Transnet Supplier Declaration/Application

The Financial Director or Company Secretary

Transnet Vendor Management has received a request to load your company on to the Transnet vendor database. Please furnish us with the following to enable us to process this request:

1. Complete the "Supplier Declaration Form" **(SDF)** on page 2 of this letter
2. **Original** cancelled cheque **OR** letter from the bank verifying banking details (**with bank stamp)**
3. **Certified** copy of Identity document of Shareholders/Directors/Members (where applicable)
4. **Certified** copy of certificate of incorporation, CM29 / CM9 (name change)
5. **Certified** copy of share Certificates of Shareholders, CK1 / CK2 (if CC)
6. A letter with the company's letterhead confirming physical and postal addresses
7. **Original** or **certified** copy of SARS Tax Clearance certificate and Vat registration certificate
8. A signed letter from the Auditor / Accountant confirming most recent annual turnover and percentage black ownership in the company **AND/OR** BBBEE certificate and detailed scorecard from an accredited rating agency (SANAS member).

NB:
- ***Failure to submit the above documentation will delay the vendor creation process.***
- *Where applicable, the respective Transnet business unit processing your application may request further information from you. E.g. proof of an existence of a Service/Business contract between your business and the respective Transnet business unit etc.*

IMPORTANT NOTES:

a) **If your annual turnover is less than R5 million,** then in terms of the DTI codes, you are classified as an Exempted Micro Enterprise (EME). If your company is classified as an EME, please include in your submission, a signed letter from your Auditor / Accountant confirming your company's most recent annual turnover is less than R5 million and percentage of black ownership and black female ownership in the company AND/OR BBBEE certificate and detailed scorecard from an accredited rating agency (e.g. permanent SANAS Member), should you feel you will be able to attain a better BBBEE score.

b) **If your annual turnover is between R5 million and R35million**, then in terms of the DTI codes, you are classified as a Qualifying Small Enterprise (QSE) and you claim a specific BBBEE level based on any 4 of the 7 elements of the BBBEE score-card, please include your BEE certificate in your submission as confirmation of your status.
NB: BBBEE certificate and detailed scorecard should be obtained from an accredited rating agency (e.g. permanent SANAS Member).

c) **If your annual turnover is in excess of R35million**, then in terms of the DTI codes, you are classified as a Large Enterprise and you claim a specific BEE level based on all seven elements of the BBBEE generic score-card. Please include your BEE certificate in your submission as confirmation of your status.
NB: BBBEE certificate and detailed scorecard should be obtained from an accredited rating agency (permanent SANAS Member).

d) **To avoid PAYE tax being automatically deducted from any invoices received from you,** you must also contact the Transnet person who lodged this request on your behalf, so as to be correctly classified in terms of Tax legislation.

e) Unfortunately, **No payments can be made to a vendor** until the vendor has been registered, and no vendor can be registered until the vendor application form, together with its supporting documentation, has been received and processed.

f) Please return the completed Supplier Declaration Form (SDF) together with the required supporting documents mentioned above to the Transnet Official who is intending to procure your company's services/products in order that he/she should complete and Internal Transnet Departmental Questionnaire before referring the matter to the appropriate Transnet Vendor Master Office.

Regards,
Transnet Vendor/Supplier Management *[please substitute this with your relevant Transnet department before sending this document out]*

Supplier Declaration Form

Company Trading Name						
Company Registered Name						
Company Registration Number Or ID Number If A Sole Proprietor						
Form of entity	CC	Trust	Pty Ltd	Limited	Partnership	Sole Proprietor
VAT number (if registered)						
Company Telephone Number						
Company Fax Number						
Company E-Mail Address						
Company Website Address						
Bank Name		Bank Account Number				
Postal Address			Code			
Physical Address			Code			
Contact Person						
Designation						
Telephone						
Email						

Annual Turnover Range (Last Financial Year)	< R5 Million		R5-35 million		> R35 million	
Does Your Company Provide	Products		Services		Both	
Area Of Delivery	National		Provincial		Local	
Is Your Company A Public Or Private Entity			Public		Private	
Does Your Company Have A Tax Directive Or IRP30 Certificate			Yes		No	
Main Product Or Service Supplied (E.G.: Stationery/Consulting)						

BEE Ownership Details						
% Black Ownership		% Black women ownership		% Disabled person/s ownership		
Does your company have a BEE certificate		Yes		No		
What is your broad based BEE status (Level 1 to 9 / Unknown)						
How many personnel does the firm employ		Permanent		Part time		

Transnet Contact Person	
Contact number	
Transnet operating division	

Duly Authorised To Sign For And On Behalf Of Firm / Organisation			
Name		Designation	
Signature		Date	

Stamp And Signature Of Commissioner Of Oath			
Name		Date	
Signature		Telephone No.	

NB: Please return the completed Supplier Declaration Form (SDF) together with the required supporting documents mentioned above to the Transnet Official who is intending to procure your company's services/products.

2. VENDOR TYPE OF BUSINESS

(Please tick as applicable) **(* - Minimum requirements)**

2.1	Indicate the business sector in which your company is involved/operating:

Agriculture		Mining and Quarrying			
Manufacturing		Construction			
Electricity, Gas and Water		Finance and Business Services			
Retail, Motor Trade and Repair Services		Wholesale Trade, Commercial Agents and Allied Services			
Catering, accommodation and Other Trade		Transport, Storage and Communications			
Community, Social and Personal Services		Other (Specify)			
Principal Business Activity *					
Types of Services Provided					
Since when has the firm been in business?					

2.2	What is your company's annual turnover (excluding VAT)? *

<R20k	>R20k <R0.3m	>R0.3m <R1m	>R1m <R5m	>R6m <R10m	>R11m <R15m	>R16m <R25m	>R26m <R30m	>R31m <R34m	>R35m

2.3	Where are your operating/distribution centres situated *

3. VENDOR OWNERSHIP DETAIL

(Please tick as applicable) **(* - Minimum requirements)**

3.1	Did the firm previously operate under another name? *		
YES		NO	

3.2	If Yes state its previous name:*
Registered Nam	
Trading Name	

3.3	Who were its previous owners / partners / directors?*

SURNAME & INITIALS	ID NUMBERS

3.4	List Details of current partners, proprietors and shareholders by name, identity number, citizenship, status and ownership as relevant: *

SURNAME & INITIALS	IDENTITY NUMBER	CITI-ZENSHIP	HDI	DIS - ABLED	GENDER	DATE OF OWNERSHIP	% OWNED	% VOTING

3.5	List details of current directors, officers, chairman, secretary etc. of the firm: *

SURNAME & INITIALS	IDENTITY NUMBER	TITLE	DIS - ABLED	GENDER	% OF TIME DEVOTED TO THE FIRM	CONTACT NUMBER

3.6	List details of firms personnel who have an ownership interest in another firm: *

SURNAME & INITIALS	IDENTITY NUMBER	NAME & ADDRESS OF OTHER FIRM	TITLE IN OTHER FIRM	% OWNED	TYPE OF BUSINESS OF OTHER FIRM

4. VENDOR DETAIL

(Please tick as applicable) **(* - Minimum requirements)**

4.1	How many personnel does the firm employ? *

	BLACK	WHITE	COLOURED	INDIAN	OTHER	TOTAL
Permanent						
Part Time						

4.1.1	In terms of above kindly provide numbers on women and disabled personnel? *

	BLACK	WHITE	COLOURED	INDIAN	OTHER	TOTAL
Women						
Disabled						

4.2	Provide Details of Contact Person/s Responsible for Broad Based Black Economic Empowerment (BBBEE) in the Company *

SURNAME	INITIALS	DESIGNATION	TELEPHONE NO.

4.2.1	Is your company a value adding supplier (i.e. registered as a vendor under the VAT Act of 1991, where NPAT + total labour cost > 25% of total revenue)?

YES		NO	

4.2.2	Is your company a recipient of Enterprise Development Contributions?*

YES		NO	

4.2.3	May the above mentioned information be shared and included in Transnet Supplier Database for future reference? *

YES		NO	

4.2.4	If you are successful in the tender/contract (where applicable) and this is awarded to your company / organisation, will this have a positive impact on your employment plans? *

YES		NO	

4.2.5	If yes (above) kindly provide the following information:

	BLACK	WHITE	COLOURED	INDIAN	OTHER	TOTAL
Permanent						
Part Time						

4.2.6	In terms of above kindly provide numbers on woman and disabled personnel:

	BLACK	WHITE	COLOURED	INDIAN	OTHER	TOTAL
Women						
Disabled						

4.2.7	Are any of your members/shareholders/directors ex employees of Transnet?

YES		NO	

4.2.8	Are any of your family members employees of Transnet?

YES		NO	

4.2.9	If Yes to points 4.2.7 & 4.2.8, list details of employees/ex-employees

SURNAME & INITIALS	IDENTITY NUMBER	NAME & ADDRESS OF OTHER FIRM	TITLE IN OTHER FIRM	% OWNED	TYPE OF BUSINESS OF OTHER FIRM

Internal Transnet Departmental Questionnaire (for office use only)

Section 1: To be completed by the Transnet Requesting / Sourcing Department											
TFR		TRE		TPT		TPL		TNPA		TRN	
Create		Amend		Block		Unblock		Once-Off / Emergency			
Extend		Delete		Undele							

Supplier's trading name				
Supplier's registered name				
Please indicate if the Supplier has a contract with sourcing Transnet OD	Yes		No	
If yes please submit a copy of the letter of award				

a) What is being procured from the supplier?				
i. Products only	Yes		No	
ii. Services only	Yes		No	
iii. Labour only	Yes		No	
iv. Mix of services and products	Yes		No	
v. Mix of services and labour	Yes		No	

b) If your answer is **YES** to questions II, III, IV or V in paragraph **a)** above, please indicate whether the relevant **PAYE questionnaires** have been forwarded to the appropriate **Transnet Operational Divisions'** decision making bodies / **Strategic Supply Management** team for a directive /decision on tax withholding from payments to this supplier.

Yes		No	

c) If your reply to (**b**) is "**NO**", please furnish reasons :

d) Certification and Approval of proposed Vendor Creation/Unblocking/Other Changes by Transnet Official with Appropriate Delegated Authority :

I HEREBY CERTIFY THAT THE TRANSNET DETAILED PROCUREMENT PROCESS (DPP) / PROCUREMENT MECHANISM HAS IN ALL RESPECTS BEEN ADHERED TO AND I THEREFORE APPROVE THE PROPOSED VENDOR CREATION/APPROVAL/OTHER CHANGES TO BE EFFECTED ON THE VENDOR MASTER

Name	Grade	Date	Signature
		Y Y Y Y M M D D	

Tel No:		Fax	

Section 2: To be completed by the BEE Department (this section is for Confirmation/Determining of BEE Status)

NARROW BASED (NB)					BROADBASED (BBBEE)				
BEE O/S	BWBE	DPBE	MR		CONTB. LEVEL	EME: <R5m	QSE: >R5m <R35m	LARGE: >R35m	VALIDITY DATE

Name	Grade	Date	Signature
		Y Y Y Y M M D D	
		Y Y Y Y M M D D	

SPOORNET

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)

Authors:	Engineering Technician (level 1) Section: Technology Management	B.L. Ngobeni	.....
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Authorised:	Senior Engineer Section: Technology Management	L.O. Borchard	.....

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Engineering &Technology: Technology Management

INDEX

1.0 SCOPE

This specification covers Spoornet'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-XLPEdistribution 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 Spoornet 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 Spoornet 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 Spoornet for inspections to be carried out before delivery of the equipment.

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 (mm^2): .....

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 (mm^2): .....

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 (mm^2): .....

END

SPOORNET
(INFRASTRUCTURE)(POWER SUPPLIES)

SPECIFICATION No. CEE.0023.90

THIS ISSUE CANCELS
SPECIFICATION NO.:
CEE.0023.86

SPECIFICATION FOR THE INSTALLATION OF CABLES

This specification covers Spoornet's requirements for the installation, laying, terminating, jointing, testing and commissioning of the high and low voltage cables.

INDEX

1.0 SCOPE

1.1 This specification covers Spoornet's requirements for the installation, laying, terminating, jointing, testing and commissioning of high and low voltage cables.

2.0 REFERENCE LIST

The following publications, drawings and documents (latest edition) are referred to herein.

2.1 South African Bureau of Standards

SABS 97 - Impregnated paper insulated electric cables.

SABS 0142 - Code of practice for the wiring of premises.

SABS 150 - Polyvinylchloride (PVC) insulated electric cables and flexible cords.

SABS 763 - Hot-dip (galvanised) zinc coating.

SABS 1339 - Cross-linked polyethylene insulation of electric cables.

SABS 1299 - Direct-acting indicating electrical measuring instruments and their accessories.

2.2 British Standard Institution

BS 5467 - Armoured cables with thermosetting insulation for electricity supply.

BS 6480 - Impregnated paper-insulated cables.

2.3 Machinery and Occupational Safety Act, Act No. 6, 1983

2.4 Spoornet

CEE.0012 - Method of Tendering

CEE.0045 - Painting of steel components of electrical equipment.

CEE.0089 - Drawings of electrical equipment supplied under electric light and power contracts.

Safety Instructions - High Voltage Electrical Equipment

3.0 APPENDICES

The following appendices form an integral part of this specification.

3.1 Appendix 1 - "Scope of Work"

3.1.1 This appendix specifies the extent of the work required and the order of priorities.

3.2 Appendix 2 - "Drawings".

3.2.1 This appendix lists Spoornets drawings applicable to the installation,

3.2.2 Cable routes indicated on these drawings shall only be a general guide to the contractor.

3.3 Appendix 3 - "Schedule of Items, Estimated Quantities, Unit Rates and Prices".

3.3.1 To ensure a uniform basis for tendering purposes, tenders shall be based on the estimated quantities given in this schedule which shall be completed in full and returned as part of the tender.

Complies/Does not comply

3.3.2 The importance of full completion of this schedule cannot be overstressed as this will constitute the tenderer's quotation.

Complies/Does not comply

3.3.3 Rates specified in this schedule will be applicable if any adjustments to requirements become necessary.

Complies/Does not comply

3.3.4 Any additional items considered to be necessary by the tenderer for the satisfactory completion of the installation and fulfilment of his guarantee shall be added by the tenderer on a similar unit price basis to this schedule and included in his total tendered price.

Complies/Does not comply

3.3.5 Actual quantities required will be based on the final survey by the successful contractor, and payment will be based on the actual measurements.

Complies/Does not comply

4.0 DRAWINGS AND INSTRUCTIONS

4.1 All drawings submitted by the tenderer shall be in accordance with Spoornets Specification No. CEE.0089

Complies/Does not comply

4.2 Where joints and terminations are to be done by others, the contractor shall submit detailed instructions regarding the procedure recommended by the cable manufacturer.

Complies/Does not comply

5.0 STANDARD OF WORK

5.1 The electrical installation shall conform to the requirements of SABS Code of Practice 0142 and shall be to the satisfaction of Spoornet.

Complies/Does not comply

5.2 Galvanising, where specified, shall be in accordance with SABS 763.

Complies/Does not comply

6.0 SAFETY INSTRUCTIONS

6.1 Work on the high voltage equipment shall be carried out in accordance with the Safety Instructions High Voltage Electrical Equipment of Spoornet.

Complies/Does not comply

6.2 All work done must comply with the requirements of the MACHINERY AND OCCUPATIONAL SAFETY ACT, Act No. 6, 1983.

Complies/Does not comply

7.0 SURVEYS

7.1 Pre-installation Route Surveys.

7.1.1 The Contractor shall within 30 days after being awarded the contract, carry out a pre-installation route survey which shall include digging test holes and, guided by the drawings contained in appendix 2, determine a suitable route.

Complies/Does not comply

7.1.2 The contractor shall determine where cables are liable to be subjected to chemical, electrolytic, mechanical or other damage and shall submit his recommendation to the Engineer for approval.

Complies/Does not comply

7.1.3 The Contractor shall submit in triplicate plans of the cable routes selected to the Engineer for approval. Plans may be submitted in sections as the survey progresses.

Complies/Does not comply

7.1.4 No excavation of any section of the cable route shall commence before the Contractor is in possession of the relevant approved plans and the Engineer has authorised the commencement of work on the section concerned.

Complies/Does not comply

7.2 Post Installation Surveys

7.2.1 After completion of all cable laying and jointing and before commissioning of any cable the Contractor shall carry out a final "as laid" survey of the cable routes and submit plans on transparencies suitable for reproduction.

Complies/Does not comply

7.2.2 The cable route plans shall include the following information :

7.2.2.1 Overall length, type, size and voltage of each cable.

7.2.2.2 Accurate indication of the position of each cable joint by indicating two distances to each joint from permanent structures.

Complies/Does not comply

7.2.2.3 Pipes and chambers provided.

8.0 EXCAVATIONS

8.1 Excavations shall be carried out in strict compliance with the specification No. E.7 for works on, over, under or adjacent to a railway line.

Complies/Does not comply

8.2 Trenching procedure shall be programmed in advance, approved by the Engineer and shall not be departed from except with the consent of the Engineer.

Complies/Does not comply

8.3 The Contractor will be advised of any known buried services such as cables, pipes, etc. in the vicinity of the cable route.

8.3.1 When trenching the contractor shall take all necessary precautions to prevent damage to underground services.

Complies/Does not comply

8.3.2 On encountering any uncharted service, the Contractor shall promptly advise the Engineer who will give the necessary instructions. Additional excavations shall be paid for at scheduled rates.

Complies/Does not comply

8.4 Should any underground service, water mains, road pavement, drainage system, building or any other structure be damaged by the Contractor's staff, it shall be reported immediately to the Engineer, who shall arrange for the necessary repairs. The Contractor shall be responsible for the cost of repairs.

Complies/Does not comply

8.5 The removal of obstructions along the cable routes shall be subject to the approval of the Engineer and shall be paid for at the agreed rates.

Complies/Does not comply

8.6 The Contractor shall not trench beneath any railway line without departmental supervision. Should the contractor wish to carry out such work, a minimum of 14 working days notice is required by the Engineer to arrange for the necessary supervision. The cost of such supervision shall not be charged to the Contractor.

Complies/Does not comply

8.7 Excavations crossing oil pipe lines shall not commence until an authorised representative is present on site. The Engineer shall be advised 14 days in advance when such excavations will take place.

Complies/Does not comply

8.7.1 Cable crossings of oil pipe lines shall only be at right angles.

Complies/Does not comply

8.8 Trenches across roads, access ways or foot-paths shall not be left open. If trenching, cable laying and backfilling cannot be done during the same shift, the portion of trench across the full width of the road, etc., must be temporarily backfilled and consolidated sufficiently to carry the traffic concerned without subsidence. Alternatively, adequately strong cover plates shall be laid across the trench.

Complies/Does not comply

8.9 Power driven mechanical excavators may be used for trenching operations. Spoornet shall not be responsible for any damage to other Services in close proximity when using mechanical excavators.

Complies/Does not comply

8.10 The Contractor shall provide shuttering in places where the danger exists of the trench collapsing, and causing damage to formations or other nearby structures.

8.10.1 Shuttering shall be paid for at scheduled rates.

Complies/Does not comply

8.11 Trenches shall be as straight as possible and the bottom of each cable trench shall be firm and of smooth contour without sharp dips or rises which may cause tensile forces in the cable during backfilling.

Complies/Does not comply

8.11.1 Trenches shall have no sharp objects which may cause damage to the cable during laying or backfilling.

Complies/Does not comply

8.12 The unfinished depth of trenches unless otherwise stated shall be as follows :

8.12.1 HV cables and associated pilot cables = 1 000 mm

8.12.2 LV cables and separate pilot cables = 750 mm

8.13 The width of the trench unless otherwise stated shall be 500 mm for one or two HV cables and associated pilot cables, and shall increase by 300 mm for each additional HV cable and its associated pilot cable.

8.13.1 The width of the trench at any bend or places where cable slack is required, shall be such that the bending radius of the cables shall not be less than that specified for the particular cable as per specifications SABS 150, SABS 97 and SABS 1339.

Complies/Does not comply

8.13.2 Trenching in railway formations shall be in accordance with Spoornet's Chief Civil Engineer's drawing FG 263.

8.14 The material excavated from each trench shall be placed in such a manner as to prevent nuisance or damage to adjacent ditches, railway lines, drains, gateways and other properties and shall not interfere with traffic.

Complies/Does not comply

8.14.1 Where, owing to certain considerations, this is not possible the excavated materials shall be removed from site and be returned for refilling the trench on completion of laying.

Complies/Does not comply

8.15 When excavating close to railway tracks, the ballast must be covered by tarpaulins or other sheeting to prevent soiling.

Complies/Does not comply

8.16 Removal of accumulated water or other liquid from trenches shall be done by the Contractor at his expense. The Contractor shall provide all pumps and appliances required to carry out this operation. Water or any other liquid removed shall be disposed of without creating any nuisance or hazard.

Complies/Does not comply

8.17 Spoornet reserves the right to alter any cable route or portion thereof prior to cable laying. Payment in respect of any additional work involved shall be at scheduled rates.

Complies/Does not comply

9.0 CABLE LAYING

9.1 General

9.1.1 All possible care shall be exercised in handling cables on site.

Complies/Does not comply

9.1.2 Any drum of cable showing signs of damage shall not be used.

Complies/Does not comply

9.1.3 The outer covering of cables shall not be damaged in any way and cables shall not be bent at radii less than allowed by the manufacturer.

Complies/Does not comply

9.1.4 When cable is supplied by the contractor, the drums thereof remain the property of the Contractor and shall be removed from the site and disposed of by him.

Complies/Does not comply

9.1.5 Cable pulling and laying shall be done manually unless otherwise approved by the Engineer. No cable shall be subjected to a tension exceeding that stipulated by the cable manufacturer.

9.2 IN TRENCHES

9.2.1 High Voltage cables shall be spaced at a minimum of 300 mm apart (centre to centre).

9.2.2 Low Voltage cables shall be spaced at a minimum of 150 mm apart (centre to centre).

9.2.3 Pilot cables shall be laid beside the associated power cables.

9.2.4 High Voltage and Low Voltage cables (and pilot cables not associated with High Voltage cable) shall be spaced at a minimum of 300 mm apart.

9.2.5 Pilot cables, when they are routed separately from their associated power cables, may be run next to one another.

9.2.6 Cables shall not be buried on top of each other except where cable runs cross.

9.2.7 Where the cable cannot be laid down at the specified depth, prior authority shall be obtained from the Engineer by the Contractor to protect the cable by means of 150 mm diameter half round concrete pipes with 50 mm concrete slab coverings, or other approved methods.

