CSIR CHPC
ROSEBANK, HOPE STREET, CAPE TOWN

INSTALLATION OF BULK POWER SUPPLY CABLES AND ELECTRICAL INFRASTRUCTURE AT CSIR CHPC: ROOMS 27, 31, AND MAIN DATA CENTER

ELECTRICAL ENGINEERING INFRASTRUCTURE
TECHNICAL SPECIFICATIONS

Table of Contents:

CSIR CHPC
Rosebank, Hope Street, Cape Town

THE INSTALLATION OF ELECTRICAL INFRASTRUCTURE

TECHNICAL SPECIFICATIONS

1. GENERAL TECHNICAL SPECIFICATION

1.1 GENERAL

The purpose of this section of the specification is to detail, as far as possible, the general requirements pertaining to the new electrical installation for this project. The actual scope of the electrical equipment to be supplied, installed, or refurbished shall be in accordance with the requirements of the specifications and drawings.

The project involves the extension of the bulk power supply from existing Uninterruptible Power Supply (UPS) Distribution Boards (DBs) to new high-density ICT rack locations within Room 27, Room 31, and the Main Data Center. The design philosophy centers on Tier III redundancy, ensuring each rack receives a dual-feed (System A and System B) to maintain concurrent maintainability.

1.2 PROJECT DESCRIPTION

This contract comprises the supply, delivery, installation, refurbishment, modification, testing, and handing over in good working order of the complete electrical installation and infrastructure as described in this specification.

1.2.1 Low Voltage (LV) Cable Installation and Distribution Infrastructure

- **Bulk Supply Cables:** Supply and install new XLPE/SWA/PVC copper cables (600/1000V grade) from the existing UPS Room DBs to the new Distribution Boards in Room 27 and Room 31, as well as to the existing, upgraded Distribution Board in the Main Data Center.
- **Distribution Boards:** Supply and install four new dual-feed DBs (System A and System B) across Room 27 and Room 31 to feed new ICT racks and cooling infrastructure. Execute the comprehensive refurbishment, component upgrade, and integration of new expansion circuits within the existing Main Data Center Room Distribution Board to safely accommodate the new expansion ICT rack loads.
- **Routing:** Cables shall be installed on new or existing heavy-duty galvanized wire mesh cable trays. All penetrations through fire-rated walls must be sealed using approved fire-stop specialized foam or pillows to maintain the facility's fire integrity.
- **System Separation:** System A and System B cabling must be physically separated by a minimum of 300mm on cable trays or installed on entirely separate containment routes to mitigate simultaneous failure risks.
- **Labelling:** All cables must be clearly labelled at both ends and at 5m intervals with UV-resistant, engraved Trifoliate tags indicating source, destination, and cable size.

1.2.2 Distribution Board (DB) Installation

Supply, deliver, and install the following floor-standing or wall-mounted (as per site space constraints) powder-coated sheet steel DBs:

Location	DB Designation	Primary Load Type
Room 27	DB-R27-A & DB-R27-B	ICT Racks & Cooling Systems
Room 31	DB-R31-A & DB-R31-B	ICT Racks & Cooling Systems
Main Data Center	DB-MDC-Ext-A & B	ICT Racks Only

Technical Specifications for DBs:

- **Fault Level:** Minimum 10kA (or as determined by final discrimination study).
- **Incomers:** Appropriately rated 4-Pole MCCBs with integrated surge protection (Type 1+2).
- **Monitoring:** Digital power meters (Class 0.5) with Modbus/TCP integration capabilities for remote monitoring via the Building Management System (BMS).
- **Busbars:** Tinned copper busbars, color-coded and shrouded for safety.

1.2.3 Rack Power Distribution

- **Dual Feed Logic:** Each rack position shall be provided with two independent circuits (Feed A from System A DB and Feed B from System B DB).
- **Final Sub-circuits:** Installation of 32A (or as per rack spec) single-phase or three-phase industrial sockets (e.g., IEC 60309 "Commando" type) under the raised floor or overhead on ladder racking, depending on the rack configuration.
- **Cooling Supplies:** Dedicated radial circuits from Room 27 and Room 31 DBs to the In-Row or Perimeter cooling units, including local isolators.

1.2.4 Containment and Infrastructure

- **Raised Floor Work:** Lifting and replacing of floor tiles. Ensure all under-floor cabling is neatly loomed and does not obstruct the airflow of the cooling system.
- **Earthing and Bonding:** All new DBs and cable trays must be integrated into the existing clean-earth (telecoms earth) grid of the CHPC facility. Ensure all racks are bonded to the common bonding network (CBN).

1.2.5 Testing and Commissioning

- **SANS 10142-1 Compliance:** Issuance of a Certificate of Compliance (CoC) for the entire installation.
- **Load Balancing:** Measurement and adjustment of phases to ensure a balanced load across the UPS systems.
- **Point-to-Point Testing:** Verification of A/B redundancy at every rack socket to ensure no single point of failure exists between System A and System B.
- **Labelling & Schematics:** Provision of updated "As-Built" drawings in CAD/PDF format and updated laminated single-line diagrams (SLDs) inside every new DB door.

1.3 SCOPE OF WORKS

The electrical scope of works for the CSIR CHPC facility involves the supply, installation, refurbishment, and commissioning of a redundant low-voltage distribution system to support the expansion of Room 27, Room 31, and the Main Data Center. This entails:

- **Cable Installation:** Routing new XLPE/SWA/PVC copper bulk supply cables from the existing UPS Room distribution boards via new heavy-duty galvanized wire mesh trays to the designated distribution nodes.
- **New Distribution Boards:** Supplying, installing, and commissioning four new dual-feed DBs (comprising System A and System B units) in Room 27 and Room 31, configured to supply both the new ICT racks and their associated cooling infrastructure.
- **Existing DB Refurbishment:** Carrying out the comprehensive refurbishment, modification, and component upgrade of the existing Distribution Board within the Main Data Center room to safely accommodate and integrate the new expansion ICT rack loads.
- **Rack Power Distribution:** Providing independent A and B power feeds to each new rack position across all three rooms, terminated at appropriately rated industrial-grade sockets (IEC 60309) to ensure Tier III concurrent maintainability.
- **Ancillary Works and Compliance:** The contractor shall be fully responsible for all secondary containment, certified fire-stopping at all new wall penetrations, earthing and bonding to the facility's existing clean-earth grid, and the integration of digital metering for BMS tracking. The entire installation must culminate in rigorous testing and the issuance of a SANS 10142-1 Certificate of Compliance (CoC).

1.4 METHODOLOGY AND SEQUENCE OF WORK

1.4.1 Overview and Pre-construction Requirements

The primary objective of this project is to upgrade the electrical infrastructure supporting the CSIR CHPC Data Center with minimal disruption to ongoing operations and near-zero downtime. The entire scope of electrical upgrading work shall be executed over a period of three to four months. While this section outlines the mandatory minimum sequencing framework required by the Employer, the successful Electrical Contractor shall remain fully responsible for the detailed operational execution. Prior to the commencement of any physical construction or site work, the Contractor shall produce and submit a comprehensive, site-specific Method Statement and a detailed Construction Work Programme for formal approval by both the CSIR and the Engineer.

