

AFRICA'S FIRST AUTOMOTIVE CITY

TASEZ PHASE 2: ELECTRICAL BULK SERVICES INFRASTRUCTURE PROJECT

BULK INFRASTRUCTURE SERVICES TECHNICL SPECIFICATIONS

EXTERNAL INFRASTRUCTURE SERVICES

13th August 2025





TASEZ Phase 2 Development Programme

Bulk Infrastructure Services Technical Specifications

External Infrastructure Services

SECTION A

5A1 SCOPE OF WORK

1. Electrical Infrastructure Scope of Works

The electrical bulk services infrastructure scope of works will include the following:

2. Watloo Infrastructure Network

- 2.1. The supply, delivery to site, offloading, placing into final position, installation and guarantee of all the electrical bulk services and associated loose equipment, MV cables, fibre optic communications cables, as specified in this document and accompanying drawings.
- 2.2. Supply & install 4 new MV Panels complete with all associate metering & control units.
- 2.3. Supply & install 4 x 300mm² x 3 core Al 11kV cables from Waltloo Substation to new distribution substation on Erf 179.
- 2.4. Trenching, backfilling and compacting of cable routes for MV cabling.
- 2.5. The reinstatement of roadways, driveways, paving and gardens required once the MV reticulation has been installed.
- 2.6. Build a brick build \$1 substation complete with 11kV switchgear on Erf 178 as indicated on the schematic diagram & layout plan.
- 2.7. Sleeves, horizontal drilling and road crossings.
- 2.8. Supply & install a 25mm² x 4 core PVC insulated AI ECC cable from minisub to streetlights as per layout drawings & schematic diagram (future extension to Vonkprop Road)
- 2.9. Streetlighting installation to future extension to Vonkprop Road.
- 2.10. Supply and installation of a SCADA communications and control system to new MV infrastructure including fibre optic cable to City of Tshwane requirements.
- 2.11. Testing, commissioning and handover of the bulk supply infrastructure to CoT on completion of the project.

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3. <u>Nellmapius Substation Infrastructure Network</u>

- 3.1. Supply & install a 4MVA metering type RMU for Erf 173 as per layout plan & schematic diagrams
- 3.2. Supply & install a 4 MVA metering type RMU for Erf 174 as per layout plan & schematic diagrams
- 3.3. Supply & install a 500 kVA 11kV miniature substation for Erf 176 as per layout plan & schematic diagrams
- 3.4. Earthing system to substations and MV reticulation.
- 3.5. Trenching, backfilling and compacting of cable routes for MV cabling.
- 3.6. The reinstatement of roadways, driveways, paving and gardens required once the MV reticulation has been installed.
- 3.7. Supply and installation of MV cable network infrastructure to CoT specifications and standards.
- 3.8. Sleeves, horizontal drilling and road crossings.
- 3.9. Supply and installation of a SCADA communications and control system to new MV infrastructure including fibre optic cable to City of Tshwane requirements.
- 3.10. Testing, commissioning and handover of the bulk supply infrastructure to CoT on completion of the project.

5A2 NATURE AND SCOPE OF WORKS

1. General

This Technical Specification details the *External Infrastructure Services* for the TASEZ Phase 2 Development.

2. MV Reticulation Infrastructure

- 2.1. The MV cabling installation will be provided in a ring system configuration designed to operate with a "normally open" bus coupler. All MV cable reticulation will be designed in accordance with CoT standards and SANS requirements. The overall MV infrastructure reticulation schematic is depicted on the technical drawings included in this RFQ.
- 2.2. MV cabling from the CoT Waltloo 123/11 kV substation to the TASEZ Phase 2 Development 11 kV bulk distribution substation will consist of 4 x 300mm2 3-core Al 11 kV XLPE cables supplied and installed in a ring formation to City of Tshwane specifications and standards.

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- 2.3. The proposed MV cable route for the installation of these cables is depicted on the technical drawings, included in this RFQ, and terminated in the Watloo substation on the new MV feeder switchgear and in the TASEZ Bulk Distribution Substation in the CoT Incomer switchgear.
- 2.4. The MV cable installation will include cable joints and terminations on both ends of the feeder cables.
- 2.5. All cables will be tested in accordance with SANS and CoT requirements prior to energization and commissioning.

3. Trenching and Reinstatement of Existing Infrastructure

- 3.1. All trenches for MV cabling shall be a minimum of 600 mm wide and 1 000 mm deep. MV cables will be laid in accordance with the detailed trenching detail indicated on the technical drawings included in this RFQ. All trenches are to be backfilled and compacted in 150mm layers to 91% MOD ASHTO with compaction test results being forwarded to the Electrical Engineer for approval.
- 3.2. Provision has been made for horizontal drilling and the installation of 160 mm diameter sleeves to an anticipated road crossings identified on the cable route. Provision has been made for the re-instatement of gardens and walkways together with driveway crossings identified on the cable route. A methodology for the HDD is detailed in this technical specification.
- 3.3. MV cable route markers shall be provided every 100m and when the route changes direction. The cable markers shall be encased in concrete and shall be buried at least 250mm below final ground level and shall protrude by at least 150mm.
- 3.4. Provision has been made in the provisional Bills of Quantities for the reinstatement of existing driveways, paving, landscaping and infrastructure on completion of the trenching and cable installation.

5A3 COMMENCEMENT OF INSTALLATION

Construction work will commence on site as soon as all tender procedures are complete, and the successful tenderer will be required on site shortly after the Sub-Contract is awarded.

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Technical Specification: External Bulk Electrical Infrastructure Services



5A4 SCHEDULE OF DRAWINGS

Tender drawings are indicated on the drawing register and are issued as part of this RFQ.

5A5 HANDOVER OF PROJECT

Upon final handover of the project the electrical contractor shall provide 3 x sets of comprehensive as-built drawings, maintenance manuals together with a full set of infrared scans of all distribution boards as well as the MV equipment and installation.

All documentation is to be prepared in both hard and soft copies. Kindly note that the contract will not be considered complete until such documentation is accepted by the Electrical Engineer and Client.

5A6 COMMISSIONING

The Contractor shall allow to commission the entire MV installation in terms of SANS 0142 specifications together with the Engineers and City of Tshwane.

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SECTION B

MV Reticulation Infrastructure – Detailed Specification

5B1 DETAILED SCOPE OF WORK

This contract is for the supply, delivery to site, offloading, placing into final position, installation and guarantee of all the streetlights and associated loose equipment, LV cables, pilot cables, as specified in this document and accompanying drawings.

1. <u>Watloo 3 Network</u>

- 1.1. Supply & install 4 new MV Panels complete with all associate metering & control units.
- 1.2. Supply & install 4 x 300mm² x 3 core Al 11kV cables from Waltloo Substation to new distribution substation on Erf 2.

2. Nellmapius / Eerste Fabriek Network

- 2.1. Supply & install a 4MVA metering type RMU for Erf 173 as per layout plan & schematic diagrams
- 2.2. Supply & install a 4 MVA metering type RMU for Erf 174 as per layout plan & schematic diagrams
- 2.3. Supply & install a 500 kVA 11kV Mini Substation for Erf 176 as per layout plan& schematic diagrams

5B2 LOCATION OF SITE

The site is situated in Watloo, bordering Propshaft Road & existing Bronkhorstspruit Road. Tenderers are advised to visit the site to acquaint themselves with the local conditions access to site etc.

