TRANSNET freight rail

A Division of Transnet SOC Limited

TECHNOLOGY MANAGEMENT

SPECIFICATION

THE MANUFACTURE OF 3 KV DC BREAKER CELLS AND TRUCKS

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INDEX

1.0 SCOPE

This specification covers Transnet Freight Rail's requirements for the design and manufacture of a modular 3kV DC 2000A circuit breaker cell and truck for use on a 3kV DC traction system.

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 SANS and Transnet freight rail's publications which are referred to in this specification:

2.1 SOUTH AFRICAN NATIONAL STANDARDS

SANS 1091: National Colour Standards.

SANS 1222: Enclosures for Electrical Equipment.

SANS 1274: Coatings applied by the powder-coating process.

2.2 TRANSNET FREIGHT RAIL'S SPECIFICATIONS

BBD5994: Technical Documentation Management Policy.

CEE.0045: Painting of Steel Components of Electrical Equipment.

CEE.0099: 3kV DC High Speed Circuit Breakers.

CEE.0224: Drawings, Catalogue, Instruction Manuals and Spares lists of Electrical equipment supplied under contract.

2.3 TRANSNET FREIGHT RAIL'S DRAWINGS

The following drawings form an integral part of this specification.

BBF1336: 3kV DC Circuit Breaker Components.

BBF1337: Secheron 3kV DC track breaker with DC Feeder protection relay.

BBF1338: EMC 3kV DC track breaker with DC Feeder protection relay.

CEE-TBP-42: Sheet 1. Connection Diagram for HSCB: New Breaker Cell.

CEE-TBP-42: Sheet 2 Connection Diagram for "ABB" HSCB: New Breaker Cell.

CEE-TBP-42: Sheet 3. Connection Diagram for "Ansaldo IR6003" HSCB: New Breaker Cell.

3.0 DEFINITIONS

AC: Alternating current.

Breaker: 3kV DC high speed circuit breaker.

Cell: Housing for circuit breaker and truck

DC: Direct current.

ECR: Electronic closing relay.

Truck: Circuit breaker mounted onto

4.0 METHOD OF TENDERING

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 APPENDIX

The following appendix forms an integral part of this specification:

Appendix 1 : List of drawings for both ECR and DC feeder protection relay.

6.0 SERVICE CONDITIONS

6.1 ENVIRONMENTAL CONDITIONS

The breaker cell, truck and associated equipment shall be designed and rated for operation under the following:

6.1.1 Altitude: 0 - 1800m above sea level.

6.1.2 Ambient temperature: -10^0 C to $+55^0$ C.

6.1.3 Relative humidity: 10% to 90%.

6.1.4 Lightning conditions: 20 ground Flashes/km^2/annum.

6.2 ELECTRICAL CONDITIONS

6.2.1 The nominal Voltage shall be 3300 Volts. The lowest shall be 2250 V and highest being 3900 V.

6.2.2 The nominal Current shall be 2000 A and the highest being 4500 A.

6.2.3 The maximum fault current shall be or up to 55kA.

7.0 DRAWINGS AND INSTRUCTION MANUALS

Drawings and instruction manuals shall be in accordance to Transnet Freight Rail's specification CEE.0224 and technical documentation management policy BBD5994.

8.0 TECHNICAL REQUIREMENTS

8.1 BACKGROUND

The older types of circuit breaker cells are made from gas concrete, Asbestos and in combination with the trucks are outdated and difficult to erect. For this reason a new modular type of design, where cells could be easily erected, added or removed, is required. The specification depicts the requirements for modular one cell and one truck. It is required that any number of individual cells be coupled together to form a unit.

8.2 BREAKER CELL

8.2.1 The cell shall be constructed using a rigid steel frame with sheet metal enclosures. The dimensions shown in Appendix 1 exclude the framework and may be modified if necessary to accommodate the breaker truck. Any other changes in dimensions shall be submitted for approval to the office of Transnet Freight Rail's Senior Engineer (Electrical) – Technology Management.

8.2.2 The sides and back of the breaker cell shall be of mild steel sheet metal not less than 2mm thick.

8.2.3 The floor of the breaker cell shall be of mild steel sheet metal not less than 3mm thick.

8.2.4 Provision must be made on the floor of the cell for "Rawl" bolts to bolt the cell to the floor of the substation. On the sides of the cell provision must be made to bolt cells together.

8.2.5 The whole cell will be moved as a unit after construction and therefore special attention must be given by the tenderer to the mechanical strength of the cell, including provision for attachment of lifting gear.

