public works & infrastructure

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NATIONAL DEPARTMENT OF PUBLIC WORKS AND INFRASTRUCTURE

ELECTRICAL ENGINEERING SERVICES

MDANTSANE LABOUR CENTRE
SUPPLY AND INSTALLATION OF CARPORTS
(WCS NO:057001)

PROJECT ELECTRICAL SPECIFICATIONS

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Prepared for:
Department of Public Works and Infrastructure
Gqeberha Regional Office
Construction Project Management
Eben Donges Building
Corner Robert and Hancock Street
Private Bag X3913
North End Port Elizabeth
6056

Prepared by:
in-house Professional Services

[DOCUMENTATION TO BE REVIEWED EVERY 5 YEARS IN ACCORDANCE WITH ISO STANDARD TO ENSURE QUALITY CONTROL]

SPECIFICATION COMMITTEE

NAME	REVISION NO.	DATE	SIGNATURE

PROJECT SPECIFICATION FOR ELECTRICAL WORK

PART 1 – GENERAL SPECIFICATION

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PART 1 – GENERAL SPECIFICATIONS

1.1. INTRODUCTION

1.1.1. These General Specifications cover the general technical requirements for the equipment, materials, installation, testing, commissioning and maintenance of electrical installations for the Department. These requirements must be read in conjunction with the Documents as specified below as well as the other sections of this document.

1.1.2. The source documents used for the incorporation of this document are the Standard specifications PW 354 part A, B and C and the South African National standards. The Standard Specifications can be located on the departmental website, consultant guidelines section. www.publicworks.gov.za.

1.1.3. Unless otherwise stated the description on of each item shall be deemed to include manufacturing, conveying and delivering, unloading, storing, unpacking, hoisting, setting, fitting and fixing in position, cutting, waste, patterns, templates, plant, temporary works, return of packings, establishment charges, profit and other obligations arising out of the conditions of contract.

1.2. DEFINITIONS

1.2.1. The table below provide a description of the main terms in the document but are not limited to:

No.	Term	Description
1.	**General Specification**	The general specifications provide a broad description of work and materials that is required for a project.
2.	**Standard Specification**	The standard specifications are pre-established guidelines that are widely used and accepted on projects, they ensure consistency and quality by setting uniform standards for material, methods and practices.
3.	**Project specification**	The project specification are specific to a particular project and detail the requirements for that project, they include all the necessary information to complete the project according to the client's need and the project conditions. It is the combination of the General, Standard and detailed specifications.
4.	**Detailed Specification / Detail Specification**	The detailed specifications provide an in-depth description of every aspect of works, including the quality of materials, workmanship and methods implemented.
5.	**Particular Specification**	The particular specification are tailored information to address a specific requirements or conditions of a project that are not covered by the general, standard or detailed specifications. The focus is on unique aspects for further detail.
6.	**Supplementary Specification**	The supplementary specifications modify the general or detailed specifications, they address specific conditions or requirements that arise during the project and are not covered by the original project specifications.
7.	**Contractor**	"Contractor" shall mean the person, partnership, company or firm appointed for the supply, installation, testing, commissioning and maintenance of the Electrical Installation. In the case of the Electrical Installation being a sub-contract, nominated in terms of the Main Contract or otherwise, the word "Contractor" shall also mean "Sub-Contractor" in terms

		of the Sub-Contract Conditions for the specific installation. Where applicable the Builder or Principal Contractor shall be referred to as "Main Contractor".
8.	**Accredited / Competent Person**	A person who has the necessary knowledge, training, experience, and qualifications specific to the work being performed. This person must be capable of identifying potential hazards and taking appropriate measures to mitigate them. Additionally, they must be authorized to take corrective actions to ensure a safe working environment by a statutory body.
9.	**Quality Specification**	Department Standard Specification Part C.
10.	**Wiring Code**	SANS 10142
11.	**Earthing**	Connection of the exposed-conductive-parts of an installation to the main earth terminal of that installation
12.	**Equipotential Bonding**	Electrical connection maintaining various exposed-conductive-parts and extraneous-conductive-parts at substantially the same potential.
13.	**Departments Authorised representative**	The department Authorised representative may be the Project manager, Engineer, Principal agent, Employer's Representative, or Engineer's representative.
14.	**Department**	The Department in the context of this document refers to the Department of Public works and Infrastructure.
15.	**Documents**	The complete set of contract documents, including the Department's Tender Conditions, Tender Qualifications, the Standard Specification and the Detailed Specification including all drawings and variation orders issued in terms of the contract and all other contract documents of the contract
16.	**Submittals**	Documents, shop drawings, datasheets, samples, Mock-ups or other items that a contractor submits to the professional team for approval prior to manufacture, purchase or installation.
17.	**Reputable Brand**	A reputable brand in construction is one that is widely recognized for its quality, reliability, and trustworthiness. These brands have established a strong reputation over time through consistent delivery of high-quality products and services, excellent customer service, and adherence to industry standards.

1.3. INSTALLATION WORK

1.3.1. The complete installation shall comply with the requirements of all parts of the specifications and laws of the Republic of South Africa. Should any discrepancies or contradictions exist between the general/standard specifications and the detailed specification for the specific installation, then the detailed specifications will take precedence.

1.3.2. In the event of discrepancies between the drawings, specifications and bill of quantities then the Department shall decide whether the work as executed shall be remeasured on site or whether remeasurement shall be effected from the working drawings only. The decision must be provided in writing before the commencement of any works.