9.2.8 Where cables have to be drawn around corners well lubricated skid plates shall be used. The skid plates shall be securely fixed and constantly examined during cable laying operations.

9.2.9 Suitable rollers may be used during the laying of cables.

9.2.10 Cables shall be visually inspected for damage during and after laying. Any damage shall be reported immediately to the Engineer who will issue the necessary instructions.

Complies/Does not comply

9.3 IN SLEEVE PIPES

9.3.1 All cables crossing beneath roads and pavements shall be enclosed in asbestos cement pipes with a minimum internal diameter of 150mm. The Engineer shall be advised timeously of the locations and quantity of pipes to be laid and chambers to be provided by others. Separate lengths of pipe shall be properly jointed.

Complies/Does not comply

9.3.2 Pipes shall maintain or exceed the specified cable spacing.

Complies/Does not comply

9.3.3 Only one High Voltage cable shall be laid per pipe.

Complies/Does not comply

9.3.4 Pipes shall extend at least 1 m on either side of the road- or pavement formations and shall maintain the specified cable depth. All pipes shall be graded for water drainage : the required grade is 1:400.

Complies/Does not comply

9.3.5 All cables crossings underneath railway tracks shall be in pipes in accordance with Chief Civil Engineer's drawing FG 263.

9.4 IN DUCTS AND BUILDINGS

9.4.1 Concrete ducts and pipes within buildings will be provided by others.

9.4.2 Before installing cables, the ducts are to be inspected to ensure that they are suitable and clean as not to damage the cables.

Complies/Does not comply

9.4.3 The cables are to be neatly positioned and cross overs are to be avoided.

Complies/Does not comply

9.4.4 Steel checker plates over ducts will be supplied by others. The tenderer will however be required to cut all the slots for emerging cables. These slots are to be neatly cut and smoothed to avoid damage to the cable.

Complies/Does not comply

9.4.5 The Contractor shall supply all cable trays, racks, wooden cleats or other supports required to adequately support cables not laid in ducts.

Complies/Does not comply

9.4.6 Cable trays or racks shall be of reinforced glass fibre or steel suitably treated to prevent corrosion, Steel trays, racks and other supports shall be galvanised in accordance with SABS 763 when used within 50 km of the sea or inland exposed conditions.

Complies/Does not comply

9.5 UNDER BRIDGES AND IN TUNNELS

9.5.1 Where a cable route can only be against the concrete wall of a bridge or tunnel the cable shall be supported on :

9.5.1.1 suitable brackets at 750 mm intervals.

or

9.5.1.2 straining wire secured at maximum 1 200 mm intervals.

Complies/Does not comply

9.5.2 Brackets shall be of robust design and shall be galvanised and painted in accordance with specification CEE.0045

Complies/Does not comply

9.5.3 The height of the cable route on the brackets or strain wire shall be determined and agreed upon on site.

Complies/Does not comply

9.5.4 The brackets or strain wire shall be supplied and installed by the contractor.

Complies/Does not comply

9.6 CROSSING OF PIPELINES AND OTHER CABLES

9.6.1 Cables shall pass beneath pipelines with a 300 mm minimum clearance between the top of any cable and the bottom of any oil pipe.

Complies/Does not comply

9.6.1.1 The level of any cable at an oil pipeline crossing shall be maintained for not less than 3 m on either side of the centre line of the pipeline or on either side of the centre line of the outermost pipelines where there is more than one pipeline on the same route.

Complies/Does not comply

9.6.2 Where cables cross communication or signal cables, at least 300 mm of fill shall be provided between the two cables. In addition a concrete slab in accordance with Spoornets drawing No. CEE 55/027367 shall be placed between the two cables parallel to the lower cable.

Complies/Does not comply

9.7 IN RAILWAY FORMATIONS

9.7.1 Cables to be accommodated in railway formations shall be laid in accordance with Chief Civil Engineer's drawing No. FG 263.

Complies/Does not comply

9.8 SECURED TO POLES

9.8.1 Cables to be terminated at disconnectors (isolators) mounted on wood, concrete or steel poles, shall be clamped onto such structures by means of stainless steel straps applied at such a tension that the cable or cable sheath is not damaged. Straps shall be located at intervals of not more than 1,2 m.

Complies/Does not comply

9.8.2 Cables shall be protected by a pipe or boxed section of galvanised steel or other approved material for a distance of 250 mm below and 600 mm above ground level, strapped or screwed to the pole at a minimum of two points and connected to the earth connection, if of steel construction.

Complies/Does not comply

9.8.3 Straps and pipes shall be supplied and installed by the Contractor.

Complies/Does not comply

9.9 EXPOSED CONDITIONS

9.9.1 Whenever cables enter buildings or tunnels, or where excavations are not permitted down banks or cuts, the exposed portion shall be suitably protected by means of concrete slabs, or suitable steel pipes or boxed sections which shall be galvanised in accordance with SABS 763.

Complies/Does not comply

9.9.2 These pipes or boxed sections shall be firmly secured to the bank or cut, at regular intervals.

Complies/Does not comply

9.9.3 All such material shall be supplied and installed by the Contractor.

Complies/Does not comply

9.9.4 Stake routes shall only be supplied when specifically called for in Appendix 1.

10.0 CABLE TERMINATIONS

10.1 General

10.1.1 All cables shall be terminated and connected to the respective equipment, whether provided by the Contractor or by others.

Complies/Does not comply

10.1.2 Jumpers between cable end boxes and disconnectors shall either be short enough to be rigidly self supporting, or shall be supported on suitably placed pin insulators.

Complies/Does not comply

10.1.3 Termination of cables on outdoor equipment shall not be done during inclement weather conditions.

Complies/Does not comply

10.1.4 Both ends of each cable shall be identified by means of embossed stainless steel strips clamped around the cables. The characters shall have a minimum height of 6 mm.

Complies/Does not comply

10.1.5 All materials necessary for cable termination shall be provided by the Contractor.

Complies/Does not comply

10.1.6 The contractor shall ensure that correct phase rotation is maintained throughout.

10.1.7 Glands of cables terminating on equipment provided with frame leakage protection shall be insulated from the frame by high grade non-deteriorating, non-hygroscopic insulation, at least 2 mm thick, capable of withstanding a test voltage of 4 kV DC for one minute.

Complies/Does not comply

10.2 HV Cables

10.2.1 The cable armouring shall be bonded with an approved copper bond to the cable end box at one end of the cable only as directed by the Engineer. This bond shall be easily removable for testing purposes.

Complies/Does not comply

10.2.2 Where for any reason a cable cannot be terminated, sufficient length of cable shall be left to reach the cable end box position. The cable shall be coiled and buried or otherwise protected, The cable end of paper insulated cables shall be capped immediately with a plumbed lead seal. Other cables shall be sealed with suitable tape.

Complies/Does not comply

10.3 LV Cables (and Pilot Cables)

10.3.1 All cut ends of cables are to be sealed with suitable tape, or other approved means until they are ready to be terminated.

Complies/Does not comply

10.3.2 The cables shall terminate in compression type glands, brass or bronze, suitable for PVC SWA ECC cables.

Complies/Does not comply

10.3.2.1 The glands shall be fitted with neoprene shrouds.

Complies/Does not comply

11.0 CABLE JOINTS

11.1 General

11.1.1 Jointing shall be carried out strictly in accordance with the manufacturer's jointing instructions and by artisans thoroughly experienced and competent in jointing the classes of cables used. They shall be adequately supervised to ensure the highest quality of workmanship.

Complies/Does not comply

11.1.2 Jointing shall not be carried out during inclement weather.

Complies/Does not comply

11.1.3 The cores of cables shall be jointed number to number or colour to colour.

Complies/Does not comply

11.1.4 The joints shall not impair the anti-electrolysis characteristics of the cables.

Complies/Does not comply

11.1.5 The conductor bridging the armouring shall be adequate to carry the prospective earth fault current.

Complies/Does not comply

11.1.6 A through joint shall only be permitted after every full drum length of cable.

Complies/Does not comply

11.1.7 Each cable joint shall be identified by a non-corrodible label fixed securely to the top of the joint. Each label shall have stamped on it, in characters having a minimum height of 10 mm, the identification of equipment at each end of the cable concerned.

Complies/Does not comply

11.1.8 Spoornet reserves the right to be present during jointing operations to familiarise themselves with any special techniques.

Complies/Does not comply

11.1.9 No joint shall be situated inside a cable pipe.

Complies/Does not comply

12.0 COVERING, BACKFILLING AND REINSTATEMENT

12.1 Filling of trenches shall not commence before the Engineer or his authorised representative has inspected and approved the cables and cable joints in situ in the section of trench concerned.

Complies/Does not comply

12.2 Trenches in railway formations shall be backfilled and reinstated in accordance with Spoornet's Chief Civil Engineer's drawing No. FG 263.

Complies/Does not comply

12.3 All other trenches shall be backfilled and reinstated as follows:

12.3.1 Two 75 mm thick layers of soil sifted through a 6 mm mesh shall be laid directly under and over the cables respectively and consolidated by hand ramming only.

Complies/Does not comply

12.3.1.1 Only soil with a thermal resistivity of 1,5 degrees C.m/watt, or lower may be used for this purpose.

Complies/Does not comply

12.3.1.2 When necessary imported fill shall be arranged by the Contractor and paid for at scheduled rates.

Complies/Does not comply

12.3.2 HV cables shall, where likely to be mechanically damaged as decided by the engineer, be protected by concrete slabs (to Drawing No. CEE 55/027367) to be supplied and laid by the Contractor on top of the sifted soil. These slabs shall be laid close-butted, convex end to concave end, directly above each HV cable throughout the underground portion except where otherwise protected as by pipes, etc. Only unbroken cable protection slabs may be used, and only slabs actually laid will be paid for.

Complies/Does not comply

12.3.3 The minimum dry densities of backfilling after compaction shall be not less than 1 600 kg/cubic metre.

Complies/Does not comply

12.3.4 All excavations made (whether for the purpose of cable laying, joint bays or trial holes) shall be back-filled in 150 mm layers, the earth in each layer being well rammed and consolidated and sufficient allowance being made for settlement. The back-filling shall be completed to the satisfaction of the Engineer. If necessary, water shall be used to obtain the specified compacted density. Any cable damaged during backfilling shall be replaced by the Contractor at his own expense.

Complies/Does not comply

12.3.4.1 Backfilling at pipe entries shall be such as not to stress or damage the cable during compaction from the top.

12.3.5 A continuous plastic cable warning tape, to drawing No. CEE-MA-307 shall be laid directly above each HV cable, 150 mm below the normal surface level and run for the full length of the cable before completing the back-filling.

Complies/Does not comply

12.4 The back filled trench shall be maintained in a thoroughly safe condition by the contractor for the duration of the contract.

Complies/Does not comply

12.5 All back filling of road crossings shall be mechanically rammed.

Complies/Does not comply

12.6 Final surfacing of roads shall be restored by others unless called for under "Scope of Work", Appendix 1.

Complies/Does not comply

12.7 Concrete cable route markers shall be provided and installed by the contractor in accordance with drawing CEE-PK-14.

Complies/Does not comply

12.8 Pipes shall be filled with a sand/water mixture to also have a thermal resistivity of 1,5 degrees C.m/watt or lower when dry. The sand used in the mixture shall be chemically tested not to be harmful to the cable outer sheath.

Complies/Does not comply

13.0 MEASUREMENTS

13.1 All measurements for payment purposes shall be made jointly by representatives of the Contractor and Spoornet and shall be agreed upon by both parties. The Contractor shall be responsible for obtaining the Engineer's signed approval of such measurements.

Complies/Does not comply

13.2 Measurements of cable length shall be made from centre to centre of cable joints and to the cable ends and will exclude any wastage due to jointing and terminating.

Complies/Does not comply

13.3 When cable is drawn through pipes, only the portion remaining in the pipe will be paid for at the rates quoted for "as installed in pipes".

Complies/Does not comply

13.4 Determination of trench volume for measurement purposes shall be based on measured length and specified width and depth. No allowance shall be made where trenches have to be widened at the bottom to accommodate cables, cable joints and protection slabs.

Complies/Does not comply

13.5 The classification of different types of ground for measurement purposes shall be as follows:

13.5.1 Soft rock will be taken as broken or friable rock which can be removed by pick or mechanical excavator or paving breaker. This includes hard clay.

13.5.2 Hard rock will be taken as rock which cannot be removed by a mechanical excavator and requires drilling and blasting or splitting. This includes reinforced or plain concrete.

14.0 TESTS

14.1 The costs of all post-installation tests shall be borne by the Contractor.

Complies/Does not comply

14.2 The Contractor shall be responsible for remedial work necessary due to damages caused during tests.

Complies/Does not comply

14.3 Spoornet reserves the right to carry out any further tests deemed necessary, using either the Contractor's instruments and equipment or its own, or both. The costs of such tests will not be charged to the Contractor.

Complies/Does not comply

14.4 Test instruments shall be of the accuracy class 1.0 or better in accordance with SABS 1229. Calibration certificates from a recognised testing authority shall be available for inspection and shall not be older than one year.

Complies/Does not comply

14.5 Time measurements shall be carried out using an approved digital timer.

Complies/Does not comply

14.6 The final commissioning site tests will be carried out by Spoornet.

Complies/Does not comply

14.6.1 A suitably qualified staff member of the Contractor shall assist Spoornet during the tests and shall carry out any remedial work where necessary.

Complies/Does not comply

14.7 The contractor shall notify the Engineer in writing 4 weeks before the commissioning date and shall have carried out the following site tests before such date :

Complies/Does not comply

14.7.1 Prove the continuity and insulation resistance of the multicore pilot cables.

Complies/Does not comply

14.7.2 Verify that the insulation level between frame and earth of switchboards fitted with frame leakage protection is not reduced by the installation of the cables.

Complies/Does not comply

14.7.3 The following voltage withstand tests on each completed cable run:

14.7.3.1 Paper insulated cables:

(i) rating up to 12,7/22 kV : test specified in paragraph D-3 of SABS 97.

Complies/Does not comply

(ii) rating 19/33 kV : test specified in paragraph B-3 of BS 6480, Part 1.

Complies/Does not comply

The extruded PVC impermeable serving shall withstand a test voltage of 10 kV DC between armouring and earth for 1 minute.

Complies/Does not comply

The insulation between armouring and lead sheath shall withstand a test v for 1 minute.

Complies/Does not comply

14.7.3.2 XLPE Insulated Cables:

All cables rated up to 19/33 kV shall be tested as specified in appendix E, clause 1.4, of SABS 1339, and cables rated up to 1,9/3,3 kV shall be tested as specified in appendix B, clause B.6, of BS 5467.

Complies/Does not comply

Note :

Where a new XLPE cable is to be joined to an existing XLPE Cable, the test shall differ, in that a 4 kV DC test voltage shall be applied for one minute between the brass screens of the cores and the armouring. The outer sheath shall withstand a test voltage of 10 kV DC for 1 minute between the armouring and earth.

Complies/Does not comply

14.7.4 PVC insulated cables shall be tested as specified in paragraph D-3 of SABS 150.

Complies/Does not comply

14.7.5 The Contractor shall submit three copies of certified test reports to the Engineer within three weeks after completion of the tests.

15.0 GUARANTEE

15.1 All work undertaken by the Contractor shall be subject to a guarantee for a period of one year against faulty and/or inferior workmanship and material.

Complies/Does not comply

15.2 The guarantee period shall commence the day the installation is formally handed over to and accepted by Spoornet.

Complies/Does not comply

15.3 The Contractor shall undertake to repair all faults or defects due to bad workmanship and/or faulty materials, and to replace all defective equipment or materials during the guarantee period.

Complies/Does not comply

15.4 Any defects that may become apparent during the guarantee period shall be rectified to the satisfaction of, and free of cost to Spoornet.

Complies/Does not comply

15.5 The Contractor shall undertake work on the rectification of any defects that may arise during the guarantee period within 7 days of his being notified by Spoornet of such defects.

Complies/Does not comply

15.6 Should the Contractor fail to comply with the requirements stipulated above, Spoornet shall be entitled to undertake the necessary repair work or effect replacement of defective apparatus or materials, and the Contract shall reimburse Spoornet the total cost of such repair or replacement, including the labour costs incurred in replacing defective material.

Complies/Does not comply

TENDERER'S SIGNATURE .....

DATE .....

CHIEF ENGINEER (POWER SUPPLIES)
(INFRASTRUCTURE)

SCOPE OF WORK

1.0 Site inspection required/not required.

Date : .....

Time : .....

CHIEF ENGINEER (POWER SUPPLIES)
(INFRASTRUCTURE)

REFERENCE :

DRAWINGS

DRAWING NO.	TITLE
CEE 55/027367	Concrete slab, cable protection
CEE-PK-14	Route marker, cable, electrical.
CEE-MA-307	Tape, cable warning, underground
FG 263	Accommodation of cables in Railway formations.

CHIEF ENGINEER (POWER SUPPLIES)
(INFRASTRUCTURE)

REFERENCE :

SCHEDULE OF ESTIMATED QUANTITIES AND UNIT RATES

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
1.0	Route surveys (clause 7.0)		complete		
2.0	Excavations in				
a)	Hard rock		/cubic metre		
b)	Soft rock		/cubic metre		
c)	Soil		/cubic metre		
3.0	Transportation of soil		/cubic metre		
4.0	Shuttering (clause 8.10)		/m		
5.0	Concrete slabs supplied and installed (clause 12.3.2)		each		
6.0	Plastic cable warning tape supplied and installed (clause 12.3.5)		/m		
7.0	150 mm dia. half round concrete pipes supplied and installed (clause 9.2.7.)		/m		
8.0	150 mm dia. asbestos cement pipes supplied and installed		/m		
9.0	Cutting of checker plates (clause 9.4.4)		/m cut		
10.0	Backfilling of trenches with soil (clause 12.3)		/cubic metre		
11.0	Backfilling of trenches with 10:1 soil/cement mix (clause 12.2)		/cubic metre		

SCHEDULE OF ESTIMATED QUANTITIES AND UNIT RATES

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
12.0	Importation of soil		/cubic metre		
13.0	Concrete cable route markers		each		
14.0	Reinstate tarred surface		/cubic metre		
15.0	Reinstate concrete surface		/cubic metre		
16.0	Installation of cables				
16.1	Installed in trenches (Clause 9.2)				
16.1.1	High Voltage Cables		/m		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				
16.1.2	Low Voltage Cables		/m		
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
16.2	Installed in sleeve pipes (clause 9.3)				
16.2.1	High Voltage Cables		/m		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				

SCHEDULE OF ESTIMATED QUANTITIES AND UNIT RATES

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
16.2.2	Low Voltage Cables		/m		
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
16.3	Installed in ducts (clause 9.4)				
16.3.1	High Voltage Cables		/m		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				
16.3.2	Low Voltage Cables		/m		
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
17.0	Installation of cables (Special conditions)				
17.1	Cable supports (clause 9.4.5 and 9.4.6)				
17.1.1	High Voltage Cables		/m		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				

SCHEDULE OF ESTIMATED QUANTITIES AND UNIT RATES

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
17.1.2	Low Voltage Cables		/m		
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
17.2	Securing cables to poles (clause 9.8)				
17.2.1	High Voltage Cables		/m		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				
17.2.2	Low Voltage Cables		/m		
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
17.3	Securing cables to concrete/tunnel walls				
17.3.1	High Voltage Cables		/m		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				

SCHEDULE OF ESTIMATED QUANTITIES AND UNIT RATES

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
17.3.2	Low Voltage Cables		/m		
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
17.4	Installation of cables in track formations				
17.4.1	High Voltage Cables		/m		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				
17.4.2	Low Voltage Cables		/m		
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
18.0	Cable terminations complete (Supply material, terminate and connect up).				
18.1	XLPE cable				
18.1.1	High Voltage terminations		each		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				

SCHEDULE OF ESTIMATED QUANTITIES AND UNIT RATES

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
18.1.2	Low Voltage terminations		each		
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
18.2	PILC SWA cable				
18.2.1	High Voltage terminations		each		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				
18.2.2	Low Voltage terminations		each		
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
19.0	Cable joints complete (Supply material, terminate and connect up)				
19.1	PVC to PVC		each		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				

SCHEDULE OF ESTIMATED QUANTITIES AND UNIT RATES

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
19.2	XLPE to XLPE		each		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				
19.3	PILC to PILC		each		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				
19.4	XLPE to PILC		each		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				

TENDERER'S SIGNATURE .....

DATE .....

CHIEF ENGINEER (ELECTRICAL)
(INFRASTRUCTURE)

SPOORNET

A division of Transnet limited

TECHNICAL
RAILWAY ENGINEERING
SPECIFICATION

PAINTING OF STEEL COMPONENTS OF ELECTRICAL EQUIPMENT

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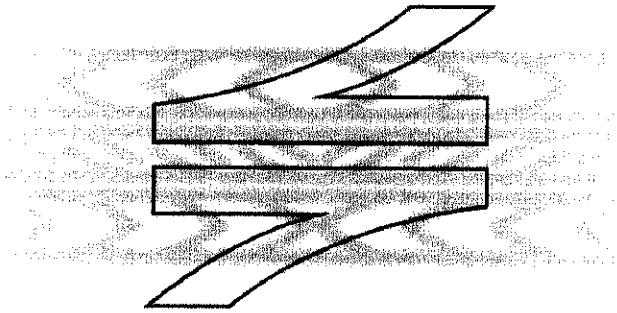
Date: 27 February 2002

Circulation restricted to:
Technical: Maintenance (Infrastructure)
Technical: Maintenance



SPOORNET

A division of Transnet limited

TECHNICAL
RAILWAY ENGINEERING
SPECIFICATION

PAINTING OF STEEL COMPONENTS OF ELECTRICAL EQUIPMENT

Circulation restricted to:
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INDEX

1.0 SCOPE

This specification covers the surface preparation, paint systems and painting of steel components of electrical equipment.

2.0 REFERENCES AND GLOSSARY

The following standards and specifications are referred to herein:

2.1 South African Bureau of Standards: -

SABS 064 : Code of Practice for the Preparation of Steel Surfaces for Coating.
SABS 1091 : National Colour Standards for Paint.