1.4.2 Phase 1: New Distribution Infrastructure and Containment

The initial phase of works focuses on establishing the core power distribution footprints for the expansion zones without affecting the live environment. The Contractor shall manufacture, factory-test, deliver, and install all new electrical distribution boards (DBs) designated for Room 27 and Room 31. Following successful installation of the panels, the Contractor shall lay, secure, and terminate the main sub-transmission supply cables connecting these new DBs in Room 27 and Room 31 directly to the primary UPS supply source. At this stage, no permanent wiring or terminations shall be made to the server racks within Room 27 and Room 31, as the existing Main Data Center must maintain operational priority.

1.4.3 Phase 2: Temporary Power Routing for Core Operations

To facilitate the critical upgrades required on the central infrastructure, the existing Main Data Center server racks must temporarily draw power from a redundant footprint. The Contractor shall route and terminate temporary supply cabling from the newly commissioned DBs in Room 27 and Room 31 to the live racks within the existing Main Data Center. This temporary bypassing operation must be coordinated meticulously to guarantee continuous, uninterruptible power supply to the active server infrastructure.

1.4.4 Phase 3: Central Infrastructure Upgrades and Permanent Rack Wiring

With the live critical load safely migrated to the temporary supply matrix, work on the primary power hub can commence. The Contractor shall execute the scheduled upgrades, technical improvements, and component replacements on the existing UPS DBs servicing the Main Data Center. Concurrently, the Contractor shall install the permanent, high-integrity new wiring networks from these upgraded distribution systems to all the newly deployed server racks within the Main Data Center space, preparing the primary room for its final configuration.

1.4.5 Phase 4: Critical Switchover and Expansion Integration

Once the primary Main Data Center distribution hub is fully upgraded and verified, the critical power migration must take place under strict supervision. The Contractor shall execute a seamless power switchover, transferring the Main Data Center racks from their temporary supply lines (Room 27 and Room 31) back onto the newly upgraded, permanent UPS DB's. Once the Main Data Center is stable on its permanent supply, the Contractor shall proceed to wire, connect, and power up the expansion server racks located in Room 27 and Room 31.

1.4.6 Phase 5: Testing, Commissioning, and Handover

The final phase requires rigorous verification of the entire interconnected electrical system to ensure grid compliance, protection coordination, and system reliability. The Contractor shall conduct comprehensive testing and commissioning of all modified and newly installed infrastructure under the supervision of the Engineer. The sequence of work concludes with the mandatory compilation of all test records and the issuance of a formal Certificate of Compliance (CoC) to the CSIR, signalling successful project completion and handover.

1.4.7 Mandatory Sequence of Work

The electrical contractor shall strictly adhere to the following sequential order of execution:

- **Step 1:** Submit detailed Construction Programme and Method Statement for CSIR and Engineer approval.
- **Step 2:** Manufacture and install all new electrical distribution boards for Room 27 and Room 31.
- **Step 3:** Install and terminate supply cables between the new DBs in Room 27 and Room 31 and the main UPS supply (Do not wire Room 27 and Room 31 racks).
- **Step 4:** Install and commission temporary power wiring from the new DBs in Room 27 and Room 31 to the active racks in the existing Main Data Center.
- **Step 5:** Execute upgrading and infrastructure improvements on the existing UPS DBs in the Main Data Center.
- **Step 6:** Install permanent new wiring to all the new racks within the Main Data Center.
- **Step 7:** Perform the critical power switchover to transfer the Main Data Center racks from the temporary supply back to the upgraded permanent UPS DBs.
- **Step 8:** Complete the permanent wiring, connection, and final power-up of the expansion server racks in Room 27 and Room 31.
- **Step 9:** Conduct final testing and commissioning of the entire electrical installation.
- **Step 10:** Issue the official Certificate of Compliance (CoC) and close out the site.

1.5 STANDARD OF MANUFACTURE

All electrical equipment supplied for the CSIR CHPC facility shall be suitable for operation in a high-density data center and office environment and must be of approved manufacture. All components, installations, and refurbishment works shall comply in all respects with the latest relevant editions of International (IEC), South African (SANS, SABS, and NRS), British (BS), or American (NEMA/IEEE) standards and codes of practice.

Particular adherence to **SANS 10142-1** (The Wiring of Premises) is mandatory for all new installations and modifications to existing infrastructure.

Where equipment is offered to specifications other than those explicitly called for, full technical details must be provided at the tender stage at no additional cost. The Contractor shall be required to supply two copies of each such alternative specification for review and approval by the Engineer.

The contractor must explicitly indicate the manufacturer and brand names of all materials and switchgear tiered/tendered on within the provided returnable schedules.

1.6 QUALITY OF MATERIALS

Unless otherwise specified, directed, or approved, all materials and workmanship on the Works shall comply with the appropriate SANS Specification or Code of Practice. In the absence of a relevant local standard, the appropriate British Standard (BS) or International Electrotechnical Commission (IEC) Specification or Code shall apply. All equipment and components shall bear the official mark of the appropriate standards authority.

All materials shall, except where otherwise specified, be brand new, of the highest commercial quality, and must be suitable to withstand and operate satisfactorily under the specific localized climatic and weather conditions reasonably expected at the Rosebank, Cape Town site. Given the critical nature of the CHPC data center environment, particular attention must be paid to dust mitigation, indoor temperature profiles, and continuous operational reliability.

All storage, handling, transport, erection, or installation of plant, equipment, and materials shall be carried out strictly in accordance with the supplier's or manufacturer's written instructions; however, the Engineer reserves the right to vary such instructions should they deem such variations necessary for site integration.

Where the supplier's or manufacturer's instructions conflict with these Specifications, the requirements of these Specifications shall take precedence unless otherwise explicitly agreed to in writing by the Engineer. The Contractor is under a strict obligation to bring any such conflict to the Engineer's notice immediately upon discovery.

1.7 SAFETY

The statutory requirements of the Occupational Health and Safety Act No. 85 of 1993 (as amended), Mineral Act and Regulations (Act No 50 of 1991) (as amended) or any other act passed in substitution thereof and applicable to The Local Authority. Particular regard to safety of personnel shall be taken in the installation and guarding of all electrical equipment.

The contractor must appoint a health and safety officer as required by law, unless appointed by Contractor. The contractor must supply with his tender his health and safety plan as well as his risk assessment plan. The contractor must implement all check sheets for material and equipment as required by law.

The contractor must include the price of these requirements for his Occupational Health and Safety expenses.

The client must check and audit the contractor on applying the steps as mentioned above. If the client is not capable to check the contractor on the above, he may appoint a capable person to act on his behalf.

