

**REQUEST FOR TENDERS –APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION FOR THE PERIOD OF SIX MONTHS**

**TENDER NUMBER: 13-06-2023 GAU (EL)**




**prasa tech**  
TECHNICAL DIVISION

## **ANNEXURE 1: DETAIL SCOPE OF WORK**

**REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR THE RECONSTRUCTION OF THE 3 kV DC TRACTION AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION.**

**TENDER NUMBER: 13-06-2023 GAU (EL)**

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

## 1 INTRODUCTION

### 1.1 Background

The project was informed by theft and vandalism that took place at various PRASA railway networks. PRASA decided to invest in recovery programmes which include substations and overhead traction equipment infrastructure.

The project, therefore, seeks to address the following:

- Provide adequate and effective security systems fitted with the latest technology.
- Ensure compliance with the latest standards and regulations.
- Modernisation of the traction substation, AC distribution substations and
- Upgrade the traction substation to cater for future load requirements.

The following substations for both AC Distribution and Traction Substations will be covered by this project specification:

- a) Anglers 3kV DC Traction Substation, Single unit at 88kV nominal voltage;
- b) Stretford 3kV DC Traction Substation, Double unit at 88kV nominal voltage;
- c) Houtheuwel 3kV DC Traction Substation, Single units at 88kV nominal voltage;
- d) Stretford intake 88kV/6.6kV, 5 MVA distribution substation;
- e) Houtheuwel Signal Cabin 6.6kV/400V, 50kVA; and
- f) Houtheuwel Intake 88kV/6.6kV, 10MVA distribution substation.

## 2 TERMINOLOGY AND ABBREVIATIONS

### 2.1 Terminology

Power Plant	This forms part of the main circuit through which the electrical power flows
Control Plant	LV equipment forming part of the substation control and protection system
Double Unit Substation	The substation has two transformers and rectifier units, supplying power independently from each other to a common 3kV DC busbar inside the substation building
Employer	PRASA Tech

## 2.2 abbreviations

A	Ampère
AC	Alternating Current
AIS	Air Insulated Switchgear
BOQ	Bill of Quantities
BS	British Standards
CCD	Charge Couple Device
CCTV	Closed Circuit Television
°C	Degrees Celsius
DC	Direct Current
EL&P	Electric Light and Power
FAT	Factory Acceptance Test
fps	Frames Per Second
HDPE	High-Density Polyethylene
HMI	Human Machine Interface
HSCB	High-Speed Circuit Breaker
HV	High Voltage
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Device
IP	Internet Protocol
km	kilometre
kV	kilo Volt
kVA	kilo Volt Ampère
LV	Low Voltage. Nominal voltage levels up to and including 1kV
m	Metre
MCCB	Moulded Case Circuit Breaker
MCB	Miniature Circuit Breaker
mm	millimetre
MPa	Mega Pascal


MV	Medium Voltage. Nominal voltage levels greater than 1kV and less than 44kV
MVA	Mega Volt Ampère
MW	Mega Watt
NRS	National Rationalised Specifications
NTP	Network Time Protocol
NVR	Network Video Recording
OEM	Original Equipment Manufacturer
OHL	Overhead Line
OHTE	Overhead Track Equipment
OHS	Occupational Health & Safety
PIDS	Perimeter Intruder Detection System
PLC	Programable Logic Controller
PoE	Power over Ethernet
PRASA	Passenger Railway Agency of South Africa
QA	Quality Assurance
RTU	Remote Terminal Unit
SAT	Site Acceptance Test
SANS	South African National Standards
SCADA	Supervisory Control and Data Acquisition System
TFR	Transnet Freight Rail
V	Volt

### 3 EXTENT OF THE WORKS

**Note:** Clause 3 of this scope of work covers the high-level Extent of the substation's Works. This Clause must be read in conjunction with the relevant Clauses of this document which constitute the detailed technical requirements for this Project. Any conflicting clauses or statements must be immediately brought to the attention of PRASA Technical.


#### 3.1 Summary of Scope

- a) The works cover the detailed design, for a complete substation including the power plant and the control plant with accompanying operation procedure reports,

<b>REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION</b>	
<b>TENDER NUMBER:13-06-2023 GAU(EL)</b>	


manufacture, transportation to site, installation, testing, and commissioning of all two (2) Traction Substation, 88kV AC to 3kV DC Single unit traction substations and six (6) AC Distribution Substation.

- b) The traction substation designs shall comply with the applicable TFR/PRASA and related national/international standards, regulations, and codes.
- c) The high-level extent of the works is as follows: -
  - (i) Supply and install 88kV AC to 3kV DC, complete single unit traction substation comprising of 6.1 MVA transformer.
  - (ii) Supply and install 88kV AC to 3kV DC, complete double unit traction substation comprising of 2 x 6.1 MVA transformers.
  - (iii) The 6.1MVA transformer shall be used to supply power to a 100kVA 2.36kV/400V auxiliary transformer.
  - (iv) Supply and install a 400kVA, 6.6kV/400V, Dyn11, 3-phase AC, 50Hz, stepdown Distribution Transformer complete for the outdoor yard.
  - (v) Supply and install a 10kVA, 6.6kV/400V, Dyn11, 3-phase AC, 50Hz, stepdown Distribution Transformer complete for indoors.
  - (vi) Supply and install a 50kVA, 6.6kV/400V, Dyn11, 3-phase AC, 50Hz, stepdown Distribution Transformer complete for the outdoor yard.
  - (vii) Supply and install Isolation transformer, ratio 1:1 for protection.
  - (viii) Perform protection setting calculations and configuration of the various protection schemes proposed on the final approved designs. The Contractor shall present the detailed design to PRASA for acceptance before proceeding to the implementation stage.
  - (ix) Once the detailed designs (shop drawings) and accompanying design report have been reviewed and accepted by PRASA, the Contractor shall proceed with but not limited to the following: -
    - (x) Decommission the existing equipment and remove all equipment, demolish the old foundation of outdoor equipment and unutilised structures.
    - (xi) Transport decommissioned equipment to PRASA's electrical depot.
    - (xii) Rubble and waste are to be transported and dumped in an environmentally approved dumping site for rubble and waste and submit the approved certificate to confirm that waste has been dumped on an accredited site.
    - (xiii) Toxins such as Polychlorinated Biphenyls (PCB) that may be found in transformer or wave filter capacitor oil shall be handled and disposed of in a manner that is compliant with environmental regulations. The contractor shall

<b>REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION</b>	
<b>TENDER NUMBER:13-06-2023 GAU(EL)</b>	

submit the approved certificate to confirm that waste has been dumped on an accredited site.

- (xiv) Any asbestos found in the HSCB arc chutes or circuit breaker in situ cells shall be disposed of in a manner that is compliant with environmental regulations. The contractor shall submit the approved certificate to confirm that waste has been dumped on an accredited site.
- (xv) Clear and prepare the site for construction.
- (xvi) Surveying and setting out of the Works.
- (xvii) Perform all the necessary earthworks and compaction.
- (xviii) Supply and transportation of material and installation of the substation earth mat. Gauteng has a high concentration of lightning bolts which is to be considered during electrical protection design.
- (xix) Supply and transportation of material and construction of substation equipment foundations.
- (xx) Refurbishment of the substations control building.
- (xxi) Construction of toilet facility and provision to connect it to the municipalities sewer network.
- (xxii) Manufacture various power plant equipment and control plant equipment.
- (xxiii) Supply, transportation and installation of all power and control plant equipment.
- (xxiv) Supply, transportation, and installation of substations perimeter fencing and kerbing for all substations.
- (xxv) Supply, transportation, and installation of substations yard lighting.
- (xxvi) Supply, transportation, and installation of substation outdoor equipment supporting steelworks and barrier fences complete.
- (xxvii) Supply, transportation, and installation of substations yard crusher stones after application of an environmentally approved weed killer suitable for local conditions.
- (xxviii) Supply, transportation and installation of power and control cables and associated hardware/fittings, including the feeder cables between the 3kV DC HSCBs and the OHTE track switch structures.
- (xxix) Supply, transportation, and installation of the 3kV DC negative return cables to the manholes and bonds to the rails.
- (xxx) Supply, transportation, and installation of protection schemes.
- (xxxi) Supply, transportation, and installation of all interfacing equipment/cables for tele-control equipment.

<b>REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION</b>	
<b>TENDER NUMBER:13-06-2023 GAU(EL)</b>	


- (xxxii) Supply, transportation and installation of a new SIS500 tele-control outstation.
- (xxxiii) Supply, transportation and installation of a complete new Telecommunication system
- (xxxiv) Supply, transportation and installation of AC and DC auxiliary supplies.
- (xxxv) Supply, and installation of substation labels.
- (xxxvi) Perform factory and site acceptance testing.
- (xxxvii) Implement protection settings.
- (xxxviii) Do pre-commissioning and final commissioning testing of the new installation.
- d) After PRASA is satisfied with the new installation, energise the new assets into services.
- e) All relevant test, commissioning, maintenance, operational, training, etc. documentation and relevant training shall form part of these Works.
- f) Any other work arising from or incidental to the above or required from the Contractor for the proper completion of the Works by the true meaning and intent of the Contract documents.

#### **4 TEMPORARY WORKS**

- a) No temporary Works have been identified, but any temporary work that might be required during this project's implementation shall be the Contractor's responsibility.
- b) This includes any associated safety, engineering and design that may be required. Therefore, it is the responsibility of the Contractor to identify such Works.

#### **5 APPLICABLE STANDARDS**

- a) Except for Employer owned documents and standards, the Contractor shall obtain the latest version/publications of these specifications and standards from their sources or publishers at their own cost.
- b) Unless otherwise specified all materials and equipment supplied shall comply with the current edition of the relevant SANS, BS and IEC publications where applicable.
- c) Where reference is made to PRASA/TFR or Spoornet specifications, such documents shall form part of the contract document for easy reference.
  - (i) Any items offered by other standards will be considered at the sole discretion of PRASA. The Contractor shall be responsible for supplying full details stating where the item offered differs from the specifications listed below and

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

supplying a copy (in English) of the recognised standard specification(s) with which it complies.

## 5.1 General Standards

The general standards are listed in Table 1 below:

Document Number	Description
SANS 1921-6	Part 6: HIV/Aids awareness
SANS 1921-1	Part 1: General Engineering and Construction Works
SANS 1200AB	Section AB: Engineer's Office
SANS 1200A	Section A: General
RSR Act	Railway Safety Regulator Act 16 of 2002
OHS Act	Occupational Health and Safety Amendment Act, No.85 of 1993
OHS Act	Machinery and Occupational Safety Act, 1983 (Act 6 of 1983)

**Table 1: List of General Standards**

## 5.2 Building Standards

The building standards are listed in Table 2 below:

Document Number	Description
SANS 10400	The application of the National Building Regulations
SANS 791	uPVC pipes for underground non-pressure application
SANS 558	Boxes and manhole and inspection covers and frames
SANS 1200LC	Cable ducts
SANS 1200LB	Bedding (pipes)
SANS 1200GE	Pre-cast concrete (structural)
SANS 1200GB	Concrete (ordinary buildings)
SANS 1200G	Concrete (structural)
SANS 1200DB	Earthworks (pipe trenches)
SANS 1200DA	Earthworks (small works)
SANS 1200C	Site Clearance

**Table 2: List of building standards**

## 5.3 EL & P Standards

The EL&P standards are listed in Table 3 below.




**REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION**



**TENDER NUMBER:13-06-2023 GAU(EL)**

Document Number	Description
SANS 60309-1	Plugs, Socket-outlets and couplers for industrial purposes (Part 1: General requirements)
SANS 60269-1	Low-voltage fuses – Part 1: General requirements
SANS 60168	Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1 000 V
SANS 60076-7	Power transformers Part 7: Loading guide for oil-immersed power transformers
SANS 60076-5	Power transformers Part 5: Ability to withstand short circuit
SANS 60076-4	Power transformers Part 4: Guide to the lightning impulse and switching impulse testing - Power transformers and reactors
SANS 60076-3	Power transformers Part 3: Insulation levels, dielectric tests and external clearances in air
SANS 60076-2	Power transformers Part 2: Temperature rise for liquid-immersed transformers
SANS 60076-1	Power Transformers
SANS 60060-1	High-voltage test techniques Part 1: General definitions and test requirements
SANS 60060-2	High-voltage test techniques Part 2: Measuring systems
SANS 60056	High Voltage alternating current circuit-breakers
SANS 60044-2	Instrument Transformers, Part 2- Inductive Voltage Transformers
SANS 60044-1	Instrument Transformers, Part1- Current Transformers
SANS 529	Heat resisting wiring cables
SANS 50054-7	Fire detection and fire alarm systems Part 7: Smoke detectors – Point detectors using scattered light, transmitted light or ionisation
SANS 50054-5	Fire detection and fire alarm systems Part 5: Heat detectors – Point detectors
SANS 1799	Watt-hour meters – AC electronic meters for active energy
SANS 1777	Photoelectric control units for lighting PECUss)
SANS 1765	Low Voltage switchgear and controlgear assemblies (distribution boards) with a rated-short circuit withstand strength up to and including 10kA
SANS 1619	Small power distribution units (ready boards)
SANS 156	Moulded case circuit breakers
SANS 1433-2	Electrical terminals and connectors – Part 2: Flat push-on connectors
SANS 1433-1	Electrical terminals and connectors – Part 1: Terminal blocks having a screw and screwless terminals

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	 <b>prasa tech</b> <small>TECHNICAL DIVISION</small>
TENDER NUMBER:13-06-2023 GAU(EL)	


SANS 1411-1	Materials of insulated electric cables and flexible cords – Part 1: conductors
SANS 1239	Plugs, socket outlets and couplers for industrial purposes
SANS 1213	Mechanical cable glands
SANS 1195	Busbars
SANS 1063	Earth rods and couplers
SANS 10313	Protection against lightning
SANS 10142-2	The wiring of premises Part 2: Medium-voltage installations above 1 kV AC not exceeding 22 kV AC and up to and including 3 000 kW installed capacity
SANS 10142-01	Wiring of premises Low-voltage Installation

**Table 3: List of EL&P standards**


#### 5.4 IEC Standards

The IEC standards are listed in Table 4 below.

