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& infrastructure

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Public Works and Infrastructure
REPUBLIC OF SOUTH AFRICA

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**SUNDUMBILI MAGISTRATE OFFICE:
ADDITIONAL ACCOMMODATION**

BID DOCUMENT

**BOOK 4 OF 4: SPECIFICATIONS – ELECTRICAL, ELECTRONIC
AND MECHANICAL WORKS**

November 2023

ISSUED BY:

**THE DIRECTOR GENERAL
DEPARTMENT OF PUBLIC WORKS
PRIVATE BAG X54315
DURBAN, 4000**

NAME OF BIDDER:



**EXPANDED PUBLIC WORKS PROGRAMME
CONTRIBUTING TO A NATION AT WORK**

DEPARTMENT OF PUBLIC WORKS



public works
& infrastructure

Department:
Public Works and Infrastructure
REPUBLIC OF SOUTH AFRICA

SUNDUMBILI MAGISTRATE COURT: ADDITIONAL ACCOMMODATION, UPGRADING AND RENOVATIONS OF EXISTING BUILDING, INCLUDING SECURITY MEASURES, FENCING AND LIGHTING.

BOOK 4 OF 4: SPECIFICATIONS – ELECTRICAL, ELECTRONIC AND MECHANICAL WORKS

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NOVEMBER 2023

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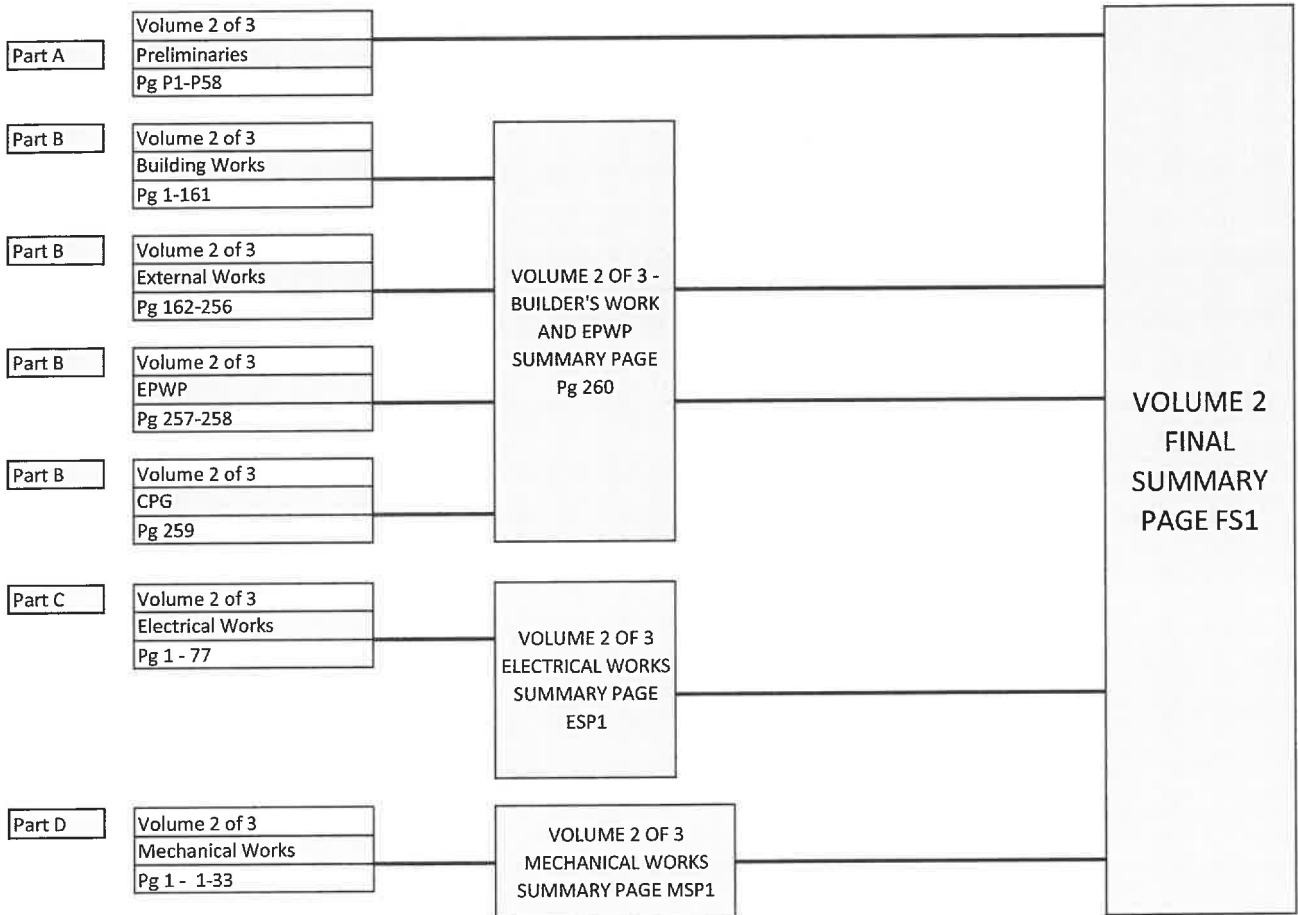
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WCS 044999: SUNDUMBILI MAGISTRATE OFFICE: ADDITIONAL ACCOMMODATION



NB: This illustration is for information purposes only and is articulated in order to guide tenderers on the structure of the Bills of Quantities. No liability is accepted in respect of any errors that may be contained above.



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Department:
Public Works
REPUBLIC OF SOUTH AFRICA

SUNDUMBILI MAGISTRATE OFFICE: ADDITIONAL ACCOMMODATION

ELECTRICAL AND ELECTRONIC SPECIFICATIONS



public works

Department:
Public Works
REPUBLIC OF SOUTH AFRICA

ELECTRICAL INSTALLATION
OF A
COMPREHENSIVE SERVICE
AT
SUNDUMBILI MAGISTRATES COURT

WCS 044999

OCTOBER 2021

WCS 044999 : SUNDUMBILI MAGISTRATES COURT
GENERAL ELECTRICAL INSTALLATION

SPECIFICATION FOR THE ELECTRICAL INSTALLATION
OF A COMPREHENSIVE SERVICE

AT

SUNDUMBILI MAGISTRATES COURT

SPECIFICATION FOR ELECTRICAL WORK

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GENERAL ELECTRICAL INSTALLATION

1 TESTS

After completion of the works and before practical completion is achieved, a full test will be carried out on the installation for a period of sufficient duration to determine the satisfactory working thereof. During this period the installations will be inspected and the Contractor shall make good, to the satisfaction of the Principle Agent/Electrical Engineer or the employer, any defects which may arise.

The Contractor shall provide all instruments and equipment required for testing and any water, power and fuel required for the commissioning and testing of the installations at completion.

2 MAINTENANCE OF INSTALLATIONS

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

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

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

3 REGULATIONS

The installation shall be erected and tested in accordance with the Acts and Regulations as indicated in the scope of works

4 NOTICES AND FEES

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

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

5 SCHEDULE OF FITTINGS

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

6 QUALITY OF MATERIALS

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

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

Materials wherever possible, must be of South African manufacture.

7 CONDUIT AND ACCESSORIES

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

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

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

- a) Screwed metallic conduit and accessories: SANS 61386-1 and 21.
- b) Plain-end metallic conduit and accessories: SANS 61386-1 and 21.
- c) Non-metallic conduit and accessories: SANS 61386-1 and 21.

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

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

Draw-boxes are to be provided in accordance with the "Wiring Code" and wherever necessary to facilitate easy wiring.

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

2 of this specification or indicated on the drawings.

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

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

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

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

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

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

All conduit and accessories used in areas within 50 km of the coast shall be galvanised to SANS 32 and SANS 121.

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

8 CONDUIT IN ROOF SPACES

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

Nail or crampets will not be allowed.

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

Under flat roofs, in false ceilings or where there is less than 0,9m of clearance, or should the ceilings be insulated with glass wool or other insulating material, the conduit shall be

installed in such a manner as to allow for all wiring to be executed from below the ceilings.

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

9 SURFACE MOUNTED CONDUIT

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

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

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

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

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

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

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

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

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

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

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

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

10 CONDUIT IN CONCRETE SLABS

In order not to delay building operations the Contractor must ensure that all conduits and

other electrical equipment which are to be cast in the concrete columns and slabs are installed in good time.

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

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

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

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

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

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

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

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

Aluminium and zinc alloy connectors will not be acceptable.

12 WIRING:

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

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

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

Wiring for lighting circuits is to be carried out with 1,5mm² conductors and a 1,5mm²-earth

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

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

The wiring shall be done in PVC insulated 600/1000 V grade cable to SANS 1507.

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

13 SWITCHES AND SOCKET OUTLETS

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

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

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

14 SWITCHGEAR

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

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

15 SWITCHBOARDS

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

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

Any construction or standard type board proposed, as an alternative to that specified

must have the prior approval of the Employer.

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

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

16 WORKMANSHIP AND STAFF

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

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

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

17 VERIFICATION AND CERTIFICATION OF ELECTRICAL INSTALLATION (CERTIFICATE OF COMPLIANCE AND TEST REPORT

On completion of the service, a certificate of compliance must be issued to the Principal Agent/Electrical Engineer or Employer in terms of the Occupational Health and Safety Act, 1993 (Act 85 of 1993) in the format as set out in SANS 10142-1 & 2.

18 EARTHING OF INSTALLATION

Main earthing

The type of main earthing must be as required by the supply authority if other than the Employer, and in any event as directed by the Principal Agent/Electrical Engineer, who may require additional earthing to meet test standards.

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

Alternatively or additionally earth rods or trench earths may be required as specified or directed by the Electrical Engineer.

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

Connection from the main earth bar on the main board must be made to the cold water

main, the incoming service earth conductor, if any and the earth mat or other local electrode by means of 12mm x 1,60 mm solid copper strapping or 16 mm² stranded (not solid) bare copper wire or such conductor as the Department's representative may direct. Main earth copper strapping where installed below 3m from ground level, must be run in 20 mm diameter conduit securely fixed to the walls.

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

Roofs, gutters and down pipes

Where service connections consist of overhead conductors, all metal parts of roofs, gutters and down pipes shall be earthed. One bare 10mm² copper conductor shall be installed over the full length of the ceiling void, fixed to the top purlin and connected to the main earth conductor and each switchboard. The roof and gutters shall be connected at 15m intervals to this conductor by means of 12mm X 0,8mm copper strapping (not conductors) and galvanised bolts and nuts. Self-tapping screws are not acceptable. Where service connections consist of underground supplies, the above requirements are not applicable.

Sub-distribution boards

A separate earth connection shall be supplied between the earth busbar in each sub-distribution board and the earth busbar in the Main Switchboard. These connections shall consist of a bare or insulated stranded copper conductors installed along the same routes as the supply cables or in the same conduit as the supply conductors. Alternatively armoured cables with earth continuity conductors included in the armouring may be utilised where specified or approved.

Sub-circuits

The earth conductors of fall sub-circuits shall be connected to the earth busbar in the supply board in accordance with SANS 10142.

Ring Mains

Common earth conductors may be used where various circuits are installed in the same wire way in accordance with SANS 10142. In such instances the sizes of earth conductors shall be equivalent to that of the largest current carrying conductor installed in the wire way, alternatively the size of the conductor shall be as directed by the Engineer. Earth conductors for individual circuits branching from the ring main shall be connected to the common earth conductor with T-ferrules or soldered. The common earth shall not be broken.

Non-metallic Conduit

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

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

Flexible Conduit

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

Connection

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

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

19 MOUNTING AND POSITIONING OF LUMINAIRES

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

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

Luminaires installed against concrete ceilings shall be screwed to the outlet boxes and in addition 2 x 6mm expansion or other approved type fixing bolts are to be provided. The bolts are to be $\frac{3}{4}$ of the length of the luminaires apart.

Luminaires to be mounted on board ceilings shall be secured by means of two 40mm x No. 10 round head screws and washers. The luminaires shall also be bonded to the circuit conduit by means of locknuts and brass bushes. The fixing screws are to be placed $\frac{3}{4}$ of the length of the fitting apart.

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

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1. NOTES TO TENDERERS

- NOTE 1** Contractors are advised that this tender is based on the Electrical Specifications which impose very specific and rigid conditions for the technical and quality requirements of the equipment, materials, installation, testing, commissioning and maintenance of all aspects of this tender.
- NOTE 2** Contractors must acquaint themselves fully with all requirements of the Standard Specifications. Where prices are to be obtained from suppliers of equipment, such as switchboards, Sub-Contractors must ensure that their suppliers are also fully conversant with the relevant Standard Specifications.
- NOTE 3** The Engineer will rigidly enforce each and every requirement of the Standard Specifications.
- NOTE 4** Unless otherwise agreed by the Engineer, all equipment shall be of South African manufacture.
- NOTE 5** Contractors are advised that only the highest standard of workmanship will be accepted and that all materials supplied must be strictly in accordance with this tender document. If workmanship and/or materials are not suitable, the Engineer will request that the work is repeated or the materials returned until a satisfactory standard is achieved. No additional payment will be made in respect of any remedial works.
- NOTE 6** The submission of all commencement, compliance and completion forms including any test certificates which may be required will remain the responsibility of the Contractor. Copies to be submitted to the Engineers.

2. REGULATIONS, FACTORIES ACT AND BY-LAWS

The latest editions and/or amendments of the following Standards and Codes shall be considered a minimum requirement. In the event of differing requirements, the most stringent Code or Standard shall apply:

- Occupational Health and Safety (OHS) Act No. 85 of 1993.
- South African National Standard Specifications.
- DIN or British Standard Specifications.
- N.O.S.A. Safety Guidelines.
- The National Building Regulations

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- The Wiring of Premises (SANS 10142-1).
- The Local Fire Office Regulations.
- The Municipal by-laws and any special requirements of the local Supply Authorities of the area or district concerned.
- The applicable BS Specifications or the IEC Specifications where no SABS or BS Specifications exist.

No claims for extras in respect of failure by the Contractor to comply with any of the above regulations will be considered.

Where conflict exists between any of the above regulations and the specifications, the said conflict must be referred to the Engineer in writing for his ruling.

