A Division of Transnet SOC Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

3kV RECTIFIER (5MW or 6MW) FOR TRACTION SUBSTATIONS

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Circulation Restricted To:

Transnet Freight Rail – Rail Network
– Technology Management

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LIST OF AMENDMENTS TO THE SPECIFICATION

Version No.	Date Issued	Clause No.	Page No.	Remarks
15	28/03/2014			Original version
				POPIA declaration statement inserted
		2		IEC and SANS standards added
		7.1.10		Clause has been added
		7.4.2.4		Clause has been added
		7.5.7		Clause has been added
		17		Appendix A has been added

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1.0 SCOPE

1.1 This specification covers Transnet Freight Rail's requirements for the design, manufacture, supply and installation of 3 kV Direct Current (DC) rectifier units (5MW – 6MW) for DC traction substations.

1.2 This specification contains a schedule of requirements (Appendix A) which must be completed by the Transnet representative and technical data sheet (Appendix B) for tenderer

2.0 NORMATIVE REFERENCES

2.1 Unless otherwise specified all materials used, equipment developed and supplied shall comply with the latest edition of the relevant International Electro-technical Commission (IEC), International Organization for Standardization (ISO), South African National Standards (SANS) or Transnet publications.

2.2 The following publications are referred to in this specification:

2.2.1 INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC 60051: Direct acting indicating analogue electrical-measuring instruments and their accessories.

IEC 60146-2: Semiconductor converters - Part 2: Self-commutated semiconductor converters including direct dc converters.

IEC 61812-1: Time relays and coupling relays for industrial and residential use - Part 1: Requirements and tests.

2.2.2 SOUTH AFRICAN NATIONAL STANDARDS

SANS 1019: Standard voltages, currents and insulating levels for electrical supply.

SANS 61000: Electromagnetic compatibility (EMC) – Part 6-2: Generic standards - Immunity for industrial environments

2.2.3 TRANSNET FREIGHT RAIL

BBB 2721: AC Primary Circuit Breaker Control Panel and AC/DC Distribution Panel for 3kV Traction Substations.

BBB 5452: Transnet Freight Rail's Requirements for the Installation of Electrical Equipment for 3kV DC Traction Substations.

CEE.0224: Drawings, catalogues, instruction manuals, spares list for electrical equipment supplied under contract.

2.3 Any items offered in accordance with other standards will be considered at the sole discretion of Transnet Freight Rail. The tenderer shall supply full details stating where the item differs from these specifications as well as supplying a copy (in English) of the recognised standard specification(s) with which it complies.

3.0 SERVICE CONDITIONS

3.1 ATMOSPHERIC CONDITIONS

The equipment shall be designed and rated for installation and continuous operation under the following conditions:

Altitude: 0 to 1800m above sea level.

Ambient temperature: -10°C to +55 °C.

Relative humidity:	10% to 90%.
Lightning Conditions:	20 ground flashes per square kilometre per annum.
Pollution:	Heavily salt laden or polluted with smoke from industrial sources.

3.2 MECHANICAL SERVICE CONDITIONS

3.2.1 The rectifiers are installed in substations next to or within close proximity of railway tracks and will be subjected to vibration from the trains.

3.3 ELECTRICAL SERVICE CONDITIONS

3.3.1 INPUT VOLTAGE

3.3.1.1 The rectifier AC input voltages for six-pulse configuration is in the order of 2450V AC per phase. For 12-pulse configuration the AC input voltages can be in the order of 1120V to 1375V phase to phase.

3.3.1.2 The rectifier receives its supply from a 3.3MVA to 5MVA main transformers (and 6MVA where transformers are replaced).

3.3.2 OUTPUT VOLTAGE

3.3.2.1 The nominal busbar output voltage rating of the system is 3150 Volts but can vary between 2400V DC and 3900V DC.

4.0 DESIGN OF EQUIPMENT

4.1 The rectifier unit and its associated control equipment shall be built up to form an independent unit.

4.2 The rectifier design shall be suitable for operation for existing or new traction substations, the details of which shall accompany this specification.

4.3 For multiple unit substations it shall be possible for each unit to operate completely independently of each other.

4.4 For single transformer, multi-group arrangements, it shall be possible to isolate and switch off one group without affecting the other group.

4.5 Six or twelve pulse operation is used depending on the configuration of the transformers.

4.6 This specification includes all the required control and protection circuits which shall be installed and wired to existing substation control panels by the supplier.

4.7 The control circuitry for tripping and indication purposes shall operate with 110V DC or 230V AC.

4.8 RATINGS

4.8.1 The DC output of the equipment shall be rated at 5MW or 6MW full load continuously with overload ratings related to full load as follows:

2 x full load for 30 minutes
3 x full load for 1 minute
3.5 x full load for 10 seconds.
4.25 x full load instantaneous tripping.

4.8.2 The equipment shall withstand a short circuit current for 50kA for 10 milli-seconds.

4.8.3 The ratings of the rectifier with its configuration shall be displayed on a silkscreen label fixed on the rectifier unit.

4.9 The rectifiers and associated equipment shall be designed to minimise any tendency to resonate or to produce high voltage surges when operating in conjunction with DC smoothing equipment.

4.10 Lightning, transients, surges and tripping are present in the substation environment

5.0 INSULATION LEVELS

5.1 Insulation levels for high voltage equipment shall be in accordance with the recommendations of SANS 1019.

5.2 The nominal 1.5kV and 3kV insulation to earth shall be so designed that the complete rectifier assembly shall be able to withstand a test voltage of 10.5kV, 50Hz AC for one minute.

5.3 Where PVC trunking is used for the routing of cables it shall be so installed that there can be no danger of a flash over or tracking occurring between the trunking and high voltage circuitry.

6.0 CLEARANCES AND CREEPAGE DISTANCES

6.1 The following minimum safety clearances shall be maintained:

For the nominal DC system voltage, the minimum air clearance shall not be less than 150mm from any conductor or metal normally live and ground level.

6.2 Ribbed insulators and standoff bushings shall be used for 3kV DC and shall have a creepage distance of not less than 239 mm.

7.0 RECTIFIER UNIT

7.1 RECTIFIER DESIGN REQUIREMENTS

7.1.1 The silicon rectifier diode assemblies shall comply with SANS 60146-2.

7.1.2 The rectifier unit shall comprise of silicon semiconductor-diodes and be of the hockey puck capsule type.

7.1.3 All materials used shall be flame retardant.

7.1.4 To prevent flashovers no insulation material shall be used between rectifier branches. The minimum air clearance of 150mm is required between diode modules as well as between diode modules and any earthed metal.

7.1.5 The minimum distance between the incoming supply phases to the rectifier shall not be less than 150mm.

7.1.6 It is required that the equipment offered be designed to remain in service in the event of any individual diode in a branch becoming defective.

7.1.7 The rated repetitive peak reverse voltage of a series connected branch of diodes shall be such that should a diode in that branch become defective, the rated repetitive peak reverse voltage of the remaining diodes will be at least twice the value of the applied reverse voltage. The peak inverse voltage shall be not less than 4000V DC or higher for a 24 diode bank.

7.1.8 The creepage distance across the resistor capacitor (RC) circuit components shall be commensurate with the creepage distance across the diode insulation.

7.1.9 Tenderers shall provide a full description of the over voltage and surge protection circuits offered illustrating how this circuit has been designed.

7.1.10 Each rectifier unit shall be provided with a digital DC voltmeter instrument display, range 0-4 000 volts and a digital DC ammeter instrument display range 0-4000 amperes. These shall be mounted on the front of the rectifier unit.

7.1.10.1 The digital LED / LCD display instruments shall be of flame retardant material, safe and reliable.

7.1.10.2 The digital LED / LCD display meters shall have a high definition colour backlight.

7.1.10.3 Digital instruments shall have an LED / LCD display of 4 digits, +14 millimetres character height and have an accuracy of 0.5%.

7.1.11 The DC voltmeter shall be connected to the more negative side of the voltage divider.

7.1.12 For the DC ammeter a 4000 ampere 50 mV shunt shall be fitted on the negative busbar of the rectifier.

7.1.13 The DC voltmeter and ammeter shall be class 1.5 or better. The dimensions of the analogue face of the meters fitted on the rectifier unit shall not be less than 144mm x 144mm with a 90 degree display.

7.1.14 A high voltage fuse and potential divider shall be provided for the voltmeter.

7.1.15 The potential divider shall consist of not less than ten separate vitreous enamel resistance elements connected in series.

7.1.16 The DC output of the rectifier unit shall be protected from external voltage transients by means of fused resistance capacitance parallel metal oxide varistor circuitry. The fuse shall be fitted with a trip contact, which can be utilised for indication and control.

7.2 DIODES

7.2.1 For 5MW and 6MW rectifiers the diodes ZP 3000/68 (exact equivalent or approved types) shall be used.

7.2.2 Proof of origin of the diodes and certified test certificates shall be supplied with the diodes.

7.2.3 The forward voltage drop of the diodes shall be within ± 5% variations.

7.2.4 Tenderers shall submit fully detailed data sheets of the type of diode offered.

7.2.5 Each individual diode shall form an integrated module with its heatsink, snubber circuit and parallel voltage- equalising resistor circuit. The module shall contain no connection wires or lugs. All connections shall be made directly through the mounting of the snubber printed circuit board busbar terminations. The design of the module shall enable it to be removed within a short period of time, without disturbing any other modules.

7.2.6 The rectifier design shall be such that only the diode module securing bolts need to be removed for replacement of a module. No busbars or other parts shall obstruct the removal of the diode module.

7.2.7 For identification of the diode polarity, the rectifier symbol shall be clearly marked on the heatsink module and on the diode.

7.2.8 Tenderers shall indicate the recommended intervals between the testing of diodes and their RC snubber components so as to establish their soundness.

7.3 SNUBBER (RC) AND VOLTAGE EQUALISING CIRCUITRY

7.3.1 The capacitors and resistors employed in the snubber RC circuits shall be of the highest quality and shall be suitably rated for high voltage applications encountered. Vitreous enamel wire wound resistors or similar shall be used and high voltage suitable capacitors shall be used.

7.3.2 If standoff posts are used to support sensing circuits they shall be securely fixed to the main diode module by means of lock washers and nuts to ensure that no sparking occurs due to poor contact.

7.4 DIODE MONITORING EQUIPMENT

7.4.1 DIODE SENSOR TRANSMITTER MONITORING MODULE

7.4.1.1 Sensing circuitry shall be incorporated to monitor each individual diode for open or short circuit conditions.

7.4.1.2 Specific attention shall be given to the protection of the diode monitoring circuit boards in the event of the diode going open circuit and destroying the monitoring modules.

7.4.1.3 Protection circuitry shall be provided for each sensor module.

7.4.1.4 The sensor module shall be powered from the snubber RC circuit of the diode and shall be designed so as not to change the characteristics of the RC circuit across which it is connected.

7.4.1.5 The snubber RC circuitry, and the diode sensing circuitry, shall be removable as a unit with the diode module when the diode module is removed for replacement or repair.

7.4.1.6 The components used to manufacture the diode sensor transmitter module shall be of the highest quality.

7.4.1.7 If resistors are employed they shall be vitreous enamel insulated or similar and shall withstand at least 700 Volts across them.

7.4.1.8 The diode sensing circuit board shall be removable from the diode module as an individual circuit board for repair or replacement.

7.4.1.9 The diode sensing circuit board shall be constructed in such that it will be protected against reverse polarity on installation after repair or replacement.

7.4.1.9.1 The output signal from the diode sensor transmitter board shall be fibre optic transmitted. Wire conductors are not acceptable.

7.4.1.9.2 Diode monitoring systems utilising Programmable Logic Controllers (PLC) is not acceptable.

7.4.2 RECTIFIER DIODE MONITORING PANEL AND DISPLAY

7.4.2.1 The rectifier unit shall be fitted with a diode monitoring panel for monitoring the condition of each diode.

7.4.2.2 Each diode shall be clearly numbered on the front display cover of the diode monitoring panel as well as on the diode module. The markings shall be silk screened engraved or similar.

7.4.2.3 The panel shall be fitted with Light Emitting Diodes (LED's) to indicate the condition of the diodes. The LED's shall be green for a healthy diode and red for an open circuit or short circuit diode.

7.4.2.4 The panel shall be fitted with a yellow LED for fan control and the red LED for over-temperature.

7.4.2.5 A remote reset switch or button to reset the LED's and the diode monitoring panel shall be fitted in the primary circuit breaker control panel.

7.4.3 ELECTRONICS

7.4.3.1 All printed circuit boards shall be constructed from high quality fibreglass material.

7.4.3.2 All printed circuit boards shall slide in high quality edge connectors and shall be easily removed for replacement or repairs.

7.4.3.3 All printed circuit boards with its components shall be coated for protection against moisture, corrosion and dust.

7.4.3.4 Each printed circuit board shall be polarised to prevent the card from being plugged into the wrong socket and to prevent the card from being inserted upside down.

7.4.3.5 The control unit shall be designed to fail to safe in the event of power supply failure or printed circuit board failure. Contacts shall be provided which can be utilised for lockout signals.

7.4.4 POWER SUPPLY SYSTEM

7.4.4.1 The power supply shall be of the switch mode design and shall be able to operate within the range of the voltages available in the substation.

7.4.4.2 The power supply as well as the remainder of the unit shall be extensively protected from lightning, transients and surges. Extensive use of gas arresters, inductors and capacitors will be required.

7.4.5 FIBRE OPTIC MONITORING BOARD

7.4.5.1 The annunciator shall be fitted with fibre optic receivers for signals transmitted from the diode sensor transmitter module.

7.4.6 INTERFACE INPUT-OUTPUT PRINTED CIRCUIT-BOARD

7.4.6.1 The diode monitoring main board shall be able to communicate the condition of the diodes by means of relay contacts.

8.4.6.1.1 Provision shall be made for one diode failure to lockout the substation with a remote flag indication and give a signal to the telecontrol system.

7.4.6.2 The relays shall function in the fail safe mode, i.e. the relays will be energised and will de-energise under faulty conditions.

7.5 COOLING

7.5.1 The rectifier unit shall be fitted with cooling fans with temperature sensors for the control of the cooling fan, temperature monitoring and rectifier over-temperature protection.

7.5.2 The direct heat sink temperature sensing method shall be used with multiple sensors connected in series.

7.5.3 Two thermal control switches shall be fitted to the rectifier for the energising of the cooling fans at a temperature of 50°C. Provision shall be made to prevent the fan from cycling at the energising temperature.

7.5.3.1 Suitable fan control circuitry shall be provided by the supplier.

7.5.4 The rectifier unit shall be provided with two over temperature sensing switches which shall be set at 80°C.

7.5.5 The rectifier over temperature protection shall be used for tripping purposes. The circuitry shall be provided by the supplier.

7.5.6 The wiring from the sensors to the fan controller shall be of the plastic fibre optic type and the sensors shall obtain their supply from the RC circuit.

7.5.7 The fan indication lights must be mounted on a fan cover for fan ON and OFF.

7.5.8 Fan airflow failure circuitry (vane switches) and relays shall be provided for control and indication purposes. A fan test switch which is spring loaded to the off position shall be provided and installed in the primary circuit breaker control panel.

7.5.9 Adequate measures shall be taken to ensure that the rectifier equipment does not overheat during periods of high loading. Details of the over temperature protective scheme shall be submitted with the tender.

7.5.10 Provision shall be made for adjustable current sensing to control the operation of the cooling fan(s). The fan(s) shall be energised when the main current reaches a value of 700 amps (adjustable.) The current sensing circuitry shall be sufficiently isolated and shall be installed in the primary circuit breaker control panel.

8.0 INSTALLATION

8.1 The contractor shall be responsible for the transport to site, off-loading, handling, storage and security of all material required for the installation of the rectifier unit.

8.2 The rectifier shall be installed within the substation building and shall be totally insulated from the floor by means of channel insulation or other high voltage insulating material.

9.0 EARTHING

9.1 The metal framework of the rectifier shall be connected to the existing DC earth leakage earthing system in accordance to drawing no. CEE-TBD-7. Should the existing earth strap not be suitable for re-use a new copper earth strap of least cross-section area or a stranded insulated copper conductor with a cross-sectional area of at least 95mm ^{2} shall be used.

10.0 CABLES

10.1 Armoured cables shall be used for the wiring of the cooling fans and any other external power circuitry.

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

10.3 Screened cables and conductors shall be used for electronic screening and noise reduction techniques where required.

10.4 The fibre optic cables between the rectifier and the annunciator panel shall be protected from damage by means of conduit or trunking or other suitable means. Open fibre optic cables are not acceptable.

10.5 All cabling shall be clearly marked with high quality permanent markers. Sticker marking numbers will not be acceptable.

11.0 INTERCONNECTION OF EQUIPMENT

11.1 Suitably rated Copper or Aluminium busbars shall be used for the interconnection of the rectifier to the secondary winding of the traction transformer. The busbars between separately mounted equipment shall incorporate a degree of flexibility to avoid any over stressing of these connections due to movement caused by conductor expansion/contraction and to facilitate alignment of equipment. Sizes for AC (Copper

50X10mm and Aluminium 25X50mm) and sizes for DC (Copper 100X10mm and Aluminium 127X12.5mm).

11.2 High conductive silicon grease shall be liberally applied to all connections.

11.3 All dissimilar metal connections copper to aluminium (Cu to Al) shall be made using bi-metallic clamps that are specifically designed and manufactured to make that particular connection. (Adhoc fabricated clamps are not acceptable).

11.4 All copper connections to steel (galvanised) shall be tinned or silver coated.

12.0 INSPECTION, SITE TESTS AND COMMISSIONING

12.1 Transnet Freight Rail reserves the right to carry out inspection and any tests on the equipment at the works of the supplier/ manufacture.

12.2 Arrangements must be made timeously for such inspections to be carried out before delivery of the equipment to the client.

12.3 The contractor shall be responsible for carrying out on-site functional tests before the commissioning of the rectifier unit.

12.4 The testing of the rectifier shall include type tests for new design of rectifier units and routine tests which shall be conducted on all units. Quality Assurance labels must be mounted on the rectifier rating board.

12.4.1 The testing shall include the following: -

- Insulation tests.
- Light load tests.
- Functional tests on the associated control equipment and circuitry of the rectifier.
- Temperature rise tests i.e. temperature measurements on diode heatsinks. Maximum temperature rise shall not exceed 75° C.
- Checking of auxiliary and protective devices and control equipment.
- Rated output tests.
- Overcurrent capability test.
- Measurement of output voltage.
- Power loss determination.

12.4.2 Functional Acceptance by the Maintenance Manager 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.

12.5 Commissioning will only take place after all defects have been rectified to the satisfaction of the Maintenance Manager.

12.6 Commissioning will include the energising of equipment from the primary isolator to the track feeder circuits. The contractor must prove the satisfactory operation of equipment under live conditions.

12.7 On completion of commissioning the contractor will hand the equipment over to the Maintenance Manager in terms of the relevant engineering instructions.

13.0 DRAWINGS, INSTRUCTION MANUALS AND SPARES LISTS

13.1 Drawings, instruction manuals and spare parts catalogues shall be supplied in accordance with Transnet Freight Rail's specification CEE0224.

13.2 All drawings (paper prints) shall be submitted to the technical officer for approval. No Construction or manufacturing activity will be allowed prior to the associated drawings having been approved by the technical officer.

13.3 The tenderer shall supply three copies of an instruction/maintenance manuals, schematic diagrams, diode application notes and protection and filter ratings.

13.4 The contractor shall submit details of spares required in accordance with specification CEE0224

13.5 All spares recommended for normal maintenance purposes that are not available locally (requires importation) must be highlighted.

14.0 SPECIAL TOOLS AND/OR SERVICING AIDS

14.1 Special tools or servicing aids necessary for the efficient maintenance, repair or calibration of the equipment shall be quoted for separately.

14.2 Tenderers shall submit detailed offers for special tools and servicing aids including all specialised equipment required for the servicing and maintenance of the equipment supplied.

15.0 TRAINING

15.1 The tenderer shall submit details with the tender of the training courses, which will be conducted by the contractor for the training of Transnet Freight Rail's maintenance staff in the operation and maintenance of the equipment supplied. The courses shall include theoretical as well as practical tuition. The date and venue of this training course shall be arranged with the Maintenance Manager.

16.0 GUARANTEE AND DEFECTS

16.1 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 design, materials and workmanship.

16.2 The guarantee period for all substations shall expire after: -

A period of 12 months commencing on the date of completion of the contract or the date the equipment is handed over to Transnet Freight Rail whichever is the later.

16.3 Any specific type of fault occurring three times within the guarantee period and which cannot be proven to be due to other faulty equipment not forming part of this contract e.g., faulty locomotive or overhead track equipment, etc., shall automatically be deemed an inherent defect. Such inherent defect shall be fully rectified to the satisfaction of the Maintenance manager and at the cost of the Contractor.

16.4 If urgent repairs have to be carried out by Transnet Freight Rail's staff to maintain supply during the guarantee period the contractor shall inspect such repairs to ensure that the guarantee period is not affected and should they be covered by the guarantee, reimburse Transnet Freight Rail the cost of material and labour.

17.0 APPENDIX A: SCHEDULE OF TECHNICAL REQUREMENTS

(To be completed by Transnet Representative)

1	Name of Depot	Ermelo
2	Name of the substations	Boschmanskop Substation
3	Quantity of the rectifiers	One (1)
4	Supply Voltage to Rectifier Transformer (88KV or 132kV AC)	132kV AC
5	Rectifier Transformer size (3.3MVA, 5MVA or 6MVA)	6MVA
6	Rectifier Transformer configuration (6 Pulse rectification or 12 Pulse rectification)	12 Pulse
7	Rectifier size (5MW or 6MW)	6MW
8	Special requirements	

Completed by:	Nomveliswa Ndaba
Capacity:	Engineering Technician
Signature:	
Date:	09/02/2026

18.0 APPENDIX B: TECHNICAL DATA SHEET

(To be completed by Tenderer)

1.0 Rectifier ratings (MW):_____

2.0 Number of diodes per branch:_____

3.0 Type of Diode:_____

3.0 Full load current rating of diode. $I_{FRMS:}$_____

4.0 Average current rating of diode. $I_{FAVM:}$_____

4.0 Repetitive Peak Reverse Voltage of diode:_____

5.0 Surge forward current 10 milli second Sine Wave:_____

6.0 Method of cooling of rectifier:_____

7.0 Method of temperature sensing: _____

8.0 Type of insulation used for frame to floor: _____

9.0 Physical dimensions of rectifier unit:

Height: _____ Breadth: _____ Width: _____

10.0 Name of suppliers where rectifier diodes can be sourced: _____

_____

11.0 Method of correct torque adjustment for heat sinks: _____

_____

12.0 Diode test certificate attached Yes/No:_____

A Division of Transnet SOC Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

REQUIREMENTS FOR METAL OXIDE SURGE ARRESTERS WITHOUT GAPS FOR TRACTION AND DISTRIBUTION SUBSTATIONS

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Date: 19 April 2024

Circulation Restricted To:

Transnet and Relevant Third Parties

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LIST OF AMENDMENTS

Version	Date issued	Summary of changes
04	21/09/2009	Not indicated
05	07/09/2020	Title amended
		Additional SANS standards
		Service conditions amended
		Added energy absorption and charge transfer to the operating duty of surge arrester
		Changed arrester classification and added minimum creepage and minimum thermal energy rating
		Added arrester housing requirements
		Added end fittings requirements
		Added surge counter and leakage current meter requirements
		Added inspection and tests requirements
		Added marking requirements of arrester
		Added packaging and storage requirements
		Added documentation requirements
		Added quality assurance requirements
		Added statement on guarantee and defects
		Added schedule of requirements (Appendix A)
		Added technical datasheet (Appendix B)
06	09/03/2022	Added POPI Act disclaimer statement
		Amended document requirements clauses
		Amended Appendix B
		Method of tendering changed to technical compliance
07	19/04/2024	Short-circuit current rating reduced from 100 kA to 63 kA
		Removed technical compliance clause

1.0 SCOPE

1.1 This specification covers Transnet's requirements for the supply of gapless metal oxide surge arrester of the station class to be installed in Transnet's traction and distribution substations.

1.2 This specification contains schedule of requirements (Appendix A) which must be completed by the relevant Transnet Representative.

1.3 This specification contains technical datasheet (Appendix B) which must be completed by the tenderer and must be submitted as part of the tender documents.

2.0 NORMATIVE REFERENCES

Unless otherwise specified all materials used, equipment developed and supplied shall comply with the latest edition of the relevant South African National Standards (SANS) and Transnet publications.

2.1 SANS

2.1.1	SANS 121	Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods
2.1.2	SANS 936	Spheroidal graphite iron castings
2.1.3	SANS 1019	Standard voltages, currents and insulation levels for electricity supply
2.1.4	SANS 2230	Rubber products: Guidelines for storage
2.1.5	SANS 9001	Quality management systems – Requirements
2.1.6	SANS 60099-4	Surge arresters Part 4: Metal-oxide surge arresters without gaps for AC systems
2.1.7	SANS 60815-1	Selection and dimensioning of high-voltage insulators intended for use in polluted conations Part 1: Definitions, information and general principles
2.1.8	SANS 60815-3	Selection and dimensioning of high-voltage insulators intended for use in polluted conations Part 3: Polymer insulators for AC systems

3.0 SERVICE CONDITIONS

3.1 ENVIRONMENTAL CONDITIONS

Altitude:	0 - 1800 m above sea level
Relative humidity	10% to 90%
Ambient temperature	-10° C to +55° C
Wind pressure	750 Pa
Lightning conditions	20 ground flashes/km^2 per annum
Pollution	Heavily salt laden with industrial pollutants including diesel- electric locomotive emissions

3.2 MECHANICAL SERVICE CONDITIONS

3.2.1 The surge arrester shall be mounted on a steel structure and shall be exposed to intermittent vibration due to passing trains.

3.3 ELECTRICAL SERVICE CONDITIONS

3.3.1 Nominal system frequency is 50 Hz.

3.3.2 Maximum duration of the earth fault is less than 1 second.

3.3.3 Transnet Freight Rail's traction and distribution substations are considered to be effectively earthed.

3.3.4 The nominal supply voltages from power utility to the traction and distribution substations are 22 kV, 33 kV, 44 kV, 66 kV, 88 kV, 132 kV, and 220 kV.

3.3.5 The surge arresters will be connected vertically between phase and earth.

4.0 ARRESTER OPERATING DUTY

4.1.1 Arresters shall be able to absorb energy from switching events or transfer charge from lightning events and subsequently thermally recover under applied temporary overvoltage and following continuous operating voltage conditions as stated in SANS 60099-4.

4.1.2 The following equipment shall be protected by the surge arrester.

a. Traction and distribution power transformers
b. Current Transformers
c. Circuit breakers
d. Auxiliary transformer
e. Voltage transformer
f. Rectifiers

5.0 TECHNICAL REQUIREMENTS

The surge arresters shall be single column and shall comply with the following technical requirements:

5.1 INSULATION LEVEL

5.1.1 The recommended insulation level in accordance with SANS 1019 is indicated in Table1 for medium and high voltage electrical systems.

Table 1 Standard voltage and insulation levels

Highest phase-to-phase RMS voltage for equipment (Um)	Nominal system RMS voltage (Un)	Rated lightning impulse withstand voltage peak	Rated short duration power frequency withstand r.m.s voltage
24 kV	22 kV	150kV	50 kV
36 kV	33 kV	200 kV	70 kV
52 kV	44 kV	250 kV	95 kV
72,5 kV	66 kV	350 kV	140 kV
100 kV	88kV	380 kV	150 kV
145 kV	132 kV	550 kV	230 kV
245 kV	220 kV	850 kV	360 kV
Insulation levels for highest voltage for equipment Um < 100 kV are based on an earth fault factor equal to $\sqrt{3}$ and for Um > 100 kV an earth fault factor equal to $0{,}8\sqrt{3}$.			

5.2 SCHEDULE OF RATINGS OF SURGE ARRESTER

Table 2 indicates schedule of ratings of surge arresters for effectively earthed systems in accordance with SANS 60099-4 employed for protection of electrical equipment mentioned in section 4.2. Deviations from the table are permissible subject to approval from Technology Management (Electrical Technology) in writing.

Table 2 Surge arrester schedule of ratings

	Nominal system r.m.s. voltage (Us)	**22 kV**	**33 kV**	**44 kV**	**66 kV**	**88 kV (All areas)***	**88 kV (Between Antra and Moolman)**	**132 kV**	**220 kV**
5.2.1	Rated voltage of surge arrester (Ur)	21 kV	36 kV	42 kV	60 kV	84 kV	96 kV	120 kV	204 kV
5.2.2	Continuous operating voltage of surge arrester (Uc)	17 kV	26 kV	34 kV	48 kV	67 kV	77 kV	96 kV	163 kV
5.2.3	Nominal discharge current (8/20 μ s)	10 kA	10 kA	10 kA	10 kA	10 kA	20 kA	10 kA	10 kA
5.2.4	High current (4/10 μs)	100 kA	100 kA	100 kA	100 kA	100 kA	100 kA	100 kA	100 kA
5.2.5	Pressure relieve capability (0.2s)	40 kA	40 kA	40 kA	40 kA	40 kA	40 kA	40 kA	40 kA
5.2.6	Arrester designation	SM	SM	SM	SM	SM	SH	SM	SM
5.2.7	Minimum Repetitive charge transfer rating (Qrs)	1.6 Q	1.6 Q	1.6 Q	1.6 Q	1.6 Q	2.4 Q	1.6 Q	1.6 Q
5.2.8	Minimum thermal energy rating (Wth), in kJ/kV of Ur	7	7	7	7	7	10	7	7
5.2.9	Rated short circuit current	63 kA	63 kA	63 kA	63 kA	63 kA	63 kA	63 kA	63 kA
5.2.10	Minimum creepage distance (mm), Site pollution severity class e (Very heavy) in accordance with SANS 60815-1	744	1116	1488	2248	3100	3100	4495	7595

* All areas except for the section between Antra and Moolman substations in the coal line

5.3 SURGE ARRESTER HOUSING REQUIREMENTS

5.3.1 The arrester shall be designed such that the housing is able to adequately withstand surges during conduction of lightning and switching impulse currents and during anticipated maximum power frequency overvoltage as stated in clause 6.1 of SANS 60099-4.

5.3.2 The surge arrester housing shall be made of polymeric insulation and profiles to be designed in accordance with the requirements in SANS 60815-3. An epoxy resin will NOT be acceptable as an arrester housing material.

5.3.3 The housing shall be designed to suite application and meet specified minimum creepage distance as per Table 2.

5.3.4 The sheds shall be stabilized against the effects of ultraviolet, other solar radiation and against the effects of airborne contaminants.

