# PART: B

# ELECTRICAL INSTALLATION

public works

Department:
Public Works
REPUBLIC OF SOUTH AFRICA

# SPECIFICATION

# FOR THE

# ELECTRICAL INSTALLATION

# AT

# BERGVILLE MAGISTRATES COURT

**OCTOBER 2021**

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**SPECIFICATION FOR ELECTRICAL WORK**

**PART 1 - GENERAL**

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## PART 1 - GENERAL

### 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.

THE NORMAL CONTRACTUAL FREE MAINTENANCE AND GUARANTEE PERIOD INCLUDED IN THIS CONTRACT SHALL BE 12 MONTHS.

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 following Acts and Regulations:

a) The latest issue of SANS 10142-1 : The wiring of premises – Part 1: Low-voltage installations" – herein referred to as the "Wiring Code",

b) The Occupational Health and Safety Act, 1993 (Act 85 of 1993) as amended,

c) The Local Government Ordinance 1939 (Ordinance 17 of 1939) as amended and the municipal by-laws and any special requirements of the local supply authority,

d) The Fire Brigade services Act 1993 Act 99 of 1987 as amended,

e) The National Building Regulations and Building Standards Act 1977 (Act 103 of 1977) as amended,

f) The Post Office Act 1958 (Act 44 of 1958) as amended,

g) The Electricity Act 1984 (Act 41 of 1984) as amended and

h) The Regulations of the local Gas Board where applicable.

### 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 preferable 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 aboard 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 by 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.

Fluorescent 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 ¾ of the length of the luminaires apart.

Fluorescent 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 ¾ 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".

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

## PART 2: INSTALLATION DETAILS

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## PART 2: INSTALLATION DETAILS

### 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.

### 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

The installation and mounting of luminaires must conform to clause 19 of Part 1 of this specification.

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

The supply will be at 400/230 Volt 50Hz.

The Contractor must arrange in good time with ESKOM for the upgrade of the current supply to an 100kVA connection 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.

**Standby Plant**

The 100kVA standby plant complete with automatic changeover control panel be supplied, installed and commissioned by a specialist contractor under this contract. The specifications for the generator for this contract is given in the "Outdoor Generator Specification" document that is available from the Department of Public Works.

The Contractor will only be responsible for the supply and installation of the cable connections between the Main Distribution Board and the changeover Control Panel.

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 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.

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

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

The power skirting shall be manufactured from 1mm (minimum) thick sheet steel or aluminium (as specified) in approximately 2,5m lengths.

The covers shall be manufactured in modular lengths, as specified in the Detail Technical Specification or otherwise in 1 m lengths and shall be secured to the wall channel by means of toggle or swivel nuts. Snap-in covers are also acceptable.

At the building module lines, covers of specified length or otherwise in 250 mm lengths shall be installed, against which partition walls may be installed, thereby trapping these covers. The removable modular covers shall be installed between these "fixed" covers.

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

Unless otherwise specified, no provision shall be made on the covers of the telephone or light current services compartments for the installation of sockets.

Factory-made end covers shall be installed at the ends of all runs of power skirting. All internal and external bends or offsets shall be factory-made and shall be installed to provide a neat and workmanlike appearance.

## 14 CABLES

The Contractor shall supply and completely install all distribution cables as indicated on the drawings, 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 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-resign 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 that 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. LAYING, JOINTING AND MAKING OFF OF ELECTRICAL CABLES

1. The use of the term "Inspector", includes the engineer or inspector of the 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 unnecessary exposed to the atmosphere and consequently the ingress of 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 ± 5°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 Part 1 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 Part 3 of this specification, and be approved by the Employer's Electrical Engineer.

The distribution board schedule is given in clause 21 of this document.

## 17. SOLAR SYSTEM (INCLUDING BATTERIES)

### 17.1 SCOPE OF WORKS

The contractor shall be responsible for the complete design, deliver, supply, build, installation, testing and commissioning of the works. It is a specific requirement of this project that this scope of works is done by a specialist contractor. The contractor shall be responsible to prepare a full design including schematics, drawings and calculations prior to ordering of any equipment. These design submissions will be reviewed by the Engineer for comment.