1.8 STATUTORY ACTS, REGULATIONS, AND STANDARDS

The entire electrical installation and refurbishment shall be executed, tested, and commissioned in strict accordance with the statutory requirements, regulations, and bylaws listed below, including all latest amendments:

- The Occupational Health and Safety Act, 1993 (Act No. 85 of 1993), as amended.
- The Electricity Regulation Act, 2006 (Act No. 4 of 2006), as amended.
- The National Building Regulations and Building Standards Act, 1977 (Act No. 103 of 1977), as amended.
- The Local Government: Municipal Systems Act, 2000 (Act No. 32 of 2000), alongside relevant City of Cape Town Municipal Electricity Supply By-Laws and any special requirements of the local supply authority.

The latest editions of the following South African National Standards (SANS) are explicitly applicable to this contract:

Standard Number	Description
SANS 10142-1	Code of Practice for the Wiring of Premises (Part 1: Low-voltage installations)
SANS 1507 (Series)	Electric cables with extruded solid dielectric insulation for fixed installations
SANS 60947-2	Low-voltage switchgear and controlgear (Part 2: Circuit-breakers)
SANS 156	Moulded-case circuit-breakers
SANS 1973-3	Low-voltage switchgear and controlgear assemblies (Part 3: Safety-tested distribution boards)
SANS 61386-21	Conduit systems for cable management (Part 21: Particular requirements - Rigid conduit systems)
SANS 950	Unplasticized polyvinyl chloride (PVC-U) conduits and fittings for use in electrical installations
SANS 60669-1	Switches for household and similar fixed electrical installations
SANS 767-1	Earth leakage protection units (Part 1: Fixed earth-leakage protection circuit-breakers)
SANS 1085	Wall-mounting boxes for electrical accessories
SANS 62305 (Series)	Protection against lightning (Surge Protection Measures)

1.9 TESTING AND COMMISSIONING

The Engineer reserves the right to inspect any of the equipment to be supplied or refurbished at any stage of manufacture, assembly, or erection, and to be present during any stage of the specified testing procedures.

Upon completion of the electrical installation, the Contractor shall perform all mandatory tests in strict accordance with **SANS 10142-1** and any specific requirements stipulated by the Engineer. These tests are required to ensure that all new and modified equipment, distribution boards (including the refurbished Main Data Center DB), bulk cabling, final sub-circuit wiring, industrial socket outlets, and luminaires have been correctly connected, balanced across phases, and that the entire installation is safe and ready for handing over into regular, continuous service.

The Contractor shall commission all equipment and distribution networks in the presence of the Engineer. This must include point-to-point verification of the independent System A and System B dual-feed redundancy at every new rack position.

The Contractor shall provide all necessary testing and calibration equipment, which must be of an accepted international standard. All test instruments utilized by the Contractor on site must have been calibrated within the 12 months preceding the testing date, and valid calibration certificates must be available on site for inspection by the Engineer.

The Contractor shall give the Engineer at least **14 days' written notice** prior to the commencement of any formal testing and commissioning schedules.

A valid statutory **Certificate of Compliance (CoC)**, as required by the OHS Act and SANS 10142-1, alongside fully detailed, marked-up "As-Built" drawings and updated single-line diagrams, shall be submitted to the Engineer immediately upon successful completion and prior to the final handing over of the site.

1.10 DRAWINGS

The positions of plant, distribution equipment, cable containment routes, and electrical outlet points shown on the engineering drawings are approximate only and, in some instances, diagrammatic. The building plans provided are sufficiently accurate for Tenderers to measure quantities for tendering purposes. However, the Contractor must verify all actual positions and structural dimensions on site prior to commencement of any fabrication or installation works. No claims for extras will be entertained for any alterations required to work that proceeded without prior site verification.

Before fixing any containment, conduits, distribution boards, or accessories, the Electrical Contractor shall coordinate closely with the Principal Contractor and consult the latest architectural and structural detail drawings to ensure the exact positioning of all equipment. Any discrepancy, spatial conflict, or misalignment between the Electrical Engineering drawings, Architectural drawings, and the actual site conditions must be reported immediately to the Engineer in writing for clarification before proceeding with the affected works.

1.11 CABLES

1.11.1 PVC INSULATED CABLES

The cables shall be manufactured in accordance with SANS 1507 and bear the SANS mark.

Cables shall be constructed as follows:

Unarmoured cables: PVC-insulated/PVC-sheathed

Armoured cables: PVC-insulated/PVC-bedded/armoured/black extruded PVC outer sheath

Single core cables: PVC-insulated unsheathed for installation in wire ways

Single core cables: PVC-insulated with PVC sheath to SANS 1507-3

Insulation: PVC 600V/1000V

The conductors shall be of high conductivity annealed or hard drawn stranded copper.

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. The bedding may be extruded as part of the PVC sheathing.

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.

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

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

1.11.2 CABLE GLANDS FOR PVC CABLES

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

Glands shall be suitable for general purpose 600/1 000 V Grade cable with steel armouring.

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

The glands shall consist of a barrel carrying a cone bush screwed into one end and a nickel-plated brass nipple carrying a nickel-plated brass or a heavy galvanised steel locknut screwed into the other end. The galvanising shall comply with SANS 763.

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.

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

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

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

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

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

1.11.3 PVC CABLE JOINTS

Cable through-joint boxes shall be similar or equal to "Scotch cast" manufacture.

Dry type joints may only be used with prior approval of the Engineer.

1.11.4 CABLE TRENCHING, LAYING AND JOINTING

1.11.4.1 TRENCHES

H.T. cables shall be laid at a depth of 1000mm and L.T. cables at a depth of 800mm.
Backfilling shall be done in layers of 200mm and each layer shall be compacted before the next layer is filled in.

1.11.4.2 LAYING OF CABLES

In rocky ground cable shall be laid on a 50mm deep sand bed, and shall also be covered by 150mm deep layer of sand, free from stones and rocks.
In soft ground the cables shall be laid directly on the trench floor and covered with a 150mm layer of sand.

All handling of cables shall be done in a workmanlike manner.

No cable trenches shall be backfilled without permission from the Engineer.
Under no circumstances shall any multi-core cable be bent at a radius of less than 12 times the outside diameter of the cable or 20 times the outside diameter of the cable for single core cables.

Where cable enters buildings or crossroads, cable ducts will be provided by the Building Contractor. The Electrical contractor shall check that cable ducts for the electrical installation are installed correctly.
Cable ducts entering buildings shall be sealed at both ends after installation of cables. During the course of construction and until final sealing, cable ducts shall be kept clean and free of debris by means of temporary plugs. Final sealing shall consist of weak cement and sand mixture or stuffing.

Where cables are run up outside walls they shall be protected to a height of 2 meters by sealed galvanised water pipes securely saddled to the walls by rawl bolts or equal. In the roof spaces, unless otherwise specified, cables shall be saddled to wooden boards installed by the Building Contractor to the requirements of the Electrical Contractor.

