
Part C1: Agreement and Contract Data

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Contract Data

The Employer is

Name Transnet SOC Limited, Trading as Transnet Freight Rail
Address C/o Paul Kruger & Minnaar streets, Nzasm Building, Pretoria
Telephone (012) 315 2137/2 Fax No. (012) 315 2138
E-mail Nico.swart3@transnet.net

The works is: The design, supply, install, test and commissioning of 11kV switchgear at Pyramid South ERS and Doornpoort 11kV distribution substations under the control of the Depot Engineer, Koedoespoort

The site is Pyramid South ERS and Doornpoort 11kV distribution substations

The starting date is to be advised.....

The completion date is to be advised.....

The reply period is two weeks

The defects date is fifty two weeks after completion

The defect correction period is within 2 (two) weeks after defects date

The delay damages are R2,000.00 per day

The assessment day is the 18th (eighteen) of each month

The retention is 10% on the total contract value

Does the United Kingdom Housing Grants, Construction and Regeneration Act (1996) applies? **No**

The Adjudicator is

Name: To be advised if disputes arise.....

Address:.....

Telephone:.....Fax No.

E-mail:.....

Contract Data

The interest rate on late payment is 2% per complete week of delay.

The Contractor is not liable to the Employer for loss of or damage to the Employer's property in excess of R2m (two million) for any one event.

The Employer provides this Insurance: **Transnet Principal Control Insurance**

The minimum amount of cover for the third insurance stated in the Insurance Table is

> R25,000.00 (Limited to R10, 000, 000.00. for any one event)

The minimum amount of cover for the fourth insurance stated in the Insurance Table is:

Not applicable

The adjudicator nominating body is: **The Chairman of the Association of Arbitrators (Southern Africa)**

The tribunal is: **Arbitration**

If the tribunal is arbitration, the arbitration procedure is: **The rules for the Conduct of Arbitrators of the Association of Arbitrators (Southern Africa)**

The conditions of contract are the NEC3 Engineering and Construction Short Contract (June 2005) and the following additional conditions:

As mentioned in paragraph 1.0 (Contractual obligations)

1.0 CONTRACTUAL OBLIGATIONS

- 1.0 This project specification covers Transnet freight rail's requirements for the design, supply, install, test and commissioning of 11kV switchgear at Pyramid South ERS and Doornpoort 11kV distribution substations under the control of the Depot Engineer, Koedoespoort
- 1.1 The Contractor shall not make use of any sub-Contractor to perform the works or parts thereof without prior permission from the Employer.
- 1.2 The Contractor shall ensure that a safety representative is at site at all times. All safety measures prescribed by Transnet Freight Rail – Electrical Safety Instructions and the "Occupational Health and Safety Act 1993 (Act 85 of 1993)" associated with working on a project of this nature shall be adhered to.
- 1.3 The Contractor shall comply with all applicable legislation and Transnet safety requirements adopted from time to time and instructed by the Employer / Employer's Deputy. Such compliance shall be entirely at his own cost, and shall be deemed to have been allowed for in the rates and prices in the contract.

- 1.4 The Contractor shall, in particular, comply with the following Acts and Transnet Specifications:-
 - 1.4.1 The Compensation for Occupational Injuries and Diseases Act, No. 130 of 1993. The Contractor shall produce proof of his registration and good standing with the Compensation Commissioner in terms of the Act.
 - 1.4.2 The Occupational Health and Safety Act (Act 85 of 1993).
 - 1.4.3 The explosive Act No. 26 of 1956 (as amended). The Contractor shall, when applicable, furnish the Employer / Employer's Deputy with copies of the permits authorising him or his employees, to establish an explosives magazine on or near the site and to undertake blasting operations in compliance with the Act.
 - 1.4.4 The Contractor shall comply with the current Transnet Specification E.4E, Safety Arrangements and Procedural Compliance with the Occupational Health and Safety Act, Act 85 of 1993 and Regulations and shall before commencement with the execution of the contract, which shall include site establishment and delivery of plant, equipment or materials, submit to the Employer / Employer's Deputy.
 - 1.4.5 The Contractor shall comply with the current Specification for Works On, Over, Under or Adjacent to Railway Lines and near High Voltage Equipment – BBD 8210, if applicable, and shall take particular care of the safety of his employees on or in close proximity to a railway line during track occupations as well as under normal operational conditions.
- 1.5 The Contractor's Health and Safety Programme shall be subject to agreement by the Employer / Employer's Deputy, who may, in consultation with the Contractor, order supplementary and/or additional safety arrangements and/or different safe working methods to ensure full compliance by the Contractor with his obligations as an employer in terms of the Act.
- 1.6 In addition to compliance with clause 1.4 hereof, the Contractor shall report all incidents in writing to the Employer / Employer's Deputy. Any incident resulting in the death of or injury to any person on the works shall be reported within 24 hours of its occurrence and any other incident shall be reported within 48 hours of its occurrence.
- 1.7 The Contractor shall make necessary arrangements for sanitation, water and electricity at these relevant sites during the installation of the equipments.
- 1.8 A penalty charge of **R2,000** per day will be levied for late completion of the project.
- 1.9 No retention money will be retained.
- 1.10 The Contractor shall supply a **site diary** (with triplicate pages). This book shall be used to record any unusual events during the period of the work. Any delays to the work shall also be recorded such as delays caused by poor weather conditions, delays caused by permits being cancelled etc. The appointed Employer or Employer's Deputy must countersign such delays. Other delays such as non-availability of equipment from 3rd party suppliers must be communicated to the Employer or Employer's Deputy in writing.
- 1.11 The Contractor shall supply a **site instruction book** (with triplicate pages). This book shall be used to record any instructions to the Contractor regarding problems encountered on site – for example the quality of work or the placement of equipment. This book shall be filled in by the Employer or Employer's Deputy and must be countersigned by the Contractor.
- 1.12 Both books mentioned in 1.10 and 1.11 shall be the property of Transnet Freight Rail and shall be handed over to the Employer or Employer's Deputy on the day of energising or handing over.

- 1.13 All processes or the manufacture and assembly of the product components must be subjected to a quality assurance system.
- 1.14 The Contractor will remain liable for contractual delivery dates irrespective of deficiencies discovered during workshop inspections.
- 1.15 The Contractor will only receive payment after he has been called by a Transnet technician to commission certain equipment or the complete substation.
- 1.16 The Contractor must submit a site diary and test sheets with the invoice as proof that the work has been done.
- 1.17 The Contractor must wear correct PPE at all times while doing tests in the substations

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Contract Data

The Contractor's Offer

The Contractor is:

Name

Address

Telephone Fax No.

E-mail

The percentage for overheads and profit added to the Defined Cost for people is.....%

The percentage for overheads and profit added to other Defined Cost is.....%

The Contractor offers to Provide the Works in accordance with the *conditions of contract* for an amount to be determined in accordance with the *conditions of contract*.

The offered total of the Prices is (VAT @14% inclusive) **(In words)**.....

Amount in figures: R.....(VAT @14% inclusive)

Signed on behalf of the Contractor

Name

Position

Signature..... Date

The Employer's Acceptance

The Employer accepts the Contractor's Offer to Provide the Works

Signed on behalf of the Employer

Name

Position

Signature..... Date

Part C2: Pricing Data

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Part C2.1: Pricing Data

Price Instructions

2.0 PRICING INSTRUCTIONS

1. The agreement is based on the NEC Engineering and Construction Short Contract 3. The contract specific variables are as stated in the contract data. Only the headings and clause numbers for which allowance must be made in the Price list are recited.
2. Preliminary and General Requirements are based on part 1 of SANS 1921, 'Construction and Management Requirements for Works Contracts'. The additions, deletions and alterations to SANS 1921 as well as the contract specific variables are as stated in the contract data. Only the headings and clause numbers for which allowance must be made in the Price list are recited.
3. It will be assumed that prices included in the Price list are based on Acts, Ordinances, Regulations, By-laws, International Standards and National Standards that were published 28 days before the closing date for tenders.
4. Reference to any particular trademark, name, patent, design, type, specific origin or producer is purely to establish a standard for requirements. Products or articles of an equivalent standard may be substituted.
5. The Price list is not intended for the ordering of materials. Any ordering of materials, based only on the Price list, is at the Contractor's risk.
6. The amount of the Preliminaries to be included in each monthly payment certificate shall be assessed as an amount prorated to the value of the work duly executed in the same ratio as the preliminaries bears to the total of prices excluding any contingency sum, the amount of the Preliminaries and any amount in respect of contract price adjustment provided for in the contract.
7. The amount or items of the Preliminaries shall be adjusted to take account of the theoretical financial effect which changes in time or value (or both) have on this section. Such adjustments shall be based on adjustments in the following categories as recorded in the Price list:
 - a) An amount which is not to be varied, namely Fixed (F).
 - b) An amount which is to be varied in proportion to the contract value, namely Value Related (V).
 - c) An amount which is to be varied in proportion to the contract period as compared to the initial construction period, excluding revisions to the construction period for which no adjustment the Contractor is entitled to in terms of the contract, namely Time Related (T).
8. The following abbreviations are used in the Price list:

Hr	=	Hour
Ea	=	Each
Quant	=	Quantity
9. The prices and rates in these Price list are fully inclusive prices for the work described under the items. Such prices and rates cover all costs and expenses that may be required in and for the execution of the work described in accordance with the provisions of the scope of work and shall cover liabilities and obligations set forth or implied in the Contract data, as well as profit.

- 10 Where the scope of work requires detailed drawings and designs or other information to be provided, all costs associated therewith are deemed to have been provided for and included in the unit rates and sum amount tendered for such items.
- 11 Where no quantity has been provided against an item in the Price list, the Contractor shall use their discretion and provide the quantity.
- 12 The quantities set out in these Price list are approximate and do not necessarily represent the actual amount of work to be done. The quantities of work accepted and certified for payment will be used for determining payments due and not the quantities given in these Price list.
- 13 The short descriptions of the items of payment given in these Price list are only for purposes of identifying the items. More details regarding the extent of the work entailed under each item appear in the Scope of Work.
- 14 Contractor shall ensure that provision (financial as well as time) for excavations in a range of soil types is made for in their tenders.
- 15 For each item in the Price list, including Preliminaries, the Contractor shall provide in the appropriate column the portion of the tendered sum (inclusive of labour and material) which has been sourced locally (Republic of South Africa).
- 16 The Contractor shall also arrange forward cover within two weeks after contract award on all imported items.
- 17 The Contractor shall provide information related to imported content, i.e. equipment to be imported, value and applicable exchange rates. This information shall be provided as an Annexure to the Price list.
- 18 The total in the Price list shall be exclusive of VAT.
- 19 Transnet Freight Rail payment terms: 30 days from month end statement.

