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## **PART 1: GENERAL AND TECHNICAL SPECIFICATION**

## **1 GENERAL AND STANDARD TECHNICAL SPECIFICATIONS**

### **1.1 General**

1. The installation described in this document shall comply with various standard specifications and requirements as well as the Project Specification or Supplementary Technical Specification.
2. The Project Specification (Part 2) shall be read as forming part of the standard specifications. Where there is any discrepancy between the Project Specification and the standard specifications, the Project Specification (Part 2) shall have preference. The Tenderer shall immediately enquire about such discrepancy.

### **1.2 Specifications and Drawings**

The Engineer's drawings covering the various sections of the installation have been provided with the tender document. The working drawings of the contract shall, however, consist of:

1. The Engineer's drawings
2. The Architect's drawings
3. The Structural Engineer's drawings, as applicable
4. The Engineer's drawings of other disciplines, as applicable
5. The drawings of other service installations that are relevant for co-ordination and installation purposes
6. The installation drawings of other Contractors, where applicable.

Unless otherwise stated, three sets of the Engineer's Drawings, Specifications and schedules (if any) and one set of 1.2 will be issued free of charge to the contractor for installation purposes.

Provisions are made in the building structure to accept the specified installation.

The Contractor shall supply to the Engineer three copies of marked-up structural, or other drawings showing all builders work and/or additional requirements to be made in the structure in order to fit in dimensions of apparatus and materials to be installed by him. This information to be supplied in accordance with a programme mutually agreed upon by the Contractor and the Engineer.

Copies of shop drawings, as prescribed in Part 2 hereof, shall be submitted to the Engineer for approval and to demonstrate compliance with the contract documents. Shop drawings are drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are prepared by the Contractor, manufacturer, supplier or distributor, and which illustrate relevant portions of the work.

The Engineer's approval of shop drawings or samples is limited to check conformity with design requirements and shall not relieve the Contractor of responsibility for erection or installation fit, or for any deviation from the requirements of the contract unless the Contractor has informed the Engineer in writing of such deviation at the time of submission of shop drawings or samples, and the engineer has given written approval for the specific deviation. The Engineer's approval shall not relieve the Contractor of responsibility for erection or installation fit or for errors or omissions in the shop drawings or samples.

The Engineer's drawings and specifications shall be considered binding with regard to the quality, quantity, general scheme, system, arrangement and function of the Contract works. All dimensions specially marked on the drawings shall be strictly followed.

During the execution of the work one of the sets of prints of drawings as mentioned in 1.2 above, and a specification shall be available for reference on site. Any discrepancy between the Drawings and the Specification and/or Schedules shall be drawn to the attention of the Engineer immediately such discrepancy is discovered.

Upon or before receiving final payment, the Contractor shall return to the engineer all such documents bearing the Engineer's name as have been stipulated to be returned. None of the documents herein before mentioned shall be used by any of the parties hereto for any other purposes than this contract and neither of the parties shall divulge or use, except for the purpose of this contract, any information contained in these documents. A deposit may be charged by the Engineer for possession of the specification documents. This deposit will be refunded upon the return of the documents.

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### **1.3 Installation - General**

1. The equipment mentioned in this specification shall be installed complete in all respects by the Contractor for this complete contract as specified in this Specification and as indicated on the relevant drawings.
2. Water and drainage connections (if required) will be provided as part of this contract to all equipment requiring connections. Fittings for final connections from these points to the equipment supplied shall form part of this contract.
3. Electrical connections will be provided for all electrically operated equipment to a specific point in close vicinity (2 m) of all items of equipment. The material for the final electrical connections from these points to the various items of equipment and the final connection itself, shall form part of this contract.
4. All equipment mentioned in this specification must be completely pre-wired and pre-piped in the manufacturer's works to form complete units, which shall be ready for installation on arrival on site.
5. All equipment shall be suitable for operation on an electrical power supply of 400/230 V, single/three phase, 50 Hz alternating current.
6. All equipment and the installation thereof, must conform to the Occupational Health and Safety Act of 1983, as amended, with special reference to pressure vessels.
7. All electrical equipment, installations and wiring must conform to the regulations governing such work. All conduits, control panels, control wiring, etc. are to be recessed.

### **1.4 Metric Calibration of Instruments**

All instruments and gauges on all items of equipment shall be in the SI unit metric system.

### **1.5 Painting**

The paintwork of all equipment, which is damaged during the course of the erection and installation and prior to acceptance, must be satisfactorily made good by the contractor(s).

### **1.6 Information to be provided with the tender**

1. Tenderers are required to enter at the time of tender in the Schedule of materials the manufacturers of the materials and equipment, on which their tender is based, and the catalogue numbers and other information by which the materials and equipment may be identified. Sufficient details must be given to enable the unit concerned to be identified without ambiguity. It is not sufficient for a Tenderer to state in the schedules "as specified".
2. All tender offers must be supported with descriptive literature and technical data for each item of equipment offered.

### **1.7 Commissioning and testing**

The commissioning and testing of each item of equipment and system is the responsibility of the contractor concerned with the supply, delivery and installation of the particular items of equipment and systems. All final testing shall be carried out in the presence of the engineer and all tests shall be to his satisfaction.

Recognised and statutory test procedures shall be carried out on all equipment.

### **1.8 Approval of equipment**

All equipment offered must be of an approved and well-known manufacture. Only equipment of proven manufacture and quality will be considered.

### **1.9 Material**

Where stainless steel is specified, this shall mean "chrome nickel steel" type 304 18/8 grade. Lower

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grades of steel will not be acceptable.

#### 1.10 Dimensions

The dimensions specified are maximum measurements, which must not be exceeded.

Tenderers must ensure, wherever possible, that the dimensions of equipment offered can be accommodated within the spaces provided and as scaled from the drawings. This requirement is essential for the matching of associated equipment and the building layout.

A workshop drawing indicating equipment layout for each building as well as all relevant dimensions shall be submitted for approval before manufacturing shall commence.

#### 1.11 Trade Names

Where trade names are indicated in this specification, it should be clearly understood that such trade names are never mandatory but merely assist to identify the quality and performance of the article required by the Department.

The tenderer is therefore at liberty to provide his own choice of article provided that the article is of equal quality and performance as the named article.

Quality refers to:

- The value of the article:
  - sturdiness/solidity in make
  - composite materials
  - aspect (appearance)
  - size or volume (if important)
  - price

Performance refers to:

- The output of the article;
  - economical use
  - tamper resistance
    - of article itself
    - of its fixation
  - maintenance
    - cost of
    - ease of
    - accessibility for

Where a trade name is mentioned, it does not imply that the named article complies with the specification in all respects. It is the responsibility of tenderers to verify that equipment and/or materials offered complies with all specification requirements and is capable to perform the required duties.

#### 1.12 The following Standard Specification as issued by the Department of Public Works, although not bound in this document, is applicable:

- Electrical Installation and Equipment pertaining to Mechanical Services, Issue IX 1998.
  - Standard Specification for Kitchen Equipment (Architectural)
  - SABS 460 : Copper and Copper alloy tubing
  - SABS 455 : Covered electrodes for the manual arc welding of carbon and carbon manganese steels
  - SABS 044 : Welding : Parts 1 to VII
  - SABS 0238 : Welding and thermal cutting processes – Health and safety
  - SABS 763 : Hot-dip (galvanised) zinc coatings (other than on continuously zinc-coated sheet and wire)
  - SABS ISO 3573 : Continuous hot-dip zinc-coated carbon steel sheet of commercial, local
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- SABS 0214 : forming and drawing qualities.
- SABS 1186-1 : The design, fabrication and inspection of articles for hot-dip galvanising.
- OHS ACT : Symbolic Safety Signs Part 1 : Standard signs and general requirements.
- OHS ACT : The Occupational Health and Safety Act, Act 85 of 1993.

## **PART 2    QUALITY SPECIFICATION**

## **PART 2A**

### **GENERAL SPECIFICATION FOR ELECTRICAL WORK**

#### **1. REGULATIONS, LAWS AND BY-LAWS**

- a) The latest issue of the SABS 0142 " Code of Practice for the Wiring of Premises" hereafter called the Wiring Code"
- b) The Occupational Health and Safety Act 1993.
- c) The Municipal by-laws and any special requirements of the local supply Authorities.
- d) The local Fire Office Regulations.

#### **2. NOTICE AND FEES**

The contractor shall give all notices required by and pay all necessary fees, including any inspection fees, which may be due to the local supply Authority. The fee charged by the Supply Authority for connection of the installation of the supply mains, will be arranged and paid by the contractor.

#### **3. SCHEDULE OF FACILITIES.**

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

#### **4. QUALITY OF MATERIALS**

Only materials of the 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 material shall comply with the relevant South African Bureau of Standards specifications, or to British Standard Specifications, where no SABS specification exist.

Materials wherever possible must be of South African manufacture.

#### **5. DELAYS**

If the electrical contractor's work should cause any delay to the building operations, he will be held responsible for any claims arising out of such delay.

#### **6. MAINTENANCE PERIOD AND RETENTION MONEY**

The maintenance period shall be three months; calculated from the date the installation has been taken over by the department.

Payment of the retention money will be affected after the lapse of the maintenance period and provided the installation has been in satisfactory working order during this period.

#### **7. CONDUIT AND ACCESSORIES**

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

The conduit and conduit accessories shall comply fly 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 accessories: SABS 162
- b) Plain – end metallic conduit and accessories: SABS 1007
- c) Non-metallic conduit: SABS 950

Insulated heat-resistant boxes shall be used for outlets of totally enclosed luminaires and other fittings where excessive temperatures are likely to occur.