In addition to the above Sub-Contractors are advised that only the highest standard of workmanship will be accepted and that all materials supplied must be strictly in accordance with this specification. If workmanship and/or materials are not suitable, the Engineer will request that the work is repeated or the materials returned until a satisfactory standard is achieved. No additional payment will be made in respect of any remedial works.

3. SCOPE OF WORK

3.1 Inclusions

The scope of work shall include manufacture, conveying and delivering, unloading, storing unpacking, hoisting, setting, fitting and fixing in position, cutting and waste, patterns, models and templates, plant, temporary works, return of packings, establishment charges, profit and all other obligations arising out of the Conditions of Contract of the following:

- Low Voltage Busbar Trunking
- Low Voltage Power Cabling and cable supports
- Low Voltage Distribution Boards and Panels
- Interior, emergency, exterior, security lighting
- Normal and dedicated single phase switch socket outlets
- Conduit, power skirting, metal trunking, draw-boxes.
- Emergency Generator
- UPS for this Facility
- Single Phase power points for:
 - Extract Fans
 - Hot air hand dryers
 - Heat Pumps
 - Hydroboils
 - Three Phase power points for:
 - Air-conditioning plant

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- Wireways for the following services:
- Access Control & Biometrics
- Building Management System
- CCTV System
- Computer and Data wiring
- Fire Detection System
- Security Systems,
- Thermostat wiring for A/C control
- Earthing system

In addition, the Sub-Contractor shall supply all necessary manpower, labour, supervision, equipment, materials (installed and consumable), tools, services and testing devices for all aspects of this Sub-Contract as indicated hereunder and the Sub-Contract sum shall be deemed to cover all cost and expense thereof :

- All electrical installations and equipment would be designed and installed in accordance with the Electrical Standard specification.
- Submission of all detailed engineering design data and drawings for approval.
- Supply of all static and dynamic loading characteristics and resonant frequencies in order that foundation and support structure can be designed.
- The Sub-Contractor shall employ a full-time planner for this project, who shall be responsible for generating and maintaining a detailed plan of all work to be undertaken on this project. The planner shall update the plan on a daily basis and issue a hard copy to the Employer's Site Engineer on a weekly basis.
- Submission of a manufacturing quality control plan. (In accordance with ISO 9000)
- Submission of manufacturing, procurement, and commissioning programmes.
- Packing, shipping and off loading of all equipment at site.
- Sub-Contractor will implement a material control procedure to adequately control equipment and materials from "off loading to completion of installation"
- Sub-Contractor will provide stores facilities which will accommodate the project requirements for an open laydown area and a lockable store area.
- Site establishment and removal of site establishment.
- Supply of all scaffolding and additional crane requirements.
- Supervision of the positioning and installation of the above equipment.
- Painting of equipment;
- Supply and installation of all safety equipment (guards, notices, etc.);
- Supply of all holding down bolts, anchors, studs or any other retaining devices as required.
- Supply of "as-built" drawings, 3 copies of the operation and maintenance manuals, test certificates and detailed recommended spare parts lists.
- Compilation of test packs with all relevant certification witnessed and signed by the Engineer.
- Commissioning.

3.2 Design and Engineering Criteria

The equipment sizes supplied shall not be less than those indicated in the specification or attached drawings. The Sub-Contractor shall however be responsible for the performance of the equipment and shall verify and confirm the size selection. Should the Sub-Contractor not be in agreement with the selection, alternative sizes shall be offered with full justification for the change?

The information supplied in this Specification in the form of data, drawings and descriptions, etc., is intended to serve as a guide to the requirements of the Employer with respect to the design and operation of the installations. The Sub-Contractor shall either concur with each proposal or preference or submit alternative proposals for consideration.

The acceptance of the information in this Sub-Contract shall in no way relieve the Sub-Contractor of its responsibilities in terms of the design and engineering performance of the installations.

3.3 Exclusions

Excluded from the scope of this sub-contract are the following:-

- All civil, structural and building works – foundations, transformer bays, DB cupboard, concrete flooring, holding down bolts etc.
- Air-conditioning plant
- Electric fence.

3.4 Terminal Points

The terminal points of this contract are:

- Consumer Busbar Unit
- Main Switch of all A/C plant DBs
- Main Switch of all Lift DBs

4. PROJECT SPECIFICATION

4.1 Alternative Equipment to Specification

The Sub-Contractor shall price the tender document in accordance with the specification. Where the Sub-Contractor wishes to offer an alternative or an equal and approved, the Sub-Contractor shall either specify these in their covering letter with rates for the items and full detailed specifications of the alternatives, or preferably submit an alternative tender with the specification tender, with the alternatives offered inclusive of full details of the alternatives.

Should the Sub-Contractor supply materials or equipment that is not as per specification or received formal approval, prior to close of tender, of an alternative

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from the Engineer, these shall be rejected and removed from site at the Sub-Contractors cost. The materials or equipment shall be replaced with the specified materials or equipment at no extra cost to the Employer or project.

4.2 Supervision

The work shall at all times, for the duration of the Sub-Contract be carried out under the supervision of a skilled and competent representative of the Contractor who is in possession of a valid Wireman's License and who will be able and authorised to receive and carry out instructions on behalf of the Contractor. A sufficient number of workmen shall be employed at all times to ensure satisfactory progress of the work.

4.3 Work Sequence

The sequence, in which the work must be carried out, must be established in consultation with the Main Civil Engineering Contractor, Engineer and other Contractors on site.

4.4 Early Delivery of Built-In Items.

As soon as the contract has been awarded, the Electrical Sub-Contractor must establish the full requirements relating to all built-in items, and arrange for their earliest manufacture and delivery to site to suit the programme.

4.5 Deliveries to Site and off-loading

When despatching plant or materials to site, the Electrical Sub-Contractor shall arrange to have a responsible representative on site to supervise and arrange the off-loading. The Electrical Sub-Contractor shall supply his own labour and equipment necessary for the off-loading, and arrange for the storage and safekeeping of any special items. Machinery shall be despatched to site to suit the plant erection programme and to minimise double handling on site.

4.6 Security of Materials and Equipment

Unless expressly allowed for in the Contract Sum, the Electrical Sub-Contractor shall in connection with the works, provide and maintain, at his own cost, all lights, guards, barriers, fencing and watching when and where necessary or as required by the Engineer or by any competent statutory or other authority for the protection of the works or for the safety and convenience of the public.

4.7 Storage

The Electrical Sub-Contractor must provide adequate and secure storage, to the satisfaction of the Engineer, for all materials supplied to him. All material must, in addition be stored or stacked in positions that will not interfere with other work in progress in the area.

4.8 Handling Equipment into Position

The handling of items of plant into position shall be done with the aid of hoisting lugs situated over the hoist-well openings, or with crawl beams for external hoisting,

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where hoist-well openings have not been provided. The Electrical Sub-Contractor shall supply all the lifting equipment required. Care shall be exercised at all times to protect walls, columns, brickwork, sheeting, etc., against any possible damage arising from careless handling.

4.9 Provisional Building for Plant

All conduit and accessories shall as far as possible be built in. Authorisation must be obtained from the Structural Engineer prior to any chasing. The Electrical Contractor must supply full details of his requirements regarding work to be carried out by the Civil Contractor, including dimensions and positions of all openings, ducts etc., in walls and floors, and full particulars of all holding down bolts, cables holes for motors, etc. All retaining devices like studs and bolts shall be supplied by the Electrical Contractor. Where a defect is found this shall be reported to the Engineer timeously so that corrective action can be taken. Under no circumstances will delays and consequential cost be entertained due to the failure to ensure that the mountings are correct.

4.10 Bolts, Nuts, Washers, Brackets and Mounting Accessories

All fixing and mounting accessories shall be hot dipped galvanised mild steel. In general, the contact between dissimilar metals shall be avoided. Should accessories manufactured from corrosive materials be used on site, the Engineer shall instruct the Electrical Sub-Contractor to remove such accessories and replace them at the Electrical Sub-Contractors expense. Where hot dipped galvanised items need to be cut on site, they shall be cold galvanised immediately.

4.11 Scaffolding

The Electrical Sub-Contractor shall provide all the necessary scaffolding for the erection and painting of the various items of plant where this is required.

4.12 Damage to Buildings

The Electrical Sub-Contractor will be held responsible at all times for all damage to the buildings and plant due to negligence of any of his workmen or those of his Sub-Contractors. Any damage arising out of such negligence shall be repaired by the Electrical Sub-Contractor at their own cost.

4.13 Notices

The Electrical Sub-Contractor shall issue all notices and make the necessary arrangements with Supply Authorities, the Postmaster-General & Telkom, Transnet, Provincial or National Road Authorities and other Authorities as may be required with respect to the installation. The Electrical Sub-Contractor will be held responsible for damage to any existing services brought to his attention by the relevant authorities and will be responsible for the cost of repairs.

4.14 Harmonic Distortion

The Supply Authority will not permit the connection of equipment that generates harmonics. The limits are defined in IEC 6100-3-2. If such equipment is found to have been supplied it must be modified, fitted with harmonic filters or replaced with an acceptable alternative.

4.15 Contract Work

The installation shall be carried out entirely by the Electrical Sub-Contractor's own staff and shall not in any way be sub-let. This part of the specification has preference to any other part of the specification. Electrical Sub-Contractors are advised that only the highest standard of workmanship will be accepted and that all materials supplied must be strictly in accordance with this tender document.

If workmanship and/or materials are not suitable, the Engineer will request that the work is repeated or the materials returned until a satisfactory standard is achieved. No additional payment will be made in respect of any remedial works.

4.16 Interchangeability of Equipment

Equipment to be supplied under this contract must be identical in all respects and it shall be possible to interchange such equipment should it become necessary.

All material and equipment must be suitable for 400/230 V supply voltage, 50 Hz supply frequency and must be approved by the Engineer. In addition all equipment shall be designed, manufactured and tested in accordance with the relevant South African Bureau of Standards Specification or otherwise the relevant British Standard Specification.

All products and equipment used as part of a fixed electrical installation shall bear the "SABS safety mark or SABS approved safety mark" and the necessary precautions shall be taken against corrosion, i.e. all metal shall be hot dipped galvanised in accordance with SANS 121, SANS 32 and SANS 10064.

4.17 Specification and Drawings

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

Electrical Sub-Contractors must ensure that their copy of the specification is complete and that all electrical drawings as listed have been received from the Engineer.

4.18 Contract Drawings

The layout and extent of the electrical installation are shown on the drawings which form part of this document. The positions of all power, light and switch outlets or

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routes which may be affected by other services must be confirmed by the Sub-Contractor with the Engineer before placing such outlets.

The Sub-Contractor must request a complete set of Architectural / Structural and any other Services drawing from the Main Contractor for his information. Dimensions shown on the latest revision of Architectural / Structural drawings must be used by the Sub-Contractor for setting out purposes. No claims regarding revisions in Architectural / Structural which are not indicated on the Electrical Drawings will be accepted.

4.19 Construction Record Drawings

The Engineer shall issue the Electrical Sub-Contractor with a complete set of electrical drawings. The Electrical Sub-Contractor shall ensure that exact cable routes, manholes, sleeves, cable joints etc are shown and dimensioned from a building reference point and any changes shall be marked in red. The construction record drawings shall be submitted 2 weeks before the handover of the project (First Delivery). Final computer generated drawings shall be produced by the Engineer. These final construction record drawings shall be signed by both the Engineer and the Electrical Sub-Contractor before submission to the Employer.

4.20 Power Supply

4.20.1 Normal Mains Supply

The local supply authority will provide the site with LV supply by means of a busbar unit consumer.

Provision is made for UPS units to supply essential circuits in the event of a supply authority outage of short duration. Provision is made for a standby generator for supply authority outages of longer duration.

4.20.2 Metering

For demands of up to 150kva, LV metering will be provided.

4.21 Electrical Power Failure Philosophy

The local regulatory authority will supply the primary source of electrical power to the building. In the event of a power failure or power outage affecting the electrical supply to the building the following sequence of events will take place to ensure that this disruption is minimised.

- The UPS units will continue to supply the dedicated circuits, which essentially will be all the computer and communications systems. The UPS units can provide a back-up time of up to one hour.
- A relay in the incoming supply panel will detect a power failure and will signal the AMF panel on the Standby Diesel generator set. The plant will start

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automatically and when up to speed will switch over via mechanical and electrical interlock and supply power to the building. (The same principle will apply to the standby generator sets that supply the communications centre).

- Once the normal supply has been re-established the changeover switch will revert to normal supply and the standby generator set switched-off.
- The standby generator can provide back for any length of time provided the fuel tank is monitored and replenished regularly.
- During the period that the standby generator is supplying power to the building only essential services such as the air conditioning plant for the communications building and the UPS room as well as the lifts and all dedicated switched socket outlets.
- Emergency lighting with one hour integral battery back-up shall be provided.

4.22 Distribution Boards

Distribution Boards within the building will be housed (within a Distribution Cupboard that is aligned to risers and droppers between each floor. The cupboard door will be non-lockable and clearly identified as an electrical distribution cupboard. Within the cupboard cavity will be housed a floor standing distribution board. Each DB shall have a critical section and a normal section, the critical is supplied by the emergency generator during mains power failure. Refer to the Distribution Board Standard Specifications and Single Line Diagrams.

The DBs shall comply with SANS 10142-1, SANS 60439 and SANS 1473 and the switchgear shall comply with SANS 60947. The top of the DB shall not exceed 2100mm AFFL.

4.23 Cables

It shall be the responsibility of the Contractor to establish the correct lengths of cable on site, before placing an order. The transport of the cable to the required area shall be for the Contractor's account. After installation, the Engineer shall measure exact cable lengths on site. Adjustments to the contract price shall then be calculated using rates in the Bill of Quantities. The Contractor shall not be reimbursed for any surplus cable or any material over supplied.

4.23.1 Low Voltage Cables and Terminations

All low voltage cables shall comply with SANS 1507 and shall be PVC/SWA/PVC cables. Main LV 4 core cables shall have copper conductors and shall have a separate insulated copper earth conductor. Cables shall bear the SABS mark. The earth conductors must be bound to the cables at intervals not exceeding 1 meter. All Cables shall bear the SABS mark. The total insulation must have the phase colour. All LV cables shall be installed in accordance with SANS 0198.