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Contract Data Price List

Item	Description	Unit	Qty	Unit Rate	Price
A1	Pyramid South ERS 11kV Substation				
1	Dismantle and remove old equipment from site on to Koedoespoort depot.	sum	1		
2	Supply and install 3 phase, 11kV switchgear in accordance with specification BBB 4182 Version 3 complete with protection relays.	ea	5		
3	Supply and install 70mm 11kV Cable incomer and two feeders and concrete cable route makers paint top section of maker with dark green paint	sum	1		
4	Supply and install batter charger 110V with batteries.	sum	1		
5	Supply and install control panel	sum	1		
6	Supply and install control cables to connect new switchgear to telecontrol equipment.	sum	1		
7	Supply termination kits per cable installation.	sum	1		
8	Modify checker plates to correct switchgear size and re-paint checker plated black.	sum	1		
9	Supply substation earthing in accordance with Drawing No. CEE-PA-23.	sum	1		
10	Installation, Testing and Commissioning.	sum	1		
11	Catalogues, manuals and drawings.	sum	1		
12	70mm 11kv Cables feeding and connected to the line shall be put in a steel pipe and fill with concrete and secure pipes to pole and at the bottom of the ground also cover with concrete	sum	1		
13	P's and G's (Labour, site establishment, Power supply, civil work, etc.).	sum	1		
14	Security	sum	1		
A	Total (Excl. VAT)		R		
B	VAT @ 14%		R		
C	Total Amount Due (VAT incl.)		R		

Contract Data Price List

Item No	Description	Unit	Qty	Unit Rate	Total amount
A 2	Doornpoort 11kV Substation				
1	Dismantle and remove old equipment from site on to Koedoespoort depot.	sum	1		
2	Supply and install 3 phase, 11kV switchgear in accordance with specification BBB 4182 Version 3 complete with protection relays.	ea	5		
3	Supply and install 70mm 11kV Cable incomer and two feeders and concrete cable route makers paint top section of maker with dark green paint	sum	1		
4	Supply and install batter charger 110V with batteries.	sum	1		
5	Supply and install control panel	sum	1		
6	Supply and install control cables to connect new switchgear to telecontrol equipment.	sum	1		
7	Supply termination kits per cable installation.	sum	1		
8	Modify checker plates to correct switchgear size and re-paint checker plated black.	sum	1		
9	Supply substation earthing in accordance with Drawing No. CEE-PA-23.	sum	1		
10	Installation, Testing and Commissioning.	sum	1		
11	Catalogues, manuals and drawings.	sum	1		
12	70mm 11kv Cables feeding and connected to the line shall be put in a steel pipe and fill with concrete and secure pipes to pole and at the bottom of the ground also cover with concrete	sum	1		
13	P's and G's (Labour, site establishment, Power Supply, civil work, etc.).	sum	1		
14	Security	sum	1		
A	Total (Excl. VAT)		R		
B	VAT (14%)		R		
C	Total Amount Due (Incl. VAT)		R		

Part C3: Scope of Work

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Contract Data

Works Information

2.0 DESCRIPTION OF WORKS

2.1 EMPLOYER'S OBJECTIVE

The main objective of Transnet Freight Rail is to replace old OCB 11kV switchgears with GCB 11kV switchgears at Pyramid South ERS and at Doornpoort distribution substations under the control of the Depot Engineer, Koedoespoort. The switchgear panels must be of withdraw able vacuum type. The Contractor should specify manufacture and type of equipment on his/her offer.

2.2 EXTENT OF THE WORKS

The Contractor shall perform the following:

2.3. PYRAMID SOUTH ERS 11 KV SUBSTATION

Disconnect, dismantle and remove the existing old 11 kV switchgears. The Contractor shall then transport the switchgears to Koedoespoort depot.

The Contractor shall supply and install 3 phase, 11kV switchgear in accordance with specification BBB 4182 Version 3 complete with protection relays.

The Contractor shall re-use existing control cables to connect new switchgear to telecontrol equipment.

Contractor shall make one of the 3 phase, 11kV switchgears a coupler in accordance with specification BBB 8695 version 4 drawing.

Supply termination kits per cable installation. All cabling and wiring shall be in accordance with specification BBC 0198 version 1 and SANS 10142-1.

Contractor shall re-use existing trenches and modify checker plates to correct switchgear size and re-paint checker plated black.

Supply paint and paint substation floor grey and substation wall white.

Redo substation earthing in accordance with Drawing No. CEE-PA-23. A 95 mm² earthing cables shall be used instead of a 10 mm² as indicated in the drawing.

Contractor shall make provision for temporal power supply for his/her tools and equipment i.e. standby generator.

2.4 DOORNPOORT 11 KV SUBSTATION

- 2.4.1 Disconnect, dismantle and remove the existing old 11 kV switchgears. The Contractor shall then transport the switchgears to Koedoespoort depot.
- 2.4.2 The Contractor shall supply and install 3 phase, 11kV switchgear in accordance with specification BBB 4182 Version 3 complete with protection relays.
- 2.4.3 The Contractor shall re-use existing control cables to connect new switchgear to telecontrol equipment.
- 2.4.4 Supply termination kits per cable installation. All cabling and wiring shall be in accordance with specification BBC 0198 version 1 and SANS 10142-1.
- 2.4.5 Contractor shall re-use existing trenches and modify checker plates to correct switchgear size and re-paint checker plated black.
- 2.4.6 Supply paint and paint substation floor grey and substation wall white.
- 2.4.7 Redo substation earthing in accordance with Drawing No. CEE-PA-23. A 95 mm² earthing cables shall be used instead of a 10 mm² as indicated in the drawing.
- 2.4.8 Contractor shall make provision for temporal power supply for his/her tools and equipment i.e. standby generator.

Incomer AA (HV/KV Transformer)

- Frame leakage protection.
- Earth fault protection (IDMT).
- Over current protection (IDMT) with high-set element for define time operation.
- Sensitive earth fault.

Buchholz protection is required

Feeder BB

- Buchholz protection if required.
- Earth fault protection (IDMT) with high-set element for define time operation.
- Over current protection (IDMT) with high-set element for define time operation.
- Oil over-temperature protection if required.
- Winding temperature protection if required.

Feeder CC

- Buchholz protection if required.
- Earth fault protection (IDMT) with high-set element for define time operation.
- Over current protection (IDMT) with high-set element for define time operation.
- Oil over-temperature protection if required.
- Winding temperature protection if required.

Current and Voltage Transformers

- The current and Voltage transformers shall be in compliance with Clauses 14.0 and 15.0 of the Specification no. BBB 4182 Version 2.
- **AA** current transformers are to be supplied as per following ratios:
 - Type (VBA) O.C.B. Rating (150MVA)
 - Form (3) Cycles (50)
 - CT Ratio (10/5) Output (15VA)
 - Busbar Rating (600) Current Rating (400)
 - Short Time Rating (13.1kA) 3 sec
- **BB & CC** current transformers are to be supplied as per following ratios:
 - Type (VBA) O.C.B. Rating (150MVA)
 - Form (3) Cycles (50)
 - CT Ratio (5/5) Output (15VA)
 - Busbar Rating (600) Current Rating (400)
 - Short Time Rating (13.1kA) 3 sec
- These CT ratios were recorded from existing old equipment at the distribution substations. The Contractor shall be responsible to verify that CT ratios and other ratings are suitable for the protection requirements at the substation.

2.5 STEELWORK

- 2.5.1 The design, supply and installation of all steel structures for the support of equipment shall be the responsibility of the Contractor. This shall be in accordance with Transnet freight rail specification CEE.0183.2002.
- 2.5.2 The manufacture of any steelwork shall not take place prior to the approval of the design drawings by the Supervisor/ Electrical Officer.
- 2.5.3 Transnet Freight Rail shall inspect the steelwork at the manufacturers works prior to dispatch.
- 2.5.4 All fasteners (nuts & bolts) shall be secured using flat and spring washers where necessary.
- 2.5.5 All steelwork shall be galvanized in accordance with SANS 121 and, where required painted in accordance with specification CEE 045 of 2002/1.

3 CABLING AND WIRING

- 3.1 The Contractor shall supply 11kV rated cables with suitable cable rating for each application.
- 3.2 Cabling and wiring shall be in accordance with CEE.0023.90 and SANS 10142-1.

- 3.3 No joining of cables will be accepted. The Contractor shall provide cables that are long enough for the application.
- 3.4 All cables shall terminate in compression type glands. These glands shall be fitted with neoprene shrouds.
- 3.5 All dissimilar metal connections (Cu to Al) shall be made using bi-metallic clamps that are specifically designed and manufactured to make that particular connection (ad hoc fabricated clamps are not acceptable).
- 3.6 All copper connections to steel (galvanised) shall be tinned.

4 **INSTALLATION**

- 4.1 The Contractor shall be responsible for the transport to site, off-loading, handling, storage and security of all material required for the construction/execution of the works.
- 4.2 All fasteners on steelwork, components and electrical connections (nuts and bolts) shall be secured using flat as well as lock washers.
- 4.3 Contractor shall re-use multi core cable and re-connect the tele-control that is currently available in the substation. The substation shall not be switched on unless the tele-control is fully operational.

5 **INTERCONNECTION OF EQUIPMENT**

- 5.1 High conductive silicon grease shall be liberally applied to all the connections.
- 5.2 All dissimilar metal connections (Cu to Al) shall be made using bi-metallic clamps that are specifically designed and manufactured to make that particular connection (ad hoc fabricated clamps are not acceptable).

6 **DISPOSAL AND TREATMENT OF OIL AND OIL FILLED EQUIPMENT**

- 6.1 The collection, handling and disposal of oil from the VCBs and VTs from the substation shall be done in a safe and environmentally sound manner.
- 6.2 Unless any equipment to be replaced containing oil is clearly certified PC free, the Contractor shall test or make arrangements for the testing of the equipment oil for Polychlorinated Biphenyls (PCBs) before replacing the equipment and submit the results to Transnet Freight Rail.
- 6.3 This will be done by first conducting preliminary screening chlorine tests and where the levels of chlorine presence are above 50ppm, further detailed PCB tests and analyses shall be conducted.
- 6.4 The units with levels of contamination less than 20ppm Chlorine shall be disposed of following the normal disposal procedure.
- 6.5 Any units with residual PCB pollution, or oils contaminated to a level greater than 50ppm shall be treated as PCB ITEMS.

