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# Part C1: Agreement and Contract Data

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## Contract Data

The Employer is:

Name : Transnet SOC Limited, trading as Transnet Freight Rail  
Address: Nzasm Building, Room 210, Corner of Paul Kruger and Minnaar Streets, Pretoria.  
Telephone: (012) 315 2059 Fax No. (012) 315-2125  
E-mail: [Yvonne.scannell@transnet.net](mailto:Yvonne.scannell@transnet.net)

The work is: DESIGN, SUPPLY, INSTALLATION AND COMMISSIONING OF WAVE FILTER EQUIPMENT (PLANT) AND EXTRACTOR FANS AT VARIOUS 3KV SUBSTATIONS AND BATTERY ROOMS UNDER THE CONTROL OF DEPOT ENGINEER, KOEDOESPOORT

The sites are: Doornpoort and Bonn Accord SUBSTATIONS

The starting date is: To be advised.....

The completion date is: To be advised.....

The reply period is : Two weeks.....

The defects date is: 52 weeks week after completion of project.....

The defect correction period is: within two weeks after defects date.....

The delay damages are: R2, 000.00 per day (penalties).....

The assessment day is the: 13<sup>th</sup> (thirteenth) of each month.....

The retention is : 10 percent (%).....

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

The Adjudicator is:

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

Address: .....

Telephone: ..... Fax No. ....

E-mail: .....

## Contract Data

The interest rate on late payment is **2% (two percent)** per complete week of delay.

The Contractor is not liable to the Employer for loss of or damage to the Employer's property in excess of **R1,000,000.00 (one million)** for any one event.

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

The minimum amount of cover for the third insurance stated in the Insurance Table is: **>R25, 000.00 (Limited to R10, 000,000.00. for any one event)**

The minimum amount of cover for the fourth insurance stated in the Insurance Table is: **Not applicable**.....

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

The tribunal is: **Arbitration**.....

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

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

As mentioned in paragraph 1.0 (Contractual obligations)

### 1.0 CONTRACTUAL OBLIGATIONS

This project specification covers Transnet Freight Rail's requirements for the supply, install of copper busbars in the busbar chamber, complete mechanical interlocking and tuning coils at Wapadskloof 3kV dc traction substation under the control of the Depot Engineer, Witbank.

- 1.1 The Contractor shall not make use of any sub-Contractor to perform the works or parts thereof without prior permission from the Employer's Deputy.
- 1.2 The Contractor shall ensure that a safety representative is at site at all times.
- 1.3 The Contractor shall comply with all applicable legislation and Transnet safety requirements adopted from time to time and instructed by the Employer's Deputy / Supervisor. Such compliance shall be entirely at his own cost, and shall be deemed to have been allowed for in the rates and prices in the contract.
- 1.4 The Contractor shall, in particular, comply with the following Acts and Transnet Specifications:-
  - 1.4.1 The Compensation for Occupational Injuries and Diseases Act, No. 130 of 1993. The Contractor shall produce proof of his registration and good standing with the Compensation Commissioner in terms of the Act.
  - 1.4.2 The Occupational Health and Safety Act (Act 85 of 1993).
  - 1.4.3 The explosive Act No. 26 of 1956 (as amended). The Contractor shall, when applicable, furnish the Employer's Deputy / Supervisor with copies of the permits authorising him or his

employees, to establish an explosives magazine on or near the site and to undertake blasting operations in compliance with the Act.

- 1.4.4 The Contractor shall comply with the current Transnet Specification E.4E, Safety Arrangements and Procedural Compliance with the Occupational Health and Safety Act, Act 85 of 1993 and Regulations and shall before commencement with the execution of the contract, which shall include site establishment and delivery of plant, equipment or materials, submit to the Employer's Deputy / Supervisor.
- 1.4.5 The Contractor shall comply with the current Specification for Works On, Over, Under or Adjacent to Railway Lines and near High Voltage Equipment – E7/1, if applicable, and shall take particular care of the safety of his employees on or in close proximity to a railway line during track occupations as well as under normal operational conditions.
- 1.5 The Contractor's Health and Safety Programme shall be subject to agreement by the Employer's Deputy / Supervisor, who may, in consultation with the Contractor, order supplementary and/or additional safety arrangements and/or different safe working methods to ensure full compliance by the Contractor with his obligations as an employer in terms of the Act.
- 1.6 In addition to compliance with clause 1.4 hereof, the Contractor shall report all incidents in writing to the Employer's Deputy / Supervisor. Any incident resulting in the death of or injury to any person on the works shall be reported within 24 hours of its occurrence and any other incident shall be reported within 48 hours of its occurrence.
- 1.7 The Contractor shall make necessary arrangements for sanitation, water and electricity at these relevant sites during the installation of the equipments.
- 1.8 ***A penalty charge of R2,000.00 per day will be levied for late completion.***
- 1.9 ***10% Retention money will be retained and will be released 12 months after the completion date of the contract.***
- 1.10 The Contractor shall supply a ***site diary (with triplicate pages)***. This book shall be used to record any unusual events during the period of the work. Any delays to the work shall also be recorded such as delays caused by poor weather conditions, delays caused by permits being cancelled etc. The appointed Employer's Deputy or Supervisor must countersign such delays. Other delays such as non-availability of equipment from 3<sup>rd</sup> party suppliers must be communicated to the Employer's Deputy or Supervisor in writing.
- 1.11 The Contractor shall supply a ***site instruction book (with triplicate pages)***. This book shall be used to record any instructions to the Contractor regarding problems encountered on site – for example the quality of work or the placement of equipment. This book shall be filled in by the Employer's Deputy or Supervisor and must be countersigned by the Contractor.
- 1.12 Both books mentioned in 1.10 and 1.11 shall be the property of Transnet Freight Rail and shall be handed over to the Employer's Deputy or Supervisor on the day of energising or handing over.
- 1.13 The successful Contractor shall provide a Gantt or a similar chart showing when the works will be done and energised. A final chart should be submitted to the Employer's deputy or Supervisor within 14 days after the award has been made to the successful Contractor.
- 1.14 All processes or the manufacture and assembly of the product components must be subjected to a quality assurance system.
- 1.15 The Contractor will assume full responsibility for assuring that the products purchased meet the requirements of Transnet Freight Rail for function, performance, and reliability, including purchased products from 3<sup>rd</sup> part suppliers.

- 1.16 The onus is on the repairer to prove the effectiveness of their system to Transnet Freight Rail during the production of the prototype.
- 1.17 ISO.9000 to 9004 inclusive (SABS 0157 parts 1 to 4) must be regarded as a guideline, where applicable.
- 1.18 The Contractor will remain liable for contractual delivery dates irrespective of deficiencies discovered during workshop inspections.

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## Contract Data

### The Contractor's Offer

The Contractor is:

Name : .....

Address: .....

.....

Telephone: ..... Fax No. ....

E-mail: .....

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

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

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

The offered total of the Prices is R.....  
(Enter the total of the prices in numbers from the price list, inclusive of VAT)

State amount in words (Incl. of VAT): .....

.....  
**Signed on behalf of the Contractor:**

Name: .....

Position: .....

Signature: ..... Date .....

### The Employer's Acceptance

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

**Signed on behalf of the Employer**

Name: .....

Position: .....

Signature: ..... Date .....

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## Part C2: Pricing Data

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## Pricing Data

### Price Instructions

#### 2.0 PRICING INSTRUCTIONS

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

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



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

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**Contract Data  
Price List**

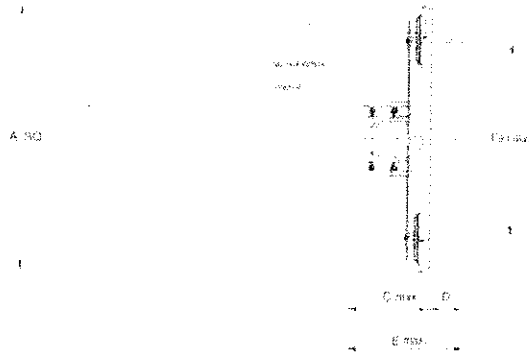
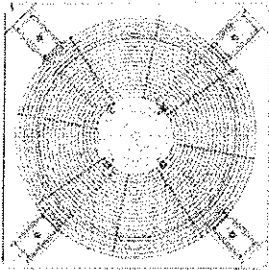
Item	Description	Unit	Qty	Rate	Price
<b>Bon accord Substation</b>					
<b>A</b>	<b>Wave filter</b>				
1	Supply and install 10 Micro Farad ( $\mu$ F) capacitors	ea	2		
2	Supply and install 50 Micro Farad ( $\mu$ F) capacitors	sum	1		
3	Supply and install 100 Ampere High Rupturing Capacity (H.R.C.) fuse	sum	1		
4	Supply and install fuse holder	sum	1		
5	Supply and install 75 kilo Ohm resistor	sum	2		
6	Supply and install 95mm <sup>2</sup> PVC insulated copper cables	meter	15		
7	Supply and install wall bushings for conductors	sum	1		
8	Supply and install control and power cables including HT wave filter cables	sum	1		
9	Supply and install 1.173mH for 12 <sup>th</sup> harmonic	sum	1		
10	Supply and install 1.759mH for 24 <sup>th</sup> harmonic	sum	1		
<b>A1</b>	<b>EXTRACTOR FAN</b>				
11	Supply and install Hiflo Propeller Extractor Fan	sum	1		
12	Supply and install 10A, 5ka rating circuit breaker	sum	1		
13	Supply and install 2,5mm 3 core "Surfix" wire	sum			
14	Supply and install steel cage	sum	1		
15	Supply and vandalized proof weather louver guard	sum	1		
<b>A2</b>	<b>Plinth , surface area &amp; commission</b>				
16	Ps & G's	sum	1		
17	Commissioning	sum	1		
i	<b>Total Price for Bon accord =</b>			<b>R</b>	
ii	<b>10% Contingency =</b>			<b>R</b>	
iii	<b>Total Excl. VAT=</b>			<b>R</b>	

**Contract Data**  
**Price List**

Item	Description	Unit	Qty	Rate	Price
<b>Doornpoort Substation</b>					
<b>B</b>	<b>Wave filter</b>				
1	Supply and install 10 Micro Farad ( $\mu$ F) capacitors	ea	2		
2	Supply and install 50 Micro Farad ( $\mu$ F) capacitors	sum	1		
3	Supply and install 100 Ampere High Rupturing Capacity (H.R.C.) fuse	sum	1		
4	Supply and install fuse holder	sum	1		
5	Supply and install 75 kilo Ohm resistor	ea	2		
6	Supply and install 95mm <sup>2</sup> PVC insulated copper cables	sum	1		
7	Supply and install wall bushings for conductors	sum	1		
8	Supply and install control and power cables including HT wave filter cables	sum	1		
9	Supply and install 1.173mH for 12 <sup>th</sup> harmonic	sum	1		
10	Supply and install 1.759mH for 24 <sup>th</sup> harmonic	sum	1		
<b>B1</b>	<b>EXTRACTOR FAN</b>				
11	Supply and install Hiflo Propeller Extractor Fan	sum	1		
12	Supply and install 10A, 5ka rating circuit breaker	sum	1		
13	Supply and install 2,5mm 3 core "Surfix" wire	sum	1		
14	Supply and install steel cage	sum	1		
15	Supply and vandalized proof weather louvre guard	sum	1		
<b>B2</b>	<b>Plinth , surface area &amp; commission</b>				
16	Ps & G's	sum	1		
17	Commissioning	sum	1		
<b>i</b>	<b>Total Price for Doornpoort =</b>			<b>R</b>	
<b>ii</b>	<b>10% Contingencies =</b>			<b>R</b>	
<b>iii</b>	<b>Total Excl. VAT=</b>			<b>R</b>	

**APPENDIX 1**
**1. Dimension data sheet of fan and louver**
**Dimensions**

Flakt Woods 18/2018/01



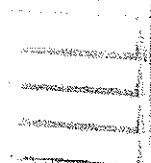
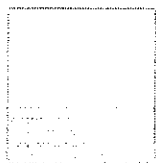
D (mm)

A (mm) B

Fan Size	A	B	C	D	E	F	Weight (kg)	Power (kW)	Flow (m³/s)
200	420	340	120	110	240	300	420	0.2	8
250	470	390	120	110	240	300	470	0.2	8
300	520	440	120	110	240	300	520	0.2	12
350	570	490	120	110	240	300	570	0.2	17
400	620	540	120	110	240	300	620	0.2	22
450	670	590	120	110	240	300	670	0.2	27
500	720	640	120	110	240	300	720	0.2	32
550	770	690	120	110	240	300	770	0.2	37
600	820	740	120	110	240	300	820	0.2	42
650	870	790	120	110	240	300	870	0.2	47
700	920	840	120	110	240	300	920	0.2	52
750	970	890	120	110	240	300	970	0.2	57

**Ancillaries**

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Wall Duct

Louvers Shutter

Fixed Louvers

Wall Duct	A	B	C	D	E	F	G	H	I	J
250	570	470	400	1000	300	400	1000	300	400	4000
300	620	520	400	1000	300	400	1000	300	400	4000
350	670	570	400	1000	300	400	1000	300	400	4000
400	720	620	400	1000	300	400	1000	300	400	4000
450	770	670	400	1000	300	400	1000	300	400	4000
500	820	720	400	1000	300	400	1000	300	400	4000
550	870	770	400	1000	300	400	1000	300	400	4000
600	920	820	400	1000	300	400	1000	300	400	4000
650	970	870	400	1000	300	400	1000	300	400	4000

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## Part C3: Works Information

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## Contract Data

### Works Information

#### 2.0 SITE ESTABLISHMENT

- 2.1 The Contractor shall be responsible to transport material to site, off-loading, handling, storage and security of all material required for the construction/execution of the works.
- 2.2 Transportation insurance must be arranged by successful contractor to ensure their handling responsibility while material are in transit to site and during off loading as agreed upon.
- 2.3 The Contractor shall be responsible for all necessary (as decided by the Transnet Freight Rail Employer's deputy or Technical Officer) connections between the equipment as found before site establishment and other components in the substation including connections to the earth-mat.