Luminaires and other fittings shall no be supported by no-metallic conduit or conduit boxes. These fittings

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shall be secured to the surrounding structure in a way that is acceptable to the Department.

The Conduit shall be supported and fixed with saddles with a maximum spacing of 1m, even in roof spaces. (Refer to SABS 0142). The contractor shall supply and install ALL ADDITIONAL SUPPORTING TIMBER REQUIRED.

It shall be possible to rewire the completed installation in the future without undue difficulty.

Non-metallic conduit and fittings shall not be used under the following conditions:

- a) Outside a building (unless protected, or sheltered under eaves).
- b) For mechanical load bearing.
- c) Where they may be subjected to temperatures below – 10 degrees celsius or above 70 degrees celsius for prolonged periods.
- d) As primary electrical insulation.
- e) In areas where they may be subjected to mechanical damage.
- f) For applications other than those for which they are designed.

### **PAINTING OF CONDUITS**

Exposed conduit may be painted with normal oil or PVA paints, but care must be taken to ensure that paint used does not contain any component that will soften or have any other detrimental effect on the materials from which the conduit and fittings are manufactured.

### **CONNECTING OF CONDUIT TO METAL EQUIPMENT/COMPONENTS**

When any part of a non-metallic conduit system has to be connected to metal equipment or components (e.g. switchboards, surface socket-outlet, existing metallic conduit system etc.) fitting and joints manufactured specifically for this purpose must be used. Non-metallic conduit must not be threaded to fit metallic connectors.

### **BEND**

In conduit of nominal size not exceeding 25mm, bends may be made as described hereunder. In all other cases bends must be achieved by the use of accessories that are introduced into the conduit run. Bends shall comply with the relevant requirements of SABS 0142.

### **BENDING**

Conductor of nominal size up to 20mm and including 25 mm may be bent by hand provided that the radius of the bend is greater than six times the nominal size of the conduit, and that the external angle of the bend does not exceed 90 degrees. The procedure (which involves the use of a bending spring) should be as follows:

- a) Determine the angle through which the conduit is to be bent.
- b) Warm the cold conduit over the length to be bent by rubbing with hands.
- c) Select a bending spring which matches the conduit size and insert it into the conduit beyond the point where the bend is required.
- d) Bend the conduit slowly with one motion (either with the hands alone approximately 1 m apart, or across the knee) to double the required angle, release the conduit and, when its position is stable, withdraw the bending spring (turning it in an anti-clockwise direction to reduce its diameter) and gently correct the angle.
- e) Install and secure the conduit immediately following bending.

### **ADHESIVE JOINTS**

All adhesive joints must be made in a clean dry area. The surface of all components to be bonded must be dry and clean.

The insertion depth should be marked on the conduit end and the adhesive applied (by means of a soft clean brush) as quickly as possible to the surface to be bonded by brushing lengthwise along the conduit, ensuring that a thin coating of uniform thickness is formed. The joint must be made immediately after the

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application of the adhesive by pushing the prepared parts squarely together with a twisting motion of the full insertion depth. Care must be taken to avoid squeezing adhesive into the cableway and all excess adhesive must be wiped off.

**Note.** Solvent adhesive containing highly volatile liquids and their containers should not be left open.

### **Cutting of Conduit**

A fine-tooth hacksaw should be used to cut conduit to the required length. Each cut end should be square and free from swarf, burrs and loose material. When determining the length of conduit to be cut, allowance must be made for the length of couplings or accessories attached to the conduit. Incorrect determination will cause bulging of the conduit or insufficient joint length.

## **8. CONDUIT IN ROOF SPACES**

In roof spaces, the conduit shall be installed in such a manner as to allow for all wiring to be executed from below the ceilings.

Conduit shall be secured at intervals not exceeding 1m by means of saddles fixed to the roof timbers by means of screws or acceptable clout nails.

In the case of repairs and renovations, conduit runs from a distribution board shall, where possible, terminate in fabricated sheet steel draw boxes installed directly above or in close proximity to the boards.

## **9. WIRING**

Except where otherwise specified in part 3 of the specification, wiring shall be carried out in conduit throughout. Only one circuit per conduit will be permitted, provided the circuits are of the same loading i.e. not mixed.

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

Unless otherwise specified in Part 3 of this specification or indicated on the service drawings, the wiring to the installation shall be carried out in accordance with "Wiring Code". In addition to the requirements of the "Wiring Code" concerning the installation of earth conductors of minimum size and maximum length it is a specific requirement of this document that where plain-end metallic conduit or non-metallic conduit has been used, earth conductor must be provided and drawn into the conduit with the main conductors to all points, including all lighting points throughout the installation.

Wiring for lighting circuits is to be carried out with 1.5mm<sup>2</sup> conductors and a 2.5mm<sup>2</sup> earth conductor. For socket outlet circuits the wiring shall comprise 2.5mm<sup>2</sup> and a 2.5mm<sup>2</sup> earth conductor. In certain instances, as will be directed in Part 3 of this specification the sizes of the aforementioned conductors may be increased for specified circuits. Sizes of conductors to be drawn into conduits 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 in accordance with "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 300/500 V grade cable to SABS 1507.

Where cable ends connect into switches, fittings, 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.

## **10. 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.

Only 16A 3 pin sockets shall be used, unless other special purpose types are Distinctly specified or shown on the drawings.

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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 outlet shall be indicated on the drawings.

## **11. SWITCHGEAR**

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

For uniform appearance of switchboard, only one approved make of each of the different classes of Switchgear mentioned shall be used throughout the installation.

## **12. SWITCHBOARDS**

All boards shall be 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 board proposed as an alternative to that specified, must have the prior approval of the Department. All busbars, 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 auxiliary equipment must be provided where required.

Clearly engraved labels are to be mounted on or below every switch. The wording of the labels, in English shall be according to the layout drawings or as directed by the Departments, representative and must be confirmed on site. Flush mounted boards to be installed with the top of the board 2,0 above the finishing floor level.

## **13. WORKMANSHIP AND STAFF**

All employees employed on the service must be under the constant supervision of a registered accredited person.

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

All inferior work shall, on indication by electrical consulting engineer or the Department's inspecting officers, immediately be removed and rectified by and at the expense of the electrical contractor.

## **14. EARTHING OF INSTALLATION**

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

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

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

Installations shall be effectively earthed in accordance with the "Standard Regulations" and to the requirements of supply authority. All hot and cold water and waste pipes are to be effectively bonded by means of 12.x 1.6mm solid or perforated copper tape and brass bolts with nuts at intervals not exceeding 18m. Self-tapping screws are not acceptable as means of securing earth conductors.

Connection from the main earth bar on the main board must be made at the cold water main, the incoming service earth conductor, if any, and the earth mat or other local electrode by means of 12,5mm x 1,60mm

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solid copper tape or 16mm<sup>2</sup> stranded (not solid) bare copper wire or such conductor as the Department's representative may direct.

## **15. MOUNTING AND POSITIONING OF LIGHT FITTINGS**

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

The layout of the fittings, as indicated on the drawing must be adhered to as far as possible, but the exact positions must be confirmed with the Department's representative.

Fluorescent fittings, 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  $\frac{3}{4}$  of the length of the fittings apart.

Fluorescent fittings to be mounted on the board ceilings shall be secured by means of two 40mm X No 10 round head screws and washers and in turn secured to the ceiling branderings. The fittings shall also be bonded to the circuit conduit by means of locknuts and brass bushes. The fixing screws are to be placed  $\frac{3}{4}$  of the length of the fitting apart. The use of Butterfly clips to secure the light fittings will not be acceptable.

In addition to the above, an earth conductor is to be taken from the earthing terminal on all fluorescent fittings and solidly bonded onto the conduit installation.

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

## **16. VARIATIONS IN EXTENT OF CONTRACT**

The Department reserves the right to instruct the contractor to carry out variations to the contract either in terms of clause 18 of the Standard Conditions of Contract or in accordance with prices quoted by the contractor in the Price Schedule for Variations or Bills or Quantities, whichever is applicable.

For variations not provided for in the Price Schedule, Bills or Quantities the Department may call on the contractor to submit a separate written quotation.

Labour and material shall be based on clause 10 of the Standard Conditions of contract, and no payment will be made for the transport of labour and material to and from the service.

The Department, however, reserve the right to execute any alterations or additions that may be necessary by others.

Before any light fittings are ordered by Contractor, the makes and types of these fittings must be approved by the Department. The Department reserves the right to omit the supply for light fittings, cooking appliances and hot-water cylinders from the contract in whole or in part, and to deliver such material to the contractor by others.

## **17. DEPARTMENTAL MATERIAL**

When certain materials are supplied by the Department to the contractor for installation, the contractor must arrange for taking delivery and providing safe storage of these materials.

The contractor will be held responsible for all damage to or loss of such material while it is his custody.

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## **PART 2B**

### **QUALITY SPECIFICATION**

#### **2.1 CONDUIT AND CONDUIT ACCESS**

##### **2.1.1 General**

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

##### **2.1.2 Screwed conduit**

Conduit shall comply with SABS 162 and shall bear the SABS mark.

All conduits shall be heavy gauge, welded or solid drawn, hot-dip galvanised or black enamelled.

Galvanised conduit shall be hot-dipped inside and outside in accordance with SABS 763.

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.

##### **2.1.3 Metal conduit accessories.**

All metal conduit accessories shall be malleable cast iron or pressed steel with brass bushes in accordance with SABS 162. 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.