The works shall include all necessary equipment, fittings, fixtures and accessories required for the completion of the works.

The scope of work is the following (more specifically defined in the employer's works information):

- Full design of the PV facility according to applicable local and international standards.
- Supply of PV modules, inverters, mounting structure, cabling, mounting hardware reticulation, grid connection works and remote monitoring and control.
- The photo voltaic system shall be a 16 kWp Hybrid System with lithium ion battery backup. The PV panels shall be mounted on the undercover parking bay roof structure. The inverter will be cable of Grid-Tie operation and be able to operate in a "UPS" mode when the main grid supply is lost. The inverter should also have programmable supply priority.
- Mechanical Completion in terms of the employers works information and inspection by the contractor.
- Complete testing and commissioning in accordance to the relevant and applicable local standards.
- Submission of preliminary and final as build design documentation as well as grid code compliance certificate to Municipality.
- 12 months defects period, operation and maintenance (O&M) period.
- 12 month training programme of 5 Bergville Justice maintenance staff and engineers in PV facility O&M.

## 17.2 INSTALLATION SITE

The inverter/s will be installed indoor in the server room as indicated in the drawings. The PV panels will feed the inverter located approximately 60m away via a suitably sized cable as indicated on the single line drawing of the facility. The batteries will also be stored in the server room, in close proximity to the inverter/s.

## 17.3 OPERATING LIFE AND PV PLANT PERFORMANCE

a) The operating life of the plant shall be a minimum of 25 year.

b) The overall energy performance ratio of the system shall exceed 75%. (Sum total of the system energy losses shall not exceed 25%). E.g. For global solar insolation in the Plane of Array (POA) of 5 kWh/m2 (5 Peak Sun Hours) for the day, 100kWp PV power plant AC energy output shall be minimum of 375 kWh (75kWx5hrs) for the day.

## 17.4 COMPONENTS OF THE SYSTEM

- A metering system for the PV plant with Ethernet interface.
- The interface to the current electrical infrastructure installation on site.
- The PV plant will consist of:
- PV module arrays mounted on the parking bay roofs, as indicated on the project drawings;
- PV module attachment structure;
- String/Array combiner boxes;
- DC cabling;
- DC distribution box;
- Inverter;
- AC cabling
- AC distribution boxes
- Plant AC energy meter
- Lithium ion battery and storage

## 17.5 SUPPLY AUTHORITY REQUIREMENTS

- Contractors must provide a "Dead Grid Safety Lock" meeting Municipal/Eskom requirements.
- Any connection where applicable must comply to Municipal/Eskom Standard for the Interconnection of Embedded Generation.
- A connection diagram must be supplied as part of the returnable documents. This will be used to obtain permission from the local municipality to proceed with the project.

## 17.6 PV ARRAY

i. There is no restriction on any of the available technologies, such as monocrystalline, thin film, etc. as long as sufficient technical data is provided. The panels must however be of Tier 1 category.

ii. The PV modules and arrays shall comply to the following:

iii. Module junction boxes shall accommodate serial and parallel connections of modules adjacent modules and serial strings to construct PV arrays;

iv. The module shall be provided with junction boxes where live parts are protected against accidental contact and protect against polarity reversal;

v. Junction boxes shall be weather proof with solar cables included;

vi. The PV module specifications must be clearly visible on the supplied equipment;

vii. The following minimum PV module specifications shall apply:

Description Minimum spec**.**

| Description | Minimum spec |
|---|---|
| Minimum power at STC | 400W for polycrystalline/monocrystalline |
| Peak power temperature coefficient | Pmax < -0.43%/ ˚C |
| Power at NOCT must be more than 72.5% of power at STC | PNOCT/PSTC > 72.5 % |

- The module frame is made of corrosion resistant material, electrically compatible with other metallic mounting structures.
- The front surface of the module shall consist of impact resistant, low iron and high transmission toughened glass.
- The module glass must be able to withstand hail, rain, wind and temperatures conditions found in Bergville.
- The module must be able to handle temperatures range between -10°C and 40°C.
- The module must be able to handle winds speeds with a minimum of 100 km/h.
- The contractor must have a life cycle management program that recycles modules and initiates end-of-life take back, e.g. PV Cycle Membership. Preference will be given to module suppliers with a life cycle management program that recycles modules and initiates end-of-life take back, e.g. PV Cycle Membership.