1.3.3. The Department's authorised representative will inspect the installation from time to time during the progress of the work. Discrepancies of the contract will be pointed out to the Contractor and these must be remedied at the contractor's expense in accordance with the

contract. Under no circumstances will these inspections relieve the Contractor of his obligations in terms of the Documents and Contract.

1.3.4. The Contractor must notify the Department timeously (Minimum 7 days) when the installation reaches important stages of completion (e.g. before closing cable trenches, before casting concrete, etc.) so that the Department's authorised representative may schedule his inspections in the best interest of all parties concerned.

1.4. COMPLIANCE WITH REGULATIONS

1.4.1. The installation must be erected and tested in accordance with the South African Acts, Department's quality specifications and Regulations or IEC/EN regulations where applicable.

1.4.2. The entire installation must be carried out in accordance with SANS Regulations, by-laws, and the Occupational Health and Safety Act.

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

1.4.4. Where conflict exists between regulations, specifications or drawings, the said conflict must be referred to the Department's authorised representative in writing for his ruling.

1.5. CODES OF PRACTICE OR STANDARD SPECIFICATION

1.5.1. Where reference is made to any Regulations, Code of Practice or Standard specification in this document, the latest edition or amendment will be applicable.

1.6. NOTICES AND FEES

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

1.6.2. 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.

1.6.3. The Contractor must issue all notices and pay all of the required fees in respect of the installation to the authorities, and shall exempt the Department from all losses, claims, costs or expenditures which may arise as a result of the Contractor's negligence in complying with the requirements of the regulations.

1.6.4. It is the responsibility of the Contractor to make the necessary arrangements with the local Supply Authority at his own cost and to supply the labour, equipment and means to inspect, test and commission the installation to the satisfaction of the Local and Supply Authorities.

1.6.5. The Contractor must supply and install all notices and warning signs that are required by the relevant laws, regulations and/or the Documents.

1.7. SITE CONDITIONS

1.7.1. Tenderers are advised to visit the site and acquaint themselves with all local conditions pertaining to the execution of the installation before tender closing date or as indicated on the tender document with the permission of the department. No claims from the contractor which may arise from insufficient knowledge of site access, type of site, labour conditions,

establishment space, transport and loading/unloading facilities, power and water supply, etc. will be considered after submission of tenders.

1.7.2. For services where prior permission is required before contractors can visit the site, a visit will be arranged for all interested parties at the request of the Department.

1.8. COMPETENCE OF PERSONNEL, WORKMANSHIP AND STAFF

1.8.1. All work must be executed and supervised by suitably qualified staff. Only "ACCREDITED/COMPETENT PERSONS" will be permitted to carry out and supervise electrical work on site. Copies of all qualifications, certifications and registration must be issued to the Department's authorised representative prior to the commencement of works.

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

1.8.3. The workmanship must be of the highest grade and to the satisfaction of the Department's authorised representative.

1.8.4. All inferior work will that is not in accordance with the Department's Quality specifications, SANS regulations, on indication by the Department's authorised representative, must immediately be removed and rectified by and at the expense of the Contractor.

1.8.5. The Contractor must at all times have an adequate number of employees available during the construction period to ensure that the electrical works does not delay the construction programme.

1.9. ELECTRICAL EQUIPMENT AND QUALITY OF MATERIALS

1.9.1. Only materials of first class quality must be used and all materials must be subject to the approval of the Department's authorised representative. Departmental specifications for various materials to be used on this Contract are attached to, referred to and form part of this specification.

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

1.9.3. All equipment and fittings supplied must be in accordance with the specifications, suitable for the relevant supply voltage and frequency and must be approved by the Department's authorised representative.

1.9.4. Materials and equipment used in this Contract must, where possible, comply with the specifications. Proof of compliance must be submitted prior to installation of any materials or equipment in the form of submittals.

1.9.5. The Contractor must submit samples of all materials or equipment for approval by the Engineer and Employer before installation, unless prior approval to the contrary has been obtained in writing from Department's authorised representative. Such samples must be labelled, documented and held for purposes of comparison with equipment and materials installed and will be released on satisfactory completion of the Contract.

1.9.6. All apparatus, components, fittings and materials supplied and/or installed, whether expressly specified herein or not, must conform in respect of quality, tests and performance as indicated in the detailed and quality specification.

1.9.7. Where a certain manufacturer's material or apparatus is mentioned in the drawings or specifications, such materials or apparatus shall be provided as specified, except where an alternative to this condition is allowed in the specifications. Where a detailed specification for material or apparatus is not provided, it must be understood that all normal requirements for the use of such materials or equipment will apply.

1.9.8. Where certain products of a specified manufacturer are unobtainable, substitutes may be offered, but only be supplied after written consent by the Department's authorised representative.

1.10. MAINTENANCE OF INSTALLATIONS

1.10.1. With effect from the date of the Practical completion/completion certificate dependent on the type of contract, the contractor must at his own expense undertake the regular servicing of the installation during the maintenance period stipulated by the contract and must make all adjustments necessary for the correct operation thereof.

1.10.2. 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, the contractor must immediately upon being notified thereof take steps to remedy the defects and make any necessary adjustments.

1.10.3. Should such stoppages be so frequent as to become troublesome, or should the installations otherwise prove unsatisfactory during the said period the Contractor must, if called upon by the Department's authorised representative, at his own expense replace the whole of the installations or such parts thereof as the Department's authorised representative may deem necessary with apparatus specified by the Department's authorised representative.

1.11. SCHEDULE OF FITTINGS

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

1.12. SWITCHES AND SOCKET OUTLETS

1.12.1. All switches and switch-socket outlet combination units must conform to the Department standard specifications Part C (Quality Specification) and relevant SANS regulations, which form part of this specification.