5B3 ACCEPTANCE AND ADJUDICATION OF TENDERS

- Tender bids shall be submitted on the Form of Tender provided, and the total amount shall correspond with the total amount entered in the Schedule of prices. The latter shall be completed in full, the Tenderer clearly stating "no quote" against any item for which a bid is declined.
- The Employer reserves the right to accept offers from different suppliers, and the prices offered against each item shall not be affected by the acceptance or not of the other items.

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The Tenderer shall submit samples of equipment offered, if requested to do so, for inspection and approval by the Engineer.

5B4 GUARANTEE

- The Supplier shall include in his tender bid any and all costs involved to ensure that all equipment and materials are unconditionally guaranteed for a period of 12 months from the date of practical completion of the Contract
- 2. Such guarantee shall cover all labour and materials to repair equipment in situ within one day of notification of failure. Any defects not remedied within a reasonable time will be effected at the Suppliers risk and expense on the instruction of the Engineer, but without prejudice to any other rights against the Supplier.
- 3. The Engineer reserves the right to demand the replacement or making good by the Supplier of any part of the equipment, which is shown to have any latent defect, or not to have complied with the Specification, notwithstanding the fact that such equipment has been taken over or the guarantee period having expired.

5B5 WAYEAVES

- 1. The tenderer shall be responsible to obtain all necessary wayleaves based on the cable route indicated on the drawings.
- 2. The tenderer shall ensure that the wayleaves are approved by all Departments prior to commencing installation of the streetlight cables.

5B6 AS-BUILT DRAWINGS

- 1. The electrical contractor shall carry out a final as-built survey of the cable and all other installations, including conduit and draw boxes, outlets etc. and submit to the engineer as-built route plans of the complete installation. The following information shall be reflected on the plans or be submitted as separate schedules along with the plans:
 - 1.1. Overall length of each cable.
 - 1.2. Locations of all joints in relation to permanent reference points.
 - 1.3. Locations of all cable markers in relation to permanent reference points.
- 2. The work will be deemed incomplete until all as-built drawings and information have been submitted to the Engineer.

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5B7 VOLTAGE CHECK

Upon switch-on by City of Tshwane the Contractor shall establish the voltage and ensure that transformer tap settings are correct before energising the LV systems.

5B8 BALANCING OF SUPPLY

The Electrical contractor shall ensure that the entire installation is balanced as closely as possible and report the readings to the Engineer in writing

5B9 MAINTENANCE AND INSTRUCTION MANUALS

The Electrical contractor shall prepare and hand hand-over to the Engineer on practical completion 3 x sets of operating and maintenance instruction manuals.

5B10 INSTALLATION

The entire installation shall comply with the requirements of SANS 10142 Code of Practice (as amended), as well as those of the local authority.

5B11 CABLES

- 1. Positioned on northern and western side of the roads at a distance of 2m from the erf (road reserve) boundary.
- 2. Depth for MV cables is 600 mm wide x 1 000 mm deep.
- 3. All cables shall be labelled at both ends. (Refer to City of Tshwane specifications).

5B12 SLEEVES FOR CABLES

- All township roads and new driveways (where positions are known) shall be crossed with 160mm diameter uPVC sleeves where cables are larger than 95 mm² x 4 Core. Cables being 95 mm² x 4 core and smaller may be installed in 110mm diameter uPVC sleeves.
- 2. All sleeves shall be equipped with 2mm diameter galvanised steel draw wires.
- 3. All sleeves shall be sealed with Styro-foam to avoid ingress of ground and dirt.
- 4. Road crossing shall be strictly in accordance with City of Tshwane specifications.
- 5. Service cables for one domestic unit where the distance is less than 5m from the CMK to the erf boundary shall not be installed. A 50mm diameter sleeve with a slow bend into the CMK must be provided from the CMK which extends 500mm into the erf at a depth of 600mm.
- 6. Only one distribution cable and a maximum of three (3) domestic service cables are allowed per sleeve.

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5B13 SITE FACILITIES AVAILABLE

- Potable water, stormwater, sewer, communication and electrical services are available near the site. The Contractor shall make the necessary arrangements and pay for the required services and for any reticulation and connections and metering and maintenance which may be needed in order to utilise these services.
- 2. No illegal water or electricity connections are permitted, and all connections shall be in terms of the current Municipal By-laws and regulations. The Employer accepts no responsibility for shortages of any of these axillary services and/or facilities due to any cause whatsoever and the cost of arranging auxiliary power or water supply shall be solely borne by the Contractor and it shall be deemed that the costs of providing such services and/or facilities are covered in the rates tendered.
- 3. The Contractor shall be responsible for supplying his own sanitary facilities at his own cost for the remainder of the Contract and such cost will be deemed to be covered in the rates tendered in the Schedule of Quantities. The Contractor shall ensure that the facilities are kept in a clean and sanitary condition at all times.
- 4. Under no circumstances may the Contractor's staff make use of the surrounding buildings, structures, grounds or vegetation as a sanitary facility or litter/wastage disposal area.

5B14 SITE FACILITIES REQUIRED

- One SAICE type notice board be supplied and erected on site, maintained and removed after completion of the works. A venue for the purpose of holding site meetings must be provided.
- 2. This venue can be an office with a desk, six chairs and ventilation where the resident engineer can meet with the contractor and hold site meetings.

5B15 FEATURES REQUIRING SPECIAL ATTENTION

1. Dealing with Traffic

The contractor has to maintain the flow of traffic while ensuring the safety of the road users at all times during the construction period. The Contractor shall furthermore ensure that the accommodation of traffic and other ancillary works comply with the requirements of City of Tshwane Metropolitan Council Roads

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Department, SANS 1200 and the South African Road Traffic Signs manual Volume 2 chapter 13.

2. Existing Services

- 2.1. The Contractor must expose all existing services that lie within the area of the works and protect these services throughout the construction period. Exploratory trenches must be hand excavated in the road reserve at regular intervals in such a way that the position and depth of the existing services can be established where excavations will take place.
- 2.2. Although every effort has been given to mark the existing services on the drawings, the contractor must be aware that the possibility exist that unmarked services can be encountered.
- 2.3. Existing services are to be protected and relocated if necessary. The contractor is responsible for contacting the service providers before construction commences and to locate the existing services in liaison with the service providers.