**17.7 INVERTER**

- The inverter will be a hybrid type inverter (Grid-tie and UPS mode of operation). The inverter/s shall have the ability to install up to 20 kWp of solar panels and the ability to supply up to 20 kW while connected to grid.
- All inverters must comply with the Electrical Supply quality specifications NRS 048-2.
- All inverters must comply with the embedded generator specifications NRS 097-2-1.
- All inverters must use multiple power point tracking (MPPT). A minimum of 2 MPPTs per inverter.
- All inverters must have internal protection against any sustained faults and/or lightning in DC and AC grid circuits.
- All inverters must have the DC side disconnection switch/device integrated into the inverter.

- The inverter units must be able to communicate with the battery banks battery management system.
- The inverter unit's specifications must be clearly visible on the specification sheets provided;
- The inverter units shall comply to the following specifications:

Description Minimum spec.

| Description | Minimum spec |
|---|---|
| Peak inverter efficiency shall be a minimum | 98 % |
| Euro Efficiency shall be a minimum | 97.5 % |
| Nominal AC frequency tracking range | +/- 3Hz for 50Hz system |
| Self-consumption over night | < 10 W |
| Warranty | 15years |

- The output power factor shall be on a range to supply or sink reactive power.
- The AC voltage on site is 400V, ±10% tolerance.
- The inverter shall have internal cooling arrangements for operation in non-air conditioned environment.
- The inverter(s) shall be for indoor use.
- The inverter shall have programmable supply priority.
- The inverter shall incorporate a terminal display screen that displays PV array and DC voltage, current and power, AC output voltage and current, AC power, Power Factor and AC energy and system frequency.
- The inverter units must have flexible input and output connection support for monitoring electronics.
- The Inverter units shall comply to the relevant IEC or equivalent standards until relevant SANS standards become available:

a. IP65 for electronics in accordance with IEC 60529

b. IEC 62109: Safety of power converters for use in photovoltaic power systems

c. IEC 62116: Test procedure of islanding prevention measures for utilityinterconnected photovoltaic inverters

d. IEC 62093: Balance-of-system components for photovoltaic systems - Design qualification natural environments

e. Electromagnetic compatibility (EMC) to be tested to EN 61000

## 17.8 LITHIUM ION BATTERY

a. The battery bank must be capable of providing 15kWh of storage. The batteries shall have a 10year warranty. Lithium-ion batteries will be used. The battery bank output voltage should be compatible with the inverter/s.
b. Service Life: under normal circumstances, cycle life should be more than 7000 times at 70% depth of discharge
c. The battery must be capable of working in temperatures of between -30°C and 60°C.
d. Uniformity: The battery must have a charged maintenance ability according to IEC standards.
e. The battery must be capable of rapid charging in 1 ~ 6 hours.
f. The battery bank must be appropriately fitted and stored in cabinet with front and rear mesh panels. The batteries should preferably be installed in a rack mount type cabinet.
g. The battery bank must contain an intelligent battery management system that is capable of interfacing with the chosen inverter.

## 17.9 BALANCE OF SYSTEMS (BoS)

a. The balance of system consists of all parts excluding the PV modules and inverters.
b. All wiring, earthing, and electrical connections shall be made in accordance with SANS 10142-1 for Low Voltage connections (<1 kV AC).
c. The system will be in connection with a Eskom feed.
d. The system shall comply to the South African Grid Code.
e. Earthing:

- PV array, DC equipment, inverter, AC equipment, and distribution wiring shall be earthed as per SANS 10142.
- Equipment grounding shall connect all non-current carrying metal receptacles, electrical boxes, appliance frames, chassis, and PV module mounting structures in one long run; the grounding wire must not be switched, fused or interrupted.
- The complete earthing system shall be electrically connected to provide return to earth from all equipment independent of mechanical connection.
- An earth bus and a test point shall be provided.

f. Combiner & Distribution boxes:

- String/array combiner boxes shall incorporate DC string circuit breakers, DC array disconnect switch (easily accessible), lightning and over voltage protectors, protection equipment, screw type terminal strips and strain-relief cable glands.
- Combiner boxes shall have a protection rating of IP54.
- DC disconnect/isolator shall be provided in an easily accessible location, capable of disconnecting under full current.
- AC distribution box shall incorporate AC circuit breaker, surge voltage protectors, protection equipment, plant energy meter, screw type terminal strips and strain-relief cable glands.

