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**SPECIFICATION FOR THE ELECTRICAL  
INSTALLATION UPGRADE FOR SARS  
BROOKLYN DATA CENTRE**

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# SPECIFICATION FOR THE ELECTRICAL INSTALLATION FOR SARS BROOKLYN DATA CENTRE

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PROJECT SPECIFICATION

FOR THE

ELECTRICAL INSTALLATION

FOR

SARS BROOKLYN DATA CENTRE

PART 1

PROJECT SPECIFICATION FOR THE ELECTRICAL INSTALLATION FOR SARS BROOKLYN  
DATA CENTRE

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## 1. GENERAL

### NOTES

1.1.1 The project specification together with all other documentation such as the conditions of tender and contract, the standard specifications, and all schedules and drawings as described in this tender document, constitute the specification and will be the basis of the contract.

#### 1.1.2 Scope of Work

The Work to be performed under this contract includes the supply, procurement, delivery, erection, testing, commissioning and handover of a complete electrical installation for the SARS Brooklyn Data Centre Upgrade, operational to SARS and the guarantee and comprehensive maintenance thereof for a further period of 12 months.

The installation shall be complete and shall include all material and equipment necessary for the proper functioning thereof.

The work involves the following:

- The supply and installation of:
  - Supply and installation of low voltage cables;
  - Supply and installation of low voltage distribution boards;
  - Supply and installation of light fittings and lighting control equipment;
  - Supply and installation of all conduits and wiring;
  - Supply and installation of all wiring trunking, trays and cable ladders for the power distribution system;
  - Decommissioning, removal and redundant cables, ladders, trays and distribution boards.

### SPECIFICATIONS

This project specification is specifically applicable to this installation and will have preference over the Standard Specifications.

The latest revision of applicable SANS standards will be applied to all work and material supplied under this contract. The contractor is required to be familiar with the standards and have their own copies available for reference. No claims in this regard will be accommodated.

The Contractor shall ensure that the Installation, including all equipment used, is designed, installed and maintained in compliance with the following regulations:

- (a) SANS 10142: Code of Practice for Wiring of Premises.
- (b) Occupational Health and Safety Act - Act 85: 1993 as amended by the Occupational Health and Safety Amended Act No. 181 of 1993 and the labour Relations Act, No. 66 of 1995.
- (c) National Building Regulations - Act 103 of 1977 a.a. as deemed to be satisfactory in terms of SANS 10400-2010 a.a.
- (e) Municipal, Local or where applicable other authorities by laws and regulations

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- with regard to building, electrical, fire, gas, water, traffic and health requirements.
- (h) General Machinery Regulations GNR 1521 of 5 August 1988.

### RESPONSIBILITY OF THE CONTRACTOR

The Installation referred to in this Tender is for the Principal contract, the word "Contractor" refers to the Subcontractor responsible for the Installation.

### ARRANGEMENTS WITH THE SUPPLY AUTHORITY

- 1.4.1 Permanent bulk supply cost  
Not applicable to this contract.
- 1.4.2 Builder's supply  
Not applicable to this contract.
- 1.4.3 Register, Installation and Inspection Fees  
Not applicable to this contract

### PRELIMINARIES AND GENERAL

The contractor will familiarize himself with all site conditions during the site visit and include all cost to successfully complete the Scope of Work. No additional claims for P&G's are allowed. P&G's will be fixed.

### QUALITY & RELEVANT EXPERIENCE

The Electrical Contractor will be required to ensure that work is always executed under supervision of a competent, qualified and experienced site foreman who is able to receive instructions on behalf of the Contractor and is approved by the Engineer.

The contractor should take special note of the high-risk environment in which work will be executed. The contractor should allow adequate time and resources to ensure that all planning and safety meetings can be attended.

The contractor shall issue a planned resource list before each work package is executed. It will be the contractor's responsibility to ensure that sufficient man power and the required equipment is available to ensure that work is executed as planned.

Most of the work will be executed after office hours and over weekends.

The contractor needs to have relevant experience in executing project in the ICT power environment. A reference list of projects completed in the last 5 years will be submitted with the tender, the list should include contact details of reference clients. The reference list will be evaluated as part of the evaluation criteria during tender adjudication

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**Hold Points:**

To assist the Contractor in order that corrective action can be taken in good time, the following hold points are deemed critical. The following hold points shall be adhered to at all times.

	HOLD POINT REQUIRED
Approval of all major equipment prior to order placement.	YES
Approval of samples	Light fittings
Shop/For Construction drawings of DB's	YES

**SITE, SITE CONDITIONS & SITE FACILITIES****1.7.1 Site Location**

This site is located at 299 Bronkhorst St, Brooklyn, Pretoria, Gauteng, 0181

**1.7.3 Site Visit**

A compulsory site visit is planned. The contractor must attend the site visit and ensure that the site visit register is completed. Failure to attend the site visit will result in disqualification

**1.7.2 Site Conditions**

The Contractor shall acquaint himself fully to the prevailing site conditions, access to the site, storage and other facilities prior to submitting a tender since no claim in this regard will be considered.

The contractor shall make sufficient precautions to ensure that the work is executed without any interruptions to the existing electronic and networking equipment.

The contractor shall provide his own site office and/or storage facilities .

Tenderers shall acquaint themselves of the security and other site procedures to be adhered to.

**PROJECT MANAGEMENT AND PLANNING**

The successful tenderer shall compile a construction program for approval by SARS and the Engineer.

**DRAWINGS****1.9.1 Available Drawings**

The Contractor shall acquaint himself fully with the available information on the following



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drawings:

- Architect's drawings
- Drawings available of all other services such as electrical, mechanical, plumbing and other specialised services.

#### 1.9.2 Drawing Standards

All drawings shall be of sufficient quality to ensure - clear and legible copies at all times.

#### 1.9.3 Detail Design Drawings (Shop Drawings)

The Contractor shall submit to the Engineer, in accordance with the construction programme, electronic copies of each shop drawing for approval.

A marked-up copy with the Engineer's and SARS's comments will be returned to the Contractor. The Contractor will update the original accordingly resubmit to the Engineer for final approval.

The Engineer's approval shall not relieve the Contractor of his responsibility for erection or installation or of errors or omissions in the shop drawings.

The drawings shall be sufficiently detailed to enable SARS's staff to maintain, dismantle, reassemble and adjust all parts of the works. The layouts shall indicate the location of all manual and automatic control devices, control panels, sensors, etc.

A copy of the wiring diagram shall be mounted in the plant room in a glass fronted frame. The diagrams shall be printed by a non-fading process.

#### 1.9.4 "As Installed" Drawings

Drawings shall be updated as work progresses in order that the "As-Installed" Drawings on completion reflect the final Installation.

One set of hard copy and soft copy drawings shall form part of each O&M manual.

Soft copy drawings shall be compatible with AUTOCAD & .pdf software

Three (3) sets of paper prints As-Installed drawings forming part of the approved O & M manual shall be supplied to the Engineer prior to the Practical Completion of the Project.

### **RESPONSIBILITY OF OTHER PARTIES**

The Electrical Contractor shall co-ordinate his activities with SARS

The Electrical Contractor is responsible for the installation of all changeover switches and associated cabling to ensure that all AC equipment is supplied by 2 different power supplies.

## OPERATING AND MAINTENANCE MANUALS

Three complete & colour printed sets of O&M manuals including "As Installed" drawings must be supplied to the Engineer.

The contractor will also issue three electronic copies of the O&M Manuals on CD.

## INSPECTION, TESTING, COMMISSIONING AND HANDOVER

The Contractor is primarily responsible for his quality and shall compile the necessary snaglists.

The contractor shall also arrange for the necessary inspections and tests with the Consulting Engineer and shall supply all test equipment. The Contractor's attention is drawn to the relevant clauses in the attached Standard Specification for General Requirements and Procedures - A-SPES-00-01.

### 1.12.1 Progress Inspections

The Engineer will hold inspections at his discretion during the contract to ensure that the Contractor meets the requirements of the Specification and that the Contractor is fulfilling his responsibility regarding quality control.

Should remedial action be required the Engineer will notify the Contractor, and the Contractor shall rectify this work within 7 days.

### 1.12.2 "Hold Point" Inspections and Tests

"Hold Point" inspections and Tests are listed above and the Contractor requires written approval to proceed.

The Engineer is required to inspect and test certain equipment listed in the specification under "Hold Points" at their place of manufacture and such equipment may not be delivered to the Contract site, nor may the Contractor proceed with the manufacture and/or installation of such equipment without prior written consent from the Engineer.

The Contractor must give the Engineer at least 7 days advance notice of the date at which such tests and inspection are to be carried out unless otherwise agreed by both parties.

### 1.12.3 Completion and Take-Over Procedures

In terms of the Conditions of Contract the following procedure will apply to the "take-over" of the Installation, or if required by the Employer to the sectional completion of a portion thereof.

#### **Form A: Application for Practical Completion Inspection**

After the physical completion of manufacturing and upon completion of the installation, the Contractor shall carry out his own internal quality control checks on all the various items of the installation, where after such "Contractor's Inspection List" shall be signed off by the Contractor and be submitted to the Engineer together with a "Form A" to apply to the Engineer within one week for the Practical Completion Inspection List.

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Subject to the discretion of the Engineer detailed in writing, the Installation may be divided into different sections for the application of the above inspection procedure.

Any inspection carried out by the Engineer on the request of the Contractor without the above documentation will be regarded as unofficial, and the cost may be recovered from the Contractor.

### **Form B: Practical Completion Inspection Certificate**

Once the Engineer has received a "Form A" from the Contractor he will officially inspect the Installation, listing all minor outstanding items still to be rectified on a Practical Completion List - Form B1.

### **Commissioning:**

All site testing and all commissioning activities as specified shall be carried out in close cooperation with the Engineer.

It is a requirement of this Contract that the Contractor shall submit a complete testing and commissioning procedure to the Engineer for approval, at least two weeks prior to the commencing of the actual testing and commissioning activities on Site.

All testing and commissioning shall be carried out in the presence of the Engineer or his duly authorised representative and shall at all times be thorough and in strict accordance with the specified requirements and approved procedures. All tests carried out without the Engineer being duly notified, will be regarded as unofficial and may at the discretion of the Engineer have to be repeated at the cost of the Contractor.

### **Form C: Works Completion Certificate**

The Engineer will issue Form C, after the items listed on Form B1 have been completed to his satisfaction, together with his Final Completion List containing all outstanding and unacceptable work (except undetected patent and latent defects). The Contractor shall complete all items listed within 20 working days.

