SPECIFICATION / SCOPE OF WORK	
DESCRIPTION OF GOODS / SERVICES / WORK	Rebuilding, supply, installation, testing and commissioning of 3kV DC Traction and Distribution Equipment at Substations along the Daveyton-Johannesburg corridor for Metrorail Gauteng Region
DIVISION	Infrastructure
USER DEPARTMENT	Electrical

1. INTRODUCTION

This document serves as a bid specification for the appointment contractor for the; Rebuilding, supply, installation, testing and commissioning of 3kV DC Traction and Distribution Substation equipment along the Daveyton- Johannesburg corridor'. The works is to rebuild, supply, installation, testing and commissioning of 3kV DC Traction and Distribution Substation Equipment.

2. BACKGROUND INFORMATION

2.1. Status Quo

Traction Substations provide power to electrical locomotives used to haul passenger and freight trains through railway tracks. There are three types of traction substations in South Africa, 3kV DC, 25kV AC and 50kV AC. PRASA in Gauteng only uses the 3kV DC type. A typical arrangement of DC traction systems is depicted in figure 1 below.

DC substations are located next to the railway track at intervals of ± 10km's, they are supplied from the grid (Eskom or Municipality) with voltages ranging from 22-132kV AC. This is converted to DC power by use of rectifiers and other equipment. This is then delivered to the line (contact wire) by use of copper and Aluminum cables where the locomotives are able to collect using pantographs.

The Tie station is an intermediary where the distance between traction substations is in excess of 15km. This allows the electrical supply capacity of the substations to be set higher.

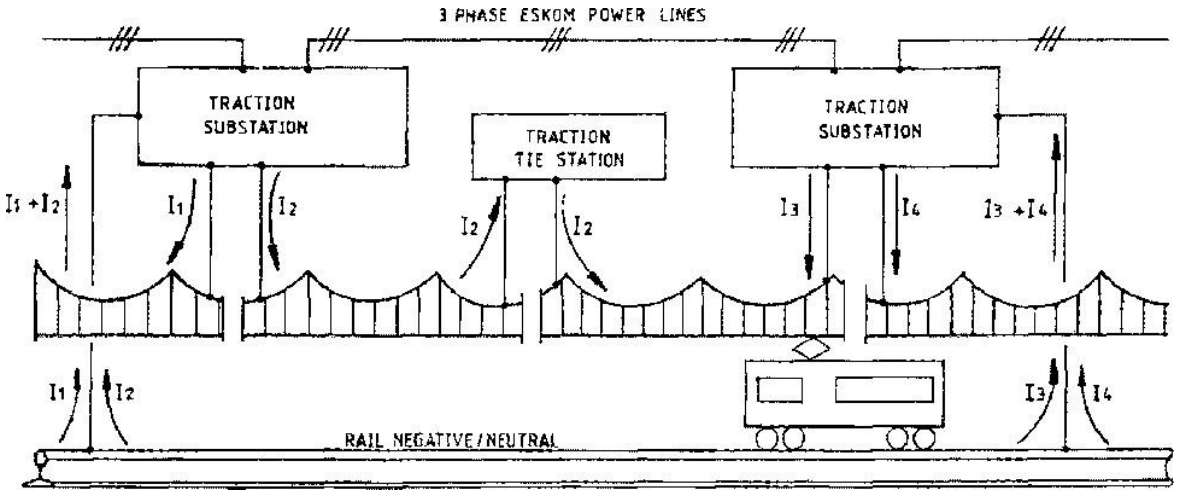


Figure 1: Typical Feeding arrangement for DC Traction Systems

The Distribution substations, also referred to as E, L&P (Electrical Lighting and Power) supply the signals relay rooms which in turn supply the signals and points. These substations also provide lighting power to platforms and yards. Office buildings e.g. Mjantshi House, Shosholoza Meyl, etc. also receive electrical power from distribution substations.

The electrical department is currently experiencing extremely high volumes of on-going theft and vandalism in the Gauteng region. These thefts are crippling the network badly as far as the electrical substations are concerned.

Figure 2 below is a diagram that shows the Gauteng feeding arrangement, where red represents the substations that are completely off. As can be seen from the diagram most of the network is not available (Electrical) and needs a structured approach in reviving it.

Because the frequency of these thefts is very high, the number of off-line substations may change as and when the theft and vandalism occur.

It must be noted that whilst substations consist of similar electrical equipment, the configuration is site specific and the damage caused by theft and vandalism is not the same. This is the reason why it was necessary that an as and when contract be considered.

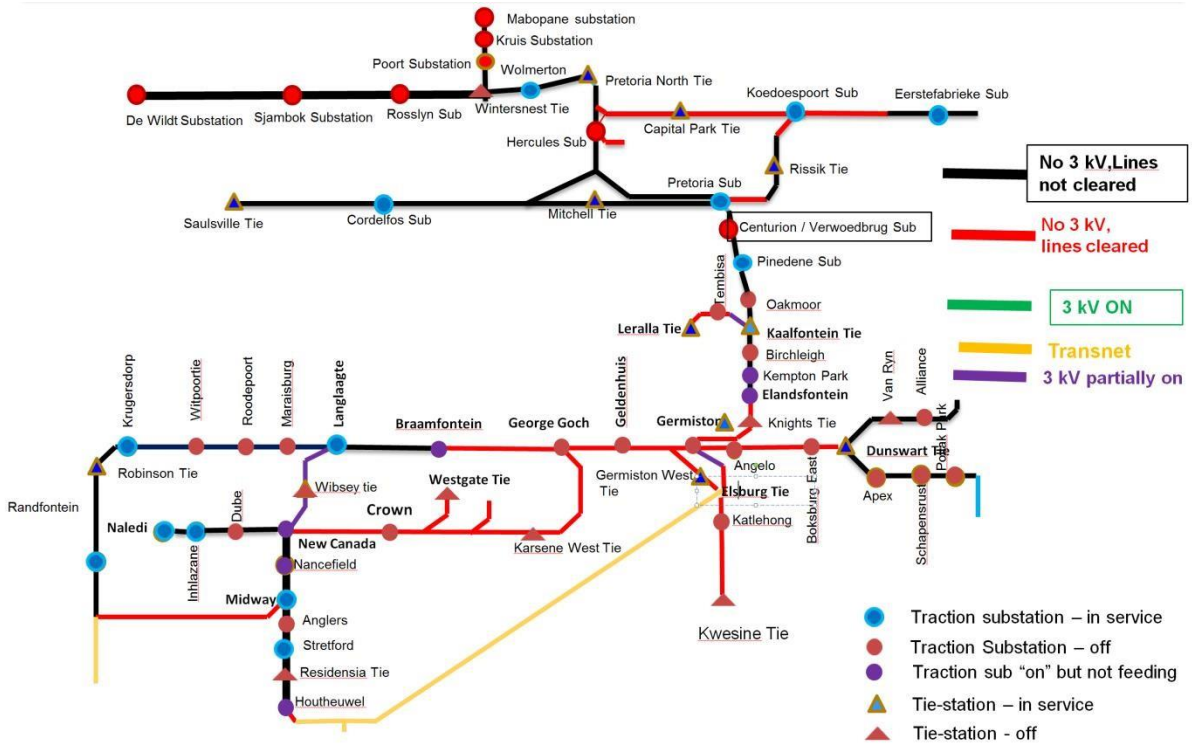


Figure: 2 Network layout showing Substations currently off-line in Red

2.2. Problem Statement

An inadequate and unreliable power supply system has a negative impact on the running of a successful train service that is predictable and reliable. Such a system will cause unexpected

service disruptions that can result in agitated commuters leading to the loss of revenue (ticket re-funds).

From the condition assessment above, majority of the substation equipment are due for replacement due to theft and vandalism. The region has suffered unprecedented levels of theft and vandalism in the last few months which left the substations without critical equipment. The priority corridors are severely affected and as a result; the corridors are using diesel locomotives to haul the commuter train which is costly. Other corridors remain suspended. Figure three below shows a traction transformer that has been burned down in order to access the copper inside, this has happened in a lot of substations. The crippling of a transformer renders the substation ‘useless’ especially in cases where the adjacent substations are not functional.

2.3. Pictorials

Figure 3: Vandalized traction transformer

2.4 Alliance 3kV Substation outdoor

2.5 Alliance 3kV Eskom outdoor building

2.5 Angelo 3kV Substation outdoor

2.6 Boksburg East 3kV Substation

3. OBJECTIVES OF THE PROPOSED PROJECT

a. DESIRED OUTCOMES FOR CARRYING OUT THE PROPOSED PROJECT

The project aims to restore the traction power to the 3kV DC traction and Distribution substations in the Gauteng province.
The restoration of power to these substations will enable the use of electrical traction in the region, thereby reducing the cost of providing the service.
It will also enable the signalling and telecoms infrastructure as it is heavily reliant on the distribution substations for provision of power.

b. PROJECT BENEFITS TO PRASA

The Project will assist the organisation to reinstate lines and corridors that have been closed due to the challenges on the OHTE and unavailability of traction power. This will therefore assist PRASA in achieving its primary mandate of providing a reliable rail transport service to Gauteng commuters and enable the business to collect fare revenue from those commuters. By restoring the Electrical Traction system (Substations and OHTE) PRASA will be able to provide a reliable and safe service to its customers.
The added benefit is that the new trains currently being manufactured will be utilised and PRASA will realise the benefits and value for money.
PRASA will be able to run trains safely as the signalling and telecommunication will be enabled thereby complying with the RSR directives.

c. CURRENT MECHANISMS IN PLACE TO ADDRESS THE PROBLEM

None, the incapability of substations hampers the availability of electrical traction. Added to this is the fact that the OHTE is also unavailable.