Accessories must be hot-dip galvanised to SABS 763.

##### **2.1.4 Circular type boxes**

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 fixing holes shall be diametrically opposite each other, drilled and tapped at 50mm centres.

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

##### **2.1.5 Switch boxes and socket-outlet boxes**

All switch boxes and socket-outlet boxes shall be manufactured of pressed galvanised 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 SABS 518 and SABS 1085.

Only galvanised or metal wall boxes will be acceptable to the Department, even if the tenderer offered to use non-metallic conduit and accessories. Light switch boxes shall be 100 x 50 x 50mm with two 20mm knockout on the sides and a single knockout on the top, bottom and back.

Socket-outlet boxes shall be 100 x 100 x 50mm with 20mm knock-outs each on the top, bottom, sides and back.

Where cavity walls are encountered tenderers must allow to install deep back (one end closed) wall boxes. Switch and socket-outlet cover plates shall comply with SABS 1084

##### **2.1.6 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 plastic sheathed (complex or equal). Flexible conduit shall only be used as specified and shall then be installed in accordance with SABS 0142.

##### **2.1.7 Plain-end metallic conduit**

As an alternative to the threaded conduit, plain-end (unthreaded) metallic conduit with accessories

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may be used.

Unthreaded conduit shall be manufactured of mild steel with a minimum thickness of 0,9mm and shall comply with SABS 1007. Bending and setting of conduit shall be done with the correct apparatus recommend by the manufacturer of the conduit.

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

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

#### **2.1.8 Non metallic conduit**

Non-metallic conduit shall comply with SABS 950.

#### **2.1.9 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 washer and shall be so constructed that the clamp will fit firmly to the conduit without any additional packing.

### **2.2 POWERSKIRTING**

#### **2.2.1 General**

The channel and cover shall be manufactured of 1mm thick rolled sheet steel. The channel and cover shall be epoxy coated after manufacture.

#### **2.2.2 Outlets**

Outlets pre-punched on a modular basis shall be provided to accommodate socket outlets or future socket outlets. In addition to standard lengths, covers of 250mm length shall be provided for installation on building module lines.

### **2.3 PVC-INSULATED CABLES - 600/1000 V GRADE**

#### **2.3.1 General**

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

#### **2.3.2 Construction**

Cables shall be manufactured in accordance with SABS 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. |
| c) Single core cable | - | PVC-insulated/unsheathed                 |

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

The insulation shall be general purpose PVC, 600/1000 V Grade.

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

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

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

### **2.3.3 PVC-Sheathed aluminium -covered cables**

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

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

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

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

### **2.3.4 Lengths**

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

### **2.3.5 Tests**

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

## **2.4 GLANDS**

Glands to be used for terminating PVC/PVC/SWA/PVC cables shall be of the adjustable type.

Glands shall be suitable for general purpose 600/1000 V Grade cable with steel armouring.

The glands shall be made of nickel-plated bronze or brass.

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 galvanised shall comply with SABS 763.

Non-watertight glands must be easily converted to watertight glands by means of 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.

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.

Glands shall be provided with ISO threads and shall be suitable for the specified cable sizes.

Flameproof glands shall comply with SABS 808, Group 1, 2a and 2b. 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. Groove cut into the barrel or cone bush to accommodate the earth continuity conductors are not acceptable.

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.

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## **2.5 CABLE TERMINATION AND JOINTS**

### **2.5.1 Heat-shrinkable materials**

#### **2.5.1.1 General**

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

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.

The materials shall comply with VDE 9278 and the supplier shall be called upon to confirm this aspect before acceptance of the materials of installation.

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.

#### **2.5.1.2 Terminations with heat-shrinkable materials**

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

The cores of all cables terminated outdoors and the cores of 3.3kV and higher voltage cables terminated indoors shall be completely covered with a shrunk-on protective layer against surface tracking, ultraviolet radiation and weathering.

## **2.6 LIGHT SWITCHES**

### **2.6.1 General**

This section covers the requirements for switches for use in general installation under normal environmental conditions.

Light switches of one manufacturer only, will be acceptable per project.

#### **2.6.2 Flush and surface mounted switches**

All switches shall be suitable for mounting in 100 x 50 x 50mm boxes, shall comply with SABS 163 and shall bear the SABS mark.

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

Switches shall have protected terminals for safe wiring.

Contacts shall be made of silver material.

On multi-lever switches, it shall be possible to individually change any of its switches.

The yoke strap shall be slotted to allow for easy alignment. The covers of surface mounted switches shall have toggle protectors.

Where light switches are installed in partitions, they shall, where possible, be of the special narrow type intended for installation into the mullions.

#### **2.6.3 Watertight switches**

Watertight switches shall be of the micrograph type suitable for surface mounting and shall bear the SABS mark.

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The housing shall be galvanised cast iron or die-cast aluminium with watertight cover plate and toggle.

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

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

#### **2.6.4 Ceiling switches**

Ceiling switches shall be rated at 10A. 220/250V and shall be suitable for ceiling mounting on a round conduit box.

The switch shall be made of high impact strength nylon material.

Adequate space shall be provided within the unit for ease of wiring. The switch colour shall be white and shall be fitted with a nylon cord 1,25m long.

#### **2.6.5 Cover plates**

Cover plates shall be finished in ivory coloured baked enamel, anodised bronze or aluminium unless otherwise specified. Cover plates shall overlap the outlets to cover wall imperfections. Cover plates shall comply with SABS 1084.

### **2.7 UNSWITCHED AND SWITCHED SOCKET OUTLETS**

#### **2.7.1 General**

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

Switch sockets of one manufacturer only, will be accepted per project.

#### **2.7.2 Flush and surface mounted switched sockets**

All switched socket-outlets shall be suitable for mounting on 100 x 100 x 50mm or 100 x 50 x 50mm boxes, shall comply with SABS 164 and shall bear the SABS mark.

Switches shall be of a tumbler operated micrograph type rated at 16 A, 220/250V.

Terminals shall be enclosed for safe wiring.

Contacts shall be silver material.

Safety shutters shall be provided on live and neutral openings.

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

The covers of surface mounted-switched sockets shall have toggle protectors.

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

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

#### **2.7.3 Watertight switched sockets**

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

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

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

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

## **2.8 TUBULAR FLUORESCENT LAMP LUMINAIRES FOR INTERIOR APPLICATIONS**

### **2.8.1 General**

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

Lamps shall be delivered separately.

Tenders shall be accompanied by fully descriptive information of luminaires offered.

Photometric data, i.e. polar cubes and coefficients of utilization certified by SABS shall be made submitted tenders for all luminaries offered.

### **2.8.2 General technical requirements**

#### **2.8.2.1 General.**

Tubular fluorescent lamp luminaires shall comply fully with SABS 1119 and all amendments as well as the additional requirements of this specification. Luminaires which bear the SABS mark are preferred.

The Engineer reserves the right to have samples of luminaires offered tested by the SABS for compliance with SABS 1119 the cost of such tests shall be borne by the Tenderer.

#### **2.8.2.2 Construction**

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 mounting of the entire luminaire.

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

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

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

All components, including screws, bolts and nuts utilised in the construction of the luminaire or fixing of its components, shall be corrosion proof.

#### **2.8.2.3 Internal wiring**

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

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

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

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The wiring shall terminate on suitable terminal block. There shall be no joints in internal wiring. 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 means of a crimped lug.

#### **2.8.2.4 Lamp holders**

Lamp holders shall be telescopic spring loaded type.

#### **2.8.2.5 Control gear**

The control gear, ballasts, capacitors and starters shall be designed and manufactured to suit the control circuitry adopted.

Ballasts shall comply with SABS 890 and 891, suitable for operation on 220/250 V, 50Hz supplies.

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

Noisy ballasts will not be accepted and shall be replaced at no cost to the Client.

Starters shall comply with BS3772. Starters with metal cans shall contain integral earthing facilities to earth the can upon insertion.

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

#### **2.8.2.6 Capacitors**

Capacitors shall comply with SABS 1250. The power factor of each complete fitting shall be corrected to at least 0.85.

#### **2.8.2.7 Lamps**

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

If no colour is specified in Project Specification, the light colour shall correspond to colour 2 (4 300K) of SABS 1041.

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

### **2.8.3 Channel luminaires**

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

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

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

A knockout suitable for a 20mm dia. 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.

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

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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.

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 fixing device for reflections. The action of the latching device shall not deteriorate due to use and/or ageing.

#### **2.8.4 Industrial Luminaires**

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

The reflectors shall be manufactured of cold rolled steel, not less than 0.8mm thick.

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

#### **2.8.5 Bulkhead fittings with unbreakable polycarbonate lens.**

Bulkhead fitting shall be of the circular type and must be manufactured to suite the outdoor and indoor applications and to accommodate the following lamps in respect to the tube of lamps specified.

The base of the fitting shall be of die cast or heavy gauge pressed aluminium. The base shall be treated against corrosion and shall have a black Matt finish.

Threaded conduit entries to take 20mm diameter conduits must be provided on at least two sides and one for back entry. At least two of the conduit entries must be fitted with brass/neoprene stoppers. All control gear shall be suitable for the supply voltage of 22.230 Volt. -5 Hz applications and shall bear the SABS mark of approval or equivalent.

The diffuser shall be injection moulded, prismatic, clear polycarbonate. The diffuser shall be held in position by three stainless steel screws via reinforced holes in the lens and the screws must be provided with gaskets to prevent the ingress of moisture. The fittings shall be provided with either a neoprene or silicon gasket fitted between the diffuser and the base.