Cable lengths where scheduled are for tendering purposes only, any variation between schedules and actual lengths will be allowed for at schedule rates. It is essential that the actual cable lengths required shall be checked on site before orders are placed, as no joints will be permitted (except where lengths exceed 300 meters).

1.11.4.3 JOINTING OF CABLES

Up to lengths of 150 meters no joints are permissible.

At all joints the trench shall be suitably widened to allow adequate space for workmen.

All P.I.L.C.D.S.T.A. cable joints shall be provided with a 750 x 450 x 100mm concrete slab under the joints box to prevent sagging. This slab shall be in position before the joint is made.

1.11.5 CABLE MARKERS AND DRAWINGS

1.11.5.1 CABLE MAKER

All outdoor cable routes shall be marked with 150 x 150 x 400mm deep concrete cable markers placed in the ground over the cable with the top of the marker flush with the surrounding ground.

Cable markers shall be placed at all points of entry to buildings, road crossings, changes of direction and at all joints and at intervals not exceeding 30 meters.

1.11.5.2 CABLE ROUTE DRAWING

Before finally handing over the installation, a cable route drawing shall be provided by the Contractor showing accurately the cable routes, the position of all joints and the true cable lengths.

1.12 DISTRIBUTION BOARDS

Distribution boards shall be surface mounted when housed in switch rooms and cupboards. Elsewhere they shall be flush mounted unless otherwise specified.

Trays and chassis shall be galvanised. Boards shall be robustly constructed of minimum 1,6mm sheet metal. Interior metalwork shall be finished in a suitable light colour and exterior metalwork in approved colour enamel paint. Hammertone finish will not be accepted. Metalwork where not galvanised shall be rust-proofed prior to painting. Boards shall be of suitable sizes to accommodate without cramping the equipment as specified on the drawings. Expanded metal to be spot welded to rear of all bonding trays for 115mm walls.

A chassis of rigid construction for mounting of equipment, fixed to the bonding tray and provided with the necessary means for fixing of circuit breakers, isolator, etc., shall be incorporated. Single pole circuit breakers are to be installed side by side.
Panels of sheet steel, suitably stiffened, with machine punched slots to allow for flush mounting of circuit breakers, isolators and other switchgear. For large boards the FACIA panel shall be in sections to facilitate access.

Flush mounting boards shall have removable adjustable architraves and hinged doors with folded edges unless otherwise approved, and if the board exceed 600mm in width, double hinged doors shall be provided. Door catches shall be fitted.

Internal busbars, of solid copper for each phase, wiring and terminals shall be of suitable size and rating, and terminals shall be of brass and comply with section 3.14.2 of SANS 152 - 1977.

The wiring is to be carried out from the front and sides of chassis where possible on distribution boards and to be carried out by means of neatly arranged vertical and horizontal rows and laced together by means of purpose made self-lock nylon strap or equal.

Each distribution board is to be provided with neutral and earth busbar of solid brass with one way for each circuit and for each conductor.

Boards including busbars and neutral bars shall allow an extra 30% space for future extensions.

All equipment on distribution boards are to be clearly labelled by means of screws of channelling.

In the case of S.P.M.C.B.'s for lighting, socket outlets, etc., they must be numbered form one onwards and a corresponding legend card covered by a removable glass or Perspex, shall be installed in the inside of the door and circuits shall be clearly designated on this card. Distribution boards must be fitted with corresponding labels fixed on the outside of the metal doors.

All distribution boards shall be installed with the top of the board at maximum 2 meters AFFL.

Drawings of all boards shall be submitted for approval before commencing manufacture.

Labels must be fixed to the boards immediately below the equipment by means of screws of channelling.

1.13 SWITCHGEAR

1.13.1 MINIATURE AND MOULDED CASE CIRCUIT BREAKERS

This section covers single or multi-pole moulded-case circuit-breakers for use in power distribution systems, suitable for panel mounting, for ratings up to 1 000 A, 600V, 50Hz.

The circuit-breakers shall comply with SANS 156, as amended.

The overload and short circuit trips in the circuit-breakers may be of the following types to suit the application:

Combined thermal/magnetic trips with interchangeable trip units, the magnetic trip setting being adjustable.

Combined thermal/magnetic trips with fixed and non-adjustable units.

Hydraulic/magnetic trips with fixed and non-adjustable trip units.

Solid state controlled trips with interchangeable fixed rating plugs for overload tripping and adjustable magnetic trip settings incorporating a short time delay.

Solid state controlled trips with interchangeable adjustable rating plugs for overload tripping and adjustable magnetic trip settings incorporating a short time delay.

1.13.2 ISOLATORS

Microgap switches shall be suitable for ratings up to 44 A at 660 V (triple-pole) and may be used for main and distribution switches in domestic applications, offices, small factories and similar applications.

Double-pole and triple pole switches shall be suitable for voltages up to 250 V and 400V respectively.

The switches shall conform fully to SANS 152 as amended.
Microgap switches may be used on A.C. circuits only.

Metal clad and moulded castings are acceptable.

Microgap switches shall be capable of carrying rated current continuously and making and breaking rated current.

Heavy, fully accessible, brass terminals with two grip screws each shall be provided to facilitate easy wiring. Contacts shall have large contact surfaces, made from high quality material such as solid silver.

The "ON" and "OFF" positions and the rating of the switch shall be clearly and indelibly marked.

1.13.3 FUSED SWITCHES

Combination switch-fuse units shall be triple pole devices fitted with neutral links.
Light duty (up to 200 A, 250 V) switches shall comply with BS 2510 as amended.

Heavy-duty (up to 1 200 A, 660 V) switches shall comply with BS 3185 as amended. The maximum rating of 1 200 A does not apply to motor isolating switches, for which the maximum rating is 800 A.

The switches shall be of the on-load type capable of carrying full load continuously, making and braking rated current and tested to IEC 408 for making and breaking capacity.

The cartridge fuses used in the units shall conform to BS 88 or the equivalent DIN and VDE standards. The category of duty shall be suitable for the voltage level and the fault level at the point where the fuses are installed. Time/current characteristics shall be matched to the equipment supplied or protected by the switch.

The switch-fuse shall have a hand-operated lever with clearly marked "ON" and "OFF" positions. The normal rating, voltage and allowable fuse ratings shall be clearly and indelibly marked on the cover.

Switch-fuse units shall be of the double air-break, quick-make, quick-break type with an arc chamber. The mechanism shall be driven by springs on both sides. The unit shall consist of a fixed contact assembly, heavy duty mechanism, moving contact carriage and a retractable operating handle mounted on a rigid frame. The contact shall be of high quality material. Fusegear carrying the HRC fuses on the cover, the cover also forming the operating lever, is regarded as a fuse isolator and is not acceptable.

When the switch is in the "OFF" position the fuses shall be fully isolated at both the load and supply ends. Interlocks shall be provided to prevent the cover from being opened when the switch is "ON" and to prevent the switch from being operated when the cover is open.