- DC Surge protection shall be provided by means of 1000VDC surge protection, 5kA, Citel Type 1 + 2 (DS50PVS-1000G/12KT).

g. Cables:

- Cables with double insulated and polarized (reverse polarity protected) DC connectors shall be used.
- All DC and AC cables shall be terminated using crimped cable lugs/sockets and screw type terminal strips and be protected from weather and corrosion.
- Conduits/ cable trays shall be provided for all DC cabling on the roof and neatly secured onto the roof.
- Conduits must be corrosion resistant stainless steel.
- PVC must be avoided for all cabling material. Any sourced alternatives must have the required documentation to prove that PVC has not been used. If PVC products cannot be avoided, they should be sourced from re-used PVC or recycled contents. Documentation will be required to prove the source of the PVC.
- AC and DC cables of electrical voltage and current ratings shall be rated for 'in conduit wet and outdoor use', with all external cables being weather and UV resistant.
- DC and AC cabling between inverter and distribution boxes shall be secured with conduits/cable trays.
- Total AC cable losses shall be maximum of 2% of the plant AC output over the specified ambient temperature range.
- Total DC cable losses shall be maximum of 3% of the plant DC output over the specified ambient temperature range.
- Cables feeding into building shall be looped to prevent water ingress;
- All cables shall be neatly tied up;
- Cables shall be located as far as possible from lightning protection;
- All DC cables shall be clearly identifiable;
- All cables shall be given string numbers;
- Cables on roofs shall not interfere with the flow of rainwater;
- Inverter wiring (including monitoring system) shall be carried out with the inverter disconnected from both the grid and PV modules;

h. The structure and walkways shall be of aluminium construction and be non-penetrating.

General:

a. All BoS parts shall have an operating lifetime of 25 years.
b. A certificate of compliance (COC) is handed over at commissioning to the engineer on all installed BoS parts.

c. All installed BoS parts shall be SABS approved and clearly identifiable.
d. Utilise electrical feed from electrical distribution boards.

### 17.10 MONITORING AND METERING

a. An electricity meter shall be installed which measures: Voltage, AC power output, Power factor and AC current.
b. The meter shall allow for integration into the data system through an Ethernet connection.

### 17.11 STRUCTURAL AND MECHANICAL SPECIFICATIONS

a. The existing roof spaces identified will be used.
b. The contractor shall obtain the required roof details and evaluate the site during a scheduled site visit.
c. Structural support must be able to withstand the weather conditions of the region, including wind, hail and extreme temperatures.
d. Additional waterproofing shall be provided in the areas where fixture to the roof is made.
e. Array support structure shall be fabricated using corrosion resistant material; anodized aluminium, galvanized or stainless steel. Where galvanizing is used, the integrity of galvanization shall not be compromised by cutting, drilling or handling.
f. PV modules shall be secured to support structure using screw type fasteners and/or metal clamps. Measures shall be taken to ensure no corrosion occurs on any parts of the installation.
g. All welded joints and fasteners shall be treated for corrosion resistance.
h. All parts shall be free from corrosion when installed.
i. Trunking and cable trays are to be incorporated into the mounting structure. No loose cables are allowed.
j. Accessibility must be provided for cleaning purposes.
k. Full compliance required with the Health and Safety Act of South Africa.

### 17.12 SYSTEM LAYOUT

a. Spacing shall be provided between module rows to allow for ease of replacement, cleaning, maintenance and personal protection.
b. Spacing shall be incorporated between vertically stacked modules and between the modules and the roof to allow for ventilation and air flow.
c. Structure and PV spacing shall incorporate existing features e.g. vents, skylights, antennae.
d. Clearance shall be provided in the layout of the inverter and DC/AC distribution boxes for cooling and ease of maintenance.