8.2.6 On both sides of the cell, the control panel (right top of the side view) and 3kV DC incoming busbar (left top of busbar chambers) shall have removable panels for the future extension of the cells.

8.2.7 At the back of the cell the 3kV DC incoming and outgoing busbars must be accessible via removable panels. All of these removable panels shall be secured with bolts or screws.

8.2.8 A warning notice of plastic material (sandwich board) shall be mounted on each of the 3kV DC incoming busbar removable panels (at the back of all cells and the two side panels) and shall read as follows (Red on white):

WARNING

DO NOT REMOVE PANEL BEFORE ALL EQUIPMENT IS ISOLATED.

8.2.9 A warning notice of plastic material (sandwich board) shall be mounted on each of the 3kV outgoing busbar removable panels (at the back of all cells) and shall read as follows (Red on white):

WARNING

DO NOT REMOVE PANEL BEFORE TRACK SWITCH IS OPEN AND THE BREAKER WITHDRAWN.

8.2.10 The size of the notice boards shall be 200mm x 150mm with red letters on a white background. The words "WARNING" shall be bigger than the rest of the easily readable words on the notices.

8.2.11 The roof of the cell shall be of a flat piece of fire retardant glass fibre or similar insulation material.

8.2.12 Provision for cooling on a trunk of the 3kV DC breaker cells (fins on the front of the trunk) shall be made at the back of the cell and have the same capacity as the truck. If the DC feeder relay is installed then the cooling shall be through the roof.

8.2.13 The 3kV DC outgoing busbar chamber shall be completely isolated from the 3kV DC incoming busbar chamber and other adjacent 3kV DC outgoing busbar chambers.

8.2.14 Provision shall be made for the termination of a 3kV DC cable onto the 3kV outgoing busbar. This cable screen must be insulated from the cell and therefore insulation material must be provided where the cable is terminated in the cell. (150mm clearance from cable to metal parts and cable chambers must stay individual).

8.2.15 Details of the 3kV incoming and outgoing busbar must be cable entry at the bottom chamber and busbar entry. The 3kV incoming and outgoing busbars must be able to handle a continuous DC current of 2000A. (Size of copper busbar: 100mm x 10mm.)

8.2.16 The 3kV incoming and outgoing busbars shall be fitted on synthetic insulators with the necessary tensile strength. (150mm clear from metal).

8.2.17 The whole busbar system must withstand the stresses created when the truck is pushed into or pulled out of the cell. The insulators must therefore be mounted on a steel frame in the cell and not only on the sheet metal.

8.2.18 Provision shall be made on the 3kV DC incoming busbar and the earth busbar to extend them from one cell to another. The extension busbar pieces (slotted) shall be provided by the tenderer.

8.2.19 The earth busbar shall not be less than half the size of the 3kV DC busbars and must be electrically connected to all the metal parts of the cell. The earth busbar must be able to handle 1500A continuously.

8.2.20 From the earth busbar a solid connection point for the truck shall be provided. This connection shall make when the truck is pushed into the cell so as to earth the truck before the main 3kV contacts make.

8.2.21 The opening which provides access to the cell's main 3kV contacts shall be covered by a non conductive, fire retardant material if the cell contacts are closer than 100mm to the shutter, otherwise metal can be used.

8.2.22 This shutter shall automatically open to give access to both main contacts as the truck enters the cell and shall close as the truck is removed from the cell.

8.2.23 Under no circumstances shall it be to come into contact with the 3kV DC incoming or 3kV DC outgoing busbars if the truck is removed from the cell.

8.2.24 This shutter shall be lockable by hand and automatically mechanically lock itself in the closed position with the truck removed from the cell. The shutter shall automatically unlock and open while the truck is pushed back into the cell. The shutter mechanism shall be developed by the tenderer.

8.2.25 In the control panel, three busbars must be provided for the operating supply of 110V DC to the breakers. The 110V busbars must be able to handle a continuous DC current of 30A.

8.2.26 Provision shall be made on all three busbars to extend them from one cell to another. The extension busbar pieces (slotted) shall be provided by the tenderer.

8.2.27 The 110V DC busbars shall be colour coded using a heat shrink method and shall be insulated from the metal cell via insulators. The top busbar shall be the negative 110V DC busbar and shall be coloured black. The second from top busbar shall be the positive 110V DC busbar and shall be coloured red. The third from the top and last busbar shall be the holding coil supply and shall be coloured grey.