1.13.4 ISOLATING SWITCHES

This section covers switches suitable for panel mounting for use in power distribution systems up to 600 V, 50 Hz. Switches for motor isolation are include.

The switches shall be of the triple-pole, hand operated type conforming to BS 861 Part 1, (up to 200 A, 600 V) and Part 2, (up to 1 200 A, 600 V). Braking capacities shall conform to BS 755 Part 1.

The switches shall be suitably rated for the continuous carrying, making and breaking of rated current as well as through-fault current capacity as specified.

To distinguish the switches from circuit-breakers the operating handles shall have a distinctive colour and/or the switch shall be clearly and indelibly labelled "ISOLATOR".

1.13.5 EARTH LEAKAGE PROTECTION

Earth leakage protection shall be of the current-balance type. A static tripping arrangement, either a magnetic or a solid-state amplifier of simple design, shall be used.

The relay shall be of such sensitivity that immediate tripping will result from a total leakage of between 15 mA and 30 mA.

The relay shall have an integral tripping facility and shall also be temperature-compensated.

The relay shall stand up to high values of earth-fault current without damage to the tripping arrangement.
Circuit-breakers with trip coils used integrally with earth leakage units (two-pole for single-phase units and four-pole for three-phase units) shall conform to SANS 156.

On-load switches used integrally with earth leakage units (two-pole for single-phase units and four-pole for three-phase units) shall comply with BS 5419.

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

1.14 CONDUIT

All conduits shall be heavy gauge welded or solid drawn steel, black enameled screwed tube, except where exposed to the weather or in coastal installations, where galvanised conduit shall be used. Conduit shall comply with SANS Specification 162 - 1978.

Black enameled conduit shall be coated inside and outside and galvanised conduit shall be hot dipped in accordance with SANS 763.

1.14.1 CONDUIT ACCESSORIES

Conduit accessories shall comply with SANS 162 1978 in all respects.
Junction, drawn-in, inspection and outlet boxes shall be of malleable iron of adequate size and shall be supplied with heavy gauge metal cover plates. Zincalloy accessories shall not be acceptable. Accessories shall be black enameled except where exposed to weather where galvanised pressed steel shall be used. Shallow boxes shall only be used for surface and ceiling applications. All bushes shall be of solid brass, smooth bore and undercut threads so that they can be screwed home. All sundry materials not specifically detailed shall be of robust construction and of the highest quality standard available.

Earth clamps shall be of at least 2mm copper with a minimum width of 13mm and brass bolt of 25mm x 5mm dia.

1.14.2 SWITCH AND SOCKET OUTLET BOXES

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

1.14.3 FLEXIBLE CONDUIT

Flexible steel conduit and adaptors shall conform to 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 may only be used where explicitly specified and shall then be used in accordance with par. 5.4.4 or SANS 0142.

1.14.4 PLAIN END METALLIC CONDUIT

As an alternative to the threaded conduit, plain-end (unthreaded) metallic conduit with accessories may be used if stated in the detail specification and/or the bill of quantities.

Unthreaded conduit shall be manufactured of mild steel with a minimum thickness of 0,9mm and shall comply with SANS 1007.

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

The Contractor or supplier shall be responsible to obtain the approval of local authorities for the use of this system.

All conduit and accessories used in areas within 50 km of the coast shall be hot dip galvanised to SANS 763. In inland areas electro-galvanised or cadmium-plated accessories will be accepted.

1.14.5 NON METALLIC CONDUIT

Non metallic conduit shall comply fully with SANS 950 and shall be installed in accordance with Appendix C of the same specification.

1.14.6 INSTALLATION OF CONDUIT

The installation of conduit as detailed in the "Standard Regulations" shall be strictly adhered to. In addition the following shall also apply:

The minimum conduit size shall be 20mm O.D.

Except where otherwise specified all conduit shall be concealed by laying in concrete, chasing in walls or running in roof space. The Building Contractor shall be notified in good time of all holes, openings, sleeves, etc. which may be required. The Electrical Contractor shall arrange to have all conduits, switchboards, etc., ready in good time in order that the building work is not delayed.

Drops to wall outlets shall be from ceiling level and unless otherwise approved no conduit shall be allowed to rise from floor level forming a "U" trap in the installation.

Except in the roof space or in surface installations, conduit shall be looped from point to point and no draw-in boxes which are not in themselves outlets, shall be permitted unless approved and approval shall be sought where necessary. Failure to comply with this requirement may render necessary structural alterations at the expense of the Electrical Contractor. Draw in boxes shall be installed where it is necessary to draw cables round more than two 90□ bends or sets or the equivalent thereof or where conduit runs exceed 22m. Draw-in boxes in the roof space shall be in easily accessible positions. Any draw-in boxes in ceilings shall have flat metal covers and countersunk screws so as to be flush with the ceiling. Cover plates to overlap boxes by 15mm on all sides and painted to match surrounding finishes.

In roof spaces conduit runs shall be run along or at right angles to the direction of roof trusses. Conduit runs parallel to ceiling joints or tie beams shall be fixed to the sides and not on the top of such timbers. In roof spaces and on surface installations conduit runs shall, where possible, be grouped together and shall be fixed at reasonable spacing (not exceeding 2m). In surface installations conduit shall be supported on spacer saddles to allow approximately 3mm clearance behind the conduit and shall be fixed at spacing not exceeding 1,5m.

Except for surface installations outlet boxes for ceiling fittings shall finish flush with the underside of the ceiling. Wood plugs shall not be used for conduit or other fixings.

All joints shall be metal to metal and shall be screwed home, with lock nuts where necessary. Running joints shall be avoided where possible but where used shall be fitted with lock nuts.

The conduit installation shall be watertight and shall be mechanically and electrically continuous. During construction, precautions shall be taken against the ingress of moisture and dirt and open ends shall be plugged with socket and metal plugs or sockets and conduit fishtails.

After screwing home, all joints shall be sealed externally with quick drying varnish or with anticorrosive paint. Any exposed screw threads or parts where galvanising or enamel has been damaged shall be touched up with anticorrosive paint.

Conduit shall be installed as far as possible in straight lines, with easy sets or bends and, where practicable, shall be drained. In concrete slabs, handmade easy sets or bends may be made otherwise bends and sets shall be made cold with a bending machine. All bends and sets shall be free of indentation or distortion. Bends with internal threads shall not be used. Unless otherwise approved manufactured bends, elbows and "T" pieces shall not be used, and where allowed shall be of the inspection type. Circular boxes should be used where tee-joints are required. Sherardized steel or brass screws shall be used on conduit fittings.

Unless approved, no conduit shall be laid in any ground floor slab.

Where conduit rises free from a floor it shall be protected by galvanised water pipe sleeve clear of the floor.

The inside of all conduit shall be cleaned free of burrs and sharp edges. Open ends shall be fitted with brass bushes.

Where conduit enters boards and trays, etc., locknuts shall be used inside and outside with female bushes inside. Where conduit enters outlet boxes, couplings and male bushes may be used.

