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

VOLUME 2 (B): RETURNABLE DOCUMENTS

Department:
Public Works
REPUBLIC OF SOUTH AFRICA

ELECTRICAL SERVICES SPECIFICATION

FOR

VULAMEHLO MAGISTRATE COURT

DUDUDU

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AUGUST 2014

SCOPE OF PROJECT SPECIFICATION

The Project Specification is set out in three parts. The purpose of each of the three parts is as follows:

Part A:

This part of the specification provides general information in respect of the project.

Part B:

This part of the specification provides quality specifications for the equipment and services required for this project.

Part C:

This part of the specification provides the installation specifications for the equipment and material required for this project. The installation specifications detail the requirements to be complied with and the inspections and testing to be done for each section of the works in order to verify compliance with these specifications.

Part D:

Part D specification provides the detail of the equipment and services required for this project.

Note:

The following specifications from the Department of Public Works form part of this contract specification and can be obtained from their website or collected in person form their offices:

1) STANDARD ELECTRICAL SPECIFICATIONS:-

SECTION A: PREAMBLE TO STANDARD SPECIFICATIONS

SECTION B: INSTALLATION SPECIFICATIONS

2) STANDARD ELECTRICAL SPECIFICATION SECTION C: QUALITY SPECIFICATION FOR MATERIALS AND EQUIPMENT OF ELECTRICAL INSTALLATIONS

PROJECT SPECIFICATION

PART A

SPECIFICATION FOR ELECTRICAL INSTALLATION

GENERAL SPECIFICATION

CONTENTS

PART A: PROJECT DESCRIPTION AND GENERAL INFORMATION

1. GENERAL

1.1 The work to be carried out comprises of the electrical services installation for Vulamehlo Magistrate Court, Dududu, KwaZulu-Natal.

1.2 The Project Specification shall be read in conjunction with the schedule of quantities contained in Section 11 of this document and the drawings. Where contradictions occur between the documents, the most stringent requirement shall rule, unless otherwise stated by the engineer.

1.3 Only equipment based on proven technology and of high reliability shall be considered for use.

1.4 All schedules included in the project documentation shall be completed in full and submitted with the tender. Failure to comply with the above will result in the tender being disqualified.

1.5 All relevant technical information regarding each component or item offered shall be included either in the forms to be completed by the Tenderer or as an appendix to the tender, in order that the engineer can make a true evaluation of the offer.

1.6 Tenderers shall be deemed to have waived and renounced any condition printed upon any stationary used by him for the purpose of or in connection with the submission of his tender.

1.7 Where Tenderers choose to offer items imported from other countries, these shall be offered as an alternative offer. Complete technical details of all alternative equipment shall be included in the tender and the Tenderer shall prove that all the requirements of the specification have been complied with.

2. SITE LOCATION AND DETAILS

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

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

2.2 The site is subject to the following prevailing conditions:

- Maximum Temperature 42° C
- Minimum Temperature 13° C
- Relative Humidity: High
- Altitude ±464m above sea level

2.3 The system conditions are as follows:

- Supply voltage 400 V, 3 phase
- Rated frequency 50 Hz

3. DETAILS OF CONTRACT

The work to be carried out under this subcontract consists mainly of the electrical services installation at Vulamehlo Magistrate Court, complete repair and renovations.

4. SITE FACILITIES

4.1 No provisions have been made for these facilities separately and will fall under the Main Contractor. The Electrical Sub-Contractor shall supply all equipment e.g. scaffolding, ladders and other resources required for the proper execution of the works. Tenderers shall therefore include the costs of these items in their prices.

4.2 The Sub-Contractor shall, at his own expense, be responsible for obtaining and the distribution of water and electricity required for the construction and domestic use. No separate payment will be made for obtaining and distributing water and electricity and the cost thereof.

4.3 The Sub-Contractor shall supply, install, arrange for, properly maintain and on completion remove all temporary construction facilities and utilities necessary for complete execution of own work. Such items might include:

(a) temporary buildings;
(b) water and electricity supplies;
(c) sanitary facilities; and
(d) first aid facilities.

5. CONSTRUCTION PROGRAMME

5.1 A detailed construction programme shall be submitted within fourteen (14) days after acceptance of the tender. This programme shall be finalised in liaison with the Main Contractor and shall have to be approved by the Engineer.

5.2 The Main Contractor's programme shall be co-ordinated with the programme of all his Subcontractors and shall include allowance for builders holidays and public holidays as specified in the Standard Conditions of contract.

6. STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender of all the applicable SABS/SANS specifications, Department of Public Works standards and specifications, publications and codes of practice including Manufacturers' specifications and installation instructions, shall be read in conjunction with this specification and shall be deemed to form part thereof.

7. DELAYS AND OVERTIME

7.1 If the Electrical Sub-Contractor's work should cause any delay to the late completion of the works, he will be held responsible for any claims arising out of such delays in accordance with the stipulations of the Principal Contract.

7.2 Payments for overtime will only be considered if formally instructed by the Engineer and no payment will be made for overtime to maintain progress in accordance with the programme or to make good lack of progress by the Electrical Sub-Contractor.

8. SECURITY OF MATERIALS AND EQUIPMENT

8.1 The Electrical Sub-Contractor shall provide and maintain, at his own cost, all lights, guards, barriers, fencing and safeguarding as may be required for his works, installations, materials, equipment and public safety, until the works have been completed in full and handed over to the client. Any materials damaged or stolen from site prior to final handover of the whole project shall be replaced by the Sub-Contractor with no cost to the Client.

8.2 All materials e.g. distribution boards, light fittings, etc supplied as part of this Contract shall be well protected against damage during transport, off loading, storage and building operations.

9. STORAGE

The Sub-Contractor shall be responsible for provision of an adequate and safe storage for all his materials. All materials shall be stored or stacked in positions that will not interfere with other work in progress in the area, or the safe and unhindered movement of the public in the area.

10. QUALITY OF MATERIALS

10.1 All materials supplied by the Electrical Sub-Contractor under this contract works shall be new and unused. Only materials of first class quality shall be utilised. Samples of all materials e.g. luminaires, outlets, cable support systems, etc, shall be subject to approval by the Engineer before the procurement process commences.

10.2 All materials shall comply with the relevant specifications as listed in Section 6 above.

10.3 All materials shall be unconditionally guaranteed for a period of 12 months from the date of practical completion of the Whole of the Contract Works. Where Supplier's guarantees are of a shorter duration than 12 months, the Sub-Contractor shall unreservedly agree to the extension and cession of all warranties and guarantees.

10.4 The Sub-Contractor shall replace any materials that are found to be defective during the 12 months defects liability period.

10.5 Factory tests
The Contractor shall arrange factory inspections and tests by the Engineer of equipment manufactured and supplied as part of this Contract e.g. DB's, etc.

11. COMPETENCE OF PERSONNEL, WORKMANSHIP AND STAFF

11.1 All work shall be executed and supervised by suitably qualified staff. Only suitably qualified Artisans shall be permitted to carry out and supervise work. The Sub-Contractor shall provide proof of current Artisan qualifications and experience on request.

11.2 The Sub-Contractor shall at all times have an adequate number of employees, plant and equipment available during the construction period to ensure that the electrical work does not delay the construction programme.

12. COORDINATION OF SERVICES

The Main Contractor shall be responsible for the on site co-ordination of all the work on site. Due allowance shall be made for this continuous liaison and on-site co-ordination in the tender price.

13. FINISHING AND TIDYING

13.1 In view of the concentration of construction and other activities likely to be experienced during the Contract period, progressive and systematic finishing and tidying will form an essential part of this Subcontract. On no account will soil, rubble, materials, equipment or unfinished operations be allowed to accumulate in such a manner as to unnecessarily impede the activities of others. In the event of this occurring, the Client will have the right to withhold payment for as long as may be necessary in respect of the relevant Works in the area(s) concerned, without thereby prejudicing the rights of others to institute claims against the Sub-Contractor on the ground of unnecessary obstruction.

13.2 Finishing and tidying shall therefore not be left to the end of the Contract, but shall be a continuous operation.

14. SUPERVISION

Work shall at all times be subject to full time supervision by qualified and experienced Artisans. These representatives must be authorised and competent to receive instructions on behalf of the Sub-Contractor.

15. PROTECTION OF OTHER SERVICES AND STRUCTURES

15.1 The Sub-Contractor shall take all the necessary precautions to protect existing services, finishes and structures during the execution of the Contract, and shall be fully responsible for all repairs and damages thereto. The costs for any repairs of damages shall be recovered from the sub-contractor.

15.2 The Sub-Contractor shall also exercise extreme care when excavations are made, to avoid damage to existing or newly installed services. Any damages to other services shall be rectified forthwith and the costs for the rectification will therefore be recovered from the subcontractor.

16. SHOP DRAWINGS

A set of three (3) copies of all drawings must be submitted to the Engineer for approval before manufacture commences.

17. INSPECTIONS

17.1 The Engineer will inspect the installation at any time. All inferior, unsuitable, unacceptable or rejected work shall, if indicated by the inspecting officers, be removed and shall be rectified by the Sub-Sub-Contractor at his own expense. Under no circumstances will these inspections relieve the Sub-Contractor of his obligations in terms of the document nor will these inspections be regarded as final approval of the works or portions thereof.

17.2 Where inspections are requested by the Engineer, the Engineer's inspection shall only be carried out after the Sub-Contractor has carried out his own preliminary inspection to ensure that the works are completed and comply with the documents. The Engineer's inspection shall therefore not be regarded as supervision, fault listing, quality assurance or site management.

18. SITE TESTS AND COMMISSIONING

18.1 It is the responsibility of the Electrical Sub-Contractor to provide all labour, accessories and properly calibrated and certified measuring instruments necessary for all the tests required under this Contract.

18.2 Prior to beginning any aspect of commissioning, the Sub-Contractor shall present for the Engineer's review/approval, two copies of a complete commissioning procedures manual including checklists. The relevant checklists shall be utilised and formally signed off as part of the commissioning phase.

18.3 Preparation of commissioning report shall include, but not necessarily limited to:

18.3.1 Manufacturer's operating, servicing and maintenance manuals for each and every individual item of plant installed.

18.3.2 Inventory for the items of mechanical/electrical plant(s) and or equipment that shall be for installation in the project.

18.4 After submission of the test results, the Contractor shall notify that the installation is complete, tested and in working order. The Engineer will witness the re-testing of the installation.

19. AS-BUILT OPERATING AND MAINTENANCE MANUALS

19.1 The Contractor shall prepare as-built drawings for the complete installation and any other equipment installed as part of this Sub-Contract.

19.2 One copy of the Operating and Maintenance Manuals shall be submitted to the Engineer for approval at least one month prior to commissioning of the works.

19.3 Approved drawings and documents shall be bound in hard cover dossiers, fully indexed and shall not be limited to:

19.3.1 As-built drawings on compact disc

19.3.2 Word documents and spreadsheets containing Project information on computer compact discs in MS Word and MS Excel format

19.3.3 Test sheets and certificates, Guarantees and Warranties

19.3.4 Inspection reports, test reports, measurements and calibration reports where necessary, of all disciplines and work aspects

19.3.5 Three copies of each dossier and CD must be submitted

20. 12-MONTH DEFECTS LIABILITY PERIOD

20.1 The equipment and installation supplied under this Sub-Contract shall be guaranteed for a period of twelve months from date of completion of the whole project of the Contract Works. The tender price shall include for the above.

20.2 The defects liability will be for a period of twelve months, calculated from the date of issue of the Certificate of Completion of the whole of the contract works. Retention funds will be reduced to 5% (if applicable) upon the commencement of the defects liability period. The balance of the retention money will be paid out after the lapse of the defects liability, provided the installation has in the opinion of the Engineer been in satisfactory working order during this period.

PART B

SPECIFICATION FOR ELECTRICAL INSTALLATION

SECTION B6

INSTALLATION OF CABLES

This section covers the installation of cables for the distribution of power in buildings, other structures and in ground for system voltages up to 11 kV, 50 Hz.

1. GENERAL

1.1 Cable Types

(a) All cables and jointing and termination accessories used for power distribution shall comply with the Department of Public Work's (DPW) Quality Specifications, Section C.

(b) Cables with copper conductors shall be used throughout unless otherwise specified or approved.

(c) All un-armoured cables shall be installed in metal trunking, sleeves or conduit unless clearly specified to the contrary.

(d) XLPE Cables shall only be used in exceptional circumstances with the written permission of the Department.

1.2. Competence of Personnel

It is a definite requirement that the Contractor shall only employ personnel fully conversant with cable manufacturer's recommendations for joining and terminating cables.

2. IDENTIFICATION OF CABLES

2.1 Cables shall be identified at all terminations by means of punched metallic bands or marked with labels or tags. (Refer also to SANS 10142).

2.2 The use of PVC tape with punched characters is not acceptable.

2.3 The identification numbers of cables shall be shown on "as built" drawings of the Installation.

3. TRENCHING

3.1 General

3.1.1 The Contractor shall be responsible for all trenching excavations unless specified to the contrary.

3.1.2 The Contractor shall, before trenching commences, familiarise himself with the routes and site conditions and the procedure and order of doing the work shall be planned in conjunction with the general construction programme for other services and building requirements.

3.1.3 The Contractor shall acquaint himself with the position of all the existing services such as stormwater pipes, water mains, sewer mains, gas pipes. telephone cables, etc. before any

excavations are commenced. For this purpose he shall approach this Department's representative, the local municipal authority and any other authority which may be involved, in writing.

3.1.4 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.

3.1.5 The Contractor shall take all the necessary precautions and provide the necessary warning signs and/or lights to ensure that the public and/or employees on site are not endangered.
3.1.6 The Contractor shall ensure that the excavations will not endanger existing structures, roads, railways, other site constructions or other property.

3.2 Mechanical Excavators

3.2.1 Power driven mechanical excavators may be used for trenching operations provided that they are not used in close proximity to other plant, services or other installations likely to be damaged by the use of such machinery.

3.2.2 The use of power driven mechanical excavators shall be subject to the approval of the Department. Should the excavator produce trenches that exceed the required dimensions, payment based on volumetric excavation rates will be calculated on the required dimensions only.

3.3 Blasting

3.3.1 No guarantee is given or implied that blasting will not be required.

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

3.4 Routes

3.4.1 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 Department beforehand. Refer also to par. 10.4.

3.4.2 The Department 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.

3.4.3 The removal of obstructions along the cable routes shall be subject to the approval of the Department.

3.5 Shoring and Water-logging

3.5.1 The Contractor shall provide shoring for use in locations where there is a danger of the sides of the trench collapsing due to water-logging or other ground conditions. Refer to the Occupational Health and Safety Act (OHS).

3.5.2 The strength of shoring must be adequate for site conditions prevailing and the shoring must be braced across the trench.

3.5.3 The Contractor shall provide all pumps and equipment required to remove accumulated water

from trenches. Water or any other liquid removed shall be disposed of without any nuisance or hazard.

3.6 Trenching

3.6.1 Trenching shall be programmed in advance and the approved programme shall not be departed from except with the consent of the Department.

3.6.2 Trenches shall be as straight as possible and shall be excavated to the dimensions indicated in this specification.

3.6.3 The bottom of the trench shall be of smooth contour. and shall have no sharp dips or rises which may cause tensile forces in the cable during backfilling.

3.6.4 The excavated material shall be placed adjacent to each trench in such a manner as to prevent nuisance, interference or damage to adjacent drains, gateways, trenches, water furrows, other works, properties or traffic. Where this is not possible the excavated materials shall be removed from site and returned for backfilling on completion of cable laying.

3.6.5 Surplus material shall be removed from site and disposed of at the cost of the Contractor.

3.6.6 Trenches across roads, access ways or footpaths shall not be left open. If cables cannot be laid immediately the Contractor shall install temporary "bridges" or cover plates of sufficient strength to accommodate the traffic concerned.

3.6.7 In the event of damage to other services or structures during trenching operations the Contractor shall immediately notify the Department and institute repairs. (Refer to par. 3.1.3 and 3.1.4)

3.6.8 Prior to cable laying the trench shall be inspected thoroughly and all objects likely to cause damage to the cables either during or after laying shall be removed.

3.6.9 Where ground conditions are likely to reduce maximum current carrying capacities of cables or where the cables are likely to be subjected to chemical or other damage or electrolytic action, the Department shall be notified before installing the cables. The Department will advise on the course of action to be taken.

3.6.10 Extreme care shall be taken not to disturb surveyor's pegs. These pegs shall not be covered with excavated material. If the surveyor's pegs are disturbed, they shall be replaced by a person qualified to do so.

3.7 Dimensions of trenches

3.7.1 Cable trenches for one or two cables shall not be less than 300 mm wide and need not be more than 450 mm wide. This dimension shall be valid for the total trench depth.

3.7.2 The width shall be increased where more cables are installed to allow for the spacing stipulated in par. 4.2.

3.7.3 Where trenches change direction or where cable slack is to be accommodated. the Contractor shall ensure that the requirements of the relevant SABS/SANS Specification regarding the bending radii of cables are met when determining trench widths.

3.7.4 Trench depths shall be determined in accordance with cable laying depths and bedding thickness.

3.7.5 Payment will be made on a volumetric excavation rate calculated on the basis of the given maximum dimensions or the actual dimensions, whichever is the lesser. Refer also to par. 3.2.2 and 3.7.1 above.

3.8 Joint Holes

Where cable joints are required to be made in the course of a cable run, a joint hole shall be excavated of sufficient size to enable the cable jointer to work efficiently and unimpeded.