5.3.5 The preferred colour for the shed material is grey.

5.4 END FITTINGS REQUIREMENTS

5.4.1 The end fittings shall preferably be made of spheroidal graphite cast iron to grade SG 50 in accordance with SANS 936. Alternatively, stainless steel material can be used on request and subject to Technology Management formal approval.

5.4.2 The metal fittings and associated locking devices shall be hot-dip galvanized in accordance with SANS 121. The galvanized surface shall be smooth.

5.4.3 End fittings of the surge arresters shall be permanently protected from moisture ingress with a flexible and weather-resistant sealant.

5.5 ADDITIONAL EQUIPMENT REQUIREMENTS

5.5.1 Each surge arrester installed in substations between Antra to Moolman must be fitted with a surge counter and a leakage current meter. However, in other sections it is optional as per schedule of requirements.

5.5.2 Surge counter and leakage current meter shall be in weather-proof enclosures suitable for mounting on structure of lightning arrester.

5.5.3 Insulating base shall be provided for the connection of surge counter and leakage current meter.

6.0 TESTING AND INSPECTIONS

6.1.1 Transnet reserves the right to be present at all tests and inspections as called for in this clause.

6.1.2 The responsibility of arranging the tests called for in this clause rests with the successful tenderer.

6.1.3 A Transnet Freight Rail, Technology Management (Electrical Technology) department representative may request any additional test deemed necessary to ensure compliance.

6.1.4 The surge arrester shall be subjected to type and routine tests in accordance with SANS 60099-4.

6.1.5 The insulating base and mounting brackets shall be tested separately in accordance with SANS 60099-4.

7.0 MARKING OF THE SURGE ARRESTER

7.1 Each surge arrester shall be clearly and permanently marked with the following information:

a. Designation of surge arrester.

b. Continuous operating voltage.

c. Rated voltage.

d. Rated short circuit current.

e. Name or trademark of the manufacturer.

f. The year of manufacture.

g. Serial number or similar means of production identification.

8.0 PACKAGING AND STORAGE OF SURGE ARRESTERS

8.1 The packaging and storage of the surge arresters shall comply with SANS 2230.

8.2 No part should be tied or tagged in such a way as to cause damage on the sheds of the arrester.

8.3 Installation, storage and transportation instructions must accompany each packaging.

9.0 DOCUMENTATION REQUIREMENTS

9.1 GENERAL

9.1.1 Drawings and documents submitted with tender shall be written in English.

9.1.2 All units indicated in the documentation shall be in metric system.

9.1.3 TFR reserves the right to require any additional information; manuals, catalogues, drawings, etc. that may contribute to complete information supplied by the manufacturer.

9.2 DOCUMENT TO BE SUBMITTED TENDER

9.2.1 Surge arrester technical datasheet and drawing.

9.2.2 Completed Appendix B.

9.3 TECHNICAL DOCUMENTS TO BE SUBMITTED BY THE SUCCESSFUL TENDERER.

9.3.1 The method of installation of the complete surge arrester.

9.3.2 The type test certificates.

10.0 QUALITY ASSURANCE

10.1 The successful tenderer shall maintain a Quality Management System (QMS) based on or certified to SANS 9001.

11.0 GUARANTEES AND DEFECTS

11.1 The successful tenderer shall accept liability for makers' defects, which may appear in design, material and workmanship.

11.2 The successful tenderer shall provide all information regarding guarantees and warranties in writing

END

12.0 APPENDIX A: SCHEDULE OF REQUIREMENTS

12.1 The table below must be completed by a Transnet representative.

1.	Name of the Depot	Ermelo
2.	Is the substation located between Antra and Moolman? (Yes/No)	No
3.	System nominal voltage	132kV
5.	Is the surge counter required? (Yes/No)	Yes
6.	Is the earth leakage current meter required? (Yes/No)	No
7	End fittings material (Cast iron/ Stainless steel	Cast iron
8	Special requirements	…… …… …… …… …… ……

Completed by:	Nomveliswa Ndaba
Capacity	Engineering Technician
Signature	
Date	13.02.2026

13.0 APPENDIX B: TECHNICAL DATASHEET

13.1 The table below must be completed by the tenderers and submitted with tender.

Surge arrester identification		
Supplier		
Manufacturer name		
Electrical characteristics of arrester		
Arrester classification		
Arrester designation		
Nominal discharge current (8/20 µs)		kA
Rated short-circuit current		kA
Arrester rated voltage (U_r)		kV
Continuous operating voltage (U_C)		kV
Thermal energy rating (W_{th})		kJ/kV
Repetitive charge transfer rating (Qrs)		Q
Creepage distance		mm
Reference voltage		kV
Reference current		kA
Rated frequency		Hz
Arrester minimum temporary overvoltage withstand capability, with prior duty		
Minimum TOV applied for 1 s		kV
Minimum TOV applied for 10 s		kV
Mechanical Properties		
Specified long-term load (SLL) kN		
Specified short-term load (SSL) kN		
Arrester mounting		
Orientation		
Overall height of arrester		
Miscellaneous		
Housing material		
Color of housing		
Total mass of assembled unit		kg
Minimum expected life of arrester at standard conditions		Years

Completed by:	
Capacity	
Signature	
Date	

APPENDIX A

SCHEDULE OF REQUIREMENTS
(To be completed by client)

1.0 SYSTEM DETAIL

1.1 Current transformers required for: Boschmanskop substation/location.

1.2 Pollution level: Heavy_____ Very Heavy ✓

1.3 Quantity of current transformers required. 2

1.4 Nominal phase to phase voltage for 3 phase system: 132 kV.

1.5 Nominal phase to neutral voltage for single phase systems: 76.21 kV.

1.6 Frequency: 50 Hz

2.0 DETAIL OF CURRENT TRANSFORMER.

MEASURING CURRENT TRANSFORMERS

2.1 Measuring current transformer required: ~~Yes~~ / No

2.2 Number of measuring cores required: 2

2.3 Transformer ratio: Primary 50 Ampere, Secondary 1 Ampere.

2.4 Rated primary current: 50 Ampere. Rated secondary current: 1 Ampere

2.5 Rated burden: 15 VA

2.6 Accuracy class: 0.5

PROTECTION CURRENT TRANSFORMERS

2.7 Protection current transformer required: ~~Yes~~/No

2.8 Number of protection cores required: 1

2.9 Rated primary current: 50 Ampere. Rated secondary current: 5 Ampere

2.10 Accuracy class: 10P

2.11 Accuracy limit factor: 10

2.12 Rated Burden: 15 VA

CLASS PX PROTECTION CURRENT TRANSFORMERS

2.13 Class PX protection required: Yes/No

2.14 Number of Class PX protection cores required:_____

2.15 Transformation ratio: Primary_____Ampere, Secondary_____Ampere.

2.16 Rated primary current: _____ Ampere. Rated secondary current: _____ Ampere.

2.17 Rated turns ratio: _____

2.18 Rated knee point e.m.f: _____V

2.19 Maximum secondary winding resistance: _____ Ohms at _____ ° C

END

TRANSNET
freight rail

A Division of Transnet SOC Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

REQUIREMENTS FOR OUTDOOR POST TYPE CURRENT TRANSFORMERS FOR TRACTION AND DISTRIBUTION SUBSTATIONS.

Author:	Engineer Technology Management	A.R. Netsianda	
Approved:	Senior Engineer Technology Management	L.O. Borchard	
Authorised:	Principal Engineer Technology Management	S.E. Sibande	

Date: 03 October 2016

Circulation Restricted To:

Transnet Freight Rail
Transnet and Relevant Third Parties

Contents

1.0 SCOPE

1.1 This specification covers Transnet Freight Rail's requirements for the design, manufacture, testing and supply of outdoor post type current transformers for use with electrical measuring instruments and electrical protection devices.

1.2 The current transformers shall be suitable rated for nominal system phase to phase rms voltages ranging from 22 kV up to 220 kV.

2.0 STANDARDS

2.1 Unless otherwise specified all materials used and equipment developed and supplied shall comply with the current equivalent edition of the relevant SANS, IEC or Transnet Freight Rail publications where applicable.

2.2 The following publications/specifications (latest editions) are referred to herein:

2.2.1 SOUTH AFRICAN NATIONAL STANDARD (SANS)

SANS 1019:	Standard voltages, currents and insulation levels for electricity supply.
SANS 60529:	Degree of protection provided by enclosures (IP code)
SANS 61869-1:	Instrument transformers Part 1: General requirements.
SANS 61869-2:	Instrument transformers Part 2: Additional requirements for current transformers.
SANS 62271-204:	High-voltage switchgear and control gear Part 204: Rigid gas-insulated transmission lines for rated voltage above 52 kV
SANS 9001:	Quality management systems - Requirements.

2.2.2 INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60296:	Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear.
IEC 60376:	Specification of technical grade sulfur hexafluoride (SF6) for use in electrical equipment.
IEC 60417:	Graphical symbols for use on equipment.
IEC 60455:	Resin based reactive compounds used for electrical insulation.
IEC 60815:	Selection and dimensioning of high-voltage insulators intended for use in polluted conditions.
IEC 60867:	Insulating liquids - Specifications for unused liquids based on synthetic aromatic hydrocarbons.

2.2.3 TRANSNET FREIGHT RAIL'S SPECIFICATIONS

CEE 0183:	hot dipped galvanizing and painting of electrification steelwork.

3.0 METHOD OF TENDERING

3.1 Tenderers shall indicate clause-by-clause compliance with this specification. This shall take the form of a separate document listing all the specifications clause numbers indicating the individual statement of compliance or non-compliance. This document can be used by tenderers to elaborate on their response to a clause.

3.2 A statement of non-compliance shall be motivated by the tenderer.

3.3 Tenderers shall submit descriptive literature consisting of a detailed technical specifications,

general constructional details and principal dimensions, together with clear illustrations of the equipment offered.

3.4 Failure to comply with clauses 3.1, 3.2 and 3.3 could preclude a tender from consideration.

4.0 SERVICE CONDITIONS

4.1 ENVIRONMENTAL CONDITIONS

Altitude:	0 - 1800 m above sea level
Relative humidity:	10% to 90%
Ambient temperature:	-10° C to +55° C
Wind pressure:	750 Pa
Lightning conditions:	20 ground flashes/km^2 per annum
Pollution:	Heavily salt laden with industrial pollutants including diesel-electric locomotive emissions
Electromagnetic interference:	The device shall be used in environments exposing it to substantial electric and magnetic field intensities

4.2 ELECTRICAL SERVICE CONDITIONS

4.2.1 The current transformer shall be suitable for single phase AC traction supply systems with nominal voltage ranging from 22 kV – 220 kV AC with +-5% tolerance.

4.2.2 The current transformer shall be able to operate at a frequency of 50 Hz with +- 2.5% tolerance.

4.3 MECHANICAL SERVICE CONDITIONS

4.3.1 The device may be exposed to vibration and shock. The design must be adequately robust so as to ensure reliability of the equipment under such handling and transportation conditions.

5.0 TECHNICAL REQUIREMENTS

5.1 GENERAL REQUIREMENTS

5.1.1 The current transformers shall be designed, manufactured and tested in accordance with the requirements of SANS 61869-1 and SANS 61869-2 specifications.

5.1.2 The current transformers shall be suitable for operation under the nominal phase to phase voltages or phase to neutral voltages specified in Appendix A.

5.1.3 The current transformers shall be designed for outdoor use.

5.1.4 The current transformers shall be provided with measuring and protection cores as specified in Appendix A.

5.1.5 For certain applications, dual measuring cores as specified in Appendix A shall be provided for the purpose of ESKOM metering.

5.2 INSULATION LEVELS

The rated insulation levels of the current transformers shall comply with the requirements specified in Table 1.

Table 1 lists the nominal system voltages present on Transnet Freight Rail and the required insulation levels as specified in accordance with SANS 1019.

Highest phase-to-phase r.m.s voltage for equipment. (Um)	Nominal system phase-to-phase r.m.s. voltage	Rated lightning impulse withstand voltage peak.	Rated short duration power- frequency withstand r.m.s voltage.
24 kV	22 kV	150kV	50 kV
36 kV	33 kV	200 kV	70 kV
52 kV	44 kV	250 kV	95 kV
72,5 kV	66 kV	350 kV	140 kV
100 kV	88kV	380 kV 450 kV	150 kV 185 kV
145 kV	132 kV	550 kV 650kV	230 kV 275 kV
245 kV	220 kV	550 kV 650kV	360 kV 395 kV
Insulation levels for highest voltage for equipment $U_m < 100$ kV are based on an earth fault factor equal to $\sqrt{3}$ and for $U_m > 100$ kV an earth fault factor equal to $0{,}8\sqrt{3}$.			

TABLE 1: Standard Voltages and insulation levels in accordance with SANS 1019:2014

For the 25 kV and 50kV single phase ac traction systems the ac high voltage circuit breakers shall be designed to the following nominal system phase to phase r.m.s voltages and withstand insulation levels:

- For the 25 kV (phase to earth) ac traction systems the ac high voltage circuit breakers current transformer shall be rated for a nominal system phase to phase r.m.s voltage of at least 44 kV and designed to withstand the required insulation level for that nominal system voltage.
- For the 50 kV (phase to earth) ac traction systems the ac high voltage circuit breakers shall be rated for a nominal system phase to phase r.m.s voltage of at least 88 kV and designed to withstand the required insulation level for that nominal system voltage.

5.2.1 Primary terminal

5.2.1.1 The primary terminal insulation levels of the current transformer shall be as per clause 5.2 table 2 of SANS 61869-1 specification.

5.2.1.2 The partial discharge level shall not exceed the limits specified in Table 3 of SANS 61869-1 specification. These limits shall be tested as per clause 7.3.2.2 of SANS 61869-1 specification.

5.2.1.3 Current transformers that are not Gas Insulated shall be capable to withstand a chopped lightning impulse voltage applied to its primary terminals having a peak value of 115 % of the rated lightning impulse withstand voltage.

5.2.1.4 The primary terminals shall be of approved type material i.e. aluminium or electroplated copper and shall be able to carry the rated short circuit current of the current transformer.

5.2.1 **Secondary terminal**

5.2.1.1 The rated power-frequency withstand voltage for secondary insulation shall be at least 3 kV.

5.2.1.2 The secondary terminals shall be mounted in a metal terminal box suitable for the termination of the current transformer secondary windings to the outgoing external circuits for the protection relays, metering and indicating instruments.

5.2.1.3 The secondary winding connections shall be brought out through the tank into the terminal box by means of bushings.

5.2.1.4 Links shall be provided for shorting out the secondary windings not in use.

5.2.1.5 A rail mounted terminal strip shall be provided inside the terminal box for the termination of the current transformer secondary connections to the external circuits. The terminals shall be of the screw clamp type or spring-loaded insertion type.

5.2.1.6 The secondary winding terminal box shall be provided with a weatherproof cover and bottom entry cable entries. The degree of protection shall be at least IP 54 in accordance with SANS 60529.

5.2.1.7 An earthing stud of at least 6mm shall be provided inside the terminal box for the earthing of the secondary windings.

5.3 CURRENT TRANSFORMER RATINGS

5.3.1 MEASURING CURRENT TRANSFORMERS

5.3.1.1 The transformer ratio(s) shall comply with the requirements of Appendix A.

5.3.1.2 The secondary current rating shall be 1 Ampere unless otherwise specified in Appendix A.

5.3.1.3 The minimum rated output burden shall be 10 VA unless otherwise specified in Appendix A.

5.3.1.4 The accuracy class shall be as follows:

- For metering purposes the class of accuracy shall be 0.5 for current transformers with ratios up to 400/1 and class 0.2 for ratios greater than 400/1.
- For Indication or measuring purposes the accuracy class shall be 0.5.

5.3.2 PROTECTION CURRENT TRANSFORMERS

5.3.2.1 The transformer ratio(s) shall comply with the requirements of Appendix A.

5.3.2.2 The secondary current rating shall be 1or 5 Ampere. Refer to Appendix A.

5.3.2.3 The rated output burden shall comply with the requirements of Appendix A but shall not be less than 10 VA.

5.3.2.4 The accuracy limit factor shall be as specified in Appendix A.

5.3.2.5 The accuracy class shall be as specified in Appendix A.

5.3.2.6 The protection core shall be provided with a 10 ampere test winding.

CLASS PX CURRENT TRANSFORMERS

5.3.2.7 Class PX protection current transformers shall be provided where specified in Appendix A.

5.4 DESIGN AND CONSTRUCTION

5.4.1 Requirements for liquid filled in equipment

5.4.1.1 The manufacturer shall specify the type and the required quantity and quality of the liquid to be used in current transformer.

5.4.1.2 For oil-filled equipment, insulating oil shall comply with IEC 60296 specification.

5.4.1.3 For synthetic liquid-filled equipment refer to IEC 60867 specification.

5.4.1.4 The current transformer shall have a device for checking the liquid level. The device shall indicate whether the liquid level is within the operating range, during operation. This device shall be readable from the ground level.

5.4.1.5 The device shall be sealed to avoid any liquid loss. Liquid loss represents a danger of insulation contamination.

5.4.2 Requirements for gas filled in equipment

5.4.2.1 The manufacturer shall specify the type and the required quantity and quality in the equipment.

5.4.2.2 New SF6 (sulphur hexafluoride) gas shall comply with IEC 60376 specification.

5.4.2.3 The handling of SF6 gas shall be in accordance with clause 6.2 of SANS 61869-1 specification.

5.4.2.4 The maximum allowed moisture content within current transformers filled with gas at rated filling density for insulation shall be as per clause 6.2.2 of SANS 61869-1 specification.

5.4.2.5 Gas-insulated transformers having a minimum functional pressure above 0,2 MPa shall be provided with pressure or density monitoring device. Gas monitoring devices may be provided alone or together with the associated equipment.

5.4.2.6 All current transformers that use gas, other than air at atmospheric pressure, as an insulating medium shall conform to clause 6.2.4.2 of SANS 61869-1 specification.

5.4.2.7 The pressure relief valve shall be protected against any accidental damage.

5.4.2.8 For Gas Insulated Switchgear (GIS) current transformers refer to SANS 62271-204, Clause 5.105.

5.4.3 Requirements for solid materials used in equipment

5.4.3.1 Specifications for organic material used on current transformer (i.e. epoxy resin, polyurethane resin, epoxy-cycloaliphatic resin, composite material, etc.) shall conform to IEC 60455 series specifications.

5.4.3.2 For insulation guidance, IEC 61109 specification for outdoor insulation shall be used.

5.4.4 Requirements for temperature rise of parts and components

5.4.4.1 The temperature-rise of windings, magnetic circuits and any other parts of the current transformer shall not exceed the appropriate value given in SANS 61869-1 specification Table 5, when operating under the conditions specified on 4.0 of this specification.

5.4.4.2 The influence of altitude on temperature rise of the transformer shall be as per clause 6.4.2 of SANS 61869-1 specification.

5.4.5 Requirements for earthing of equipment

5.4.5.1 The frame of each equipment device, if intended to be earthed, shall be provided with a reliable earthing terminal for connection to an earthing conductor suitable for specified fault conditions. The connecting point shall be marked with the "earth" symbol, as indicated by symbol No 5019 of IEC 60417 specification.

5.4.5.2 The enclosure of current transformers for gas-insulated switchgear (GIS) shall be connected to earth. All metal parts which do not belong to a main or an auxiliary circuit shall be earthed.

5.4.5.3 The continuity of the earthing circuits shall be ensured.

5.4.5.4 For the interconnection of enclosures, frames, etc., fastening (e.g. bolting or welding) is acceptable for providing electrical continuity.

5.4.5.5 The tank or base of each current transformer shall be fitted with an earthing terminal suitable to accommodate a cable lug for a 95mm² copper conductor or copper busbar for the earthing of the current transformer.

5.4.6 Requirements for the external insulation

5.4.6.1 For outdoor instrument transformers with ceramic insulators susceptible to contamination, the creepage distances for given pollution levels shall conform to Table 6 of SANS 61869-1 specification.

5.4.6.2 The creepage distances shall also conform to IEC 60815 specification.

5.4.6.3 For installations at an altitude higher than 1000 m, the arcing distance under the standardised reference atmospheric conditions shall be determined by multiplying the withstand voltages required at the service location by a factor k in accordance with Figure 2 of SANS 61869-1 specification.

5.4.7 Mechanical requirements

These requirements apply only to current transformers having a highest voltage for equipment of 72,5 kV and above.

5.4.7.1 The current transformer shall be capable of withstanding static loads as per table 7 of SANS 61869-1 specification.

5.4.7.2 Provision shall be made that the current transformers can be bolted to the support structure.

5.4.8 Multiple chopped impulse on primary terminals

5.4.8.1 Chopped impulses shall be as per clause 7.4 of SANS 61869-1 specification.

5.4.9 Internal arc fault protection requirements

5.4.9.1 Internal arc fault test on all oil- immersed and gas-insulated free-standing current transformers having rated voltage ≥ 72,5 kV shall conducted and classed as per clause 6.9 of SANS 61869-1 specification.

5.4.10 Degrees of protection by enclosures

5.4.10.1 The degree of protection of all current transformers with the associated components shall be as per clause 6.10 of SANS 61869-1 specification; this shall be done in conjunction with SANS 60529 specification.

5.4.11 Electromagnetic Compatibility (EMC)

5.4.11.1 For current transformers that have rated voltage (*U*m) ≥ 123 kV, the Radio Interference Voltage (RIV) shall not exceed 2 500 µV at 1,1 *U*m 3 .

5.4.11.2 The current transformers that are containing active electronic components shall conform with the requirements of electromagnetic immunity as per clause 6.11 of SANS 61869-1 specification.

5.4.11.3 All current transformers that have rated voltage (*U*m) ≥ 72,5 kV shall have requirement for transmitted overvoltage's as stipulated in SANS 61869-1 specification.

5.4.12 Corrosion

5.4.12.1 Caution has to be taken against corrosion of the equipment during the service life.

5.4.12.2 All bolted or screwed parts of the main circuit and of the enclosure shall remain easy to demount.

5.4.12.3 Galvanic corrosion between materials in contact shall be considered because it can lead to the loss of tightness. All these parts shall be galvanized as per CEE 0183 specification.

5.4.13 Markings

All instrument transformers shall carry at least the following markings on a rating plate securely attached to the transformer:

a) The manufacturer's name or other mark by which he may be readily identified;

b) The year of manufacture and a serial number or a type designation, preferably both,

c) Rated frequency;

d) Highest voltage of equipment;

e) Rated insulation level;

f) Temperature category;

g) Mass in kg;

h) Class of mechanical requirements (for *U*m≥72kV).

i) Class of insulation if different from Class A;

j) All indications relative to the measuring characteristics;

k) Type of the insulating fluid;

l) Rated filling pressure;

m) Minimum functional pressure;

n) Insulating fluid volume (or mass) contained;

p) the corresponding terminals of each winding.

6.0 QUALITY ASSURANCE

6.1 The manufacturer shall ensure a manufacturing process that is compliant with specification SANS 9001.

7.0 DOCUMENTATION REQUIREMENTS

7.1 The manufacturer must provide one PDF file and two hard copies of the technical specification of the current transformer.

7.2 The manufacturer must provide one PDF file and two hard copies of the installation procedure, these includes connection diagram with terminal and polarity markings.

7.3 Drawings showing details of construction and outline dimensions of the currents transformers shall be submitted with the tender documents.

7.4 The manufacturer must provide type test certificates from a SANAS/international accredited laboratory to verify conformance to the requirements and these must be submitted with tender documents.

7.5 The manufacturer must complete and provide technical data sheet as per Appendix B.

8.0 GUARANTEE AND DEFECTS

8.1 The contractor shall guarantee the satisfactory operation of the current transformers supplied and accept liability for maker's defects, which may appear in design, materials and workmanship.

8.2 The guarantee period shall expire after: - A period of 12 months commencing on the date of energising of the current transformers

8.3 Any specific type of fault occurring three times within the guarantee period and which cannot be proven to be due to other faulty equipment not forming part of this contract, shall automatically be deemed an inherent defect. Such inherent defect shall be fully rectified to the satisfaction of the maintenance manager of the depot and at the cost of the Supplier.

8.4 If urgent repairs have to be carried out by Transnet Freight Rail's staff to maintain supply during the guarantee period the supplier shall inspect such repairs to ensure that the guarantee period is not affected and should they be covered by the guarantee, reimburse Transnet Freight Rail the cost of material and labour.

9.0 SUPPORT

9.1 The supplier shall provide support whenever is required, this can be in a form of telephone or email communications and also a site visit.

9.2 Training and support shall be provided by the supplier if required.

10.0 PACKAGING AND TRANSPORT

10.1 The package shall have handling instructions on it.

10.2 The tenderer shall provide transport for the delivery of the equipment to the site where required.

END

APPENDIX A

SCHEDULE OF REQUIREMENTS
(To be completed by client)

1.0 SYSTEM DETAIL

1.1 Current transformers required for: _____ substation/location.

1.2 Pollution level: Heavy_____ Very Heavy _____

1.3 Quantity of current transformers required. 2

1.4 Nominal phase to phase voltage for 3 phase system: _____ kV.

1.5 Nominal phase to neutral voltage for single phase systems: _____ kV.

1.6 Frequency: 50 Hz

2.0 DETAIL OF CURRENT TRANSFORMER.

MEASURING CURRENT TRANSFORMERS

2.1 Measuring current transformer required: Yes / No

2.2 Number of measuring cores required: _____

2.3 Transformer ratio: Primary _____ Ampere, Secondary _____ Ampere.

2.4 Rated primary current: _____ Ampere. Rated secondary current: _____ Ampere

2.5 Rated burden: _____ VA

2.6 Accuracy class: _____

PROTECTION CURRENT TRANSFORMERS

2.7 Protection current transformer required: Yes/No

2.8 Number of protection cores required: _____

2.9 Rated primary current: _____ Ampere. Rated secondary current: _____ Ampere

2.10 Accuracy class: _____

2.11 Accuracy limit factor: _____

2.12 Rated Burden: _____ VA

CLASS PX PROTECTION CURRENT TRANSFORMERS

2.13 Class PX protection required: Yes/No

2.14 Number of Class PX protection cores required:_____

2.15 Transformation ratio: Primary_____Ampere, Secondary_____Ampere.

2.16 Rated primary current: _____ Ampere. Rated secondary current: _____ Ampere.

2.17 Rated turns ratio: _____

2.18 Rated knee point e.m.f: _____V

2.19 Maximum secondary winding resistance: _____ Ohms at _____ ° C

END

APPENDIX B

TECHNICAL DATA SHEET
(To be completed by tenderer)

1.0 DESIGN DETAIL

1.1 Manufacturers name: _____

1.2 Highest voltage for equipment: _____ kV

1.3 Nominal r.m.s voltage: _____ kV

1.4 Rated insulation level: _____ kV

1.5 Rated frequency: _____ Hz

2.0 DETAIL OF CURRENT TRANSFORMERS.

MEASURING CURRENT TRANSFORMERS

2.1 Transformer ratio: _____

2.11 Rated primary current: _____ Ampere. Rated secondary current: _____ Ampere

2.12 Accuracy class: _____

2.13 Rated Burden: _____ VA

2.14 Rated short-time current: _____kA for _____ seconds

PROTECTION CURRENT TRANSFORMERS

2.15 Transformer ratio: _____

2.8 Rated primary current: _____ Ampere. Rated secondary current: _____ Ampere

2.16 Accuracy class: _____

2.17 Accuracy limit factor: _____

2.11 Rated Burden: _____ VA

2.12 Rated short-time current: _____kA for _____ seconds

CLASS PX PROTECTION CURRENT TRANSFORMERS

2.20 Rated primary current: _____ Ampere. Rated secondary current: _____ Ampere.

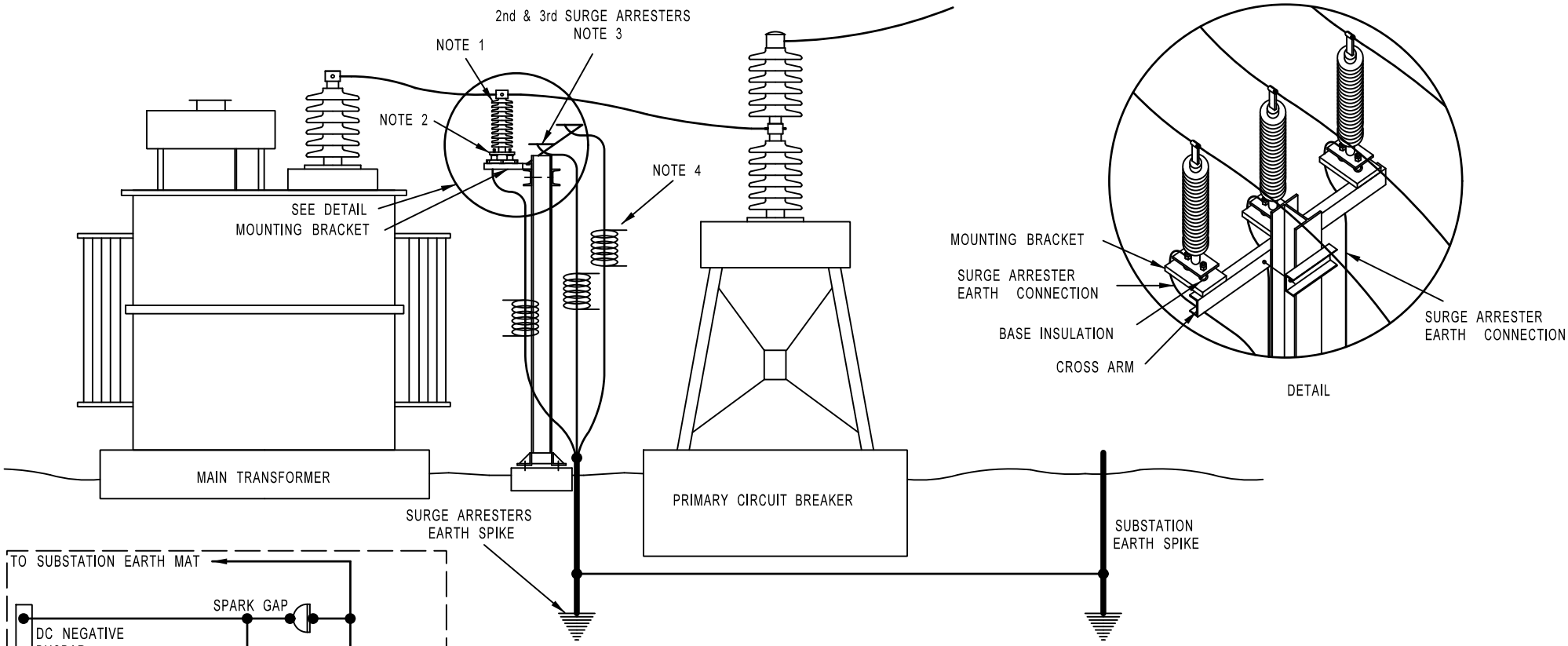
2.21 Rated turns ratio: _____

2.22 Rated knee point e.m.f: _____V

2.23 Maximum secondary winding resistance: _____ Ohms at _____ ° C

2.24 Rated short-time current: _____kA for _____ seconds

END



NOTES

1. 10kA POST MOUNTED TYPE SURGE ARRESTERS AS PER SPECIFICATION BBB0845.
2. THE SURGE ARRESTERS ARE MOUNTED ON THE CROSS ARM ON A MOUNTING BRACKET WITH BASE INSULATION AS PRESCRIBED BY SUPPLIERS OF SURGE ARRESTERS.
3. EACH SURGE ARRESTER SHALL BE INDIVIDUALLY CONNECTED TO THE EARTH SPIKE WHICH IS CONNECTED TO THE SUBSTATION EARTH. CABLING SHOULD BE AS SHORT AS POSSIBLE.
4. SURGE COUNTER IF REQUIRED.
5. THE SURGE ARRESTERS MOUNTED ON THE CROSS ARM SHALL BE OF THE POLYMER TYPE.
6. THE DISTANCE BETWEEN TRANSFORMER BUSHING AND THE INSTALLED SURGE ARRESTER SHALL NOT BE LESS THAN THE LENGTH OF THE SURGE ARRESTER.
7. FOR 3kV DC TRACTION SUBSTATION EARTHING ARRANGEMENT SEE DRG. NO. BBB3620.