Wiring trays shall be installed in the roof space directly above distribution boards to facilitate the conduit installation. Such trays shall be constructed of minimum 2mm sheet steel with detachable covers and shall be galvanised. The length of the trays should be equivalent to the width of the board below. The width shall be sufficient to accommodate conduits entering from the sides plus spares at saddle distance apart but not less than 300mm. They shall not be less than 75mm deep and 25mm wide entry knockouts or blanked off-sets. Two spare 20mm and one spare 25mm conduits shall be installed between each distribution board and its roof wiring tray.

Conduit laid in concrete shall be laid above the reinforcing bars and securely tied to the bars and shall terminate in long spout deep circular malleable iron boxes for lighting points.

Conduit chased in brick walls shall be secured at reasonable spacing (not exceeding 2m) by means of pipe hooks or 300mm cut nails driven into brick joints.

All conduits shall be kept at least 150mm clear of and if possible below steam or hot water pipes.

The positions of all conduit outlets for boxes such as light points, switch points, socket outlets, power outlets, fans, silent call outlets, telephones, etc., shall be verified on site with the Architect's detail drawing.

Outlets to sterilisers, laundry machines, etc., shall terminate as described for stove connections.

The Electrical Contractor shall be responsible for all chasing work and shall make good any damage resulting from such work.

Chasing shall be neatly filled with a 4:1 sand-cement mixture and conduit shall be at least 13mm from the final finished surface level.

All conduit runs crossing expansion joints shall be supplied with a draw-box on one side of the joint. From this box, a conduit, of one size larger than that being used, shall extend from the draw-box up to the joint. The fixing of this conduit to the draw-box shall be rigid with two locknuts. The normal conduit at the other side of the expansion joint shall extend inside the over-sized conduit to 30mm inside the draw-box. A 4mm copper conductor shall span the joint and shall be securely clamped to the far side conduit by means of a brass earth clamp and bolted to the draw-box with brass screws and nuts. In addition to the above, a 4mm copper

earth conductor shall be installed between the two closest conduit draw-boxes on either side of the joint. The number of such expansion boxes shall be kept to a minimum.

1.15 WIRING CHANNELS

1.15.1 CHANNELS

Wiring channels shall be of the "SANKEYSTRUT", POWASTRUT", “UNISTRUT" or similar type.

The channels shall be manufactured of rolled sheet steel. The minimum thickness of the sheet steel shall be.

1,4mm for ribbed channels with a maximum width of 42mm.

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

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

The channels shall be finished as follows:

In coastal areas	Hot-dip galvanised to SANS 736 or epoxy powder coating.
Cast in concrete	Pre-galvanised
False ceiling voids	Pre-galvanised
Vertical building ducts	Hot-dip galvanised to SANS 763 or epoxy powder coating.
Surface mounted in plant rooms, substation, service tunnels, basements	Epoxy powder coating or electro-galvanised
Damp areas, exposed to weather, underground runs in contact with earth	Hot-dip galvanised to SANS 763 or epoxy powder coating
Undercover industrial applications	Hot-dip galvanised to SANS 763 or epoxy powder coating.

The above-mentioned finishes shall apply unless specified to the contrary or approved by the Engineer. Hot-dip galvanised or electro-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 spray canisters recommended by the manufacturer of the channels.

1.15.2 COVER PLATES

All channels shall be supplied with cover plates. Channels up to 125mm wide shall have snap-in cover plates of metal or PVC.

For channels wider than 125mm only metal cover plates shall be used.

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

1.15.3 ACCESSORIES

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

1.16 CABLE TRAYS AND LADDERS

1.16.1 METAL CABLE TRAYS

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

Less than 250mm wide 1,6mm minimum thickness with 12mm minimum upstand

250mm and wider equivalent to trays supplied by "PERFORATION AND CONIDURE" manufactured from 2mm thick steel with folded over returns and a minimum upstand of 50mm

250mm and wider (heavy duty) 2,4mm thickness with 76mm minimum upstand as alternative to the above or where heavy duty trays are specified.

The upstands of trays shall not be perforated and the top of the upstand shall be smooth. The same cable tray shall be used in long parallel tray runs.

1.16.2 CABLE LADDERS

Metal cable ladders shall consist of a 76mm high side rail of 2mm minimum thickness. Cross pieces consisting of P4000 "SANKEYSTRUT" channel sections shall be spaced at maximum intervals of 250mm. Where cables of 10mm5 or smaller are installed on cable ladders, the spacing of the cross pieces shall be 125mm. Cables shall be clamped in position by means of purpose made cable clamps that fit into cross pieces.

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. Where prior approval has been obtained, these cable ladders may be used in horizontal cable runs for small cables for communication and control wiring if prior approval of the Engineer is obtained.

1.16.3 PLASTIC CABLE TRAYS

Rigid unplasticised PVC cable trays complying with the following standards may be used if specified in the Detail Technical Specification:

Less than 250mm wide 3,0mm minimum thickness and 40mm minimum upstand.
250mm and wider 4,0mm minimum thickness and 60mm minimum upstand.

1.16.4 FINISHES

Metal cable trays and ladders shall be finished as follows:

In coastal areas	Hot-dip galvanised to SANS 763 or epoxy powder coating.
False ceiling voids	Electro-galvanised or epoxy powder coating.
Plant rooms, substations, service tunnels, base-ments	Electro-galvanised or epoxy powder coating
Damp areas, exposed to weather	Hot-dip galvanised to SANS 763 or epoxy powder coating
Undercover industrial application	Hot-dip galvanised to SANS 763 or epoxy powder coating

1.16.5 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.

1.17 WIRING

1.17.1 WIRING CONDUCTORS

Except where otherwise specified the entire installation shall be wired with P.V.C. insulated annealed copper cable drawn into conduit. Earthed concentric wiring will not be accepted. P.V.C. conductors to be used for the wiring of buildings shall be of the 250 volt grade, P.V.C. insulated copper conductor type. All conductors shall be of fresh stocks and shall arrive on site with the manufacturer's wrappings and seals intact and shall bear the SANS 1507 - 1957 stamp.

1.17.2 INSTALLATION OF WIRING

The installation of wiring as detailed in the SANS code of practice shall be strictly adhered to. In addition the following shall also apply:-

Unless otherwise specified, no cable of less than 1,5mm 5 shall be used for lighting and power mains voltage circuits. Circuits shall be wired in cables of not less than the following sizes:-

Lighting	1,5mm²
5 Amp, Socket outlets	1,5mm²
15 Amp socket outlets and generally,	2,5mm²
single phase circuits protected by up to 15 Amp MCB	1,5mm
three phase circuits protected by up to 10 Amp MCB	1,5mm²
single phase circuits protected by up to 30 Amp MCB	4mm²
Three phase circuit protected by up to 25 Amp MCB	4mm²
single phase circuit protected by up to 40 Amp MCB	6mm²
Three phase circuit protected by up to 40 Amp MCB	6mm²

Only one circuit may be run in any conduit except that in risers between distribution boards and wiring trays, four single phase circuits may be grouped in one conduit where necessary to limit the number of conduits entering the board, provided that the number of cables in a conduit does not exceed the limits laid down in the code of practice.