3.9 Bedding

3.9.1 The bottom of the trench shall be filled across the full width with a 75mm layer of suitable soil sifted through a 6mm mesh and levelled off.

3.9.2 Only sandy clay or loam soil with a satisfactory thermal resistivity (not exceeding 1.5°C m/W) may be used for this purpose. Sea or river sand, ash, chalk, peat, clinker or clayey soil shall not be used. The use of crusher sand is acceptable.

3.9.3 Where no suitable soil is available on site, the Contractor shall import fill from elsewhere and make all the necessary arrangements-to-do so. The cost of importing soil for bedding purposes shall be included in the unit rates for excavations.

3.9.4 After cable laying a further layer of bedding shall be provided to extend to 75 mm above the cables.

3.9.5 The bedding underjoints shall be fully consolidated to prevent subsequent settling.

3.10 Cable Sleeves

3.10.1 Where cables cross under roads, railway tracks, other service areas, etc. and where cables enter buildings, the cables shall be installed in Polyethylene (HDPE) (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 the pipe and the sheathing or outer serving of the cables.

3.10.2 Pipes shall be joined in accordance with the manufacturer's instructions.

3.10.3 Sleeves shall cross roads and railway tracks at right angles.

3.10.4 Sleeves shall have a minimum diameter of 100mm. They shall extend at least 2m beyond the tracks of a railway line or of the outermost tracks where there is more than one line. In the case of roads, the sleeves shall extend at least 2m beyond the road edge or kerb on both sides of the road.

3.10.5 All sleeves shall be graded 1:400 for water drainage.

3.10.6 Cable sleeves shall be installed to the spacing and depths stated in paragraph 4 below.

3.10.7 Galvanised metallic sleeves up to and including 76mm dia. shall be supplied and installed by the contractor.

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

3.11 Backfilling

3.11.1 The Contractor shall not commence with the backfilling of trenches without prior notification to the Department 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. Such an inspection will not be unreasonably delayed.

3.11.2 For high voltage cables (1 kV to 11 kV) a coloured plastic marking tape shall be installed 400 mm above the cable. The tape shall be yellow, marked with the words "ELECTRIC CABLE/ELEKTRIESE KABEL" in red. These markings shall not be more than 1m apart from centre to centre.

3.11.3 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.

3.11.4 The Contractor shall have allowed in his tender for the importation of suitable backfill material if required.

3.11.5 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.

3.11.6 On completion, the surface shall be made good to match the surrounding area.

3.11.7 In the case of roadways or paved areas the excavations shall be consolidated to the original density of the surrounding material and the surface finish reinstated.

3.12 Cable Markers (for HV cables only, except where otherwise specified)

3.12.1 Cable markers shall be provided along all HV cable routes but need only be provided along LV cable routes where specified.

3.12.2 Cable markers shall consist of concrete blocks in the shape of truncated pyramids, approx. 300mm high, 150 x 150mm at the top and 250 x 250mm at the bottom.

3.12.3 Brass plates shall be cast into the tops of the blocks in such a manner that they cannot be prised loose. The wording "ELECTRIC CABLE/ELEKTRIESE KABEL" shall be stamped on the brass plates as well as direction arrows and the cable voltage rating.

3.12.4 Cable markers shall be installed on the surface along all the underground routes and shall project 35 mm above normal ground level unless the projected markers could be a hazard to pedestrian or other traffic in which case they shall be installed flush with the surface.

3.12.5 Cable markers shall be installed at the beginning and end of a cable run (e.g. where a cable enters a substation or building), at all changes of direction, above all joints, above cable pipe entries and exits and at intervals not exceeding 50 m along the cable route.

3.12.6 The position of cable markers shall be indicated on the "as built" drawings.

3.13 TRANSNET, Provincial Administration or National Road Crossings

3.13.1 The Contractor shall not trench beneath any railway tracks without the TRANSNET Administration's supervision. The Contractor shall request the Department timeously to arrange for the necessary supervision. The cost of such supervision will be paid for by the Department.

3.13.2 The Department will arrange for the necessary wayleave and permission to cross TRANSNET property and railway tracks, or Provincial or National road reserves and TELKOM Authority approval of proposed cable routes.

3.13.3 The Contractor shall carry out the crossing installation in strict accordance with the TRANSNET and Provincial Administration's requirements and stipulations. Where these requirements are in contradiction with this specification, the Department's ruling shall be sought.

3.13.4 The Contractor shall ensure that he will comply with the various Administration's requirements regarding crossing of Provincial and National roads, especially with regard to the safeguarding of the public. The Contractor shall also provide proof of adequate insurance cover against any claim from any accident as a result of work done by the Contractor during the crossing operation. The Department shall also be indemnified from all liability in this regard.

3.13.5 The Contractor shall liaise with the various Administrations well in advance regarding the intended dates, times and expected duration of the crossing operations and obtain their approval of the programme and method of operation before commencing with the work.

4. INSTALLATION OF UNDERGROUND CABLES

4.1 Installation Depths

4.1.1 Cables shall be installed at the following minimum depths below final ground level:

Up to 11kV: 800mm

4.1.2 All cable depth measurements shall be made to the top of the cable when laid directly in ground or the top of the duct or sleeve where these are provided.

4.1.3 The above depths shall apply to the top layer where cables are installed in layers.

4.1.4 The Contractor may only deviate from the above depths provided prior authority in writing has been obtained from the Department. In this event the cables shall be protected with a suitable concrete covering.

4.1.5 The depth of cable pipes or ducts beneath railway lines or roads shall be not less than 1.1m below the formation level.

4.2 Cable Spacing

4.2.1 Cables installed in the same trench shall be laid parallel to each other with the following spacing between cables (LV: up to 1 kV; HV: 1 kV to 11kV):
LV/LV 2 cable diameters
LV/HV 150mm minimum

HV/HV 150mm minimum
LV/HV/PILOT I cable diameter

4.2.2 Where HV and LV cables have to be installed in the same trench, both shall be laid at a depth of 800 mm and then covered with 200mm of soil. The soil shall then be compacted, and then backfilled layer by layer and compacted until the trench is completely backfilled.

4.2.3 Cables for telephones, communication systems and other low voltage systems (less than 50 V) shall be separated from power cables by at least 1m. All control or pilot cables without a lead sheath and steel armouring shall be laid at least 300mm from power cables.

4.2.4 Cables shall not be buried on top of each other unless layers are specified. The minimum spacing between layers shall be 200mm.

4.3 Cable Laying

4.3.1 Except where ducts, tunnels or pipes are provided, cables shall be laid directly in the ground.

4.3.2 The cable shall be removed from the drum in such a manner that the cable is not subjected to twisting or tension exceeding that stipulated by the cable manufacturer.

4.3.3 Cable rollers shall be used as far as possible to run out cables. Rollers shall be spaced so that the length of cable in the trench will be totally suspended during the laying operation and sufficiently close to prevent undue sagging and the cable from touching the ground. Rollers shall also be placed in the trench in such a manner that they will not readily capsize.

4.3.4 Cable rollers shall have no sharp projecting parts liable to damage the cables.

4.3.5 Where cables have to be drawn around corners, well-lubricated skid plates shall be used. The skid plates shall be securely fixed between rollers and shall constantly be examined during cable laying operations.

4.3.6 Where cables have to be drawn through pipes or ducts, a suitable cable sock shall be used and particular care shall be exercised to avoid abrasion, elongation or distortion of any kind. In the case of oil filled cables, a cable sock may never be used. Special eyes giving access to the interior of the cable must be utilised.

4.3.7 The maximum allowable tension when pulling a cable is 70 N/mm2 of conductor area.

4.3.8 It will be assumed that the price or rates contained in the tender includes for the installation of cables in pipes and ducts or below existing or newly installed services.

4.3.9 The Department shall-be informed timeously of the intention to carry out all cable laying operations to allow an inspection of the works by the Department if so required.

5. INSTALLATION OF CABLES IN CONCRETE TRENCHES

5.1 General

This paragraph covers the installation of cables in building trenches, service ducts) etc.

5.2 Installation

Cables shall be in stalled in one of the following ways:
(a) On horizontal cable trays.
(b) On horizontal metal supports with suitable clamps.
(c) On vertical cable trays or metal supports fixed to the side of the trench. The cables shall be clamped in position.

Cables shall not be bunched and laid on the floor of the building trenches.

5.3 Covers

5.3.1 The covering of concrete trenches shall as a rule fall outside the scope of the electrical installation. The Contractor shall however be responsible for the cutting or drilling and smoothing of holes for cables through chequer plates, concrete or other coverings as required.

5.3.2 Cables shall enter and exit the trench through sleeves protruding 300mm beyond the covering. The sleeves shall be permanently secured in position and the open space between the cable and sleeves shall be sealed with a non-hardening, watertight compound.

5.4 Filled trenches

5.4.1 Where specified, floor trenches shall be filled with fine crusher sand (no river or sea sand).

5.4.2 If a sand filling is specified, the cables shall be fixed to non-corroding supports.

5.4.3 Sand-filled trenches other than in substations shall be covered in one of the following ways:

(a) Reinforced concrete covers.
(b) Sand and cement screed.
(c) Removable chequer plates.

5.4.4 Method (a) above shall be used where vehicular traffic may be encountered over trenches. Unless otherwise specified allowance for a mass of 2 tons shall be made.

5.4.5 Cable trenches in substations, switch rooms and generator rooms shall be covered in accordance with the Department's standard specification for "COVERING AND SEALING OF CABLE TRENCHES", Par. 9 of Section B13.

6. FIXING OF CABLES TO TRAYS OR STRUCTURES

6.1 Installation

Cables may be installed in one of the following ways:

(a) Or horizontal cable trays.
(b) Against vertical cable trays with suitable clamps.
(c) Against horizontal or vertical metal supports or brackets with suitable clamps.
(d) On clamps which are fixed to the structure.

6.2 Clamps

Suitable clamps (cleats) which will secure cables without damage shall be used. Metal clamps or drilled hard wood blocks shall be used. Clamps shall consist of adjustable metal wings which

clamp to a metal support, or consist of two halves that are bolted together. The correct clamp size to fit the cable shall be used. Cables of different sizes may only be fixed by a common clamp when the clamp is specially made to accommodate the various cables.

6.3 Spacing of Supports

Two methods of supporting cables are found in practice. The most generally known method is the restrained installation where the distance between supports is small enough to prevent any noticeable sag in the cable. The alternative method is the unrestrained installation where the distance between supports should be great enough to ensure that there will be obvious sag in each span between supports.

6.4 Spacing of Supports of Unrestrained Cables

Large single core cables shall always be installed according to this method. Generally, single core cables with conductors exceeding a cross sectional area of 185mm2 should be supported at spacing in excess of 2m since the sag between supports will safely accommodate any thermal expansion. Reducing the spacing between the supports to 1.5m or less shall be avoided at all costs, as expansion cannot be taken up by a change of sag and chances of sheath failure become considerable.

6.5 Spacing of Supports of Restrained Cables

Additional cleats shall be installed at each bend or offset in the cable run. The maximum distance between supports or cleats for multi-core control cables shall be 20 times the outside diameter of the cable with a maximum spacing of 550mm for un-armoured cables and 30 times the outside diameter of the cable with a maximum spacing of 900mm for armoured cables. Spacing of supports for cables for high voltage lighting shall be in accordance with Table 8 of SANS 10142. A minimum of 20mm ventilation clearance shall be maintained between cables and the wall to which they are cleated.

7. GROUPING AND SPACING OF CABLES IN BUILDINGS AND STRUCTURES

7.1 Spacing correction factors

Cables shall as a rule be spaced two cable diameters apart, for which no grouping correction factor need be applied.

7.2 Cables on Different Levels

Where parallel cable runs are installed at different levels (e.g. on parallel cable trays) and where the spacing of the layers is not specified, a minimum spacing of 300mm shall be maintained.

7.3 Single Core Cables

Where single core cables are installed along a three-phase circuit, the cables shall be installed in trefoil formation and bound together at 300mm intervals.

7.4 High Voltage Cables

High voltage cables shall be separated from other cables and services throughout the installation and shall as far as possible be installed in separate floor trenches, pipes or metal channels. Where this is not feasible a minimum spacing of 500 mm shall be maintained.

7.5 Cables for Other Services

Cables for telephones, communication systems and other low voltage systems (less than 50 V) shall be separated from power cables. In building ducts a physical barrier shall be provided between power cables and cables for other services. Where armoured cables are used for such other services, they shall be installed on separate cable trays or shall otherwise be at least 1m away from power cables. Where un-armoured cables are used for these other services, they shall be installed in separate conduits or metal channels.

Cross-Sectional Area of Cable Conductors (mm^2)	MAXIMUM SPACING OF SUPPORTS (CLEATS) (mm) FOR RESTRAINED CABLES			
	Wire Armoured Cables		Other than Wire Armoured Cables and Unarmoured Cables	
	Horizontal Cable Routes	Vertical Cable Routes	Horizontal Cable Routes	Vertical Cable Routes
1,5	450	750	300	400
2,5	450	750	300	400
4,0	600	750	300	400
6,0	600	750	300	400
10,0	750	900	400	450
16,0	750	1000	400	550
25,0	900	1000	450	550
35,0	900	1000	450	550
Bigger than 35,0	900	1000	450	550

For larger cables the spacing shall be 10 x outside diameter of the cable.

8. TERMINATION AND JOINTING OF CABLES

8.1 General

8.1.1 Cable ends shall be terminated with glands or in cable boxes with the associated accessories such as clamps, shrouds, etc. complying in all respects with the Department's quality specifications, Section C.

8.1.2 Connection of cables to switchgear shall always be effected in such a way that the various phases, seen from the front of the switchgear will be in the following positions:

No. 1 conductor: left (red) (A)
No. 2 conductor: centre (white) (B)
No. 3 conductor: right (blue) (C)

8.1.3 Exposed armouring shall be covered with bitumen-base paint.

8.1.4 All cable ends shall be supplied with the necessary earth connection.

8.1.5 A channel or other approved means of support shall be provided to remove mechanical stress from the glands.

8.1.6 Cable cores shall be marked with heat-shrunk sleeves where necessary to identify the phases. Refer to SANS 10142.

8.1.7 The current-carrying capacity and breakdown voltage of the cable end shall be the same as for the complete cable.

8.1.8 Cables shall be terminated in accordance with the recommendations laid down by the manufacturers of the cables and glands employed.

8.2 Termination of Paper-Insulated Cables

8.2.1 The ends shall be terminated in cable end boxes filled with bituminous, cold filling or resin oil semi-fluid compound or heat-shrinkable terminations in accordance with the Department's standard specification for "CABLE END BOXES AND COMPOUND", Section C8 or "CABLE TERMINATIONS AND JOINTS", Section C6.

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

8.2.3 Before terminating or jointing paper-insulated cables, a test to establish the presence of moisture must be carried out.
The following procedure may be followed:

(a) Place an adequate quantity of cable impregnating oil in a suitable container and heat up to 130 C ±5 C.

(b) Cut a small length (± 300mm) of the cable concerned and remove the armouring and sheath, taking care not to handle the dielectric in any way.

(c) Dip a section of the outer insulating impregnated paper (belt paper) in the heated oil, taking care not to contaminate the tapes with moisture from the hands. If frothing appears on the surface of the oil, this is a clear indication of the presence of moisture in the paper.

(d) The same procedure should then be repeated on the insulating impregnated paper around the conductors (especially those layers closest to the conductors). Frothing will also indicate the presence of moisture.

(e) Should only a small number of bubbles appear on the surface of the oil, this is an indication of air bubbles on the paper and not moisture since the presence of moisture will result in a series of bubbles rising to the surface of the oil for a number of seconds, until all moisture has been removed.

8.2.4 The armouring shall be bonded to the main earth bar of the switchgear or transformer, but the bond shall be easily removable for testing purposes.

8.2.5 The lead sheath shall be wiped against the conical wiping gland

8.2.6 All cut cable ends which will be exposed to the atmosphere for more than two hours shall be sealed and wiped to prevent penetration of moisture.

8.3 Termination of XLPE Cables

8.3.1 These cables shall only be used in exceptional circumstances and only with the written permission of the Department.

8.3.2 Cross-linked polyethylene cables (XLPE) shall be terminated in accordance with the Department's standard specification for "CABLE TERMINATIONS AND JOINTS", Section C6 unless a pre-fabricated system based on pre-moulded slip-on EPR stress cones is used.

8.3.3 The copper tapes of the earth screen on the cable shall be bonded to the main earth bar of the switchgear or transformer, but the-bond-shall be easily removable for testing purposes.

8.3.4 The cable shall be firmly secured on the switchgear by means of a clamp to prevent mechanical stress on the cable and terminations.

8.4 Termination of PVC-insulated Cables

8.4.1 Cable ends shall be terminated by means of adjustable glands in accordance with the Department's standard specification for "GLANDS FOR PVC-INSULATED CABLES", Section C5.

8.4.2 The glands shall be fitted in accordance with the cable and gland manufacturer's instructions.

8.4.3 The correct size and type of gland shall be used for the particular cable and application.

8.5 Connection of Cable Conductors

8.5.1 Suitable lugs shall be used, preferably solidly sweated to the cable conductor ends. Lugs may be crimped, using mechanical or pneumatic tools designed for this purpose, on condition that evidence is submitted that the method used complies with the performance requirements of BS 4579, Part 1: "COMPRESSION JOINTS IN COPPER".

8.5.2 Contact surfaces shall be thoroughly cleaned and smoothed and fixing bolts shall match the hole size of the lug.

8.5.3 Cables that are connected to clamp type terminals where the clamping screws are not in direct contact with the conductor need not be lugged but the correct terminal size shall be used.