### 17.13 GENERAL REQUIREMENTS

a. The contractor provides the system’s layouts showing orientation, location, walkways, and the maximum power that will be generated from the layout.
b. All layouts and structural designs shall require the approval from the engineer before installation.
c. The housing for the inverter and all BoS equipment is confirmed with engineer before installation.
d. The system shall withstand operating environmental conditions for a period of minimum 25 years.
e. The total load on the roof shall not exceed the limits as specified by engineer.
f. Safety and theft risks are minimised with measures confirmed with engineer before installation.

g. Full compliance to municipal requirements for grid integrated PV systems where applicable.

### 17.14 LOCAL CONTENT

All components must comply with local legislation and must comply to the following content of locally manufacturing:

| Component | Local content | Minimum Local Content Threshold |
|---|---|---|
| Laminated PV Module | Applicable | 15% |
| Module frame Applicable 65% | Applicable | 65% |
| DC Combiner Boxes | Applicable | 65% |
| Mounting Structure | Applicable | 90% |
| Inverter | N/A Applicable | N/A |

### 17.15 OPERATION AND MAINTENANCE (O&M)

An operation and maintenance contract shall be provided for a two-year period with the following requirements:

a. DC String/Array and AC Inverter monitoring: Continuous and computerized.
b. AC energy monitoring: Continuous and computerized.
c. Visual Inspection of the plant post installation and as agreed upon post RFP process.
d. Functional checks of protection components and switchgears post installation and as agreed upon post tender process.
e. Clean PV array and installation area post installation.
f. Inverter, transformer, data acquisition, energy meters and power evacuation checks:

Half yearly.

a. Support structure and roof water proofing checks: Yearly.
b. O&M log sheet shall be kept and handed over at the end of the O&M contract.
c. Repair and replacement work shall be completed within two weeks from the time of reporting the fault.
d. Any costs must be market related.
e. All recorded data for the first two years shall be preserved in electronic format and submitted at hand over.
f. Costing for 2 site visits per year for inspection and testing of the system.
g. All site visits are to performed with prior arrangement and in the presence of the engineer representative.
h. The engineer representative will accompany the service provide for all site visits to ensure knowledge transfer for post O&M contract. A detailed maintenance schedule must be provided to the representative for ongoing maintenance.

i. An as built report submitted to the engineer upon completion of the works and prior to practical completion for the works in compliance to the South African Renewable Energy Technology Centre or equivalent industry body.

**17.16 STANDARDS AND COMPLIANCE**

a. It is expected that all bids will comply with the required standards relevant to any PV rooftop installation in South Africa.
b. Current best practises should be determined and applied by the successful contractor.
c. An electrical Certificate of Compliance as per SANS 10142-1 is required for the electrical installation.
d. Factory setting sheet or other documentation showing that the inverter has been set according to NRS 097-2-1 is required.
e. The installation must be signed off on commissioning by an ECSA registered professional engineer or technologist.
f. The successful contractor will be suitably registered with the CIDB at the grading level.

**17.17 INSTALLATION AND COMMISSIONING**

All electrical work shall be carried out by a suitably qualified person in line with the Health and Safety standards of South Africa. Working with PV systems is hazardous and extra care needs to be taken with the following:

a. PV arrays always produce electricity when exposed to light, thus the modules are live even if they are not yet installed or connected.
b. PV modules will continue to produce voltage, even if there is a fault on the circuit.
c. PV arrays are limited current sources, fuses and circuit breakers do not operate the same as normal AC power circuits.
d. Construction are roof based, slip and fall hazards are likely, sufficient safety harnesses are to be used.
e. Disconnections of any kind (including removal of string fuses) should not be made when the array is under load, due to danger of arcing.
f. Inverter wiring (including monitoring system) shall be carried out with the inverter disconnected from both the grid and PV modules.
g. The overall energy performance ratio of the system shall exceed 75%. (Sum total of the system energy losses shall not exceed 25%). E.g. For global solar insolation in the Plane of Array (POA) of 5 kWh/m2 (5 Peak Sun Hours) for the day, 100kWp PV power plant AC energy output shall be minimum of 375 kWh (75kWx5hrs) for the day.
h. The relevant South African standards to be complied to when installing site cables and wiring systems.