The internal finish of the fitting shall be of high-grade heat resistant white enamel and the fitting shall be provided with a removable metal lamp holder platforms. The fitting shall also be provided with a reflector between the lamp and the base, and wiring leads to the lamp holder shall be high heat resistant and preferably covered with silicone.

The overall dimensions shall be approximately 200mm x150 deep for circular in shape fittings.

#### **2.8.6 Flood lights with polycarbonate diffuser**

##### **General**

The luminaire must be of the wall-mounted type for use with gas discharge lamps of the 125-Watt Mercury Vapour type and must be designed for the functional perimeter lighting of buildings.

##### **Construction details**

##### **Diffuser:**

The diffuser must be of a precise injection moulding with prisms for optimum light control and manufactured in either tough Ultra —violet resistant acrylic or in highly vandal resistant Uv sterilised polycarbonate.

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**Diffuser Frame:**

The diffuser frame must be of die-cast powder coated corrosion resistant aluminium casting incorporating the diffuser of which both can be removed from the body utilising one captive stainless steel screw.

**Luminaire Body:**

The luminaire body must be manufactured from black epoxy coated aluminium which can incorporate all the electrical components, the reflector and the gasket which seals frame and body. A back entry hole suitable for a 20mm diameter conduit must be provided to accommodate the wiring entry and two mounting holes suitable for 60mm diameter screws must be provided as a standard feature.

**Reflector:**

The reflector must be manufactured from ultra pure pre-anodised aluminium for maximum reflection.

**Electrical:**

The terminal block and lamp holder must be manufactured from porcelain and the wiring must be coated with resistant silicone rubber. All control gear shall be suitable for the supply voltage of 220/230Volt 50 Hz and shall bear the SABS mark of approval or equivalent.

**2.8.7 Round wall and ceiling luminaires**

Luminaires shall be of the circular type and must be manufactured to suite the outdoor or indoor application and to accommodate the following in respect of the type of lamp specified.

The base of the luminaire shall be made of die-cast aluminium and stainless steel. The base shall be treated against corrosion and shall have a black Matt finish.

A back entry hole suitable for a 20mm dia. Conduit must be provided to accommodate the wiring entry. All control gear shall be suitable for the supply voltage of 220/250 Volt- 50Hz and shall bear the SABS mark of approval or equivalent.

The diffuser shall be polycarbonate with a high impact resistance and held in position by means of a round ring with three stainless steel screws via reinforced holes in the diffuser and the diffuser screws must be provided with gaskets to prevent ingress of moisture. The fittings shall be provided with either a neoprene or a silicone gasket fitted between the lens and the base.

The internal finish of the fittings shall be of high-grade heat resistant white enamel and fitting shall be provided with a removable metal lamp holder platform. The fitting shall also be provided with a reflector between the lamp and the base, and wiring leads to the lamp holder shall be high heat resistant and preferably covered with silicone.

The overall dimension shall be approximately 230mm in diameter x 115mm deep and circular in shape.

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## **2.9 EARTHING ELECTRODES**

### **2.9.1 General**

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

### **2.9.2 Category and type**

Only the following type of earth rods shall be used:

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

2.9.2.1 Bare aluminium is not acceptable as an electrode material.

2.9.2.2 All rods shall be solid and of circular cross section with length as specified in Project Specification.

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

### **2.9.3 Couplings and conductor clamps**

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

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

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

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

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.

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

## **2.10 SWITCHBOARDS (Up to 1kV)**

### **2.10.1 General**

#### **2.10.1.1 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 voltage up to 1kV.

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### **2.10.1.2 Size**

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

### **2.10.1.3 External dimensions**

The maximum allowable height of free standing switchboards is 2.2m where, due to space restrictions, a board exceeds 2.2m 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 switchboard shall be strictly adhered to. If the clearances specified cannot be adhered to as a result of restricting external dimensions, the contractor shall obtain the approval of the Engineer before manufacturing the switchboards.

### **2.10.1.4 Moisture and vermin**

All switchboards shall be rendered moisture proof and vermin proof and shall be adequately ventilated.

### **2.10.1.5 Load Balance**

The load shall be balanced as equally as possible across multi-phase supplies.

## **2.10.2 Construction of flush mounted switchboards**

### **2.10.2.1 Standard**

Flush mounted switchboards shall comply fully with SABS 1180, Part I. Unless the depths of the switchboards are specified, depths shall be determined in accordance with 3.10.4

### **2.10.2.2 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.

### **2.10.2.3 Knock-outs**

Knockouts 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. Knockouts shall be provided for an equal number of 20mm and 25mm diameter conduits.

### **2.10.2.4 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.

### **2.10.2.5 Fixing of front panels**

The front panels shall be secured to the architrave frame by means of 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.

### **2.10.2.6 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 higher or wider than 450mm, handles consisting of

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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 which may be equipped with spring loaded flush mounted ring type latches. Square key operated catches are not acceptable unless specified.

### **2.10.3 Construction of surface mounted switchboards**

#### **2.10.3.1 Standard**

Surface mounted switchboards shall comply with SABS 1180, Part II.

#### **2.10.3.2 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 made provided.

#### **2.10.3.3 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 at least 20mm to accommodate flush doors.

#### **2.10.3.4 Chassis**

A sheet steel chassis for the mounting of equipment shall be bolted to the tray and shall comply with the requirements of par.2.10.4.

#### **2.10.3.5 Front panel and door**

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

#### **2.10.3.6 Dimension**

Unless the depth of the switchboards is specified, the dimensions shall be determined in accordance with requirements of par 2.10.4

### **2.10.4 Mounting of equipment**

#### **2.10.4.1 Standard**

The mounting of equipment shall comply with SABS 1180 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.

#### **2.10.4.2 Mounting of chassis**

The chassis of flush mounted and smaller surface mounted boards shall be mounted in accordance with SABS 1180. 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.

#### **2.10.4.3 Grouping of equipment**

Equipment shall be arranged and grouped in logical fashion.

Where earth leakage units are required, the associated circuit breakers shall be installed adjacent to the unit.

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#### **2.10.4.4 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 that the toggles are in the up position when "ON" and "OFF".

#### **2.10.4.5 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 made mounted in an easily accessible position and clearly marked.

#### **2.10.4.6 Mounting of fuses**

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

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

#### **2.10.4.7 Equipment in main boards**

Equipment in main low voltage switchboards and sub-main boards shall be grouped in individual compartments.

### **2.10.5 WIRING**

#### **2.10.5.1 Cabling**

Cables connected to incoming or outgoing circuits shall be terminated on a gland plate supplied for this purpose. Power cables up to and including 70mm<sup>2</sup> 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<sup>2</sup> shall terminate on bus bars that are connected to associated equipment.

Parallel incoming or outgoing cables shall be connected to a collector bus bar without crossing the conductors.

#### **2.10.5.2 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.

#### **2.10.5.3 Internal wiring**

- a) Standard 600/1000 V Grade PVC-insulated stranded annealed copper conductors to SABS 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<sup>2</sup>. Flexible cord of minimum size 1,0mm<sup>2</sup>.
  - b) Where heat generating equipment is present and internal temperature of the board is likely to exceed 50°C, silicon-rubber insulated stranded conductors or for the colour identification of conductors.
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- 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 shall be used.
- 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 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.
- f) The loop shall be arranged to produce a twisting motion when the door opened or closed. A flexible protection sleeve shall be installed over the conductors.
- g) 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 channel. Channels shall not be more than 40% full.
- h) All wiring between different panels within the same switchboard shall be installed in wiring channels.
- i) Grommets shall be installed in each hole in the metal work through which conductors pass.
- j) 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.
- k) Conductors may be jointed at equipment terminal strips only. No other connections are allowed.
- l) Where conductors change direction, smooth bends shall be formed with 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 switchboard or control board only unless clearly specified to contrary. Screened cables entering control boxes through pressed knockouts, shall terminate in compression glands. Conductors shall as far as possible remain inside the screening at terminations.

Where possible remain inside the screening at termination. 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 smooth and connected to the earth terminal.

- n) Where neutral connections are looped between the terminals of instruments, it is essential that the two conductors' 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 smallest circuit breakers and the associated main circuit breaker as well as the wiring from circuit breaker to lightning and socket-outlet circuit.
- 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. main circuit breaker feeding other circuit breakers), stub bus bars shall be provided for the various conductors.

#### **2.10.5.4 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.

#### **2.10.5.5 Wiring to circuit-breakers**

Equipment with a rating exceeding the current rating of 70mm<sup>2</sup> conductors shall be connected by means of bus bars to the main bus bars. Looped connections may only be installed for a maximum of two outgoing circuits. Where there are more than two outgoing circuits, bus bars shall be used and equipment connected individually to the bus bars.

#### **2.10.5.6 Conductor terminations**

Conductors connected to terminals complying with the Standard Specification for "WIRING TERMINALS", 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.

#### **2.10.5.7 Identification**

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

### **2.10.6 Paint Finish**

Metal components of the framework, panels and chassis shall be painted in accordance with Standard Specification "STANDARD PAINT SPECIFICATION".

### **2.10.7 Labelling**

#### **2.10.7.1 General**

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

#### **2.10.7.2 Material**

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

#### **2.10.7.3 Switchboards**

All equipment on switchboards shall be identified with the necessary 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.

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#### **2.10.7.4 Fixing labels**

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

Engraved strips be secured to facilitate a neat future 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.

#### **2.10.8 Tests**

The Engineer 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.