8.5.4 Ferrules shall be used as far as possible where cable conductors are connected directly to equipment with screws against the conductor strands.

8.5.5 When cutting away insulation from cable conductors to fit into tugs, care shall be taken that no strands are left exposed. Under no circumstances may any of the conductor strands be cut away to fit into tugs.

8.6 Joints

8.6.1 Joints in cable runs will not be allowed unless specified in the Detailed Technical Specification or authorised by the Department.

8.6.2 Jointing shall be carried out strictly in accordance with the manufacturer's instructions and by personnel competent in jointing the types of cables used.

8.6.3 During outdoor jointing operations, the joint bays shall be adequately covered by tents of

waterproof material suitably supported. Where necessary a trench shall be excavated around the bay to prevent the ingress of moisture. The sides of the hole shall be draped with small tarpaulin or plastic sheeting to prevent loose earth from falling in during jointing operations.

8.6.4 The joint shall not impair the anti-electrolysis characteristics of the cable.

8.6.5 The Contractor shall notify the Department timeously of the day on which jointing is to be carried out in order that an inspection may be arranged if so required. Any cable joint not inspected by the Department because of insufficient notice being given, shall be opened for inspection and redone at the discretion of the Department at the cost of the contractor.

8.6.6 HV cable joints on paper insulated cables shall be of the compound cast type and the compound used shall comply with the Department's standard specification for "CABLE END BOX FILLING COMPOUND", par. 2 of Section C8.

8.6.7 HV cable joints on XLPE-insulated cables shall be of the heat shrinkable type and shall comply with- the Department's standard specification for "CABLE TERMINATIONS ANEL JOINTS Section C6, or shall be based on a prefabricated system utilising pre-moulded slip-on stress cones.

8.6.8 LV cable joints shall be of the epoxy-resin type.

8.6.9 Joints shall be fully water and air tight and shall be free of voids and air pockets.

8.6.10 The crossing of cores in joints will not be permitted under any circumstances.

9. TESTING

9.1 Each cable shall be tested after installation in accordance SABS 150 (up to 1 kV) and SANS 97 (up to 11 kV) as well as the requirements of the Local and Supply Authorities.

9.2 LV Cables shall be tested by means of a suitable megger at 1 kV and the insulation resistance shall be tabulated and certified.

TABLE B6.2

Cable Rating (kV)	TEST VOLTAGE (Applied for 15 minutes) (kV)				
	Paper-insulated cables				XLPE-insulated cables
6,6 11	Between conductors		Conductors to sheath		Conductors to screen
	AC (r.m.s)	DC	AC (r.m.s)	DC	DC
	12 20	18 30	12 20	18 30	11 18

* High Voltage test with DC to 2kV for 1 minute only. Discharge cable slowly via discharge stick (1 minute). Clamp all conductors to earth for 24 hours.

9.3 HV Cables shall be high voltage tested in accordance with Table B6.2 and the exact leakage current shall be tabulated and certified.

9.4 The Contractor shall make all arrangements, pay all fees and provide all equipment for these tests. The cost of testing shall have been included in the tender price.

9.5 The Contractor shall notify the Department timeously so that a representative of the Department may witness the tests.

9.6 On completion of the tests on any cable, the Contractor shall without delay, submit three copies of the certified Test Reports to the Department.

10. MEASUREMENTS

10.1 All measurements for payments shall be made jointly by the representatives of the Department and the Contractor and the Contractor shall obtain the signature of the Department's representative including approval of such measurements.

10.2 No allowance shall be made for the breaking away of the trench sides, other earth movements or for trenches excavated in excess of the stipulated dimensions. Refer also to par. 3.7.5 above.

10.3 The classification-shall be-as follows:
Very hard rock shall mean rock that can only be excavated by means of explosives.

Hard rock shall mean granite, quartzitic sandstone, slate and rock of similar or greater hardness, solid shale and boulders in general requiring the use of jack hammers and other mechanical means of excavations.

Soft rock and earth shall mean rock and earth that can be loosened and removed by hand-pick and shovel.

10.4 Where very hard rock and hard rock are encountered, the prior approval of the Department shall be obtained before proceeding with the excavation. This requirement is stipulated in order to afford the Department the opportunity to determine whether an alternative cable route is justified.

10.5 All cable lengths indicated in the Detail Technical Specification and/or shown in the cable route drawings shall be regarded as estimates and are given for tendering purposes only. The successful Tenderer shall measure actual cable lengths on site before ordering.

10.6 The final price for the supply and installation of all cables will be adjusted, on the basis of the actual lengths of installed cables, in accordance with the unit rates quoted at the time of tendering. Cable lengths shall be measured on site to the nearest 500mm for this purpose and surplus cable will not be paid for.

11. COMPLETION

11.1 The Department reserves the right to inspect the installation at any stage during the course of construction. Such inspections will however not deem the portions inspected as being complete or accepted and the Contractor shall remain responsible for completing the installation fully in accordance with the Contract Documents.

11.2 The Contractor shall carry out a final "as built" survey of the cable routes and present to the Department "as built" route plans of the complete installation. The following information shall be reflected on the plans or submitted as separate schedules with the plans:

(a) Overall length of each cable.
(b) Locations of all joints (if any) in relation to permanent reference points. Dimensions shall be shown and the method of triangulation i.e. two dimensions to each joint. shall be used.
(c) Identification of each cable.

11.3 The works will be deemed to be incomplete until all tests have been conducted successfully and all "as built" drawings and schedules have been handed to the Department.

SECTION B7

INSTALLATION OF LIGHT SWITCHES AND SOCKET-OUTLETS

1. GENERAL

1.1 Standards

Light switches and socket-outlets shall comply with the Department's quality specification for "LIGHT SWITCHES", Section C10 and UNSWITCHED AND SWITCHED SOCKET-OUTLETS", Section C11. Surface or flush mounted boxes and cover plates, complying with the Department's quality specification for "CONDUIT AND CONDUIT ACCESSORIES", Section C 1, shall be provided.

1.2 Position of Outlets

Switches and socket-outlets shall be accurately positioned in accordance with the drawings. It is the Contractor's responsibility to ensure that all outlets are installed level and square, at the correct height from the floor and at the correct position relative to building lines and equipment positions as specified. It is the Contractor's responsibility to determine the correct final floor level and ceiling level in conjunction with the Main Contractor.

1.3 Cover Plates

All switches and socket-outlets shall be fitted with standard metal cover plates. The colour of cover plates shall be as specified or shall otherwise match the surrounding finishes as closely as possible. Unless specified to the contrary, ivory cover plates shall be installed on painted walls. Cover plates in the same area shall have the same colour. Flush mounted cover plates shall overlap the draw-box and edges of the recess. Cover plates shall under no circumstances be cut unless authorised by the Department.

1.4 Escutcheon Plates

Where flush mounted switches or socket-outlets are installed in special wall finishes e.g. wood or board panels, acoustic tiles or other cladding, etc. and where the wall finishes must be cut to accommodate the switch, it may be necessary to fix an escutcheon plate to the wall to cover the cut-outs. The escutcheon plate shall fit closely around the outlet boxes and shall be fixed independently of the boxes and cover plates. Bevelled cover plates shall be fixed to the outlet boxes and shall fit firmly against the escutcheon plate.

1.5 Appearance

The sides of adjacent switches, plugs, push-buttons etc. shall be parallel or perpendicular to each other and uniformly spaced. A common escutcheon plate shall be placed around flush mounted outlets and accessories where the standard cover-plates do not cover the cut-outs in the finishes.

1.6 Deep Boxes

Where switch or socket-outlet boxes have been set deep. spiral type steel wire spacers shall be used to fix the yoke of the switch or socket.

2. INSTALLATION OF SOCKET-OUTLETS

2.1 Mounting Height

Unless specified to the contrary, socket-outlets shall be installed at the following heights above finished floor level, measured to the centre of the outlet:

Flush mounted in general: 300mm
Domestic kitchens, tea kitchens: 1,05m
Commercial kitchens: 1,4m
Factories, workshops, garages: 1,4m

2.2 Walls

In cases where socket-outlets must be mounted at a nominal height of 300mm and where the lower portion of the wall consists of face bricks and the upper portion is plastered, the outlets shall be installed in the plastered portion of the wall. If however the plastered portion of the wall commences 500mm or more above floor level the outlets shall be installed in the face bricks. Where a wall has different surface finishes the outlets shall be installed within the same finish and not in the dividing lines between the different wall finishes. All outlets shall be installed at least 150mm away from door frames.

3. INSTALLATION OF LIGHT SWITCHES

3.1 Mounting

Light switches shall be installed 1,4m above finished floor level unless specified to the contrary. Mounting heights given shall be measured from the finished floor level to the centre of the switch. All single switches shall be installed with the long side of the toggle vertical.

3.2 Doors

Unless specified to the contrary, switches adjacent to doors shall be installed on the side containing the lock. If the position of the lock is not shown on the drawings, the position shall be verified before the switch-box is installed. Switch boxes in brick or concrete walls shall be installed 150mm from the door frame. Light switches installed in partitions or door frames shall be of the type designed for that purpose.

3.3 Walls

Where the lower portion of a wall is face brick and the upper portion plastered, light switches shall be installed wholly in the plaster provided that the lower edge of the plaster is not higher than 1 ,6m above the finished floor level. In general where different wall finishes are used in the same area, switches shall be installed within the same finish and not on the dividing lines between finishes.

3.4 Partitions

Light switches installed in partitions shall preferably be of the type designed to be accommodated in the partition construction. Switches installed in the metal supports do not require switch boxes. Switches may not be flush mounted in partition walls without switch boxes.

3.5 Watertight Switches

Switches that are exposed to the weather or are installed in damp areas shall be of the watertight type complying with the Department's quality specification for "WATERTIGHT SWITCHES", par. 3 of Section C10.

3.6 Multiple Switches

Where several switches are required in one position, multi-lever switches in a common switch box shall be provided wherever possible. All circuits wired into this box shall be on the same phase in order that voltages in excess of 250 V are not present in the box. Where it is not possible or practical to do this, barriers shall be installed and a label shall be prominently displayed within the box stating that voltages in excess of 250 V are present.

SECTION B8

PHOTO-ELECTRIC DAYLIGHT SENSITIVE SWITCH FOR OUTSIDE LIGHTING

1. INSTALLATION

1.1 The outside lighting of each individual building i.e. light circuits marked "T' on the drawings, shall be controlled by photo-electric daylight sensitive switches.

1.2 The positions of the switches as indicated on the drawings are provisional and the exact positions shall be confirmed with the representative of the Department on site.

1.3 Individual outside lighting circuits on a building may be connected directly to the daylight sensitive switch.

1.4 Where two or more lighting circuits are to be controlled by a single daylight sensitive switch, a contactor actuated by the unit shall be provided in the switchboard.

1.5 A by-pass switch enabling the lights to be turned on at any time shall be provided.

1.6 Standard control circuits are indicated in fig. B8.1 and B8.2.

2. CONSTRUCTION

2.1 The unit shall comprise a photo cell, thermal actuator and change-over switch. The cover of the unit shall be manufactured from a tough, durable material providing protection against tampering. The cover shall have good weathering properties. It shall be ultraviolet-resistant and shall not deteriorate when exposed to sunlight for prolonged periods.

2.2 The unit shall be of the wall mounting type and shall be supplied complete with a suitable bracket.

2.3 The operational level shall be factory preset for "ON' at a light level of approximately 54 lux and "OFF" at approximately 108 lux. Voltage variations shall not materially affect the operational levels.

2.4 A time delay of not less than 15 seconds shall be provided to prevent the unit from functioning due to short period changes in illumination.

2.5 The unit shall be effectively safeguarded against voltage surges by means of a suitable surge protector which shall preferably form an integral part of the unit.

SECTION B9

INSTALLATION OF LUMINAIRES

1. POSITIONS

The mounting positions of luminaires shall be verified on site. All luminaires shall be placed symmetrically with respect to ceiling panels, battens, beams, columns or other architectural features of the space unless otherwise indicated. The layout as shown in the Documents shall generally be adhered to but any discrepancies or clashes with structural or other features must be referred to the Department, before commencing erection of the installation.

2. COVER PLATES

Cover plates shall be fitted over all draw-boxes and outlets intended for luminaires that are not covered by the luminaire canopy, lamp-holder, ceiling rose or similar accessories.

3. FIXING TO DRAW-BOXES

Where an outlet box or draw-box provides the necessary support for a luminaire, all luminaires with the exception of fluorescent luminaires mounted against ceilings, shall be fixed directly to the box. Fluorescent luminaires and luminaires with a mass in excess of 10kg shall however be suspended independently of the outlet box.

4. HANGERS AND SUPPORTS

Where provision has not been made for the fixing of luminaires, the Contractor shall supply the necessary supports, hangers, conduit extensions, angle brackets or any other fixing method approved by the Department.

5. SUSPENDED LUMINAIRES

The necessary hangers shall be provided where luminaires which are of the non-suspension type have to be fixed below false ceilings or roof slabs. The use of 20mm conduits fixed to the roof slab or ceiling is preferred. Provision shall be made for adjustments to enable the levelling of luminaires. Suspended conduits shall be fixed to the ceiling by means of screwed dome lids, bolts and nuts. Ball-and-spigot type domelids shall be used where conduit lengths exceed 600mm. Wiring shall be installed in the conduit hangers.

6. SUSPENDED WIRING CHANNELS

Luminaires (especially fluorescent luminaires) may also be suspended from ceilings by means of suspended metal channels. The metal channel may be supported by conduits or threaded rods. Should metal rods be utilised, these shall be screwed to anchor bolts fixed in the roof slab. Wiring shall either be installed in conduits fixed to the metal channel or in the metal channels and covered with a suitable cover plate. Purpose-made clamps shall be used to fix the luminaires to the cable channel.

7. CEILING BATTENS

Where wooden blocks are used to suspend luminaires. ceiling battens shall not be cut. The wooden blocks shall be cut to fit around battens and shall be screwed to the ceiling. Battens may however be cut where fluorescent or incandescent luminaires with metal canopies have to be installed against a false ceiling.

8. GLASS-BOWL LUMINAIRES

Unless specified to the contrary, suspended glass-bowl luminaires shall be installed with the underside at least 2.1m above finished floor level.

9. FLUORESCENT LUMINAIRES FIXED TO CONCRETE SLABS

Fluorescent luminaires to be installed directly against concrete slabs or walls shall be securely fixed to the outlet box and at two additional points. Shot-fired fixings are not acceptable. Where approved, fluorescent luminaires may be installed against metal wiring channels in which the wiring is housed. The channel fixing may in this case be shot-fired. Purpose-made fluorescent fixing adaptors shall be used to fix luminaires to cable channels.

10. FLUORESCENT LUMINAIRES FIXED TO CEILINGS

10.1 In all cases where luminaires are fixed to false ceilings, the Contractor shall ensure that the ceiling is capable of carrying the weight of the luminaires before commencing installation. Should any doubt exist in this regard, the matter shall be referred to the Department.

10.2 In cases where the weight of the luminaire is not carried by the ceiling but by a support or other suspension method, provision shall be made to prevent relative movement between the ceiling and luminaire, ceiling rose or connection point.

10.3 Surface mounted fluorescent luminaires shall fit firmly against the ceiling brandering without leaving gaps between luminaire and ceiling. The luminaire shall be fixed directly to the ceiling by means of brass plated round-head wood screws and washers.

10.4 In the case of tiled ceilings with exposed or concealed T-section supports, surface mounted luminaires shall be fixed only to the tiles by means of butterfly screws or bolts with nuts and washers. The tiles shall be suitably reinforced.

10.5 Luminaires may alternatively be fixed to metal cross-pieces resting in the ceiling tees.

10.6 Drilling of holes in ceiling tees to support luminaires will not be allowed.

10.7 Luminaires shall be fixed in neat relation to the ceiling lay-out.

11. CONTINUOUS ROWS OF LUMINAIRES

In cases where fluorescent luminaires are installed in tandem, only one connection outlet need be supplied per circuit. All luminaires shall be coupled to one another by means of nipples or brass bushes and locknuts to ensure that wiring is not exposed and that earth continuity is maintained. Luminaires on the same circuit may be wired through the channel formed by the luminaire bodies. In this case silicon-rubber insulated conductors shall be used and internal connections shall be

made at porcelain terminal blocks. "SCREW-IT" or similar connectors may only be used if prior permission is obtained from the Department. The wiring for any other circuits or outlets, even though these may be in the same row, may not be installed through the luminaire bodies. The Contractor shall ensure that continuous rows are straight and parallel to the relevant building lines.

12. RECESSED LUMINAIRES

12.1 Where recessed luminaires are specified, the Contractor shall maintain close liaison with the ceiling Contractor. In the case of tiled ceilings, the luminaires shall preferably be installed while the metal supports are being installed and before the tiles are placed in position. The Electrical Contractor shall be responsible for the co-ordination of the cutting of ceiling tiles with the other contractors concerned.

12.2 All mounting rings and other accessories shall fit closely into cut-outs to ensure a proper finish.

12.3 In all false ceilings where wiring channels are used, recessed luminaires shall be connected to the wiring channels by means of un-switched 5A socket-outlets.

12.4 The following requirements shall be adhered to:

(a) Socket-outlets used shall comply with the Department's quality specification for "UNSWITCHED-AND-SWTGHED SOCKET-OUTLETS", par. 4 of Section 11 and shall be of 5A minimum rating.