The Engineer will only issue Form C if all O&M manuals, and "As-Installed" drawings have been received and training of personnel has taken place.

### **Form D: Final Completion Certificate**

The Engineer will issue, on request by the Contractor, a Final Completion Certificate at the end of the Defects Liability (Retention) Period.

### **Cost of Re-inspections**

Should the Engineer, after an inspection or test, find that the number of outstanding defects is of such a nature that he is unable to issue a meaningful list or certificate, or that due to the Contractor not attending to previous lists or reports, re-inspections are required, such re-inspections will be charged to the Contractor and deducted from the balance of his account by means of a variation order. The Engineer will be compensated accordingly by SARS.

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## TRAINING OF EMPLOYERS PERSONNEL

Once the Contractor has completed and commissioned the Installation and issued the O & M manuals to the satisfaction of the Engineer, he shall train the Employer's personnel the proper operation and maintenance of the plant.

The Contractor shall prepare and submit a recommended training program to the Engineer for approval.

The Contractor shall give the Engineer sufficient time to make the necessary arrangements.

## TOOLS, EQUIPMENT, TEST INSTRUMENTS AND MAINTENANCE TOOLS

The Contractor shall provide all tools and equipment necessary for the proper and efficient execution of the work.

The Contractor shall provide all test instruments necessary for the proper testing of equipment or systems to ensure that the specified requirements are met.

The Contractor shall provide valid calibration certificates for all instruments.

## CODING, LABELING, NOTICES AND NAME BOARDS

The language shall be English, or as specified by the Engineer.

To reduce the possibility of incorrect wording the Contractor shall submit a proposed "Schedule of Labels and Notices" to the Engineer for approval prior to manufacture and at least 4 (four) weeks in advance thereof.

### 1.15.1 Manufacturer's Nameplate

All equipment shall be provided with a manufacturer's nameplate, which shall be a copper, anodised aluminium or stainless steel tag, welded or riveted to the equipment. (No "glue-on" plates will be accepted.) The lettering thereon shall be suitable to withstand the climatic or other conditions under which the equipment is to operate.

The nameplates shall display the information required by the relevant SANS specifications. At least the following shall be shown:

- Manufacturer's name
- Model number
- Volume where applicable
- Size, Speed, Power input, Power output, FLA,
- All letters shall be hard stamped and at least 4 mm.
- Supply Voltage, etc whichever may be applicable.

### 1.15.2 Identification Tag

The Contractor shall provide an identification tag or label with the equipment identification code, in approved format, screwed or riveted next to each piece of equipment (no 'glue on' attachment will be accepted).

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Black engraved letters on a white background shall be used.

The minimum height of letters shall be as follows:  
Equipment identification = 10 mm

### 1.15.3 Notices

The Contractor shall install all notices required in terms of Statutory Regulations and shall amongst others include the following:

- Prohibiting unauthorised persons from entering specific areas during construction.
- Prohibiting unauthorised persons from handling or interfering with electrical apparatus.
- Directions and procedures to be followed in case of fire or emergency.
- Directions as to resuscitation of persons suffering from the effects of electrical shock.

## GUARANTEE PERIOD

The Electrical Contractor will be responsible to guarantee the installation for a period of 12 months after the Form of Acceptance, Form C, has been issued.

## CERTIFICATE OF COMPLIANCE

The Engineer will not issue a Final Completion Certificate - Form D until he is in receipt of such a Certificate of Compliance.

## 2. LOW VOLTAGE DISTRIBUTION BOARDS

### GENERAL

- The distribution boards shall be manufactured in strict accordance with the applicable and relevant schematic diagrams and shall be in accordance with applicable national standards.
  - The proposed DB manufacturer must be disclosed in section 6 in the equipment schedule. The responsibility falls on the tenderer to ensure that these suppliers are carrying the SABS or equivalent mark.

**For distribution boards with a Fault level higher than 10 kA, an approved and certified type tested manufacturer must be used. Proof of this certification shall be supplied to the Engineer at the start of the contract. These distribution boards shall be type tested in accordance with SANS 1973-1 and SANS 10142-1**

Additional space for future extensions must be allowed for in the distribution boards as specified on the schematic diagrams.

The electrical contractor shall confirm the maximum dimensions, in particular the width of the distribution boards as indicated on the schematic diagrams prior to the order placement of the board and shall obtain the engineer's full agreement and approval.

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The Contractor shall determine the positions and dimensions of all distribution boards timeously and ensure that ample provision has been made in the structure to accommodate all boards and for sleeves, access holes, etc.

All distribution boards shall be totally enclosed, vermin and insect proof, drip- and dustproof to at least class IP 42 of IEC 144.

The type of distribution board shall be as indicated on the schematic diagrams

The name of the switchboard manufacturer shall appear on each distribution board.

The Contractor shall, during commissioning, balance single phase loads as evenly as possible over the phases and shall amend the "as installed" drawings

### CONSTRUCTION OF FLOOR STANDING BOARDS

Floor standing distribution boards shall be of the multi-tiered, fixed pattern, sectional construction type, allowing for the logical grouping of equipment behind individual hinged doors or panels to the full approval of the Engineer. The distribution board shall mainly consist of the following:

A rigid channel base frame of at least 2 mm thickness and of sufficient strength to prevent any distortion.

The top, side and rear panels of the distribution board shall be of minimum 1,6 mm folded steel. Front panels shall be fixed by means of two locating pins at the bottom and two square key operated panel locate on top.

All joints shall be welded and shall be completed to a smooth finish.

Dome nuts of self-tapping screws to secure front panels will not be accepted.

If doors are specified in the "Detail Specification" or on the schematic diagrams, the width of the doors shall not exceed 800 mm and it shall be manufactured from minimum 1,6 mm sheet steel, folded in a 20 mm deep rigid pan section with a 10 mm return edge towards the inside, parallel to the closing face of the board.

A neoprene type seal of 3 mm thickness shall be applied to the 10 mm return edge of the door.

The doors for weather proof boards for outdoor applications shall be arranged to close over a 10 mm return edge on the board frame, projecting into the door pan, to the full approval of the Engineer.

Machine punched slots or holes shall be provided in the front panels to allow for the operating handles of circuit breakers and switches, without excessive gaps.

Galvanised gland plate/s with minimum thickness of 3 mm for glanding off of all required cables shall be provided at the base or in the top of the board.

Front panels shall have machine punched slots for housing the specified and future flush

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mounted switchgear. The distance between the inside of the closed doors and the panel shall not be less than 20 mm. No equipment may be mounted on the panel unless the panel is permanently hinged to the switchboard frame.

Switchboard doors shall be equipped with padlock-able "lever locks.

### CONSTRUCTION OF SURFACE MOUNTED BOARDS

Surface mounted boards not larger than 1500 x 1500 shall be totally enclosed and shall consist of:

A minimum of 2,0 mm sheet metal enclosure, of approved design suitably braced and with the necessary reinforced fixings for wall mounting.

All applicable requirements for "floor standing boards" in Clause 3.2 will also apply to surface mounted boards.

### METALWORK FINISH AND PAINTING

The colour of the distribution boards shall be:

- Distribution Boards as indicated on the schematic drawings

All metalwork shall be smooth, free from rust, scale or grease and shall be cleaned in strict accordance with SABS 780, and finished with either baked enamel or electrostatically applied powder coating in the case of interior applications, in the case of all outdoor applications the final paint layer shall consist of an ultra-violet resistant epoxy type paint to the approval of the Engineer. The paint finish shall generally comply with:

- Dry ground-layer paint thickness - minimum 0,03 mm of approved rust inhibiting paint.
- Total dry-paint thickness for indoor applications - minimum 0,06 mm.
- Total dry-paint thickness for outdoor applications - minimum 0,09 mm.
- Shock resistance on 0,9 mild steel plate - 25 Kg.
- Scratch resistance 2000 grams.

Where the electrostatic powder coating method is used, the paint shall be baked to harden within 10 minutes at a constant temperature of 190NC.

The internal surfaces of all boards shall have a final coat in the same colour as that for the outside. All equipment mounting frames shall similarly be painted white.

The compartment for "Emergency Supply" of all boards shall be painted signal red.

Special attention shall be given to achieving the required paint thickness to all edges and corners, as well as the inside of slots and channels formed by folding of the metal.

It is a requirement of this Specification that the fully painted metal cubicle be subject to inspection and approval by the Engineer prior to any wiring or equipment being fitted

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Any damage to paintwork incurred during transport and erection shall be made good to the full approval of the Engineer, by thoroughly cleaning the damaged portion to the original metal surface and applying the full number of coats that had previously existed.

## **BUSBARS**

All busbars shall be of solid drawn, high conductivity copper and shall comply with SABS 784, BS 159 and BS 1433. Completed busbar installations shall withstand the full test voltage specified in the relevant BS specification.

### **2.5.1 Application**

Busbars shall be provided for the following applications:

- (a) Distribution of supply voltage (main busbars).
- (b) Connection to all equipment with current ratings exceeding 200 Amps.
- (c) Connection of outgoing circuits with current ratings in excess of 200 Amps.
- (d) Collection bars for parallel circuits.
- (e) Connection bars for neutral conductors.
- (f) Earth busbars
- (g) Connections to miniature circuit-breakers

### **2.5.2 Rating**

Busbars for system voltages up to 600 V shall be designed to withstand a test voltage of 2,5 kV for 1 minute.

The maximum allowable temperature of busbars carrying full load current in an ambient temperature of 35 NC shall not exceed 80 NC. All busbar designs shall be submitted to the Engineer for approval prior to manufacturing.

Busbar installations shall comply with SABS 0142 and shall be designed to a maximum current rating of 2,1 Amp per sq. mm for all applications where the current is less than 1000 Amp and 2,2 Amp per sq mm for applications where the current is in excess of 2000 Amp. Manufacturers shall where requested prove that the busbar design and enclosure comply with the temperature rise as specified above.

In addition to the current rating, busbars shall comply with the fault level rating as specified in the relevant BS specification.

### **2.5.3 Mounting of Busbars**

The copper surfaces of busbars at joints shall be tin coated.

All busbars shall be installed horizontally or vertically with the longer side of the cross section



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in the vertical plane. Main busbars shall be supported on resin bound panels or similar insulating material to the approval of the Engineer. These panels shall be firmly bolted to the switchboard frame and shall fit tightly and neatly around the busbars. Busbars may also be mounted on resin insulators. Porcelain insulators are not acceptable.