All cabling shall be looped from point to point. There shall be no joints in cabling or wiring. Not more than two conductors shall be looped together in any one terminal.

Cable shall not be drawn in conduit until the complete circuit run has been installed and swabbed out clean and dry and the building has so far advanced that there is no likelihood of the ingress of dirt or moisture.

All wiring in cold rooms shall be in M.I.M.S. cable.

There shall be no cutting away or nicking of wire strands.

Earth wire shall be run:-

a) in circuits to distribution boards where such boards are supplied by cable in conduit;

b) to laundry machinery and outlets;

c) to sterilizers;

d) with PVC cables;

e) as specified elsewhere.

Earth wires shall be of stranded bare copper as specified in SANS 1014.

Secondary, extra low voltage, wiring for bell, silent call, radio or similar circuits shall each be run in a separate conduit system, and where such wiring is run in the same tray as mains voltage wiring it shall be shielded there from by earthed metal.

Secondary, extra low voltage, bell and silent call wiring shall be approved PVC insulated copper wire of not less than 1,5mm5 unless otherwise specified.

1.17.3 EARTHING

The whole installation is to be earthed efficiently, and effectively, so that the resistance to earth from any point does not exceed the value laid down in the operative wiring regulations. The whole installation must be efficiently bonded as far as the main switchgear.

All hot and cold water and waste pipes are to be effectively bonded by means of copper tape (not wire) clamped round the pipes. For this purpose, galvanised or brass bolts and nuts shall be used. The gutters and down pipe, if metal, are to be bonded and effectively earthed. Metal sinks, worktops, etc., are all to be bonded and effectively earthed.

Where H.T. switchgear is included in the installation, completely separate connections to the main earth bar as below are to be provided for this, connected by 25mm x 3mm copper strap into each H.T. panel.

Where transformers are included in the installation, the neutral of each shall be earthed by means of a separate copper strap each connecting to the main earth bar as below. These straps shall be insulated by PVC tape wrapping and fixed by means of porcelain insulators away from other earthed material. Transformer frames shall be earthed by separate copper straps common with the L.T. switchboard earthing system. Straps shall be one 25mm x 3mm or equivalent section for every 75 kVA of transformer rating.

The main switchboard is to be earthed by means of one 25mm x 3mm copper strap or equivalent per 75 kVA of main switch rating, connected to the main earth bar as below, and the same size, but a separate earth conductor shall be connected from the main board to the cold water main where it enters the building.

The main earth bar shall consist of a length of copper busbar at least equal in section to the largest conductor connecting to it. It shall be supported on the substation wall in a suitable position readily accessible for inspection by means of porcelain insulators. Conductors connecting to it shall be brazed on in such a manner that the section of braze is at least twice that of the conductor in each case.

From the main earth bar a conductor of the same section as the bar, brazed to it as above, shall be led to the main earth electrode. This conductor shall be PVC tape wrapped and supported on porcelain insulators until entering the ground.

Main earth electrodes shall consist of at least two 20mm "Copperweld" or equal rods, to approval, 3,6 meters long and at least 3 meters apart, driven vertically down into the ground in a location specified, or if not specified, in the nearest open area to the switch room concerned.

The heads of these shall be accessible below 250mm x 250mm cast iron inspection covers, where they shall be brazed to the straps from the main earth bar. The section of braze shall be at least twice that of the strap in each case.

Where specified, further rods may be required and these shall again be 3,6m long and 3m from the nearest rod. The full copper section shall be run to each from the main earth bar.

Where ground conditions, e.g. rock, do not permit the use of driven rods, with the approval of the Engineer, a mat of 25mm x 3mm copper at least 5,5m by 1 850mm or 3,6m x 3,6m with a 1 850 mesh, shall be buried as deep as possible. Earth straps shall be bonded to this in at least two places on opposite sides. The ground filled in over shall be well consolidated.

The inspection covers as specified above shall be supplied and set in position by the Electrical Contractor. The Contractor shall provide concrete for casting into position.

Bare copper cable of equivalent section to the tape specified may be used, but the method of jointing this shall be to approval. No joints, which are dependent upon solder as a current carrying medium will be accepted.

Earth connections must under no circumstances be carried through steel or iron conduits or sleeves.

All earthing straps shall be run in one continuous length as far as possible, but shall not be bent or formed in any way that necessitates hammering or severe distortion. Any joints shall be brazed with the braze section at least twice that of the strap. If multiple straps are used they shall be clamped together and fixed at maximum 750mm intervals.

The tenderer shall allow for testing the earth resistance of the main earth electrodes in the presence of the Engineer.

Sub-distribution boards shall normally be earthed via the armouring of the cable connection unless otherwise specified. The earths of such armouring shall be visible for inspection and shall consist of at least m x 2mm copper strap unless otherwise specified. In addition the cable armouring shall be internally bonded to the cable gland.

Sub-distribution boards for all laundries, for kitchens which have trolley washing bays and in certain other instances to be specified, shall in addition be fitted with local earths similar to the specification above except that 20mm x 3mm strap may be used, one 3m copperweld rod, or in hard ground a 1 850mm x 1 850mm earth mat with 900mm mesh, may be used.

Earths shall be installed as early as possible in the building programme, and the onus in on the Electrical Contractor to arrange this with the Contractor so as to avoid later disturbance of completed construction. Before proceeding, however, the attention of the Engineer is to be drawn to the exact proposals, and approval obtained.

Further to the above, the Main Earth shall be in accordance with any supplementary local Municipal Regulations.

Unless otherwise specified, bare earth conductors, equivalent to half the sectional area of the current carrying conductors, shall be drawn into conduits, together with the current carrying conductors, between all main, sub-main and sub-distribution boards. Ends of earth conductors shall have sweated lugs securely bolted to switchboard frames or trays.

1.18 WIRING CONNECTIONS

1.18.1 LIGHT FITTING CONNECTIONS

Connections to light fittings and appliances shall, where necessary, be done with nylon or PVC block connectors with brass screws and clamp-nuts. In all light fittings with lamps of more than 60 watt, wiring from the fitting to the circuit shall be done with asbestos insulated conductors and the connection to the circuit shall be done in the conduit box

1.18.2 CONNECTION OF MOTORS

Where applicable, the wiring of motor circuits may be done in multi-core steel wire armoured PVC insulated underground cable. In all other cases conduit with single PVC insulated conductors shall be used in accordance with the SANS Code of Practice. Insulated copper earthwire to be installed with each cable and properly earthed on each end.

1.19 LIGHT SWITCHES AND SOCKET OUTLETS

1.19.1 LIGHT SWITCHES

All switches shall be suitable for mounting in 100mm x 50mm x 50mm galvanised steel or stove enameled boxes and shall comply with SANS 163 - 1978 and must bear the SANS mark.