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

#### **2.10.9 Drawings**

##### **2.10.9.1 Drawings for approval**

A set three print of the shop drawing for the switchboards shall be submitted to the Engineer for approval before the boards are manufactured. The following information shall be presented:

- a) A complete wiring diagram of the equipment of the boards.
- b) A complete layout of the arrangement of switchboards indicating all equipment dimensions and construction of the boards. The position and method of fixing and sizes of bus bars shall be shown.
- c) All labelling information 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 this responsibility to the Client to supply the switchboards according to the requirements of this Specification.

##### **2.10.9.2 Completion**

The supply contract shall be regarded as incomplete until all tests have been conducted successfully and all information has been handed to the Engineer.

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## **PART 3 PROJECT SPECIFICATION**

## **SPECIFICATION FOR ELECTRICAL WORK**

### **PROJECT SPECIFICATIONS**

#### **3.1 CONTRACT WORK**

The installation shall be carried out entirely by the Sub-Contractor's own staff and shall not in any way be sub-let. This part of the specification shall have preference to any other part of the specification.

#### **3.2 CONTRACT PRICE ADJUSTMENT**

The tender price (contract sum) in this particular Sub-contract shall not be subject to price adjustment (Escalation as per Principal contract)

#### **3.3 SITE**

The Tenderers must, before submitting their tenders, acquaint themselves with the local conditions, accessibility of the sites, soil conditions, availability of labour and labour conditions, transport, off loading store and custody conditions for materials and equipment necessary for the completion of the total contract. No claim based on ignorance in this regard shall be considered.

Permission must be obtained from the Client Representative before any Tenderer visits the site, or the Contractor establishes himself of the site.

#### **3.4 EXTENT OF WORK**

The work covered by this contract comprises the complete electrical installation, in working order, as shown on the drawings and as per this specification, including the supply and installation of all fittings and the installation of such equipment.

#### **3.5 SUPPLY AND CONNECTION**

The Consulting Engineer will arrange with the Eskom for the permanent electrical supply as well as the commissioning thereof. Payment of the service connection shall be made by the Client.

Electrical Sub-Contractor shall be responsible for the supply, installation and connection of all the specified low-voltage cables including the supply cable from the supply point of the Eskom.

#### **3.6 INFORMATION**

The tenderer's attention is drawn to the fact that if the schedules of this specification are not complete, his tender cannot be adjudicated and may be disqualified.

#### **3.7 SPECIFICATION AND DRAWINGS**

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

Tenders must ensure that their copy of the specification is complete and that all drawings as listed have been received.

Any discrepancy must immediately be brought to the attention of the **Engineer**.

##### **3.7.1 Contract Drawings**

The layout and extent of the electrical installation are shown on the drawings which form part of this document.

The positions of all power-, light- and switch outlets or routes which may be affected by other services must be confirmed by the Contractor with the Consultant before placing such outlets.

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### **3.7.2 “As-built” Drawings**

The contractor is to prepare the “as-built” paper prints in strict accordance with this specification. These drawings are to be kept in the site office. Retention money normally due before commencement of the maintenance period will not be released until “as-built” drawings have been prepared to the satisfaction of the Engineer and the Client Representative.

### **3.8 MAKING GOOD**

The successful tenderer will be responsible for making good in all trades of any damage to buildings or other services which he or his employees may have incurred during the construction of the works.

The Contractor will be responsible for keeping the site clean and tidy and shall remove from the site all rubble and litter resulting from the construction work.

### **3.9 WORDING**

The word “approve” means approval by the Client inspection engineer or representative.

### **3.10 SUPERVISION**

Work must under all circumstances be supervised by a qualified and experienced representative of the Contractor who must be registered as an accredited person. The representative must be authorized by the Contractor and must be able to receive instructions on behalf of the Contractor.

### **3.11 ELECTRICAL EQUIPMENT**

All fittings, material and equipment and component parts thereof are to be in accordance with the quality specifications and must have the approval of the Client representative. In addition all equipment shall be designed, manufactured and tested in accordance with the relevant South African Bureau of Standards Specification or otherwise the relevant British Standard Specification.

All material and equipment must be suitable for the supply voltage 415/230V and the necessary precautions shall be taken against corrosion, i.e. exposed metal shall be anti-rust treated to approval and all metalwork to be galvanised or painted.

### **3.12 CONDUIT AND WIRING**

The installation may be in galvanized steel conduit or PVC conduit. All conduits shall be concealed in the building work where possible. Galvanised steel conduit shall be screwed or plain end.

Should for some reason it not be possible to conceal conduit in the building work and conduit must be surface mounted, only galvanised conduit may be used in up country areas.

Steel conduit exposed to damp or weather conditions shall be galvanised to SABS 763.

PVC conduit must comply with SABS 950.

PVC conduit and conduit accessories must be used in areas within 50km off the coast.

All conduits shall bear the stamp or approval by the SABS.

All conduits, regardless of the system employed, shall be installed strictly as described in the project specification. Wiring of the installation shall be carried out as directed in the project specification.

PVC conduit must be supported at 1 000mm intervals maximum.

Galvanised draw wires must be provided in all conduits provided for other services.

All steel conduit joints in concrete slabs and all running joints must be painted.

No chasing by hammer and chisel will be accepted. Slots for conduits must be cut where necessary.

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The metal conduit installation must provide a continuous earth.

Bushes on metal conduit shall be of brass only.

All outlet box cover plates must be metal and steel outlet boxes must be hot-dipped galvanised to SABS 763.

Blank cover plates on round outlet boxes must be fixed with flat head brass screws and a gasket to seal the box. Blank cover plates on 100 x 100 mm outlet boxes must be fixed with two countersunk chrome screws.

Where outlet boxes or draw boxes are mounted on finished surfaces the Electrical Contractor shall take care that such outlets are mounted symmetrically. It will not be sufficient to scale the position of any outlet off the drawings. No extra payment will be allowed where the outlets are not mounted symmetrically and have to be changed.

Draw boxes on the lead in sleeves/conduits for the supply to toilet blocks must be flush mounted and must be fitted with weatherproof lids which must have levelled edges. The lids must be fixed with tamper resistant screws to the boxes and must in general comply with the specification on distribution board doors. The draw boxes may not be smaller than 100 x 100 mm. Standard factory made boxes may be considered if submitted beforehand to the Consultant for approval.

### **3.13 SWITCHES AND SOCKET OUTLETS**

All switches and socket outlets shall conform to the quality specification and must be approved by the Client's representative.

#### **FLUSH AND SURFACE MOUNTED SWITCHES.**

All switches shall be suitable for mounting in 100x50x50mm boxes shall comply with SANS 1663 and shall bear the SANS mark.

Switches shall be of tumbler operated micro gap type rated at 16A, 220/250V.

Switches shall have protected terminals for safe wiring.

#### **WATERTIGHT SWITCHES**

Water tight switches shall be of the micro gap type suitable for surface mounting and shall bear the SANS mark.

The housing shall be of galvanized cast iron or die cast aluminium with watertight cover plate and toggle.

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

The installation of switches and socket outlets shall be carried out in accordance with the project specification.

Light switches must be mounted 1 400mm a.f.f.l.

Switch socket circuits must be protected by 30mA earth leakage units. Light switch and switch sockets of one manufacturer only, will be accepted.

Screws longer than 30 mm to mount light switches or switch socket outlets will not be accepted.

#### **FLUSH AND SURFACE MOUNTED SWITCHED SOCKETS**

All switched sockets-outlets shall be suitable for mounting in 100x100x50mm.

Terminals shall be enclosed for safe wiring.

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

#### **WATER TIGHT SWITCHED SOCKETS**

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

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

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

### **3.14 DISTRIBUTION BOARDS**

#### **3.14.1 General**

Supply and install the distribution boards in the position shown on the drawings.

One spare 25 mm dia and three spare 20 mm dia conduits must be supplied from all distribution boards to roof spaces.

Five sets of factory drawings on all distribution boards must be submitted for inspection before manufacture of the distribution boards commence.

The Department must be notified at least two weeks in advance of the completion of the distribution boards in order that an inspection may be carried out before delivery.

#### **3.14.2 Construction**

The construction must be in accordance with SABS standards.

All distribution boards must be flush mounted and must have doors which must be pad lockable.

The current capacity of bushbars may not exceed 1.6 A.

Openings into distribution boards must tie up with the installation.

Cables must be mounted with "K"-clamps to the distribution board tray. Earth rings and glands must be used to earth cable armouring inside distribution boards.

#### **3.14.3 Installation**

The distribution boards must be placed in such a way that the Building can build them into the walls where applicable. Special provision must be made that the distribution board tray is not damaged while being built in.

The distribution boards must be placed in the position shown on the drawings.

All distribution boards must be installed level.

Apparatus and requirements by the Supply Authority are not indicated on the distribution board diagram and schedules. It is expected of the Electrical Contractor to install all such apparatus, accessories and systems as may be required by the Supply Authority, as part of the electrical contract price.

A neutral bar associated with each bank of mccb's must be positioned below each bank of mccb's and must be wired in the same sequence as the mccb's. Not more than one conductor per connector will be accepted.

Only hydraulic-magnetic operated mccb's must be used if the new micro ranges are not used.

Excluding the metering kiosk, 2.5 kA circuit breakers may be accepted in distribution boards.

The minimum conductor size between lightning arrestors and earth shall be 4mm<sup>2</sup>.

Bushbar stubs must be provided where more than one conductor terminates on equipment.

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Earth conductors must be fastened with two screws and shoes to earth bars.