The busbars shall be fixed and supported at sufficient intervals to withstand the mechanical forces encountered during the maximum fault current that can occur. The maximum allowable spacing of busbars supports for fault levels of 20 kA and more is 500 mm.

Where a busbar consists of 2 or more busbars laminations per phase the laminations shall be separated by a minimum distance equal to the thickness of one lamination. The laminations shall be clamped together with copper spacers at intervals not exceeding 450 mm in order to equalise the current distribution in the laminations.

The busbars shall withstand a fault current test under the conditions of the specified fault level for 1 sec. If a fault level is not specified, the busbars shall be tested at 20 times rated current for 1 second. The fault current during tests shall be:

- (a) between all three phases,
  - (b) any two phases,
  - (c) neutral and the adjacent phase, and
  - (d) earth conductor and the nearest phase conductor.
- Busbars shall be at least 150 mm from the nearest equipment. Where busbars protrude through a switchboard panel for incoming or outgoing circuits, the busbars shall be properly insulated and rigidly supported on the inside of the switchboard. This shall be achieved by means of resin bound synthetic material or similar insulating material with cut-outs which fit tightly around the busbars. The insulating panel shall be firmly bolted to the frame. Busbars or "droppers" that pass through internal partitions in the switchboard shall be similarly insulated and supported.

The minimum clearances between current carrying parts and other metal parts for system voltages up to 600 V is in accordance with SABS 784 and BS 159 but shall not be less than 25mm. The side panels shall be provided with an insulated pad with an area of at least double the area of the cross section of the busbars at both ends to prevent the busbar from touching the side panel during expansion of the busbar.

#### 2.5.4 Insulation

All busbars shall be covered with coloured heat-shrinkable products. The colour shall correspond to the colour of the supply phase.

Alternatively, busbars may be covered with two coats of coloured insulation paint if approved by the Engineer. Busbars shall be radius edged where they change direction.

Joints shall be insulated on site after installation on site and after the Engineer has checked the bolts. High tensile steel bolts with washers and spring washers shall be used at joints.

#### 2.5.5 Connections to Busbars

All conductors and cables shall be bolted to busbars using crimped lugs of the correct size to suite the conductor. Cadmium plated steel bolts and nuts, washers and lock washers shall be

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used. Only hexagon type crimping tools and lugs shall be used where the conductor sizes exceed 10 sq mm.

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#### 2.5.6 Neutral Busbars

Neutral busbars in 3 phase, 4 wire supplies shall have a cross-section of at least 60 % of the cross-section of the phase busbars. Where single phase circuits (e.g. lighting and general power circuits) are protected by single phase circuit breakers or fuses, all neutral conductors shall be connected to a separate neutral busbar mounted in a suitable position.

The cross-section of the busbar shall be at least 6 mm x 25 mm and the busbar shall be long enough for the lug of each conductor to be bolted separately to the busbar. Only one neutral conductor is allowed per nut and bolt combination.

A separate neutral bar shall be provided for each earth leakage unit provided on the switchboard.

#### 2.5.7 Earth Busbar

An earth busbar shall be installed in a convenient position along the entire length of the switchboard. All earth connections shall be bolted separately to the busbar. The cross-sectional area of earth busbars shall be calculated according to the relevant formula in IEC 439 with a minimum cross-section of 6 mm x 25 mm.

In addition, the longer side of the earth busbar shall be at least twice the diameter of the largest bolt that will be fitted to the busbar. The earth bar shall be bolted to the frame of the switchboard. Brass earth strips with tapped holes and screws are not acceptable. Busbars with clamp type terminals that fit over the bar, are acceptable as an alternative to bolted connections. The earth busbar shall be clearly marked with green paint or green heat shrink cords in suitable positions.

### CONDUCTORS

#### 2.6.1 Power Conductors

Connections between busbars and all equipment in the switchboard shall consist of heavy-duty coloured PVC insulated stranded annealed copper conductors manufactured to SABS 1507 and/or solid high conductivity copper bars of ample cross-section covered with heat shrinkable material.

The colours to be used in all instances shall be red, white and blue for phase connections and black for neutral connections. All circuits with a rating of 200 A and more and all connections to cables larger than 70 sq. mm shall consist of busbars only.

#### 2.6.2 Current Rating

The current rating of all conductors used for the internal wiring of switchboards shall be equal to the capacity of the circuit breaker or fuse which protects the circuit and shall be selected to comply with SABS 10142, Table B, column 4.

#### 2.6.3 Internal Wiring

- (a) Standard 600/1000 V grade PVC-insulated stranded annealed copper conductors to SABS 1507 shall be employed for the internal power wiring of switchboards. The smallest conductor size to be used for power wiring in switchboards shall be 2,5 mm<sup>2</sup>.

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- (b) Where heat generating equipment is present and the internal temperature of the board is likely to exceed 50 °C, silicon-rubber insulated stranded conductors shall be used.
- (c) Wiring shall be neatly arranged in horizontal and vertical rows and shall be installed in PVC wiring channels or bound with plastic straps where channels are not practical. Under no circumstances may PVC adhesive tape be used for the bunching of conductors or for the colour identification of conductors.
- (d) Conductors to hinged panels and doors shall be secured on both the door and the frame and shall be looped to allow sufficient movement. "Glue on" type clamping methods will not be acceptable. A flexible protection sleeve shall be installed over the conductors.
- (e) Where wiring channels are used, they shall be installed horizontally and vertically. The wiring used for all control wiring shall be 600 V grade.
- (f) All wiring between different panels within the same switchboard shall be installed in wiring channels.
- (g) Grommets shall be installed in each hole in the metalwork through which conductors pass. Such holes shall be of adequate size to prevent heating due to Eddy currents in the metal work.
- (h) All wiring shall be installed away from terminals, clamps or other current carrying parts. Wiring shall also be kept away from exposed metal edges or shall be protected where they cross metal edges.
- (i) A maximum of 2 conductors per terminal may be joined at equipment terminals or numbered terminal strips only. No other connections are allowed.
- (j) Where conductors change direction, smooth bends shall be formed with a radius of at least 5 times the outside diameter of the conductor or harness.
- (l) Where neutral or earth connections are looped between the terminals of instruments or other equipment, it is essential that the two conductor ends be inserted into a common lug and are crimped or soldered together in order that the neutral connection is not broken when the conductors are removed from one of the instruments.
- (m) Conductors terminating on meters, fuse holders and other equipment with screw terminals shall be fitted with crimped wire end ferrules.
- (n) Wiring should be confined to the front portions of switchboards as far as possible for ease of access. This requirement is important for wiring between circuit breakers with a rating of less than 60 A and the associated main circuit breaker as well as the wiring from circuit breakers to lighting and socket circuits.
- (o) A maximum of two conductors will be allowed per equipment terminal. Where more conductors must be connected to the same equipment terminal (eg. a main circuit breaker feeding other circuit breakers), stub busbars shall be provided for the various conductors.

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- (p) Cables bundled together shall be de-rated according to the applicable SABS specifications.

All instrument fuses shall be accessible from the front, located behind the front panels.

Where equipment is fed by busbars, the fuse holders shall be bolted directly onto the busbars. In other cases, conductors from the incoming circuit to the fuse shall be as short as possible. Each fuse shall be separately labelled stating instrument circuit, phase and rating.

### IDENTIFICATION OF CONDUCTORS

The colour of all conductors for 400V or 230 V AC circuits shall comply with the colour requirements specified in SANS 10142.

Conductors for DC circuits and earth connections shall be grey and green respectively in compliance with BS 158 but the conductors for control, alarm, interlocking and measuring circuits, shall preferably have different colours which are installed according to a consistent colour code.

Each conductor including conductors at terminals shall be marked at both ends by means of durable ferrule type plastic wiring/cable markers. Cable markers specially manufactured for this purpose shall be used. Hand-punched PVC or other type is not acceptable. The numbers of all conductors shall appear on and correspond to the switchboard drawings.

### CABLES

All cables for incoming or outgoing circuits shall terminate on a gland plate supplied for this purpose and be supported to take the force off the gland.

All outgoing power cables shall terminate within 500 mm of the gland plate to avoid long leads. Where this is not possible, each lead must be separately braced to the approval of the Engineer.

### ESSENTIAL AND NON-ESSENTIAL SUPPLIES

"Essential supply" means that in case of a power interruption, standby power is either automatically or manually switched to these circuits from a standby power source. Special care shall be taken to prevent any feedback from the "Essential" to the "Non-essential" supply or vice versa and that motor starting currents do not exceed the capability of the standby power source. If necessary, special precautions must be taken to limit the motor starting currents.

The switchboard shall be divided into electrically separate sections with sheet metal barriers to isolate the "Essential" and "Non-essential" compartments.

A main switch shall be provided in both the "Essential" and "Non-essential" supply sections of the switchboard. Each main switch must be interlocked with the access door or panel in that section to ensure that the door can be opened only when the main switch is in the OFF position.

### EQUIPMENT SPECIFICATION

### 2.10.1 Metal Clad Air Circuit Breaker, Withdrawable Type

- (a) The metal clad circuit breaker shall comply with the National Requirements
- (b) The circuit breaker shall be horizontally withdrawable and shall be a self contained unit of the dead front type, allowing maintenance and tests to be carried out without having to remove the circuit breaker from the withdrawal mechanism. The unit shall contain the necessary mechanical interlocks to prevent:
  - o Access to "Live" terminals when the breaker is withdrawn.
  - o The withdrawal or insertion of the unit, when breaker is in the closed position.
  - o Closing of the circuit breaker following an automatic trip condition without resetting the mechanism.
- (c) Adjustable thermal overload releases shall be provided to suit the required current range. In addition, instantaneous magnetic short circuit trips which are adjustable shall be fitted. The tripping devices shall be direct acting. This delay adjustment shall be bypassed with an instantaneous making current release when the circuit breaker is closed to prevent the delay timer from operating when the circuit breaker is closed on a fault.
- (d) The tripping time characteristics of the circuit breaker shall be such that good discrimination grading can be obtained between the main incoming circuit breaker and the switchgear on the outgoing circuits, under overload and short circuit conditions.
- (e) The air circuit breaker shall be of the quick-make, quick-break type with a stored-energy spring assisted operating mechanism provided with:
  - o A trip free mechanical hand operated closing mechanism.
  - o A manually operated mechanical trip mechanism suitably protected to prevent inadvertent tripping.
  - o A positively driven mechanical device to provide ON/OFF/TRIP indication. This indication shall be clearly visible with the circuit breaker in position.
- (f) Provision shall exist for the addition, if specified, of a source-side under voltage lock-out.
- (g) Circuit breakers shall have electrically separate auxiliary contacts as specified. Where none are specified two N/O and two N/C auxiliary contacts shall be provided. Shunt trips and electrical stored energy breakers shall be interlocked to prevent repeated operation of the trips or winding mechanisms when the breaker is in the tripped or closed position.
- (h) All non-current carrying metal parts of the circuit breaker shall be solidly interconnected and connected to an earth contact which shall engage with a mating contact or copper plate which is connected to the earth busbar of the switchboard. The arrangement shall be such that the circuit breaker frame is earthed in the test

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position and before the breaker contacts engage the live fixed contacts.