(b) The connector cord attached to the luminaire may not exceed 3m in length and shall consist of 1,5mm2 minimum, 3-core, PVC-insulated flexible cord.

(c) The 5A socket-outlets shall be positioned such that they are not more than 600mm above the false ceiling.

13. SPECIAL CEILINGS

In cases where special ceilings e.g. aluminium strips, decorative glass, metal leaves, etc. are to be installed, the Contractor and the Manufacturer of the ceiling shall agree upon the method of fixing of luminaires in the ceiling.

14. BULKHEAD LUMINAIRES

Surface mounted bulkhead luminaires shall not be screwed directly to conduit ends. The conduit shall terminate in a round draw-box at the top or rear of the luminaire. The PVC- insulated conductors shall terminate in a porcelain terminal strip in the draw-box. Silicon- rubber-insulated conductors shall be installed from the terminal strip to the luminaire lamp- holder. "SCREW-IT" or similar connectors may only be used if prior permission is obtained from the Department.

15. TYPE OF CONDUCTOR

PVC-insulated conductors, unless protected by an approved heat-resistant sheathing, shall not be used where the temperature of the insulation is likely to exceed 70°C. In unventilated luminaires or luminaires capable of housing incandescent lamps over 60W, the interconnecting wiring from the lamp-holder to the circuit wiring shall consist of silicon-rubber insulated conductors. Silicon-rubber insulated conductors shall be used exclusively in the case of high bay fillings. Refer also to the provisions of SABS 0142.

16. WIRING OF LAMPHOLDERS

The central terminal of Edison Screw (E.S.-type) LAMP-HOLDERS shall be connected to the phase conductor and the screwed housing to the neutral conductor.

17. HIGH BAY LUMINAIRES

17.1 High bay luminaires shall be securely suspended from the roof structure.

17.2 The luminaires may be fixed to suspended wiring channels containing the wiring on condition that:

(a) Rigid channels with a maximum width of 42 mm be used.
(b) the channels are supported at intervals that will prevent sag or warp and
(c) the channels are large enough to accommodate the wiring.

17.3 Luminaires may be suspended from metal roof trusses with the aid of "CADDY" or similar fasteners.

17.4 Luminaires shall preferably be connected to un-switched 5A socket outlets. Silicon-rubber insulated flexible cord shall be used exclusively to connect the luminaire to the outlet.

17.5 A safety chain to keep the luminaire from falling when loosened shall be provided.

SECTION BI0

CONNECTIONS TO EQUIPMENT

1. GENERAL

This section covers the final electrical connections to switchboards and various equipment in general electrical installations under normal environmental conditions for system voltages up to 600 V. Refer also to the Department's standard specifications for "WIRING", Section B5 and "INSTALLATION OF CABLES", Section B6.

2. CONNECTIONS TO SWITCHBOARDS

2.1 Conduit Entries

2.1.1 Where sufficient space for conduit entries as well as adequate space for future conduit entries is available. conduits may be terminated directly on the switchboard.

2.1.2 Alternatively, conduits connected to switchboards shall terminate in a common fabricated sheet steel draw-box installed in the vicinity of the switchboard. In open roof spaces this draw- box shall be placed in a roof space of not less than 900mm clearance.

2.1.3 Lighting and socket-outlet circuits may be separately grouped in common conduits or metal ducts (trunking) from the distribution board to the draw-box. The drawbox shall be of sheet steel with a minimum thickness of 1.6mm and shall be fitted with a removable cover plate.

2.2 Flush Mounted Switchboards

Where flush mounted switchboards are required, the recessed switchboard tray shall be built into the brick or concrete wall. All conduits from the floor or roof shall be fully recessed and shall be bonded directly to the tray by means of locknuts on both sides and the ends of the conduits fitted with a brass bush.

2.3 Surface Mounted Switchboards

Where surface mounted switchboards are specified but where the conduits can be fully recessed, the conduit shall be connected to a recessed connection box installed behind the switchboard. An opening with the same dimensions as the connection box shall be cut in the back of the switchboard and fitted with a suitable grommet.

2.4 Spare Conduits

Where conduits from a switchboard run into a false ceiling space above the board, a minimum of two 25mm and two 20mm spare conduits shall be installed into the ceiling space immediately above the board.

2.5 Cable Connections

2.5.1 Where underground cables are to be connected to switchboards, it shall be the responsibility of the Contractor to ensure that metal, earthenware, asbestos-cement or other approved sleeves are built in correctly to enable installation and connection of the cable to the switchboard.

2.5.2 PVC or pitch fibre sleeves are not acceptable - refer to par. 3.10 of the Department's standard specification for "INSTALLATION OF CABLES", Section B6.

2.5.3 Sleeves shall tie installed with a fall from inside to outside of the building to facilitate drainage. The sleeves shall be sealed with a non-hardening compound after installation of the cables to render the installation vermin proof and waterproof.

2.5.4 A metal cable channel with removable metal cover plate shall be installed by the Contractor and shall extend from the switchboard to the floor or into the ceiling void as required. The channel shall coincide with the position of sleeves. The channel shall be flush mounted except in the case of surface mounted switchboards and then only with the permission of the Department's representative

2.5.5 The cable channel shall be large enough to permit the installation of cable glands and future cables, particularly where spare sleeves have been provided.

2.5.6 The colour of the channel cover shall match that of the associated switchboard.

2.6 Cable Trenches

Where cables in floor trenches have to be connected to wall mounted switchboards, approved sleeves or conduits shall be installed from the side of the trench to the bottom of the switchboard. These sleeves shall be positioned and fixed before the concrete is cast.

3. CONNECTIONS TO MOTOR DRIVEN EQUIPMENT.

3.1 An isolator or starter containing an isolator shall be installed within 2m of motor driven equipment. The requirements of SANS 10142 shall be met. If this isolator cannot be installed on a wall, switchboard or other suitable place, an approved free-standing pedestal shall be provided. The pedestal shall be 1m high and outside normal walkways, access routes, etc.

3.2 The connection to the equipment shall be carried out as follows:

(a) Metal reinforced plastic or PVC-covered flexible metal conduits with individual conductors or a multi-core PVC insulated cable and separate bare earth conductor installed inside the conduit may be used. The flexible conduit shall not exceed 600mm. Screwed conduit shall be used from the end of the flexible conduit to the isolator and/or starter. Refer to the department's standard specification for "FLEXIBLE CONDUIT", Section B1 , par. 5.

(b) Multi-core armoured PVC or rubber insulated cable and earth conductor. The installation and termination of the cables shall comply with the Department's specification for "INSTALLATION OF CABLES, Section B6.

(c) Cables and flexible conduits shall be provided with sufficient slack to allow positional adjustment of the equipment.

3.3 Supply cables to equipment may not be installed across floors which are for general use.

4. CONNECTIONS TO WATER HEATERS

4.1 Each water heater shall be connected to a separate circuit with a separate earth conductor.

4.2 The conduit from the switchboard to the water heater shall terminate in a draw-box within 1 m of the water heater terminals. The connection from the draw-box shall be conductors in conduit or PVC-insulated cable. Only in instances where heaters are mounted out of normal reach may flexible conduit and round boxes with dome lids be used for the final connection.

4.3 Three-phase supplies to fixed storage water heaters shall be in accordance with the wiring diagram, Fig. B10.1.

4.4 The mounting of the water heater and the provision of the water connections will be undertaken by others. The Contractor shall ensure that the elements and thermostats can easily be replaced.

4.5 Before testing a water heater, the Contractor shall confirm with the Plumbing Contractor that the unit is filled with water.

4.6 Unless otherwise specified in the Detailed Technical Specification, the wiring of hot-water heater circuits not exceeding 4 kW shall consist of 4mm² conductors and 2.5mm² earth conductor.

4.7 Unless it is specified that isolators for water heaters shall be provided in the switchboard, a local isolator shall be provided for each water heater. In the case of water heaters not exceeding 4 kW, a 30 A double-pole metal-clad isolator shall be surface mounted over the flush conduit outlet box.

5. CONNECTIONS TO HEATERS, FANS AND AIRCONDITIONING UNITS

5.1 Isolators

A flush mounted suitably rated double-pole isolator shall be provided within 1 m of the unit. Where the equipment is mounted out of reach, the isolator shall be installed at 1,5m above floor level. Only where units are mounted in easily accessible positions and where an isolating switch is incorporated in the unit, may this isolator be omitted. Where flush isolators are used, flush conduit shall be installed to link with the equipment outlet point. Flexible cords of sufficient rating may be used for the final connection to the equipment.

5.2 Wiring

The minimum conductor size to be used shall be 4 mm². Each fan, heater or air-conditioning unit shall be on a separate circuit.

5.3 Flush Mounted Convection Heaters

The heater frame or tray shall be built or cast into the wall at a height such that the underside of the heater is at 250mm above floor level. Conduits shall terminate on the frame near the terminals.

5.4 Surface Mounted Equipment

5.4.1 Connections to surface mounted equipment shall consist of a draw-box located in the vicinity of the terminals of the unit. In workshops and industrial areas the connections shall be made by

means of flexible conduit connected to dome lids on the draw-box. Conductors shall be connected directly to the unit.

5.4.2 In non-industrial applications PVC-insulated 3-core flexible cables may be used for the connection.

5.4.3 Where flexible cables are used, a bush shall be provided at the rear of the unit for cable entry and a bush and clamp (or gripper gland) at the draw-box. The clamp shall tightly grip the outer insulation of the cable to prevent tension on the connections between cable and conductors in the draw-box.

5.4.4 Where heaters or air-conditioning units are situated above power skirting, the isolator shall be installed in the power skirting and the flexible cable or cord to the unit shall be installed in the power skirting through a gripper or compression gland. The cable shall be made as short as practical and shall be neatly saddled to the surface of the wall.

5.5 Radiant Heaters

The installation of radiant heaters and asbestos heaters, where specified, shall comply with the requirements of paragraph 5.4, with the exception that they shall be mounted on spacers, 25mm away from the mounting surface.

5.6 Fan Heaters

5.6.1 The contractor shall allow for the supply, installation and electrical connection of the fan heaters as indicated on the drawings. The fan heaters shall be rated at 3 kW and shall be complete with control units.

5.6.2 The heaters shall be secured by means of approved expansion bolts at 2.4m above floor level in positions as shown, with the control units at 1.5m above floor level, directly below the unit.

5.6.3 The fan heater shall be installed on a box directly behind the unit.

5.6.4 Each connection shall be protected by means of a single-pole circuit-breaker on the associated switchboard.

5.6.5 Brass bushes shall be provided to protect the wiring at the rear cable entries to the control unit and fan connection box.

6. CONNECTIONS TO UNDERFLOOR HEATING

6.1 Where underfloor heating cable is specified, the Contractor shall supply the cable and thermostats which shall be purchased from a specialist supplier. The cable shall be laid by the specialist supplier and connected by the Contractor. The Contractor shall also be responsible for testing of the cables prior to their being covered by the screed and immediately thereafter. Details of circuit wiring and control of underfloor heating will be specified in the Detail Technical Specification.

6.2 PVC-insulated heating cable with a rating of not higher than 13 W per linear metre shall be used. Thermal insulation will be provided by the Builder.

6.3 The capacity of the heating cable shall he sufficient to give a 20°C temperature rise with an outside ambient temperature of 5°C.

6.4 The total heating load shall, however, not he more than 135 W/m2.

7. CONNECTIONS TO INCINERATORS

7.1 General

This section covers connections to incinerators used for domestic purposes in buildings. Unless specified to the contrary, the supply and installation of incinerators will form part of the electrical installation and shall comply with the Department's quality specification, "INCINERATORS", SECTION C14.

7.2 Flush Mounted Incinerators

Where flush mounted incinerators have been specified, the Contractor shall supply the mounting tray to the Builder in good time for it to be built into the structure.

7.3 Mounting Height

Unless specified to the contrary, incinerators shall be installed with the bottom 1m above finished floor level.

7.4 Isolator

A flush mounted 30A double-pole isolator shall be installed approximately 1,5m above the finished floor level adjacent to each incinerator. The isolator cover plate shall wholly fall within either the tiled or plastered surface of the wall. Unless specified to the contrary, the cover plate shall be finished in white baked enamel. An engraved label shall be provided at each isolator marked as follows:
'SWITCH OFF TO CLEAN AND REMOVE ASH"
"SKAKEL AF VIR SKOONMAAK EN ASVERWYDERING"

7.5 Flues

The Contractor shall supply flue pipes to the Builder for installation. Two bends and an "H" piece exhaust canopy shall be allowed for each flue pipe.

7.6 Exhaust Fans

Where more than 5 incinerators are connected to the same flue or where more than two 90° bends are used in the flue, an exhaust fan shall be installed at the flue outlet. In addition a small fan must be provided at each incinerator.

7.7 Wiring

Single incinerators shall be connected by means of 2 x 4mm² PVC insulated conductors and a 2,5mm² bare copper earth conductor in a 20mm conduit. Each incinerator shall be connected to a separate circuit where a common exhaust fan is not used. Where a common exhaust fan is needed, the following applies:

(a) All fans and incinerators connected to the same flue shall be on the same circuit.

(b) The current rating of the circuit-breaker shall be sufficient to allow the simultaneous operation of all the fans and 50 % of the incinerators.

(c) A 30A double-pole isolator shall be flush mounted adjacent to each incinerator as described in paragraph 7.4. However if the current rating of the circuit-breaker protecting the circuit is larger than 15A, a 15A fuse and fuse holder shall be installed at each incinerator in addition to the isolator. The draw-box and cover plate for the isolator shall be large enough to accommodate the isolator and fuse. Alternatively, a 15A circuit- breaker may be installed adjacent to each incinerator in lieu of the isolator and fuse.

(d) The circuitry shall be arranged to ensure that all the fans will operate when any one of the incinerators is switched on.

(e) Earth leakage protection shall be installed on all incinerator circuits.

8. CONNECTIONS TO COOKING APPLIANCES

8.1 Unless specified to the contrary, the circuit connection to each cooking appliance shall consist of:

(a) 2 x 10mm² PVC-insulated conductors and 6mm² bare copper earth conductor for single phase connections, or

(b) 4 x 4mm² PVC-insulated conductors and 2,5mm² bare copper earth conductor for three phase connections.

8.2 A 60A double pole or 30A triple pole micro-gap isolator flush mounted in a wall outlet box, shall be installed 1.5m above floor level to the left or right of the appliance in accordance with SANS 10142. A white baked enamel cover plate shall be provided, situated wholly on the tiled or plastered surface as applicable.

8.3 The conduit shall terminate 450mm above floor level behind the appliance position. The conduit end shall be approximately 75mm long and shall face downwards. Connections from the conduit end to the appliance shall be installed in accordance with SANS 10142. Sufficient slack shall be provided in the flexible connection to move the appliance 600mm away from its normal position for cleaning or maintenance.

8.4 Alternatively a 45A, 3-pin socket-outlet may be mounted on a round draw-box 450mm above floor level. The connection to the appliance shall consist of a plug and 10mm², rubber insulated and sheathed cable in accordance with SABS 168. The cable shall be long enough to enable the appliance to be moved 600mm from its normal position for cleaning or maintenance.

8.5 Crimped or soldered lugs shall be provided on all conductors intended for connection to cooking appliances.

8.6 Each appliance shall be connected to a separate circuit. A separate earth wire shall be provided for each appliance.

SECTION B11

EARTHING

This section covers the earthing of electrical installations in buildings or other structures. The total earthing system of any electrical installation shall be in complete accordance with SABS 0142.

1. GENERAL RECOMMENDATIONS ON THE PRACTICAL INSTALLATION OF EARTH ELECTRODES

1.1 Requirements of an Effective Earth

1.1.1 An effective earth must prevent dangerous over voltages arising between metallic structures, frames, supports or enclosures of electrical equipment and the ground during fault conditions.

1 .1.2 An effective earth must be able to permit fault currents of sufficient magnitude to flow so as to operate protective devices to isolate the fault before damage can occur.

1.1.3 The ohmic resistance of an effective earth must be low enough to ensure that the step potential on the ground in the vicinity of the earthing point is within safe limits under fault conditions i.e. a voltage gradient not exceeding 40 V/m for fault durations exceeding 1 s.

1.2 Types of Earth Electrodes

Three types of earth electrodes are suitable:

1.2.1 Trench Earths

Trench earths comprise a bare copper or galvanised iron conductor laid at a minimum of 800mm below ground level, usually when underground cables are installed. This type of earth electrode provides a relatively large contact area between electrode and surrounding ground, makes contact with a variety of types of soil and soils of varying moisture content en route and is economical to install.

1.2.2 Spike Earths

Spike earths comprise rods of bare copper, copper-coated steel, stainless steel or galvanised steel designed for the purpose of penetrating ground to depths of up to several metres. A low resistance earth may sometimes be obtained by driving multiple spikes at some distance from each other in order to provide parallel paths.
In hard or rocky ground, it is usually necessary to drill holes into which earth spikes are inserted and then packed with soft soil.

1.2.3 Foundation Earths

Foundation earths comprise bare copper or galvanised iron conductors laid under the foundations of buildings, miniature substations, distribution pillars, bases of wooden, concrete or steel poles and structures. Because soil under foundations usually retains moisture, foundation earths are

located to take advantage of this favourable condition. Furthermore, they are economical to install.

1.3 Materials for Earth Electrodes

1.3.1 Bare copper, either in stranded, strip or rod form, is considered the most suitable general purpose material for earth electrodes. Its main disadvantage is its cost and susceptibility to theft.