2.2 Trade names :

OptiDegreaser
OptiPrime^{Aqua}
Noxyde

2.3 Classification of level of surface degradation:

RE1 – 0.05% of surface rusted
RE2 – 0.5% of surface rusted
RE3 – 1.0% of surface rusted
RE4 – 3.0% of surface rusted
RE5 – 8.0% of surface rusted

3.0 METHOD OF TENDERING

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

4.0 SURFACE PREPARATION

4.1 NON-GALVANISED STEELWORK

4.1.1 New Steelwork

SURFACE PREPARATION (Read: NOTES and SPECIAL INSTRUCTIONS)	PRODUCT REQUIREMENTS & APPLICATION (See Variations for Specific Environmental Conditions)
➢ Sandblast to a standard of Sa2 to remove mill scale and/or flash rust ➢ Remove dust with clean compressed air (Check air for oil contamination)	➢ Apply a stripe coat to edges, bolts, crevices, nuts and rivets. ➢ Apply one thick coat of Noxyde to the entire structure with contrasting color. ➢ Apply a final thick coat of Noxyde at a consumption rate of minimum 400g/m^2

4.1.2 Previously Coated Steelwork

4.1.2.1 COATING START FAILING TO A LEVEL OF RE 2

➢ Test for adhesion (refer to supplier) ➢ Degrease thoroughly with OptiDegreaser ➢ Hydro Blast complete substrate using a rotating nozzle and minimum 250 bar at the nozzle	➢ Apply a stripe coat to edges, bolts, nuts and rivets and fill crevices. ➢ Apply one coat of Noxyde to entire substrate in a contrasting color

4.1.2.2 COATING FAILURE AND RUSTING TO A LEVEL OF RE 4

➢ Remove all visible traces of rust by mechanical means ST2 (chip/grind/sand) OR shotblasting /spotblasting) ➢ Degrease thoroughly with OptiDegreaser ➢ Hydro Blast complete substrate using a rotating nozzle and minimum 250 bar at the nozzle.	➢ Apply a thick coat of Noxyde to the de-rusted areas, edges, bolts, nuts and rivets and fill crevices ➢ Apply one coat of Noxyde at a consumption rate of minimum 400g/m^2 to the entire substrate using a contrasting color.

4.1.2.3 BITUMEN COATED

➢ Remove all visible rust and loosely adhering bitumen coating by means of chipping and scraping (ST2) ➢ Degrease thoroughly with OptiDegreaser ➢ Hydro Blast complete substrate using a rotating nozzle and minimum 250 bar at the nozzle.	➢ .Apply a thick coat of Noxyde to the de-rusted areas, edges, bolts, nuts and rivets and fill crevices ➢ Apply two coats of Noxyde at a consumption rate of minimum 400g/m^2 per coat to the complete substrate using contrasting colors

4.1.2.4 BADLY RUSTED STEEL WITH PITTING & CRUST FORMATION TO RE 5

➢ 1.Degrease thoroughly with OptiDegreaser ➢ 2.Hydro Blast complete substrate using a spinner tip and minimum 250 bar at the nozzle ➢ Shotblast/sandblast complete substrate giving particular attention to bolts nuts rivets and crevices. Sa2 ➢ 4.Dedust	➢ Apply a first thick coat of Noxyde to the entire substrate ➢ Apply a stripe coat to edges, bolts, nuts and rivets and fill crevices using a contrasting color ➢ Apply a final coat of Noxyde at a consumption rate of minimum 400g/m^2

4.2 GALVANISED STEELWORK

4.2.1 NEW AND WEATHERED GALVANISING WITH A SMOOTH GLOSSY FINISH

➢ Degrease thoroughly with OptiDegreaser ➢ Rinse down with copious quantities of potable water	➢ Apply one thin coat of OptiPrime^{Aqua} (100 micron wet/35 micron dry) ➢ Apply a stripe coat of Noxyde to edges, bolts, nuts and rivets and fill crevices ➢ Apply two coats of Noxyde at a consumption rate of minimum 400g/m^2 per coat to the complete substrate using contrasting colors

4.2.2 WEATHERED GALVANISING

4.2.2.1 White rust (zinc oxide)

➢ Degrease thoroughly using OptiDegreaser – ensure that all traces of "white rust" are removed ➢ Rinse down with copious quantities of potable water	➢ Apply one thin coat Noxyde ➢ Apply a stripe coat of Noxyde to edges, bolts, nuts and rivets and fill crevices ➢ Apply a final coat of Noxyde at a consumption rate of minimum 400g/m^2 per coat to the complete substrate using a contrasting color

4.2.2.2 Combination of red rust (iron oxide) and white rust (zinc oxide)

➢ Remove all traces of red rust ➢ Degrease thoroughly using OptiDegreaser – ensure that all traces of "white rust" are removed ➢ Rinse down with copious quantities of potable water	➢ Apply a thick coat of Noxyde to the de-rusted areas, edges, bolts, nuts and rivets and fill crevices ➢ Apply a final coat of Noxyde at a consumption rate of minimum 400g/m^2 per coat to the complete substrate using a contrasting color

NOTES and SPECIAL INSTRUCTIONS:		
1 Sand or Grit-blasting a) Always use clean, non-recycled grit b) Always use fine or extra fine grit c) Always use oil free air d) Always use a moisture trap e) Dedust	2 Degreasing: a) Use only OptiDegreaser b) Dilute according to instructions – see data sheet c) Always follow up with hydro-blasting to remove all chemical residues	3 Hydro-blasting: a) Always use clean potable water b) Use a rotating nozzle and ensure a pressure of minimum 250 bar at the nozzle c) Remove ALL traces of dirt and any form of salt contamination and residues of the degreasing agent d) Concentrate in crevices and other similar "collection" areas

5. PRODUCT APPLICATION

5.1 METHOD OF APPLICATION

OptiPrime^{Aqua}	Noxyde
Temperature-Min 5 °C Relative humidity-Max 80% R.H. ➢ Apply by brush, lacquer roller or airless spray using a no. 11 nozzle ➢ Apply one thin coat only - 100 micron wet = 35 micron dry (DFT) ➢ Small parts can be dipped - dilute with 10% water for dipping	Temperature-Min. 8 °C, Max. 55 °C Relative Humidity-Max 80% R.H. ➢ Apply by brush, roller or airless spray ➢ For airless spray applications refer to "Tips for airless spraying of Noxyde"

5.2DRYING TIME AND OVERCOAT PERIODS

➢ Do not overcoat within 12 hours ➢ Wash down with clean potable water (100 bar) before over coating to remove dust or any other form of intermediate contamination	➢ Drying time is dependant on ambient conditions and can vary from a few minutes (in dry windy conditions) to a few hours (in humid shaded conditions) ➢ Overcoat as soon as possible to avoid contamination of previous coat ➢ Wash down with clean potable water (100 - 150 bar) before over coating if danger of contamination exists or if left more than 4 hours before over coating

5.3 CURING TIME

n/a	➢ 7 - 14 days to "full cure". During this period the product is prone to mechanical damage - the longer time it is allowed to cure, the tougher it becomes

5.4 DRY FILM THICKNESS (DFT) READINGS

35 micron	➢ Severe coastal & marine environments (in the spray zone) – TWO stripe coats & overall minimum DFT of 400 micron ➢ Normal coastal environment (1 5 km from the coast line) - a single stripe coat & overall minimum DFT of 400 micron ➢ Non coastal high rainfall areas, in the immediate vaccinate of rivers, dams, lakes, etc., and in industrial areas with high levels of chemical pollution - a single stripe coat & overall minimum DFT of 400 micron ➢ Dry non aggressive environments - a single stripe coat & overall minimum DFT of 250 micron NOTE: DFT readings can only be taken after 72 hours

5.5 Notwithstanding the above requirements, all surfaces shall be cleaned according to the appropriate method described in SABS 064 for the particular surface to be cleaned, the contamination to be removed and the primer to be applied.

5.6 Blast cleaning of components shall be in accordance with clause 4.3 of SABS 064 to a degree of cleanliness of at least Sa 2 for inland exposure components and Sa 2 ½ for coastal exposure components. See Table 1 of SABS 064 for the appropriate profile.

5.7 Sheet metal that cannot be blast cleaned shall be cleaned by pickling according to clause 4.6 of SABS 064.

5.8 Components that will be powder coated shall be cleaned and prepared by the surface conversion process according to clause 5 of SABS 064 to a medium weight classification of table 2 of that specification.

5.9 Oil and accumulated dirt on steel components where no rusting is present shall be removed according to clause 3 of SABS 064.

6.0 PAINT SYSTEM

A choice of two systems is available to suit the contractors equipment.

6.1 Noxyde paint system

1st coat: OptiPrime^{Aqua}

Wet film thickness: 100 micrometers. Dry film thickness: 35 micrometers.

2nd coat: Noxyde Topcoat

Dry film thickness: 165 micrometers @ 400g/m^2.

6.1.1 Paint application:

6.1.1.1 The primer and paint is normally applied by brush at supply viscosity (no reducer required).

6.1.1.2 The practical spreading rate of the primer and paint is a function of the ambient temperature, wind velocity and the application technique, but will generally fall in the range of 400g/m^2 in low to mild corrosive areas, and 500g/m^2 in severely corrosive areas.

6.1.1.3 Once the applied coat of primer/paint is touch dry, the next coat of paint may be applied.

6.1.1.4 If painted steelwork is to be bolted onto structures, it is imperative that the paint has been allowed to hard dry before the steelwork is bolted onto structures. This is to prevent the soft paint being damaged when tightening the bolts securing the steelwork to the structures.

6.2 Powder Coating System.
The powder-coating process shall be in accordance with SABS 1274 type 4: Corrosion-resistant coatings for interior use and using the thermosetting type high gloss coatings.

7.0 COATINGS AND WORKMANSHIP

7.1 All specified coatings shall be applied according to the relevant specification and the manufacturer's instructions shall be followed.

7.2 Coatings shall not be applied under conditions that may be detrimental to the effectiveness of the coating or the appearance of the painted surface.

7.3 When examined visually, the finished products shall have a uniform appearance and shall show no sign of damage. Damaged areas shall be repaired coat for coat to obtain the desired finish.

TENDERER'S SIGNATURE……

DATE……

SPOORNET

(INFRASTRUCTURE)(ELECTRICAL)

THIS ISSUE CANCELS SPECIFICATION NO. CEE.0111.84

SPECIFICATION FOR 25KV AC TRACTION SUBSTATIONS

This specification covers Spoornet's requirements for the design, manufacture, testing, installation and commissioning of 25kV AC single phase substations for an electric traction system.

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SECTION 1 - SUBSTATION DESIGN INFORMATION

1.0 SCOPE

1.1 This specification covers Spoornet's requirements for the design, manufacture, testing, installation and commissioning of 25kV 50 hertz AC single phase traction substations for feeding the overhead track equipment of the Spoornet's AC traction system. Adjoining the Spoornet substation yard will be an Eskom yard. The equipment in the Eskom yard, including the earth mat will be provided and installed by others.

2.0 STANDARDS

2.1 Unless otherwise specified all materials and equipment supplied shall comply with the current edition of the relevant SABS, BS, IEC or Spoornet publication where applicable.

The following publications are referred to in this specification:

2.2 South African Bureau of Standards

SABS 03-1985 - The Protection of Structures against Lightning
SABS 150 - PVC Insulated Electric Cables and Flexible Cords
SABS 156 - Moulded Case Circuit Breakers
SABS 555 - Insulating Oil for Transformers and Switchgear (uninhibited)
SABS 763 - Hot-dip Galvanised Zinc Coatings
SABS 780 - Distribution Transformers
SABS1019 - Standard Voltages, Currents and Insulation Levels for Electricity Supply
SABS1035 - Insulated Bushings
SABS1091 - National Colour Standards for Paint
SABS1222 - Enclosures for Electrical Equipment
SABS1299 - Direct Acting Indicating Electrical Measuring Instruments and their Accessories
SABS0142 - The Wiring of Premises

2.3 International Electrotechnical Commission

IEC 56 - High Voltage Alternating Current Circuit Breakers
IEC 76 - Power Transformers
IEC 129 - Alternating Current Disconnectors and Earthing Switches
IEC 354 - Loading Guide for Oil Immersed Transformers

2.4 British Standards Institution

BS 159 - Busbars and Busbar Connections
BS 162 - Electric Power Switchgear and Associated Apparatus
BS2692 - Fuses for Voltages Exceeding 1000V AC
BS2914 - Surge Diverters for Alternating Current Systems
BS3938 - Current Transformers
BS3955 - Electrical Controls for Domestic Appliances
BS4360 - Specification for Weldable Structural Steels
BS5311 - AC Circuit Breakers of Rated Voltage above 1kV

2.5 Spoornet

CEE.0224.94 - Drawings, Catalogues, Instruction Manuals and Spares
CEE 0040.83 - Manual or Motor Operated 25kV Track Sectioning Switches
CEE.0045.96 - Painting of Steel Components of Electrical Equipment
CEE.0085.84 - Self Contained Battery and Battery Charger Units

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

3.0 **APPENDICES**

3.1 The following appendices form an integral part of this specification:

APPENDIX 1 : Substation sites (names and locations) and degree of pollution.

APPENDIX 2 : Schedule of requirements for AC traction substations.

APPENDIX 3 : Schedule of drawings supplied by Spoornet.

4.0 **DEFINITIONS**

4.1 "Single unit substation" refers to a substation to be provided with one traction transformer.

4.2 "Double unit substation " refers to a substation to be provided with two traction transformers, a busbar coupler and associated equipment.

4.3 “Substation” refers to a traction substation

4.4 “Local” operation refers to a condition in which a circuit breaker can only be switched by operating the breaker controls provided in the substation.

4.5 “Remote” operation refers to a condition in which a circuit breaker can only be switched by operation of a control system from a location remote from the substation

4.6 Breaker “remain open” refers to a breaker that trips and stays in the open position and can be closed from local or remote.

4.7 A circuit breaker that is open and has an “operational inhibit” refers to a condition in which the breaker can not be closed until certain conditions return to normal. (thermal protection, undervoltage protection etc.)

4.8 "Lockout" of a circuit breaker refers to a condition where local manual reset of the control circuit is required before any attempt to close the circuit breaker can be made.

4.9 “Technical Officer” Is the person appointed by Spoornet to manage and administer the contract works.

5.0 **TENDERING PROCEDURE**

5.1 Tenderers shall submit a main offer in duplicate, complete in every respect in compliance with the specification.

5.2 Tenderers shall indicate clause by clause compliance or non 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. This document can be used by tenderers to elaborate on their response to a clause.

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

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

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

6.0 **GENERAL REQUIREMENTS**

6.1 The primary supply voltage shall be as specified in the schedule of requirements.

6.2 The locations of the substations to be provided, as well as the differing requirements to suit any particular substation are given in Appendices 1 and 2.

6.3 Equipment / Installations supplied shall be in terms of this specification. Deviations from the specification will not be allowed without the written consent of the Technical Officer.

6.4 Spoornet reserves the right to subject material and equipment offered to test or inspection to check compliance with the clauses of this specification prior to adjudication or at any stage during manufacture.

6.5 The onus to prove compliance to the specification shall rest with the tenderer during the tender stage and with the successful tenderer once the contract has been awarded.

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

6.8 Acceptance by the Technical Officer of the equipment / installation offered in no way relieves the successful tenderer of his obligation to fulfil his statement of compliance with the specification.

6.9 All equipment shall be adequately earthed, insulated, enclosed and interlocked to ensure the safety of staff (operators) as well as equipment.

6.10 Any portion of the equipment which may be likely to cause injury to staff or fire by being overloaded or failing, or by an arc set up by the equipment in operation, shall be so arranged as to prevent the possibility of injury to staff as well as preventing damage to other equipment.

7.0 SERVICE CONDITIONS

7.1 The equipment shall be designed and rated for operation under the following service conditions :-

Altitude	: 0 to 1 800m above sea level
Ambient temperature range	: Minus 5 °C to plus 50 °C
Relative humidity	: 10% to 90%
Wind pressure on equivalent projected area normal to direction of wind	: 750Pa
Lightning conditions	: 5,5 Flashes/km^2/annum

8.0 INSULATION LEVELS

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

8.2 Secondary equipment at 25kV (phase to earth) shall have a rated insulation level based on an equivalent 3 phase system with a highest voltage for equipment of 52kV r.m.s, i.e., a rated lightning impulse withstand voltage of 250kV peak, and a rated power frequency withstand voltage of 95kV r.m.s.

8.3 Primary equipment (voltages phase to phase r.m.s) shall have a rated insulation level based on an equivalent 3 phase system as indicated in the following table:

Nominal system voltage	66kV	88kV	132kV	220kV
Highest voltage for equipment	72,5kV	100kV	145kV	245kV
Rated lightning impulse withstand voltage	350kV	380kV	550kV	850kV
Rated power-frequency withstand voltage	140kV	150kV	230kV	360kV

9.0 CLEARANCES

9.1 The following minimum earth clearances shall be maintained between any conductor or metal normally alive and earthed metal :-

Nominal System Voltage	25kV	66kV	88kV	132kV	220kV
Outdoor	540mm	770mm	1000mm	1450mm	1850mm
Indoor	300mm	-	-	-	-

9.2 The following minimum safety clearances shall be maintained between any conductor or metal normally alive and ground surface level:-

Nominal system voltage	25kV	66kV	88kV	132kV	220kV
Within security fence	3400mm	3270mm	3500mm	3950mm	4350mm
Outside security fence but within Spoornet's reserve	5400mm	5700mm	5900mm	6300mm	6700mm
Outside Spoornet's reserve	5400mm	5700mm	5900mm	6300mm	6700mm

10.0 **CREEPAGE DISTANCES**

10.1 The insulators or bushings provided on all high voltage AC disconnecting switches, circuit breakers and transformers shall comply with the requirements of SABS 1035.

10.2 Secondary equipment at 25kV (phase to earth) shall have creepage distances based on an equivalent 3 phase system with a highest voltage of the system of 48kV r.m.s, i.e. 960mm and 1 200mm for normal and extremely polluted areas respectively.

10.3 Primary equipment (voltages phase to phase) shall have creepage distances based on an equivalent 3 phase system in accordance with the following table:

Nominal system voltage	66kV	88kV	132kV	220kV
Highest voltage for equipment	72,5kV	100kV	145kV	245kV
Normal or light pollution	1150mm	1600mm	2320mm	3920mm
Heavy Pollution	1660mm	2300mm	3340mm	5640mm

11.0 **PREVENTION OF CORROSION**

11.1 **Preparation of outdoor structural steelwork.**

11.1.1 Steelwork for outdoor installation in inland areas, i.e, at a distance greater than 20km from the coast, shall be hot-dip galvanised to SABS 763.

11.1.2 Steelwork for outdoor installation in coastal areas, i.e, within 20km of the sea, shall first be hot-dip galvanised to SABS 763, followed immediately at the galvanising plant by the application of the Sterling paint system in accordance with specification CEE.0045.

11.2 **Preparation of steel buildings.**

Where it is impractical to galvanise large areas of sheet steel, surfaces for outdoor exposure in both inland and coastal areas shall be prepared in accordance with specification CEE.0045.

11.3 **Handling and final treatment of painted steelwork.**

11.3.1 Painted steel shall be handled with care and/or suitably packed to avoid damage during transport and installation.

11.3.2 Any damage to painted surfaces shall be repaired, after installation after which a final finish coat of the paint specified in specification CEE.0045. shall be applied.

11.3.3 The following table specifies the colours to be used:

♦ Coastal structural support steel	Tower Grey
♦ Traction transformer tank	Navy light Grey (G35)
♦ Traction transformer conservator tank	White
♦ Substation building	White
♦ Interior of building and all outdoor enclosures	White
♦ Indoor equipment/control panels	Navy light Grey (G35)

12.0 **SUBSTATION OPERATIONAL PROTOCOLS**

All traction substation circuit breakers shall trip and remain open (operational inhibit) should the circuit breakers tripping power supply (110V DC) be lost completely or fall below 70% of nominal battery voltage. It shall only be possible to close the circuit breakers when the supply voltage reaches 85% of the nominal value.

12.1 **PRIMARY ISOLATOR**

12.1.1 It shall not be possible to operate the primary isolator unless the primary circuit breaker is open.

12.1.2 It shall not be possible to earth the load side of the primary isolator before the isolator blades are completely open.

12.1.3 With the isolator in the open position it shall be possible to operate the primary circuit breaker for test purposes.

12.2 **PRIMARY CIRCUIT BREAKERS**

12.2.1 The primary circuit breaker shall trip and remain open for the following events:

12.2.1.1 Inverse Definite Minimum time operation. (primary)

12.2..1.2 Transformer winding and or oil temperature.

12.2.2 The primary circuit breaker shall trip and lockout for the following events:

12.2.2.1 When the SF6 gas pressure falls to the first warning pressure value (before it reaches the safe operational threshold)

12.2.2.2 Transformer Bucholtz operation

12.2.2.3 Transformer restricted earth fault

12.2.2.4 Transformer biased differential

12.3 **SECONDARY ISOLATOR (25kV)**

12.3.1 It shall not be possible to operate the secondary isolator unless the 25kV Incomer circuit breaker is open.

12.3.2 With the isolator in the open position it shall be possible to operate 25kV Incomer circuit breaker for test purposes.

12.4 **SECONDARY CIRCUIT BREAKERS (25kV)**

12.4.1 **Incomer circuit breaker**

12.4.2 The 25kV Incomer shall trip and remain open for the following events:

12.4.2.1 When the SF6 gas pressure falls to the first warning pressure value.

12.4.2.2 Inverse Definite Minimum time operation. (secondary overcurrent)

12.4.2.3 Intertripping with the primary circuit breaker. If the primary circuit breaker is tripped by any of the transformer protection relays, then the incomer circuit breaker shall trip and shall not be able to close until the primary circuit breaker is closed.

12.4.2.4 In the case of substations connected in parallel (will be specified in the schedule of requirements), the incomer will trip and remain open, in the event of reverse current flow.

12.4.3 It shall not be possible to parallel incoming 25kV supplies through a substation busbar coupler in double unit substations. (it must not be possible to close both Incomer circuit breakers with the Busbar coupler in the closed position) Where a busbar coupler is required in a single unit substation, this feature shall be provided for future use when the incoming supply is doubled.

12.4.4 The operation of the Busbar coupler (opening or closing) shall only be possible if all the Secondary Circuit Breakers (Incomers and Track feeders) are in the open position.

12.4.5 **Track feeder circuit breakers**

12.4.6 The track feeder circuit breakers shall trip and remain open for the following events:

12.4.6.1 When the SF6 gas pressure falls to the first warning pressure value.

12.4.6.2 Operation of the thermal overload relay. The breaker shall trip and remain open (operational inhibit) until the relay resets. The auto reclose function shall not be initiated by this relay.