DIMENSIONS : mm TOLERANCE : LIN± XX ANG± - MATERIAL : - VERSION INFO : DRAWING FRAME CHANGED	+ APPROVED	+ AUTHORISED	CONNECTION OF HIGH VOLTAGE SURGE ARRESTER INSTALLED ON CROSS ARM

SCALE : NTS
ITEM NO: -

TRANSNET freight rail

BBB0938
VERSION 9
A4

DO REF: CDO/ 7245 ECP REF: BBD8165 DRAWN: D HATTINGH DESIGNED: - CHECKED: H VAN VUUREN

SCHEDULE OF REQUIREMENTS
(To be completed by client)

1.0 SYSTEM DETAIL

1.1 AC Circuit Breakers: Boschmanskop substation/location.

1.2 Pollution level: Heavy _____ Very Heavy ✓

1.2 Quantity of AC Circuit Breakers. 1

1.1 Nominal phase to phase voltage for 3 phase system: 132 kV.

1.2 Nominal phase to neutral voltage for single phase systems: 72.21 kV.

1.3 Frequency: 50 Hz

1.4 Circuit breaker control DC voltage: 110 V

1.5 Circuit breakers to be used for the following:

- 3 kV DC Traction substations. ~~Yes~~/No
- Distribution substations. Yes/No
- 25 kV AC Traction substations. Yes/No
- 50 kV AC Traction substation. Yes/No

DETAIL OF AC CIRCUIT BREAKERS.

2.0 Type of circuit breakers required:

Vacuum: Yes / No

Gas (SF6): ~~Yes~~ / No _____

2.2 Number of circuit breakers required: 1

2.3 Number of poles: 3-phase

2.4 Rated Voltage: 132 kV

2.5 Rated short-circuit breaking current: 40kA/3s kA

2.6 Rated normal current: 3150 Ampere.

END

TRANSNET freight rail

TECHNOLOGY MANAGEMENT.

SPECIFICATION.

REQUIREMENTS FOR OUTDOOR ALTERNATING-CURRENT CIRCUIT BREAKERS FOR TRACTION AND DISTRIBUTION SUBSTATIONS

Author:	Chief Engineering Technician Technology Management	D.O.Schulz	.....
Approved:	Senior Engineer Technology Management	L.O.Borchard	.....
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Date: 21st September 2009

Circulation Restricted To:

Transnet Freight Rail – Chief Engineer Infrastructure
- Technology Management

INDEX

1.0 SCOPE

1.1 This specification covers Transnet freight rail requirements for the design, manufacture, testing and supply of outdoor Alternating Current (AC) circuit breakers in accordance to SANS 62271-100.

1.2 The alternating current circuit breakers shall be suitable rated for nominal phase to phase r.m.s voltages ranging from 22 kV to 220 kV.

2.0 STANDARDS, PUBLICATIONS AND DRAWINGS

2.1 Unless otherwise specified all materials and equipment supplied shall comply with the applicable and latest editions of SANS or Transnet freight rail publication.

2.2 The following publications are referred to in this specification:

2.2.1 SOUTH AFRICAN NATIONAL STANDARDS

SANS 121:	-	Hot-dip Galvanized coatings for fabricated iron or steel articles.
SANS 1431:	-	Weldable structural steels.
SANS 60529:	-	Degrees of protection provided by enclosures (IP code).
SANS 60694:	-	Common Specifications for high-voltage switchgear and controlgear standards.
SANS 60815	-	Guide for the selection of insulators in respect of polluted conditions
SANS 62271-100:	-	High Voltage Alternating Current Circuit Breakers.

2.2.2 TRANSNET FREIGHT RAIL SPECIFICATIONS.

CEE.0045:	Painting of Steel Components of Electrical Equipment.
CEE.0224:	Drawings, Catalogues, Instruction Manuals and Spares.

2.2.3 Occupational Health and Safety Act No 85 of 1993.

2.2.4 TRANSNET FREIGHT RAIL DRAWINGS

CEE-TBK-0027:	-	Control circuit diagram. No-volt coil protection.

2.3 Any items offered in accordance with other standards will be considered at the sole discretion of Transnet freight rail. The tenderer shall supply full details stating where the item differs from these specifications as well as supplying a copy (in English) of the recognised standard specification(s) with which it complies.

3.0 TENDERING PROCEDURE

3.1 Tenderers shall indicate clause-by-clause compliance with this specification as well as the relevant equipment specifications. This shall take the form of a separate document listing all the specifications clause numbers indicating on individual statement of compliance or non-compliance.

3.2 The tenderer shall motivate a statement of non-compliance.

3.3 Tenderers shall complete Appendix 2. " Information to be provided by tenderers".

3.4 Tenderers shall submit detailed technical literature of the current transformers offered together with drawings showing, general constructional details and principal dimensions.

3.5 Any items offered in accordance with other standards will be considered at the sole discretion of Transnet freight rail. The tenderer shall supply full details stating where the item differs from these specifications as well as supplying a copy (in English) of the recognised specification(s) with which it complies.

3.6 Failure to comply with clauses 3.1, 3.2, 3.3, 3.4 and 3.5 could preclude a tenderer from consideration.

4.0 APPENDICES

The following appendices form an integral part of this specification and shall be read in conjunction with it.

4.1 Appendix 1 -"Schedule of Requirements".

This appendix details the specific requirements for this application.

4.2 Appendix 2 - " Information to be provided by tenderers".

This appendix calls for specific technical information to be furnished by tenderers.

5.0 SERVICE CONDITIONS.

The current circuit breaker shall be designed to operate under the following conditions.

5.1 ATMOSPHERIC CONDITIONS

5.1.1	Altitude:	0 to 1800m above sea level.
	Ambient temperature:	-5°C to +45 °C.
	Relative humidity:	10% to 90%
	Lightning Conditions:	12 ground flashes per square kilometre per annum.
	Pollution:	Heavily salt laden or polluted with smoke from industrial sources.

5.2 ELECTRICAL CONDITIONS

5.2.1	Supply voltage:	The incoming AC voltage can vary ± 5% of the nominal system r.m.s voltage.
5.2.2	Frequency:	Frequency of the supply voltage is 50 ± 2.5 Hz.

6.0 REQUIREMENTS FOR ALTERNATING CURRENT CIRCUIT BREAKERS.

6.1 The AC circuit breakers shall be designed, manufactured and tested in accordance with the requirements of specifications SANS 62271-100 and SANS 60694.

6.2 The circuit breakers shall be of the outdoor type suitable for operation under the nominal phase to phase voltages or phase to neutral voltages specified in Appendix 1.

6.3 The insulating medium of the primary circuit breakers shall be SF6 gas or vacuum, depending on the supply voltage. (Refer to Appendix 1)

6.3.1 Vacuum circuit breakers may be used for voltages ranging from 22 kV up to 33 kV

6.4 The AC circuit breakers used on Transnet freight rail may the single, double or triple pole type.

6.4.1 Double or triple pole type circuit breakers shall be ganged operated.

6.5 The circuit breakers shall be rated at the highest r.m.s. voltage for equipment operating at the nominal system voltage specified in Appendix 1.

6.6 The minimum rupturing capacities for the respective voltages and current ratings for the circuit breakers shall be in accordance to the SANS 62271-100. The rated short–circuit breaking current shall be at least 20kA.

6.7 The circuit breakers shall be rated for a continuous current of at least 1250 Ampere

6.8 The circuit breakers shall have a first pole to clear factor of 1.5.

6.9 The circuit breakers shall have a making time not greater than 1 second.

6.10 The circuit breakers shall be capable of twice rupturing the specified fault current at the specified voltages, with a one minute interval between operations and then shall be in a condition to be closed and carry the rated current without it being necessary to inspect or make adjustments.

6.11 The circuit breaker shall be electrically operated from a nominal 110 Volt DC control voltage unless otherwise specified in Appendix 1.

6.12 It shall be possible to close the circuit breaker only when the control voltage is above 85% of the nominal voltage. The circuit breaker shall trip automatically when the control voltage falls below 70% of the nominal voltage.

6.13 The circuit breaker shall have a motor wound spring operating mechanism.

6.14 The operating mechanism shall be provided with shunt release for both opening and closing.

6.15 Pneumatic, hydraulic or gas control for tripping and closing the primary circuit breakers are not acceptable.

6.16 The operating mechanism shall be so designed so that the breaker may be closed manually from ground level by means of a suitable detachable handle.

6.17 The operating mechanism shall be constructed of non-ferrous material.

6.18 The operating springs shall recharge automatically after the completion of a closing operation.

6.19 The circuit breaker shall be of the trip-free type.

6.20 A visual mechanical indicating device shall be provided to indicate the state of the spring and shall be inscribed "Spring Charged" when the mechanism is in the condition to close the circuit breaker and "Spring Free" when it is in any other condition.

6.20.1 One pair of normally open and normally closed contacts shall be provided for the indication circuitry to the substation control panel for indication of the "Spring Charged" and "Spring Discharged" conditions.

6.21 Auxiliary contacts shall be provided for operation in conjunction with the protection and other auxiliary circuits specified. At least one spare pair of normally open and one spare pair of normally closed contacts shall be provided.

6.22 Circuit breaker control switches shall be provided on the circuit breaker mechanism. They shall return automatically to the neutral position when the handle is released after being turned to either the "close" or "trip" positions.

6.23 Local/Remote selector switches shall be provided on the circuit breaker mechanism and shall be of the two-position type. The switch shall have no "off" or "neutral" position.

6.23.1 Provision shall be made that when the circuit breaker is switched to the local position, the protection and trip circuitry to the circuit breaker shall not in any way be by-passed.

6.24 Mechanical operation shall be provided on the circuit breaker for any closing or trip release, which is normally electrically operated.

6.25 The circuit breaker shall be provided with a no volt coil with a mechanical latching mechanism, which will trip, lockout and inhibit the circuit breaker from closing when the no volt coil is de-energised. Refer to Transnet Freight Rail's drawing No. CEE-TBK-27 which forms part of this specification, for details of the control circuitry for the no volt protection.

6.25.1 The no volt coil circuitry with its associated mechanical latching mechanism shall operate separately from the trip coil circuitry.

6.26 A counter shall be provided on the circuit breaker to indicate the total number of operations of the breaker.

6.27 Tenderers shall advise the number of circuit breaker operations under full load and fault conditions, after which maintenance and/or measurement of contact wear is recommended.

6.28 The circuit breaker operating mechanism including its controls and relays shall be housed in a metal enclosure.

6.29 The enclosure housing shall be manufactured from stainless steel or hot dipped galvanised steel.

6.30 The coating of the enclosure if galvanised shall comply with the requirements of Transnet freight rail's specification CEE.0045.

6.31 The degree of protection of the enclosure shall be in accordance with SANS 60529 and shall be IP 55.

6.32 Provision shall be made for the enclosure to be pad-lockable.

6.33 The enclosure shall be provided with a gland plate for bottom entry of the control cables.

6.34 VACUUM CIRCUIT BREAKERS.

6.34.1 Vacuum switching devices shall be evacuated and sealed in accordance with the latest technology and accepted practice.

6.34.2 The pre striking and chopping current shall be kept below 5 amperes. Tenderers shall give full details regarding these characteristics.

6.34.3 Where vacuum circuit breakers are specified in Appendix 1 they shall be either of the motor wound spring operating mechanism or magnetic actuator operating mechanism type.

6. 35 SULPHUR HEXAFLOURIDE CIRCUIT BREAKERS. (SF6)

6.35.1 The SF6 circuit breaker shall be fitted with a pressure gauge/densiometer to monitor the gas pressure.

6.35.2 The pressure gauge/densiometer circuit shall be provided with a minimum of two sets of contacts for alarm and indication for the substation's annunciator or flag circuit.

6.35.3 The supplier shall wire the SF6 circuit breaker local control circuit, such that in the event of a gas leakage or drop in gas pressure, the SF6 circuit breaker will trip and lockout.

6.35.4 A set of normally closed contacts shall be provided in the circuit breaker mechanism control box for the low gas trip circuitry.

6.35.5 The SF6 circuit breaker shall trip and lockout before the minimum safe SF6 gas pressure is reached.

6.35.6 In terms of the Occupational Health and Safety Act No 85 of 1993. Code 1704 (pressure vessels) the successful tenderer shall furnish a certificate of manufacture complying with the terms of the Act for the circuit breakers.

6.36 INSULATION LEVELS, CREEPAGE DISTANCES AND CLEARANCES

6.36.1 INSULATION LEVELS

The rated insulation levels of the AC circuit breakers shall comply with the requirements specified in Table 1.

6.36.1.1 Table 1 lists the nominal system voltages present on Transnet freight rail and the required insulation levels as specified in accordance with SANS 1019.

Highest phase-to-phase r.m.s voltage for equipment. (Um)	Nominal system phase-to-phase r.m.s. voltage	Rated lightning impulse withstand voltage peak.	Rated short duration power- frequency withstand r.m.s voltage.
24 kV	22 kV	150kV	50 kV
36 kV	33 kV	200 kV	70 kV
52 kV	44 kV	250 kV	95 kV
72,5 kV	66 kV	350 kV	140 kV
100 kV	88kV	380 kV 450 kV	150 kV 185 kV
145 kV	132 kV	550 kV 650kV	230 kV 275 kV
245 kV	220 kV	850 kV 950 kV	360 kV 395 kV
Insulation levels for highest voltage for equipment U_m < 100 kV are based on an earth fault factor equal to $\sqrt{3}$ and for U_m > 100 kV an earth fault factor equal to $0,8\sqrt{3}$. Where more than one insulation level is given per voltage system, the higher level is appropriate for equipment where the earth fault factor is greater than 1,4			

TABLE 1: Standard Voltages and insulation levels in accordance with SANS 1019:2008 [1]

6.36.1.2. For the 25 kV and 50kV single phase ac traction systems the ac high voltage circuit breakers shall be designed to the following nominal system phase to phase r.m.s voltages and withstand insulation levels:

- For the 25 kV (phase to earth) ac traction systems the ac high voltage circuit breakers current transformer shall be rated for a nominal system phase to phase r.m.s voltage of at least 44 kV and designed to withstand the required insulation level for that nominal system voltage.
- For the 50 kV (phase to earth) ac traction systems the ac high voltage circuit breakers shall be rated for a nominal system phase to phase r.m.s voltage of at least 88 kV and designed to withstand the required insulation level for that nominal system voltage.

6.36.2 CREEPAGE DISTANCES

6.36.2.1 The standard creepage distance between phase and earth shall be in accordance with table ii of SANS 60815.

6.36.2.2 For coastal areas and very heavy polluted inland areas the standard creepage distance shall be the very heavy polluted level, i.e. 31mm/kV of the highest r.m.s phase to phase voltage U_m for equipment.

6.36.2.3 For inland areas the standard creepage distance shall be the heavy polluted level, i.e. 25mm/kV of the highest r.m.s phase to phase voltage U_m for equipment.

6.36.3 CLEARANCES

6.36.3.1 The following minimum safety outdoor earth clearances shall be maintained between any live conductor or metal and earthed metal: -

Highest phase to phase r.m.s voltage for equipment.	24kV	36kV	48kV	72kV	100kV	145kV	245kV
Outdoor distance	320mm	430mm	540mm	770mm	1000mm	1450mm	1850mm

6.36.3.2 The following minimum safety clearances shall be maintained between any live conductor or metal and ground surface level: -

Highest phase to phase r.m.s voltage for equipment.	24kV	36kV	48kV	72.5kV	100kV	145kV	245kV
Nominal phase to phase r.m.s system voltage	22kV	33kV	44kV	66kV	88Kv	132kV	220kV
Within security fence. (Restricted access way)	2820mm	2930mm	3040mm	3270mm	3500mm	3950mm	4350mm
Outside security fence but within Transnet freight rail's reserve	5200mm	5300mm	5400mm	5700mm	5900mm	6300mm	6700mm
Outside Transnet freight rail's reserve	5500mm	5500mm	5500mm	5700mm	5900mm	6300mm	6700mm

6.37 SUPPORT STEELWORK.

6.37.1 The circuit breaker shall be provided with its own support steelwork, which shall be hot- dip galvanised in accordance with specification SANS 121 and shall comply to requirements of SANS 1431: for weldable structural steels.

6.37.2 Support steelwork exposed to a high pollution/corrosive atmosphere shall be painted in accordance with specification CEE.0045.

7.0 SPECIAL TOOLS, SERVICING AIDS AND MANUALS AND SPARES LISTS.

7.1 The tenderers shall submit a separate offer for special tools and servicing aids necessary for the servicing and maintenance of SF6 circuit breakers.

7.2 Three copies of instruction/maintenance manuals, spares list's and wiring diagrams of the circuit breakers in accordance with Transnet freight rail's specification CEE.0224. shall be supplied upon delivery.

8.0 TRAINING.

8.1 The tenderer shall submit details with the tender of the training courses, which will be conducted by the supplier for the training of Transnet freight rail maintenance staff in the operation and maintenance of the circuit breaker. The courses shall include theoretical as well as practical tuition. The date and venue of this training course shall be arranged with the maintenance manager of the depot. The cost of the training shall be quoted for separately.

9.0 TEST CERTIFICATES.

9.1 The manufacture shall make available type test certificates for the equipment (as specified in SANS 62271-100 when required. Routine test certificates shall be supplied with each circuit breaker.

10.0 GUARANTEE AND DEFECTS.

10.1 The contractor shall guarantee the satisfactory operation of the circuit breaker supplied and accept liability for maker's defects, which may appear in design, materials and workmanship.

10.2 The guarantee period shall expire after: -

A period of 12 months commencing on the date of energising of the circuit breaker.

10.3 Any specific type of fault occurring three times within the guarantee period and which cannot be proven to be due to other faulty equipment not forming part of this contract, shall automatically be deemed an inherent defect. Such inherent defect shall be fully rectified to the satisfaction of the maintenance manager of the depot and at the cost of the Supplier.If urgent repairs have to be carried out by Transnet freight rail staff to maintain supply during the guarantee period the supplier shall inspect such repairs to ensure that the guarantee period is not affected and should they be covered by the guarantee, reimburse Transnet freight rail the cost of material and labour.

11.0 INSPECTION.

11.1 Transnet freight rail reserves the right to carry out inspection and any tests on the equipment at the works of the supplier/ manufacture.

11.2 Arrangements must be made timeously for such inspections to be carried out before delivery of the equipment to the client.

12.0 PACKAGING AND TRANSPORT.

12.1 The tenderer shall ensure that the equipment be packed in such a manner that it will be protected during handling and transport.

12.2 The tenderer shall provide transport for the delivery of the equipment to the site where required.

13.0 BIBLIOGRAPHY

[1] SANS 1019: 2008. Edition 2.5

END

SCHEDULE OF REQUIREMENTS
(To be completed by client)

1.0 SYSTEM DETAIL

1.1 AC Circuit Breakers: _____ substation/location.

1.2 Pollution level: Heavy_____ Very Heavy _____

1.2 Quantity of AC Circuit Breakers. _____

1.1 Nominal phase to phase voltage for 3 phase system: _____ kV.

1.2 Nominal phase to neutral voltage for single phase systems: _____ kV.

1.3 Frequency: _____ Hz

1.4 Circuit breaker control DC voltage: _____ V

1.5 Circuit breakers to be used for the following:

- 3 kV DC Traction substations. Yes/No
- Distribution substations. Yes/No
- 25 kV AC Traction substations. Yes/No
- 50 kV AC Traction substation. Yes/No

DETAIL OF AC CIRCUIT BREAKERS.

2.0 Type of circuit breakers required:

Vacuum: Yes / No

Gas (SF6): Yes / No _____

2.2 Number of circuit breakers required: _____

2.3 Number of poles: _____

2.4 Rated Voltage: _____ kV

2.5 Rated short-circuit breaking current: _____kA

2.6 Rated normal current: _____ Ampere.

END

TECHNICAL DATA SHEET
(To be completed by tenderer)

DETAIL OF CIRCUIT BREAKER

1.1 Make and manufacturer _____

1.2 Rated Voltage _____ kV.
(Highest rated voltage for equipment)

1.3 Rated Insulation level _____ kV.
(Rated lightning withstand Voltage)

1.4 Number of Poles: _____

1.6 Rated short circuit breaking current _____ kA.

1.7 Rated normal current: _____ Ampere.

1.6 Breaker operating time:

1.6.1 Closing: _____ ms.

1.6.2 Opening: _____ ms.

1.7 Number of operations after which breaker contact maintenance / measurement is required:

1.7.1 Under full load conditions_____

1.7.2 Under fault conditions _____

1.8 First Pole to Clear Factor_____

1.9 DC control voltage: _____ V

A Division of Transnet SOC Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

300 VOLT GAS ARRESTER SPARK GAP FOR TRACTION POWER SUPPLIES

Author:	Engineer Technology Management	K L Rendall	
Approved:	Senior Engineer Technology Management	T Chetty	
Authorised:	Principal Engineer Technology Management	K Motupa	

Date: 22 06 2023

Circulation Restricted To:

Transnet and Relevant Third Parties

LIST OF AMENDMENTS TO THE SPECIFICATION

Version No.	Date Issued	Clause No.	Page No.	Remarks
4	May 2021			Updated to new specification document format.
		2	4	Definition and background sections merged to form new background section.
		4.1	4	Lightning conditions updated and pollution conditions added.
		5	4&5	Technical requirements are divided into electrical and mechanical requirement subsections.
		5.1.1	5	Inserted gas arrester measurement.
		7	5	Section added
		8	5	Section updated
		9	6	Section added
		10	6	Method of tendering has been updated.

TABLE OF CONTENTS

1.0 SCOPE

1.1 This specification details Transnet's requirements for the manufacturing and supply of the 300 Volt (V) gas arrestor spark gap for use in traction power supply system.

1.2 This specification contains technical datasheet (Annexure A) which must be completed by the tenderer and must be submitted as part of the tender documents.

2.0 BACKGROUND

The spark gaps assemblies are used to limit voltages between the earthing system and the traction negative return system i.e., to limit contact voltages for the protection and safety of the staff and the public.

Spark gaps are used at substations, bridges, station platforms sidings, switching structures, H-masts, etc. The spark gap assembly is a voltage limiting device which consists of a gas arrestor and is contained in a housing according to Transnet drawing BBB 0906.

3.0 NORMATIVE REFERENCES

Unless otherwise specified all materials used, equipment developed and supplied shall comply with the latest edition of the relevant South African National Standards (SANS) or Transnet publications.

3.1 SANS STANDARDS:

3.1.1 SANS 9001 : Quality management systems — Requirements.

3.1.2 SANS 60479-1 : Effects of current on human beings and livestock

3.2 TRANSNET PUBLICATION:

3.2.1 BBB 0906 : Spark Gap Assembly Gas Filled Arrester.

3.3 IEEE PUBLICATION:

3.3.1 Std 80 : IEEE Guide for Safety in AC Substation Grounding

4.0 SERVICE CONDITIONS

4.1 ENVIRONMENTAL CONDITIONS

Altitude:	0 - 1800 m above sea level
Relative humidity:	10% to 90%
Ambient temperature:	-10° C to +55° C
Wind pressure:	750 Pa
Lightning conditions:	20 ground flashes/km2 per annum
Pollution:	Heavily salt laden with industrial pollutants including diesel- electric locomotive emissions.

5.0 TECHNICAL REQUIREMENTS

The technical requirements stated in this document are for the completely assembled spark gap unit, which includes each of the components listed in BBB 0906.

5.1 Electrical Requirements

5.1.1 The spark gap shall be fitted with a gas arrester with a diameter of below 25 mm and length of 16 mm.

5.1.2 The gas arrester device shall be of the type that returns to its initial state after discharging the impulse current in case of over voltages due to lightning effects.

5.1.3 The gas arrester shall comply with the following parameters:

5.1.3.1. U_{ac} – Rating of the gas arrestor: 300 V. (Refer to BBH6355 for the calculation)

5.1.3.2. AC-spark over voltage – 50 Hz voltage ramp: 255 V ≤ U_{ac} ≤ 345 V. (15% tolerance)

5.1.3.3. Impulse spark over voltage 1.2/50 µs Impulse voltage: ≤ 1000 V.

5.1.3.4. Impulse current without welding: 0.5 to 5 kA (10/350 µs).

5.1.3.5. Impulse current without mechanical failure: 20 kA (10/350 µs).

5.1.3.6. Short circuit current: 14 kA to 28 kA (peak) 50 Hz: t > 30 ms.

5.1.4 In the event of failure, the gas arrestor shall fail to short circuit mode.

5.2 Mechanical Requirements

5.2.1 The spark gap housing shall be manufactured in accordance to drawing No. BBB 0906 and its associated drawings.

5.2.2 The spark gap shall be assembled with the gas arrester installed according to the drawing BBB 0906.

5.2.3 The complete assembled spark gap shall be torqued to a value of 60 Nm to ensure sufficient surface contact between the gas arrester and spark gap housing.

6.0 TESTING AND INSPECTIONS

6.1 Transnet reserves the right to be present at all tests and inspections as called for in this specification. The gas arrester shall be subjected to tests as per the standards specified, to verify that its performance is in accordance with the specifications.

6.2 A pre-production sample shall be tested in accordance with this specification at the manufacturer's facility.

6.3 The responsibility of arranging the tests called for in this clause rests with the successful tenderer.

6.4 A Transnet Freight Rail, Technology Management (Electrical Technology) department representative may request any additional test deemed necessary to ensure compliance.

6.5 The issuing of acceptance certificates will be authorised by the Quality Assurance section of Transnet.

6.6 Tests shall be carried out on the gas arresters to verify the spark over voltage rating. (All gas arresters in the complete unit must be tested to ensure the breakover voltage is correct)

7.0 DOCUMENTATION REQUIREMENTS

7.1 The following technical documentation shall be submitted with tender:

7.1.1 One hard copy of the technical specification/detailed drawing.

7.1.2 One hard copy of detailed drawing.

7.1.3 One hard copy of method of installation.

7.1.4 One hard copy of the maintenance manual.

7.1.5 One hard copy of design and type test certificates shall be provided for the spark gab assembly to show compliance to clause 5.1.2, 5.1.3 and 5.1.4 of this specification.

7.2 Supplier shall advise how to proceed with the equipment at the end of its operating life, taking into consideration environmental requirements and regulations.

8.0 QUALITY ASSURANCE

8.1 The successful tenderer shall maintain a Quality Management System (QMS) based on or certified to SANS 9001.

9.0 GUARANTEE AND DEFECTS

9.1 The appointed tenderer shall guarantee that the supplied spark gap conforms to Transnet's requirements.

9.2 The appointed tenderer shall accept liability for makers' defects, which may appear in design, material and workmanship.

9.3 The appointed tenderer shall provide all information regarding guarantees and warranties in writing.

END

10.0 ANNEXURE A: TECHNICAL DATA SHEET

(To be completed by the tenderers and submitted as part of their tender)

10.1	**TENDER INFORMATION**	
10.1.1	Tenderer	
10.1.2	Tender No.	
10.1.3	Date	
10.2	**ELECTRICAL INFORMATION**	
10.2.1	Gas arrester diameter	
10.2.2		
10.2.3	Uac – Rating of the gas arrestor	
10.2.4	AC-spark over voltage	
10.2.5	Impulse spark over voltage	
10.2.6	Impulse current without welding	
10.2.7	Impulse current without mechanical failure	
10.2.8	Short circuit current	

TRANSNET freight rail

TECHNOLOGY MANAGEMENT.

SPECIFICATION.

REQUIREMENTS FOR BATTERY CHARGERS FOR 3kV DC TRACTION SUBSTATIONS.

Author:	Chief Engineering Technician Technology Management	D.O.Schulz	.....
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Date: 21st September 2009

Circulation Restricted To:

Transnet Freight Rail – Chief Engineer Infrastructure
- Technology Management

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1.0 SCOPE.

1.1 This specification covers the requirements for the design, manufacture and supply of battery charger units used in 3 kV DC traction substations.

2.0 GENERAL.

2.1 The equipment is required to charge a 53 cell lead acid 3 kV DC substation or tie station battery bank. The ampere-hour rating of the battery bank may vary between 100 to 250 ampere hours. The charger must be able to supply the substation or tie station load as well as float charge the battery under normal conditions.

2.2 The battery could be subjected to momentary heavy discharges from 50 amperes to 250 amperes for a period of 1 to 3 seconds. The discharge current is for the closing coils of the 3 kV DC high-speed circuit breakers. The discharge current is dependent of the model of the circuit breaker used.

2.3 In addition to charging the battery bank the charger must supply a constant voltage to the high-speed circuit breaker's holding coils. As the trip calibration of the high-speed circuit breakers is dependent on the holding coil voltage, the voltage must be maintained at 110 volts by means of a suitably tapped diode string or other means. In the event of failure of the battery charger, the diode string shall be automatically short-circuited and the holding coils of the track breakers shall be fed directly from the battery.

3.0 STANDARDS.

The following latest editions of the following publications are referred to herein.

3.1 SOUTH AFRICAN NATIONAL STANDARDS

SANS 1091:	National colours standards for paint.
SANS 1274:	Coatings applied by the powder-coating process.
SANS 1652:	Battery chargers – Industrial type

3.2 TRANSNET FREIGHT RAIL.

BBB0041:	Preparation of drawings for Transnet Freight Rail infrastructure.
CEE.0045:	Painting of steel components of electrical equipment.
CEE.0224:	Drawings, catalogues, instruction manuals and spares lists for electrical equipment supplied under contract.

4.0 DEFINITIONS

4.1 BOOST CHARGE: A partial charge, generally at a high rate, for a short period. It is also known as a fast charge or a quick charge.

