par. 2.5. The panels shall be arranged in multi-tiered fashion to allow for the logical grouping of equipment in accordance with par. 6.

4.3.2 The hinged front panels shall have a dished appearance with 20mm upturns which fit over a lip on the switchboard frame. Alternatively the hinged panels shall have folded edges and shall be fitted flush or slightly recessed in the switchboard frame. The latter method shall be used where doors are required. (Also refer to par. 4.6). Corners shall be welded and smoothed.

4.3.3 The panels shall be of 2mm minimum sheet steel with machine punched slots to allow for the flush mounting of instrumentation, switchgear toggles and operating handles. A minimum clearance of 50mm shall be maintained between the rear of equipment mounted on the panels (taking into account terminals or other projections) and the frame and chassis of the switchboard. Separate panels shall preferably be provided for the mounting of instrumentation and for covering flush mounted switchgear. Enclosed switchgear with front panels e.g. combination fuse-switch units, may be flush mounted in the board in lieu of separate hinged panels.

4.3.4 Hinged panels shall be suitably braced and stiffened to carry the weight of flush mounted equipment and to prevent warping.

4.3.5 Hinged panels with flush mounted equipment and panels higher than 600mm shall be supported by hinges of adequate strength to ensure smooth and reliable operation. 16mm pedestal or similar heavy duty hinges with single fixing bolts may be used on panels smaller than 600mm. On the larger panels long pedestal type hinges with two fixing bolts per hinge are preferred. Piano hinges are not acceptable for this application.

4.3.6 A tubular chromium-plated handle shall be fitted on each panel. The handle may be omitted if "DZUS" or "CAMLOC" fasteners are used.

4.3.7 Blanking plates shall be fitted over slots intended for future equipment. These plates shall be fixed in a manner which does not require the drilling of holes through the front panel. Dummy circuit-breakers may be fitted where applicable.

4.3.8 Front panels containing live equipment such as instrumentation or control switches, shall be bonded to the switchboard frame with a braided copper earth trap with an equivalent cross-sectional area of at least $4mm^2$.

4.4 Securing of Front Panels

Hinged panels shall be secured in position by means of square key operated non-ferrous fasteners designed to draw the panels closed or similar quick-release fasteners. Self-tapping screws are not acceptable. Where non-hinged removable panels are specified, they shall be secured in position by means of 6mm studs and hexagonal chromed brass dome nuts and washers or hank nuts. Non-hinged removable panels may alternatively be secured in position by means of two pins at the bottom and a latch or lock at the top.

4.5 Chassis

A suitably braced chassis for the mounting of switchgear and equipment shall be firmly secured to the frame of the switchboard. The chassis shall be designed so that the switchgear can be installed in accordance with par. 6. Circuit-breakers and isolating switches which are not of the moulded-case air-break type and the insulators of busbars for ratings of 200 A and more may be secured directly to the framework. (Refer to par. 6.1).

4.6 Doors

(a) Doors need only be provided when specified. Doors shall be arranged in multi-tiered fashion to allow for the logical grouping of equipment in accordance with par. 6.

(b) Doors shall have a dished appearance with a minimum of 20mm upturns which fit over a lip on the switchboard frame or shall fit flush in the switchboard frame. Corners shall be welded and smoothed.

(c) Doors shall be of aluminium sheet steel with machine punched slots to allow for the flush mounting of instrumentation, control and protection equipment. Switchgear shall be flush mounted in the front panels behind the doors unless specified to the contrary. A minimum clearance of 50mm shall be allowed between the rear of equipment mounted on doors (including terminals and projections) and the frame, front panel and chassis.

(d) Doors shall be suitably braced and stiffened to carry the weight of the equipment and to prevent warping.

(e) Hinges for doors shall be provided as described in par. 4.3.5. At least three hinges shall be provided on doors higher than 1,2m.

(f) Doors shall be fitted with handles consisting of a pushbutton-and-handle combination with springloaded catch or a rotary handle-and-catch combination. Flush mounted ring type handles or square key operated latches are not acceptable. The same key shall fit all locks on the switchboard in cases where locks are required.

(g) Doors shall be fitted with hypalon or neoprene seals.

(h) Doors containing any electrical equipment shall be bonded to the switchboard frame with a braided copper earth w re with an equivalent cross-sectional area of at least $4mm^2$.

4.7 Sections

For ease of transportation and to facilitate access to the allocated accommodation, switchboards may be dismantled into cubicles or sections. Each section shall be rigidly manufactured to ensure that damage to the switchgear will not occur during transportation and handling. Where required, switchboards shall have temporary wood or steel bracing to protect switchgear and facilitate handling.

4.8 Grouping of Switchgear

The switchgear shall be logically arranged and grouped as described in par. 6. Depending upon the number and size of components, a common front panel may be installed over one or more groups of equipment. All equipment shall be installed in accordance with the requirements of par. 6.

4.9 Cable Gland Plate

A cable gland plate shall be installed across the full width of each power cubicle at a minimum height of 300mm above the bottom of the switchboard to house the cable glands. A Steel cable channel or other approved support shall be provided to carry the weight of the cable and remove mechanical

stress from the cable glands. A minimum distance as required by the bending radius of outgoing cables shall be provided between the lowest terminals of major equipment and the gland plate.

4.10 Ventilation

Switchboards shall be property ventilated, especially cubicles containing contactors, transformers, motor starters, lighting dimmers and other heat producing equipment. Louvres shall be fitted to provide adequate upward or cross ventilation. All louvres shall be vermin proofed with 1,5mm brass mesh or perforated steel plate internally spot welded over the louvres. The internal ambient temperature shall not exceed 40°C.

4.11 Vermin Proofing

Free standing boards shall be protected against vermin, especially from below, where cables have to pass through the gland plate, rubber grommets shall be provided and enough non-hardening compound shall be delivered with the board so that these holes can be sealed properly after installation of the cables.

5. CONSTRUCTION OF MAIN LOW TENSION SWITCHBOARDS

Main low tension switchboards and sub-main low tension switchboards heavily equipped shall comply with par. 4.1 to 4.11 as well as the following exceptions or additions:

(a) These boards shall be fully extensible with removable busbar cover plates in the side panels.
(b) Doors shall not be supplied unless specifically called for.
(c) Switchgear and equipment shall be installed in accordance with the requirements of par. 6.
(d) Provision for metering equipment shall be made in accordance with requirements of local authorities where applicable.

6. MOUNTING OF EQUIPMENT

6.1 The mounting of equipment shall comply with SANS 1765 where applicable. Equipment to be mounted on the chassis shall be mounted by bolts, washers and nuts or by bolts screwed into tapped holes in the chassis plate. In the latter case the minimum thickness of the chassis plate shall be 2,5mm. The latter method shall not be used where boards will be subject to vibration or mechanical shocks. Self-tapping screws will not be accepted.

6.2 Space Requirements

In designing the switchboards the following requirements shall be strictly adhered to:-

(a) A minimum of 50mm between any piece of equipment and the frame or internal partitioning. This minimum space is required on all sides of the equipment. In the case of a single row of single-pole circuit-breakers the spacing on one side row may be reduced to 25mm if the incoming side of the circuit-breakers is busbar connected.

(a) A minimum of 75mm between horizontal rows of equipment. The maximum outside dimensions of equipment shall be considered.
(c) Circuit-breakers up to a fault rating of 10 kA may be installed adjacent to each other. For higher ratings a minimum of 40mm shall be allowed between circuit-breakers or isolators.
(d) Sufficient space shall be provided for wiring allowing for the appropriate bending radius.
(e) Space for future equipment shall be allowed as described in par. 1.2.

6.3 Mounting of Chassis

The chassis of flush mounted and smaller surface mounted boards shall be mounted in accordance with SANS 1765. For all free standing switchboards and surface mounted switchboards where the main switch rating exceeds 100 A (triple-pole), space for wiring shall be provided between the chassis and tray. This space shall be adequate to install the supply cable behind the chassis and terminate on the main switch without sharp bends in the cable cores.

6.4 Grouping of equipment

6.4.1 Equipment shall be arranged and grouped in logical fashion as follows:
(a) Main switch - to be installed either at the top or bottom of the board.
(b) Short circuit protection equipment - fuse gear or fuse-switches.
(c) Change-over contactors or other contactors controlling the supply.
(d) Motor supplies.
(e) Fuse-switches for outgoing circuits.
(f) Other circuits and equipment.
6.4.2 Where a portion of the equipment on the switchboard is supplied from a standby power source, the change-over contactor and the associated equipment shall be grouped in a separate compartment.
6.4.3 Where earth leakage units are required, the associated circuit-breakers shall be installed adjacent to the unit.

6.5 Mounting of Circuit-Breakers

All moulded-case circuit-breakers shall be flush mounted with only the toggles protruding. Miniature circuit-breakers may be installed in clip-in trays mounted on the frame. All other circuit-breakers shall be bolted to the chassis. Special provision shall be made for large main switches when designing the framework. Care shall be exercised that the rear studs of circuit-breakers are properly insulated from the steel chassis. Where necessary, insulating material shall be installed between the rear studs and the chassis. Circuit-breakers shall be installed so that the toggles are in the up position when "ON" and down when "OFF".

6.6 Instrumentation

All metering instruments shall be flush mounted in the front panel or door. The rear terminals of instruments mounted on doors shall be covered with an insulating material to prevent accidental contact. Current transformers for metering shall be mounted so that the rating plate is clearly visible. Fuses for instrumentation shall be mounted in an easily accessible position and clearly marked.

6.7 Mounting of Fuses

6.7.1 Fuse holders shall be mounted semi-recessed in the front panel so that fuses can readily be changed without removing the front panel. Busbar mounted fuses for instrumentation shall be used as far as possible.

6.7.2 Where equipment requiring fuses is specified on a board (fuse switches etc), a ruling shall be obtained from the Department on the quantity of spare fuses to be provided.

6.8 Equipment in Main Boards

Equipment in main low tension switchboards and sub-main boards shall be grouped in individual compartments. Equipment shall be installed as follows:

6.8.1 Rack-out type air circuit-breakers shall be mounted in the bottom section, flush behind the panel with the handle only protruding. If this is not possible, the panel shall be omitted and the air circuit-breakers installed behind a door.

6.8.2 If the main switch is a moulded-case circuit-breaker or isolator it shall be flush mounted.

6.8.3 Contactors controlling the supply shall be installed behind separate front panels.

6.8.4 All metering, protection and indicating equipment shall be clearly visible from the front of the board. Current transformer ratios and multiplication factors shall be clearly marked. Where doors are specified the equipment shall be installed flush in the doors and covered as described in par. 6.6.

6.8.5 All circuit-breakers and fuses (with the exception of fuse-switches) may be grouped together behind one or more panels as described in par. 4.8.

6.8.6 Fuses or fuse-switches providing back-up protection for circuit breakers, shall be grouped with the associated circuit-breakers. Exposed surfaces effuse-switches shall be of the same finish and colour as the rest of the board where practical.