12.4.6.3 Impedance distance protection operation. The breaker shall trip and the single shot auto reclose sequence will be initiated. Should the breaker trip again after the auto reclose sequence, it shall remain open. (no lockout or auto reclose)

12.4.6.4 When local operation of a circuit breaker is selected any auto reclose feature provided shall be rendered inoperative.

12.4.6.5 When closing any circuit breaker from remote any auto reclose feature provided shall be rendered inoperative for a period of 30 seconds.

SECTION 2: - TRACTION SUBSTATION EQUIPMENT

13.0 **STEELWORK**

13.1 The design, supply and installation of all steel structures for the support of equipment and tensioning of conductors shall be the responsibility of the successful tenderer.

13.2 Structural steel shall comply with BS 4360.

13.3 All welded joints shall be seal welded with no gaps or blow holes.

13.4 All steelwork shall be hot-dip Galvanised to SABS 763.

13.5 A lattice type steel gantry (25kV gantry) shall be provided on which for secondary circuit breakers of the outdoor structure mounted type the following items of equipment shall be mounted:

- 25kV Isolator
- 25kV Busbar
- Lightning arrestors (for each feeder circuit)
- Auxiliary transformer
- Voltage transformer
- All Secondary Circuit Breakers (Incomer as well as the track feeders)
- All track feeder overhead feeders (500 mm^2 Aluminium) shall be made off on this structure with the span length being the distance to the Overhead track equipment switch structure which will be provided by others.

13.6 A typical layout of the above arrangement is shown on Drawings No's CEE-TDB-41 sht's 1&2 which form part of this specification.

13.7 Support steel structures for the following equipment shall be provided:

- High voltage double pole isolator.
- High voltage lightning arrestors. (structure shall be similar to that shown on Sketch No. 1 in Appendix No.3)
- Primary circuit breaker.
- High voltage Current Transformer. (structure shall be similar to that shown on Sketch No 1 in Appendix No.3)

13.8 The manufacture of any steelwork shall not take place prior to the approval by the Technical Officer of the design drawings.

13.9 Spoornet shall inspect the steelwork at the manufacturers works prior to dispatch.

14.0 **PRIMARY AND SECONDARY ISOLATORS**

14.1 Isolators and earthing switches shall comply with the requirements specified in IEC 129.

14.2 Isolators and earthing switches shall be of the air break type suitable for outdoor installation and be designed for manual operation from ground level.

14.3 The primary isolator shall be of the double pole type.

14.4 The secondary isolator shall be of the single pole type.

14.5 Interlocking shall be provided on the primary isolator to ensure that the isolator can only be opened with the primary circuit breaker in the open position.

14.6 Interlocking shall be provided on the secondary isolator to ensure that the isolator can only be opened with the incomer circuit breaker in the open position.

14.7 The primary isolator shall be provided with means to earth the load side of the isolator when in the open position.

14.8 The isolators shall be rated to suit the associated equipment.

14.9 Tenderers shall provide details of the isolators offered and the proposed method of interlocking.

15.0 LIGHTNING ARRESTERS

15.1 Lightning arresters shall comply with the requirements of BS 2914.

15.2 Heavy duty station class arresters shall be provided.

15.3 Lightning arresters shall be connected to each phase of the incoming primary supply. The supply system may be considered to be effectively earthed.

15.4 Lightning arresters rated for 39kV rms shall be provided for connection to each 25kV circuit feeding the overhead track equipment.

15.5 Lightning arresters rated for 3,3kV rms shall be provided for connection to the main transformer return current bushing.

15.6 All lightning arresters earth lug shall be connected to the substation main earth mat by means of the specified conductor.

16.0 **PRIMARY CIRCUIT BREAKERS**

16.1 Primary circuit breakers shall be of the SF6, gas filled type. Circuit breakers shall comply with IEC 56 in so far as that specification is applicable to the type of circuit breaker offered.

16.2 The circuit breaker shall be of the double pole type for outdoor operation.

16.3 The circuit breaker shall be suitably rated for the substation equipment's electrical rating as specified in the schedule of requirements.

16.4 The rated short-circuit breaking current shall be at least 16kA .

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

16.6 The circuit breakers shall be designed for electrical operation at 110V DC from the substation battery supply.

16.7 Tension springs shall not be used for either closing or tripping mechanisms.

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

16.9 A visual mechanical indicating device shall be provided to show whether the circuit breaker is closed or open.

16.10 The operating mechanism shall be constructed of non-ferrous material or cadmium plated steel.

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

16.12 The circuit breaker shall be provided with a control panel in the substation building on which are mounted the protection relays, control switches and associated equipment.

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

16.14 Local/Remote selector switches shall be provided on the control panel in the substation building as well as on the circuit breaker mechanism and shall be of the two-position type (no "off" or "neutral" position).

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

16.16 The circuit breaker shall be provided with a no volt coil which will trip and lock out the breaker when the coil is de-energised. Drawing No. CEE-TBK-27 forming part of this specification, details control circuitry.

16.17 It shall be possible to close the circuit breaker only when the control voltage is above 85% of the nominal value, and the circuit breaker shall trip automatically when the control voltage falls to 70% of the nominal value.

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

16.19 A counter shall be provided on the control panel to indicate the number of trips initiated by the protection scheme.

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

17.0 TRACTION TRANSFORMER

17.1 GENERAL

17.1.1 The transformer shall comply with IEC 76.

17.1.2 The transformer shall be suitable for providing supplies to a single phase railway traction system and as such will be subjected to cyclic overloads up to 2 per unit (maximum duration 2 minutes). For thermal considerations the overall loading requirements of IEC 354 will not be exceeded. In addition the possibility exists that a high incidence of short-circuit faults will be applied to the transformer secondary terminals. Tenderers must comment on the ability of transformers offered to meet these requirements and provide this comment and the following details of transformers previously built for traction supplies with the tender :-

- User.
- Where installed.
- Date installed.
- Quantity supplied.
- MVA rating.
- Voltage ratio.
- BIL of Primary and secondary windings.
- Range of tappings.
- Location of tappings.
- In addition to the above any information relating to reliability and in-service performance should be submitted in support of the above.

17.2 TECHNICAL REQUIREMENTS.

17.2.1 The following are the technical requirements of the required transformer:

Frequency	50Hz
Type	OUTDOOR
Cooling	ONAN
Rated power	20MVA
Rated voltages	As specified in schedule of requirements
Tap changer	OFF LOAD
Tapped winding	Secondary
Tapping range in 6 equal steps.	Minus 0 % Plus 15 %
Winding connections	Primary Phase to phase. Secondary Phase to earth.
Insulation	Primary and secondary fully insulated

Impedance	Limits on any tapping at 75 °C and at rated frequency expressed in percent of $\frac{(\text{Nominal Voltage})^2}{\text{MVA}}$	Max 12% Min 10%

17.2.2 Protection current transformers on the primary side shall be fitted on the transformer primary bushings for primary voltages of 88kV and less. For voltages above 88kV the primary protection current transformers will be separate units. All protection current transformers on the secondary side (25kV) shall be fitted on the transformer secondary bushings.

17.2.3 Transformer oil shall conform to SABS 555.

17.3 **ANCILLARY EQUIPMENT**

The following shall be provided :-

17.3.1 A conservator tank which shall be painted white, fitted with a silica gel dehydrating breather and an oil-level gauge and drain cock.

17.3.2 The connecting pipe to the conservator shall extend at least 50mm into the tank to form a sediment trap. All pipe connections shall have flange joints.

17.3.3 A weather-proof dial type thermometer graded in ºC for registering "top oil" temperature. The instrument shall be fitted with a resettable maximum temperature indicator. Adjustable trip and alarm contacts shall be fitted to the thermometer. The contacts shall normally be set to operate at a temperature of 90 ºC.

17.3.4 A single-float Buchholz relay to provide tripping facilities.

17.3.5 A thermal type overload relay to protect the transformer windings against sustained overloads. This relay shall have a load-temperature characteristic approximately the same as the transformer winding hot spot. Suitable means of compensation for variation of ambient air temperature shall be provided.

17.3.6 The relay shall be provided with trip and alarm contacts. The contacts shall normally be set to operate at 100 ºC.

17.3.7 A oil drain cock, oil sampling cock and thermometer pockets on the main tank. The sampling cock shall be so arranged that a oil sampling bottle may be easily filled.

17.3.8 Two cocks, one on top and one at the lowest point on opposite sides of the main tank shall be provided, for connecting up to an oil filtering system. The cocks shall be screwed 50mm gas or metric equivalent female thread. If desired, the cock at the lowest point of the tank may be combined with the drain cock required above by the addition of a suitable fitting having a 50mm gas or metric equivalent female thread.

17.3.9 A suitable explosion vent may be provided on the main tank if considered necessary by the manufacturer, but the provision of such a vent shall not effect the efficiency of the Buchholz relay in the event of a transformer fault.

17.3.10 Bushing stems and terminals of a size to ensure sufficient mechanical strength for attaching and supporting external connections, which shall not in any case be smaller than 26mm diameter (primary and secondary). At least two earthing terminals on opposite sides of the transformer shall be fitted on the outside of the transformer tank to facilitate connection to the substation main earth mat.

17.3.11 All pipe joints and inspection covers shall be sealed using O-ring gaskets.

17.3.12 Pockets for the temperature indication probes shall be located in areas where the oil is freely circulating, thus avoiding the possibility of incorrect oil temperature measurement.

17.3.13 A separate quote for the optional supply of the following on the transformer is required:

- A “Bagged conservator” (A bag installed in the conservator tank which prevents air from coming into contact with the transformer oil)
- A Chainings UAU transformer filter system
- A on load tap changer

17.4 **TANK AND COOLING RADIATORS**

17.4.1 The transformer tank and its associated components shall have adequate mechanical strength and rigidity to permit the complete transformer minus cooling radiators but filled with oil, to be lifted, jacked and skidded in any direction. Welded seams shall not be covered by stiffeners.

17.4.2 The transformer tank shall have a welded top cover.

17.4.3 Transformers shall not be fitted with rollers, but shall be provided with a substantial base that is rectangular (has no protruding lugs or protrusions) and is so constructed that it can be supported on a flat concrete plinth that has a raised portion the same size as the transformer base, to prevent the possibility of water standing in contact with the transformer base. Provision shall be made on the transformer for the attachment of a tackle for the purpose of skidding. Jacking lugs shall be provided for lifting the transformer complete with oil.

17.4.4 The transformers shall be fitted with removable cooling radiators which shall be hot-dip galvanised externally. Suitable valves shall be provided so that the radiators can be removed without having to drain the oil from the transformer tank.

17.5 **RATING PLATES**

17.5.1 A non-corrosive metal plate shall be fixed to each transformer tank (not cooling tubes).

17.5.2 Comprehensive information shall be provided on the rating plate in respect of both electrical and mechanical aspects.

17.5.3 Details must be submitted to Spoornet for approval prior to construction.

17.6 **TESTING**

17.6.1 The transformer shall be tested in accordance with IEC 76, including a test with lightning impulse chopped on the tail.

17.6.2 Spoornet will conduct an out of tank inspection of the transformer prior to the transformer being tanked as well as witnessing all the routine manufacturers tests carried out at the works. The co-ordination of manufacturers testing shall be the responsibility of the successful tenderer.

17.6.3 Type test certificates of the transformer design offered shall be submitted with the tender. Should type test certificates not be available, the required tests shall be carried out, the cost of which must be included in the tender price quoted as a separate item.

17.6.4 Should the transformer offered not have a short circuit type test certificate available, a simulated computer model of this test may be submitted for Spoornet’s approval, but should this model be unacceptable short circuit tests will be required and shall be conducted in accordance with IEC 76 Part 5 . An out of tank inspection shall be carried out after completion of the tests. The tests shall comprise two short circuits on each of the extreme and centre tappings. The short circuits on each tapping shall be of opposite asymmetry. Short circuit duration shall not be less than 0,5 seconds. Short circuit current shall not be less than that calculated for a fault on the secondary terminals of the transformer with rated voltage on the primary terminals from a supply of not less than 2 500MVA .

18.0 **CURRENT TRANSFORMERS**

18.1 Current transformers shall be of the bar-primary type and comply with BS 3938. Ratings, ratios and class of accuracy shall be determined by the protection scheme as shown on Drawing No. CEE-TBB-109. A margin of 5VA shall be provided for testing purposes.

18.2 If the primary supply voltage is 88kV and below, then the current transformers for main transformer protection shall be installed in the transformer bushings. If the primary supply voltage exceeds 88kV then only the current transformers on the secondary side of the main transformer shall be mounted in the transformer bushings, with the primary side's current transformers being of the post type.

18.3 Secondary protection current transformers shall be mounted in the transformer bushings.

18.4 Current transformers shall be installed on the load side of the associated circuit breaker. It shall be possible to remove the current transformers with the minimum of disturbance to other equipment.

18.5 Separate current transformers shall be provided for main and back-up protection on all 25kV track feeder circuit breakers.

18.6 Since the accurate measurement of harmonics in the traction supply will be necessary from time to time, current transformers offered shall be suitable for this purpose.

19.0 VOLTAGE TRANSFORMERS

19.1 Voltage transformers shall be single phase and have a ratio of 26,4kV/110V . They shall comply with the requirements of BS 3941 and be class E for protection.

19.2 Voltage transformers shall be outdoor structure mounted, oil filled type.

19.3 The return side of the primary winding shall have a bushing insulated for 3,3kV and must not be connected to the Voltage Transformer's tank.

19.4 The secondary winding shall be terminated in a cable box.

20.0 AUXILIARY POWER TRANSFORMERS

20.1 Unless otherwise stated two 16kVA 27 500V/240V single phase transformers mounted on the substation portal structure shall be provided by the successful tenderer.

20.2 The transformers shall comply with SABS 780.

20.3 The transformers and the connected equipment shall be capable of operating satisfactorily for a supply voltage varying between 27,5kV and 22,0kV. Main transformer secondary voltage under traction no-load conditions will normally be 27,5kV and auxiliary equipment shall be capable of operating continuously at this voltage.

20.4 Each transformer shall be provided with a suitably rated drop-out fuse link provided in the high voltage supply conductor.

21.0 BUSBAR COUPLER

21.1 The 25kV busbars of each unit at all double unit traction substations shall be connected together by means of a busbar coupler. A busbar coupler shall be provided in single unit substations where specified in the Schedule of Requirements.

21.2 For secondary circuit breakers of the outdoor structure mounted type, the busbar coupler shall be a motor operated 25kV AC track sectioning switch supplied in accordance with specification CEE.0040.83.

21.3 The track sectioning switch shall be rated at 1500A and the operating voltage of the switch mechanism shall be 110V DC.

22.0 SECONDARY CIRCUIT BREAKERS

GENERAL REQUIREMENTS

22.1 Secondary Circuit breakers shall be of the vacuum type. Circuit breakers shall comply with BS 5311 in so far as that specification is applicable to the type of circuit breaker offered.

22.2 Circuit breakers of a service proven design are required and full-supporting details in this respect shall be furnished with tenders. The circuit breakers shall be single pole.

22.3 Circuit breakers shall be of the outdoor structure mounted type and shall be mounted on a suitably designed structure, in the manner indicated on Drawing No's CEE-TDB-41 sht's 1 & 2

22.4 The mounting method of the circuit breaker and the operating mechanism shall be adjustable to allow for alignment.

22.5 The circuit breakers shall have a rated voltage of 44kV, and the system frequency is 50Hz.

22.6 The rated continuous current shall be at least 1 200A.

22.7 The rated short-circuited breaking current shall be 12kA at a nominal voltage of 25kV . In addition the circuit breaker shall be capable of interrupting 6kA at a recovery voltage of 44kV in the case where a short circuit between phases occurs.

22.8 Fault making current shall be 30kA peak and at least 12kA for 3 seconds.

22.9 Opening time on low impedance track faults including relay operating time shall not exceed 0,1 seconds, for track feeder circuit breakers.

22.10 Tenderers shall advise the capability of circuit breakers offered to interrupt :-

- Capacitive currents.
- Currents with a high harmonic content.

22.11 Tenderers shall advise the chopping current levels of the circuit breaker offered and what steps are taken to keep these values to a minimum.

22.12 Tenderers shall also advise whether special precautions are required to limit the effects of chopped current and to give details.

22.13 The operating mechanism shall be constructed of non-ferrous material or cadmium plated steel.

22.14 The operating voltage shall be 110V DC.

22.15 The circuit breaker operating mechanism shall be housed in a weatherproof enclosure, and shall be accessible by means of a lockable door.

22.16 The following shall be provided within the enclosure:

- A thermostatically controlled anti-condensation heater.
- A fluorescent light operated by a door switch.
- A 15A, 220V AC socket outlet in accordance with SABS 0142.

22.17 The circuit breaker mechanism shall be of the spring operated type with shunt release for both opening and closing. The closing operation shall charge the tripping spring.

22.18 It shall not be possible for the circuit breakers to close while the spring is being charged.

22.19 The spring shall be fully charged before it can be released to close the circuit breaker.

22.20 It shall be possible to charge the spring when the circuit breaker is closed and if the spring can be, and is released, the circuit breaker shall not open.

22.21 There shall not be any danger of a fully charged spring being released by vibration caused by the opening of the circuit breaker under any conditions.

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

22.23 Means shall be provided for charging the spring by hand.

22.24 Means shall be provided for discharging the spring when the circuit breaker is in the "open" position without the circuit breaker attempting to close.

22.25 Facilities shall be provided for locking of the local manual release of the closing spring mechanism.

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

22.27 Tension springs shall not be used for either closing or tripping mechanisms.

22.28 Facilities shall be provided to permit manual slow closing of the circuit breaker for maintenance purposes.

22.29 The mechanism shall be trip-free. The contacts shall make before the breaker starts to open.

22.30 If the circuit breaker fails to latch on closing it shall trip before any significant damage can occur.

22.31 A visual mechanical indicating device shall be provided to indicate whether the circuit breaker is closed or open.

22.32 Unless the design of the circuit breaker mechanism is such that compensation for interrupter contact wear is provided automatically, a visible indication shall be provided to show when adjustment is needed. In the case of circuit breakers incorporating more than one interrupter it shall be possible to make such adjustments individually to suit the requirements of each interrupter.

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

22.34 Local/Remote selector switches on the circuit breaker equipment shall be of the two-position type (no “off” or “neutral” position).

22.35 Circuit breaker control switches shall be arranged to return automatically to the neutral position when the handle is released after being turned to either the "close" or "trip" positions.

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

22.37 A counter shall be provided on each track feeder circuit breaker control panel to indicate operations (trips) initiated by any of the track feeder protection relays.

22.38 Tenderers shall advise the number of circuit breaker operations under the following conditions, after which maintenance and/or measurement of contact wear is recommended :-

- Rated breaking capacity.
- Breaking 6kA.
- Breaking 1500A.

23.0 TRACTION substation building

23.1 The building to be provided shall be of the prefabricated steel modular type. It shall be robust, waterproof, vermin proof and of sufficiently strong construction to resist all weather conditions encountered in South Africa.

23.2 Details of a suggested design are shown on Drawing No. CEE-TEC-28. This design or variations thereof may be used but tenderers are free to offer alternatives that comply with this specifications requirements.

23.3 When a single unit substation is required, the building design shall facilitate extension to accommodate equipment for a double unit substation in the future.

23.4 Steelwork shall be treated in accordance with the prevention of corrosion requirements specified in clause 11.

23.5 The building shall have a "double-skinned" roof construction to allow a free circulation of air between the skins.

23.6 The outer skin shall be of flat sheet steel of the same thickness as the building.

23.7 The inside walls shall be thermally insulated to the equivalent of 40mm of glass-fibre. The tenderer shall give full details of the material he intends to use as well as the fixing method of the material to the walls (Glue is not acceptable). Protection against mechanical damage to the insulation shall be provided.

23.8 The building shall be large enough to accommodate all equipment that will be contained within the building with enough space for comfortable maintenance of the equipment. The following major items of equipment as called for in this specification must be accommodated within the building:

- An aluminium self-supporting ladder with a height of 1.2m.
- A wall mounted metal key box with a lid and provision for at least 20 keys as shown on Drawing CEE-TCA-92.
- Suitable brackets and/or storage for ladder, special tools and earthing apparatus.
- Suitable bracket on the wall immediately adjacent to the annex door for mounting of a fire extinguisher. (Fire extinguisher will be provided by others).
- Suitable brackets for mounting of a control selector telephone and telecommunications distribution board.
- A complete set of wiring and circuit diagrams for the substation.
- A steel cabinet / desk combination approximately 1150mm wide, 600mm deep and 1
000mm high. '
- Telecontrol cabinets (provided by others).
- Battery tripping unit.
- Primary Circuit Breaker control panels.
- Secondary Circuit Breaker control panels.
- Low voltage distribution board.

23.9 One door is required for entrance into the building. The door shall be situated in the narrow wall opposite that which contains the ventilation fan.

23.10 It shall be possible to remove, without dismantling, any equipment contained within the building through the door provided.

23.11 The door shall be fitted with a robust locking mechanism capable of being locked by means of a stout padlock provided by Spoornet.

23.12 Door hinges shall be robust with hardened steel pins. Doors shall be fitted with a suitable stay to hold them in the open position.

23.13 A foundation and plinth of concrete for the support of the building and its equipment and for the maintenance and handling of all indoor equipment shall be provided.

23.14 The plinth shall be so designed as to eliminate the possibility of water standing in contact with the base of the building.

23.15 Tenderers shall give details of the measures they propose taking to seal the base of the building to the concrete plinth.

23.16 The finished level of the plinth shall not be less than 250mm above ground level .

23.17 The floor surfaces shall be durable non-slip and of pleasing appearance and shall not be subject to damage or marking by normal maintenance activities. In the case of a concrete floor it shall be coated with "Solidkote" or similar.

23.18 Provision shall be made for the entry of cables from the outdoor yard into the building.

23.19 The building design shall be such as to provide the necessary trunking for cable entry to all equipment which will be top entry. (no underfloor trunking)

HEATING AND VENTILATION

23.20 A ventilation fan shall be provided in the substation control equipment building. The fan shall be capable of providing 20 air changes per hour.

23.21 Whirlybird or similar ventilators suitable to ventilate the building shall be provided and installed on the roof.

23.22 The fan shall draw air from inside the building and blow to the outside through automatically closing shutter louvers.

23.23 Thermostatically controlled heaters shall be provided to prevent condensation within the building. Thermostats shall comply with BS 3955 part 2 section 2F and be to category A.