The signalling operations are also crippled by this condition and have reverted to manual authorization of trains. This is not ideal.

4. *SCOPE OF WORK AND AREAS OF FOCUS*

a. SCOPE OF THE DESIRED SOLUTION

The scope of works will be site specific, but the following are the expectations from most of the sites. The contractor shall:

- Dismantle the existing equipment and transport it to Driehoek stores.
- Refurbish the substation building this includes painting of the walls and repairing/ rebuilding the roof. Electrical lighting and distribution (including wall plugs) shall be refurbished and a compliance certificate (COC) issued.
- Supply, install, test and commission the indoor and outdoor equipment (main transformers, High speed circuit breakers, distribution Switchgear, Rectifiers, panels, etc.). All electrical connections and wiring shall be configured to operate with the existing equipment.
- Supply and installation of safe doors, windows shall be protected by steel mesh.

b. Details on preferred solution

The preferred solution is to appoint the contractor to reinstate all the traction, tie and distribution substations in the Daveyton-Johannesburg corridor:

- All the equipment will be supplied by a single contractor that will therefore uphold the guarantee/ warranties of various equipment (suppliers tend to void guarantees on equipment if a different supplier interconnects to their equipment).

c. Areas Targeted by this project

- The project will cover all the traction, tie and distribution substations on the Daveyton-Johannesburg corridor for Metrorail Gauteng Province

d. Extent and Coverage of the project

The project will cover all the traction and distribution substations on the Daveyton - Johannesburg corridor for Metrorail Gauteng province

e. Other related projects

The other related projects are: ○ Supply and installation of OHTE on the Daveyton - Johannesburg corridor

5. *SPECIFICATION OF THE WORK OR PRODUCTS OR SERVICES REQUIRED*

The specification of work for this project includes:

5.1. AC Disconnects

5.1.1. The contractor shall dismantle and remove existing AC disconnects and steelwork, the contractor shall transport all released material to the Metrorail store at Driehoek in Germiston.

5.1.2. The contractor shall supply and install the support steelwork in accordance to specification BBB5452 and clause 8.0 of specification BBB7842 and all other sundry items required for the proper support thereof.

The contractor shall supply and install a set of AC disconnects combined with earth switches for the secondary disconnects in accordance with the specification BBB7842. The contractor's price for the AC disconnects shall include the supply and installation of all steelwork required for the proper mounting of the equipment.

5.1.3. The contractor shall supply and erect concrete foundations and any other works required for the proper completion of the foundations, the foundations shall be allowed sufficient time to cure before mounting the equipment. These shall be as referred to in specification BBB5452.

5.1.4. The contractor shall complete and return Annexure 2 of specification BBB7842.

5.1.5. The rated voltages of each site shall comply with the Eskom nominal voltages.

5.1.6. The contractor shall supply and install bus bars from the AC disconnects to the PCB.

5.1.7. The disconnecting switches shall have auxiliary contacts for interlocking with primary circuit breaker as per specification BBB7842 clause 7.11

5.2. Primary Circuit breakers

5.2.1. The contractor shall dismantle and remove from site the existing old primary circuit breakers (PCB), foundations and steelwork, the contractor shall transport all released material to the Metrorail store at Driehoek in Germiston.

5.2.2. The contractor shall drain oil from the old oil circuit breaker into storage drums (provided by the contractor) and disposed of in accordance with the environmental legislations.

5.2.3. The contractor shall supply and erect concrete foundations suitable for mounting the PCB offered, the foundations shall be allowed sufficient time for curing before mounting equipment.

5.2.4. The contractor shall supply and install support steel work and all other sundry items required for the proper support of the offered breaker.

5.2.5. The contractor shall supply and install a 3 phase (SF6) Gas Filled Circuit Breaker complete with operating mechanisms and all material and equipment for proper mounting and connection to the existing infrastructure. The circuit

breakers shall be supplied and installed in accordance with the requirements of specifications BBB1267 Version 6.

5.2.6. The contractor shall supply and install (including connection) of the control and power cables, earthing and any other item necessary for the full functionality of the equipment. The operation of the circuit breaker shall be in accordance and interfaced with specification BBB2721 Version 10 attached.

5.2.7. The Circuit Breaker shall be of ratings specified in the data sheet of specification BBB1267

5.2.8. The contractor shall supply and install aluminium bus bars from the PCB to The CT's.

5.2.9. The rates quoted for the supply and installation of this equipment shall be deemed to have catered for all requirements to supply and install, including design (if any).

5.3. Metal Oxide Surge Arrestors

5.3.1. The contractor shall supply and install Metal oxide surge arrestors as per clause 10 of BBB5452 and specification BBB0845.

5.3.2. The contractor shall cater for the supply and erection of new structures and foundations to mount this equipment. The structures shall be connected to the rest of the substation earth as per applicable specifications.

5.3.3. The surge arresters shall be connected between each phase of the high voltage supply and substation main earth electrode/earth mat.

5.4. Current Transformers (CT's)

5.4.1. The contractor shall dismantle and remove the existing CTs, the contractor shall transport all released material to the Metrorail stores facility at Driehoek in Germiston.

5.4.2. The main CTs shall be free standing and shall be mounted on foundations and steelwork (supplied and installed by the contractor) as per clauses 39 and 40 of BBB5452.

5.4.3. The main current transformers shall be supplied and installed according to specification BBB0937. (A set of three CT's shall be supplied and installed)

5.4.4. The CT''s shall be the two-core type providing for metering and protection.

5.4.5. The contractor shall supply and install an Earth Leakage current transformer (this shall be supplied as per clause 17 of specification BBB5452. The drawings referred to in this specification are applicable for connecting the transformer to the earth mat).

5.5. Main Transformers

5.5.1. The contractor shall:

5.5.1.1 Decommission the existing transformers and transport them to the Metrorail store in Driehoek, in Germiston.

5.5.1.2 Drain the oil and dispose of it in line with the environmental legislation regulating such oil (PCB contaminated oil shall be handled as per legislative requirement including the disposal thereof).

5.5.1.3 Clean oil contamination in the plinth before placing the new transformers.

5.5.1.4 Replace contaminated soil and stone around the plinth. The contractor shall excavate up to a depth of 2m and up to 1m from the edge of the plinth.

5.5.1.5 Supply and install transformer bund walls in accordance to specification DOCS_MHQ-#99049-v1-bund_walls_specification.

5.5.1.6 Supply and install new **6 MVA** traction transformers in accordance with specification BBB5019, all electrical and mechanical connections. Droppers shall be made of aluminium and of suitable size (Based on the electrical properties of the transformer supplied).

5.5.1.7 Contractor shall ensure that they provide transformer manufacturers with the correct requirements and adequate information regarding the requirements for each transformer. The contractor shall be responsible for ensuring that the transformer supplied is in accordance with specification **BBB5019 Version 5** attached.

5.5.1.8 In some of the sites, main transformers are located inside the building (indoor type). This shall be considered when designing the cooling system of the individual units.

5.5.1.9 Connections shall be designed such that there will not be excessive forces exerted on the bushings should there be shock induced.

5.5.1.10 The transformers shall be filled with virgin oil as per clause 9.0 of specification BBB5019.

5.5.1.11 The transformer designs shall be submitted to the Project Manager for approval prior to manufacture. Hard copies shall be supplied in this regard.

5.5.1.12 The contractor shall arrange with the Project Manager for FAT to ensure the correct functioning of the transformer (compliance with the specification). This shall be witnessed by the client's representative.

5.5.1.13 Clause 11 of specification BBB5019 shall be applicable in this regard.

5.5.1.14 Clause 11.2 of specification BBB5019 shall read as follows *'Heat runs shall be carried out on all transformers supplied under this contract'*.