8.2.28 On the front door of the control panel the ECR or DC feeder protection relay and receivers – (Current and voltage), open/close switch, local/remote switch, five miniature DC circuit breakers and three lights shall be mounted in a correct order(Close, lockout and open). On the inside of the control panel a terminal strip, limiting resistors and 154X relay or similar relay approved by Transnet Freight Rail – Technology Management, depending on the breaker used shall be fitted.

8.2.29 The tender shall supply all equipment as follows:

8.2.29.1 Three 110V LED's with red, yellow and green plastic covers for the indication lights.

8.2.29.2 A 110V, 15A double pole make before break switch for the local/remote switch.

8.2.29.3 A 110V, 15A switch, similar to the local/remote switch, for the open/close switch.

8.2.29.4 Three 2A, 110V DC circuit breakers and two 5A, 110V DC circuit breakers must be provided for the control of each breaker. The tenderer shall be notified in advance of which type of breaker will be used.

8.2.29.5 All the interconnections shall be done with 2,5mm square stranded copper wires. The interconnections shall be done according to drawing no. CEE-TBP-42 and the terminal strip shall be clearly marked as in this drawing.

8.2.29.6 A single 10 core control cable, 2,5mm square stranded copper per core, shall be provided for the connections to the breaker. This cable shall be fixed to the cell.

8.2.29.7 A connector that can be mounted on the breaker truck must also be provided to fit the 20 core cable connector.

8.2.29.8 The control cable shall be mechanically strengthened by a steel cable, running parallel with the control cable, of a shorter length. This steel cable must be fixed to the control cable connector and the breaker cell. The length of the cable shall allow the breaker truck to be fully removed from the cell for service purposes.

8.2.29.9 On returning the breaker truck to the breaker cell, the cable slack shall be taken in automatically in such a way that it is 150mm away from the breaker and out of the way of the operator.

8.2.30 Breaker cell – metal enclosure shall be as follows:

8.2.30.1 All the side walls of the breaker cell enclosure shall be covered with an insulation material of 4mm thickness and no metal parts from side walls shall protrude the insulation material.

8.2.30.2 The insulation material to be used shall be of polycarbonate panels.

8.2.30.3 The insulation panels shall be installed on insulators and they shall be in such a manner that they don't interfere with the removal and inserting of the breaker.

8.3 BREAKER TRUCK

8.3.1 The breaker truck's dimensions make provision for the latest designs of breakers.

8.3.2 The truck shall consist of a rigid steel frame with a mild steel sheet metal front panel. All dimensions shown are outer dimensions and shall not be changed without the approval of the office of Transnet Freight Rail's Senior Engineer (Electrical) in Technology Management.

8.3.3 The breaker must not be accessible, in any way, if the breaker is in service. The cooling fins in the front panel must therefore be constructed as shown.

8.3.4 The cell and truck shall be vermin proof when the breaker is in service.

8.3.5 Provision for the mounting of a breaker is made via a mounting plate.

8.3.6 The safety precautions to be followed when operating the bar.

8.3.6.1 The operator must open the breaker via the open/close switch whenever he removes the breaker from the cell or returns it to the cell. For a safety measure an electrical interlocking system must be implemented through the operating bar.

8.3.6.2 With the operating bar in the "OPEN" position, it shall open the breaker if the operator fails to do so via the open/close switch.

8.3.6.3 With the operating bar in the "OPEN" position, the truck would be free to be removed from the cell and returned to the cell.

8.3.6.4 With the operating bar in the "CLOSE" position, it shall be possible to operate the breaker. This will enable the operator to operate the breaker via the open/close switch.

8.3.6.5 With the operating bar in the "CLOSE" position and the truck fully entered in the cell, it shall not be possible to remove the truck from the cell.

8.3.6.6 After removal of the truck from the cell, it shall be possible for the operator to push the operating bar from the "OPEN" position to the "CLOSE" position. With the operating bar in the "CLOSE" position, it shall not be possible for the main contacts to be closed. The distance between the main 3kV DC contacts, mounted on the truck, and main 3kV busbar contacts shall not be less than 150mm.

8.3.6.7 With the operating bar in the "CLOSE" position and the truck removed from the cell, it shall be possible to test/calibrate the breaker.

8.3.6.8 When the breaker is put back into service, by using the operating bar on the front panel, the truck must be pushed into the cell for the main contacts to connect properly. When the truck has fully entered the cell, the operating bar must lock the truck in this position.