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Cable glands shall conform to SANS 1213. Cable glands shall be suitable for outdoor use with corrosion guard. Type: Pratley Enviroglan or equal and approved.

A complete cable schedule shall be issued to the Contractor after contract award. The Contractor shall provide a cable pulling schedule, with the final length measured on site, which must be authorised by the Engineer on site prior to cables being cut off the drum.

4.23.2 Cable Junction Boxes

IP68 rated three-way orange cable boxes shall be Pratley Ezee-fit No.2 with polycarbonate lid.

4.23.3 Cable Trench Excavation and Cable Installation

Refer to Excavation & Cable Laying Standard Specification.

4.23.4 Cable Slack

At every termination, sufficient slack shall be provided for future repairs to the cable end should this become necessary due to a fault or some unforeseen circumstances on site. An amount of 800mm of cable slack shall be allowed at each termination for tender pricing purposes.

4.23.5 Cable Identification

Every power distribution cable, switchboard interconnecting cable, and any other cable, shall be provided at both ends of the run with an approved Bowthorpe Hellerman tag showing the size and details of the cable. All identifications shall correspond with the construction record drawings and single-line diagrams associated with the contract.

4.23.6 Cable laid direct in Ground

Except where indicated on the Contract Drawings or in the Cable Schedules, and except where cables enter building or traverse railways or roads or other paved areas likely to be subject to vehicular traffic, underground cables shall be buried direct in the ground.

4.23.7 Cable in Ducts

The total cross sectional areas of any cable installed in a duct shall not exceed 40% of the internal cross sectional area of the duct. After installation of the cable, duct stoppers shall be fitted to each end of each duct run and at the entry to all buildings to effectively seal to duct from ingress of vermin etc.

4.23.8 Cable Ducts

All cable ducts for this Contract shall be supplied and installed by the Civil Engineering Contractor. The Contractor shall inform the Engineer should the cable ducts provided not meet his requirements so that if required, remedial action may be taken.

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Cable ducts passing under roads carrying heavy vehicles or under railways shall be completely surrounded with lean-mix concrete to a minimum thickness of 150mm.

Where cable ducts deviate from a straight line, the radius of curvature, in the plane of the deviation, shall be not less than 0,5metres.

Cable duct runs shall, in general, be laid level with a tolerance of ± 10 mm. Where the nature of the ground makes this impracticable, they shall be laid to drain naturally towards one or both ends, where adequate provision for drainage shall be made.

Adequate precautions shall be taken to prevent the cable duct system acting as storm water or ground water drainage system.

4.23.9 Cable Tile

A 230mm wide reinforced concrete cable tile will be laid 150mm above the cable (this applies to MV cable only) during installation.

Marker Tape

An approved yellow polythene marker tape 150mm wide will be laid 300mm above all cables during back-filling to indicate the presence of all electrical cables.

The tape shall be yellow, with the words "ELECTRIC CABLE BELOW" and the "Triangular Danger Sign" in red. These markings shall not be more than 1m apart from centre to centre.

4.23.10 Cable Joints

Low voltage cable joints in cable runs shall not be allowed unless specified or authorised in writing by the Engineer.

Where cable joints are to be made, a joint hole must be excavated of 1830mm x 1220mm. Each cable end must be left in a loop of 0,9m to prevent any tension on the joint. During back filling the section supporting the joint must be compacted to the extent that no movement will take place after the trenches have been back-filled.

The Contractor will issue the Engineer with a copy of the jointing instructions associated with each type of termination or straight through joint, being installed on site.

All joints in underground LV cables and terminations shall be made either by means of compound filled boxes according to the best established practice by competent cable jointers using first class materials or by means of approved epoxy-resin pressure type jointing kits such as "Scotchcast".

MV cable joints shall be undertaken by competent specialist cable jointers who are approved by the supplier of the joint kit in accordance with SANS 0198.

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Where applicable, Dept. of Public Works maintenance staff will be permitted to observe the method of jointing to facilitate any repairs which may be required during the future maintenance of the installation, after the retention period has expired.

Cables are to be made off with sealing glands and materials designed for this purpose which must be of an approved make. Where cables are cut and not immediately made off, the ends are to be sealed immediately.

4.23.11 Cable Tests

Each section of laid and jointed cable shall be tested in accordance with SANS 1507. The insulation resistance shall be measured with a 1000 volt Megger and the readings shall be tabulated and certified. Similarly the earth continuity resistance of each section of cable shall be measured and recorded. All low voltage cables must be tested on site before final terminations after installation of cable glands, in the presence of Engineer. All test results must be submitted to the Engineer.

Tests on completion of the installation and jointing of the various cables shall be carried out on site in the presence of the Engineer and the test results properly recorded and submitted in triplicate.

On each completed section of laid and jointed cable, the insulation resistance shall be tested in accordance with Specification for Testing included elsewhere in this document.

The cables must be adequately supported at intervals during the whole operation. Particular care must be exercised where it is necessary to draw cables through pipes and ducts to avoid abrasion, elongation or distortion of any kind. The ends of such pipes and ducts shall be sealed to approval after drawing in of the cables.

4.24 Balancing of Load

The Electrical Sub-Contractor is required to balance the load as equally as possible over the multiphase supply. Generally adjacent luminaires shall be supplied of alternate phases.

4.25 Conduit

All conduit and conduit accessories shall be manufactured from uPVC and shall comply and be installed in accordance with SANS 950 and shall bear the SABS mark. All conduits shall be concealed in the building work where possible. Open wiring will not be allowed in roof spaces or elsewhere. Galvanised draw wires must be provided in all conduits provided for other services. Bending and setting of conduit must be done with special bending apparatus manufactured for that purpose and are obtainable from the manufacturers of the conduit system. The Electrical Sub-Contractor shall ensure that all conduit and accessories are installed in good time and hence not to delay other Contractors.

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Conduit in brickwork shall be built in. Where chasing is unavoidable, this must be undertaken using an angle grinder, chasing by hammer and chisel is unacceptable. A vertical "V" slots for conduit must be cut with an angle grinder. Where conduits are installed in the structural steelwork and have to pass through steel beams, the position of these holes is to be confirmed acceptable with the Structural Engineer.

All conduit boxes etc. are to be securely fixed to the shuttering to prevent displacement when concrete is cast. Conduit having a wall thickness of less than 1.6 mm will not be allowed in screeding laid on top of concrete slabs. The Engineer reserves the right to inspect the conduit installation before the casting of concrete however; the responsibility for the correct positioning of the outlet boxes shall remain with the Electrical Sub-Contractor. Before any concrete is cast all conduit droppers to switchboards shall be neatly spaced and rigidly fixed.

The Electrical Sub-Contractor shall inform the Engineer at least 48 hours before each concrete pour. A competent person shall be present during every concrete pour. No claims for conduit damaged during the casting of concrete will be accepted. The Electrical Sub-Contractor shall find an alternate route to the approval of the Engineer.

Draw boxes, if required must be placed in unobtrusive positions. Blank cover plates on 300 x 300 mm boxes must be fixed with four countersunk chrome screws.

Expansion joints: Wherever conduits cross expansion joints, an expansion box shall be installed, consisting of a suitably sized uPVC box with conduit sleeves of a larger size than the crossing conduits. These sleeves shall be run from the box to the expansion joint and crossing conduits shall be run through them up to 25 mm into the expansion box.

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

Where outlet boxes or draw boxes are mounted onto finished-surfaces the Electrical Sub-Contractor shall take care that such outlets are mounted symmetrically.

It will not be sufficient to scale the position of any outlet off the drawings. No extra payment will be allowed where the outlets are not mounted symmetrically and have to be changed. The mounting heights of outlets shall be indicated on drawings. Outlets located on walls near a change of wall finish, (e.g. tiles) shall be arranged so that the cover plates fall completely within one surface finish. The Electrical Sub-Contractor shall ascertain the height of the surface finish changes before installation of outlet points.

The loop-in system shall be used. This shall mean that all wiring shall be done from below the ceiling space where applicable. Conduit in roof spaces shall be installed directly from outlet to outlet without draw-boxes and shall be secured with suitable clamps at 1m intervals. The Electrical Sub-Contractor shall provide additional supporting members as required.

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4.26 Wiring Channel

All recessed lighting shall be supplied via 5A plugs mounted in 76mm x 63mm wiring channel with 5A knockouts. The channel shall be mounted in the ceiling void as shown on the drawings and shall link the relevant DB. The channel shall be galvanised with PVC covers.

126mm x 76mm wiring channel shall be mounted in the ceiling void as shown on the drawings and shall link the relevant DB / Access Duct. The channel shall be galvanised with PVC covers.

One channel shall be provided for each of the following:

- Normal Power
- Dedicated Power
- Telephone
- Data

4.27 Powerskirting

The Electrical Sub-Contractor shall be responsible for the supply and installation of all power skirting complete with corner pieces, splices, end pieces, junction pieces, supply conduits, cover plates and power outlets as specified and indicated on the drawings.

The powerskirting must comply with SANS 1197. The Electrical Sub-Contractor must ensure that the powerskirting is installed to the satisfaction of the Engineer before commencing with the wiring of the powerskirting.

Three compartments with two cover power skirting shall be supplied and installed as indicated in the drawings. The compartments shall be power (normal and dedicated), telephone and computer data.

The powerskirting shall be Legrand uPVC powerskirting or equal and approved.

The channel and cover shall be manufactured from uPVC. Colour to be selected after award.

4.27.1 Outlet Covers

Outlet covers shall be supplied and installed to accommodate normal and dedicated socket outlets, telephone and computer data outlets as shown on the drawings. The Electrical Sub-Contractor shall supply and install the Normal and Dedicated Switch socket outlets with covers and only the covers for the telephone and computer data outlets, as the installation and connection of telephones and computer data lines and outlets shall be carried out by others.

4.27.2 Access Floor Outlet Boxes

These shall be cast into the floor slab. Conduit shall link the box to the powerskirting and to the ceiling void.

Manufacturer : O-line or equal and approved

4.27.3 Partition Boxes

These shall be installed in the dry wall partitions. Conduit shall link the box to the powerskirting and to the ceiling void wiring channel as required.

Manufacturer : O-line or equal and approved

4.28 Wiring

All wiring used for this Sub-Contract shall be PVC insulated 600/1000 V grade to SANS 1507. The minimum wiring shall be as follows unless otherwise stated on the relevant single line diagrams of the Distribution Boards:

- Lighting Circuits - 2.5 mm² PVC insulated 600/1000 V Cu conductor + 2.5 mm² insulated earth wire in 20 mm diameter uPVC conduit.
- Socket Outlet – 4 mm² PVC insulated 600/1000 V Cu conductor + 2.5 mm² insulated earth wire in 20 mm diameter uPVC conduit.
- Electrical Water Heater Circuits – 4 mm² PVC insulated 600/1000 V Cu conductor + 2.5 mm² insulated earth wire in 20 mm diameter uPVC conduit.

Refer to the relevant single line diagrams of the Distribution Boards for the wiring of circuits not mentioned above. The conduit sizes shall be in accordance with the SANS – 10142-1.

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

4.29 Lighting

All luminaires shall be as specified in the Bill of Quantities and as indicated on the drawings. All luminaires comply with the SABS safety standard.

Samples of all luminaires must be approved by the Engineer before any order is placed. All following luminaires must be complete with lamps and where necessary, control gear. All control gear shall bear the SABS mark.

4.29.1 General Requirements

- All luminaires comply with the SABS Safety Standards.
- LED technology shall be used.

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- All lamps and control gear shall bear the relevant SABS mark.
- Ceiling tiles are 600mm x 600mm hence recessed downlighters shall be supplied with a 5A plug top and 3 metre long cable.
- The latest energy saving technology shall be offered i.e.
 - Motion / Infra Red Sensors
 - Photo electric sensors (close to windows to dim lighting to required level)
 - Each office user shall have the ability to set his preferred lighting level.

NB: Passage and common areas (toilets etc. on the wing) shall be switched on whenever the floor is occupied.

4.29.2 Positions

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

4.29.3 Hangers and supports

Where provision has not been made for the fixing of luminaires, the Electrical Sub-Contractor shall supply the necessary supports, hangers, conduit extensions, angle brackets or any other fixing method approved by the Engineer. Fluorescent luminaires installed against concrete ceilings shall be screwed to the outlet boxes and in addition a minimum of 2 x 6 mm expansion or other approved type fixing bolts are to be provided. The bolts are to be placed 3/4 of the length of the luminaires apart.

LED panel luminaires to be mounted on board ceilings shall be secured by means of two 40 mm x No. 10 round head screws and washers. The fixing screws are to be placed 3/4 of the length of the fitting apart.

4.29.4 Bulkhead luminaires

Surface-mounted bulkhead luminaires shall not be screwed directly to conduit ends. The conduit shall terminate in a round draw-box at the top or rear of the luminaire. The PVC-insulated conductors shall terminate in a porcelain terminal strip in the draw-box. Silicon-rubber insulated conductors shall be installed from the terminal strip to the luminaire lampholder. "Screw-it" or similar connectors are not acceptable. The luminaires shall be fixed with 2 x 6 mm expansion bolts with a solid metal backing plate installed between the luminaire and the column as detailed on the drawings.

4.29.5 Wiring to enclosed luminaires

The wiring, within enclosed, unventilated luminaires shall consist of tinned copper conductors insulated with silicone-rubber, braided with a heat resistant fibrous material (e.g. glass or terephthalate fibre). Several parallel strands of nickel-chrome or "KANTHAL" resistance wire insulated with porcelain beads may be used as an alternative.

Connection to Luminaires

Connectors to the wiring or luminaires and other appliances where connectors are used, shall be effected by means of brass screw couplers shrouded in porcelain, neoprene or PVC or by means of approved spring steel locking connectors insulated in unbreakable material. Other types of connectors are not acceptable.

4.29.6 Knock-Outs

Where knock-outs are used for the wiring of luminaires and other appliances, brass bushes or gripper glands shall be used.