5.5.1.15 Final commissioning tests that shall be conducted on site shall include the following:

- Insulation test
- Ratio test
- The insulation oil test
- The Contractor shall make provision for the supply and installation of any small steel parts, bolts, and nuts (stainless steel) as required for the proper and complete connection of the equipment supplied under this contract.
- The transformer main tanks and their associated conservator tanks shall be painted grey and white respectively and in accordance with Transnet freight rail specifications CEE.0045.
- The transformer tank top cover shall be welded.
- The transformer shall have a tertiary winding as per specification BBB5019 clause 7.1.8. The tertiary winding shall be rated no less than 100kVA.
- Bushings and suitable studs (as per clause 7.9.3 of BBB5019) shall be provided for the connection of the auxiliary transformer.
- The transformer shall be equipped with the following protection features:
- Core
- Winding Temperature
- Oil Temperature
- Buchholz
- Pressure relief

- The Primary terminals shall constitute bushings on top of the transformer suitable for connection to an overhead line. This shall have suitable clamps to be able to accommodate a 95mm^2 Cu flex.
- The transformer shall have a neutral bushing.
- Two earthing points shall be provided on the transformer tank with M12 studs.
- The transformer tap shall have 5 settings with the following configuration.
- Taps range: -5%, -2.5%, 0%, +2.5% and +5% of nominal voltage.
- The Eskom nominal voltage (22/44kV/88kV) shall be applicable at the 0% setting.
- All insulators and electrical components shall be covered when spraying and or painting equipment indicated in the schedule of quantities.
- The Contractor shall provide the oil filtering equipment, oil storage container and an adequate three-phase power plant.
- The Contractor shall fill the transformer with virgin mineral insulating oil after the placement of the transformer and connection of all accessories (fins, insulators, etc.). This shall be performed under vacuum conditions.
- The Contractor shall filter the oil when filling the transformer.
- The oil shall comply with the requirements specified in SABS 555 edition 4 of 2002.
- The Contractor shall perform oil tests for all the transformers upon energizing as well as 48 hours after the completion of the works. The oil samples shall be taken from the top and bottom of the main tank of the transformer.
- Notwithstanding what is stated in clause 13,2 of specification BBB 5019, the transformer shall be guaranteed for a period of 24 months from date of commissioning.

- The transformer and the tank shall be properly earthed in accordance with the Code of Practice for earthing CEE-.0177.86. The earth conductors shall be connected to the substation's AC earth-mat.

5.6. Auxiliary Transformer

5.6.1 The contractor shall supply and install an auxiliary transformer as per specification BBB5452 clause 15. The rating of the auxiliary transformer shall be 100kVA.

5.7. 3kV Rectifier

5.7.1 The contractor shall remove the existing rectifier equipment and transport all released material to Metrorail facility at Driehoek, In Germiston.

5.7.2 The contractor shall supply and install rectifiers in accordance with specification BBB5452, BBB0496.The rectifiers shall be 12 pulse and rated 6MW.

5.7.3 The rectifier fence or bay screen and gates shall be in accordance to specification BBB5452 and painted accordingly as specified in specification BBB5452.

5.7.4 The contractor shall supply and install 2 (two) 500mm^2 copper cables between the rectifier and the positive isolator.

5.8. 3kV DC Reactor

5.8.1 The contractor shall remove the existing equipment and transport all released material to Metrorail facility at Driehoek, in Germiston

5.8.2 The contractor shall Supply and install 1.8 milli henry 3kV DC air core reactor for each rectifier in accordance with specification BBB5452 and BBB3890.

5.8.3 The reactor shall be insulated from the substation floor by means of insulating stands that will withstand the weight of the reactor as well the electrical

stresses. Technical documentation of the insulating stands shall be provided before installation.

5.8.4 Sufficient space shall be allowed for access to the reactor for maintenance and inspection purposes.

5.9. Wave filter equipment

5.9.1 The contractor shall remove the existing equipment and transport all the released material to Metrorail stores facility at Driehoek, in Germiston

5.9.2 The contractor shall supply and install wave filter equipment in accordance

5.9.3 with specification BBB3139 for wave filter capacitors and BBB3162 for inductor coils.

5.9.4 All the sub-clauses of specification BBB5452 clause 20 are applicable.

5.9.5 The wave filter equipment shall be housed in the existing cubicle.

5.9.6 The contractor shall supply and install all equipment required for the full functioning of the wave filter equipment including but not limited to bus bars, insulators, etc.

5.9.7 The wave filter room shall be cleaned and painted prior to installations.

5.10. Tele-control

5.10.1 The contractor shall Supply and install a tele-control system (Transnet Sys500 with PRASA modifications – 2 x RS232 serial input)

5.10.2 The system shall comprise of the following:

5.10.3 Meanwell 110V – 24V DC – DC converter installed inside

5.10.4 Logic Rack with the following cards.

5.10.4.1 1 X PSU card

5.10.4.2 2 X DO cards

5.10.4.3 3 X DI cards

5.10.4.4 1 X LMCU Digital card

5.10.4.5 3 x Pulse Rail Cards

5.10.4.6 12 x Latch Rail Cards

5.10.4.7 48 x Digital input Rail Cards

5.10.4.8 10 X IO Cables 40cm long

5.10.4.9 3 X RS232 cable

5.10.4.10 3 X Common negative return cable

5.10.5 The contractor shall ensure that the tele-control is fully functional before commissioning can be done.

5.11. Positive Isolator

5.11.1 The contractor shall remove existing positive isolator equipment and transport all the released material to Metrorail facility at Driehoek, in Germiston

5.11.2 The contactor shall supply and install 3kV DC positive isolators in accordance with the Specification BBB4724 version 4 and all other associated works and equipment for the complete functionality of the positive isolator.

5.11.3 The contractor shall supply and install a busbar from the reactor coil to the positive isolator; the busbar entering the positive isolator shall be 120 X 10 mm^2 thickness.

5.11.4 The contractor shall supply and install XLPE (complete power) cables, earthing and any other item necessary for the full functionality of the positive isolator. The client's requirements in specification BBC0198 shall be taken into account when pricing for the cables.

5.11.5 The contactor shall supply and install 3.8/6.6kV single core XLPE 500mm^2 cable between the positive isolator and the DC bus-bar chamber.

5.11.6 The contractor shall supply and install an under-voltage relay with the positive isolator (Complete with fibre optic cables).

5.11.7 The under-voltage relay shall be in accordance with specification BBB5452 and BBB3005.

5.12. AC/DC distribution and PCB control panels

5.12.1 The contractor shall remove existing AC/DC distribution panel and AC PCB control panel equipment and transport all the released material to Metrorail facility at Driehoek, in Germiston.

5.12.2 The contractor shall supply, install and commission a new AC/DC distribution and AC control panel in accordance with specifications BBB5452 and BBB2721.

5.12.3 The contractor shall supply and install new interlocking (complete) in accordance to specification BBB5452 clause 31.

5.12.4 The contractor shall supply a panel that has gland plates situated at least 300mm above ground, no use of spacers will be allowed.

5.12.5 The DC earth leakage relays shall be mounted on the side of the distribution panel inside polycarbonate boxes (not Perspex).

5.12.6 The tripping of the overload relay shall be via a slave relay which shall be provided by the contractor.

5.12.7 Notwithstanding what is stated in specification BBB2721, the contractor shall supply a relay in accordance with the addendum (Addendum to specification BBB2721 paragraph 8.8. **The relay supplied shall be connected to measure and store energy consumption/ events history (up to 90 days) for each unit.**

5.12.8 All cabling shall be PVC wire armoured.

5.12.9 The contractor shall supply and install all control cables for the full functioning of the panel.

5.12.10 The contractor is responsible for the supply and installation of cables between the

panels and the Buchholz relay, CT's, disconnects etc.

5.12.11 The contractor shall test and pre commission the new panels in accordance to specification BBB2721.

5.13. Indoor and outdoor earthing

5.13.1 The contractor shall supply and install all indoor earthing as per specification BBB5452 and drawings **CEE-TBD-0007 and BBB3620**. Specification **BBB2721** is applicable for the supply and installation of the DC earth leakage relay.

5.13.2 The contractor shall check and repair outdoor earthing, earth measurements need to be conducted to determine the extent of intervention required. The contractors will quote on the wholesale replacement of the earthing system.

5.13.3 New earth leakage relays (DC and AC) shall be supplied and installed.

5.13.4 New AC earth leakage current transformer shall be supplied and installed in accordance with specification BBB5452 clause 17.0

5.13.5 All metal structures (existing and new) shall be connected to earth as per specification BBB5452 clause 30 and all specifications and drawings referred to.

5.13.6 The contractor shall renew all insulation between all existing structures and foundations, all new structures shall be adequately insulated as per specification BBB5452.

5.13.7 All cabling for protection and earthing shall be supplied and installed by the contractor.

5.14. Batteries and Battery chargers

5.14.1 The contractor shall supply and install gel type batteries and the battery charger equipment as per specification BBB5452 clauses 23 and 24 and specification BBB2502.

5.14.2 The capacity of the battery supplied shall be 250AH for Traction Substations and Ties. The charger shall be fully capable of charging the battery bank supplied.

5.14.3 The contractor shall supply and install all cabling required for the full functioning of the batteries and battery charger.

5.14.4 The battery bank supplied shall have a service life of 20-25 years; this shall be backed up with technical documentation.