5B16 HEALTH & SAFETY

- 1. This Contract requires strict compliance with the Occupational Health and Safety Act, 1993 and the Construction Regulations 2014, related thereto.
- 2. During preparations of his tender, special attention must be given by the Tenderer to Special Conditions of Contract 1.2, and to the Health and Safety Specification bound into this document. The rates entered in the various items making up the Works and particular items in the Preliminary and General Section in the Schedule of Quantities will be assumed to make due allowance for such compliance and no further monies will be paid to the Contractor for such compliance.
- The Contractor shall ensure at all times that his operations do not endanger any
 property or any member of the public, Employer's staff or staff of adjacent
 businesses, residences, road users and pedestrians.
- 4. The Contractor shall liaise with the Employer to determine the particular Health and Safety rules and regulations pertaining to Main Road site and acquaint himself and his staff therewith and comply with these at all times.
- 5. The Contractor shall ensure that all personnel and equipment are fitted with the correct safety equipment and fittings as described in the Health and Safety Act

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- and Construction Regulations and identified in terms of the Health and Safety Specification and the Contractor's own risk assessments.
- 6. The Contractor shall appoint the required safety officers to ensure Health and Safety Act compliance at all working areas within the site for the entire contract.
- 7. The Contractor is to ensure that all safety clothing, i.e. hardhats, safety boots, dayglow vest, gloves, eye protection etc. as required are used by all his staff, Subcontractors' staff and other visitors to the areas of work within the site at all times and shall ensure that sufficient additional personal protective
- 8. clothing is available within the site offices for use by all parties present at the site meetings and site visits.
- Access to the site shall be restricted to the Contractor's and his Sub-contractors personnel and to the authorized agents and authorized staff of the Employer.
- 10. The Contractor shall supply the Engineer with a fortnightly schedule of personnel, plant and equipment to be employed on the Contract. The Contractor shall ensure that the personnel remain within the confines of the site and the costs related thereto shall be covered by the rates tendered in the Schedule of Quantities.
- 11. Should the Contractor not comply with the Occupational Health and Safety Regulations, the Engineer or his representative may instruct the Contractor to suspend all work to the site until the regulations are complied with, the cost of such standing time being for the account of the Contractor.

5B17 MATERIALS ON SITE

No materials on site will be paid for.

5B18 INVOICES

Invoicing is to be provided as per the conditions of contract and notes to tenderers.

5B19 VARIATION ORDERS

Any variation to the contract is to be approved by the project manager before the additional work is to commence. This is to be through a formal request from the contractor accompanied by a letter from the engineer with a cost breakdown of the value of the variation order.

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5B20 APPLICABLE STANDARD SPECIFICATIONS

- 1. The South African Bureau of Standards Code of Practice for the Wiring of Premises, SABS 0142-1987, referred to herein as the `Wiring Code'.
- 2. The Machinery and Occupational Safety Act of 1983 as amended.
- 3. The Municipal By-laws and Regulations and any regulations of the Supplier of Electricity.
- 4. The Local Fire Office Regulations.
- 5. Regulations of the Department of Posts & Telecommunications.
- The applicable SABS Specifications and Codes of Practice or the BSI or IEC Specifications and Codes of Practice where no SABS Specifications or Codes of Practice exist.
- 7. The regulations of the local gas supplier where applicable.
- 8. The National Building Regulations SABS 0400 effective October 1988 as amended.

5B21 ALLOWANCE FOR SECURITY GUARDS ON SITE DURING CONSTRUCTION

- A sum has been allowed for the appointment of security guards by the Contractor
 to monitor the area of the construction works. Details of the company providing
 the security services must be submitted to the Engineer for approval. The rate will
 include for sufficient security guards for the duration of the contract, but at least
 two at any particular point in time.
- The Contractor's attention is drawn to the fact that work will occur simultaneously
 in areas remote from each other and the security arrangements shall sufficiently
 accommodate this. This sum will be only paid if security personnel are actually on
 site.

5B22 RELOCATION OF EXISTING SERVICES

- The provisional sum allowed for under PSA 3, includes for the cost of all authorised relocation carried out by the owner and/or entity responsible for the service on the instructions of the Engineer.
- 2. The Contractor will be required to pay for all relocations instructed by the Engineer and the Contractor will be reimbursed for the invoiced costs plus a mark-up as specified in the SOQ through the payment certificates. Measurement and payment will be based on invoices submitted to the Engineer.

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5B23 RELOCATION OF EXISTING TRAFFIC SIGNALS

A provisional sum has been allowed for the cost of the relocation of traffic signal poles and heads as well the provision for cabling and sleeves. The provisional sum shall also cover the cost of re-erection as directed by the Engineer.

5B24 FOR COMPLIANCE WITH HEALTH & SAFETY ACT 2003

- The sum tendered shall include for full compliance with provisions, conditions and requirements as described in Clause 1.2 of the Special Conditions of Contract, Clause PS11 of the Project Specifications and the Health and Safety Specification included as Section 11 of this document.
- 2. Payment will be made as a single instalment for fixed charge items and in monthly instalments for time related items."

5B25 REMOVE, STORE & RE-ERECT EXISTING STREETLIGHTS

- Streetlights identified to be removed will be removed, stored and re-erected in liaison with City of Tshwane. The rate shall cover the cost of careful removal of Street Lights to secure storage until reinstatement as well as the cost of reinstatement.
- 2. The Contractor shall keep an record of the exact positions where Street Lights were positioned and ensure that these are repositioned in these exact locations, the cost of which will be deemed covered by the rates tendered for this item.

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SECTION C

TECHNICAL SPECIFICATION - TYPE S1 CONSUMER SUBSTATIONS

(Single Busbars)

5C1 COMPLIANCE WITH REGULATIONS AND STANDARDS

- The MV Switchgear shall comply with the latest revisions and amendments of the following:
 - 1.1. The South African Bureau of Standards Code of Practice for the Wiring of Premises, SABS 0142-1987, referred to herein as the `Wiring Code'.
 - 1.2. The Machinery and Occupational Safety Act of 1983 as amended.
 - 1.3. The Municipal By-laws and Regulations and any regulations of the Supplier of Electricity.
 - 1.4. The Local Fire Office Regulations.
 - 1.5. Regulations of the Department of Posts & Telecommunications.
 - 1.6. The applicable SABS Specifications and Codes of Practice or the BSI or IEC Specifications and Codes of Practice where no SABS Specifications or Codes of Practice exist.
 - 1.7. The regulations of the local gas supplier where applicable.
 - 1.8. The National Building Regulations SABS 0400 effective October 1988 as amended.
- 2. No claims for extras for failure of the Manufacturer to comply with any of the regulations and standards listed above will be considered.
- Where conflict appears to exist between any of the regulations and standards listed above and the specification, refer such conflict to the Engineer in writing for his ruling.

5C2 MATERIAL AND EQUIPMENT

- All material and equipment shall conform in respect of quality, manufacture, tests
 and performance, with the requirements of the South African Bureau of Standards
 or where no such standards exist, with the relevant current Specification of the
 British Standards Institution.
- All material and equipment shall be of high quality and suitable for the conditions on site. These conditions shall include weather conditions as well as conditions under which materials are installed, stored and used.

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3. The manufacturer shall, where requested to do so, submit samples of equipment and material to the Engineer for approval before installation.

5C3 GENERAL

1. General Detail and finishing

- 1.1. All indoor MV switchboards shall be of the indoor extensible metal clad type, provided with an integral flush-mounted instrument and relay panel associated with each breaker, switch or isolator panel unless otherwise specified or approved.
- 1.2. The Contractor shall also be responsible for the off-loading, erection, levelling and grouting of all switchgear and shall provide all the necessary tools, staging, lifting tackle, etc., for off-loading, handling and installation of the switchgear, and these items shall be removed from site when erection is completed. The switchgear shall be high voltage tested after erection.