#### 3.0 DESCRIPTION OF WORK

The work entails the following:

- 3.1 The Contractor shall supply and install the wave filter plant in accordance with Transnet Freight Rail's specification BBB 3139 for wave filter capacitors and BBB 3162 for inductor coils.
- 3.2 The wave filter is connected in parallel with the rectifier output. The filter unit is a capacitive inductive circuit, which is tuned at specific harmonic frequencies.
- 3.3 The wave filter equipment shall be so designed that no individual harmonic voltage is greater than 2% of the output voltage.
- 3.4 The inductor coils shall have sufficient adjustment to compensate for change in the capacitance values due to ageing refer in compliance to BBB 3483 for assembly.
- 3.5 A 100 Ampere High Rupturing Capacity (H.R.C.) fuse shall be fitted to protect the wave filter equipment.
- 3.6 The fuse holder shall be mounted on insulators.
- 3.7 The insulators shall be so designed that the flashover path is not less than 100mm and shall support the fuse at a distance of not less than 100mm from the bolts securing the base plate. The insulators shall have a minimum dry flashover value of 20kV.
- 3.8 Access to the wave filter equipment shall only be possible once the wave filter capacitors have been connected to rail, discharged and the primary circuit breaker tripped. A 75 kilo Ohm resistor consisting of four 75 kilo Ohm vitreous enamel resistors connected in parallel shall be provided for the discharging of the wave filter capacitors when the equipment is isolated and earthed.
- 3.9 The discharge resistors shall be mounted on a suitable insulation panel or bar, which shall be insulated for 3kV DC. A minimum clearance of 75mm must be provided between the terminals, and 100mm between any 3kV live portion of the equipment, and earth.
- 3.10 The wave filter capacitors shall be earthed with 95mm<sup>2</sup> PVC insulated copper cables to the DC earth leakage system.
- 3.11 All wall bushings for conductors into the wave filter rooms shall be replaced.

- 3.12 The wave filter equipment shall be housed in the existing wave filter room.
- 3.13 The Contractor shall supply and install all control and power cables including HT wave filter cables in accordance with the Specification BBC 0198 version 1 and CEE 0023 of 1990.
- 3.14 The Substations do have a 12 pulse rectification and shall be tuned for filtering 12<sup>th</sup> and 24<sup>th</sup> harmonic frequencies and each unit shall consist of the following components.

COMPONENTS AND RATINGS	QUANTITY
<b>CAPACITORS</b>	
10 Micro Farad (µF)	2
50 Micro Farad (µF)	1
<b>INDUCTORS</b>	
1.173 mH for 12 <sup>th</sup> harmonic	1
1.759 mH for 24 <sup>th</sup> harmonic	1

- 3.15 For connections refer to drawing no. JEE - TBB - 0159.
- 3.16 Framework for supporting Wave filter coils will be measured on site.
- 3.17 The Contractor must supply and install six new Hiflo Propeller Extractor Fans by Actom (H28041SPEP).
- 3.18 The extractor fans must be **ACID RESISTANT** (epoxy coated) and **SPARKPROOF** to **SANS 60079**.
- 3.19 The electrical supply system will be 1 phase 3 wires, 50 Hz, alternating current with earth, at a nominal voltage of 220V.
- 3.20 The voltage may vary within the range of 95% to 105% of the nominal and the equipment installed shall be suitable for the efficient operation at any voltage within this range.
- 3.21 The position from where the extractor fan has to feed from (distribution board) will be indicated to the contractor by a Transnet representative.
- 3.22 The extractor fan must be protected at the feeding point with an SABS approved 10A, 5ka rating circuit breaker from where the fan will be operated from.
- 3.23 The fan will be connected to the supply point with SABS approved 2,5mm 3 core "Surfix" wire, installed inside an appropriate square PVC trunking.
- 3.24 The best possible route for the wiring of the extractor fans must be determined on site by the contractor and a Transnet Representative. (Electrician) Measurements to be taken of the length of wiring and trunking for each site.
- 3.25 The extractor fan mounted to a steel cage will be covering an existing window that will be indicated to the contractor by a Transnet representative during the site meeting.
- 3.26 Existing burglar bars and extractor fans to be removed from the indicated windows if applicable and returned to the Infra Depot Koedoespoort.

- 3.27 A fixed vandalized proof weather louver guard must be installed on the outside of the window also to a steel cage to cover the window and must also be epoxy coated.
- 3.28 The steel cages must be constructed of 40mm x 40mm x 5mm angle iron and boxed with 2mm steel plate. The cages must be painted with red oxide undercoat and two coats of white epoxy paint.
- 3.29 The steel cages must have 4 angle iron supports welded to it so that it can be bolted to the wall with 4 x 8mm rawl bolts. The head of the rawl bolts must be welded to prevent loosening of it.
- 3.30 The size of the steel cages will be different at the various sites and exact measurements to be taken during the site meeting by the contractor.

#### **4.0 COMMISSIONING AND TESTS OF EQUIPMENT**

- 4.1 The Contractor shall be responsible for carrying out on-site tests and Commissioning of the equipment supplied / installed or serviced in terms of this specification and the contractual agreement.
- 4.2 Functional on-site tests shall be conducted on all items of equipment and circuitry to prove the proper functioning and installation thereof.
- 4.3 The Contractor shall arrange for the Manager or Technical Officer appointed or his representative to be present to witness the on-site tests.
- 4.4 On-site tests shall include the following;
- The functionality of all electrical circuitry.
  - A functional test of all protection circuits.
- 4.5 At the completion of the on-site tests the Manager or Technical Officer appointed shall either sign the test sheets (supplied by the Contractor) as having witnessed the satisfactory completion thereof, or hand to the Contractor a list of defects requiring rectification.
- 4.6 Upon rectification of defects the Contractor shall arrange for the Employer's deputy or Technical Officer appointed to certify satisfactory completion of on-site tests for the installations and repairs.
- 4.7 Acceptance by the Employer's deputy 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.
- 4.8 The commissioning of the equipment by Transnet will in no way absolve the Contractor from any of his responsibilities during the guarantee period. It is the contractor's responsibility to satisfy him 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
- 4.9 Commissioning will only take place after all defects have been rectified to the satisfaction of the Employer's deputy or Technical Officer appointed.
- 4.10 Commissioning will include the energising of equipment. The contractor must prove the satisfactory operation of equipment under live conditions.



## **5.0 HANDING OVER OF WORKPLACES**

- 5.1 On completion of commissioning the Contractor will hand the equipment over to the Employer's deputy in terms of the relevant instructions.
- 5.2 Handing over inspections will be convened on an ad-hoc basis as agreed by the Employer's deputy / Technical Officer and the Contractor.
- 5.3 It is the duty of the Contractor to send a copy of the hand over certificate, which has been certified as correct by the Employer's deputy / Technical Officer, together with the relevant pages of the site diary, to the office of the Depot Engineer for the payment to be made. The hand over certificate is included in this document.

## **6.0 PROVISION OF COMMUNICATION**

- 6.1 The Contractor will ensure that the supervisor on site has a cell-phone for communication purposes.

## **7.0 GUARANTEE AND DEFECTS**

- 7.1 The Contractor shall guarantee the satisfactory operation of the complete electrical installation supplied and erected by him and accept liability for maker's defects that may appear in design, materials and workmanship.
- 7.2 The Contractor shall be issued with a completion certificate with the list of all defects that may appear within 14 working days after commissioning.
- 7.3 The guarantee period for this work shall expire after: A period of 12 months commencing on the date of completion of the contract or the date the equipment was handed over to Transnet Freight Rail.
- 7.4 Any defects that may become apparent during the guarantee period shall be rectified to the satisfaction of Transnet Freight Rail, and to the account of the Contractor.
- 7.5 The Contractor shall undertake work on the rectification of any defects that may arise during the guarantee period within 7 days of him being notified by Transnet Freight Rail of such defects.
- 7.6 Should the Contractor fail to comply with the requirements stipulated above, Transnet Freight Rail shall be entitled to undertake the necessary repair work or effect replacement of defective apparatus or materials, and the Contractor shall reimburse Transnet Freight Rail the total cost of such repair or replacement, including the labour costs incurred in replacing defective material.
- 7.7 Any specific type of fault occurring three times within the guarantee period and which cannot be proven to be due to other faulty equipment not forming part of this contract e.g., faulty locomotive or overhead track equipment, etc., shall automatically be deemed an inherent defect. Such inherent defect shall be fully rectified to the satisfaction of the Employer's deputy or the Technical Officer and at the cost of the Contractor.
- 7.8 If urgent repairs have to be carried out by Transnet Freight Rail staff to maintain supply during the guarantee period, the Contractor shall inspect such repairs to ensure that the

guarantee period is not affected and should they be covered by the guarantee, reimburse Transnet Freight Rail the cost of material and labour.

## 8.0 QUALITY AND INSPECTION

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

## 9.0 TECHNICAL SPECIFICATION AND STANDARDS

- 9.1 Unless otherwise specified all materials used and equipment developed and supplied shall comply with the current edition of the relevant SABS, IEC or Transnet's publications where applicable.
- 9.2 **Transnet Freight Rail specifications:** The following publications are referred to in this specification:
  - 9.2.1 BBB 5452: Installation of Electrical equipment for 3kv DC Traction Substations.
  - 9.2.2 BBB 3139: Wave filter capacitors for 3Kv DC Traction Substations.
  - 9.2.3 BBB 3139: Wave filter capacitors for 3Kv DC Traction Substations.
  - 9.2.4 BBC 0198: Requirements for the supply of electric cables.
  - 9.2.5 CEE 0023: Specification for the installation of cables.
  - 9.2.6 CEE-TCK-4: Wave Filter Cell Layout.
  - 9.2.7 JEE-TBB-159: Wave Filter connection Diagram.
  - 9.2.8 BBB 3483: Wave Filter harmonic coil carrier.
  - 9.2.9 BBB 3484: Wave Filter harmonic coil carrier components assembly.
  - 9.2.10 BBB 3486: Inductance coils for resonant shunt circuits.
  - 9.2.11 BBB 3487: Harmonic filter coil winding details.
  - 9.2.12 CEE-TCK-2: Wave filter discharge resistance.
  - 9.2.13 CEE-TCK-12: Framework for supporting harmonic wave filter coils.

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

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

**11.0 Constraints on how the Contractor Provides the Works**

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

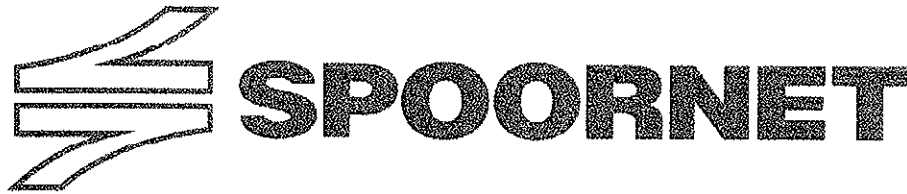
11.1 Requirements for the programme

- 11.1.1 Programme of work: To be submitted by successful Contractor
- 11.1.2 Format : Gantt chart
- 11.1.3 Information : How work is going to be executed and commissioned
- 11.1.4 Submission : 3 weeks after the award of contract
- 11.1.5 Site diary : Successful Contractor to supply in triplicate carbon copies
- 11.1.6 Site instruction book: Successful Contractor to supply in triplicate carbon copies

**11.2 Services and other things provided by the Employer**

- 11.2.1 Transnet Freight Rail shall inspect all equipment before dispatching the equipment to site.
- 11.2.2 Transnet Freight Rail shall have an electrician available for isolation and the erection of barriers to live electrical equipment and issuing of work permits.
- 11.2.3 Upon successful completion of the works to the satisfaction of Transnet Freight Rail, Transnet Freight Rail shall perform necessary protection tests and commission the equipment.
- 11.2.4 The Contractor shall make necessary arrangements for sanitation, water and electricity at these relevant sites during the installation of the equipments.
- 11.2.5 Transnet Freight Rail will arrange for the reconnecting of telecontrol equipment in the substation and no final energising shall take place without this

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## TECHNICAL RAILWAY ENGINEERING

### SPECIFICATION CONTROL PAGE

#### WAVE FILTER CAPACITORS FOR 3kV DC TRACTION SUBSTATIONS

**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: Engineer S. Nhlabathi  
Traction Power  
Supply Technology

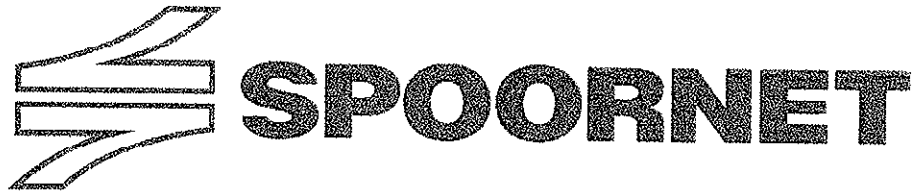
Co-author: Chief Engineering Technician J. Rothman  
Traction Power  
Supply Technology

Approved: Senior Engineer L.O. Borchard  
Traction Power  
Supply Technology

Authorised: Principal Engineer W.A. Coetzee  
Railway Engineering: Electrical  
Technology

Date: 05 August 2002

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



A division of Transnet limited

**TECHNICAL  
RAILWAY ENGINEERING**

**SPECIFICATION**

---

**WAVE FILTER CAPACITORS FOR 3kV DC TRACTION SUBSTATIONS**

---

Circulation restricted to:

- Technical
- Railway Engineering
  - Asset Life Cycle Management
  - Infrastructure Maintenance
  - Acquisition, Evaluation and Review

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## 1.0 SCOPE

- 1.1 This specification covers Spoomet's requirements for the supply of wave filter capacitors, required for DC applications such as harmonic filters.
- 1.2 The capacitors shall be used with the resonant shunts to reduce the magnitude of the 6<sup>th</sup>, 12<sup>th</sup>, 18<sup>th</sup> and the 24<sup>th</sup> harmonics at the busbar of the 3 000 V DC rectifier traction substation.