Document Number	Description
IEC 62271	Specification for AC metal-enclosed switchgear and control gear, for voltages above 1kV up to and including 52kV
IEC 61869-2	Instrument Transformers - Part 2: Current Transformers.
IEC 61869	Instrument Transformers: Additional General Requirements for Low Power Instrument Transformers.
IEC 60947-7-1	Low-voltage switchgear and controlgear - Ancillary equipment - Terminal blocks for copper conductors
IEC 60947-6-2	Low-voltage switchgear and controlgear - Multiple function equipment - Control and protective switching devices for equipment
IEC 60947-6-1	Low-voltage switchgear and controlgear - Multiple function equipment - Automatic transformer/Transfer switching equipment
IEC 60947-4-3	Low-voltage switchgear and control gear - Contactors and motor-starters - AC semiconductor controllers and contactors for non-motor loads
IEC 60947-4-2	Low-voltage switchgear and control gear - Contactors and Motor Starters - AC Semiconductor motor controllers and starters
IEC 60947-4-1	Low-voltage switchgear and control gear – Electromechanical Contactors and Motor Starters
IEC 60947-3	Low-voltage switchgear and control gear - Switches, disconnectors, switch disconnectors

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	 <b>prasa tech</b> <small>TECHNICAL DIVISION</small>
TENDER NUMBER:13-06-2023 GAU(EL)	

IEC 60947-2	Low-voltage switchgear and control gear - Circuit Breakers
IEC 60947-1	Low-voltage switchgear and control gear - General rules
IEC 60815:	Guide for the selection of insulators in respect of polluted conditions.
IEC 60730-2-9.	Automatic electrical controls for household and similar use Part 2-9: Particular requirements for temperature sensing controls
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60502-4	Power cables with extruded insulation and their accessories for rated voltages
IEC 60502-2	Power cables with extruded insulation and their accessories for rated voltages
IEC 60502-1	Power cables with extruded insulation and their accessories for rated voltages
IEC 60298	AC metal-enclosed switchgear and controlgear for rated voltages above 1kV and up to and including 52kV.
IEC 60297-1:	Dimensions of mechanical structures
IEC 60296	Fluids for Electrotechnical Applications - Unused Mineral Insulating Oils for Transformers and Switchgear.
IEC 60255-5	Electrical Relays - Insulation Coordination for Measuring Relays and Protective Equipment- Requirements and Tests.
IEC 60255-22	Measuring Relays and Protection Equipment - Part 22-5: Electrical Disturbance Tests - Surge Immunity Test.
IEC 60255-121	Measuring Relays and Protection Equipment - Part 121: Functional Requirements for Distance Protection.
IEC 60255-11	Measuring Relays and Protection Equipment - Part 11: Voltage Dips, Short Interruptions, Variations and Ripple on Auxiliary Power Supply Port.
IEC 60255-1	Measuring Relays and Protection Equipment - Part 1: Common Requirements.
IEC 60099-4	Surge Arresters - Part 4: Metal-Oxide Surge Arresters without Gaps for AC Systems.
IEC 60092-352	Choice & Installation of Cables for Low Voltage Power Systems
IEC 60092_376	Cable for Control & Instrumentation Circuits
IEC 60092_375	General Instrumentation, Control & Communication Cables
IEC 60076-8	Power transformers - Application Guide
IEC 60076-7	Power transformers Part 7: Loading guide for oil-immersed power transformers
IEC 60076-5	Power transformers - Ability to withstand short circuit
IEC 60076-4	Power transformers - Guide to the lightning impulse and switching impulse testing

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

IEC 60076-3	Power transformers - Insulation levels, dielectric tests and external clearances in air
IEC 60076-2	Power transformers - Temperature rise
IEC 60076-10	Power transformers - Determination of sound levels
IEC 60076-1	Power transformers – General
IEC 60051-1	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories - Part 1: Definitions and General Requirements Common to all Parts.
IEC 60044-2:	Instrument transformers- Part 2: Inductive voltage transformers

**Table 4: List of IEC standards**

## 5.5 Building Management and Energy Efficiency Standards

The building management and energy efficiency standards are listed in Table 5 below.


Document Number	Description
SANS 941	The energy efficiency of electrical and electronic apparatus
SANS 50285	The energy efficiency of electric lamps for household use - Measurement methods
SANS 50001	Energy management systems - Requirements with guidance for use
SANS 204-3	Energy efficiency in buildings Part 3: The application of the energy efficiency requirements for buildings with artificial ventilation or air conditioning
SANS 204-2	Energy efficiency in buildings Part 2: The application of the energy efficiency requirements for buildings with natural environmental control
SANS 204-1	Energy efficiency in buildings Part 1: General requirements
SANS 204	Energy efficiency in buildings
SANS 10400-XA	The application of the National Building Regulations (Part X: Environmental sustainability Part XA: Energy usage in buildings)

**Table 5: List of building management and energy efficiency standards**

## 5.6 Environmental Standards

The environmental standards are listed in Table 6 below.

Document Number	Description
-----------------	-------------

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	


SANS 61753-2-1	Fibre optic interconnecting devices and passive components performance standard Part 2-1: Fibre optic connectors terminated on single-mode fibre for category U - Uncontrolled environment
SANS 61000-6-5	Electromagnetic compatibility (EMC) Part 6-5: Generic standards - Immunity for power station and substation environments
SANS 61000-2-3	Electromagnetic compatibility (EMC) Part 2: Environment Section 3: Description of the environment - Radiated and non-network-frequency-related conducted phenomena
SANS 61000-2-2	Electromagnetic compatibility (EMC) Part 2-2: Environment - Compatibility levels for low frequency conducted disturbances and signalling in public low voltage power supply systems
SANS 60793-1-5	Optical fibres Part 1: Generic specification Section 5: Measuring methods for environmental characteristics
SANS 300132-3	Environmental Engineering (EE); Power supply interface at the input to telecommunications equipment Part 3: Operated by a rectified current source, alternating current source or direct current source up to 400V
SANS 300132-2	Environmental Engineering (EE); Power supply interface at the input to telecommunications equipment Part 2: Operated by direct current (dc)
SANS 23045	Building environment design - Guidelines to assess the energy efficiency of new buildings
SANS 16818	Building environment design - Energy efficiency - Terminology

**Table 6: List of environmental standards**


## 5.7 Electrical and Steel Structures Standards

The electrical and steel structures standards are listed in Table 7 below.

Document Number	Description
SANS 474	Code of practice for electricity metering
SANS 780	Distribution Transformers.
SANS 62305	Physical Damage to Structures and Life Hazard Protection Against Lightning Part 1, 2 And 3.
SANS 62271-102	High-voltage switchgear and control gear Part 102: Alternating current disconnectors and earthing switches
SANS 62271-100	High-voltage switchgear and control gear Part 100: Alternating-current circuit breakers


REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	 <b>prasa tech</b> <small>TECHNICAL DIVISION</small>
TENDER NUMBER:13-06-2023 GAU(EL)	

SANS 62262	Degrees of Protection Provided by Enclosures for Electrical Equipment against External Mechanical Impacts (IP Code).
SANS 62208	Empty Enclosures for Low-Voltage Switchgear and Control Gear Assemblies- General Requirements.
SANS 61439-2	Low-voltage switchgear and controlgear assemblies Part 2: Power switchgear and controlgear assemblies
SANS 60670	Boxes and Enclosures for Electrical Accessories for Household and Similar Fixed Electrical Installations Part 1: General Requirements.
SANS 60529	Degrees of Protection Provided by Enclosures (IP Code).
SANS 60439-5	Low-voltage switchgear and controlgear assemblies Part 5: Particular requirements for assemblies for power distribution in public networks
SANS 60439-4	Low-voltage switchgear and controlgear assemblies Part 4: Particular requirements for assemblies for construction sites (ACS)
SANS 60439-3	Low-voltage switchgear and controlgear assemblies Part 3: Particular requirements for low-voltage switchgear and controlgear assemblies intended to be installed in places where unskilled persons have access for their use - Distribution boards
SANS 60439-2	Low-voltage switchgear and controlgear assemblies Part 2: Particular requirements for busbar trunking systems (busways)
SANS 60439-1	Low-voltage switchgear and controlgear assemblies Part 1: Type-tested and partially type-tested assemblies
SANS 60137	Insulated Bushings for Alternating Voltages above 1000V.
SANS 60099-4	Requirements for Metal Oxide Surge Arresters without Gaps for AC systems
SANS 60044-2	Instrument transformers Part 2: Inductive voltage transformers
SANS 60044-1	Instrument transformers Part 1: Current transformers
SANS 555	Unused and Reclaimed Mineral Insulating Oils for Transformers and Switchgear (Uninhibited).
SANS 50025-6	Replacement of SANS 1431, Hot rolled products of structural steels Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition
SANS 50025-5	Replacement of SANS 1431, Hot rolled products of structural steels Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

SANS 50025-4	Replacement of SANS 1431, Hot rolled products of structural steels Part 4: Technical delivery conditions for thermo-mechanical rolled weld-able fine grain structural steels
SANS 50025-3	Hot Rolled Products of Structural Steels Part 3: Technical Delivery Conditions for Normalized Rolled Weldable Fine Grain Structural Steels.
SANS 50025-2	Replacement of SANS 1431, Hot rolled products of structural steels Part 2: Technical delivery conditions for non-alloy structural steels
SANS 50025-1	Replacement of SANS 1431, Hot rolled products of structural steels Part 1: General technical delivery conditions
SANS 50025	Hot Rolled Products of Structural Steels.
SANS 2063	Thermal Spraying - Metallic and other Inorganic Coatings - Zinc, Aluminium and their Alloys.
SANS 2001	Construction Works Part CS1: Structural Steelwork.
SANS 1574	Electric Flexible Cores, Cords and Cables with Solid Extruded Dielectric Insulation.
SANS 156	Moulded Case Circuit Breakers.
SANS 1507	Electric Cables with Extruded Solid Dielectric Insulation for Fixed Installations (300/500V to 1900/3300V).
SANS 1274	Coatings Applied by the Powder-Coating Process.
SANS 121	Hot Dip Galvanized Coatings on Fabricated Iron and Steel Articles - Specifications and Test Methods.
SANS 1200H	Structural Steelwork
SANS 1200 HC	Standardized Specification for Civil Engineering Construction Section HC: Corrosion Protection of Structural Steelwork.
SANS 1200 HA	Standardized Specification for Civil Engineering Construction Section HA: Structural Steelwork (Sundry Items).
SANS 1186	Symbolic safety signs Part 1: Standard signs and general requirements
SANS 1091	National Colour Standard.
SANS 10400	The Application of the National Building Regulations
SANS 10313	Protection Against Lightning - Physical Damage to Structures and Life Hazard.
SANS 10389-2	Exterior Security Lighting



REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

SANS 10222-5-1-3	Electrical security installations Part 5-1-3: CCTV installations - CCTV surveillance systems for use in security applications - Installation, planning and implementation requirements
SANS 10222-2-7	Access Control Systems: Barriers
SANS 10222-2-2	Access Control
SANS 10222-2-1	Access Control Systems: General Requirements
SANS 10222-1-8	Environmental Testing
SANS 10222-1-7	Intruder Alarms: Power Units
SANS 10222-1-5	Intruder Alarms Systems, Passive Infra-Red Detectors
SANS 10222-1-2	Intruder Alarms Systems, Infra-red Beam Interruption Detectors
SANS 10222-1-1	Electrical security systems Part 1-1: Intruder alarm systems - General requirements
SANS 10199	The Design and Installation of Earth Electrodes
SANS 1019	Standard Voltages, Currents and Insulation Levels for Electricity Supply.
SANS 10142-2	The Wiring of Premises Part 2: Medium-Voltage Installations above 1kV AC Not Exceeding 22kV AC and up to and Including 3000kW Installed Capacity.
SANS 10142-1	The Wiring of Premises Part 1: Low-Voltage Installations.


**Table 7: List of electrical and steel structure standards**

## 5.8 National Rationalised Specifications (NRS)

The NRS standards are listed in Table 8 below.

Document Number	Description
NRS 048-2	Electrical supply – Quality of supply Part 2
NRS 030	Electromagnetic voltage transformers for rated AC voltages from 3,6kV up to and including 145kV



REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

**Table 8: List of NRS standards**

## 5.9 BS Standards

The BS standards are listed in Table 9 below.

Document Number	Description
BS EN 62271-100	AC Circuit Breakers of Rated Voltage above 1kV
BS EN 61439-2:2011	Low-voltage switchgear and controlgear assemblies. Power switchgear and controlgear assemblies
BS EN 60730	Electrical Controls for Domestic Appliances
BS EN 60099-1	Surge Diverters for Alternating Current Systems
BS EN 60044-1	Current Transformers.
BS 7354	Code of Practice for the design of high voltage open-terminal stations
BS 5486-1	Specification for factory-built assemblies of switchgear and control gear for voltages up to and including 1000V AC and 1200V DC
BS 159	Busbars and Busbar Connections

**Table 9: List of BS standards**


## 6 TFR/PRASA SPECIFICATIONS

### 6.1 Specifications for Substation Equipment

- These specifications are generic in nature and might refer to other projects and the references to those projects should be disregarded. However, the technical requirements of the equipment shall be applicable.
- Although these are TFR specifications, to a certain degree, similar technology and operational philosophy are shared with PRASA.
- It shall be the Contractor's responsibility to ensure that has the latest version of these specifications.