- (i) The fixed cradle shall be of high mechanical strength.
- (j) The circuit breaker shall have RACKED-OUT, TEST and ENGAGED positions which shall be clearly marked.
- (k) The circuit breaker shall bear a clearly legible rating plate indicating the current rating, breaking capacity and voltage rating.
- (l) Extension type operating handles shall be fixed to the circuit breaker on completion of the installation.
- (m) The circuit breaker shall be designed to allow the incoming terminals to be at the top or bottom without affecting the operation of the unit.
- (n) The circuit breakers shall be derated as necessary to compensate for the following environmental factors:
  - o Maximum ambient air temperature in excess of 40 deg. C or the daily average ambient air temperature in excess of 30 ° C. This is especially important with regard to the type of enclosure in which the circuit breaker is to be installed.
  - o Height above sea level.
  - o Operational duty cycle and estimated loading.
- (o) The complete circuit breaker and its electrical and mechanical constituents and accessories must be a standard product of a single original manufacturer.

#### 2.10.2 Molded Case Circuit Breaker

- (a) MCB's shall be of the same manufacture for the specific project, and to the approval of the Engineer.
- (b) The circuit breaker shall be of the single pole or multipole free handle, air break type, housed in a moulded phenolic or glass polyester case and suitable for panel mounting.
- (c) The circuit breaker shall comply with the requirements of SANS 156.
- (d) Circuit breakers shall be suitable for operation on supply voltages of 380/220 V to 440/250 V, 50 Hz and the rupturing capacity at these voltages, when the circuit breakers are tested in accordance with Clause 7.10 of SANS 156
- (e) The overload and short circuit trips of the circuit breaker may be of the following type to suit the application:
  - o Combined thermal/magnetic trips with interchangeable trip units, the magnetic trip setting being adjustable.
  - o Combined thermal magnetic trips with fixed and sealed trip units, the magnetic

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trip setting being adjustable.

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

### 2.10.3 Earth Leakage Relays

- (a) Single phase or three phase earth leakage relays with associated double or triple pole circuit breakers shall be supplied and installed on all circuits feeding socket outlets and other general power circuits in compliance with the Code of Practice for the Wiring of Premises, SANS 0142 and shall conform to SANS 767.
- (b) The relays shall operate on the core balance (current balance) principle. The operation shall be independent of mains voltage and shall function with any of the supply conductors (and neutral) disconnected or broken.
- (c) The sensitivity and operating response of the relay must be such that instantaneous tripping will occur at a total earth leakage current of 30 mA or more. The unit shall have compensation for ambient temperature variations and the sensitivity and operating response time must be maintained over the range of normal frequency variations. Stability of operation, long life and retention of characteristics are essential.
- (d) The unit shall be provided with integral test facilities by means of which the correct functioning of the unit may be tested.
- (e) The unit shall withstand fault currents of at least 5 kA or as specified, either between phase and earth, or between phase and neutral, without any damage being caused thereby.
- (f) The circuit breaker associated with the earth leakage unit shall be of the double pole (for single phase circuits) and triple pole (for three phase circuits), free handle type, having a rupturing capacity of not less than 5kA. The circuit breaker shall be fitted with a release tripping mechanism and must match with the earth leakage unit.
- (g) The circuit breaker and earth leakage relay shall be suitable for operation on a 220/250 V, 50 Hz supply on single phase circuits and 380/440 V, 50 Hz supply on three phase circuits.
- (h) The earth leakage unit shall comply fully with SANS 767.
- (i) Where specified for wall mounting, the circuit breaker and earth leakage relay shall be mounted in a sheet metal case with anti-corrosion treatment and baked enamel finish.
- (j) The earth leakage unit shall be so designed that the case do not saturate and sender unit inoperative when the total harmonic component of the voltage exceeds 2,5%.

### 2.10.4 Full load, Fault -making Isolators



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- (a) Full load, fault-making isolators shall be of the triple pole, hand operated, panel mounting, air break type suitable for operation on 380/440 V, 50 Hz systems.
- (b) The contacts shall be of silver alloy and the switch mechanism shall be of the quick-make, quick-break type.
- (c) The switches shall be capable of opening and closing the full current rating of the switch. The current rating of the switch shall be at least 20% in excess of the full load current of the circuit which the switch will be required to open. In the case of motor circuits the switch shall be capable of breaking the "locked rotor current" of the motor.
- (d) The switches shall further be capable of being closed on to a fault. The switches shall be adequately rated to withstand the maximum fault current that can occur at that point in the circuit for a sufficient time to allow the back-up protection (circuit breakers or fuses) to open the circuit.
- (e) The switches shall be suitable for mounting behind switchboard panels.
- (f) To distinguish the switches from circuit breakers, the operating handle shall have a distinctive colour or other clear indelible indication and shall be clearly labelled "ISOLATOR".

#### 2.10.6 Power Fuses and Fuse Holders

- (a) High rupturing capacity (HRC) fuses shall comply with the requirements of SANS 172 or BS 88 with a fusing factor of 1,5.
- (b) Fuses which are not mounted integrally with switches, shall be mounted on insulated draw-out carriers (holders) which hold the fuses positively after withdrawal. Fuse holders shall comply with SANS 173.
- (c) Each fuse link and holder shall incorporate a visual inspection eye for fault location.
- (d) Should live terminals become exposed after the withdrawal of fuses, rigid barriers shall be provided between adjacent sets of terminals to prevent accidental contact during withdrawal or insertion of the fuses.
- (e) Control circuits shall be protected by suitably rated fuses. Instrument fuses shall be mounted in close proximity to the relevant instrument. These fuses shall be clearly labelled with engraved or similar strips indicating use, rating and duty.
- (f) Striker pin fuses shall be equipped with an alarm contact so arranged that the contact closes and remains closed when the striker pin operates.
- (g) Fuses shall be so connected that the live terminal is at the top.
- (h) Fuse ratings shall be accurate to within 5% of the published value for unused fuses and shall not vary significantly after long periods of service.
- (i) Fuses shall be de-rated for ambient temperatures above 25 °C in accordance with the manufacturer's recommendation. If no such recommendation exists, a de-rating factor of 1 % per deg. C above 25 °C shall be applied.
- (j) Fuses shall be de-rated for altitudes of more than 1 000 above sea level in accordance

- with the manufacturer's recommendation. If no such recommendation exists, a de-rating factor of 1 % per 300 m above 1000 m above sea level shall be applied.
- (k) Time/current characteristics shall be chosen to suit the application.
    - o Cable protection: The fusing factor shall not exceed 1,5.
    - o Motor circuits: Time-lag characteristic shall be such that the starting currents will not cause deterioration of the fuse.
    - o Capacitor circuits: Fuses shall be chosen to withstand a higher than normal full-load current (1,5 times rated capacitor current) to allow for harmonics and shall not deteriorate due to the high transients at switch-on.
    - o Distribution systems: The total operating IE2t let through by secondary (minor) fuses shall be less than that of primary (major) fuses in any specific branch.
  - (l) It shall be ensured that the rupturing capacity of a fuse chosen for a specific application shall be adequate both as far as short circuit current and applied voltage are concerned.

#### 2.10.7 Contactors

- (a) Contactors shall be of a manufacturer approved by the engineer, suitably rated for the application.  
  
All contactors on a specific project shall be of a single manufacturer.
- (b) Contactors shall be of the totally enclosed, double or triple pole, electromechanically operated air-break type suitable for 220/250 V or 380/440 V supplies and shall comply with SANS 1092.
- (c) The current rating of the contactor shall be as specified for the circuit with a switching duty in accordance with the IEC 158-1, utilisation category AC1 for lighting and power circuits and utilisation category AC3 for motor starting.
- (d) The mechanical duty of the contactor shall comply with the specified requirements for Class IV of Clause 5.6 of BS 775.
- (e) Contactors shall be suitable to accept clip on auxiliary contact modules and sufficient space shall be allowed on the board layout.
- (f) Contactors for motor starters shall be fitted with adjustable thermal overload protection modules with single-phasing sensitivity to IEC 292 - 1C.
- (g) Contactors for normal/standby change-over circuits shall be electrically and mechanically interlocked. Contactors shall also be electrically and mechanically interlocked in star-delta starters.
- (h) Contactors or motor starters not located in a switchboard shall be housed in a purpose made enclosure of the same manufacture as the contactors to at least IP55.

#### 2.10.8 Control Relays and Timer

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- (a) All relays and timers shall be of a manufacturer approved by the Engineer.

All control devices on a specific project shall be of the same manufacturer as the contactors.

- (b) Relays shall be rail mounted and shall be to IEC 159-1, 337 and 255.

#### 2.10.9 Indoor Lightning Arrestors

All the distribution boards shall be equipped with suitably rated lightning arrestors/Surge Protection Devices , integrated and fully compliant to the existing Lightning Protection and Earthing system,.

- (a) Lightning arrestors shall be of the single pole indoor type suitable for mounting in the switchboard and suitable for the protection of domestic electrical appliances.
- (b) The arrestors shall conform to SANS 171
- (c) They shall be suitable for installation at altitudes of up to 1800 m above sea level.
- (d) The arrestors shall be suitable for systems with grounded neutral and voltages up to 250 V to earth, and shall comply with the requirements of SANS 171 or VDE 0675.