4.29.7 Type of Conductor

Wiring from the lampholder to the general wiring shall be heat resisting silicon compound insulated conductors.

4.29.8 Screwed Lampholders

The central terminal of Edison Screw (ES) lampholders shall be connected to the phase conductor (i.e. conductor with red insulation) and the screwed housing to the neutral conductor i.e. conductor with black insulation).

4.29.9 Earthing

Earth conductors must be drawn in with the circuit wiring and connected to the earthing terminal of all luminaires in accordance with the SANS 10142-1

4.29.10 Fire Escape Lighting

Individual luminaires with LED and Running Man signs shall be offered for this purpose. The units shall be of the maintained type with 1 hour battery backup.

4.29.11 Stairwell Lighting

Emergency back-up units shall be supplied and installed at all stairwell luminaires. The emergency back-up unit shall form part of the fitting. cable. A hole shall be provided at 0.4m below ground level for the supply cables.

4.30 Photo Cell

The area lighting must be switched by either a contactor mounted in the distribution board, which is controlled by a photocell or direct by the photocell. The photocell shall comply with NRS 025.

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The photocell must be mounted as indicated on the drawings in such a manner that the luminaires will not affect the operation of the photocell.

The photocell must be linked with the distribution board by 3 x 2,5mm² PVC conductors drawn in conduit in the roof space.

The photocell must comply with the following: -

- Area lights must be switched ON when the illumination drops to 50 Lux.
- Area lights must be switched OFF when the illumination reaches 90 Lux.
- It must be weatherproof and be resistant to Ultra –Violet light.
- It must have a built in time delay of approximately 30 seconds.
- Built in protection against voltage surges must be provided.
- A sample of the proposed photocell must be submitted to the Engineer for approval.
- 20 A rating must be provided.
- Type : National ZA 20

4.31 Light Switches

All light switches shall conform to SANS 163 and must bear the SABS mark.

4.32 Interior Light Switches

Interior light switches in walls shall be flush mounted in 100 mm x 50 mm x 50 mm conduit boxes must be mounted 1 200 mm AFFL. Type Crabtree or equal and approved.

4.33 Switch Socket Outlets

Switch socket outlets shall conform to SANS 164 and must bear the SABS mark. Switch socket outlets must be mounted at mounting heights as shown on the drawings, powerskirting, multiway box and partition boxes. All switch socket outlets shall of the combination switch type 16 A, three pin. Switch socket outlets in walls shall be flush mounted in 100 mm x 100 mm x 50 mm conduit boxes. Normal Switch socket circuits must be protected by 30 mA earth leakage units and a 15A circuit breaker with a maximum of three outlets per circuit.

Dedicated socket outlets shall be red with shaved earth pin and must be protected by a 15A circuit breaker with a maximum of three outlets per circuit. These are fed via UPS

4.34 Power Points

The following power points must be supplied:

4.34.1 Extract Fans outlet

A 5 A un-switched socket outlet shall be installed for every extract fan as indicated on the drawings. These fans shall be wired to the relevant light circuits.

Hand Dryers

The Electrical Sub-Contractor shall supply and install 20 mm conduit from the distribution board to the hand dryer positions in the ablutions as indicated on the drawings. The conduit shall be installed flush and terminated to a 100 mm x 100 mm conduit box installed at a height of 1200 mm AFFL. A 20A DP Isolator with Neon indication shall be installed at 2500mm AFFL.

4.34.2 Electrical Water Heater Outlets

Supply and installation of outlets only, for all hot-water cylinders as indicated on the drawings. Each outlet shall consist of a 30 A double pole isolator with indicator light mounted on surface as close as possible to the hot-water cylinder. The Isolator shall be Crabtree or equal and approved.

The isolator shall be connected to the relevant distribution board by means of 2 x 4 mm² PVC insulated conductors, and 1 x 2.5 mm² insulated copper earth wire in 20 mm diameter uPVC conduit. Flexible uPVC conduit shall be used for the connection from the isolator to the electrical water heater.

The circuit breaker supplying the geyser shall be combined with a single pole isolator for switching the neutral.

The supply, installation of the electrical water heaters and plumbing work shall be the responsibility of the Civil Contractor. The Electrical Sub-Contractor shall electrically connect all electrical water heaters as specified and liaise with the Civil Contractor with regard to the position of mounting the electrical water heater and the isolator.

4.34.3 Exterior air-conditioning outlets

Double pole isolators, assembled in an IP 65 enclosure and mounted adjacent to the plant as shown on the drawings will be supplied and installed by the Electrical Sub-Contractor. Air-conditioning plant to be supplied and connected to isolator by the Electrical Sub-Contractor. They shall be Moeller or equal and approved.

4.34.4 Interior air-conditioning outlets

Double pole flush-mounted isolators adjacent to the plant as shown on the drawings will be supplied and installed by the Electrical Sub-Contractor. Final positions and mounting heights must be confirmed with the A/C Contractor. Air-conditioning plant to be supplied and connected to isolator by the Electrical Sub-Contractor. They shall be Crabtree or equal and approved.

4.35 Earthing & Bonding

The entire electrical installation shall be earthed and bonded in accordance with SANS 10142-1. The type of main earthing must be as required by the supply authority. The entire installations shall be effectively earthed in accordance with the SANS 10142-1 and to the requirements of the supply authority. All earth conductors shall be stranded copper with or without green PVC insulation.

Connection from the main earth bar on the main board must be made to the cold water main, the incoming service earth conductor, if any and the earth mat or other local electrode by means of 70 mm² stranded (not solid) bare copper wire or such conductor as the Engineer may direct.

The main earth bar of a minimum cross sectional area of 40 mm x 6 mm of a high conductivity tinned copper bar shall be supported on insulators. The inter-connecting earth between bars shall be 70 mm² insulated copper conductors. The trench earth conductors shall be 70 mm² bare copper wire.

The final resistance of every main distribution board, metering panel must comply with SANS 10142-1.

Main earth copper strapping where installed below 3m from ground level must be run in 20 mm diameter uPVC conduit securely fixed to the walls.

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

4.35.1 Sub-distribution Boards

A separate earth connection shall be supplied between the earth busbar in each sub-distribution board and the earth busbar in the Main Switchboard.

These connections shall consist of bare or insulated stranded copper conductors installed along the same routes as the supply cables or in the same conduit as the supply conductors.

4.35.2 Sub-Circuits

The earth conductors of all sub-circuits shall be connected to the earth busbar in the supply board in accordance with SANS 10142-1.

4.35.3 Ring Mains

Common earth conductors may be used where various circuits are installed in the same wireway in accordance with SANS 10142-1. In such instances the sizes of earth conductors shall be equivalent to that of the largest current carrying conductor installed in the wireway, alternatively the size of the conductor shall be as directed by the Engineer.

Earth conductors for individual circuits branching from the ring main shall be connected to the common earth conductor with T-ferrules or soldered. The common earth shall not be broken.

4.35.4 Non-Metallic Conduit

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

4.35.5 Flexible Conduit

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

4.35.6 Connection

Under no circumstances shall any connection points, bolts, screws, etc., used for earthing be utilised for any other purpose.

It will be the responsibility of the Electrical Sub-Contractor to supply and fit earth terminals or clamps on equipment and materials that must be earthed where these are not provided. Unless earth conductors are connected to proper terminals, the end shall be tinned and lugged.

4.35.7 Earth Electrodes

Earth electrodes shall be of stainless steel or shall have a steel core with copper cladding of, at least, 0,25 mm thickness, applied by the molten welded process, to form a microscopic crystalline copper steel alloy between the two metals, as to ensure that abrasion or bending, during driving, will not damage the outer copper skin. Earth Electrodes shall be approximately 1600 mm in length with provision for screwing together to form a mechanically and electrically continuous rod.

The joint, between the extensible electrodes, shall not permit the ingress of moisture. The coupling shall be of a material that will inhibit electrolytic action between the coupling and the copper skin on the electrode.

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Electrodes shall be driven into the soil in a professional manner that will ensure that no unnecessary vibrations are set up. The manufacturer's recommended electrode-driving practice shall be closely followed.

The top of the electrode, after installation, shall be, at least, 400 m below surface level.

4.36 Notices, Signs, Drawings & Labels in Electrical Equipment Rooms

All substations and rooms accommodating electrical equipment shall be equipped with the required statutory warning, safety and first aid signs and notices in accordance with the NOSA, OHS Act and SABS 0142-1.

Notwithstanding anything to the contrary, the contractor shall provide the following as minimum requirements:

A notice of all entrances prohibiting unauthorized persons from entering rooms containing electrical equipment and switchboards.

A notice prohibiting unauthorized persons from handling or interfering with electrical equipment located in areas accessible to the general public and within each room having electrical equipment.

A notice in each room containing electrical equipment providing instructions as to the restoration of persons suffering from the effects of an electrical shock.

- All entrance doors shall be labelled as to room function, i.e. Main MV Switch and Control Room, Transformer Room, etc.
- Each switch and equipment room shall be provided with:

Framed behind glass, wiring and control schematic diagrams fixed to the wall in a convenient position.

A suitable A4 size or larger hard covered and durable log book fixed by a non-ferrous chain to a suitable wall-mounted timber desk top.

"Equipment Operating and Switching Instructions" - these may be included on the framed diagrams or included as part of the Log Book or as a separately bound hard covered manual.

4.37 Vermin-Proofing and Sealing Of Ducts

All ingress positions to substations and electrical rooms shall be adequately vermin-proofed by means of non-corrodible vermin-proof mesh. Wherever possible the vermin-proofing shall be demountable to facilitate subsequent modifications and additions to the incoming and outgoing cabling.

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Unless otherwise specified all cable trenches, sleeves and ducts between substation rooms shall be sealed off in a manner as to ensure a water and gas-tight seal. The method used shall be easily removed to accommodate future changes to the cabling and shall provide a 4-hour rated fire cut-off between rooms.

4.38 Electrical Testing and Commissioning

The Electrical Sub-Contractor shall test the entire electrical installation in terms of Regulation 7 of the Electrical Installation Regulations 1992 of the Occupational Health and Safety Act 1993 and shall issue a Certificate of Compliance on the official form, obtainable from the Electrical Contracting Board of South Africa. All tests shall be carried out in conjunction with and to the satisfaction of the Supply Authority and in the presence of the Engineer.

Each length of cable shall be tested for insulation and polarity by means of a 1000 V megger designed for that purpose. In the case of underground cables this shall be done before back filling.

In addition, the earth-loop impedance of each main and sub-main feed shall be measured. The earth resistance at each down conductor electrode shall be measured. The earth resistance shall be tested by means of an approved instrument.

If there is no power on the day of the test, the Electrical Sub-Contractor shall supply a 3 kW 230 V generating plant for testing purposes.

"Danger" notices shall be displayed at remote ends of cables under test.

The Electrical Sub-Contractor shall advise the Engineer in writing of all results and furnish copies of all certificates.

The Electrical Sub-Contractor shall undertake load balancing.

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

The Engineer will provide the Electrical Sub-Contractor with quality control check sheets, which must be used and completed in full. These check sheets do not relieve the Electrical Sub-Contractor from carrying out his own checks and tests.

The responsibility of the installation meeting specification and statutory requirements remain with the Electrical Sub-Contractor.

The Electrical Sub-Contractor shall ensure that the installation is completed in every respect and that there are no major defects before notifying the Engineer (in writing)

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for the first delivery inspection. The certificates of compliance shall be issued to the Engineer at the first delivery inspection.

The Engineer will accept zero minor defects during the final inspection. Should any defects as listed during the first delivery inspection be found not to have been corrected then the Engineer will terminate that inspection and request that an additional final inspection be arranged by the Electrical Sub-Contractor. The cost of the Engineers time for the re-inspection will be deducted from the contract price in the form of a variation order.

TESTING	MINIMUM REQUIREMENTS
Insulation resistance	Whole installations: better than 1 Meg Ohm
LT Installation	Each sub-distribution section: better than 5 Meg Ohms. Each un-terminated cable : better than 5 Meg Ohms
Earth Leakage on socket outlets	Better than 30 milli amps
Max Resistance of earth continuity conductor	As per SANS 10142-1
Earth electrode resistance	Better than 10 Ohms

The Electrical Sub-Contractor is fully responsible for all commencement and completion forms required by statutory bodies and municipalities.

5. RETURNABLE SCHEDULES

RETURNABLE SCHEDULES
ELECTRICAL WORK
MATERIAL SCHEDULE

The contractor shall complete the following schedules and submit them with his tender.

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

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

Item	Material	Make or trade name	Supplier
1.	Distribution boards		
2.	Circuit breakers 1P, 2P, 3P		
3.	On load isolators without trips		
4.	Contractors 1P, 2P, 3P		
5.	Earth leakage relays 2 & 3 phase		
6.	Current transformers		
7.	Voltmeter		
8.	Maximum demand ammeter		
9.	Daylight sensitive switch		
10.	Conduit		
11.	Conduit boxes		
12.	Power skirting		
13.	Ducting		
14.	Surface switches		
15.	Watertight switches		
16.	16A flush socket outlets		
17.	16A surface socket outlets		
18.	16A watertight socket outlets		
19.	Internal surface mounted isolators		
20.	External surface mounted isolators		
21.	Luminaries		
	Type A1		
	Type B1		
	Type B2		
	Type C1		
	Type C2		
	Type D1		
	Type E1		
	Type E2		

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	Type E3		
	Type E4		
	Type F1		
	Type J1		
22	PVC cables		
23	Access Control System		
24	Biometric Readers		
25	Building Management System		
26	CCTV System		
27	Camera's		
28	Fire Detection system		
29	Fire Cabling		
30	Intercom System		
31	PA System		
32	Speakers		
33	Standby Generator		
34	UPS		
35	Hybrid Backup System with Grid Tie And Solar Charging		

NOTE:

Should the contractor wish to supply materials other than that originally offered, prior written approval must be obtained from the Representative/Agent before any orders are placed

CONTRACTOR: _____

SIGNED: _____

DATE: _____

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1 CABLE SLEEVE PIPES

Where cables cross under roadways, other services and where cables enter buildings, the cables shall be installed in earthenware or high-density polyethylene pipes.