6. 9 Standby Supplies

6.9.1 Where standby power from a diesel-generator set or other sources is available and has to be connected to some of the equipment on a switchboard, the switchboard shall be divided into separate sections with sheet metal divisions to isolate standby power and mains power sections.

6.9.2 Standby and normal supply shall each have its own incoming isolator or circuit-breaker.

6.9.3 The two sections of the switchboard shall be labelled "ESSENTIAL" and "NON-ESSENTIAL" respectively.

6.9.4 The front panels of standby and no-break supply sections shall be painted in distinctive colours as follows:

(a)	Normal supply	"LIGHT ORANGE",	colour B26 of SANS 1091
(b)	Standby power	"SIGNAL RED",	colour All of SANS 1091
(c)	No-break supply	"DARK VIOLET",	colour F06 or
		"OLIVE GREEN".	colour H05 of SANS 1091

7. BUSBARS IN SWITCHBOARDS

7.1 Application

7.1.1 Busbars shall be manufactured of solid drawn high conductivity copper with a rectangular cross-section in accordance with SANS 1473, SANS 1195 and BS 159 and BS 1433, where applicable.

7.1.2 Although SANS 1473 refers only to overhead or rising busbars, busbars in switchboards shall comply with applicable sections of this specification especially as far as insulation and clearance values, creepage distance, joints, insulation resistance, dielectric strength, deflection test, absorption resistance and rated short time withstand current are concerned.

7.1.3 Busbars shall be supplied for the following applications:

(a) Distribution of supply voltage.

(b) Connection of equipment with ratings exceeding the current rating of 70mm^2 conductors (par. 8.6).

(c) Connection of outgoing circuits with current ratings in excess of that allowed for 70mm^2 conductors (par. 7.8).
(d) Collector bars for parallel cables (par. 8.1).
(e) Connection bars for neutral conductors (par. 7.9).
(f) Earth busbars (par. 7.10).
(g) Connections to miniature circuit-breakers (par. 8.6).

7.2 See Part C15 for further details.

8. WIRING

8.1 Cabling

Cables connected to incoming or outgoing circuits shall be terminated on the gland plate supplied for this purpose. (Refer to par. 4.9). Power cables up to and including 70mm^2 may terminate on clamp type terminals where the clamping screws are not in direct contact with the conductor. Connection to the equipment can then be made with cables that are similarly connected to the clamp terminal. All power cables larger than 70mm^2 terminate on busbars that are connected to the associated equipment. Parallel incoming or outgoing cables shall be connected to a collector busbar without crossing the conductors.

8.2 Terminal Strips

External wiring for low voltage, control, interlocking, alarm, measuring and DC circuits shall terminate on numbered wiring terminals complying the with Department's standard specification for "WIRING TERMINALS", Section C9. The correct terminal size as recommended by the manufacturer for each conductor to be connected shall be used throughout. The terminal numbers shall appear on the wiring diagrams of the switchboard. Terminals for power wiring shall be separated from other terminals. Terminals for internal wiring shall not be interposed with terminals for external circuits. All connections to terminals shall be identified as described in par. 8.8. Where switchboards consist of separate sections, the control wiring passing between sections shall be terminated on strips in each section so that control wiring can be readily re-instated when reassembling the board.

8.3 Current Ratings

The current rating of conductors for the internal wiring shall be sufficient for the maximum continuous current that can occur in the circuit. This value shall be determined from the circuit-breaker or fuse protection of the circuit.

TABLE 12.3

CURRENT RATING FOR INTERN

Nominal cross-Section mm^2	CONDUCTOR RATING (A)				
	Number of conductors in bunch				
	1	2-3	4-5	6-9	10 and more
2,5	28	25	22	19	16
4	37	33	30	26	22
6	47	42	38	33	28
10	64	54	51	44	38
16	85	76	68	59	51
25	112	101	89	78	67
35	138	124	110	96	88
50	172	154	137	120	103
70	213	191	170	149	127

The above table shall be applied for ambient temperatures up to 30°C. (Refer to table 41.2 in VDE 0100). For higher ambient temperatures the values shall be derated as prescribed by SANS 10142. Table 10.

8.4 Internal Wiring

(a) Standard 600/1 000 V grade PVC-insulated stranded annealed copper conductors to SANS 1507 shall be employed for the internal power wiring of switchboards. The smallest conductor size to be used for power wiring in switchboards shall be 2.5mm^2. Flexible cord of minimum size 1,0mm^2 may be used for control wiring.

(b) Where heat generating equipment is present and the internal temperature of the board is likely to exceed 50°C, silicon-rubber insulated stranded conductors shall be used.

(c) Wiring shall be arranged in horizontal and vertical rows and shall be bound with suitable plastic straps or installed in PVC wiring channels. Under no circumstances may PVC adhesive tape be used for the bunching of conductors or for the colour identification of conductors.

(d) Bunched conductors shall be neatly formed to present a uniform appearance without twisting or crossing the conductors. Conductors leaving the harnesses shall be so arranged that they are adjacent to the chassis.

(e) Conductors to hinged panels and doors shall be secured on both the door and the frame and shall be looped between the two points. The loop shall be arranged to produce a twisting motion when the door is opened or closed. A flexible protection sleeve shall be installed over the conductors.

(f) Where wiring channels are used, they shall be installed horizontally and vertically. Under no circumstances may power and control circuit wiring be installed in the same wiring channels. Channel shall not be more than 40% full.

(g) All wiring between different Panels within the same switchboard shall be installed in wiring channels.

(h) Grommets shall be installed in each hole in the metalvvork through which conductors pass.

(i) All wiring shall be installed away from terminals, clamps or other current carrying parts. Wiring shall also be kept away from exposed metal edges or shall be protected where they cross metal edges protected where they cross metal edges.

(k) Conductors may be jointed at equipment terminals or numbered terminal strips only. No other connections are allowed.

(l) Where conductors change direction, smooth bends shall be formed with a radius of at least 5 times the outside diameter of the conductor or harness.

(m) Where screened cables are specified, the screening shall be earthed in the switchboard or control board only unless clearly specified to the contrary, Screened cables entering control boxes through pressed knock-outs, shall terminate in compression glands. Conductors shall as far as possible remain inside the screening at terminations. Where conductors have to separate from the screen, the braiding shall be separated and the conductors drawn through the braid without damaging the braiding. The conductors shall then be connected to their respective terminals and the screening smoothed and connected to the earth terminal.

(n) Where neutral connections are looped between the terminals of instruments, it is essential that the two conductor ends be inserted into a common lug or ferrule and are crimped or soldered together in order that the neutral connection is not broken when the conductors are removed from one of the instruments.

(o) Wiring should as far as possible be confined to the front portions of switchboards for ease of access. This requirement is important for wiring between smaller circuit-breakers and the associated main circuit-breaker as well as the wiring from circuit-breakers to lighting and socket-outlet circuits.

(p) A maximum of two conductors will be allowed per equipment terminal. Where more conductors must be connected to the same equipment terminal (e.g. a main circuit-breaker feeding other circuit-breakers), stub busbars shall be provided for the various conductors. Refer also to par. 8.6.

8. 5 Load End Connections

The supply end connections to all equipment shall under all circumstances be at the top and the load end connections at the bottom.

8.6 Wiring to Circuit-breakers

Equipment with a rating exceeding the current rating of 70mm^2 conductors shall be connected by means of busbars to the main busbars. Looped connections may only be installed for a maximum of two outgoing circuits. Where there are more than two outgoing circuits, busbars shall be used and equipment connected individually to the busbars. Where miniature circuit-breakers are mounted in continuous rows and supplied by busbars connected to each MCB. each busbar shall be supplied by a separate conductor. This conductor shall be connected to the busbar by means of a separate lug and not via an MCB terminal.

8.6 Conductor Terminations

Conductors connected to terminals complying with the Department's standard specification for "WIRING TERMINALS". Section C9, need not be soldered or ferruled. Connections to circuit-breakers, isolators or contactors shall be made by one of the following methods:

(a) A ferrule of the correct size,

(b) soldering the end of the conductor, or

(c) winding a conductor strand tightly around the end to totally cover the end.
All conductors terminating on meters, fuse holders and other equipment with screwed terminals shall be fitted with lugs. The lugs shall be soldered or crimped to the end of the conductor. The correct amount of insulation shall be stripped from the end to fit into the terminal. Strands may not be cut from the end of the conductor.

8.8 Identification

8.8.1 The colour of the conductors for all 220/250 V circuits shall correspond to the colour of the supply phase for that circuit. Neutral conductors shall be black.

8.8.2 All other conductors in the board, supplying control circuits, etc. shall be coded in colours other than those specified above. A colour code shall be devised for each board and the colour code shall be shown on the wiring diagrams.

8.8.3 All conductors that terminate at wiring terminals and all conductors used for the internal wiring of the switchboard, shall further be identified at both ends by means of durable cable marking ferrules. PVC or other tape is not acceptable.

8.8.4 The numbers on the markers shall be shown on the wiring diagrams.

9. PAINT FINISH

Metal components of the framework, panels and chassis shall be painted in accordance with the Department's "STANDARD PAINT SPECIFICATION". Section C39.

10. LABELLING

10.1 Care shall be taken to ensure that all equipment is fully labelled and that accurate descriptions and safety warning notices appear in both official languages.

10.2 Material

Engraved plastic or ivory sandwiched strips shall be used throughout. The strips shall bear white lettering on a black background for normal labels and red letters on a white or yellow background for danger notices.

10.3 Main Switchboards

Main switchboards and sub-main switchboards shall be supplied with the following bilingual labels:

(a) Number and allocation of switchboard. Example:
CONTROL BOARD A4
BEHEERBORDA4
Lettering: at least 10 mm high prominent position. Label on the outside in a prominent position.

(b) Designation of busbar sections. Example:
BUSBAR SECTION 2
GELEISTAMSEKSIE2
Lettering: at least 10mm high. Label on the outside in a prominent position.

(c) Designation of all switchgear including circuit-breakers, isolators, contactors, etc. If the current rating of circuit-breakers is not clearly marked on the equipment, the value shall be indicated on the engraved label. Example:

SUPPLY TO BOARD C3 TOEVOER NA
BORD C3

PUMP SUPPLY
POMPTOEVOER
Letters at least 5mm high. Label on the outside of the switchboard.

(d) All other equipment including meters, instruments, indicator lights, switches, push-buttons, circuit-breakers, fuses, contactors, control relays, protection relays, etc. shall be identified. The function of the equipment and circuits shall be clearly indicated. The main switch shall be labelled as such and designated:
"SWITCH OFF IN CASE OF EMERGENCY"
"SKAKEL AF IN NOODGEVAL"

Flush mounted equipment within doors or front panels shall be identified with labels fixed to the doors or front panels respectively. The labels for equipment installed behind panels, shall be fixed to the chassis close to the equipment. If this equipment is positioned too close together to accommodate descriptive engraved labels, the equipment may be identified by a code or number on an engraved label which shall be fixed close to the equipment. The code number shall be identified on a legend card which shall be installed on the switchboard behind a plastic or other protective cover.