### 6.2 Generic Test Sheets, Certificates and Reports

- The information provided on the test sheets might not all be relevant to the works but they provide the Contractor with an example of the type of documents required during the test and commissioning process.
- Therefore, these shall only be used for information purposes, test sheets for this project shall be developed by the Contractor.
- The Contractor shall be responsible to submit test sheets to PRASA for acceptance at the same time as providing equipment designs.

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

- d) Approved test sheets shall be made available by the Contractor before the commencement of any SAT and functional testing.

## 7 ENGINEERING

### 7.1 Design Brief and Deliverables

- a) The Contractor shall prepare a detailed design (shop drawings and design report) incorporating the minimum specifications including but not limited to the specific items listed below: -
- (i) Fully functional substations incorporating both power plant and control plant equipment.
  - (ii) Substations control building, guard room building, and toilet/restroom building.
  - (iii) All equipment shall be adequately earthed, insulated, enclosed and interlocked to ensure the safety of staff (operators) as well as equipment.
  - (iv) Fault Level calculations.
  - (v) Protection setting calculations and configuration.
  - (vi) SIS500 tele-control outstation, telecommunications panel and security systems.
  - (vii) Interfacing with the OHTE and traction substation.
  - (viii) Any temporary works deemed necessary.

### 7.2 Service Conditions


The equipment shall be designed and rated for operation under the following service conditions given in Table 10: -

Description	Criteria
Altitude	0 To 1 800m Above Sea Level
Ambient Temperature Range	Minus 5 °C to Plus 50 °C
Relative Humidity	10% To 90%
Wind Pressure on Equivalent Projected Area Normal to Direction of Wind	750Pa
Lightning Conditions	1 Flashes / km <sup>2</sup> / Annum

**Table 10: Service conditions**

### 7.3 Insulation Levels

- a) The insulation levels for the equipment shall be by the recommendations of SANS 1019.

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

- b) The insulation level for 3kV DC shall be based on 6.6kV AC nominal system voltage insulation requirements.

The power equipment (voltages phase to phase RMS) shall have a rated insulation level as indicated in Table 11 below.

Nominal System Voltage	6.6kV	11kV	22kV	88kV
Highest System Voltage for Equipment	7.2kV	12kV	24kV	100kV
Rated Lightning Impulse Withstand Voltage for 50 $\mu$ s	75kV	95kV	150kV	380kV
Rated Power-Frequency Withstand Voltage for 60 Sec	22kV	28kV	50kV	150kV

**Table 11: Insulation levels**

#### 7.4 Clearances

Table 12 indicates the minimum earth clearances that shall be maintained between any conductor or metal normally alive and earthed metal.

Nominal System Voltage	6.6kV	11kV	22kV	88kV
Minimum Safety Clearance	150mm	200mm	320mm	1000mm


**Table 12: Minimum earth clearances**

#### 7.5 Corrosion Protection

All steelwork for outdoor installation shall be hot-dip galvanised to SANS 121. Steelwork shall be painted by specification CEE.0045 after galvanising.

##### 7.5.1 Preparation of Steel

- Where it is impractical to galvanise large areas of sheet steel, surfaces for outdoor exposure shall be prepared by specification CEE.0045.
- The Contractor shall advise PRASA of any large sheet steel areas which is intends not to galvanise, for both parties to agree on such material before construction starts.
- The Contractor shall cover any material deems not to be galvanised in the covering letter with proof that it is impractical to have such material galvanised.

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

### 7.5.2 Handling and Final Treatment of Painted Steelwork

- a) Painted steel shall be handled with care and/or suitably packed to avoid damage during transportation and installation.
- b) Any damage to painted surfaces shall be repaired after installation, after which a final finish coat of the paint specified in specification CEE.0045 shall be applied.

Item No.	Description	Colours Description
1	Coastal structural support steel	Tower Grey
2	Traction transformer tank	G12
3	Traction transformer conservator tank	White
5	All other outdoor enclosures	White


**Table 13: Outdoor equipment colours**

## 7.6 Services


- a) The Contractor shall appoint a civil/structural engineering specialist for structural tests and a certificate of occupancy.
- b) The Contractor shall appoint an electrical protection specialist for protection system design, earth mat, soil resistance test/s, settings, and approval.
- c) The Contractor shall appoint a specialist intruder prevention security and fire protection design company for the full design of these two systems.
- d) The security system design shall comply with the applicable SANS 10222 various parts standards for Electrical Security Systems and Installations.
- e) The fire protection system design shall comply with the Occupational Health and Safety Act, Act 85 of 1993, SANS 10400 and SANS 10139 latest amendments.
- f) Training of personnel is of importance as the effectiveness of the system depends on the training and suitability of the personnel.

### 7.6.1 Security and Intrusion Detection


- a) The entire security system shall be connected to the telemetry system for remote monitoring from the security system control panel.
- b) The security system shall include access control at the substation which is compatible with the existing dominant group system standard.
- c) The access control shall include biometrics and vehicle license plate recognition.
- d) The security system shall include an electric fence covering the entire fence height as well as an 8-strand electric fence above the entire perimeter fence.

<b>REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION</b>	
<b>TENDER NUMBER:13-06-2023 GAU(EL)</b>	

- e) The proposed electric fencing system shall include the following:
  - (i) Fence energiser
  - (ii) Siren
  - (iii) Lightning diverters
  - (iv) High tension insulated electric cabling and conduit
  - (v) Fence High voltage warning signs
  - (vi) Fence energised indicators
  - (vii) High tension galvanised steel wire forming part of the fence
  - (viii) Fencing posts, stays, intermediates, brackets, wire tensioners and insulators.
- f) The security camera system shall include intruder detection and alarm capabilities. The Perimeter Intruder Detection System (PIDS) shall detect the breach attempt and provide the location of the attempted breach in all weather conditions during day and night-time.
- g) The security system shall include a CCTV system that will be linked to the offsite monitoring system via a network switch and optic fibre patch panel. Additional illumination for dark areas to enhance the cameras' vision during the night shall be included where necessary and the design shall comply with SANS 10389-2.
- h) The following shall be considered when deciding on the placement of cameras:
  - (i) All access points to the building including emergency escape doors.
  - (ii) Sensitive areas within the yard and around the building.
  - (iii) Adequate CCTV camera surveillance for the entire substation area.
- i) All the camera housing, mounting equipment and electric fence shall be suitable to withstand the prevailing South African Railway environment conditions including but not limited to:
  - (i) 3kV DC electrical interference
  - (ii) Electrical stray current
  - (iii) Vibrations
  - (iv) High Winds
  - (v) Heat
  - (vi) Dust Particles
  - (vii) Rain
  - (viii) Corrosion
  - (ix) Tampering and Vandalism

<b>REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION</b>	
<b>TENDER NUMBER:13-06-2023 GAU(EL)</b>	

- j) The design shall consider the electromagnetic compatibility in the 3kV DC railway environment on emission immunity of the telecommunication and fixed power installation and apparatus.
- k) The CCTV system cameras shall produce sharp, detailed and stable images on the monitor in sufficient detail to provide positive identification of individuals within the protected areas under all conditions of light.
- l) Type 1 and type 4 Internet Protocol (IP) based cameras shall be used for indoor and outdoor respectively, as indicated in the PRASA security specification.
- m) A combination of fixed and pan, tilt and zoom configurations shall be used at every point or structure pole to maximise monitoring requirements.
- n) All cameras shall be installed with a vandal and tamper-proof mechanism.
- o) The camera lenses for field view shall be capable to collect light reflected from the scene and focusing it into an image onto the CCTV camera sensor by using the height of the image sensor (charge couple device – CCD).
- p) Network Video Recording (NVR)
  - (i) IP cameras shall be used with an NVR supporting infrastructure with Power over Ethernet (PoE) at the site of the camera using a Cat6 cable.
  - (ii) Recorded images shall have the time, date and camera up superimposed on the CCTV vision.
  - (iii) A Network Time Protocol (NTP) shall be used for clock synchronisation.
  - (iv) Watermarking on the CCTV vision shall be the feature of the system.
  - (v) The CCTV systems shall achieve a frame rate of 25 (fps) or greater, regardless of the number of cameras connected.
- q) Capacity Recording
  - (i) Recording shall be achieved for a minimum of 30 days or more with the capability for upgrade as and when required.
  - (ii) Movement detection feature shall be applied for all the recorded data to optimise the recorded capacity.
  - (iii) Access to the recorders shall be logged on a system management database integrated with the administration logging rights and history of activities and events.
  - (iv) Cameras having images recorded in a colour vision shall be used inside the building.
  - (v) Outdoor cameras shall facilitate the function of automatically switching between monochrome and colour depending on the level of light intensity.

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

**(vi) The monitoring of the CCTV camera system shall be done at a remote security control office. Existing optic fibre transmission shall be used for connection between the substation and control office.**

- r) The Contractor shall supply and install intrusion detection door limit switches on all external doors, which shall be wired to the substation telecontrol system.
- s) The Contractor shall submit the designs to PRASA for approval before material purchases and installation commence.
- t) It is the Contractor's responsibility to ensure that such equipment is installed in the substation before any equipment is energised.


## **7.6.2 Fire Protection Equipment**

- a) The fire protection and security specialist shall first conduct a fire risk assessment and provide a report with recommendations for PRASA's acceptance.
- b) The fire protection and security specialist shall design, supply and install fire detection and protection system suitable for use on electrical machinery.
- c) The inert gas fire protection system using nitrogen gas cylinders is the preferred method.
- d) The fire detectors shall comply with SANS 50054-5 (heat) and SANS 50054-7 (smoke).
- e) The system shall be connected to the telecontrol system for remote monitoring and the local system from the fire protection control panel.
- f) The design must comply with the Occupational Health and Safety Act, Act 85 of 1993 and the relevant SANS specification (i.e. SANS 10400, SANS10139).
- g) The design of the fire protection system shall interlock with the fresh air supply fan, air vents and the main 88kV AC electrical power supply circuit breakers to shut down the substation when the fire is detected.
- h) The fire suppression system shall be installed for fire protection inside the transformer bay room and control panel room.
- i) It is the Contractor's responsibility to ensure that such equipment is installed at the substation before any equipment is energised.

## **7.7 Control and Protection**

### **7.7.1 General**

- a) The Contractor shall be responsible for the design, the ratings of all cabling, wiring, protection circuitry, sizing of contactors, relays, MCCBs, MCBs, isolators, fused isolators, fuse ratings, terminations and any other equipment and circuitry used.

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

- b) In the event of a dispute, PRASA shall make the final decision on technical matters.
- c) PRASA reserves the right to change the layout of any control and/or distribution panel to suit its requirements in terms of standardizing panel layouts.


#### **7.7.2 Panels**

- a) Panels shall comply with IEC60297-1. The following panels shall be provided in the traction substation building: -
  - (i) 88kV Primary circuit breaker control and protection panels.
  - (ii) Telecontrol outstation panel.
  - (iii) Communications cabinet.
  - (iv) Telecommunication panel
  - (v) Battery charger panel.
  - (vi) AC/DC distribution panel.
- b) The control and protection panels shall contain all the protective relays (IEDs) and circuit control equipment required for the operation of the associated breakers at the traction substation switching station.

#### **7.7.3 Panel Construction**

- a) The panels shall be constructed from steel sheeting of not less than 2mm thickness.
- b) The panels shall be of rigid construction and fitted with lifting hooks.
- c) The panels shall be of the swing frame type (access to the panel being via the front swing frame and having no rear access).
- d) The panels shall be fitted with dummy interior covers to ensure that when components are mounted, no bolts or screws are visible on the exterior of the panel.
- e) Panel shall be fitted with gland plates, which will allow for cable entry from the bottom.
- f) The installation Contractor shall punch all required holes into the gland plate on site. Spare holes shall be provided in the gland plates but sealed off with suitable sealing plugs.
- g) All indoor panels shall be powder coated by SANS 1274.
- h) The finishing colours shall be a white gloss on the inside of the panels, and on the outside be Eau-de-Nil H43.



<b>REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION</b>	
<b>TENDER NUMBER:13-06-2023 GAU(EL)</b>	

- i) The control and protective equipment shall be mounted on or within suitable panels constructed of sheet metal and fitted with front opening hinged doors all to allow for easy access to the equipment.
- j) The panels shall be so constructed that control switches, indicating lamps, voltmeters and ammeters as well as LED-type flag indication devices are visible without opening the hinged front doors.
- k) The layout of the control equipment fitted on or in the panels, which includes relays, contactors, busbar, terminal strips etc. shall provide for easy access.
- l) The panels shall be provided with 230V AC panel lights, which shall switch on only when the panel doors are open.
- m) A three-pin 16A industrial type switched socket-outlet shall be installed inside the AC/DC panel for 230V AC supplies for hand tools.