5.14.5 The battery room shall be refurbished in accordance with specification BBB5452 clause 47.0.

5.15. 3kV DC High speed circuit breaker (HSCB)

5.15.1 The contractor shall supply and install 3 kV HSCB's in accordance with specification BBB5452 and CEE.099.

5.15.2 The contractor shall supply and install modular cells and breaker trucks in accordance with specification CEE.0027 and specification BBB5452 clause 26.

5.15.3 Specifications BBB5452, DOCS_MHQ#99048 V1, DOCS_MHQ#99054V1 as well as CEE-0099 are also applicable.

5.15.4 The contractor shall supply, install and commission the Electronic Control Relay (ECR) and accessories for each HSCB.

5.15.5 The breaker shall be Metrorail approved; the Contractor shall complete the appendix of specification CEE 0099 for evaluation.

5.15.6 The Circuit breakers shall be fully capable of bi-directional tripping. It shall sense and trip on over and fault current in both forward and reverse directions.

5.15.7 Each breaker shall have the **indirect tripping** facility installed.

5.15.8 The circuit breakers shall employ a closing coil that also serves as a holding coil once the breaker is closed. Current through coil shall be reduced by a current limiting resistor (this resistor shall be supplied with the breaker).

5.15.9 Where Secheron HSCB's are offered, an insulated cover plate shall be installed over the yoke of the trip mechanism to prevent dust and debris from the arc chute to settle in the air gap between the yoke and the moving core that could prevent the trip mechanism from opening the breaker under fault conditions.

5.15.10 The arc chutes shall be constructed from ceramic material to provide a low maintenance arc chute.

5.15.11 The design of the arc chute and its release mechanism shall be such that it can be removed and refitted by one person. For this purpose, an arc chute lifting lever and slide to release the arc chute for removal shall be supplied and installed.

5.15.12 Contractors shall indicate clause by clause compliance with the technical specifications listed here.

5.15.13 The contractor shall supply and install new 500mm^2 single core XLPE cable rated 6.6kV between the HSCB's and the Track Switch structures.

5.16. Isolating Procedure

5.16.1 Rectifier unit isolation guideline in clause 32.0 of specification BBB5452 shall be used and as such no deviation from the guideline shall be considered.

5.17. Indoor cabling, bus bars, chequer plates and associated equipment

5.17.1 The contractor shall supply and install cabling, bus bars, chequer plates and all other associated works in accordance with specification BBB5452 clause 33.0 and all its sub-clauses.

5.17.2 The wall shall be broken to make room for a 12-pulse feeding arrangement from the main transformers.

5.17.3 Suitable wall bushings shall be supplied as per specification BBB5452 clause 33.

5.18. Outdoor cabling, Bus bars and connection

5.18.1 The contractor shall supply and install all outdoor cabling, bus bars, connections and all other associated works in accordance with specification BBB5452 clause 34.0 and all its sub-clauses.

5.19. Substation negative return cables

5.19.1 The contractor shall supply and install negative return cables and all other associated works in accordance with specification BBB5452 clause 36.1 and all its sub-clauses.

5.19.2 The contractor shall install rail negative return and all other associated works in accordance with specification BBB5452 clause 36.2 and all its subclauses.

5.19.3 The contractor shall supply and install negative feeder monitoring system and all other associated works in accordance with specification BBB5452 clause 36.3 and all its sub-clauses.

5.19.4 The sleepers and the rail shall be free issued.

5.20. 3kV DC positive feeder cables

5.20.1 The contractor shall supply and install 500mm^2 single core copper cable between the structures and the HSCB. The contractor shall cater for new structures with foundations and all steelwork should the arial feeder connection be adopted.

5.20.2 The contractor shall supply and install all insulation, accessories and terminations required for the correct mounting and connection of cables to this structure including the requirements for the prevention of corrosion of the structure.

5.20.3 Cleats shall be used to mount the cable to the structures.

5.20.4 The cables shall be installed inside PVC pipes (100mm diameter) and filled with concrete to a height no less than 3m from ground.

5.21. Foundations and Support steel structure

5.21.1 The contractor shall be responsible for the supply and casting of all foundations in the substation in accordance with specification BBB5452 clause 39.0 and all its sub-clauses.

5.21.2 The contractor shall be responsible for the supply and installation of all steel structures in accordance with specification BBB5452 clause 40.0 and all its sub-clauses.

5.22. Safe doors

5.22.1 The contractor shall supply and install steel safe doors and frames to entrances at the substation.

5.22.2 Existing doors shall be dismantled, removed from site and transported to the Metrorail store at Driehoek in Germiston.

5.22.3 Upon demolition of existing doors, new safe doors shall be installed on the same day before the work team leaves the site in order not to leave the site exposed.

5.22.4 The safe doors shall be constructed of steel with the outer plate having a thickness of at least 6mm.

5.22.5 All doors (single and double) shall allow opening from inside with the main door allowing opening from outside as well.

5.22.6 Double doors need to have slits for ventilation purposes (these openings should be from the centre to the bottom end of the doors), these shall be fitted with air filters to prevent dust. The slits shall be cut out from the sliding door panel and not bolted/ riveted.

5.22.7 The door frame shall be constructed of angle iron (70 x70 X 6) mm.

5.22.8 The door frame shall be secured to the wall by means of at least 6 (six) grip plugs.

5.22.9 The slots for the locking pins shall align automatically with the locking pins from the safe door when the door is closed.

5.22.10 All key operated locks shall be of the high security type (seven levers).

5.22.11 Anti-tamper facilities shall be provided for each lock installed, the design shall be subject to Project Manager's approval.

5.22.12 Each door shall have 8 locking bolts (4 fixed and 4 moveable).

5.22.13 The locking mechanism shall be freely moveable and protected from dust.

5.22.14 Contractor shall provide literature for equipment to be supplied for evaluation purposes.

5.22.15 The contractor shall supply 4 sets of keys for each door; the keys shall be unique on all doors.

5.22.16 A sample shall be supplied for the main double door.

5.23. Weed killing and crusher stones

5.23.1 The contractor shall apply weed killing and all other associated works in accordance with specification BBB5452 clause 43.0 and all its sub-clauses.

5.23.2 The contractor shall supply and install crusher stones and all other associated works in accordance with specification BBB5452 clause 43.0 and all its sub-clauses.

5.24. Painting

5.24.1 The contractor shall paint indoor equipment, indoor and outdoor equipment, metal screens and barriers in accordance with specification BBB5452 clause 44 and all its sub-clauses.

5.25. Substation Building

5.25.1 The contractor shall demolish all existing buildings and rebuild from scratch buildings to accommodate new equipment.

5.25.2 The contractor shall be responsible for the drafting of plans and approval thereof.

5.25.3 All equipment to be provided under this contract shall be able to fit in the building.

5.25.4 The design shall cater for the outdoor yard and equipment where this was previously the case.

5.25.5 The preferred design shall be such that all equipment is accommodated in one building.

5.25.6 The contractor shall supply and install new roof for the substations (IBR galvanised sheets 2mm thick) with ventilation and gutters (industrial aluminium) and all associated works. The roof shall be painted in accordance to specification BBB5452.

5.25.7 The contractor shall replace all broken glass with similar on all the buildings.

5.25.8 The contractor shall refurbish and paint the battery room including the plumbing.

5.25.9 The contractor shall refurbish the ablution facilities including the floors.

5.25.10 The contractor shall supply and install indoor power and lighting including DC lights that are connected to the substation batteries.

5.25.11 The contractor shall supply and install at least three roof mounted louvres (Wheelie Birds).

5.25.12 The contractor shall seal all cable entry points and ducts to prevent vermin.

5.25.13 The contractor shall supply and install substation High Voltage Signs as per specification BBB5452 both in and outside of the building.

5.26. Distribution, lighting of substation building and 400V auxiliary supplies

5.26.1 The contractor shall supply and install all light fittings, plugs, conduits, distribution boards, switches, cables and isolation transformer in accordance with specification BBB5452 clause 45 and all its sub-clauses.

5.26.2 The battery room building shall be fitted with energy saving lighting as well as a plug.

5.26.3 The contractor shall supply and install security lighting for each side of the main building in line with specification BBB5452.

5.27. 50KVA isolation Transformers

5.27.1 The contractor shall supply and install isolation transformer in accordance to specification BBB5453 clauses 45.5.4 and 45.5.5.

5.28. Medium Voltage Switchgear

5.28.1 The indoor, medium voltage metal enclosed switchgear shall be in accordance with Specification No. BBB4182.

5.28.2 All panels shall be labelled with the ‘designation’ as requested by the technical team on each site.

5.28.3 All circuit breakers/ switchgear shall be rated 12kV, 3 phase, 50Hz.

5.28.4 The rated continuous current shall not be less than 800A.

5.28.5 The incomer/ bus bar panel shall be rated 1250A.

5.28.6 The rated short circuit breaking current shall not be less than 20kA.

5.28.7 The short time withstand current rating for the medium voltage equipment supplied shall not be less than 20kA for 3s.