4.2 FLOAT CHARGE: A constant voltage charge ideally sufficient to maintain a cell or battery in a fully charged state.

4.3 EQUALISING CHARGE: An extended charge applied to correct relative density imbalance amongst the cells of a battery.

4.4 INITIAL CHARGE: An increased charge for new or uncharged battery cells.

5.0 TENDERING PROCEDURE

5.1 Tenderers shall indicate clause by clause compliance with the specification. This shall take the form of a separate document listing all the specifications clause numbers indicating the individual statement of compliance or non-compliance.

5.2 A statement of non-compliance shall be motivated by the tenderer.

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

5.4 Failure to comply with clauses 4.1, 4.2, and 4.3 could preclude a tender from consideration.

6.0 SERVICE CONDITIONS.

The battery charger shall be designed to operate under the following service conditions.

6.1	Altitude:	0 – 1800 meters above sea level.
6.2	Ambient Temperature Range:	-10°C to +45°C.
6.3	Relative Humidity:	10% to 90%
6.4	Lightning Conditions:	12 Ground flashes per square kilometre per annum.

7.0 ELECTRICAL REQUIREMENTS

7.1 INPUT VOLTAGE.

7.1.2 The charger must be capable of working off an auxiliary supply with a poor waveform, as a result of thyristor controlled locomotives, line switching and lightning induced surges. A total harmonic voltage distortion figure of 27% must be catered for.

7.1.3 Appendix 1 shows the Quality of Supply characteristics of a typical 230 Volt AC auxiliary supply of a 3 kV DC traction substation.

7.1.4 The battery charger output shall be fitted with low pass filtering to reduce the effect of harmonic frequencies and ripple on the battery and load circuits.

7.2 The following input supplies are available at the 3 kV DC traction substations.

1. Single phase 230 volts AC ± 10% (r.m.s)
2. Three phase 400 volts AC ± 10% (r.m.s)
3. Frequency 50Hz ± 2Hz.

7.3 OUTPUTS.

7.3.1 The charger must be capable of driving varying loads and be unaffected by sudden changes in load current and transients generated by the load.

7.3.2 With no battery connected to the output, the charger must be capable of withstanding a short-circuit across its terminals, without any resultant component damage.

7.3.3 The conductors of the battery charger output must be rated to carry the maximum load current continuously. For a 100 ampere hour battery bank, 35 milli meter square conductors are recommended to make provision for short circuit ratings.

7.3.4 Upon switch on, the charger must incorporate a soft start feature, so that at no time either the DC output current or voltage exceeds their full load values.

7.3.5 The charger outputs shall be voltage and current limited for "float" and "boost" charging.

7.4 OUTPUT PARAMETERS.

The following parameters shall be complied with:

7.4.1 SYSTEM DC VOLTAGE.

7.4.1.1 The nominal voltage shall be 110 volts.

7.4.1.2 The charging battery voltage shall be 110volts to 119.25volts for the automatic mode. (2.25volts per cell).

7.4.1.3 The charging battery voltage shall be 110 volts to 127.2 volts for the boost mode. (2.35 volts to 2.40 volts per cell)

7.4.2 TOTAL CURRENT

7.4.2.1 The output current shall be 30 ampere (current limit in the automatic mode)

7.4.2.2 The current shall be 5 ampere to 25 ampere in the boost mode.

7.4.3 LINE REGULATION

7.4.3.1 The line regulation shall be a maximum of 0.75% when the input varies ± 10%.

7.4.4 RIPPLE VOLTAGE

7.4.4.1 For all output current up to 100% battery charger capacity into a resistive load:
The maximum peak to peak ripple voltage at the charger output terminals (with resistive load coupled to the output terminals instead of the battery) shall not exceed 5% of the nominal battery voltage.

7.4.4.2 The peak to peak ripple voltage shall be measured at nominal input voltage.

7.4 .5 RIPPLE CURRENT

7.4.5.1 The maximum peak to peak ripple (AC) voltage measured across the shunt for the total current shall not exceed 5% of the nominal battery voltage.

7.4.5.2 The peak to peak ripple current shall be measured at nominal input voltage.

7.4.5.3 The maximum superimposed r.m.s value of the AC component shall always have a positive value even if it is very small i.e. 100 milli ampere. The AC ripple shall be limited to 5% of the ampere hour rating capacity expressed in amps for example 5 ampere or less for a 100 ampere hour battery bank.

7.4.5.4 The battery charger shall meet the requirement that the charging current never becomes negative (discharge) in value.

7.4.6 DC OUTPUT CHARGE VOLTAGE

7.4.6.1 The DC output voltage must remain within ± 1% of the respective value for boost and float modes and within 5% for initial charge mode.

7.4.7 FLOAT MODE

7.4.7.1 The output voltage shall be pre-set at 2,25 volts per cell but adjustable by ± 5%. For 53 cells the float voltage shall be 119,25 volts adjustable. The values shall be within 1% in the automatic mode.

7.4.8 BOOST MODE

7.4.8.1 The output voltage shall be pre-set at between 2,35 volts to 2,40 volt – 5% per cell, adjustable. For 53 cells the boost voltage shall be set at 124,55 volts. (2,35 volts per cell) to 127.2 volts (2.40 volts per cell). The boost voltage shall remain within 1% of the required boost voltage. In automatic operational mode the battery charger shall revert back to float charge mode when the boost charge cycle is completed.

7.4.9 MANUAL BOOST MODE

7.4.9.1 A push button is required to switch the charger to "boost mode" manually. The battery charger shall revert back to float charge mode when the boost charge cycle is completed i.e. when the set boost voltage is reached. (124.55 volts to 127.2 volts). An additional push button shall be provided to be able to cancel the boost mode when required.
An adjustable 0-4 hour timer shall be installed to automatically switch off the manual boost in the event of the manual boost mode not being switched off by the technical staff.
After the boost mode has being switched off, the charger shall remain in the trickle charge mode for a period of not less 30 minutes before changing back to automatic boost mode if the battery voltage has not reached the required float voltage.

7.4.10. AUTOMATIC BOOST CHARGE.

7.4.10.1 The battery charger shall initiate an automatic boost charge every 28 days to ensure maximum life and reliability of the battery. The battery charger shall revert back to float charge when the battery is fully charged.

7.4.11 CURRENT LIMITING

7.4.11.1 Current limiting is required for the battery charger current. In float and boost modes these limits must be downward adjustable by 25% of the maximum values.
The charger shall control limits within ± 5% of the adjustable value.

7.5 EFFICIENCY

7.5.1 The efficiency shall not be less than 60% for single phase chargers at maximum charger output capacity.

7.5.2 The efficiency shall not be less than 70% for three phase chargers at maximum charger output capacity.

7.6 INPUT TRANSFORMER.

7.6.1 The main power transformer shall incorporate an electrostatic screen between the primary and secondary windings. The screen shall be connected to the frame.

7.7 ELECTRONIC CIRCUITRY.

7.7.1 PRINTED CIRCUIT BOARDS

Printed circuit boards shall comply with the following requirements in accordance to SANS 1652:

7.7.1.1 They shall be made of material similar to epoxy fibreglass laminate or better.

7.7.1.2 They shall be suitably protected from the effects of moisture and dust.

7.7.1.3 They shall be marked to allow the board type, and each individual component to be readily identified.

7.7.1.4 Printed circuit boards shall be provided with rigid and positive support and shall be easily replaceable.

7.7.1.5 The plug-in-boards shall be polarised to prevent the plug-in-boards being plugged into a wrong socket or being inserted upside down.

7.8 CONTROL AND ALARM SETTINGS.

The battery charger shall be fitted with the following alarms and alarm relays:

7.8.1 Charger low voltage alarm between 90 volts and 105 volts adjustable. Relay to be fitted for flag operation when relay is de-energised.

7.8.2 Charger high volt alarm. (Float). This alarm is pre-set just above normal float voltage. This alarm allows boost charging while providing protection against overcharging. Relay to be fitted. (127.2 volts).

7.8.3 Charger high volt alarm. (Boost). This alarm level is pre-set just above normal boost volts. When the normal boost voltage is exceeded the boost mode shall be terminated and a high volt alarm and relay contacts shall be initiated.

7.8.4 Battery charger input voltage mains failure relay and contacts.

7.9 ILLUMINATED INDICATORS.

7.9.1 Only Light Emitting Diodes (LED's) are to be used.

7.9.2 The following colours for the LED's shall be used:

Green: Normal condition. Mains on.
Red: Fault condition. Battery voltage low, high volts etc.
Amber: To indicate a specific status e.g. Boost charge, Initial charge.

7.10 METERS.

7.10.1 VOLTMETER

7.10.1.1 The digital Voltmeter shall be able to measure between 80 volts to 150 volts. The display shall be 3.5 digits, 12 milli meters high with an accuracy of ± 0.5%.

7.10.1.2 The digital Voltmeter shall be connected so that it can measure both the battery voltage and the high speed circuit breaker holding coil voltage. A high quality two-way selector switch shall be employed and mounted on the face of the battery charger.

7.10.2 AMMETER

7.10.2.1 The digital ammeter shall be 3.5 digits, 12 milli meters high with an accuracy of ± 0.5%, class 0.5. The ammeter shall measure shall measure the total charger current by means shunt sensing.

7.10.2.2 The ammeter shall be connected so that it can measure total current and battery charging current. A high quality two-way selector switch shall be employed and mounted on the face of the battery charger.

7.10.2.3 The markings for both voltage and current positions shall be by means of labels, which are riveted or screwed to the face of the panel.

7.10.2.4 Both Voltmeters and ammeters shall be protected against transients and surges. Suitable protection circuitry such as metal oxide varistors and resistance capacitance circuits shall be fitted to the input leads of the meter.

7.11 LIGHTNING AND SURGE PROTECTION

7.11.1 The equipment shall be fitted with surge and lightning protection on the input AC supply to the charger. The supplier shall provide circuitry or protection units for this purpose. Separate external modules are acceptable for protection. The protection circuitry shall consist of a combination of resistors, capacitors, metal oxide varistors and gas arresters. Dehnventile type or equivalent protection will be preferred.

7.12 HIGH SPEED CIRCUIT BREAKER SERIES DROPPING DIODES.

7.12.1 A regulated supply is required for the high speed circuit breaker holding coils. Suitably rated series dropping diodes shall be employed for this purpose. Refer to clause 2.3.

7.12.2 The charger shall be supplied with a suitably rated series diode dropping chain for the high-speed circuit breakers holding coils. The series diode dropping chain shall be able to be bridged out by means of electrical contactors for regulation purposes as required.

7.12.3 The charger shall be provided with a minimum of three output terminals namely, battery positive, holding coil positive and battery negative.

8.0 CONSTRUCTURAL REQUIREMENTS

8.1 The battery charger shall be a self-contained unit housed in a rigidly constructed sheet metal cubicle, suitable for floor or wall mounting.

8.2 The inside and outside of the cubicle shall be powder coated in accordance with SANS 1274. The coating shall be type 4 for corrosion-resistant coatings for interior use using thermosetting type high gloss coatings. The exterior finishing colour shall be Eau-de-Nil to SANS 1091 colour No H 43 and the interior high gloss white.

8.3 The cubicle shall be adequately ventilated to prevent overheating of the electrical equipment and be vermin-proof. Natural cooling shall be used. The use of cooling fans is not permissible.

8.4 The design and arrangement of the cubicle and equipment shall provide ease of inspection and maintenance.

8.5 The cubicle shall be provided with an earthing terminal welded to the frame to facilitate the connection of a 95mm ^{2} earthing cable using a M12 lug.

8.6 Provision shall be made for suitable cable or conduit entry for the incoming AC supply and DC output supplies.

8.7 The wiring shall be executed in a neat and orderly fashion and shall consist of PVC insulated stranded copper conductors to ensure flexibility and mechanical strength and be suitably rated for the current carrying capacity of the circuits.

8.8 The wiring shall be provided with identification tags at terminals and shall be marked in accordance with the wiring diagrams.

8.9 The control switches, m.c.b's etc mounted on the panel shall be suitably labelled to clearly indicate their function. The lettering of the labels shall consist of white lettering on a black background.

8.10 The labels shall be permanently fixed with screws, rivets or other approved method.

9.0 INSPECTION AND TESTING.

9.1 Transnet Freight Rail reserves the right to carry out inspection and any tests on the equipment at the works of the supplier/ manufacture.

9.2 Arrangements must be made timeously for such inspections to be carried out before delivery of the equipment to the client.

10.0 DRAWINGS, INSTRUCTION MANUALS AND SPARES LISTS

10.1 Drawings, instruction manuals and spare parts catalogues shall be supplied in accordance with Transnet Freight Rail's specification CEE.0224.

10.2 The preparation of the drawings shall comply with Transnet Freight Rail's specification BBB0041

10.3 The tenderer shall supply three copies of instruction/maintenance manuals, schematic diagrams, diode application notes and protection and filter ratings.

10.4 The contractor shall submit details of spares required in accordance with specification No. CEE.0224.

10.5 All spares recommended for normal maintenance purposes that are not available locally (requires importation) must be highlighted.

11.0 SPECIAL TOOLS AND/OR SERVICING AIDS

11.1 Special tools or servicing aids necessary for the efficient maintenance, repair or calibration of the equipment shall be quoted for separately.

11.2 Tenderers shall submit detailed offers for special tools and servicing aids including all specialised equipment required for the servicing and maintenance of the equipment supplied.

12.0 TRAINING

12.1 The tenderer shall submit details with the tender of the training courses, which will be conducted by the contractor for the training of Transnet Freight Rail's maintenance staff in the operation and maintenance of the equipment supplied. The courses shall include theoretical as well as practical tuition. The date and venue of this training course shall be arranged with the maintenance manager.

13.0 GUARANTEE AND DEFECTS

13.1 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 design, materials and workmanship.

13.2 The guarantee period for all substations shall expire after: -

A period of 12 months commencing on the date of completion of the contract or the date the equipment is handed over to Transnet Freight Rail whichever is the later.

13.3 Any specific type of fault occurring three times within the guarantee period and which cannot be proven to be due to other faulty equipment not forming part of this contract e.g., faulty locomotive or overhead track equipment, etc., shall automatically be deemed an inherent defect. Such inherent defect shall be fully rectified to the satisfaction of the Maintenance manager and at the cost of the Contractor.

13.4 If urgent repairs have to be carried out by Transnet Freight Rail's staff to maintain supply during the guarantee period the contractor shall inspect such repairs to ensure that the guarantee period is not affected and should they be covered by the guarantee, reimburse Transnet Freight Rail the cost of material and labour

END

APPENDIX 1

QUALITY OF SUPPLY CHARACTERISTICS OF A TYPICAL 230 VOLT AC AUXILIARY SUPPLY'S OF A 3 KV DC TRACTION SUBSTATION.

1. 230 VOLT AC AUXILIARY SUPPLY SERVICE CONDITION

1.1 The auxiliary supply is derived from the tertiary windings within the traction transformer or from the secondary of the traction transformer by means of a step down transformer. Under traction load, i.e. an electric train drawing power from the substation the AC waveform is distorted due to harmonics created by the traction rectifier.

1.2 The Total Harmonic Distortion, which can be expected is up to 27 %.

1.3 A typical voltage waveform, which can be expected, is shown in figure 1 and its corresponding frequency spectrum (FFT) is shown in figure 2.

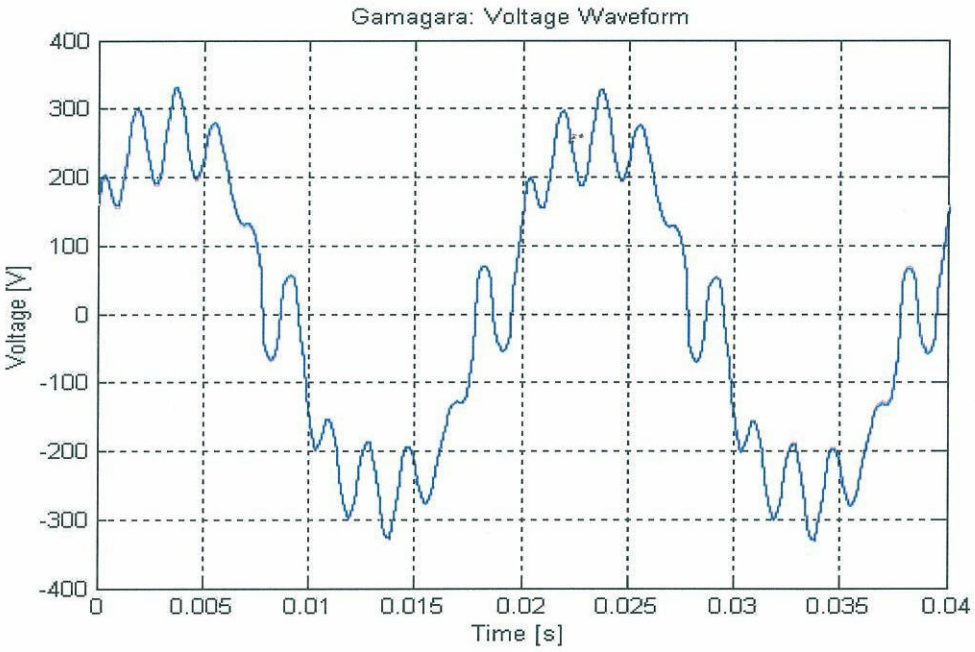

Figure 1: Voltage waveform under traction load (traction = 3000A)

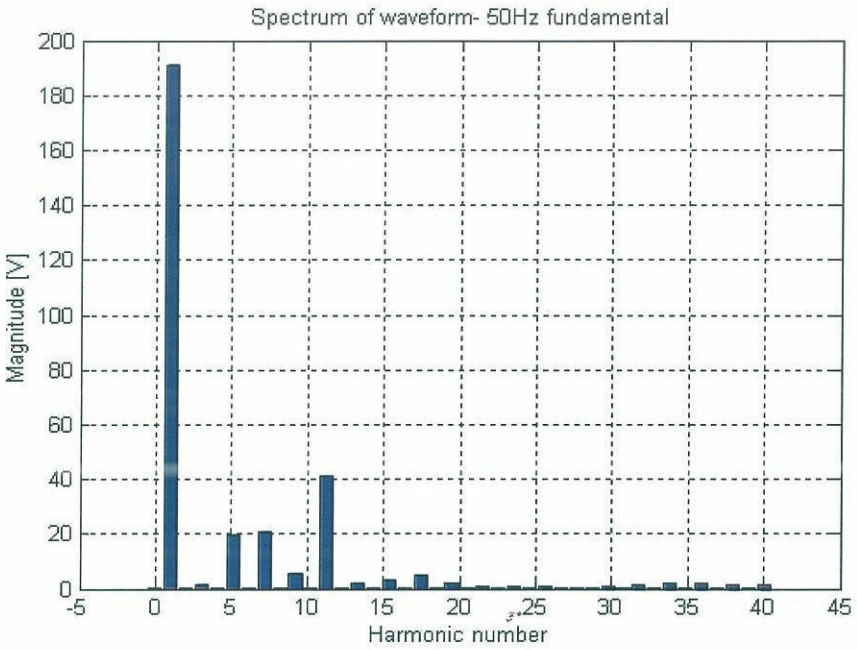

Figure 2: Frequency spectrum (FTT) of voltage waveform as shown in figure 1.

END

APPENDIX 2

TECHNICAL DATA SHEET.

(To be completed by client)

1.0 SUBSTATION NAME: _____

2.0 SUPPLY VOLTAGE: _____

3.0 AMPERE HOUR RATING: _____

4.0 CONSTRUCTION:

FLOOR MOUNTED: YES / NO

WALL MOUNTED: YES / NO

END

TRANSNET
freight rail

A Division of Transnet Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

3 KV DC TRACTION SUBSTATION EARTHING SYSYTEM FOR HIGH VOLTAGE OUTDOOR YARDS

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Authorised:	Principal Engineer Technology Management	W.A. Coetzee	

Date: 27 August 2010

Circulation Restricted To:

Transnet Freight Rail

Transnet and Relevant Third Parties

INDEX

1.0 SCOPE

1.1 This specification specifies Transnet freight rail's requirements for the design, supply, installation and testing of the earthing systems for new and existing 3kV DC traction substations.

1.2 This specification must be read in conjunction with Transnet freight rail's drawings BBB 3620 and CEE-TBD-7.

2.0 STANDARDS AND PUBLICATIONS

2.1 Unless otherwise specified all materials and equipment supplied shall comply with the applicable and latest editions of SANS and Transnet Freight Rail's publications.

2.2 The following publications (latest editions) are referred to in this specification:

2.2.1 SOUTH AFRICAN NATIONAL STANDARDS

SANS 1063	Earth rods, couplers and connections.
SANS 1507 -1-3	Electric cables with extruded solid dielectric insulation for fixed installations. (300/500V to 1900/3300V).
SANS 2063	Thermal spraying - Metallic and other inorganic coatings - Zinc, aluminium and their alloys.
SANS 10199	The design and installation of earth electrodes.

2.2.2 TRANSNET FREIGHT RAIL

CEE.0177	Code of Practice: Earth systems for electric light and power and traction installations.

TRANSNET FREIGHT RAIL'S DRAWINGS.

BBB 3620	3kV DC earthing arrangement system for high voltage outdoor yards.
CEE-TBD-7	3kV DC earthing arrangement system of traction substation.

3.0 METHOD OF TENDERING

3.1 Tenderers shall indicate clause by clause compliance with the specification. This shall take the form of a separate document listing all the specification's clause numbers indicating the individual statement of compliance or non-compliance.

3.2 A statement of non-compliance shall be motivated by the tenderer.

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

3.4 Failure to comply with clauses 3.1, 3.2, 3.3 could preclude a tender from consideration.

4.0 DEFINITIONS

Definitions are in accordance with SANS 10199.

4.1 EARTH ELECTRODE

One or more conductive parts embedded in the earth for the purpose of making effective electrical contact with the general mass of the earth, and to act as a path for the discharge of either lightning currents or fault currents.

4.2 EARTHED

So connected to the general mass of earth as to ensure at all times an immediate discharge of electrical energy without danger.

4.3 EARTHING SYSTEM

A system intended to provide at all times, by means of one or more earth electrodes, a low impedance path for the immediate discharge of electrical energy without danger into the general mass of earth.

5.0 EARTHING SYSTEMS OF TRACTION SUBSTATIONS

The earth leakage protection consists of an AC earth leakage and a DC earth leakage system as described below:

5.1 AC EARTH LEAKAGE SYSTEM

The AC earth leakage system is used to detect flashovers on high voltage HV outdoor yard equipment. The equipment in the outdoor yard is insulated from the substation earth mat and connected in parallel through a current transformer to earth mat. (Minimum resistance to earth mat is 10 Ohms). The output of the current transformer feeds to an earth leakage relay, which will trip and lock out the primary circuit breaker when operated.

5.2 DC EARTH LEAKAGE SYSTEM

The DC earth leakage system is used to detect 3kV DC and 380V AC insulation failures. The steelwork and panels inside the traction substation are bonded to a DC earth leakage busbar, which is insulated from earth mat. (Minimum resistance to earth mat is 25 Ohms). The DC earth leakage busbar is connected to the substation negative busbar through a DC earth leakage relay.

Operation of this relay will isolate the complete substation from all sources of supply and lock out the primary circuit breaker and all the 3kV DC high speed circuit breakers.

6.0 SERVICE CONDITIONS

6.1 ATMOSPHERIC CONDITIONS:

Altitude	:	0 to 1800m above sea level.
Ambient temperature	:	-10% to +50 °C.
Relative humidity	:	10% to 90% percent
Lightning Conditions	:	12 ground flashes per square kilometre per annum.
Pollution	:	Heavily salt laden or polluted with smoke from industrial sources.

6.2 SOIL CONDITION:

The soil resistivity can vary from 10 Ohmmeter to more than 5,000 Ohmmeter. Earth value enhancement methods will have to be used, where necessary to obtain the desired value of 5 Ohms or less.

6.3 CORROSION:

Buried conductors will be exposed to both severe galvanic and chemical corrosion. There is a high level of stray current in the vicinity of 3kV DC traction substations which will reduce the life of the earthing system.

7.0 TECHNICAL REQUIREMENTS

7.1 The design and installation of Transnet Freight Rail's earthing system for outdoor yards shall be in accordance with Transnet Freight Rail's drawings BBB 3620 and CEE-TBD-7.

7.2 A 5-second fault current duration shall be used for the rating of the earthing system. The earth down conductors and earth tails shall be able to withstand 6,2 kA for 5 seconds when exothermically welded. The rated AC fault level for 3kV DC traction substations shall be taken to be 16kA.

7.3 Deviation of the design shall be submitted to the project manager for approval.

8.0 EARTHING LAYOUT

8.1 The following electrical equipment in the outdoor yard shall be bonded directly to earth mat.

- The support steel structures for the surge arresters at the Eskom supply side.
- All high voltage surge arresters.
- The high voltage AC disconnects.
- Voltage transformer steel structures where applicable.
- Main Current transformers on Eskom side of primary circuit breaker in high voltage (HV) yard.
- The perimeter fence posts and gates.
- Substation metal roof.

8.2 The following electrical equipment forms part of the AC earth leakage system and shall be connected via a current transformer to earth.

- Main traction transformer.
- Primary circuit breaker.
- Main current transformers between primary circuit breaker and main traction transformer.
- The Auxiliary transformer's barrier screen.

8.3 The following electrical equipment is connected directly to the substation negative busbar.

- The auxiliary transformer tank.
- All spark gaps.

8.4 The following outdoor electrical equipment is connected directly to the DC earth leakage relay busbar.

- The Anode wall plate (Wall Bushings).
- The auxiliary transformer neutral point.
- AC / DC motorised link framework and structure where fitted.
- The auxiliary transformer short circuiting switch fitted on substation wall in the outdoor yard.

9.0 MATERIALS TO BE USED.

EARTHING

9.1 Only copper rods of at least 70 mm^2 shall be used for earth electrodes in accordance to SANS 1063.

The length of the rods will be dependant on the application:

- Earth electrodes (earth spikes). Minimum length of 1.5 meters shall be used.
- Down conductors, earth tails and interconnecting conductors. Rods of varying lengths may be used.

9.2 The minimum size of cable/conductor used for the earthing system shall be 95 mm^2 copper.

9.3 For the installation or replacement of the main earth mat/earth electrode, Copper conductor of at least 16mm diameter shall be used and shall be buried at least 1,5 meters below the ground. The earth mat shall cover an area of at least 1,5 square metre.

9.4 The earth mat shall be provided with a test point connection for test purposes. This test point shall protrude a minimum of 100mm above ground level and shall be protected by means of a metal pipe or metal housing.

9.5 The location of the earth mat/earth spike shall be as close as possible to the main surge arresters support structures.

AC EARTH LEAKAGE SYSTEM

9.6 PVC insulated 95 mm^2 copper cable shall be used where insulated earthing conductors are required for the interconnecting of the high voltage equipment on the AC earth leakage system.

9.7 The resistance between the outdoor yard steelwork connected to AC earth leakage system and main earth electrode shall be a minimum of 10 Ohms.

10.0 INSTALLATION OF EARTHING SYSTEM.

10.1 EARTHING SURVEY

10.1.1 For new installations the contractor shall carry out an earthing survey in accordance with the method as described in specification CEE.0177 or SANS 10199 to determine the type of earthing system required. The contractor shall be required to submit a separate quotation for the survey.

10.1.2 For existing substations the contractor shall carry out earth resistance tests to establish the condition of the existing earth mat/earth spike and shall replace such earth mat/earth spike where required.

10.2 TRENCHING

10.2.1 Before any trenching commences the contractor shall consult with Transnet Freight Rail staff for approval with regard to the routing of the trenches in the outdoor yard.

10.2.2 Trenching shall include all trenches required for the installation of the earthing system.

10.2.3 The perimeter fence trenching shall be as close as possible to the perimeter fence on the inside of the HV yard.

10.2.4 The depth of trenches shall be at least 700 millimetres. Care must be taken not to damage existing cables in the high voltage outdoor yard during trenching operations.

10.2.5 Before the trenches are closed a representative from Transnet Freight Rail shall inspect the earthing system for correct installation procedure.

10.3 INSTALLATION PROCEDURES

10.3.1 Earth electrodes shall be driven into the ground in the perimeter fence trench at the corners of the outdoor yard and in between the corners.

10.3.2 In the case of double unit substations the number of earth electrodes between the corner electrodes shall be determined in consultation with Transnet Freight Rail.

10.3.3 The depth of the earth electrodes driven into the ground shall be such that the top of the earth electrode shall be a minimum of 700 mm below the surface of the ground.

10.3.4 The earthing of the support steel structures for the surge arresters, AC disconnects, voltage transformers (where installed) and current transformers shall be in accordance with Transnet Freight Rail's drawing BBB 3620.

10.3.5 The surge arresters base shall be connected directly to earth mat/spike.

10.3.6 Where surge arresters are fitted on the main transformer provision shall be made to install an earth electrode in close proximity to the transformer. The earth electrode shall be connected directly to the earth system as shown in drawing BBB3620.

10.3.7 All underground connections which include connections to the earth electrodes, the joints in the copper plated steel rods, connections to the perimeter fence posts, support steel structures and the connection to the new or existing earth mat shall be exothermic welded or crimped by means of tinned lugs or by means of brass clamping system.

10.3.8 Where exothermic welding cannot be carried out, galvanised or stainless steel grade S304 studs, nuts, tinned cable lugs and any other approved means may be used for the termination of the earthing conductors to the fence posts, surge arresters down leads, metal structure and other electrical equipment.

10.3.9 Exothermic welded joints and steel components exposed to corrosion shall be sealed with a durable waterproofing compound i.e. Bitumen, Denso tape or Noxide.

10.3.10 All crimped connections that are above ground level must be filled with an anti corrosive compound.

10.3.11 Where the exothermic welding is carried out on galvanised surfaces of the support steel structures, the galvanising must be removed and the surface cleaned. After completion of the exothermic weld, the surface area on the support steel structure where the galvanising was removed shall be treated in accordance with the requirements of SANS 2063.

10.3.12 Exothermic joints shall be hammer tested on recommendation of the manufacturer to ensure that the mechanical strength of the joints are adequate. The exothermic weld is tapped by a hammer and by sound it is determined whether the joints are solid or that there are voids in the joint.

10.3.13 Where two earthing conductors run parallel to each other, exothermic parallel joints shall be installed every 1,5 metres on all straight sections between these conductors.

10.4 CERTIFICATION OF CONTRACTORS (EXOTHERMIC WELDING)

10.4.1 Only Contractors who are certified and accredited by the exothermic welding industry shall be used for the installation.

10.5 CRUSHER STONE

NEW SUBSTATIONS

10.5.1 After completion of construction, installation of equipment, the laying of all cables and earthing conductors, a suitable weed killer approved by Transnet Freight Rail's Project Manager shall be applied in the outdoor yard unless otherwise specified.