Two (2x) keyed alike with 016 keys, Standard padlocks must be provided with the Meter Kiosk.

### **3.15 LABELLING**

Circuits which are not wired must be marked "SPARE" on the distribution boards.

Labels indicating the supply point and size of the supply cable must be provided on each distribution board.

Where switchboards are positioned behind doors of building structure i.e. build-in cupboards, a suitable approved electrical danger sign as well as the applicable distribution boards designation label must be supplied and fitted in a suitable position on the outside top section of one of the entrance doors at each such location.

### **3.16 POWER DISTRIBUTION BOARDS**

Supply and install the power distribution boards in the position shown on the drawings.

The power distribution board should have:

- It should have a dedicated mounting plate for device installation.
- A front plate to block direct access to live parts.
- Prefabricated busbar connections
- Systems for on-site connections and running of auxiliary wires.
- Vertical and flat bars.
- Specific enclosure models dedicated and optimized to receive functional inputs.

The equipment shall be installed and secured to the floor in accordance with the manufacture's specification.

Five sets of factory drawings on all distribution boards must be submitted for inspection before manufacture of the distribution boards commence.

The Department must be notified at least two weeks in advance of the completion of the distribution boards in order that an inspection may be carried out before delivery.

#### **3.16.1 Construction**

The construction must be in accordance with SABS standards.

All Power distribution boards must have doors which must be pad lockable.

Openings into distribution boards must tie up with the installation.

Cables must be mounted with "K"-clamps to the distribution board tray. Earth rings and glands must be used to earth cable armouring inside power distribution boards.

#### **3.16.2 Installation**

All Power distribution boards must be installed level.

Apparatus and requirements by the Supply Authority are not indicated on the Power distribution board diagram and schedules. It is expected of the Electrical Contractor to install all such apparatus, accessories and systems as may be required by the Supply Authority, as part of the electrical contract price.

A neutral bar associated with each bank of mccb's must be positioned below each bank of mccb's and must be wired in the same sequence as the mccb's. Not more than one conductor per connector will be accepted.

Busbar stubs must be provided where more than one conductor terminates on equipment.

Earth conductors must be fastened with two screws and shoes to earth bars.

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### **3.17 LABELLING**

Circuits which are not wired must be marked "SPARE" on the Power distribution boards.

Labels indicating the supply point and size of the supply cable must be provided on each Power distribution board.

### **3.18 POWER POINTS**

The Contractor shall make allowance for the complete installation of all power points as indicated on the drawings and described hereunder:-

All sockets or switch boxes shall be manufactured of pressed galvanized steel of at least 1mm thickness. All boxes shall be fitted with the necessary lugs to suit standard flush mounted switches and sockets manufactured in accordance with SANS 1085. Switch and socket cover plates shall comply with SANS 1084.

### **3.19 BALANCING OF LOAD**

The electrical contractor is required to balance the load as equally as possible over the multi-phase supply.

### **3.20 EARTHING OF INSTALLATIONS**

Installations shall be effectively earthed in accordance with the "Standard Regulations" and to the requirements of the supply authority, as well as the Eskom's Representative, who may require additional earthing to meet test standards. Earthing must comply with S.A.B.S 0142 – 1993.

All hot and cold water as well as waste pipes must be effectively bonded by 12.5 x 1.6mm solid or perforated copper tape (not wire) clamped by means of brass bolts and nuts. The tape is to be fixed to walls by means of roundhead brass screws at intervals not exceeding 150 mm.

The earth connection from the main earthbar in the mainboard must be made to the cold watermain and the incoming service earth conductor by means of 16mm<sup>2</sup> stranded (not solid) bare copper earth wire or such conductor as the Eskom's Representative may direct. Where applicable all steel roofsheeting as well as steel walkways and stairs shall be suitably earthed.

Furthermore an earth electrode (earth spike) of at least 1,5m long must be provided and driven into the ground at the centre of each gable-end wall of each individual block. These earth electrodes shall be installed at least 1 m from the building's perimeter and shall clear all aprons and water channels. These earth spikes must be driven into the ground to at least 300 mm below ground level and only after final bonding and tests have been carried out must proper backfilling and compacting of same be executed.

In each instance these earth spikes must be interconnected by means of a 16mm<sup>2</sup> stranded bare copper earth conductor which must be installed in the inside of the ridging of the roof structure, encased in 20mm flush conduits installed in the gable walls. This earth conductor must be bonded to the roof sheeting at intervals not exceeding 5 m, ensuring that roof sheeting on both sides of the ridging are properly bonded, as specified in the project specification.

The overall earth resistance at the Main Distribution Board shall not exceed 10hm. The contractor shall assess the soil and site conditions at the time of tendering and allow for this to enable him to perform the proper earthing and bonding of all installations.

### **3.21 LUMINAIRES**

Supply and install the luminaires schematically indicated on the drawings. The luminaires must comply with the requirements and the particulars listed hereunder.

The required luminaire types are specified on the drawings and tie up with the types indicated on the layouts. Samples of all luminaires must be approved by the client representative before any order is placed. All control gear within luminaires, shall bear the stamp of approval by the SABS.

The installation of luminaires must be done in accordance with the relevant clauses in the general project

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specification.

All luminaires must be complete with lamps and where necessary, control gear. Starters of fluorescent luminaire for starters must be covered to the approval of the client representatives. Lamp holders for GLs lamps must be porcelain or heavy duty brass.

The following luminaires are indicated on the respective drawings and must conform to the general project specifications of this contract.

#### **3.21.1 Light Fitting Specifications for 4 Classroom Block and 2 Computer Laboratories**

***Note: All luminaires must be approved by the Consultant representative prior to the installation of or any order being placed.***

TYPE A: 4x58 Watts LBR fluorescent light fitting.

TYPE B: 26 Watts water resistant LED bulkhead light fitting with 50 000hrs lifetime

TYPE C: Battery back up emergency.

TYPE D: 2x58 Watts fluorescent light fitting.

TYPE E: 26 Watts water resistant LED wall mounted bulkhead light fitting with 50 000hrs lifetime

#### **3.21.2 Light Fitting Specifications for 2 Classroom Block and 1 Computer Laboratory**

***Note: All luminaires must be approved by the Consultant representative prior to the installation of or any order being placed.***

TYPE A: 4x58 Watts LBR fluorescent light fitting.

TYPE B: 26 Watts water resistant LED bulkhead light fitting with 50 000hrs lifetime

TYPE C: Battery back-up emergency.

TYPE D: 2x58 Watts fluorescent light fitting.

TYPE E: 26 Watts water resistant LED wall mounted bulkhead light fitting with 50 000hrs lifetime

#### **3.21.3 Light Fitting Specifications for Administration Block.**

***Note: All luminaires must be approved by the Consultant representative prior to the installation of or any order being placed.***

TYPE A: 4X58 Watts LBR fluorescent light fitting.

TYPE E: Battery back up emergency light.

TYPE F: Signage Entrance/Exit.

TYPE G: 117 Watts LED Floodlights with 60 000hrs lifetime.

TYPE H: 26 Watts water resistant LED bulkhead light fitting with 50 000hrs lifetime

#### **3.21.4 Light Fitting Specifications for Library Resource Centre**

***Note: All luminaires must be approved by the Consultant representative prior to the installation of or any order being placed.***

TYPE C: Battery back-up emergency light.

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TYPE D: Signage light Entrance/Exit.

TYPE E: 26 Watts water resistant LED bulkhead light fitting with 50 000hrs lifetime

### **3.21.5 Light Fitting Specifications for Multi-Purpose Hall**

***Note: All luminaires must be approved by the Consultant representative prior to the installation of or any order being placed.***

TYPE A: 160 Watts LED low bay light fitting with 60 000hrs – 90 000hrs lifetime

TYPE B: 2x58 Watts fluorescent light fitting.

TYPE D: Battery back up emergency light fitting

TYPE E: Signage light Entrance/Exit.

TYPE F: 117 Watts LED Floodlights with 60 000hrs lifetime..

TYPE G: 26 Watts water resistant LED bulkhead light fitting with 50 000hrs lifetime

TYPE H: 5x250 Watts spotlight for stage

### **3.21.6 Light Fitting Specifications for the Site Reticulation**

***Note: All luminaires must be approved by the Consultant representative prior to the installation of or any order being placed.***

TYPE A: 8M 62 Watts solar operated steel pole mounted LED street light fitting with 60 000hrs lifetime.

TYPE B: Steel pole mounted LED light fitting 3.5m 62 watts with 60 000hrs lifetime.

TYPE C: 117 Watts LED Floodlights with 60 000hrs lifetime.

TYPE D: 26 Watts water resistant LED bulkhead with 50 000hrs lifetime

### **3.21.7 Light Fitting Specifications for the Workshop**

***Note: All luminaires must be approved by the Consultant representative prior to the installation of or any order being placed.***

TYPE A: 250 Watts high bay light fitting with 60 000hrs – 90 000hrs lifetime.

TYPE B: Battery back up emergency light fitting.

TYPE C: 4x58Watts fluorescent light fitting.

TYPE D: 26 Watts water resistant LED wall mounted bulkhead light fitting with 50 000hrs lifetime

TYPE E: 2x58 Watts fluorescent light fitting.

TYPE F: 117 Watts LED Floodlights with 60 000hrs lifetime.

TYPE H: 26 Watts water resistant LED bulkhead with 50 000hrs lifetime

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### 3.22 PHOTO CELL

The area lighting must be switched direct by the photo cell. The photo cell must be mounted where indicated on the drawings in such a manner that the luminaires will not affect the operation of the photo cell.