### INSTRUMENTS

#### 2.11.1 Voltmeters

- (a) Voltmeters shall be PCI type Fv voltmeters.
- (b) Voltmeters shall be of the moving iron type with Class 1,5% accuracy as specified in IEC 51 and shall be suitable for flush mounting on vertical switchboard panels.
- (c) Voltmeters shall be 72 mm square pattern unless specified to the contrary. Voltmeters, ammeters, frequency meters, etc. shall all have the same dimensions for any particular application.
- (d) Voltmeters shall be manufactured in accordance with the requirements of BS 89 for industrial grade accuracy. The voltmeters shall be calibrated and shall withstand an insulation test voltage of 2 kV AC for 1 minute.
- (e) Voltmeters shall be fitted with zero adjustment screws.
- (f) Voltmeters shall be screened to prevent magnetic interference and shall be fitted with anti-static glass.
- (g) Voltmeters shall be protected by suitable 2 Amp fuse to BS88.
- (h) Where voltmeters are connected to potential transformers, the ratio of the potential transformer shall be marked on the voltmeter faceplate.
- (i) Under certain conditions voltmeters to be supplied shall be of the suppressed zero type

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and shall be scaled in accordance with the requirement of the switchgear.

- (i) Where only one voltmeter is specified, a voltage selector switch shall be provided having four positions marked "Off", "R-B", "R-Y" and "Y-B".

#### 2.11.2 Ammeters

No ammeters are required in the distribution boards.

#### 2.11.3 Maximum demand ammeters

If the main circuit breaker or main isolator of the distribution board is equal or larger than 150A, maximum demand ammeters will be installed if indicated on the schematic diagram.

- (a) Ammeters shall be PCI type Fa ammeters.
- (b) Ammeters shall be of the moving iron type suitable for flush mounting on vertical board panels.
- (c) Ammeters shall be manufactured to the requirements of BS 89 with an accuracy which need not exceed 1,5%. Direct reading ammeters up to a maximum of 60 Amp may be used. Current transformer operated ammeters of 5A full scale shall be used to measure large currents. The current transformer ratio shall be indicated on the scale. Full load ratings shall be indicated by a red line. Ammeters shall withstand a test voltage of 2 kV AC for 1 minute.
- (d) In the case of ammeters connected into protection circuits, such meters shall be fitted with saturation current transformers in order to protect the meter and associated circuiting. For normal load applications these current transformers shall saturate at 200% of their full load and at 700% on motor load applications.
- (e) The applicable requirements set out in Clause 3.12.1 will also apply to ammeters.

#### 2.11.4 Bulk Kilowatt-hour Meter

Three phase Kilowatt-hour meters will be supplied and installed in the main distribution boards as shown and specified on the schematic diagrams.

All metering CT's shall be rated at 15VA, Class 0,5 and shall be clamped to the relevant busbars.

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- (a) The meter shall be manufactured in accordance with the requirements of BS 37. The meter shall be suitable for operation on a three phase, 50 Hz AC system with Class 2 accuracy.
- (b) Up to 80A meters shall provide a direct reading in kWh without the use of multiplication factors.
- (c) Over 80A, 5A meters shall be provided with the correct ratio Class 0,2 metering current transformers for the application. An engraved label shall be installed below the meter indicating the factor by which the meter reading shall be multiplied to obtain the correct Kwh value.
- (d) Combined kVA/kWh meters shall be provided when specified
- (e) If required on the drawings, the meter shall be equipped with a 30 minute integrated kVA maximum demand indication which shall be ambient temperature compensated and shall have an accuracy of 3%.
- (f) The Contractor shall provide the Engineer with a Certificate from an approved specialist test authority, who has tested and certified the meter after installation on site including the meter reading at hand over.

### TERMINAL BLOCKS

All incoming and outgoing wiring shall be terminated on separate terminal blocks.

Terminals and conductors on either side shall be suitably marked.

Terminations of "live" conductors shall be covered to prevent accidental contact and shall be provided with a warning

### EARTHING

Each switchboard shall be provided with a copper earth bar with minimum dimensions of 25 mm x 6 mm.

The earthbar shall be pre-drilled over its full length at 15 mm centres with holes with a minimum diameter of 5 mm. The above earthbar shall be earthed to the main substation earth.

All exposed instruments shall be effectively earthed to the earthbar by means of copper conductors with a minimum cross-sectional area of 2,5 mm<sup>2</sup>, which shall be insulated by means of green PVC insulation. Care shall be taken that the gland plate and screens of all incoming cables be connected to the above earthbar to the approval of the Engineer.

### BOLTS AND NUTS

Unless otherwise approved all bolts and nuts shall be metric sizes complying with an approved international standard. Terminal bolts or studs used for carrying current of more than 100 Amps shall not be less than 12 mm in diameter.

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All terminal bolts and studs used for electrical connections with diameter less than 4 mm shall be made from either stainless steel or phosphor bronze. Brass shall not be used.

Self-tapping screws are not acceptable. All bolts, nuts and washers exposed to atmospheric conditions shall be suitably treated to prevent corrosion by means of cadmium plating to the approval of the Engineer.

Bolts and Nuts shall project a maximum of 4 - 8 threads and a minimum of 1 thread through their respective nuts.

### **DRAWINGS AND APPROVAL**

A set of three for construction shop drawings for the manufacture of the distribution boards must be submitted to the Engineer for approval at least two weeks before manufacturing commences.

- A detail general arrangement of the arrangement of the switchboard indicating all equipment dimensions and the construction of the board. The positions and method of fixing and sizes of wiring shall be shown.
- All labelling information in the required languages shall be provided on a separate sheet.
- The make, catalogue number and capacity of all equipment such as isolators, circuit breakers, fuses etc.

The approval of drawings shall not relieve the Contractor of his responsibility to supply the switchboards according to the requirements of this specification and limitations of the building.

### **3. LOW VOLTAGE CABLES**

The following cables shall be used:

- (a) 600/1000V PVC insulated cables for all supply voltages between 50 V and 600V.

Only armoured cables shall be used for underground cable runs, whether installed in pipes or laid in the ground. Unarmoured cables may only be used when installed in conduit or enclosed metal ducts along the entire cable route.

All cables installed on the cable trays, in floor trenches, in vertical riser ducts and all cable runs that are partially installed in conduits, underground pipes or metal ducts, shall be fully armoured.

All cables shall comply with the relevant SABS, EDC or NEMA specifications and shall be installed, fixed, protected and terminated in a proper fashion according to approved methods and in accordance with the manufacturer's specifications and the Code of Practice for the Wiring of Premises, SANS 0142. The Contractor shall employ competent staff for the installation of the various cable types.

Cables with conductor sizes of less than 1,5 mm<sup>2</sup> shall not be used except for communication or control systems where the supply voltage is less than 50 V. Only cables with copper conductors shall be used unless approved otherwise.

Cable sizes shall be determined strictly in accordance with the relevant tables of the Code of Practice of the Wiring Premises, SANS 0142. Special attention shall be paid to group de-rating factors and cables sized for equipment requiring low voltage drops (especially in the case of motors starting high inertia loads.) Cables spaced apart by a minimum of 2 cable diameters need not be de-rated.

Through joints will not be allowed in cables without the written permission of the Engineer's Representative.

Unless clearly specified to the contrary, each cable run which forms part of the low tension distribution system, and each cable feeding equipment, shall be provided with an earth continuity conductor. The earth conductor size shall be selected in accordance with Table 3 and Appendix H of the Code of Practice for the Wiring of Premises, SANS 0142. No earth continuity conductor shall be less than 2,5 mm<sup>2</sup>.

The earth continuity conductor shall consist of:

- (a) A separate un-insulated stranded copper conductor installed along the same route as the associated cable, or
- (b) one of the cable conductors, or

The armouring of an armoured cable shall be connected to the earth continuity conductor at both cable ends and at all joints. The cross sectional area of the armouring at joints shall not be reduced and shall be made continuous across joints.

### PVC INSULATED ARMOURED CABLES

All cables supplied and installed for this project will be 600/1000V, PVC/SWA/PVC insulated Flame Retardant (FR) *Red Stripe* armoured cables in accordance with the following requirements

All PVC/SWA/PVC cable shall comply with SANS 150/1970 and shall consist of PVC insulated copper conductors, PVC bedding, galvanised steel wire armouring and an extruded PVC outer sheath.

Cable ends shall be terminated in approved cable glands to ensure a moisture proof connection between the outer sheath, gland and equipment.

In cases where copper earth conductors are included in the armouring (ECC/SWA cables), special glands in accordance with SABS 150 par. 5.8.3 (c) shall be used.

Cable glands shall be of the type in which the armouring is clamped between tapered cones, tightened down and fitted to a cable gland plate or equipment housing by means of locknuts.

A neoprene shroud shall cover the gland externally and form an effective seal with the outer sheath of the cable.

### SCHEDULE OF CABLES

All low voltage cables are indicated on distribution board single line diagrams.

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All cables shall be PVC/SWA/PVC/PVC type with copper conductors, manufactured in compliance with SABS 1507:2007.

ECC Cables to be supplied as specified in the BOQ.

#### 4. CABLE TRENCHES AND SLEEVES

Where the Electrical Contractor must install cables and/or sleeves through walkways and existing paving, the paving bricks shall be removed as carefully as possible, where after the Main Contractor will be responsible for the relaying of the paving bricks.

The requirements can be summarised as follows:

- LV cables buried in ground shall be installed in a cable trench at a depth of 800 mm below final ground level which has been excavated, back filled and compacted in accordance with this specification by the electrical contractor.
- Trenches for single cables shall be 350 mm wide.
- Where more than one cable is installed in a trench, the cables shall be at least 100 mm apart.
- Cable warning tape shall be installed 300 mm above the cables.
- A bedding layer of sifted top soil 75 mm deep shall be placed underneath and on top of the cables in all excavated trenches.
- All trenches shall be inspected and approved by the engineer before laying of cables with bottom bedding in place as well as after the cables have been installed with the top bedding in place. No trench shall be backfilled unless the above inspections were carried out and the trenches approved by the engineer.
- Backfilling of the trenches shall be in layers of 200 mm and compacted to 95% in accordance with AASHTO/SABS 1200D. The classification for "SOFT GROUND" will be accepted to apply, unless witnessed and certified by the Engineer to the contrary.
- Sufficient cable markers shall be provided to identify the cable route

#### 5. WIRING, CONDUITS AND ACCESSORIES

##### WIRING

The following conductor sizes are applicable:

Circuit	Power Conductor	Earth Conductor
Lighting	2,5mm <sup>2</sup>	2,5mm <sup>2</sup>
Power	4,0mm <sup>2</sup>	2,5mm <sup>2</sup>



All earth conductors will be insulated.

