TRANSNET
freight rail

A Division of Transnet SOC Limited

TECHNOLOGY MANAGEMENT.

SPECIFICATION.

REQUIREMENTS FOR POSITIVE ISOLATOR FOR 3 kV DC TRACTION SUBSTATIONS

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1.0 SCOPE.

1.1 The specification covers Transnet Freight Rail's requirements for the design, manufacture, testing, supply and installation of 3kV DC positive isolator for 3kV DC traction substations.

2.0 BACKGROUND.

2.1 The positive isolator is an Off-load isolating switch which must be installed between the 3kV DC reactor and the substation 3 kV DC positive busbar. The purpose of the positive isolator is to isolate and earth the 3kV DC output of the rectifier and wave filter equipment from the substation positive busbar that feeds via high-speed circuit breakers to the overhead track equipment.

2.2 The positive isolator switch combined with its 2 X earthing switches and control equipment is housed in a freestanding metal cubicle.

3.0 STANDARDS AND PUBLICATIONS

Unless otherwise specified all materials used and equipment developed and supplied shall comply with the current edition of the relevant SANS, NEMA and Transnet freight rail specifications which are referred to in this specification:

3.1 SOUTH AFRICAN NATIONAL STANDARDS

SANS 1091:	National Colour Standard.
SANS 1274:	Coatings applied by the powder-coating process.

3.2 NATIONAL ELECTRICAL MANUFACTURING ASSOCIATION

NEMA GPO-3:	For Grade GPO-3 insulating material.

3.3 TRANSNET FREIGHT RAIL

BBB 3005:	3kV DC Under Voltage relay manufacturing specification.
BBD5994:	Technical Documentation Management Policy.
BBF3690:	Transnet Freight Rail - Electrical Safety Instructions 2012.

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

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

5.0 SERVICE CONDITIONS.

5.1 ATMOSPHERIC SERVICE CONDITIONS

Altitude:	0 to 1800m above sea level.
Ambient temperature:	-10°C to +55 °C.
Relative humidity:	10% to 90%.
Lightning Conditions:	15 ground flashes per square kilometre per annum.
Pollution:	Heavily salt laden or polluted with smoke from industrial sources.

5.2 ELECTRICAL SERVICE CONDITIONS

5.2.1 The nominal traction substation DC supply voltage is 3kV DC but can vary between 2.2kV and 3.9kV for sustained periods.

5.2.2 The positive isolator can be subjected to short circuit conditions up to 30kA for 200 milli seconds.

5.3 MECHANICAL SERVICE CONDITIONS

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

6.0 GENERAL DESIGN

6.1 The positive isolator comprises of an isolating switch and 2 X earthing switches complete with its operating mechanism. The equipment is housed in a metal cubicle with the required control circuitry for the 3kV DC Ampere and Voltage meters and the 3kV DC undervoltage relay protection (if required).

6.1.1 The isolating and earthing switches with its operating mechanism shall be mounted on a metal frame.

6.1.2 The 3 kV DC voltmeter and DC ammeter and undervoltage relay (if specified) shall be fitted in the low voltage metering and calibration compartment and shall be totally isolated from the high voltage compartment.

6.2 The general design and layout of the positive isolator shall ensure that no access to the equipment is possible when the switch is in the closed position.

ISOLATING SWITCH

6.3 The isolating switch shall be a medium voltage, manually operated off load switch rated at a minimum for 3kV DC and 4000 Amperes continuous (rated according to the transformer and rectifier).

6.4 The isolating switch shall be designed to carry the continuous rectifier output current without overheating when switched on load.

6.5 The isolating switch shall comprise of a moving arm finger contact that engages smoothly and solidly with a fixed contact.

6.6 The isolating switch moving arm finger contact and fixed contact shall be manufactured from copper or silver plated.

6.7 The minimum dimensions of the moving arm contact shall be 120mm X 10mm. The fixed contact shall be designed to accommodate the moving contact.