5.28.8 A minimum clearance of 800mm shall be maintained at the rear of the newly installed panel. The front shall have sufficient space for the breakers to be racked out and withdrawn with ease.

5.29. Switching Devices

5.29.1 Switching devices shall follow Clause 9.0 of Specification no. BBB4182.

5.29.2 The circuit breaker and its control panel shall be supplied from the same supplier/manufacturer.

5.29.3 The switchgear shall be issued with a corresponding remote pendant (chicken switch).

5.30. Medium Voltage Protection

5.30.1 The protection system and relays shall be in compliance with Clause 11.0 of Specification No. BBB4182.

5.30.2 The protection required per panel shall be as specified below and comply with the requirements of specification BBB4182:

5.31. HV Transmission Line:

The relay shall provide the following:

5.31.1. Overcurrent Protection.

5.31.2. Earth Fault Protection.

5.31.3. Sensitive Earth Fault Protection.

5.31.4. Auto-reclosing.

5.32. HV Cable:

The relay shall provide the following:

5.32.1. Overcurrent protection

5.32.2. Earth fault protection

5.33. Transformer (≥500KVA)

The relay shall provide the following:

5.33.1. Buchholz protection

5.33.2. Oil and winding over-temperature protection

5.33.3. Primary overcurrent and Earth fault protection

5.34. Transformer (≤500KVA)

5.34.1. The contractor shall supply and install an on-load isolator.

5.35. Busbars (with bus sectionalizer)

5.35.1. Frame leakage (zone) protection.

5.35.2. Frame leakage protection, with current transformer ratio of 100/5 (class 10P)

5.35.3. Reverse power protection, inter-tripping and phase failure protection or monitoring

5.36. Indication Instruments

5.36.1. Indicating instruments shall follow Clause 12.0 of Specification No. BBB4182 Version 3.

5.36.2. An Ammeter shall be supplied and installed in the panel. The current in all three phases shall be readable.

5.36.3. A Voltmeter shall be supplied and installed.

5.37. Energy meters

5.37.1. All protection relays supplied under this contract shall be capable of energy metering and shall be wired as such.

5.38. Current and Voltage Transformers (CT and VT)

5.38.1. Current and voltage transformers shall follow Clauses 14.0 and 15.0 of Specification No. BBB4182 Version 3.

5.38.2. The current transformer ratios shall be determined by the contractor and approved by the Project manager.

5.38.3. The Contractor shall provide a 10 A rated test winding on protection CT's.

5.38.4. Voltage transformers shall be installed on the cable side.

5.38.5. All current transformers shall be suitable for use in both 6.6 and 11kV circuits.

5.38.6. Dual ratio voltage transformers (6.6/11kV) are required for VT's. VT's shall have a secondary output of 110V.

5.38.7. A VT selection relay shall be provided where more than one VT is installed in a substation.

5.39. Cabling and Wiring

5.39.1. All cabling and wiring shall be in accordance with specification BBC0198 Version 1, CEE0023 and SANS 10142-1.

5.39.2. The contractor shall replace the transformer supply cables, from the switchgear, with new cables.

5.39.3. Contractor shall quote for a XLPE cable

5.39.4. The quotation for the transformer cable shall include the necessary termination on both sides.

5.39.5. No joining of cables will be allowed. The Contractor shall provide cables that are long enough for the application. Joining of cables will only be done in exceptional cases on approval by the contract supervisor.

5.39.6. All cables shall terminate in compression type glands. These glands shall be fitted with neoprene shrouds.

5.39.7. All dissimilar metal connections (Cu to Al) shall be made using bi-metallic clamps that are specifically designed and manufactured to make that connection (ad hoc fabricated clamps are not acceptable).

5.39.8. All copper connections to steel (galvanized) shall be tinned.

5.40. Earthing

5.40.1. Earthing of the substation shall be done in accordance with drawing no. CEEPA-23. A 95 mm² Cu cable shall however be used instead of a 10 mm² as indicated on the drawing.

5.40.2. Contractors are encouraged to propose alternatives; however, the main offer shall be for the provision of copper. A separate offer may be submitted for this.

5.40.3. A new meter box and earth spike shall be installed at the substation.

5.40.4. The earth resistance reading of the earth spike shall be less than 5 ohms. Contractor shall make provision in their offers for installing trench earthing to achieve the required earth reading, where required.

5.40.5. Contractor shall provide for trenching and earthing. The cable route will be pointed out by the depot.

5.41. LV Control Panel

5.41.1. The contractor shall supply and install low voltage control panel with the components as in accordance with specification no. CEE. 0082.90

5.41.2. The control panel must be painted orange with the practice recommended in SABS 064. 1979 and as specified in Spoornet's specification CEE.0045.90.

5.42. Batteries and Chargers

5.42.1. The contractor shall supply and install sealed batteries and battery charger units in accordance with specification CEE 0085.

5.42.2. The supply voltage for all control circuits shall be 110V DC.

5.42.3. The capacity of the battery shall be no less than 26AH.

5.42.4. A 10A charger (minimum) shall be supplied under this contract.

5.42.5. The contractor shall be responsible for all connections required for the interfacing of equipment supplied under this contract with the existing.

5.43. Indoor and Outdoor distribution Transformer

5.43.1. The contractor shall:

5.43.1.1. Decommission the existing transformers and transport the equipment to the Metrorail store in Driehoek, Germiston.

5.43.1.2. Supply and install a new 11/6,6KV/400V indoor distribution transformer.

5.43.1.3. Supply and install pole mounted transformers (6,6/11kV/400V)

5.43.1.4. Supply and install a new outdoor distribution transformer in accordance to specification BBB 8205. The nominal voltage ranges from 22, 44 and 88kV, with the secondary voltage being 11/6,6kV. Droppers shall be made

of aluminium and of suitable size (based on the electrical properties of the transformer supplied).

5.43.1.5. Supply flexible connections that will not exert excessive forces on the bushings should there be shock induced.

5.43.1.6. Conduct preliminary tests to ensure the correct functioning of the transformer and of all protection.

5.43.1.7. Be present to witness the final commissioning tests.

5.43.1.8. Make provision for the replacement of any small steel parts, bolts, and nuts (stainless steel) as required for the proper and complete connection of the equipment supplied under this contract.

5.43.1.9. The transformers main tanks and their associated conservator tanks shall be painted grey and white respectively and in accordance with Transnet freight rail specifications CEE.0045.

5.43.2. The transformer tank shall be welded.

5.43.3. The gasket shall be Type 72 with the thickness of 10 mm for the top gasket and oil fins, and 6mm for the rest of the attachment brackets

5.43.4. The transformer shall be equipped with the following protection features:

5.43.4.1. Core

5.43.4.2. Winding Temperature

5.43.4.3. Oil Temperature

5.43.4.4. Buchholz

5.43.4.5. Pressure relief

5.43.5. The Primary terminals shall constitute bushings on top of the transformer suitable for connection to an overhead line. This shall have suitable clamps to be able to accommodate a 95mm² Cu flex.

5.43.6. Two earthing points shall be provided on the transformer tank with M12 studs.

5.43.7. The transformer tap shall have 5 settings with the following configuration.

5.43.7.1. Taps range: -5%, -2.5%, 0%, +2.5% and +5% of nominal voltage.

5.43.7.2. The nominal voltage for indoor local transformer(11/6,6kV) shall be applicable at the 0% setting.

5.43.8. The nominal voltage for outdoor intake transformer (22, 44 or 88kV) shall be applicable at 0% setting.

5.43.9. All insulators and electrical components shall be covered when spraying and or painting equipment indicated in the schedule of quantities.

5.43.10. The Contractor shall provide the oil filtering equipment, oil storage container and an adequate three-phase power plant.

5.43.11. The Contractor shall fill the transformer with virgin mineral insulating oil after the completion of work. This shall be performed under vacuum conditions.

5.43.12. The Contractor shall filter the oil when filling the transformer.

5.43.13. The oil shall comply with the requirements specified in SABS 555 edition 4 of 2002.

5.43.14. The Contractor shall perform oil tests for all the transformers upon energizing as well as 48 hours after the completion of the works. The oil samples shall be taken from the top and bottom of the main tank of the transformer.

5.43.15. The Contractor shall perform oil purification of the transformer oil in accordance with Transnet freight rail specification CEE.0229 of 1995.