## 2.0 STANDARDS AND PUBLICATIONS

- 2.1 Unless otherwise specified all materials used and equipment developed and supplied shall comply with the current edition of the relevant SABS, IEC or Spoomet's publications where applicable.
- 2.2 The following publications are referred to in this specification:
  - IEC 6871 – 1 (1997) : Shunt capacitors for AC power systems having a rated voltage above 1 000V.
  - GEE TCK 004 : Wave filter cell layout.

## 3.0 TENDERING PROCEDURE

- 3.1 The tenderer shall indicate compliance with the specification. This shall take the form of a separate document listing all the clause numbers of the specification with an individual clause by clause statement of compliance or non-compliance.
- 3.2 The tenderer shall motivate a statement of non-compliance.
- 3.3 The tenderer shall submit descriptive literature consisting of detailed technical specifications, general construction details and principal dimensions, together with clear illustrations of the equipment offered.
- 3.4 The tenderer shall complete and submit the technical data sheet in appendix B.

## 4.0 DEFINITIONS

- 4.1 The definitions of all the technical terms used in this specification are listed in clause 3 of the IEC 6871 – 1 (1997) specification.

## 5.0 SERVICE CONDITIONS

### 5.1 ATMOSPHERIC CONDITIONS

- 5.1.1 Altitude : 0 to 1800m above sea level.
- 5.1.2 Ambient Temperature : -5 to +45 °C (daily average +35 °C).
- 5.1.3 Relative Humidity : As high as 90 percent (Condensing).
- 5.1.4 Lightning Conditions : 12 ground flashes per square kilometre per annum.
- 5.1.5 Pollution : Heavily salt laden or polluted with smoke from industrial sources.

### 5.2 MECHANICAL SERVICE CONDITIONS

- 5.2.1 The 3kV DC traction substations are situated next to railway lines and the equipment will therefore be subjected to vibration. The design must take appropriate counter measures to ensure reliability of equipment that is sensitive to vibration.
- 5.2.2 The capacitors are to be installed in the 3kV DC traction substations and shall be floor mounted.

### 5.3 ELECTRICAL SERVICE CONDITIONS

- 5.3.1 The nominal no-load DC voltage of a traction substation output varies between 3150 V and 3400 V.
- 5.3.2 The maximum voltage under no-load conditions can increase up to 3900 V depending on the traction transformer tap settings, Eskom's supply voltage and regenerative braking.
- 5.3.3 The substation voltage under load conditions may decrease to 2300 V.

## 6.0 POWER FILTER CAPACITORS

### 6.1 GENERAL

- 6.1.1 The capacitors are to form part of the resonant shunt connected to the positive and negative busbar to reduce the magnitude of the following harmonics:
- 6<sup>th</sup> at 300Hz,
  - 12<sup>th</sup> at 600Hz,
  - 18<sup>th</sup> at 900Hz,
  - 24<sup>th</sup> at 1200Hz.
- 6.1.2 Substations with 12-pulse rectification are normally tuned for 12<sup>th</sup> and 24<sup>th</sup> harmonics at 600Hz and 1200Hz, respectively. The 6-pulse type rectifier substations are normally equipped with 300Hz and 900Hz filters to reduce the effect of the 6<sup>th</sup> and 18<sup>th</sup> harmonics.



- 6.1.3 The design, construction and operation of the capacitors shall comply with the IEC 6871 – 1 (1997) specification.
- 6.1.4 A dielectric made from Polyester / Polypropylene film (PPR) is preferable.
- 6.1.5 The capacitor container shall be constructed of steel or stainless steel and shall have adequate mechanical strength to avoid bulging or bursting.
- 6.1.6 If lifting lugs are required each capacitor container shall be provided with two lugs.
- 6.1.7 Each capacitor container shall be provided with an earthing lug drilled for a 10-mm screw.
- 6.1.8 The capacitor container shall be hermetically sealed. Moisture and electrical environmental interference shall have no effect on the capacitor
- 6.1.9 Each capacitor shall be provided with two bushings, one for each pole. The creepage and air clearance of the bushings shall not be less than 200 mm between the live parts of the bushings, the metal base of the container and between the bushing terminals.
- 6.1.10 The basic insulation level (BIL) for the bushings shall be at least 100kV.
- 6.1.11 The capacitors shall be immersed in a non-flammable, non-toxic and biodegradable insulating medium and sealed under vacuum.
- 6.1.12 The positioning of the capacitors in the wave filter cell is shown in drawing CEE TCK 004.
- 6.1.13 The capacitor shall have an integral discharge resistor.
- 6.1.14 The wave filter equipment in the traction substation is connected in series to a 100A fuse.

## 6.2 CAPACITOR RATINGS

6.2.1 The capacitors shall be made up of the following units:

- 10 MicroFarad - 80 ampere continuous,
- 20 MicroFarad - 80 ampere continuous,
- 50 MicroFarad - 80 ampere continuous.

The quantities required of the above values are dependent on the substation rectifier arrangement (12-pulse or 6-pulse rectification).

- 6.2.2 The capacitor shall be rated to handle up to four and one third (13 000 V) of the full load voltage (3kV) for one minute.
- 6.2.3 The capacitance tolerance of each capacitor shall not vary by more than 5% at 45 °C. Tenderers shall state and guarantee the tolerance of the capacitors offered.
- 6.2.4 Tenderers are requested to state the following:
  - Maximum permissible voltage of the capacitor,
  - Maximum permissible current of the capacitor, as per requirement of clauses 19 and 20 of the IEC 6871 – 1 (1997) specification.

### 6.3 ADMISSIBLE OVERLOADS

- 6.3.1 The continuous rated excess voltage shall be at least 20% of the full load voltage (3 kV).
- 6.3.2 The excess continuous current rating shall be at least 50% of the rated current.
- 6.3.3 The rated kilo-Volt-Ampere reactive (kVAR) power shall be at least 40% of the rated power.

### 6.4 RATING PLATE

6.4.1 A non-corrosive metal nameplate shall be fixed to each capacitor container giving the following information:

- Manufactures Name,
- Identification Number,
- Continuously Rated AC Current,
- Rated DC Voltage,
- Temperature Category,
- Insulating Medium,
- Insulating Level,
- Measured Capacitance in MicroFarad.

6.4.2 The nameplate shall be positioned such that it is visible in the position of normal service and installation.

### 6.5 INSULATION

- 6.5.1 All capacitors shall be insulated to withstand a pressure of not less than 20 000 volts DC for one minute between the terminals. This must also be applicable between the short-circuited terminals and the container.
- 6.5.2 Tenderers are requested to state the expected deterioration pattern of the dielectric of the capacitors with time, while in service, and the test voltages that can be applied to the capacitors approximately six months after the manufacture's tests.

### 6.6 LIFE EXPECTANCY OF THE CAPACITOR

- 6.6.1 The capacitor shall have a rated life expectancy of not less than 20 years (175 000 working hours).

**6.7 TESTS**

- 6.7.1 The capacitors shall be subjected to the test requirements as set out in clause 5 of the IEC 6871 – 1 (1997) specification.
- 6.7.2 All the types of tests as classified in clause 6 of the IEC 6871 – 1 (1997) specification shall be conducted on each type of capacitor offered.
- 6.7.3 A TYPE TEST certificate shall be submitted for each type of capacitor offered.
- 6.7.4 The tender shall also submit routine test certificates for each capacitor offered.

**7.0 QUALITY ASSURANCE**

- 7.1 Spornet reserves the right to carry out inspection and any tests on the equipment at the works of the supplier/ manufacture.
- 7.2 Arrangements will be made timeously for such inspections to be carried out before the delivery of the equipment.

**8.0 GUARANTEE AND DEFECTS**

- 8.1 The tenderer shall guarantee the satisfactory operation of the equipment supplied by him and accept liability for maker's defects, which may appear in design, materials and workmanship.
- 8.2 The guarantee period for the equipment shall expire after: A period of 12 months commencing on the date of installation and commissioning of the equipment or the date the equipment is handed over to Spornet whichever is the later.

**9.0 PACKAGING AND TRANSPORT**

- 9.1 The tenderer shall ensure that the equipment be packed in such a manner that it will be protected during handling and transport.
- 9.2 The tenderer shall provide transport for the delivery of the equipment to the site where required.

**END**

**APPENDIX A**

**SCHEDULE OF REQUIREMENTS**

(To be filled in by Spoorinet's Maintenance Depot or Logistics Department)

**1. CAPACITORS**

**1.1 10 MicroFarad**

• Quantity Required: \_\_\_\_\_

**1.2 20 MicroFarad**

• Quantity Required: \_\_\_\_\_

**1.3 50 MicroFarad**

• Quantity Required: \_\_\_\_\_

**2. MAINTENANCE DEPOT**

**2.1 Depot Name:** \_\_\_\_\_

**2.2 Depot Address:** \_\_\_\_\_

END

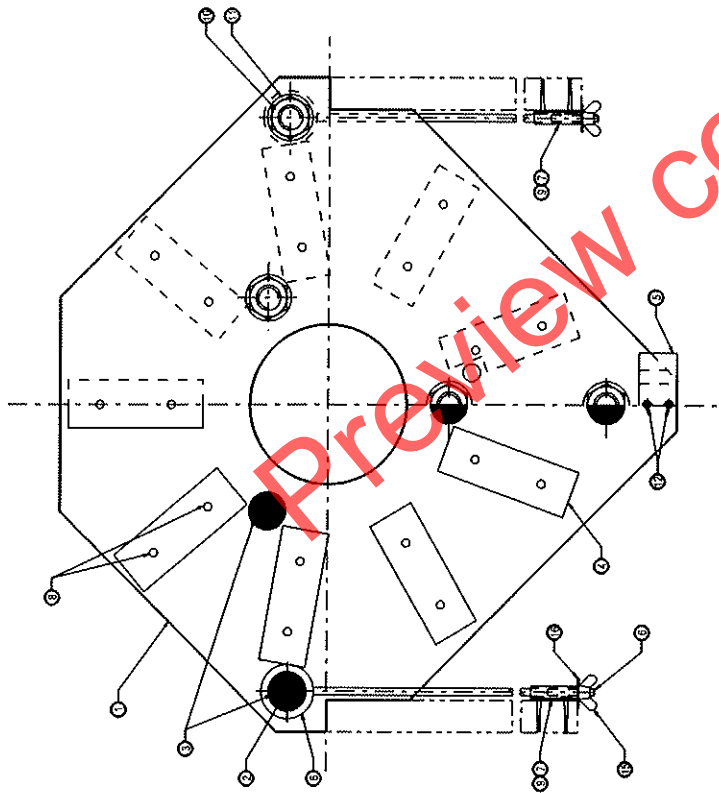
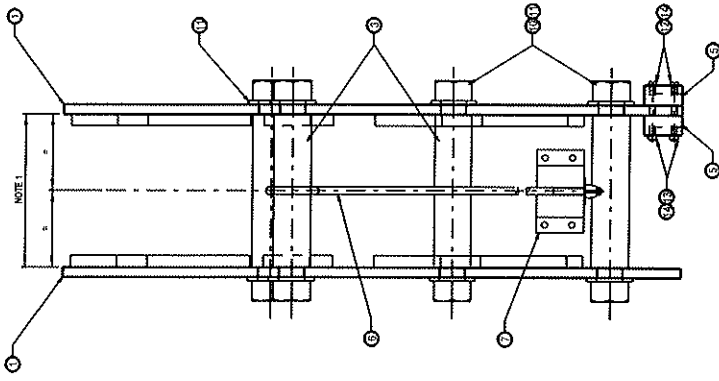
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**APPENDIX B**  
**TECHNICAL DATA SHEET**

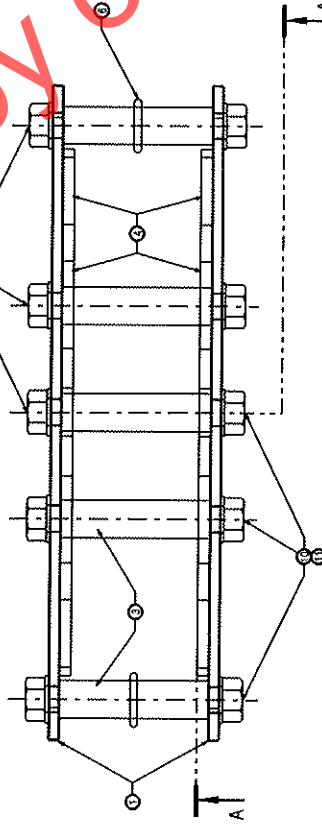
(To be filled in by Tenderer)

- Capacitance Value ( $C_N$ ): \_\_\_\_\_
- Capacitance Tolerance: \_\_\_\_\_
- Detailed Description of Capacitor: \_\_\_\_\_
- Overall Mass of the Capacitor: \_\_\_\_\_
- Overall Dimensions of the Capacitor: \_\_\_\_\_
- Dielectric Insulating Medium: \_\_\_\_\_
- Container Material: \_\_\_\_\_
- Rated Current in RMS ( $I_N$ ): \_\_\_\_\_
- Rated Voltage in RMS ( $U_N$ ): \_\_\_\_\_
- Rated Output ( $Q_N$ ): \_\_\_\_\_
- Temperature Category: \_\_\_\_\_
- Maximum Permissible AC Current: \_\_\_\_\_
- Maximum Permissible AC Voltage: \_\_\_\_\_
- Maximum Permissible Temperature: \_\_\_\_\_
- Capacitor Losses: \_\_\_\_\_
- Active Power: \_\_\_\_\_
- Steady State Condition: \_\_\_\_\_
- Residual Voltage: \_\_\_\_\_
- BIL (Bushing): \_\_\_\_\_
- Life Expectancy: \_\_\_\_\_

**END**



SECTION A - A



NOTES

1. FOR SMALL AND LARGE COILS SEE DIMENSION "D" ON DRG NO BBB3484 ITEMS 2 & 3.
2. CAPACITY OF ASSOCIATED CAPACITOR TO BE STENCILED ON COIL CHEEK.
3. FOR FRAMEWORK FOR SUPPORTING WAVE FILTER HARMONIC COILS SEE DRG NO BBB3485.
4. FOR SUPPORT BRACKET FRAMEWORK FOR WAVE FILTER HARMONIC COILS SEE DRG NO BBB3499.
5. FOR DETAILS OF COIL WINDINGS SEE DRG NO BBB3486.
6. FOR SPECIFICATION SEE DOCUMENT NO BBB3182.