10.4 Other Switchboards

All equipment on switchboards shall be identified with the necessary bilingual labels.The circuit numbers shall appear at grouped single-pole circuit-breakers. The circuit numbers shall correspond to the circuit numbers on the final installation drawings. The above-mentioned circuits shall be identified on a legend card, which shall be installed on the inside of the switchboard door, or in any other position where it can conveniently be observed. All fuses, including instrument fuses, shall have labels stating function, fuse rating and duty or type where applicable. All other equipment shall be identified separately and their functions shall be clearly indicated.

10.5 Fixing of Labels

10.5.1 Labels shall not be fixed to components or trunking but to doors, panels, chassis or other permanent structures of the switchboard.

10.5.2 Engraved strips shall be secured to facilitate a neat alteration of the designation of the labels. Sufficient fixing points shall be provided to prevent labels from warping. Labels in slotted holders shall be secured in position to prevent unauthorised removal. Labels may be secured by the use of brass bolts and nuts, self-tapping screws, slotted label holders or pop-rivets.

11 TESTS

11.1 The Department shall be notified when the mechanical construction of the switchboard, i.e. frame, panels and base frame, is complete in order that it may be inspected at the factory.

11.2 Function tests of all equipment, control and interlocking circuits shall be conducted to the satisfaction of the Department. Testing equipment and facilities including instruments, dummy loads and additional switchgear and cables shall be provided by the Contractor at no extra cost. The Department shall be notified in writing two weeks in advance of any test to be conducted, to allow its representative to be present at such tests. A complete report on the tests shall be handed to the Department.

11. DRAWINGS

12.

12.1 Drawings for Approval

A set of three prints of the shop drawings for the switchboards shall be submitted to the Department for approval before the boards are manufactured. The following information shall be presented:

(a) A complete wiring diagram of the equipment on the boards.

(b) A complete layout of the arrangement of the switchboards indicating all equipment dimensions and the construction of the boards. The positions and method of fixing and sizes of busbars shall be shown.

(c) All labelling information in both the official languages on a separate sheet.

(d) The make, catalogue number and capacity of all equipment such as isolators, circuit-breakers, fuses, contactors, etc.

The approval of drawings shall not relieve the Contractor of his responsibility to the Department to supply the switchboards according to the requirements of this Specification.

12.2 Final Drawings

A complete set of "as-built" transparent drawings of all switchboards shall be submitted to the Department within two weeks after delivery of the boards. The following information shall be presented:

(a) Item (a) to (d) of the previous paragraph.
(b) Terminal strip numbers, numbers and colours of conductors connected to the terminal strips and numbers and colours of the conductors utilised for the internal wiring.
(c) A separate schedule of all equipment.

12.3 Manuals

Three sets of manuals for all specified main and sub-main switchboards shall be supplied to the Department at no extra cost. These manuals shall include the following information:

(a) Complete information on the operation of the equipment.
(b) Complete information for maintenance of the equipment.
(c) Brochures and ordering information.
(d) A complete equipment list indicating quantities and relevant catalogue numbers.

12.4 Completion

The supply contract shall be regarded as incomplete until all tests have been conducted successfully and all drawings and manuals have been handed to the, Department

SECTION C14

C.14 MOULDED-CASE CIRCUIT-BREAKERS

1. This section covers single or multi pole moulded case circuit breakers for use in power distribution systems, suitable for panel mounting, for ratings up to 1 000 A, 600 V. 50 Hz.
2. The circuit breakers shall comply with SANS 156.
3. The continuous current rating, trip rating and rupturing capacity shall be as specified.
4. The contacts shall be silver alloy and shall close with a high pressure wiping action.
5. Where specified, the circuit breaker shall be capable of accommodating factory fitted shunt trip or auxiliary contact units or similar equipment.
6. The operating handle shall provide clear indication of "ON", "OFF" and "TRIP" positions.
7. The mechanism shall be of the TRIP-FREE type preventing the unit from being held in the ON position under overload conditions.
8. All moulded case circuit breakers in a particular installation shall as far as is practical be supplied by a single manufacturer.
9. The incoming terminals of single pole miniature circuit breakers shall be suitable for connection to a common busbar.
10. The circuit breaker shall have a rating plate indicating the current rating, voltage rating and breaking capacity.

13. Extension type operating handles shall be provided for units of 600 A rating and above.

SECTION C15

C.15 EARTH LEAKAGE RELAYS

1. Earth leakage relays shall be single or three-phase units with a sensitivity of 30mA with associated circuit breaker or on-load switch for use on 220/250V single phase or 380/433 V three phase, 50 Hz, supplies.

2. The units shall be suitable for installation in switchboards in clip-in trays or bolted to the chassis.

3. The earth leakage relay shall function on the current balance principle and shall comply with SANS 767 as amended, and shall bear the SANS mark. Integral test facilities shall be incorporated in the unit.

4. Circuit breakers with trip coils used integrally with earth leakage units (two pole for single phase units and three pole for three phase units) shall comply with SANS 156.
5. On-load switches used integrally with earth leakage units (two pole for single-phase units and three pole for three phase units) shall comply with SANS 60497.

6. The fault current rating of the unit shall be 2,5kA or 5kA as required, when tested in accordance with SANS 156.

SECTION C16

C.16 CURRENT TRANSFORMERS

1. GENERAL

Current transformers shall comply with the requirements of BS 3938 and IEC 185 with the exception of the required impulse test level, par.6 below.

2. RATINGS

Current transformers shall be suitable for the primary currents listed hereunder and their decimal multiples:
10, 12.5, 15, 20, 25, 30, 40, 50, 60 and 75.
The preferred values are:
10,15, 20, 30, 50 and 75.

2.2 Current transformers shall have secondary ratings of 1, 2 and 5A, with 5A being preferred.

2.3 Current transformers shall have standard outputs of 2, 5, 5, 10, 15 or 30 VA as applicable in terms of the burden of the instruments and interconnecting wiring. The current transformer output shall match the actual instrument burden as closely as possible in order not to introduce unnecessary errors.

3. ACCURACY CLASS

3.1 For metering applications, accuracy classes of 0.1, 0.2, 0.5, 1, 3 or 5 are applicable.Where no accuracy class has been specified, the following table may be used as a guide:

Application	Primary Current	Suggested Class
Indicating Instruments	All .	5
Metering Applications	Up to 200 A	1
Metering Applications	250 to 600 A	0.5
Metering Applications	800 A and above	0.2

3.2 Where ring type current transformers are specified, the aperture shall not be unnecessarily large as accuracy is thereby reduced.

3.3 The classes for protection are 5P, 10P, 15P, 20P or 30P with 5P and 10P being standard. Turns compensation shall not be employed on protection current transformers for ratios greater than 150/5.

3.4 Class X current transformers shall be used in differential protection systems.

3.5 Manufacturers shall supply the magnetisation curve details and saturation factors for each different transformer ratio.

4. MARKINGS

All current transformers shall come complete with a label on which the following Information is indelibly stamped:
Manufacturer.
Serial No. or Type.
Rated primary and secondary current.
Rated frequency.
Rated output and accuracy class.
Highest system voltage.
Rated insulation level.

5. FAULT CURRENT

Current transformers shall be capable of withstanding the dynamic forces resulting from the maximum through-fault current which may be encountered at the point where they are installed. The short time current rating of current transformers shall be at least equal to that of the associated circuit breaker.

6. IMPULSE LEVEL

Current transformers used in system voltages in excess of 660 V shall withstand an impulse test level of 95 kV. Impulse levels for current transformers used in system voltages up to 660 V shall comply with BS 3938.

7. TESTS

7.1 One protection current transformer of each type used in a contract shall be tested to confirm the estimated characteristics. The following results shall be submitted:

(a) Magnetisation Curve

(b) Secondary resistance

(c) Secondary leakage reactance, if not negligible or if required by the Department.

7.2 The power frequency, secondary to earth and over voltage inter-tum tests in accordance with BS 3938 shall be conducted on all current transformers. Impulse tests shall be conducted on all current transformers intended for use in system voltages in excess of 660 V.

SECTION C18

C.18 TRIPLE POLE ON-LOAD ISOLATORS

1. This section covers switches suitable for panel mounting for use in power distribution systems up to 600 V, 50 Hz. Switches for motor isolation are included.
2. The switches shall be of the triple pole, hand operated type complying with SANS 60947.
3. The switches shall have a high speed closing and opening feature.
4. The switches shall be suitably rated for the continuous carrying, making and breaking of the rated current specified as well as the through-fault current capacity as specified.
5. To distinguish the switches from circuit breakers the operating handles shall have a distinctive colour and/or the switch shall be clearly and indelibly labelled "ISOLATOR".

SECTION C19

C.19 TIME SWITCHES AND PHOTOCELLS

1. Time switches shall be of single-pole type, suitable for 220/250 V systems, with contacts rated for the duty to be performed with a minimum rating of 15A. Contacts shall be of high quality material, e.g. silver-plated or solid silver.
2. The clock shall be driven by a self-starting, hysteresis synchronous motor, keeping accurate mains time. All clocks shall be controlled by an electrically wound escapement providing the main spring with a minimum of 15 hours reserve in case of a power failure. The main spring shall be kept fully wound without the use of slipping clutch devices that may wear and fall out of adjustment.
3. The main spring shall have a minimum of 15 hours reserve under full load and if fully discharged, shall be completely rewound within 15 minutes of the restoration of power.
4. An external manual bypass switch shall be provided to permit the circuit to be switched "ON" or "OFF" manually without affecting the operation of the time switch.
5. The time switch shall have a 24 hour dial, with day and night indication, that can be set to switch in 30 minute steps. The dial shall be fitted with 48 tappets corresponding to 48 change-over operations in a 24 hour period.
6. The time switch shall be fitted with a day omission dial comprising a total of 14 tappets which can be set to switch in 12 hour steps.
7. The time switch shall be housed in a dust-tight moulded plastic or metal case, consisting of a plastic clip-on front cover and a moulded plastic or metal base. Time switches to be used for surface mounting on walls shall be provided with a suitably positioned 20mm conduit knock-out.

PHOTOCELLS

1. GENERAL

1.1 The switches shall be used for the control of street lights and shall be provided with switch contacts able to carry at least 5 A. The current during no-load conditions may not exceed 50 mA.

1.2 The units shall be suitable for 240 V + 6%. 50Hz. single-phase alternating current.

2. CONSTRUCTION

2.1 The units shall be weather and vibration resistant as they are to be mounted on top of streetlight luminaires. The design shall be of such a nature that the units will be able to withstand both hail damage and damage by stone-throwers. If the units do not meet with these requirements, separate wire screens shall be provided for this purpose.

2.2 The units shall be provided with a standard NEMA plug and socket. The socket shall have a bracket for mounting on a pole.

2.3 All components shall be treated to be corrosion resistant.

3. OPERATING CONDITIONS

3.1 The units shall be suitable for operating under dusty conditions between temperatures of -5 EC and 55 EC.

4. TECHNICAL REQUIREMENTS

4.1 units shall switch on when the light intensity drops to 15 lux + 20% and shall switch off when the light intensity again reaches 40 lux + 20%.