#### **7.7.4 Protective Relays, Contactors, MCCBs, MCB and Selector Switches**

- a) All contactors and relays shall be of liberal rating and design and the sturdiest construction; they shall not be affected by vibration and shall be silent when energised.
- b) Contacts shall be made of silver or other approved metal to minimise damage through oxidation and shall be designed to maintain good contact under all operating conditions.
- c) Relays shall be completely sealed against the ingress of dust and dirt using non-inflammable covers, which are easily removable.
- d) The relays shall have a protection rating of IP34 as defined in IEC 60529.
- e) All protection relays shall be housed in withdrawable pattern cases and shall be so designed and mounted to make them free from equipment vibration problems.
- f) All protection relays shall comply with the requirements of specification IEC 60255.
- g) All relays, contactors, links, MCCBs, and MCB and test terminals shall be readily accessible so that routine examination, maintenance and testing may be carried out without the need to remove bolted panels.
- h) The coils of all devices operated from the substation auxiliary AC supplies shall be capable of satisfactorily operating under the harmonic voltage conditions encountered in a DC traction system.
- i) All low voltage circuits in the panels, which require protection, shall be protected by suitably rated MCCBs or MCBs, which comply with SANS 156.
- j) The circuit breakers shall have tripping characteristics of a C-curve design.
- k) The MCBs shall isolate independent circuits from the bus wires.


- l) All circuits supplied by the auxiliary transformers shall be protected by an earth leakage relay.
- m) All 110V DC MCBs for supplying protecting equipment shall be double pole ganged.
- n) DC-operated relays shall be capable of satisfactory operation between 85 Volts and 140 Volts without any damage to the relays.
- o) AC-operated relays and contactors shall be suitably rated for the auxiliary supply voltage, which could vary due to the tapping range of the main and auxiliary transformers.
- p) All circuitry shall be wired in the fail-to-safe mode i.e. relays and contactors must be de-energised under fault conditions.
- q) No anti-condensation heaters are required in panels situated inside the traction substation building.
- r) All circuit breakers, contactors, relays and indicating lamps shall be readily available on the open market.
- s) Selector switches used for the DC voltmeter shall be of the make and break type.

#### **7.7.5 Surge Protection**

- a) Surge protection devices shall be used for suitable protection of electronic equipment against overvoltage, surges and transients
- b) Liberal use of metal oxide varistors is also encouraged.
- c) Surge protection devices shall be provided for the 110V DC supply and shall be connected as follows:
  - (i) One unit connected between the 110V DC Positive and Negative.
  - (ii) One unit connected between the 110V DC Positive and the panel earth.
  - (iii) One unit connected between the 110V DC Negative and the panel earth.
- d) A 2-pole surge protection device shall be installed for the 230-volt AC supply to the control panels.
- e) A 4-pole surge protection device shall be installed for the 400-volt AC supply to AC/DC distribution panel.

#### **7.7.6 Electrical Measuring Instruments**


- a) The type of measuring instruments shall be readily available on the open market.
- b) The details of instruments shall be marked with the ratio of the associated instrument transformers.
- c) All analogue and digital electrical indication meters shall be by IEC 60051-1.

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

- d) The meters shall be flush mounted in the panel doors. Analogue meters used for the measuring of AC and DC values shall have a class index of 1.5.
- e) The analogue face of the meters shall not be less than 96mm x 96mm with a 90-degree display.
- f) Digital meters used for the measuring of AC or DC values shall have a display of 3.5 digits, 12mm high and have an accuracy of 0.5%.

#### 7.7.7 Wiring and Terminals

- a) All wiring shall be carried out on the loop-in system and the looping-in shall be done at the terminal strips.
- b) “X” type wiring will not be acceptable.
- c) The method of loop wiring from one relay to another without protection for the individual circuits is not acceptable.
- d) The cross-sectional area of all small conductors for low voltage circuits shall be not less than that required to ensure sufficient mechanical strength.
- e) The conductors shall be of the multi-stranded type to ensure flexibility.
- f) All wires and conductors for low voltage circuits shall be a minimum of 2.5mm<sup>2</sup> except for the main battery supply cables between the main battery switch and busbar, which shall be at least 25mm<sup>2</sup>.
- g) All wires and conductors shall be routed via PVC channel trunking with a removable cover.
- h) Trunking of sufficient capacity to easily hold the conductors and wires shall be provided.
- i) Conductor supports that are attached by adhesive are not acceptable.
- j) Where low voltage busbars are mounted inside panels, they shall be mounted in such a manner as not to cause a hazard to maintenance staff working in the panels.
- k) These busbars shall be covered with translucent polycarbonate barriers to prevent accidental contact with a live busbar. The barriers shall be provided with warning signs.
- l) Where equipment is mounted on the doors of the panels, adequate flexibility of the wiring shall be provided to eliminate any damage to the conductors.
- m) The panels shall be provided with earthing studs for lugs of 95mm<sup>2</sup> earthing cables.
- n) Sufficient terminal strips shall be provided for the number of outgoing/incoming circuits.
- o) Terminals shall be provided near the bottom of the panels for the connection of cables from cable ducts.

<b>REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION</b>	
<b>TENDER NUMBER:13-06-2023 GAU(EL)</b>	


- p) The terminal strips shall be grouped and arranged to facilitate the removal of connections.
- q) Suitable terminal strips shall be provided to facilitate wiring from the various items of equipment to the remote-control station or telecontrol and telecommunication systems.
- r) All panel doors shall be fitted with flexible braided earthing straps bolted to earthing studs on the doors and panels.

#### **7.7.8 Labelling and Numbering**

- a) All terminals on equipment such as switches and relays shall be suitably numbered and reflected on the substation schematics and wiring diagrams.
- b) All terminal blocks and groups of terminal blocks shall be suitably numbered.
- c) All wires shall be provided with identification tags at terminals and shall be marked as reflected on the panel-wiring diagram.
- d) The diagram markings and wire markings shall be the same.
- e) All cables shall be numbered and labelled at both ends with numbers the same as those which appear on the wiring schematics and diagrams.
- f) All relays, cables, terminal strips, etc. which are mounted on panel doors shall be suitably labelled to indicate their function.
  - (i) All control switches, indicating lights, control push buttons, etc which are mounted on the doors shall be suitably labelled on the inside and outside of the door to indicate their function.
- g) The labels shall be engraved with white lettering on a black background and permanently fixed with miniature screws or rivets.
- h) Labels shall be fixed to the panel walls, support plates or doors. Labels shall not be fixed to components.
- i) The proposed labelling scheme shall be submitted to PRASA for acceptance before the manufacturing of the labels.


#### **7.7.9 Protection Test Block**

- a) A PK2 test block shall be installed in the main overload protection circuits to enable the temporary connection of instruments, meters or test equipment without interfering with fixed wiring.
- b) Test blocks shall be fitted on the panel doors.
- c) The test block shall be wired in between the terminals where the wires from the current transformers terminate in the panel and the overload protection relays.

<b>REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION</b>	
<b>TENDER NUMBER:13-06-2023 GAU(EL)</b>	

## 7.8 Warning Boards, Danger Signs and Phase Colour Boards

- a) A substation name board shall be provided to clearly show the name of the substation.
- b) The name board shall be manufactured by drawing no. CEE-TEA-2 with the PRASA Logo and all substations' names under this project as the names.
- c) Danger warning notices as per drawing no. CEE-TWN-0002, CEE-TWN-0010, CEE-TWN-0035, CEE-TWN-0037, WW23 and CEE-TWN-0006 shall be supplied and fitted to the substation building access doors, substation gates and the palisade fence.
- d) On request from the Contractor, PRASA shall show the Contractor where each sign must be attached.
- e) All signs shall be supplied complete with supporting brackets, bolts and nuts.
- f) Colour identification shall be applied to the Traction Transformers.
- g) Each rectifier unit shall be clearly labelled.
- h) All nameplates, labels and warning boards shall be in English.
- i) All labels shall be made of a composite sandwich type plastic material of the following colour combinations:
  - (i) Identification labels – White lettering on Black background. Letters must be of sufficient size to be legible from a distance of 3m.
  - (ii) Danger labels – White lettering on Red background. Letters must be of sufficient size to be legible from a distance of 3m.
- j) All symbols and names on boards and danger signs shall be silk screened on to equal or similar approved to Chromadek plate with "Miracle Ink".
- k) All danger boards and signs shall comply with SANS 1186.
- l) All labels shall be mounted in a steel galvanized frame attached by bolts to equipment, buildings and fences.
- m) All labels shall be neatly secured by rivets, screws or bolts and nuts.
- n) The following is a list of switchgear equipment labels.
  - On (I)
  - Off (O)
  - Open (Verb.)
  - Close (Verb.)
  - Closed
  - Open

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	


- Trip
  - Local
  - Remote
  - Do not operate link under load
  - Open and earthed
- (ii) Each circuit breaker control panel shall be provided with labels to indicate the breaker designation and telecontrol code.
- (iii) PRASA shall supply these designations and telecontrol codes to the Contractor.
- (iv) The proposed labelling scheme must be submitted to PRASA for acceptance before the manufacture of the labels.

## 7.9 Defects and Liability

- a) The contractor shall guarantee the satisfactory operation of the complete electrical installation supplied and installed by him and accept liability for maker's defects, which may appear in the design, materials and workmanship.
- b) The guarantee period shall commence from the date of successful commissioning of the substation.
- a) The guarantee period for the substation shall expire after a period of 12 months commencing from the date of successful completion of the contract or the date the equipment is handed over to PRASA whichever is late latter
- b) The Contractor shall make arrangements with the suppliers to ensure the provision of a 2-year warranty, that shall commence immediately after the 1-year guarantee period.
- c) The Contractor's liability for any latent defects shall continue beyond the date of the Final Approval Certificate but PRASA shall have no claim against the Contractor arising out of any latent defect which first manifests itself later than the period of 5 years after the issue of the Final Approval Certificate in terms of this Clause.

## 8 CONSTRUCTION OF SUBSTATION

- a) The Contractor shall submit a programme to PRASA, for acceptance, indicating when he intends to start with construction activities on site. The programme shall be submitted well in advance.
- b) PRASA will ensure that the site is available and prepared in time for the Contractor to start with his activities.

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	 <b>prasa tech</b> <small>TECHNICAL DIVISION</small>
TENDER NUMBER:13-06-2023 GAU(EL)	

### 8.1 Decommissioning and Demolition

- a) Decommission the existing equipment and remove all equipment, demolish the old foundation of outdoor equipment and unutilised structures
- b) Transport decommissioned equipment to the PRASA Roodepoort depot.
- c) Rubble and waste to be transported and dumped in an environmentally approved dumping site for rubble and waste.
- d) Toxins such as Polychlorinated Biphenyls (PCB) that may be found in transformers' or wave filter capacitors' oil shall be handled and disposed of in compliance with environmental regulations.
- e) Any asbestos found in the HSCB arc chutes or circuit breaker in situ cells shall be disposed of in a manner that is compliant with environmental regulations.
- f) Clear and prepare the site for construction.

### 8.2 Site Preparation

- a) Setting out of the site levels for the earthworks and the preparation of the site shall be done by the Contractor.
- b) The security fence and kerbing shall not be installed before the installation of all the transformers and major associated equipment that could damage the fences during delivery and construction.
- c) PRASA will authorise the timing of the installation of the security fencing and kerbing.
- d) Access to the sites shall be using the existing service road.

### 8.3 Earth Works for the Substation Platform

- a) The earthworks and platform construction shall be done by the Contractor.
- b) The substation platform will be inspected and signed off by PRASA and the Contractor before any construction takes place on the prepared platform.

### 8.4 Ground Conditions

- a) Should the Contractor require additional information regarding Geotech information, the contractor shall make arrangements to obtain such information and allow it on price.
- b) The Contractor shall further allow for any tests necessary to ascertain ground-bearing pressures as part of the supporting information on foundation casting locations.
- c) Test results shall be submitted to PRASA at the various holding points as indicated on the quality control plan to be provided by the Contractor.



## **8.5 Substation Building**

- a) Refurbish of substations building and associated structures with Buildings doors must be vandal-proof.

## **8.6 Installation of Substation Equipment**

- a) The installation of the equipment required for the construction of the substation will be carried out by the final designs done by the Contractor's Professional Engineers and accepted by PRASA.

## **8.7 Foundations**


### **8.7.1 General**

- a) Design outdoor lighting using wall-mounted fittings and industrial covers with anti-vandal proof.
- b) The clearances between equipment may not be altered without prior acceptance from PRASA.
- c) The general design and layout of all equipment make provision for easy and safe access to and around equipment for construction and maintenance purposes.
- d) The equipment, especially the traction transformer, shall be installed in such a manner as to limit fire damage, which may be caused by equipment failure, overheating or flashovers.
- e) The top of all equipment support foundations shall be finished-off, off 200mm above the finished platform level in the yard.
- f) All foundation edges shall be bevelled at 45° and the surfaces shall be steel float finished.
- g) The construction shall be such as to prevent standing water on top of the foundations.
- h) The top of all support foundations shall be at the same level.
- i) An HDPE corrugated pipe shall be cast into all concrete foundations for earth and control cabling to be taken up the structure and shall be done similar to drawing CEE-TEE-173 with the bolt groups bonded together with two earth straps to the main earth mat.
- j) The Contractor needs to determine beforehand on which side of equipment the control/power cabling is situated to ensure that the sleeve pipes are installed in the correct position in the foundations.

### **8.7.2 Concrete for Foundations**

- a) The 28-day strength of all concrete to be used shall be a minimum of 20MPa unless otherwise specified and shall comply with Specification S420.



REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	


- b) If ready-mix concrete is used, it shall be supplied with test certificates to confirm the concrete strength.
- c) The Contractor shall be responsible to arrange for sampling and testing of all concrete used and shall furnish test cube results to PRASA.
- d) Hand-mixed concrete is not acceptable.
- e) Only mechanically mixed concrete will be accepted.
- f) The addition of water to a concrete mix reduces the strength of the concrete very significantly and on no account, may water be added to a mix after test cubes have been taken.
- g) There shall be a minimum of 50mm concrete cover around all steel reinforcing of structural bearing.
- h) The Contractor shall allow all concrete to be vibrated throughout the pouring process to ensure a solid foundation with a smooth finish.