10.5.2 The successful tenderer shall exercise the greatest care to avoid contaminating private property.

10.5.3 After treatment with the weed killer, a 100mm layer of 25mm to 37mm crusher stone shall be laid over the whole area of the Transnet Freight Rail high voltage outdoor yard (within the apron).

EXISTING SUBSTATIONS

10.5.4 The contractor shall remove the necessary crusher stone before any excavation commences.

10.5.5 The contractor shall restore the crusher stone to its original condition once the installation work has been completed.

10.5.6 The contractor shall supply any additional crusher stone required to restore the trenched areas to original condition.

11.0 SPECIAL TOOLS (OPTIONAL)

11.1 Tenderers shall furnish quotations for the special bending equipment, crimping tools and exothermic welding moulds required for the installation of the earthing system.

11.2 The price shall form a separate part of the quotation.

12.0 TESTS AND ACCEPTANCE

12.1 The contractor shall perform resistance measurement tests, which shall be witnessed by a representative of Transnet Freight Rail. The resistance measurements shall be entered into the substation station log book.

12.2 In the event of any dispute, Transnet Freight Rail reserves the right to make the final decision on the acceptance of the earthing system.

END

11.0 APPENDIX 1

SCHEDULE OF REQUIREMENTS

(To be filled in by Transnet Freight Rail's Maintenance Depot)

1.0 CAPACITORS

1.1 10 MicroFarad

- Quantity Required: 2

1.2 20 MicroFarad

- Quantity Required: _____

1.3 50 MicroFarad

- Quantity Required: 1

2.0 MAINTENANCE DEPOT

2.1 Depot Name: Ermelo

2.2 Depot Address: 22 industria avenue, ermelo, mpumalanga, 2351

TRANSNET
freight rail

A Division of Transnet SOC Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

WAVE FILTER CAPACITORS FOR 3kV DC TRACTION SUBSTATIONS

Author:	Chief Engineering Technician Technology Management	B.L Ngobeni
Approved:	Senior Engineer Technology Management	L.O Borchard
Authorised:	Principal Engineer Technology Management	S.E Sibande

Date: 24 April 2019

Circulation Restricted To:

Transnet Freight Rail - Rail Network
- Technology Management

TABLE OF CONTENT

1.0 SCOPE

1.1 This specification covers Transnet Freight Rail's requirements for the supply of wave filter capacitors required for DC applications such as harmonic filters.

1.2 The capacitors shall be used with the resonant shunts to reduce the magnitude of the 6^{th}, 12^{th}, 18^{th} and the 24^{th} harmonics at the busbar of the 3 000V DC rectifier traction substation.

2.0 STANDARDS AND PUBLICATIONS

Unless otherwise specified all materials used and equipment developed and supplied shall comply with the current edition of the relevant IEC, SANS and Transnet Freight Rail's publications where applicable.

2.1 INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC 60871 -1: 2014:	Shunt capacitors for A.C power systems having a rated voltage above 1 000V.

2.2 SOUTH AFRICAN NATIONAL STANDARDS

SANS 1019:	Standard voltages, currents and insulation levels for electricity supply.
SANS 1091:	National Colour Standards.
SANS 60137:	Insulated Bushings for Alternating Voltages above 1000V

2.3 TRANSNET FREIGHT RAIL'S PUBLICATIONS

CEE 0224: 2002	Drawings catalogues instruction manuals and spares list for electrical equipment supplied under contract.
CEE 0045: 2014	Painting of Steel Components of Electrical Equipment.
CEE TCK 004:	Wave filter cell layout.

3.0 TENDERING PROCEDURE

3.1 The tenderer shall indicate compliance with the specification. This shall take the form of a separate document listing all the clause numbers of the specification with an individual clause by clause statement of compliance or non-compliance in English.

3.2 The tenderer shall motivate a statement of non-compliance.

3.3 The tenderer shall submit descriptive literature consisting of detailed technical specifications, general construction details and principal dimensions, together with clear illustrations of the equipment offered.

3.4 The tenderer shall complete and submit the technical data sheet in appendix 2.

3.5 Failure to comply with clauses 3.1, 3.2, 3.3 and 3.4 could preclude a tender from consideration

4.0 APPENDICES

The following appendices form an integral part of this specification and shall be read in conjunction with it.

4.1 Appendix 1 -"Schedule of Requirements"

This appendix details the specific requirements for this application.

4.2 Appendix 2 -" Information to be provided by tenderer"

This appendix calls for specific technical information to be furnished by tenderer.

5.0 SERVICE CONDITIONS

5.1 ATMOSPHERIC CONDITIONS

Altitude:	0 to 1800m above sea level.
Ambient Temperature:	-10°C to +55°C.

Relative Humidity:	10% to 90%
Lightning Conditions:	20 ground flashes per square kilometre per annum.
Pollution:	Heavily salt laden or polluted with smoke from industrial sources.

5.2 MECHANICAL SERVICE CONDITIONS

5.2.1 The 3kV DC traction substations are situated next to railway lines and the equipment will therefore be subjected to vibration. The design must take appropriate counter measures to ensure reliability of equipment that is sensitive to vibration.

5.2.2 The capacitors are to be installed in the 3kV DC traction substations and shall be floor mounted.

5.3 ELECTRICAL SERVICE CONDITIONS

5.3.1 The nominal no-load DC voltage of a traction substation output varies between 3150V and 3900V.

5.3.2 The maximum voltage under no-load conditions can increase up to 4000V depending on the traction transformer tap settings, Eskom's supply voltage and regenerative breaking.

5.3.3 The substation voltage under load conditions may decrease to 2300 V.

6.0 POWER FILTER CAPACITORS

6.1 GENERAL

6.1.1 The capacitors shall form part of the resonant shunt connected to the positive and negative busbar to reduce the magnitude of the following harmonics:

- 6^{th} at 300Hz,
- 12^{th} at 600Hz
- 18^{th} at 900Hz,
- 24^{th} at 1200Hz

6.1.2 Substations with 12-pulse rectification are normally tuned for 12^{th} and 24^{th} harmonics at 600Hz and 1200Hz, respectively. The 6-pulse type rectifier substations are normally equipped with 300Hz and 900Hz filters to reduce the effect of the 6^{th} and 18^{th} harmonics.

6.1.3 The design, construction and operation of the capacitors shall be in accordance to specification IEC 60871 -1: 2014.

6.1.4 A dielectric made from Polyester / Polypropylene film (PPR) is preferable.

6.1.5 The capacitor container shall be constructed of steel or stainless steel and shall have adequate mechanical strength to avoid bulging or bursting.

6.1.6 If lifting lugs are required each capacitor container shall be provided with two lugs.

6.1.7 Each capacitor container shall be provided with an earthing lug drilled for a 10mm screw.

6.1.8 The capacitor container shall be hermetically sealed. Moisture and electrical environmental interference shall have no effect on the capacitor

6.1.9 Each capacitor shall be provided with two bushings, one for each pole. The creepage and air clearance of the bushings shall not be less than 200 mm between the live parts of the bushings, the metal base of the container and between the bushing terminals.

6.1.10 The basic insulation level (BIL) for the bushings shall be at least 100kV.

6.1.11 The capacitors shall be immersed in a non-flammable, non-toxic and biodegradable insulating medium and sealed under vacuum.

6.1.12 The positioning of the capacitors in the wave filter cell shall be in accordance to drawing CEE TCK 004.

6.1.13 The capacitor shall have an integral discharge resistor.

6.1.14 The wave filter equipment in the traction substation is connected in series to a 100A fuse.

6.2 CAPACITOR RATINGS

6.2.1 The quantities required of the capacitor values are dependent on the substation rectifier arrangement (12-pulse or 6-pulse rectification).The capacitors shall be made up of the following units:

- 10 Microfarad - 80 ampere continuous,
- 20 Microfarad - 80 ampere continuous,
- 50 Microfarad - 80 ampere continuous.

6.2.2 The capacitor shall be rated to handle up to four and one third (13 000 V) of the full load voltage (3kV) for one minute.

6.2.3 The capacitance tolerance of each capacitor shall not vary by more than 5% at 45 °C. Tenderers shall state and guarantee the tolerance of the capacitors offered.

6.2.4 Tenderers are requested to state the following:

- Maximum permissible voltage of the capacitor,
- Maximum permissible current of the capacitor, as per requirement of clauses 19 and 20 of the IEC 60871 -1: 2014 specification.

6.3 ADMISSIBLE OVERLOADS

6.3.1 The continuous rated excess voltage shall be at least 20% of the full load voltage (3 kV).

6.3.2 The excess continuous current rating shall be at least 50% of the rated current.

6.3.3 The rated kilo-Volt-Ampere reactive (kVAr) power shall be at least 40% of the rated power.

6.4 RATING PLATE

6.4.1 A non-corrosive metal nameplate shall be fixed to each capacitor container giving the following information:

- Manufactures Name,
- Identification Number,
- Continuously Rated AC Current,
- Rated DC Voltage,
- Temperature Category,
- Insulating Medium,
- Insulating Level,
- Measured Capacitance in Microfarad.

6.4.2 The nameplate shall be positioned such that it is visible in the position of normal service and installation.

6.5 INSULATION

6.5.1 All capacitors shall be insulated to withstand a pressure of not less than 20 000 volts DC for one minute between the terminals. This must also be applicable between the short-circuited terminals and the container.

6.5.2 Tenderers are requested to state the expected deterioration pattern of the dielectric of the capacitors with time, while in service, and the test voltages that can be applied to the capacitors approximately six months after the manufacturer's tests.

6.6 LIFE EXPECTANCY OF THE CAPACITOR

6.6.1 The capacitor shall have a rated life expectancy of not less than 20 years (175 000 working hours).

6.7 TESTS

6.7.1 The capacitors shall be subjected to the test requirements as set out in specification IEC 60871 -1: 2014.

6.7.2 All the types of tests shall be done in accordance to specification IEC 60871 -1: 2014 and shall be conducted on each type of capacitor offered.

6.7.3 A Type Test certificate shall be submitted for each type of capacitor offered.

6.7.4 The tenderer shall also submit routine test certificates for each capacitor offered.

7.0 QUALITY ASSURANCE

7.1 Transnet Freight Rail reserves the right to carry out inspection and any tests on the equipment at the works of the supplier/manufacturer.

7.2 Arrangements will be made timeously for such inspections to be carried out before the delivery of the equipment.

8.0 GUARANTEE AND DEFECTS

8.1 The tenderer shall guarantee the satisfactory operation of the equipment supplied and accept liability for maker's defects, which may appear in design, materials and workmanship.

8.2 The guarantee period for the equipment shall expire after: A period of 12 months commencing on the date of installation and commissioning of the equipment or the date the equipment is handed over to Transnet Freight Rail whichever is the latest.

9.0 PACKAGING AND TRANSPORT

9.1 The tenderer shall ensure that the equipment be packed in such a manner that it will be protected during handling and transportation.

9.2 The tenderer shall provide transport for the delivery of the equipment to the site where it is required.

10.0 BIBLIOGRAPHY

[1] SANS, "SANS 1019: 2014 Standard voltages, currents and insulation levels for electricity supply," SABS Standards Division, Pretoria, South Africa, 2014.

[2] SANS, "SANS 1091: National Colour Standards," SABS standard division, Pretoria, South Africa.

[3] SANS, "SANS 60137: Insulated Bushings for Alternating Voltages above 1000V," SABS standard division, Pretoria, South Africa.

[4] IEC, "IEC 60871 -1: 2014: Shunt capacitors for A.C power systems having a rated voltage above 1 000V," International Electrotechnical Commission, 2014.

END

11.0 APPENDIX 1

SCHEDULE OF REQUIREMENTS

(To be filled in by Transnet Freight Rail's Maintenance Depot)

1.0 CAPACITORS

1.1 10 MicroFarad

- Quantity Required: _____

1.2 20 MicroFarad

- Quantity Required: _____

1.3 50 MicroFarad

- Quantity Required: _____

2.0 MAINTENANCE DEPOT

2.1 Depot Name: _____

2.2 Depot Address: _____

12.0 APPENDIX 2

TECHNICAL DATA SHEET

(To be filled in by Tenderer)

- Capacitance Value (C_N):_____
- Capacitance Tolerance:_____
- Detailed Description of Capacitor:_____
- Overall Mass of the Capacitor:_____
- Overall Dimensions of the Capacitor: _____
- Dielectric Insulating Medium:_____
- Container Material:_____
- Rated Current in RMS (I_N):_____
- Rated Voltage in RMS (U_N):_____
- Rated Output (Q_N):_____
- Temperature Category:_____
- Maximum Permissible AC Current:_____
- Maximum Permissible AC Voltage:_____
- Maximum Permissible Temperature:_____
- Capacitor Losses:_____
- Active Power:_____
- Steady State Condition:_____
- Residual Voltage:_____
- BIL (Bushing):_____
- Life Expectancy:_____

END

12.0 APPENDIX A

SCHEDULE OF REQUIREMENTS

(To be filled in by Transnet Freight Rail's Maintenance Depot)

1. INDUCTORS

1.1 The following table shall be filled in with reference to the table contained in drawing BBB3486.

Harmonic	Inductor Required (mH)	Quantity Required
6th	2.814	
12th	1.173	60uF (50x1 and 10x1)
18th	1.564	
24th	1.759	10uF (10x1)

2. MAINTENANCE DEPOT

2.1 Depot Name: Ermelo

2.2 Depot Address: 22 industria avenue, ermelo, mpumalanga, 2351

TRANSNET
freight rail

A Division of Transnet SOC Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

WAVE-FILTER INDUCTORS FOR 3kV DC TRACTION SUBSTATIONS

Author:	Chief Engineering Technician Technology Management	B.L Ngobeni	
Approved:	Senior Engineer Technology Management	L.O Borchard	
Authorised:	Principal Engineer Technology Management	S.E Sibande	

Date: 24 April 2019

Circulation Restricted To:

Transnet Freight Rail - Technology Management
- Rail Network

"I acknowledge that this application contains personal information as defined in the Protection of Personal Information Act, 2013 (the "Act"). By accessing/using this application, I consent to the processing of my personal information in accordance with the requirements of the Act. I acknowledge that I cannot unreasonably withhold my consent. I acknowledge that the purpose for processing my personal information is in terms of this application."

TABLE OF CONTENT

1.0 SCOPE

1.1 This specification covers Transnet Freight Rail's requirements for the supply of wave-filter; air cored inductor coils for 3kV DC traction substation.

1.2 The inductor coils shall be mounted indoors and form part of the resonant shunt circuit designed to attenuate the magnitude of the 6^{th}, 12^{th}, 18^{th} and the 24^{th} harmonic frequencies.

2.0 STANDARDS AND PUBLICATIONS

Unless otherwise specified all materials used and equipment developed and supplied shall comply with the current edition of the relevant IEC, SANS and Transnet Freight Rail's publications where applicable.

2.1 INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC 60310: 2016:	Railway applications - Traction transformers and inductors on board rolling stock.

2.2 SOUTH AFRICAN NATIONAL STANDARDS

SANS 1019:	Standard voltages, currents and insulation levels for electricity supply.

2.3 TRANSNET FREIGHT RAIL'S PUBLICATIONS

CEE 0224: 2002	Drawings catalogues instruction manuals and spares list for electrical equipment supplied under contract.
CEE TCK 004:	Wave filter cell layout.
BBB3483:	Wave-Filter Harmonic Coil Carrier assembly for 3kV DC substation.
BBB3484:	Wave-Filter Harmonic Coil Carrier components for 3kV DC substation.
BBB3486:	Inductance Coils for resonant shunt circuits for 3kV DC substation.
BBB3487:	Harmonic Filter Coil winding details (as wound) for 3kV DC substation.
BBD5994:	Technical Documentation Management Policy.

3.0 TENDERING PROCEDURE

3.1 The tenderer shall indicate compliance with the specification. This shall take the form of a separate document listing all the clause numbers of the specification with an individual clause by clause statement of compliance or non-compliance in English.

3.2 The tenderer shall motivate a statement of non-compliance.

3.2.1 The tenderer shall submit descriptive literature consisting of detailed technical specifications, general construction details and principal dimensions, together with clear illustrations of the equipment offered.

3.3 The tenderer shall complete and submit the technical data sheet in appendix B.

3.4 Failure to comply with clauses 3.1, 3.2, 3.3 and 3.4 could preclude a tender from consideration

4.0 SERVICE CONDITIONS

4.1 ATMOSPHERIC CONDITIONS

4.1.1	Altitude:	0 to 1800m above sea level.
4.1.2	Ambient Temperature:	-10°C to +55°C.
4.1.3	Relative Humidity:	10% to 90% .
4.1.4	Lightning Conditions:	20 ground flashes per square kilometre per annum.

4.1.5 Pollution : Heavily salt laden or polluted with smoke from industrial sources.

4.2 MECHANICAL SERVICE CONDITIONS

4.2.1 The 3kV DC traction substations are situated next to railway lines and the equipment will therefore be subjected to vibration. The design must take appropriate counter measures to ensure reliability of equipment that is sensitive to vibration.

4.3 ELECTRICAL SERVICE CONDITIONS

4.3.1 The nominal no-load DC voltage of a traction substation output varies between 3150 V and 3900 V.

4.3.2 The maximum voltage under no-load conditions can increase up to 4000 V due to a combination of the traction transformer tap settings and Eskom's supply voltage or regenerative braking.

4.4 THE WAVE-FILTER CIRCUIT

4.4.1 The wave-filter circuit is connected across the output of the 3kV rectifier. In each 3kV DC substation, the wave-filter equipment is located in an enclosure isolated from the rest of the substation equipment.

4.4.2 Wave-filter combinations are used according to the configuration type of rectifier in the substation. The six pulse type rectifier substations are normally equipped with 300Hz, 600Hz, 900Hz and 1200Hz filters to reduce the effect of the 6^{th}, 12^{th}, 18^{th} and 24^{th} harmonics frequencies respectively.

4.4.3 Substations with 12-pulse rectification are normally tuned for the 12^{th} and 24^{th} harmonics frequencies.

4.4.4 The wave-filter circuit is a RLC-circuit consisting of resistors and inductor coils with corresponding capacitor banks.

4.4.5 Drawing BBB3486 contains a table with the calculated and required standard values for the inductor coils and corresponding capacitor banks.

4.4.6 A 100-Ampere fuse and a resistor are connected in series with the resonant circuit for protection against the increase of harmonic current according to drawing CEE TCK 004.

4.4.7 The wave-filter circuit on substations with external wave-filter rooms, has a link switch for mechanical discharging the circuit capacitors.

4.4.8 The busbar insulator provides insulation between the positive busbar and the substation walls.

4.4.9 The discharge resistor is included for safety precautions to prevent the rapid collapse of flux when the circuit is opened.

5.0 TECHNICAL REQUIREMENTS

5.1 GENERAL

5.1.1 The inductors shall be air cored and specifically manufactured for high-voltage 3kV-DC applications.

5.1.2 The inductors shall be mounted on a wooden frame and the capacitors on the floor unless otherwise specified.

5.1.3 The inductors shall be manufactured according to the constructional and dimensional values in the drawings BBB3483, BBB3484 and the tables in drawings BBB3486 or BBB3487, in order to fit into newly manufactured or existing wooden frames.

5.1.4 Each inductor consists of two coils. The successful tenderer shall supply the coils in accordance to the requirement indicated in schedule of requirements appendix A.

5.2 **INDUCTOR VALUE IN MILLI HENRY (MH)**

5.2.1 The required mutual inductance values are given in drawing number BBB3486 and the alternative values are listed in BBB3487. The required mH values shall be obtained with the inductors installed on the wooden frame and placed at a distance "D" apart.

5.2.2 Drawing BBB3487 shows the required minimum and maximum mutual inductance values of the coils at the minimum and maximum spacing "D".

5.3 **VOLTAGE RATING**

5.3.1 The table in drawing BBB3486 lists the harmonic voltage operating requirements with respect to each harmonic LC-circuit parameters. The continuous, 1-minute and the 30-minute voltage ratings are also provided.

5.3.2 The inductors shall be manufactured to withstand continuous DC voltages between 3150 V and 4000V under no-load or regenerative braking conditions.

5.4 **CURRENT RATING**

5.4.1 The current operating requirements for the continuous, 1-minute and 30-minute ratings are given in the table contained in drawing BBB3486 with respect to each harmonic circuit.

5.5 **WIRE REQUIREMENTS**

5.5.1 The details for the particular wire required are described in the table contained in drawing BBB3486.

5.5.2 The wire shall be made of aluminium material.

5.5.3 The wire shall be fabric or cotton covered and no joints will be acceptable in the wire.

5.6 **BOBBIN / COIL CARRIER REQUIREMENTS**

5.6.1 The bobbin shall be made of Phenolic paper grades "Tufnol" or fibreglass reinforced polyester material.

5.6.2 The successful tenderer shall refer to drawing BBB3483 and BBB3486 for the design and dimensions of the bobbin.

5.7 **WINDING DETAILS**

5.7.1 The details regarding the required wounding, direction, connection, bounding, length, turns and layers of each winding are shown in BBB3486.

5.7.2 The mutual inductance shall be achieved by differentially coupling the two windings.

5.7.3 The distance "D" shown in the table contained in drawing BBB3486 shall be adjustable to achieve the desired mutual inductance.

5.7.4 The number of layers depends on the type of harmonic filter; the coils are designed for e.g. 6^{th}, 12^{th} harmonic frequencies, etc. The details for the number of layers and turns are shown in BBB3486.

5.8. **LIFE EXPECTANCY OF THE INDUCTOR**

5.8.1 The coils shall have a rated life expectancy of not less than 20 years (175 000 working hours).

6.0 CABLES AND CONNECTIONS

6.1 Tails at least 500 mm long shall be supplied for connection of the inductor coils to the rest of the wave-filter circuit. The tails shall be insulated and fitted with 16-mm lugs securely crimped to the tails.

7.0 RATING PLATE

7.1 A non-corrosive metal plate shall be fixed to each inductor giving the following information:

- Manufacture's Name
- Manufacture's Serial Number
- Type of Inductor

- Rated Current (Mean DC current)
- Value of Inductance in Millie Henry
- Rated DC Voltage
- Total Mass

7.2 The nameplate shall be visible in the position of normal service and installation.

7.3 The value of the associated capacitor to be clearly stencilled on both coils.

8.0 TESTS REQUIREMENTS

8.1 The inductors shall be subjected to the test requirements set in specification IEC 60310.

8.2 Type test and routine test certificates shall be supplied for each inductor offered.

8.3 In addition to the requirements of appendix B, the tenderer shall supply the following as per requirement in IEC 60310 specification: The rated values and service conditions i.e. current, voltage, frequency, duration, duty cycle, ventilation, etc.

9.0 QUALITY ASSURANCE

9.1 Transnet Freight Rail reserves the right to carry out inspection and witness any tests on the equipment at the works of the supplier/ manufacture.

9.2 Arrangements will be made timeously for such inspections to be carried out before the delivery of the equipment.

10.0 GUARANTEE AND DEFECTS

10.1 The tenderer shall guarantee the satisfactory operation of the equipment supplied by him and accept liability for maker's defects, which may appear in design, materials and workmanship.

10.2 The guarantee period for the equipment shall expire after a period of 12 months commencing on the date of installation and commissioning of the equipment or the date the equipment is handed over to Transnet Freight Rail whichever is the later.

11.0 PACKAGING AND TRANSPORT

11.1 The tenderer shall ensure that the equipment be packed in such a manner that it will be adequately protected against mechanical damage and ingress of moisture during handling and transportation.

11.2 The tenderer shall provide transport for the delivery of the equipment to the site where required.

12.0 APPENDIX A

SCHEDULE OF REQUIREMENTS

(To be filled in by Transnet Freight Rail's Maintenance Depot)

1. INDUCTORS

1.1 The following table shall be filled in with reference to the table contained in drawing BBB3486.

Harmonic	Inductor Required (mH)	Quantity Required
6^{th}	2.814	
12^{th}	1.173	
18^{th}	1.564	
24^{th}	1.759	

2. MAINTENANCE DEPOT

2.1 Depot Name: _____

2.2 Depot Address: _____

13.0 APPENDIX B

TECHNICAL DATA SHEET

(To be filled in by Tenderer)

- Inductor Tolerance (mH) at operational frequencies: _____
- Max Nominal Inductance at operational frequencies: _____
- Number of Turns (N): _____
- Rated Peak Current in Amperes (I): _____
- Rated DC Current in Amperes (I_N): _____
- Overall Mass of the Inductor (kg):_____
- Overall Dimensions of the Inductor (mm): _____
- Max Ambient Temperature in °C (T_a):_____
- Max Surface Temperature in °C (T_s): _____
- Maximum Permissible Operational Temperature in °C: _____
- Maximum Permissible AC Current in Amperes: _____
- Maximum Permissible AC Voltage in Volts: _____
- Maximum Energy Stored in Inductor at rated peak current (I): _____

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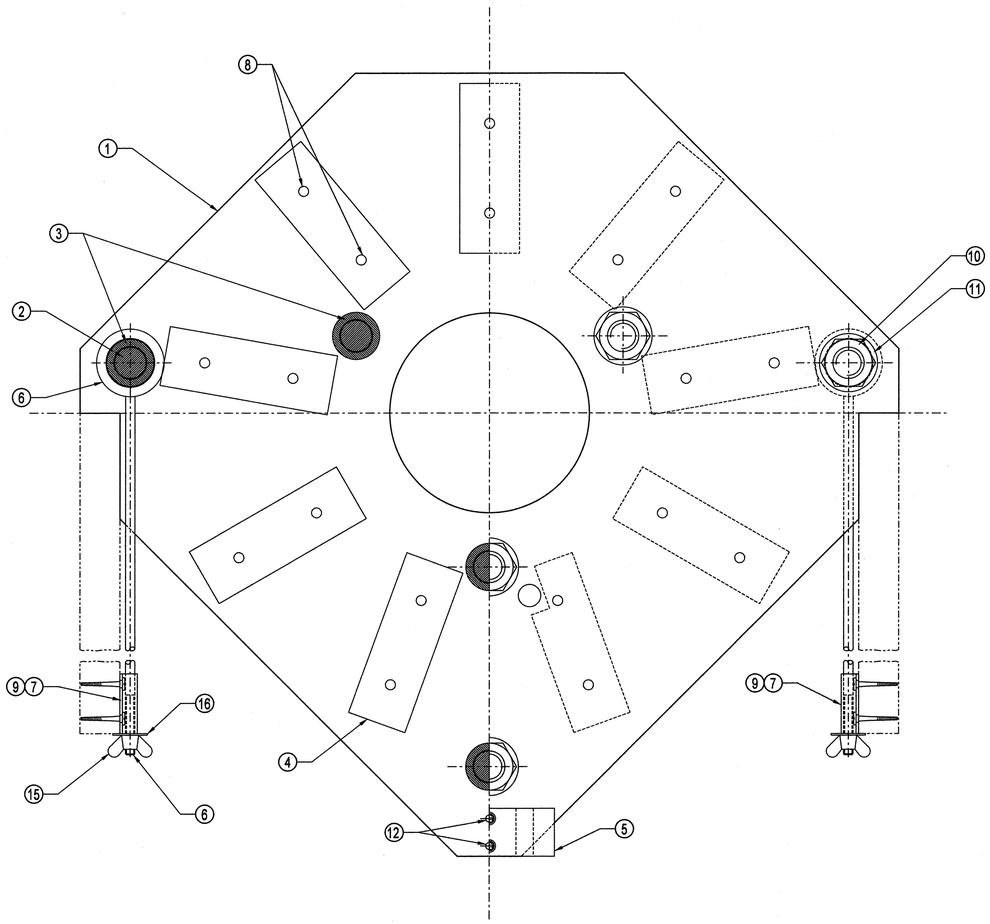
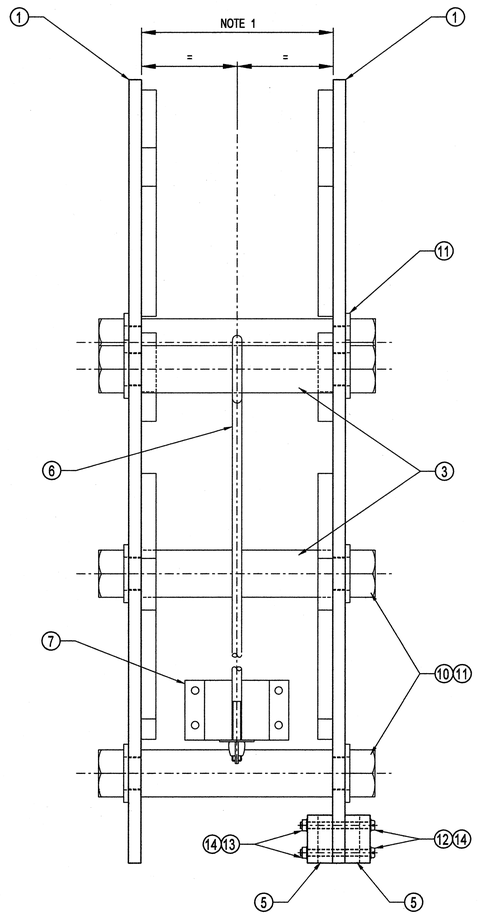
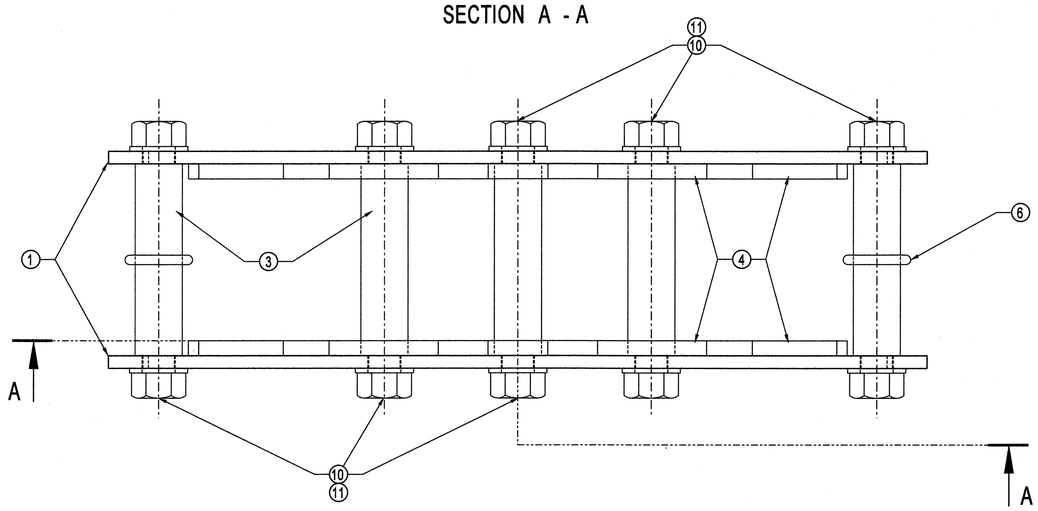




SECTION A - A



NOTES

1. FOR SMALL AND LARGE COILS SEE DIMENSION "D" ON DRG NO BBB3484 ITEMS 2 & 3.
2. CAPACITY OF ASSOCIATED CAPACITOR TO BE STENCILED ON COIL CHEEK.
3. FOR FRAMEWORK FOR SUPPORTING WAVE FILTER HARMONIC COILS SEE DRG NO BBB3485.
4. FOR SUPPORT BRACKET FRAMEWORK FOR WAVE FILTER HARMONIC COILS SEE DRG NO BBB3499.
5. FOR DETAILS OF COIL WINDINGS SEE DRG NO BBB3486.
6. FOR SPECIFICATION SEE DOCUMENT NO BBB3162.