4.2 When the unit is in the "on" position there must be a delay of one minute if it were to switch off in the case of a sudden increase in the light intensity.

SECTION C20
C.20 CONTACTORS

1. Contactors shall be of the open or totally enclosed, triple- or double-pole, electromechanically operated, air-break type suitable for 380/433 V or 220/250 V supplies and shall comply with ~~SANS 1092~~.
2. Contactors shall have the following characteristics:

(a) Enclosed coil easily replaceable.
(b) A permanent air gap in the magnetic circuit to prevent sticky operation.
(c) Provision for quick and simple inspection of contacts.
(d) Clearly marked main and auxiliary terminals.

3. All parts shall be accessible from the front.
4. Contactors which are not located in switchboards shall be housed in enclosures which comply with IP 54 of IEC 144.
5. The current rating of the contactor shall be as specified for the circuit with a switching duty in accordance with the ~~SANS 1092~~ or IEC 158-1, utilisation category ACI for lighting and power circuits and utilisation category AC3 for motor starting.
6. In addition to the required current carrying capacity and switching duty of a contactor, the contactor chosen for a particular application shall be rated for the maximum through fault current allowed by the back-up protection devices at the point where the contactor is installed. Careful co-ordination of short circuit devices shall take place.
7. All laminations of the magnetic system of the contactor shall be tightly clamped. Noisy contactors will not be accepted.
8. Non-current-carrying metallic parts shall be solidly interconnected and a common screwed earth terminal shall be provided. The contactor shall be earthed to the switchboard earth bar.
9. Latched contactors shall be provided with a trip coil and a closing coil. The contactor shall remain closed after de-energising the closing coil and shall only trip on energising the trip coil.
10. Contactor operating coils shall have a voltage rating as required by the control circuitry and shall have limits of operation and temperature rise as specified in Clause 7.5 and Table IV of IEC 158-1. Latched contactors shall be capable of being tripped at 50% of the rated coil voltage.
11. Contactors for normal/standby changeover circuits shall be electrically and mechanically interlocked. Contactors in star-delta starters shall be electrically interlocked.
12. Contactors with provision to add auxiliary contacts and convert auxiliary contacts on site are preferred. Contactors with permanently fixed auxiliary contacts shall have at least 1 x N/0 and 1 x N/C spare auxiliary contacts in addition to the contacts specified or control purposes and in addition to contacts required for self-holding operations or economy resistances. Where the number of auxiliary contacts required is greater than the number of contacts that can be accommodated on the contactor, an auxiliary relay or additional contactor shall be provided to supply the additional contacts.
13. It shall be possible to replace main contacts without disconnecting wiring.
14. Auxiliary contacts shall be capable of making, carrying continuously and breaking 6A at 230V AC, unity power factor for contactors used on 380-433/220-250 V systems.
15. Auxiliary contact functions required e.g. "lazy" contacts late-make, late-break, make-before-break, etc. shall be inherent in the contact design. Under no circumstances may these functions be improvised by bending contacts, loading contacts, etc. These functions shall be available in all contactors.
16. Spare auxiliary contacts shall be wired to numbered terminal strips in the switchboard and shall appear on the switchboard drawings.
17. All contactors on a specific project shall be from a standard range of one single manufacturer, unless specified to the contrary

SECTION C21

C.21 INDOOR SURGE ARRESTORS

1. Surge arrestors shall comply with the requirements of SANS 61643 or VDE 0675.
2. Surge arrestors shall be suitable for installation at altitudes of up to 1800m above sea level.
3. The unit shall be contained within a thermoplastic or cast resin housing and all internal components shall be fully sealed in.
4. The unit shall be supplied complete with a galvanised steel mounting bracket for convenient mounting onto the metalwork or tray of a switchboard.
5. Alternatively, the unit shall be of the type which can be mounted into the clip-tray of a switchboard.
6. Surge arrestors shall be provided in all cases where a switchboard is supplied directly from an overhead line.
7. In other cases, surge arrestors, if required, will be specified in the Detail Technical Speci

SECTION C22

C.22 STANDARD PAINT SPECIFICATION

1. FINISH REQUIRED

Metalwork of electrical equipment such as switchboards, equipment enclosures, sheet steel luminaire components, purpose-made boxes, etc. shall be finished with a high quality paint applied according to the best available method. Baked enamel, electrostatically applied powder coating or similar proven methods shall be used.

2. CORROSION RESISTANCE

Painted metal shall be corrosion resistant for a period of at least 168 hours when tested in accordance with SANS 166.

3. EDGES

Care shall be taken to ensure that all edges and comers are properly covered.

4. SURFACE PREPARATION

Surface preparation shall comply with SANS 10064. Prior to painting, all metal parts shall be thoroughly cleaned of rust. mill scale, grease and foreign matter to a continuous metallic finish. Sand or shot blasting or acid pickling and washing shall be employed for this purpose.

5. BAKED ENAMEL FINISH

5.1 Immediately after cleaning all surfaces shall be covered by a rust inhibiting, tough unbroken metal-phosphate film and then thoroughly dried.

5.2 Within forty eight (48) hours after phosphatising, a passivating layer consisting of a high quality zinc chromate primer shall be applied, followed by two coats of high quality alkyd-based baked enamel.

5.3 The enamel finish on metal luminaire components shall comply with SANS 783, Type III.

5.4 Other metal parts e.g. switchboard panels, etc., shall comply with SANS 783, Type IV with a minimum paint thickness after painting of 0,06mm. In coastal areas, the dry film thickness shall be increased to at least 0,1mm.

5.5 The paint shall have an impact resistance of 5,65 J on cold-rolled steel plate and a scratch resistance of 2kg

6. POWDER COATED FINISH (NOT TO BE USED LESS THAN 50km FROM SEASIDE)

6.1 Immediately after cleaning the metal parts shall be pre-heated and then covered by a microstructure paint powder applied electrostatically.

6.1 The paint shall be baked on and shall harden within 10 minutes at a temperature of 190°C.

6.3 The minimum paint thickness after baking shall be 0,05mm. The dry film thickness shall be increased in coastal areas. The paint cover shall have an impact resistance of 5,65 J on cold-rolled steel plate and a scratch resistance of 2kg.

7. TOUCH-UP PAINT

In the case of switchboards and larger equipment enclosures, a tin of matching touch-up paint not smaller than 1 litre shall be provided.

8. COLOURS

8.1 The colour of HV switchboards and HV switchgear enclosures shall be "DARK ADMIRALTY GREY", colour G12 of SANS 1091.

8.2 The colour of LV switchboards and equipment enclosures in buildings shall be "LIGHT ORANGE", colour B26 of SANS 1091 as recommended in SANS 10140, Part II unless specified to the contrary.

8.3 The colour of LV distribution kiosks and miniature substations shall be "AVOCADO GREEN", colour C17 or "LIGHT STONE", colour C37 of SANS 1091.

8.4 The standby power section of LV switchboards in buildings shall be coloured "SIGNAL RED", colour All of SANS 1091.

8.3 Switchboards for No-Break Power Supplies or sections of switchboards containing No-break power supplies, shall be coloured "DARK VIOLET", colour F06 or "OLIVE GREEN" colour H05 of SANS 1091

PART 4: Specification for supply, installation and commissioning of an outdoor emergency generator

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SECTION 1 – GENERAL

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1. SECTION 1 – GENERAL

1.1. Intent of Specification

The specification is intended to cover the complete installation and commissioning 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.

For the purposes of this document the following applies:

- Generator Contractor shall be referred to as the Generator Contractor or simply Contractor;
- The masculine includes the feminine;
- The singular includes the plural.

1.2. Standards and Codes

All standards referenced shall be the latest editions.

SANS 10142-1	the wiring of premises: Low Voltage Installations

SANS 8528 Reciprocating internal combustion engine driven alternating current generating sets.

SANS 60034	Rotating electrical Machines
SANS IEC 60947	Low Voltage Switchgear
OHSACT	Occupational Health and Safety Act.

Department of Public Works Quality Specification Parts A, B and C.

Local municipality by-laws for generator installations. (To be obtained from local municipality)

1.3. Compliance with Regulations

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

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

b) 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,

c) The Fire Brigade services Act 1987 (Act 99 of 1987) as amended,

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

e) The Electricity Act 1984 (Act 41 of 1984) as amended.

f) The environmental Act and regulations

1.4. Scope of Work

Included in this Outdoor Generator Specification

Supply, delivery, installation and commissioning of the complete outdoor emergency generator inside an IP65 canopy/container set on a concrete plinth as specified in this document.

The successful tenderer shall supply, deliver and install a complete single enclosed diesel driven standby generator set in a position that will be determined on site. The machine shall be totally enclosed in a 3CR12 stainless steel housing. The exhaust shall be manufactured from stainless steel.

The housing is to be provided on galvanized 3CR12 stainless steel skids so that the generator set can be transported to site and placed in position on a concrete plinth, casted by the successful tenderer. The skids must be of sufficient height to allow for the passage of storm water under the set.

1.5. Co-ordinating

The Contractor shall familiarise himself with the requirements of the other professional disciplines and shall examine the plans and specifications covering each of these sections.

The generator space, noise and vibration requirements shall be carefully checked with other professional disciplines to ensure that the equipment can be installed in the proper sequence in the space allotted.

1.6. Tests 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 must be present during the test to satisfy themselves that the generating set complies with the specification and delivers the specified output. The test must be carried out in accordance with SANS 8528. The Representative/Agent must be timeously advised of the date for the test.

b) After completion of the works and before practical completion 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 Representative/Agent.

The total costs for these test shall be included in the tendered amount.

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

1.7. Operating and Maintenance Manuals

The Contractor shall be responsible for the compilation of a complete set of Operating and Maintenance manuals.

This shall be done in accordance with Section 4 – Operating and Maintenance manuals.

All information shall be recorded and reproduced in electronic format as well as supplying the Representative/Agent with three sets of hard copies.

Approval of the final Operating and Maintenance Manuals shall be a prerequisite for issuing of a Certificate of Practical Completion of the installation.

1.8. Guarantee

After works completion of the installation have been achieved, there will follow a 12-month free maintenance period.

During this period the generator contractor shall maintain the generator installation as per the requirements of the Occupational Health and Safety Act. This maintenance shall include systematic examinations, adjustments and lubrication of all generator equipment. Electrical and mechanical parts shall be repaired or replaced whenever it is required to maintain optimum performance without additional cost to the Department, unless the condition was caused by misuse or vandalism of the generator equipment or natural hazards/force majeure.

The work under this section shall be performed by competent, qualified accredited personnel under the supervision and in the direct employment of the Generator Contractor and shall not be transferred to any non-affiliated agent. Contract maintenance and repair work shall be done during normal working hours and shall further provide emergency call-back service twenty-four (24) hours a day, seven (7) days a week.

During the guarantee/maintenance period the Department will invite tenders for the comprehensive maintenance of the generator, which will commence after the final completion has taken place, i.e. after the twelfth month guarantee period is over and all defects are corrected.

1.9. 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 Representative/Agent.