1.12.2. All socket outlets must be in accordance with SANS 164, unless other types are distinctly specified or indicated on the drawings or detailed specifications.

1.12.3. All light switches and socket outlets must be installed in accordance with SANS 10400-S or otherwise indicated.

1.12.4. 5A Socket outlets are only permitted to supply power to light fittings in accordance with SANS 10142-1.

1.12.5. The following sample labelling shall be used for socket outlets, switches, isolators etc:

a) DB-NAME CIRCUIT BREAKER NUMER CIRCUIT TAG
eg. DB-GG CB4 P2

1.13. SWITCHGEAR

1.13.1. Switchgear, which includes circuit breakers, iron-clad switches, interlocked switch-socket outlet units, contactors, time switches, etc. are 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.

1.13.2. For uniform appearance of switchboards and protection coordination, only one approved make of each of the different classes of switchgear mentioned in the Quality Specifications shall be used throughout the installations. All switchgear to be SABS approved or have an ASTA diamond mark or CE markings.

1.14. DISTRIBUTION BOARDS

1.14.1. All distribution boards must be in accordance with the types as specified, be constructed according to the shop or type drawings and must be approved by the Department's authorised representative prior to manufacture or installation.

1.14.2. 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.

1.14.3. Any construction or standard type board proposed, as an alternative to that specified must have the prior approval of the Department's authorised representative.

1.14.4. 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 must be mounted within the boards to give a flush front panel. Cable and boxes and other ancillary equipment must be provided where required.

1.14.5. Each unoccupied opening of a distribution board must be fitted with a blanking plate.

1.14.6. There must be labelling for the internal bars, termination points and identification of incoming and outgoing circuits to allow for ease of tracing, isolation, testing and debugging.

1.14.7. Clearly engraved labels are to be mounted below every switch. The working of the labels in English, is to be according to the layout drawings or as directed by the Department's authorised representative 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.

1.14.8. The distribution boards must have a danger notice on or near it.

1.14.9. All distribution boards 10kA or above are to be provided with a type test certificate.

1.14.10. Distribution boards with alternative supply must have a notice to indicate the type of alternative supply feed and a power-on indicator.

1.15. CONDUIT AND ACCESSORIES

1.15.1. 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 the detailed specification section of this specification.

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

1.15.3. The conduit and conduit accessories shall comply fully with the applicable SANS 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.

1.15.4. 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.

1.15.5. 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.

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

1.15.7. 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 (SANS 10142)" for the specified number and size of conductors, unless otherwise directed in the detailed specification or indicated on the drawings.

1.15.8. Only one manufactured type of conduit and conduit accessories will be permitted throughout the installation to ensure uniformity.

1.15.9. Running joints in screwed conduit are to be avoided 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.

1.15.10. 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.

1.15.11. 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 authorised representative, be completely removed and rectified and any wiring already drawn into such damaged conduits must be completely renewed at the Contractor's expense.

1.15.12. 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.

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

1.15.14. 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.

1.16. CONDUIT IN ROOF SPACES

1.16.1. 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 suitable saddles screwed to the roof timbers.

1.16.2. Nail or crampets will not be allowed.

1.16.3. 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.

1.16.4. 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.

1.16.5. 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.

1.16.6. All conduits are to be supplied with draw wires.

1.17. SURFACE MOUNTED CONDUIT

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

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

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

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

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

1.17.6. 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.

1.17.7. 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.

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

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

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

1.17.11. Painting of surface conduit shall match the colour of the adjacent wall finishes, there should be no flaking or peeling of paint from the conduit after it is painted. The preparation and painting must be in accordance with guidelines from the paint manufacturer or the architect.

1.17.12. 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.

1.17.13. All surface conduit to be galvanised unless otherwise indicated in the detailed specifications.

1.17.14. All conduits are to be supplied with draw wires.

1.18. CONDUIT IN CONCRETE SLABS

1.18.1. In order not to delay building operations the Contractor must ensure that all conduits and other electrical elements which are to be cast in the concrete columns and slabs are installed timeously.

1.18.2. The Contractor shall have a representative in attendance at all times when the casting of concrete takes place with the sign off of all embedded electrical elements prior to the casting.

1.18.3. 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.

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

1.18.5. 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.

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

1.18.7. All conduits are to be supplied with draw wires.

1.19. CHASES AND BUILDER'S WORK

1.19.1. Except where otherwise specified the Builder or Main Contractor shall be responsible for the builder's work related to the installation of conduits, outlet boxes, switchboard trays, bonding trays and other wall outlet boxes and will undertake the necessary chasing and cutting of walls and the provision of openings in ceilings and floors for luminaries and other electrical outlets. The Contractor shall notify the Builder or Main Contractor of his requirements and the responsibility lies with the Contractor to ensure that all builder's work is clearly indicated or marked in accordance with his requirements prior to chasing.

1.19.2. Electrical materials to be built in must be supplied, placed and fixed in position by the Contractor when required to do so by the Builder or Main Contractor. The Contractor shall also ensure that these materials are installed in the correct positions and a quality checklist must be signed confirming the fixing and position before plastering.

1.19.3. Where no Builder or Main Contractor is available, the Contractor must provide all chases and is required to cover conduits installed. Chases shall be deep enough to ensure that the top of conduits are at least 12 mm below the finished surface of the plaster.

1.19.4. Where the Contractor is responsible for the cutting of chases or the building in of conduits and other equipment, he will be held responsible for all damage as a result of this work and will be required to make good to the satisfaction of the Department.