- 6.6 Equipment and oil with a PCB content of between 20 and 49 PPM is classified as 'mildly contaminated' and shall be properly identified, i.e. marked with yellow stickers, and disposed of as contaminated.
- 6.7 In case of PCB items being identified, handling and disposal of the equipment shall be done in accordance to "A Manual and Guidelines for Management of Polychlorinated Biphenyls in Transnet Freight Rail".
- 6.8 Approved degreasing agents on concrete surfaces shall be used, if required.
- 6.9 The costs for the screening chlorine test and provisional analyses of oils and soil for PCB's, the tests and analysis of soil to determine the levels where spillages has occurred, must be furnished by the Contractors.
- 6.10 The Contractor shall provide a provisional method statement and cost for the legal disposal of PCB items, such methodology and costing becoming applicable only in the event of PCB items requiring disposal, as specified, being required.
- 6.11 The old equipment that is not contaminated shall be transported by the Contractor to Transnet Freight Rail's Witbank Electrical Depot and scrapped by Transnet Freight Rail following normal Procedures.
- 6.12 The disposal of any PCB items shall be by thermal destruction method; encapsulation method is not permitted.

7 SITE TESTS

- 7.1 The equipment shall be inspected / tested and approved by Transnet Freight Rail Quality Assurance at the Contractor's workshop prior to it being taken to site. Only once the approval has been granted can the equipment be taken to site for installation.
- 7.2 The Contractor shall be responsible for carrying out of on-site tests and commissioning of all equipment supplied and installed in terms of this specification and the contractual agreement.
- 7.3 Functional on-site tests shall be conducted on all items of equipment and circuitry to prove the proper functioning and installation thereof.
- 7.4 The Contractor shall submit a detailed list of on-site tests for the approval of the Employer's deputy or Supervisor.
- 7.5 The Contractor shall arrange for the Supervisor or his representative to be present to witness the on-site tests.
- 7.6 The on-site tests and subsequent commissioning **will not commence until ALL CONSTRUCTION** work has been completed. Construction staff, material and equipment shall be removed from site prior to the commencement of testing. Testing and commissioning of the power plants equipment will not be allowed to take place in a construction site environment.
- 7.7 The on-site tests shall include the following:
 - Test for the functionality of all electrical circuitry.
 - Trip tests on relays.
 - Test on equipment as per manufacturer's instructions.

- Insulation tests.

- 7.8 At the completion of the on-site tests, the Employer's deputy or Supervisor or his representative shall either sign the tests sheets (supplied by the Contractor) as having witnessed the satisfactory completion thereof, or hand to the Contractor a list of defects requiring rectification.
- 7.9 Upon rectification of defects, the Contractor shall arrange for the Employer's deputy or Supervisor or his representative to certify satisfactory completion of on-site tests.
- 7.10 Acceptance by the Employer's deputy or Supervisor 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.

8 COMMISSIONING OF EQUIPMENT

- 8.1 Commissioning will only take place after all defects have been rectified to the satisfaction of the Employer's deputy or Supervisor.
- 8.2 On completion of commissioning, the Contractor will hand the equipment over to the Employer's deputy or Supervisor in terms of the relevant instruction.
- 8.3 The commissioning of protection equipment by Transnet Freight Rail will in no way absolve the Contractor from any of his responsibilities during the guarantee period.
- 8.4 It is the Contractor's responsibility to satisfy him or herself that the commissioning of the protection equipment has been carried out in a satisfactory manner, and in no way compromises the proper operation of the equipment supplied in terms of the contract.
- 8.5 The Contractor shall be present during the testing and setting of the protection to rectify any faults found.

9 GUARANTEE AND DEFECTS

- 9.1 The Contractor shall guarantee the satisfactory operation of the complete electrical installation supplied and erected by him and accept liability for maker's defects that may appear in design, materials and workmanship.
- 9.2 The Contractor shall be issued with a completion certificate with the list of all defects to be repaired within 14 working days after commissioning.
- 9.3 The guarantee period for these standby plants shall expire after: A period of 12 months commencing on the date of completion of the contract or the date the standby plant was handed over to Transnet Freight Rail.
- 9.4 Any defects that may become apparent during the guarantee period shall be rectified to the satisfaction of Transnet Freight Rail, and to the account of the Contractor.
- 9.5 The Contractor shall undertake work on the rectification of any defects that may arise during the guarantee period within 7-days of him being notified by Transnet Freight Rail of such defects.
- 9.6 Should the Contractor fail to comply with the requirements stipulated above, Transnet Freight Rail shall be entitled to undertake the necessary repair work or effect replacement of defective apparatus or materials, and the Contractor shall reimburse Transnet Freight Rail the total cost of such repair or replacements, including the labour costs incurred in replacing defective material.

- 9.7 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 Employer's deputy or Supervisor and at the cost of the Contractor.
- 9.8 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.

10 QUALITY AND INSPECTION

- 10.1 Transnet Freight Rail shall inspect the equipment under contract on the premises of the Manufacturer or successful Contractor.
- 10.2 The Contractor shall notify Transnet Freight Rail 14 days in advance of such an inspection date.
- 10.3 The Contractor shall apply 14 days in advance for the date of energizing and ensure that all work is completed before any commissioning can take place.
- 10.4 The Contractor shall be responsible to issue a compliance certificate in terms of SANS 0142 for each site before energizing of the equipment shall take place.

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Contract Data

Works Information

11 Specifications

Unless otherwise specified all material and equipment supplied shall comply with the current edition of the relevant SANS, BS, IEC or Transnet Freight Rail publication where applicable.

The following standard specifications will be applicable to this contract.

12.1 South African National Standards:

- | | |
|-------------------|--|
| 12.1.1 SANS 1091 | National colour standard. |
| 12.1.2 SANS 763 | Hot dip galvanised zinc coating. |
| 12.1.3 SANS 121 | Hot dip galvanised coating for fabricated iron or Steel Article. |
| 12.1.4 SANS 10142 | Wiring Code. |

12.2 British Standards

- | | |
|-----------------|---|
| 12.3.1 BS 37: | Electricity meters |
| 12.3.2 BS 3938: | Specification for current transformers. |

12.4 IEC Standards

- | | |
|-------------------|--|
| 12.4.1 IEC 60051: | Direct acting analogue electrical measuring instruments. |
| 12.4.2 IEC 60243: | Electrical strength of insulating material. |

12.5 South African National Standards

- | | |
|------------------------|--|
| 12.5.1 SANS 109: | National colour standards for paint. |
| 12.5.2 SANS 1019: | Standard voltages, currents and insulating levels for electrical supply. |
| 12.5.3 SANS 62271-100: | High voltage switchgear and control gear. |
| 12.5.4 SANS 60044-1: | Instrument transformers-current transformers. |
| 12.5.5 SANS 60060: | High voltage test techniques. |
| 12.5.6 SANS 60298: | A.C. metal enclosed switchgear and control gear for rated voltages above 1kV and up to 52kV. |
| 12.5.7 SANS 60947: | Low voltage switchgear and control gear control circuit devices |

and switch elements.

12.6 Transnet Freight Rail

- 12.6.1 BBB 4182 Ver-3 Indoor, high voltage, alternating current switchgear and control gear.
- 12.6.2 BBC 0198 Ver-1: Specifications for requirements for the supply of electrical cables.
- 12.6.3 CEE.0023.90: Specifications for the installation of cables.
- 12.6.4 CEE.045: Painting of steel components of electrical equipments.
- 12.6.5 CEE.0183.2002: Hot dip galvanising and painting of electrification steelwork.
- 12.6.6 CEE.0224.2002: Drawings, catalogues, instruction manuals and spares list for electrical equipment supplied under contract.
- 12.6.7 CEE-PA-13: Drawing for test block.
- 12.6.8 CEE-PA-56: Connection diagram for protection relays to CTs.

NOTE: Any other specifications referenced in the above mentioned specification, will be for information purposes and may be provided on request.

Occupational Health and Safety Act No. 85 of 1993 (Available at depot for referral)

13.0 Constraints on how the Contractor Provides the Works

The constraints shall be as specified in the specifications of the particular equipment.

14.0 Requirements for the programme

Programme of work	: To be submitted by successful Contractor
CIDB rating	: 3EP and above
Format	: Bar chart
Information	: How work is going to be executed and commissioned
Submission	: Not Applicable
Site diary	: Successful Contractor to supply in triplicates carbon copies

15.0 Services and other things provided by the Employer

- 15.1 Transnet Freight Rail shall have an electrician available for isolation and the erection of barriers to live electrical equipment and issuing of work permits.
- 15.2 Upon successful completion of the works to the satisfaction of Transnet Freight Rail, Transnet Freight Rail shall perform necessary protection tests and commission the equipment.



TRANSNET
freight rail

A Division of Transnet Limited

**ENGINEERING & TECHNOLOGY
TECHNOLOGY MANAGEMENT**

SPECIFICATION

**INDOOR, MEDIUM VOLTAGE METAL ENCLOSED
SWITCHGEAR AND CONTROL GEAR IN ACCORDANCE
WITH IEC 62271-200**

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1.0. SCOPE

- 1.1. This specification cover's TFR's requirements for the supply of indoor three phase medium voltage metal enclosed switchgear and controlgear.

2.0. STANDARDS AND PUBLICATIONS

The latest version of the following publications and standards are referred herein.

2.1. INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60044-1*	Instrument transformer Part 1: Current Transformer
IEC 60044-2*	Instrument transformer Part 2: Inductive voltage transformer
IEC 60051	Direct acting indicating analogue electrical measuring instruments and their accessories.
IEC 60243-1	Electrical strength of insulating materials – Test methods – Part 1 Tests at power frequencies.
IEC 60255-5	Electrical Relays: Part 5: Insulation coordination for measuring relays and protection equipment – Requirements and tests
IEC 60282-1*	High-voltage – Current limiting fuses
IEC 60529*	Degrees of Protection provided by enclosures (IP code)
IEC 60947-5-1*	Low-voltage switchgear and control gear Part 5-1. Control circuit devices and switching elements. Electromechanical control circuit devices.
IEC 61000-4	Electromagnetic compatibility Part 4:- Testing and measuring techniques
IEC 62053-21	Electricity metering. Part 21
IEC 62271-100*	High Voltage alternating current (AC) circuit breaker.
IEC 62271-102*	Alternating current disconnectors and earthing switches.
IEC 62271-105*	Alternating current (AC) switch-fuse combinations.
IEC 62271-200*	AC metal enclosed switchgear and controlgear for rated voltages above 1kV and up to and including 52kV.