2. Switchboards - General

- 2.1. Switchboards shall be laid out electrically and physically as specified or approved and shall be vermin proof and where possible, dust proof unless otherwise specified or approved. The housing shall be made from sheet metal steel having a minimum thickness of 2mm.
- 2.2. Switchboards shall be designed to allow for extensions as indicated on the drawings, and as specified.
- 2.3. Switchboard colour shall be as specified to SABS 1091 or as approved. All interior parts of switchboards shall be finished in white. All visible control switches, etc. shall be either black or chromium plated.
- 2.4. The layout of the panels shall be such that when facing the front of the board, the sequence of panels is as stated in the schedules and / or as indicated on the diagrams.
- 2.5. Cable boxes complete with all accessories and compound must be provided to suit cable sizes as specified. All cable boxes shall be arranged for bottom entry, unless otherwise specified or approved.
- 2.6. Available space for MV switchboards is indicated on the drawings. The Contractor must ensure that switchgear can fit into the available space, with proper allowance for working space behind and alongside boards

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and sufficient room in front of the boards to allow breakers to be racked out.

- 2.7. Each circuit shall be provided with individual cubicles so arranged that accidental contact with live metal in adjacent circuits is impossible.
- 2.8. It shall be possible to make off all cables of any circuit without exposure to any live conductors on the same circuit with the busbars energised.
- 2.9. On withdrawal of circuit breakers, all live parts must automatically be covered by shutters of robust mechanical design. Provision shall be made for padlocking these shutters in the closed position. Busbar shutters shall be clearly marked "busbars" in white lettering on red.
- 2.10. All panels shall be fitted with anti-condensation heaters each provided with an isolator suitable for 240V AC operation. Easily accessible terminals shall be provided on the boards where the 240 volt AC supply can be connected. The same supply shall be used for the DC tripping unit.
- 2.11. The Contractor shall be responsible for all the wiring and terminations.
- 2.12. Suitable cable boxes for MV cables and gland trays for LV cables shall be provided on all panels. Cable boxes shall be individually earthed to the earth bar.
- 2.13. All metal parts other than those forming part of electrical circuits shall be connected to an earth bar of 40mm x 4mm section run along the bottom rear of the switchboard. The earth bar shall be earthed at both ends of the switchboard to the substation earth bar. The earthing bar shall be in an accessible position to allow for earthing of the cables. The Electrical Contractor shall ensure that the non current-carrying parts, are connected to the earth bar either by means of their mounting arrangements on the panel or by means of a special earthing conductor fitted with lugs for attaching to the earth bar.
- 2.14. To minimise the effect of electrolysis, coils shall be so placed in the circuit that they are not connected to the positive pole of a battery except through normally open contacts.
- 2.15. Where a switchboard is made up of a number of units, some with relays or instruments and others without, all units without relays or instruments shall be fitted with blank panels to present a uniform appearance.

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- 2.16. Where switchgear is provided with doors, they shall be provided with non-ferrous fasteners designed to draw the panel closed. The doors shall have at least three points of latching and shall be suitably reinforced to prevent distortion when open. Doors shall be lockable by means of a padlock.
- 2.17. Doors shall have stops to prevent overswing of the door when opening and to prevent interference with adjacent panels.

3. Type of Switchgear

- 3.1. The Contractor shall offer vacuum or SF6 insulated switchgear, unless otherwise specified.
- 3.2. Full details of equipment offered shall be submitted at tender stage.

4. Characteristics of Switchgear

1	Number of poles	3
2	Туре	As specified.
3	Rated Voltage	The switchgear shall be suitable for an earthed system for the rated voltages as set out in the project specification.
4	Rated impulse withstand voltage (peak):	75kV unless otherwise specified.
5	Fault rating	250MVA
6	Rated frequency:	50Hz unless otherwise noted.
7	Duration of short circuit:	3 seconds
8	Phase rotation:	Clockwise, Red-White-Blue, unless otherwise specified.

5. Busbars

- 5.1. Switchgear shall be single busbar type.
- 5.2. Switchgear shall be single busbar type.
- 5.3. All busbars and droppers shall be of suitable cross-section to comply with BS 159 with regard to temperature rise at the specified altitude and of sufficient mechanical strength for normal and fault conditions.
- 5.4. All busbars and connections shall be air insulated and shall be taped and / or shrouded on all straight sections and joints where possible and shall withstand the full power frequency test voltage.
- 5.5. All joints and tees in busbar connections shall preferably be made with shererised bolts, nuts and washers of not less than 12mm diameter. I0mm Diameter high tensile (black) bolts having a reference symbol "R" for the tensile range in accordance with BS970 will be accepted as an alternative.

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- In this case proof of the tensile range shall be provided during the manufacture stage.
- 5.6. The design of busbars and the overlaps and joints in busbars shall conform to the applicable SABS specification and all joints shall be made with at least two bolts.
- 5.7. Busbars and connections shall be clearly colour-marked with the respective phase colours: Red, White, Blue.
- 5.8. The busbar chamber shall be completely vermin proof.
- 5.9. Busbars extending through fire walls shall be fitted with fire barriers and shall have a fire rating of at least 2 hours.

6. Impulse Withstand and Corona Levels

- 6.1. The complete switchboard assemblies shall withstand one-fifth microsecond volt wave with a peak value of 75kV successively at sea level conditions. Certified copies of test certificates issued by a recognised testing authority in this respect shall be submitted with the tenders.
- 6.2. The ends of the busbar chamber shall be blanked off with easily removable steel covers to allow for expansion of the switchboards.

7. Auxiliary Switches

- 7.1. Equipment shall be suitable for remote indication, auxiliary switches shall be provided to give the status of the switchgear.
- 7.2. Over and above the number of auxiliary switches specified above, two normally open and two normally closed spare auxiliary switches shall be provided.
- 7.3. All the auxiliary switches on each panel shall be wired to an easily accessible terminal block at the back of each panel.

8. <u>Instrumentation and Lamp Indication</u>

- 8.1. Metering instruments shall conform to the requirements specified herein. Metering instruments and lamp indication shall be provided as specified.
- 8.2. Where indicating lamps are supplied by the batteries, it shall be separately wired from the mechanism and tripping circuits to an easily accessible terminal block at the back of a panel.

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9. Cable end boxes, clamps and terminations

- 9.1. Suitable cable end boxes and / or clamps shall be provided for the type(s) and sizes of cables as specified.
- 9.2. The Contractor shall ascertain from the Engineer before the manufacture of the panels the type and size of cable box to be used, depending of the choice of PILC cable or cross-linked polyethylene cable and copper or aluminium core cable.
- 9.3. The switchgear riser terminals shall be properly tinned.
- 9.4. Where cross-linked polyethylene cables are used, the switchgear manufacturer shall provide suitable tinned lugs, bolts, nuts and washers for the sizes of cables to be used.
- 9.5. Where paper insulated cables are used, the switchgear manufacturer shall provide suitable cast iron or sheet steel fabricated compound filling cable end boxes suitable for the sizes of cables to be used. The switchgear manufacturer shall also provide the necessary flexible or copper bar connections between the riser terminals and the cable end box terminals.
- 9.6. Cable end boxes with sealed stem bushings shall be provided. Cable boxes shall be large enough for phasing out cables. Special manufacture cable end boxes shall be used for cables larger than 120mm².

10. Earthing Arrangement

All switchgear shall be so constructed that it is possible to earth the cables. It must not be possible to earth the busbars under any circumstances.