ITEM NO	DESCRIPTION	QTY	STORES ITEM NO	DRAWING NO
16	WASHER, BRASS, FLAT, ROUND, ø6,5 I.D. x ø25 O.D. x 1,6	2	-	-
15	WINGNUT, BRASS M6	2	-	-
14	WASHER, BRASS, FLAT, ROUND, M4	4	-	-
13	NUT, BRASS, HEX HEAD, M4	2	-	-
12	CHEESE HEAD BRASS SCREWS M4 x 45L	2	-	-
11	WASHER, BRASS, FLAT, ROUND, M20	12	-	-
10	NUT, BRASS, HEX HEAD, M20	12	-	-
9	WOODSCREW, BRASS, No. 10 x 25L	8	-	-
8	DOWEL, WOOD ø6 x 20L	36	-	-
7	CLAMPING SADDLE	2	-	BBB3484 ITEM 7
6	THREADED CLAMPING ROD	2	-	BBB3484 ITEM 6
5	CLEAT	2	-	BBB3484 ITEM 5
4	SPACER	18	-	BBB3484 ITEM 4
3	CLAMPING ROD TUBE	6	-	BBB3484 ITEM 3
2	CLAMPING ROD	6	-	BBB3484 ITEM 2
1	COIL CHEEK	2	-	BBB3484 ITEM 1

DIMENSIONS : mm SCALE : 1 : 2
TOLERANCE : LIN ± - ANG ± ITEM NO : -
MATERIAL : -
VERSION INFO : REDRAWN, DRG NO WAS ENW-E1C-240

DO REF : CDO/ 2193
ECP REF : 2002-072
DRAWN : JR Anthony
DESIGNED : -
CHECKED : JD van Dyk

DATE: 2015 - 7 - 28

APPROVED

AUTHORISED

CENTRAL DRAWING OFFICE

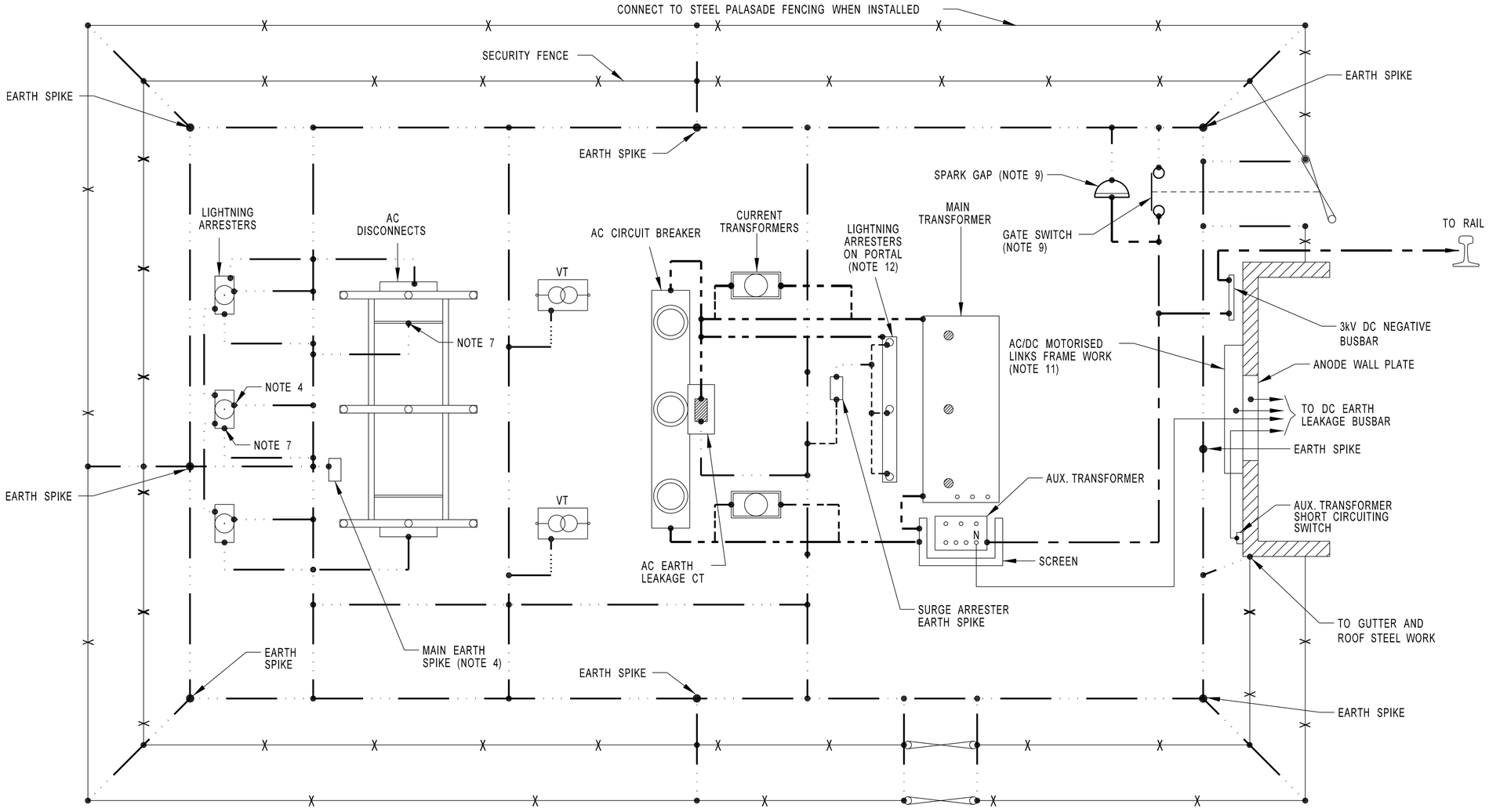
WAVE FILTER HARMONIC COIL CARRIER ASSEMBLY
3kV DC SUBSTATION

SPOORNET

BBB3483

VERSION 1

A1



NOTES

1. DRAWING MUST BE READ IN CONJUNCTION WITH SPECIFICATION BBB3059.
2. DEEP EARTH OR TRENCH SYSTEM. SEE CODE OF PRACTICE CEE.0177 FOR "EARTH SYSTEMS FOR ELECTRIC LIGHT AND POWER AND TRACTION INSTALLATIONS".
3. THE OVERALL RESISTANCE OF THE AC EARTH SYSTEM MUST NOT EXCEED 5 OHMS.
4. UNNECESSARY BENDS IN THE DOWN LEADS FROM THE LIGHTNING ARRESTERS TO THE AC EARTH SYSTEM SHALL BE AVOIDED.
5. THE INSTALLATION OF THE MAIN EARTH AND TEST SPIKE SHALL BE LOCATED AS CLOSE AS POSSIBLE TO THE INCOMING SUPPLY AC LIGHTNING ARRESTERS.
6. ALL BURIED CONNECTIONS, TO THE SUPPORT STEEL STRUCTURES AND CONNECTIONS TO THE CORNER, INTERMEDIATE AND GATE POSTS OF THE SECURITY FENCES SHALL BE BOLTED.
7. THE EARTHING TAILS FROM THE SUPPORT STEEL STRUCTURES OF THE AC DISCONNECTS AND LIGHTNING ARRESTERS TO THE AC EARTH SYSTEM SHALL BE LOOPED.
8. THE MINIMUM SIZE OF CABLE / CONDUCTOR USED FOR EARTHING SHALL BE 95mm² COPPER CONDUCTOR.
9. THE GATE SWITCH ATTACHED TO THE SUBSTATION OUTDOOR YARD GATE, THE 3kV DC O/H FEEDER SECURITY AREA GATE AND THE REGEN RESISTANCE ENCLOSURE ARE TO BE SO MOUNTED THAT THE GATE SWITCH IS OPEN WHEN THE GATE IS CLOSED AND CLOSED WHEN THE GATE IS OPEN.
   THE SPARK GAP USED WITH THE GATE SWITCH ASSEMBLY SHALL COMPLY WITH SPECIFICATION BBB1616 AND DRG BBB0906.
10. SUPPORT STEEL STRUCTURES OF CURRENT TRANSFORMERS INSTALLED BETWEEN PRIMARY CIRCUIT BREAKER AND MAIN TRANSFORMER SHALL BE CONNECTED TO THE AC EARTH LEAKAGE SYSTEM.
11. AC/DC MOTORISED LINKS FRAME WORK SHALL BE CONNECTED TO THE DC EARTH LEAKAGE BUSBAR.
12. FOR CONNECTION OF HIGH VOLTAGE LIGHTNING ARRESTER INSTALLED ON CROSS ARM SEE DRG. NO. BBB0938.
13. CHANGE OF CURRENT TRANSFORMER BETWEEN CIRCUIT BREAKER AND TRANSFORMER WITH FRAMEWORK CONNECTED ON AC EARTH LEAKAGE: IF THERE IS NOT SUFFICIENT SPACE FOR THE CURRENT TRANSFORMER IT MAY BE INSTALLED BETWEEN THE AC DISCONNECT AND AC CIRCUIT BREAKER WITH THE FRAMEWORK CONNECTED TO AC EARTH.
14. FOR ALTERNATIVE EARTHING SYSTEM SEE BBB3620 SHEET 1.

DIMENSIONS : mm	SCALE : NTS	DO REF : CDO/ E0759	+ 18/03/2025 APPROVED: B L NGOBENI
TOLERANCE : LIN ± - ANG ± -	ITEM NO : -	ECP REF : -	
MATERIAL : -		DRAWN : XR BHOMELA	+ AUTHORISED: Y CHETTY
VERSION INFO : CONNECT CURRENT TRANSFORMER TO THE AC EARTH LEAKAGE SYSTEM		DESIGNED : -	
		CHECKED : LS KEKANE	

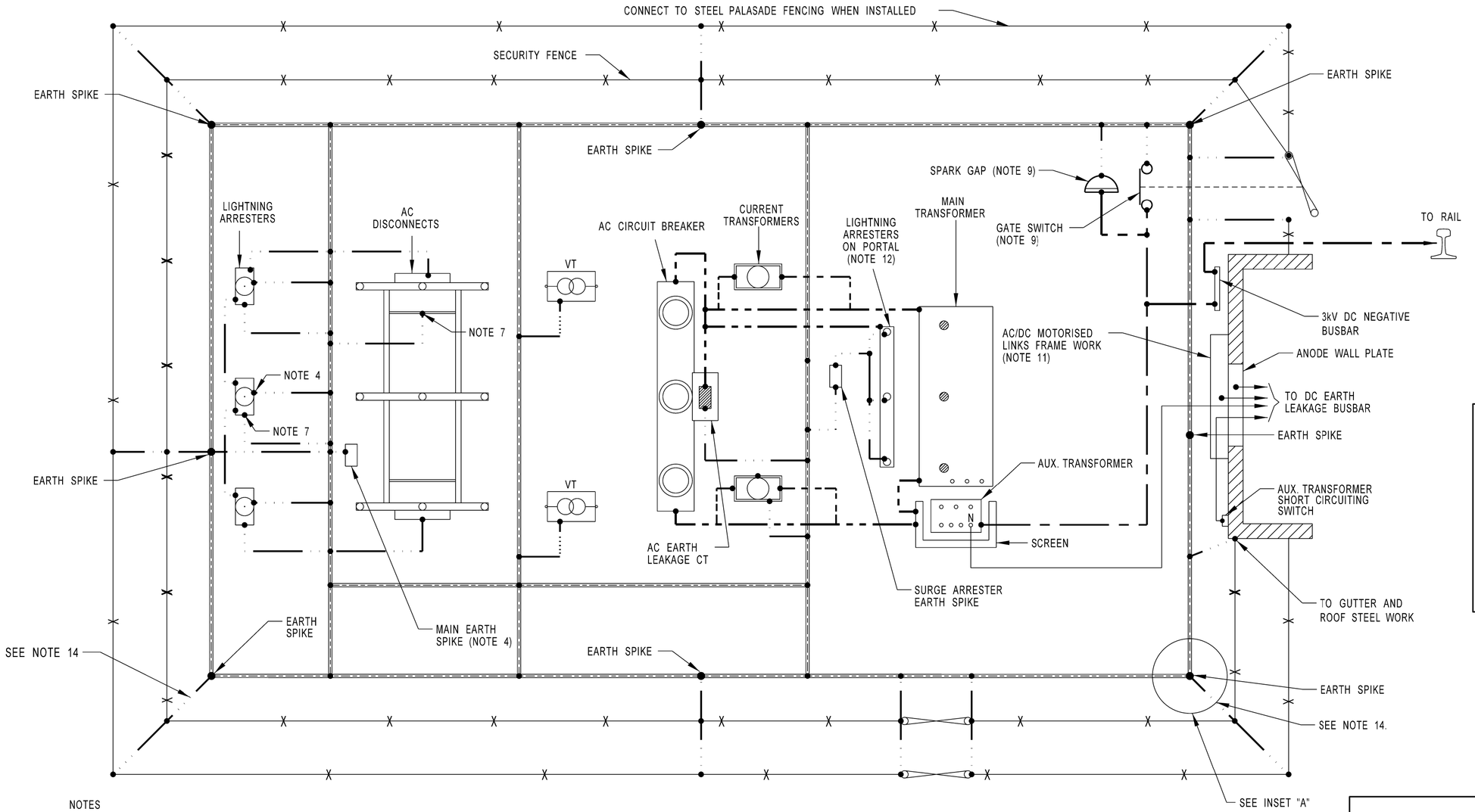
3kV DC EARTHING ARRANGEMENT SYSTEM FOR HIGH VOLTAGE OUTDOOR YARDS

TRANSNET freight rail

BBB3620 SHT 1

VERSION 9

A2

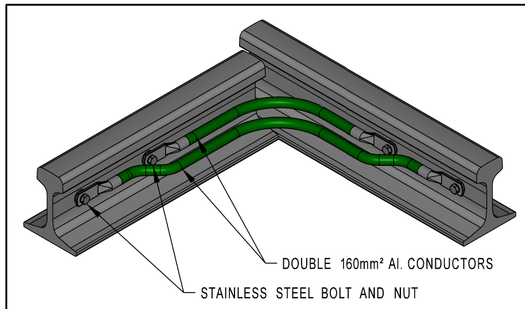


LEGEND

- DC NEGATIVE SYSTEM
- AC EQUIPMENT EARTH LEAKAGE SYSTEM
- AC EARTH SYSTEM
- AC EARTH SYSTEM RAILS
- SECURITY FENCE

NOTES

1. DRAWING MUST BE READ IN CONJUNCTION WITH SPECIFICATION BBB3059.
2. DEEP EARTH OR TRENCH SYSTEM. SEE CODE OF PRACTICE CEE.0177 FOR "EARTH SYSTEMS FOR ELECTRIC LIGHT AND POWER AND TRACTION INSTALLATIONS".
3. THE OVERALL RESISTANCE OF THE AC EARTH SYSTEM MUST NOT EXCEED 5 OHMS.
4. UNNECESSARY BENDS IN THE DOWN LEADS FROM THE LIGHTNING ARRESTERS TO THE AC EARTH SYSTEM SHALL BE AVOIDED.
5. THE INSTALLATION OF THE MAIN EARTH AND TEST SPIKE SHALL BE LOCATED AS CLOSE AS POSSIBLE TO THE INCOMING SUPPLY AC LIGHTNING ARRESTERS.
6. ALL BURIED CONNECTIONS, TO THE SUPPORT STEEL STRUCTURES AND CONNECTIONS TO THE CORNER, INTERMEDIATE AND GATE POSTS OF THE SECURITY FENCES SHALL BE BOLTED.
7. THE EARTHING TAILS FROM THE SUPPORT STEEL STRUCTURES OF THE AC DISCONNECTS AND LIGHTNING ARRESTERS TO THE AC EARTH SYSTEM SHALL BE LOOPED.
8. THE MINIMUM SIZE OF CABLE / CONDUCTOR USED FOR EARTHING SHALL BE 95mm² COPPER CONDUCTOR.
9. THE GATE SWITCH ATTACHED TO THE SUBSTATION OUTDOOR YARD GATE, THE 3kV DC O/H FEEDER SECURITY AREA GATE AND THE REGEN RESISTANCE ENCLOSURE ARE TO BE SO MOUNTED THAT THE GATE SWITCH IS OPEN WHEN THE GATE IS CLOSED AND CLOSED WHEN THE GATE IS OPEN. THE SPARK GAP USED WITH THE GATE SWITCH ASSEMBLY SHALL COMPLY WITH SPECIFICATION BBB1616 AND DRG BBB0906.
10. SUPPORT STEEL STRUCTURES OF CURRENT TRANSFORMERS INSTALLED BETWEEN PRIMARY CIRCUIT BREAKER AND MAIN TRANSFORMER SHALL BE CONNECTED TO THE AC EARTH LEAKAGE SYSTEM.
11. AC/DC MOTORISED LINKS FRAME WORK SHALL BE CONNECTED TO THE DC EARTH LEAKAGE BUSBAR.
12. FOR CONNECTION OF HIGH VOLTAGE LIGHTNING ARRESTER INSTALLED ON CROSS ARM SEE DRG. NO. BBB0938.
13. CHANGE OF CURRENT TRANSFORMER BETWEEN CIRCUIT BREAKER AND TRANSFORMER WITH FRAMEWORK CONNECTED ON AC EARTH LEAKAGE: IF THERE IS NOT SUFFICIENT SPACE FOR THE CURRENT TRANSFORMER IT MAY BE INSTALLED BETWEEN THE AC DISCONNECT AND AC CIRCUIT BREAKER WITH THE FRAMEWORK CONNECTED TO AC EARTH.
14. IN CASE OF RAILS BEING USED AS AC EARTH SYSTEM IN THE HV YARD, THE CONNECTION TO THE FENCE SHALL BE DOUBLE 160mm² ALUMINIUM CONDUCTORS.



INSET "A"

DIMENSIONS : mm	SCALE : NTS	DO REF : CDO/ E0759	+ 18/03/2025 APPROVED: B L NGOBENI
TOLERANCE : LIN ± - ANG ± -	ITEM NO : -	ECP REF : -	
MATERIAL : -		DRAWN : XR BHOMELA	
VERSION INFO : CONNECT CURRENT TRANSFORMER TO THE AC EARTH LEAKAGE SYSTEM		DESIGNED : -	+ AUTHORISED: T CHETTY
		CHECKED : LS KEKANE	

ALTERNATIVE 3kV DC EARTHING ARRANGEMENT FOR HIGH VOLTAGE OUTDOOR YARDS (USED RAILS)

TRANSNET freight rail

BBB3620 SHEET 1

VERSION 9

A2

TRANSNET
freight rail

A Division of Transnet SOC Limited

TECHNOLOGY MANAGEMENT SPECIFICATION

REQUIREMENTS FOR A 1.8 Milli Henry DC REACTOR FOR 3kV DC TRACTION SUBSTATIONS.

Author:	Chief Engineering Technician Technology Management	B.L. Ngobeni	
Approved:	Senior Engineer Technology Management	L.O. Borchard	
Authorised:	Principal Engineer Technology Management	S.E. Sibande	

Date: 17 October 2016

Circulation Restricted To:

Transnet Freight Rail - Chief Engineer Infrastructure
- Technology Management

TABLE OF CONTENTS

1.0 SCOPE

This specification covers the design and supply of a 1.8 milli Henry DC reactor for 3kV DC traction substations.

2.0 BACKGROUND

The DC reactor is installed in series with the 3kV DC output of the rectifier of the traction substation. The reactor protects the system against the rise of current under fault conditions and reduces harmonics generated by the rectifier.

3.0 STANDARDS AND PUBLICATIONS

The reactor shall comply with all relevant requirements of the latest editions of the following standards and publications unless otherwise specified.

3.1 SOUTH AFRICAN NATIONAL STANDARDS

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 60815: Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles.

3.2 TRANSNET FREIGHT RAIL

BBB0041: Preparation of Drawings for Transnet Freight Rail Infrastructure.

BBB5994: Technical Documentation Management Policy.

4.0 TENDERING PROCEDURE

4.1 Tenderers shall indicate clause by clause compliance with the specification. This shall take the form of a separate document listing all the specifications clause numbers indicating the individual statement of compliance or non-compliance.

4.2 A statement of non-compliance shall be motivated by the tenderer.

4.3 Equipment type test certificates as specified shall be submitted with the tender. These shall be in English or a certified translation.

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

4.5 Failure to comply with clauses 4.1, 4.2, 4.3 and 4.4 could preclude a tender from consideration.

5.0 SERVICE CONDITIONS.

5.1 ATMOSPHERIC CONDITIONS

5.1.1 The reactor shall be designed to operate under the following service conditions.

Altitude:	0 – 1800 meters above sea level.
Ambient Temperature Range:	-10°C to +55°C.
Relative Humidity:	10% to 90%
Lightning Conditions:	12 Ground flashes per square kilometre per annum.

5.2 ELECTRICAL CONDITIONS

5.2.1 Nominal voltage 3150V DC which can vary between 2,4kVDC and 3,9kV DC.

5.3 MECHANICAL CONDITIONS

5.3.1 The reactor will be subjected to vibrations as it is installed in close proximity to railway lines.

6.0 TECHNICAL REQUIREMENTS

6.1 The reactor shall be designed for indoor installation.

6.2 The inductance of reactor shall be 1.8 milli-Henry

6.3 The reactor shall be air cored and naturally air cooled.

6.4 The continuous full load current rating of the reactor is be 1500 Amperes, but the reactor may subjected to the following overload conditions:

2 times full load for thirty minutes.

3 times full load for one minute.

3 ½ times full load for ten seconds.

6.5 The rated short time current shall be at least 30kA for 200milli seconds.

6.6 The mechanical withstand force shall be at least 70kA peak.

6.7 The reactor and its support insulators shall be capable of withstanding the forces generated under the voltage and current conditions in clauses 6.4 and 6.5.

6.8 The reactor shall be terminated with two terminating bars minimum size 100mm X10mm thick.

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

6.10 The supplier shall submit details of the total height, outside diameter and net mass of the reactor to Transnet Freight Rail as certain substations have space constraints.

7.0 INSULATION AND CLEARANCES

7.1 The reactor with its support insulators shall be able to withstand a test voltage of 10,5kV AC rms for one minute to earth.

7.2 The selection and testing of the insulators shall be done in accordance to SANS 60815 and SANS 60168.

7.3 The minimum clearance between the reactor and any metal frame and earth shall be not less than 100mm.

7.4 The insulation temperature index shall be class F with a limiting ambient temperature of 40°C.

7.5 If epoxy resin impregnation is offered the tenderer shall supply full electrical, mechanical and chemical details thereof.

8.0 INSPECTION AND TESTING.

8.1 Transnet Freight Rail reserves the right to carry out inspection and any tests on the equipment at the works of the supplier/ manufacture.

8.2 Arrangements must be made timeously for such inspections to be carried out before delivery of the equipment to the client.

9.0 QUALITY ASSURANCE

9.1 Transnet Freight Rail reserves the right to carry out inspection and tests on the equipment at the works of the supplier/manufacturer.

9.2 Arrangements must be made timeously for such inspections and tests in accordance with the equipment specifications are carried out before delivery of the equipment to the site.

9.3 Test sheets of the equipment shall be forwarded to the Project Manager.

10.0 DRAWINGS, INSTRUCTION MANUALS AND SPARES LISTS

10.1 Drawings, instruction manuals and spare parts catalogues shall be supplied in accordance with Transnet Freight Rail specification BBD5994.

10.2 The preparation of the drawings shall comply with Transnet Freight Rail's specification BBB0041.

10.3 The contractor shall submit details of spares required in accordance with specification No. BBD5994.

10.4 All spares recommended for normal maintenance purposes that are not available locally (requires importation) must be highlighted.

11.0 GUARANTEE AND DEFECTS

11.1 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 design, materials and workmanship.

11.2 The guarantee period for all substations shall expire after:- A period of 12 months commencing on the date of completion of the contract or the date the equipment is handed over to Transnet Freight Rail whichever is the later.

11.3 Any specific type of fault occurring three times within the guarantee period and which cannot be proven to be due to other faulty equipment not forming part of this contract e.g., faulty locomotive or overhead track equipment, etc., shall automatically be deemed an inherent defect. Such inherent defect shall be fully rectified to the satisfaction of the Maintenance manager and at the cost of the Contractor.

11.4 If urgent repairs have to be carried out by Transnet Freight Rail staff to maintain supply during the guarantee period the contractor shall inspect such repairs to ensure that the guarantee period is not affected

11.5 Should the repairs be covered by the guarantee, the contractor shall reimburse Transnet Freight Rail the cost of material and labour

END

A Division of Transnet SOC Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

REQUIREMENTS FOR TRACTION TRANSFORMERS FOR 3kV DC TRACTION SUBSTATIONS

Author:	Chief Engineering Technician Technology Management	B.L Ngobeni	
Approved:	Senior Engineer Technology Management	T. Chetty	
Authorised:	Principal Engineer Technology Management	K. Motupa	

Date: 29 November 2024

Circulation Restricted To:

Transnet and Relevant Third Parties

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LIST OF AMENDMENTS TO THE SPECIFICATION

Version No.	Date Issued	Clause No.	Page No.	Remarks
06	07/11/2018			Original version
06	30/06/2021			Technical documentation requirements revised. One copy instead of two copies required.
07	16/09/2021			POPIA declaration statement inserted
				Appendix B Technical data sheet structure re-numbered
				Definitions and abbreviations added to the document
				Method of tendering changed to technical compliance
				Documents requirements divided into documents to be submitted by all tenderers and documents to be submitted only by the successful tenderer
07		6.8.4		Clause added
07		8.4		Clause added
07				Re-numbering of the entire document
07		10.0		Clauses re-numbered and added
07		11.0		Clauses added

TABLE OF CONTENTS

1.0 SCOPE

1.1 This specification details Transnet's requirements for the design, manufacture, testing and delivery of traction transformers for 3kV DC traction substations.

1.2 This specification contains schedule of requirements (Appendix A) which must be completed by the relevant Transnet Representative.

1.3 This specification contains a technical datasheet (Annexure B) which must be completed by the tenderer and must be submitted as part of the tender documents.

2.0 BACKGROUND

2.1 Transnet's traction substations consist of single or double-units', each unit has a traction transformer which supplies either a 6 - pulse or 12 - pulse rectifier configurations.

2.2 Each rectifier unit comprises of a set of high voltage AC disconnects, primary circuit breaker, two current transformers, two sets of lightning arrestors and a traction transformer connected for six or twelve-pulse rectification with its control and protection circuitry.

3.0 ABBREVIATIONS

AC:	Alternating Current
Hz:	Hertz
kA:	kilo Ampere
kV:	kilo Volt
MΩ:	Mega Ohm
OEM:	Original Equipment Manufacturer
V:	Volt

4.0 NORMATIVE REFERENCES

Unless otherwise specified all materials used, equipment developed and supplied shall comply with the latest edition of the relevant International Electro-technical Commission (IEC), International Organization for Standardization (ISO), South African National Standards (SANS) or Transnet's publications.

4.1 SOUTH AFRICAN NATIONAL STANDARDS

SANS 121:	Hot Dip Galvanized Coatings on Fabricated Iron and Steel articles.
SANS 555:	Unused and reclaimed mineral insulating oils for transformers and switchgear.
SANS 1019:	Standard voltages, currents and insulation levels for electricity supply.
SANS 1091:	National Colour Standards.
SANS 9001:	Quality Management Systems – Requirements.
SANS 10142-1:	The wiring of premises Part 1- Low voltage installations.
SANS 60076-1:	Power Transformers Part 1- General.
SANS 60076-2:	Power Transformers Part 2- Temperature rise for liquid immersed transformers.
SANS 60076-3:	Power Transformers Part 3- Insulation levels, Dielectric tests and External clearances in air.
SANS 60076-5:	Power Transformers Part 5- Ability to withstand short circuit.
SANS 60076-7:	Power Transformers Part 7- Loading Guide for Oil-immersed Power Transformers.
SANS 60076-10:	Power transformers Part 10: Determination of sound levels.
SANS 60076-18:	Power transformers Part 18: Measurement of frequency response.

SANS 60137:	Insulated Bushings for Alternating Voltages above 1000V.
SANS 61869-2:	Instrument Transformers Part 2- Current Transformers.

4.2 TRANSNET'S PUBLICATIONS

BBH7364:	Transformer Oil Valve Cover
CEE 0045:	Painting of Steel Components of Electrical Equipment.
CEE 0224:	Drawings, Catalogues, Instruction manuals and Spare lists for electrical equipment supplied under the contract.

5.0 SERVICE CONDITIONS

5.1 ENVIRONMENTAL CONDITIONS

Altitude:	0 - 1800 m above sea level
Relative humidity:	10% to 90%
Ambient temperature:	-10° C to +55° C
Wind pressure:	750 Pa
Lightning conditions:	20 ground flashes/km^2 per annum
Pollution:	Heavily salt laden with industrial pollutants
	Including diesel- electric locomotive emissions.

5.2 MECHANICAL SERVICE CONDITIONS

The transformers are installed in substations next to or within close proximity of railway tracks and will be subjected to vibration from the trains.

5.3 ELECTRICAL SERVICE CONDITIONS

5.3.1 Frequency: The frequency of the AC High Voltage supplied by the utility will be 50 ± 2.5 Hz.

5.3.2 Supply Voltage: Under normal conditions the system supply voltage will be maintained at ±5% of the nominal voltage over a 24-hour period. Under crippled supply network conditions, the voltage can be expected to drop up to 15%.

6.0 TECHNICAL REQUIREMENTS

6.1 GENERAL

6.1.1 Unless specified the transformers shall be for outdoor use and of the oil natural air natural (ONAN) cooled type and shall comply with specification SANS 60076-1.

6.1.2 All components used in the traction transformer shall be free from polychlorinated biphenyls (PCB free).

6.1.3 The design of the transformers shall be such that harmonic disturbances are minimised.

6.1.4 The primary winding of the main traction transformer shall be star connected.

6.1.5 The configuration of the secondary winding shall either be two separated delta windings giving +15° and - 15° phase shift on the respective secondary windings or two separated delta and star windings which achieve the same desired phase shift as the delta-delta windings. The secondary winding shall consist of six phases and the output voltage of each phase shall be approximately from 1220V to 1440V depending on the vector group.