1.19.5. Under no circumstances shall face brick walls or finished surfaces be chased or cut without the written permission of the Department. Where it is necessary to cut or drill holes in the concrete structure, the prior permission of the Department shall be obtained.

1.19.6. Chases must be made by means of a cutting machine and not using a chisel and hammer, this ruling is particularly applicable but not exclusively to the rewiring and renewal of existing installations.

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

1.20.1. 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.

1.20.2. 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.

1.20.3. Aluminium and zinc alloy connectors will not be acceptable.

1.21. WIRING

1.21.1. Except where otherwise specified in the detailed specification and drawings, wiring shall be carried out in conduit throughout. Only one circuit per conduit will be permitted.

1.21.2. 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.

1.21.3. Unless otherwise specified in the detailed 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.

1.21.4. Minimum wiring sizes for lighting circuits is to be carried out with 2,5mm² conductors and a 2,5mm²-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 the detailed 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".

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

1.21.6. The wiring shall be done in PVC insulated to SANS 1507 or unless otherwise specified in the detailed specifications.

1.21.7. Where wiring ends connect onto switchgear, switches, luminaires etc., the end strands must be lugged and firmly secured. Cutting away of wire strands of any cable will not be allowed.

1.21.8. No exposed copper on conductor at the point of termination will be accepted.

1.21.9. All wiring to be terminated and labelled in accordance with SANS 10142-1.

1.22. EARTHING OF INSTALLATION

1.22.1. The Earthing and Bonding must be done in accordance with SANS 10313 and SANS 10292.

1.22.2. The Earthing system objectives are to protect persons against direct and indirect contact with the electrical system elements and equipment. Another objective is to provide a short path for any fault to return to earth.

1.22.3. The earthing system utilised in South Africa is generally but not limited to the TN-C-S and TN-S.

1.22.4. To avoid differences of potential between circuits, which can arise with many earthing systems, a common earth will be installed either for power, IT and communication equipment.

1.22.5. The earthing and bonding system will comprise:

a) Earth grid with earth electrodes
b) Main earth terminal located in Substation/LV Room
c) Earth terminal in each distribution board
d) Protective conductor for the MV/LV transformer
e) Protective conductors for circuits
f) Equipotential Bonding conductors

1.22.6. Main earthing

1.22.6.1. 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 Department's authorised representative, who may require additional earthing to meet test standards.

1.22.6.2. In order to achieve the desired resistance of less than 10Ω, interconnected electrodes would have to be installed in the form of an earth grid.

1.22.6.3. The earth grid shall consist of a number of electrodes buried to a specified depth (quantity and depth are dependent on soil resistivity tests to be done by specialist) and interconnected in a linear array with bare copper earth wire.

1.22.6.4. The earth mat resistance for the transformers, generators and sensitive equipment should be less than 1Ω.

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

1.22.6.6. Alternatively or additionally earth rods or trench earths may be required as specified or directed by the Department's authorised representative.

1.22.6.7. 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 dependent on the application.

1.22.6.8. 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 authorised 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. If metallic conduit is used then it needs to be bonded accordingly.

1.22.6.9. All other metallic 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.

1.22.7. Roofs, gutters and down pipes

1.22.7.1. 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.

1.22.8. Sub-distribution boards

1.22.8.1. 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.

1.22.9. Sub-circuits

1.22.9.1. The earth conductors of all sub-circuits shall be connected to the earth busbar in the supply board in accordance with SANS 10142. If earth continuity cables are used for motor loads then an additional earth cable will still be required for additional safety.

1.22.9.2. The minimum standard for the earthing protective conductor as follows:

a) For phase cables cross sectional area less than 16mm², the protective conductor will be the same as for the phase cable.

b) For phase cables between 16 and 35mm² the protective conductor will be 16mm².

c) For phase cables larger than 35mm², the protective conductor will be half the phase cable with the minimum of 16mm².

1.22.10. Ring Mains

1.22.10.1. 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 Department's authorised representative. 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.

1.22.11. Non-metallic Conduit

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

1.22.11.2. 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.

1.22.12. Flexible Conduit

1.22.12.1. 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.

1.22.13. Connection

1.22.13.1. 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.

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

1.23. LIGHTNING PROTECTION SYSTEM

1.23.1. The lightning protection risk assessment must be done by the specialist to validate the assumptions of the design engineer in the concept design.

1.23.2. The lightning protection system must be installed by a Lightning Protection System Specialist. Prior to carrying out the installation, the specialist must test the soil resistivity of the site and report to the Department's authorised representative on the sufficiency of the concept design for the site conditions.

1.23.3. The lightning protection is the primary protection against direct or indirect strikes that induce overvoltage. The secondary protection will consist of surge arrestors in the distribution boards.

1.23.4. The Lightning protection system must be done in accordance with SANS 62305, 62561 and SANS 10313.

1.23.5. The lightning protection system will consist of an aerial conductor system, down conductor system, test points and an earthing systems that consists of earth rods, spikes or plates.

1.23.6. The specialist must test the resistance to earth of each earth electrode and of the complete lightning protection system. This resistance must be less than 10Ω.

1.24. MOUNTING AND POSITIONING OF LUMINAIRES

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

1.24.2. 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 authorised representative. The contractor is responsible to ensure that the luminaries are free of damage, debris and is installed in an aesthetic manner. The contractor is to ensure that the fixing of suspended luminaire are correct and safe to prevent the falling of fittings, there should be an additional safety wire connection in accordance with the manufacturer's requirements to ensure additional safety.

1.24.3. Incandescent and Fluorescent luminaires are not permitted to be installed in any installation in accordance with the requirements of SANS 204, 10400 XA and Green building policy.