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

2 NOTICES

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

3 ELECTRICAL EQUIPMENT

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

4 DRAWINGS

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

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

The list of Drawings attached to this tender are as follows:

1. NCEP/001/01/E - Basement Level: Lighting Layout
2. NCEP/001/02/E - Basement Level: Power, Telephone & Data Layout
3. NCEP/001/03/E - Basement - Reticulation Layout
4. NCEP/001/04/E - Basement Level: CCTV & Access Control Layout
5. NCEP/001/05/E - Basement Level: Fire Detection and Voice Evacuation Layout
6. NCEP/001/06/E - Lower Ground Floor: Lighting Layout
7. NCEP/001/07/E - Lower Ground Floor: Power, Telephone & Data Layout

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8. NCEP/001/08/E - Lower Ground floor - Reticulation Layout
9. NCEP/001/09/E - Lower Ground Floor: CCTV & Access Control Layout
10. NCEP/001/10/E - Lower Ground Floor: Fire Detection and Voice Evacuation Layout
11. NCEP/001/11/E - Ground Floor: Lighting Layout
12. NCEP/001/12/E - Ground Floor: Power, Telephone & Data Layout
13. NCEP/001/13/E - Ground floor - Reticulation Layout
14. NCEP/001/14/E - Ground Floor: CCTV & Access Control Layout
15. NCEP/001/15/E - Ground Floor: Fire Detection and Voice Evacuation Layout
16. NCEP/001/16/E - First Floor: Lighting Layout
17. NCEP/001/17/E - First Floor: Power, Telephone & Data Layout
18. NCEP/001/18/E - First floor - Reticulation Layout
19. NCEP/001/19/E - First Floor: CCTV & Access Control Layout
20. NCEP/001/20/E - First Floor: Fire Detection and Voice Evacuation Layout
21. NCEP/001/21/E - Second Floor: Lighting Layout
22. NCEP/001/22/E - Second Floor: Power, Telephone & Data Layout
23. NCEP/001/23/E - Second floor - Reticulation Layout
24. NCEP/001/24/E - Second Floor: CCTV & Access Control Layout
25. NCEP/001/25/E - Second Floor: Fire Detection and Voice Evacuation Layout
26. NCEP/001/26/E - Third Floor: Lighting Layout
27. NCEP/001/27/E - Third Floor: Power, Telephone & Data Layout
28. NCEP/001/28/E - Third floor - Reticulation Layout
29. NCEP/001/29/E - Third Floor: CCTV & Access Control Layout
30. NCEP/001/30/E - Third Floor: Fire Detection and Voice Evacuation Layout
31. NCEP/001/01/PV - Roof PV System Layout

32.NCEP/001/01/LP - Roof Plan Lightning Protection Layout

5 BALANCING OF LOAD

The Contractor is required to balance the load as equally as possible over the multiphase supply.

6 SERVICE CONDITIONS

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

7 SWITCHES AND SOCKET OUTLETS

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

8 LIGHT FITTINGS AND LAMPS

All Light fittings installed for this project is to be of the LED type, unless otherwise stated.

The following international standard specifications and South-African Bureau of Standards shall apply to the LED luminaire specification:

SANS 475	Luminaires for interior lighting, street lighting and floodlighting – Performance and requirements
SANS 10114-1	Interior lighting part 1: Artificial lighting of interiors
SANS 10114-2	Interior lighting part 2: Emergency lighting
SANS 60598-1	Luminaires part 1: General requirements and tests
SANS 60598-2.1	Luminaires part 2: Particular requirements section 1 – Fixed general purpose luminaires.
SANS 60598-2.2	Luminaires part 2: Particular requirements section 2 – Recessed luminaires.
SANS 60598-2.3	Luminaires part 2: Particular requirements section 3 – Luminaires for road and street lighting.
SANS 60598-2.5	Luminaires part 2: Particular requirements section 5 – Flood lighting.
SANS 61347-1 to 13	Lamp control gear
SANS 62031	LED modules for general lighting – Safety specifications
SANS 62384	DC or AC supplied electronic control gear for LED modules – Performance requirements.

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SANS 62560	Self-ballasted LED lamps for general lighting services with supply voltages > 50V – Safety specification.
SANS 62612	Self-ballasted LED lamps for general lighting services with supply voltages > 50V – Performance requirements
EN 55015	Limits and methods of measurement of radio disturbance of electrical lighting or equipment.
EN 61000-3.2	Electromagnetic compatibility (EMC) limits for harmonic current emissions.
EN 61000-3.3	Electromagnetic compatibility (EMC) limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems.
EN 61547	Equipment for general lighting purposes: EMC immunity requirements.
IEC-EN 62471	Photo biological safety of lamps and lamp systems for LEDs
IES LM-79-08	Approved method: Electrical and photometric measurement of solid-state lighting products.
IES LM-80	Approved method: Measuring lumen maintenance of LED light sources.

General requirements:

The luminaire shall be suitable for operation with mid-power LEDs.

Note that no LED tubes are allowed to be used.

The luminaire shall be suitable for operation on a 230V single phase 50Hz mains supply.

Power factor capacitors shall be supplied to correct the power factor to at least 0.95 or higher.

The luminaire shall be marked with identification labels stating the brand name and model and shall bear the SANS approval mark.

The driver shall comply with IEC 61347-1 and IEC 61347-2B as applicable and shall be suitable for operation on 230V \pm 10%, 50Hz single phase system and it must be insured that harmonics filter is provided as per SANS 61000-3-2. The drivers and LED circuitry shall be protected against lightning and power surges. Suitable surge arrestors with a 10kA rating shall be provided for indoor installations and 20kA for outdoor installations.

Colour rendering (Ra) shall be not less than 80 and lumen depreciation of not more than 30% L70 at 50 000 hours @ Tq 25°C. Colour temperature of the LED lamp shall be 4000K, unless otherwise stated.

Thermal requirements:

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The luminaire must be able to withstand an ambient temperature of 35°C. Storage temperature of this luminaire should be able to handle $-40^{\circ}\text{C} < T < 60^{\circ}\text{C}$.

To this end internal electrical and mechanical components shall not be allowed to exceed their maximum temperature ratings of 75°C. Test reports from an independent authorised testing facility proving this requirement shall be made available on request.

Noise requirements:

The noise level emitted from the luminaire shall be kept as low as possible. Drivers/electronic components shall therefore fully comply with the latest edition of SANS 55015.

-

All fittings to be supplied by the Contractor shall have the approval of the Employer.

The light fittings must be of the type specified in the Schedule of Light Fittings.

9 EARTHING AND BONDING

The Contractor will be responsible for all earthing and bonding of the building and installation. The earthing and bonding is to be carried out strictly as described in clause 18 of Part 1 of this specification and to the satisfaction of the Employer/s Electrical Engineer.

10 MAINTENANCE OF ELECTRICAL SUPPLY

All interruptions of the electrical supply that may be necessary for the execution of the work, will be subject to prior arrangement between the Contractor and the Client and the Employer's Electrical Engineer.

11 EXTENT OF WORK

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

12 SUPPLY AND CONNECTION

Eskom Supply

The Eskom supply available to supply the Magistrate Court is only 200kVA at 400/230 Volt 50Hz.

The Contractor must arrange in good time with Eskom for the installation of the 200kVA

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transformer and low-tension meter point and submit the account to the Employer's Regional Office for payment.

The Contractor will be responsible for the supply and installation of the supply cable from the meter box to the main low-tension distribution board (MDB). The size and length of the cable is listed in the Schedule of Cables and measured in the Bills of Quantities.

Hybrid Backup with Grid Tie and Solar Charging

Due to the Eskom Supply not being sufficient to supply the total demand at the Magistrates Court, a Hybrid backup with Grid tie and solar charging system shall be installed to supplement the Eskom supply. This system shall utilize Lithium Iron batteries to store DC Power when Solar Power is unobtainable.

Standby Plant

The 500kVA Prime Power Standby plant complete with automatic changeover control panel (Distribution Board – X) be supplied, installed and commissioned by others.

The Contractor will only be responsible for the supply and installation of the cable connections between the Main Distribution Board and the Charge- over Control Panel (Distribution Board - X).

The supply cables are listed in the Schedule of Cables and measured in the Bills of Quantities.

13 CONDUIT AND WIRING

Conduit and conduit accessories shall be black enameled/galvanized screwed conduit or black enameled/galvanized plain end conduit in accordance with SANS 61386.

All conduits, regardless of the system employed, shall be installed strictly as described in the applicable paragraphs of clauses 4 to 8 of Part 1 of the specification. Wiring of the installation shall be carried out as directed in clause 9 part 1 of this specification.

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

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

13.1 Telephone Installation

The Contractor shall allow for the complete installation of all conduits, outlet boxes, the communication service provider Distribution boards, sleeve pipes, etc., required for the telephone system as shown on the drawings.

The sizes of all telephone conduits are indicated on the drawings and must be installed

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in the floor slab. Galvanized steel draw-wires shall be installed in all conduits.

End boxes must consist of a 50mm x 100 mm x 100mm outlet box fitted with suitable blank cover plates, flush mounted 0,4m above floor level.

The communication service provider Distribution Board must consist of a 150mm x 600mm x 600mm metal box and hinged door with a 20mm thick wooden backboard. The board must be flush mounted, 1,37m above the floor.

13.2 Intercom Installation

The supply and installation of the intercom system is not included in this Contract.

The Contractor shall allow for the complete supply and installation of all conduits and outlet boxes required for the intercom installation as shown on the drawings.

The size of all conduits, boxes and mounting heights of the end boxes are indicated on the drawings. Galvanized steel draw-wires shall be installed in all conduits and the boxes fitted with suitable blank cover plates.

13.3 Power Trunking

The Contractor shall be responsible for the supply and installation of all power trunking complete with corner pieces, end pieces, junction pieces, supply conduits, cover plates and power outlets as specified and indicated on the drawings.

The power trunking must comply with SANS 61084. The Contractor must ensure that the power trunking is installed to satisfaction of the Employer's Electrical Engineer before commencing with the wiring of the power trunking.

14 POWER POINTS

Allow for the installation of power points and equipment as indicated on the drawings and measured in the Bills of Quantities.

15 CABLES

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

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

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

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clean and the bottom and sites free from rocks or stones liable to cause damage to the cable.

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

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

All joints in underground cables and terminations shall be made either by means of compound filled boxes according to the best established practice by competent cable jointers using first class materials or by means of approved epoxy-resin pressure type jointing kits. Epoxy-resin joints must be made entirely in accordance with the manufacturer's instructions and with materials stipulated in such instructions. Low tension PVCA cables are to be made off with sealing glands and materials designed for this purpose which must be of an approved make. Where cables are cut and not immediately made off, the ends are to be sealed without delay.

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

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

On each completed section of the laid and jointed cable, the insulation resistance shall be tested to approval with an approved "Megger" type instrument of not less than 500 V for low tension cables.

Earth continuity conductors are to be run with all underground cables constituting part of a low tension distribution system. Such continuity conductors are to be stranded bare copper of a cross-sectional area equal to at least half that of one live conductor of the cable, but shall not be less than 4mm² or more than 70mm². A single earth wire may be used as earth continuity conductor for two or more cables run together, branch earth wires being brazed on where required.

15.1 Laying, Jointing and making off of Electrical Cables

[The requirements specified hereafter, are aimed essentially at high tension cable but are also valid for low tension cable, where applicable.]

1. The use of the term "Inspector" includes the engineer or inspector of the

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Department or an empowered person of the concerned supervising consulting engineer's firm.

2. No cable is to be laid before the cable trench is approved and the soil qualification of the excavation is agreed upon by the Contractor and inspector.
3. After the cable has been laid and before the cable trench is back-filled the inspector must ensure that the cable is properly bedded and that there is no undesirable material included in the bedding layer.
4. All cable jointing and the making off of the cables must only be carried out by qualified experienced cable jointers. Helpers of the jointers may not saw, strip, cut, solder, etc. The cable and other work undertaken by them must be carried out under the strict and constant supervision of the jointer.
5. Before the Contractor allows the jointer to commence with the jointing work or making off of the cable (making off is recognized as half a joint) he must take care and ensure:
 - 5.1 That he has adequate and suitable material available to complete the joint properly and efficiently. Special attention must be given to ensure the cable ferrules and cable lugs are of tinned copper and of sufficient size. The length of the jointing lugs must be at least six times the diameter of the conductor,
 - 5.2 That the joint pit is dry and that all loose stones and material are removed,
 - 5.3 That the walls and banks of the joint pit are reasonable firm and free from loose material which can fall into the pit,
 - 5.4 That the necessary coffer-dams or retaining walls are made to stop the flow of water into the joint pit,
 - 5.5 That the joint pit is provided with suitable groundsheets so that the jointing work is carried out in clean conditions,
 - 5.6 That the necessary tents or sails are installed over the joint pit to effectively avert unexpected rainfall and that sufficient light or lighting is provided,
 - 5.7 That the necessary means are available to efficiently seal the jointing or cable end when an unexpected storm or cloudburst occurs, regardless of how far the work has progressed,
 - 5.8 That the cables and other materials are dry, undamaged and in all respects are suitable for the joint work or making off,
 - 5.9 That the heating of cable oil, cable compound, plumbers metal and solder is arranged that they are at the correct temperature when required so that the cable is not unnecessarily exposed to the atmosphere and consequently the ingress of

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moisture (care must be taken of overheating)

Flow temperatures of cable oil and compound must be determined with suitable thermometers. Cable oil and compound must not be heated to exceed the temperatures given on the containers and precaution must be taken to ensure that the tin is not overheated in one position. The whole mass must be evenly and proportionally heated.

(Temperatures of solder and plumbers metal may be tested with brown paper (testing time: 3 seconds). The paper must colour slightly - not black or burnt).

6. Before the paper-insulated cables are joined, they must be tested for the presence of moisture by the cable jointers test. This consists of the insertion of a piece of unhandled insulated impregnated paper tape in warm cable oil heated to a temperature of $130 \pm 5^{\circ}\text{C}$.

Froth on the surface of the oil is an indication that moisture is present in the impregnated insulation and the amount of the froth gives an indication of the moisture present.