All wiring used shall be 600/1000 V PVC insulated, single core multi stranded copper conductors and green PVC insulated copper conductors for earth continuity (no bare stranded copper) and shall be compounded and stabilised to comply with SANS 175.

All conductors shall be installed in wire ways, cable channels or power skirting of metal unless otherwise approved. Exposed conductors at any point will not be allowed.

Conductors from different switchboards may not be installed in the same wire way or cable channels. The number of conductors in a conduit shall comply with the requirements of SANS 0142.

The combined total cross-sectional area (including insulation) of conductors installed in enclosed cable channels may not exceed 40% of the cross-sectional area of the channel.

Conductors for power, control DC supply, telephone and other services shall be installed in separate conduits for each separate service or system. Conductors for power and control of motor circuits only may be run in the same conduit, provided the insulation of the control wiring is of the same voltage grade as that of the power wiring.

Conductor sizes shall be determined strictly in accordance with the relevant tables for current ratings and voltage drops as listed in SANS 0142.

A loop-in system of wiring shall be followed for outlets or equipment on the same circuit. Joints in conductors will not be allowed.

Not more than 2 ends will be allocated at any outlet point.

Where the conductors of more than one circuit are present in wire ways, cable channels or power skirting, the conductors of each circuit (including earth conductors) shall be taped together at intervals of 1m. The conductors of the various circuits shall, however, be separate in order that any circuit can be withdrawn.

Circuits are to be marked at 3 m intervals when installed in trunking and/or powerskirting.

Circuits of different phases may not be present in the same outlet box, switch box or connection point except where three phase equipment is installed.

The colour of conductors shall be as follows:

Normal power:

3-phase	=	Red/White/Blue
Single-phase	=	Red
Neutral	=	Black
Earth	=	Green
Emergency power	=	Purple
UPS Power	=	Brown
Return circuit from lights	=	White

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Conductors installed in vertical conduit or cable duct runs shall be clamped at intervals not exceeding 3 m. The clamps shall be installed in suitable accessible draw-boxes.

Clamps are to be of durable insulating material that cannot damage insulation of conductors.

#### Terminations of conductors

Where earth conductors are installed according to a loop system, all looped connections shall be ferruled to avoid breaking earth continuity when the conductors are removed from any such terminals. Termination to be on body of outlet box with tail piece to accessory.

The conductor insulation shall only be removed sufficiently for full insertion into the terminal. Bare conductors shall not be visible. (No insulation tape will be allowed).

Conductor strands may not be cut away under any circumstances.

Crimped lugs shall be used for terminations to equipment such as motors and terminal blocks.

Wire end ferrules are to be used at all screwed connections.

Wiring conductors shall not be installed until the entire conduit or wire way for the circuit has been completed and cleaned.

### WIRING ACCESSORIES

#### 5.2.1 Occupancy Sensors

Subject to review and approval of SARS.

#### 5.2.2 Power Sockets Outlets

Subject to review and approval of SARS.

### CONDUITS

#### 5.3.1 Screwed Steel Conduits

Bosal black enameled conduit will be allowed for this contract

#### 5.3.2 Plain-end Galvanised Steel Conduits

Plain-end galvanised steel conduits will be allowed for this project.

#### 5.3.3 Galvanised Conduits (Screwed Only)

(a) Galvanised conduits and fittings shall be used under the following circumstances:

- In areas exposed to the weather
- For surface mounted conduits installations in kitchens, boiler rooms, air conditioning plenum chambers, basements or damp areas.

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- (b) Conduit and accessories for the above applications shall comply with SANS 1065 and shall be hot-dip galvanised to SANS 763.

#### 5.3.4 Rigid Non-Metallic Conduits

- (a) UPVC conduits may only be installed under the following circumstances.
  - o For surface mounted electronic systems such as smoke detection etc.
  - o Conduits and fittings shall be to SANS 950.
- (b) UPVC conduits may not be used under the following conditions:
  - o When exposed to direct sun.
  - o In case of mechanical load bearing.
  - o When subject to temperature below -10NC or above 70NC.
  - o Where conduits may be subject to mechanical damage such as in concrete slabs and columns.
- (d) Joints and couplings shall be glued and only moulded screw fittings may be used.
- (e) An earth conductor shall be provided for earth continuity.

#### 5.3.6 Aluminium Sheathed Conductors ("Surfix")

Surfix conductors may be used under the following conditions:

- o When specified and with the written approval of the Engineer.
- o For connections to small equipment with sufficient loops to allow for vibration or movement.
- o Provided that all fittings are of the same approved manufacturer.

#### 5.3.7 Conduit Accessories

- (a) Where galvanised conduits are used all conduit accessories shall also be galvanised.
- (b) All accessories shall be compatible with the conduit and wiring system used.
- (c) All outlet boxes and draw boxes shall be of the inspection type. Inspection type bends and T-pieces will not be allowed without the Engineer's approval.

#### 5.3.8 Installation

- (a) Position of outlets

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It is the responsibility of the Contractor to ensure that all outlet boxes are correctly positioned for the specified purpose.

(b) Continuity

Mechanical and electrical continuity shall be maintained throughout the conduit installation, but under no circumstances shall the conduit be relied on for earth continuity.

(c) Draw wires

Galvanised steel wire (0,9 mm dia) shall be installed in all unwired conduits.

(d) Bends

Only two 90N bends or equivalents angular displacement will be allowed between draw boxes and/or outlets. All bends shall be made cold without flattening the conduit. The inner radius of a bend shall be at least three times the outside diameter of the conduit.

(e) Prior to and during installation conduits shall be kept clean and dry. Open ends shall be plugged with stoppers (Paper, PVC etc. not allowed).

(f) Prior to wiring conduits shall be cleaned.

(g) All conduit ends shall be reamed and free of burrs.

(h) Exposed threads, damaged painting and damaged galvanising shall be repaired immediately with an appropriate protective coating to the Engineer's approval.

(i) The Contractor shall allow for the installation of sufficient draw boxes and these shall be placed in positions where access will remain possible after completion of the building.

(j) Expansion Joints

Where a conduit crosses an expansion joint, an approved type of expansion draw box shall be provided.

The expansion draw box shall be installed adjacent to the expansion joint. A conduit sleeve, one size larger than that specified for the circuit, shall be provided on the side of the draw box nearest to the joint. One end of the sleeve shall terminate at the edge of the joint and the other shall be secured to the draw box by means of locknuts.

The circuit conduit passing through the sleeve shall terminate 40 mm inside the draw box and the conduit ends shall be fitted with a brass bush. The gap be sealed with silicon sealer to prevent the ingress of wet cement.

(k) An earth connection which shall be bonded to the box by means of 2,5 mm<sup>2</sup> bare copper earth wire and a brass bolt and nut.

Expansion draw boxes shall be provided with sheet metal covers and screws.

Where the number of conduits run in parallel they shall transverse the expansion joint via a single expansion draw box, or by means of separate boxes placed not closer than 700 mm to each other.

(l) Conduits built into walls

The Sub Contractor shall co-ordinate such activities with the Principal Contractor since no cutting of plastered walls will be allowed.

(m) Chasing walls for conduits

The chasing of walls for the installation of conduits will only be allowed under the following conditions:

- Face brick walls may not be chased.
- Brickwork already plastered may only be chased with the written approval of the Engineer.
- The Contractor shall be responsible for all chasing and fixing of conduits and outlet boxes.
- The minimum plaster cover over conduits shall be 20 mm.

(n) Surface installations

Offsets

Where crossovers of conduits are unavoidable, offsets shall be made in one of the conduits only and shall be symmetrical and as short as possible and secured on either side of the cross-over.

Steel conduits shall be installed in accordance with Clause 5.4.2 of SANS 0142 and secured with steel saddles (not plastic clip fasteners) at least at 2 m spacings and at least 150 mm from a bend or outlet/draw box and at 3 m spacings in ceilings.

Saddles for galvanised conduits shall also be galvanised.

Rigid Non-Metallic conduits shall be installed in accordance with Clause 5.4.3 of SANS 0142 and secured with PVC saddles at 1 m spacings and 1,5 m in ceilings (Poly clips not allowed).

Aluminium sheathed conductors (surfix) shall be fixed at 500 mm spacings with P-saddles (not PVC polysaddles).

### 5.3.9 Termination of Conduits

Refer to A-SPES-07-01 clause 6.3.9

## 6. TRUNKING, POWER SKIRTING AND FLOOR DUCTS

### WIRING CHANNELS (TRUNKING)

Wiring channels shall be performed galvanised sheet metal channels and all fittings such as bends and junctions shall be factory made with radius corners by the same manufacturer. Covers shall be performed galvanised sheet metal.

Wiring channels shall be equal with the following minimum thickness:

1 mm for unribbed channels with a maximum width of 42 mm

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

1,6 mm for ribbed channels with a maximum width of 42 mm cast into concrete

2,5 mm for unribbed channels with a maximum width in excess of 42 mm cast into concrete.

Exposed wiring channels shall be powder coated in the colour specified.

Adjoining lengths shall be correctly aligned and securely joined by means of fishplates fixed by mushroom bolts, washers and nuts or connection pieces that are pop-riveted to both adjoining sections. All adjoining sections shall be rectangular and butt tightly. Covers shall fit tightly across the joint. All bolts and rivets shall be of the correct length and thickness without sharp internal protrusions to prevent damage to conductors.

Where channels cross expansions in the concrete, suitable expansion joints shall be provided in the channels by means of fishplates pop-riveted or screwed to the channel on one side of the expansion joint and floating freely in the channel on the other side of the expansion joint. (Bonding across joint).

All channels up to 125 mm wide shall have snap-in cover plates of metal or PVC. Cover plates for wider channels shall be of metal and shall be fixed by means of screws spaced at suitable intervals to prevent warping. The finish of the covers shall match the finish of the channel.

All conductors in inverted cable channels shall be retained by means of metal clips or metal spacer bars at not less than 1 m centres.

All wiring channels shall be sealed and vermin proof after installation.

Electrical and mechanical continuity shall be maintained throughout the channel installation. A copper bonding strip shall be placed across each expansion joint and secured to both adjoining channels by means of brass bolts and nuts. The channel shall be bonded to the earth bar of the associated switchboard.

The inside edges of all joints shall be smooth with no sharp protrusions inside which can damage the conductor insulation.