8.3.6.9 The breaker must now be controlled by the switches on the control panel. The operating bar mechanism shall be developed by the tenderer.

8.3.7 The truck and cell must have a guide system similar to the present rail (cell) and wheel (truck) system to guide the truck to make a proper connection between the main 3kV DC busbar contacts and main 3kV DC contacts, mounted on the truck.

8.3.8 The truck must be fitted with a copper earthing contact, in the middle under the truck, which is electrically connected to all the metal parts of the truck. This contact shall be electrically connected with the earth busbar in the cell before the main contacts are connected, when the truck enters the cell.

8.3.9 The main 3kV DC contacts, mounted on the truck, shall be of the female type (covered on the outside by insulation material if clearance between cell steel work and contact is less than 75mm), fit properly (electrically and mechanically) over the main 3kV DC busbar contacts and shall be rated to carry a continuous current of 2000A.

8.3.9.1 The temperature rise of the main contacts (copper) shall not exceed 55 degrees Celsius while passing the continuous rated current.

8.3.9.2 The main 3kV DC contacts, mounted on the truck, shall be solidly mounted on fire retardant insulating material with the nearest metal part of the truck 150mm away.

8.4 ECR OR DC FEEDER PROTECTION RELAY

8.4.1 The ECR must be Transnet Freight Rail (TFR) approved according to the TFR design and drawings.

8.4.2 The DC feeder protection relay must be Transnet Freight Rail approved.

8.4.3 The relay and all its associated equipment must work on 110V DC.

8.4.4 The receivers for voltage and current must be mounted in a control cubicle and must get the input from the transducer via fibre optic.

8.4.5 The fibre optic shall not be in the same trunk or pipe as the control wires.

8.4.6 The transducer shall not have 3kV DC on the more positive connection if the line test contacts on the High Speed Circuit Breaker are closed.

8.4.7 The DC feeder protection relay shall have the Resistor, Contactor (Line test), Transducer, Voltage receiver, Current receiver and the relay.

8.4.8 The relay reset button and two receivers shall be mounted in the control cabin.

8.4.9 The transducer, resistor and line test relay shall be mounted above the busbar chamber but in a separate chamber.

8.4.10 The shunt shall be mounted on the cable side of the busbar on the breaker (4000A, 50mV shunt).

8.4.11 The equipment required for the DC feeder protection relay shall be installed on top of the busbar chamber at the back of the breaker cell and truck.

8.4.12 Sufficient airflow/ventilation shall be provided for the resistors at the top roof of its compartment.

8.4.13 The 3kV DC circuit of the feeder protection relay shall be disconnected from the main 3kV DC circuit in the event of the circuit breaker/truck being removed from the cell.

8.4.14 Wiring in the 3kV DC circuit breaker shall be of high voltage.

8.4.15 Low voltage, high voltage and fibre optic wiring shall be separately installed in its own piping/tubing.

8.4.16 Wiring installed from the front panel to the back of the cell shall be installed in separate pipes. Where one shall be for the control purposes (At 110V DC) and the other for the fibre optic.

8.4.17 High Speed Circuit breaker installed shall be in accordance to specification CEE 0099.

8.4.18 The 3kV DC circuit breaker shall be Bi-directional type.

8.4.19 In the event of 3kV DC circuit breaker being controlled by feeder protection relays an intertripping circuit/coil shall be provided.

9.0 PAINTING

9.1 All equipment shall be painted in accordance with Transnet Freight Rail Infrastructure (Electrical) specification CEE.0045. The finishing coats shall be of the colours specified below.

9.2 Colour code numbers shall be in accordance to SANS 1091.

9.2.1 Exterior of the breaker cell and truck and roof: - Eau-de nil.

9.2.2 Interior of the cell and the truck frame :- White (Gloss) fire retardant paint.

9.3 Coatings applied by powder shall be in accordance to SANS 1274.

10.0 INSULATION LEVELS

10.1 The minimum clearance distance in air that shall apply from the 3kV DC circuit to the auxiliary circuits and to the steel work of the cell and truck shall be 150mm, except for the 3kV DC busbar

configuration, where it may be reduced to 75mm. Alternatively, double insulation or barriers shall be provided.

10.2 The insulation between the 3kV DC circuit and the auxiliary circuits and the steel work of the cell and truck shall be capable of withstanding a test voltage of 10,5kV AC 50Hz for one minute.

11.0 TESTS BY TRANSNET FREIGHT RAIL

11.1 Transnet Freight Rail reserves the right to test a cell, truck and main contacts for compliance with the following clauses.