7. If the cable contains moisture or is found to be otherwise unsuitable for jointing or making of the inspector is to be notified immediately and he will issue the necessary instruction to cope with the situation.
8. The joint or making off of paper insulated cables must not be commenced during rainy weather.
9. Once a joint is in progress the jointer must proceed with the joint until it is complete and before he leaves the site.
10. The jointer must ensure that the material and his tools are dry at all times, reasonably clean and absolutely free from soil.
11. Relating to the jointing of the cable the following requirements apply:
 - 11.1 All jointing must be carried out in accordance with recognized and tried techniques and comply strictly with the instructions given by the supplier of the jointing kit.
 - 11.2 The cables must be twisted by hand so that the cores can be joined according to the core numbers. If necessary the cable is to be exposed for a short distance to accomplish this. Under no circumstances may the cores in a joint be crossed so as to enable cores to be joined according to the core numbers. If it is not possible to twist the cables so that the preceding requirements can be met, then cores are to be joined in the normal way without any consideration of the core numbers.
 - 11.3 Normally the cables will have profile conductors. The conductors shall be pinched with gas pliers to form a circular section, bound with binding wire so that they do not spread, and then tinned before jointing.

- 11.4 Jointing ferrules, the length of which are at least 6 times the diameter of the conductors, must be slid over the conductor ends to be joined and pinched tightly. Then they are soldered by means of the ladle process whilst being pinched further closed.

Use resin only as a flux. The slot opening in the ferrule must be completely filled, including all depressions.

Remove all superfluous metal with a cloth dipped in tallow. Work during the soldering process must be from top to bottom. Rub the ferrule smooth and clean with aluminium oxide tape after it has cooled down to ensure that there are not any sharp points or edges.

NB: The spaces between the conductor strands must be completely filled by soldering process and must be carried out quick enough to prevent the paper insulation from burning or drying out unnecessarily.

- 11.5 After the ferrules have been rubbed smooth and clean, they and the exposed cores must be treated with hot cable oil (110°C) to remove all dust and moisture. These parts are to be thoroughly basted with the oil.
- 11.6 The jointer must take care that his hands are dry and clean before the joint is insulated. Also the insulating tape which is to be used must first be immersed in warm cable oil (110°C) for a sufficient period to ensure that no moisture is present.
- 11.7 After the individual cores have been installed they must be well basted with hot cable oil and again after the applicable separator and/or belt insulation tape is applied before the lead joint sleeve is placed in position.
- 11.8 The lead joint sleeve must be thoroughly cleaned and prepared before it is placed on the cable and must be kept clean during the whole jointing process. Seal the filling apertures of the sleeve with tape until the sleeve is ready for compound filling.
- 11.9 The plumbing joints employed to solder the joint sleeve to the cable sheath, must be cooled off with tallow and the joint sleeve is to be filled with compound while it is still warm. Top up continuously until the joint is completely filled to compensate for the compound shrinkage.
- 11.10 The outer joint box must be clean and free from corrosion. After it has been placed in position it must be slightly heated before being filled with compound. Top up until completely full.
12. As far as cable end boxes are concerned the requirements as set out above are valid where applicable.

16. DISTRIBUTION BOARDS

In addition to clause 14 and clause 15 of General Part of this specification the following shall also be applicable to switchboards required for this service.

The Contractor shall supply and install the distribution boards as indicated on the drawings and listed in the distribution Board Schedule. All distribution boards shall comply with the quality specification in this specification and be approved by the Employer's Electrical Engineer.

The following types of distribution boards are required for the service:

DB NAME	AREA	DRAWING NUMBER	CONNECTED LOAD
Main LV Board	Basement	SL00	538560
DB-F	Basement	SL01	8619
DB-A1	Lower Ground Floor	SL02	56090
DB-A1E	Lower Ground Floor		7952
DB-B1	Ground Floor	SL03	3697
DB-B2	Ground Floor		48220
DB-B2E	Ground Floor		17026
DB-C1	First Floor	SL04	83050
DB-C1E	First Floor		29140
DB-C2	First Floor	SL05	58950
DB-C2E	First Floor		16393
DB-D1	Second Floor	SL06	61390
DB-D1E	Second Floor		12419
DB-D2	Second Floor	SL07	17200
DB-D2E	Second Floor		5218
DB-E1	Third Floor	SL08	50200
DB-E1E	Third Floor		22478
DB-E2	Third Floor	SL09	32650
DB-E2E	Third Floor		7868
DB-UPS	Basement	SL10	
DB-P1	Basement	SL00	13000

18. SCHEDULE OF LIGHT FITINGS

The Departmental Quality Specification for the relevant luminaires must be included in Part 3 of the specification.

The light fittings and accessories are to be according to the quality specifications in Part 3 and shall be approved by the Employer.

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- Type A1: 65W LED recessed mounted 1200mm x 600mm luminaire with mid-power LED strip complete with diffuser colour 4000K with SANS approved mark.
- Type B1: 40W LED recessed mounted 600mm x 600mm luminaire with mid-power LED strip complete with Parabolic diffuser, colour 4000K with SANS approved mark.
- Type B2: 40W LED recessed mounted 600mm x 600mm luminaire with mid-power LED strip complete with Prismatic diffuser, colour 4000K with SANS approved mark, as Altsa Vandal Proof 50W LED tamperproof, or similar and approved by the engineer.
- Type C1: 50W LED surface mounted luminaire with corrosion resistant aluminium housing and high impact UV resistant polycarbonate protector for LED's, IP66 with optimal photometric performance and flexible combinations of LED arrays, colour 4000K with SANS Approved mark, as Altsa Vapour Proof 50W LED IP66, or similar and approved by the engineer.
- Type C2: 27W LED surface mounted luminaire with vandal resistant aluminium housing and high impact UV resistant polycarbonate protector for LED's, IP66 with optimal photometric performance and flexible combinations of LED arrays, colour 4000K with SANS approved mark.
- Type D1: 12W LED recessed mounted down light luminaire with aluminium reflector and high impact UV resistant polycarbonate protector for LED's, Non-dimmable LED arrays, colour 4000K with SANS approved mark as MB-DL05-12w LED Downlighter 120 lpw, or similar and approved by the engineer.
- Type E: 18W LED surface mounted Bulkhead luminaire with aluminium trim and high impact UV resistant acrylic protector for LED's, Non-dimmable LED arrays, colour 4000K with SANS approved mark, as MB-BHTP-18w 120lpw IK10, or similar and approved by the engineer. White trim.
- Type E1: 24W LED surface mounted luminaire with aluminium housing and high impact UV resistant acrylic protector for LED's, IP66 with optimal photometric performance and flexible combinations of LED arrays, colour 4000K with SANS approved mark, as MB-BHTP-24w 120lpw IK10, or similar and approved by the engineer. Black trim.
- Type E2: 10W LED surface mounted Red Pilot Light luminaire with aluminium housing and high impact UV resistant acrylic protector for LED's, colour 4000K with SANS approved mark.
- Type E3: 15W LED recessed mounted Brick Light luminaire with aluminium housing and high impact UV resistant acrylic protector for LED's, colour 4000K with SANS approved mark.

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- Type E4: 30W LED surface mounted Flood Light luminaire with aluminium housing and high impact UV resistant acrylic protector for LED's, colour 4000K with SANS approved mark, as FLD/RF/030/230/120/814/06/MNW/STD with 80x140 beam spread Rhino 30w LED Floodlight, or similar and approved by the engineer.
- Type F: 55W LED Post Top luminaire, mounted on a 4000mm Aluminium Pole, as MB-PTGA-55w 4000K 120 lpw 55w LED Post Top, or similar and approved by the engineer.

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DISTRIBUTION BOARDS
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All major Distribution Boards and equipment shall be designed and manufactured in accordance with SANS 1973/60439. The equipment shall conform to SANS 60947 Parts 1-7, unless otherwise stated, and shall be suitable for operation on supply voltages of 230/400 Volts, 50 Hz, AC. Reference must be made to the detailed technical specification, the relevant line diagrams, as well as to the following specific requirements.

1. CONSTRUCTION OF MOTOR CONTROL CENTRE ASSEMBLIES

- All Distribution Boards shall generally be of the free standing, floor mounted, with front and back access, suitable for bottom cable entries from cable trenches below the assembly. The schematic drawings show the specific requirements applicable to each assembly.
- The assembly shall be constructed of electrolytically deposited zinc coated mild steel sheet similar to Zintex manufacture. Where specified the assembly enclosure may be required to be manufactured from stainless steel or 3CR-12.
- The minimum thickness of 1.6mm for panels less than 0.5mm² and 2mm thick for larger panels, except for gland plates which shall be a minimum of 3mm. Thicker sheets shall be used for very large panels and where the weight of the equipment would cause buckling or vibration.
- Unless otherwise specified, the metal enclosures, internal panels and all equipment support frames shall be manufactured from the same type of plate. When required, glass panels may be specified for viewing indication equipment.
- The degree of protection shall not be less than IP53, for an assembly installed in an enclosed unpressurised room or IP53 for an assembly installed in a general plant area or outdoors in a semi protected area in accordance with SANS 1222 and capable of withstanding the temperature, humidity and conditions normally associated with heavy industrial applications. The assembly shall be fully vermin proofed.
- A hot dipped galvanised steel base frame with predrilled holes for fixing the DB to the floor shall be provided and removable lifting eyes with blanking off plugs shall be provided for lifting heavy assemblies. All panels shall be suitably braced to ensure rigidity. The method of preparing platework, priming and painting shall be in accordance with the standard painting specification.
- The DBs are to be fully assembled in the manufacturers factory for final acceptance tests. Where broken down for transportation to site, the DBs will be provided with

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all items required for re-assembly. Provision must be made for future extension at either side of the DB. All holes provided for such extension to be suitably plugged or covered.

- The overall outside dimensions of the assembly shall be suitable for easy handling of the switchgear as indicated on the drawings. The height of the assembly shall generally not exceed 2100mm above floor level.
- All hinged front panels shall be fitted with stainless steel or heavy duty rustproof hinges of Barker & Nelson or Zeus manufacture with an 180° movement and shall be secured in the closed position by means of locking devices of approved quality. Hinged front panels in excess of 450mm height shall be secured at both the top and bottom. Lockable catches are required on all hinged front panels. All hinged front panels are to be fitted with earth straps.
- Covers, other than the hinged type, shall be provided with chromium plated handles to facilitate removal. Removable covers shall be secured in position by means of patent screw locking devices approved by Engineer. All removable covers and hinged front covers shall have a neoprene or rubber gasket to ensure that the required IP rating of the panel is achieved.
- All the equipment shall be mounted behind the hinged front panels and neat machine punched openings shall be provided for the purpose of operating handles etc. Engineer's drawings will detail the instruments required which will be flush mounted. The positions of instruments shall be such that the glass cannot be broken by other equipment when the hinged front panels are in the fully open position.
- Cut outs which are provided for future equipment and instruments shall be neatly blanked off by means of removable dummy frames. Back plates shall be provided in all spare cubicles for the specified future equipment.
- To avoid damage to paintwork, screws, bolts, door lock, etc. must not be in direct contact with painted surfaces.
- The manufacturer's detailed working drawings of the assembly must be approved by Engineer before any fabrication commences. Any other construction or type of assembly proposed as an alternative to that specified, must have the approval of Engineer in writing. The drawings will detail all dimensions of busbars, connections, electrical component make, type and rating. Positions and layout of busbars, earth bars and gland plates will be shown in front and side elevation drawings.

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2. PAINT SPECIFICATION

All metal used for the fabrication of the board shall be painted, i.e. internally and externally. Baked enamel, electro statically applied powder coating or similar proven methods, other than standard enamel paint applied by brush, shall be used.

In general, the following standard colours shall be used, but the final colours are to be confirmed with Engineer.

- Non-essential sections Electric orange (colour B26 - SANS 1091).
- Essential sections Signal red (Colour A11 - SANS 1091).
- Uninterrupted power (UPS) Purple.
- Instrumentation and control Blue.

2.1 Edges

- Care shall be taken to ensure that all edges and corners are properly covered, after all burrs and sharp edges have been removed.

2.2 Surface Preparation

- Surface preparation shall comply with SANS 10064. Prior to painting, all metal parts shall be thoroughly cleaned of rust, mill scale, grease and foreign matter to a continuous metallic finish. Sand or shot blasting or acid pickling and washing shall be employed for this purpose.
- The corrosion inhibiting process shall be suitable for the environmental conditions to be encountered on site and full details shall be provided at the time of tendering. Details of the chemical process employed and the method of application shall also be provided at the time of tendering.

As a minimum requirement, the finishing process shall consist of the following:

2.3 Mild Steel – Baked Enamel Finish

- Immediately after cleaning, all surfaces shall be covered by a rust inhibiting, tough, broken metal-phosphate film and then thoroughly dried.
- Apply two-pack wet primer to 15 microns, allow to dry in accordance with supplier's recommendations followed by two sprayed coats of high quality

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alkyd-based baked enamel, with a minimum paint thickness after baking of 60 microns.

2.4 Mild Steel – Powder Coated Finish

- Immediately after cleaning, those metal parts shall be pre-heated and then covered by a micro structured paint powder applied electro statically, with a minimum final paint thickness of 60 microns.

2.5 3CR12

- One (1) coat of suitable etch primer (15 microns)
- Apply epoxy polyester powder coat (60 microns final thickness)
- 3CR12 steel, where specified, shall be correctly pickled and passivated prior to being painted. Picking and passivation shall be undertaken after basic manufacture of the Enclosure is complete.