23.24 Heaters shall be robust with elements completely enclosed in a metal tube.

23.25 Heaters shall be positioned and mounted in such a manner that they are not subject to damage during normal maintenance activities.

23.26 Details of the type and rating of heaters must be supplied by tenderers.

24.0 **AUXILIARY POWER SUPPLIES**

24.1 All low voltage power and lighting circuits shall comply with the requirements of SABS 0142.

24.2 Under traction load conditions the substation supply voltage will have a high harmonic content and equipment supplied from the auxiliary transformer shall be capable of satisfactory operation under these conditions.

24.3 A low voltage distribution board shall be provided in the substation building. The output of the auxiliary transformers shall be connected to two 80A double pole miniature circuit breakers (MCB's) on the distribution board. The MCB's shall be withdrawable or lockable.

24.4 The output from the auxiliary transformers shall be connected to an automatic change-over contactor which must not allow the supplies to be paralleled under any circumstances.

24.5 Where only one auxiliary transformer is called for Spoornet will arrange for the supply from a second auxiliary transformer to be connected to one of the 80A MCB'S called for above.

24.6 The distribution board shall be provided with MCB'S to protect and control all lighting, heating, ventilation, socket outlets, control circuits, and supplies to the Eskom equipment. MCB'S shall comply with SABS 156**.**

24.7 Provision shall be made for six single MCB spare cut-outs for future additions.

24.8 The distribution board must provide for a 110V 10A DC supply and a 220V 20A AC supply to be cabled to the Eskom equipment in the Eskom yard. AC and DC circuits shall be physically separated either by means of a partition or separate distribution boards.

24.9 At least two 15A 220V 3 pin socket outlets shall be provided in the building as well as one outlet mounted in the control panels.

LIGHTING

24.10 Lighting points shall be provided in each building to provide a general level of illumination of 20 lux. Light fittings shall be of the fluorescent type.

24.11 Two outdoor fluorescent lights shall be provided on the outside of the control equipment building. One shall be mounted above the buildings door and the other shall be mounted on the long side of the building facing the track. These lights shall be controlled by light sensitive switch.

24.12 Outdoor lighting shall be provided in at least two positions to provide a general level of illumination of 20 lux in the substation yard. These lights shall be controlled from within the control equipment building. Care shall be taken to avoid glare in the eyes of train drivers and the layout must be approved by the Technical Officer.

25.0 **REQUIREMENTS FOR TELECONTROL**

25.1 Telecontrol and telemetering equipment will be provided by Spoornet.

25.2 The telecontrol equipment cabinet, the size of which is approx 1600x800x800 (hwd**)**, will be housed in the substation control equipment building. Spoornet will deliver this cabinet to site, with the installation thereof being the responsibility of the successful tenderer.

25.3 A "Klippon" or similar terminal strip with 250 terminals shall be provided to act as the interface between the substation equipment and the telecontrol equipment. This terminal strip can be housed in one of the switchgear control panels (space permitting) or housed in a dedicated enclosure. The successful tenderer shall terminate all conductors for the telecontrol functions required on one side of this terminal strip. The successful tenderer shall supply and install the cable required to connect the telecontrol equipment cabinet (supplied by Spoornet) to the terminal strip. One side of this cable will be connected to the terminal strip with the other side being made off in the telecontrol equipment cabinet for connection by others.

25.4 The relay contacts provided in the telecontrol cabinet for remote operation of switchgear will have a maximum rating of 0,5A at 110V DC.

25.5 Indication for telecontrol purposes shall be provided by means of voltage free open and closed contacts on the switchgear.

25.6 Provision shall be made for the following principal telecontrol operations indications and alarms: -

- Open and close command function for all circuit breakers.
- Open and close indication for all circuit breakers.
- Lockout indication for all circuit breakers.
- Indication of failure of voltage transformer output (protection reference voltage).
- Indication of failure of distance protection relay supply voltage. Detection must take place at each relay.
- Indication of charger failure for DC control batteries.
- Indication of transformer pressure relief device operation.
- Indication of low gas (SF6 breakers, Primary and Secondary).

25.7 The following transducers capable of measuring true RMS values of distorted waveforms shall be provided :-

25.7.1 A current transducer to monitor each main transformer secondary current.

25.7.2 A voltage transducer to monitor each secondary busbar voltage.

25.8 The output of these transducers shall be wired to the telecontrol terminal strip.

25.9 Tenderers shall state the type and suppliers of the transducers they intend using.

25.10 Any additional telecontrol functions that might be necessary due to the supply and installation of any specialised equipment offered shall be provided.

25.11 A detailed list of telecontrol commands, indications and alarms shall be submitted for approval by the Technical Officer.

26.0 CONTROL PANELS

A control panel shall be provided for each Primary and Secondary circuit breaker provided in the substation. These control panels shall contain all the protective relays and circuit control equipment required for the operation of the associated breaker.

26.1 PANEL CONSTRUCTION

26.1.1 The panels shall be constructed of steel sheeting of not less than 2mm thickness. The panel shall be of rigid construction with facilities for lifting.

26.1.2 The panels shall of the swing frame type (access to the panel being via the front swing frame and having no rear access).

26.1.3 The panels shall be fitted with dummy interior covers so as to ensure that when components are mounted, no bolts or screws are visible on the exterior of the panel.

26.1.4 The panel shall be supplied with a gland plate which allows for cable entry from the top. The installation contractor shall punch all required holes into the gland plate on site.

26.2 EQUIPMENT INSTALLED IN THE PANELS

26.2.1 All contactors and relays shall be of liberal rating and design and of the sturdiest construction, they shall not be affected by vibration and shall be silent when energised. Contacts shall be made of silver or other approved metal to minimise damage through oxidation and shall be designed to maintain good contact under all operating conditions.

26.2.2 Relays shall be completely sealed against the ingress of dust and dirt by means of non-inflammable covers which are easily removable. The relays shall have a protection rating of IP34 as defined in SABS 1222.

26.2.3 All protection relays shall be housed in withdrawable pattern cases and shall be so designed and mounted as to make them free from equipment vibration problems.

26.2.4 All relays, contactors, links, MCB's and test terminals shall be readily accessible so that routine examination, maintenance and testing may be carried out without the need to remove bolted panels.

26.2.5 The control equipment provided shall be capable of correct operation within the voltage limits specified in BS 5311 : Part 3 : 1976. In addition the coils of all devices operated from the substation auxiliary transformer AC supply shall be capable of satisfactorily operating under the harmonic voltage conditions encountered in an AC traction system.

26.2.6 All low voltage circuits in the panel which require protection shall be suitably protected by miniature moulded case circuit breakers which comply with SABS 156. The circuit breakers shall be B-curve design.

26.2.7 All electrical conductors shall be routed in plastic channel trunking with a removable cover. This trunking must be of sufficient size to easily hold the conductors. Should trunking not be feasible, a metal rod can be brazed onto the panel onto which the conductor bundle can be attached by cable ties or some other suitable method. Conductors supports that are attached by adhesive are not acceptable.

26.2.8 Panel bus wires shall be fully insulated and shall be run separately along the panel. MCB's shall be provided to enable independent circuits to be isolated from the bus wires. Separate troughs or ducts shall be provided for the building wiring and control wiring.

26.2.9 Protection circuits shall be provided with PK2 type test blocks to enable the temporary connection of instruments, meters or test equipment without interfering with fixed wiring.

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

26.2.11 All cables shall be marked at both ends with markings the same as that which appears on the wiring schematics and diagrams.

26.2.12 All relays, cables, terminal strips, switches, lamps, push buttons etc. which are mounted on panels, shall be labelled to clearly indicate their function.

26.2.13 An annunciator indicating panel giving visual (LED display) indication of the reason for the circuit breaker's trip shall be provided on the circuit breaker control panel.

A counter shall be provided on the control panel of each circuit breaker to indicate the number of trips initiated by the protection scheme.

26.2.14 Each protective element that causes the circuit breakers to trip shall be catered for (Bucholtz, overload, SF6 low gas, distance protection etc.). The visual alarm shall continue until the indication alarm is accepted and reset.

26.2.15 No anti condensation heaters are required inside the panels.

26.2.16 Each panel shall have and interior fluorescent lamp which will be switched by a door switch.

26.3 INDICATING INSTRUMENTS

26.3.1 All indicating instruments shall be designed, manufactured and tested in accordance with SABS 1299, and shall be flush mounted.

26.3.2 The dials of instruments shall be marked with the ratio of the associated instrument transformers.

26.3.3 The full-scale deflection of instruments shall be not less than 85mm and the scales shall be:

- Voltmeters 0 - 30kV
- Ammeters 0 - 1 500A

26.3.4 A voltmeter shall be provided to indicate the voltage of each section of the 25kV busbar.

26.3.5 An ammeter shall be provided to indicate the primary and secondary current.

27.0 **DC BATTERY AND CHARGER**

27.1 The DC control battery and charger shall comply with specification No.CEE.0085 except where special arrangements are necessary to suit the design of equipment offered. The Tenderer shall complete appendix No.2 of that specification**.**

27.2 The rating of the battery and charger to be installed in each substation shall be based on the burden of the equipment to be supplied.

27.3 The nominal voltage of the battery shall be 110V.

27.4 The batteries shall be of the nickel cadmium sealed type and shall comply with the requirements of CKS 455 if the capacity thereof is lower than 10 ampere hours otherwise they shall be of the non-sealed vented type.

28.0 **PROTECTION**

Drawing No. CEE-TBB-109 shows the principal protection requirements for a substation and must be read in conjunction with the following specific requirements.

28.1 Separate current transformers shall be provided for main and back-up protection on all 25kV track feeder circuit breakers.

28.2 **PRIMARY CIRCUIT BREAKER TRIPPING**

28.2.1 The following protection relays shall be provided and when operated shall cause the primary circuit breaker to trip and lockout: -

28.2.1.1 Buchholz.

28.2.1.2 Restricted earth fault on both primary and secondary windings.

28.2.1.3 Transformer percentage biased differential.

28.2.1.4 Primary circuit breakers SF6 low gas.

28.2.1.5 Traction transformer pressure relief valve.

28.2.2 The following protection relays shall be provided and when operated shall cause the primary circuit breaker to trip only, allowing reclosure from remote.

28.2.2.1 Transformer winding and oil temperature.

28.2.2.2 Inverse Definite Minimum Time (IDMT) operated from transformer primary current.

28.2.2.3 Circuit breaker tripping supply undervoltage detection.

28.3 **SECONDARY CIRCUIT BREAKER TRIPPING**

28.3.1 Secondary circuit breaker protection relays shall be circuit specific:

28.3.2 The following protection relays shall be provided and when operated shall cause the secondary circuit breaker to trip only, allowing reclosure from remote.

28.3.3 **Incomer circuit breaker**

28.3.3.1 Inverse Definite Minimum Time (IDMT) overcurrent relay.

28.3.3.2 In the case of double unit substations feeding parallel fed sections, a reverse power relay which will operate in the event of the reverse flow of power.

28.3.4 **Track feeder circuit breaker**

28.3.4.1 Distance Impedance relay with directional mho characteristics suitable for electrified railway systems (GEC Alsthom Optimho relay). A track feeder circuit breaker will normally be the only feed into a section of railway line and will therefore not be required to discriminate with other track feeder circuit breakers. The relay shall provide for instantaneous tripping up to a relay setting equivalent to an overhead equipment impedance of 64 ohms at an angle of 65° The relay characteristic shall be designed to discriminate between load and fault current conditions at high impedance settings.

28.3.4.2 Thermal overload relay to match the thermal characteristics of the overhead equipment which permits a continuous current of 780A, 950A for 5 minutes and 1 720A for 1 minute.

28.3.4.3 Single shot auto reclose relay with dead time and reclaim time independently adjustable from 5 to a total of 25 seconds. An operations counter shall be provided. The auto reclose sequence shall only be initiated by the impedance distance protection relay

28.3.4.4 Low SF6 Gas pressure detection.

28.4 **AUXILIARY TRANSFORMER PROTECTION**

Each 16KVA auxiliary transformer shall be provided with a 1 Amp dropout fuse in the primary supply conductor.

28.5 **RELAYS AND CIRCUITRY PROTECTION**

28.5.1 All circuits supplied by the auxiliary transformers shall be protected by an earth leakage relay.

28.5.2 All circuits, regardless of source of supply shall be protected by suitably rated miniature circuit breakers. (MCB's)

28.5.3 Due to the susceptibility of protection relays to damage due to poor quality of supply as well as lightning surges, the tenderer must state what measures will be implemented to safeguard this equipment.

29.0 **CONDUCTORS, CABLES, AND SMALL WIRING**

29.1 The following electrical conductors shall be used in the construction of a substation:

♦ Primary (HT) flying busbar/jumper	160 mm^2 Al (stranding 19/3.35)
♦ Secondary (25kV) overhead conductors/jumpers	500 mm^2 Al(stranding 37/4.25)
♦ Earth mat	3x30 mm Cu strap (90 mm^2)
♦ Steelwork earth mat connections cast in concrete foundations	95 mm^2 Cu equivalent ERICO cadstrap earth tails
♦ Earth connections from isolator earth blade to earth mat	95 mm^2 Cu equivalent ERICO cadstrap earth tails
♦ Earth connections from all lightning arresters to earth mat	150 mm^2 Al stranded insulated cable
♦ Neutral return overhead conductor	500 mm^2 Al (stranding 37/4.25)
♦ Auxiliary transformer and VT neutral conductors	70 mm^2 stranded Cu unarmoured cable insulated for 3,3kV
♦ Auxiliary transformer positive conductor	50 mm^2 stranded annealed Cu
♦ Earthing harness	95 mm^2 stranded annealed insulated conductor

29.2 The 25kV busbar shall be Aluminium and shall have a continuous rating of 1500A. Busbars shall comply with BS 159.

29.3 Outdoor high voltage conductors shall be of all aluminium composition. ACSR conductors are not acceptable.

29.4 All low voltage cables shall be 600/1 000 Volt PVC insulated sheathed in terms of specification SABS 150.

29.5 Cables for indoor use only may be unarmoured. Cables for outdoor use shall be armoured, and suitable for laying direct in the ground.

29.6 Small wiring and termination's shall comply with BS 162. The current ratings for the various sizes of conductors shall not be exceeded.

29.7 All instrument and control wiring shall be a minimum size of 2,5mm^2 cross-section with stranded copper conductors. Wires connected to the current transformers shall have a minimum cross-section of 4mm^2 .

SECTION 3: - INSTALLATION OF EQUIPMENT

30.0 **SUBSTATION SITES**

Details of substation site sizes and positions (orientation to track) are shown on substation layout drawings listed in Appendix 1.

30.1 SITE PREPARATION

All substation sites will be cleared i.e. shrubs, bush, stumps and debris shall be completely removed from the site. Trees shall be uprooted and removed.

30.2 SITE LEVELS

30.2.1 The site level shall be raised 500mm above the natural ground level.

30.2.2 The final level of the earthworks on site shall be at a cross fall of not less than 2% parallel to the shortest rectangular dimension of the site. The fall must be in the same direction as the prevailing fall of the natural ground level parallel to the shortest rectangular dimension.

30.2.3 The site must be flat.

30.3 MATERIAL

30.3.1 The in situ material may be used for the bottom layer in a cut to fill operation if the material can be compacted as per compaction requirements. Should this not be the case the material may not be used.

30.3.2 Material of quality G5 must be used for earthworks.

30.4 COMPACTION

30.4.1 The material shall be deposited in layers, not exceeding 300mm prior to compaction. Material shall be compacted to 95% Mod. AASHTO at OMC.

30.4.2 All substation sites shall be inspected and signed off by the Technical Officer prior to any construction taking place.

30.4.3 Each substation site shall be fenced by a stock/boundary fence as well as by a security fence in accordance with the fence lines shown on the substation layout drawings listed in Appendix No. 1

30.4.4 The extent of kerbing to be installed at each substation site is shown on the substation layout drawings listed in Appendix No. 1.

30.4.5 The security fence and kerbing shall be installed in accordance with the drawing specified in Appendix 2 and shall not be installed prior to the installation of all steelwork and equipment and the making off of all overhead conductors. The technical Officer shall authorise the installation of the fencing and kerbing.

30.4.6 The stock/boundary fence shall be installed in accordance with Drawing No CCE Type 1-45. This installation shall occur simultaneously with the security fencing.

30.4.7 After completion of construction a suitable weedkiller to be approved by the Technical Officer shall be applied throughout the site within the boundaries of the small stock/boundary fence, in accordance with the manufacturers instructions. The successful tenderer shall exercise the greatest care to avoid contaminating private property.

30.4.8 After treatment with the weedkiller, a 100mm layer of 25mm crusher stone shall be laid over the whole area of the Spoornet yard (within the kerbing).

30.4.9 Access to the sites shall be by means of Spoornet maintenance roads. Should the tenderer feel that these roads are not adequate, a separate quotation for any work deemed necessary shall be submitted with the tender.

31.0 **FOUNDATIONS**

31.1 The successful tenderer shall be responsible for the design and installation of foundations for all the structures, equipment and buildings within the substation yard.

31.2 The successful tenderer shall carry out his own survey in regard to soil types and their load bearing capabilities.

31.3 Tenderers must ensure that provision (financial as well as time) for excavations in a range of soil types is allowed for in their tenders.

31.4 Equipment support foundations shall be finished off 200mm above the finished earth level of the yard. The design must be such as to prevent standing water.

31.5 All foundations edges shall be bevelled, and the surfaces must be float finished.

31.6 All support foundations shall be at the same level.

31.7 An earth mat conductor shall be cast in the concrete foundation for the connection of support steelwork to the earth mat. This shall be done in accordance with Drawing No. CEE-TEE-173 sht's 1-3.

31.8 This earth conductor shall be electrically connected to the foundation bolt group such that in the event of the visible earth connection being removed, a earth connection via the bolt group is maintained. This shall be done in accordance with Drawing No CEE-TEE-173 sht's 1-3.

31.9 A plastic pipe shall be cast into all concrete foundations for earth/control cabling to be taken up the structure and shall be done in accordance with Drawing No CEE-TEE-173 sht's 1-3.

31.10 If the foundation for the main traction transformer is larger than the transformer base plate, then a portion of the foundation the exact size of the base plate must be raised at least 50mm to prevent the possibility of standing water against the transformers base plate.

32.0 **CONCRETE**

32.1 The 28-day strength of all concrete used shall be a minimum of 20Mpa.

32.2 The successful tenderer shall arrange for sampling and testing of all concrete used, and shall submit full records to the Technical Officer. Spoornet reserves the right to undertake testing of concrete samples and the successful tenderer shall furnish test cubes if requested by the Technical Officer.

32.3 Hand mixed concrete is not acceptable, it must be mechanically mixed.

32.4 The addition of water to a concrete mix reduces the strength of that concrete very significantly and on no account shall water be added to a mix after test cubes have been taken.

32.5 There shall be a minimum of 100mm concrete cover for all steel reinforcing.

33.0 **INSTALLATION OF SUBSTATION EQUIPMENT**

33.1 The installation of the equipment required for the construction of the required substations will be carried out in accordance with the substation layout drawings listed in Appendix 1. These drawings will indicate the particular requirements for each substation.

33.3 All fasteners (nuts & bolts) shall be secured using flat as well as lock washers.

Requirements for the installation of substation equipment are as follows:

33.4 **PRIMARY ISOLATOR**

33.4.1 The primary supply conductors will be made off by the supply authority on a terminal structure which shall be supplied and installed by the successful tenderer. Tails and clamps for the connection of the primary supply to the primary isolator will be provided by the successful tenderer. These tails will probably be Wolf conductors, which must be confirmed by the Technical Officer.

33.4.2 The earth connection of the earthing blades shall be connected to the substation earth mat.

33.5 **MAIN TRANSFORMER**

33.5.1 The interface between the traction transformer plinth and the steel tank must be sealed using a outdoor UV resistant silicone sealer.

33.5.2 A 150mm diameter PVC pipe shall be cast into the transformer plinth to allow for the routing of control and protection cables. This pipe shall be installed based on the principles indicated on Drawing No. CEE-TEE-174 sht's 1-3. This pipe shall be positioned such that the cables enter the transformer control cable terminal box vertically.

33.5.3 The earth conductors connecting the transformer tank to the earth mat at two places shall be cast into the transformer plinth such that a minimum of the conductor is exposed, based on the principles indicated on Drawing No. CEE-TEE-174 sht's 1-3. This conductor must be cast into the plinth in such a manner as to prevent the conductor being damaged during the installation of the transformer.

33.5.4 The secondary transformer bushing that will be designated as the positive (25kV) bushing is the bushing on the left side of the transformer looking at the transformer from the secondary side.

33.5.5 The negative secondary bushing shall be connected to the substation earth mat via a lightning arrestor rated at 3,3kV. The lightning arrestor must be mounted on the transformer tank in close proximity to the negative bushing. The conductor to be used for this connection to the earth mat shall be similar to that specified for the earth connection of the primary isolator.

33.6 **VOLTAGE TRANSFORMER**

33.6.1 For secondary circuit breakers of the outdoor structure mounted type, the voltage transformers shall be mounted outdoors on the secondary switchgear gantry. (25kV gantry)

33.6.2 The live side of the primary winding shall be connected to the 25kV busbar.

33.6.3 The neutral side of the primary winding of each voltage transformer shall be connected to the overhead neutral return current conductor.

33.6.4 The secondary winding shall be connected to the appropriate circuits through MCB's.

33.7 **AUXILIARY TRANSFORMER**

33.7.1 The primary positive pole of the auxiliary transformer shall be connected on the traction transformer side of the secondary isolator and should a second auxiliary transformer connected to the 25kV supply be required, its primary positive pole shall be connected to the overhead track equipment on the load side of the track feeder switch **(**see Drawing No. CEE -TBB -109).

33.7.2 The auxiliary transformer connected to the main transformer side of the isolator shall be mounted on the 25kV gantry. It shall be mounted in such a manner as to allow space for the drop out fuse to be mounted and to function safely, above the auxiliary transformer.

33.7.3 The second 25kV auxiliary transformer (see schedule of requirements) shall be mounted on one leg of the overhead track equipment track switch structure. (see Drawing No. CEE-PFB-30 for typical mounting details)

33.7.4 The neutral of the primary winding of each 25kV Auxiliary transformer shall be connected to the overhead neutral return current conductor.

33.7.6 The secondary output of the auxiliary transformers shall be cabled to a distribution board in the substation building.