2.2. SOUTH AFRICAN STANDARDS (SANS)

SANS 156	Moulded-case circuit breaker
SANS 1091	National colour standards for paint.
SANS 1274	Coatings applied by powder for paint.
SANS 1507	Electrical cables with extruded solid dielectric insulation for fixed installations. (300V/550V-1,900V/3,300V) Part 1: General

2.3. TRANSNET FREIGHT RAIL (TFR)

BBD 7524 Version1	Switching & Lightning Surges protection system for a low voltage equipment installed in substation.
BBD 8946	Testing, setting and operation of a rogowski coil.
CEE.0224	Drawings, catalogues, instruction manuals and spares list for electrical equipment supplied under contracts.

3.0. APPENDICES

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

- 3.1. Appendix 1: "Schedule of requirements" - to be filled in by Transnet Freight Rail (Client).
 3.2. Appendix 2: "Technical Data Sheet" – to be furnish by tenders.
 3.3. Appendix 3: "Tests conducted on the switchgear"

4.0. TENDERING PROCEDURE

- 4.1. Tenderers shall indicate clause by clause compliance with this specification. This shall take the form of a separate document listings all the specification clause numbers the individual statement of compliance or non-compliance.
- 4.2. The tenderer shall motivate a statement of non-compliance.
- 4.3. Tenderers shall complete Appendix 2. "Technical Data Sheet".
- 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**

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

Altitude	: 0 to 1,8m 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

The nominal operational conditions are specified in clauses 1.3, 4.1 and 6.0 of Appendix 1.

5.3. MECHANICAL CONDITIONS

The switchgear is installed in close proximity to railway tracks and be subjected to vibration.

6.0. GENERAL REQUIREMENTS OF SWITCHGEAR AND CONTROLGEAR

- 6.1. The switchgear and controlgear shall be designed, manufactured and tested in accordance with IEC 622171-200.
- 6.2. The design of the equipment shall be make provision for the safety of the persons concerned in the normal operation and maintenance of the equipment.
- 6.3. The equipment shall be capable to operate under full load and fault conditions.
- 6.4. It shall not be possible to manually operate the circuit breaker unless it is in the "service" or "earthed" position.
- 6.5. The switchgear and controlgear shall be of the following:
- Withdrawable vacuum interrupted switchgear and controlgear.
 - Non-withdrawable SF6 gas insulated vacuum interrupted switchgear and controlgear.

7.0. WITHDRAWABLE VACUUM INTERRUPTED SWITCHGEAR AND CONTROLGEAR

- 7.1. It shall not be possible to rack in the circuit breaker unless the truck is properly located in the correct position.
- 7.2. Position indication shall be provided to mechanically/manually indicate the position of the withdrawable circuit breakers, disconnectors and earthing devices, and fuse combinations, i.e. racked-in, racked-out (isolated), earthed, on/off. The indication shall be readily visible from the front of each panel.

- 7.3. Shutters from free fall design shall be provided to cover the "Busbar" and "Circuit" high-voltage sockets into which the contacts of the circuit breaker engages. These shutters shall automatically cover the sockets with a positive action when the switchgear is withdrawn.
- 7.4. Facilities of independently padlocking each shutter in the closed position shall be provided.
- 7.5. Busbar shutters shall be red (colour A11 in SANS 1091) and shall be clearly marked "Busbars".
The "Circuit"
- 7.6. The withdrawable circuit breaker shall be mounted on a transporting truck device, and fitted with wheels.
- 7.7. Flexible test rigs/cables shall be provided for testing the operation of the circuit breaker when fully withdrawn from the panels.

8.0. NON-WITHDRAWABLE SF6 GAS INSULATED VACUUM INTERRUPTED SWITCHGEAR AND CONTROLGEAR.

- 8.1. Live parts, switching functions and vacuum interrupters shall be housed in a completely sealed stainless steel tank.
- 8.2. The steel tanks shall be fitted with gas pressure densimeters provided with alarm contacts for low gas conditions. Low SF6 gas pressure for gas insulated vacuum interrupted switchgear shall trip the switchgear.
- 8.3. Position indication shall be provided to mechanically/manually indicate the position of the non-withdrawable circuit breakers, disconnectors and earthing switches and fuse combinations, i.e. on/off and earthed (isolated). The indication shall be readily visible from the front of each panel.
- 8.4. The sealed stainless tank, housing the live high voltage switching equipment shall be safe to touch.
- 8.5. All components doors giving direct access to high voltage equipment shall be mechanically and electrically interlocked so that the doors cannot be opened whilst the equipment is live.
- 8.6. A visible voltage detection system shall be supplied to verify safe isolation from supply during switching and maintenance operations.

9.0. SWITCHING DEVICES -: WITHDRAWABLE AND NON-WITHDRAWABLE

9.1. GENERAL

Switching device shall be ganged triple-pole construction.

- 9.1.1. Motors used for spring charging or other applications shall be protected by thermal overload and low voltage circuit protection.
- 9.1.2. Where motor driven operation is supplied, interlocking shall be provided to prevent three position switch-disconnectors from being switched from the closed position directly to the earthed position.
- 9.1.3. It shall be possible to manually charge the spring-operated mechanism.
- 9.1.4. A mechanical operated device shall indicate whether the spring is charged or free and this shall be visible without opening the operating cubicle doors.
- 9.1.5. The spring release coil shall be suitable for operation from the substation battery supply, which can vary between 80% to 120% of the stated nominal voltage.
- 9.1.6. It shall be possible to control the spring close/open mechanism from local/remote source depending on the position of the "local/remote" selector switch.
- 9.1.7. Tripping shall be by means of shunt trip coils.
- 9.1.8. A minimum of two normally open normally closed auxiliary contacts shall be provided on each switching device. The spare contacts shall be wired to a terminal strip in the panel. For withdrawable switchgear and controlgear auxiliary plugs and sockets shall be used.
- 9.1.9. Each individual switching device panel shall be fitted with "close" and "open" controls.
- 9.1.10. Where "close" and "open" pushbuttons protrude to the outside of the panel they shall be shrouded.

9.2. CIRCUIT BREAKER

- 9.2.1. The circuit breaker shall be designed, manufactured and tested in accordance with IEC 62271-100.
- 9.2.2. Only Vacuum interrupters shall be used.
- 9.2.3. Circuit breakers shall be equipped with trip-free closing mechanisms. An electrical manual closing mechanism shall be provided for maintenance purposes.
- 9.2.4. Presrting and chopping current shall be kept to a minimum. The tenderer shall give full details regarding these characteristics at the time of tendering.
- 9.2.5. The first pole clear factor shall be 1.5.
- 9.2.6. The making time shall not be greater than 100 milliseconds.
- 9.2.7. The breaking time shall not be greater than 40 milliseconds.
- 9.2.8. If a direct means of indicating contact wear and the necessity for replacement is not provided in withdrawable switchgear, a concise description of how this can be determined shall be provided on a label permanently fixed to the switchgear or switch panel.
- 9.2.9. Where remote pendant control system for the opening and closing of the circuit breaker is required, the design of the system shall be in conjunction with TFR staff.

9.3. FUSE-SWITCH COMBINATIONS

- 9.3.1. Fuse-switch combinations shall be designed, manufactured and tested in accordance with IEC 602271-105.
- 9.3.2. The switches shall be of the load break-fault make type.
- 9.3.3. Undervoltage releases shall not be fitted.
- 9.3.4. Fuse-switch combinations shall be fitted with striker pins for automatic tripping purposes.
- 9.3.5. High Rupturing Capacity (HRC) fuses used shall be in accordance with IEC 60282-1.

9.4. DISCONNECTORS (ISOLATORS) AND EARTHING SWITCHES

- 9.4.1. Disconnectors and earthing switches shall be designed, manufactured and tested in accordance with IEC 602271-102.
- 9.4.2. Earthing switches shall be of the fault make type.
- 9.4.3. The operation mechanism shall be positioned on the front of the panel and lockable in all switching positions.
- 9.4.4. The operation of the disconnectors shall be manually operated.
- 9.4.5. Reliable mechanical indication of these positions shall be visible from the front of the panel.
- 9.4.6. A notice with the following inscription shall be provided adjacent to the operating mechanism:-
“DO NOT OPERATE UNDER LOAD CONDITION”

10.0. PROTECTION SYSTEM

- 10.1. The protection relays shall be designed, manufactured and tested in accordance with IEC 60255-5.
- 10.2. The contractor shall be responsible for the design, supply and installation of the protection system. In the event of any discrepancies or disputes concerning the protection, Transnet freight Rail (TFR) reserves the right to final decision. TRF will provide the settings for the protection system.
- 10.3. The protection system shall be submitted to Transnet Freight Rail for approval.
- 10.4. Protection relays shall be supplied as specified in Appendix 1. (Protection schedule).
- 10.5. The protection relays shall be flush mounted and shall be contained in a dust-proof metal case. The degree of protection of the relay enclosure shall be IP 34 in accordance with IEC 60529.
- 10.6. The protection relays shall be capable of being reset without the necessity for opening the case.
- 10.7. It shall not be possible to operate any relay by hand to trip without opening the case.

- 10.8. The protection relays shall unless otherwise approved be provided with double contacts independent of each other, for controlling duplicate tripping circuits if necessary.
- 10.9. High speed tripping relays shall be self-latching and unless otherwise specified, the coil circuit shall be broken by self-contained contacts.
- 10.10. Relays used for master tripping shall be of the electromechanical type which can only be reset manually.
- 10.11. Protection relays used shall be continuously rated for the rated current setting.
- 10.12. The protection relays shall have reset flag indication on each element, save for fuse switch combination protective systems.
- 10.13. The relays shall have an additional set of normally open contacts for remote indication of the relay operation. These contacts shall be capable of handling 50W in the range of 24 to 110V DC, and shall be wired to a terminal strip at the back of the panel.
- 10.14. The protection settings of the relays shall be menu driven and it shall be possible to manually program the protection relays from the front of the panel and by means of computer equipment if required.
- 10.15. Suitable surge protection shall be provided across the relay supply voltage to protect the electronic relays from incoming voltage transients. The surge protection shall be in accordance with BDD 7524.
- 10.16. Where multi-function, micro-processor protection relays are supplied they shall provide protection, measuring, supervisory and basic control functions.
- 10.17. It shall be possible to configure the relays for applications specific for TRF protection systems.
- 10.18. The relays shall comply with IEC 61000-4 for electrostatic discharge tests.