11. Labellina

- 11.1. All switchgear shall also be provided with a similar label at the back of the panel. Where possible labels shall not be fixed to removable panels or doors.
- 11.2. All switchgear shall be provided with a manufacturer's label fixed in an easily accessible position inside the instrument panel showing the following data:
 - 11.2.1. Fault capacity
 - 11.2.2. Line Voltage
 - 11.2.3. Maximum current carrying capacity of busbars
 - 11.2.4. Maximum current carrying capacity of circuit breaker or isolator

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- 11.2.5. Voltage transformer ratio (where applicable)
- 11.2.6. Current transformer ratio and Class (where applicable)
- 11.2.7. Manufacturer
- 11.2.8. Type and serial number

12. Anti-Condensation Heaters

- 12.1. Anti-condensation heaters shall be installed in the busbar and current transformer chambers.
- 12.2. The heaters shall be supplied from the voltage transformer or an external supply where this is available.

13. Panel Wiring

- 13.1. All panel wiring shall be PVC insulated and no insulated wire shall have less than three strands. The cross-sectional area of wires shall not be less than 2.5mm.
- 13.2. Each end of each wire or control cable connection shall be provided with a ferrule and a number corresponding to that on the diagram of connections.
- 13.3. Additional red ferrules marked "T" in white, must also be fitted on all wires associated with trip circuits.
- 13.4. All terminal blocks for current transformers, relay and instrument connections shall be neatly finished and readily accessible. Terminal strips which do not rely on pinch screws rotating on the wire strands shall be provided and full details and samples of the terminal strips proposed, shall be submitted to the Engineer for prior approval.
- 13.5. The design of the wiring cleats where used, shall be such that only limited pressure can be transmitted to the wires.

14. Cable Trench Checker Plate Supports

Suitable adjustable treated angle irons shall be fitted to the bottom frame of switchgear to support the checker plates of indoor substation cable trenches.

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15. Tools

- 15.1. If the design of switchgear is such that integral earthing of cables is not possible, then suitable earthing equipment shall be provided for each type of circuit breaker and isolator for each substation or switch room.
- 15.2. Suitable testing equipment and jumpers shall be provided for the switchgear for each substation where the design of switchgear requires such equipment.
- 15.3. At least two spring charging handles, operating handles and door keys shall be provided for each substation or switch room.
- 15.4. Wall mounted brackets shall be provided for carrying the manual, operating handles and test jumpers.
- 15.5. If special tools are required, a complete set of chrome finished case-hardened spanners and special wrenches to fit every nut and bolt on the equipment supplied, shall be provided under this contract. Any special tools or keys that may be required for effecting adjustments of parts as well as all standard earthing and test equipment, shall also be provided.
- 15.6. These tools shall be accommodated in suitable, neat, properly designed, wall constructed steel equipment board with the tool positions marked. The board shall be capable of being locked by means of a padlock.
- 15.7. A fully detailed list of tools shall be supplied before delivery.
- 15.8. The tools shall not be used for the erection of the contract works.

16. Spare Fuses and Lamps

One spare fuse shall be provided for each LV fuse used on the switchgear. Two spare lamps shall be provided for each lamp type used on the switchgear. The spare lamps and fuses shall not be used by the Contractor.

5C4 CIRCUIT BREAKERS

1. General

All circuit breakers shall be of the triple-pole, vertical or horizontal isolation, drawout truck type, fitted on separate frame with wheels.

2. Ratings

2.1. The circuit breakers shall be capable of carrying the normal currents as specified at the site altitude.

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- 2.2. The circuit breakers shall be capable of interrupting the symmetrical and asymmetrical fault currents and also making and latching against the current stated on the schematic drawings at the minimum voltage specified.
- 2.3. Each circuit breaker shall be clearly marked to show the current and MVA ratings to which the breaker has been satisfactorily tested.

3. Operating Mechanisms

- 3.1. Circuit breakers shall be provided with spring operated mechanisms with handspring charging, or solenoid mechanisms as specified.
- 3.2. Spring and solenoid operated switchgear shall be provided with electrical control switches on the instrument panels for local closing and tripping as specified.
- 3.3. The total break times measured from the instant of energising the trip coil to final arc extinction shall be less than 100ms.
- 3.4. An approved method for locking the control switches in the neutral position shall be provided.
- 3.5. The circuit breakers shall be fitted with an electrical tripping push button mounted on the instrument panel.
- 3.6. If motor wound spring mechanisms and/or solenoid mechanisms are offered, then the Contractor must ensure that suitable batteries with sufficient capabilities are provided to supply the motors and/or solenoids respectively.

4. Anti-pumping

- 4.1. All circuit breakers shall be of the trip-free type and means shall be provided to prevent pumping while the closing circuit remains energised and the breaker either fails to latch or trips during closing due to the operation of the protective relays. The arrangement shall be to the approval of the Engineer.
- 4.2. Where anti-pumping relays are provided, they shall be continuously rated.

5. Closing Devices

5.1. All electrically operated closing devices shall be at least suitable for operation at any voltage between 100 percent and 80 percent of the

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nominal control voltage at the device terminals. The maximum and steady state current at nominal voltage required by each closing device shall be stated in the Schedules.

- 5.2. All operating coils of closing coil contactors shall be continuously rated. The contacts, however, may be short time rated.
- 5.3. The closing coil circuit shall be provided with a normally closed auxiliary contact which opens when the circuit breaker is latched closed, so as to prevent repeated closing signals being given to the coil.
- 5.4. Circuit breakers and contactors shall be fully interlocked such that it will not be possible to withdraw, lower or plug the units in before it is tripped. It must not be possible to close the unit before it is fully plugged in or fully withdrawn to the "test", "service" or "earth" positions. It shall also be fully interlocked against any other maloperation that might be possible and peculiar to the type of equipment offered. It shall be sufficiently interlocked to make it completely safe for operation by personnel not familiar with the equipment.

6. Tripping Devices

- 6.1. All electrical tripping devices shall be of the shunt type suitable for operation at any voltage between 120 percent and 80 percent of the nominal voltage at the device terminals. The maximum and steady state current at nominal voltage required by each tripping device shall be stated in the schedules.
- 6.2. The tripping devices of a circuit breaker, when the circuit breaker is not carrying current, shall be capable of operating satisfactory down to 50% of the nominal auxiliary supply voltage measured at the device terminals.
- 6.3. A normally open contact operated by the breaker mechanism shall be placed in series with the trip coil and shall be capable of interrupting the maximum trip coil current.

7. Indicating Services

- 7.1. A mechanical indicating device to show whether the breaker is open or closed shall be provided. The device shall be labelled ON and OFF and shall be clearly visible from the front of the panel.
- 7.2. A mechanical indicator shall also be provided to indicate whether the breaker is racked in or out.

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- 7.3. All mechanical indications shall be clearly visible from the front of the panel, otherwise additional electrical indication shall be provided.
- 7.4. In all cases positive indication must be provided.
- 7.5. All circuit breakers shall be clearly marked to indicate the correct panel into which each unit should be plugged.