6.1.6 The secondary windings shall be designed to be compatible with 6 or 12 pulse rectifier units.

6.1.7 The substation Senior Electrical Engineer at Transnet Freight Rail – Technology Management shall be consulted to accept before any transformer design is finalized.

6.1.8 Provision shall be made for a three-phase tertiary winding on the secondary side of the transformer to supply the auxiliary transformers. The winding may be tapped off the secondary winding or be separately wound. The tertiary winding shall have separate bushings for connection to the auxiliary transformer. The tertiary voltage shall match that of auxiliary transformer primary voltage.

6.1.9 The tertiary winding shall be rated to supply a 50kVA 400V 3-phase auxiliary transformer (230V AC single phase) unless otherwise specified.

6.2 TEMPERATURE RISE AND RATING

6.2.1 The temperature rise of the transformer windings after thermal equilibrium and a steady temperature has been reached on continuous full load, shall not exceed 65°C.

6.2.2 The maximum temperature rise of the windings subsequent to the application of any of the following rectifier overloads, after the constant continuous rated full load temperature has been attained are as follows:

- 3 x full load for 1 minute the temperature rise of the windings shall not exceed 70°C.
- 3.5 x full load for 10 seconds the temperature rise of the windings shall not exceed 70°C.
- 2 x full load for 30 minutes the temperature rise of the windings shall not exceed 100°C.

6.2.3 The temperature rise of the windings shall be measured by the increase of resistance method. Standard correction for cooling during the measurement of resistance shall be applied.

6.3 VOLTAGE RATIO AND TAPPINGS

6.3.1 The transformer shall be designed to operate at the nominal system voltage as specified in the schedule of requirements

6.3.2 Tapings shall be provided on the primary windings. (5 tap position). The tap range shall be +2,5% and -2,5%, and +5% and -5% of the nominal voltages.

6.3.3 The transformers shall supply full load output at all tapings.

6.3.4 The full load voltage regulation of the transformer shall not be more than 5%.

6.3.5 The tap changing gear shall be externally, manually operated, positively locking, off load type. The arrangement shall be such that excessive backlash will not affect the making of proper contact when the tap changing gear is operated in either direction. Rotary type having high-pressure type contacts must be used.

6.3.6 The tap changing switch shall be lockable with provision for a padlock.

6.3.7 The positions of the tap changing switch shall be clearly marked.

6.4 BUILT IN CURRENT TRANSFORMERS

6.4.1 Where build-in current transformers are required, the transformer’s functionality shall be in accordance with SANS 61869-2. The ratings of the current transformers shall be sent to Technology Management for approval.

6.5 TRANSFORMER IMPEDANCE

6.5.1 The transformer impedance shall be as high as possible taking into account the voltage regulation as specified in clause 6.3.3 but shall not be less than 8 %.

6.6 MECHANICAL STRENGTH OF TRANSFORMER WINDINGS

6.6.1 The transformer windings shall be able to withstand the electromagnetic and mechanical stresses caused by high fault currents.

6.6.2 In the adjudication of tenders particular attention will be given to:

- The mechanical design of the solid bolted clamping arrangement of the windings.

- The coil stacks in order to withstand short circuit forces.
- The methods employed to ensure thorough pre-shrinking and pre-stressing of the coils.

6.6.3 Tenderers shall describe fully with the aid of detailed drawings of the construction of the windings and clamping arrangements.

6.6.4 Tenderers shall quote for transformers having the following design features listed below. No alternative to the requirements laid down in the following sub clauses will be considered unless complete details are submitted giving the advantages and improvements that will result:

6.6.4.1 Primary and secondary coil stacks shall be provided with solid bolted clamping arrangements which will distribute the clamping force over the whole end periphery of each coil stack.

6.6.4.2 Tenderers shall state the actual force anticipated under the worst fault conditions and the effective force applied by the clamping bolts on each winding.

6.6.4.3 Round conductor shall not be used for any windings.

6.6.4.4 High voltage windings shall be of the continuous disc type while low voltage windings shall be of the helix winding type.

6.6.4.5 Reliance shall not be placed on any resin used on the windings for increasing the mechanical stability of the coils, nor shall such resin have any detrimental effect on the transformer oil.

6.6.4.6 If laminated insulating material is subjected to mechanical compression forces, the construction shall be such that these forces are normal to the plane of the laminations.

6.6.4.7 All spacers and clacks on packing shall be suitably locked in position. Reliance shall not be placed on the pressure applied to the windings, or an adhesive, to keep the packing pieces in position.

6.6.4.8 The end frames shall be well braced and be of substantial construction.

6.6.4.9 The internal copper connections between the windings and connections to the leads shall be crimped and bolted.

6.6.4.10 Only high tensile steel bolts shall be used for the bolted connections.

6.6.4.11 The nuts of the bolted connections shall be torqued to the following recommended values to ensure a good stable electrical contact between the mating surfaces:

Bolt Size	Torque value
M10	35.5NM
M12	61.3NM
M16	147 NM

6.6.4.12 Standard machine locknuts or approved locking plates shall be used to lock the nuts of the bolted connections.

6.7 INSULATION LEVELS

6.7.1 Transformer bushings shall comply with SANS 60137.

6.7.2 Test voltages and minimum creepage distances for normal and polluted atmospheres shall be in accordance with SANS 60137.

6.8 INSULATION OF WINDINGS

6.8.1 The transformers are required to operate in severe lightning areas. Surge arresters will be connected between the high voltage busbars and the substation earth. The neutral of the primary Star connected windings is not required to be brought out.

6.8.2 All windings are to be fully insulated. Full and detailed particulars of the insulation and methods employed to reduce the risk of damage by overvoltage caused by system surges and lightning must accompany the tender.

6.8.3 The primary and secondary windings shall be insulated to withstand the test pressures referred to in SANS 60076-1. The secondary windings must be insulated for a system highest voltage of 7,2 kV.

6.8.4 All the transformer windings shall be designed to have uniform insulation, to reduce the risk of partial discharge and improve the thermal stability of the transformer.

6.9 TERMINALS AND BUSHINGS

6.9.1 All terminals shall be extended to the top of the transformer tank through suitable outdoor type bushings.

6.9.2 The bushings shall conform to the insulation levels as specified in SANS 60137 for the system nominal supply voltage at which the equipment must operate.

6.9.3 All bushings, stems and terminals shall be of sufficient size to ensure sufficient mechanical strength of attaching and supporting external connections and shall not be smaller than
a) 19 mm diameter for primary and secondary connections.
b) 12 mm diameter for auxiliary supply connections.

6.9.4 Provision shall be made for an earthing terminal fitted on the outside of the transformer tank for the connection of a 95 mm^2 cable.

6.9.5 The height of the wall bushings of the substation is 2,8 meters above ground level. Should the design of the transformer offered be such that the total height of the transformer and secondary bushings is less than 2,7 meters, screens must be provided. Tenderers must include the provision of screens in their offer. Details of the screens shall be submitted to Transnet Freight Rail Technology Management – Senior Electrical Engineer for approval.

6.9.6 The clearance from the lowest, high voltage connection of the transformer to the finished ground level shall not be less than 3,6m for supply voltages up to 88kV, and not less than 4,1m for supply voltages exceeding 88kV.

6.10 TANK AND COOLING RADIATORS

6.10.1 The transformer tank shall be constructed of steel plate not less than 6 mm thick.

6.10.2 Transformers shall not be fitted with rollers, but be provided with a substantial base, which will enable it to be supported on steel skid rails, which are embedded in a concrete plinth. The spacing between centres of the skid rails is 1000 mm.

6.10.3 Provision shall be made on the transformer base for the attachment of a tackle for this purpose.

6.10.4 Four jacking lugs shall be provided for lifting the transformer complete with oil. Tenderers shall submit dimensioned drawings showing details of the tank and base construction.

6.10.5 Transformers shall be fitted with detachable radiators with drain and filling plugs.

6.10.6 Provision shall be made for radiator shut off valves to allow the removal of the radiators without having to drain the oil from the transformer tank.

6.10.7 The design of the cooling radiators shall ensure sufficient circulation of cooling oil.

6.10.8 Hot dipped galvanized radiators shall be used for coastal areas or where specified. The radiators shall be galvanized in accordance to the requirements of SANS 121.

6.10.9 The transformer cover shall be bolted to the tank. For this purpose, a flange will be embedded on to the tank. An “O-ring” gasket will be installed between the cover and the tank to prevent oil leaks.

6.10.10 All access covers shall be bolted to the transformer tank and shall be provided with “O-rings” to prevent oil leaks. And they shall have handles and lifting lugs.

6.11 FITTINGS ON THE TRANSFORMERS

The following fittings shall be provided:

6.11.1 Conservator tank with a silica gel dehydrating breather, oil level gauge and drain cock.

6.11.2 The connecting pipe to the conservator shall extend at least 50mm into it. All pipe connections shall have flange joints.

6.11.3 Where specified in Appendix A, the conservator shall be provided with a sealed oil preservation bag:

6.11.3.1 The bag shall not restrict the normal draining of the conservator or the flow of oil to the transformer.

6.11.3.2 The bag shall allow for expansion without any increase in pressure or the causing of a partial vacuum over the specified temperature range.

6.11.4 The transformer shall be fitted with a weatherproof dial type thermometer graduated in °C for registering “top oil” temperature. The instrument shall be fitted with a resettable maximum temperature indicator.

6.11.5 Adjustable contacts shall be fitted to the thermometer. The contacts shall normally be set to operate at a temperature of 90°C. The trip contacts shall be liberally rated and adequate for closing at 110 volts, and at least 6 Amperes DC circuits. If not suitable, auxiliary relays may be provided.

6.11.6 A single—float Buchholz relay fitted with contacts for trip and alarm functions.

6.11.7 A thermal type overload relay to protect the transformer windings against sustained overloads. This relay shall have a load—temperature characteristic approximately the same as the transformer winding hot spot. Suitable means for compensation for variation of ambient air temperature shall be provided. Full details shall be submitted.

6.11.8 The relay shall be provided with trip contacts. The tenderer is to recommend the temperature setting for these contacts, which are normally set at 115 °C. The trip contacts shall be liberally rated and adequate for closing 110 volt, 6 Ampere DC circuits. If not suitable, auxiliary relays shall be provided.

6.11.9 A drain cock, two sampling cocks and thermometer pockets on the main tank.

6.11.10 A pipe entering the top of the main tank at the conservator end, with a cock easily accessible from ground level, and one cock on the opposite side of the main tank, at its lowest point, for connecting up to an oil filtering system. The cocks shall be screwed 50mm gas or metric equivalent female thread. If desired, the cock at the lowest point of the tank can be combined with the drain cock required in clause 6.11.9 by the addition of a suitable fitting having a 50mm gas or metric equivalent female thread.

6.11.11 A suitable pressure relief device fitted on the main tank if it is considered necessary by the manufacturer. The provision of the pressure relief device shall not affect the efficiency of the Buchholz relay in the event of a transformer fault.

6.11.12 Tenderers shall ensure that the pockets for the temperature indication are located in areas where the oil is freely circulating, thus avoiding the possibility of incorrect oil temperature measurement. Ambient temperatures can be very high in summer, and the location of the thermometer pockets must take solar radiation into account.

6.11.13 Where a marshalling box is fitted to the transformer the degree of protection shall be IP55 and corrosion protected.

6.11.14 The drawings of the connection of the marshalling box must be provided and be kept in a marshalling box.

7.0 CORROSION PROTECTION AND PAINTING

7.1 PREPARATION OF TRANSFORMER TANK

7.1.2 Rust and milliscale shall be removed by shot blasting or acid cleaning. Welds which are not ground smooth shall be shot blasted or otherwise descaled and cleaned.

7.2 PAINTING

7.2.1 The outer surface of the transformer tank shall be painted Grey to the colour code G12 in accordance with SANS 1091. The conservator shall be painted white. The total paint thickness shall be at least 75 microns. For coastal or heavily polluted conditions it shall be at least 125 microns.

7.2.2 Internal surfaces of the conservator above oil level shall be cleaned and painted with one coat of oil resistant rust inhibiting etch primer. The radiators shall be hot dipped galvanized. It is recommended that galvanized radiators used at heavily polluted areas be painted.

8.0 TRANSFORMER OIL

8.1 Only unused mineral insulating oil shall be used.

8.2 The transformer oil shall meet with the requirements specified in SANS 555.

8.3 The oil shall be readily miscible with the oil supplied in conformity with the above mentioned specification by the major oil companies in South Africa, without detriment to the chemical, physical and electrical properties of the oil.

8.4 Transformer oil valve at the bottom shall be covered in accordance with drawing BBH7364.

9.0 RATING PLATE AND INSTRUCTION LABELS

9.1 A none—corrosive metal plate shall be fixed to each transformer tank (not cooling tubes), giving the following information:

- Maker’s name.
- Maker’s serial No.
- Transnet Freight Rail’s serial No. (Left blank).
- Rated output in MVA.
- Frequency.
- Secondary voltage and current.
- Primary voltage and current.
- Primary voltage tapings.
- Transformer reactance (%).
- Transformer impedance (%).
- Vector diagram.
- Diagram of connections.
- Quantity of oil in litres.
- Conservator fitted with bag.
- Total mass of transformer inclusive of oil in kg.
- Transport mass of transformer in kg.
- Year of manufacture.

9.2 Drawings, instruction manuals and spares lists shall be supplied in accordance with Transnet Freight Rail’s specification CEE.0224.

9.3 Three copies of each of the following drawings shall be submitted to the responsible project manager for approval within 7 days of the order being placed.

9.3.1 Dimension drawings showing external arrangements of transformer.

9.3.2 External wiring diagrams for the transformer.

9.3.3 Vector diagram and rating plate.

10.0 TESTING AND INSPECTIONS

10.1 Transnet reserves the right to be present at all tests (including type tests) and inspections called for in this specification.

10.2 The responsibility of arranging the tests called for in this specification rests with the successful tenderer/supplier.

10.3 A Transnet Freight Rail, Technology Management (Senior Electrical Engineer for substations) may request any additional tests deemed necessary to ensure compliance.

10.4 Type and routine tests shall be carried out on the transformers in accordance with the current editions of SANS 60076.

10.5 Type tests certificates are required for all new designs of any transformer.

10.6 If the supplier does not have type tests certificates from the OEM, they shall arrange for tests to be conducted at their own costs in the presence of Transnet Freight Rail – Quality Assurance team.

10.7 Transnet Freight Rail shall be provided with type test certificates and two copies of test sheets, which record the values of the routine tests, or special tests that are carried out on the transformers written in English.

10.8 Heat runs shall be carried on the first transformers of a specific design.

10.9 The temperature rise of the transformer windings after thermal equilibrium and a steady temperature has been reached on continuous full load, shall not exceed 65°C. 2 x full load for 30 minutes the temperature rise of the windings shall not exceed 100°C.

10.10 The maximum temperature rise of the windings subsequent to the application of any of the following rectifier overloads after the constant continuous rated full load temperature has been attained are as follows:

- 3 x full load for 1 minute the temperature rise of the windings shall not exceed 70°C.
- 3.5 x full load for 10 seconds the temperature rise of the windings shall not exceed 70°C.

These values can be proved by calculations

10.11 The temperature rise of the windings at 100% and 200% shall be measured by the increase of resistance method. Standard correction for cooling during the measurement of resistance shall be applied.

10.12 Insulation resistance – Meggering:

10.12.1 A minimum resistance of 1000 MΩ is required between any winding and earth and between windings.

10.12.2 A minimum resistance of 500 MΩ is required between the core and earth or core clamps.

10.13 Sound level determination shall be done in accordance to SANS 60076 part 10.

10.14 Sweep frequency response analysis shall be done in accordance to SANS 60076 part 18.

11.0 COMMISSIONING

11.1 Commissioning shall only take place after all defects have been rectified to the satisfaction of the Maintenance Manager.

11.2 Commissioning shall include the energising of equipment from the primary isolator to the track feeder circuits. The contractor must prove the satisfactory operation of equipment under live conditions.

11.3 On completion of commissioning the contractor shall hand the equipment over to the Maintenance Manager.

11.4 Functional Acceptance by the Maintenance Manager 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.

12.0 QUALITY ASSURANCE

12.1 The successful tenderer shall maintain a Quality Management System (QMS) based on or certified to ISO 9001.

13.0 GUARANTEES AND DEFECTS

13.1 The successful tenderer shall accept liability for makers' defects, which may appear in design, material and workmanship.

13.2 The guarantee period for the transformer shall expire after a period of 12 months commencing on the date of commissioning of the equipment.

13.3 The successful tenderer shall provide all information regarding guarantees and warranties in writing.

END

14.0 APPENDIX A: SCHEDULE OF REQUIREMENTS

(To be completed by Transnet Representative)

1.0 Transformer required for: Aberdeen substation/location

2.0 Nominal system voltage: 88 kV

3.0 Frequency: 50 Hz

TRANSFORMER DETAIL

1.0 Number of phases: Primary winding: 3 Secondary winding: 6

2.0 Secondary winding configuration: LV1:Delta LV2:Star

3.0 Rated power: 6 MVA

4.0 Impedance %: 10.37

5.0 Primary voltage rating: 88 kV

6.0 Secondary voltage rating: 3 kV

7.0 Vector group: _____

CURRENT TRANSFORMERS

1.0 Built in current transformers required (Yes/No): No.

2.0 Current transformer data:

	Protection	Metering
Ratio:	100/5	100/1
Class:	10p10	10p10
VA Rating	15 VA	15 VA

OFF CIRCUIT TAPPING SWITCH

1.0 No of positions: 5 %Steps: 2

TRANSFORMER DIMENSIONS

1.0 Dimensions (if critical)

Length: -- mm. Breadth: -- mm. Height: -- mm

SPECIAL REQUIREMENTS

1.0 Conservator to be fitted with oil preservation bag. Yes / ~~No~~

2.0 Radiators galvanised. Yes / ~~No~~

3.0 Transformer oil valve cover in high theft areas (BBH7364): Yes / ~~No~~

Other special requirement:

……

……

Completed by:	Nomveliswa Ndaba
Capacity:	Engineering Technician
Signature:	
Date:	22/01/2026

15.0 APPENDIX B: TECHNICAL DATA SHEET

(To be completed by the tenderers and submitted as part of their tender)

Supplier and Manufacturer's name:……

TRANSFORMER DETAILS

15.1 Primary voltage rating:……KV

15.2 Secondary voltage rating:……..KV

15.3 Rated power:……MVA

15.4 Impedance:……..%

15.5 Off Circuit Tap Switch: No of positions:…….. %Steps:…….

15.6 Vector group:……

TANK AND TANK COVER

15.7 Free-breathing: Yes/No

15.8 Tank cover bolted to tank: Yes/No

15.9 Radiators galvanised: Yes/No

15.10 Method of Cooling:…….

15.11 Overall dimensions: Length…….mm. Breadth……mm. Height……mm

15.12 Winding material: HV……LV……

15.13 Mass of core and windings:……Kg

15.14 Oil Capacity :……..(Litres)

15.15 Mass of transformer complete with oil:……..……Kg

15.16 Adjustable axial coils provided: Yes/No

15.17 Type of breather and dehydrating agent:…….

The following information refers to the transformer when connected on the principal tapping and appropriate reference temperature for the class of insulation used:

15.18 Iron loss (Watts):……...

15.19 Copper loss at full load:……at……°C

15.20 Total load losses (Watts):……at……°C

15.21 Impedance at full load (%Z):……

15.22 Reactance (% X):……

15.23 Regulation at full load at: 1.0 PF……..%, 0.8 PF…… % at……°C

15.24 Efficiency at full load at: 1.0 PF……..…. %, 0.8 PF……..…% at……°C

15.25 Temperature rise at rated voltage and power of:

Windings:……°C Top oil:……°C

15.26 Temperature rise at rated voltage and 2 times rated power of:

Windings:……°C

A Division of Transnet SOC Limited

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TECHNOLOGY MANAGEMENT

SPECIFICATION

OUTDOOR, HIGH VOLTAGE, ALTERNATING CURRENT DISCONNECTORS COMBINED WITH EARTHING SWITCHES

Author:	Chief Engineering Technician Technology Management	B.L Ngobeni	
Approved:	Senior Engineer Technology Management	S. Smit	
Authorised:	Chief Engineer Technology Management	N. Gobhozi	

Date: 07 November 2021

Circulation Restricted To:

Transnet and Relevant Third Parties

LIST OF AMENDMENTS TO THE SPECIFICATION

Version No.	Date Issued	Clause No.	Page No.	Remarks
1	18th Oct 2004	All	All 11	Original Document.
2	2021	All	All	Document template changed.
				All the Clauses re-arranged and background added.

TABLE OF CONTENTS

1.0 SCOPE

1.1 This specification details Transnet's requirements for the supply of outdoor, 2 or 3 phase, 50 hertz AC disconnects combined with automatic earthing switches for high voltage supplies.

1.2 Equipment is required for installation at the end of overhead transmission lines to control the power supply to traction substations and step- down points and shall consist of a 2 pole for 25kV AC or 3 pole for 3kV DC substations. Disconnects to be connected to the line and provided with facilities to earth the "load" side of the circuit.

1.3 This specification contains schedule of requirements (Appendix A) which must be completed by the relevant Transnet Representative.

1.4 This specification contains technical datasheet (Annexure B) which must be completed by the tenderer and must be submitted as part of the tender documents.

2.0 BACKGROUND

2.1 Traction substations are supplied via transmission lines from Eskom and in some areas, the local municipality. The supply point is connected to the high voltage yard of Transnet traction substations via AC disconnecting switches.

AC disconnect switches are used for isolating the Eskom/Municipal supply from the traction substation in order to conduct maintenance on the load side. This AC disconnects are electrical interlocked with primary circuit breakers and are provided with automatic earthing contacts blades that operate during opening. AC disconnects should be operated under no-load (off-load) condition.

3.0 NORMATIVE REFERENCES

Unless otherwise specified all materials used, equipment developed and supplied shall comply with the latest edition of the relevant International Organization for Standardization (ISO), South African National Standards (SANS) or Transnet publications.

3.1 ISO STANDARD:

3.1.1	ISO 9001	Quality Management systems.

3.2 SANS STANDARD:

SANS 121:	Hot dip galvanized coatings on fabricated iron and steel articles.
SANS 10280:	Overhead power lines for conditions prevailing in South Africa Part 1: Safety.
SANS 60273:	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000 V.
SANS 60529:	Degrees of protection provided by enclosures (IP Code).
SANS 60815:	Selection and dimensioning of high-voltage insulators intended for use in polluted conditions.
SANS 62271-102:	High voltage switchgear and controlgear part 102: Alternating Current disconnectors and earthing switches.

3.3 TRANSNET'S PUBLICATIONS

BBF3690	Electrical Safety Instructions.
CEE.0224:	Drawings, catalogues, instruction manuals, spares list for electrical equipment supplied under contract.

4.0 SERVICE CONDITIONS

4.1 ENVIRONMENTAL CONDITIONS

Altitude:	0 - 1800 m above sea level
Relative humidity:	10% to 90%
Ambient temperature:	-10° C to +55°C
Wind pressure:	750 Pa
Lightning conditions:	20 ground flashes/km2 per annum
Pollution:	Heavily salt laden with industrial pollutants
	including diesel- electric locomotive emissions.

4.2 MECHANICAL SERVICE CONDITIONS

4.2.1 Traction substations are situated next to railway lines and the equipment will therefore be subjected to vibration. The design must take appropriate counter measures to ensure reliability of equipment that is sensitive to vibration.

4.3 ELECTRICAL SERVICE CONDITIONS

4.3.1 The incoming high voltage supply to the traction substations shall be 44/66/88/132KV or 220kV AC depending on the electrical supply from Eskom and Municipality at a frequency of 50 ± 2.5 Hz.

4.3.2 The AC supply voltage can vary within ±5% of the nominal system r.m.s voltage. Under crippled conditions the supply voltage can drop to as low as minus 15% of the nominal r.m.s voltage.

5.0 TECHNICAL REQUIREMENTS

5.1 DISCONNECTS COMBINED WITH EARTHING SWITCHES

5.1.1 The combined disconnectors and earthing switches shall be designed, manufactured and tested in accordance with SANS 62271-102.

5.1.2 Disconnectors and earthing switches shall have been type tested to verify performance and safety. Proof of these tests in the form of type test certificates shall be included in the tender documents.

5.1.3 The disconnectors shall be provided with a means for earthing the "load" side of the circuit, either by means of a separate earthing switch interlocked with its operating mechanism or contacts so placed that when the disconnect is in the "open" position, the "load" side is earthed.

5.1.4 The disconnectors shall be of the air-break type with the blades operating in a horizontal plane.

5.1.5 The operation mechanism of the disconnectors shall either be manual for DC traction substations or motor operated for AC traction substations.

5.1.6 The operating mechanism shall be constructed of anti-corrosive material to prevent sticking due to rust. All ferrous material shall be galvanised.

5.1.7 The operating handle shall be provided with suitable attachments to enable it to be locked in the up (closed) position and in the down (open and earthed) position by standard locks, supplied by Transnet maintenance manager (Electrical).

5.1.8 The operating assembly shall be fixed at a satisfactory operating height of approximately 1m from the bottom of the structure.

5.1.9 A mechanism shall be provided to mechanically (Only required for DC subs) and electrically interlock (All substations) the operating handle with the associated primary circuit breaker to ensure that operation is only possible when the circuit breaker is in the "open" position. It must, however be possible to close the primary circuit breaker when the earthing switch is in the "earthed" position.

5.1.10 Electrical contacts shall be fitted to interlock the operating handle with the associated primary circuit breaker. In the event of accidental operation or movement of the operating handle the primary circuit breaker shall be tripped before the main contacts of the AC disconnects start opening.

5.1.11 A notice with the following inscription shall be mounted next to the operating mechanism:

"DO NOT OPERATE UNDER LOAD".

5.1.12 For disconnectors operated only by motor operating mechanism in AC traction substations, the motor shall be able to be operated by supply voltage of 48/110V DC from the substation batteries.

5.1.12.1 The motor shall be easy to operate, light in weight and able to be housed in a compact enclosure.

5.1.12.2 The motor shall be energy efficient and able to be operated for several times without draining the existing battery supply power.

5.1.12.3 The complete unit shall able to perform interlocking functions and be manual operated.

5.1.12.4 The motor enclosure shall have a protection degree of IP65 in accordance to SANS 60529.

5.2 SUPPORT STRUCTURES

5.2.1 The combined AC disconnects and earthing switches shall be rigidly mounted on robust, hot-dipped galvanised supporting steel structures or pedestals in accordance with SANS 121.

5.2.2 The supporting steel structures or pedestals shall provide a minimum clearance of 3,6 metres (up to 88 kV) or 4,1 metres (above 88 kV) from the lowest "live" high voltage connection to finished yard level. Outline drawings submitted with tenders must indicate the actual clearances proposed.

5.3 CONNECTIONS

5.3.1 All high voltage connections must be of the solderless, concentric grip, or other approved solderless type, and must be of adequate cross-sectional area to suit both electrical and mechanical requirements. All connections to the disconnects must be flexible so as not to affect smooth operation of the blade mechanism.

5.4 POST INSULATORS

5.4.1 All post insulators shall be designed, manufactured and tested in accordance with SANS 60273.

5.4.2 Creepage distances for heavy polluted atmospheres shall be in accordance with SANS 60815

5.5 CLEARANCES

5.5.1 The following minimum safety clearances shall be maintained between any live conductor and earthed metal as stated in SANS 10280: -

Table 1: Safety clearances

Nominal phase to phase r.m.s system voltage	44kV	66kV	88kV	132kV	220kV
Highest phase-to-phase r.m.s voltage for equipment.	48kV	72kV	100kV	145kV	245kV
Safety clearance	540mm	770mm	1000mm	1450mm	2100mm

6.0 TESTING AND INSPECTIONS

6.1 The tests shall be done in accordance with SANS 62271-102.

6.2 Transnet reserves the right to be present at all tests and inspections as called for in this clause.

6.3 The responsibility of arranging the tests called for in this clause rests with the successful tenderer.

6.4 Transnet reserves the right by prior arrangement to inspect the equipment at any stage during manufacture.

6.5 A Transnet Freight Rail, Technology Management (Electrical Technology) department representative may request any additional test deemed necessary to ensure compliance.

7.0 RATING PLATE AND INSTRUCTION LABELS

7.1 All nameplates and labels shall be in English.

7.2 Screws or rivets shall fix labels other than interchangeable labels.

7.3 All labels shall be made of composite sandwich type plastic material of the following colour combinations:

7.3.1 Identification labels: White lettering on Black background. Letters must be of sufficient size to be clearly legible from a distance of 3m.

7.3.2 Danger labels: White lettering on Red background. Letters must be of sufficient size to be clearly legible from a distance of 3m.

7.4 The following is the list of labels to be used:

On (1)
Off (0)
Open (Verb.)
Close (Verb.)

8.0 DOCUMENTATION REQUIREMENTS

8.1 The following technical documentations shall be submitted with tender:

8.1.1 One hard copy of the technical specification and detailed drawings.

8.1.2 One hard copy of the method of installation.

8.1.3 One hard copy of maintenance manual.

8.1.4 One hard copy of design and type test certificates to verify conformance to the requirements.

8.2 Supplier shall advise on how to dispose the equipment at the end of its operating life, taking into consideration environmental requirements and regulations.

9.0 QUALITY ASSURANCE

9.1 The successful tenderer shall maintain a Quality Management System (QMS) based on or certified to ISO 9001.

10.0 PACKAGING, STORAGE AND HANDLING

10.1 The equipment shall be packed in such a manner that it will be adequately protected during handling and transportation.

11.0 GUARANTEE AND DEFECTS

11.1 The appointed tenderer shall guarantee that the supplied AC disconnects with earthing switch conforms to Transnet's requirements.

11.2 The appointed tenderer shall accept liability for makers' defects, which may appear in design, material and workmanship.

11.3 The appointed tenderer shall provide all information regarding guarantees and warranties in writing

12.0 METHOD OF TENDERING

12.1 Tenderers shall indicate clause-by-clause compliance document with the specification. This shall take the form of a separate document listing each of the specification's clause and sub-clause numbers, indicating the individual statements of compliance or non-compliance.

12.2 The tenderer shall motivate statement of non-compliance, as per 12.1.

12.3 Tenderers shall submit comprehensive literature consisting of detailed technical specifications, general constructional details and principal dimensions, maintenance schedules, datasheets, together with clear illustrations of the equipment offered.

12.4 Any items offered in accordance with other standards will be considered at the sole discretion of Transnet. The tenderer shall supply full details stating where the item differs from these specifications as well as supplying a copy (in English) of the recognized standard specification(s) with which it complies. Any deviations must be approved by Transnet Freight Rail, Technology Management (Electrical Technology) department in writing.