11.1.1 Insulation tests, clauses 10.1 and 10.2.

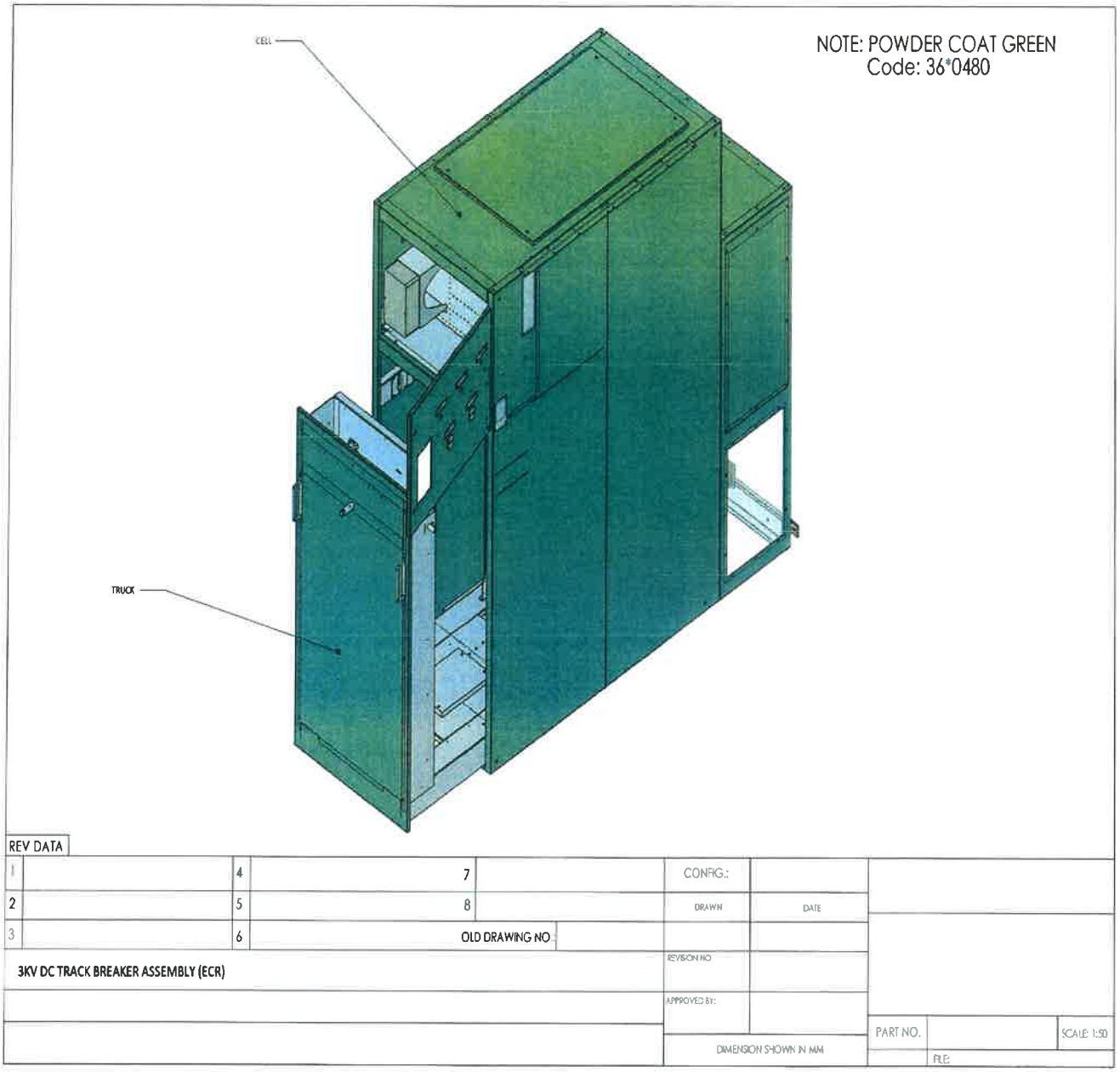
11.1.2 Temperature rise of the main contacts, clause 8.3.9.2.