5.43.16. The purified oil shall comply with the requirements specified in SABS 555 edition 4 of 2002.

5.43.17. The Contractor shall provide the following test parameters no later than 48 hours after energizing the transformer:

5.43.17.1. Moisture Content

5.43.17.2. Acid Content

5.43.17.3. Dielectric Strength Test

5.43.17.4. Dissolved Gas Analysis

5.43.17.5. Sludge Test

5.43.17.6. Chlorine Test

5.43.17.7. PCB Test (performed only if the Chlorine test is positive).

5.43.17.8. Furanic Test.

5.43.18. The Contractor shall provide containers for sampling and labels for the information to be supplied with the sample. The labels shall make provision for the following information: - 5.43.18.1. District / Depot

5.43.18.2. Location (of substation)

5.43.18.3. Date of sample

5.43.18.4. Sampled by: (name)

5.43.18.5. Unit Duty (Traction/ Auxiliary Transformers)

5.43.18.6. Unit Make

5.43.18.7. Unit Serial Number

5.43.18.8. Unit Voltage (kV)

5.43.18.9. Unit Capacity (MVA)

5.43.18.10. Sampling Point

5.43.18.11. Temperature Gauge reading

5.43.18.12. Contract Number

5.43.19. The transformer shall be guaranteed for a period of 24 months from date of commissioning.

5.44. Pole mounted transformers

5.44.1 The transformer shall be 50KVA or 100KVA 11/6.6/0.4kV outdoor transformers with the following parameters:

5.44.1.1. Impedance	: 4.5-5%
5.44.1.2. Type	: Hermetically sealed
5.44.1.3. Primary voltage	: 11/6,6kV
5.44.1.4. No load secondary voltage	: 400V
5.44.1.5. Phase and frequency	: 3 & 50hz
5.44.1.6. Vector group	: DYN 11
5.44.1.7. Selectable taps	: 0%, 2.5%, 5%
5.44.1.8. Tap adjustment	: From externally controlled off load 5 selector Switch
5.44.1.9. LV Neutral	: To be insulated from tank and brought out on Separate Insulator for external connection
5.44.1.10. Use	: Low loss type
5.44.1.11. Oil level indicator	: Required
5.44.1.12. Cooling	: ONAN
5.44.1.13. Terminals	: MV&LV bushings (incl. star point)
5.44.1.14. Windings	: Only double wound copper windings will be acceptable
5.44.1.15. Thermometer pocket	: Required
5.44.1.16. Indicating thermometer	: Required
5.44.1.17. Position of installation	: Outdoor

5.44.1.18. Color of transformer : Electrical orange

5.45. Aerial bundle conductor (Low voltage)

5.45.1. The contractor shall:

5.45.1.1. Supply and install 35mm^2 600/1000V aluminium aerial bundle conductor. The cable shall be a 3 core hard drawn stranded compacted aluminium conductors.

5.46. Drawings and Manuals

5.46.1. The contractor shall supply drawings and manuals in line with the requirements of specification BBB0041.

5.46.2. The format of the electronic version shall be agreed to between the contractor and the client.

5.46.3. The contractor shall supply manuals and as built/ wired drawings for the following:

5.46.3.1. Primary Circuit Breaker

5.46.3.2. Transformer

5.46.3.3. Rectifier

5.46.3.4. AC/ DC Distribution Panel

5.46.3.5. AC Control Panel

5.46.3.6. Track breakers

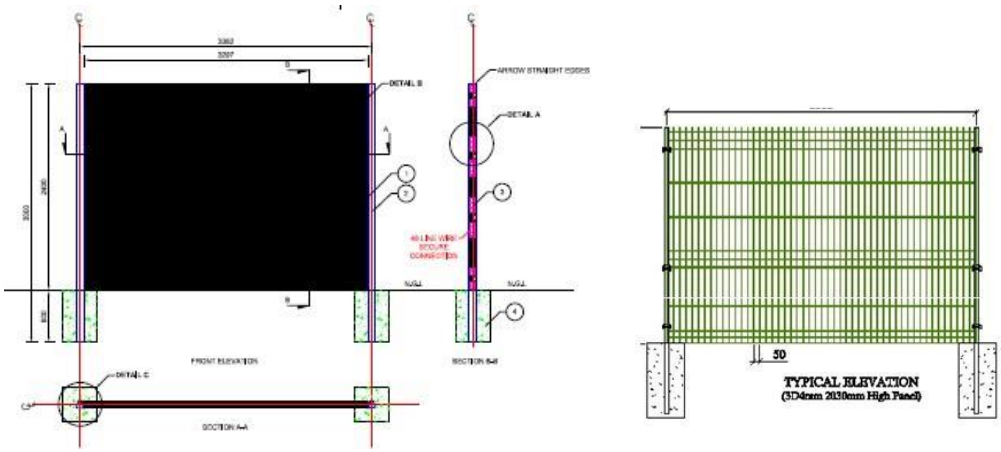
5.46.3.7. Positive isolator

5.46.3.8. Switchgear Panels

5.46.3.9. Battery Charge

5.47. See-through fence

NB: See attached illustrative sketch below



Sketch of a typical See Through fence

5.47.1. Part 1 - General

5.47.2. Scope

a. This specification covers material requirements and installation of security fencing and gates,

5.47.3. Work included

a. Furnish and install fence and gates, and accessories as required and shown.

5.47.4. References Codes and Standards

a. CSIR, SABS, North Atlantic Treaty Organization (NATO) and International Aviation Authority Organization (ICAO).

CSIR Test	980289, 050036, 050056, T09998
SABS Test	536/YM139
Nato Stock	5600/99-458-7474
ICAO	ICAO Security Manual

5.47.5. Submittals

a. Certificate of compliance for materials and coatings
b. Shop drawing for gates
c. Submittal requirements are identified within the Specification.
d. Quality control program shall be submitted to the Engineer for review prior to commencement of any work.

5.47.6. Part 2 – Products

5.47.7. General

a. All steel materials shall be of good commercial quality, galvanized steel.
b. All pipes shall be galvanized, one piece without joints. Furnish moisture proof caps for all posts.
c. Zinc coating shall be smooth and essentially free from lumps, globs, or points.
d. Miscellaneous material shall be galvanized

5.47.8. Description of Fence System

a. Posts:

- Post shall be 3m long Taper Locking Post.
- Post width shall be 85mm - tapering to 45mm with a depth of 85mm.
- Post shall include ‘Locking Recess Mechanism’ to secure panel edge.
- Post shall be sealed with a UV stabilized polymer cap.
- Post finish shall be galvanized.

b. Panel:

- Panel shall be of 3,297m width and 2.4m in height.
- Panel aperture size (centres) shall be 76.2mm x 12.7mm.
- Wire diameter will be 3mm
- The panel shall be reinforced with 4 x 50mm deep 'V' formation horizontal recessed bands (rigidity)
- Panel shall have 2 x 70° flanges along sides (internal fixtures- all fixtures shall be on the inside of fence line)
- Panel shall have 2 x 30° flange along top and toe (integrated rigid angle).
- Panel post shall have a flush panel post finish with no climbing aid.
- Panel shall be affixed to post over 48 line wires using 8 x Double bolt comb clamps and 8 x Single bolt comb clamps using 24 x Anti vandal bolts.
- Panel and fixtures shall be galvanized.
- Panel Post connection minimum break force.

c. Additions

No additions.

d. Fence Corner Configuration.

The fence configuration should not have any sharp corners and all angles at changes of direction should be a minimum of 130 degrees.

5.47.9. Gates

5.47.9.1. Swing gates

a. All connections and joints shall be welded to form rigid frames or assembled with corner fittings.
b. Hinges shall not twist or turn under the action of the gate, shall be so arranged that a closed gate cannot be lifted off the hinges to obtain entry.
c.

5.47.9.2. Sliding gates

a. Gate frame fabrication and miscellaneous items shall be similar to Swing Gates.
b. All fittings, brackets and rear wheel tracks shall be standard manufactured products for the intended application.

5.47.10. Part 3 – Execution

5.47.10.1. General

a. Install all fencing and gates in accordance with the drawings, specifications, instructions, and as specified lines and grades indicated. Line posts shall be spaced at intervals of 3.382 m (10 ft). Terminal posts shall be set at abrupt changes in vertical and horizontal alignment.

5.47.10.2. Posts

a. Post holes shall be cleared of loose material. Waste material shall be spread where directed by Engineer. The ground surface irregularities along the fence line shall be eliminated to the extent necessary

b. Posts shall be set plumb, and follow the indicated alignment. All posts shall be set to the depth indicated on the design documents. Concrete shall be thoroughly consolidated around each post, free of voids, and finished with a domed shaped surface, with the base of dome at grade elevation. Concrete shall be allowed to cure prior to installing any additional components to the posts.

c. Concrete footings shall be carried down to at least the depth indicated on the design documents and shall not be smaller than the dimensions shown. Where a rock layer is encountered within the required depth to which the post is to be erected, a hole of a diameter slightly larger than the largest dimension of the post may be drilled into the rock and the post grouted in. Then the regular concrete footing shall be placed between the top of the rock and the top of the footing elevation as shown on the design documents. Posts shall be approximately centred in their footings. All concrete shall be placed promptly and consolidated by tamping or other approved methods.

d. Where the ground is firm enough to permit excavation of the post hole to neat lines, the concrete may be placed without forms by completely filling the hole. Curing may be achieved by covering the concrete with not less than four inches of loose moist material immediately after placing concrete, or by using a curing compound. All excess material from footings, including loose material used for curing, shall be disposed of as directed by the Engineer

e. Where the ground cannot be satisfactorily excavated to neat lines, forms shall be used to place concrete for footings. Under these conditions the earth and forms coming in contact with the concrete shall be moistened and all ponded water shall be removed from the hole prior to placing concrete. When forms are removed, the footing shall be backfilled with moistened material, and thoroughly tamped. The top of the concrete shall then be covered with not less than 100 mm (4 in) of loose moistened material or use curing compound if the 7-days cure is not completed. All excess material from footings, including loose material used for curing, shall be disposed of as directed.