ITEM NO	DESCRIPTION	QTY	STORAGE
1	WASHER, BRASS, FLAT, ROUND, #8 S.D., X .75 O.D., X 1.76	2	
2	WASHER, BRASS, FLAT, ROUND, #8	2	
3	WASHER, BRASS, FLAT, ROUND, #8	2	
4	NUT, BRASS, HEX HEAD, #8	2	
5	NUT, BRASS, HEX HEAD, #8	2	
6	CHEESE HEAD BRASS SCREWS #4 X .45	2	
7	WASHER, BRASS, FLAT, ROUND, #20	12	
8	NUT, BRASS, HEX HEAD, #20	12	
9	WOODSCREW, BRASS, No. 10 X 2.5L	8	
10	DOWEL, WOOD #2 X 2.0L	35	
11	CLAMPING SADDLE	2	
12	TREASURED CLAMPING ROD	2	
13	SPACER	2	
14	CLAMPING ROD TUBE	15	
15	CLAMPING ROD	6	
16	COIL CHEEK	2	
17	COIL CHEEK	2	
18	COIL CHEEK	2	
19	COIL CHEEK	2	
20	COIL CHEEK	2	
21	COIL CHEEK	2	
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99	COIL CHEEK	2	
100	COIL CHEEK	2	

SPOORNET  
 BBB3483  
 VERSION 1

WAVE FILTER HARMONIC COIL CARRIER ASSEMBLY  
 3KV DC SUBSTATION

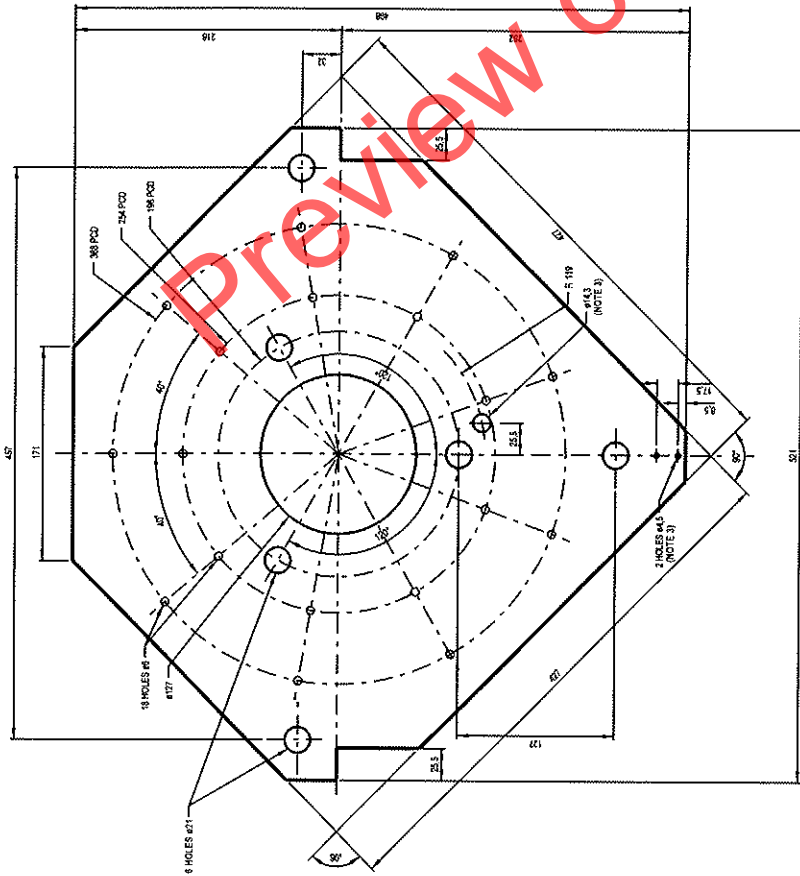
CENTRAL DRAWING OFFICE

APPROVED  
 AUTHORIZED

DATE:

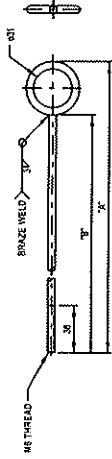
DO REF : CD07183  
 ECP REF : 2002472  
 DESIGNED : Anthony  
 CHECKED : JD WFD/OK

DIMENSIONS : mm  
 UNIT : mm  
 SCALE : 1:1  
 ITEM NO :  
 VERSION INFO : RESSAWM, DRG NO WAS EWM/EG-240  
 CHECKED : JD WFD/OK

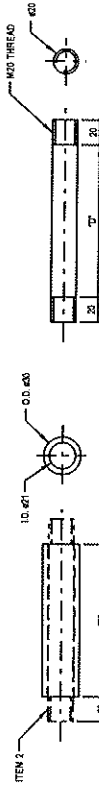


ITEM 1

TABLE	
TYPE OF COIL	DIMENSION "B"
0TH AND 18TH HARMONIC COIL	233.5
12TH AND 24TH HARMONIC COIL	140



ITEM 6

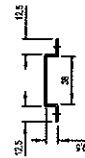


ITEM 2

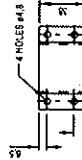
ITEM 2 MUST BE A FREE FIT IN ITEM 3

DIMENSION "A" FOR SMALL COIL: 70.5mm  
 DIMENSION "A" FOR LARGE COIL: 72mm  
 DIMENSION "D" TO BE ADJUSTED TO SUIT FINISHED SIZE OF COILS TO ENSURE COILS ARE FIRMLY CLAMPED.

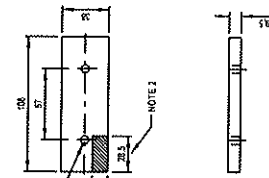
ITEM 3



ITEM 5



ITEM 7



ITEM 4

NOTES  
 1. FOR ASSEMBLY SEE DRG NO BB3484-010  
 2. BRILL HOLES #4.5 AND #4.3 ON ONE CHECK ONLY.

ITEM NO	DESCRIPTION	QTY	STORAGE	DRAWING NO
1	BRASS PLATE 30 x 1.18 x 65.5	2		
2	BRASS ROD #8 (SEE TABLE FOR LENGTH)	2		
3	HARD WOOD 30.5 x 44 x 115	2		
4	GLASS REINFORCED PLASTIC FIBRE GLASS 30 x 118 x 63	16		
5	GLASS REINFORCED PLASTIC FIBRE GLASS ON THERMO TUBE #30 O.D. x 27 I.D. x 30" L	6		
6	BRASS ROD #8 x 30" L	6		
7	FRIBRO CLAMPERS (TOUNG) 452 x 452 x 8	2		



DATE:

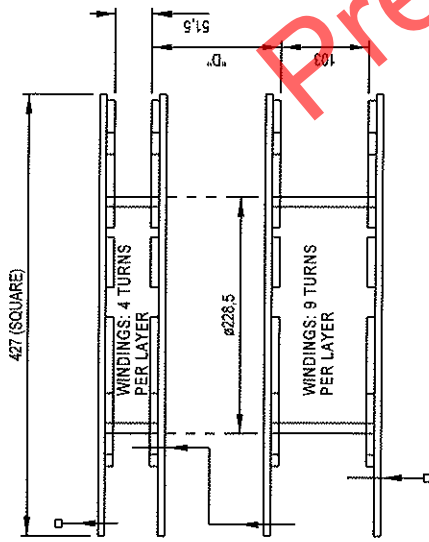
DD REF : C007193  
 EDP REF : 202-072  
 MATERIAL : Fibreglass  
 DESIGNED : J. B. WEDY  
 CHECKED :

© COPYRIGHT PROTECTED  
 DIMENSIONS : mm  
 SCALE : 1:1.2  
 MATERIAL : UNL 0.5 ANG 4 OF 36  
 VERSION INFO : REDRAWN, DRG NO WAS ENW4E1C241

CENTRAL DRAWING OFFICE  
 WAVE FILTER HARMONIC COIL CARRIER COMPONENTS  
 3KV DC SUBSTATION

SPOORNET  
 BBB3484  
 VERSION 1

**SPOOL AND WINDING DETAILS**



**PARTICULARS OF WIRE:-**  
 STRANDING: 37/1, 1176 DOUBLE BRAIDED.  
 CROSS SECTIONAL AREA: 36.3096  
 DIMENSIONS OVER BRAIDING: 10.5 x 8 (APPROXIMATELY)  
 RESISTANCE: 0.000487 ohm/m AT 15.5°C

**SERIES REACTOR:-**  
 1. (a) 1.76mH (ACTUAL VALUE) (b) 0.004574 ohm (CALCULATED) COPPER.  
 2. (a) 1.76mH (ACTUAL VALUE) (b) 0.00741 ohm (CALCULATED) ALUMINIUM.

HARMONIC SHUNT	CONDENSER CAPACITY (µF)	No OF PAIRS OF COILS	MUTUAL INDUCTANCE (mH)		NUMBER OF TURNS			SPACING OF COILS "g" (mm)	APPROXIMATE LENGTH OF WINDING (m)	RESISTANCE OF SHUNT COILS (PER PAIR) DC ohms	REDUCTION FACTOR	HARMONIC (Volts.)		CURRENT (Amps.)			
			REQUIRED	CALCULATED	LARGE COIL LAYERS & TURNS	SMALL COIL TOTAL LAYERS	TOTAL					CONTINUOUS	30min.	CONTINUOUS	30min.		
6th	1 x 100	1	2.814	2.826	9 + 7	88	7	95	111	0.0518		205	217	305	61.8	65.4	91.9
12th	3 x 20	1	1.173	1.189	6 + 2	56	6	115	70	0.0327		104	154	158	15.68	23.2	23.8
18th	1 x 20	1	1.564	1.557	7 + 4	67	5	115	78	0.0364		66.2	91.2	116	6.65	9.17	11.65
24th	1 x 10	1	1.759	1.769	7 + 7	70	6	115	85	0.0430		50.5	63	38	3.81	4.75	6.64

**NOTES**

- 12th AND 24th SHUNT COIL TURNS ALTERED TO SUIT 60 AND 10µF CONDENSERS RESPECTIVELY.
- ALL COILS TO BE BOUND IN 6 POSITIONS WITH 6 TURNS OF MASON'S LINE AND VARNISHED.
- VALUE OF ASSOCIATED CONDENSER TO BE CLEARLY STENCILLED ON BOTH COILS.
- BOTH COILS WOUND IN THE SAME DIRECTION AND CONNECTED AS SHOWN BY ARROWS.
- WIRE TO BE WOUND ON FLAT i.e. WITH 10.5 SIDE TOWARDS COIL AXIS.
- FOR ALTERNATIVE WIRE AND "AS WOUND" DETAILS SEE DRG NO BBB3487 (HARMONIC FILTER COILS).

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DIMENSIONS : mm  
 TOLERANCE : LIN± - ANG±  
 MATERIAL : -  
 VERSION INFO : REDRAWN, DRG NO WAS ENW E1C-367 SHT 1

DO REF : COO/2189  
 ECP REF : 2032-072  
 DRAWN : JR Anthony  
 DESIGNED : -  
 CHECKED : JD van Dyk

DATE:

--- APPROVED ---  
 --- AUTHORIZED ---

CENTRAL DRAWING OFFICE

**INDUCTANCE COILS FOR RESONANT SHUNT CIRCUITS**  
**3KV DC TRACTION SUBSTATION**



BBB3486  
 VERSION 1

A3



PARTICULARS OF WIRE	HARMONIC	MUTUAL INDUCTANCE (mH)	NUMBER OF TURNS			APPROXIMATE LENGTH OF WINDING (m)	MUTUAL INDUCTANCE OF MASTER COILS AT MAX. AND MIN. SPACING. (mH)
			LARGE COIL		SMALL COIL		
			LAYERS & TURNS	TOTAL			
DIMENSIONS OVER BRAIDING: 10,5mm x 8mm APPROXIMATE. 37/1.1176 DOUBLE BRAIDED.	6th	2,814	10 + 2	92	7 + 1	29	Max. 2,630 Min. 3,010
	12th	1,173	5 + 8	53	7 + 1	29	Max. 1,090 Min. 1,270
	18th	1,564	7 + 1	64	7 + 1	29	Max. 1,440 Min. 1,660
	24th	1,759	7 + 7	70	7 + 1	29	Max. 1,650 Min. 1,890
DIMENSIONS OVER BRAIDING: 10,5mm x 8mm APPROXIMATE.	6th	2,814	10 + 1	91	7 + 1	29	Max. 2,645 Min. 3,018
	12th	1,173	5 + 7	52	7 + 1	29	Max. 1,080 Min. 1,250
	18th	1,564	7 + 1	64	7 + 1	29	Max. 1,460 Min. 1,700
	24th	1,759	7 + 5	68	7 + 1	29	Max. 1,650 Min. 1,889

**NOTES**

1. MASTER COIL INDUCTANCES OF THE MASTER COILS WERE MEASURED WITH THE COILS ASSEMBLED IN CHEEKS ETC. AND MOUNTED ON THE STANDARD RACK.
2. FOR CALCULATED WINDING DETAILS SEE DRG NO BBB3486 (INDUCTANCE COILS FOR RESONANT SHUNT CIRCUITS).