USER INTERFACE

- 10.19. The user interface and menu shall be in English.
- 10.20. A display shall be provided for input data maintenance information and reporting functions.
- 10.21. Alarm indication shall be provided on the front cover of the relay.

DATA COMMUNICATION

- 10.22. Where specified, data communication shall be possible between the protection relay(s) and remote transmission or supervisory equipment. SCADA (Supervisory and Data Acquisition) equipment.
- 10.23. Transnet Freight Rail shall be consulted for a decision on the compatibility of the protocol offered with the existing telecontrol system in the substations.

PROTECTION RELAYS FUNCTIONALITY

The clauses below cover the requirements for multifunction or individual relays.

- 10.24. The protection relays shall function with one-Ampere or five-Ampere secondary (1:5) windings of current transformer or with Rogowski coil sensor in accordance with BDD 8946.
- 10.25. The relays shall be provided with self monitoring "watchdog" facilities. Automatic tests shall be performed on start up and on a cyclic self monitoring process. Both software and hardware shall be monitored for errors.
- 10.26. Access to the relay settings shall be password protected to prevent casual access to the relay control

11.0. PROTECTION RELAYS

11.1. OVERCURRENT AND EARTH FAULT RELAYS

- 11.1.1. Inverse Definite Minimum Time (I.D.M.T) overcurrent and earth fault relays shall be of the microprocessor protection type having adjustable operating settings for standard, very or extreme inverse current/time characteristics. The relays shall incorporate an adjustable high-set element for definite time operation.
- 11.1.2. Sensitive earth fault relays shall be of the microprocessor protection type and have a current setting of 0.5 percent – 8 percent and an operating time adjustable from 1-99 seconds.

11.2. DIFFERENTIAL PILOT WIRE FEEDER PROTECTION

- 11.2.1. Only those systems, which do not require the use of, screened pilot wires and which utilise current transformers with earthed secondary windings will be considered.
- 11.2.2. The relays incorporate for this system shall:-

- 11.2.2.1. have minimum settings not exceeding 90 percent for phase faults and 40 percent for earth faults where 100 percent corresponds to rated secondary current.
- 11.2.2.2. provide "instantaneous" tripping.
- 11.2.2.3. be compensated for any inherent out-of-balance in the current transformer supplied and shall be automatically biased against tripping on through faults.
- 11.2.3. it shall be the responsibility of the tenderer to ensure that the transformer and relays supplied will match exactly the equipment installed at the other end of the cable to be protected and that the whole protection system will be stable on through-faults but will operate satisfactory on feeder faults.

11.2.4.

11.3. AUTO_RECLOSE RELAY

- 11.3.1. This system shall consist of instantaneous and time lag over-current and earth fault relays and auto-reclosing relay.
- 11.3.2. After a preselected number of times if the fault remains the auto-reclosing relay will lock-out.
- 11.3.3. If the fault clears during the reclosing cycle the auto-reclosing relay shall reset to initial condition.
- 11.3.4. The relay shall be provided with the following functions:-
 - 11.3.4.1. the facility to select the number and sequence of the instantaneous and of the delayed trips which form the reclosing cycle, up to at least 4;
 - 11.3.4.2. adjustable setting to set the duration of the time interval between the tripping and reclosing in the range 0-30 seconds,
 - 11.3.4.3. adjustable setting to set the definite minimum time of the delayed tripping between 0-10 seconds.
- 11.3.5. The auto-reclosing system shall be provided with a non resettable cumulative operation counter.
- 11.3.6. The auto-reclosing system shall be inhibited in the event of a sensitive earth fault operation.

11.4. BUSBAR FRAME LEAKAGE PROTECTION

- 11.4.1. Instantaneous earth fault protection for the complete busbar panel.
- 11.4.2. The system shall consist of an instantaneous relay with adjustable current setting from 0 to 100 percent where 100 percent corresponds to the secondary rating of the current transformer associated with the relay.
- 11.4.3. A master trip relay shall be incorporated in circuitry so that when energised by the operation of the frame leakage relay it shall trip all the switching devices and inhibit them from been closed form remote until the manual resetting of the master trip relay.
- 11.4.4. The master trip relay shall be a mechanical latched relay with flags and manual reset.

BUSBAR ZONED FRAME LEAKAGE PROTECTION

- 11.4.5. Instantaneous earth fault protection to isolate only the faulty section of a sectionalised busbar panel.
- 11.4.6. This system shall consist of individual zone relays, which shall trip all switching devices in their respective zones to isolate the fault from all sources of supply.
- 11.4.7. Busbar zoned frame leakage protection master trip shall be in terms of clauses 11.4.3 and 11.4.4 above.
- 11.4.8. The bus-section switching device shall be a separate zone.
- 11.4.9. Insulating material between zones and earth shall be high grade non-deteriorating and non-hygroscopic, at least 2mm thick cut to size and ready for installation.
- 11.4.10. The insulating material shall have an electric strength of not less than 4 kV when tested in accordance with IEC 60243-1 for 1 minute.
- 11.4.11. The insulating material required for the installation of the switchgear, shall be supplied with the switchgear panels.

11.5. TRANSFORMER PROTECTION

(3 phase, 2 winding power transformer)

11.5.1. OVER-CURRENT AD EARTH-FAULT PROTECTION

- 11.5.1.1. The relay shall consist of the following elements:-

- two extremely inverse definite minimum time lag over-current elements,
- two high set instantaneous over-current elements with low transient over each characteristic,
- one extremely inverse definite minimum time lag earth fault element.

11.5.2. RESTRICTED EARTH FAULT PROTECTION

11.5.2.1. The relay shall:-

- be of the high impedance instantaneous type,
- be fitted with low pass filter or be tuned to 50 Hz,
- stability on through fault shall be maintained up to the fault rating of the switchgear,
- sensitivity shall be equal to the rated current of the current transformer.

11.5.2.2. The successful tenderer shall supply the current transformer for installation in the neutral connection of the power transformer.

11.5.2.3. The insulation rating of the neutral current transformer shall be of withstanding the power frequency withstand test specified in IEC 60044-1 for electrical equipment with a rated insulation level for the highest voltage of 12kV.

11.5.2.4. The tenderer shall advise the maximum lead burden.

11.5.2.5. Should the current transformer be installed by others the Contractor shall be responsible for the correct operation of the restricted earth fault protection system.

11.5.3. BIASED DIFFERENTIAL PROTECTION

11.5.3.1. The relay shall:-

- have a high speed characteristic,
- be biased to provide stability during through faults,
- not be operated by normal magnetising inrush current.

11.5.3.2. Current transformer for the higher voltage winding of the power transformer will be installed by others but the tenderer shall advise the maximum lead burden.

11.5.4. OVER TEMPERATURE, GAS DETECTION AND OVERPRESSURE PROTECTION

11.5.4.1. Circuit breakers controlling transformers shall be provided with the instantaneous trip auxiliary relays with mechanical flags for indication purposes.

11.5.4.2. The relays for oil /winding temperature shall trip and inhibit the reclosing of the circuit breaker until the oil or winding temperature of the transformer has cooled down sufficiently for the relay to reset by itself.

11.5.4.3. The relays for the transformer Bucholz shall trip and inhibits the reclosing of the circuit breaker until Bucholz relay has been reset manually.

11.5.5. TANK - EARTH PROTECTION

11.5.5.1. The circuit breaker panel shall be provided with an instantaneous type relay.

11.5.5.2. The current transformer associated with the above relay for installation between the transformer tank and earth shall be supplied loose to Transnet Freight Rail when called for in APPENDIX 1.

12.0. INDICATING INSTRUMENTS

12.1. AI, indicating instruments shall be of the analogue type and shall comply with the requirements of IEC 60051.

12.2. All indicating instruments shall:-

- be flush-mounted and dustproof. The degree of protection shall be IP 34 in accordance with IEC 60529,
- have a minimum a scale length of not less than 85mm,

- have a minimum accuracy class of 2.5,
 - be marked with the ratios of the associated current and/or voltage transformers.
- 12.3. The ammeter full-scale deflection shall be the first standard value above the normal primary current rating of the associated current transformers.
- 12.4. Voltmeter full-scale deflection shall indicate nominal voltage at approximately 75 percent of the scale length and shall be marked with a red line.
- 12.5. Maximum demand ammeters shall be of the 15-minute thermal type and shall be integrated with the marking ammeters.

13.0. ENERGY METERS

- 13.1. Energy meters shall comply with the requirements specified in IEC62053-21.
- 13.2. Suitable surge protection shall be provided across the low voltage supplies for the energy meters in accordance with BBD7524 version 1.

14.0. CURRENT TRANSFORMERS

- 14.1. Current transformers shall be designed, manufactured in accordance with IEC 60044-1.
- 14.2. The current transformers shall have the following accuracies:-
- Indicating instruments : Class 3
 - Metering : Class 0.5
 - Protective systems : Class 10P
- 14.3. Ring type current transformers shall have separate insulation between live conductors of the main circuit and inner surface of the current transformers.

15.0. VOLTAGE TRANSFORMER

- 15.1. All voltage transformers shall be designed, manufactured and tested in accordance with IEC 60044-2.
- 15.2. Voltage transformer secondaries shall have the following minimum accuracy:
- Metering : Class 0.5
 - Indicating Instrument : Class 3
 - Protective systems : Class 6P
- 15.3. The secondary winding of the voltage transformer shall be provided with fuses.
- 15.4. Phase or neutral earthing of the secondary winding through a removable link shall be provided. No fuses or miniature circuit breaker shall be fitted in this connection to earth.
- 15.5. The burden shall be suitable for the connected load but shall not be less than 50VA per phase.