5.47.10.3. Gates

Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Slide gates shall be installed as recommended by the manufacturer.

5.47.10.4. Adjusting

a. Gate: Adjust gate to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

5.48. Health, Safety and Environment

5.48.1. All work in this contract shall comply with the Occupational Safety Act, 1993 (Act No: 85 of 1993, National Environmental management 107 of 1997 Act and construction regulation 2014). These items shall all be included in the tendered rates. A copy of the act as well as an approved safety file shall be kept on site for the duration of the project.

5.48.2. The contractor shall be responsible for the safety of personnel on site; a detailed safety plan shall therefore be submitted with the tender offer for evaluation. The following shall also form part of the safety plan:

5.48.2.1. Transportation of equipment and personnel.

5.48.2.2. Transportation, storage and handling of hazardous equipment

5.48.3. The site access certificate shall only be issued (to the successful bidder) after the evaluation and approval of the safety file.

5.48.4. The safety file will be approved only after all the requirements on the checklist are met. **WITS_LIB/RISK_MGT/SHE File Checklist (version 3)** is attached in this regard.

5.48.5. The Contractor shall comply with all applicable legislation and PRASA's safety requirements adopted from time to time and instructed by the Project Manager / Technical Officer. Such compliance shall be entirely at the contractor's cost, and shall be deemed to have been allowed for in the rates and prices in the contract.

5.48.6. The Contractor shall report all incidents in writing to the Project Manager / Technical Officer. Any incident resulting in the death of or injury to any person on the works shall be reported within 15 minutes of its occurrence and any other incident shall be reported within 12 hours of its occurrence.

5.48.7. The Contractor shall make necessary arrangements for sanitation, water and electricity at these relevant sites during the installation of the equipment.

5.49. Quality Assurance

5.49.1. Contractors shall submit descriptive literature consisting of detailed technical specifications, constructional details and principal dimensions, together with clear illustrations of the equipment offered.

5.49.2. Contractors shall submit equipment type test certificates for equipment to be supplied in this contract. These shall be in English.

5.49.3. The Project Manager shall be notified timeously for inspection of equipment before it is delivered to site.

5.49.4. Testing and Commissioning schedules shall be provided for all equipment provided under this contract.

5.49.5. The quality control plan shall be submitted and approved by PRASA's project manager.

5.50. Care of the Works

5.50.1. From the date on which the Site is handed over to the Contractor to the date of the issue of a Certificate of Completion, the Contractor shall take full responsibility for the care of the Works and the Employer's Assets on the Site and of all Plant intended for incorporation into the Works and materials on the Site intended for incorporation into the Works.

5.51. Overall Staffing and Key Professional staff

5.51.1 (a) Bidder will have to commence construction activities simultaneously in all the substations be reinstated on the section, therefore, the bidder shall have the capabilities and capacity to provide separate construction teams to cover all the sites and to complete the project at the specified duration.

5.51.1 (b) The technical staff requirements for the construction phase from the appointed contractor for this capital project will comprise the following key areas of practice:

5.51.2 (a) Project /Construction Manager

5.51.2 (b) Civil Construction Supervisors

5.51.2 (c) Electrical Installation Supervisors

5.51.2 (d) Electrician

5.51.2 (e) Occupational Health & Safety Officers

5.51.2 (f) Optical Transport Network (OTN) Technician

5.52. Bidder to complete the Compliance Specification Sheet: Complete Yes to confirm compliance to the listed technical specifications. A sheet with a **No** or **not fully** completed sheet will be regarded as non-compliant to the specific technical specification.

Minimum Qualifications of the technical staff listed above are outlined below. All educational qualifications should be SAQA accredited.

5.52.1. PROJECT / CONSTRUCTION MANAGER

5.52.1(a) BSc or B Tech in Electrical Engineering (Heavy Current);

5.52.1(b)Registered with the Engineering Council of South Africa (ECSA) as a Professional Engineer or Technologist.

5.52.1(c)Registered with the South Africa Council for the Project and Construction Management Professions (SACPCMP) as a professional manager.

5.52.2. CIVIL CONSTRUCTION SUPERVISORS

5.52.2. (a) National Certificate level 3 (N3) in Civil Construction Engineering.

5.52.2. (b) Trade test certificate.

5.52.3. ELECTRICAL INSTALLATION SUPERVISORS

5.52.3. (a) National Certificate level 3 (N3) in Electrical Engineering (Heavy Current) or valid A-brown certificate.

5.52.3. (b) Trade test certificate

5.52.4. ELECTRICIAN

5.52.4. (a) National Certificate level 3 (N3) in Electrical Engineering (Heavy Current) or valid A-brown certificate.

5.52.4. (b) Trade test certificate.

5.52.5. OCCUPATIONAL HEALTH AND SAFETY OFFICERS

5.52.5. (a) National Diploma or Certificate in Safety, Health, Environment, Risk and Quality (SHERQ).

5.52.5. (b) Professional registered with SACPCMP.

5.52.6. OPTICAL TRANSPORT NETWORK (OTN) TECHNICIAN

5.52.6. (a) OTN Systems Certified on installations and commissioning of OTN systems.

5.53. To be provided by the contractor

5.53.1. Site books (each in triplicate) to record:

5.53.1.1. All incidents as well as the progress of work during the occupation.

5.53.1.2. All instructions pertaining to the technical details of the work being performed at that time

5.53.2. Upon appointment, the contractor shall supply machinery, equipment, material, labour and consumables, etc. necessary for the undertaking and completion of the works to satisfaction of the client.

5.53.3. The client will require conformance documentation for each item of material procured by the contractor for installation used in this contract.

5.53.4. Any damage caused to the property of PRASA will be for the contractors account.

5.53.5. The contractor shall verify the position of all services and all other obstacles and existing works on site before commencement of works. Where any underground services are shown on the drawings, the contractor shall have the equipment available on site for as long as is necessary to detect and locate such services and, if so ordered, he or she shall excavate by hand to expose such services in areas and in a manner and at a time agreed upon with the Technical officer.

5.53.6. Protection of cables- Before any excavations take place near identified service cables, the contractor shall contact the Technical officer.

5.53.7. The contractor shall advise the Technical officer at least 7 days in advance of the actual date on which to excavate near any cable. The contractor shall not use mechanical equipment to excavate within 3m of the estimated position of identified cable and shall, if necessary, expose the cable by means of hand excavation carried out under proper supervision.

5.54. Measurement of quality of construction

5.54.1. The works shall be quantified by the contractor with the assistance of PRASA personnel, the payment will be subject to the rates submitted in the tender.

5.54.2. Where the condition of the site is such that the specified performance standards cannot be achieved, the contractor should record all relevant information in conjunction with the Technical Officer before and after working. Correctness and final approval shall be the responsibility of PRASA.

5.55. Rectification of sub-standard work

5.55.1. Where the specified standards of workmanship and accuracy are not attained, the Contractor shall rectify at own cost within 7 working days.

5.56. General

5.56.1. Should any claim arise due to damage caused by any action of work by the Contractor to property of PRASA and his employees or any other person/s, the Contractor shall be held liable to settle such claims at his own cost.

5.56.2. The contractor shall provide transport, equipment, tools, consumables, supervision, protection and labor necessary to successfully complete the contract.

5.57. Safety

5.57.1. The Contractor shall comply with requirements of safety legislations and regulations in all respects.

5.57.2. All drivers shall be in possession of valid driver's licenses and Public Drivers Permits (PDP) where applicable. Crane operators will be required to have a valid Crane Operator's certificate. All vehicles shall be roadworthy.

5.57.3. The Contractor shall be responsible for all protective clothing and –equipment for his employees. All employees required to climb structures shall be issued with suitable harnesses.

5.57.4. The contractor shall be responsible for security of personnel and material onsite as well as during transit.

5.57.5. All work shall at all times comply with the E7/1 Specification attached hereto.

5.57.6. Normal protection measures in accordance with the Protection Manual shall apply.

5.57.7. An effective safety procedure to be followed by all personnel on any work site in the case of approaching rail traffic shall be compiled by the Contractor and implemented before any work commences. This procedure shall be updated whenever the need arises, and any changes shall be communicated to all employees on a works site before work proceeds.

5.57.8. It is the requirement of this contract that the contractor should provide PRASA with a detailed safety plan prior to being issued with a site access certificate, in accordance with the latest version of the OHS Act and the SPK7 and SHE specification.