### **8.7.3 Concrete Plinths and Bund Walls for Transformers**

- a) The design of the concrete plinths for the transformers includes a concrete gutter or bund around the perimeter of the plinths to contain any spillage of transformer oils.
- b) Oil sump pits are provided with an oil separation arrangement for each bund.
- c) The design includes details of an oil trap clearly showing how rainwater will be released from the confined area without the oil being released at the same time.
- d) A 110mm diameter HDPE ribbed/corrugated pipe with corrugated construction shall be cast into the transformer plinth to allow for the routing of control and protection cables.
- e) This pipe shall be positioned such that the cables enter the transformer control cable terminal box vertically.
- f) The two insulated earth conductors connecting the transformer tank to the primary of the AC earth leakage CT at two places, shall be run separately into a dedicated HDPE ribbed sleeve pipe.

### **8.8 Steel Support structures**

- a) Special attention shall be taken for the prevention of corrosion of all metallic parts.
- b) The bases of studs, bolts, support structures and other parts made of ferrous material associated with the electrical connections outdoors, shall be hot-dip galvanised, by SANS 121.
- c) Steelwork for outdoor installation in coastal areas, shall be hot-dip galvanised to SANS 121 and painted tower grey by CEE. 0045.

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

- d) Structural steel shall comply with SANS 1431. All welded joints shall be seal welded with no gaps or blowholes.
- e) All fasteners, nuts and bolts used for the installation of substation steelwork and equipment shall be hot-dip galvanized to prevent corrosion.
- f) Electroplated material will not be accepted.
- g) All steel sections, brackets and beams, which need to be bolted, shall be secured with fasteners using flat and lock washers. Bevelled washers shall be used on steel sections having tapered flanges.

## 9 INSTALLATION


- a) This part of the document refers to certain portions of specification BBB5452, "TFR's Requirements for the Installation of Electrical Equipment for 3kV DC Traction Substations" and highlights any requirements that may differ for this project.
- b) This document further covers any deviations and additions which are specified in the TFR generic specifications forming part of this document.
- c) This document must be read in conjunction with specification BBB5452 and any other related specifications.

### 9.1 General Operational Requirement

- a) The substation primary circuit breaker shall trip and remain open (operational inhibit) should the circuit breaker's tripping power supply (110V DC) be lost completely or fall below 70% of the nominal battery voltage.
- b) It shall only be possible to close the circuit breakers when the supply voltage reaches 85% of the nominal value.

#### 9.1.1 Mechanical Interlocking


- a) A mechanical key exchange interlocking system shall be supplied and installed for Isolating and earthing MV conductors in the traction substation. This is required as a safety measure to only access equipment after live conductors have been isolated and earthed.
- b) The interlocking system shall be the trapped key system.
- c) Full details of the type offered shall be submitted for acceptance by PRASA.
- d) The mechanical interlocking system must be designed to prevent access to the medium voltage equipment whilst "live" and ensure that switching and isolating operations are carried out in the correct sequence.
- e) All equipment shall be delivered with the necessary interlocks fitted.

<b>REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION</b>	
<b>TENDER NUMBER:13-06-2023 GAU(EL)</b>	

- f) It shall not be possible to operate the locks and release the keys in any but the correct sequence or any position of the switches or gates, other than the fully "closed" or fully "open" position.
- g) When a unit is switched to local control and isolated, no remote switching from the electrical control office shall be possible.
- h) The Contractor shall furnish full explanatory details through an operational philosophy report of the arrangement whereby the foregoing provisions are met.
- i) The track feeder breakers shall remain closed throughout the isolation procedure.

### **9.1.2 Isolating and Earthing Procedure (applicable on double units)**

- a) The following is a sequence to isolate and earth rectifier unit B:
  - (i) Trip medium voltage AC circuit breaker in Substation A intake switching station. Key "1" will be released.
  - (ii) Remove key "1" from the lock position "1b". The AC circuit breaker will now be locked in an open and earthed position.
  - (iii) Insert key "1" into interlock position "1b" on the shorting links of the auxiliary supply's three-phase isolating and earthing switch. Earth this supply with the switch. Key "1" is now trapped. Key "2" is released.
  - (iv) Remove key "2" from the lock position "2b" on the above switch.
  - (v) Insert key "2" into interlock position "2b" on the DC positive isolating and earthing switch enabling this switch to open.
  - (vi) Open DC positive isolating and earthing switch. Key "2" is now trapped and key "3" is released.
  - (vii) Remove key "3" from position "3b". The DC positive isolating and earthing switch is locked in an open and earthed position.
  - (viii) Insert key "3" into the lock on the rectifier unit bay gate and turn to open the gate.
  - (ix) If several types of equipment are required to be isolated before the rectifier bay gate can be opened and more than one interlocking key must be used, a multiple key exchange system may be used.
  - (x) The procedure must be done in reverse order to switch the rectifier unit back on load.
  - (xi) The foregoing sequence is given as a guide and may be altered to suit offered equipment. The design shall be approved by PRASA.
  - (xii) Access to the wave filter room shall only be possible once the primary circuit breaker is tripped and locked and the positive isolator is open and earthed.

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

(xiii) Any deviation from the above guideline must be approved by PRASA.

- b) The same sequence must be followed to isolate and earth rectifier unit A, except that unit B, does not have short links for the auxiliary supply and hence, only have 2 keys are used. The key positions for unit A are designated as “a”.

## 9.2 Outdoor Equipment


This section covers the requirements of outdoor cable connections from outdoor equipment to indoor equipment and feeder cables to the OHE.

### 9.2.1 88kV HV AC Primary Circuit Breaker, Current Transformers and AC Disconnectors

- a) The contractor shall identify the position of the 88kV HV AC Disconnectors, thereafter, design, supply and install/construct complete foundation/s and steel structures. Submit all design drawings to PRASA in conjunction with ESKOM for review and final approvals.
- b) The contractor shall identify the position of the current transformers 88kV HV AC, thereafter, design, supply and install/construct complete foundation/s and steel structures. Submit all design drawings to PRASA in conjunction with ESKOM for review and final approvals.
- c) The contractor shall identify the position of the 88kV HV AC Primary Circuit breakers, thereafter, design, supply and install/construct complete foundation/s and steel structures. Submit all design drawings to PRASA in conjunction with ESKOM for review and final approvals.
- d) The Contractor shall make all the necessary cable connections and ensure that there is seamless integration between the AC Disconnectors, Current Transformers, Primary circuit breakers and Traction Transformers.
- e) Contractor shall make provision for an additional CT coil for metering, which means the current transformer will have a total of three (3) coils. Also provide Voltage Transformer, associated integration cables and equipment inside PRASA traction substation.
- f) Measuring equipment shall comply with NRS \_057\_Electricity metering, IEC 61869-2, SANS 60044-1 and 2, and BS EN 60044-1.
- g) Additional coil is for measuring system for PRASA substations.

### 9.2.2 Main Traction Transformer

- a) The Contractor shall design, supply and install Traction Transformer/s.
- b) The design of the traction transformers shall be generally by specifications BBB 5019 and BBB 5452.

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

- c) Notwithstanding clauses 7.1.4 and 7.1.5 of BBB 5019 the transformer vector-group configuration shall be as depicted in Table to achieve 12 pulse rectification. The contractor has to do further investigation and confirmation of the vector group configuration of each traction transformer.
- d) The transformer Buchholz relay shall have test switches for alarm and trip function.

**Table 14 below specifies the transformer vector-group configuration to obtain 12 pulse rectification on the 3kV DC bubsbar single unit traction substations. The Contractor may recommend an alternative vector group arrangement for achieving 12 pulse rectification based on the OEM recommendations. Alternative vector groups shall first be accepted by PRASA before orders are placed.**

Pulse Number	No. of Pulses per group	The phase shift between groups	Transformer vector groups
12	2	15 degrees (30 minutes)	Dy10:45d11:45yn0


**Table 14: Rectifier transformer configuration for 12 pulse rectification**

The 6.1MVA traction transformer for unit shall have the configuration specified in Table 15 below.

Winding	Power MVA	Voltage(kV)	Group	Tap Changer
Primary	6 .1	33 (0; $\pm 2.5\%$ , $\pm 5\%$ )	D	Offload
Secondary	2 x 3	1,220/1,220	y10:45/d11:45	-
Tertiary	0,1	2,360	yn0	-
Vector Group		Dy10:45d11:45yn0		

**Table 15: transformer configuration.**

- e) The Contractor shall ensure that the new transformer oil supplied complies with SANS 555 and the oil shall be tested before being put into the transformer.
- f) The transformers shall be installed with an online dissolved gas analyser

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

- g) In addition to factory tests, the transformer shall again be tested upon delivery to the site to ensure its integrity.
- h) The Contractor shall supply and install busbars with removable flexible connections from the traction transformer to the anode wall plate bushings.
- i) The transformers shall be electrically insulated from their plinths.
- j) The transformer for unit B shall be supplied with tertiary windings for supply to a 100kVA auxiliary transformer as shown in Table above.


### 9.2.3 Auxiliary Transformers

#### 9.2.3.1 Main Auxiliary Transformer

- a) The Contractor shall supply and install a 100kVA, 2.36kV/400V, 3-phase AC, 50Hz auxiliary transformer partly by specifications BBB 8204 and BBB 5452.
- b) The primary of this transformer shall be connected to the tertiary winding of the Unit B traction transformer.
- c) The transformer shall be protected by clause 16.0 of BBB 5452. The current transformers shall be mounted inside the traction transformer tertiary winding cable termination box.
- d) The auxiliary transformer shall have cable termination boxes on the primary and secondary sides with no exposed live parts.
- e) The output of the auxiliary transformer can be subjected to 3kV DC under fault conditions and requires to be insulated to reduce the risk of damage caused by the overvoltage.
- f) The insulation between the input winding and the output winding shall be able to withstand the rated power frequency test of 22kV AC specified for a system's highest voltage of 7.2kV AC as specified in SANS 1019.
- g) The output winding terminals (400V) shall be insulated for medium voltage.
- h) The transformer shall be able to withstand a test voltage of 22kV AC as specified in SANS 1019 for applied between the shorted output terminals and the input winding and tank for one minute.

#### 9.2.3.2 Standby Auxiliary Transformer

- a) The Contractor shall supply and install a 100kVA, 88kV/400V, 3-phase AC, 50Hz distribution transformer that will serve as a standby auxiliary transformer partly by specifications BBB 8204 and BBB 5452.
- b) The LV supply cable from the transformer secondary shall be protected by an LV withdrawable circuit breaker. The withdrawable circuit breaker shall be installed in a lockable steel powder-coated enclosure.

<b>REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION</b>	
<b>TENDER NUMBER:13-06-2023 GAU(EL)</b>	

- c) The auxiliary transformer shall have cable termination boxes on the primary and secondary sides with no exposed live parts.
- d) The insulation between the input winding and the output winding shall be able to withstand the rated power frequency test of 70kV AC specified for a system's highest voltage of 36kV AC as specified in SANS 1019.
- e) The output winding terminals (400V) shall be insulated for medium voltage.
- f) The transformer shall be able to withstand a test voltage of 22kV AC as specified in SANS 1019 for applied between the shorted output terminals and the input winding and tank for one minute.


#### **9.2.4 Wall Bushings**

- a) The Contractor shall supply and install anode wall plates complete with bushings. The wall bushings shall be adequately rated for the output of the 6MVA traction transformers.
- b) The wall plates and bushings shall be as shown in drawing no. CEE-TDE-27 and ENW-E1D-294.

#### **9.2.5 Cabling, Busbars and Wiring**

- a) The Contractor shall supply and install all cabling and wiring for the equipment supplied.
- b) The Contractor shall determine all cable, wiring and busbar sizes based on the current they will carry for the equipment supplied.
- c) The cable routes shall be indicated on the Contractor's cable layout to be approved by PRASA.
- d) No deviations will be allowed without the approval of PRASA.
- e) Joints in cables, flexible wired busbars and conductors shall not be permitted. All cables, wired busbars and conductors used shall be long enough for the intended purpose.
- f) Block jointing of all armoured cables shall be done by clause 33.24 of specification BBB5452, this includes cables from substation A and the outdoor yard entering the building.
- g) All low voltage cables shall be terminated and connected to terminal strips inside the panels.
- h) All connections shall be tight.
- i) All armoured cables shall terminate in mechanical type glands.
- j) These glands shall be secured in correctly sized holes in gland plates and fitted with neoprene shrouds.




REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

- k) All cabling and wiring shall be installed, terminated and connected by SANS10142-1, specifications BBC 0198, CEE 0023 and clause 34 of BBB 5452.
- l) The cables shall be supplied according to specification BBC 0198.
- m) The cable runs for the medium voltage cables shall be marked by cable markers painted brilliant green (H10), while cable markers for low voltage cables shall be painted black (S).
- n) Cable markers shall be according to drawing no. CEE-PK-14 with the PRASA name.
- o) All cable routes shall be provided with a continuous cable warning tape laid directly above each cable and installed 150mm below platform level for the full length of the cable.
- p) The special condition for outdoor cable trenches has to be 1m deep.
- q) The backfilling of trenches shall be done according to specification CEE 0023.

