TRANSNET
freight rail

A Division of Transnet SOC Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

3kV DC UNDER VOLTAGE RELAY MANUFACTURING SPECIFICATION

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1.0 SCOPE

This specification provides Transnet Freight Rail's requirements for the manufacturing of the 3kV DC Under voltage relay utilising optic fibre.

2.0 BACKGROUND

The 3kV DC under voltage relays are installed at Transnet Freight Rail's 3kV DC traction substations and tie-stations. The purpose of the relay is to clear faults which occur whilst the feeding network is crippled. The relay is set to operate at the highest voltage (i.e. smallest volt-drop) that can occur under crippling conditions with a fault in the section.

The under voltage relay trips the 3kV DC track breakers when the 3kV DC busbar voltage drops below the set value. This optic fibre relay is an alternative to the existing switching under voltage relay and other models of relays fitted in the 3kV DC traction substations throughout Transnet Freight Rail.

Spare parts for the switching under voltage relays and other models are difficult to obtain and are costly. The optic fire under voltage relay is constructed from components, which can be locally sourced.

3.0 STANDARDS AND PUBLICATIONS

Unless otherwise specified all materials and equipment shall comply with the current edition of the relevant SANS or Transnet Freight Rail publication where applicable.

3.1 SOUTH AFRICAN NATIONAL STANDARDS

SANS 1091:	National Colour Standards
SANS 1274:	Coatings applied by the Powder Coating Process

3.2 TRANSNET FREIGHT RAIL DRAWINGS

CEE- TBD-7:	3kV DC earthing arrangement system for traction substations.

4.0 APPENDICES

The following appendix from an integral part of this specification,

Appendix 1:	Circuit and manufacturing drawings

5.0 TENDERING PROCEDURE

5.1 Tenderers shall indicate clause by clause compliance with the specifications. 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 and it shall be written in English.

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 5.1, 5.2 and 5.3 could preclude a tender from consideration.

6.0 SERVICE CONDITIONS

The equipment shall be designed and rated for operation under the following service conditions.

6.1 ENVIRONMENTAL

6.1.1	Altitude:	0 - 1800m above sea level.
6.1.2	Ambient temperature range:	- 5°C to +55°C.
6.1.3	Relative humidity:	10% to 90%.
6.1.4	Lighting conditions:	19 flashes/km²/annum
6.1.5	Pollution:	Heavily salt laden or polluted with smoke from industries sources

6.2 ELECTRICAL SERVICE CONDITIONS

6.2.1	Nominal 3 kV DC busbar voltage:	3150 volts DC
6.2.2	Variable 3 kV DC busbar voltage:	2100V DC – 4000V DC

6.3 MECHANICAL SERVICE CONDITIONS

6.3.1	Vibration:	Vibration can be expected as the Substations are next to the railway lines.

7.0 GENERAL REQUIREMENTS

7.1 Equipment supplied shall be in terms of this specification. Deviations from this specification will not be allowed without written consent of Transnet Freight Rail's Traction Power Supply Technology staff.

7.2 Transnet Freight Rail reserves the right to subject equipment offered to test or inspection to check compliance with clauses of this specification.

7.3 The onus to prove compliance with the manufacturing specification shall rest with the successful tenderer once the manufacturing contract has been awarded.

7.4 The successful tenderer will be responsible for all costs caused by modifying or replacing equipment accepted by Transnet Freight Rail on the grounds of his statement of compliance and found by Transnet Freight Rail not to comply.

8.0 TECHNICAL AND MANUFACTURING REQUIREMENTS

8.1 DESCRIPTION OF THE UNDERVOLTAGE RELAY

8.1.1 The main components of the 3kV DC under-voltage relay are as follows:

- 3kV Voltage divider.
- Optic fibre transmitter.
- Optic fibre receiver.
- Control circuit.

8.2 3kV VOLTAGE DIVIDER

8.2.1 The voltage divider shall consist of 9x22 kΩ, 50 watt and 3x8,2 kΩ, 50 watt aluminium housed resistors in series as shown in circuit diagram BBB2932.

8.2.2 A 3 Ampere 3.3 kV, minimum 5kA rated fuse shall be provided and connected on the 3 kV positive input side in series with the resistors as shown in circuit diagram BBB2932.

8.2.3 The resistors shall be arranged on a Celeron plate, which shall be fitted with stand off insulators for mounting on the wall in the busbar chamber. These insulators must provide a minimum allowable clearance of 100mm for 3kV potential.

8.2.4 If encapsulated voltage dividers are offered the successful tenderer shall supply Transnet Freight Rail Electrical samples for inspection and acceptance.

8.2.5 The encapsulated voltage divider shall consist of the same amount of resistors and the ohms values as the above divider.

8.2.6 Carbon resistors are not acceptable, as they are extremely temperature sensitive. Only high quality resistors such as metal oxide or vitreous enamel resistors may be used for the encapsulated voltage divider.

8.2.7 Suitable studs minimum 6mm shall be provided for the positive connection from the potential divider to the under-voltage relay and 10mm stud for the negative return circuit.