6.8 The contact surfaces of the isolating switch moving contact, fixed contact, and busbar joints in positive isolator cubicle shall be silver plated.

EARTHING SWITCHES

6.9 The earthing switches shall comprise of a moving arm contact and a fixed contact into which the moving contact makes contact.

6.10 The earthing switches shall be a medium voltage, manually operated off load switch with minimum rating of 1500 Ampere. For the main earthing switches – the wave filter earthing switches only need to carry 750 Amperes.

6.11 The earthing switches moving and fixed contact shall be manufactured from copper or silver plated.

PANEL CONSTRUCTION

6.12 The panel shall be constructed from steel sheeting of at least 2,5 mm thickness. The panel shall be of a rigid construction with facilities for lifting purposes.

6.13 The dimensions of the panel shall be in the order of:

Height	2000 mm
Width	800 mm
Depth	1000 mm

6.14 The removable covers shall be fitted with fasteners that require a special tool in order to remove the covers. Hinged covers are not acceptable.

6.15 The panel shall have a High Voltage and a Low Voltage compartment partitioned by a substantial metal sheet.

6.16 The front cover for the low voltage compartment shall be fitted with a window to give visibility to the indicating / measuring instruments.

6.17 A window shall be provided in the HV compartment to provided visibility of the position of the moving and fixed contacts of the positive isolator and earthing switches.

6.18 The windows shall be manufactured from clear polycarbonate, or non-shattering laminated glass or other approved material.

6.19 The interior and exterior surface of the panels 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 interior and exterior of the panel shall be Eau-de-Nil, colour code No H 43 in accordance with SANS 1091.

6.20 The frame of the metal cubicle that houses the positive isolator shall be fitted with support insulators to insulate the equipment from the floor.

LOW VOLTAGE COMPARTMENT

6.21 The 3kV DC voltmeter and DC ammeter and under-voltage relay (if specified) shall be fitted in the low voltage compartment and shall be totally isolated from the high voltage compartment.

6.22 The compartment shall be provided with a hinged plate on which the 3kV DC indicating/measuring instruments are mounted.

6.23 The hinge plate shall provide easy access to the under voltage relay transmitter and receiver in the LV compartment for calibration purposes.

6.24 The hinged plate shall be fitted behind the front cover of the low voltage compartment so that the front cover must first be removed before access can be gained to the low voltage compartment.

6.25 The supplier shall make provision for an electrical interlock to be fitted on the front cover of LV compartment which will cause the substation to trip and lockout in the event of the cover been removed while the traction substation is on load.

HIGH VOLTAGE COMPARTMENT

6.26 The HV compartment shall house the positive isolator switch combined with its earthing switches, all the 3kV DC busbars and 500mm² copper cables, the potential dividers and fuse for the metering equipment.

6.27 Provision shall be made for the rail connection for the negative connections of the 3 kV DC potential dividers for the undervoltage relay and voltmeter. The rail connection shall consist of a copper busbar mounted on an insulator.

6.28 The positive connections for the fuse and potential dividers for the 3 kV DC undervoltage relay and voltmeter shall be connected to the 3 kV DC positive busbar on the track breaker side of the positive isolator.

6.29 High voltage insulated cables shall be used for the fuses and positive and negative connections of the potential dividers.

6.30 A 6mm X 50mm copper busbar connected to the earthing switches be provided in the rear of the HV compartment for the termination of the cables of the traction substation DC earth leakage system and the earthing cable of the metal cubicle of the positive isolator.

6.31 All low voltage wiring in the high voltage compartment shall be run in metal trunking.

CLEARANCES AND INSULATION

6.32 The positive isolator switch 3kV insulation to earth shall be designed to withstand a test voltage of 10,5kV, 50 Hz AC for one minute.

6.33 The clearance of the positive isolating equipment at nominal 3kV DC and steelwork shall be not less than 150 mm.

6.34 The insulating material used in the construction of the positive isolator switch shall comply with NEMA standards for GP03 or better for satisfactory operation at coastal and other high humidity areas.