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DIMENSIONS : mm  
 TOLERANCE : LIN± . ANG± .  
 MATERIAL :  
 VERSION INFO : REDRAWN, DRG NO WAS ENW ETC-367 SHT 2

DO REF : CDO/2183  
 ECP REF : 2002-072  
 DRAWN : JR Anthony  
 DESIGNED :  
 CHECKED : JD van Dyk

DATE:

--- APPROVED ---  
 --- AUTHORISED ---

CENTRAL DRAWING OFFICE

**HARMONIC FILTER COIL WINDING DETAILS (AS WOUND)**  
**3KV DC TRACTION SUBSTATION**

**SPOORNET**

BBB3487  
 VERSION 1

A3



**TRANSNET**  
freight rail

**TECHNOLOGY MANAGEMENT.**

**SPECIFICATION.**

**TRANSNET FREIGHT RAIL'S REQUIREMENTS FOR THE  
INSTALLATION OF ELECTRICAL EQUIPMENT FOR 3kV DC  
TRACTION SUBSTATIONS**

Author	Chief Engineering Technician Technology Management	B.L. Ngobeni
Approved:	Senior Engineer Technology Management	L.O. Borchard
Authorised:	Principal Engineer Technology Management	W. A. Coetzee

*[Handwritten signature of B.L. Ngobeni]*  
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*[Handwritten signature of L.O. Borchard]*  
.....

*[Handwritten signature of W.A. Coetzee]*  
.....

Date: 06<sup>th</sup> October 2011

Preview copy only.

Circulation Restricted To:

Transnet Freight Rail – Chief Engineer Infrastructure  
- Technology Management

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**SECTION 1: SUBSTATION DESIGN INFORMATION**
**1.0 SCOPE**

- 1.1 This specification covers Transnet Freight Rail's requirements for the installation of electrical equipment in 3kV DC traction substations.
- 1.2 This specification should be read with the Scope of Work specification for each site/project and the applicable equipment specifications.
- 1.3 This specification also covers the requirements for the supply of security fencing, preparation of the High Voltage (HV) outdoor yard and the erection of all structural steelwork.

**2.0 STANDARDS, PUBLICATIONS AND DRAWINGS**

Unless otherwise specified this specification must be read in conjunction with the current edition of the relevant SANS, BS and Transnet Freight Rail's specifications.

**2.1 SOUTH AFRICAN NATIONAL STANDARDS (SANS)**

SANS 121:	Hot dip galvanized coatings for fabricated iron or steel articles. Specifications and test methods.
SANS 156:	Moulded-case Circuit Breakers.
SANS 780:	Distribution Transformers.
SANS 1019:	Standard voltages, currents and insulation levels for electricity supply.
SANS 1091:	National Colour Standard.
SANS 1222:	Enclosures for Electrical Equipment.
SANS 1339:	Cross-Linked Polyethylene (XLPE) - Insulated Electric cables for rated voltages (3,8/6,6kV to 19/33kV)
SANS 1431:	Weldable structural steels.
SANS 1507:	Electric cables with extruded solid dielectric insulation for fixed installations. (300/500V to 1900/3,300V) Part 1
SANS 10142-1:	The wiring of premises. Part 1
SANS 60044-1:	Instrument Transformers Part 1. Current Transformers.

**2.2 TRANSNET FREIGHT RAIL SPECIFICATIONS/ ENGINEERING INSTRUCTIONS**

CEE.0023:	Laying of cables.
CEE.0045:	Painting of steel components of electrical equipment.
CEE.0099:	Specification for 3kV DC high speed circuit breakers for traction substations.
CEE.0224:	Drawings, catalogues, instruction manuals and spares lists for electrical equipment supplied under contract.
CEE.0227:	The manufacture of 3kV DC breaker cells and trucks.
BBB 0496:	3kV rectifier for traction substations.
BBB 0845:	Requirements for metal oxide surge arresters in accordance with SANS 60099-4.
BBB 1267:	Specification for Outdoor High Voltage Alternating Current Circuit Breaker in Accordance with SANS 62271-100.
BBB 1616:	450 Volt gas arrester spark gap for traction power supplies.

BBB 2502:	Requirements for battery charger for 3kV DC traction substations.
BBB 2721:	AC primary circuit breaker control panel and AC/DC distribution panel for 3kV traction substation.
BBB 3005:	3kV DC under voltage relay manufacturing specification.
BBB 3139:	Wave filter capacitors for 3kV DC traction substations.
BBB 3162:	Wave filter inductors for 3 kV DC traction substations.
BBB 3890:	Requirements for 1.8 milli Henry DC reactor for 3kV DC traction substations.
BBB 5019:	Requirements for traction transformers for 3kV DC traction substations in accordance with BS 171 and IEC 60076-1.
BBB 7842	Outdoor, High Voltage, Alternating Current Disconnectors combined with earthing switch.
BBC 0198:	Requirements for the supply of cables.
BBC 0330:	Isolation transformer.

### 2.3 STATUTORY REQUIREMENTS

Occupational Health and Safety Act and Regulations, Act 85,1993

### 3.0 TENDERING PROCEDURE

- 3.1 Tenderers shall indicate clause-by-clause compliance with the specification as well as the relevant equipment specifications. This shall take the form of a separate document listing all the specifications clause numbers indicating the individual statement of compliance or non-compliance.
- 3.2 The tenderer shall motivate a statement of non-compliance.
- 3.3 Tenderers shall submit descriptive literature consisting of detailed technical specifications, general constructional details and principal dimensions, together with clear illustrations of the equipment offered.
- 3.4 Failure to comply with clauses 3.1, 3.2, and 3.3 could preclude a tender from consideration.

### 4.0 SERVICE CONDITIONS

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

Altitude:	0 to 1800m above sea level.
Ambient temperature:	-5°C to +45 °C.
Relative humidity:	10% to 90%
Lightning Conditions:	12 ground flashes per square kilometre per annum.
Pollution:	Heavily salt laden or polluted with smoke from industrial sources.

### 5.0 ELECTRICAL SERVICE CONDITIONS

- 5.1 The incoming AC voltage can vary  $\pm 5\%$  of the nominal system r.m.s voltage. Under crippled conditions the supply voltage can drop to as low as minus 15% of the nominal r.m.s voltage.
- 5.2 Frequency of the supply voltage is  $50 \pm 2.5$  Hz.
- 5.3 The AC high voltage system shall be treated as effectively earthed unless otherwise specified.
- 5.4 The traction DC supply voltage is 3,15 kV DC nominal but can vary between 2,4kV and 3,9kV for sustained periods.
- 5.5 The 3kV DC equipment may be subjected to fault currents up to 30kA for 200 milli seconds.

## **6.0 GENERAL REQUIREMENTS**

- 6.1 Equipment/Installations supplied shall be in terms of this specification. Deviations from the specification will not be allowed without the written consent of the Project Manager/Engineer.
- 6.2 Transnet Freight Rail reserves the right to subject material and equipment offered to test or inspection to verify compliance with the clauses of this specification, prior to adjudication or at any stage during manufacture.
- 6.3 The tenderer shall submit the layout drawings of equipment, electrical wiring schematics, and constructional designs to Transnet Freight Rail for design review.
- 6.4 The successful tenderer will be responsible for all costs caused by modifying or replacing equipment accepted by Transnet Freight Rail on the grounds of his statement of compliance and found by Transnet Freight Rail not to comply.
- 6.5 All equipment shall be adequately earthed, insulated, enclosed and interlocked to ensure the safety of staff as well as equipment.
- 6.6 The general design and layout of all equipment shall provide for easy access to all parts.
- 6.7 The equipment shall be installed in such a manner so as to limit fire damage, which may be caused by equipment failure, overheating or flashovers.
- 6.8 The substation control and protection circuits shall be designed and wired according to the fail-safe principle. Control equipment, contactors and relays shall de-energise under fault, power failure or alarm (flag) conditions.
- 6.9 No high voltage cables shall be laid in the same trench or duct as low voltage cables.

## **7.0 GENERAL DESIGN OF EQUIPMENT**

- 7.1 This section covers substation equipment with electrical capacities between 3,0 MW and 6,0 MW.
- 7.2 The overload ratings of the rectifier units shall be:
- 2 times full load for thirty minutes.
  - 3 times full load for one minute.
  - 3 ½ times full load for ten seconds.
- 7.3 The substation can either be a single unit or double unit substation. Each unit comprises of one set of high voltage AC switchgear, one rectifier transformer, and one rectifier assembly, connected for 6 or 12 pulse operation and protected by a AC primary circuit breaker.
- 7.4 For a double unit substation each unit shall have the overload rating as specified in clause 7.2.
- 7.5 Each substation unit shall be capable of operating independently to allow for maintenance, fault finding and servicing of the equipment.

## **8.0 INSULATION AND CLEARANCES FOR 3kV DC EQUIPMENT**

- 8.1 All indoor equipment, which may be energised at a potential of more than 1,0kV shall be protected by, metal barriers, mesh type screens or panels.
- 8.2 The minimum clearance in air between the rectifier unit and any metal barriers, mesh type screens or panels shall not be less than 450mm.
- 8.3 All exposed electrical equipment and busbars connected between the rectifier transformer secondary and the rectifier cubicle(s), or between the rectifier cubicle(s), positive isolators, DC smoothing equipment or track breakers, which is at a potential above 1,0kV, shall be arranged so that there is a minimum clearance of 2,7 m from the lowest "live" high voltage connections and ground or the floor of the access way, unless suitably screened, or otherwise protected.
- 8.4 All nominal 1,5kV and 3kV insulation to earth shall be designed such that the complete rectifier assembly, when installed on site ready for commissioning, will successfully withstand a test voltage of 10,5kV, 50 Hz AC for one minute.

- 8.5 Where the equipment or subassemblies of the rectifier assembly is enclosed and insulated from the outer framework, the insulation between the equipment and outer framework shall withstand the test voltage of 10,5kV 50 Hz for one minute.
- 8.6 The clearance between the reactor and any metal frame shall not be less 100mm. The reactor must successfully withstand a test voltage of 10,5kV AC 50 Hz for one minute
- 8.7 The successful tenderer shall advise what precautions must be taken before undertaking the withstand insulation level voltage tests to avoid damage to the equipment.
- 8.8 Creepage distance of insulation and the required air clearances shall be as large as possible. The latter shall not be less than:
- Outdoors: 150mm between the transformer secondary busbars and any steelwork such as wall plates, screening etc.
  - Indoors: 100mm between the equipment at nominal 1,5kV or 3kV DC and negative busbars and panel steelwork, between the high voltage AC supply to the rectifier cubicles and panel steelwork, the equipment at nominal 3kV DC and negative busbars.

## 9.0 OUTDOOR CLEARANCES AND INSULATION LEVELS

- 9.1 The minimum safety outdoor earth clearances which shall be maintained between any live conductor or metal and earthed metal and the minimum clearances of power lines above ground are in accordance with the statutory requirements of clause 15.1 of the "Electrical Machinery Regulations" of the "Occupational Health and Safety Act and Regulations, Act 85,1993", and are tabled below: -

**TABLE 1:**

Highest phase-to-phase r.m.s voltage for equipment. ( $U_m$ )	24kV	36kV	48kV	72kV	100kV	145kV
Nominal system r.m.s. voltage. ( $U_n$ )	22kV	33kV	44kV	66kV	88kV	132kV
Minimum safety outdoor clearance	320mm	430mm	540mm	770mm	1000mm	1450mm
Minimum clearance of power lines above ground						
Outside security fence but within Transnet Freight Rail's reserve	5200mm	5300mm	5400mm	5700mm	5900mm	6300mm
Outside Transnet Freight Rail's reserve	5500mm	5500mm	5500mm	5700mm	5900mm	6300mm

- 9.2 In terms of Transnet Freight Rail's Electrical Safety Instructions the clearances between the nearest exposed electrical equipment and a restricted access way are tabled below: -

**TABLE 2:**

Highest phase-to-phase r.m.s voltage for equipment. ( $U_m$ )	24kV	36kV	48kV	72.5kV	100kV	145kV
Nominal system r.m.s. voltage. ( $U_n$ )	22kV	33kV	44kV	66kV	88kV	132kV
Restricted access way (Vertical height) *	2820mm	2930mm	3040mm	3270mm	3500mm	3950mm



\*See clause 903.1.3 of "Transnet Freight Rail's Electrical Safety Instructions"

(The vertical heights in restricted access ways for the various system voltages are calculated by adding 2,5metres to the normal outdoor earth clearance for the different system voltages. Refer to Annexure 9.4 of Transnet Freight Rail's Electrical safety Instructions).

### INSULATION LEVELS

- 9.2 For the medium and high voltage nominal r.m.s voltage systems on Transnet Freight Rail the recommended Insulation levels in accordance with SANS 1019 is tabled in table 3.

**TABLE 3**

Highest phase-to-phase r.m.s voltage for equipment. ( $U_m$ )	Nominal system r.m.s. voltage. ( $U_n$ )	Rated lightning impulse withstand voltage peak.	Rated short duration power- frequency withstand r.m.s voltage.
7,2 kV	6,6 kV	75 kV	22 kV
12 kV	11 kV	95 kV	28 kV
24 kV	22 kV	150kV	50 kV
36 kV	33 kV	200 kV	70 kV
52 kV	44 kV	250 kV	95 kV
72,5 kV	66 kV	350 kV	140 kV
100 kV	88kV	380 kV 450 kV	150 kV 185 kV
145 kV	132 kV	550 kV 650 kV	230 kV 275 kV
245 kV	220 kV	850 kV 950 kV	360 kV 395 kV

Insulation levels for highest voltage for equipment  $U_m < 100$  kV are based on an earth fault factor equal to  $\sqrt{3}$  and for  $U_m > 100$  kV an earth fault factor equal to  $0,8\sqrt{3}$ . Where more than one insulation level is given per voltage system, the higher level is appropriate for equipment where the earth fault factor is greater than 1,4.