8. Isolating Devices

- 8.1. Circuit breaker spouts and sockets shall be such that all circuit breakers of similar type and current rating shall be interchangeable. It shall not be possible to insert a circuit breaker into a higher rated circuit.
- 8.2. All fixed portions of isolating devices and connections thereto shall be of the same current rating as the associated circuit breaker.
- 8.3. Automatically operated shutters shall be provided so that on withdrawal of the circuit breaker spouts, these shutters cover the sockets automatically to prevent inadvertent contact with live busbars.
- 8.4. Facilities shall be provided for padlocking the circuit breakers in the "racked in" and "racked out" position and also the spout shutters.
- 8.5. With units withdrawn to the "test" or "service" position, provision shall be made for reconnection of the auxiliary circuits for testing purposes. In cases where this necessitates the use of a separate jumper plug or other arrangement, the contract price shall include for the supply of at least one such jumper plug or other device per separate switchboard.

9. Mechanical Interlocks and Safety Shutters

- 9.1. The following minimum interlocks are required:
 - 9.1.1. It must not be possible to raise, lower or withdraw the circuit breaker unless tripped.
 - 9.1.2. It must be impossible to close the circuit breaker unless it is either fully plugged-in, fully withdrawn or earthed.
 - 9.1.3. It must be impossible to plug the circuit breaker or to close it unless the truck is properly secured.
 - 9.1.4. On withdrawal of circuit breakers, all live parts must automatically be covered by substantial vermin-proof shutters. Shutters shall be provided with means for padlocking in the closed positions.

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- 9.1.5. In instances where the control and protection circuits are connected by multicore cable and a plug to the circuit breaker mechanism contacts, additional interlocking is required to prevent the circuit breaker being closed in the operating position without the protection circuits being connected.
- 9.2. All safety shutters shall be clearly and indelibly labelled in letters of the largest practical size, indicating the live apparatus screened off by the shutters.

10. Relays

- 10.1. Each circuit breaker shall be fitted with protection and auxiliary relays as specified on the drawings and schedules.
- 10.2. Where the circuit breaker is to be equipped for remote indication and control, all the relay auxiliary switches shall be wired to an easily accessible terminal block on the back of each panel.
- 10.3. Solid state relays shall be provided. Allowance shall be made for additional terminal blocks on every panel for testing purposes. Combined solid state overcurrent and earth fault relays must be equipped with indicating flags showing the cause of the tripping either earth fault or overcurrent.

11. Auxiliary Switches

- 11.1. Circuit breakers shall be provided with sufficient direct auxiliary contacts to suit the circuits served. In addition, at least four spare contacts shall be provided. These spare contacts shall be readily convertible from normally-opened to normally-closed operation and shall be completely wired to an accessible terminal board adjacent to the outgoing control cable termination. Auxiliary contacts shall be coupled in such a manner as to follow positively the operation of the switching device concerned and no slave relays shall be used to provide additional contacts. Means shall be provided for adjusting the auxiliary contacts relative to the operating mechanism.
- 11.2. Where insufficient contacts are available a slave relay shall be provided but shall be used for indication only.

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12. Circuit Breaker Truck Connections

Where the auxiliary control connections between the circuit breaker truck and the fixed housing are made by means of flexible connections, these shall be contained in a flexible tube. If metallic flexible tubing is provided this shall be PVC covered to the Engineer's approval.

5C5 ISOLATORS AND SWITCHES

1. General

All isolators and switches shall be of identical construction to the circuit breakers specified above but without protection.

5C6 TESTING

1. Type testing

Type Tests shall be carried out on each switchgear type to be installed. Manufacturer's type test will be acceptable.

2. Routine Testing

Routine tests shall be made on all switchgear at the manufacturers works to ensure that the equipment complies in every respect with the operational requirements and the applicable standard specification.

3. Site Tests

Switchgear shall be impulse and operation tested on site prior to commissioning and as specified.

5C7 INSTALLATION AND ERECTION

Alignment and Fixing of Switchgear

- 1. All indoor switchgear panels shall be properly aligned, erected, plumbed, bolted together and fixed onto the floor.
- 2. If the floor is not level, suitable packing shall be used to level the switchboard.
- 3. The contractor shall ensure that switchgear can be freely operated without any physical obstruction after the switchgear has been placed in position.
- 4. Each individual panel shall be levelled before the panels are bolted together.
- 5. The panels shall be assembled and erected strictly in accordance with the manufacturer's instructions.
- 6. Switchgear trucks shall move freely and shall be properly aligned.

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5C8 TRIPPING BATTERIES AND TRICKLE CHARGERS

1. General

- 1.1. The trickle chargers and battery cabinets shall be enclosed in an adequately ventilated steel enclosure.
- 1.2. Each set or bank of batteries shall be provided with a separate battery charger.
- 1.3. Each set or bank of batteries shall be housed in a separate self-contained floor-standing metal-clad cabinet as one unit.
- 1.4. The battery charger shall be connected to a terminal block at the back of the switchgear panel by means of PVC cable and shall be supplied from the voltage transformers.
- 1.5. No fuses or circuit breakers shall be installed in the trip circuits from the batteries to the switchgear panels.
- 1.6. The sizes of the AC and DC cables between the battery unit and switchgear panels shall be suitable for the loads of the equipment. The cost of the cables shall be included in the price for the supply of the battery unit.
- 1.7. Where lights are specified on switchgear and control panels to be supplied from the batteries, the supply to the lights shall be separated from the mechanism and tripped circuits by means of a separate cable to be installed to the switchgear or control panels.

2. Batteries

- 2.1. Where spring charging motor and solenoid mechanisms are used, 110V battery sets shall be provided for the supply of the mechanisms as well as for tripping and closing coils. 110V or 32V battery sets shall be provided.
- 2.2. Where lights are specified on switchgear and control panels to be supplied from the batteries, the supply to the lights shall be separated from the mechanism and tripped circuits by means of a separate cable to be installed to the switchgear or control panels.
- 2.3. The battery sets offered shall be fully capable of providing the load requirements of all motors, lamps, relays, coils, etc.
- 2.4. The battery sets shall be capable of providing the full standing load of all associated equipment during complete failures of the AC supply, for a

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minimum period of 6 hours, after which period it shall be possible to open and close all circuit breakers once in rapid succession.

- 2.5. The cells shall be so arranged that the electrolyte is clearly visible and the batteries easily maintained.
- 2.6. All batteries shall be of sealed type, unless otherwise specified.

3. Charaina Equipment

3.1. Rectifier

- 3.1.1. The unit shall comprise a solid-state type rectifier with a double wound transformer.
- 3.1.2. The output voltage shall not vary more than 1% in variations of 10% of the input voltage at ambient temperature ranges at the site.
- 3.1.3. The charger shall be of the constant voltage control type with a higher (booster) and lower (trickle) rate of charge. The higher rate of charge shall be such as to completely charge a fully discharged battery in a period of 15 hours.
- 3.1.4. The capacity of the charger shall be such that it can provide the full standing load plus battery charging current.

3.2. Instruments

The following instruments are required:

- 3.2.1. DC ammeter for charging current
- 3.2.2. DC voltmeter for battery voltage
- 3.2.3. Loose voltmeter to measure cell voltage.

3.3. Indication Lights

An indication light is required to indicate each of AC supply healthy and common fault.

3.4. Switches and Fuses

The following switches and fuses are required:

- 3.4.1. A main switch to isolate the AC input
- 3.4.2. Fuses on the DC and AC sides except in the trip circuits of the switchgear.