33.8 **SECONDARY ISOLATOR**

33.8.1 The secondary isolator shall be mounted on the 25kV gantry structure.

33.9 **SECONDARY CIRCUIT BREAKERS**

33.9.1 Secondary circuit breakers of the outdoor structure mounted type shall be mounted on the 25kV gantry structure.

33.9.2 The outdoor switchgear shall be mounted on suitably designed horizontal steel beams forming part of the 25kV gantry structure (see Drawing No's CEE-TDB-41 sht's 1 & 2)

33.9.3 The outdoor switchgear mounting arrangement shall allow for lateral and vertical adjustment to enable proper alignment of switchgear to take place.

33.9.4 The switchgear shall be mounted in such a manner as to allow an isolating gap of not less than 300mm between the circuit breaker terminals and the 25kV busbar should the jumper be removed.

33.10 **SECONDARY LIGHTNING ARRESTORS**

33.10.1 All secondary lightning arrestors shall be mounted on the 25kV gantry and shall be connected in the circuit in accordance with Drawing No. CEE-TBB-109.

33.10.2 The earth connection of all the secondary lightning arrestors shall be connected to the substation earth mat by means of the specified earthing conductor.

33.11 **25kV BUSBAR**

33.11.1 For secondary circuit breakers of the outdoor structure mounted type, the 25kV aluminium busbar shall be mounted between the two vertical legs of the 25kV gantry in such a manner as to allow for a isolating gap of 300mm between the busbar and the terminals of the secondary circuit breakers should the jumper be removed.

33.12 **BUSBAR COUPLER (DOUBLE UNIT TRACTION SUBSTATIONS)**

33.12.1 For secondary circuit breakers of the outdoor structure mounted type the busbar coupler shall be mounted on the 25kV gantry structure as shown on Drawing No. CEE-TDB-41 sht 2.

33.12.2 The installation of the busbar coupler shall be done in accordance with specification No. CEE.0040.83.

33.12.3 The jumpers used to connect the busbar coupler switch to the two busbars shall be rated at 1500A.

33.12 **SUBSTATION BUILDING**

33.12.1 The substation steel building shall be bolted to the foundation plinth and sealed to prevent the ingress of vermin.

33.12.2 The orientation of the building to the site will be shown on the substation layout drawings.

33.13 **EQUIPMENT INSTALLED IN THE SUBSTATION BUILDING**

33.13.1 The layout of the equipment installed within the building shall be in accordance with Drawing No. CEE-TEC-28.

33.13.2 All equipment installed within the substation building shall be attached to either the floor or the walls.

33.14 **CABLES**

33.14.1 Cable trenches shall have a minimum depth of 500mm measured from ground level. All trenches shall be backfilled and compacted in layers to the compaction of the surrounding yard.

33.14.2 The exact position and size of each cable in the yard shall be shown on the cable layout plan. These drawings shall be submitted for approval prior to installation.

33.14.3 Asbestos-cement cable pipes shall be installed beneath any roadway, where the crossing of a roadway by cables is required. These pipes shall be not less than 150mm in diameter and shall protrude at least 500mm on either side of the roadway. The pipes shall be graded 1:400 for water drainage.

33.14.4 All cables entering the control equipment building shall be block jointed (50mm of armouring to be removed) above the ground. The block jointing shall be done before the cables are installed into the control equipment building. The block joint shall be covered by a heatshrink sleeve.

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

33.14.6 Armoured cables terminating on outdoor equipment shall have their armouring connected to earthed metal by means of a suitable gland.

33.14.7 Cables and earthing conductors connected to equipment installed on steel support structures shall be supported on the steel structure vertically and horizontally by means of a cable tray. This cable tray shall be of the O-Line GS50 Gridspan Wire Mesh type or similar with the wire mesh having a diameter of 4mm and a hot dip galvanised finish.

33.14.8 The cable trays shall be attached to the support steel in accordance with Drawing No. CEE-TDC-10.

33.14.9 Should the cable termination box of an item of equipment overhang the vertical steel support structure, the cable can be installed directly from the cable trench to the terminal box provided a hot dip galvanised steel cable support is provided. This support must either be securely attached to the terminal box or be concreted into the ground. (see Drawing No. CEE-TDC-10)

33.14.10 Cable trays for indoor installation shall be galvanised type O-line PT38 or similar.

33.14.11 The cables shall be fixed to the cable trays using UV stabilised cable ties.

33.15 **INTERCONNECTION OF EQUIPMENT**

33.15.1 Conductors between separately mounted outdoor equipment shall incorporate a degree of flexibility to avoid any stressing of these connections due to foundation movement or conductor expansion/contraction and to facilitate alignment of equipment.

33.15.2 All connections to the overhead conductors shall be made using clamps that are specifically designed and manufactured to make that particular connection (ad hoc fabricated clamps are not acceptable).

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

33.15.4 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).

33.15.5 All copper connections to steel (galvanised) shall be tinned.

33.15.6 The overhead neutral return conductor shall be insulated using disc insulators for 3,3kV.

33.15.7 The overhead track feeder conductors shall be provided between the 25kV gantry and the overhead track equipment portal structure.

33.15.8 The overhead track feeder conductors complete with insulation and fitted with suitable bi-metallic clamps for the connection of two 160 mm^2 Cu conductors (provided by others), shall be supplied and made off on the track switch portal by the contractor. Others shall do the connection of these conductors to the track switches. This forms the substation / overhead track equipment contract boundary.

33.16 **FENCING AND KERBING**

33.16.1 The boundary/stock fence, security fence and concrete kerbing shall only be installed once all major items of equipment and steelwork have been delivered and installed and all overhead conductor stringing is complete.

33.16.2 The extent of Boundary/stock fencing, security fencing as well as kerbing for each substation site is shown on the substation layout drawings listed in Appendix No. 1.

33.16.3 The security fence required shall be in accordance with the drawing as specified in Appendix 2.

33.16.4 Kerbing shall be installed in accordance with Drawing No. CEE-TEA-1.

33.17 "RETURN" CURRENT AND SUBSTATION EARTHING

33.17.1 RETURN CURRENT

33.17.1.1 It is required that the return current from the traction system shall not return to the main transformer via the substation earth. Therefore the principles set out below and indicated on Drawing No.CEE-TBD-8 shall be adhered to and adapted to suit the particular equipment offered.

33.17.1.2 An overhead return conductor shall be provided between one terminal of the main transformer secondary winding (negative bushing) and the overhead track equipment switch structure, where it will be connected to the overhead track equipment's return circuit by others. This conductor shall be insulated for at least 3,3kV.

33.17.2 SUBSTATION EARTH

33.17.2.1 A main earth mat shall be installed in Spoornet's substation yard in accordance with Drawing No. CEE-TBD-8.

33.17.2.2 The earth mat shall be a trench earth system consisting of copper conductor with a cross sectional area of 90mm^2 buried in trenches at a depth of 700mm.

33.17.2.3 Should soil conditions be such that this depth can not practically be achieved, the reduced depth shall be approved by the Technical Officer. If the trench depth is below 600mm, precast concrete slabs shall be placed 100mm above the copper earth conductor in the trench and backfilled.

33.17.2.4 All earth mat joints shall be brazed or exothermically welded.

33.17.2.5 The earth mat connections to structural support steel as called for on drawing No. CEE-TBD-8 shall be made via the copper earth connection cast into the associated foundations. The earth mat shall be brazed to the tails protruding from the support foundations at a depth of 600mm.

33.17.2.6 The earth resistivity of the earth mat shall be less than 5 ohms.

33.17.2.7 A ring earth, not forming part of the floor, with a 90mm^2 copper cross-sectional area shall be provided in the substation building. This ring earth shall electrically connect all steel modules, which the building consists of.

33.17.2.8 The fences bordering the Spoornet substation yard shall be bonded to the substation main earth mat as shown on Drawing No. CEE-TBD-8.

33.17.2.9 Substation equipment shall be connected to the earth mat in accordance with the requirements shown on Drawing No. CEE-TBD-8. The following connections shall also be connected to earth mat:-

- The earth connection of all lightning arresters
- The earth connections of the earth blades on the high voltage isolator.
- A suitable terminal to allow for the connection of the secondary switchgear earthing harness's to the earth mat.

33.17.2.10 A mast air terminal lightning protection system, hazard class A3, with an earth electrode separate from the substation earth mat shall be provided and positioned in accordance with SABS 03-1985 to provide lightning protection for the complete traction substation installation.

33.17.3 EARTHING DEVICES

33.17.3.1 Any device provided for earthing of equipment shall comprise PVC covered 65 sq. mm Cu conductors, link stick clamps to fit 500 sq. mm Al. Conductors similar to that shown on Sketch No. 2 at one end, and a clamp for clamping to the earth mat terminal at the other.

33.17.3.2 The clamps for the connection of the overhead feeder to the load side of the secondary switchgear, shall be designed such that a suitable attachment for the earthing harness is provided.

33.17.3.3 Portable earth connections adequately designed for safety in application shall be supplied. All portable earth harnesses shall be approved by the Technical officer.

33.17.3.4 In a single unit substation a portable earthing harness shall be provided for connecting all secondary switchgear outdoor bushing terminals simultaneously to the substation main earth mat.

33.17.3.5 In double unit substations two portable earthing harnesses as per the previous clause shall be provided.

33.18 **NAMEPLATES AND LABELS**

33.18.1 A substation nameplate shall be provided. The names of the substations shall be as specified in Appendix No. 1. The nameplate shall be manufactured in accordance with Drawing No. CEE-TEA-2.

33.18.2 Danger warning notices as per Drawing CEE TA-196 shall be supplied and fitted to the substation building access door, on each half of the substation gate, one notice on the narrow side substation fence and two notices on the long side substation fence.

33.18.3 All nameplates and labels shall be in English.

33.18.4 Labels shall be attached by screws or rivets or by a method approved by the Technical Officer.

33.18.5 All labels shall be made of composite sandwich type plastic material of the following colour combinations :-

33.18.6 Identification labels : White lettering on black background. Letters must be of sufficient size to be clearly legible.

33.18.7 Danger labels : White lettering on red background. Letters must be of sufficient size to be clearly legible.

33.18.8 The following is a list of approved labels.

- On (I)
- Off (O)
- Open (Verb.)
- Close (Verb.)
- Closed
- Open
- Trip
- Local
- Remote
- Do not operate link under load
- Open and earthed

33.18.9 Each circuit breaker and circuit breaker control panel shall be provided with labels to indicate the breaker designation and telecontrol code. Spoornet (Technical Officer) will supply these designations and telecontrol codes

33.18.10 The proposed labelling scheme must be submitted to the Technical Officer for approval prior to the manufacture of the labels.

SECTION 4: - TESTING AND COMMISSIONING

34.0 **TYPE AND ROUTINE TESTING REQUIREMENTS**

34.1 Type and routine tests shall be conducted on the equipment to be supplied. These tests shall be carried out at the successful tenderers expense.

34.2 Test certificates in respect of type tests conducted on identical equipment may be accepted in lieu of type tests at the discretion of Spoornet.

34.3 Delivery of equipment shall not commence before acceptance of type test certificates has been obtained from the Technical Officer.

34.4 Primary circuit breakers shall be tested in accordance with BS 5311.

34.5 Secondary circuit breakers shall be tested in accordance with BS 5311.

34.6 Primary and secondary isolators and earthing switches shall be tested in accordance with IEC 129.

34.7 High voltage fuses for protection of auxiliary transformers shall be tested in accordance with BS 2692.

34.8 Voltage transformers shall be tested in accordance with BS 3941.

34.9 Auxiliary transformers shall be tested in accordance with SABS 780.

34.10 The transformer shall be tested in accordance with IEC 76, including a test with lightning impulse chopped on the tail.

34.11 Spoornet staff will conduct an out of tank inspection of the transformer prior to the transformer being tanked as well as witnessing all the routine manufacturers tests carried out at the works. The co-ordination of manufacturers testing shall be the responsibility of the successful tenderer.

34.12 Type test certificates of the transformer design offered shall be submitted with the tender. Should type test certificates not be available, the required tests shall be carried out, the cost of which must be included in the tender price quoted as a separate item.

34.13 Should the transformer offered not have a short circuit type test certificate available, a simulated computer model of this test may be submitted for Spoornet's approval, but should this model be unacceptable short circuit tests will be required and shall be conducted in accordance with IEC 76 Part 5 . An out of tank inspection shall be carried out after completion of the tests. The tests shall comprise two short circuits on each of the extreme and centre tappings. The short circuits on each tapping shall be of opposite asymmetry. Short circuit duration shall not be less than 0,5 seconds. Short circuit current shall not be less than that calculated for a fault on the secondary terminals of the transformer with rated voltage on the primary terminals from a supply of not less than 2 500MVA .

34.14 The successful tenderer shall test all concrete used for the construction of the works and the results submitted to the Technical Officer for approval.

34.15 The following equipment shall be inspected by Spoornet staff at the place of manufacture prior to delivery to the successful tenderers works or to site:

- All structural steelwork
- The substation building
- Battery tripping unit
- All control panels

35.0 **SITE TESTS AND COMMISSIONING**

The successful tenderer shall be responsible for carrying out on-site tests and commissioning of all equipment supplied and installed in terms of this specification and the contractual agreement.

35.1 **ON-SITE TESTS**

35.1.1 Functional on-site tests shall be conducted on all items of equipment and circuitry to prove the proper functioning and installation thereof.

35.1.2 The successful tenderer shall submit a detailed list of on-site tests for the approval of the Technical Officer at least six weeks before tests are due to commence at the first substation.

35.1.3 The successful tenderer shall arrange for the Technical Officer or his representative to be present to witness the on-site tests at each substation.

35.1.4 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 substation equipment will not be allowed to take place in a construction site environment.

35.1.5 On-site tests shall include the following ;

- Polarity tests on all VT's and CT's
- Ratio tests on all VT's and CT's
- Magnetising current of all CT's
- Secondary injection of all relays
- Trip testing, all relays must be checked for correct operation.
- The functionality of all electrical circuitry must be tested.
- A power frequency voltage test on all 25kV equipment at 57kV for one minute.
- A power frequency voltage test on all small wiring at 2kV for one minute.
- A millivolt-drop test on 25kV circuits with a current of not less than 200A.
- A proof of vacuum test on vacuum circuit breakers.
- Tests on primary circuit breakers and other primary equipment in accordance with manufacturer's instructions.

35.1.6 At the completion of the on-site tests the Technical Officer or his representative, shall either sign the test sheets (supplied by the successful tenderer) as having witnessed the satisfactory completion thereof, or hand to the successful tenderer a list of defects requiring rectification.

35.1.7 Upon rectification of defects the successful tenderer shall arrange for the Technical Officer or his representative to certify satisfactory completion of on-site tests for that particular substation.

35.1.8 Acceptance by the Technical Officer 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.

35.2 **COMMISSIONING OF EQUIPMENT**

35.2.1 Commissioning will include the energising of equipment from the primary isolator to the track feeder circuits. The successful tenderer must prove the satisfactory operation of all equipment under live conditions .

35.2.2 On completion of commissioning the successful tenderer will hand the substation over to the Technical Officer in terms of the relevant instructions.

35.2.3 Tenderers shall allow a period of at least three days per substation between satisfactory completion of on-site tests and commissioning of equipment.

35.2.4 During this period the Spoornet's Test staff will test the operation of all protective relays and circuits and set the protection relays at each substation.

35.2.5 The successful tenderer installation staff shall be present during the testing and setting of the protection to rectify any faults found.

35.2.6 On-site testing of the first substation must therefore commence ahead of the contract completion date, by a period not shorter than a total of three days per substation.

35.2.7 The commissioning of the protection equipment by Spoornet will in no way absolve the successful tenderer from any of his responsibilities during the guarantee period. It is the successful tenderers responsibility to satisfy himself 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.

35.2.8 The commissioning dates for the substations will be dependent on the availability of power supplies from the supply utility as well as Spoornet's electrification program and will be defined by the Technical Officer.

36.0 **DRAWINGS, INSTRUCTION MANUALS AND SPARES LISTS**

Drawings, instruction manuals and spare parts catalogues shall be supplied in accordance with Spoornet specification CEE.0224.94

36.1 **DRAWINGS**

36.1.1 All as built drawings shall be supplied in electronic format. (Microstation/Acad)

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

36.1.3 The following drawings are required for approval prior to construction and submission in as built form at the completion of the works:

- Electrical schematic diagrams
- Detailed electrical wiring diagrams
- Foundation design drawings (for all foundations)
- Structural support steelwork design drawings
- Site equipment layout plan showing equipment and conductor profiles.
- Earth mat layout plan showing position of buried conductors.
- Buried cable layout plan showing position of buried cables.
- Substation control equipment building plans.

36.1.4 A complete set (paper copies bound in book form) of the electrical schematic and detailed wiring diagrams shall be provided for each substation and shall be in the substation at the commissioning stage.

36.2 **INSTRUCTION MANUALS**

The tenderer shall supply three copies of an instruction/maintenance manual for each unique installation. (if a number of substations are of the same design only three copies of the manual will be required with the names of all the substations to which the manual applies to clearly indicated on the cover)

36.3 **SPARES LISTS**

36.3.1 The successful tenderer shall submit details of spares required in accordance with specification No. CEE.0224.94

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

36.3.3 Tenderers shall however include in their offers, separate quotes for the supply of certain major items of equipment as strategic spares. Individual prices shall be given for one of each of the following items:

- 20MVA traction transformer complete
- HT traction transformer bushing
- LT traction transformer bushing
- HT primary circuit breaker complete with operating mechanism
- 25kV secondary circuit breaker complete with operating mechanism
- 27,5kV/240V 16kVA auxiliary transformer
- 26,4kV/110V Voltage Transformer

37.0 **SPECIAL TOOLS AND/OR SERVICING AIDS**

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

37.2 The tenderer shall quote for the supply of SF6 gas filling equipment as well as a distance impedance relay test set.

37.3 Tenderers shall submit detailed offers for special tools and servicing aids including all specialised equipment required for the servicing and maintenance of SF6 and vacuum circuit breakers, distance impedance relay calibration and testing equipment.

38.0 **TRAINING**

The tenderer shall submit details with the tender of the training courses which will be conducted by the successful tenderer for the training of Spoornet maintenance staff in the operation and maintenance of the substation equipment with emphasis on the protection scheme. The courses shall include theoretical as well as practical tuition. The dates and venue of these training course shall be arranged with the Technical Officer.

39.0 **GUARANTEE AND DEFECTS**

39.1 The successful tenderer shall guarantee the satisfactory operation of the complete electrical installation supplied and erected by him and accept liability for makers defects which may appear in design, materials and workmanship.

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

- A period of 12 months commencing on the date of completion of the contract or the date the substation is handed over to Spoornet whichever is the later, or
- A period of 12 months commencing on the date of commissioning of the last substation, whichever is the later date.

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

39.4 If urgent repairs have to be carried out by Spoornet staff to maintain supply during the guarantee period the successful tenderer shall inspect such repairs to ensure that the guarantee period is not affected and should such repairs be covered by the guarantee, reimburse Spoornet the cost of material and labour.

APPENDIX 1

SUBSTATION SITES (NAMES AND LOCATIONS) AND DEGREE OF POLLUTION

SUBSTATION SITE NO.	SUBSTATION NAME	X-AXIS KM POSITION	LAYOUT PLAN DRAWING No.
1	ANTRA	2.543km	CEE-TEB-177

Degree of pollution - Specify the pollution level applicable to each site. Most sites will have the same degree of pollution (average polluted area), with traction substations at the coast or in industrial areas being defined as severely polluted areas.

The X-axis km position is the position on the track to which the X-axis indicated on the layout drawing for a traction substation site must be aligned to.

APPENDIX 2

SCHEDULE OF REQUIREMENTS FOR AC TRACTION SUBSTATIONS

1.0 The Number of substations required and their Primary voltage must be specified.

1.1 The specific requirements for each traction substation must be specified eg. (No. of breakers, what type of security fence is required, extent of security fencing and kerbing, any special design considerations etc.)

1.2 The following table must be completed quantifying the major items of equipment required at each traction substation.

P.I.	P.C.B.	M.T.	S.I.	I.F.	T.F.	B.C.	A.T.	V.T
1	1	1	1	1	2	0	2	1

NOTE 1:

P.I. Primary isolator.
P.C.B. Primary circuit breaker.
M.T. Main transformer.
S.I. Secondary isolator.
I.F. Incoming feeder.
T.F. Track feeder.
B.C. Bus coupler.
A.T. Auxiliary transformer.
V.T. Voltage transformer.

APPENDIX 3

SCHEDULE OF DRAWINGS SUPPLIED BY SPOORNET

DRAWING No.	TITLE
CEE-TCA-92	Key box 25kV AC traction substation
CEE-TDB-41 sht 1	Double unit switch gantry 25kV AC traction substation
CEE-TDB-41 sht 2	Single unit switch gantry 25kV AC traction substation
CEE-TDC-10	Cable tray details in yard 25kV AC traction substation
CEE-TDF-15 sht 1	Substation security fence detail 25kV AC traction substation
CEE-TDF-15 sht 2	Gate detail for security fence 25kV AC traction substation
CEE-TDF-16	Substation Palisade fencing detail 25kV AC traction substation
CCE-TYPE 1-45	Boundary / stock fencing
CEE-TEA-1	Kerbing for substation 25kV AC traction substation
CEE-TEA-2	Traction substation nameboard
CEE-TEB-177	Antra substation yard layout - 25kV AC traction substation
CEE-TEB-178	Intshamanzi substation yard layout - 25kV AC traction substation
CEE-TEB-179	Nseleni substation yard layout - 25kV AC traction substation
CEE-TEB-180	Ekupheleni substation yard layout - 25kV AC traction substation
CEE-TEE-173 sht 1	Pipe and earth details in small foundation 25kV AC traction substation
CEE-TEE-173 sht 2	Pipe and earth details in large foundation 25kV AC traction substation
CEE-TEE-173 sht 3	Pipe and earth details for transformer plinth 25kV AC traction substation
CEE-TEC-28	Substation building detail and layout 25kV AC traction substation
CEE-TBK-27	No volt coil for circuit breakers
CEE-TBB-109	Single line diagram and protection requirements 25kV AC traction substation
CEE-TBD-8	Earthing arrangement 25kV AC traction substation
CEE-TA-196	Sign warning, electric shock hazard 25kV AC traction substation
CEE-PFB-30	Typical mounting arrangement for Aux transformer on track structures
CCE-FG-263	Details of cables in Spoornet's formation

SKETCHES

The following sketches are part of this appendix and are referred to in the specification:

SKETCH No. 1	Structural steel support for CT's and LA's
SKETCH No. 2	Earth harness clamp

SPOORNET

A division of Transnet limited

TECHNICAL

RAILWAY ENGINEERING

SPECIFICATION CONTROL PAGE

HOT DIP GALVANISING AND PAINTING OF ELECTRIFICATION STEELWORK

Statement of authorisation:

There is no SABS specification available for similar material / equipment and as far as can be ascertained no other specification / standard suitably covers Spoornet requirements. The specification has been compiled in a manner, which shall favour / encourage local manufacture of material/equipment to a maximum degree.