1.3.2 Bare galvanised iron and steel, either in stranded, strip or rod form, has a satisfactory record of survival in non-aggressive soils and is more economical than copper.

1.3.3 Bare aluminium is unsuitable as electrode material.

1.4 Corrosion

Because galvanised ferrous metals corrode sacrificially to copper, galvanised iron and steel electrodes should not be buried in close proximity to bare copper.

2. TECHNICAL REQUIREMENTS OF NEUTRAL EARTHING

The following relevant aspects have been extracted from the "AMEU CODE OF PRACTICE FOR THE APPLICATION OF NEUTRAL EARTHING ON LOW VOLTAGE DISTRIBUTION SYSTEMS."

2.1 Distribution Systems

Multiple Earthed Neutral (MEN) and Protective Multiple Earthing (PME) systems.

Distribution equipment associated with transformer substations that are either ground mounted or pole mounted and fed by underground cable or overhead line, with or without an earth continuity conductor, (ECC), should be installed, connected and earthed in accordance with the following requirements:

(a) Where the resistance to earth of the HV equipment earth is 1 ohm or less, it is permissible to earth the LV neutral to the HV earth electrode.

(b) Where the HV equipment earth exceeds 1 ohm the LV neutral shall be earthed at a minimum distance of 6m from the HV equipment earth (i.e. 6m from the HV electrode/s and also from any earthed metalwork connected thereto).

(c) Notwithstanding the requirements of (a) above, where transformers are associated with HV overhead lines, it is considered good practice to separate the HV and LV earth electrodes. The minimum earth separation should be 6m or one LV span.

(d) The overall resistance to earth of the neutral of an LV distributor or distribution system must not exceed 10 ohms.

(e) The LV neutral may be connected to other supply neutrals, earth electrodes, cable sheaths and armouring and these connections used to obtain the required earthing value of 10 ohms or less specified in par. (d). above.

(f) The neutral of underground and overhead LV distributors must be earthed at the remote ends of each distributor.

(g) Where the overall resistance to earth of the neutral of the distribution system exceeds 10 Ohms. the neutral shall be earthed at intermediate positions on the distributor/s to reduce its resistance to earth to below this limit.

(h) The cross-sectional area of the neutral of all LV distributors must not be less than that of a phase conductor.

(i) No circuit-breakers. isolators, fuses, switches or removable links shall be installed in the neutral between the transformer star point and the remote end of any LV distributor or service connection.

(j) All metallic sheathing and armouring of cables and all metalwork associated with meter cabinets, fuse pillars, etc., supporting or enclosing LV cables shall be bonded to the distributor neutral conductor.

(k) Where a Separate Neutral-Earth (SNE) cable is part of an MEN or PME system, the armouring and/or metallic sheath and any ECC shall be bonded to the neutral at the supply end of the cable.

(l) To ensure the integrity of the neutral, it is recommended that all connections and joints on or to overhead line conductors be made by compression fittings or, alternatively double bolted connectors.

(m) MEN or PME may be applied to any single LV distributor without alterations to other LV distributors supplied from the same transformer.

2.2 Protective Neutral Bonding (PNB) System

Since the neutral is earthed at one point only, the question of multiple earthing does not arise and there is therefore no necessity to meet the MEN/PME technical requirements.

2.3 Service Connections

2.3.1 MEN System

The following conditions apply to consumers' service connections as well as service connections to traffic signals, road signs, street lighting and other power-consuming equipment installed in public places:

(a) All service connections must be by means of cable with an insulated phase, an insulated neutral conductor and an ECC.

(b) A single phase service connection comprises a live, a neutral and an ECC.

(c) A polyphase service connection comprises two or three phase conductors, a neutral and an ECC.

(d) The service neutral and ECC must be solidly and separately connected to the distributor neutral at the tee-off point.

(e) The consumer's earthing lead is connected to the Supply Authority's earth terminal which is in turn connected to the ECC in the service cable at the consumer's supply point.

(f) The neutral must not be connected to earth at the consumer's supply point.

(g) If required by the Supply Authority and earth electrode must be installed at the consumer's supply point.

(h) In a service connection to traffic signals, street light and other power-consuming equipment installed in public places, such equipment is earthed to the ECC of the service connection.

2.3.2 PME System

(a) All service connections must be by means of a cable with an insulated phase and an insulated neutral conductor.

(b) A single phase service comprises a live conductor and a neutral.

(c) A polyphase service connection comprises two or three phase conductors and a neutral.

(d) The consumer's earthing lead is connected to the supplier's neutral and to a mandatory earth electrode at the consumer's supply point.

(e) A label must be attached at the consumers supply point on his premises indicating that the installation is part of a PME system.

Note: It is not recommended that the PME system be applied to supply traffic signals, street signs or other power-consuming equipment installed in public places, because the PME system is inherently unsafe under "broken-neutral" conditions.

3. SUBSTATION EARTHING

In order to comply with the requirements of par. 1 and 2 above, an earth resistivity measurement shall be undertaken at the site of a new substation or miniature substation, preferably by a specialist firm. The contractor shall then submit to the Department details of a proposed substation earth indicating whether a trench earth, spike earth or foundation earth is intended and the proposed interconnections with the installation.

4. FENCES OF OUTDOOR SUBSTATIONS

In cases where substations contain transformers or switchgear installed outdoors, the compulsory fence shall be earthed as follows, if no other method is specified:

(a) A 70mm^2 earth wire shall be installed 400mm below ground level and 500mm from the fence on the outside of the sub-station along the entire length of the fence. This earth wire shall be earthed at each corner by means of a 1.8m earth rod and the rod and earth wire bonded to the fence. The earth wire shall also be bonded, at least at two points, to the main earthing system.

(b) A 70mm^2 earth wire shall also be buried at a depth of 400mm around each transformer and switch and bonded to the main earthing system.

5. EARTHING OF A GENERAL ELECTRICAL INSTALLATION

5.1 General

All earth conductors shall be stranded copper with or without green PVC insulation. The conductors shall comply with the Department's quality specification for "PVC-INSULATED

CABLES", Section C4. All earth conductor sizes shall be determined in accordance with SABS 0142, par. 4.6 where the earth does not form an integral part of the cable.

5.2 Switchboards

A separate earth connection shall be supplied between the earth busbar of the main switchboard and the earth busbar of every sub-switchboard. These connections shall consist of bare or insulated stranded copper conductors installed along the same routes as the supply cables or in the same conduit as the supply conductors. Alternatively armoured cables with earth continuity conductors included in the armouring may be utilised.

5.3 Sub-circuits

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

5.4 Ring Mains

Common earth conductors may be used where various circuits are installed in the same wiring channel in accordance with SABS 0142. In such instances the sizes of earth conductors shall be specifically approved by the Department. Earth conductors for individual circuits branching from the ring main shall be connected to the common earth conductor with T-ferrules or soldered. The common earth shall not be broken.

5.5 Connections

Under no circumstances shall connection points, bolts, screws, etc. used for earthing be utilised for any other purpose. It will be the responsibility of the Contractor to supply and fit earth terminals or clamps on equipment and materials that must be earthed where these are not provided. Unless earth conductors are connected to proper terminals, the ends shall be tinned and lugged. Lugs may be crimped, using mechanical or pneumatic tools designed for this purpose, on condition that evidence is submitted that the method used complies with the performance requirements of BS 4579, Part 1 : "COMPRESSION JOINTS IN COPPER."

5.6 Non-metallic Conduit

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

5.7 Flexible Conduit

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

5.8 Water Pipes

Metal cold water mains shall be bonded to the earth busbar in the Main Switchboard by solid 15 x 2mm copper strapping. All other hot and cold water pipes shall be connected by 12 x 0,8mm perforated or solid copper strapping (not conductors) to the nearest switchboard. The strapping shall be fixed to the pipe work by brass nuts and bolts and against walls be brass screws

at 150mm centres. In all cases where metal water pipes. down pipes, flues. etc. are positioned within 1.6 m of switchboards. an earth connection consisting of copper strapping shall be installed between the pipe work and the board, in vertical building ducts accommodating both metal water pipes and electrical cables, all the pipes shall be earthed at each switchboard.

5.9 Roofs

Where service connections consist of overhead conductors, all metal parts of roofs. gutters and down pipes shall be earthed. One bare 10mm² copper conductor shall be installed over the full length of the ceiling void, fixed to the top purlin and connected to the main earth conductor of each switchboard. The roof and gutters shall be connected at 15m intervals to this conductor by means of 12 x 0.8mm copper strapping (not conductors) and galvanised bolts and nuts. Self-tapping screws are not acceptable. Where service connections consist of underground supplies, the above requirements are not applicable.

SECTION B12

PROVISION FOR TELEPHONE INSTALLATION

1. CONTRACTOR'S RESPONSIBILITY

The Contractor shall only supply and install outlet points. wiring channels and/or conduits for telephones. The telephone installation will be carried out by others.

2. REGULATIONS

All provisions for telephones in buildings shall comply with the latest issue of "FACILITIES FOR TELECOMMUNICATION SERVICES IN BUILDINGS" as issued by the Department of Posts and Telecommunications.

3. SEPARATION OF SERVICES

3. 1 Cables or conductors for telephone services shall be separated from all other services by:

(a) providing separate metal channels or conduits, or

(b) installing power cables, conductors and accessories at a minimum distance of 300mm from routes reserved for telephone cables, or

(c) an earthed metal barrier installed in such a manner to ensure that the minimum distance through free air space between the telephone cables and other services is at least 300mm.

3.2 In cases where high voltage cable runs are parallel to telephone cable runs for more than 50m, the correct spacing shall be determined by conferring with the Department of Posts and Telecommunications.

3.3 Conduits or wiring channels provided for telephone services may not be used for any other purpose. Where non-metallic channels are used, the separation stated in par. 3.1 (b) shall he maintained throughout the installation.

4. MAIN TELEPHONE DISTRIBUTION BOARD

4.1 The size and position of the Main Telephone Distribution Board, where required, shall be in accordance with the requirements of the Detail Technical Specification.

4.2 The board shall consist of a metal tray, architrave frame and hinged doors and shall be flush mounted in the position shown on the drawing(s).

4.3 A 20mm thick soft wooden panel (fine grade pine to SABS 1098, without knots) shall be installed in the main telephone distribution board and shall cover the entire back of the board. Chipboard or similar materials are not acceptable.

4.4 All conduits and sleeves to telephone outlets or sub-distribution boards in the buildings or on

the site as well as the main incoming sleeves shall terminate at the main telephone distribution board as indicated on the drawing(s).

4.5 Where 100 x 100 x 50mm draw-boxes are specified as main or sub-distribution boards. the boxes shall be flush mounted and provided with a cover plate. A wooden panel need not be provided in these cases.

5. VERTICAL BUILDING (SERVICE) DUCTS

5.1 If the telephone cables are to be installed in the same duct as power cables the separation of services described in par. 3 shall be maintained.

5.2 Conduits and metal channels to and from building duct(s) shall be installed—from the section containing the telephone cables to obviate telephone cables crossing power cables or other services in the duct.

5.3 Where more than one vertical building duct is provided in the structure, the ducts shall be interconnected by at least 2 x 32mm dia. conduits at each floor level unless otherwise specified or indicated on the drawings.

6. TELEPHONE OUTLETS

6.1 Blank cover plates shall be fitted to all telephone outlets.

6.2 Telephone outlets in walls shall consist of flush mounted 100 x 100 x 50mm draw-boxes.

6.3 Telephone outlets in floors shall be of the same type as floor outlets for power socket-outlets. These provisions also apply to underfloor ducting. If the type of floor outlet is not specified, 100 x 100 x 50mm flush mounted draw-boxes shall be provided in the floor at the positions indicated on the drawings. The cover plates for these draw-boxes shall be of the diecast type.

6.4 Where twin underfloor ducts are provided and where the one duct is intended for telephone cables, the separation between the ducts shall be maintained throughout the underfloor ducting installation.

6.5 Where power skirting is specified for telephone installations, the Contractor need only install the skirting with covers since the telephone socket will be fixed directly to the cover. Where multiple power skirting is provided containing other services, no other cables may be installed in the section intended for telephone cables and the separation between the sections shall be maintained throughout the installation.

6.6 Refer also to the Department's standard specification for the "INSTALLATION OF WIRING CHANNELS, UNDERFLOOR DUCTING AND POWER SKIRTING", Section B2.

7. CONNECTION OF TELEPHONE OUTLETS

7.1 Telephone outlets shall be inter-connected and connected to the telephone distribution boards as shown on the drawings.

7.2 If the inter-connecting conduits are not specified, conduit sizes shall be determined as follows:

(a) Inter-connection of 10 outlets maximum - 25mm dia. conduit.

(b) Inter-connection of 20 outlets maximum - 32mm dia. conduit.

7.3 Metal channels or power skirting installed on the same floor level on opposite walls of the same area as well as parallel runs of underfloor ducting intended for the installation of telephone cables, shall be interconnected at intervals of 6m. Conduit may be used for these inter-connections.

7.4 All conduits and all ducts or channels which do not have removable covers, shall be provided with galvanised steel draw-wires.

7.5 Conduit connections to power skirting or surface mounted metal channels shall consist of a 100 x 100 x 50mm draw-box which is flush mounted immediately behind the duct or channel in which the telephone cables are to be installed. A hole shall be cut in the back of the duct or channel, immediately opposite the draw-box. The edges of the hole shall be grommeted. The draw-box shall be accessible from the front when the cover is removed.

7.6 Purpose-made accessories for the connection of conduits to underfloor ducts shall be used. Where these are not available, a 100 x 100 x 50mm draw-box shall be installed below the underfloor duct opposite a floor telephone outlet. Inter-connecting conduits shall terminate at the draw-box. The edges of the hole shall be grommeted. The draw box shall be accessible from the top via the floor outlet.

7.7 Exposed conduit ends intended for future extensions shall be terminated by means of a coupling and screwed brass plug. Only galvanised conduit shall be used in these instances.

SECTION B16

SPECIFICATION FOR THE PLANTING OF STREET-LIGHT POLES, THE TERMNATION OF CABLES INSIDE THE POLES AND THE CONNECTION OF THE CABLES TO THE STREET-LIGHT LUMINAIRES

1. SCOPE

This specification shall be read with relevant drawing and comprising of the following:

1.1 The planting of streetlight poles

1.2 The drawing-in of the conductors into the poles.

1.3 The mounting of the luminaire after the pole has been erected.

1.4 The termination of streetlight cables inside the poles, inside the outdoor substation (where applicable), as well as the connection between cables and the streetlight luminaire.

1.5 The specification, as well as the installation of light-intensity relays and the electrical connection thereof.

1.6 The wiring of the streetlight control unit inside the mini substation and the installation of the discharge lamps in the luminaires upon completion of the Contract.

2. THE PLANTING OF STREET-LIGHT POLES

2.1 The Contractor shall dig the pole holes in accordance with the positions indicated on the plan. All measurements between the poles shall be maintained as specified.

2.2 The depth and size of the excavation for streetlight poles shall be 1.5 m and at least 400 mm x 400 mm respectively. In the case of poles being planted deeper than 1.5 m, an indication to the effect shall appear on the plan.

2.3 All poles shall be provided with base plates rigidly bolted down by means of hook bolts before being planted.

2.4 The back of the poles shall be planted vertically.

2.5 The streetlight poles shall be planted in such a way that the mounting bracket will be in the direction of the roadway and rectangular with the centre line of the road, unless otherwise determined by the Engineer.

2.6 After the poles have been placed in the holes, the holes shall be filled with soil free from stones, plants. etc, and shall be properly compacted to the satisfaction of the Engineer.

2.7 In the case of sandy, loose or marshy soil conditions, the poles shall be planted in a 12:1 sand-cement mixture.

2.8 The poles may under no circumstances be sawn off in order to create the impression that they have been planted at the correct depth.

3. THE CONNECTION OF THE CABLE INSIDE THE STREET-LIGHT POLE

3.1 Every pole shall be provided with a mounting plate welded on the inside of the pole. The cables shall be connected to the mounting plate as indicated. The incoming and outgoing cables shall be terminated at every pole in accordance with supplied drawings, as amended, and the necessary cross- connections of the cable cores. as well as the earthing of the cable armouring shall be done neatly on the terminal blocks referred to in 4.3 hereof.

3.2 A 5A circuit breaker designed for a 250V working voltage and with a 5kA breaking capacity shall be installed at each pole and shall be connected as indicated on the drawing referred to above.

3.3 Terminal blocks similar to Pratley Klippon, suitable for the relevant cable size, shall be installed as indicated on the Drawing and the necessary connections shall accordingly be made thereon.

4. MOUNTING AND CONNECTION OF THE STREET-LIGHT LUMINAIRE

4.1 After the pole has been planted and the luminaire conductors have been drawn in, the streetlight luminaire shall be pushed completely over the mounting piece on the end and be properly secured with bolts and/or nuts provided for the purpose. If the lamp does not fit well, the galvanising must be filed slightly around the end.

4.2 The luminaire shall be mounted absolutely horizontally so that the light may be diffused evenly on both sides of the pole on the roadway, unless otherwise determined by the Engineer.

4.3 The streetlight luminaire shall be provided with a terminal block marked with the letters L, N and E, or alternatively, it shall be provided with conductors in the standard colours prescribed by the SABS/SANS, viz. blue, brown and green-and-yellow.

4.4 The connection between the terminal block of the luminaire and the terminal block at the bottom of the pole shall be done by means of two PVC-insulated, 1.5mm conductors. A black and red PVC conductor shall be used for the neutral and the phase conductor respectively. Approximately half a metre extra of each conductor shall be left in order that the changing of the luminaire may take place without effort.