8.3 OPTIC FIBRE TRANSMITTER

8.3.1 The circuitry components for the optic fibre transmitter shall be in accordance with circuit diagram, drawing No BBB2930 and printed circuit board layout, drawing No BBB2935. These shall be housed in a high impact plastic /fibre box which is mounted on the 3kV voltage divider board.

8.3.2 The reference voltage of 0 to 400 volts is obtained from the voltage divider and is the operating voltage for the fibre optic transmitter unit.

8.3.2.1 The required reference voltages are obtained and generated from an integrated circuit, IC1 and a 24V Zener diode.

8.3.1 Voltage comparison is carried out by IC2 (LM 741). Pick up and drop out voltages are adjusted with potentiometers P2 and P3, which are multi turn top adjustable potentiometers.

8.3.2 The transmitter is mounted on a high quality fibreglass printed circuit and is populated by resistors (tolerance 2%) and capacitors.

8.3.3 The circuitry is protected by Metal Oxide Varistors (MOV'S).

8.3.4 The output of the optic fibre transmitter is connected to the optic fibre receiver.

8.4 OPTIC FIBER RECEIVER

8.4.1 The optic fibre receiver and control circuits shall be mounted in a metal enclosure with a hinged door to enable ease of maintenance.

8.4.2 The optic fibre printed board shall be manufacture according to circuit diagram BBB2929 and circuit board layout BBB2934.

8.4.3 The optic fibre isolation level for the transmitter and receiver shall not be less than 7 kV.

8.4.4 The operating voltage for the receiver is a 110 V DC voltage obtained from a voltage divider R1 and R2. Activating the optic fibre receiver results in the energising of a relay by means of a transistor on the fibre optic receiver printed circuit board.

8.5 CONTROL CIRCUIT

8.5.1 The control circuitry shall be mounted in same metal enclosure as the optic fibre receiver and shall consist of the components shown in drawing BBB2931.

8.5.2 The front door of the metal enclosure shall be fitted with a red lamp which indicates that the 3kV DC is present and an amber lamp which indicates that a trip has occurred as well as electrically actuates the trip counter which counts the number of trips.

8.5.3 The operating voltage for the control circuit is 110V DC.

8.5.4 The input control signals as well as the output control signals shall be routed to a clearly marked terminal strip.

8.5.5 The internal wiring of the control circuit shall be wired with 1.0 mm^2 stranded copper wire.

8.5.6 The 110V DC shall be protected by a 180V MOV and a 4 Ampere fuse.

8.5.7 If the line voltage is above the pick-up voltage the optic fibre transmitter activates and the optic fibre receiver enables the switching transistor to energise relay 1 (R1) this retains the circuit breaker holding coil when timed contacts open.

8.5.8 If the line voltage drops below the drop out voltage the fibre optic transmission stops and relay 1 is de-energised.

The metal enclosure shall be power coated in accordance with SANS 1274 and the colour of the enclosure shall be light orange to SANS 1091 colour No. B26.

8.5.9 Provision shall be made for cable entry at the bottom of the metal enclosure.

8.5.10 A suitable earthing terminal for a 95mm^2 earth conductor shall be provided on the metal enclosure.

8.6 MODIFICATIONS AND IMPROVEMENTS

8.6.1 If the successful tenderer wishes to submit recommendations for modifications or improvements he shall first contact members of Transnet Freight Rail Technology Management (Electrical) staff who will approve or reject them.

8.6.2 No additions, alterations or modifications shall be accepted unless Transnet Freight Rail (Technology Management - Electrical) staff is in agreement.

8.7 TEST METHOD

For testing of the operation of the under-voltage relay a variable 0 to 400V DC supply is required.

- Inject 140V DC on the input side of the Optic Fibre transmitter and set the Trimpot P1 until a output voltage of 10V (reference voltage) is obtained at pin N06 on the output side of the reference IC1. Connect a temporary Optic Fibre cable between Optic Fibre transmitter and the receiver.
- Supply the under-voltage relay with 110V DC at terminals 1 (positive) and 2 (negative) and inject 250V to the transmitter. Adjust the Trimpot P2 until the under-voltage relay picks up. Reduce the voltage to the transmitter to 240V and adjust The Trimpot P2 until the relay drops out.
- To set the pick-up time, connected a positive 110V DC supply to terminal 7 of the fleeting timer relay and adjust until the require time setting is obtained.

END

APPENDIX 1

CIRCUIT AND MANUFACTURING DRAWINGS

DRAWING No	**TITLE**
BBB2929:	Optic Fibre Receiver Circuit Diagram.
BBB2930:	Optic Fibre Transmitter Circuit Diagram.
BBB2931:	3kV Under-voltage Relay Circuit Diagram.
BBB2932:	Voltage Divider Circuit Diagram.
BBB2934:	Optic Fibre Receiver PC Board and component Layout.
BBB2935:	Optic Fibre Transmitter PC Board and component Layout.
BBB2942:	General arrangement of High Tension Divider Board.

END