Author:	Chief Engineering Technician Configuration management	Jan C van Tonder
Approved:	Senior Technologist Railway Engineering	HA Slier
Authorised:	Senior Engineer Railway Engineering	L O Borchard

Date: January 2002

This page is for control purposes only and shall not be issued with the specification.

SPOORNET

A division of Transnet limited

TECHNICAL

RAILWAY ENGINEERING

SPECIFICATION

HOT DIP GALVANISING AND PAINTING OF ELECTRIFICATION STEELWORK

Circulation restricted to:

Technical

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1.0 SCOPE

1.1 This specification covers the hot dipped galvanising and painting of electrification steelwork.

1.2 The extent of work includes galvanising and painting of steelwork consisting of universal column masts with welded on bases up to 14 m in length and small part steelwork consisting of channel, angle and flat iron fittings, welded assemblies and tubular cantilevers.

2.0 REFERENCES

2.1 The following publications (latest edition) are referred to herein:

SABS 763: Hot Dipped Galvanising.

SABS 1091: National Colour Standards for Paint.

3.0 METHOD OF TENDERING

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

3.2 The Schedule of Requirements, Quantities and Prices, Appendix 1 to this specification shall be fully completed by Tenderers. Failure to submit a fully completed sheet may preclude a tender from further consideration.

4.0 APPENDICES

The following appendices form an integral part of this specification:

Appendix 1: Schedule of Requirements, Quantities and Prices.

5.0 GALVANISING OF STEELWORK

5.1 The steelwork must be cleaned and hot dip galvanised to SABS 763 except for the following:

5.1.1 No ammonium chloride salts shall be used on withdrawal from the molten zinc.

5.2 After galvanising no passivation must take place. Quenching may be done with clean water. No sodium dicromate must be used.

5.3 All surface contamination of zinc oxide (zinc ash) must be removed by means of brushing.

6.0 PRIMER COATING

6.1 The hot dip galvanising shall be followed as soon, as is practical by the painting procedures as specified hereunder:

6.1.1 Prior to painting, all steelwork shall be cleaned with a solvent cleaner and washed down with clean water to remove all traces of solvent. The solvent cleaner used must be compatible with zinc (similar to Galv Clean).

6.1.2 The primer coating, a two-component polyamide cured epoxy primer e.g.: PLASCOGUARD GEHOPPENS PRIMER or equivalent shall be applied to a dry film thickness of 75 microns. Application shall be in accordance with the manufacturers

instructions.

6.1.3 The primer coating shall be allowed to cure for a minimum period of 48 hours before handling to facilitate coating of the rest of the surfaces as well as the application of the intermediate coat.

6.1.4 A coat of a two-component high-build micaceous iron oxide pigmented polyamide cured re-coatable epoxy e.g.: SIGMACOVER CM MIOCOAT or equivalent shall be applied to a wet film thickness of 75-85 microns. Application shall be in accordance with manufacturers instructions.

6.1.5 A further 48 hours period must be allowed for curing of the primer coatings before handling the steelwork for transportation purposes.

6.2 All care must be exercised during handling to prevent damage of the painted surfaces.

6.3 Loading of steelwork must be done in such a way to limit damage of surfaces to a minimum during transit.

6.4 Only non-metallic slings should be used, preferably nylon or cotton material.

6.5 Spoornet reserves the right to inspect the premises where this work is carried out at any time during the duration of galvanising and primer painting.

6.6 Spoornet shall inspect all steelwork at the Tenderers premises before dispatch of any such steelwork.

7.0 TOP COATING

7.1 The topcoat shall be applied directly after erection of the steelwork in accordance with procedures hereunder:

7.1.1 Damage of the primed surfaces shall be repaired, after erection, by the application of one or more coats of a two component high build micaceous iron oxide pigmented polyamide cured re-coatable epoxy coating e.g.: SIGMACOVER CM MIOCOAT or equivalent until the original film thickness is obtained.

7.1.2 A topcoat of a two-component aliphatic isocyanate cured acrylic finish e.g.: SIGMADUR GLOSS or equivalent shall be applied according to the paint manufacturers instructions to a minimum dry film thickness of 50 microns. The topcoat shall be determined by whether steelwork is for Spoornet or the South African Rail Commuter Corporation.

7.1.2.1 For Spoornet the colour shall be French Grey (SABS 1091: Code H30).

7.1.2.2 For the South African Rail Commuter Corporation the colour shall be Medium Sea Grey (SABS 1091: Code G24).

8.0 QUALITY

8.1 The tenderer shall submit a copy of a Quality Plan to be implemented during the process. The Quality Plan shall include stages for preparation of metalwork prior to galvanising, for the galvanising and for the painting process.

8.2 The Quality Plan shall furthermore make provision for the customer's requirements for inspection and acceptance points and witnessing of tests to establish whether requirements of SABS 763 in so far as preparation of steelwork prior to galvanising, galvanising and painting requirements as per this specification are complied with.

9.0 SUBSTITUTION

7.1 This instruction replaces Specification CEE.0183.95.

7.2 All clauses have been revised to suit latest requirements e.g.: removal of the Complies/Does not complies reference.

END

TENDERER'S SIGNATURE: _____

DATE: _____

FOR SPOORNET: _____

GRADE: _____

Appendix 1

SCHEDULE OF REQUIREMENTS, QUANTITIES AND PRICES

1.0

END

FOR SPOORNET: _____

GRADE: _____

SPOORNET

A division of Transnet limited

TECHNICAL

CONFIGURATION MANAGEMENT

SPECIFICATION CONTROL PAGE

DRAWINGS, CATALOGUES, INSTRUCTION MANUALS AND SPARES LISTS FOR ELECTRICAL EQUIPMENT SUPPLIED UNDER CONTRACT

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Author:	Chief Engineering Technician *Documentation management*	J C van Tonder
Approved:	Senior Engineer Railway Engineering	L O Borchard
Authorised:	Senior Technologist Configuration Management	J H Hancock

Date: January 2002

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SPOORNET

A division of Transnet limited

TECHNICAL

CONFIGURATION MANAGEMENT

SPECIFICATION

DRAWINGS, CATALOGUES, INSTRUCTION MANUALS AND SPARES LISTS FOR ELECTRICAL EQUIPMENT SUPPLIED UNDER CONTRACT

Circulation restricted to:

Technical

INDEX

1.0 SCOPE

This specification covers Spoornet's requirements for drawings, catalogues, and instruction manuals and spares lists of electrical equipment supplied under contract.

2.0 DEFINITIONS

2.1 "Design drawings for approval" defines those drawings, which have to be submitted to Spoornet for approval prior to manufacture of equipment.

2.2 "Installation drawings" defines those drawings, which are required for the installation of the equipment.

2.3 "As Built drawings" defines those drawings, which reflect all the various approved designs, layouts, etc., of the actual final accepted state of the equipment.

3.0 STANDARDS AND SPECIFICATIONS

3.1 The following standards and specifications are referred to:

CEE.0012: Method of Tendering

SABS 0111: Engineering Drawings.

BS 308: Engineering Drawing Practice.

NRS 002: Graphical Symbols for Electrical Diagrams.

IEC 617: Graphical Symbols for Diagrams.

ASHRAE: American Society of Heating Refrigeration Air-conditioning Engineers Standard.

3.1.1 The following Spoornet standard (Electrical) symbol drawings are listed for reference:

CEE-PA-19: Symbols for Electrical Installations.

CEE-PA-42: Symbols for Distribution and Transmission Layout.

CEE-PA-101: Symbols for Air-conditioning installations.

CEE-TA-62: Standard Electrification Symbols.

3.2 Tenderers and contractors shall ensure that they work to the latest issues and amendments of the above standards and specifications.

4.0 APPENDIX

The following appendix forms an integral part of this specification:

Appendix 1:SCHEDULE OF REQUIREMENTS

This appendix calls for specific requirements applicable to the contract.

5.0 METHOD OF TENDERING

5.1 Tendering shall be in accordance with Spoornet (Electrical) specification CEE.0012.

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

5.3 The Schedule of Requirements, Quantities and Prices, Appendix 1 to this specification shall be fully completed by Tenderers. Failure to submit a fully completed sheet may preclude a tender from further consideration.

6.0 LANGUAGE AND UNITS OF MEASURE

Drawings and documents shall be prepared in English and the ISO unit of measure. Other offers will be considered on merit.

7.0 DRAWINGS

7.1 Drawings shall be generated in either Microstation or any CAD format, which can be read by Microstation, but offers on other media will be considered on merit.

7.2 Drawings shall be prepared in such a manner that they fully comply with the requirements of SABS 0111 and/or BS 308.

7.3 Symbols, with their explanations used on the drawings but not covered by the NRS 002, IEC 617, ASHRAE or Spoornet's symbol drawings shall be furnished i.e. then included on the drawing or supplied on a separate symbol list which is to be cross referenced to the drawing.

7.4 Where the publications referred to in clause 3.1 are at variance, the practice detailed in SABS 0111 shall take preference.

7.5 Drawings shall be prepared for ISO; "A" series size sheets and shall not be greater than A1 size except as detailed below.

7.5.1 Where under exceptional circumstances the nature of the work is such that a size A1 is impractical, then the AO size may be used.

7.5.2 Long drawings, where necessary for wiring/circuit diagrams, cable run diagrams, track layouts, etc., shall be prepared with widths equal to the widths of the "A" series sheets as required, but preferably not exceeding the length of an A0 sheet.

7.6 All interrelated drawings shall be clearly and adequately cross-referenced.

7.7 The Contractor hereby grants to Transnet a non-exclusive licence, in accordance with the provisions of section 22 of the Copyright Act, 1978;

7.7.1 to copy any plan, diagram, drawing, specification, bill of quantities, design calculation or other similar document made by the Contractor, other than under the direction or control of Transnet, in connection with the extent of work;

7.7.2 to make free and unrestricted use thereof for its own purposes;

7.7.3 to provide copies thereof to consultants to Transnet to be used by them for the purpose of such consultations and consulting services and-

7.7.4 to provide other parties with copies thereof for the purpose of tenders invited by Transnet.

7.7.5 Such non-exclusive licence shall apply *mutatis mutandis* to any plan, diagram, drawing, specification, bill and/or schedule of quantities, design calculation or other similar document made, other than under the direction or control of Transnet, by any principal or sub-contractor of the Contractor. The provisions of this clause shall not apply to documents made, in the case of plant or equipment to be supplied, for the manufacturing process of such equipment, but only to the equipment supplied itself.

7.7.6 Transnet shall make no separate or extra payment in respect of any non-exclusive licence granted in terms hereof.

8.0 INFORMATION REQUIRED ON DRAWINGS

8.1 A title block shall be provided in the lower right hand corner of each drawing, indicating:

8.1.1 Descriptive title.

8.1.2 Contractor's drawing number.

8.1.3 Space for Spoornet's drawing number (as requested in clause 7.7).

8.1.4 Place of installation.

8.1.5 Contract / Order number.

8.1.6 Contractor's name.

8.1.7 Signature or name of approving officer (as requested in clause 8.0).

8.1.8 Approval date.

8.1.9 Issue number.

8.1.10 Projection symbol for multi-view drawings, if required.

8.2 Successful Tenderers can obtain a copy of Spoornet's standard title block (Microstation or DXF formats) free of charge by contacting the Documentation Management section.

8.3 On wiring and circuit diagrams, the following shall be specified:

8.3.1 Cable and wire sizes.

8.3.2 Values of resistance.

8.3.3 Breaking capacity of switches.

8.3.4 Ratings of equipment.

8.4 On each assembly or sub-assembly drawing, the following shall be given:

8.4.1 Description of item.

8.4.2 Quantity required for assembly depicted.

8.4.3 Material manufactured from.

8.4.4 The classification of the material according to the relevant SABS specification or other specifications referred to herein.

8.4.5 The class or process of finish and/or coating.

8.4.6 Where special parts are specified, the name of the manufacturer, the size, capacity and the name or catalogue number of each part shall be furnished.

8.4.7 The mass of finished item depicted on the drawing.

8.4.8 Dimensions from a proper reference surface.

8.4.9 Dimension tolerances.

8.5 *On electrification drawings, the following shall be specified:*

8.5.1 Kilometre distances.

8.5.1.1 Kilometre distances of all new and existing masts measured from the preceding kilometre post.

8.5.2 Civil

8.5.2.1 The following civil information shall be shown:

8.5.2.1.1 Bridges.

8.5.2.1.2 Tunnels.

8.5.2.1.3 Pipes.

8.5.2.1.4 *Culverts.*

8.5.2.1.5 Subways.

8.5.2.1.6 Manholes.

8.5.2.1.7 Off track platforms.

8.5.2.1.8 Water-furrows along track.

8.5.2.1.9 Service roads that may influence electrification.

8.5.2.1.10 Level crossings.

8.5.2.1.11 All banks and cuttings.

8.5.2.1.12 Retaining walls.

8.5.2.1.13 Gradient markers and gradients.

8.5.2.1.14 Boundary fences (where relevant).

8.5.2.1.15 The beginning and ending of transition and circular curves and the radius.

8.5.2.3 On all station plans the beginning and ending of the platforms to be indicated, as well as all buildings and structures on the platform which may effect electrification. All secondary platforms/structures/obstacles, which may effect electrification, must also be shown.

8.5.2.4 All points with stock rail joints, intersection of centre lines and all ends of point positions to be shown, as well as the type of point, e.g. 1:9 LH (left hand.

8.5.3 Electrical

8.5.3.1 The following electrical information shall be shown:

8.5.3.1.1 New and existing masts and structures with appropriate sizes.

8.5.3.1.2 Span lengths.

8.5.3.1.3 Tension lengths.

8.5.3.1.4 Mast to track centres.

8.5.3.1.5 Tension type (spring or weight).

8.5.3.1.6 Transmission lines, Transnet and Eskom (Showing crossing heights above rail level).

8.5.3.1.7 Telkom lines.

8.5.3.1.8 Height gauges.

8.5.3.1.9 Power and Lighting kiosks.

8.5.3.1.10 Electrical cables nearer than 3,2m from track centre, as well as cables crossing the track.

8.5.3.2 Wire profiles showing clearances/wire heights for all transmission and telecommunication lines that cross the tracks shall be shown on the drawing at the point of crossing, in either tabular or graphic format.

8.5.3.3 Wire profile for all bridges and tunnels shall be shown on separate drawings.

8.5.3.4 Important information that shall be noted are:

8.5.3.4.1 Basic span.

8.5.3.4.2 Ruling contact wire height.

8.5.3.4.3 Reference to bonding drawings.

8.5.3.4.4 Wire sizes.

8.5.3.4.5 Types of structures and foundations.

8.5.3.4.6 Tables for traction and transmission line (Showing wire heights).

8.5.3.4.7 Dropper chart.

8.5.3.4.8 Overlaps.

8.5.3.4.9 Jumpers.

8.5.3.4.10 Staggering.

8.5.3.4.11 References to switching diagram drawings.

8.5.3.4.12 Any other relevant information.

8.5.4 Signal.

8.5.4.1 The following signal information shall be shown:

8.5.4.1.1 Signal gantries (showing direction of aim).

8.5.4.1.2 Independent signals (showing direction of aim).

8.5.4.1.3 Signal kiosks.

8.5.4.1.4 Telephones.

8.5.4.1.5 Signal relay rooms.

8.5.4.1.6 Radio repeater rooms.

8.5.4.1.7 Signal cables nearer than 3,2m from track centre, as well as cables crossing the track.

8.5.5 Electrification information must be clearly indicated on drawings (see also drg no CEE-TA-62 for Standard Electrification Symbols).

8.7 The successful tenderer shall obtain Spoornet's drawing numbers from the Documentation Management section of Spoornet well in advance in writing, wherein details of all relevant drawings, i.e. titles and makers numbers are quoted. Against this information Spoornet will allocate its own numbers for inclusion by the Contractor on the original drawings.

9.0 CERTIFICATION OF DRAWINGS

The contractor against a date to certify that the drawing has been checked and is correct in all respects shall approve each drawing. This also includes changes.

10.0 CHANGES TO DRAWINGS

Any drawing returned to the Contractor for changes shall be re-submitted to Spoornet within 21 days with the appropriate changes endorsed thereon.

11.0 SUBMISSION OF TENDER DRAWINGS

The Tenderer shall submit drawings of all major items of equipment with the tender. The drawings shall be sufficiently detailed (e.g. safety factors) to enable suitability of the design to be judged and to enable Spoornet to prepare a reasonably accurate estimate of the cost of maintenance.

12.0 DRAWINGS TO BE SUPPLIED BY SUCCESSFUL TENDERER

12.1 Two prints of each design drawing for approval to be submitted prior to commencement of work or manufacture of any equipment to Spoornet. This includes drawings of general layouts, cable routes, schematic diagrams, foundations, equipment etc.

12.2 Two prints of each installation and/or erection drawing to be submitted to Spoornet. This includes drawings of modular steel buildings, structures etc. and shall be delivered at the same time the delivery of the equipment commences.

12.3 The successful tenderer shall supply one complete set of approved (signed) "As Built" working drawings as well as the electronic files thereof. Drawings shall be fully dimensioned, fully detailed, clear and neat. The set shall comprise all electrical and mechanical drawings considered necessary by Spoornet and shall include drawings of all renewable parts or items. "As Built" drawings of all enclosures, structures and foundations shall also be supplied.

12.4 All relevant "As Built" drawings required shall be delivered to Spoornet within 90 days of completion of the installation and delivery of equipment.

12.5 Until all relevant drawings called for in the contract are delivered, the contract will be considered incomplete.

13.0 CATALOGUES

13.1 Tenderers shall submit a separate quotation for the supply of the itemised part catalogues when specified in the Schedule of Requirements. The size shall be A4 (297 mm x 210 mm). Consideration shall be given on merit of the supply of these catalogues electronically (PDF format).

13.2 The information contained in the catalogues shall be classified into convenient sectors and be indexed. Thumb tabs shall be provided for quick reference to sections. All apparatus shall be illustrated by means of photographs or detailed sketches on which both the parts and the catalogue numbers of the parts are clearly shown. Catalogues shall have exploded views of components for clarity where needed.

13.3 The following information shall be given in tabular form:

13.3.1 Designation of apparatus or item of equipment.

13.3.2 Description of part including information such as dimensions, sizes, resistance values, stranding, material, current ratings, etc.

13.3.3 Catalogue number.

13.3.4 Manufacturer's name.

13.3.5 "As Built" drawing and item number where applicable.

13.3.6 Quantity of parts required for each piece of apparatus.

13.3.7 Illustrating photographs or sketch number.

13.3.8 Nato registration where applicable.

13.4 In a suitable section of the catalogue the following information shall be given:

13.4.1 Index to "As Built" Drawings.

13.4.1.1 "As Built" drawing number.

13.4.1.2 Heading.

13.4.1.3 Parts shown on drawing.

13.4.2 Index to catalogue numbers.

13.4.2.1 Catalogue numbers in numerical order.

13.4.2.2 Catalogue volume number, where applicable.

13.4.2.3 Section in which part is listed.

13.4.2.4 Page number.

13.4.3 Special tools.

13.4.3.1 Designation and description of special tools.

13.4.3.2 Catalogue number.

13.5 Each volume shall be neatly bound in hard serviceable cover on which the contract numbers volume number and titles are printed. All the information in the catalogues shall be given in a clear legible manner. The catalogues shall include all items of equipment to be supplied by the successful tenderer.

13.6 *Catalogues shall be delivered before date of completion of the contract.*

14.0 INSTRUCTION MANUALS

14.1 Tenderers shall submit a separate quotation for the supply of the number of copies of instruction manuals specified in the Schedule of Requirements. The size shall be A4 (297 mm x 210 mm). Consideration shall be given on merit of the supply of these catalogues electronically (PDF format).

14.2 The successful tenderer shall submit draft instruction manuals for approval prior to final printing/compiling and delivery.

14.3 The approved instruction manuals shall be delivered before commissioning the equipment. If this cannot be met, the successful tenderer shall furnish at least three copies of preliminary instruction manuals, suitable for the use of maintenance staff, until the final instruction manuals are to hand (which shall be before the date of completion of the contract).

14.4 The construction, method of operation and purpose of all items of equipment shall be fully explained by means of descriptions and photographs, sketches, drawings or circuit diagrams showing all details.

14.5 The information contained in the instruction manuals shall be classified into convenient sections and indexed. Where multiple models are produced each model shall be described in a separate section in such a manner that models not applicable can be omitted. Where possible the sections shall be subdivided as follows:

14.5.1 Installation and commissioning.

14.5.2 General description and method of operation.

14.5.3 Maintenance and inspection.

14.5.4 Overhaul and repair of equipment.

14.5.5 Technical and maintenance data.

14.5.6 Test procedure flow charts.

14.5.7 Fault finding and trouble shooting.

14.6 The method of calibrating, setting or adjusting all equipment requiring such attention shall be described and where necessary illustrated. The necessary data shall be given in each case to enable the equipment to be checked by measurement if required.

14.7 Full step-by-step instructions regarding the servicing and repair of the equipment shall be given together with all the necessary data such as dismantling and assembling procedures, working clearances, tolerances, limits, fits, maximum permissible wear, recommended lubricants, use of special tools, insulation and winding data, spring pressures and tensions, brush data, fuse data, etc. Recommended servicing/rework/replacement of parts frequencies shall also be included in the maintenance and inspection section of the instruction manual.

14.8 Any delay in delivery of the complete supply of satisfactory instruction manuals/preliminary manuals as provided for in this clause, will subject the Contractors to a deduction from the contract sum, of a penalty as defined in the tender, counting from the specified delivery time until such time as the said manuals are delivered.

15.0 COMBINED DOCUMENTS

If desired the catalogues and instruction manuals specified in clauses 12.O and 13.O may be combined into single volumes. Tenderers shall state whether or not it is their intention to do so. In this case the delivery shall be as specified in clause 13.3, alternatively the conditions described in clause 13.8 applies.

16.0 SPARES LIST

16.1 To enable Spoornet to catalogue and timeously acquire all spares required, the following information shall be submitted before commissioning of equipment:

16.1.1 An itemised schedule of the spares (with reference to alternatives) which are recommended for normal maintenance purposes.