16.0. REMOTE CONTROL OF ELECTRICAL SWITCHGEAR

- 16.1. Remote control of electrical switchgear shall be equipped with circuits and wired up for the remote open and close operation and indication from the "Centralised Electrical Control Office".
- 16.2. The circuits shall include the following:-
- A minimum of one set of normally open (N/O) and normally closed (N/C) auxiliary contacts to indicate the "open" or "closed" condition of the switching device and for the closing and tripping operations.
 - All remote circuits shall be wired to a terminal strip at the back of the panel.
 - A selector switch on the front of the panel to select between "local" and "remote" operation.

17.0. CLOSING AND TRIPPING SUPPLIES

- 17.1. Battery voltage closing and tripping shall be utilised unless otherwise specified.
- 17.2. The battery and battery charging unit shall comply with requirements of Transnet Freight Rail's (TFR) specification No.CEE.0085.
- 17.3. The preferred battery supply voltage for the switchboard is 110V DC unless otherwise specified.
- 17.4. A battery undervoltage relay shall be provided. The relay shall be adjustable between 80% and 100% of the nominal battery supply voltage. Hysteresis adjustment shall be incorporated.
- 17.5. In the event of low voltage or no battery voltage, the battery undervoltage relay shall trip and inhibit the reclosing of all the circuit breakers.

18.0. TEST TERMINAL BLOCKS

- 18.1. Readily accessible, suitably enclosed test terminal blocks as shown on drawing CEE-PA-13 shall be provided on the front panel of each switch unit for the purposes of testing all protective systems.
- 18.2. Test terminal blocks need not be provided for the frame protection systems if the associated current transformers are mounted externally.
- 18.3. The test block shall be wired to the protective relays and associated current transformer as indicated in the typical connection drawing CEE-PA-56.

19.0. CONTROL SWITCHES

- 19.1. All control switches shall be designed, manufactured and tested in accordance with IEC 60947-5-1.
- 19.2. Rotary pistol grip switches or push buttons shall be used on electrically operated switching devices.
- 19.3. The electrical and mechanical endurance of the control switches shall be not less than 100 000 operations.

20.0. MOULDED-CASE CIRCUIT BREAKERS

- 20.1. The moulded-case circuit breaker shall be designed, manufactured and tested in accordance with SANS 156.

21.0. LOW VOLTAGE WIRING

- 21.1. Low voltage wiring shall be a stranded copper conductor type and shall comply with SANS 1507.
- 21.2. Wiring shall be:
- numbered at the terminals using white non-split, PVC ferrule type markers with black lettering,
 - terminated by means of compression lugs or soldering on terminal blocks or strips,
 - of minimum size of 1.5mm² for instrument or control circuits and 2.5mm² for current transformer circuits,
 - heat-resistant from heaters to terminals,
 - suitably strapped and enclosed in flexible conduit when looping from panels to doors,
 - continuous without joints.
- 21.3. Current transformer star point on secondary windings shall be earthed in the immediate vicinity of the transformer as well as onto the main circuit earth.

22.0. NAMEPLATES AND LABELS

- 22.1. All nameplates and labels shall be in English and the lettering, shall be minimum height of 6mm.
- 22.2. Each switchgear and controlgear panel shall be fitted with a nameplate in conspicuous position indicating the following:-

Maker's name

Maker's type number
Maker's serial number
Service voltage
Number of phases
Continuous rating
Rating kA seconds

- 22.3. Identical nameplate as that on all current and voltage transformers shall be mounted in a conspicuous position inside the protection relay compartment. The phase colour with which each current/voltage transformer is associated shall appear beneath each nameplate.
- 22.4. Engraved labels, showing panel designation shall be fitted to the front and rear of the fixed part of each cubicle and associated withdrawable equipment.
- 22.5. All control equipment, relays, terminal strips etc shall clearly marked in accordance with the wiring and schematic drawings.
- 22.6. Voltmeter labels shall state whether busbar or cable voltage is indicated.

23.0. PAINTING AND OTHER PROTECTIVE COATINGS

- 23.1. All equipment shall be power coated in accordance with specification SANS 1274.
- 23.2. The switchboard panels shall be painted light orange colour of B26 in accordance with SANS 1091.

24.0. TESTS

- 24.1. All equipments shall be tested as detailed in Appendix 3.

25.0. INSPECTION

- 25.1. Transnet Freight Rail (TFR) reserves the right to inspect the equipment at any stage during manufacture.

26.0. DRAWINGS AND INSTRUCTIONS

- 26.1. Drawings, instruction manuals and spares lists shall be supplied in accordance with TFR's specification CEE.0224.

27.0. TOOLS AND APPLIANCES

- 27.1. One set of special tools and appliances required for normal operation and maintenance of each installation shall be supplied.

28.0. SPARES

- 28.1. The tenderer shall state whether a complete range of spares is held in stock by their local representatives for subsequent purchase by Transnet Freight Rail, as and when required.
- 28.2. A detailed description of each item including manufacturer's catalogue for maintenance purposes.
- 28.3. The spares list shall be divided into two parts, one covering items likely to be used in a 12-month period and those likely to be used in a 10-year period.

29.0. PACKING

- 29.1. The equipment shall be packed in such a manner that it will be protected during handling and transport. The movement of instruments, meters and relays shall be protected against vibration damage during transit.

30.0. TRAINING

- 30.1. In the event of training or training courses being required the contractor shall submit a training plan for approval by Transnet Freight Rail (TFR).
- 30.2. The cost of training shall be included in the tenderer.

END

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APPENDIX 1

SCHEDULE OF REQUIREMENTS

(To be completed by the Client)

A. SWITCHGEAR AND CONTROLGEAR

- Number of switching devices required :.....
- System voltage nominal voltage :.....
- Number of Phases :.....
- Frequency (Hz) :.....

1.0. NEUTRAL EARTHING

- 1.1. Unearthed :.....
- 1.2. Solidly earthed :.....
- 1.3. Reactance earthed :.....
- 1.4. Resistance earthed :.....

2.0. BATTERY SUPPLY

- 2.1. CLOSING SUPPLY
 - Rated voltage :.....
- 2.2. TRIPPING SUPPLY
 - Rated voltage :.....

3.0. BUSBARS

- 3.1. Rated nominal current :.....
- 3.2. Dimensions:
 - Width :.....
 - Thickness :.....