Separate channels for different services shall be provided.

Where vertical channel lengths exceed 5 m, conductors shall have intermediate fixings.

Channels shall be large enough to ensure that the combined total cross-sectional area

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(including insulation) of all conductors does not exceed 40% of the cross-sectional area of the channel.

The Contractor shall supply and install all hangers, supports or fixings for the channels. Channels up to 76 x 76 mm shall be supported at maximum intervals of 2 m and larger channels at maximum intervals of 2,4 m provided that there are at least two supports between joints.

Where channels are cast into the concrete, reinforced types (ribbed) shall be used. Additional spacer blocks shall be used where necessary to prevent channels from being bent when the concrete is cast. Channels shall be filled with polystyrene or other suitable fillers to prevent the ingress of cement and shall be securely fixed in position to the shuttering.

Where channels pass through walls a cover not more than 500 mm shall be built in and the wall shall be sealed around the channel as a fire barrier.

All conduit connections shall be terminated by means of two locknuts and a brass female bush. All holes through which conductors pass shall be equipped with grommets.

#### Punch-outs

The Contractor shall study the drawings to ensure that, where required, more than the standard number of pre-punched openings for sockets outlets to light fittings is provided by the manufacturer. (Additional surface mounted outlets shall only be as approved by the Engineer.)

## 7. CABLE SUPPORTS

### **CABLE TRAYS AND LADDERS**

Only hot dipped galvanized cable ladders and supports is allowed.  
The dimensions of the cable ladders are indicated on the drawings and BOQ.

The Contractor shall supply and install all cable trays or ladders as specified or as required by the cable routes including the necessary supports, clamps, hangers, fixing materials, bends, angles, junctions, reducers, T-pieces etc.

Metal cable trays shall be manufactured from perforated rolled galvanised steel unless otherwise specified. Only factory manufactured accessories such as bends, reducers, droppers, tees, etc. of the same make as the cable trays may be used. Metal trays manufactured to the following standards shall be used:

- (a) Less than 150 mm wide - 1,0 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 - 2,5 mm minimum thickness with 76 mm return

The upstands or trays listed in (a) and (b) shall not be perforated and the top of the upstand shall be smooth. The same cable tray type shall be used in long parallel tray runs.

Metal cable ladders shall consist of a 76 mm high side rail of 2 mm minimum thickness similar to O-Line medium duty. Cross pieces channel section shall be spaced at maximum intervals of

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375 mm. Where cables of 10 mm<sup>2</sup> 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. Cross pieces consisting of slotted metal rails which accommodate plastic or metal cable binding bands, may be used in vertical cable runs against walls etc. where the prior approval from the Engineer has been obtained. These cross pieces are not acceptable in horizontal cable runs.

Purpose-made hot dipped galvanised and bolted 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 approximately 10 mm apart to allow cable clamps or metallic binding bands to affix the cables to the tray along the full length.

Rigid unplasticised PVC cable trays are acceptable. Only the following tray types may be used:

- (a) Less than 250 mm wide - 3 mm minimum thickness and 40 mm minimum return
- (b) 250 mm and wider - 4 mm minimum thickness and 60 mm minimum return.

Metal cable trays and ladders shall be finished as follows:

- (a) False ceiling voids

Electro galvanised or epoxy powder coated.

- (b) Vertical Building ducts  
Hot-dip galvanised to SABS 763 or epoxy powder coated.
- (c) Plant rooms, substations, service tunnels, basements  
Electro galvanised or epoxy powder coated.
- (d) Damp areas, exposed to weather  
Hot-dip galvanised to SABS 763 or epoxy powder coated.
- (e) Undercover industrial applications  
Hot-dip galvanised to SABS 763 or epoxy powder.

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

Trays shall be supported at the following maximum intervals

- (a) 1,2 mm to 1,6 mm thick metal trays with 12 to 19 mm return @1 m maximum spacing
- (b) 2,5 mm thick metal trays with 76 mm return @ 1,5 m spacing



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- (c) Ladder with 76 mm side rail of 2 mm thickness @ 1,5 m spacing
- (d) Metal cable ladders other than (c) above including site manufactured angle iron types @ 1 m spacing
- (e) 3 mm thick PVC trays with 40 mm return @ 1 m maximum spacing
- (f) 4 mm thick PVC trays with 60 mm return @ 1,5 m maximum spacing

In addition to the above spacing on the longitudinal run, trays and ladders shall be supported at each bend, offset and T-junction.

Joints shall be smooth and without projections or rough edges that may damage the cables. The Contractor will be required to cover joints with rubber cement or other non-hardening rubberised or plastic compounds if in the opinion of the Representative joints may damage cables. Joints shall as far as possible be arranged to fall on supports.

Where joints do not coincide with supports, joints shall in the case of trays with single returns (items (a) to (c) of Clause 5.1.2) be made by means of wrap around splices of the same thickness as the tray and at least 450 mm long. The two cable tray ends shall butt tightly at the centre of the splice and the splice shall be bolted to each cable tray by means of at least 8 round head bolts, nuts and washers.

Splices shall have the same finish as the rest of the tray.

Trays shall be bolted to supports by at least two round head bolts per support. Bolts shall be securely tightened to avoid cables being damaged during installation.

The supports for cable trays and ladders shall in all cases be securely fixed to the structure by means of heavy duty, expansion type anchor bolts. It is the responsibility of the Contractor to ensure that adequate fixing is provided since cable trays and ladders that work loose shall be rectified at his expense.

Horizontal and vertical bends, T-junctions and cross sections 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 1 m minimum. The inside dimensions of all horizontal angles or connections shall be large enough to ensure that the allowable bending radius of the cables is not exceeded. Sharp angles shall have 45N cornices.

Cables shall be installed adjacent and parallel to each other on the trays with spacings as determined by the current ratings. Horizontal trays and ladders shall in general be installed 450 mm below slabs, ceilings etc., to facilitate access during installation.

All metal trays and ladders shall be bonded to the earth bar of the switchboard to which the cables are connected. Additional bare copper stranded conductors or copper tape shall be bolted to the tray or ladder where the electrical continuity cannot be guaranteed.

## SHAFTS

The shafts as shown on the layout drawings will be provided for vertical cable routes.

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Cables shall be supported and clamped at maximum spacings of 1 m.

#### Fire Seal

The Contractor shall seal all openings of sleeves and shafts between floors as follows:

Cut to size and fit 50 mm thick 160 density minimal wood board and fit into the electrical duct around cables.

Coat the minimal wood board on both sides with fire retardant to a dry film thickness of  $\pm 3$  mm.

Coat cables and surround of opening for 500 mm from seal.

### 8. LIGHT FITTINGS

#### **GENERAL**

All light fittings required under this contract are specified in the attached Schedule of Luminaires.

All luminaries shall be installed in such a manner that it will be insect free. Appropriate seals/gaskets shall be used to the full approval of the Engineer.

Samples of all light fittings shall be submitted for approval by the Engineer.

#### **INSTALLATION**

##### Recessed Luminaires

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

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

The following requirements shall be adhered to:

- (a) Socket outlets used shall comply with this specification and shall be of 5 A minimum rating and moulded type plugs shall be used.
- (b) The connector cord attached to the luminaire may not exceed 3 m in length and shall consist of 1,5 mm<sup>2</sup> minimum, 3 core, PVC-insulated flexible cord.
- (c) The 5 A socket outlets shall be positioned such that they are not more than 600 mm above the false ceiling.

##### 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.

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**LIGHT FITTINGS SCHEDULE**

As the luminaires will be installed in an existing ceiling, the contractor will ensure that the custom frame for the luminaire does in fact fit into the existing ceiling. Sample installation will be done for client and engineer approval.

TYPE	DESCRIPTION	SPECIFICATION
A	<b>TYPE A - 1200 x 300 LED PANEL LIGHT</b> <ul style="list-style-type: none"><li>-3971 lumens output</li><li>-Ceiling recessed in custom 1500 x 500 frame</li><li>-Finished in white</li><li>-Electronic control gear with onboard motion sensor</li><li>-DALI Dimmable</li><li>-4000K</li><li>-50 000-hour lamp life and 100 000-hour driver life. (5-year warranty)</li><li>-40W</li><li>-&gt;80 CRI</li></ul>	<i>LUXON –</i> REGENT LIGHTING, or similar
B	<b>TYPE B - 1200 x 300 LED PANEL LIGHT</b> <ul style="list-style-type: none"><li>-3971 lumens output</li><li>-Ceiling recessed in custom 1500 x 500 frame</li><li>-Finished in white</li><li>-Electronic control gear with onboard motion sensor</li><li>-DALI Dimmable</li><li>-4000K</li><li>-50 000-hour lamp life and 100 000-hour driver life. (5-year warranty)</li><li>-40W</li><li>-&gt;80 CRI</li><li>- WITH EMERGENCY BATTERY BACKUP</li></ul>	<i>LUXON –</i> REGENT LIGHTING, or similar

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## APPENDIX TO SPECIFICATION

**FORM A:** Application for Practical Completion Inspection

**FORM B : B:** Practical Completion Certificate)

**B1:** Practical Completion List

**FORM C:** Works Completion Certificate

**FORM D:** Final Completion Certificate

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FORM A

**APPLICATION FOR PRACTICAL COMPLETION INSPECTION**

PROJECT : .....

INSTALLATION : .....

PORTION : .....

CONTRACTOR : .....

REFERENCE NO. : .....

As Contractor responsible for the erection of the abovementioned Installation, I hereby certify that the Installation has been completed in full accordance with the Specification and the Engineer's instructions, and that initial commissioning has been completed.

As responsible person of the Contractor I hereby certify that I have inspected the installation and that all the items as listed on my "Contractor's Inspection List", a copy of which is attached, have been completed to my satisfaction.

I therefore officially request that the "Practical Completion Inspection" in terms of the contract be performed by the Engineer. I accept that should the inspection prove fruitless due to false declarations in the above paragraphs, I will be liable for the Engineer's cost in performing additional inspections.

I herewith hand over draft copies of the Operation and Maintenance Manual, "As Installed Drawings" and Commissioning Procedures for the Engineer's comments.

SIGNED : \_\_\_\_\_  
For Contractor Print Name

DATE : ...../...../.....

**COPIES:**

1. \_\_\_\_\_  
Engineer
2. \_\_\_\_\_  
Employer
3. \_\_\_\_\_  
Principal Contractor

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FORM B

**PRACTICAL COMPLETION CERTIFICATE**

PROJECT : .....