5.57.9. Occupational Safety Act, 1993 (Act No: 85 of 1993)

5.57.10. Electrical Safety instruction (BBF 3690, Version 2)

5.57.11. National Environmental Management Act 107 of 1997

5.57.12. Construction regulation 2014

5.58. Measurements and payments

5.58.1. Claims for payment will be made for completed work only.

5.58.2. Any rejected and incomplete work will not be paid for.

5.58.3. All rates in the schedule of quantities must be made per unit as requested and should be an all-inclusive rate.

5.58.4. The rate quoted by the Contractor (s) and accepted by PRASA must hold well till the completion of the work and shall not be subject to any escalation due to increase in the local market rates for materials & labor. No claim on this account whatsoever shall be entertained at any stage including the extended period.

5.59. Bonds

5.59.1. The Preferred Bidder shall provide PRASA with a performance bond which shall be 10% of the value of the entire Project price offered by the Preferred Bidder and it shall be issued within 30 days of receipt of notice of appointment as Preferred Bidder. The Performance Bond shall be valid for the Contract period. The format of the Performance Bond is attached as Annexure 3.

5.60. Guarantee

5.60.1. All work undertaken by the Contractor shall be subject to a guarantee for a period of one year against faulty and/or inferior workmanship and material.

5.60.2. The guarantee period shall commence the day the installation is formally handed over to and accepted by the Project Manager (practical completion).

5.60.3. The Contractor shall undertake to repair all faults or defects due to bad workmanship and/or faulty materials during the guarantee period.

5.60.4. Any defects that may become apparent during the guarantees period shall be rectified to the satisfaction of and free of cost to the Client.

5.60.5. The Contractor shall undertake work on the rectification of any defects that may arise during the guarantee period within the time noted in the Contract Document, from the time of being notified by the Client.

5.60.6. Should the Contractor fail to comply with the requirements stipulated above, Metrorail shall be entitled to undertake the necessary repair work or effect replacement of defective apparatus or material, and the Contractor shall reimburse Metrorail the total cost of such repair of replacement, including the labour costs incurred in replacing defective material.

5.61. Payment certificate

5.61.1. On or after the assessment date, the Supervisor and the Contractor will together assess the quantities of the progress on each item in the Bill of Quantities and complete the Progress Assessment Detail form, where after the Progress Assessment Certificate will be issued.

5.61.2. The Contractor shall then submit a VAT invoice and attach the above Progress Certificate for payment by PRASA.

5.61.3. Contractor to provide PRASA with the necessary details regarding banking details to enable PRASA to make electronic payments.

5.62. Pricing the works

5.62.1. The contractor is required to provide firm prices/ rates for material and labor for the duration of the contract.

5.62.2. The contract period shall be inclusive of the delivery and installation period as well as an additional period of at least one year starting from the date of acceptance by the client of the last unit.

5.62.3. The contractor shall make provision for the costs (direct or otherwise) associated with works on, over or adjacent to railway lines. The Contractor is advised to study the requirements of the SPK 7/1 and ensure that all works can be completed in accordance with these requirements.

5.62.4. The contract offer shall be based on the rates as indicated in the bill of quantities.

5.63. Penalties

5.63.1. If the Contractor fails to complete the Services within the time stipulated in this Contract for completion of Services or a part or portion of Services, the Contractor

shall be liable to the Employer for an amount calculated at 0.3% of the Contract Price per delayed Day per order, which shall be paid for every Day which shall elapse between the time for due completion and completion of the relevant Services. However, the total amount due under this sub-clause shall not exceed the maximum of 10% of the Contract Price.

5.63.2. The imposition of such penalty shall not relieve the Contractor from its obligation to complete Services or from any of its obligations and liabilities under the Contract,

5.63.3. PRASA may set off or deduct from the fees due to the Contractor any penalty amounts due and owing by the Contractor in terms of clause 5.58.1

5.64. Commissioning tests and completion

5.64.1. Designated PRASA personnel, in conjunction with the Contractor, shall carry out the final commissioning test. The Contractor shall carry out any remedial work, if necessary.

5.65. Handing over

5.65.1. The handovers shall be for each portion of the work when the Electrical System is tested and commissioned to the satisfaction of the Technical Manager, in accordance with the details as set out in the handing over documentation of PRASA.

6 Construction Related Security

6.1 All security companies used by the Contractor shall be PSIRA registered with a valid letter of good standing.

6.2 Security personnel shall all be PSIRA registered with a clear criminal record and no criminal pending cases.

6.3 The security to be provided by the contractor shall be responsible for safeguarding both the appointed contractor's and PRASA's assets on site until the site is handed over to PRASA. A list of all functioning equipment that do not form part of this scope of work will be shared with the successful bidder and shall be signed off by both the successful bidder and PRASA's representative.

6.4 The contractor shall be sole responsible of the site (including all the equipment within the boundary limit) from the time the site is handed over to the contractor, until such time the contractor hands over the site back to PRASA.

6.5 The boundary limits for each substation will include all assets in the substation until the switching structure. The equipment associated with the switching structure is also included in the boundary limits.

6.6 The contractor shall provide on-site security for personnel and material stock and should ensure that patrols are in place at the site handed over to the contractor until the completed work is handed over to PRASA. No claims of material or losses must be lodged with the client for stolen goods during the construction before the completed work is handed over to PRASA.

6.7 Furthermore, it is the contractor's responsibility to ensure that valuable metal i.e. copper is adequately protected while in transit to and from site.

6.8 The contractor shall make sure that all material removed from site is quantified, counted, logged in the site diary and that it is co-signed by a PRASA representative on site before it is removed from site.

6.9 Scrap metal removed from the section shall be adequately protected until it is delivered to PRASA's stores.

6.10 PRASA reserves the right to conduct ad-hoc inspections to ensure Compliance.

6.11 Any lost, damaged or stolen material by the successful bidder in accordance to clauses

6.1 to 6.10 above shall be liable to PRASA.

7 List of Transnet/ PRASA specifications that form part of this scope of work

- BBB 5452: Transnet Freight Rails Requirements for the Installation of Electrical Equipment at 3kV DC Traction Substations.
- CEE.0023: Laying of cables.
- CEE.0045: Painting of steel components of electrical equipment.
- CEE.0224: Drawings, catalogues, instruction manuals and spares lists for electrical equipment supplied under contract.
- CEE-TBD-0007: 3kV DC earthing arrangement system for traction substations.
- BBB 0496: 3kV rectifier for traction substations (addendum included is also applicable)
- BBB 0845: Requirements for metal oxide surge arresters in accordance with SANS 60099-4.
- BBB0937: Requirements for outdoor post type current transformers for traction and distribution substations
- BBB 1267: Specification for Outdoor High Voltage Alternating Current Circuit Breaker in Accordance with SANS 62271-100.
- BBB 1616: 450 Volt gas arrester spark gap for traction power supplies.
- BBB 2502: Requirements for battery chargers for 3KV DC traction system (addendum included is also applicable)

- BBB 2721: AC primary circuit breaker control panel and AC/DC distribution panel for 3kV traction substation. (Addendum to specification BBB2721 paragraph 8.8 is also applicable)
- BBB 3005: 3kV DC under voltage relay manufacturing specification.
- BBB 3139: Wave filter capacitors for 3kV DC traction substations.
- BBB 3162: Wave filter inductors for 3 kV DC traction substations.
- BBB 3620: 3kV DC earthing arrangement system for High Voltage outdoor yards.
- BBB3890: Requirements for 1.8 milli henry DC reactor for 3kV DC traction substation.
- BBB 4724: Requirements for positive isolator for 3kV traction substation
- BBB 7842 Outdoor, High Voltage, Alternating Current Disconnects combined with earthing switch.
- BBC 0198: Requirements for the supply of cables.
- BBB 5019: Requirements for traction transformers for 3kV traction substations in accordance with BS171 and IEC 60076-1

List of South African National Standards that form part of this scope of work

- SANS 121: Hot dip galvanized coatings for fabricated iron or steel articles. Specifications and test methods.
- SANS 156: Moulded-case Circuit Breakers.
- SANS 780: Distribution Transformers.

- SANS 1019: Standard voltages, currents and insulation levels for electricity supply.
- SANS 1091: National Colour Standard.
- SANS 1222: Enclosures for Electrical Equipment.
- SANS 1339: Cross-Linked Polyethylene (XLPE) - Insulated Electric cables for rated voltages (3,8/6,6kV to 19/33kV)
- SANS 1431: Weldable structural steels.
- SANS 1507: Electric cables with extruded solid dielectric insulation for fixed installations. (300/500V to 1900/3,300V) Part 1
- SANS 10142-1: The wiring of premises. Part 1
- SANS 60044-1: Instrument Transformers Part 1. Current Transformers.

9. Is this a CIDB related Project? (Yes)

If YES, What is the applicable Class of Work & Grade?

Class of Work: EP

Minimum Grade: 9