#### **9.2.6 XPLE Cable feeds and aerial Conductors to OHTE Switch Structure**

- a) The existing OHTE positive feeding cables shall be replaced with new cables and installed according to clause 37.1 of BBB 5452 with at least 2x630mm<sup>2</sup> single core type A 6.6kV XLPE aluminium cable per positive circuit.
- b) The contractor shall supply and install aerial feeder wires, associated components and structures where feasible.
  - 1. Where aerial conductors are used for the negative return or positive feeders, the contractor shall provide the wall plates and wall bushings; and
  - 2. The contractor shall make provisions for conductors and installation.
- c) Notwithstanding clause 37.1.7 of BBB 5452, the Contractor shall be responsible for all the works necessary for cables to pass under the tracks.
- d) The Contractor shall supply and install a negative return system using suitably rated buried XPLE single core cables with at least 4x630mm<sup>2</sup> single core type A 6.6kV XLPE aluminium cable.
- e) The Contractor shall supply and install 110mm diameter HDPE sleeve pipes for all the feeder and negative return cables crossing the railway lines. The depth of the sleeve pipes shall be at least 1m deep. This work shall be done with the PRASA per-way inspector on site.
- f) The Contractor shall supply and install the negative return bonds according to specifications BBC1678 and BBB5608.




REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

### 9.2.7 Earthing and Crusher Stones


- a) An outdoor earth termination system (earth mat) shall be supplied and installed by the earth mat design drawing, clause 30.0 of specification BBB 5452, specification BBB 3059 and drawing no. BBB 3620 in as far as applicable.
- b) All fence posts and gates shall be bonded to the earth mat.
- c) Flexible bonds shall be provided between the swing gate frames and their posts. These bonds shall be fitted with lugs on both ends and bolted to the gate frame and fence posts.
- d) The Contractor shall supply and install an AC earth leakage scheme by specification BBB 5452 clause 17.0 and 30.0 and specification BBB 2721 section 8.5.
- e) Notwithstanding clause 17.1 the AC earth leakage bar primary type current transformer shall be installed in a steel box and mounted next to the respective traction transformer.
- f) Based on the lightning risk assessment conducted according to SANS (IEC) 62305-2 the risk is well within the tolerable limits.
- g) Notwithstanding clause 43.3 of BBB5452, the crusher stone shall be a 100mm layer of 19mm stone with a wet resistivity of 3000Ω.m.

### 9.2.8 Fencing, Kerbing and Gates

- (i) Military-graded fencing and gates shall be manufactured and installed.
- (ii) The manufacture and installation of the safety barriers by engineering instruction S.016 is required are
- (iii) The military-graded security fence and concrete kerbing shall only be installed once all major items of equipment and steelwork have been delivered and installed.
- (iv) The extent of the military-graded security fencing including gates as well as kerbing for each substation site.
- (v) The military-graded fence shall cover the entire substation yard.
- (vi) A gate switch shall be supplied and installed on the pedestrian gates that provide access to the MV traction substation yard (transformer bay). The switch shall connect the earth mat to the negative return when the gate is in the open position. A gas arrester spark gap shall be supplied, installed and connected between the two terminals of the gate switch. Refer to drawing no. CEE-TBD-7 and BBB 3620.
- (vii) The general specifications for fencing and gate material shall be the Reinforced 358-mesh fence (military grade) or equivalent and sliding gates

<b>REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION</b>	
<b>TENDER NUMBER:13-06-2023 GAU(EL)</b>	

- (viii) The contractor shall supply and install all grade 350W steel materials, galvanized steel
- (ix) The contractor shall supply and install all galvanized pipes, one piece without joints. Furnish moisture proof caps for all posts.
- (x) The contractor shall supply and install zinc coating that shall be smooth and essentially free from lumps, globs or points.
- (xi) The contractor shall supply and install miscellaneous material that shall be galvanized.
- (xii) The contractor shall supply and install all king posts 4.2m long strengthened Taper Locking Posts.
- (xiii) The contractor shall supply and install All king posts which are 85mm thick - tapering to 45mm with a depth of 85mm & a thickness of 4mm.
- (xiv) The contractor shall supply and install all king posts which include “Locking Recess Mechanism” to secure panel edge.
- (xv) The contractor shall supply and install all king posts shall be galvanized, then alu-coated.
- (xvi) The contractor shall supply and install all panels that are of military grade reinforced panels (including composite).
- (xvii) The contractor shall supply and install panels which shall be 3.305m in width and 3.5m in height (modular split)
- (xviii) The contractor shall supply and install panel aperture sizes(centers) which shall be 76.2 x 12.7mm.
- (xix) The contractor shall supply and install wire diameter which shall be 3mm.
- (xx) The contractor shall supply and install panels which shall have 2 x 70 degree flanges along sides (internal fixtures-all fixtures shall be on the inside of fence line).
- (xxi) The contractor shall supply and install panels which shall have 1 x 90degree flange along top & 1 x 30-degree flange along toe (integrated rigid angle).
- (xxii) The contractor shall supply and install panel king posts which shall have a flush panel post finish with no climbing aid.
- (xxiii) The contractor shall supply and install panel which shall be affixed to king post over 48-line wires using 8 x Double Bolt comb and 8 x Single bolt comb clamps using 24 x Anti-Vandal Bolts.
- (xxiv) The contractor shall supply and install panels and fixtures which shall be galvanized.

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	


- (xxv) The contractor shall supply and install panel post connection which can withstand all possible loading combinations including impact loading, wind, dead, live and seismic loading as per the applicable SANS standards.
- (xxvi) The contractor shall provide composite infill which shall be reinforced with a specialized tube to resist angle grinder, reciprocating saw and acetylene torch.
- (xxvii) The contractor shall provide and install a 100mm high toughened steel Shark Tooth Spike which shall be affixed to panel edge, internally at 150mm intervals using Anti-Vandal bolts.
- (xxviii) The contractor shall provide and install a spike finish which shall be galvanized.
- (xxix) The contractor shall provide and install a 400mm “under-dig” which shall be secured to the lower edge integrated angle.

### 9.2.9 Substation Yard Lighting

- a) Bulkhead lights shall be supplied and installed on the outside of the substation building.
- b) A light switch installed in the substation building shall control these lights.
- c) The Contractor shall supply and install lighting in the substation yard to provide a general level of illumination of not less than 20 lux.
- d) These lights shall be operated by light-sensitive control units.
- e) Care shall be taken to avoid glare from yard lights in the eyes of train drivers.
- f) The lights shall be mounted on an 8m mid-hinge steel pole.

#### 9.2.9.1 Light Sensitive Control Units

- a) The complete unit shall be of the solid-state type and housed in a sealed weatherproof casing, suitable for mounting in any position.
- b) The light-sensitive control unit shall have an impact-resistant translucent cover to protect the light sensor from physical damage.
- c) The cover shall be suitably protected against the effects of ultraviolet radiation.
- d) The unit shall be supplied complete with a suitable mounting bracket or be provided with a single hole fixing for 20mm conduit thread including lock nuts and gaskets.
- e) The unit shall not operate to light fluctuations shorter than 5 minutes duration.
- f) The unit shall incorporate main contacts rated at not less than 16 Amps.

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

- g) The unit shall be mounted against the building wall in a position giving coverage of the northwest hemisphere.

### 9.3 Indoor Equipment

This section covers the requirements of indoor equipment, indoor cabling and indoor earthing.

#### 9.3.1 3kV DC Rectifier

- a) Further to clause 18.0 of specification BBB 5452 and specification BBB 0496: The Contractor shall design, supply and install 2 x 6 MW AC to DC rectifiers with a 12-pulse configuration supplied from the 6 MVA and/or 6.1 MVA transformers. For Double units.
- b) Each rectifier shall be supplied complete with a diode monitoring system and cooling fan control and fully comply with TFR's specification BBB 0496.
- c) The rectifier shall be rated 6 MW full load continuously.
- d) The rectifier shall provide for full wave 12 pulse rectification from the 6-phase output of 6.1 MVA (unit A) and 6.1 MVA (unit B) traction transformer. For Double units.
- e) All components, especially diodes shall be easily accessible for maintenance and replacement purposes.

#### 9.3.2 Reactor Coils


- a) The Contractor shall supply and install reactor coils with a 1.8mH rating by specification BBB 3890 and clause 19 of specification BBB 5452.

#### 9.3.3 Wave Filter Equipment

- a) The Contractor shall supply and install wave filter equipment by TFRs capacitor specification BBB 3139, inductor specification BBB 3162 and installation specification BBB 5452 clause 20.0 and drawing no. BBB 3483.

#### 9.3.4 3kV DC Positive Isolator

- a) The Contractor shall supply and install positive isolators and earthing switches, by installation specification BBB 5452 clauses 21.0 and specification BBB 4724.
- b) The positive isolator switch shall have a minimum current rating of 3000A continuous as per clause 6.3 of specification BBB 4724.
- c) The earthing switch shall have a minimum current rating of 1500A as per clause 6.10 of specification BBB 4724.

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	 <b>prasa tech</b> <small>TECHNICAL DIVISION</small>
TENDER NUMBER:13-06-2023 GAU(EL)	

- d) The MV compartment shall include a potential divider for the under-voltage relay and fuses for metering as per clause 6.28 of specification BBB 4724.
- e) The Contractor shall design, supply and install suitably sized copper conductors between the positive isolator and the 3kV DC busbar with a continuous current rating of 4000A.

### **9.3.5 3kV DC Under-Voltage Relay**


- a) Further to clause 6.1 of specification BBB 4724 and clause 28.6 of specification BBB 5452, the Contractor shall supply and install an under-voltage relay as part of the low voltage control gear of the positive isolator.
- b) The LV compartment shall include an under-voltage relay, ammeter and voltmeter as per clause 6.21 of specification BBB 4724.
- c) The under-voltage relays supplied shall fully comply with specification BBB 3005 and be installed with the potential divider as per 28.0 of specification BBB 5452.

### **9.3.6 Primary Circuit Breaker Control and Protection Panel**

- a) The Contractor shall design, supply and install primary circuit breaker control panels by TFRs specification BBB 2721.


### **9.3.7 AC/DC Distribution Panel**

- a) The Contractor shall design, supply and install an AC/DC Distribution panel by TFRs specification BBB 2721.
- b) The two LV cables from the two auxiliary transformers shall be connected to the automatic changeover inside the AC/DC panel.
- c) The changeover shall automatically connect the standby auxiliary transformer to the 3-phase 400V busbar in case of power loss from the main auxiliary transformer.
- d) The contractor has to supply and connect an additional changeover panel for 6.6kV standby supply in case entire traction substation is OFF, applicable to Double units traction where two Auxiliary transformers are connected and additional standby supply installed.
- e) The Contractor shall supply and install power supply protection relays for each auxiliary supply. The relays shall monitor phase failure, phase rotation as well as over and under voltages, and detection relays for 400V AC supply on panels. The relays shall form part of the control circuit of the change-over system.
- f) The Contractor shall submit details of the relay for acceptance by PRASA before installation of the equipment.

<b>REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION</b>	
<b>TENDER NUMBER:13-06-2023 GAU(EL)</b>	

### 9.3.8 Telecontrol Outstation Panel Interface

- a) The Contractor shall design, supply and install all SIS500 telecontrol outstation and telemetering equipment according to specification BBC 0653.
- b) The Contractor shall be responsible to supply and install all multi-core control cabling between the control and protection panels and the Tele control panel.
- c) The Contractor shall further be responsible to connect the necessary circuits required for telecontrol functions in the control and protection panels.
- d) Connecting of the multi-core control cables onto the telecontrol panel shall be done by the Contractor.
- e) The Contractor shall be responsible to label the cables and cores at both ends of the specified multi-core cables at the control and protection panels, the terminal strips and the telecontrol panel.
- f) The relay contacts provided in the telecontrol cabinet for remote operation of switchgear shall have a maximum rating of 0,5A at 110V DC.
- g) Indication for telecontrol purposes shall be provided using voltage-free open and closed contacts on the switchgear.
- h) Provision shall be made for the following principal telecontrol operations indications and alarms: -
  - (i) Open and close command function for all circuit breakers.
  - (ii) Open and close indication for all circuit breakers.
  - (iii) Lockout indication for all circuit breakers.
  - (iv) Indications of failure of DC feeder protection relay supply voltage. Detection must take place at each relay.
  - (v) Indication of charger failure Tele-control batteries.
  - (vi) Indication of transformer pressure relief device operation.
  - (vii) Door intruder alarm indication.
  - (viii) Holding coil supply indication
  - (ix) 3kV DC under voltage indication
  - (x) 110V DC fail indication
  - (xi) DC earth leakage indication
  - (xii) Diode failure indication
  - (xiii) 400V AC fail indication
  - (xiv) Rectifier temperature indication

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	


- i) Any additional telecontrol functions that might be necessary due to the supply and installation of any specialised equipment offered shall be provided by the Contractor.
- j) The Contractor shall provide an event log/fault record data transmitted through the telecontrol panel.
- k) The Contractor shall test the functionality of the entire telecontrol system before the energizing of the substation equipment (the installation of the telecontrol equipment is included in another part of this contract).
- l) The Contractor shall provide a commissioning certificate for the telecontrol installation.
- m) PRASA shall endorse this certificate to indicate acceptance of the telecontrol installation.
- n) The Contractor shall be responsible for the preparation of such a certificate.
- o) The Contractor shall include a certificate as part of the overall substation commissioning report.

### **9.3.9 Telecommunication system specification**

#### **9.3.9.1. Scope of work for Telecontrol Transmission network**

- a) Supply, installation, rehabilitate, test and commission of Telecontrol Transmission Network Node, Din rail mount 19" INCH at Electrical Substations in Gauteng Region.
- b) Supply and installation of 19" INCH Din rail mount plate.
- c) Supply and installation of 48VDC power supply unit.
- d) Supply and Installation of 1U 19" brush panels.
- e) Supply and Installation of a ground copper bar.
- f) Supply and Installation of SFP 850nm – SX, 1.5km range.
- g) Supply and Installation of SFP 1310nm – LX, 3 km range.
- h) Supply and Installation of SFP 1310nm – EX, 32 km range.
- i) Supply and Installation of SFP 1550nm – ZX, 70 km range.
- j) Supply and Installation of SFP 1550nm - DWDM C-band, 80 km range.
- k) Supply and Installation of SFP 1550nm - DWDM C-band, 120 km range.
- l) Supply and Installation of SFP 1310 nm – BIDI, 20 km range.
- m) Supply and Installation of SFP 1550nm - BIDI, 20 km range.
- n) Supply and Installation of SFP 1310nm – BIDI, 40 km range.



REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	 <b>prasa tech</b> <small>TECHNICAL DIVISION</small>
TENDER NUMBER:13-06-2023 GAU(EL)	

- o) Supply and Installation of SFP 1550nm – BIDI, 40 km range.
- p) Supply and Installation of STM1/4-I optic SFP module, 0,5 km range.
- q) Supply and Installation of STM1/4-S1 optic SFP module 15 km range.
- r) Supply and Installation of OS License (one per node)
- s) Supply and Installation of Redundancy licence.
- t) Supply and Installation of TXCare license (one per node) up to 100 nodes
- u) Supply and Installation of a Serial Drop cable (3m) - 2 per card.
- v) Supply and Installation of power cables.
- w) The contractor shall provide training for the installation and commissioning of the network node.
- x) The Contractor shall provide a 2-year warranty for the entire local system commencing after the 1-year guarantee period.

#### 9.3.9.2 Network Node Specification


DESCRIPTION	SPECIFICATION
<ul style="list-style-type: none"> <li>Utility design</li> </ul>	<ul style="list-style-type: none"> <li>10 Ethernet ports</li> <li>2 serial ports</li> </ul>
<ul style="list-style-type: none"> <li>LAN or WAN operation</li> </ul>	<ul style="list-style-type: none"> <li>2x 1/10Gbps SFP+ based ports</li> <li>2x 1Gbps SFP-based ports.</li> </ul>
<ul style="list-style-type: none"> <li>L2 and L3 Features</li> </ul>	<ul style="list-style-type: none"> <li>2x 1Gbps SFP.</li> <li>4xGigabit RJ-45 ports with PoE+ (PoE: IEEE 802.3af &amp; 802.3at compliant).</li> </ul>
<ul style="list-style-type: none"> <li>Alarm integration.</li> </ul>	<ul style="list-style-type: none"> <li>Digital inputs and 2 Digital outputs.</li> </ul>
<ul style="list-style-type: none"> <li>Easy Configuration</li> </ul>	<ul style="list-style-type: none"> <li>SD Card.</li> </ul>
<ul style="list-style-type: none"> <li>Integration</li> </ul>	<ul style="list-style-type: none"> <li>TXCare integrated for monitoring and configuration.</li> </ul>
<ul style="list-style-type: none"> <li>Housing</li> </ul>	<ul style="list-style-type: none"> <li>DIN rail mountable.</li> </ul>
<ul style="list-style-type: none"> <li>Operating Temperature</li> </ul>	<ul style="list-style-type: none"> <li>-30°C to +65°C</li> </ul>
<ul style="list-style-type: none"> <li>Input Power</li> </ul>	<ul style="list-style-type: none"> <li>24 - 57VDC</li> </ul>
<ul style="list-style-type: none"> <li>Dimensions (HxWxD)</li> </ul>	<ul style="list-style-type: none"> <li>150mm x 90mm x144,2mm</li> </ul>

**Table 16: Network Node Specification**

#### 9.3.9.3. Optical Modules

SFP Type	Distance
----------	----------



REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	 <b>prasa tech</b> <small>TECHNICAL DIVISION</small>
TENDER NUMBER:13-06-2023 GAU(EL)	

SFP 850nm - SX	Typical distance: 1,5 km
SFP 1310nm - LX	Typical distance:3 km
SFP 1310nm - EX	Typical distance: 32 km
SFP 1550nm - ZX	Typical distance: 70 km
SFP 1550nm - DWDM C-band	Typical distance: 80 km
SFP 1550nm - DWDM C-band	Typical distance: 120 km
SFP 1310 nm - BIDI	Typical distance: 20 km
SFP 1550nm - BIDI	Typical distance: 20 km
SFP 1310nm - BIDI	Typical distance: 40 km
SFP 1550nm - BIDI	Typical distance: 40 km
STM1/4-I optic SFP module	Typical distance: 0.5 km
STM1/4-S1 optic SFP module	Typical distance: 15 km

**Table 17: Specification of Optical Modules**


#### 9.3.9.4. Software

Name	Licence
OS License (one per node)	OS License
Redundancy licence. (one per node)	Redundancy License
TXCare license (one per node) for up to 100 nodes	TXCare Node License

**Table 18: Details of the Software requirements**

#### 9.3.9.5. 48 Vdc Power supply

DESCRIPTION	SPECIFICATION
Type	Switch Mode
AC Input Voltage	230VAC
DC Output Voltage	48VDC
Output Current	5A
Number of Outputs	1
Special Features	Compact Size, Cooling by Free Air Convection, LED Indicator for DC Low, LED Indicator for DC Power On, 3- Years Warranty, 100% Full Load Burn-In Test
Mounting Type	DIN Rail, Vertical Mount
Short Circuit Protection	Yes
Over Voltage Protection	Yes
Indication of Output Voltage	LED, continuous green light

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

Applications	Sensors, Transmitters/receivers, Analyzers, PLCs Motors, Actuators, Solenoids, Relays
Operating Temperature	-25°C to 70°C
Dimensions	60mm x 130mm x 125mm


**Table 19: Specification of the 48 Vdc power supply**

### **9.3.10 3kV DC High-Speed Circuit Breakers**


- a) The 3kV DC Track Feeder High-Speed Circuit Breakers shall be supplied and installed by clauses 25 and 26 of specification BBB 5452 and specifications CEE.0099 and CEE.0227.
- b) The Contractor shall provide trucks, modular steel cells, high-speed circuit breakers, feeder protection relays and other associated components necessary to produce a complete functioning modular track breaker unit.
- c) The modular steel cells shall consist of a feeder cable earth switch with a warning label stating that “Do not apply earth before track switch is open”.
- d) A separately enclosed earthing switch to earth the 3kV DC positive busbar shall be supplied and installed to one end of the connected cells.
- e) The earthing contacts shall be visible through fixed polycarbonate panels in the enclosure when applying the earth.
- f) This earthing switch shall be robust and lockable in both positions (earthed and not earthed) and electrically interlocked with the primary circuit breaker and all HSCBs to prevent accidental earthing of the live busbar.
- g) The electrical interlock shall cause the substation to trip and lockout.
- h) The shutter gear in the cells, covering the busbars when the circuit breaker is withdrawn shall be robust and mechanically locked to prevent it from being opened while the truck is withdrawn from the cell.
- i) Notwithstanding clauses 25.3 and 25.4 of specification BBB 5452, the Contractor shall supply and install a Electronic Control Relay, as per clause 9.3.11 of this document.
- j) Notwithstanding clause 8.1.1 of specification CEE.0099, the breaker’s continuous current rating shall be 4000A.
- k) The High-Speed Circuit Breaker shall be supplied with adequate surge protection.

### **9.3.11 Electronic Control Relay**

- a) The relay is required to operate in conjunction with the 3 kV DC High-Speed Circuit Breaker.

<b>REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION</b>	
<b>TENDER NUMBER:13-06-2023 GAU(EL)</b>	

- b) The Contractor shall ensure compatibility between the relay and circuit breaker and further ensure that the relay trip time command is the same as the HSCB trip coil.
- c) The Contractor shall ensure that the engineering support and training on the relay are available locally.
- d) The Contractor shall provide a letter from the supplier as part of the bid confirming that the DC feeder protection relay is compatible with the HSCB and the provision of a 2-year warranty commencing after the 1-year guarantee period.
- e) The main functions of the relay are to be used as: -
  - (i) Protection of the overhead track equipment.
  - (ii) Automatic line test function to determine if any fault is on the system before the circuit breaker is closed or to prevent auto reclosing onto a fault.
  - (iii) Over current protection ( $I^2t$  and  $di/dt$  discrimination).
  - (iv) Under-voltage protection.
  - (v) Frame fault protection.
  - (vi) Thermal protection of the Overhead Track.
  - (vii) Control of the breaker.
  - (viii) Auto re-closure in the event of no fault on the system.
  - (ix) Auxiliary contacts.
  - (x) Serial Communication port (RS232/RS485).
  - (xi) As a measurement/condition monitoring device on each track circuit.
  - (xii) Measure Current (DC)
  - (xiii) Measure Voltage (DC)
  - (xiv) Measure Energy kWh (Export and Import)
  - (xv) The relay shall operate from the 110 Volt DC substation battery supply.
- f) The relay must be able to communicate with the receiver panel inside the substation via Bluetooth and Wi-Fi.
- g) The protection relay must have a lock-out remote reset feature.
- h) If resistors, potential dividers and current transducers are used in the design, the clearance and insulation levels for 3 kV DC must be adhered to.
- i) The Contractor's attention is drawn to space restrictions.
- j) The physical size of the resistor used for line testing shall be limited to Length 600 mm x Width 400mm x Height 500 mm).

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

### 9.3.12 Negative Return Monitoring System

- a) The Contractor shall supply and install a negative return feeder monitoring system as per TFR's installation specifications BBC 1843 and BBC 1844.

### 9.3.13 DC Earth Leakage and Cable Fault Protection

- a) The Contractor shall supply and install DC earth leakage relay by specification BBB 5452 clause 29.0 and specification BBB 2721 section 8.6.
- b) The Contractor shall supply and install cable fault indication relay as per drawing CEE-TBD-7.
- c) The DC earth leakage relay protection system shall be capable of distinguishing faulty zones for indication purposes to allow for ease of fault identification and repair.


### 9.3.14 Battery Charger Cabinet and Batteries

- a) The Contractor shall supply, install and commission a battery bank as per specifications BBB 5452 and BBB 2502.
- b) The batteries shall consist of a 53-cell 110 Volt Planté lead acid battery bank or similar approved.
- c) The capacity of the battery shall either be 100 Ampere hour rating, 200 Ampere hour rating or capacity depending on the substation requirements.
- d) The standard for the batteries shall be the 10-hour rate at 20°C. The battery shall be capable of delivering a minimum of 10 Amperes for 10 hours.
- e) Batteries are installed in the traction substations for control and protection purposes. The battery is used for the following functions: -
  - (i) Tripping and closing of primary circuit breakers.
  - (ii) Supply to protection relays.
  - (iii) Closing and holding coil supply to DC high-speed circuit breakers.
- f) The Contractor shall supply and install a battery charger and battery cabinet by specifications BBB 5452 and BBB 2502.
- g) The battery charger and cabinet shall be insulated from the substation floor using "Marley" or "Lino" floor covering or similar not less than 2mm thick.

### 9.3.15 Supply and Installation of Cables as per BBC 0198 and CEE.0023

- a) The Contractor shall prepare a cable layout design for the accommodation of all cables, as required.
- b) The design shall be submitted to PRASA for approval.

- c) No deviations from the approved layout will be permitted without approval from PRASA.
- d) The equipment layout design shall provide for optimum placement of equipment in trenches.
- e) Cables in the outdoor yard shall run in trenches directly in the ground and the brick trenches inside the building.
- f) The chequered plates shall be at the same level as the rest of the building floor.
- g) The Contractor shall cut all slots in chequer plates for emerging cables.
- h) The edges of the slots shall be filed smooth to avoid damage to cables.
- i) Where trenches inside the building are not suitably close to the equipment, portions of cables outside trenches shall be routed in PVC conduit or PVC surface mounted channels, having removable covers.
- j) These conduits or channels shall be wall mounted and be of sufficient size to easily house the conductors.
- k) These channels shall not be laid on floors over accessways.
- l) All crimping lugs shall be hexagonally compressed with a crimping tool.
- m) Insulated lugs, of the crimp-on type, shall be used to terminate wiring onto equipment and strip connectors.
- n) All wiring for DC circuits shall be done in the grey-coloured wire.
- o) Conductors and/or supports that are attached by adhesives are not acceptable.
- p) Joints in cables and aerial busbars will not be permitted.
- q) The Contractor shall only install busbars and cables that are long enough for each application.
- r) All cables shall be terminated and connected to a terminal strip inside the panels.
- s) All wiring and cabling shall be carried out by SANS 10142, specification CEE.0023 and installation specification BBB 5452 clause 33.
- t) All busbars used to interconnect equipment on the 3kV DC circuit shall be rated at 2000A with the main 3kV DC busbar rated at 4000A.
- u) All trenches inside the building shall be covered with chequered plates.
- v) The Contractor shall also be required to supply and install all cabling required to the telecontrol panel by specification BBB 2721 clause 13.0.
- w) The contractor shall supply and install buried XPLE single core type A, 630mm<sup>2</sup> Aluminium cables, at least two in parallel per positive feeder circuit.
- x) The contractor shall supply and install buried XPLE single core type A, 630mm<sup>2</sup> Aluminium cables at least four in parallel for the substation negative return circuit.

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

### **9.3.16 LV Distribution in the Substation Building**

#### **9.3.16.1 General**

- a) The Electrical Contractor shall carry out the installation by the South African Bureau of Standards Code of Practice for the Wiring of Premises, SANS 10142-1 and the requirements as laid down in this specification.
- b) The Contractor shall furnish a certificate of compliance for the entire low voltage distribution system signed by an accredited person in terms of SANS 10142-1 on completion of the installation. This person shall be registered with the Electrical Contracting Board.