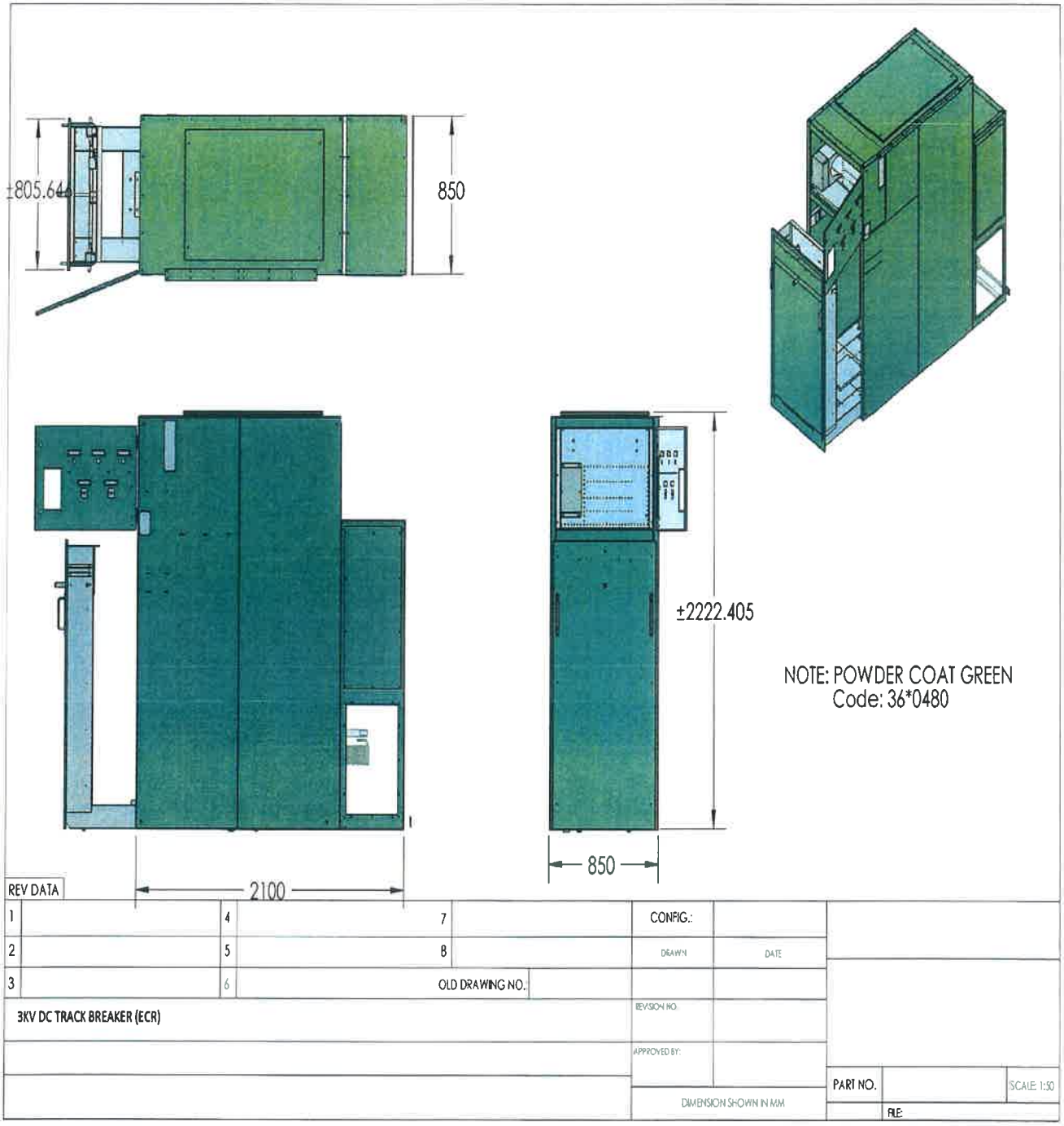
12.0 PROTOTYPE

One prototype of the breaker cell and truck shall be provided for evaluation by Transnet Freight Rail, before the balance of the order is built.