2.6 Touch-up Paint

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

3. BUSBARS

- All busbars shall be manufactured from solid high conductivity copper and shall comply with the requirements laid down in SANS 1195. The completed busbar system shall be a standard modular system and shall have been tested to SANS approval and a certificate shall be made available confirming the full busbar technical description, current rating and fault rating together with full details of the test results. Busbars for systems up to 600V shall be designed to withstand a test voltage of 2.5kV AC for one minute.
- The busbar assembly shall be rated in accordance with the specified ultimate projected fault level, which will be not less than the short-circuit stresses limited by the protective device(s) on the supply side of the busbars, as well as the specified continuous full load current, with a current density not exceeding 1,60 Amps per mm². The busbars shall withstand a fault current under test conditions of the specified fault level for 1 second. If a fault level is not

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specified, the busbars shall be tested at 20 times rated current for 1 second. The fault current during tests shall be:

- between all three-phases
 - any two phases
 - neutral and the adjacent phase, and
 - earth conductor and the nearest phase conductor.
- The busbars shall be continuously rated for the specified current with a maximum temperature rise of 40°C relative to a peak ambient temperature of 40°C giving a maximum peak busbar temperature of 80°C.
 - Busbars shall be mounted in the top section of the assembly and shall be rigidly supported by means of approved insulated busbar clamps (at intervals not exceeding 500mm) to prevent damage resulting from the specified short circuit conditions.
 - The busbars shall run along the entire length of the assembly up to 76mm from either end. The phase busbars shall be identified in the phase colours red, white and blue.
 - The busbars shall be arranged horizontally with the longer side of the cross-sections in the vertical plane and one behind the other in the horizontal plane. The minimum clearance between live conductors and live conductors and earth shall be 40mm for systems up to 600 volts.

3.1 Earth Busbar

- A solid copper earth bar shall be provided inside each assembly at the back and along the entire length, at a height of approximately 500mm above floor level, or 200 mm above the gland plates. A bar is to be provided at the top of the assembly where top entries exist and this shall be solidly connected to the bottom earth bar.
- The bar will be supported on robust spacers and will have a minimum clearance of 40mm to the sheet steel panel.
- The earth bar shall have a cross-section of not less than 40mm X 6.3mm and shall be drilled with the requisite number of holes for the individual connection of all cable ECC and other earth conductors.
- The earth bar, and busbar joints and cable terminations must not be insulated.

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- High tensile phosphor bronze or cadmium plated nuts, bolts and lock washers shall be provided through the earth bar at each earthing position and at least 5 additional holes will be provided for future connections, each being fitted with nuts and bolts as above.
- The earthing positions shall be evenly spaced along the length of the earth bar and the bar must be clearly identified as the earth.

3.2 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 6.3 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.

3.3 Busbar Droppers

- All busbar droppers must be suitably supported (maximum spacing @ 500mm centres) and braced to suit the specified and/or projected short circuit conditions. They should be fully insulated and screened against accidental contact.
- The droppers to the supply side of a single functional unit, as well as the components included in this unit, may be rated on the basis of the reduced short-circuit stresses occurring on the load side of the short-circuit protective device in this unit provided that these conductors are arranged such that under normal operating conditions an internal short-circuit between phases and/or between phases and earth is only a remote possibility, for example by being provided with adequate insulation or shrouding.
- Particular attention shall be paid to the provision of adequate facilities for making off the main power supply cables. Attention must be paid to the vermin proofing of single core cabling.
- Bunched cable connections will not be accepted between busbars and outgoing power circuit breakers, fuses or isolators.

3.4 Busbar Connections

- All connections and extensions to busbars shall be effected by means of high tensile phosphor bronze nuts, bolts and washers or cadmium plated, high tensile steel bolts and nuts which shall also be provided for future extensions. The minimum diameter of any hole will be 10 mm.
- In exceptional cases a relaxation of SANS 1973 may be permitted to allow the drilling of holes, in which case the cross-sectional area as measured is to be reduced by the area of the holes.

4. EQUIPMENT

- Unless otherwise stated on the drawings the latest version of the following minimum specifications shall be assumed for equipment to be installed in the switchboards:

Busbars	SANS 1195
Circuit breakers	SANS 60947 Part 2 and SANS 156
Switches, disconnecters and fuse combination units	SANS 60947 Part 3
Contactors and motor starters	SANS 60947 Part 4
Control circuit devices and Switching elements	SANS 60947 Part 5
Multi-function switching devices	SANS 60947 Part 6
Ancillary equipment	SANS 60947 Part 7
HRC fuses and fuse switches	SANS 60269/1& 2 & SANS 172

- SANS 60947 relates specifically to equipment for use at voltages up to 1000V AC. Where a voltage in excess of 1000 Volts is specified, the manufacturer must confirm that the equipment is suitable and has been tested to that higher voltage.
- The equipment to be mounted in the panels will be detailed in the drawings and schedules provided.

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- All contactors shall be protected with suitable back-up HRC fuses or current limiting circuit breakers to protect the equipment against abnormally high currents or short circuits developing in the system.
- Unless otherwise stated, contactors shall be rated for 10 million operations for making and breaking no-load currents to category AC3 as laid down in SANS 60158.
- Each switchboard shall be provided with a means to isolate the incoming supply. This may be achieved by the use of an isolator, circuit breaker (fixed or draw-out) or fuse switch, rated to make against the full system fault at the point and break the full load current. The incoming supply section containing switchgear, protection equipment, controls and instrumentation shall form a clearly labelled, self-contained unit behind one or more hinged panels. The operating handle of the isolator, circuit-breaker or fuse switch controlling the incoming supply shall protrude through the panel and shall be interlocked to ensure that the panel can only be opened when the supply is off.
- Equipment that cannot be flush mounted on the panel, shall be mounted on a suitable metal chassis and shall protrude through a close fitting cutout in the panel. All protection relays contained in enclosed units with glass fronts shall be flush mounted on the hinged panels, contactors, thermal overload relays, etc. shall be mounted on a chassis behind the panel.
- Equipment to be supplied under this contract must be identical in all respects and it shall be possible to interchange such equipment should it become necessary.
- All material and equipment must be suitable for 415/240V-supply voltage, 50 Hz supply frequency and must be approved by Engineer. In addition all equipment shall be designed, manufactured and tested in accordance with the relevant IEC Standard Specification and the necessary precautions shall be taken against corrosion, i.e. all metal shall be galvanised.

4.1 Derating of Equipment

- Full cognisance must be taken of manufacturers derating tables for equipment located in enclosures and the rating of that equipment must be increased accordingly. In all such cases labels must be provided on the front of the associated cubicle stating the maximum permitted circuit loading.
- Where high ambient temperatures and/or continual high loadings are anticipated, the assembly must incorporate adequate ventilation systems to eliminate the possible build-up of excessive temperatures. Where specified, renewable filter elements must be incorporated.

4.2 Cable Terminations

- Due to the continuing miniaturisation of equipment, difficulties can be experienced in terminating power cables onto equipment terminals, particularly where more than one cable has to be terminated. The manufacturer shall ensure that suitably designed and rigidly braced copper stubs are extended from such terminals to facilitate the termination of all cables. Flash barriers must be used between the phase terminals of circuit breaker equipment.

5. INSTRUMENTATION

- All instruments shall be of a matching flush pattern, preferably with a 96mm X 96mm square dial. The single line diagram will indicate the ratio of CTs where required. The instruments shall be suitable for the environment in which they are installed. All instruments shall withstand a test voltage of 2kV for 1 minute and the terminals of all instruments mounted on hinged panels shall be shrouded.
- All main incoming panels shall be provided with three combined maximum demand/instantaneous ammeters, a voltmeter and selector switch as well as any additional instrumentation detailed on the single line diagrams.

5.1 Ammeters

- Each Incomer shall have three combined maximum demand type instruments will comprise a moving iron ammeter showing the instantaneous current value, combined with an ambient corrected, manually reset, thermal maximum indicating ammeter which will indicate the mean current reached during any 15 minute period. The maximum demand ammeter shall be in accordance with IEC 60051 and the accuracy need not exceed 3%.

5.2 Current Transformers

- Where applicable, the current transformers shall generally be of the ring type complying with the requirements of SANS 60044-1, as amended. The current transformers shall have a Class 3 or 5 accuracy. The CT's shall have 1 Ampere secondary.

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5.3 Voltmeters

- Voltmeters shall be of the moving iron, suppressed zero type, having a full scale deflection of not less than 480 Volts, unless otherwise specified. The voltmeter shall have Class 1,5 accuracy in accordance with IEC 60051-1

5.4 Kilowatt Meters

- These shall be provided on the DB incomer if specified in the Detailed Specification.
- Kilowatt meters shall be in accordance with IEC 60051-1 suitable for operation on a three phase 50 Hz AC system with Class 2 accuracy and shall be driven of 1A CTs.

5.5 Power Factor Meters

- These shall be provided on the DB incomer if specified in the Detailed Specification.
- Power factor meters shall be in accordance with IEC 60051-1 suitable for operation on a three phase 50 Hz AC system with Class 2 accuracy.

5.6 Instrumentation Fuses

- All instrument fuses shall be mounted in the panel onto or next to the busbars. 6mm² wiring shall be used between the busbars and the fuses and shall be kept as short as possible.
- HRC cartridge fuse links to SANS 172 shall be used and shall incorporate a visual indication device to facilitate the location of blown fuses on visual inspection. They shall be designed to clip into the fuse carrier contacts without the use of fixing screws.
- Wiring from fuse bases to instruments may be bunched but must be suitably supported in Bowthorpe Hellerman trunking or lacing.
- Each fuse shall be separately labelled stating the instrument circuit, phase and rating.

6. SWITCHES

6.1 Voltmeter Selector Switch

- All voltmeter selector switches shall be wired to connect the voltmeter between all phases and each phase and neutral and shall disconnect it in the OFF position. The switch shall have a positive located switching mechanism.

6.2 Control Selector Switches

- All other selector switches specified e.g. control by-pass switches, ON/OFF, Duty Standby, Field/Off/PLC switches shall provide the required switching functions. Rotary switches shall have roll and wipe contacts to ensure low resistance. Rocker arm or toggle switches shall have bifurcated contacts.

6.3 Time Switches

- Time switches shall be of single-pole type, suitable for 220/250V systems, with contacts rated for the duty to be performed, with a minimum rating of 15 A. Contacts shall be of high quality material, e.g. silver-plated or solid silver.
- The clock shall be driven by a self-starting hysteresis synchronous motor, keeping accurate mains time. All clocks shall be controlled by an electrically wound escapement providing the main spring with a minimum of 15 hours reserve in case of a power failure. The main spring shall be kept fully wound without the use of slipping clutch devices that may wear and fall out of adjustment.
- The main spring shall have a minimum of 15 hours reserve under full load and if fully discharged, shall be completed rewound with 15 minutes of the restoration of power.
- An external manual bypass switch shall be provided to permit the circuit to be switched "ON" or "OFF" manually without affecting the timing of the time switch.
- The time switch shall have a 24-hour dial with day and night indication that can be set to switch in 30-minute steps. The dial shall be fitted with 48 tappets corresponding to 48 change over operations in a 24-hour period. Alternatively, electronic time switches with 30-day battery timing back up may be offered.
- The time switch shall be fitted with a day omission dial comprising a total of 14 tappets, which can be set to switch in 12-hour steps.

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- The time switch shall be housed in a dust tight moulded plastic or metal case consisting of a plastic clip-on front cover and a moulded plastic or metal base. The time switch shall have a transparent face to enable an operator to determine the time and settings without having to remove any covers. Time switches to be used for surface mounting on walls shall be provided with a suitably positioned 20mm conduit knockout.

6.4 Sequence Time Switches

- Sequence time switches suitable for starting a group of machines in a predetermined sequence, shall be provided as required. The switches shall provide the number of steps indicated and minimum time intervals of 15 seconds between starts.
- Sequence time switches shall have normally open contacts unless specified to the contrary. The contacts shall be of silver-to-silver or other approved type with a minimum rating of 10 A.
- Sequence time switches shall be of the reversible type, i.e. switching the machines on in the reverse sequence when rotating backwards.
- Sequence time switches or time-delay switches shall be provided to prevent the simultaneous starting of major or multiple items of equipment. The sequence shall not be reversible.
- The switches shall be constructed so that the driving motor of the unit shall switch off when forward rotation is complete while the controlled machines run on uninterrupted. When the machinery is to be switched off, the drive motor on the unit shall rotate backwards and switch the machinery off in the reverse sequence. An ON/OFF switch shall control the sequence time switch from a remote position, where "ON" denotes the starting sequence and "OFF" denotes the stopping sequence. Switch positions shall be indelibly labelled.
- The switches shall return automatically to the start-up position when a power failure occurs.
- The switches shall be suitable for operation at the system voltage.
- Sequence time switches controlled by an electronic control unit providing the above functions are acceptable.

7. ANTI-CONDENSATION HEATERS

- One 22,5mm diameter white LED HEATER ON indication with neon lamp with label for motors greater than 22kW.

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- One motor heater circuit mcb/ fuse + fuse-holder for motors greater than 22kW.
- One N/C auxiliary contact on contactor for motor heaters rated at 400W for motors greater than 22kW

8. SUPPLIES TO HEATER BANKS

- Switchgear, control and instrumentation for heater banks shall be grouped together in the switchboard. Equipment for the control and protection of heater banks shall be provided. Ammeters and indicator lights shall be flush mounted on a hinged front panel.
- All circuit breakers shall be flush mounted on a chassis behind the hinged panels with punched cutouts. It is essential that the fault level at the output to each heater unit does not exceed the rupturing capacity of the circuit breaker. Where necessary, heater circuits shall be subdivided into groups and protected by HRC fuses and circuit breakers to limit the fault level. High-speed current limiting breakers are not acceptable. The above provisions are also applicable in cases where separate switchboards are provided to supply heater banks only.

9. CABLING, WIRING AND TERMINALS

9.1 Wiring

- Particular attention shall be paid to the method of wiring from busbars to the individual compartments, in order to avoid any cable crossing through a compartment with which it is unrelated.
- Standard 600/1000 V grade PVC-insulated stranded annealed copper conductors to SANS 1507 shall be employed for the internal power wiring of switchboards.
- The wiring between all components, isolators, fuses, contactors, overload relays and terminals is to be rated to suit the maximum capacity of the components and is to be not less than 6mm².
- Three phase panels shall be wired in red, yellow and blue PVC insulated conductors for the phases, black for neutral and green for earthed circuits.