#### **9.3.16.2 Distribution Board**


- a) A low voltage distribution board shall be installed against the inside wall of the substation building to supply power to the building services (lights, SSO, extractor fans).
- b) The distribution board shall be provided with MCB to protect and control all lighting, fans and switched socket outlet circuits. MCBs shall comply with SANS 156.
- c) Provision shall be made for spare MCBs for future additions.
- d) In addition to the spare MCB the distribution board shall allow for 30% additional space.
- e) All low voltage power and lighting circuits shall comply with the requirements of SANS 10142-1.

#### **9.3.16.3 General Purpose Wiring**

- a) All wiring shall be installed in wire ways and/or conduit as specified.
- b) Open wiring is not acceptable.
- c) Only the loop-in system of wiring shall be acceptable.
- d) Joints in the wiring shall not be permitted.
- e) All wires shall be stranded copper conductors. No suffix or twin and earth wiring will be accepted.
- f) AC and DC wiring shall be installed in separate conduits.

#### **9.3.16.4 Miniature Circuit Breakers**

- a) All MCBs used in DC applications shall be rated for DC and be double poles.

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

### 9.3.16.5 Galvanised Steel Tubing and Associated Fittings

- a) Provision shall be made for the use of steel galvanised conduits to accommodate all light circuits between the distribution board, light fittings and switched socket outlet.
- b) Where conduit is exposed to the weather elements only galvanised conduit shall be used.
- c) Threads of metallic conduit and associated fittings exposed to moisture or weather elements shall be effectively protected against rust with anti-corrosive paint.
- d) Light fittings or other equipment shall not be used as wire ways.

### 9.3.16.6 Light Switches and Switch Socket Outlets


- a) The Contractor shall supply and install light switches and socket outlets
- b) All surface-mounted wall boxes shall be manufactured from sheet material of at least 0.8mm thickness and powder coated.
- c) Wall boxes for SSO shall be 100 x 100 x 35mm with 20mm knockouts on the top, bottom and sides.
- d) Wall boxes for light switches and isolators shall be 100 x 50 x 35mm with 20mm knockouts on the top, bottom and sides.
- e) Wall outlet boxes for light switches shall be mounted 1350 mm from floor level and where possible 200 mm from door openings.
- f) No Light switches and switch socket outlets shall be installed in the battery room.

### 9.3.16.7 Light Fittings

- a) The Contractor shall supply and install lighting in all internal areas to provide a minimum maintained average illumination level of 200 lux.
- b) Light fittings shall be of the industrial LED type suitable for the environment in which they need to function.
- c) Light fittings installed in the battery room shall be appropriate for the zoned location.

### 9.3.17 Cooling and Ventilation

- a) Further to clause 46.0 of specification BBB 5452, the Contractor shall design, supply and install suitably rated fresh air supply fans complete with the required louvres, guards and filters as specified.
- b) The fresh air supply fan with a rating shall be used for this function.

<b>REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION</b>	
<b>TENDER NUMBER:13-06-2023 GAU(EL)</b>	

- c) Two separate supply air ventilation fans shall be installed to supply fresh air at a combined flow rate of 2.7m<sup>3</sup>/s at 150Pa. Each ventilation fan shall have its independent local isolator for maintenance.
- d) The fresh air ventilation system shall be complete with fan guards, weather louvres, vermin-proof screens and filter boxes.
- e) Each fan shall have its separate filter box with a removable filter drawn from the side for cleaning or replacement.
- f) The exhaust air system shall consist of a guard, weather louver, vermin screen and an air grille.
- g) The ventilation system shall not be of the ducted type.
- h) The battery room extractor fan with a local isolator shall be appropriate for the zone location and rated for 0.2m<sup>3</sup>/s at 25Pa.
- i) Ventilation for the toilet area shall be achieved with an extractor fan rated at 0.035m<sup>3</sup>/s.

### **9.3.18 Indoor Earthing**

- a) The Contractor shall supply and install indoor earthing according to specification BBB 5452 clause 29 and drawing no. CEE-TBD-7.
- b) The frames and bases of all electrical equipment inside the substation building shall be insulated from the substation building structure (walls and floor).
- c) The DC earth leakage protection system shall be capable of indicating different fault location zones for ease of troubleshooting.

## **10 TESTING, PRE-COMMISSIONING AND COMMISSIONING**

### **10.1 Payment Clause Definitions**

- a) “Commissioning” used in the clauses below shall imply pre-commissioning and or commissioning but for payment purposes, the following definitions shall apply: -
  - (i) Pre-commissioning will generally imply: -
    - Generally FAT and SAT.
    - Generally, all works required pre-energising.
    - Completion Certificate.
  - (ii) Commissioning will generally imply: -
    - Training.
    - Hand-over (Operating and Maintenance Manuals and Data Packs).



## 10.2 Type and Routine Test Requirements

- a) Type and routine tests shall be conducted on all equipment to be supplied.
- b) Test certificates in respect of type tests conducted on identical equipment may be accepted instead of type tests at the discretion of PRASA.
- c) All equipment and material shall be jointly inspected by the Contractor and PRASA, at the place of manufacture before delivery to the Contractors works or the site.
- d) These tests shall be carried out at the Contractors expense.
- e) Delivery of equipment shall not commence before acceptance of type and routine test certificates by PRASA.
- f) The Contractor shall test all concrete used for the construction of the works and the results shall be submitted to PRASA for acceptance.


## 10.3 Factory Acceptance Tests (FAT)

- a) The Contractor shall be responsible to facilitate all factory functional tests to be conducted by the manufacturers of equipment at their premises before such equipment may leave their premises.
- b) The Contractor shall make full provision for three (3) PRASA representatives to attend possible overseas trips.
- c) After the factory functional tests, the Employer shall either sign the test sheets (supplied by the Contractor) as having witnessed the satisfactory completion thereof or hand to the Contractor a list of defects requiring rectification.
- d) Upon rectification of defects, the Contractor shall arrange for the QA Inspector to certify satisfactory completion of factory functional tests for the switchgear and control equipment.
- e) Acceptance by PRASA of satisfactory completion of factory functional tests in no way relieves the Contractor of his obligation to rectify defects, which may have been overlooked or become evident at a later stage.
- f) The power transformer tests shall be according to IEC60076.
- g) The auxiliary transformer tests shall be according to SANS 780.

## 10.4 Site Acceptance Tests (SAT)

- a) The Contractor's Test Engineer shall be responsible for the calculation of all relay settings as well as all other protection settings.
- b) On-site tests and subsequent commissioning shall not commence until all construction work has been completed.
- c) Construction staff, material and equipment shall be withdrawn from the site before the commencement of testing.

- d) Testing and commissioning of the substation equipment will not be allowed to take place in a construction site environment.
- e) The Contractor shall be responsible to conduct a functional test on all equipment and circuitry to prove the proper functioning and installation thereof.
- f) Proper operation of the protection system including the tripping and lockout functions as well as interlocking required shall be checked and ensured.
- g) PRASA shall arrange for his representatives and the PRASA Test Department Engineer to be present to witness the on-site tests.
- h) On-site test shall include the following: -
  - (i) Polarity tests on all CTs.
  - (ii) Ratio tests on all CTs.
  - (iii) Ratio error and phase displacement on all CTs.
  - (iv) Magnetising current of all CTs.
  - (v) Winding resistance of all CTs.
  - (vi) Burden of all CTs.
  - (vii) Knee point voltage test of CTs
  - (viii) Secondary injection of all relays.
  - (ix) After completing the secondary injection test, the Contractor shall perform primary injection tests to ensure the correct operation of the relay's and CT's polarities and direction of protection.
  - (x) Trip testing, all relays shall be checked for correct operation.
  - (xi) The functionality of all electrical circuitry shall be tested.
  - (xii) A rated power frequency voltage test on all MV equipment at an appropriate voltage as specified by the manufacturer, for not less than one minute.
  - (xiii) A rated power frequency voltage test on all small wiring at an appropriate voltage as specified by the manufacturer of the switchgear, for not less than one minute.
  - (xiv) Calibration and testing of HSCBs and relays.
  - (xv) Various tests on all Transformers as per IEC60076 (power transformers) and SANS780 (auxiliary transformer).
- i) The Contractor shall supply all test equipment and instruments required to do all tests.
- j) After the on-site tests, the PRASA Test Department Engineer shall either sign the test sheets (supplied by the Contractor) as having witnessed the satisfactory completion thereof or hand to the Contractor a list of defects requiring rectification.

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	


- k) Upon rectification of defects, the Contractor shall arrange for the PRASA Test Department Engineer to certify satisfactory completion of on-site tests for the switchgear and control equipment.
- l) Acceptance by the PRASA Test Department Engineer, of satisfactory completion of on-site tests in no way relieves the Contractor of his obligation to rectify defects, which may have been overlooked or become evident at a later stage.
- m) All applicable outdoor and indoor tests and final commissioning shall be done by the Contractor.

#### **10.5 Commissioning of Equipment**

- a) Commissioning will include the energising of equipment from the MV primary circuit breakers to the MV feeder circuit breakers, all low voltage equipment including battery chargers, the telecontrol equipment, telecommunication system, control panels and the substation building reticulation.
- b) The Contractor shall prove the satisfactory operation of all equipment under live conditions.
- c) On completion of commissioning, the Contractor shall hand the substation over to the Regional Engineer in terms of the relevant instructions and standard handover certificates. (HOE 1 certificate)
- d) The Contractor shall allow a period of at least three days between satisfactory completion of on-site tests and the commissioning of equipment.
- e) During this period, the Region Engineer and test staff will verify the operation of all protective relays and circuits.
- f) The Contractor's installation staff, and test Engineer shall be present during the verification to rectify any faults found.

#### **10.6 Data Packs**

- a) The Contractor shall compile and supply three (3) complete sets of Data Packs. Each Data Pack shall include the following:
  - (i) Detailed operating and maintenance instructions of all equipment, switchgear relays, transformers and other electrical equipment. Hard copies and electronic format on CD/Memory Stick.
  - (ii) Test results of all factory and site tests
  - (iii) Certificates of Compliance
  - (iv) Handover documentation
  - (v) As-built drawings
- b) Data Packs shall be submitted to PRASA for acceptance.

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	


## 11 TRAINING

- a) The Contractor shall provide training on all substation equipment installed (for planned maintenance and general operations) as part of the operational readiness and take-over of equipment.
- b) Training shall include a theoretical as well as a practical portion. The theoretical portion shall be presented in a classroom environment. The practical portion shall be conducted at the substation with applicable references to the theoretical portion.

## 12 EQUIPMENT SPARES LIST

- a) The Contractor shall supply the following equipment spares as listed in Table below.

Equipment Description	Quantity
HSCB	1
Rectifier Diodes	16
Rectifier Diode Monitoring Card	1
Rectifier Attenuation Circuit Fuse	1
Rectifier Fan Motor	1
Fan Control Card Circuit Relays and Timers	1
Rectifier RC (“Snubber”) Circuit	10
Wave Filter Circuit Fuse	1
Control Panel IEDs per type used	1
110V DC Under Voltage Monitoring Relay	3
400V AC Power protection relays	2

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	


65W 230V AC LED indoor luminaire lamp	1
65W 110V DC LED indoor luminaire lamp	1

**Table 20: Required equipment spares.**

### 13. EQUIPMENT DATA SHEETS

- a) Below is list of data sheets for all major equipment.
- b) Contractor shall fill-in the data sheets with detail information for the equipment offered.

Schedule of Equipment Data Sheets		
	Specification No.	Description
<b>Equipment Requirements</b> The annexures / appendices of the specifications listed below must be completed and submitted for Tender Technical Evaluation.		
Annexure A	BBF 9986	3kV rectifier for traction substations. Appendix 1: Technical Data Sheet
Annexure B	BBB 0937	Requirements for outdoor post type current transformers for traction and distribution substations
Annexure C	BBB 1267	Requirements for outdoor alternating-current circuit breakers for traction and distribution substations
Annexure D	BBB 3139	Wave filter capacitors for 3kV DC substations. Appendix B: Technical Data Sheet
Annexure E	BBB 3162	Wave filter inductors for 3kV DC substations. Appendix B: Technical Data Sheet
Annexure F	BBB4182	Indoor, medium voltage metal enclosed switchgear and control gear in accordance with IEC 62271-200
Annexure G	BBF 9997	Requirements for traction transformers for 3kV DC traction substations in accordance with BS 171 and IEC 60076-1. Appendix 2: Information to be provided by Tenderers
Annexure H	BBB 7842	Outdoor, high voltage, alternating current disconnectors combined with earthing switches
Annexure I	BBB 8204	Medium voltage distribution transformers in accordance with SANS 780. Appendix 2: Information to be provided by Tenderers (for nominal voltages 0kV up to 33kV)
Annexure J	BBB 8205	High Voltage Supply Transformers in Accordance with IEC 60076 and BS 171. (For nominal system voltages 33kV up to 132kV)
Annexure K	CEE-0023	Installation of low and medium voltage cables. Appendix 2: Schedule of Requirements
Annexure L	CEE-0099	3 kilo Volt DC high speed circuit breakers for traction substations. Appendix 3: Technical Data Sheet

REQUEST FOR TENDERS – APPOINTMENT OF A CONTRACTOR FOR RECONSTRUCTION OF THE 3 kV DC TRACTION SUBSTATIONS AND AC DISTRIBUTION SUBSTATIONS BETWEEN ANGLERS TRAIN STATION AND HOUTHEUWEL TRAIN STATION	
TENDER NUMBER:13-06-2023 GAU(EL)	

Annexure M	CEE-0085	Self-contained battery and charger units for electric light and power substations
Annexure N	CEE-0100	The supply of main overload protection relays for traction substations. Appendix 2: This appendix is to be completed by the Tenderer

**Table 21: Schedule of equipment Data Sheets.**