**TABLE 3:** Standard Voltages and insulation levels in accordance with SANS 1019:2008 [1]

## SECTION 2: TRACTION SUBSTATION EQUIPMENT

### OUTDOOR YARD EQUIPMENT

#### 10.0 METAL OXIDE SURGE ARRESTERS

- 10.1 The contractor shall supply and install metal oxide gapless surge arresters in accordance with Transnet Freight Rail's specification BBB 0845.
- 10.2 The surge arresters shall be connected between each phase of the high voltage supply and substation main earth electrode/earth mat
- 10.3 The maximum protected distance from the main transformer bushing terminal to the surge arrester terminal shall be as indicated in table 4.

**TABLE 4:**

NOMINAL SYSTEM R.M.S VOLTAGE (kV)	MAXIMUM DISTANCE (Metres)
44kV	5
66kV	6
88kV	6
132kV	7

- 10.4 The neutrals of high voltage supplies are to be treated as effectively earthed unless otherwise specified.
- 10.5 For the installation of high voltage surge arresters on the main transformer, refer to Transnet Freight Rail's drawing BBB 0938
- 11.0 HIGH VOLTAGE AC DISCONNECTOR**
- The contractor shall supply and install the high voltage AC disconnecting switch in accordance with Transnet Freight Rail's specification BBB 7842.
- 12.0 HIGH VOLTAGE PRIMARY CIRCUIT BREAKER**
- The contractor shall supply and install the high voltage AC primary circuit breaker in accordance with Transnet Freight Rail's specification BBB 1267.
- 13.0 MAIN CURRENT TRANSFORMERS**
- 13.1 The main current transformers shall comply with the requirements of Transnet Freight Rail specification BBB 0937.
- 13.2 The main current transformers shall either be fitted in the high voltage bushings of the main traction transformer or shall be the freestanding post type current transformers install on the line side of the main traction transformer.
- 13.3 In the event of Eskom or Local Utility requiring three current transformers for metering purposes the successful contractor shall supply and install the additional current transformer.
- 13.4 The ratios, accuracy and burdens of the current transformers shall be in accordance with Transnet Freight Rail's Specification BBB 0937.as specified:
- 14.0 MAIN TRACTION TRANSFORMER**
- 14.1 The contractor shall be responsible for the delivery, assembling, filling of transformer oil and installation on site of the main traction transformer in accordance with Transnet Freight Rail's Specification BBB 5019.
- 15.0 AUXILIARY TRANSFORMER**
- 15.1 The contractor shall make provision for the supply of an auxiliary transformer which shall comply with the requirements of SANS.780
- 15.1.1 The auxiliary transformer shall be three phase with a minimum rating of 50kVA or higher depending on the substation requirements.
- 15.1.2 The 3 phase auxiliary transformer shall be supplied from the tertiary winding of the main traction transformer
- 15.1.3 The auxiliary transformer shall be the sealed unit type suitable for outdoor installation. Full details of the transformer shall be submitted.

- 15.2 In the case of a double unit substation one auxiliary transformer may be provided unless otherwise specified.
- 15.3 The secondary winding of the auxiliary transformer shall be star-connected.
- 15.4 The auxiliary transformer shall supply the required kVA rating without exceeding the permissible temperature rise laid down in SANS 780.
- 15.5 The nominal no-load secondary voltage of the auxiliary transformer shall be 400V three phase.
- 15.6 Off-load, externally operated tap changing gear shall be provided on the transformer, with tapplings to compensate for any change in the main transformer tapping.
- 15.7 All primary and secondary terminals, including the secondary neutral, shall be brought out through the transformer tank by means of bushing type terminals and shall be arranged for busbar/cable connections.

## **16.0 AUXILIARY TRANSFORMER PROTECTION**

### **PRIMARY WINDING**

- 16.1 The contractor shall make provision for overload protection of the primary winding. Refer to clause 8.8 of specification No BBB 2721.
- 16.2 The protection system shall consist of an approved type of overload relay with its associated current transformers.

### **16.3 SECONDARY WINDING**

- 16.4 The contractor shall supply and install a three phase isolating and earthing switch for the secondary supply of the auxiliary transformer to the substation.
- 16.5 The isolating and earthing switch shall be fitted with mechanical interlocking of the key exchange type, which shall form part of the interlocking procedure for the substation. Refer to clauses 31.0 and 32.0 of this specification.

## **17.0 AC EARTH LEAKAGE CURRENT TRANSFORMER.**

- 17.1 The contractor shall supply and install a bar primary current transformer for the AC earth leakage protection. The current transformer shall be installed on the support steel structure of the primary circuit breaker.
- 17.2 One terminal of the primary winding shall be connected to the primary circuit breaker frame and the other terminal shall be connected to the substation main earth electrode/mat. (Refer to drawing CEE-TBD-7 and BBB 3620).
- 17.3 The current transformer shall be class 10P10, ratio 50/5 or 100/5.
- 17.4 The current transformer shall be designed to withstand a test voltage of 2kV for 1 minute.

### **INDOOR EQUIPMENT**

## **18.0 3kV DC RECTIFIER**

- 18.1 The contractor shall supply and install 3kV DC rectifiers in accordance with Transnet Freight Rail's Specification BBB 0496.
- 18.2 Each rectifier unit and its associated control equipment shall be designed to form an independent unit.
- 18.3 The rectifier equipment shall be installed in screened bays fitted with gates.
- 18.4 The gates shall be fitted with mechanical interlocks of the key exchange type in accordance with clauses 31 and 32 of the specification.
- 18.5 The bay screens shall be constructed of approximately 25mm woven wire mesh or expanded metal fixed to tubular or angle iron frames complete with doors, pillars, gates etc.

- 18.6 The height of the screens and gates shall be similar to the height of the control panels but shall be not be less than 1,8 m.
- 18.7 In a double unit substation the rectifier units are referred to as the "A" and "B" units and shall be labelled as such.
- 18.8 It is required that each rectifier unit in a double unit substation can be isolated independently and earthed without shutting down the whole substation.
- 18.9 Individual rectifier units shall be screened from each other and from any other live common equipment. A mechanical key exchange interlocking system type in accordance with clauses 31 and 32 shall be fitted to ensure the safety of personnel working on the isolated rectifier equipment.
- 18.10 The rectifier units and bay screens shall be insulated from the floor.

### **19.0 3kV DC REACTOR**

- 19.1 The contractor shall supply and install a 1.8 milli Henry 3kV DC air core reactor for each rectifier unit. The installation shall include the supply of all the required insulators, foundations, foundation bolts and fasteners.
- 19.2 The 3kV DC reactor shall be in accordance with Transnet Freight Rail's Specification BBB 3890.
- 19.3 The reactor shall be insulated from the substation floor by means of insulators.
- 19.4 Sufficient space shall be allowed for access to the reactor for maintenance and inspection purposes.

### **20.0 WAVE FILTER**

- 20.1 The contractor shall supply and install the wave filter equipment in accordance with Transnet Freight Rail's specification BBB 3139 for wave filter capacitors and BBB 3162 for inductor coils.
- 20.2 A wave filter is connected in parallel with the rectifier output. The filter unit is a capacitive inductive circuit, which is tuned to resonate at specific harmonic frequencies.
- 20.3 The filter equipment shall be so designed that no individual harmonic voltage is greater than 2% of the output voltage.
- 20.4 The inductor coils shall have sufficient adjustment to compensate for change in the capacitance values due to ageing. Refer to Transnet Freight Rail's drawing BBB 3483 for assembly.
- 20.5 A 100 Ampere High Rupturing Capacity (H.R.C) fuse shall be fitted to protect the wave filter equipment.
- 20.6 The fuse holder shall be mounted on insulators.
- 20.7 The insulators shall be so designed that the flashover path is not less than 100mm and shall support the fuse at a distance of not less than 100mm from the bolts securing the base plate. The insulators shall have a minimum dry flashover value of 20kV.
- 20.8 Access to the wave filter equipment shall only be possible once the wave filter capacitors have been connected to rail, discharged and the primary circuit breaker tripped.  
A 75 kilo Ohm resistor consisting of two 150 Kilo Ohm, 150 watt vitreous enamel resistors connected in parallel shall be provided for the discharging of the wave filter capacitors when the equipment is isolated and earthed.
- 20.9 The discharge resistors shall be mounted on a suitable insulation panel or bar, which shall be insulated for 3kV DC. A minimum clearance of 75mm must be provided between the terminals, and 100mm between any 3kV live portion of the equipment and earth.
- 20.10 The wave filter capacitors shall be earthed with 95mm<sup>2</sup> PVC insulated copper cables to the DC earth leakage system.
- 20.11 The wave filter equipment shall be housed in a separate explosion proof room or cubicle.

**21.0 3kV DC POSITIVE ISOLATOR**

21.1 The contractor shall supply and install the 3kV DC positive isolator in accordance with Transnet Freight Rail's specification BBB 4724.

21.2 The DC positive isolator metal cubicle/housing shall be insulated from the substation floor.

**22.0 CONTROL PANELS**

22.1 The contractor shall supply and install the AC primary circuit breaker control panel and the AC/DC distribution panel in accordance with Transnet Freight Rail's specification BBB 2721.

22.2 The control panels shall be insulated from the substation floor.

**ELECTRONIC EQUIPMENT**

22.3 The tenderer must be aware that high voltage surges and transient voltages can be induced in low voltage and control wiring due to switching and lightning. Special care shall be taken in the design and layout of the equipment to limit these voltages.

22.4 Electronic equipment shall suitably be protected against over voltages, surges and transients. Dehn type surge protection units or equivalent shall be used. Liberal use of metal oxide varistors is also encouraged.

**23.0 BATTERIES**

23.1 The contractor shall supply, install and commission a 53 cell 110 Volt Plante lead acid battery bank. The capacity of the battery can either be 100 Ampere hour rating, 200 Ampere hour rating or capacity dependant on the substation requirements. The standard for the batteries shall be the 10-hour rate at 20°C. The battery shall be capable of delivering a minimum of 10 Amperes for 10 hours.

23.2 Batteries are installed in traction substations for control and protection purposes. The battery is used for the following functions:

- Tripping and closing of primary circuit breakers.
- Supply to protection relays.
- Closing and holding coil supply to DC high speed circuit breakers.
- 110 Volt supply to control panel.

**24.0 BATTERY CHARGER.**

24.1 The contractor shall supply and install the battery charger in accordance with Transnet Freight Rail's specification BBB 2502.

24.2 The battery charger shall be insulated from the substation floor by means of "Marley" or "Lino" floor covering not less than 2mm thickness.

**25.0 TRACK FEEDER HIGH SPEED CIRCUIT BREAKERS**

25.1 The successful tenderer shall supply and install the required 3kV DC high speed circuit breakers in accordance with Transnet Freight Rail's specification CEE.0099 as well as with the following additional requirements:

25.2 The high-speed circuit breakers shall be of the conventional truck mounted type as commonly used by Transnet Freight Rail in the 3kV DC traction substations.

25.3 High-speed circuit breakers shall be fitted with an automatic reclosing feature, which provides for 1 (one) reclosure at 20 to 35 seconds interval. Refer to drawings CEE-TBP-35. "Connection diagram for the high speed circuit breaker and electronic control relay". CEE-TBP-39."Circuit diagram for auto reclosure for the high speed circuit breaker.

25.4 Transnet Freight Rail shall provide the auto reclosure relays. The relays shall be wired by the contractor in accordance with the requirements of clause 25.3.

- 25.5 The high speed circuit breakers shall be complete in all respects. This shall include housings, rack out trucks, base rails, main and auxiliary contacts and flapper gear and any other fittings or equipment required for the correct operation of the high-speed circuit breakers.
- 25.6 The high-speed circuit breakers shall be racked into breaker cells, each having two fixed contacts mounted at the rear of the breaker cell. One contact is connected to the substation positive busbar and the other to a wall bushing mounted in the building outer wall.
- 25.7 All other items of material such as cell slabs, main busbars, earthing connections, wall bushing plates or blanking-off plates, control cables etc, shall be included in the tenderer's offer.
- 25.8 Transnet Freight Rail shall provide details of the wall plate frame and standard cell slabs where applicable.
- 25.9 Where access is possible to the rear of the high-speed circuit breakers (busbar chamber) access barriers shall be installed.
- 25.9.1 The barriers shall be fixed to angle iron frames with fasteners which only be removed with tools. Warning signs shall be fitted to the barriers.

## **26.0 MODULAR TYPE STEEL HOUSED HIGH SPEED CIRCUIT BREAKERS**

- 26.1 Where tenderers offer modular type high-speed circuit breakers they shall submit full information, construction and dimensional drawings with their offer.
- 26.2 Transnet Freight Rail specification CEE.0227 shall be used as a guideline.
- 26.3 The tenderers must be fully aware that the requirements of Transnet Freight Rail's specification CEE.0099 are relevant.
- 26.4 Transnet Freight Rail reserves the right to accept or reject offers for equipment after consultation with tenderers. Transnet Freight Rail's Senior Engineer, Technology Management, shall approve all designs.
- 26.5 The modular type steel housings shall be insulated from the substation floor.

## **27.0 REGENERATIVE HIGH SPEED CIRCUIT BREAKER**

- 27.1 At certain substations Transnet Freight Rail will require 3kV DC regenerative braking energy absorption equipment. If required the successful contractor shall supply the high speed circuit breaker for the protection of the regenerative braking equipment in accordance with Transnet Freight Rail's specification CEE.0099.

## **28.0 3kV DC UNDERVOLTAGE RELAY**

- 28.1 The contractor shall supply and install a 3kV DC undervoltage relay with a high voltage potential divider in accordance with Transnet Freight Rail Specification BBB 3005 and shall provide the following.
- 28.2 Fibre optic technology must be used to provide galvanic isolation between the potential divider and the undervoltage relay.
- 28.3 The potential divider shall be mounted in the 3kV busbar chamber or in the high voltage compartment of the positive isolator cubicle in accordance with Transnet Freight Rail's Specification BBB 4724.
- 28.4 The potential divider shall be protected by an H.R.C fuse connected between the positive side of the 3kV DC supply and the input of the potential divider.
- 28.5 Insulation clearance shall be not less than 100mm. All normally live equipment on the potential divider shall withstand a test voltage of 10,5kV AC RMS 50 Hz for one minute to earth without breakdown.