1.25. INSPECTION, TESTS AND COMMISSIONING

1.25.1. On completion of the erection and installation of 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 Department's authorised representative, any defects which may arise.

1.25.2. The contractor to inspect and test the services installation in accordance with the Wiring Code, the Regulations of the Supplier of Electricity and the Occupational Health and Safety Act 85. Record test results on printed test sheets and submit to the Department's authorised representative.

1.25.3. The Contractor must 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.

1.25.4. The following tests should be conducted in accordance with regulation but are not limited to the following unless otherwise indicated:

a) Ensure correct polarity, verify polarity and phase identification.
b) Continuity and resistance of earth conductor including all bonding conductors.
c) Continuity of ring circuit.
d) Earth electrode resistance.
e) Insulating resistance of the cable.
f) Earth fault loop impedance test.
g) Operation of earth leakage protection devices and circuit breakers.
h) Earthing and lightning protection
i) Luminosity test
j) Equipment test
k) Generator and UPS testing
l) Electronic system testing
m) ICT system testing

1.25.5. After inspection and testing, timeously arrange for any inspection and test by the Supplier of electricity if required, and assist as necessary the Inspector of the Supplier of electricity by providing access, tools, instruments and attendance.

1.25.6. Replace any portion of the services installation that does not comply with the Wiring Code or the Specification. Such replacement shall be done at the Contractor's expense.

1.25.7. Submit a "Certificate of Compliance by an accredited person" Annexure 1 in terms of the Occupational Health and Safety Act 85, Electrical Installation Regulation 1992, to the Client and forward a copy to the Engineer.

1.25.8. Timeously (at least 14 days) advise the Department's authorised representative of all inspections and tests as the Department's authorised representative reserves the right to witness such inspections and tests. The Department's authorised representative shall have the power at any time to examine any part of the works or materials intended for use in or on the works either on site, or at the place of manufacture or storage.

1.25.9. On completion of the works, the contractor shall submit three indexed volumes of operation and maintenance manuals to the Department's authorised representative.

1.25.10. All information must be recorded and provided in electronic format with DWG drawings formats to the Department.

1.25.11. Approval of the final Operations and Maintenance Manuals should be a prerequisite for issuing of a Certificate of Practical Completion of the installation.

1.25.12. The Manuals should contain the following information if applicable:

a) Cover Page
b) Contact Personnel & Emergency contact personnel
c) Scope of Work
d) Operating Instructions
e) Normal Operation
f) Safety Measures
g) Fault Finding Guide
h) Equipment Information
i) Schedule of Information
j) List of Spares and Agents
k) Design Data
l) Factory acceptance and site acceptance certificates
m) As Commissioned Data
n) Maintenance Requirements & Checklists
o) Manufacturers Service Recommendations
p) Manufactures Literature
q) Equipment Brochures
r) Approved Shop Drawings, Exploded Views and Wiring Diagrams
s) As Built Drawings for all systems
t) Electrical Drawings
u) System Layouts (General arrangement layouts) and Schematics
v) Certificate of compliance
w) Signed QCP(Quality control plan) documentation
x) Training Certificates/Register

1.26. VERIFICATION AND CERTIFICATION OF ELECTRICAL INSTALLATION (CERTIFICATE OF COMPLIANCE AND TEST REPORT

1.26.1. On completion of the installation, a certificate of compliance must be issued to the Department's authorised representative in terms of the Occupational Health and Safety Act, 1993 (Act 85 of 1993).

1.26.2. Certificate of completion must also be issued for Earthing and lightning protection installation and all applicable Electronic installation in accordance with South African National Standards and Occupational Health and Safety Act.

PART 2: DETAILED SPECIFICATIONS

CONTENTS

PART 2: DETAILED SPECIFICATIONS

2.1. INTENT OF SPECIFICATION

2.1.1. The objective is for the construction of carports at the existing parking area at Mdantsane Labour Centre for the client Department of Employment and Labour, Eastern Cape, South Africa.

2.2. EXTENT OF SCOPE

2.2.1. This Contract covers the manufacture, supply, factory testing, insurance, delivery, transport, handling, storing, erection, site welding and making good coatings, aligning, fixing, supporting, connecting, adjusting, guaranteeing, site testing, painting, commissioning, handing over in complete working order, providing as-built drawings, operating and maintenance instructions in triplicate, instructing staff and attending to defects for the electrical works as described in greater detail in this document and/or shown on the drawings and/or set out in the Bills of Quantities and as briefly described below:

2.2.2. The works covered by this Contract will include but not be limited to the following:

a) Decommissioning and removal of existing kiosk.
b) Installation of new kiosk with breakers and surge protection.
c) Installation of joints to existing mains and feeder cables.
d) Installation of sleeves and manholes.
e) Installation of energy efficient light fittings with photocell.
f) Installation of wire ways.
g) Installation of earthing and lightning protection system.
h) Testing, commissioning and issuing certificate of compliance

2.3. COMPLIANCE WITH REGULATIONS AND STANDARDS

2.3.1. The entire installation shall be carried out in accordance with the latest revision and amendments of the following but not limited to:

a) Electricity Regulations Act
b) Occupational Health and Safety Act with all regulations
c) Department of Public Works: General Electrical Specifications part A, B and C.
d) Department of Public Works indoor and Outdoor Generator Installation Specifications.
e) SANS 10400 – The National Building Regulations
f) SANS 10142-1 – The Code of Practice for the Wiring of Premises
g) SANS 10114-1 – Artificial Lighting of Interiors
h) SANS 10114-2 – Emergency Lighting
i) SANS 10389 – Exterior lighting
j) SANS 62305 – Protection against lightning
k) SANS 62561 – Lightning Protection System Components
l) SANS 10292 – Earthing of low voltage installation
m) SANS 10313 – Protection Against Lightning
n) SANS 1973 - Low voltage switchgear and control gear assemblies.
o) SANS 10198 - The selection, handling and installation of electric power cables of rating not exceeding 33 kV.
p) SANS 60034 - Rotating Electrical Machines.
q) SANS 8528 - Reciprocating internal combustion engine driven alternating current

2.4. NOTICES AND FEES

2.4.1. There are no notices or fees required to be paid to the supply authority due sufficient capacity of the existing supply on site.