13.0 APPENDIX 1

LIST OF DRAWINGS

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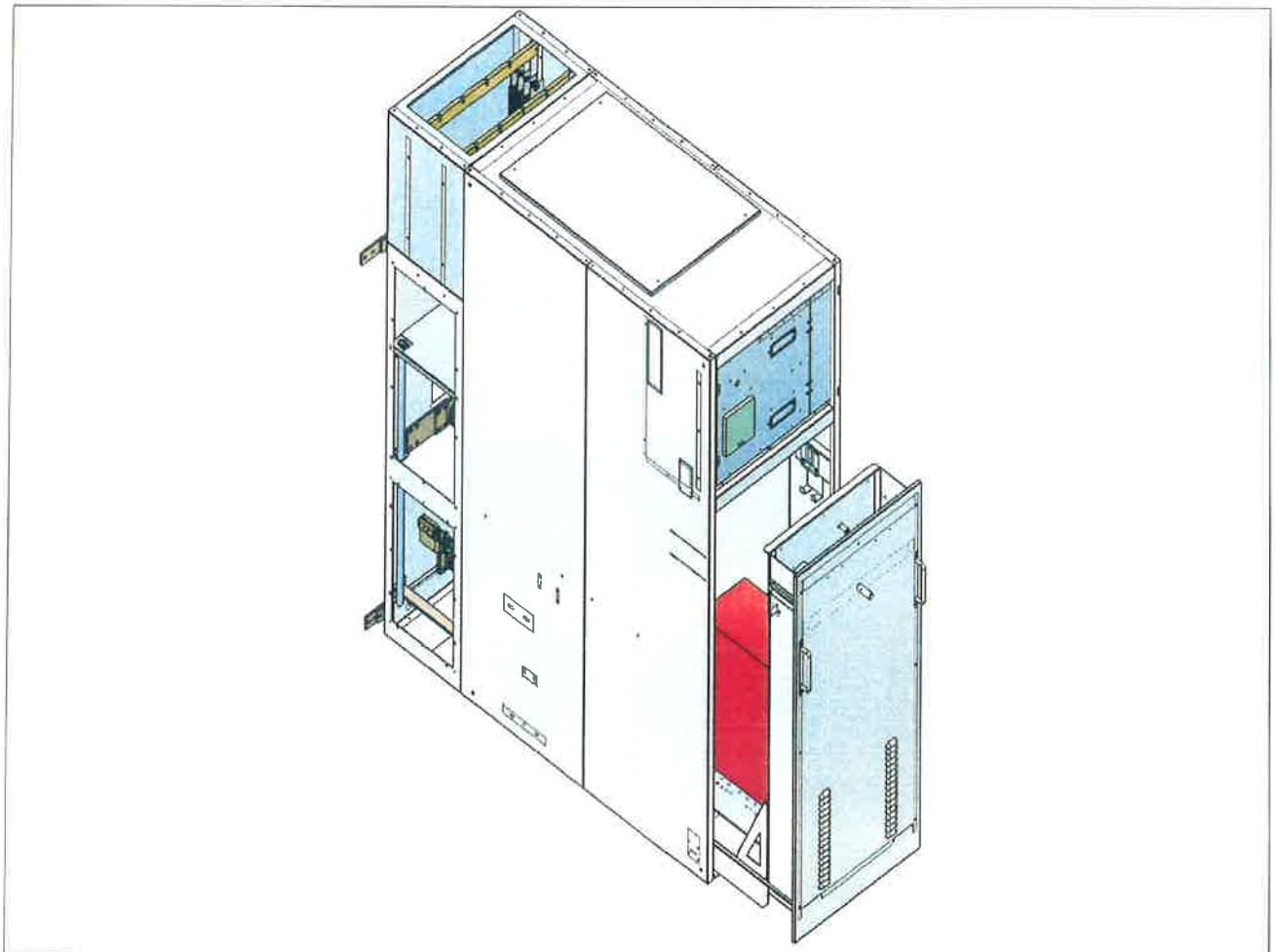