- 28.6 If the undervoltage relay is wall mounted, an engraved warning label shall be fixed to the front of the undervoltage relay panel with the following warning:

**WARNING**

THE POSITIVE BUSBAR MUST BE ISOLATED AND EARTHED BEFORE WORK IS UNDERTAKEN ON THE UNDERVOLTAGE RELAY

- 28.7 The following connections shall consist of 95mm<sup>2</sup> cross-sectional area copper or copper equivalent conductors.
- Potential divider to negative busbar.
  - Resistor base plate to DC earth leakage busbar.
  - Relay metal case to DC earth leakage busbar.

**SECTION 3: INSTALLATION**

**SUBSTATION EARTHING**

**29.0 INDOOR EARTHING (REFER TO DRAWING CEE-TBD-0007)**

The successful contractor shall supply, install and comply with the following:

- 29.1. The supply and installation in the substation building of all earthing conductors for the earthing of all metal work which includes supporting frames, control panels, battery charger, positive isolator panel, track breaker cells, rectifier bay screens, chequer plates and metal bases of insulators mounted directly on the walls or floor etc.
- 29.2. The frames and bases of all items associated with the 3kV DC including the track feeder wall plates, shall be connected through the DC earth leakage relay to the negative busbar in accordance with Transnet Freight Rail's drawing CEE-TBD-0007.
- 29.3. The DC earth leakage relay and the installation thereof shall comply with the requirements specified in clause 8.6 of Transnet Freight Rail's specification BBB2721.
- 29.4. Earthing conductors which could be subjected to 3 kV DC faults caused by insulation breakdown, etc., shall be not less than 70mm<sup>2</sup> copper strap cross-sectional area or 95mm cross-sectional area PVC insulated stranded copper cable. Other earth conductors must have a minimum of 16mm<sup>2</sup> copper cross-sectional area.
- 29.5. The earthing system for the 3kV DC positive busbar chamber shall be supplied by the successful tenderer. The design of the system shall be in conjunction with Transnet Freight Rail staff.
- 29.6. The successful tenderer shall supply the portable earthing device and cables according to Transnet Freight Rail's requirements.
- 29.7. All connections to the DC earth leakage relay shall form part of a ring circuit for safety when part of the circuit is disconnected. Refer to drawing CEE-TBD-0007.
- 29.8. The earth conductors shall not be installed in such a manner as to bridge out the earth leakage relay.
- 29.9. The resistance between the DC earth leakage busbar and the substation main earth electrode/mat shall be not less than 25 ohms.
- 29.10. Holding-down bolts grouted in the floor shall not be in direct contact with reinforcing or in with the earth under the concrete floor in the substation.
- 29.11. Where mounting bolts are used for securing electrical equipment to the floor, these bolts must be insulated to prevent electrical contact with any reinforcing or floor.
- 29.11.1 The indoor substation equipment shall be earthed in groups as shown in Transnet Freight Rail's drawing CEE-TBD-0007.

**30.0 OUTDOOR EARTHING (DRAWING NO CEE-TBD-7 AND BBB 3620)**

The successful tenderer shall supply, install and comply with the following:

- 30.1 Outdoor yard earthing which includes earth spikes, trench earths, earth connections to the support steel structures and fence posts. The material used shall comply with Transnet Freight Rail's specification BBB 3059 and drawing BBB3620.
- 30.2 A rail-earth switch mounted on the gate that provides access to the outdoor yard and where applicable to the 3kV DC overhead feeder security area and provide all connections thereto.
- 30.3 In Transnet Freight Rail switchyards where the supply from the Electrical Utility is terminated on portal structures or where a flying busbar is provided the contractor shall earth these structures.
- 30.3.1 Install two 50mm<sup>2</sup> galvanised steel earth conductors, one each between the outside portal structure or flying busbar support and the gable of the substation building.
- 30.3.2 The earth conductor shall be suitably terminated and connected to the portal or flying busbar structures. A suitable bracket shall be supplied and mounted on the gable of the substation building. The earth conductors shall directly be terminated on the bracket and connected to the main earth electrode/mat.

**Insulating of structures and electrical equipment.**

- 30.3.3 The tenderer shall make provision for the insulating of the support steel structures for i.e. the primary circuit breaker, main current transformers and any other structure that is connected to the AC earth leakage system from the concrete foundation.
- 30.3.3.1 The insulating material shall be either the same material used for the insulating of the mast bases for the overhead track equipment or other insulating material that has been approved by Technology Management.
- 30.4. The tenderer shall make provision for the insulating of the base of the main traction transformer from the concrete plinth. Malthoid or any other approved insulation shall be used.

**31.0 INTERLOCKING (mechanical)****GENERAL**

- 31.1 The equipment for each substation shall include a mechanical interlocking system; preferably the "Castell" or other approved key type. Full details of the type offered instead of the "Castell type shall be submitted with the tender.
- 31.2 The mechanical interlocking system must be designed to prevent access to the high voltage equipment whilst "live" and ensure that switching and isolating operations are carried out in the correct sequence.
- 31.3 All equipment shall be delivered with the necessary interlocks fitted.
- 31.4 It shall not be possible to operate the locks and release the keys in any but the correct sequence or in any position of the switches or gates, other than the fully "closed" or fully "open" position, as the case may be.
- 31.5 When a unit is switched to local condition and isolated, no remote switching from the control office shall be possible. Tenderers shall furnish full explanatory details of the arrangement whereby the foregoing provisions are met.
- 31.6 The track feeder breakers shall remain closed throughout the isolation procedure.

**32.0 ISOLATING PROCEDURE**

Sequence to isolate a single unit substation rectifier unit.

- 32.1 Trip high voltage AC circuit breaker.
- 32.2 Open high voltage AC disconnecting switch-key "1" released.
- 32.3 Remove key "1"- AC disconnecting switch locked in open and earthed position.



- 32.4 Use key "1" to operate auxiliary supply's three phase isolating and earthing switch - key "1" trapped - key "2" released.
- 32.5 Use key "2" to unlock DC positive isolating and earthing switch.
- 32.6 Open DC positive isolating and earthing - key "2" trapped - key "3" released. Remove key "3". DC positive isolating and earthing switch locked in open position.
- 32.7 Use key "3" to open rectifier unit bay gate (and DC smoothing reactor screen if required).
- 32.8 If a number of keys are required to open the rectifier cubicles, a key exchange system may be used.
- 32.9 Procedure is reversed to switch the rectifier unit back on load.
- 32.10 The number indicated for the keys are for single unit substations only. Where there are two units in one substation the numbers of keys for the two units shall be A1 and B1, A2, and B2, etc. It shall not be possible to exchange keys between any equipment on different units.
- 32.11 The foregoing sequence is given as a guide and may be altered to suit tenderer's equipment. The design shall be approved by Transnet Freight Rail.
- 32.12 Where the wave filter equipment is not located in the rectifier bay, the access to the equipment shall be mechanically interlocked and form part of the interlocking procedure.
- 32.13 Access to the wave filter shall only be possible once the positive isolator is earthed and the primary circuit breaker is tripped. Refer to clause 20.8
- 32.14 Any deviation from the above guideline must be approved by Transnet Freight Rail.
- 33.0 INDOOR CABLING, BUSBARS AND ASSOCIATED EQUIPMENT**
- The contractor shall supply and install the following:
- 33.1 All low voltage PVC insulated supply and control cables.
- 33.2 3kV DC copper cables and copper busbars from the Anode wall plate to the rectifier and from the rectifier equipment to the DC positive isolating switches, DC smoothing reactors, and main DC negative busbar. In the event of aluminium (grade 6063) being used the minimum size shall be 50mm X 25mm busbar.
- 33.3 Where required, the supply and fitting of hot dip galvanised anode wall plates in the wall of the substation building, at the rectifier bays. The wall plate galvanising shall comply with SANS 121.
- 33.3.1 Wall plates shall be fitted with wall bushings, one for each phase and the neutral.
- 33.3.2 Designs and drawings of the wall plate arrangement must be submitted for approval after adjudication of the tender.
- 33.4 The interconnecting busbars from the anode wall plate to the rectifier.
- 33.5 The main 3kV DC positive and negative copper busbars. Minimum dimension of busbars shall be 100mm X 10mm copper or 127mm X 12,5mm aluminium (grade 6063) busbar.
- 33.6 The 3kV DC output positive busbar system, which includes high-speed circuit breaker busbars, and where required the outgoing feeder cables between the high speed circuit breaker busbars and wall bushings.
- 33.7 Barriers in accordance with clause 8.0 where exposed busbars exist between the positive isolator and the DC track breaker positive, busbar.
- 33.8 Cables from the DC smoothing reactor or main positive busbar to the wave-filter equipment.
- 33.9 Control cables from the rectifier cubicles to their respective control panels.
- 33.10 Cables from the auxiliary equipment to the substation control panels.
- 33.11 Connections and cabling between control panels.

- 33.12 Cables between the 110V substation battery and the auxiliary DC panel (2 core, minimum 16mm<sup>2</sup>).
- 33.13 Cables (95mm<sup>2</sup> stranded copper) to the wave-filter room(s) for rail (negative) and DC earth leakage connections to wave-filter equipment.
- 33.14 Earthing cables (95mm<sup>2</sup> stranded copper) between the DC earth leakage busbar and substation negative busbar.
- 33.15 Two core 16mm<sup>2</sup> and multicore 2,5mm<sup>2</sup> cables between panel and high-speed 3kV DC circuit breakers.
- 33.16 Two core 6mm<sup>2</sup> cables between the 25A circuit breakers on the DC panel and the Electrical Supply Utility meter room. Make-off and connect at the DC panel only.
- 33.17 All other busbars and cables required for the interconnection of the substation indoor equipment.
- 33.18 Cable glands for the termination of the cables at the control panels and other equipment. Neoprene shrouds shall be fitted over the cable glands.
- 33.19 The maximum current density per square mm for open conductors shall not exceed 1.55 Ampere for copper and 1.0 Ampere for aluminium.
- 33.20 Low voltage cables for indoor use may be unarmoured.
- 33.21 All high voltage cables shall be armoured XLPE insulated and shall comply with SANS 1339 and Transnet Freight Rail specification BBC 0198. All wiring used on the 3kV DC equipment shall have nominal 3kV insulation unless the clearances comply with those laid down in clause 8.9.
- 33.22 All negative connections and terminals associated with high voltage circuits and which are accessible without first having to isolate and earth such high voltage circuits e.g. the main negative busbar, DC earth leakage relay, etc., shall be of 95mm<sup>2</sup> copper or copper equivalent cross-section. The terminals shall be painted red.
- 33.23 Notwithstanding the above clauses the contractor shall supply and install any other cables, conductors or busbars required for the successful operation of the substation.
- 33.24.0 BLOCK JOINTS**
- 33.24.1 The contractor shall make block joints in the armouring of all the low voltage supply and control cables, which are connected between the indoor control equipment and the outdoor yard equipment.
- 33.24.2 The block joints shall be clearly visible and shall be not less than 200mm from the cable glands terminating at the outdoor equipment.
- 33.24.3 The block joints shall be sealed with a heat shrink covering to prevent the ingress of moisture.
- 33.25.0 CHEQUER PLATES**
- 33.25.1 The contractor shall be responsible for the supply of all metal chequer plates required for covering of cable trenches inside the substation.
- 33.25.2 Earthing studs suitable for the fitting of 95mm<sup>2</sup> copper cable shall be welded to each chequer plate.
- 34.0 CABLES, BUSBARS AND CONNECTIONS. (OUTDOOR)**
- The Contractor shall supply and install the following:
- 34.1 The Inter-connections cables or conductors in the High Voltage yard.
- 34.2 The high voltage AC connections which shall be solderless, concentric grip, or other approved solderless type. The connections must have adequate cross-sectional area to suit both electrical and mechanical requirements.
- 34.3 Copper busbars between separately mounted outdoor equipment. The busbars shall incorporate a degree of flexibility to avoid any overstressing of connections due to foundation movement and expansion or contraction.

- 34.4 All negative connections and terminals associated with high voltage circuits and which are accessible without first having to isolate and earth such high voltage circuits e.g. the main negative busbar shall be of 95mm<sup>2</sup>, copper or copper equivalent cross-section. The terminals shall be painted red.
- 34.5 Copper busbars with removable flexible connections or "all aluminium" stranded conductor may be used interconnection conductors between the main traction transformer secondary bushings and the anode wall bushings which are fixed to the anode wall plate of the substation building.
- 34.5.1 Where "all aluminium conductors are to be installed the following sizes and number of conductors shall be installed:
- 2 X 800 mm<sup>2</sup> "all aluminium" stranded conductor per each phase for 4,5 MW substations, or 50mm X 25mm aluminium (grade 6063) busbar in accordance to Transnet freight rail drawing BBF1615.
  - 2 X 500 mm<sup>2</sup> "all aluminium" stranded conductor per each phase for 3 MW substations, or 50mm X 25mm aluminium (grade 6063) busbar in accordance to Transnet freight rail drawing BBF1615.
- 34.5.2 Where two different conductor material joints are used, the Bi-Metallic plates shall be applied.
- 34.6 Conductors from the high voltage AC line aerial conductors and between the surge arresters, AC disconnecting switch, high voltage AC circuit breaker, current transformers, rectifier transformer and rectifier.
- 34.7 Cables or busbars from the rectifier transformer to the auxiliary transformer.
- 34.7.1 The auxiliary transformer shall be connected directly to the tertiary winding of the traction transformer for new installations or existing installations where tertiary windings are employed on the main traction transformer.
- 34.8 Cable from the auxiliary transformer secondary to the short-circuiting switch.
- 34.9 Control cables from the high voltage AC disconnecter, AC circuit breaker and main and auxiliary transformers to the substation control panels.
- 34.10 A multi-core 4mm<sup>2</sup> cable between the current transformers and the Electrical Supply Utility meter room. Make-off and connect at the current transformer only.
- 34.11 In the case of the Electrical Supply Utility Tee-supplies a multi-core 4mm<sup>2</sup> cable between the voltage transformers and the Electrical Supply Utility. The Electrical Supply Utility will do the cable connection.
- 34.12 In the case of the Electrical Supply Utility Duplicate Supplies one multi-core 4mm<sup>2</sup> cable between Transnet Freight Rail's high voltage AC circuit breaker and the Electrical Supply Utility meter room. (For interlocking Electrical Supply Utility M.O.D's). The cable shall have 10% spare cores.
- 34.13 A multi-core 2,5mm<sup>2</sup> cable between the tele-control remote terminals on the control panel and the electrical supply utility meter room. (For tele-control of the Electrical Supply Utility equipment). The cable shall have 10% spare cores.
- 34.14 All other cables as specified. e.g. security lighting and alarms.
- 34.15 All control cables, security and alarm cables shall be armoured cables.
- 34.16 Notwithstanding the clauses above the contractor shall be responsible for all cables, busbars and connections required for the successful operation of the 3kV DC traction substation.
- 35.0 LABELS AND TERMINALS**
- 35.1 All labels shall be in English. All lettering shall be white on a black background. Lettering shall be a minimum of 6mm in height.
- 35.2 All labels shall be neatly secured by rivets or screws.
- 35.3 All conductors and cables shall be provided with identification tags at terminals.