12.5 Failure to comply with clauses 12.1, 12.2, 12.3 and 12.4 could preclude a tenderer from consideration.

12.6 In the event of any conflict between the various submitted relevant documents, the order of precedence shall be, and in consultation with Transnet Freight Rail, Technology Management (Electrical Technology) department:

a) Legal and safety requirements.

b) This Specification.

END

APPENDIX A: SCHEDULE OF REQUIREMENTS

(To be completed by Transnet Representative)

1.0 Required for…Boschmanskop..... (~~AC~~/DC) traction substation

2.0 Number of sets required…One……..…

3.0 Supply system Voltage:……132…… kV, 50 Hz, (3 phase/~~2 phase~~)

AC DISCONNECTS WITH EARTHING SWITCH

4.0 Rated voltage:……132……kV

5.0 Rated frequency: 50 Hz

6.0 Special requirements: .....…

.....

.....

.....

.....

.....

Completed by: Nomveliswa Ndaba

Capacity Engineering Technician

Signature

Date 13.02.2026

ANNEXURE B: TECHNICAL DATA SHEET

(To be completed by the tenderers and submitted as part of their tender)

AC DISCONNECTS WITH EARTHING SWITCH

1. Name of manufacturer:……..……..
2. Type number:……..……..
3. Number of poles:……..
4. Outdoor (Yes/No):……..……..
5. Rated voltage:……..……..
6. Rated insulation level:……..……..
7. Rated 1 minute power frequency withstand voltage:……....
8. Rated lightning impulse withstand voltage:……..…….
9. Rated frequency:……..……...
10. Rated normal current:……..…….
11. Rated short circuit making current:……...…….……..
12. Rated short time withstand current:…….…….……..
13. Mass of complete unit:…….…….……..
14. Minimum clearance in air:
    - 14.1 Between poles:…….…….……..
    - 14.2 To earth:……..
    - 14.3 For isolating distance:……
15. Type of closing mechanism:……..……..…….
16. Height above ground:…….…….…….
17. Length of insulator (taut string measurement):…….....
18. Insulators type test certificate:……..…

APPENDIX 1

SCHEDULE OF REQUIREMENTS
(To be completed by client (depot)) (tick in the correct box)

SYSTEM DETAIL

1.0 Transformer required for: Boschmanskop substation/location

2.0 Nominal system voltage: 132 kV

3.0 Number of phases: 3

4.0 Frequency: 50 Hz

5.0	Neutral point effectively earthed:	yes	✓	no
6.0				

TRANSFORMER DETAIL

1.0 Type of transformer: Outdoor: ✓ Indoor:

2.0 Number of phases: Single phase: Three phase: ✓

3.0 Rated power: 50 kVA

4.0 Impedance percentage %: 3 - 4.5%

5.0 Primary voltage rating: 1,220 to 1,440 kV

6.0 Secondary voltage rating: 0.4 kV

7.0 Vector group: Dyn11

TANK TYPE

1.0	Free-breathing	yes	X	no
2.0	Sealed (Transformer main tank cover joint shall be welded)	yes	X	no

FITTINGS REQUIRED

1.0	Conservator with oil level indication	yes	X	no
2.0	Silica gel breather	yes	X	no
3.0	Gas and oil actuating relay with test and sample valves	yes	X	no
4.0	Main tank drain valve	yes	X	no
5.0	Indicating thermometer			
5.1	Oil temperature	yes		no X
5.2	Winding temperature indication	yes		no X
6.0	Radiators.	yes	X	no
7.0	Auxiliary wiring terminal box	yes	X	no
8.0	Neutral Current Transformer required	yes	X	no

8.1 CT Ratio: 100/5

8.2 CT Class: 10P

8.3 CT Rating VA: 10

9.0 Off circuit tap switch required	yes	✓	no	

9.1 Number of tap positions: 5

10.0 Bushings required: Outdoor: ✓ Indoor: _____

High voltage side	yes	✓	no	
Low voltage side	yes	✓	no	
11.0 Cable box required	yes	✓	no	

Number and types of cables per phase

High voltage side: 3ph core x 25 mm sqr XLPE

Low voltage side: 4core SWA PVC insulated cable

12.0 Neutral required				
High voltage side	yes		no	✓
Low voltage side	yes	✓	no	

Number and types of cables per neutral: _____

13.0 Mountings

13.1 Pole mounting	yes		no	✓
13.2 Platform mounting	yes	✓	no	
13.3 Flat under base	yes		no	✓
13.4 Skid underbase	yes		no	✓
13.5 Wheels and axles	yes		no	✓
13.6 Lifting lugs	yes	✓	no	
13.7 Jacking pads	yes		no	✓

14.0 Dimensions (if critical)

Length: _____mm. Breadth: _____mm. Height: _____mm

15.0 Special requirements: _____

_____

_____

_____

TRANSNET
freight rail

TECHNOLOGY MANAGEMENT

SPECIFICATION

MEDIUM VOLTAGE DISTRIBUTION AND SUPPLY TRANSFORMERS IN ACCORDANCE WITH SANS 780. (For nominal system voltages up to 33 kV)

Author:	Chief Engineering Technician Technology Management	L.N. Makhathini
Approved:	Chief Engineering Technician Technology Management	W. Schoeman
Authorised:	Senior Engineer Technology Management	L.O. Borchard

Date: 21 June 2018

Circulation Restricted To:

Transnet Freight Rail – Chief Engineer Infrastructure
- Technology Management

DOCUMENT HISTORY:

BBB 8402: MEDIUM VOLTAGE DISTRIBUTION AND SUPPLY TRANSFORMERS IN ACCORDANCE WITH SANS 780.

(For nominal system voltages up to 33 kV)

Dates Amended	Author	Version	Amendments
29/04/2008	D O Schulz	2	Old specification
10/11/2016	L Makhathini	3	• Standards and publications • Constructional Requirement has been added • Rating Plate has been added
06/06/2018	L Makhathini	4	On appendix 1 and 2, the Yes/no: has been confusing on selection. It has been changed to yes ☐ no ☐ To tick in the correct box

INDEX

1.0 SCOPE

1.1 This specification covers Transnet freight rail's requirements for single phase and three phase oil immersed type distribution and supply transformers for indoor or outdoor use in accordance with SANS 780.

2.0 BACKGROUND

2.1 Distribution and supply transformers are used on Transnet freight rail for the following applications:

- Supply transformers are used as step down transformers for power distribution of the 11kV and 6,6 kV Transnet freight rail reticulation systems and the 11 kV and 6,6 kV transmission line network.
- Distributions transformers are used as step down transformers for the provision of power at a required voltage.
- Distribution transformers are also used on the 11 kV and 6,6 kV transmission line system for step down supply points to signals relay rooms and for auxiliary supplies to traction substations etc.

3.0 STANDARDS AND PUBLICATIONS

The transformer shall comply with all relevant requirements of the latest edition of the specifications as listed in SANS 780.

3.1 SOUTH AFRICAN NATIONAL STANDARDS

SANS 121	Hot-dip Galvanized coatings for fabricated iron or steel articles.
SANS 780	Distribution Transformer.
SANS 1091	National colour standard.
SANS 9001	Quality Management systems – Requirements.

3.2 TRANSNET FREIGHT RAIL

CEE.0224.	Drawings, Catalogues, Instruction Manuals and Spares lists for Electrical Equipment supplied under contract.
BBB 8205	High voltage supply transformers in accordance with IEC 60076 AND BS 171. (For nominal system voltages 33 kV up to 132 kV)

4.0 APPENDICES

The following appendices form an integral part of this specification:

Appendix 1:	Schedule of requirements.
Appendix 2:	Information provided by the tenderers.

5.0 TENDERING PROCEDURE

5.1 Tenderers shall indicate clause by clause compliance with the specification. This shall take the form of a separate document listing all the specifications clause numbers indicating the individual statement of compliance or non-compliance.

5.2 A statement of non-compliance shall be motivated by the tenderer.

5.3 Tenderers shall complete Appendix B. " Information to be provided by tenderers."

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

5.5 Failure to comply with clauses 5.1, 5.2, 5.3 and 5.4 could preclude a tender from consideration.

6.0 SERVICE CONDITIONS.

The transformers shall be designed to operate under the following conditions.

6.1 ATMOSPHERIC CONDITIONS

Altitude:	0 to 1800m above sea level.
Ambient temperature:	-5°C to +45 °C.
Relative humidity:	10% to 90%.
Lightning Conditions:	12 ground flashes per square kilometre per annum.
Pollution:	Heavily salt laden or polluted with smoke from industrial sources.

6.2 ELECTRICAL CONDITIONS

Frequency:	The AC high voltage supply will normally be supplied by Eskom. The frequency will be 50 ± 2.5 Hz.
Harmonics:	For the supply transformers installed at the traction substations to supply power to the 11 kV and 6,6 kV transmission lines systems, it can be expected that the low voltage winding of such transformers shall be subjected to the total voltage harmonic distortion of up to 27%. Distribution transformers that are used for step down points on the 11 kV and 6,6 kV transmission line systems to step down voltages to 400 V/ 230 V for signal relay rooms, auxiliary supplies to traction substations or any other application shall be subjected to the total voltage harmonic distortion of up to 27%.
No of Phases:	Three phase systems / Single phase

7.0 TECHNICAL REQUIREMENTS

7.1 CONSTRUCTIONAL REQUIREMENTS

7.1.1 The "schedule of requirements" Appendix 1 shall determine the constructural requirement of the transformers.

7.1.2 The tap changing gear shall be externally, manually operated, positively locking, off load type. The arrangement shall be such that excessive backlash will not affect the making of proper contact when the tap changing gear is operated in either direction. Rotary type having high-pressure type contacts shall be used.

7.1.3 Single phase winding connection with 100%, 102.5%, 105% must have external tapping bushing to SANS 780.

7.1.4 The transformer main tank cover joint shall be welded.

7.1.5 The welded joint shall be designed to permit removal of the weld with minimum damage to the mating flanges so that they will be suitable for re-welding.

7.1.6 The tank cover of large transformers shall be fitted with handles or lifting lugs (200kVA and higher)

7.1.7 Where drain valves are fitted on the transformer, it shall be steel fittings and not brass. The drain valves shall be lockable.

7.2 PAINTING AND CORROSIVE PROTECTION.

7.2.1 The corrosion protection and coatings both interior and external surfaces shall be in accordance with Clause 4.17 of SANS 780 and shall be suitable for coastal and heavily polluted conditions.

7.2.2 The transformer radiators shall be hot dipped galvanized in accordance with SANS 121 for coastal and heavily polluted conditions and be painted.

7.2.3 Internal surfaces of the conservator tank above oil level including the tank shall be protected from corrosion by varnishing, priming or painting as specified in clause 4.17.2 for coatings of interior services of SANS 780.

7.2.4 The conservator tank where required shall be painted white.

7.2.5 The finished external coats of paint of the transformer tank shall match the colour G12 for grey as specified in SANS 1091.

7.3 RATING PLATE

A non—corrosive metal plate shall be fixed to each transformer tank (not cooling tubes), giving the following information:

- Maker's name
- Maker's serial No.
- Transnet freight rail's serial No. (Left blank)
- Rated output in MVA
- Frequency
- Secondary voltage and current
- Primary voltage and current
- Primary voltage tappings
- Transformer reactance (%)
- Transformer impedance (%)
- Vector diagram
- Diagram of connections
- Quantity of oil in litres
- Conservator fitted with bag.
- Total mass of transformer inclusive of oil in kg
- Transport mass of transformer in kg.
- Year of manufacture

8.0 DRAWINGS AND MAINTENANCE MANUALS

8.1 Drawings, instruction manuals and spares lists shall be supplied in accordance with Transnet freight rail's specification CEE.0224.

8.2 Three copies of each of the following drawings shall be submitted to the responsible project manager for approval within 7 days of the order being placed.

8.2.1 Dimension drawings showing external arrangements of transformer.

8.2.2 External wiring diagrams for the transformer.

8.2.3 Vector diagram and rating plate.

9.0 INSPECTION AND TESTS

9.1 Transnet freight rail reserves the right to carry out inspection and any tests on the equipment at the works of the supplier/ manufacturer.

9.2 Arrangements must be made timeously with the Senior Engineer, Technology Management for inspections and tests prior to delivery.

9.3 All routine tests shall be carried out in accordance to SANS 780.

9.4 These tests shall be carried out at the manufacturers premises and shall be witnessed by Transnet freight rail's Quality Assurance staff.

9.5 Type test certificates for the same type of transformers with the validity of five years or less must be made available.

10.0 QUALITY ASSURANCE

10.1 The supplier must indicate what steps have been taken to implement a quality assurance system in terms of SANS 9001.

11.0 GUARANTEE AND DEFECTS

11.1 The contractor shall guarantee the transformer and accept liability for maker's defects, which may appear in design, materials and workmanship.

11.2 The guarantee period for the transformer shall expire after a period of 12 months commencing on the date of commissioning of the equipment.

END

APPENDIX 1

SCHEDULE OF REQUIREMENTS
(To be completed by client (depot)) (tick in the correct box)

SYSTEM DETAIL

1.0 Transformer required for: _____ substation/location

2.0 Nominal system voltage: _____kV

3.0 Number of phases: _____

4.0 Frequency: _____Hz

5.0	Neutral point effectively earthed:	yes		no	

6.0

TRANSFORMER DETAIL

1.0 Type of transformer: Outdoor: _____ Indoor: _____

2.0 Number of phases: Single phase: _____Three phase: _____

3.0 Rated power: _____kVA

4.0 Impedance percentage %: _____

5.0 Primary voltage rating: _____kV

6.0 Secondary voltage rating: _____kV

7.0 Vector group: _____

TANK TYPE

1.0	Free-breathing	yes		no	
2.0	Sealed (Transformer main tank cover joint shall be welded)	yes		no	

FITTINGS REQUIRED

1.0	Conservator with oil level indication	yes		no	
2.0	Silica gel breather	yes		no	
3.0	Gas and oil actuating relay with test and sample valves	yes		no	
4.0	Main tank drain valve	yes		no	
5.0	Indicating thermometer				
5.1	Oil temperature	yes		no	
5.2	Winding temperature indication	yes		no	
6.0	Radiators.	yes		no	
7.0	Auxiliary wiring terminal box	yes		no	
8.0	Neutral Current Transformer required	yes		no	

8.1 CT Ratio: _____

8.2 CT Class: _____

8.3 CT Rating VA: _____

9.0	Off circuit tap switch required	yes		no	

9.1 Number of tap positions: _____

10.0 Bushings required: Outdoor: _____ Indoor: _____

	High voltage side	yes		no	
	Low voltage side	yes		no	
11.0	Cable box required	yes		no	

Number and types of cables per phase

High voltage side: _____

Low voltage side: _____

12.0	Neutral required				
	High voltage side	yes		no	
	Low voltage side	yes		no	

Number and types of cables per neutral: _____

13.0 Mountings

13.1	Pole mounting	yes		no	
13.2	Platform mounting	yes		no	
13.3	Flat under base	yes		no	
13.4	Skid underbase	yes		no	
13.5	Wheels and axles	yes		no	
13.6	Lifting lugs	yes		no	
13.7	Jacking pads	yes		no	

14.0 Dimensions (if critical)

Length: _____mm. Breadth: _____mm. Height: _____mm

15.0 Special requirements: _____

_____

_____

_____

INFORMATION TO BE PROVIDED BY TENDERERS

(Tick in the correct box)

1.0 GENERAL

1.1 Manufacturers name: _____

2.0 TRANSFORMER DETAIL

1.0 Type of transformer: Outdoor: _____ Indoor: _____

2.0 Number of phases: Single phase: _____Three phase: _____

3.0 Rated power: _____kVA

4.0 Impedance (percentage) %: _____

5.0 Primary voltage rating: _____kV

6.0 Secondary voltage rating: _____kV

7.0 Tapping Switch.

No of positions: _____ %Steps: _____

8.0 Vector group: _____

9.0 Free Breathing	yes		no	
10.0 Sealed	yes		no	
11.0 Welded cover	yes		no	

12.0 Method of Cooling: _____

13.0 Overall dimensions: Length_____mm. Breadth_____mm. Height_____mm

14.0 Winding material: HV_____ LV_____

15.0 Mass of core and windings: _____kg

16.0 Oil capacity: _____(Litres)

17.0 Mass of transformer complete with oil: _____kg

18.0 HV end turns insulation reinforced Yes/No

19.0 Type of breather and dehydrating agent: _____

20.0 The following information refers to the transformer when connected on the principal tapping and appropriate reference temperature for the class of insulation used.

20.1 Iron loss (Watts): _____

20.2 Copper loss at full load: _____ at_____°C

20.3 Total load losses (Watts): _____at _____°C

20.4 Impedance at full load (percentage)_____Z _____X

20.5 Regulation at full load at: 1.0 PF _____Percent, 0.8 PF _____ Percent at _____°C

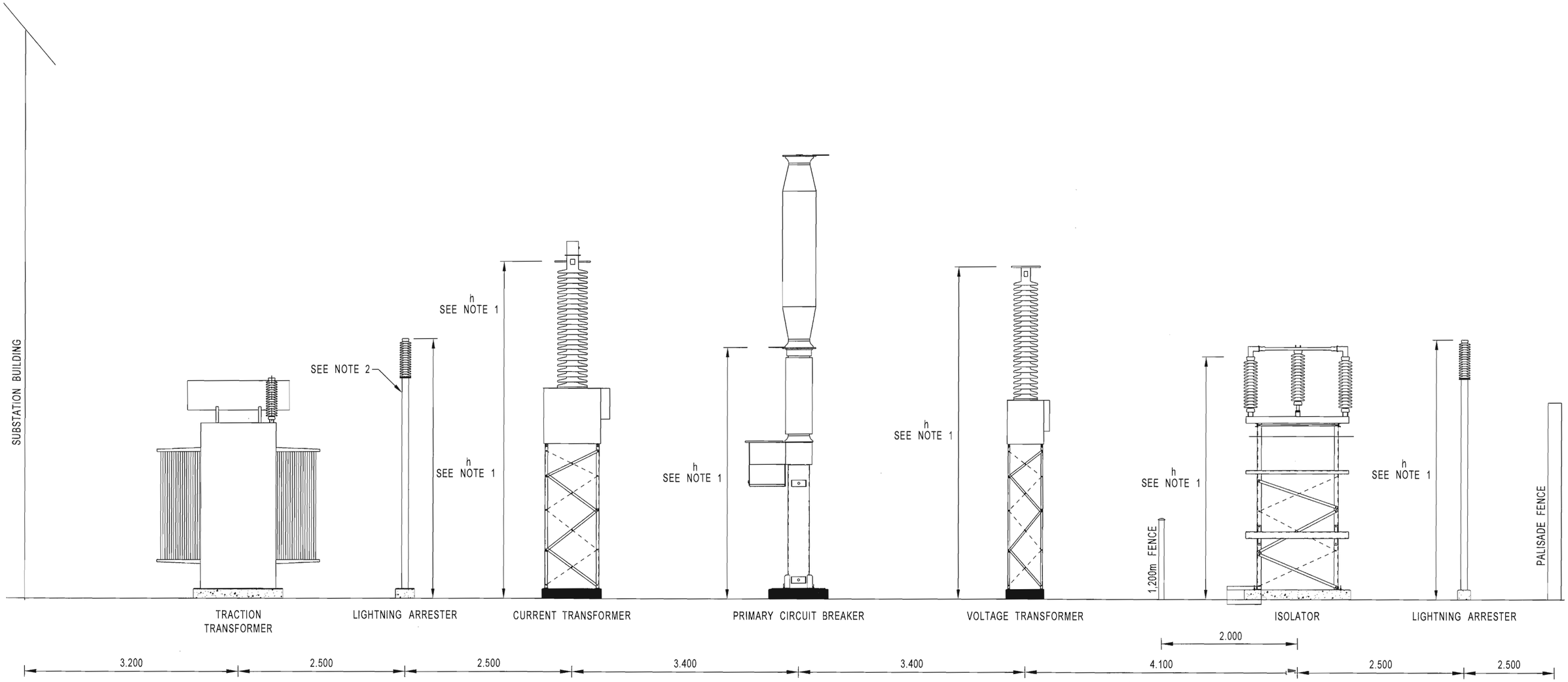
20.6 Efficiency at full load at: 1.0 PF _____Percent, 0.8 PF _____Percent at _____ °C

20.7 Temperature rise at rated voltage and power of:

Windings: _____°C

Top oil: _____°C

END



NOTE 2
IF NOT SUFFICIENT SPACE, THE LIGHTNING ARRESTER MAY BE INSTALLED ON THE TRANSFORMER WITH THE NECESSARY INSULATION. DISTANCE FROM LIGHTNING ARRESTER TO BUSHING AT LEAST THE LENGTH OF THE BUSHING. REFER TO BBB0938

NOTE 1
RESTRICTED ACCESS WAY, VERTICAL DIRECTION 2.5m PLUS NORMAL OUTDOOR EARTH CLEARANCE.
88kV: 2.5m + 1.00m = 3.5m MINIMUM.
132kV: 2.5m + 1.45m = 3.95m MINIMUM.
TOTAL LENGTH OF OUTDOOR YARD: 24.1m.

DIMENSIONS : m	SCALE : NOT TO SCALE	DO REF : CDO/ 9047	APPROVED
TOLERANCE : LIN ± ANG ±	ITEM NO : -	ECP REF : -	AUTHORISED 2018-4-4
MATERIAL : -		DRAWN : CJ MARAIS	
VERSION INFO : NOTE 2 ADDED, AND TITLE CHANGED		DESIGNED : G COETZEE	
		CHECKED : H VAN VUUREN	

TYPICAL SUBSTATION LAYOUT OF HT YARD
3kV DC, 11kV AC & 25kV AC

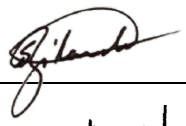
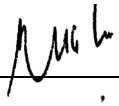
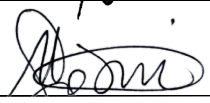
TRANSNET freight rail

BBD5061
VERSION 4

A2

TECHNOLOGY MANAGEMENT
CONFIGURATION MANAGEMENT

TECHNICAL DOCUMENTATION MANAGEMENT POLICY

Author:	Engineer (Signals)	N. Zungu	
Approved:	Configuration Manager (Acting)	MP. Sako	
	Principal Engineer	T. Ngilande	
Authorised:	Chief Engineer – Rail Network	R. Makhani	
	Chief Engineer – Technology Management	N. Gobhozi	

Date: October 2025

Circulation Restricted To:

Transnet and Relevant Third Parties

INDEX

Document Review

This policy will be reviewed annually (or as and when content changes are required) but if no changes are required, the document will retain its current revision level and status. In the case where signatories to this document are no longer part of TRIM the signatories will be updated during the first review or revision dependent on whichever occurs first.

Table of Revisions:

Revision	Item	Change	Clause	Date
4	1	Signatories revised	-	*12 August 2019*
4	2	Ref changed to BBD6683. TRE changed to TE	8.1	*12 August 2019*
4	3	Clause added to address submission of documents into TFR Document management System	8.6	*12 August 2019*
4	4	Original Clause 8.8 deleted.	8.8	*12 August 2019*
4	5	Bullet added to address submission of documents by Contractors into TFR Document management System	8.9	*12 August 2019*
5	6	Replaced all instances of TFR with TRIM throughout the document and updated the organisation's logo accordingly.		*02 September 2025*

1.0 PURPOSE

The purpose of this policy is to ensure compliance with statutory requirements and international standards in order to manage **technical** documentation across the entire life cycle of the item, system, or installation. This will facilitate the integrity and availability of technical information across the organisation including external beneficiaries

The policy defines technical documentation relevant to the Transnet Rail Infrastructure Manager (TRIM) environment and makes provision for a consistent process for the compilation and control of such documentation.

2.0 SCOPE

The technical documentation relevant to this policy is broadly defined as all the information reflecting the collective knowledge and practice of the organization. This encompasses all documents required to design, manufacture, procure, install, operate, maintain, modify, rationalise and dispose of Infrastructure assets.

This policy is applicable to all sections and personnel within Transnet involved with Infrastructure assets.

3.0 PHILOSOPHY

3.1 Transnet Rail Infrastructure Manager as asset owner carries the statutory responsibility and accountability for the life cycle management of technical documentation.

3.2 Copyright is vested in Transnet. No operating division may claim intellectual property.

3.3 All documents will be created, managed and published electronically.

3.4 Documents will be managed centrally in ***ProjectWise*** ensuring one instance of the truth.

3.5 This policy has been compiled in terms of the following statutory documents:

- ACT 16 OF 2000 Railway Safety Regulatory Act
- ACT PAIA (2000) Promotion of Access To Information Act (2000)
- ACT 25 of 2002 Electronic Communications and Transactions Act
- Transnet Enterprise Content Management Frame Work

4.0 TYPES OF DOCUMENTATION

The documentation that is to be controlled within the TRIM Configuration Management (CM) document management system is categorised as follows:

- Policies (Technical-)
- Instructions (Engineering-, Modification-, etc.)
- Specifications
- Drawings
- Manuals (inclusive of diagram books & specification sheet)
- Procedures
- Memorandums (Technical-)
- Reports (Audit-, Test-, etc.)
- Maintenance plans/Service Instructions
- Lists (Check-, etc.)
- Forms (Control-, etc.)

- Document related to training, contracts, etc.
- Software (System-, Configuration-, etc.)

For detailed descriptions and definitions, refer to **BBB0052**: Terminology and Nomenclature.

5.0 FORMAT OF DOCUMENTS

5.1 Language

All technical documentation shall be compiled in English (English UK).

5.2 Word processing standard

Documents, excluding drawings, shall be produced in applications from the MS OFFICE suite (approved Transnet version). For the standard Template for Technical Documents, see form **BBB0013**. Standard information on front sheet of word processed documents entails:

- Corporate Logo
- Number
- Version
- Title
- Document type
- Date
- Author/compiler
- Approver
- Authorising officer
- Copy right
- Circulation/distribution
- File ref. (if applicable)

5.3 Drawing standards and format

Practice and conventions for drawing content shall be in accordance with **SANS10111**;

- **BBB0041**: Preparation of drawings for Transnet Freight Rail.
- **BBD5371**: TRIM CAD Standard Instruction.

5.4 Format requirements for supplier documentation

Documentation from suppliers shall, be supplied in a format approved by TRIM. Any deviations from the standard must carry the consent of the configuration management section.

6.0 CONVERSION OF HARD COPY DOCUMENTS

Where applicable, documents will be converted (scanned) to electronic format and the hard copy documents retained as described in document **BBB0038**: Conversion and Archiving of Technical Documentation.

The Configuration Management section must be consulted before the conversion of any legacy paper documentation into the approved electronic (PDF) format.

7.0 DOCUMENTATION MANAGEMENT APPLICATION SOFTWARE

Bentley's ProjectWise Explorer is the official TRIM Technical Documentation Management application.

8.0 DOCUMENT MANAGEMENT PROCESS

(Refer to document **BBD6076:** Documentation Management Process Flow Design Detail)

8.1 Responsibilities

- Document owners - Each document is to have an identified owner (typically the Technology Owner) who will be responsible for compilation and any changes made to the content of the document.
- Document control – The Configuration Management section is responsible for the control of the document types as identified in clause 4.0, as well as document storage and the maintenance of the system document data.

8.2 Authorisation

Submission of a signed original (digital or physical) document is mandatory. (See document **BBB0034**: Authorisation of Technical Documents)

8.3 Storage and archiving of documents

Backups of documents are subject to Transnet backup policy.

8.4 Identification of documents

A document will be identified by an identifier number as described in documents: **BBB0042**: Practice and Conventions Regarding Document Identification. Legacy and Original Equipment Manufacturer (OEM) documents will not be renumbered but retain the number they were issued with.

8.5 Change control

All documents are subject to change control. Requests for changes to a document are to be referred to and authorised by the document owner. Documents will be changed according to the procedure described in document **BBB0416**: Proposal and Implementation of a Change.

8.6 Issue of documentation to TRIM Configuration Management

All documentation supplied to TRIM Configuration Management from internal and external clients shall be provided in both original source and PDF file format. The PDF file will be generated from the source file. Scanned documents will not be acceptable.

Documents of internal or external origin, that have been submitted to and registered within the TRIM Document Management system, shall be deemed to have been formally issued. Documents circulated within TRIM without having been submitted for registration in the TRIM Documentation Management system shall be deemed to be uncontrolled.

A clause to this effect shall be stipulated in all contracts where documentation is a deliverable.

8.7 Distribution

- Issue and release of documents - Authorised documents shall be released (internal to Transnet) in ProjectWise and users notified by electronic correspondence.
- External to Transnet - Requests for documents by external organisation will only be processed upon receipt of a duly completed and signed copy of the document: **BBB0322** Document Request: External Organisations - Control & Distribution of Documents.
- Documents will be distributed electronically in PDF format unless otherwise specified.

8.8 Contract documentation

- Documentation requirements for contracts, with parties both internal and external to Transnet, shall be defined and included as part of the contract.
- Documentation produced by any supplier for Transnet assets is subject to the following conditions:
  - The document produced shall be authorised by TRIM before it is accepted for use.
  - The document shall be registered and controlled in the Document Management system.
    - Only documents that have been submitted to and registered within the TRIM Document Management system shall be deemed to have been formally issued. Documents circulated by contractors within TRIM without having been submitted for registration in the TRIM Documentation Management system shall be deemed to be uncontrolled.

- Copyright in documents is applicable (see document **BBC0378:** Copyright in Plans, Drawings and Documents Compiled by Contractors For The Purpose Of Contract Work) - All final electronic documents shall only be submitted to Transnet Configuration Management.
- No electronic documents will be issued to any office other than Transnet Configuration Management who will make the information available through the approved documentation management system.

8.9 Cancellation of documents

A document may only be marked as cancelled or superseded by the Configuration Management Section. A document will only be cancelled upon receipt of a completed and duly authorised Enterprise Change Proposal (ECP) Form **BBB0006** or cancellation notification.

8.10 Retention and disposal of documents

All documents will be retained throughout the life cycle of the asset it describes.

9.0 APPLICABLE DOCUMENTS

BBB0006	Enterprise Change Proposal Form
BBB0013	Standard Document Front Sheet - Template
BBB0034	Authorisation of Technical Documents
BBB0038	Conversion And Archiving of Technical Documentation
BBB0041	Preparation of Drawings for Transnet Freight Rail
BBB0042	Practice and Conventions Regarding Document Identification
BBB0322	Control and Distribution of Documents to External Organisations
BBB0416	Proposal and Implementation of a Change.
BBB0052	Technical Documentation: Terminology And Nomenclature
BBC0378	Copyright in Plans, Drawings and Documents Compiled by Contractors for the Purpose of Contract Work
BBD5371	TRIM Cad Standard Instruction
SANS10111	Code of Practice for Engineering Drawing

NOTE!

This document supersedes all previous TRIM technical document management policies.

END