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

c) The Contractor shall be fully responsible for his work and shall replace any of the work which may be damaged, lost or stolen. The Contractor shall protect the building and its contents against damage by him, his employees or sub-contractors and shall make good any damage thereto.

d) The Contractor shall indemnify the Employer of all liability for damages arising from injuries or disabilities to persons or damage to property occasioned by any act or omission

of the Contractor or any of his sub-contractors, including any and all expenses, legal or otherwise, which may be incurred by the Employer or Representative/Agent in the defence of any claim, action or suit.

e) 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.

f) The Contractor shall thoroughly acquaint himself with the work involved and shall verify on site all measurements necessary for proper installation and commissioning 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.

g) The Contractor shall inspect and verify that the existing power feeder system is compatible with the equipment offered and any changes or upgrading of the electrical supply shall be brought to the attention of the Representative/Agent.

h) Material and equipment damaged in transit shall be replaced with undamaged material without additional cost to the Department.

i) 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.

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

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

1.10. Brochures

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

SECTION 2 – EQUIPMENT REQUIREMENTS

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2.1. SECTION 2 – EQUIPMENT REQUIREMENTS

2.2. Engine

2.2.1. General

The engine must comply with the requirements laid down in SANS 8528 and must be of the atomized 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.

Curves furnished by the engine makers, showing the output of the engine offered against the speed, for both intermittent and continuous operation as well a fuel consumption curves when the engine is used for electric generation, must be submitted with the Tender.

2.2.2. 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 SANS 8528.

2.2.3. De-Rating

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

The de-rating of the engine for site conditions shall be strictly in accordance with SANS 8528 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.

2.2.4. 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.

Starter Battery

The set must be supplied a fully charged lead-acid type or maintenance free type battery, complete with necessary electrolyte. The battery must have sufficient capacity to provide the starting torque stipulated by the engine manufacturer. 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.

2.2.5. Cooling

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

2.2.6. 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.

2.2.7. Fuel Pump

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

2.2.8. Fuel Tank

The fuel tank shall be an integral part of the base frame of the generator set. The tank shall have sufficient capacity for standby sets to run the engine on full load for a period of 24 hours. A day tank will also form part of this installation.

The diesel fuel storage system / tank which will be provided with the standby generator installation must be fitted with a fuel filtration and water separation system (filter & separator) which is entirely separate from the fuel supply line and line filter to the engine. This filtration and water separation system must be dedicated to purifying the content of the storage system / tank by way of the cleaning processes which are applied while circulating the fuel through the filter & separator unit.

The filtration system must be able to handle diesel fuel of "high" and of "low" sulphur content for an indefinite period. The suction line of the system must be connected to the lowest part of the storage system / tank. The return line must be connected in the top section of the storage system / tank in such a position and in such a way that the flow of fuel within the storage system / tank between the fuel return point and the fuel suction point will induce scouring of the bottom of the system / tank to effectively capture sediment and water in the to be filtered fuel. Fuel between the base tank and day tank to have circulation pump with filtration systems to remove the water from the diesel.

The filtration unit must filter the diesel fuel, removing suspended particles of effective diameters down to 5 micron. In addition, it must separate all water from the fuel and the fuel storage system and automatically dispose of / dump such water into an open, removable receptacle for disposal at the installation or in a suitable position outside the building. Separation of the fuel and water must be sufficiently effective that the discharged water will meet the standard required for it to be disposed of into a municipal drain and sewer system.

The filter and water separator unit must draw its power from the DC batteries used to power the relevant generator set. The circulating pump shall be provided with a controller programmed to switch the pump through not more than three complete on and off cycles of equal time (i.e. 50% on; 50% off) , per hour, with a deviation of not more than 10 % ±. The pump must be capable of a duty cycle of not less than 60% running time. The flow rate through the circulating pump must be between 1 L/min and 1.25 L /min.

The filter cartridge of the filter and water separator unit must be replaceable, and, in normal operational conditions, not require replacement within periods shorter than three months. The replacement units must be readily available.

The filtration & separator system may be mounted against the wall of the plant room or on the inside of a container, which may house the installation as may be specified elsewhere in this document.

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 of the canopy/container, 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.

The contractor shall allow for the supply and installation of a fuel shut off fusible link in the container. The fusible link shall shut off the fuel at a temperature of 130 degrees in an event of a fire in the self-contain enclosure. The fusible link shall be mounted above the engine and coupled to the shut off valve by means of a 2mm stainless steel cable. The cable shall be installed to the shut off valve without any possibility of kinking the cable which may cause malfunctioning of the protection device.

2.2.9. Governor

The speed of the engine shall be controlled by a governor in accordance with ECM of SANS 8528 if not otherwise specified in the Detailed Specification.

The permanent speed variation between no load and full load shall not exceed 4.5% of the nominal engine speed and the temporary speed variation shall not exceed 10%. External facilities must be provided on the engine, to adjust the nominal speed setting by ± 5% at all loads between zero and rated load.

2.2.10. 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 SANS 8528.

2.2.11. 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 and shall be capable of providing 20 to 30 decibels of suppression.

The exhaust system shall consist of 3CR12 steel for inland areas (greater than 50km from the coast) or Grade 304 stainless steel in coastal areas.

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 and then cladded in stainless steel sheet to reduce the heat and noise transmission in the generator enclosure and shall be protected against the ingress of driving rain at 45° to the horizontal. The exhaust pipe must extend 0,5m above the canopy.

2.2.12. 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.

2.2.13. Exhaust emissions

The exhaust emissions shall comply with US Tier III/EU stage III standards.

2.3. Alternator

2.3.1. General

The alternator shall be of the self-excited brushless 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 SANS 60034-1 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.

2.3.2. 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 0,9 lagging and within the driving speed variations of 4,5% between no-load and full load.

2.3.3. 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 milli-seconds following the application of full load and the transient voltage dip shall not exceed 18%.

2.3.4. Coupling

The engine and alternator must be directly coupled by means of a high quality flexible coupling, ISO 9001:2000 approved and must be designed and manufactured to this quality system.

2.4. Switchboard

2.4.1. 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.

2.4.2. Construction

The switchboard shall be enclosed in the steel enclosure.

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 not 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 used, 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 modular generator set controller and protection equipment shall be mounted on a separate easily replaceable panel.

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.

Access to the cubicle will be such that all components can be conveniently reached for testing and maintenance purposes.

The necessary bushes and a screen over the terminals will be provided where the power feeds enter and leave the cubicle.

The cubicle will be so constructed that the ac and dc components are screened from one another.

2.4.3. 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.

Reset push buttons are required on the modular generator set controller and a visible signal are required and the engine must stop 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 indication on the modular generator set controller must be in ENGLISH.

"OVERLOAD"

"TEMPERATURE HIGH"

"OIL PRESSURE LOW"

"OVERSPEED"

"START FAILURE"

"LOW WATER LEVEL"

In addition an audible and visible flashing signal shall be provided, when:

a) The fuel level in the service tank is low. The indication on the modular generator set controller shall be "FUEL LOW".

b) The battery charger failed. The indication on the modular generator set controller shall be "CHARGER FAIL"

A low-low level sensor must be provided. At this level the engine must stop to prevent air entering the fuel system.

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

All alarm conditions 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.

2.4.4. Modular Generator Set controller

The modular generator set controller shall be an electronic unit to match those of the other modular generator set controllers and of a high quality i.e. Levato, Deep Sea Electronics, Circom. It must be provided with IO and communication facilities.

The modular generator set controller will be supplied with all its functions and shall be mounted

on a separate easily replaceable panel with plug in termination blocks for easy installation and replacement.

The modular generator set controller interface will be implemented with relays, contactors etc.

The modular generator set controller will have a mimic display of the alternator/mains/ change over contactors configuration with LED's showing the status of the mains, alternator and change over contractors.

Configuration software shall be supplied with the system. The software will be capable of the following:

- Fault management (event log)
- Configuration management (software upgrades and function changes)
- Account management (energy management)
- Performance management (generator set point changes)
- Security management (passwords)

The modular generator set controller will have a standard RS 232/485 or Ethernet interface suitable for TCP I/P transport medium. All communication including configuration management will be done through this port. Equipment connected at each end of the RS 232 or Ethernet cable shall be adequately protected against transient over-voltages, lightning effects (particularly if the set and remote alarms are in separate buildings), switching surges, power system surges or mains and alternator borne noise/interference.

The controller will incorporate the following functions:

- Mains sensing
- Alternator output-voltage sensing
- Alternator over- frequency sensing
- Control of processor unit (self-diagnostics)
- Alarm/ Status indications
- Control selector and operation
- Phase rotation monitor

A 4- position control selector on the controller will be provided to facilitate the following modes of operation:

- OFF: Diesel/ alternator generator set switched off
- MANUAL: Mains bypassed: Diesel/ alternator will not take load
- AUTO: Diesel /alternator takes load on mains failure

- TEST: Diesel /alternator takes load on mains failure
- A standby failure alarm (SF) will be given on the controller and to the output alarms when "Not in Auto" is selected.

The modular generator set controller must monitor the following

When the voltage of the incoming mains varies by more than a pre-program value (default +-10%) from the normal voltage on any phase, the controller will signal that the incoming mains will be disconnected and the engine-starting sequence initiated.

When the frequency of the incoming mains varies by more than pre- program value (default +-5%) from the normal frequency, the controller will signal that the incoming mains will be disconnected and the engine-starting sequence initiated.

Upon restoration of the incoming mains to the pre-program value (default +-10%) of the normal voltage on all phases, the monitor will signal that the load will be disconnected from the alternator and reconnected to the incoming mains.

If the alternator has been disconnected from the load and the incoming mains within the voltage limits of +- 10% on all phases, the controller will signal that the load will be reconnected to the incoming mains.

Should the incoming mains fail or not in the specified limits while the engine is running under control of the cooling-off timer, the control for the cooling –off timer in the controller will be cancelled and the load connected to the alternator.

When the output voltage of the alternator varies by more than the pre-program value (default value +- 10 %) on ANY phase, the controller will signal that the load will be disconnected from the alternator and the engine stopped.

A software over and under-frequency monitor will be provided in the controller if the frequency exceeds or drop below pre-programmed values. It will meet the requirements of class G2 governing. The monitor will not be influenced by harmonics.

Note: Software monitors will include adjustable overshoot and undershoot timers to be fully compatible with Class G2 governing.

All timers will be implemented in software.

Incoming supply failure timer

It is essential that incoming supply failures, occurring at short intervals, do not cause a series of starts and stops.

A timer adjustable from 1 s to 10 s required

The timer default value will be generator set to 3 s

The signal generated by the mains voltage monitor will start the timer. If the duration of the signal is less than the generator setting on the timer, the signal is suppressed to that the switching and starting sequence is initiated. However, if the duration of the signal is more than the generator setting on the timer, the signal will be transmitted to initiate the switching and starting sequence.

Incoming supply restoration timer

It is essential that incoming supply failures, occurring at short intervals, do not cause a series of starts and stops.

A timer adjustable from 1 s to 10 s required.

The timer default value will be generator set to 3 s.