Except where otherwise specified, switches shall be of at least 250 volt 10 ampere rating. Where more than one switch on the same circuit is required at any position only approved multiple-gang units shall be used.

Where more than one switch on different circuits is required at any position the switches for different circuits shall be fitted in separate 100mm x 50mm x 50mm boxes.

Cover plates for flush mounting switches shall be of not less than 1,6mm with non-rotatable fixing. Finish shall be to approval but for tendering assume baked enamel unless otherwise specified. Cover plates shall provide dolly protection for switches in lift motor, calorifier, boiler, air-conditioning plant, refrigeration plant, workshop, laundry, and similar machinery rooms and in large kitchens. Where conduit is surface mounted, only approved type surface switches with dolly protection shall be used.

Weatherproof switches shall be quick make and break type in robust brass galvanised cast-iron cases with machined joints and brass operating handles.

Switches shall be flush mounted with bottom of box 1 350mm above finished floor levels unless otherwise specified. Where shown adjacent to walls on the same wall as the doors they shall be situated with the centre line between 150mm and 300mm form the edge of door frames, and shall on no account be hidden behind doors that are swung fully open. Where tiling extends to 1 500mm above floor level, switches shall be mounted just above tiling instead of at 1 350mm. Where tiling extends over 1 500mm, switches shall be mounted at 1 350mm.

Cover plates shall be fixed perpendicularly and there shall be no gaps between the plates and the walls.

CSIR CHPC
Rosebank, Hope Street, Cape Town

THE INSTALLATION OF ELECTRICAL INFRASTRUCTURE

2. BILL OF QUANTITIES

2.1. GENERAL NOTES

a. The Conditions of Contract and the application of the Contract Price Adjustment Provisions shall be as set out in Section 1: Preliminaries and General.

b. The descriptions in these Bills of Quantities shall be read in conjunction with the specification and the attached drawings.

c. The unit rate for each item in the Bills of Quantities shall include for all materials, labour profit, transport, etc. everything necessary for the execution and complete installation of the work in accordance with the description.

d. The Bills of Quantities shall not be used for ordering purposes. The Contractor shall check the lengths of cables and overhead conductors on site before ordering any of the cables. Any allowance for off-cuts shall be made in the unit rates.

e. The rates shall exclude Value-Added Tax and the total carried over to the final summary.

f. All material covered by this Specification shall, wherever possible, be of South African manufacture.

g. In the case of any error in the extensions of the unit rates, the unit rates will be accepted as correct, regardless of the extended total amounts entered in the Schedule of Prices. **In their own interest Tenderers should make doubly sure about the correctness of their schedule rates (and the extension) and the tender price.**

h. A tender may be rejected if the unit rates or prices for some of the items in the Bill of Quantities are in the opinion of the Employer unreasonable or out of proportion, and the Tenderer fails, within a period of fourteen days after having been notified in writing by the Employer to adjust the unit rates or prices of such items, to make such adjustments.

2.2. BOQ: SUMMARY (VAT EXCLUDED)

SECTION:	DESCRIPTION:	AMOUNT:
SECTION A	PRELIMINARY AND GENERAL: TIME, FIXED CHARGE, VALUE	
SECTION B1	DISTRIBUTION BOARDS	
SECTION B2	WIREWAYS, CONDUIT & ACCESSORIES	
SECTION B3	LIGHTING, INSTALLATION AND LIGHT FITTINGS	
SECTION B4	POWER OUTLET POINTS	
SECTION B5	ISOLATORS AND POWER SUPPLY	
SECTION B6	CABLES, WIRING AND EARTHWIRE	
SECTION B7	ADDITIONAL SERVICES	
SECTION B8	ADDITIONAL ELECTRICAL SERVICES	
SECTION B9	ELECTRICAL SERVICES - COMPLETION	
TOTAL OF PRICED ITEMS (EXCL. VAT):		
ADD 10% CONTINGENCIES:		
SUB-TOTAL: INSTALLATION AND CONTINGENSIES:		
ADD 15% VAT:		
TOTAL OF PRICED ITEMS (INCL. VAT):		

TOTAL TENDER PRICE – including VAT (IN WORDS):

……

……

……

SIGNATURE OF TENDERER: _____ **DATE:** _____

2.3. CONTRACT RATES:

Any variations to the contract will be priced in accordance with the rates tabulated below. Rates are to exclude VAT.

2.4. Mark-up:

- Materials ……..….. %
- Sub-Contractors ……..….. %
- Other ……..….. %

2.5. Special Items:

Any item/s not covered by the above bill of quantities or rates, shall, if necessary, be entered here:

……

……

……

……

……

SIGNATURE OF TENDERER: _____ DATE: _____

2.6. SCHEDULE OF EQUIPMENT OFFERED:

The successful tenderer must complete the following schedules and submit them within 21 days of the acceptance of the tender.

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

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

ITEM	MATERIAL	MAKE OR TRADE NAME	COUNTRY OF ORIGIN
1	Distribution Boards		
2	Circuit breakers 1P, 2P, 3P		
3	Switching Isolators		
4	Contactors 3P / 4P		
5	Surge Protection Devices		
6	Conduit		
7	Conduit boxes		
8	PVCISWA cable		
9	Cable ladder		
10	Cable trunking		
11	Cable trays		

LIST ANY OTHER ELECTRICAL ITEMS:

12			
13			
14			
15			
16			
17			
18			
19			
20			

NOTE:

Tenderers are to note that under no circumstances may materials be installed other than that offered in the above material schedule, which has been approved and accepted by the Representative/Agent of the client.

Should the successful tenderer wish to supply materials other than that originally offered, prior written approval must be obtained from the Architect / Electrical Engineer before any orders are placed.

SIGNATURE OF TENDERER: _____ **DATE:** _____

2.7. LIST OF DRAWINGS

INSTALLATION OF ELECTRICAL INFRASTRUCTURE AND BUILDING SERVICES

Attached to this document are the drawings as listed below. The drawings are for viewing and tender purposes only. The drawings shall be read in conjunction with the specifications and Bill of Quantities. These drawings are NOT TO SCALE and can only be used for Tender Purposes.

1. 32874.00-301-01 RevT0
2. 32874.00-312-03 RevT0
3. 32874.00-312-06 RevT0
4. 32874.00-312-07 RevT0
5. 32874.00-340-01 RevT0
6. 32874.00-370-02 RevT0
7. 32874.00-377-01 RevT0
8. 32874.00-380-01 RevT0
9. 32874.00-411-01 RevT0

PLEASE NOTE:

- Original drawings on A1 paper size are available to be viewed on request at BVi offices.
- No CAD drawings will be E-mailed or supplied for tendering purposes.
- CAD drawings will be issued to the successful contractor after appointment.
- Three sets of original scale drawings will be issued to the Contractor upon appointment.