16.1.2 The quantity recommended to be held against each item on the spares list and where sets are supplied, the types and quantity per type to make up a set.

16.1.3 A full and complete ordering description and number of each individual spare with drawing number if relevant.

16.1.4 Where the ordering description and number differs from that of the original manufacturer's catalogue, description and number, the original manufacturer's name, description, type and ordering number shall be listed as well as all other relevant data available.

16.1.5 The national stock number - Nato - number of each spare where the particular spare was imported from a Nato country and where a national stock number was allocated.

16.2 Initially the spares list containing the above information will suffice, but this list shall not in any way replace or supersede the spare parts catalogue mentioned in clause 12.O.

17.0 PACKING OF DRAWINGS, CATALOGUES, INSTRUCTION MANUALS AND SPARES LISTS

All items shall be packed in such a way that they are received in good condition.

18.0 SUBSTITUTION

This specification replaces specification CEE.0224.94

TENDERER'S SIGNATURE: _____

DATE: _____

FOR SPOORNET:_____

GRADE: _____

END

SCHEDULE OF REQUIREMENTS

FOR SPOORNET:_____

GRADE: _____

END

SPOORNET
(INFRASTRUCTURE)(ELECTRICAL)

SPECIFICATION No. CEE.0229.95

DRY-OUT AND REGENERATION OF INSULATING OIL AND RECLAIMING AND DE-SLUDGING OF TRANSFORMERS

This specification covers Spoornet's requirements for in situ dry-out and de-sludging of power transformers and reclaiming insulating oil by means of regeneration

INDEX

1.0 SCOPE

This specification covers Spoornet's requirements for the dry-out and de-sludging of power transformers and reclaiming of insulating oil by means of regeneration.

2.0 REFERENCE AND STANDARDS

The following publication is referred to herein.

South African Bureau of Standards

SABS 555 : Mineral Insulating Oil for Transformers and Switch gear.

3.0 METHOD OF TENDERING

3.1 Tendering shall be in accordance with Spoornet (Infrastructure) (Electrical) specification CEE.0012.

Complies/Does not comply

3.2 Tendering prices shall be based on cost of the process that will achieve the results required as per clause 9.0 for each individual transformer described in Appendix 1,2 & 3.

Complies/Does not comply

3.3 Tenderer's shall quote separately for the replacement of lost oil if required, (per litre).

Complies/Does not comply

3.4 Spoornet reserves the right to inspect the Tenderer's facilities prior to awarding the contract in order to ensure that suitable equipment is available for the type of operation.

Complies/Does not comply

4.0 APPENDICES

The following appendices form an integral part of this specification:

Appendix 1: Schedule of transformers to be regenerated.

Appendix 2: Schedule of transformers to be de-sludged.

Appendix 3: Schedule of transformers to be dried-out.

Appendix 4: Moisture content of oil leaving transformer at which dry-out process must be terminated for various transformers temperatures.

5.0 TRANSFORMER DRY-OUT (DE-ENERGISED)

5.1 Note: Any moisture present in the transformer will be partly in the oil and partly in the layers of solid insulation. Normally more than 95 percent of moisture in the transformer is trapped in the insulation and less than 5 percent in the oil. Removal of moisture from the solid insulation in situ is a slow process due to the slow rate of diffusion of moisture between insulation and oil. No quick dry-out processes (eg 48 hours) will thus be accepted, as this will dry-out the oil only and not the solid insulation.

5.2 The dry-out plant shall include a vacuum type drier, or alternative dry-out method with suitable filter (see clause 6.2.1) to remove the solid particles and a suitable pump (see clause 6.2.2).

Complies/Does not comply

5.2.1 The hoses between the dry-out plant and the transformer shall have a built-in earth conductor to avoid static electricity to be charged to a high potential. The filter and tanks in the plant shall also be connected to earth.

Complies/Does not comply

5.2.2 The transformer tank shall not be subjected to a vacuum in excess of the maximum possible indication on the transformer name plate.

Complies/Does not comply

5.2.3 The oil temperature inside the transformer tank shall not exceed 90 degrees Celsius while the dry-out process is in progress.

Complies/Does not comply

5.3 The silica gel crystals in the transformer breather shall be replaced at the start of the dry-out process and the colour change shall be monitored during the process. New crystals shall be provided when more than 50 percent of the crystals are coloured pink.

Complies/Does not comply

5.4 ON LOAD DRY-OUT

5.4.1 When using an on load dry-out plant the Contractor shall work in close conjunction with the Regional Engineer Electrical staff, who will lay down the requirements for safe operation of the plant.

Complies/Does not comply

6.0 REGENERATION OF OIL (Purification)

6.1 In order to remove acidic and colloidal contaminants an activated clay or Fuller's earth process shall be used to achieve the results required as per clause 9.0.

Complies/Does not comply

6.1.1 The purification plant shall include provision for heating, automatic vacuum degasser, and shall be able to draw a vacuum in the transformer as well as circulate the oil in the transformer.

Complies/Does not comply

6.2 In the event of reclaiming of oil only being required, the complete volume of oil in the transformer may be replaced with new or factory regenerated oil as alternative to clause 6.1. When pumping oil into electrical equipment, the following precautionary measures shall be taken:

6.2.1 A paper filter (0,5 micron) shall always be installed between the pump and the equipment.

Complies/Does not comply

6.2.2 Pumps shall not have metal-to-metal friction which can release conductive metal particles into the oil.

Complies/Does not comply

6.2.3 The Contractor shall ensure that no air is trapped in the transformer while new oil is being added to the transformer. The tenderer shall indicate what method will be used to prevent air being trapped.

Complies/Does not comply

7.0 DE-SLUDGING OF TRANSFORMERS

7.1 The transformer shall be de-sludged in situ, completely filled with oil in accordance with the following process:-

Complies/Does not comply

7.1.1 The oil shall be heated and maintained at a temperature of approximately 90 degrees Celsius in the transformer, where the sludge in the transformer will go from a solid to a solution, re-entering the oil. A temperature of approximately 80 degrees Celsius should be reached in the core of the transformer and shall then be subjected to multiple passes of hot oil, for sufficient time to dissolve the sludge inside the transformer. The dissolved sludge is to be removed from the oil by passing the oil through an activated clay or Fuller's earth medium.

Complies/Does not comply

7.2 If required, and in agreement with Spoornet, the transformer may be kept on load to minimise the amount of external energy to obtain the laid down temperature of approximately 80 degrees Celsius in the core.

8.0 REPLACEMENT OF LOST OIL

On completion of the process the oil level in the conservator shall be at the original level prior to the commencement of the dry-out, reclaiming or the de-sludging processes.

Complies/Does not comply

9.0 TESTS ON OIL

9.1 The oil shall be tested by Spoornet immediately after completion of the process to confirm compliance with the requirements of SABS 555 for both reclaiming and de-sludging. The requirements for dielectric strength shall be 65kV.

Comply/Does not comply

9.2 During the filtration dry-out process the oil shall be tested by the contractor periodically and the process shall be stopped if the moisture content in the oil leaving the transformer core is in accordance with the moisture content values as stipulated in appendix 4.

Complies/Does not comply

9.2.1 Tests shall be carried out 2 weeks after termination of the dry-out process to ensure that the moisture content in the oil is still within the permissible limits (see Appendix 4).

Complies/Does not comply

10.0 PRECAUTIONARY MEASURES

10.1 If reclamation is done on the transformer oil in the main tank with positive head pressure, a non-return check valve shall be installed between the transformer and the outlet hose from the filtration plant, in order to prevent excessive spilling of oil in the event of failure of the outlet hose.

Complies/Does not comply

10.2 An automatic isolating valve must be coupled to the transformer valve on the inlet side of the plant which will be closed automatically, in the event of a plant malfunction or when the oil level in the tank drops due to an inlet hose failure.

Complies/Does not comply

10.2.1 The following protection alarms must be provided on the dry-out plant if not attended full time:

10.2.1.1 Thermal motor failure.

Complies/ Does not comply

10.2.1.2 Pressure loss by using pressure switches.

Complies/ Does not comply

10.2.1.3 The plant must have a leak proof base, with an automatic detection device to shut off the plant.

Complies/ Does not comply

10.2.2 The above alarms can be coupled via the Spoornet tellecontrol to give an alarm indication to Electrical Control.

10.2.3 Precautionary measures shall be taken to prevent environmental pollution.

Complies/Does not comply

11.0 INSPECTION

11.1 Spoornet reserves the right to be present during any stage of the process and must be timeously advised of dates of recommencement of any process.

Complies/Does not comply

12.0 GUARANTEE

12.1 The Contractor shall guarantee the transformer oil for a period of 12 months after the reclaiming and de-sludging process has been completed to comply with the requirements of clause 9.1, except for dielectric strength and water content.

Complies/Does not comply

12.2 The moisture content of the transformer shall be guaranteed to comply with the requirements of clause 9.2.1.

Complies/ Does not comply

12.3 Should the oil fail the tests as stated in clause 9.0, the Contractor shall repeat the process at his own cost.

Complies/Does not comply

TENDERER'S SIGNATURE .....

DATE .....

CHIEF ENGINEER (INFRASTRUCTURE)
(ELECTRICAL)

SCHEDULE OF TRANSFORMERS TO BE **REGENERATED**

Identification / Location: _____

1. Type of transformer: _____

2. Volume of oil inside transformer: _____ litres.

Oil Properties	Before	After	After 12 Months
3. Acid content (mg KOH/g oil):			
4. Moisture content (ppm):			
5. Dielectric strength (kV):			
6. Sludge content (< 0,02%):			

Identification / Location: _____

1. Type of transformer: _____

2. Volume of oil inside transformer: _____ litres.

Oil Properties	Before	After	After 12 Months
3. Acid content (mg KOH/g oil):			
4. Moisture content (ppm):			
5. Dielectric strength (kV):			
6. Sludge content (< 0,02%):			

CHIEF ENGINEER (INFRASTRUCTURE)
(ELECTRICAL)

REFERENCE :

SCHEDULE OF TRANSFORMERS TO BE **DE-SLUDGED**

Identification / Location: _____

1. Type of transformer: _____

2. Volume of oil inside transformer: _____ litres.

Oil Properties	Before	After	After 12 Months
3. Acid content (mg KOH/g oil):			
4. Moisture content (ppm):			
5. Dielectric strength (kV):			
6. Sludge content (> 0,02%):			

Identification / Location: _____

1. Type of transformer: _____

2. Volume of oil inside transformer: _____ litres.

Oil Properties	Before	After	After 12 Months
3. Acid content (mg KOH/g oil):			
4. Moisture content (ppm):			
5. Dielectric strength (kV):			
6. Sludge content (> 0,02%):			

CHIEF ENGINEER (INFRASTRUCTURE)
(ELECTRICAL)

REFERENCE :

SCHEDULE OF TRANSFORMERS TO BE **DRIED-OUT**

Identification / Location: _____

1. Type of transformer: _____
2. Volume of oil inside transformer: _____ litres.
3. Maximum permissible tank vacuum: _____ torr

Oil Properties	Before	After	After 2 Weeks
4. Moisture content (ppm):			
5. Transformer oil temp (deg C)			
6. Dielectric strength (kV):			

Identification / Location: _____

1. Type of transformer: _____
2. Volume of oil inside transformer: _____ litres.
3. Maximum permissible tank vacuum: _____ torr

Oil Properties	Before	After	After 2 Weeks
4. Moisture content (ppm):			
5. Transformer oil temp (deg C)			
6. Dielectric strength (kV):			

CHIEF ENGINEER (INFRASTRUCTURE)
(ELECTRICAL)

REFERENCE :

MOISTURE CONTENT OF OIL LEAVING TRANSFORMER AT WHICH DRY-OUT PROCESS MUST BE TERMINATED FOR VARIOUS TRANSFORMER TEMPERATURES.

Oil Temperature Degrees Celsius	Moisture Content of Oil ppm (mg/kg)	Oil Temperature Degrees Celsius	Moisture Content of Oil ppm (mg/kg)
10	1,5	55	16,0
15	2,0	60	21,0
20	2,5	65	28,0
25	3,3	70	35,5
30	4,2	75	44,0
35	5,5	80	54,0
40	7,2		
45	9,3		
50	12,0		

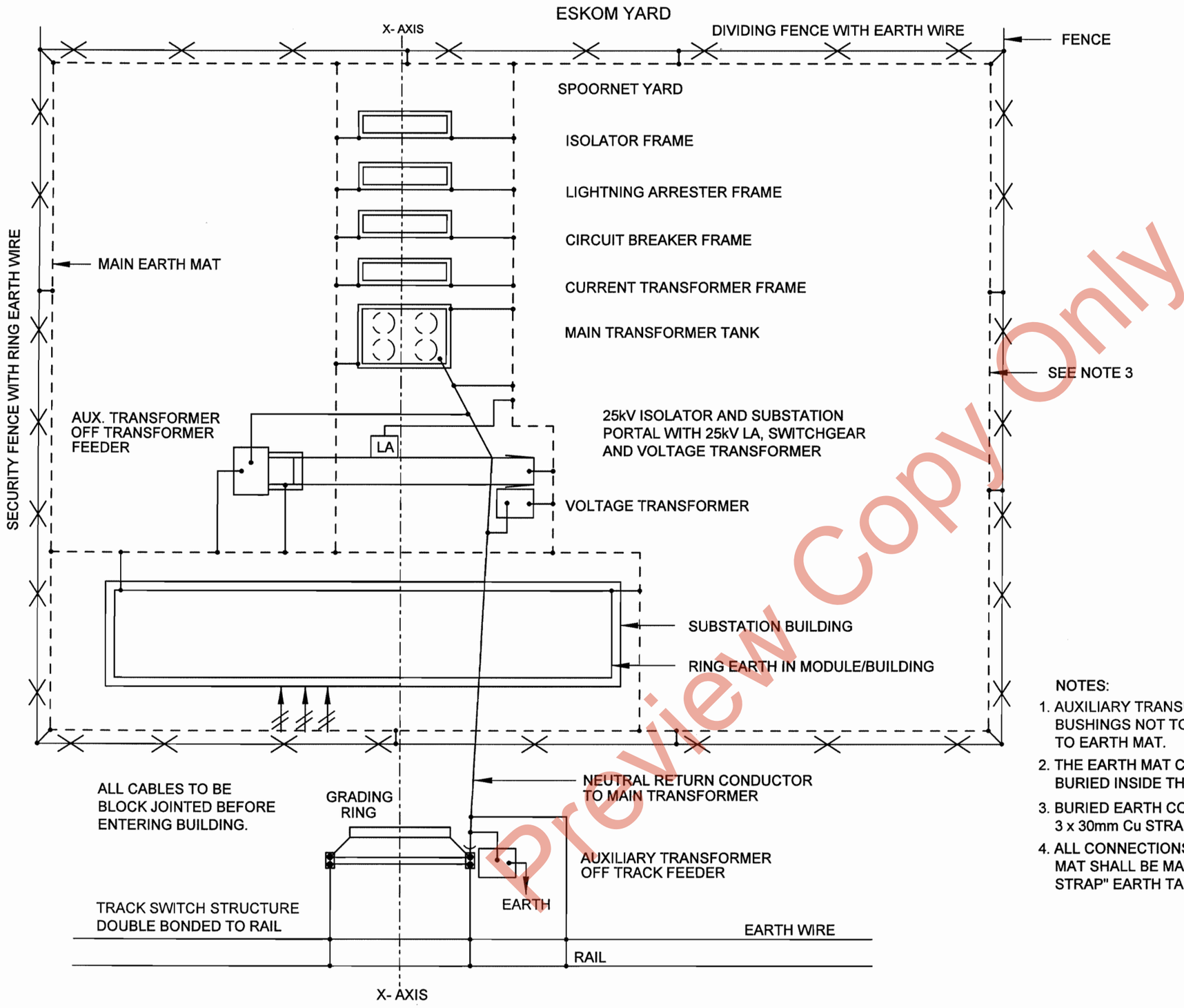
Note 1: This table is based on moisture content of not more than 2,0 percent in the paper.

Note 2: The oil temperature shall be the top oil temperature of the transformer.

Note 3: For temperatures falling in between the numbers in the table, use the next lower value.

CHIEF ENGINEER (INFRASTRUCTURE)
(ELECTRICAL)

REFERENCE :



NOTES:

1. AUXILIARY TRANSFORMERS RETURN BUSHINGS NOT TO BE CONNECTED TO EARTH MAT.
2. THE EARTH MAT CONDUCTOR SHALL BE BURIED INSIDE THE SECURITY FENCE.
3. BURIED EARTH CONDUCTORS SHALL BE 3 x 30mm Cu STRAP.
4. ALL CONNECTIONS TO THE BURIED EARTH MAT SHALL BE MADE WITH "ERICO CAD-STRAP" EARTH TAILS (95mm² Cu. EQUIVALENT).

AMENDMENTS		
NO	NAME	DATE
2	A MACPHERSON	98-07-08
REDRAWN AND REVISED DO REF: T98/030		
3	LO BORCHARD	98-10-30
DRAWING REVISED DO REF: T98/054		
4	LO BORCHARD	2003-02-26
LIGHTNING ARRESTER BETWEEN TRANSFORMER AND EARTH MAT REMOVED. NOTES REVISED. ECP REF: 2003-031 DO REF: CDO/2392		
5	LO BORCHARD	2003-03-25
MOVED MAIN EARTH MAT TO INSIDE OF SECURITY FENCE. NOTE 2 REVISED. ECP REF: 2003-040 DO REF: CDO/2552		
6	J J Burkhart	2003-08-29
TWO LIGHTNING ARRESTERS REMOVED. EARTH STRAPS ADDED TO BOTH AUX. TRANSFORMERS AND VOLTAGE TRANSFORMER. ECP REF: 2003-067 DO REF: CDO/2914		

DIMENSIONS: mm
SCALE: NTS

A3

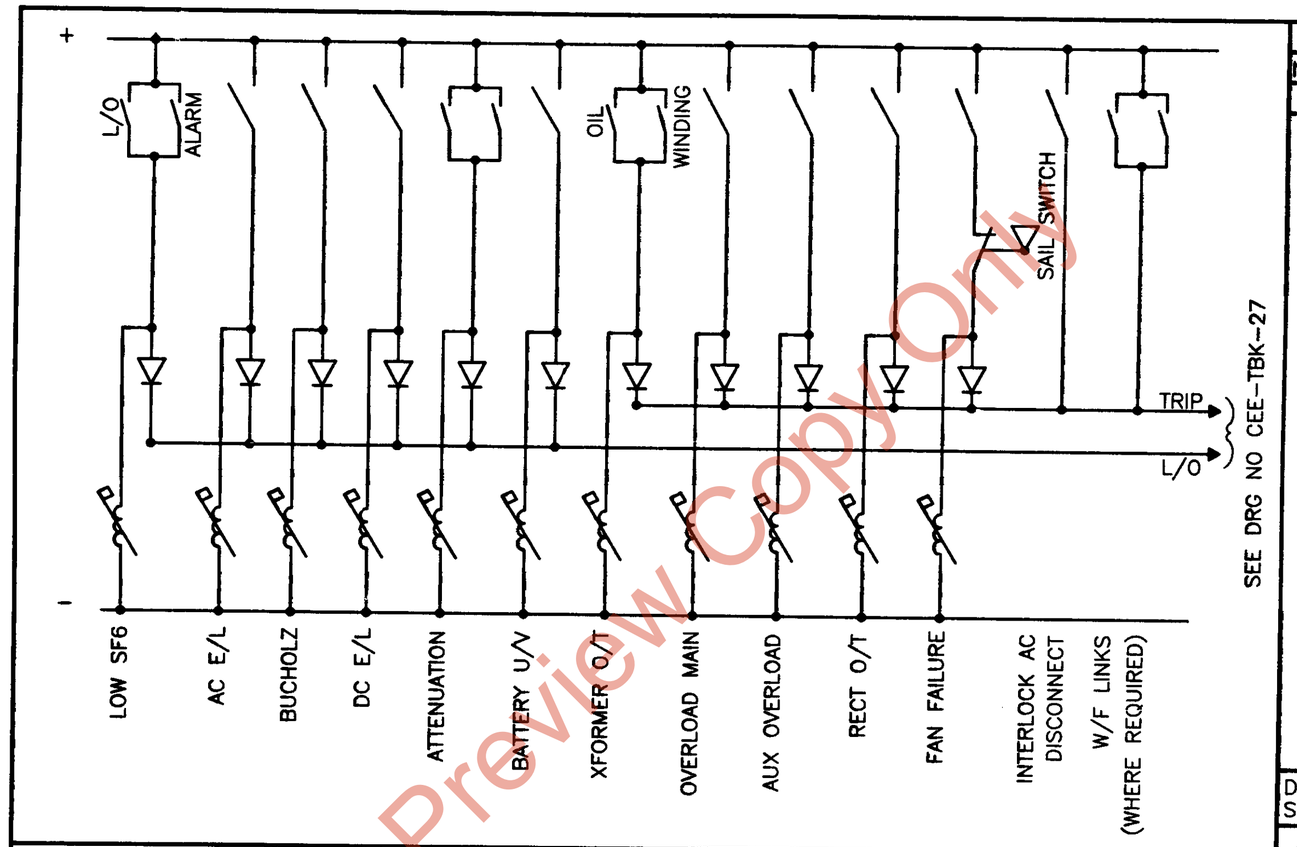
DO REF: T80/49	GEN TOL: LIN± -	ANG± -
DRN: B STEWART	CKD: H E MANTHE	DATE: 80-08-14
ENG: ————	R S MANN	for CHIEF ENG

CENTRAL DRAWING OFFICE SPOORNET

EARTHING ARRANGEMENT: 25kV AC TRACTION SUBSTATION

DRAWING NO CEE-TBD - 8

SHEET - OF -



AMENDMENTS		
NO	NAME	DATE

DO REF: T98/005	GEN TOL: LIN± –	ANG± –
DRN: S MOTELE	CKD: JVT	DATE: 98-01-21
ENG: LO BORCHARD	LO BORCHARD	for CHIEF ENG

INFRASTRUCTURE (ELECTRICAL)

SPOORNET

TRIP, LOCKOUT AND INDICATION CIRCUIT DIAGRAM

SF6 PRIMARY CIRCUIT BREAKER
TRACTION SUBSTATIONS

DIMENSIONS: mm
SCALE: NTS

A4

DRG NO CEE-TBK-28

SHT – OF –

3 4 4 3