6.35 All insulation used for the construction of apparatus shall resist the effects of humidity, dust and temperature variations and shall not have a tendency to distort.

MECHANICAL INTERLOCKING (ONLY ON INSTALLATION)

6.36 An externally mounted mechanical interlock shall be fitted to prevent the on load operation of the positive isolator switch or reconnection to the overhead track system while the rectifier bay is open.

6.37 The mechanical interlocking system for the positive isolator switch shall be of the key exchange type The "Castell" key exchange system is preferred.

6.38 The switching operation of the opening and earthing of the positive isolator shall only be possible once the traction substation has been switched off load from the incoming AC supply.

7.0 METERING, UNDERVOLTAGE RELAY AND WIRING

7.1 METERING

The 3 kV DC voltmeter and ammeter shall conform to the following requirements.

7.1.1 The 3 kV DC voltmeter shall be a moving coil type, 96mm X 96mm. The range shall be 0-4000V with a class of 1.5 accuracy (0 – 400 Calibration scale).

7.1.1.1 The 3 kV DC voltmeter shall be provided with a high voltage fuse and potential divider consisting of not less than 10 aluminium case resistors mounted on aluminium flat bars in series of 2 X flat bars and shall be installed in the HV compartment of the positive isolator panel.

7.1.1.2 The 3 kV DC voltmeter shall be labelled “Busbar Voltage”.

7.1.1.3 The fuse and voltage divider shall be housed in the HV compartment of the panel. The fuse shall be connected by means of a single core HV conductor from the positive 3kV to the potential divider.

7.1.2 A moving coil DC Ampere meter 96mm X 96mm with range of 0 - 4000 amperes and accuracy class of 1.5 shall be supplied (90^0 Display).

7.1.2.1 The 3 kV DC Ampere meter shall be calibrated for 4000 amperes full scale with an input of 50mV obtained from a 4000 amperes 50 mV shunt, which shall be supplied by the tenderer (Shunt on a rectifier).

7.2 3 kV DC UNDERVOLTAGE RELAY

7.2.1 Where specified the tenderer shall supply a 3kV DC undervoltage relay in accordance with Transnet freight rail's specification BBB 3005.

7.2.2 The potential divider and fuse shall be installed in the HV compartment of the positive isolator switch panel.

7.2.3 The transmitter and receiver of the undervoltage shall be mounted in the LV compartment.

7.2.4 Depending on space constraints in the LV compartment of the positive isolator switch panel, the 3kV DC undervoltage relay may be wall mounted in an easily accessible location.

7.2 WIRING AND TERMINALS

7.3.1 All terminal blocks and groups of terminal blocks shall be suitably numbered.

7.3.2 All wires shall be provided with identification tags at terminals and shall be marked as reflected on the panel-wiring diagram. The diagram markings and wire markings shall be the same.

8.0 LABELLING

8.1 All removable covers of the positive isolator shall be fitted with approved Transnet freight rail warning signs.

8.2 The warning signs and labelling shall be of the engraved type.

8.3 The warning signs shall read as follows:

8.4 The lettering "**CAUTION-HIGH VOLTAGE**" shall be 15mm in size and the rest of the wording on the label 10mm. The lettering shall be red on a white background.

8.5 The labels shall be screwed or riveted to the panels.

9.0 INSPECTION AND TESTING.

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

9.2 Arrangements must be made with The Senior Engineer, Technology Management Transnet freight rail for inspections to be carried out before delivery of the equipment.

9.3 Routine test quality assurance (QA) stickers shall be mounted on each positive isolator switch and under voltage relay.

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 tenderer shall supply three copies of an instruction/maintenance manuals and construction and schematic diagrams.

10.3 The contractor shall submit details of spares required in accordance with Transnet freight rail's specification BBD5994.

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: -

11.2.1 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 latest.

11.4 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.

11.5 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 and should they be covered by the guarantee, reimburse Transnet freight rail the cost of material and labour.

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