4.0. BUSBAR EARTING

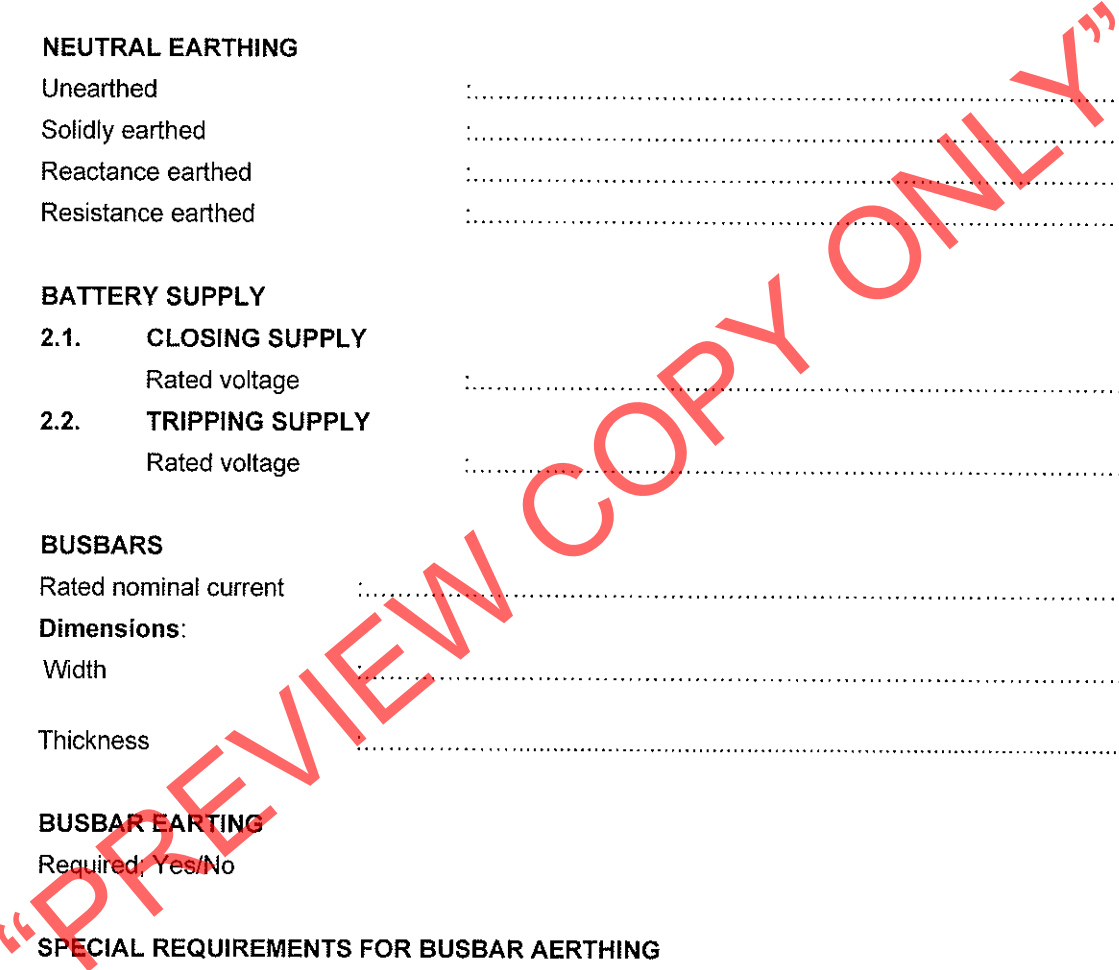
Required: Yes/No

5.0. SPECIAL REQUIREMENTS FOR BUSBAR AERTHING

-
-
-

6.0. REMOTE PENDANT CONTROL SYSTEM

Required: Yes/No



APPENDIX 1

SCHEDULE OF REQUIREMENTS

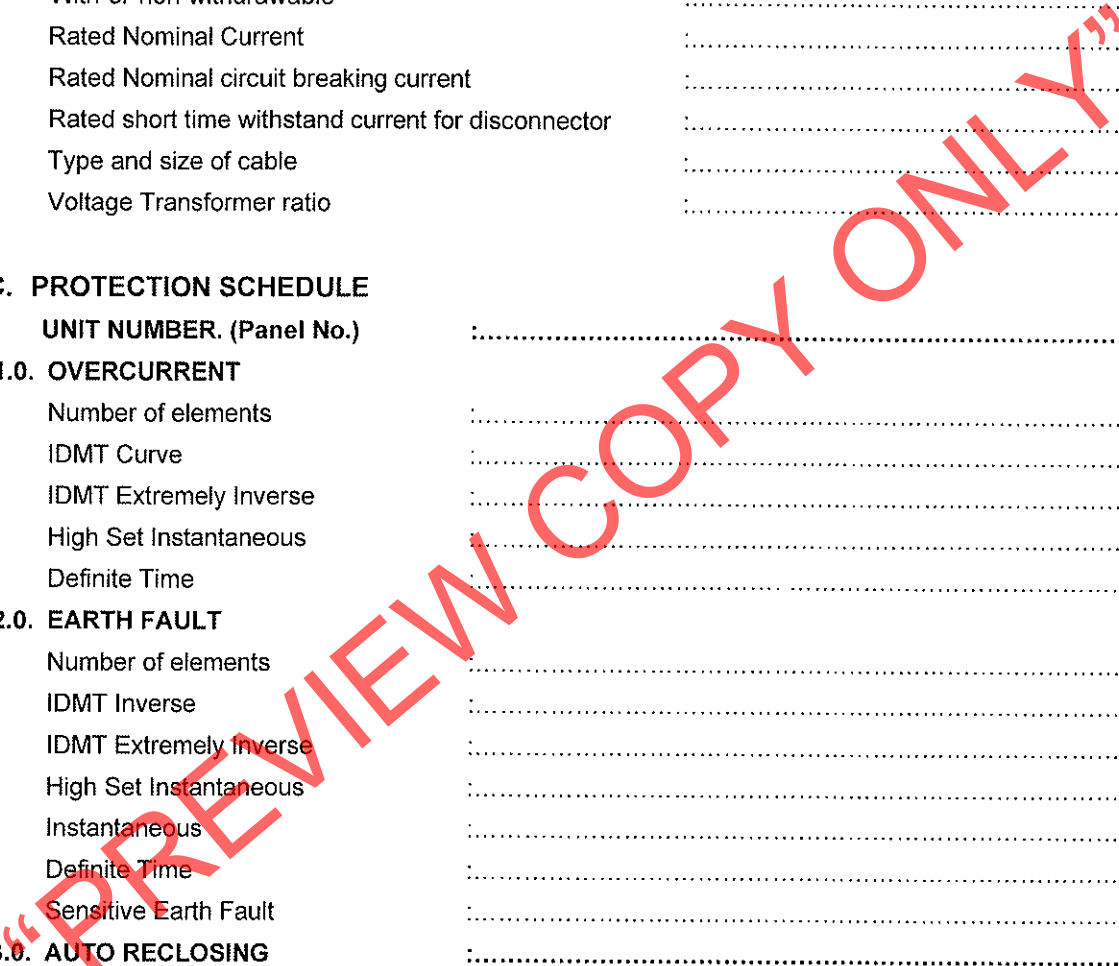
(To be completed by the Client)

B. SWITCHING DEVICES

- 1.0. UNIT NUMBER. (Panel No.) :.....
- Designation/ Drawing Number :.....
- Circuit Breaker :.....
- Fuse Switch combination :.....
- Disconnecter :.....
- Incoming or outgoing :.....
- With-or-non-withdrawable :.....
- Rated Nominal Current :.....
- Rated Nominal circuit breaking current :.....
- Rated short time withstand current for disconnecter :.....
- Type and size of cable :.....
- Voltage Transformer ratio :.....

C. PROTECTION SCHEDULE

- UNIT NUMBER. (Panel No.) :.....
- 1.0. OVERCURRENT :.....
- Number of elements :.....
- IDMT Curve :.....
- IDMT Extremely Inverse :.....
- High Set Instantaneous :.....
- Definite Time :.....
- 2.0. EARTH FAULT :.....
- Number of elements :.....
- IDMT Inverse :.....
- IDMT Extremely Inverse :.....
- High Set Instantaneous :.....
- Instantaneous :.....
- Definite Time :.....
- Sensitive Earth Fault :.....
- 3.0. AUTO RECLOSING :.....
- 4.0. DIFFERENTIAL PILOT WIRE :.....
- 5.0. FRAME LEAKAGE :.....
- Zone Number :.....
- 6.0. TRANSFORMER :.....
- Restricted Earth Fault :.....
- Differential :.....
- Tank Earth :.....
- Gas Detection :.....
- Over Pressure :.....



APPENDIX 1

SCHEDULE OF REQUIREMENTS

(To be completed by the Client)

TRANSFORMER (continues)

- Winding Over Temperature :
- Top Oil Temperature :
- 7.0. INTERTRIPPING** :
- 8.0. OTHER** :
- 9.0. SPECIAL REQUIREMENTS**
.....
.....
.....

D. CURRENT TRANSFORMER

- 1.0. UNIT NUMBER (Panel No.)** :
- 1.1. Overcurrent and Earth Fault**
 - Ratio :
- 1.2. Accuracy**
 - Limit Factor :
 - Class :
- 1.3. Differential**
 - Pilot wire :
 - Feeder Ratio :
 - Class X :
- 1.4. FRAME LEAKAGE**
 - Ratio :
 - Class of Accuracy :
 - Accuracy Limit Factor :
- 1.5. Transformer Restricted Earth Fault**
 - Ratio :
 - Class of Accuracy :
 - Accuracy Limit Factor :
- 1.6. Transformer Differential Protection**
 - Higher Voltage Winding Ratio :
 - Lower Voltage Winding Ratio :
 - Class of Accuracy :
 - Accuracy Limit Factor :
- Tank Earth Protection**
 - Ratio :
 - Class of Accuracy :
 - Accuracy limit Factor :

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APPENDIX 1

SCHEDULE OF REQUIREMENTS

(To be completed by the Client)

E. INSTRUMENT

- 1.0. UNIT NUMBER (Panel No.)** :.....
- Voltmeter :.....
- Frequency Meter :.....
- Ammeter :.....
- Ammeter Maximum Demand :.....
- Power Factor Meter :.....
- kWH Meter (if required) :.....
- Current Transformer Ratio :.....

2.0. SPECILA REQUIREMENTS:

.....
.....
.....

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APPENDIX 2

TECHNICAL DATAD SHEET

(To be completed by Tenderers)

1.0. SWITCHGEAR AND CONTROLGEAR

GENERAL

- 1.1. Makers' Name :
- 1.2. Designation Type :
- 1.3. Rated Voltage :
- 1.4. Rated Peak Withstand Current :
- 1.5. Rated Frequency :
- 1.6. Type of Insulating Medium :
- 1.7. Rated Insulation Level :
- 1.7.1. Impulse Withstand Voltage:**
 - a) To Earth and Between Phases :
 - b) Across the isolating distance :
- 1.7.2. One Minute Power Frequency Withstand Voltage:**
 - a) To Earth and Between Phases :
 - b) Across the isolating distance :
- 1.8. Degree of Protection**
 - a) For Covers :
 - b) For Partitions :
- 1.9. Method of pressure relief :
- 1.10. Type Test Certificate No, and Name of Testing Authority:
.....

2.0. SWITCHING DEVICES

CIRCUIT BREAKER

- 2.1. Interrupting Medium :
- 2.2. Rated Frequency :
- 2.3. Rated Normal Current :
- 2.4. Rated Short Circuit Breaking Current**
 - a) Root Mean Value (RMS) :
 - b) Percent DC Component :
- 2.5. Rated Making Current :
- 2.6. Rated Duration of Short Circuit :
- 2.7. Rated Operating Sequence :
- 2.8. Operating Mechanism**
 - a) Type of Closing Mechanism :
 - b) Rated Supply of Closing Mechanism :
 - c) Current required :
 - d) Rated Supply Voltage of Shunt Opening release :
- 2.9. Number and Type of spare auxiliary contacts :

APPENDIX 2

TECHNICAL DATAD SHEET (continues)

(To be completed by Tenderers)

2.10. Type Test Certificate Number and name of Testing Authority:

FUSE SWITCH COMBINATIONS

- 2.11. Rated Voltage
- 2.12. Rated Insulation Level
- 2.13. Rated Frequency
- 2.14. Rated Normal Current
- 2.15. Rated Short Circuit Breaking Current
- 2.16. Rated Short Circuit Making Current
- 2.17. Type Test Certificate Number and Name of Testing Authority:

DISCONNECTORS (ISOLATORS) AND EARTHING SWITCHES

- 2.18. Rated Voltage
- 2.19. Rated Insulation Level
- 2.20. Rated Frequency
- 2.21. Rated Normal Current (disconnectors only)
- 2.22. Rated Short Time Withstand Current
- 2.23. Rated Duration of Short Circuit
- 2.24. Rated Peak Withstand Current
- 2.25. Rated Short Circuit making Current (earthing switches only):
- 2.26. Type Test Certificate Number and name of Testing Authority:

3.0. BUSBARS

- 3.1. Size of Busbar
- 3.2. Type of Principal Insulation
- 3.3. Rated Normal Current
- 3.4. Rated Short Time Withstand Current
- 3.5. Rated Short Circuit Duration

4.0. BUSHINGS

- 4.1. Type Test Certificate Number and name of Testing Authority:

5.0. HIGH VOLTAGE FUSES

- 5.1. Make of Fuse
- 5.2. Design type Number
- 5.3. Nominal Current Rating
- 5.4. Type Test Certificate Number and name of Testing Authority:

APPENDIX 2

TECHNICAL DATAD SHEET (continues)
(To be completed by Tenderers)

6.0. CURRENT TRANSFORMER

- 6.1. Make :
- 6.2. CT Ratio :
- 6.3. VA Rating :
- 6.4. Class of Accuracy :
- 6.5. Short Time Current and Duration :
- 6.6. Connection Type :
- 6.7. Method of Limiting Partial Discharge :
- 6.8. Maximum Partial Discharge :
- 6.9. Type Test Certificate Number and name of Testing Authority:
.....

7.0. VOLTAGE TRANSFORMER

- 7.1. Make :
- 7.2. Class of Accuracy :
- 7.3. Output :
- 7.4. Method of Limiting Partial Discharge :
- 7.5. Maximum Partial Discharge :
- 7.6. Type Test Certificate Number and name of Testing Authority:
.....