The photo cell must be linked with the distribution board by 3 x 1.5 mm 5 PVC conductors drawn in conduit in the roof space.

***The photo cell must comply to the following:-***

- i) Area lights must be switched ON when the illumination dropped to 50 lux.
- ii) Area lights must be switched OFF when the illumination raised to 90 lux.
- iii) It must be weatherproof and must have a built in time delay of approximately 40 seconds.
- iv) Built in protection against voltage surges must be provided.
- v) The photo cell must be mounted in an empty bulkhead type 5 luminaire, with an aluminium base.
- vi) A sample of the proposed photo cell must be submitted to the Engineer for approval.
- vii) 16A rating must be provided.

### 3.23 CABLE TRAYS

The cable trays shall be manufactured from perforated rolled steel.

***The cable trays for the following area shall be of the following standards:***

- Vertical building ducts- hot dip galvanized to SANS 32&121.
- Plant rooms, substations, service tunnels-Electro galvanized baked enamel.
- Damp areas, exposed to weather-Hot dip galvanized to SANS 32&121.

#### 3.23.1 SPACING OF HORIZONTAL SUPPORTS.

Horizontal trays shall be supported at the following maximum intervals:

- (a) 1.2mm to 1.6mm thick metal with 12mm to 19mm return trays.
- (b) 2.5mm thick metal trays with 76mm return.
- (c) Cable ladders with 76mm side rail of 2mm thickness and with crossrugs.
- (d) 3mm thick PVC trays with 40mm return.
- (e) 4mm thick PVC trays with 60mm return.

### 3.24 POWER SKIRTING.

The channel and cover should be epoxy coated after manufacture.

The outlet pre-punched on a modular basis should be provided to accommodate socket outlets and future socket outlets.

Two or three compartment power skirting shall be supplied and installed in the positions according to the layouts indicated on the drawing.

The top compartment shall be used for power wiring and switched socket outlets, whilst the bottom compartments shall be for telephone and other light current services.

#### MODULE

Power skirting shall be manufactured from 1mm (minimum) thick sheet in approximately 2.5m lengths.

Each modular cover associated with the power compartment shall be punched and prepared for installation of either a 13A or a 16A , 3 pin standard flush switched socket outlet, whether any is specified or indicated for that module or not. Where socket outlets are not installed, the punched holes shall be blanked off, painted the same colour as the power skirting and installed at the back of the covers. These blanking plates shall be easily removable to permit future installation of socket outlets.

### 3.25 SWITCHES

All switches shall be suitable for mounting in 100x50x50mm boxes shall comply with SANS 1663.

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### **3.26 SHAVING POINT**

All shaver sockets should be a double wound isolating transformer rated at 20VA.

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

Insertion of a shaver plug shall automatically switch on the unit by energizing the primary side of the isolating transformer.

The unit should be protected against overload by a thermal overload device.

The unit shall comply with BS 3052.

### **3.27 CABLES**

#### **TRENCHING**

- (a) The Contractor shall be responsible for all trenching excavation.
- (b) The Contractor shall, before trenching commences, familiarize himself with the routes and site conditions and the procedure and order of doing work shall be planned in conjunction with the general construction programme for other services and building requirements.
- (c) The contractor will be held responsible for damage to any existing services brought to his attention by the relevant authorities and shall be responsible for the cost of repairs.
- (d) The contractor shall take all necessary precautions and provide the necessary warning signs and/or lights to ensure that the public and /or employees on site are not endangered.
- (e) The Contractor shall ensure that the excavations will not endanger existing structures and roads.

#### **BLASTING**

Should blasting be necessary and approved by the client, the Contractor shall obtain necessary authority from the Government Departments and Local Authorities. The Contractor shall take full responsibility and observe all conditions and regulations set forth by the above Authorities.

#### **ROUTES**

- (a) Trenches shall connect the points shown on the drawings in a straight line. Any deviations due to obstructions or existing services shall be approved by the Electrical Engineer.
- (b) The Electrical Engineer reserves the right to alter any cable route or portion thereof in advance of cable laying. Payment in respect of any additional or wasted work involved shall be at the documented rates.

#### **CABLE SLEEVES**

- (a) Where cables cross the road, other services and where cables enter building, the cables shall be installed in Polyethylene (6mm thickness), asbestos cement pipes or earthenware pipes. Pitch fibre and PVC pipes are not acceptable because of the adhesion that occurs after a period of time between pipe and the sheathing or outer serving of the cables.
- (b) Pipes shall be joined in accordance with the manufacture's instructions.
- (c) Sleeves shall cross roads at right angles.
- (d) All sleeves shall be graded 1:400 for water drainage.
- (e) The ends of all sleeves shall be sealed with a non-hardening watertight compound after installations of cables. All sleeves intended for future use shall likewise be sealed.

#### **BACKFILLING**

- (a) The contractor shall not commence with backfilling of trenches without prior notification of the Electrical Engineer so that the cable installation may be inspected. Should the contractor fail to give a timeous notification, the trenches shall be re-opened at the Contractor's cost.
  - (b) For high voltage cables (1Kv to 11Kv) a coloured plastic marking tape shall be installed 400mm above the cable. The tape shall be yellow, marked with words" ELECTRIC CABLE/ELEKTRISIE KABEL" in red. These markings shall not be more than 1m apart from centre to centre.
  - (c) Backfilling shall be undertaken with soil suitable to ensure settling without voids. The maximum allowable diameter of stones present in the backfill material is 75mm.
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- (d) The backfill shall be compacted in layers of 150mm and sufficient allowance shall be made for final settlement. The contractor shall maintain the refilled trench at his expense for the duration of the contract. Surplus material shall be removed from site and suitably disposed of.
- (e) On completion, the surface is made good to match the surrounding area.
- (f) In case of roadways or paved areas the excavations shall be consolidated to the original density of the surrounding material and the surface finish reinstated.

**CABLE MAKERS (FOR HV CABLES ONLY, EXCEPT WHERE OTHERWISE SPECIFIED)**

- (a) Cable makers shall be provided along all HV cable routes but need only be provided along LV cable routes where specified.
- (b) Cable makers shall consist of concrete blocks in the shape of truncated pyramids, approx.300mmhigh, 150x150mm at the top and 250x250 mm at the bottom.
- (c) Brass plates shall be cast into the tops of the blocks in such a manner that they can not be pried loose. The wording "ELECTRIC CABLE /ELEKTRIESE KABEL" shall be stamped on the brass plates as well as direction arrows and the cable voltage rating.

**INSTALLATION OF UNDERGROUND CABLES**

- (a) Cables shall be installed at the following minimum depths below final ground level:  
Up to 11Kv:800mm
- (b) The depth of cable pipes beneath roads shall be not less than 1.1m below the formation level.
- (c) Where HV and LV cables have to be installed in the same trench, both shall be laid at a depth of 800mm and then covered with 200mm of soil. The soil shall then be compacted, and backfilled layer by layer and compacted until the trench is completely backfilled.
- (d) Cables for telephones, communication systems and other low voltages (less than 50V) shall be separated from power cables at least 1m.

Cables shall be manufactured in accordance with SANS 97 and shall come only from fresh stocks.

**3.28 STANDBY GENERATOR****Output of the Sets**

1x 600kVA stationary indoor prime power rated diesel generator set at 0,8 power factor with the alternator wound for the supply of 400/230 volts, 3 phase, 4 wire, 50 Hz., and running at a speed of 1500 r.p.m.

**Factory Installed Standard**

Air Inlet	<ul style="list-style-type: none"><li>➤ Disposable Air filter</li><li>➤ Service indicator.</li></ul>
Cooling	<ul style="list-style-type: none"><li>➤ Radiator package mounted</li><li>➤ Coolant level sight gauge</li><li>➤ Low coolant level sensor</li><li>➤ Coolant drain line with valve</li><li>➤ Fan and belt guards</li></ul>
Exhaust	<ul style="list-style-type: none"><li>➤ Dry exhaust manifold</li><li>➤ Stainless steel flex fittings</li><li>➤ Exhaust flange outlet</li></ul>
Fuel	<ul style="list-style-type: none"><li>➤ Integral narrow single wall fuel tank base</li><li>➤ Primary fuel filters</li><li>➤ Fuel priming pump</li><li>➤ Engine fuel transfer pump</li><li>➤ Flexible fuel lines</li></ul>



GENERATOR	<ul style="list-style-type: none"> <li>➤ Class H insulation.</li> <li>➤ Self Excited</li> <li>➤ Class H temperature rise</li> <li>➤ 450V voltage regulator with single phase sensing and load adjustment module,</li> </ul>
Power Termination	<ul style="list-style-type: none"> <li>➤ Power center house EMCP controller.</li> <li>➤ Circuit breaker</li> <li>➤ Segregated low voltage wiring termination panel.</li> </ul>
GOVERNOR	Low emissions conversion.
CONTROL PANELS	<ul style="list-style-type: none"> <li>➤ Emergency stop pushbutton.</li> <li>➤ Instantaneous phase currents</li> <li>➤ Instantaneous phase and line voltages</li> <li>➤ Ac Voltmeter, Ammeter &amp; Frequency.</li> <li>➤ Engine Speed (rev/min)</li> <li>➤ Power Factor</li> <li>➤ Lube oil pressure</li> <li>➤ Fault Conditions</li> </ul>
LUBE	<ul style="list-style-type: none"> <li>➤ Lubricating oil .</li> <li>➤ Oil drain line with valves.</li> <li>➤ Fumes disposal</li> <li>➤ Oil filter and dipstick.</li> <li>➤ Oil cooler</li> </ul>
MOUNTING	<ul style="list-style-type: none"> <li>➤ Integral Narrow 8hr tank base.</li> <li>➤ Linear vibration isolation.</li> </ul>
STARTING/CHARGING	<ul style="list-style-type: none"> <li>➤ 24 VOLT starting motor.</li> <li>➤ 45 Amp charging alternator.</li> <li>➤ Batteries with rack and cables.</li> <li>➤ Battery disconnect switch.</li> </ul>

Technical considerations concerning the engineering, design, maintenance requirements etc., are of the utmost importance and will weigh heavily in the adjudication of tender received and Tenderers are advised to submit the fullest possible details with their tenders.