The signal generated by the mains voltage monitor will start the timer. If the duration of the signal is less than 150 sec, the signal is suppressed and the timer is regenerator set. However, if the duration of the signal is more than 150 sec, the signal will be transmitted to initiate the switching sequence.

Alternator supply/ incoming supply change-over timer

It is essential that the supply be disconnected from the load before the incoming supply is reconnected to the load. This will be software generator settable in the controller with a minimum of 5 seconds and maximum of 20 seconds.

On receipt of the switching signal, the alternator supply will be disconnected from the load and timer started. After 5 sec, the incoming supply will be reconnected to the load.

Engine cooling-off timer

After the load has been transferred to the incoming supply the engine will run without load for a period to cool off and then stop.

A timer, software adjustable in the controller from 5 to 10 min is required.

Repeat- start control

A repeat- start control is required in the controller software adjustable so that in the event of the engine falling to start on the first start attempt, the starter motor will be released and repeat the start attempt.

The repeat-start attempt will be repeated 3 times.

The duration of each start attempt will be 6 sec with a period of 15 sec between successive start attempts.

Should the engine fail to start after the third start attempt, the controller will transmit a signal for alarm purposes.

In addition to the requirement for the switchboard instruments listed elsewhere in this document metering will also form part of the modular generator set controller and must be accessible on the software.

The modular generator set controller shall display the following alarm/status indications:

- High engine temperature.
- Low Oil pressure
- High/low alternator output voltage
- Over and under speed (frequency)
- Low water level
- Emergency stop activated
- Mains fail
- Battery charger fail
- Dummy load in operation (When provided)
- Unit not in Auto
- Engine running
- Low fuel alarm
- Engine start failure

Conditions one to six above will stop the engine.

The Contractor shall provide a remote alarm mimic panel and the associated control wiring for the set. The panel shall be installed in the duty/security room at the entrance to the building approximately 70m from the generator set position.

The mimic panels must fit into furniture and blend with the design. Before manufacture, the Contractor shall submit and obtain the approval, from the Engineer, for the mimic panel.

The remote alarm must have potential free relay contacts which shall indicate the following on each set:

1) Mains on/off
2) Alternator running
3) Common fault alarm
4) Buzzer which can only be reset at the generator panel
5) Fuel low

The cable between the remote alarms is to be a signal cable with a screen and this option must be able to operate from a 12 / 24 V dc supply so that it can be powered from the generator set batteries.

A facility to originate a fault message should a warning or shutdown fault occur.

A facility to allow the mode of the control system to be changed to any of the four modes to allow the set to be run from a remote location.

A facility to originate a call to the control cellular and to transfer a fault message should a warning or shutdown fault occur. The alarm conditions above from the controller will be extended to four relays with a make and break contact and terminal strip to allow for remote monitoring of the following alarms:

- Mains fail
- Standby run
- Standby fail
- Low Fuel

A remote start facility must be supplied, software controllable in the controller.

All events relating to the status of the generator set shall be logged with date and time in a non-volatile memory (which can retain information for a period of 6 months in the absence of power to the controller) and the user shall be able to contain a hard copy on site.

The modular generator set controller system must be able to operate with a minimum DC supply voltage of 4 volts (without making use of either an internal or an external auxiliary battery) to allow cranking and starting under conditions of low battery capacity. Control cables between the set and the control panel shall be fitted with sockets for ease of undoing in the event the modular generator set controller has to be removed.

2.4.5. Manual Starting

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

2.4.6. Battery Charging 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 provided for charging the battery while the set is operational. Failure of this alternator must also activate the battery charger failure circuit.

The starter battery voltage will be software monitored by the modular generator set controller. The voltage will be digitally displayed.

2.4.7. 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. This 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.

2.4.8. Marking

All labels, markings or instructions on the switchgear shall be in English.

2.4.9. 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". 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.

2.4.10. Operation Selector Switch

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

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.

2.4.11. 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.

The contactors for this system must be electrically and mechanically interlocked.

2.4.12. 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 4 pole 4 position by-pass switch, which shall switch the connected loads as follows:

NORMAL: will allow for the normal connection i.e. connects the incoming mains to the

Automatic control gear or directly to the outgoing feeder.

In the GEN BY-PASS position the switch will disconnect the automatic changeover control gear, and will connect the municipal mains directly the essential supply busbar which will allow for the maintenance of either or both the generator and the automatic changeover equipment.

MAINS BY-PASS switching position would allow the generator to be connected directly to the essential supply busbar. This is when there is a problem with the automatic changeover equipment and there is no municipal power available.

The final position is an OFF position which will remove all power downstream of this switch.

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 are operated from the front of the compartment.

Contractor to note: The by-pass and mains isolator switch shall also break the main neutral.

2.4.13. 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.

2.4.14. 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.

2.5. 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 tenderer must wire from the switchboards to the generator cabling for the sensing of the relevant feeders and switching on the generator or off respectively.

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.

2.6. Warning Notices

Notices, in English, must be installed on the outside of the steel enclosure.

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.

The notice 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.

An engraved label shall be installed on the generator control panel that indicates the following:

Base Tank Capacity

Bulk Tank Capacity (if provided)

Full load litres per hour consumption

2.7. 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 inside an IP65 canopy/container. 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.

2.8. 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.

SECTION 3 – TECHNICAL SPECIFICATION

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3. SECTION 3 – TECHNICAL SPECIFICATION

3.1. General

Supply, deliver, install, commission, test and maintain an emergency generating set at **Pietermaritzburg High Court**

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.

Supply, delivery, installation and commissioning of the complete outdoor emergency generator set inside an IP65 canopy/container on a concrete plinth as specified in this document and indicated on the drawings.

Concrete plinth to be provided as per drawing attached.

The surface of the concrete plinth shall be 50mm higher than the existing ground level. The thickness and strength of the plinth shall be designed by the consulting engineer and are detailed on the drawings.

A tap to be provided to drain all the water that accumulates inside the bund wall. Final position of the tap will be determined on site. It is the engineer's responsibility to ensure plinth design complies with generator dimensions and weights. The bund wall shall contain 110% of the fuel, oil and water capacity of the generator. The bund wall shall not constrain the canopy doors from opening completely.

The contractor shall install an earthing system in the concrete plinth. The contractor shall install two (2) earth studs 1.8 meters long on opposite corners of the concrete plinth into the ground. The earth studs shall be connected by means of a 70mm2 bare copper earth wire to the main earth bar in the control panel. The earth conductor shall be connected to the earth bar, canopy, bass, skid and earth bar by means of suitably crimping lugs and brass bolts.

3.2. Site Information and Conditions

3.2.1. Location

The site is at Pietermaritzburg.

3.2.2. 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 : 596 Meter

b) Maximum ambient temperature : 28..... °C

c) Maximum ambient humidity at lowest temperature : 70..... %

3.3. 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	:	500kVA
Power at 0.9 power factor	:	450kW
Frequency	:	50Hz
Fault Level	:	5kA

The generating set is required to feed the following electrical load:

	Load KW	Power factor
Discharge lighting		
Fluorescent lighting		
Heaters & plugs		
Computers, radios & CRT Machines		
Aircon Plants & Aircon Units		
Fire & Security Systems		

3.4. Switchboard/Control Panel Unit

All switch- and control gear shall be rated for a fault current level of 5kA.

The switchboard/control panel unit shall be enclosed in the IP65 canopy/container.

3.5. 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	185mm² & 150mm²

3.6. 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.

3.7. Alternator

The Alternator shall be of the low harmonic type.

3.8. 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.

3.9. Enclosure

The standby set is a free standing unit and shall be mounted in an enclosure as detailed below:-

3.9.1 General

The enclosure, shall be completely vermin-proof, removable from the set and shall be constructed of 3CR12 stainless steel or equally approved of a minimum thickness of ±1.5 mm.

The enclosure shall allow easy access to the engine, alternator, radiator filler cap and control cubicle for maintenance purposes.

The door shall be flush with the rest of the canopy and of the side opening type. A minimum of four doors are required i.e. two on either side.

The door hinges and locking bars shall be of a heavy duty type and be manufactured of an alloy or mild steel which is hot dip galvanized and shall be fitted with a grease nipple.

The doors and panels shall be suitably braced and stiffened to ensure rigidity and to prevent bending and warping.

Suitable door restraints shall be fitted to all the doors, enclosure including the control panel to prevent wind damage. The restraint shall consist of a steel rod in a steel groove or slide with a spring loaded catch, which is to be manually reset to close the door.

No flexible restraints will be accepted.

The diesel fuel level indicator and alternator rating plate shall be clearly visible with the doors open.

Unless specified the silencers shall be mounted within the enclosure.

Perforated sheeting shall be fitted over all the insulating material inside the canopy of all soundproof sets.

Rubber seals on doors shall be equal to or similar to rubber pinch weld, wind lace.

9.2 Design

The enclosure shall be designed to be weather-proof and sound-proofing as specified. Rivets or self-tapping screws will under no circumstances be allowed for fixing the various sections of the enclosure. Only cadmium coated nuts and bolts are acceptable.

9.3 Roof

The roof of the enclosure shall be constructed for proper drainage of water as per the drawing.

9.4 Lamp fitting

A lamp fitting and it's associated on/off door switch shall be provided inside the enclosure for illumination of the control panel. The power for the lamp shall be obtained from the starter battery.

9.5 Sound-proofing

The sound-proofing on canopy engine sets shall be such that the maximum noise level generated by the set under any load condition shall not exceed 65 dB measured in any direction at a distance of 5m from the centre of the set with the doors closed.

The supply and discharge air paths will require separate attenuators on soundproof sets.

9.6 Padlock and keys

The contractor shall supply padlocks and keys for all the doors of the enclosure. The padlock shall be off the "Viro A82 keyed alike with stainless steel shackles" type.

Suitable brass metal plates shall be installed behind each lock for the protection of the enclosure against scratching or damaging, where the locks are hanging.

3.10. 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 of the generator container in a position as indicated by the Department's Representative.

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.

3.11. Remote Control Generator Switch

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

3.12. Fuel Drip Tray

A drip tray approximately 100mm deep shall be mounted below the generator and must be large enough to collect any fuel that drips from the generator fuel 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.

3.13. Completion Time

The Generator Set is required to be commissioned together with the LV installation, Integration with T1, T2 & Bus Coupler. The motorized ACB and changeovers to form part of this installation.

3.14. Inform

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

3.15. Fuel Supply Tank

3.16. The fuel tank shall be an integral part of the base frame of the generator set. The tank shall have sufficient capacity to run the engine on full load for a period of 24 hours. The base tank shall be an open channel self-bund walled type that shall be of sufficient capacity to contain a spillage equivalent to 110% in volume of the base tank. The containment tank shall be manufactured from black mild steel with a thickness of not less than 2mm.

A float level alarm connected to the generator controller shall be incorporated into the bund area located such that the alarm will be activated when 50% of the volume of the bund area has been reached in the event of any diesel fuel leakage.