2.5. DRAWINGS

2.5.1. 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, further clarity of the drawings are indicate in the specifications or BOQ.

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

2.5.3. Two copies of shop drawings shall be submitted to the Department's authorised representative for approval and to demonstrate compliance with contract Documents. Shop drawings are drawings, diagrams, illustration, schedules, performance charts, brochures and other data which are prepared by the contractor, manufacturer, supplier or distributor and which illustrate some portion of the work.

2.5.4. The Department's authorised representative's approval of shop drawings or samples shall not relieve the contractor of responsibility for any deviation from the requirements of this contract unless the contractor has informed the Department's authorised representative in writing of such deviation at the time of submission of shop drawings or samples and the Department's authorised representative has given written approval for the specific deviation, nor shall the Department's authorised representative's approval relieve the contractor of responsibility for errors or omissions in the shop drawings or samples.

2.5.5. A complete set of the drawings shall be issued to the contractor after installation to be marked up by the contractor to indicate the "As-Built" installation as a prerequisite to completion.

2.5.6. **Schedule of Drawings**

No.	Title	Drawing Number
1	Reticulation Layout	E202415/001
2	Lighting Layout	E202415/002
3	Earthing and Lighting protection Layout	E202415/003
4	Single line Diagram	E202415/004

2.6. CLIMATIC CONDITIONS

2.6.1. All equipment offered must be de-rated for the conditions below, the climate conditions must be validated by the contractor.

Location	Design Condition	Design Condition Value
981 Mdantsane Access-Weg,		
Mdantsane Unit 1,	Altitude	220 m
Mdantsane, 5219	Maximum ambient temperature	30 °C
	Minimum ambient temperature	5 °C
	Maximum ambient humidity	90%

2.7. MAINTENANCE OF ELECTRICAL SUPPLY

2.7.1. 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, client and the Department's authorised representative.

2.8. SUPPLY AND CONNECTION

2.8.1. The site is fed from a 100A three phase kiosk located within the boundary, the kiosk is an obstruction to the new parking area hence it will have to be relocated.

2.9. BALANCING OF LOAD

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

2.10. DISTRIBUTION BOARDS

2.10.1. **General**

a) 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.

b) 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.

c) 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 be equipped in accordance with the Single Line Diagrams and must be approved by the Department's authorised representative prior to installation.

d) The doors and architrave of the Distribution Boards shall be painted as per the schedule.

e) All distribution boards shall have a minimum of 30% spare space. Where circuit breaker sizes are shown for spare ways on the single line diagrams, these circuit breakers shall be fitted at time of manufacture.

2.10.2. **Internal wiring**

a) Standard 600/1000 V grade PVC-insulated stranded annealed copper conductors to SANS 1507 shall be used for the internal power wiring of switchboards. The smallest conductor size to be used for power wiring in switchboards shall be 2.5mm². Flexible cord of minimum size 1,0mm² may be used for control wiring.

b) Where heat generating equipment is present and the internal temperature of the board is likely to exceed 50°C, silicon-rubber insulated stranded conductors shall be used.

c) Wiring shall be arranged in horizontal and vertical rows and shall be bound with suitable plastic straps 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.

d) Bunched conductors shall be neatly formed to present a uniform appearance without twisting or crossing the conductors. Conductors leaving the harnesses shall be so arranged that they are adjacent to the chassis.

e) All wiring between different panels within the same switchboard shall be installed in wiring channels.

f) Grommets shall be installed in each hole in the metal work through which conductors pass.

g) 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.

h) Where conductors change direction, smooth bends shall be formed with a radius of at least 5 times the outside diameter of the conductor or harness.

i) Where neutral connections are looped between the terminals of instruments, it is essential that the two conductor ends be inserted into a common lug or ferrule 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.

j) Wiring should as far as possible be confined to the front portions of switchboards for ease of access. This requirement is important for wiring between smaller circuit-breakers and the associated main circuit-breaker as well as the wiring from circuit-breakers to lighting and socket-outlet circuits.

k) A maximum of two conductors will be allowed per equipment terminal. In the event of more conductors being connected to the same equipment terminal (e.g. a main circuit-breaker feeding other circuit-breakers), stub bus-bars shall be provided for the various conductors.

2.10.3. **Load End Connections**

a) The supply end connections to all equipment shall under all circumstances be at the top and the load end connections at the bottom.

2.10.4. **Wiring to Circuit-breakers**

a) Equipment with a rating exceeding the current rating of 70mm² conductors shall be connected by means of bus-bars to the main bus-bars. Looped connections may only be installed for a maximum of two outgoing circuits. Where there are more than two outgoing circuits, busbars shall be used and equipment connected individually to the bus-bars. Where miniature circuit-breakers are mounted in continuous rows and supplied by bus-bars connected to each MCB. each busbar shall be supplied by a separate conductor. This conductor shall be connected to the busbar by means of a separate lug and not via an MCB terminal.