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3.5. Control of the Charge Rate

The charge rate shall be automatically controlled.

3.6. Protection and Alarms

- 3.6.1. If a standing load is to be supplied to switchgear and control panels then the following protection systems with alarms shall be provided to trip the standing load supplied:
 - 3.6.1.1. AC supply fail relay with time delay
 - 3.6.1.2. DC under-voltage relay with 90% setting
- 3.6.2. Tripping indication for the above mentioned.
- 3.6.3. A common alarm and fault relay shall be provided and the auxiliary switches of all the relays including the abovementioned, shall be wired to an easily accessible terminal block in the charger cabinet.

4. Installation

- 4.1. The units shall be properly bolted on floors where possible. The chargers shall be connected to the AC supplies.
- 4.2. The batteries shall be connected to the switchgear or light fittings where applicable, by means of PVC armoured cables unless otherwise specified.

5C9 PADLOCKS AND LOCKING FACILITIES

- 1. Padlocks and locking facilities shall be provided to all panels and operating handles.
- 2. Padlocks shall be Brass 38mm, Union or Yale as approved equivalent manufacture
- 3. All padlocks shall be keyed alike per site. 3 keys shall be provided for each lock size and type.
- 4. Padlocks shall be divided into groups per project, per section, per substation or switchyard with master key facilities per group. 3 Master keys, which shall be numbered and labelled to correspond with their group, shall also be handed over.

5C10 CABLE TERMINATIONS

- 1. Provide suitable cable end boxes and/or clamps to suit the final selection of cables.
- 2. Switchgear riser terminals shall be tinned. For cross-linked polyethylene insulated cables, provide suitable tinned lugs, bolts, nuts and washers.

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- 3. For paper insulated cables, provide suitable cast-iron or sheet steel fabricated compound filling end boxes with the necessary flexible or copper bar connections between the riser terminals and end box terminals.
- 4. Cable end boxes shall have sealed stem bushings and shall be large enough to facilitate phasing out of cables. For cables larger than 120mm2, provide specially manufactured end boxes.

5C11 DRAWINGS, LITERATURE, TUITION, SPARES AND TOOLS

1. Rating & Diagram Plates

- 1.1. Provide rating and diagram plates on equipment in accordance with appropriate clauses of SABS, BS or IEC specifications. Diagram plates shall allow the internal connections of equipment where applicable especially for current transformers.
- 1.2. Provide rating and diagram plates on current transformers giving CT ratios, CT Class and knee point voltage where applicable, CT burden, connection instructions etc for various ratios.
- 1.3. Manufacture rating and diagram plates of mechanically strong, non-rusting, non-straining, non-discolouring and non-distorting durable material and secure with corrosion-free machine screws or rivets.
- 1.4. On dark surfaces, use white lettering on a black background. For danger notices, use red lettering on a white background. Indicate the three phases with red, white & blue. Colours shall be permanent and non-fading.

2. Shop Drawings

- 2.1. For switchgear, submit technical literature including dimensioned drawings of plan and elevations. Wiring diagrams shall be provided for all switchgear panels.
- 2.2. The approval of drawings shall not relieve the manufacturer of his responsibility to the Engineer to supply the MV equipment according to the requirements of this Specification.

3. Tools and Spares

3.1. Provide for each substation test prongs and one spare circuit breaker unit.

Provide earthing equipment, testing equipment and jumpers.

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3.2. In each substation provide a tool cabinet for housing tools, operating handles, spare fuses, and earthing and testing equipment.

4. Manuals and As Built Drawings

3 sets of manuals shall be provided and shall include the following information:

- 4.1. Manufacturers technical literature and operating instructions for circuit breakers
- 4.2. Manufacturers technical literature and operating instructions for each type of protective relay and meter.
- 4.3. Manufacturers technical literature for each type of CT and VT.
- 4.4. Manufacturers technical literature and operating instructions for HV power factor correction.
- 4.5. Recommended maintenance.
- 4.6. Copy of type test certificates.
- 4.7. Copy of factory test certificates.
- 4.8. Copy of site test certificates.
- 4.9. Copy of shop drawings comprising GA's and wiring diagrams.
- 4.10. Address and contact numbers for manufacturer and South African Agents for all equipment supplied under this contract.

5C12 PAINT

HT switchgear shall be painted with the suppliers' standard colour.

5C13 INSPECTION, TESTS AND COMMISSIONING

- All MV equipment shall be inspected by the Engineer, on completion of manufacture, prior to despatch from the manufacturer's works. The MV equipment supplier shall advise the Engineer in good time, of such completion and acceptance.
- 2. MV equipment may only be delivered to site after inspection and approval by the Engineer. Such approval, however, shall not relieve the manufacturer of his responsibility for any deviation from the requirements of this Specification.
- All the MV equipment shall be to the approval of, and shall comply with, the
 regulations of the Supply Authority and shall be the responsibility of the MV
 equipment manufacturer to establish and provide such requirements, and obtain
 approval where necessary.

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- 4. The manufacturer shall perform tests in the factory as prescribed by SABS/BS and/or IEC specifications as well as the manufacturer's own standard routine tests on all materials, equipment and assemblies.
- 5. On completion of erection and installation on site perform all tests required by the Engineer to ensure the Works are ready for operation.
- 6. Provide sufficient oil or other coolant or insulant as required for the switchgear.
- 7. Switchgear tests shall include:
 - 7.1. All mechanical operation tests
 - 7.2. All mechanical and electrical interlocks
 - 7.3. Checking of oil or gas filling, or of satisfactory vacuum
 - 7.4. Primary & secondary injection tests
 - 7.5. One minute pressure tests as follows:11kV switchgear = 24kV (r.m.s)
- 8. Cable tests shall include continuity tests of phase, any neutral, and earth conductors and armouring, and 15-minute pressure tests.
- 9. Submit written test reports to the Engineer.

5C14 DRAWING SCHEDULE

Refer to attached Drawing Register Schedule for drawings issued as part of this RFQ.

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SECTION D

EARTHING AND LIGHTNING PROTECTION SYSTEM – DETAILED SPECIFICATION

5D1 EARTHING

A main earthing system will be provided to the entire MV and LV reticulation system in accordance with SANS requirements to CoT standards and specifications. This will include earthing to each miniature substation and all MV switchgear and bonding of the earthing network to the LV reticulation system.

5D2 STRUCTURAL LIGHTNING PROTECTION SYSTEM

Structural lightning protection will be provided to the Consumer substation building in accordance with SANS requirements.

SECTION E

PUBLIC AREA LIGHTING INFRASTRUCTURE - DETAILED SPECIFICATION

5E1 STREET AND PUBLIC AREA LIGHTING INFRASTRUCTURE

- Street lighting will be installed to all streets within the proposed development in accordance with SANS 10098. Public area lighting will consist of concrete poles of 9m mounting height fitted with LED floodlight fittings fed from a 500 kVA miniature substation on Erf 2 via underground cables.
- A detailed street lighting layout is included in the will consist of concrete poles of 9m mounting height fitted with LED streetlight fittings fed from the distribution kiosks with underground cables.
- 3. The streetlighting system provides for a 9m steel pole & 3m double outreach with luminaires as per the bills of quantities. The average spacing between poles approximates to 35m. The proposed streetlighting cables have been rated to cater for future extensions. The bills of quantities allows for 3 options.