The following shall form part of this contract:

- The termination of the supply cables onto the change-over panel of the alternator set.
- Plant-rooms shall be provided and tenderers are to confirm the required sizes together with all openings etc. Galvanised sound attenuators, aluminium louvers and galvanised double acoustic door form part of this contract and shall be supplied and installed by the generator set contractor.

### 3.29 DISTRIBUTION TRANSFORMER

This contract shall consist of the supply and installation of an indoor 500kVA transformer in the Services Building above the cable trenches.

The transformer will have the following specifications:

- |       |                                 |                        |
|-------|---------------------------------|------------------------|
| i.    | Rating                          | 500kVA                 |
| ii.   | Primary Voltage                 | 11,000V                |
| iii.  | Secondary Voltage               | 400/231V               |
| iv.   | Vector Group                    | Dyn 11                 |
| v.    | Tappings                        | ±3% & ±6%              |
| vi.   | Off-circuit Lockable Tap Switch |                        |
| vii.  | Oil level indicator             |                        |
| viii. | Cooling                         | ONAN                   |
| ix.   | Mounting Arrangement            | Skid Base with Rollers |
| x.    | Terminations                    | HV and LV cable boxes  |
| xi.   | Tank Construction               | Sealed welded cover    |

All earthing of the equipment shall form part of the tender.

The LV terminals of the transformer shall be designed to accept 3x150mm<sup>2</sup> 4-core PVC cables.

All text for the labelling shall be provided to the contractor at a later stage, but preparation and installation of labels shall be included in the rates.

### 3.30 POWER FACTOR CORRECTION

The power factor correction cubicles should be equipped with up to 5 or 4 varpact comfort power modules. The cubicles should have ventilated fans.

The Distribution Board supplier should calculate the reactive and magnetizing power required by the inductive characteristics of all electrical equipment on our single line diagram. After calculating such shunt capacitors should be designed. The total power for each Power distribution board is given.

### 3.31 UNINTERRUPTIBLE POWER SUPPLY

Specification for		15kVA UPS System	30kVA UPS System
Item	Description	Requirement	
1	General Specifications		
1.1	UPS Topology	On-line double conversion	On-line double conversion
1.2	In/Out phase configuration	Three phase / Three Phase	Three phase / Three Phase
1.3	Neutral	Neutral passing through	Neutral passing through
1.4	Output waveform on mains run	Sinusoidal	Sinusoidal
1.5	Output waveform on battery run	Sinusoidal	Sinusoidal
1.6	Bypass type	Static and electromechanic	Static and electromechanic
1.7	Transfer Time	Zero	Zero
2	Input Parameters		
2.1	Nominal Voltage	400V Three Phase	400V Three Phase
2.2	Voltage Range	-20% +15%	-20% +15%
2.3	Input Frequency	50Hz to 60Hz (autosensing)	50Hz to 60Hz (autosensing)
2.4	Input Current THD at nominal voltage	<3% at full load	<3% at full load
2.5	Input Power Factor at Nominal Voltage	>0.98 from 50% to 100% of nominal load	>0.98 from 50% to 100% of nominal load
3	Output Parameters with Mains (AC - AC)		
3.1	Nominal Voltage	400V Three Phase	400V Three Phase
3.2	Nominal Power	15kVA	30kVA
3.3	Active Power	13.5kW	27kW
3.4	Voltage Variation (Static)	±1%	±1%
3.5	Voltage Variation (Dynamic 0-100%; 100-0%)	±1%	±1%
3.6	THDv on nominal power (linear load)	<0.5%	<0.5%
3.7	THDv on nominal power (not linear load P.F. = 0.7)	<1%	<1%
3.8	Frequency	50Hz to 60Hz (autosensing or selectable)	50Hz to 60Hz (autosensing or selectable)
3.9	Frequency Tolerance	Synchronised with input frequency	Synchronised with input frequency
3.10	Overload Capability		
	5min	125% load rate with no bypass intervention	125% load rate with no bypass intervention

Specification for		15kVA UPS System	30kVA UPS System
Item	Description	Requirement	
	30sec	150% load rate with no bypass intervention	150% load rate with no bypass intervention
<b>4</b>	<b>Output Parameters in Battery Run (DC - AC)</b>		
4.1	Nominal Voltage	400V Three Phase	400V Three Phase
4.2	Nominal Power	15kVA	30kVA
4.3	Active Power	13.5kW	27kW
4.4	Voltage Variation (Static)	±1%	±1%
4.5	Voltage Variation (Dynamic 0-100%; 100-0%)	±1%	±1%
4.6	THDv on nominal power (linear load)	<0.5%	<0.5%
4.7	THDv on nominal power (not linear load P.F. = 0.7)	<1%	<1%
4.8	Frequency	50Hz to 60Hz (autosensing or selectable)	50Hz to 60Hz (autosensing or selectable)
4.9	Frequency Tolerance	±1% free run	±1% free run
4.10	<u>Overload Capability</u>		
	5min	125% load rate with no bypass intervention	125% load rate with no bypass intervention
	30sec	150% load rate with no bypass intervention	150% load rate with no bypass intervention
<b>5</b>	<b>Battery</b>		
5.1	Battery Type	Lead Acid, sealed, free maintenance VRLA	Lead Acid, sealed, free maintenance VRLA
5.2	Unit Capacity	7.2 or 9Ah (12V)	7.2 or 9Ah (12V)
5.3	Nominal UPS Battery Voltage	240V DC	240V DC
5.4	Battery Charger Type	PWM hi-efficiency, one in each power module	PWM hi-efficiency, one in each power module
5.5	Charging Cycle	Intelligent with boost charge and advanced management	Intelligent with boost charge and advanced management
5.6	Maximum Charging Current	2.5A each power module	2.5A each power module
<b>6</b>	<b>Static Bypass</b>		
6.1	Type	Thyristor Bridge	Thyristor Bridge
6.2	Rated Current	1.5In	1.5In
6.3	Overload Capacity in kVA	200% - 1 min / 1000% - 10ms	200% - 1 min / 1000% - 10ms
<b>7</b>	<b>Physical Parameters</b>		
7.1	Protection	IP21	IP21
7.2	Standards	IEC 62040-3, IEC60146-1-1, IEC 61000-4-2, EN 50091	IEC 62040-3, IEC60146-1-1, IEC 61000-4-2, EN 50091
<b>8</b>	<b>Environment</b>		
8.1	Operating Temperature	0 to 40 degrees Celsius	0 to 40 degrees Celsius
8.2	Humidity	0 - 90% non-condensing	0 - 90% non-condensing
8.3	Maximum Altitude	0 - 2000m without de-rating	0 - 2000m without de-rating

### **3.32 TECHNICAL SPECIFICATION**

The selection of equipment should be submitted with relevant manufactures data to the Engineer for approval before any installation takes place. The cost of replacing any plant equipment ordered prior to approval obtained shall be borne by the contractor.

### **3.33 TESTING AND INSPECTION**

The Contractor shall test the entire installation in terms of Regulation 7 of the Electrical Installation Regulations 1992 of the Occupational Health and Safety Act 1993 and shall issue a Certificate of Compliance on the official form, Annexure 1, obtainable from the Electrical Contracting Board of South Africa.

All 200 V socket outlets shall be tested for polarity and the sensitivity of the earth leakage protection equipment shall be tested by means of an approved instrument.

Each length of cable shall be tested for insulation and polarity by means of a 1 000 Volts designed for that purpose. In the case of underground cables this shall be done before backfilling. In addition, the earth-loop impedance of each main and sub-main feed shall be measured. The earth resistance at each down conductor earth electrode shall be measured. The earth resistance shall be tested by means of an approved instrument.

If there is not power on the day of the test, the contractor shall supply a 3 kW, 230V generating plant for testing purposes.

“DANGER” notices shall be displayed at remote ends of cables under test.

The Engineer reserves the right to witness all tests. The Contractor shall advise the Engineer in writing of all results and furnish copies of all certificates.

Load balancing shall be undertaken by the Contractor in conjunction with the Engineer. Where conductors are altered to achieve satisfactory results they shall be replaced by the Contractor.

The Contractor shall provide all the necessary instruments for the proper testing of the complete installation. If there is reason to doubt the accuracy of such instruments, the Contractor shall take the necessary action to prove their accuracy.

If the results of the first delivery tests are favourable and the installation is found in order, there will be no charge for the test. If the test is found unfavourable a levy of R200-00 will be charged to the contractor for each subsequent test. In the form of a variation order omitting such costs from his contract price.

The Contractor shall ensure that the installation is completed in every respect and that there are not major defects prior to notifying the Engineer (in writing) for a first delivery inspection.

The Engineer will accept zero minor defects during the final inspection. Should this number of defects be exceeded at the final inspection then the Engineer will terminate that inspection and request that another inspection.

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