2.10.5. **Identification**

a) The colour of the conductors for all 220/250 V circuits shall correspond to the colour of the supply phase for that circuit. Neutral conductors shall be black.

b) All other conductors in the board, supplying control circuits, etc. shall be coded in colours other than those specified above. A colour code shall be devised for each board and the

colour code shall be shown on the wiring diagrams.

c) All conductors that terminate at wiring terminals and all conductors used for the internal wiring of the switchboard shall further be identified at both ends by means of durable cable marking ferrules. PVC or other tape is not acceptable.

d) The numbers on the markers shall be shown on the wiring diagrams.

2.10.6. **Labelling**

a) All distribution boards shall be provided with a legend card and holder. The legend card shall be typed and laminated, and shall indicate as a minimum the circuit breaker number, the circuit type (e.g. Lighting, Power, Air Conditioning, etc), the Circuit Number as shown on the drawings, and a brief description of the circuit. For example, a lighting circuit shown as L1 on the drawings and fed by circuit breaker number 1 shall be labelled as follows:

CB1 L1 - Lighting Area

b) All distribution boards shall be labelled with an engraved label, detailing the distribution board name, where the distribution board is fed from, the cable size, the Fault Level and the phase rotation, e.g.

DB Name: DB 2
Fed from: DB 1
Size of phase cable: 16 mm² x 4C PVC/ECC/SWA
Size of earth cable: 16 mm²
Fault Level: 5kA
Phase Rotation: Clockwise

c) Cascading labels shall be used for all sub-distribution boards with a nominal fault level of over 5kA, as well as on the Main LV Board.

2.10.7. **Schedule of Distribution Boards**

a) 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 (Electrical Rooms)/ White (buildings).
- **Standby power**: Signal Red, colour A11 of SANS 1091.
- **No-break supply**: Dark Violet, colour F06 or Olive Green, Colour H05 of SANS 1091.

b) Indicated is the probable fault level rating (kA) of the busbars. Refer to the single line diagram for the minimum fault level rating of specified equipment and details.

No.	Board	Mounting	External Colour	Fault Level (kA)
1	DK-1	Floor mounted	Municipal requirements/ tan	5KA

2.11. CABLES

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

2.11.2. 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.

2.11.3. 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.

2.11.4. 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.

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

2.11.6. 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.

2.11.7. 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.

2.11.8. 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.

2.11.9. 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.

2.11.10. 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.

2.11.11. **Laying, jointing and making off of electrical cables**

2.11.11.1. 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 Department's authorised representative.

2.11.11.2. 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.

2.11.11.3. 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.

2.11.11.4. 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:

a) 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.
b) That the joint pit is dry and that all loose stones and material are removed,
c) That the walls and banks of the joint pit are reasonable firm and free from loose material which can fall into the pit.
d) That the necessary coffer-dams or retaining walls are made to stop the flow of water into the joint pit.
e) That the joint pit is provided with suitable groundsheets so that the jointing work is carried out in clean conditions.
f) 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.
g) 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.
h) That the cables and other materials are dry, undamaged and in all respects are suitable for the joint work or making off.
i) 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).
j) 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.
k) 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).

2.11.11.5. 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.

2.11.11.6. 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.

2.11.11.7. 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.

2.11.11.8. The joint or making off of paper insulated cables must not be commenced during rainy weather.

2.11.11.9. Once a joint is in progress the jointer must proceed with the joint until it is complete and before he leaves the site.

2.11.11.10. The jointer must ensure that the material and his tools are dry at all times, reasonably clean and absolutely free from soil.

2.11.12. **Relating to the jointing of the cable the following requirements apply:**

a) 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.
b) 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.
c) 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.
d) 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.
e) Use resin only as a flux. The slot opening in the ferrule must be completely filled, including all depressions.
f) 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.
g) 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.
h) 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.
i) 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.
j) 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.
k) 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.
l) 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.
m) 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.

2.11.13. **Schedule of cables, conduit and wiring**

a) Supply, install and connect the following feeder and sub-feeder cables, conduit and wiring which are indicated in detail on the single line diagram:

No.	FROM	TO	CABLE SIZE	ESTIMATE LENGTH (m)	PHASE	CURRENT (A)	VOLT DROP (%)
1	Municipal Kiosk	DK-1	25mm² 4-core ECC	60	Three	75,29	1,71
2	DK-1	EXT-1	25mm² 3-core	20	Single	0,07	0,2

2.12. SWITHCHGEAR

2.12.1. All circuit breakers shall be of the same manufacture throughout.

2.12.2. All circuit breakers installed in the Meter Kiosk and Distribution Boards shall have an ultimate breaking capacity suitable for the installation, and shall not rely on cascading. All circuit breakers shall have standard breaking capacity trip curves. Circuit breakers with a nominal current rating of 100 to 250 Amps shall be equipped with an integral thermal magnetic trip unit, with adjustable long time and short time protection.

2.12.3. All switchgear to be installed in accordance with the single line diagram and approved distribution shop drawings.

2.13. LIGHT FITTINGS AND LAMPS

2.13.1. The installation and mounting of luminaires must conform to SANS 10114, 10389 and OHS ACT.

2.13.2. All fittings to be supplied by the contractor shall have the approval of the Department prior to installation.

2.13.3. All luminaires supplied must have the SANS-1464 mark.

2.13.4. All luminaires supplied shall be LED fittings with reputable drivers and lamps.

2.13.5. All luminaires shall be submitted for approval, prior to orders being placed. Photometric data shall accompany each fitting with a LM79 report.