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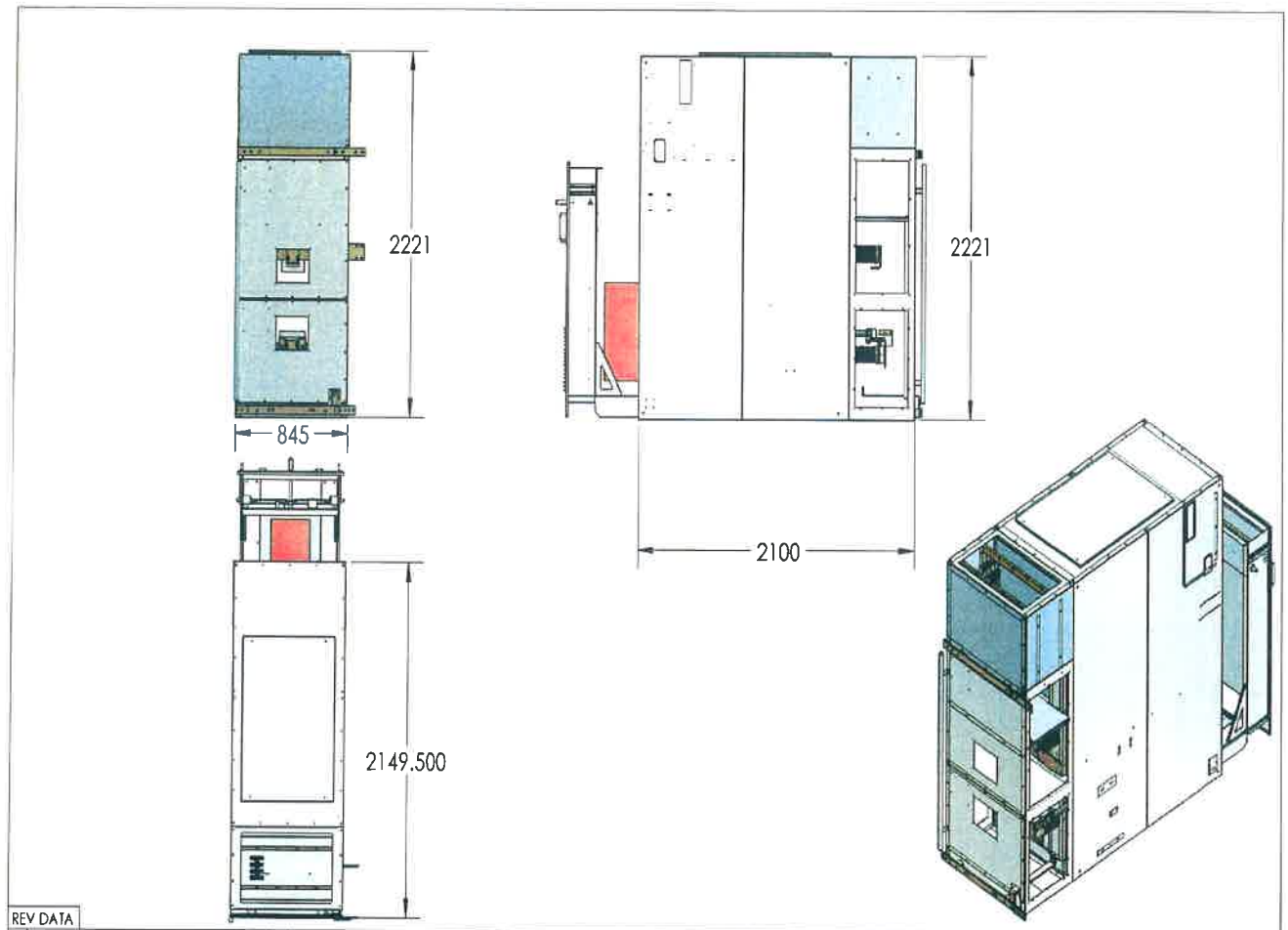

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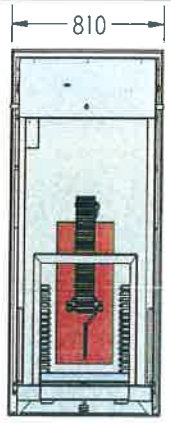

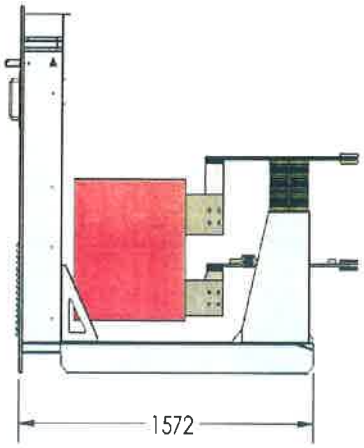

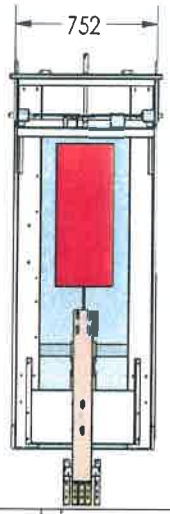

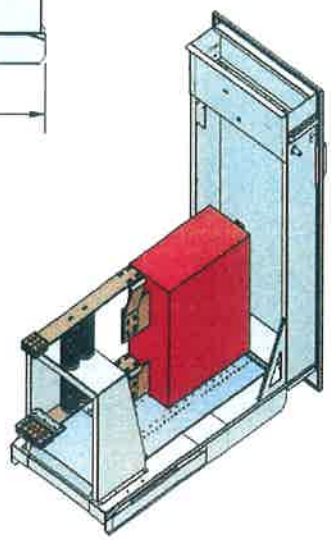

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