**17.18 WARRANTIES**

a. All warranties must comply as a minimum to the General Conditions of Contract.
b. The warranty periods for the components are:

i. Where not specified, thirty-six (36) months;

ii. PV Modules - Minimum product replacement 10 years, 90% output after 10 years and 80% power output after 25 years

iii. PV Modules - Minimum linear power warranty is 25 years at 80 %

iv. Inverter - Minimum product warranty is 15 years

v. Inverter – Minimum product replacement warranty is 15 years

vi. All BoS parts and workmanship – Minimum workmanship including product replacement is 5 years and operating lifetime of 25 years

vii. Support structure – Minimum workmanship including product replacement is replacement 10 years

viii. Power evacuation and metering equipment – Minimum workmanship including product replacement is 10 years and operating lifetime of 25 years

ix. Power plant installation - Minimum workmanship including product replacement is 10 years and operating lifetime of 25 years

**17.19 ABILITY AND CAPACITY**

The contractor provides the following minimum demonstrating its capacity and ability to supply this bid:

a. CV and roles of its key project team with a minimum of three years' experience in the industry per team member
b. CV and qualifications of the certified person that will do the final commissioning sign off meets the specification in this document
c. List of three projects of equivalent size and complexity completed in the last three years.

**17.20 TRAINING**

a. The contractor provides training in operating and maintaining the system to the engineer and 5 naval base staff members.
b. The contractor provides two full sets of drawings for the commissioned system.
c. The contractor provides 5 training manuals covering all components of the complete system.
d. The contractor allows engineer and naval base staff members to shadow its staff during the contract and maintenance period.

**17.21 INSTALLATION SCHEDULE**

The contractor provides an installation schedule and programme, within 14 days of the contract commencement.

**18. X-RAY BAGGAGE SCANNER & METAL DETECTOR**

The specifications for the X-Ray baggage scanner & metal detector is contained in "Part C- X-Ray and Metal Detector Returnables". The X-Ray baggage scanner & metal detector is to be positioned according to the drawings and the position verified on-site by the PM, PA and electrical engineer.

**19. SCHEDULE OF LIGHT FITINGS**

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

Type A: 25W LED Flush Mount, IP44 Large Form Factor Downlight Die Cast Aluminium, 4000k Colour Temp,At Least 1500lm,Wired ECG Complete With 4m, 3 Core Cabtyre, with SABS/SANS mark of compliance.

Type B: 40w CFL Surface Mount, IP65 Decorative Outdoor Eyelid Bulkhead With Blk Die-Cast Base And High Impact Acrylic Diffuser With Tamper Proof Torx Screws. Wired ECG Complete With 4m, 3 Core Cabtyre - 3500 Lumen, with SABS/SANS mark of compliance.

Type C: Vandal Proof Surface Mount Luminaire Batten Type, Suitable For Maximum Security Applications, With 2 X 20W Led Lamps, With Corrosion Resistant High Pressure Die Cast Aluminium Body, One Piece Injection Moulded Clear Polycarbonate Diffuser, Protection Class Ip65, With SABS Mark Or SANS Mark Of Compliance - 5500 Lumen.

Type D: Type D: 2 X 23w Led 1500mm Surface Mounted Ip65 Vapor Proof With Poly-Carbonate UV Stabalized Base And Diffuser With 305 Stainless Steel Clips. Wired Ecg Complete With 4m 3 Core Cabtyre, With SABS or SANS mark of Compliance.

Type E: Type D: 64w Led Flush Mount Honeycomb Panel,Wired Ecg Complete With 4m 3 Core Cabtyre - 6000 Lumen, Driver Lifetime 30 000hrs, CCT 4000k, CRI 80, with SABS or SANS mark of compliance.

TYPE EX: Led Emergency Exit Light, Single Sided, 1 Hr Backup And 20 Led Array, Non Maintained Battery Pack Wall Mount Luminaire With SANS Mark Of Compliance.

TYPE PT: 40w Led Pole Mount IP66 Street Light with Die-Cast Housing 4000 Lumen, with SABS/SANS Mark Of Compliance, Installed On A 3.6m Fibreglass Pole Complying To SANS 1749, Mounting Height 3m Above Natural Ground Level.