2.13.6. All luminaires shall be power factor corrected to a minimum of 0.85.

2.13.7. The light fittings must be of the type specified in the schedule of light fittings below.

2.13.8. The light fittings must be of the type specified in the Schedule of Light fittings as are generally utilized in a building environment as listed within the following table. All luminaires are to be approved and tested by the South African Bureau of National Standards (SABS). Luminaire testing certificates are to accompany each proposal by contractor.

2.13.9. **Schedule of light fittings**

No.	Type	Description	Areas	Picture
1	G2	24W, IP65, external bulkhead LED luminaire with die-cast aluminium housing, high impact acrylic diffuser, 2620lm, 4000k with CRI>80, PF>0.85 with reputable driver. Lifespan greater than 50 000 hours.	External - Carport	

2.14. WIRE WAYS, WIRING CHANNELS AND POWER SKIRTING

2.14.1. General

2.15.1.1. All wire ways will be designed to ensure conformity with SANS 10142 and the following percentage of utilisation will not be exceed:

a) 40% for conduit
b) 35% for ducting
c) 45% for trunking

2.15.1.2. In accordance with SANS 10198-4 the minimum burial depth of cables to the centre of the cable or sleeve at an ambient temperature of 30^0C , soil temperature of burial depth of 25^0C and a thermal resistivity of 1,2K.m/W as follows:

a) 500mm for 600/1000V cables
b) 800mm for greater 1000V Medium voltage cables

2.15.1.3. The bedding will be a minimum of 150mm thick for all sleeves and cables.

2.14.2. Sleeves

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

2.15.2.2. 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.

2.15.2.3. The main feeder cable, area lighting and water tank control panel feeds will be contained in uPVC Kabel flex electrical sleeve to serve as additional protection for the cables as indicated on the drawings.

2.14.3. Conduit

2.15.3.1. Surface mounted galvanized steel conduit will be utilized throughout the installation on the structure and PVC conduit will be utilized in the ground, the conduit will be coupled with PVC junction box. The following conduit sizes will be utilised:

a) 25mm for lighting

2.15. EARTHING AND LIGHTNING PROTECTION SYSTEM

2.15.1. Earthing and Equipotential Bonding System

2.16.1.1. The Earthing and Bonding shall be done in accordance with SANS 10313 and SANS 10292.

2.16.1.2. The overall bonding between all metallic parts of wire ways, pipes etc will be less than 0,2 ohms.

2.16.1.3. **Earthing Scheme**

2.16.1.4. **Earth Ring**

2.16.1.5. **Main Earth Terminals**

2.16.1.6. **Circuit protection**

2.15.2. Lightning Protection System

2.16.2.1. The provision of a lightning protection system is mandatory for this installation based on the risk assessment.

2.16.2.2. The Lightning Protection System shall be done in accordance with SANS 62305, 62561 and SANS 10313.

2.16.2.3. The LPS will be designed by the specialist when the soil resistivity testing is done, and the complete system will be installed, tested, commissioned and a COC provided by a specialist installer.

2.16.2.4. The overall lightning protection resistance will be less the 10 ohms.

2.16.2.4.1. **Aerial Conductor system**

2.16.2.4.2. **Down Conductor system**

2.16.2.4.3. **Test points, coupling and clamping system**

2.16.2.4.4. **Earthing rod system**

2.16. GENERATOR

2.16.1. There will be no emergency backup power in this installation in accordance with the procurement instruction.

2.17. UNINTERRUPTED POWER SUPPLY (UPS)

2.17.1. There is no UPS for this project.

PART 3: ELECTRICAL WORK MATERIAL SCHEDULE & DATASHEETS

3.1. The Contractor shall complete the following schedules, provide datasheets and submit them to the Department's authorised representative within 21 days of the date of the acceptance of the tender.

3.2. The schedules will be scrutinised by the Electrical Engineer and should any material offered not comply with the requirements contained in the specification, the contractor will be required to supply material in accordance with the contract at no additional cost.

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

Item	Material	Make or trade name	Country of origin
1.	Distribution boards		
2.	Circuit breakers 1P, 2P, 3P		
3.	On load isolators without trips		
4.	Contactors 1P, 2P, 3P		
5.	Earth leakage relays 1 & 3 phase		
6.	H.R.C. fuse switches		
7.	Kilowatt hour meter		
9.	Voltmeter		
10.	Maximum demand ammeter		
11.	Daylight sensitive switch		

13.	Conduit		
14.	Conduit boxes		
21.	luminaires		
23.	Bulkhead fittings: Type F		
24.	Spherical fittings: Type G		
30.	PVCA cable		

PART 4: NOTES FOR CONSULTANTS/INHOUSE DESIGN TEAM

4.1. INTENT

4.1.1. The intent of this document is to provide a guideline for the preparation of specifications for the Department, the information of the specifications and the final specifications that is produced is still the responsibility of the Engineer or consultant engineer.

4.2. PARTICULARS OF ELECTRICAL CONTRACTOR

4.2.1. Please ensure that DPW -22(EC) Particulars of electrical contractor is inserted in main tender document.

4.3. BILLS OF QUANTITIES (BOQ)

4.3.1. Electrical, mechanical and/or any other engineering work must be measured and be prepared in accordance with the latest edition of the Standard System of Measuring Building Work.

4.3.2. The Sample schedule in this document can be used as a guide.

4.3.3. No additional provision for provisional sums may be included in the engineering sections of the bills of quantities unless for specialised work.

4.3.4. Unless otherwise stated the description on of each item shall be deemed to include manufacturing, conveying and delivering, unloading, storing, unpacking, hoisting, setting, fitting and fixing in position, cutting, waste, patterns, templates, plant, temporary works, return of packings, establishment charges, profit and other obligations arising out of the conditions of contract.