8.0. INDICATING INSTRUMENTS

	Accuracy	Scale length (mm)
8.1. Voltmeter
8.2. Ammeter
8.3. Ammeter/Maximum Demand 15min
8.4. Power Factor Meter
8.5. Wattmeter
8.6. Frequency Meter
8.7. Ammeter Overload Rating and Duration
8.8. Type Test Certificate Number and name of Testing Authority:		

9.0. ENERGY METERS

- 9.1. Make and Type :
- 9.2. kW Rating :
- 9.3. kWh percent error :

10.0. SPARES

- 10.1. Range of Spares held in local stock:.....
- 10.2. Full description of items not held locally:.....
.....

TEST REQUIREMENTS**1.0. TYPE TESTS**

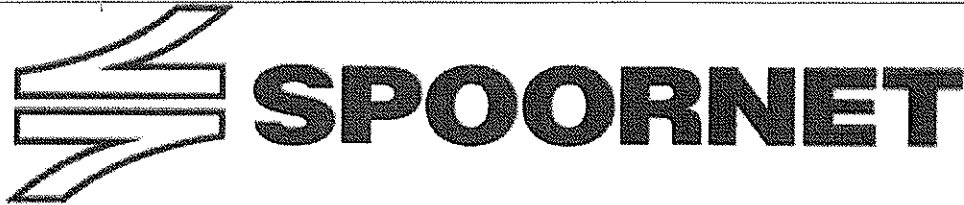
- 1.1. Where type tests are specified they shall be carried out in accordance with the recommended standards or specification referred to this specification.
- 1.2. Type tests certificates shall be submitted with tender documents.

2.0. ROUTINE TESTS

- 2.1. The following additional routine tests shall be carried out on the completed switchgear or control gear at the manufacturers works prior to delivery. Test certificate for these tests shall be supplied.
- 2.2. The ratio, polarity and magnetisation curve of each current transformer after their installation in the board.
- 2.3. The characteristic curves of each protection relay where applicable.
- 2.4. The ratio of each voltage transformer.
- 2.5. The errors of all indicating instruments.

3.0. FUNCTIONAL TESTS

- 3.1. A functional test of the complete board including all protective relays by primary injection. Test certificate for these shall be supplied.
- 3.2. Breakers' opening times.
- 3.3. Four copies of all approved routine test certificates shall be supplied, at the date not later than the delivery date of the switchgear or control gear.
- 3.4. All routine testing shall be witnessed and inspection carried out by the Quality Assurance Section of Transnet Freight Rail's Technology Management.



A division of Transnet limited

**ENGINEERING AND TECHNOLOGY
TECHNOLOGY MANAGEMENT**

SPECIFICATION

**REQUIREMENTS FOR THE SUPPLY OF ELECTRIC
CABLES**

(Appendix to be filled in by client)

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Date: 5 September 2005

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- Engineering & Technology: Technology Management

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INDEX

SECTION	DESCRIPTION	PAGE NO
1.0	SCOPE.....	3
2.0	STANDARDS.....	3
3.0	APPENDIX.....	3
4.0	TENDERING PROCEDURE.....	3
5.0	MEDIUM VOLTAGE CABLES.....	3
6.0	CABLES FOR FIXED INSTALLATIONS.....	4
7.0	QUALITY ASSURANCE.....	5
8.0	INSPECTION AND TESTING.....	5
9.0	APPENDIX 1.....	6

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1.0 SCOPE

This specification covers Spoomet's requirements for cables used for:

- Medium voltage reticulation systems, distribution systems, traction substation supplies, and 3 kV DC feeder applications (3,3/3,3 kV to 19/33 kV).
- Cables used for fixed installations (300/500 V to 1900/3300 V).

2.0 STANDARDS

The following publications (latest version) are referred to herein.

2.1 SOUTH AFRICAN NATIONAL STANDARDS

- SANS 97 : Electric cables - Impregnated paper insulated metal-sheathed cables for rated voltages 3,3/3,3 kV to 19/33 kV (excluding pressure assisted cables).
- SANS 1339 : Electric cables – Cross-linked polyethylene (XLPE) insulated cables for rated voltages 3,8/6,6 kV to 19/33 kV.
- SANS 1507 : Electric cables with extruded solid dielectric insulation for fixed installations 300/500 V to 1900/3300 V,
Part 1-General,
Part 3-PVC Distribution cables,
Part 4-XLPE distribution cables,
Part 5-Halogen free distribution cables.

3.0 APPENDIX

The following appendix forms an integral part of this specification.

- 3.1 Appendix 1 : Schedule of Requirements: Details of the cable to be supplied.

4.0 TENDERING PROCEDURE

- 4.1 Tenderers shall indicate clause-by-clause compliance with the specification. They 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 The tenderers shall motivate a statement of non-compliance.
- 4.3 The tenderer shall submit technical specifications of the cables offered.
- 4.4 Failure to comply with clauses 4.1, 4.2 and 4.3 could preclude a tender from consideration.

5.0 MEDIUM VOLTAGE CABLES

5.1 IMPREGNATED PAPER INSULATED.

- 5.1.1 Paper impregnated lead sheathed (PILC) cables used for reticulation systems and traction power supplies and other applications shall be in accordance with SANS 97.
- 5.1.2 The voltage range for the cables shall be between 3,3kV and 33kV.
- 5.1.3 The cables shall be three core with stranded copper conductors.
- 5.1.4 The cables shall be paper insulated, screened type, lead sheathed provided with an extruded PVC bedding.

- 5.1.5 The armouring shall be galvanised steel wire with outer extruded PVC over sheath over the armouring.
- 5.1.6 The cable shall be so manufactured that it is fully protected against the effect of electrolysis.
- 5.1.7 Single core cables used for 3 kV DC application shall withstand a test voltage of 10,5 kV for one minute.
- 5.1.8 Cables shall be suitable for laying directly in soil and concrete trenches.
- 5.1.9 The cables shall withstand exposure to water, corrosive conditions as well as high ultra violet conditions caused by direct sunlight.
- 5.1.10 The cables shall be tested in accordance with SANS 97. Type test certificates shall be submitted with the cables offered.
- 5.1.11 The packing, marking and sealing of cables and cable drums shall be in accordance with SANS 97.
- 5.2 CROSS – LINKED POLYETHYLENE INSULATED (XLPE).**
- 5.2.1 XLPE cables used for reticulation systems, 3kV DC traction feeders and traction power supplies and other applications shall be in accordance with SANS 1339.
- 5.2.2 The voltage range for the cables shall be between 3,8kV and 33kV.
- 5.2.3 Cables shall be single or three core with stranded copper conductors.
- 5.2.4 The cables shall be type A (armoured) for single and three core cables.
- 5.2.5 Single core type A cable shall be copper tape screened, aluminium wire armoured and provided with a PVC outer sheath.
- 5.2.6 Single core cables shall be rated for 3,8/6,6kV.
- 5.2.7 Single core cables used for 3 kV DC application shall withstand a test voltage of 10,5 kV for one minute.
- 5.2.8 Three core type A cable shall be copper tape screened, galvanised steel wire armoured and provided with a PVC outer sheath.
- 5.2.9 The manufacture of the single and three core cables shall be such that the cables are fully protected against the effect electrolysis.
- 5.2.10 The cables shall be suitable for laying directly in soil and concrete trenches.
- 5.2.11 The cables shall withstand exposure to water, corrosive conditions as well as high ultra violet conditions caused by direct sunlight.
- 5.1.12 The cables shall be tested in accordance with SANS 1339. Type test certificates shall be submitted with the cables offered.
- 5.2.12 Where specified flame-retardant and halogen free cables shall be in accordance with SANS 1339.
- 5.2.13 The packing, marking and sealing of cables and cable drums shall be in accordance with SANS 1339.

6.0 CABLES FOR FIXED INSTALLATIONS

- 6.1 Unless otherwise specified single and multi-core, wire armoured, extruded PVC insulated cables shall be used for fixed installations. The cables shall be in accordance with SANS 1507 part 1 and part 3.
- 6.2 The voltage range is between 300/500 V to 1900/3300 V.
- 6.3 Cables shall have stranded annealed copper conductors.

- 6.4 The cables shall be marked according to SANS 1507 part 3. Core identification shall be by means of colour code or numbering of the insulation.
- 6.5 The cable shall be so manufactured that it is fully protected against the effect of electrolysis.
- 6.6 Where XLPE or halogen free cables are specified the cables shall be in accordance with SANS 1507 parts 4 and 5.
- 6.7 The cables shall be tested in accordance with SANS 1507 parts 3, 4 and 5. Type test certificates shall be submitted with the cables offered.
- 6.8 The packing, marking and sealing of cables and cable drums shall be in accordance with SANS 1507.

7.0 QUALITY ASSURANCE

- 7.1 Spornet reserves the right to carry out inspection and tests on the equipment at the works of the supplier/manufacturer.
- 7.2 Arrangements must be made timeously for such inspections and type/routine tests in accordance with the cable specifications are carried out before delivery of the cables to the site.

8.0 INSPECTION AND TESTING

- 8.1 Spornet reserves the right to carry out inspections and any tests on cables at the factory of the supplier/ manufacture.
- 8.2 Arrangements must be made with The Senior Engineer, Technology Management Spornet for inspections to be carried out before delivery of the equipment.

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SCHEDULE OF REQUIREMENTS

(To be completed by the client)

1.0 MEDIUM VOLTAGE CABLES

1.1 PAPER IMPREGNATED LEAD SHEATHED (PILC)

1.1.1 Rated Voltage (V):

1.1.2 Number of cores:

1.1.3 Length of cables (m):

1.1.4 Size of conductors (mm²):

1.2 CROSS LINKED POLYETHYLENE INSULATED (XLPE)

(XLPE is recommended for 3 kV DC Applications)

1.2.2 Rated Voltage (V):

1.2.3 Number of cores:

1.2.4 Length of cables (m):

1.2.5 Size of conductors (mm²):

1.2.6 Flame retardant (required/not required):

2.1 CABLES FOR FIXED INSTALLATIONS

2.1.1 Type of cable required:

- PVC Distribution cables: (Yes/ No):
- XLPE Distribution cables: (Yes/No):

2.1.2 Rated Voltage (V):

2.1.3 Number of cores:

2.1.4 Length of cables (m):

2.1.5 Size of conductors (mm²):

END