4.5 All bolts, nuts, screws and latches of the luminaire shall be properly secured or fastened.

5. MOUNTING OF THE PHOTOCELL

5.1 The photocell shall be mounted on top of the pole nearest to the mini substation by making a hole in the luminaire and bolting the photocell to it. Alternative mounting methods shall be submitted to the Engineer for his approval.

5.2 The photocell shall be connected to the control equipment in the connection compartment of the mini substation by means of 1.5mm, 2-core, PVC steel-wire armoured cable to be provided by the Contractor and as indicated on the Drawing.

5.3 In cases where each street light is fed separately from the nearest metering cubicle, each street light shall be provided with a photocell as referred to in 5.1 hereof.

6. TESTING

6.1 After the completion of the installation. the street lights and control equipment shall be tested to the satisfaction of the Engineer.

6.2 During the testing of the installation special care shall be taken that the capacitor and choke coil of the streetlight luminaire are not damaged. A maximum alternating-current test voltage of 240 V may be used.

6.3 Hereafter the Contractor shall provide every light in the installation with a discharge lamp. The Contractor shall be responsible for any lamps, which may be damaged before or during the installation thereof.

SECTION C

QUALITY SPECIFICATIONS FOR MATERIALS AND EQUIPMENT OF ELECTRICAL INSTALLATIONS

SECTION C1

CONDUIT AND CONDUIT ACCESSORIES

1. GENERAL

This section covers the requirements for conduit and conduit accessories for general installations under normal environmental conditions.
The type of conduit and accessories required for the service, i.e. whether the conduit and accessories shall be of the screwed type, plain-end type or of the non-metallic type and whether metallic conduit shall be black enamelled or galvanised, is specified in Part 2 of this specification.
Unless other methods of installation are specified for certain circuits, the installation shall be in conduit throughout. No open wiring in roof spaces or elsewhere will be permitted.
The conduit and conduit accessories shall comply fully with the applicable SABS specifications as set out below and the conduit shall bear the mark of approval of the South African Bureau of Standards.

(a) Screwed metallic conduit and accessories: SANS 61035 parts 1 and 2.

(b) Plain-end metallic conduit and accessories: SANS 61035 parts 1 and 2.

(c) Non-metallic conduit and accessories: SABS 950

Bushes used for metallic conduit shall be brass and shall be provided in addition to lock nuts at all points where the conduit terminates at switchboards, switch-boxes, draw-boxes, etc.
Only one manufacture of conduit and conduit accessories will be permitted throughout the installation.
All metallic conduits shall be manufactured of mild steel with a minimum thickness of 1.2mm for plain-end conduit and 1.6mm in respect of screwed conduit.

2. SCREWED CONDUIT

2.1 Conduits shall comply with SANS 61035 and shall bear the SABS mark.

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

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

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

3. METAL CONDUIT ACCESSORIES

All metal conduit accessories shall be of malleable cast iron or pressed steel with brass bushes in accordance with SANS 61035. Alloy or pressure cast metal accessories or zinc base alloy fittings are not acceptable. All fittings whether galvanised or black enamelled, shall be fitted with brass screws.

4. CIRCULAR TYPE BOXES

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

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

4.3 Boxes shall comply with SANS 61035.

5. SWITCH BOXES AND SOCKET OUTLET BOXES

5.1 All switch boxes and socket outlet boxes shall be manufactured of pressed galvanised steel of at least 1mm thickness. All boxes shall be fitted with the necessary lugs to suit standard flush mounted switches and socket outlets manufactured in accordance with SABS 518 and SABS 1085.

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

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

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

6. FLEXIBLE CONDUIT

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

7. PLAIN-END METALLIC CONDUIT

7.1 As an alternative to the threaded conduit, plain-end (unthreaded) metallic conduit with accessories may be used under the conditions stated in the Department's standard specification for "INSTALLATION AND TERMINATION OF CONDUITS AND CONDUIT ACCESSORIES", par. 3 of Section B1.

7.2 Unthreaded conduit shall be manufactured of mild steel with a minimum thickness of 1.2mm and shall comply with SABS 1007.

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

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

7.5 All conduit and accessories used in areas within 50 km of the coast shall be hot-dip galvanised to SANS 5763. In inland areas electro-galvanised or cadmium-plated accessories will be accepted.

8.0 NON-METALLIC CONDUIT

Non-metallic conduit shall comply fully with SABS 950 and shall be installed in accordance with Appendix C of the same specification as well as the Department's standard specification for "INSTALLATION AND TERMINATION OF CONDUITS AND CONDUIT ACCESSORIES", par. 4 of Section B1.

9. EARTH CLAMPS

Earth clamps shall consist of copper strips at least 1.2mm thick and not less than 12mm wide secured with a brass bolt, nut and washer and shall be so constructed that the clamp will fit firmly to the conduit without any additional packing.

SECTION C2

WIRING CHANNELS, UNDERFLOOR DUCTING AND POWER SKIRTING

1.0 WIRING CHANNELS

1.1 General

1.1.1 The channels shall be manufactured of rolled sheet steel.

1.1.2 The minimum thickness of the sheet steel shall be:

(a) 1.6mm for ribbed channels with a maximum width of 42mm.

(b) 2.5mm for unribbed channels with a maximum width of 42mm

(c) 1.2mm for channels with a width in excess of 42mm.

1.1.3 The channels shall be finished as follows:

(a)	In coastal areas (under all installation conditions)	Hot-dip galvanised to SABS 763 or epoxy powder coated
(b)	Cast in concrete	Pre-galvanised
(c)	False ceiling voids	Pre-galvanised
(d)	Vertical building ducts	Hot-dip galvanised to SABS 763 or epoxy powder coated
(e)	Surface mounted in plant rooms, substations, service tunnels, basements	Hot-dip galvanised to SABS 763 or epoxy powder coated
(f)	Damp areas, exposed to weather, underground runs in contact with earth	Epoxy powder coated or electro-galvanised to SABS 763 or epoxy to SABS 763 or epoxy
(g)	Undercover industrial applications	Epoxy powder coated or electro-galvanised to SABS 763 or epoxy to SABS 763 or epoxy

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

1.2 Cover Plates

1.2.1 All channels shall be supplied with cover plates.

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

I .2.3 For channels wider than 127mm only metal cover plates shall be used.

1 .2.4 The finish of steel cover plates shall be the same as the finish of the channels.

1.3 Accessories

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

1.4 Wiring Supports

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

2.0 UNDERFLOOR DUCTING

2.1 General

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

2.2 Outlets

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

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

2.3 Pedestals

2.3. 1 Pedestals shall be manufactured of die-cast aluminium or pressed steel.

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

3. POWER SKIRTING

3.1 General

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

3.1.2 The channel and cover shall be epoxy coated after manufacture.

3.2 Outlets

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

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

SECTION C3

CABLETRAYS AND LADDERS

1. METAL CABLE TRAYS

Metal cable trays shall be manufactured from perforated rolled steel. Metal trays manufactured to the following standards shall be used:

(a)	Less than 150 mm wide	1,2 mm minimum thickness with 12 mm minimum return
(b)	150 mm to 457 mm	1,2 mm minimum thickness with 19 mm minimum return
(c)	460 mm to 610 mm (Heavy duty)	2,5 mm minimum thickness with 76 mm return

2. CABLE LADDERS

2.1 Metal cable ladders shall consist of a 76 mm high side rail of 2 mm minimum thickness. Cross pieces shall be spaced at maximum intervals of 250 mm. Where cables of 1 0 mm2 or smaller are installed on cable ladders, the spacing of the cross pieces shall be 125 mm. Cables shall be clamped in position by means of purpose-made cable clamps that fit into the cross pieces.

2.2 Cable ladders consisting of slotted metal rails which accommodate plastic or metal cable binding bands may be used in vertical cable runs against walls, etc. These cable ladders will be considered in horizontal cable runs for small cables for communication and control wiring upon the prior approval of the Department.

2.3 Purpose made cable trays consisting of 6 mm angle iron and 6 x 40 mm minimum cross pieces are acceptable in industrial applications. Cross pieces shall be welded in pairs at 250 mm maximum centre-to-centre intervals. The pairs shall be spaced approx. 10 mm apart to allow cable clamps or metallic binding bands to affix the cables to the tray.

3. PLASTIC CABLE TRAYS

Rigid un-plasticine PVC cable trays complying with the following standards may be used if specified in the Detail Technical Specification:
The up stands of trays listed in (a) and (b) shall not be perforated and the top of the up stand shall be smooth. The same cable tray type shall be used in long parallel tray runs.

4. FINISHES

Metal cable trays and ladders shall be finished as follows:

(a)	In coastal areas (under all installation conditions)	Hot-dip galvanised to SABS 763 or epoxy powder coated
(b)	Cast in concrete	Pre-galvanised

(c)	False ceiling voids	Electro-galvanised baked enamel power coated
(d)	Vertical building ducts	Hot-dip galvanised to SABS 763 or baked enamel epoxy powder coated
(e)	Plant rooms, substations, service tunnels	Electro-galvanised baked enamel or epoxy
(f)	Damp areas, exposed to weather.	Hot-dip galvanised to SABS 763 baked enamel or epoxy powder coated
(g)	Undercover industrial applications	Hot-dip galvanised to SABS 763 or baked enamel epoxy powder coated

The above-mentioned finishes shall apply unless specified to the contrary in the Detail Technical Specification. Hot-dip galvanised trays and ladders shall be cold galvanised at all joints, sections that have been cut and at places where the galvanising has been damaged. Powder coated or enamel painted trays and ladders shall likewise be touched up at joints, cuts and damaged portions using spray canisters recommended by the manufacturer of the trays and ladders.

5. ACCESSORIES

Horizontal and vertical bends, T-junctions and cross connections shall be supplied by the Contractor. The dimensions of these connections shall correspond to the dimensions of the linear sections to which they are connected. The radius of all bends shall be 1m minimum. The inside dimensions of horizontal angles or connections shall be large enough to ensure that the allowable bending radius of the cables is not exceeded. Sharp angles shall be 45° mitred.

TECHNICAL DATA SCHEDULE

The trade name and/or catalogue numbers of all equipment forming part of the tender offer must be submitted. This information schedule must be fully completed by the Contractor.

1.1 Cables

(a) Manufacturer : .....

(b) Type : .....

(c) Complies with SABS 1507 : .....(Yes/No)

1.2 Labelling system for cables

(a) Manufacturer : .....

(b) Type : .....

1.3 Cable trays : .....

(a) Manufacturer : .....

(b) Type :.....

1.4 Cable trunking

(a) Manufacturer :.....

(b) Type :.....

1.5 Cable ladders

(a) Manufacturer :.....

(b) Type :.....

1.6 Cable Sleeves

(a) Manufacturer :.....

(b) Type :.....

1.7 Manholes :.....

(a) Type :.....

(b) Dimensions : ..... (l) x (b) x (d)

1.8 Power skirting

(a) Type :.....

(b) Dimensions :..... (l) x (b) x (d)

(c) Number of compartments :.....

1.9 Wiring

(a) Manufacturer :.....

(b) Type :.....

(c) Complies with Spec :..... (Yes/No)

1.10 Labelling system for wiring

(a) Manufacturer :.....

(b) Type :.....

1.11 Local Isolators

1.11.1 Flush-mounted double pole

(a) Manufacturer :.....

(b) Type (No of pins) :.....

(c) IP rating :.....

1.11.2 Flush-mounted triple pole

(a) Manufacturer :.....

(b) Type (No of pins) :.....

(c) IP rating :.....

1.11.3 Surface mounted double pole

(a) Manufacturer :.....

(b) Type (No. of pins) :.....

(c) IP rating :.....

1.11.4 Surface mounted triple pole

(a) Manufacturer :.....

(b) Type (No of pins) :.....

(c) IP rating :.....

1.12 Switched socket outlets

(a) Manufacturer :.....

(b) Current rating :.....

1.13 Light switches

(a) Manufacturer :.....

(b) Current rating :.....

(c) Industrial type: manufacturer :.....

(d) Industrial type: current rating :.....

(e) Industrial type: IP rating :.....

1.14 Photocell

(a) Manufacturer :.....

(b) Installation method :.....

(c) Type and IP rating of enclosure :.....

1.15 Telephone outlets

(a) Manufacturer :.....

(b) To spec :..... (Yes/No)

1.16 Data outlets

(a) Manufacturer

(b) To spec :..... (Yes/No)

1.17 Luminaires

Type	Description
A	3 x 35W (or 28W) T5 recessed fluorescent luminaire complete with with mounting accessories, lamps and telescopic holders, 230V, HF, electronic ballast, IP65, white, 1200x600,
AE	3 x 35W (or 28W) T5 recessed fluorescent luminaire complete with with mounting accessories, lamps and telescopic holders, 230V, HF, electronic ballast, IP65, white, 1200x600, emergency luminaire, 8hr runtime, automatic function
B	3 x 35W (or 28W) T5 recessed fluorescent luminaire complete with with mounting accessories, lamps and telescopic holders, 230V, HF, electronic ballast, IP65, white, 600x600
BE	3 x 35W (or 28W) T5 recessed fluorescent luminaire complete with with mounting accessories, lamps and telescopic holders, 230V, HF, electronic ballast, IP65, white, 600x600, emergency luminaire, 8hr runtime, automatic function
C	2x28W T5 open channel fluorescent luminaire complete with with mounting accessories, lamps and telescopic holders, 230V, HF, electronic ballast, IP65, white
D	2 x 18W CFL bulkhead complete with mounting accessories and lamps, indoor, 230V, powder coating
E	2 x 18W CFL bulkhead complete with mounting accessories and lamps, indoor, 230V, powder coating, decorative, dimmable
F	19x1W LED downlight with diffuser, natural white, 75^0, recessed, decorative, dimmable
G	8W emergency exit light, 3hr battery backup time, auto switching, charger included, complete with accessories , maintained emergency exit sign

1.17.1 Type A :

(a) Manufacturer :.....

(b) Type

(c) Complies with Spec? :.....(Yes/No)

1.17.2 Type AE

(a) Manufacturer :..... .....

(b) Type:

(c) Complies with Spec? :..... (Yes/No)

1.17.3 Type B

(a) Manufacturer :..... .....

(b) Type :..... .....

(c) Complies with Spec? :..... (Yes/No)

1.17.4 Type BE

(a) Manufacturer :..... .....

(b) Type :..... .....

(c) Complies with Spec? :..... (Yes/No)

1.17.5 Type C

(a) Manufacturer :..... .....

(b) Type :..... .....

(c) Complies with Spec? :.....(Yes/No)

1.17.6 Type D

(a) Manufacturer :..... .....

(b) Type :..... .....

(C) Complies with Spec? :.....(Yes/No)

1 .17.7 Type E

(a) Manufacturer :..... .....

(b) Type :..... .....

(c) Complies with Spec? :..... (Yes/No)

(d) Battery duration time :..... (min)

PART C

1.17.8 Type F

(a) Manufacturer :.....

(b) Type :.....

(c) Complies with Spec? :..... (Yes/No)

1.17.9 Type G

(a) Manufacturer :.....

(b) Type :.....

(c) IP rating :.....

(d) Complies with Spec? :..... (Yes/No)

1.18 Distribution boards

1.18.1 Flush-mounted distribution Boards

(a) Manufacturer :.....

(b) Cover type :.....

(c) Dimensions :.....(l) x (b) x (d)

1.1 8.2 Surface-mounted distribution boards

(a) Manufacturer :.....

(b) Enclosure type :.....

(c) Current density of busbar :..... A/mm²

1.19 Circuit breakers

(a) Manufacturer :.....

(b) Trade name :.....

(c) Port of delivery :.....

(d) Minimum fault level :.....

1.20 Isolators

(a) Manufacturer :.....

(b) Trade name :.....

(c) Minimum fault level :.....

1.21 Earth leakage units

(a) Manufacturer :.....

(b) Sensitivity rating :.....

(c) Minimum fault level :.....

1.22 Contactors

(a) Manufacturer :.....

(b) Type :.....

(c) Current rating reference :..... (e.g. AC3)

(d) Control voltage :.....

1.23 TENDER QUALIFICATIONS

Please list all the Tenderer's deviations from this specification.

(a) .....
(b) .....
(c) .....
(e) .....
(f) .....
(g) .....
(h) .....

Signed on behalf of Tenderer.....

Name in Full: .....

COMPANY .....

DATE : .....

SCHEDULE OF PRPOSED SUBCONTRACTORS

The Tenderer shall list below any subcontractors he wishes to employ to carry out part(s) of the work. The acceptance of this tender shall not be construed as being approval of all or any of the listed subcontractors. Should any or all of the subcontractors not be approved subsequent to the acceptance of the tender, it shall in no way invalidate this tender, and the tendered unit rates for the various items of work shall remain final and binding even in the event of a subcontractor not listed below being approved by the employer.

PART OR TYPE WORK	PROPOSED SUBCONTRACTOR	WORK RECENTLY EXECUTED BY SUBCONTRACTOR	TYPE OF TRAINING TO BE OFFERED

Signed on behalf of Tenderer.....

Name in Full: .....

Company .....

Date : .....