SECTION 4 – SCHEDULES OF TECHNICAL INFORMATION

(TO BE FULLY COMPLETED BY TENDERER)

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4. SECTION 4 – SCHEDULES OF TECHNICAL INFORMATION

4.1. 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 SANS 8528 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	

NO	ITEM	REMARKS
	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	
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	

NO	ITEM	REMARKS
	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 SANS 8528, with 10% transient speed drop	

4.2. 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 0,9 power factor	
8.	De-rating for site conditions	
9.	Input required in kW	
10.	Method of excitation	
11.	Efficiency at 0,9 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	

4.3. 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	
22.	Make of mains isolator	
23.	Type of indicators for protective devices	
24.	Make of rectifier	

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

4.4. 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	

4.5. Dimensions

NO	ITEM	REMARKS
1.	Overall dimensions of set in mm	
2.	Overall mass	
3.	Is the canopy/container adequate for the installation of the set, switch board and fuel tank	

4.6. Deviation from the Specification as an Alternative (State Briefly)

NO	DESCRIPTION

4.7. 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	

PART 5: Electrical Work Material Schedule

The Contractor shall complete the following schedules and submit them to the Representative/Agent within 21 days of the date of the acceptance of the tender.

The schedules will be scrutinised by the Representative/Agent and should any material offered not comply with the requirements contained in the specification, the Contractor will be required to supply material in accordance with the contract at no additional cost.

NB: **Only one manufacturer's name to be inserted for each item.**

Item	Material	Make or trade name	Country of origin
1	Distribution boards		
2	Circuit breakers 1P, 2P, 3P		
3	On load isolators without trips		
4	Contactors 1P, 2P, 3P		
5	Earth leakage relays 1 & 3 phase		
6	Motorized ACB		
7	Voltmeter		
8	Maximum demand meter		
9	Daylight sensitive switch		
10	Conductors		
11	Conduit		
12	Conduit boxes		
13	Socket outlet 16A		
14	Light fitting round bulkhead LED		
15	LED Fluorescent fitting		
16	Generator		
17	Control System		
18	Cable trays		
19			

ANNEXURE A

SCHEDULE OF IMPORTED MATERIALS AND EQUIPMENT TO BE COMPLETED BY TENDERER

Item	Material/Equipment	Rand (R) (Excluding VAT)
1		
2		
3		
4		
5		
6		

The Contractor shall list imported items, materials and/or equipment, which shall be excluded from the Contract Price Adjustment Provisions (if applicable) and shall be adjusted in terms of currency fluctuations only. Copies of the supplier's quotations for the items, materials or equipment (provided that such costs shall not be higher than the relevant contract rate as listed above) should be lodged with the Representative/Agent of the Department within 60 (sixty) days from the date of acceptance of the tenders. No adjustment of the local VAT amount, nor the contractor's profit, discount, markup, handling costs, etc shall be allowed.

These net amounts will be adjusted as follows

FORMULA:

The net amount to be added to or deducted from the contract sum:

$$A = V \left(\frac{Z}{Y} - 1 \right)$$

A = the amount (R) of adjustment

V = the net amount (supplier's quotation) (R) of the imported item

Y = exchange rate at the closing date of tender submission

Z = exchange rate on the date of payment.

PARTICULARS OF ELECTRICAL CONTRACTOR

(To be completed by tenderers and submitted together with the tender form).

TENDER NO: _____ REFERENCE: _____

SERVICE: _____

NAME OF ELECTRICAL CONTRACTOR: _____

ADDRESS _____

_____

ELECTRICAL CONTRACTOR'S REGISTRATION NUMBER AT THE ELECTRICAL CONTRACTING BOARD OF S.A. _____

_____ _____

DATE SIGNATURE OF TENDERER

PART 6: Drawing Schedule

The following drawings are attached to this tender document:

- Drawing Sketch 2 – Enclosure
- Drawing Sketch 3 – Warning Notices
- Drawing Site Layout – EE056689-1
- Drawing Schematic Layout of Existing – EE056689-2
- Drawing Schematic Integration with LV Board – EE056689-3
- Drawing Schematic Integration with LV Board – EE056689-4
- Drawing Structural Engineers (Generator Plinth & Bund Wall) – SE056689-01

GUIDELINES FOR SAFE USE OF PERMANENT/PORTABLE GENERATOR ON MSUNDUZI MUNICIPALITY ELECTRICITY SUPPLY NETWORK

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GUIDELINES FOR SAFE USE OF PERMANENT/PORTABLE GENERATOR ON MSUNDUZI MUNICIPALITY ELECTRICITY SUPPLY NETWORK

INTRODUCTION

Permanent/Portable generators are widely used to provide electricity in case of a mains power failure. This document deals specifically with those installations at which a stand-by generator is interfaced with the same circuitry as is issued to locally distribute mains-supplied electrical power. This in turn presents a risk of inadvertent paralleling of sources of supply. Certain sections of this document are applicable also to stand-alone generator sets. Consumers who have purchased permanent/portable generators to provide electricity in the event of power outages must use safety precautions. Permanent/Portable generators can be hazardous if used improperly. The principle hazards are: (1) **carbon monoxide (CO) poisoning** from the toxic engine exhaust and (2) **electrocution** from connecting the generator to the home electrical wiring system. The document is specifically aimed at "Nonqualified"

persons who may purchase portable generators due to the perception that the grid reliability is reducing and inadvertently creating hazardous conditions when using them.

1. SCOPE

The purpose of this document is to specify the technical requirements to be met with the interfacing of low voltage generating sets with the local supply networks and to ensure that they do not compromise the network integrity or safety of the Council's network or user. The document describes some of the dangers presented by interfacing a stand-by generator with mains-supplied premises. This document deals specifically with those installations at which a stand-by generator is interfaced with the same circuitry as is used to locally distribute mains-supplied electrical power. Generator sets that are operated separately from the local supply (e.g. portable generator sets supplying lighting or heating circuits directly) are excluded from the requirements of this document, although some of the safety precautions may still be applicable.
The document applies specifically to installations where the generator set is prohibited from paralleling with the mains supply. Where it is required for a generator set to parallel with the mains supply, for whatever reason, this shall be agreed to beforehand by the affected parties, and may be subject to additional technical requirements.
This document shall be read in conjunction with SANS 10142-1, specifically Section 7.12.Alternative supplies

2. NORMATIVE REFERENCES

The following documents contain provisions which, through reference in this text, constitute provisions of this guideline. All documents are subject to revision and, since any reference to a document is deemed to be reference to the latest edition of that document, parties to the use of this document are encouraged to take steps to ensure the use of the most recent editions of the documents listed below
SANS 10142-1 the wiring of premises Part 1 Low Voltage Installations

Occupational Health and Safety Act, 1993 (Act 85 of 1993)

Relevant Municipal Electricity Supply and other Bylaws, as applicable.

DEFINITIONS AND ABBREVIATIONS

MUNICIPALITY ELECTRICITY SUPPLY NETWORK

3.1 General

3.1.1 **Circuit Breaker**: Mechanical switching device that is capable of making, carrying and breaking currents under normal conditions and of making, carrying for a specified time, and automatically breaking currents underspecified abnormal circuit conditions such as those of overcurrent.

3.1.2 **Certificate of Compliance:** Certificate that is issued by an accredited person in respect of an electrical installation or part of an electrical installation that ensures that the installation complies with SANS 10142

3.1.3 **Consumer**: Person who is supplied (or to be supplied) with electricity by a supplier, or a person who supplies his own electricity.

3.1.4 **Electricity distribution utility:** The electricity supply authority, being either Eskom or the Municipal electricity service provider in the area of the installation.

3.1.5 **Current:** Flow of electric charge through a conductor.

3.1.6 **Accredited person:** person who is registered in terms of the Occupational Health and Safety Act, 1993 (Act 85 of 1993).

3.1.7 **Distribution Board:** enclosure that contains electrical equipment for the distribution or control of electrical power from one or more incoming circuits to one or more outgoing circuits.

3.1.8 **Fault Current:** current that results from an insulation failure or from being bridging of insulation or live components.

3.1.9 **Local Authority:** -Municipality

3.1.10 **Point of common coupling:** - The point on the Utility's network, electrically nearest to a particular consumer's installation, at which more than one consumer is or may be connected or metered

3.1.11 **Point of Supply:** - the point of metered electrical connection between Pietermaritzburg Electricity& Consumer

3.1.12 **Permanent/Portable / Standby Generators:** a source of electrical power, typically a diesel or petrol driven generator, that is used as back-up or an alternative to a grid supply.

3.1.13 **Protective Earthing Conductor:** - conductor provided for purposes of safety (protection against electric shock) and that connects the supply earth to the consumer earth terminal

3.1.14 **Protective Earth and Neutral Conductor: - conductor** that forms part of a supply combining the functions of both, protective earthing conductor and neutral conductor. The conductor is also connected to other earth electrodes and exposed conductive parts of the low voltage supply.

3.2 Abbreviations

SANS South African National Standards
IEC International Electro technical Commission
ISO International Organization for Standards
COC Certificate of Compliance
MV Medium Voltage
N Neutral
PE Protective Earthing Conductor
AMP Automatic changeover panel
DB Distribution Board
MMESS **MSUNDUZI MUNICIPALITY ELECTRICITY SUPPLY SERVICES**

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4. INSTALLATION REQUIREMENTS

4.1 Legal Requirements

An application for the use of Permanent/Portable installed Generating Sets (new or existing) in cases where it will be required to interface with the same circuitry as is used to locally distribute mainssupplied

electrical power, shall be submitted to MSUNDUZI MUNICIPALITY ELECTRICITY SUPPLY SERVICES.

The application shall include, but may not be limited to, the following:

1) Contact details of the owner
2) Site Address
3) Make & Model of the Generating unit
4) Capacity of the Generating unit
5) Control circuit diagram of the generating unit including all interlocks with the main grid.

Only upon written approval from PMB Elect., before the work commence.

4.2 Safety Requirements

The attention of the owner/tenant of a permanent/stand-by /portable generator is drawn to the following requirements of the Occupational Health and Safety Act, 1993 (Act 85 of 1993):
"Any user of machinery shall

a) Ensure that all machinery used by him is suitable for the purpose for which it is used, and that it is installed, operated and maintained in such a manner as to prevent the exposure of persons to hazardous or potentially hazardous conditions or circumstances.

b) In particular cause every exposed and dangerous part of the machinery, which is within the normal reach of a person to be effectively safeguarded by means of insulation, fencing, screening or guarding, except where an inspector has granted written permission for the omission of such safeguarding.

c) Ensure that all safety equipment is kept in a good working condition and is properly used; and ensure that the quality of material used in; and the construction of the machinery or safety equipment is suitable for the purpose for which it was intended.

d) Unless a person has been authorized thereto, no person shall remove any safety equipment, which relates to the machinery in question.

e) Shall provide devices to start and stop machinery, and these devices shall
i. Be in a position where they can readily and conveniently be reached by the person who operates such machinery; and

ii. Be so constructed and arranged as to prevent the accidental starting of such machinery.

f) Shall provide positive means for rendering the controls of machinery driven by an electric motor inoperative while repairs or adjustments are being made, and such means shall not only be the mere tripping of a switch."