INSTALLATION : .....

PORTION : .....

CONTRACTOR : .....

REFERENCE NO. : .....

**NOTE:** A Practical Completion Certificate will be issued for each portion for sectional completion.

The installation is substantially completed and can be used for the purposes intended and has passed the initial tests.

**ENGINEER'S REPORT**

Contractor's Final Inspection List received?	NO/YES	DATE : ..../.../.....
Draft O & M Manual received?	NO/YES	DATE : ..../.../.....
Draft "As Installed Drawings" received?	NO/YES	DATE : ..../.../.....
Commissioning Data received?	NO/YES	DATE : ..../.../.....

The items listed on the attached Practical Completion List (Form B1) shall be rectified before the Contractor requests a Works Completion Inspection.

The Principal Agent shall ensure that the items marked as the responsibility of other parties be attended to by such parties.

SIGNED:

\_\_\_\_\_  
Engineer

\_\_\_\_\_  
Date

**COPIES:**

1. \_\_\_\_\_  
Employer
2. \_\_\_\_\_  
Contractor

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FORM B1

**QUALITY REPORT / PRACTICAL COMPLETION LIST**

PROJECT : .....

INSTALLATION : .....

PORTION : .....

CONTRACTOR : .....

REFERENCE NO. : .....

**NOTE:** This Quality Report gives a "running" record of quality and other matters which require attention and rectification and the outstanding items at date of the issue of the Practical Completion Certificate, becomes the Practical Completion List.

ITEM	DESCRIPTION	RESPONSIBLE PARTY	DATE OF INSPECTION	DATE ACCEPTED

SIGNED:

\_\_\_\_\_  
Engineer\_\_\_\_\_  
Date

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FORM C

**WORKS COMPLETION CERTIFICATE (**

PROJECT : .....

INSTALLATION : .....

PORTION : .....

CONTRACTOR : .....

REFERENCE NO. : .....

1. The items marked for the responsibility of the Contractor on the Practical Completion List (Form B1) have been rectified and completed.
2. The defects liability period will commence on the date of this Certificate.
3. Three hard & soft copies of the Operation and Maintenance Manual were received and that two copies have been handed to the Employer ..... NO/YES DATE: .....
4. Three hard and soft copies of the "As-Installed" drawings have been received and two sets has been handed over to the Employer ..... NO/YES DATE: .....
5. The Employer's personnel have been trained by the Contractor to operate the Installation. NO/YES DATE: .....
6. The Contractor has satisfactorily completed all his contractual commitments in terms of the Contract with the exception of his responsibilities during the maintenance and guarantee period, which he undertakes to do punctually.
7. All rights of equipment guarantees and warranties are hereby ceded by the Contractor to the Employer.
8. All parties accept the final contract sum to be R..... including VAT, as the full and final payment regarding the Contract signed, and declares that no further claims will be submitted. Refer to the attached Final Contract Sum Summary.
9. The Employer shall take cognisance of the expiry date of the one year maintenance and guarantee period by the Contractor and will be responsible for all maintenance of the Installation from .....
10. The Employer shall take cognisance that from the date of this Certificate he is fully responsible for the Installation and the safe operation thereof in terms of the Occupational Health and Safety Act (Act 85 of 1993).
11. Admission to the installation for retention and maintenance work shall be under the full control and authority of the Employer and the Contractor shall approach the Employer in order to make arrangements for admission for such work during the Guarantee and Maintenance period.
12. The Employer shall record all complaints regarding the operation of the Installation in the "Maintenance Log Book" and notify the Contractor thereof.
13. Dates of all visits and reports on written complaints recorded by the Employer or User shall be signed by both the Contractor and the representative or the Employer in the "Maintenance Log Book" held on site.
14. Final Completion List: The following additional remedial items shall be attended to by the Contractor within 20 days.

ITEM	DESCRIPTION	DATE ACCEPTED

SIGNED:

1. \_\_\_\_\_  
Engineer Date \_\_\_\_\_
2. \_\_\_\_\_  
Employer
3. \_\_\_\_\_
4. \_\_\_\_\_  
Contractor

Copies: Issued to all above



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FORM D

**FINAL COMPLETION CERTIFICATE**

PROJECT : .....

INSTALLATION : .....

CONTRACTOR : .....

REFERENCE NO. : .....

It is hereby certified that the Contractor has completed his obligations during the Defects Liability Period (Defects Notification Period – FIDIC) and will be relieved of further responsibilities upon acceptance by the Engineer of the following defects identified during the said period.

ITEM	DESCRIPTION	DATE OF ACCEPTANCE
For JBCC contracts	The Contractor shall complete all his responsibilities in respect of the 12 month maintenance and guarantee period for the remaining 9 months.	As per Contract

Liability for Latest Defects will be in accordance with the Contract.

SIGNED:

\_\_\_\_\_  
Engineer

\_\_\_\_\_  
Date

COPIES:

1.

\_\_\_\_\_  
Employer

2.

\_\_\_\_\_  
Contractor

2019/04

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PART 2

SCHEDULE OF EQUIPMENT

FOR THE

ELECTRICAL INSTALLATION

FOR

SARS BROOKLYN DATA CENTRE

2019/04

PART 2

ELECTRICAL INSTALLATION FOR SARS BROOKLYN DATA CENTRE

SCHEDULE OF EQUIPMENT OFFERED

EQUIPMENT	SUPPLIER/ MANUFACTURER	TYPE
1. Low voltage distribution boards ..		
2. Low voltage cables		
3. Occupancy Sensors		
4. Isolators		
5. Wiring Trunking		
6. Cable ladders		
7. LIGHTS: A..... B.....		

SIGNED BY TENDERER: .....

DATE: .....

2019/04

## DISTRIBUTION BOARDS

s

1. Name of distribution board manufacturer		
2. Does the proposed manufacturer have an approved Type Test Certificate for his DB's as required by SANS 10142-1 and SANS 1973?		
Tick one box (✓)	YES	NO
3. Name of switchgear manufacturer		
4. Contact details of distribution board manufacturer		
Address		
Tel		
E-mail		

SIGNED BY TENDERER:

\_\_\_\_\_

DATE:

\_\_\_\_\_

2019/04

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PART 3

SCHEDULE OF DRAWINGS

FOR THE

ELECTRICAL INSTALLATION

FOR

SARS BROOKLYN DATA CENTRE

2019/04

<b>DRAWING REGISTER</b>	
<b><u>A-1736-07-00-3XX</u></b>	<b><u>LIGHTING LAYOUT</u></b>
A-1736-07-00-301 RA	GROUND FLOOR
<b><u>A-1736-07-00-5XX</u></b>	<b><u>CABLE RETICULATION</u></b>
A-1736-07-00-501 RB	DATA CENTRE - CEILING RETICULATION LAYOUT
A-1736-07-00-502 RB	DATA CENTRE - ACCESS FLOOR RETICULATION LAYOUT
A-1736-07-00-503 RA	DATA CENTRE - NEW DB BOARD LOCATION LAYOUT
<b><u>A-1736-07-00-7XX</u></b>	<b><u>SINGLE LINES</u></b>
A-1736-07-00-701 RA	PDU SCHEMATIC DIAGRAM
A-1736-07-00-702 RA	DB-GEN/A SLD
A-1736-07-00-703 RA	DB-UPS/A SLD
A-1736-07-00-704 RA	CHILLER CHANGE OVER
A-1736-07-00-705 RA	DB-UPS/B EXTENSION SLD

2019/04

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PART 4

SCHEDULE OF PRICES

FOR THE

ELECTRICAL INSTALLATION

FOR

SARS BROOKLYN DATA CENTRE

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## GENERAL NOTES TO BILLS OF QUANTITIES FOR ELECTRICAL INSTALLATIONS

1. The attached Bills of Quantities form part of the Tender Document and shall be read in conjunction therewith.
2. Reference shall be made to the Specifications for the full meaning and description of work to be done and material/equipment to be used.
3. The Bills of Quantities shall be fully completed and returned to form part of a valid tender before the tender closing time.
4. No alterations, addition or erasure may be made to the text of the Bills. If such an alteration, addition or erasure is made it shall not be acknowledged and the original wording of the text shall apply.
5. All prices or rates shall be given against each item of the Bills of Quantities irrespective of any quantities given or not. The cost of items if not priced shall be taken as being included in other price or rates in the Bills of Quantities.
6. "Rates only" items, as all other rates and item prices will be used for costing variations.
7. Provisional Amounts and Contingency Sums are budgetary costs for use by the Engineer at his discretion and may be omitted in total without any compensation to the Contractor whatsoever.
8. Since the Specifications call for complete operational systems, the rates submitted shall cover the cost of associated items not specifically listed, but which are required for a complete operational installation in terms of the Specifications. Should the Tenderer wish to list such items separately, or if any requirements of the Specifications are not specifically covered by items in the Bills of Quantities, the Tenderer shall allow for these as additional items or in his Tender covering letter.
9. Unless otherwise measured all rates shall include for the detail design, engineering, procurement, supply, delivery, erection, waste, storage, commissioning, testing, maintenance and guarantee of material or equipment in terms of the Specifications.
10. Quantities in the Bills are nett and Tenderers shall allow in their rates for wastage, off cuts, "slack" or over excavations.



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11. The Engineer will use his discretion to correct conspicuous arithmetical errors when adjudicating the tenders. The price entered against an item shall be accepted as being the correct price tendered for, for the completion of the work involved. Should any difference appear between the Rate times the quantity and the total item price, the Client shall have the right to adjust the individual unit rate as he may deem necessary in order that the Rate times quantity agrees with the total item price.
12. All unit rates entered in the Bills of Quantities shall exclude Value Added Tax. 15% Value Added Tax shall however be added to the Total Net Tender sum and this value including Value Added Tax shall be carried over to the Form of Tender as the TENDER SUM.
13. The Contractor shall allow in his costing for out of sequence work and re-programming due to unforeseen circumstances during construction.
14. No orders shall be placed on the basis of the quantities in the Bills but shall be verified on site by the Contractor prior to placement of orders.
15. The final Contract price shall be measured to the actual installed net quantities of materials and work done and priced to the unit rates as stated in the Bills of Quantities, adjusted for escalation if applicable.
16. The Employer shall reserve the right to free issue cable, trunking and some of the AC changeover switches, the contractor shall ensure that the installation rates allow for free issued materials.