TYPE FD: 1 X 40w Led Floodlight, IP65, CCT 4000k, Die-Cast Aluminium Housing, Wired Ecg Complete With 4m 3 Core Cabtyre, 90lm/Watt, Driver Lifetime 30000hrs with SABS or SANS mark of compliance.

## 19. SCHEDULE OF CABLES, CONDUIT AND WIRING

Supply, install and connect the following cable, conduit and wiring:

| FROM | TO | SIZE AND TYPE | LOAD (kVA) |
|---|---|---|---|
| Meter box Normal Power | DB-MAIN | 95mm² 4-core PVC, SWA cable and 70mm² earth wire | 100 |
| DB-MAIN | DB-A | 25mm² 4-core PVC cable and 16mm² earth wire | 45 |
| DB-MAIN | DB-B | 10mm² 4-core PVC cable and 6mm² earth wire | 8 |
| DB-MAIN | DB-C | 10mm² 4-core PVC cable and 6mm² earth wire | 10 |
| DB-MAIN | DB-D | 6mm² 4-core PVC cable and 4mm² earth wire | 4 |
| DB-MAIN | DB-E | 16mm² 4-core PVC cable and 10mm² earth wire | 10 |
| DB-MAIN | DB-F | 16mm² 4-core PVC cable and 10mm² earth wire | 20 |
| DB-MAIN | DB-G | 10mm² 4-core PVC cable and 6mm² earth wire | 10 |
| DB-MAIN | DB-U1 | 10mm² 4-core PVC cable and 6mm² earth wire | 8 |
| DB-MAIN | DB-U2 | 4mm² 4-core PVC cable and 2.5mm² earth wire | 3 |

## 20. SCHEDULE OF DISTRIBUTION BOARDS

The front panels of normal supply, standby power and no-break supply sections shall be painted in distinctive colours as follows:

Normal supply : Light Orange, colour B26 of SANS 1091.
UPS supply : Signal Red, colour A11 of SANS 1091.

Indicated is the probable fault level rating (kA) of the busbars. Refer to the Summary of Switchgear and Circuits for the minimum fault level rating of specified equipment.

| BOARD | TYPE | PANEL | FAULT LEVEL | LOAD kVA |
|---|---|---|---|---|
| DB-MAIN | Floor standing, with lockable door, IP 65. | Normal power | 15kA | 100 |
| DB-A | Flush mount with door | Normal power | 10kA | 45 |
| DB-B | Flush mount with door | Normal power | 10kA | 8 |
| DB-C | Flush mount with door | Normal power | 10kA | 10 |
| DB-D | Flush mount with door | Normal power | 10kA | 4 |
| DB-E | Flush mount with door | Normal power & UPS | 8kA | 10 |
| DB-F | Flush mount with door | Normal power | 10kA | 20 |
| DB-G | Flush mount with door | Normal Power | 10Ka | 10 |
| DB-U1 | Flush mount with door | UPS | 2.5kA | 8 |
| DB-U2 | Flush mount with door | UPS | 2.5kA | 3 |

## PART 3: QUALITY SPECIFICATION FOR MATERIALS AND EQUIPMENT OF ELECTRICAL INSTALLATIONS

***"Part 3: Quality specification for materials and equipment" manual of the Department of Public Works is applicable for this Contract and the manual can be obtained from the Department of Public Works.***

**The following clauses must be adhered to for this Contract:**

**CONTENTS**

23. Time switches and Photocells
24. Contactors
25. Push-buttons and Push-button assemblies
26. Indoor surge arrestors
27. Standard Paint Specification
28. Fibreglass Reinforced Polyester Lighting Poles

## ADDITIONAL REQUIREMENTS OR SPECIFICATIONS NOT COVERED IN QUALITY SPECIFICATIONS ABOVE

### LED LIGHTS

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. |
| 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. |

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| 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.

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 of 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 +-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 lighting 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:

The luminaire must be able to withstand an ambient temperature of 35°C. Storage temperature of this luminaire should be able to handle -40°C < T < 60°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.

**= END OF SPECIFICATION =**