4.3 Additional Safety Requirements & Recommendations

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a) The installation shall take place within the boundaries of the approved application.
b) The owner/tenant shall comply with the relevant noise and pollution legislation. See Annexure C for noise levels.
c) Where new buildings are erected or alterations to existing buildings are made, building plans are to be submitted to the relevant Local Authority for approval
d) The owner/tenant shall comply with the relevant legislation for the storage of fuel
e) **NEVER** use a generator in enclosed or partially-enclosed spaces. Generators can produce high levels of CO (Carbon Monoxide) very quickly. When using a portable generator, remember that one cannot smell or see CO. Even if a person can't smell exhaust fumes, he/she may still be exposed to CO. Adequate ventilation shall be provided.
f) Only operate the generator outdoors in a well-ventilated, dry area, away from air intakes to the home, and protected from direct exposure to rain, preferably under a canopy, open shed, or carport. Do not enclose the generator in any structure.
g) Keep flammable materials away from the generator.
h) Always fuel the generator in a well ventilated area. Fuel vapours are flammable and may ignite after the engine is started be sure that any spilled fuel is cleaned up before restarting.
i) Always check for fuel leaks.

j) Before refuelling the generator, turn it off and let it cool down, fuel spilled on hot engine parts may ignite.

k) Occasionally monitoring of Generator while in use.

l) The total rated capacity of the generator should never be exceeded.

m) Keep cords/cables out of the way so as to avoid the danger of tripping over them

n) Ensure that the generator's terminal voltage rating matches that of the load equipment (typically 230V±10%)

o) Ensure that emergency isolation of the generator is possible

p) In the case of temporary generators being connected, ensure that there is complete isolation of the consumer's apparatus to PMB Electricity network

q) Have the generator run at full speed before placing load on it, this prevents damage as the generator starts and reaches full speed and switch off load before shutting down.

r) For permanently installed generators ensure that permanent approved electrical interlocking exists between the consumer and Electricity networks.

s) Ensure that all appliances/equipment connected to the generator have overcurrent protection.

t) All loads should be turned off before the Generator is turned off

u) Check that any cords are free of cuts or tears and that the plug has all three prongs, especially an earth pin.

v) **Never try to power the house wiring by plugging the generator into a wall outlet, a practice known as "back feeding."** This is an extremely dangerous practice that presents an electrocution risk to Electricity workers and neighbours served by the same transformer.

w) Consider using surge protection, it is common for generators to damage more sensitive electronic equipment.

4.4 Connection requirements

a) Where necessary for the installation of the generator set, it is the responsibility of the applicant to arrange with the Msunduzi Municipaty Electricity supply for the disconnection/reconnection of mains supply to the premises. Please note that the latest Msunduzi Municipality Electricity Supply Services tariffs will apply for this service.

b) A COC must be completed for the installation and submitted to Pietermaritzburg Electricity prior to reconnection of supply to the premises.

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c) A permanent red label (PVC or aluminium) with white lettering (at least 10mm high) shall be affixed to the main distribution board inside the premises as well as to all other distribution boards fed from the main board and the main incoming utility supply circuit breaker. The level shall read "DANGER GENERATOR CONNECTED". Where only parts of the installation are supplied by alternative means, only these circuits shall be labelled.

d) Where any form of alternate supply (generating set, UPS, etc.) is connected and automatically supplies power to circuits on the distribution board, a visible indicator (light) shall be provided on each distribution board where such circuits are live after the main supply on that board has been switched of.

e) Appropriately rated protective devices shall be supplied for short- circuit and earth fault conditions to protect the distribution board, generating set and user. The protective devices shall prohibit feedback onto the utility system once the main incoming supply has been switched off. The generating set including the connecting cable shall be provided with separate appropriately-rated over current protection circuit breaker, over and above any devices installed on the generating set itself. Earth leakage protection shall be provided in accordance with SANS 10142-1 Section 6.8.

f) **Unless specifically agreed to between MSUNDUZI MUNICIPATY ELECTRICITY SUPPLY and owner/tenant, the generating set shall not run in parallel with the main supply at any time.**

g) The consumer shall be held responsible for any and all damages incurred PMB Elect. If the devices are found to be incorrectly rated and/or the utility supply and generator supply are paralleled.

h) Neutral earthing of the generator set shall be done in accordance with SANS 10142-1 Section 7.12.3

4.4.1 **Single residential houses/individual commercial units**

a) The installation of generating sets at single residential premises shall conform to the above requirements as well as the following requirements.

b) A control panel shall be installed after the meter point for both conventional and prepayment meters, as close to the main distribution board as possible.

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c) The control panel shall include at least,

1) A main circuit breaker. (To include breaking the neutral).

2) A manual or automatic changeover switch.

Where the generating set is intended to provide a supply to an installation as a switched alternative to the main supply, the changeover switching device shall disconnect the main supply before the generating set is switched in. the changeover switching device shall be interlocked in such a way that the main supply and the alternative supply cannot be connected to the same installation at the same time. This changeover switch shall be of a break-before-make type (see annexure A) and have an appropriate rating for the size of the generating set.

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3) No other means of connection is allowed.

4.4.2 **Commercial/Official or Multi-unit Blocks**

a) The installation of generating sets at commercial premises or multi-unit premises shall conform to the above requirements as well as the following requirements. An automatic or manual changeover panel shall be installed.

b) The control panel shall have at least,

1) A main circuit breaker.

2) A visible indicating light that is on when the generation set is supplying power.

3) A manual or automatic changeover switch. This changeover switch shall be of break-before-make (see connection diagram) and have an appropriate rating for the size of the generating set.

4) An emergency stop button that is easily accessible shall be provided for the generating set, this emergency stop button shall prevent the generating set from starting.

5) (A) There shall be a remote emergency stop button (PMB Elect. controlled). The remote emergency stop button will be installed next to the main incoming Electricity supply circuit breaker with a label identifying it. Alternatively a circuit can be installed with auxiliary contacts connected to the emergency stop/starter preventing the generator from starting if the main incoming supply is switched off due to safety reasons (i.e. in case of fire, etc.)

5) (B) The remote emergency stop button shall have the means to be locked in the off position with a personal lock.

6) In the case of an automatic changeover panel:

A fool proof Intel

Rocking system shall prevent the main supply from being connected to generating set supply. This interlocking system shall incorporate a mechanical as well as an electrical interlock on the changeover contactors/relays.

d) Where an individual unit within an office/multi-unit block has a generating set, requirements for single residential houses shall be applied.

e) Where two adjacent commercial plots are supplied from a shared generating set, each

plot/connection shall have its own control/changeover panel as above.

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5. DISCLAIMER OF LIABILITY

Portable generators can pose serious health hazards if used improperly as they **produce carbon monoxide (CO) and other risk**

Portable generators are a useful tool during power interruptions, however their carbon monoxide risks are more potent than many people realize. A typical 5.5-kilowatt home generator can produce the same amount of CO as six idling cars, according to a study by the US Centre for Disease Control and Prevention (CDC). Gasoline-engine generators are not designed for indoor use.

Please note: Your home's wiring is likely not matched for your Generator use. Connecting your portable generator to your home's electrical power system or wiring can be lethal. It is recommended that a qualified electrical engineer or contractor install a transfer switch, which is used to load and unload power and is also able to cut-off the electrical output being produced by the generator, once the main-supply is restored.

Every generator manual includes the manufacturer's guidelines for safety and usage, including warnings urging users to operate their generators in a dry, well-ventilated area to avoid both electrocution and CO poisoning. It is therefore highly recommended that any running of a generator is conducted with a healthy dose of common sense and in strict compliance with the manufacture's requirements for safe use. Please pay heed to their advice, use recommended oils and lubrication, attend to the regular maintenance schedules and keep the standard operating procedures adhered to, at all times.

The guidelines expressed in this document are not intended to fringe nor replace the manufacture's guidelines for safety and usage. This document is only a suggested guideline for the safe use of portable generators on Electricity networks.

These guidelines are only intended to provide general information regarding the safe use of permanent/portable generators on Electricity networks, it is not intended to be exhaustive of any subject dealt with. The information in these guidelines, including, without limitation, all research, opinions or other content is therefore not intended, nor does it constitute consulting or other professional advice or services. Before any decision is made or any action taken which might affect the user, consultation with your own professional is advised.

All users of this resource are therefore cautioned to use the information entirely at their own risk.

Pietermaritzburg Electricity do not accept any liability for (or in respect of) any direct, indirect or consequential liability, loss or damage of any kind or nature, arising from the reliance on or provision of this information (or its failure), whether or not as a result of incorrect, inaccurate, defective or misleading data or information. Pietermaritzburg Electricity therefore will not be liable for any loss or damage, actions, proceedings, claims, demands, liability, damages, costs, charges and expenses, howsoever arising, as a result of the use of these guidelines of the information therein.

'This installation guideline meets with AMEU requirement'

Annexure A – Noise Levels

A "disturbing noise" means a noise level that causes the ambient noise level to rise above the designated zone level, or if no zone level has been designated the typical rating level for ambient noise in districts, indicated in table 2 of SANS 0103 of 2004 which appears hereunder. See SANS 0103 for more detail.

Table 2 – Acceptability rating levels for noise in districts 1	2	3	4	5	6	7
Type of district			Equivalent continuous rating level (LREG.T) for noise dBA			
Outdoors			Indoors, with open windows			
Day-Night LR,dna	Day-Time LReg,db	Night-time LR,dna	Day-night LR,dna	Day-time LReg,db	Night-time LReg,nb	
RESIDENTIAL DISTRICTS a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
NON RESIDENTIAL DISTRICTS d) Urban districts with some workshops, with business premises, and with main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

NOTE 1 If the measurement or calculation time is considerably shorter than the reference time intervals, significant deviations from the values given in the table may result.

NOTE 2 If the spectrum of the sound contains significant low frequency components, or when an unbalanced spectrum towards the low frequencies is suspected, special precautions should be taken and specialist advice should be obtained. In this case the indoor sound levels may significantly differ from the values given in columns 5 to 7. See also annex B

Note 3 Residential buildings, e.g. dormitories, hotel accommodation, residences etc. Should be allowed in non-residential districts on condition that the calculated or anticipated indoor LReg.T values given in column 3 of the table 1 are not exceeded.

a) The values given in column 2 and 5 are equivalents continuous rating levels and include corrections for tonal

Character, impulsiveness of the noise and the time of day.

b) The values given in column 3,4,6 and 7 are equivalent continuous rating levels and include corrections for

Tonal character and impulsiveness of the noise.

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CHECK LIST FOR CONNECTION OR INSTALLATION OF A BACKUP GENERATOR

Address: _____ Application number_____

_____

_____

REQUIREMENTS	YES	NO	COMMENT/REMARKS
Application Request or form			
Principles of operations			
Certificate of Compliance (COC)			
Diagram of backup generator			
Certificate of Compliance with the Bylaws relating to fire prevention and flammable liquids and substances and all relevant SABS/SANS codes			

NB: Please tick the appropriate block. If "no" is ticked provide comments in the remarks column.

_____

Signature of Accredited person and company name

_____

Date

_____

Inspector's name and signature

_____

Date

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Part 7 Annexure B: BOQ