SECTION C4

PVC-INSULATED CABLES 60011 000 V GRADE

1. GENERAL

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

2. CONSTRUCTION

2.1 Cables shall be manufactured in accordance with SABS 150, shall come only from fresh stocks, and shall be constructed as follows:

(a)	Un-armoured cables	PVC-insulated/PVC-sheathed
(b)	Armoured cables	PVC-insulated/PVC-bedded/ armoured/black extruded PVC outer sheath
(c)	Single core cables	PVC-insulated/unsheathed

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

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

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

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

2.6 Where specified, an earth continuity conductor shall be provided in the armouring in accordance with SABS 150.

3. PVC-SHEATHED ALUMINIUM-COVERED CABLES

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

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

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

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

4. LENGTHS

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

5. TESTS

At the option of the Department, acceptance tests shall be carried out on production runs of the cable in accordance with SABS 150.

SECTION C5

GLANDS FOR PVC-INSULATED CABLES

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

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

3. The glands shall be made of nickel-plated cadmium plated or in coastal area bronze or brass.

4. The glands shall consist of a barrel carrying a cone bush screwed into one end and a nickel-plated brass nipple carrying a nickel-plated brass or a heavy galvanised steel locknut screwed into the other end. The galvanising shall comply with SANS 5763.

5. Non-watertight glands must be easily converted to watertight glands by means of a waterproofing shroud and inner seal kit. On the cable entry side of the barrel a concave groove shall be provided to accommodate the top rim of the waterproofing shroud.

6. The shrouds shall be made of non-deteriorating neoprene or other synthetic rubber, and shall be resistant to water, oil and sunlight. The shrouds shall fit tightly around the glands and cable.

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

8. Flameproof glands shall comply with SANS 808, Groups 1, 2a and 2b.

9. Suitable accessories shall be provided with glands to be used on ECC armoured cables to facilitate a bolted lug connection of the earth continuity conductors. Grooves cut into the barrel or cone bush to accommodate the earth continuity conductors are not acceptable.

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

SECTION C6

CABLE TERMINATIONS AND JOINTS

1. HEAT-SHRINKABLE MATERIALS

1.1 General

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

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

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

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

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

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

1 .2 Terminations with Heat-Shrinkable Materials

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

1 .2.2 The cores of all cables terminated outdoors and the cores of 3,3 kV and higher voltage cables terminated indoors, shall be completely covered with a shrunk-on protective layer against surface tracking, ultraviolet radiation and weathering.

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

1 .3 Joints with Heat-Shrinkable Materials

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

1 .3.2 In the case of joints in cables with an outer PVC anti-electrolysis sheath. the joints shall be subject to the same electrical insulation test as the outer sheath of the cable.

2. RESIN FILLED JOINTS

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

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

2.3 The resin shall have absolute minimum shrinkage.

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

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

CABLE JOINTS BOX

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

3.2 The lid shall provide an absolute moisture barrier.

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

3.4 Unused entries shall be sealed with watertight blanking plugs.

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

SECTION C9

WIRING TERMINALS

1. Terminal bodies and screws shall be of noncorrosive metal, enclosed in fire resistant, moulded plastic insulating bodies. Terminal bodies or screws shall not project beyond the insulating material and shall afford suitable protection against accidental contact by personnel and against short circuits and tracking.

2. The construction of the terminal block and mounting rail shall cc such as to ensure a firm and positive location of the terminal blocks. It shall be possible to add additional terminal blocks within the terminal sequence without having to disconnect or dismantle the terminal strip. The terminal blocks shall be held in position by means of standard end clamps.

3. It shall be possible to intermix terminals of various sizes i.e. for different sizes of conductors whilst utilising the same mounting rail. Where smaller terminal blocks occur adjacent to larger terminal blocks, suitable shielding barriers shall be inserted to cover the terminals that might otherwise be exposed.

4. The terminal bodies and clamping screws shall be so constructed as to ensure that conductors are not nicked or severed when the clamping screws are tightened. Screws shall not come in direct contact with the conductors.

5. Terminals shall be sized and rated to match the conductors that are connected to them.

6 Each terminal block shall have provision for clip in numbering or labelling strips to be installed together with protective. clear caps over the sheets.

SECTION C10

LIGHT SWITCHES

1. GENERAL

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

2. FLUSH AND SURFACE MOUNTED SWITCHES

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

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

2.3 Switches shall have protected terminals for sale wiring.

2.4 Contacts shall be of silver material.

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

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

2.7 The covers of surface mounted switches shall have toggle protectors.

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

3. WATER TIGHTS WITCHES

3.1 Watertight switches shall be of the microgap type suitable for surface mounting and shall bear the SAGS mark.

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

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

3.4 The ON/OFF position shall be clearly marked on the switch housing.

4. CEILING SWITCHES

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

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

4.3 Adequate space shall be provided within the unit for ease of wiring.

4.4 The switch colour shall be white and shall be fitted with a nylon cord 1.25m long.

5. COVER PLATES

5.1 Cover plates shall be finished in ivory coloured baked enamel, anodised bronze or aluminium unless otherwise specified.

5.2 Cover plates shall overlap the outlet to cover wall imperfections.

5.3 Cover plates shall comply with SABS 1084.

SECTION C11

UNSWITCHED AND SWITCHED SOCKET-OUTLETS

1. GENERAL

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

2. FLUSH AND SURFACE MOUNTED SWITCHED SOCKETS

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

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

2.3 Terminals shall be enclosed for safe wiring.

2.4 Contacts shall be of silver material.

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

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

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

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

2.9 Where 1 3A flat pin switched socket-outlets are specified, these shall comply with 66 1363.

3. WATERTIGHT SWITCHED SOCKETS

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

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

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

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

4. UNSWITCHED SOCKET-OUTLETS

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

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

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

5. THREE-PHASE SWITCHED SOCKET-OUTLETS

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

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

5.3 The units shall be supplied complete with plug top.

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

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

6. SHAVER SOCKETS

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

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

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

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

6.5 The unit shall comply with BS 3052.

SECTION C41

POLES CONSTRUCTION

All poles supplied must be absolutely straight; have the same shape and shall be as described in this specification The poles must have a well-finished appearance and must not be twisted in any way due to manufactured or as result of handling The pole must be of sufficient strength that it will not undergo any permanent shape change as a result of normal of normal transportation, handling or erection.

The pole as a whole including all fittings shall be galvanised on the inside as well as on the outside in accordance with SABS 763. The welding work on the pole shall be smooth and neat. No splatter, slag or air bubbles shall be visible. The galvanising process shall be done after all welding and machine work has been done.

The pole diameter shall decrease gradually or in steps from the pole s base to the pole top and the pole shall be as slender as possible with an outer diameter of 145 5mm at the bottom, The minimum material thickness of the pole shall be 45mm. The pole shall be absolutely round.

The manufactures shall provide acceptable ventilation holes in the pole to prevent condensation of moisture in the pole. The pole shall also be rain and bee-proof.

A rectangular access hole shall be provided at the bottom end of the pole ±0.9 above finished ground level.

The opening shall be provided with a rain proof cover plate with the same profile as the pole. The cover plate may only be removed by using special tools. The cover plate shall undergo the same galvanising process after forming, cutting and drilling. The thickness of the cover plate shall not be less than 4mm.

A back plate suitable for the mounting of equipment shall be bolted in the pole A clip tray suitable for mounting two circuit breaker s shall be provided on the mounting plate as well as a Din track for terminal blocks of the clip on type and a 6mm earth stud with nut, washer and spring washer.

The poles shall be provided with round foot plates with a diameter of 350mm and thickness of 6mm attached to the pole with a least two hook bolts of sufficient strength,

The foot plate shall not be welded onto the pole and the same rust protection that is used on the pole shall be applicable on the foot plate and hook bolts The thread of the hook bolts shall be cleaned after been galvanised.

Each pole shall be provided with a cable entry at the bottom end of the pole. When planted ± 600m below finished ground level.

The cable entry shall be manufactured in such a way the cables will not be damaged by the sides of the hole. The minimum dimensions of the hole are 100mm x 60mm. The cable entry shall be at the back of the pole.

Pole extension and pole stubs shall comply with this specification.
A pamphlet furnishing full details of the poles extensions and stubs offered shall be submitted with the tender.

PART D

SPECIFICATION FOR ELECTRICAL: INSTALLATION DETAIL SPECIFICATION

1. GENERAL

1.1 This specification comprises all aspects regarding the building electrical installation of the Vulamehlo Magistrate Court. Indududu A, Dududu, KwaZulu-Natal.

1.2 The Detail Specification shall be read in conjunction with the Standard Specifications listed in section 3 below installation and quality specifications schedule of quantities drawings and Special Conditions of Contract included in this document. Where contradictions occur between the documents. the most stringent requirement shall rule, unless otherwise stated by the Engineer.

1.3 All work shall be scheduled in liaison with the Main Contractor to suit his contract programme.

2. SCOPE OF WORKS.

The scope of the installation shall comprise of the following: the supply, delivery, off-loading, installation commissioning testing and guarantee of the following material and equipment associated with the above-mentioned works:

2.1 Compilation of shop drawings, manufacture and installation of purpose-made distribution boards.

2.2 Low voltage cable reticulation from the generator room to all buildings on site.

2.3 Lighting installation.

2.4 Power installation.

2.5 Wireways and conduits to lights, socket outlets and power outlets.

2.6 Cable tray and ducting installation

2.7 Wiring of lighting and power points with PVC insulated conductors and bare copper earth wire.

2.8 Conduit and cable tray installation for communication services inside buildings

2.9 Data and telephone outlet boxes and sockets

2.10 Telephone termination panels.

2.11 Draw wires in all conduits for communication services and other services to be installed by others.

2.12 Area and security lighting

2.13 Cable sleeves.

2.14 Excavation, backfilling and compaction of cable trenches.

2.15 Earthing and bonding of metal structures and sanitary ware accessories

2.16 Lightning protection system

'2.17 Supply, installation, testing and commissioning of an Uninterruptible Power Supply (UPS) unit.

2.18 Supply, installation, testing and commissioning of a backup generator set.

2.19 Site supervision and quality management.

2.20 Commissioning testing and handing over of complete electrical installation detailed above and to provide as-built" drawings.

2.21 12-month defects liability period from the completion of the whole project.

These aspects should be seen only as a brief summary of the scope of work and not as a complete record. Quantities and shall be read or obtained from the drawings and the text of the specification

All components, mounting brackets, draw boxes, junction boxes, cabling, wiring and all other electrical mechanical and civil works required to complete the works in accordance with the specification prior to handover shall be deemed to be included in the tendered rates and prices even though some items may not be mentioned separately. No claims whatsoever in this regard, will be considered after the contract has been awarded.

3. STANDARDS AND CODES OF PRACTICE

3.1 The electrical work shall be carried out strictly in accordance with: SANS 10142A:2008: "The Wiring of Premises"

- SANS 10313-1999: "The Protection of Structures Against Lightning"
- ,Occupational Health and Safety Act 35/1993.
- Department of Public Works Standard Specification for Electrical and Mechanical Installations (These documents area available on request from the Electrical Engineer).
- The Municipal By-Laws and any Local Authority Regulations which may be in force
- The Local Fire Office Regulations.

3.2 Manufacturers specifications and installation instructions

4. POWER SUPPLY TO SITE

4.1 Three-phase, low voltage mains power supply will be connected from the transformer and standby generator power will be installed by the Contractor. The limit of responsibility of the Electrical Sub Contractor is the distribution of power from the transformer to the main distribution board in the generator room and to all buildings equipment and installations on site.

4.2 The Electrical Subcontractor shall register both his company and the work to he done with the local supply authority. Proof of registration shall be submitted to the engineer within 14 days of the

contract being awarded. All regulations and requirements of the local supply authority shall be strictly complied with.

5. WORK PROVIDED BY OTHERS

The following work shall be provided by others:

5.1 Power Supply

5.1.1 Upgrading of bulk power supply to site.

5.1.2 Supply, installation, testing and commissioning of standby power systems. The cable links between the standby generator and the main distribution board in the generator room shall however be done as part of this Subcontract.

5.2.1 Lift installation shall be done by others. The Electrical Sub-contractor shall be responsible for the supply and installation of supply cabling from the power distribution board to the lift control panel.

5.2.2 Air conditioning equipment and ventilation fans shall be supplied and installed by the Mechanical Sub-contractor.

The electrical subcontractor shall be responsible for provision of the necessary outlet points and isolators. The final connection from the isolator to the equipment shall be done by the Mechanical Sub-contractor.

5.3 Water supply and distribution

5.3.1 Geysers shall be supplied and installed by the plumbing subcontractor The Electrical Sub-contractor shall be responsible for providing the local isolator adjacent to each geyser. The final sprague connection from the isolator to the geyser shall be done as part of this subcontract.

5.3.2 Equipment for the domestic water pump system shall be supplied and installed by Others. The Electrical Sub-contractor shall be responsible for provision of supply cables to local isolators and/or distribution boards as may be required.

The final connection from the isolator and/or distribution board to the equipment shall be done by others.

5.4 Communication systems

Wiring for data and telephone services shall be done by others The Electrical Subcontractor shall be responsible for provision of all communication cable sleeves and manholes, cable trays, termination panels, conduit, data and telephone outlets including steel draw wires in all communication cable sleeves and conduit.

6. LOW VOLTAGE CABLE INSTALLATION

6.1 The tender price shall include the supply, delivery, installation, testing and commissioning of all the cables indicated on the drawings, including the marking off and connections at both ends.

6.2 All cables shall have stranded copper conductors and shall be of the PVC/SWA/PVC type 600/1000V Grade and shall comply with SANS 1507. Cables with aluminium conductors are not acceptable.

6.3 All terminations shall be done with lugs, glands and shrouds as specified. Shrouds shall cover the gland completely.

6.4 All cables shall be labelled at both ends. The cables shall be labelled by means of "Grafoplast" or approved type cable markers. The cable label shall indicate the full name of both distribution boards. Thus if DB A1 feeds DB B2 the label at each cable end shall read "DB A1/DB B2"

6.5 Copper earth continuity conductors shall be installed with all low voltage cables, and shall be strapped to the cable at 1500mm intervals.

6.6 Cables in which the phase conductors are colour coded by means of a coloured stripe along the insulation will not be accepted. The entire conductor PVC insulation shall be fully colour coded in red, white, blue or black. The conductors of cables used for single phase loads or connections shall be red and black. Cables with red, white and blue conductors will not be accepted. The entire PVC insulation shall be fully colour coded in red, white, blue or black. The conductors used for single phase loads or connections shall be red and black. Cables with red, white and blue conducts shall not be accepted for use on single phase loads or connections.

6.7 All cables shall be tested after installation in accordance with SABS 1507 by means of a 600V megger. In addition all cables shall be phased out to ensure correct phase rotation.

6.8 All test results shall be submitted to the Engineer in writing, before the final commissioning of the equipment and cables take place.

6.9 It shall be the responsibility of the Electrical Sub contractor to determine the correct lengths of cable required on site, before placing an order. The Sub-Contractor shall not be reimbursed for any surplus or shortfall of cable.

6.10 Cable reticulation outside the buildings shall be by means of underground cables installed in HDPE sleeves. Where sleeves are not specified cables shall be laid directly in the ground Minimum laying depths shall be 650 mm below final ground level unless otherwise specified and routes shall be as indicated on the drawings.

6.11 All trenching including excavations bedding layers shoring and prevention of water-logging, drainage of excavations backfilling and compaction of trenches form part of this contract. Trenches shall be compacted to a minimum of 93% of modified AASHTO density during backfilling.

6.12 The Sub Contractor shall take cognisance of the fact that other services might be installed along the same routes as the cables. The Sub Contractor shall before commencing with any excavations, peg out the proposed cable route and confirm it with the Engineer,

6.13 Positions of cable markers shall be pegged on site in collaboration with the Engineer. The wording of the labels shall be provided by the Engineer.

6.14 Joints will not be permitted in any of the low voltage cables.

6.15 Cables Installed on Cable trays.

6.15.1 Cables shall be fixed to the cable trays by means of stainless steel strapping at 600mm spacing.

6.15.2 The Contractor shall plan cable runs prior to installation of cables as crossing of cables will not be accepted unless it is impossible to avoid.

7. DISTRIBUTION BOARDS

7.1 General

7.1.1 New distribution boards shall be supplied and installed as part of the contract for the various buildings. Distribution boards shall be powder coated and colour shall be as specified.

71.2 The distribution boards shall be installed in the positions as indicated on the drawings.

7.1.3 Physical dimensions shall be confirmed by the Electrical Contractor prior to manufacturing.

7.1.4 Equipment for all distribution boards shall be fitted and wired at the factory.

7.1.5 Each distribution board shall be equipped with a label stating that that particular board is part of a fully discriminating and cascaded system and switchgear which is being replaced shall be replaced with identical equipment only.

7.1.6 Legend cards shall be installed on the inside of distribution board doors.

7.2 Manufacture

7.2.1 Electrical contractors are advised to order their distribution boards from a reputable manufacturer as inferior boards will most definitely not be accepted.

7.2.2 Distribution boards shall be of the fully surface or flush mounted type with bonding tray and pad lockable doors.

7.2.3 All equipment shall be mounted behind removable panels.

7.2.4 The front panel of the board shall be secured by means of the Perano or Procast type knurled edge catches. Catches with slots or square key facilities will not be acceptable. Each front panel shall also be fitted with 2 approved D type handles top and bottom to assist removal and replacement.

7.2.5 Door hinges shall be of the Procast or similar type. All panels shall be supplied with handles.

7.3 Equipment

7.3.1 All phase neutral and earth bars shall be adequately sized to accommodate existing circuits as well as allow for 40% future.

7.3.2 Lightning arrestors with indication shall be fitted to distribution boards as indicated on the electrical drawings.