5E2 ANTI-THEFT: PROTECTOR THEFT LOOP

Supply & install a continuous 32mm ø HDPE sleeve from the end start to the end of the streetlight poles.

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5E3 CABLE RETICULATION

Streetlighting shall be reticulated via 25mm2 4c PVC/Cu cables with a 16mm2 BCEW cables fed from the local miniature substation and controlled by a day/night photocell.

5E4 DESIGN APPROVAL

Before the commencement of construction all designs for the electrical supply network are to be approved by the CoT.

SECTION F

LV RETICULATION INFRASTRUCTURE - DETAILED SPECIFICATION

All cabling will be installed in cable trenches and through PVC sleeves at road crossings.

5F1 LV CABLING

Main LV cabling will be provided in accordance with CoT standards and SANS. All LV cable terminations shall be the heat shrinkable type. All cabling will be installed in cable trenches and through PVC sleeves at road crossings.

5F2 LV CABLE TRENCHES AND INSTALLATION

LV cable will be laid on 100mm sifted sand and covered with 100mm sifted sand topping. LV cables to be installed a minimum of 600mm below finished level. All trenches are to be backfilled and compacted in 150mm layers to 91% MOD ASHTO with compaction test results being forwarded to the Electrical Engineer for approval.

5F3 CABLE ROUTE MARKERS

LV cable route markers shall be provided every 500m and when the route changes direction. The cable markers shall be encased in concrete and shall be buried at least 300mm below the finished surface and shall protrude by at least 250mm.

5F4 EARTHING

Earthing to the LV network reticulation will be in accordance with SANS 10142-1 requirements and CoT standards and specification.

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SECTION G

HDD DRILLING METHODOLOGY - DETAILED SPECIFICATION

1. Arrival on Site

Upon arrival on site, the flagman is to exit the truck and guide traffic while the truck is parked, and traffic management is put in place. When traffic management is complete, the team then proceeds to off load the required equipment for the job on hand.

2. Stage 1 - Pilot Drill

Once the machine is setup at the entry pit, the drill team put on the pilot drill bit (75MM OD), {this drill bit has what we call a "DRILLHEAD", which enables the team to direct the drill by means of a tracking box and transmitter} The drilling fluids are then pumped through the drill head and the process begins. While drilling, the tracker keeps track of the drill path and is assigned with the duty to inform the drill operator which direction the drill needs to go.

3. Stage 2 - Back Reaming

Once the drill head reaches the exit pit, The drill team then removes the drill head and attaches a back reamer {The back reamer is what enables the drilling team to "Upsize" the pilot hole to suite the product sleeve being installed underground} The drill operator then proceeds to drill "Backwards" removing the back reamer from exit pit to entry pit.

4. Stage 3 - Pushing Forward

Once the back reamer reaches the entry pit, the drill operator must "Push forward" in order to seal the hole and allow the reamer to reach the exit pit again.

5. Stage 4 - Pulling in sleeves after Pre-Reaming

- 5.1. If the sleeve being installed is bigger than a 110mm OD HDPE Sleeve, the drilling team then need to do excessive back reaming and attach bigger back reamers in order to reach the desired size.
- 5.2. If the intended product sleeve is a 110mm OD, the drill team then attaches "Pipe Puller" to the end of the back reamer in order to pull back the product sleeve.
- 5.3. The Second and Third Stage of Drilling will be repeated until we have reached the desired hole size of S00MM OD.

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6. Stage 5 - Completion on Site

Once the product pipe has been pulled back and is in the entry pit, the job is consider completed and sleeve is installed. The drill operator is required to find the foreman/ site manager in order to get approval for work completed. The drill team then cleans up the site, loads the equipment and leaves the site.

NOTES

- Drilling fluids are pumped during the entire operation, this seals the hole and creates a
 filter cake to prevent the soil from collapsing around the sleeve or during the drilling
 process.
- 2) The principle contractor is in charge of opening and reinstating drilling pits
- 3) Principle contractor is in charge of wayleaves and exposing existing services
 - a) The horizontal directional drilling technique (HDD) is on the way up at the moment. Directional drilling operations unheard of in the past, now belong to the everyday scene on a job site. Application of HDD units make longitudinal installations up to 130 m possible with the mini machines that we use.
 - b) Crossings beneath rivers and other waters can be performed if the correct geo technical report is available. The directional method even makes drillings beneath industry complexes possible. The range of application includes all pipe construction measures within the bounds of gas, drinking water supply, the installation of pressure lines for sewers as well as cable protection pipes for television or telephone cables, traffic routing systems, emergency call boxes or low, medium, high voltage and optical fibre cables.
 - c) The installation technique is extremely protective towards the environment, causing no ecological damage at all. Minimal damage to the area is only caused within the vicinity of the unit. Several reasons also speak for the application of the directional technique in central town areas. These mainly concern the construction costs, construction periods, permission procedures, soil movement, surface restoration and the traffic, compared to open trenching methods.
 - d) The normal course taken by the drilling operation is described in the following:
 - i. Planning, preliminary survey
 - ii. Selecting the drilling units and drilling tools
 - iii. Pilot bore and detection
 - iv. Reaming(s) or upsizing bore(s)

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- v. Pulling in the product
- e) Basically, the drilling unit consists of three main system components:
 - i. Drill rig / drilling tools
 - ii. Bentonite mixing system with a two-chamber system.
 - iii. Hydraulic power unit for driving the Bentonite mixing unit
- 4) A well-planned HDD operation includes preliminary survey of the bore path area to determine existing external lines and the soil condition. The choice of the drilling unit depends upon the bore length, the diameter of the pipe to be installed and the soil quality.
- 5) To overcome this, high thrust and pulling forces are required, reaching the limits of maximum capacity in many cases. Application of Bentonite might relieve the pilot bore and the pipe traction. But experience has proved that the technical and economic advantages of Soft Boring can hardly take effect in difficult soil conditions with coarse grained components and considerable rock inclusions or building rubble deposits.
- 6) For these conditions, the TT HDD rigs have a built-in percussive hammer which can be switched on additionally, when the drilling progress becomes unsatisfactory due to problematic grounds. In other words, the drilling unit is equipped with the shattering force of a displacement hammer.
- 7) The high demands and expectations towards the quality of the drilling job waiting to be done require precise detection and steering. Detection is carried out following the transmitter-receiver principle. One operator follows the course of the bore head all the time.
- 8) Two basically different systems are possible:
 - a) Either the piston applies impact to the casing and drives the complete displacement hammer and the attached pipe string forward with one blow (rigid system) or
 - b) The piston first strikes the mobile multi-cutter cone and then the casing, which means that the soil displacements hammer moves forward in two steps. The soil displacement hammers achieve an installation speed of 15 m/h, depending on the soil. The cover should be at least ten times as thick as the diameter of the casing to avoid arching of the surface. The soil displacement machines are equipped with a reversing gear.

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9) The "Grundomat" with its mobile multi-cutter cone is simply reversed with a lever. A plugon head with integrated transmitter or a built-in transmitter in the hose makes localisation possible but is not intended for steering.

10) The soil displacement method is described in the German guideline ATV-A 125 and in the GW 304 Pipe Laying as well as in other German standards.

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