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- Single-phase panels shall be wired in red and black PVC insulated conductors, for phase and neutral respectively and green for earthed circuits.
- Neutral connections shall be black and this colour must not be used for any other wiring.
- Multi-stranded or laminated conductors shall be used between all items of equipment in preference to solid conductors. The insulation of these conductors shall not be stripped beyond the leading edge of the terminal in which it has to be accommodated. Stripping shall be carried out without damage to the conductors, preferably by means of a cable stripper.
- Approved crimping lugs and ferrules or approved clamps shall be used for connection into equipment not provided with compression type terminals.
- All panel wiring shall be completed and installed at the DB manufacturing works. The wiring shall be loomed or encased in PVC cable trunking of Hellerman manufacture or equal and shall be carried out neatly along vertical and horizontal lines.
- Connections between busbars and all equipment in the switchboard shall consist of heavy duty coloured PVC insulated stranded annealed copper conductors 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 200A and more and all connections to cables larger than 70mm² shall consist of busbars only.
- Where heat-generating equipment is present and the internal temperature of the board is likely to exceed 50°C on occasion, silicon-rubber insulated stranded conductors shall be used.
- Wiring shall be arranged in horizontal and vertical rows and shall be bound with suitable plastic straps (cable ties) or installed in PVC wiring channels. Under no circumstances may PVC adhesive tape be used for the bunching of conductors or for the colour identification of conductors.
- Bunched conductors shall be neatly formed to present a uniform appearance without twisting or crossing the conductors. Conductors leaving the harnesses so formed shall be so arranged that they are adjacent to the chassis. Conductors to hinged panels and doors shall be secured on both the door and the frame and shall be looped between the two points. The loop shall be arranged to produce a twisting motion when the door is opened or closed. A flexible protection sleeve shall be installed over the conductors.
- All wiring between different panels within the same switchboard shall be installed in wiring channels.

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- Grommets shall be installed in each hole in the metalwork through which conductors pass.
- 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.
- Conductors may be jointed at equipment terminals or numbered terminal strips only. No other connections are allowed.
- Where screened cables are specified, the screening shall only be earthed in the switchboard or control board, unless clearly specified to the contrary. Screened cables entering control boxes through pressed knockouts shall terminate in compression glands. Conductors shall as far as possible remain inside the screening at terminations. Where conductors have to separate from the screen, the braiding shall be separated and the conductors drawn through the braid with out damaging the braiding. The conductors shall then be connected to their respective terminals and the screening smoothed and connected to the earth terminal. For cables controlling electro-mechanical devices, no screening is necessary. Cables controlling electronic devices shall have high voltage screening.
- 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.
- Conductors terminating on meters, fuse holders and other equipment with screw terminals shall be fitted with crimped lugs.
- 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 breakers as well as the wiring from circuits to lighting and socket-circuits.
- A maximum of two conductors will be allowed per equipment terminal. Where more conductors must be connected to the same equipment terminal (e.g. a main circuit breaker feeding other circuit breakers). Stub busbars shall be provided for the various conductors.

9.2 Power Cable Terminations

- Sufficient space must be allowed for the connection of all known and future incoming and outgoing cables.

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- Outgoing cables shall be glanded off on galvanised gland plates at the bottom or top of the vertical cableways. Where top access is required, it will be specified in the tender document.
- Approved shrouded and shielded terminals shall be provided for the outgoing connections to each motor for conductors up to and including 35mm², rated at least 50% in excess of the conductor rating. The terminals shall be fixed in the vertical cableway of the assembly and shall have ample space for making off the outgoing cable terminations.
- Conductors of 50mm² and above shall be terminated directly onto the equipment, but the cables must be adequately supported to ensure that no strain is imposed on the equipment.

9.3 Gland Plates

- A strong and robust 3mm hot dipped galvanised cable gland plate shall be provided along the entire length of the assembly at a minimum height of 300mm above floor level. The gland plate shall be constructed in sections and bolted in position to take the load of the cables being glanded to it.
- When cables enter/exit from the top of the board, the top cover plate will act as the cable gland plate and shall also be 3mm thick. It shall be bolted to the frame so that it can be removed if necessary. The terminals associated with these cables will be mounted not less than 200mm below the top cover plate.
- All gland plates shall be machine punched in the factory to suit each and every cable gland required. Under no circumstances will any drilling or filing be allowed on site.

9.4 Outgoing Power Circuits

- All cables shall be terminated with approved glands to suit the application. Particular attention shall be paid to the termination of ECC cabling to ensure the continuity of all earth conductors.
- Every termination of a power cable shall be provided with an approved numbered Bowthorpe Hellerman tag identifying its size and destination, fixed below the cable gland plate in a position which is easily observed from the front to the board. This procedure must also be incorporated at the motor termination box.

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- All outgoing power cables shall terminate within 300mm of the gland plate to avoid long leads. Where this is not possible, each lead must be separately braced.
- Power cable sizes up to and including 70 mm² may terminate on clamp type terminals where the clamping screws are not in direct contact with the conductor, but bears upon a clamping plate. Connection to the equipment can then be made with cables that are similarly connected to the terminal. All power cable sizes larger than 70 mm² shall terminate on busbars that are connected to the associated equipment. Conductors shall have lugs that are sweated or crimped. Looping of incoming supply wiring to large circuit breakers and contactors, etc. is not acceptable. Each device shall be individually connected to the supply busbar.

10. SURGE DIVERTERS

- Where specified, the DB is to be equipped with surge diverters of approved manufacture and bearing the SANS mark.
- The arrestors or diverters shall be mounted inside the panel on the incoming unit. The supply side connections shall be made in the factory to the three phase busbars, whilst the earth side connections shall be made to the earth bar of the board.

11. EARTHING OF METAL PARTS

- All non-current carrying metal parts of the switchboard including the framework, metal enclosures of equipment, iron cores of contactors and transformer etc. shall be solidly earthed to the earth busbar. All hinged panels shall have a 4 mm² flexible copper braid connection which is bolted onto the panel and frame. Screw connections on finished surfaces shall be made with tooth washers.

12. SPARE FUSE CARTRIDGES

- Where HRC or other cartridge type fuses are specified or used to protect instruments or circuits, the DB shall be suitably equipped with a compartment for housing one third of all fuse cartridges specified, having a minimum of 1 set (i.e. 3 phase) of fuses of each size specified and all such spare fuses shall be provided inside this compartment on handing over. The compartment shall be clearly labelled: "Spare fuse cartridges: replace used-up fuses".

13. LABELS

- The requirements of SANS 10142-1 must be complied with.
- All boards or panels shall be fully labelled using ENGRAVED TRAFFOLITE labels, fixed to the board or panel by means of either screws or rivets, or by gluing into metal label holders which are bolted to the board.
- Labels should be black lettering on a white background, not less than 5mm in height and mounted centrally below each respective unit, in an approved position. A centrally mounted label shall be provided to indicate the manufacturers details, the design busbar rating and asymmetrical fault level.
- A label indicating where the board is 'Fed From' shall also be fixed to each DB.
- All relays and wiring terminal blocks inside the DB shall be labelled to clearly identify the control gear and wiring to equipment.
- Danger or Warning Labels shall have red letters on a white background.

14. WORKS TESTS

- The DB shall be fully assembled and wired before being despatched from the works. The Contractor and the switchboard manufacturer will carry out a full functional test to prove the correct operation of the entire DB, including interlocking, remote control and the simulation of all protection devices. Polarity and primary current injection tests shall be undertaken. All other circuits external to the switchboard will be simulated and will be tested accordingly. All DB's with a fault level of 10 kA or more shall be type tested by an accredited person and a signed certificate issued with the DB. The costs of all these tests shall be borne by the Contractor. The tests shall be witnessed by Engineer.
- Unless otherwise specified, the correct functioning of the PLC hardware will not be the responsibility of the DB manufacturer, but the Contractor will be expected to have an artisan standing by during these tests in order to observe the DB operations and carry out any remedial work required.
- The tests shall be witnessed by Engineer and shall be recorded in triplicate on approved test forms.

15. SITE TESTS

- After completion of erection, cabling and field wiring, the Contractor shall set all overloads, protection devices etc. and shall again carry out a full functional test to prove the correct operation of the entire DB, including the simulation of all remote devices. A signed compliance certificate by the Contractor's accredited person for the DB and its installation shall be handed over to Engineer on Completion.
- The tests shall be witnessed by Engineer and shall be recorded in triplicate on approved test forms.

16. INSTALLATION OF DISTRIBUTION BOARDS

- The Contractor shall make it his responsibility to furnish the switchboard manufacturer with all the relevant information in respect of the accommodation to be provided, including cable trenches, ducts, plinths and raised flooring.
- Where possible, the largest number of cubicles or panels should be installed intact, to avoid assembly on site, provided space and handling facilities and conditions do not lead to damage of the unit. All floor mounted motor control centre must be bolted securely to the floor.
- The Contractor will advise the manufacturer which of the cables enter or leave from the top or bottom of the DB.
- During transport to site and installation, the boards shall be protected against mechanical damage and vibration.
- Boards shall not be moved onto site nor installed until all building services and finishing trade work has been completed in the room or vicinity of where the boards are to be installed.
- The boards shall be installed in such a manner as to facilitate extensions, maintenance, testing and repair work with easy access to cable entries terminations, current transformers, potential transformers, small wiring terminal boards and relays, and busvar connections.
- Prior to the on-site tests, all screws, bolts, joints and cable terminations shall be checked for tightness. Busbar joints and cable terminations must be torqued to the correct tension.

17. DRAWINGS, ENGINEER'S APPROVAL, GUARANTEES

- CAD generated drawings of the equipment showing full details of layout and proposed wiring system and equipment offered shall be submitted for approval to Engineer prior to manufacture.
- Engineer shall also be advised when the boards are being manufactured and when they will be ready for inspection at the works. Equipment which is despatched to the site without the authorisation of Engineer may be rejected and all costs incurred in having it returned to the factory, where necessary, and any liability for delays, will be for the Contractors account.
- The Contractor will issue to Engineer the following:
 - Dimensioned general arrangement layout plans of the DB and sections through the board.
 - Busbar and dropper bracing and support details. Where the system fault level exceeds 15kA specimen calculations or test reports of the busbar supports in substantiation of short circuit capacity of the system.
 - Busbar section and size including selection/sizing criteria and calculations in sunstantation of the full load rating.
 - All labelling information of componenets and circuit wiring cross referenced on a separate sheet.
 - Wiring Schematics;
 - System and component descriptions;
 - Component data and calibration sheets if applicable;
 - Operation & Maintenance instructions with recommended preventative maintenance programme;
 - Fault finding analysis;
 - Adjustment and calibration settings of all protection devices;
 - Priced spare parts list with names of local suppliers and list of spares recommended to be kept in stock.
- CD ROM of Autocad or DXF drawing files and 3 paper print copies of drawings of the "as built" equipment which has been installed and connected on site.
- A 12 month guarantee shall cover the sheet metal enclosures and all the equipment installed therein against faulty workmanship and materials. The guarantee period shall begin from the date the DBs are completely installed and accepted by Engineer. Fair wear and tear of equipment will be excluded from the guarantee.

18. COMPLETION

- Prior to the handing over of the boards or panels, they shall be rendered completely free of all dust or rubbish that may have collected during installation and building operations, and finished surfaces shall be made good where necessary, using the identical paint finishes from the same batch, as at the time of manufacture.
- The DBs shall be vermin proofed. Similarly, all cable trenches will be thoroughly cleaned out and all covers fitted before the work will be considered as complete.
- All labels will be correctly engraved and fixed to panels and cables as specified before the work can be considered complete.

19. SUGGESTED SUPPLIERS

The following list of approved manufacturers and suppliers of electrical equipment is provided for the convenience of tenderers. Other makes and suppliers of electrical equipment may be considered by Engineer, but the tenderer is presumed to have included the following equipment in his original offer:

Air circuit breakers (ACB)	ABB Siemens
Moulded case breakers (MCB)	ABB Siemens
Relays and timers	ABB Siemens
Terminal blocks	Klippon Phoenix
Push buttons, selector switches pilot lights	ABB Siemens
Surge diverters	Dehn Phoenix
Instruments	ABB

20. MANUFACTURERS

The following list of approved South African manufacturers is enclosed for the convenience of tenderers. Other manufacturers may be considered by Engineer, but only if they have a proven track record of manufacture to SANS 1473/SANS 60439.

The tenderer shall ensure that copies of these Standard Specifications, Detailed Specifications, layout drawings and single line diagrams shall be provided to the manufacturers to ensure that they make full allowance for all requirements in their pricing.

ABB

Gamma Panels

Magnol Panels

Panel Technique

Siemens Limited

Switchboard Manufacturer's

Ultimate Grab

21. RETURNABLE DISTRIBUTION BOARD DATA SHEET

DB: SCHEDULE OF INFORMATION / COMPLIANCE DOCUMENT
(RETURNABLE DOCUMENT)

The tenderer must sign and return the compliance document. Failure to do so will automatically lead to dis-qualification of the tenderer and his/her tender will not be considered regardless of tendered value

<u>Item</u>	<u>Description</u>	<u>Required</u>	<u>Offered</u>
Enclosure	Supplier	Rittal or approved equivalent	
Enclosure	Type testing	TTA to IEC 61439-1	
Enclosure	Type testing	Internal-arc rated TR 61641 (400V, 50kA, 300ms)	
Enclosure	Material	Mild steel	
Enclosure	Door thickness	2mm	
Enclosure	Mounting plate thickness	3mm	
Enclosure	Colour	RAL 7035	
Enclosure	Voltage rating	690V	
Enclosure	Current rating	800A	
Enclosure	1s kA rating	20kA	
Enclosure	IP rating	54	
Enclosure	Fire protection	4 x 250g Stat-x unit c/w bracket & thermal head	
Switchgear	Circuit breakers & MCB's	ABB	
Switchgear	Circuit breakers for change-over	ABB	
Switchgear	Contactors	ABB	
Switchgear	Surge protection	ABB	
Switchgear	LED indication lights	ABB	
Switchgear	Terminals	ABB	
Switchgear	Timers & control relays	ABB	
Switchgear	Electronic products	ABB	
Switchgear	Fuse holders	ABB	
Switchgear	Ammeters & CT's	PCI	
Switchgear	Voltmeters	PCI	
Copper	Copper	Copalcor	
Wiring	Wiring	Abedare / Alvern	

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Date

Tenderer authorised signature

Name & Surname

Position