7.3.3 All distribution board equipment shall be of Merlin Gerin manufacture or approved equal.

7.3.4 Circuit breakers shall be used in the cascade arrangement and only cascade arrangements proven by SABS tests shall be utilised throughout.

7.3.5 All circuit breakers shall be rated for a fault level as indicated on the relevant distribution board schematic diagram.

7.3.6 All distribution board equipment shall bear the SABS mark of approval.

7.3.7 Lightning arrestors/surge diverters on all distribution boards shall be connected to the earth bar by means of 16mm^2 bare copper earth conductor.

7.3.6 Current transformers where fitted are to be fitted so that they can be removed if necessary without dismantling the complete busbar arrangement Likewise NRC fuses mounted directly onto busbars will not be permitted All fuses are to be as accessible as other items e.g. circuit breakers.

7.4 Drawings

7.4.1 Three sets of manufacturers drawings of each distribution board shall be submitted for approval by the Engineer before manufacture of the distribution boards may commence.

7.4.2 It shall be noted that late approval of drawings and distribution boards due to noncompliance with the specification will not relieve the Contractor from his obligations to complete the installation according to programme. No claims for delays or for extension of time in this regard, will be entertained.

7.5 Schedule of distribution boards

Distribution Boards shall be installed in the positions indicated on the drawings and according to the detailed schematic diagrams forming part of this specification.

8. CONDUITS, POWERSKIRTING, CABLE TRAYS AND CABLE LADDERS

8.1 Conduits

8.1.1 All conduits and accessories shall bear the SABS mark of approval.

8.1.2 Contractor to note that only galvanised steal conduit and accessories shall be used in the Cell Stock building. SABS approved PVC conduit may be used internally for the administration building.

8.1.3 All external conduits exposed to sunlight or rain shall be galvanised steel. External draw box covers shall be seated with white silicone after the installation is completed.

8.1.4 Conduit installation on masonry wall surfaces shall not be permitted in the building. All conduit to be built into walls Chasing by means of hammer and chisel will not be accepted Chasing work, if required, shall be carried out by means of power driven machinery using abrasive cutting discs after consultation and approval of the Engineer.

8.1.5 Conduit work under open roof structures and inside accessible ceilings shall be done in a

rectangular grid pattern. Steel saddles shall be used inside ceilings. Caddy clamps shall be used on roof purlins. maximum spacing of saddles and clamps shall be 750 mm.

8.1.6 All steel conduits shall be securely bonded to earth.

8.1.7 Bushes fitted to steel conduits shall be brass only. Other materials are unacceptable.

81.8 Raised conduit saddles shall be installed at 1500mm intervals.

8.1.9 All conduit offsets shall be neat and at equal angles.

8.1.10 All conduits installed for services provided by others shall be fitted with 2.5 mm^2 galvanised draw wire if the wiring is not installed as part of this subcontract.

8.1.11 Electrical Sub contractor to note that the ceiling for the security passage in the cell block shall be mesh wire therefore conduit installation from the distribution board to all circuits on the other side of the security passage shall be through the floor to achieve a neat installation.

8.2 Power skirting

8.2.1 Power skirting shall be the 250mm high x 65mm deep, 3-compartment, 3-lid galvanised steel type and shall be approved range.

8.2.2 Power skirting shall be supplied complete with purpose-made faceplate equipment and all the necessary accessories including covers, bends, clip-on partitions, etc.

8.2.3 Power skirting shall be used for power data and telephone wiring and outlets shall be compatible with the power skirting.

8.2.4 The power skirting sections shall be linked to power distribution board and telephone draw box and termination panel by conduit installed to a pre manufactured conduit entry unit behind the power skirting. The power skirting shall be clearly marked on the front cover conduit entry. At least three 32mm diameter and two 32mm diameter PVC conduits shall be used to link any section of the power skirting to the power distribution board and telephone termination board respectively.

8.2.5 The same arrangement shall apply at positions where power skirting are interlinked. A minimum of five 32 mm diameter PVC conduit shall be installed in each case; i.e. power 3x, data lx and telephone lx.

8.3 Cable trays

8.3.1 Cable trays shall be of the heavy duty 2.5 mm thickness hot dipped galvanised steel type or approved equivalent trays. The cable tray width shall be as specified on the relevant drawings.

8.3.2 Only purpose-made splices, risers, offsets anti bends shall be used.

8.3.3 Trays shall be fastened onto 500 mm lengths of P2000 unistrut. Each unistrut section shall be fixed to the roof or wall steel sheeting with galvanized 10 mm x 50mm. Fisher anchors. Unistrut spacing shall be 600 mm maximum. Only purpose-made accessories shall be used.

8.4 Cable ladders

8.4.1 Cable ladders shall be hot dipped galvanized and all members shall be 2 mm thick. with 76 mm side rails and cross rungs at 375 centres Cable ladders shall be supported at maximum 800 mm intervals with approved galvanized suspension brackets or P2000 unistrut or 10 mm galvanized threaded rod hangers.

8.4.2 The width shall be as specified and only purpose-made accessories shall be used.

8.5.1 Steel trunking where required shall be the hot dip galvanised type with 0 8 thickness complete with elbows. tees and covers. The width shall be as specified.

8.5.2 All surface-mounted distribution boards except where big cables are run from the distribution board shall be linked to openings in ceilings or floors by means of 127 mm wide hot dip galvanised steel trunking supplied complete with distribution outlets and covers. The trunking shall be powder coated and the colour shall match the DES exterior colour.

9. LIGHTING INSTALLATION

9.1 General

9.1.1 The electrical subcontractor shall allow for the supply and installation of the complete new lighting layout as indicated on the relevant drawings.

9.1.2 Samples of luminaires shall be submitted to the engineer for approval before ordering commences.

9.1.3 All light fittings shall be delivered to site in boxes as packed by the manufacturer. When the work is handed over. all light fittings shall be in a working condition, new and unused.

9.1.4 The permanent light fittings intended for installation shall not be used for temporary lighting during construction The certificate of completion for the installation will not be finalised unless all light fittings and lamps are in working order,.

9.1.5 All linear fluorescent type luminaires shall be equipped with 26mm diameter tubes generally 1200mm long and with a colour temperature of 4300K (cool white) and minimum colour rendering index (RI) of 84 unless otherwise stated. The engineer will reject unmarked lamps. All costs to replace these lamps with marked lamps will be for the contactors account.

9.1.6 All PL- type lamps shall be colour 41 with a temperature of 2700K. Lamps not marked thus will not be accepted, as stipulated above.

9.1.7 Conduits shall be installed as indicated on drawings. Special care shall be taken to ensure that conduit connections do not violate the IP rating of luminaires. This applies specifically to the exterior luminaires. Mounting holes and conduit entries shall be sealed with black silicone after connection.

9.1.8 No luminaires shall be fitted to masonry wall with fasteners smaller than 3.5 mm diameter and a wall plug smaller than 8mm diameter. Galvanised 30mm C fender washers shall be used with each fastener.

9.1.9 In suspended ceilings, the circuit wiring shall consist of 20mm conduits and standard 100 x

50 mm draw boxes above the ceiling. In close vicinity of the luminaire positions a 5A un-switched socket outlet shall be provided fixed to the conduits for support for power supply to luminaires.

9.1.10 All indoor fluorescent luminaires to be supplied with 3m electrical cord fitted with a 5Amp socket.

9.2.1 Tenderers to note the 16A current rating of switches.

9.2.2 100 x 50 x 50mm draw boxes shall be provided for light switches.

9.2.3 Light switches for the cells, cell yards, kitchen and kitchen yard shall be the industrial watertight rotatable type.

9.2.4 Except for the areas mentioned in clause 9.2.3 above all other light switches shall be the normal switches supplied complete with white steel cover plates. The light switches shall be of the same manufacture as the other outlets installed in the office buildings e.g. socket outlets.

9.2.5 Photocells shall be accommodated inside IP 65 bulkhead luminaires to direct switching of lighting circuits via photocell contacts shall be accepted.

9.3 Mounting Position

9.3.1 Internal and external light fittings shall be installed at positions shown on the relevant lighting drawings.

9.3.2 Mounting heights for wall mounted light fittings shall be as shown on the drawings.

9.4 Schedule of luminaires

9.4.1 All luminaires shall bear the SABS mark of approval Luminaires shall be provided complete with lamps and control gear.

9.4.2 The following luminaire types are to be installed in the positions indicated on the drawings:

Type	Description
A	3 x 35W (or 28W) T5 recessed fluorescent luminaire complete with with mounting accessories, lamps and telescopic holders, 230V, HF, electronic ballast, IP65, white, 1200x600,
AE	3 x 35W (or 28W) T5 recessed fluorescent luminaire complete with with mounting accessories, lamps and telescopic holders, 230V, HF, electronic ballast, IP65, white, 1200x600, emergency luminaire, 8hr runtime, automatic function
B	3 x 35W (or 28W) T5 recessed fluorescent luminaire complete with with mounting accessories, lamps and telescopic holders, 230V, HF, electronic ballast, IP65, white, 600x600
BE	3 x 35W (or 28W) T5 recessed fluorescent luminaire complete with with mounting accessories, lamps and telescopic holders, 230V, HF, electronic ballast, IP65, white, 600x600, emergency luminaire, 8hr runtime, automatic function
C	2x28W T5 open channel fluorescent luminaire complete with with mounting accessories, lamps and telescopic holders, 230V, HF, electronic ballast, IP65, white
D	2 x 18W CFL bulkhead complete with mounting accessories and lamps,

	indoor. 230V, powder coating
E	2 x 18W CFL bulkhead complete with mounting accessories and lamps. indoor. 230V, powder coating. decorative, dimmable
F	19x1W LED downlight with diffuser, natural white, 75^0, recessed. decorative, dimmable
G	8W emergency exit light. 3hr battery backup time. auto switching, charger included, complete with accessories , maintained emergency exit sign

10. POWER INSTALLATION

10.1 Power skirting

10.1 All power skirting outlets shall be compatible with the power skirting installed as part of this contract.

10.1.2 Normal outlets shall be the standard 16A 3-pin of the switched type. Dedicated outlets shall be red 16A 3-pin of the switched type with a half round earth pin. One red plug top shall be supplied with each dedicated socket outlet installed.

10.1.3 Air conditioner outlets, if required in power skirting, shall consist of 20A double pole isolators mounted in the power skirting with cord grip grommets to accommodate the air conditioner cable.

10.1.4 Telephone and data outlets shall consist of purpose-made outlet covers. Telephone outlets shall be RJ11 sockets. Data outlets shall consist of RJ45 sockets.

10.2 Single phase socket outlets in wall

Normal socket outlets shall be the 16A, flush mounted single or double 3 pin switched sockets with cover plates to match the outlets and colour to be approved by the Architect.

10.3 Isolators

10.3.1 Local isolator for hand dryer shall consist of 20A recessed double pole complete with outlet box cover plate and cord grip grommet to accommodate the hand dryer cable position shall be as indicated on the drawing.

10.3.2 Isolators for air conditioning units and geysers in offices shall consist of 20A surface mounted double pole complete with outlet box and cover plate. Position shall be as indicated on the drawing.

10.3.3 Isolators for external condensing units shall consist of 60A triple pole unit for three phase units and 20A double pole units respectively complete with IP66 York enclosure. Position shall be as indicated on the drawing

10.3.4 Isolator for cell block stove shall consist of 60A recessed triple pole unit complete with outlet box and cover plate The isolator shall be installed at 1400 affl and shall be linked to a 100 x 100 steel draw box installed directly below the isolator at 100mm affl.

11. WIRING

11.1 All internal wiring shall, unless stated otherwise, comprise of PVC insulated, stranded copper conductors and bare stranded copper earth continuity conductors.

11.2 Wiring shall not be drawn into conduit until the conduit installation has been completed, fitted with bushes and all moisture and debris has been removed.

11.3 No joints of any kind shall be permitted in wiring. No more than 1 single or 1 three phase circuit may be drawn into any conduit.

11.4 No "surfix' or "twin & earth" shall be accepted.

11.5 The following minimum conductor sizes shall be used:

Circuit	Minimum conductor (size)	
	Phase (mm^2)	Earth (mm^2)
Lighting	2.5	2.5
Socket outlet	2.5	2.5
Geyser	4	2.5
Hand drier	4	2.5
Internal Aircon	4	2.5
Extractor fans	4	2.5
Cell block stove	10	6
Refrigerator / Cold room	10	6

11.6 Wiring for telephone and data shall be supplied, installed and terminated by others. The Electrical Sub Contractor shall only be responsible for provision of all wireways and termination panels required for the data and telephone installation.

12. TELEPHONE AND DATA INSTALLATION

12.1 Supply, delivery and installation of the telephone distribution boards, conduit, draw boxes, outlets and cover plates, external sleeves and manholes form part of this contract.

12.2 Telephone points not installed in power skirting shall be flush mounted 100 x 50 x 50 mm draw boxes complete with cover plate.

12.3 2.5mm diameter galvanised draw wire shall be installed in all telephone and data conduits. All communication outlet points shall be interlinked by means of 20mm diameter conduit which shall terminate in the telephone distribution board supplied and installed as part of this contract.

12.4 Telephone outlets shall be RJ11 sockets and data outlets shall be the RJ45.

12.5 Telephone distribution board shall be 600mm x 500 mm flush mounted cabinet with door and fitted with a wooden backboard. The board shall be labelled "Telephone 03". Engraved labels shall be used.

12.6 Telephone draw box shall be the 300mm x 300 mm flush mounted cabinet with door and fitted with a wooden backboard.

13. EARTHING AND BONDING

13.1 General

13.1.1 The Electrical Sub Contractors to ensure that the installations covered in this document are effectively earthed and bonded in accordance with the requirements of SANS 10142.

13.1.2 All hot and cold water and waste metal pipes are to be effectively bonded by means of 12.5mm x 16mm 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 rounded brass screws at intervals not exceeding 150mm.

13.2 Lightning protection system

13.2.1 A provisional sum has been allowed in the bills of quantities for soil resistivity tests and provision of a lightning protection system by a specialist subcontractor.

13.2.3 The lightning protection system shall be provided for each building and it shall conform to SANS 10313 "The Protection of Structures Against Lightning".

13.2.4 The system shall comprise of roof conductors down conductors testing joints and earth electrodes

13.2.5 The materials for the component parts of the lightning protective system shall be those detailed in SANS 10313.

13.2.6 All metallic projections on or above the main surface of the roof structure shall be bonded to the protective system and shall form part of the air termination network.

13.2.7 Testing joints shall be provided at approximately 100mm above ground level.

13.2.8 Earth electrodes shall consist of copper-alloy rods and the diameter and length shall be as determined by the earthing specialist subcontractor based on the soil test results.

13.2.9 On completion of the installation the whole system shall be tested and copy of the results shall be forwarded to the Engineer together with the Certificate of Compliance for the lightning protection system as per SANS 10313.

14. AREA AND SECURITY LIGHTING

14.1 Security fighting shall be provided along the perimeter of the boundary fence as part of this Sub-Contract.

14.2 Security lighting shall be provided by means of pole mounted light fittings installed at positions shown on the relevant drawing.

14.3 Light poles shall be the 76mm diameter 3m high (mounting height manufactured from hot deep galvanised steel. The light poles shall be painted and architect shall advise on colour. Mounting brackets shall also be hot dipped galvanised.

14.4 All luminaires associated equipment and control gear shall be new and unused and shall be complete with lamp control gear visors refractor bowls as applicable mounting brackets and all

other accessories to make the luminaires fully operative. The luminaires shall be delivered to site in protective covering.

14.5 All luminaires shall be equipped with an earth terminal and shall be earthed.

14.6 70W HPS IP 65 floodlight luminaire shall be used for the security lighting.

15. CABLE: SLEEVES AND MANHOLES

15.1 All electrical and communication sleeves and manholes shown on the drawings shall be supplied and installed as part of this Sub-Contract.

15.2 The sleeves shall be installed at a minimum depth of 600mm below final ground level.

15.3 Crossings of all sleeves must be at 90° with the communication sleeves on the top.

15.4 All communication sleeves shall be fitted with 4mm ø galvanised draw wire.

15.5 On completion of the project the end of all unused sleeves shall be sealed with paper and weak cement mixture.

16. BALANCING OF LOADS

The Electrical Sub-Contractor shall be responsible for the measurement, testing and balancing of loads between all the phases of busbars to the satisfaction of the Engineer. Distribution board equipment shall be connected in such an order that the load is balanced across all three phases.

17. SITE TESTS AND COMMISSIONING

17.1 It is the responsibility of the Electrical Sub-Contractor to provide all labour, accessories and properly calibrated and certified measuring instruments necessary for all the tests required under this contract.

17.2 Prior to beginning any aspect of commissioning the contractor shall present for the Engineers review/approval two copies of a complete commissioning procedures manual including checklists. The relevant checklists shall be utilised and formally signed off as part of the commissioning phase.

17.3 Preparation of commissioning report shall include. but not necessarily limited to:

17.3.1 Manufacturers operating servicing and maintenance manuals for each and every individual item of plant installed.

17.3.2 Inventory for the items of mechanical/electrical plant(s) and or equipment that shall be for installation in the project.

17.4 The following minimum site tests shall be carried out by the electrical contractor and the results presented to the Engineer:

- Insulation resistance between all conductors and earth
- Insulation resistance between all conductors and neutral

- Insulation resistance between all 3 phase conductors
- Resistance of earth path between the main earth bar. all exposed conductive parts of the installation and distribution boards
- Polarity of light switches and socket outlets
- Earth leakage protection
- Phase rotation of three phase circuits