35.4 All terminals and equipment such as switches and relays shall be suitably numbered according to the substation schematic and wiring diagrams. All terminal blocks and groups of terminal blocks shall be suitably numbered.

### **36.0 SUBSTATION NEGATIVE RETURN**

The substation negative return system which can be in the form of the following:

- Buried XLPE insulated copper cable.
- Rail on sleepers.
- Aerial conductors.

#### **36.1 BURIED XLPE INSULATED COPPER CABLE**

36.1.1 The contractor shall install 2 x 500mm<sup>2</sup> single core XLPE copper cables from the substation negative busbar to the negative manhole situated near the railway line.

36.1.2 Transnet Freight Rail's staff will undertake the provision of the bare conductors from the negative manhole to track, as well as the rail connections.

36.1.3 The negative manhole to drawing CEE-TU-41 is to be supplied and installed by the contractor.

36.1.4 The negative return cables shall be laid, in 150mm of soft soil in a trench, at a depth of not less than 1000mm below ground level and spaced not less than 300mm between centres.

36.1.5 Where cables are likely to be damaged they shall be protected by concrete slabs. Refer to Transnet Freight Rail specification CEE.0023.

36.1.6 The cable route shall be provided with cable warning tape. Refer to Transnet Freight Rail specification CEE.0023.

36.1.7 The cable runs shall be marked by cable markers painted signal red. (Stores Item No 9/1503)

#### **36.2 RAIL NEGATIVE RETURN.**

36.2.1 Where rail is used for the negative return system Transnet Freight Rail shall supply and install the rail from the inside of the substation building to the railway track.

36.2.2 The rail shall be insulated from ground by means of concrete sleepers supplied by Transnet Freight Rail.

36.2.3 Where the rail enters the substation building it must be insulated from all concrete and brickwork to prevent stray current damage to building reinforcing or other metal. After installation the hole in the wall shall be sealed and made good by Transnet Freight Rail.

36.2.4 The rail shall be connected to negative output of the rectifier by means of a suitably rated busbar/cable supplied by the contractor. Transnet Freight Rail will make provision for terminations on the rail.

36.2.5 Transnet Freight Rail shall connect the negative return rail to the track by means of PVC insulated steel conductors.

#### **36.3 NEGATIVE FEEDER MONITORING SYSTEM.**

36.3.1 The contractor shall design supply and install a negative feeder monitoring system in accordance with Transnet Freight Rail specification BBB1843.

36.3.2 The negative feeder monitoring system shall be designed to trip the 3 kV DC track breakers in the event of the traction substation negative return circuit becoming open circuited due to cable theft of the negative return cables or other cause of failure of the negative return circuit.

#### **36.4 AERIAL CONDUCTORS**

36.3.1 Where aerial conductors are used for the negative return, the contractor shall provide the wall plates and wall bushings where required.

36.3.2 In the case of aerial conductors used for the negative return, Transnet Freight Rail shall provide the conductors and the installation.

### **37.0 3kV DC POSITIVE FEEDER CABLES**

The positive feeder cables shall be either:

- Buried armoured medium voltage XLPE insulated cable.
- Aerial aluminium conductor

#### **37.1 BURIED XLPE INSULATED CABLE**

37.1.1 The contractor shall install two single core 6,6kV, 500mm<sup>2</sup> armoured medium voltage XLPE insulated cables with stranded copper conductors. The cables shall be manufactured with copper tape screen, armour and sheath in accordance with SANS 1339 and Transnet Freight Rail specification BBC 0198. The cables shall run from the high-speed circuit breaker busbar chamber to the associated track switch structure.

37.1.2 Tenderers are to allow for making off the cables with suitable terminations. Sufficient length of cable must be left buried at the base of the track switch structure for erection and connection to the track switch. Transnet Freight Rail will do connection to the track switch.

37.1.3 The medium voltage cables shall be laid in 150mm of soft soil, in a trench at a depth of not less than 1000mm below ground level and spaced not less than 300mm between centres.

37.1.4 Where cables are likely to be damaged they shall be protected by concrete slabs. Refer to Transnet Freight Rail specification CEE.0023.

37.1.5 The cable route shall be provided with cable warning tape. Refer to Transnet Freight Rail specification CEE.0023.

37.1.6 The cable runs shall be marked by cable markers painted white (Stores Item No 9/1539).

37.1.7 Should it be necessary for the cables to pass under the tracks suitable pipes will be installed by Transnet Freight Rail.

37.1.8 Where required, the contractor shall supply the necessary wall bushings for positive feeder cables.

#### **37.2 AERIAL CONDUCTOR**

37.2.1 In the case of aerial conductors used for the positive feeders, Transnet Freight Rail shall make provision for conductors and installation.

37.2.2 Where aerial conductors are used for the 3kV DC positive, the contractor shall provide the wall plates and wall bushings.

### **38.0 TRENCHING FOR OUTDOOR YARD EARTHING CONDUCTORS AND CONTROL CABLES.**

38.1 Before any trenching commences the contractor shall consult with Transnet Freight Rail staff for approval of the routing of the trenches in the outdoor yard.

38.2 In existing substation outdoor yards the contractor shall remove the necessary crusher stone in the outdoor yard before any excavation commences. The contractor shall restore the crusher stone after the completion of the work.

38.3 Trenching includes all trenches required for the installation of the earthing system and control cables.

38.4 The depth of trenches shall not be less than 700 millimetres.

38.5 With the installation of new earthing conductors and control cables at existing substations, care must be taken not to damage existing cables in the high voltage outdoor yard during trenching operations.

38.6 The Contractor and Transnet Freight Rail staff shall inspect the trenches before and during the installation of the earthing system and control cables.

38.7 Before the trenches are closed a representative from Transnet Freight Rail shall inspect the earthing system and other cabling for damage.

### 39.0 FOUNDATIONS.

39.1 The successful tenderer shall be responsible for the design and casting of foundations for the portal and support structures in the traction substation high voltage outdoor yard.

39.2 Notwithstanding the supply arrangements (single or double) at any particular substation, tenderers shall clearly understand that all foundations and steelwork to accommodate the supply and to cater for the traction yard are to be provided and erected by the successful tenderer.

39.3 Wherever there is a combined traction and 11kV/6,6kV distribution yard, a flying busbar is to be provided in Transnet Freight Rail's yard. All foundations and steelworks required to suit this arrangement, including the erection and earthing thereof shall be included in tenderer's offers.

39.4 The foundations in the high voltage outdoor yard shall include the following:

- Voltage Transformers if applicable.
- Surge arresters.
- AC disconnectors.
- Current transformers. (If applicable)
- Primary circuit breakers.
- Main traction transformer.
- Auxiliary transformers.
- Portal lattice structures as required.
- Any other foundations as specified.

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

39.6 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.

39.7 All foundation edges shall be bevelled, and the surfaces must be float finished.

39.8 All support foundations shall be at the same level.

39.9 The design of the concrete plinth for the main traction transformer shall include a concrete gutter around the perimeter of the plinth to contain any spillage of transformer oil.

39.10 Provision shall be made on the plinth for skid rails. The spacing of the rails between centres shall be a minimum of 1meter. Details of the design and load bearing parameters of the skid rail system, plinth and rail shall be submitted to Transnet Freight Rail for approval.

39.11 The auxiliary transformer if separate shall be provided with its own concrete plinth with a concrete gutter, or may be installed on the same plinth as the main traction transformer.

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

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

### 40.0 SUPPORT STRUCTURES

40.1 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.

40.2 Special attention shall be taken for the prevention of corrosion of all metallic parts.

- 40.3 The bases of insulators, studs, bolts, support structures and other parts made of ferrous material associated with the electrical connections outdoors, shall be hot-dip galvanised, in accordance with SANS 121.
- 40.4 Steelwork for outdoor installation in coastal areas, i.e., within 50km of the coast, shall first be hot-dip galvanised in accordance with SANS 121, followed immediately at the galvanising plant by the application of the Sterling paint system in accordance with specification CEE.0045.
- 40.5 Steelwork for outdoor installation in inland areas, i.e., at a distance greater than 50km from the coast, shall be hot-dip galvanised to SANS 121.
- 40.6 All high voltage equipment shall be provided with hot-dipped galvanised support structures or pedestals to provide a minimum clearance of 3,6 m (up to 88kV) or 4,1 m (above 88kV) from the lowest "live" high voltage connection to finished ground level.
- 40.7 Structural steel shall comply with SANS 1431.
- 40.8 All welded joints shall be seal welded with no gaps or blowholes.
- 40.9 All fasteners, nuts and bolts used for the installation of substation steelwork and equipment shall be hot dipped galvanised to prevent corrosion.
- 41.0 FENCING**
- 41.1 The successful tenderer shall supply and install new perimeter fencing as specified.
- 41.2 The successful tenderer shall make provision for the levelling of outdoor yard if required.
- 41.3 The fencing shall be either of the following:
- Concrete palisade fencing in accordance to drawing CEE-TDF- 0016.
  - Hot dipped galvanised steel palisade fencing with the minimum requirements of:  
Height 2,4 metres  
Size and thickness of pales 40mm x 40mm x 3mm thick.  
Corner and intermediate posts 100mm x 100mm x 3mm.  
Horizontal cross bars 40mmx5mm.
- 41.3.1 The successful tenderer shall make provision for the installation of safety barriers in the high voltage yard in accordance with Transnet Freight Rail's requirements. (Refer to Transnet Freight Rail's Engineering instruction S.016)
- 41.3.2 The successful tenderer shall make provision for a metal barrier screen of 25mm-wire mesh or expanded metal to be constructed around the auxiliary transformer to prevent accidental contact.
- 41.3.3 The successful tenderer shall cast a concrete apron of 150mm wide x 300mm under the perimeter fences of the substation. The top of the apron shall be a minimum of 100 mm above the ground level.
- 42.0 GATES**
- 42.1 The contractor shall supply and install two 4.6 metre wide X 2,4 metres minimum height lockable gates in the perimeter fence to allow for:
- Entrance to substation building and yard.
  - Entrance to the high voltage outdoor yard adjacent to the main transformer (s).
- 42.2 Where access to the HV outdoor yard is gained between the substation building and perimeter fence, a fence the same height as the perimeter fence shall be installed. A 1000mm wide lockable gate shall form part of the fence.
- 42.3 Provision must be made for the fitting of a spark gaps and rail earth switch on the HV yard small gate. Refer to drawings CEE-TBD-7 and BBB3620. The spark gaps shall be provided by Transnet Freight Rail on request.

42.4 Where steel palisade fencing is used the gates shall be connected to the fence support post by means of a flexible connection to prevent electrolytic corrosion of gate hinges.

42.5 Warning notices and danger signs in accordance with Transnet Freight Rail's Electrical Safety Instructions shall be fitted to the perimeter fencing and gates. This shall be provided by Transnet Freight Rail.

#### **43.0 CRUSHER STONE AND WEED KILLER**

43.1 After completion of construction, installation of equipment, the laying of all cables and earthing conductors, a suitable weed killer approved by the Technical Officer shall be applied in HV outdoor yard.

43.2 Great care shall be exercised to avoid contaminating private property and water supplies.

43.3 After treatment with the weed killer, a 100mm layer of 25mm crusher stone shall be laid over the whole area of the Transnet Freight Rail high voltage outdoor yard (within the apron).

#### **44.0 PAINTING**

44.1 All indoor and outdoor steelwork, metal screens and barriers shall be painted in accordance with Transnet Freight Rail's Specification CEE.0045.

44.2 The finishing coats for indoor equipment shall be in accordance with SANS 1091.

Metal Bay Screens - Eau-de-Nil (H43).  
Support frameworks (indoor) - Eau-de-Nil (H43).

#### **45.0 DISTRIBUTION, LIGHTING OF SUBSTATION BUILDING AND STANDBY 400V AUXILIARY SUPPLIES**

45.1 The successful tenderer shall supply and install all light fittings, plugs, conduits, distribution boards, switches, cables and other material in accordance with SANS 10142-1. Galvanised, alternatively PVC conduit and galvanised fittings shall be provided at all substations within 50km of the coast.

45.2 The contractor shall furnish a certificate of compliance for the 400V/220V AC distribution and lighting of the traction substation signed by the accredited person in terms of SANS 10142-1 and who is registered with "Electrical Contracting Board".

45.3 Complete Layout drawing showing the position/type of light fittings, position of plugs, distribution board and switches to be submitted to Transnet Freight Rail for approval.

45.4 220V AC fluorescent light fittings shall provided. The minimum lighting requirement shall be 100 lux in terms of the "Occupational Health and Safety Act".

##### **11KV/6.6KV TO 400V AUXILIARY SUPPLY AND CHANGE OVER SYSTEM.**

45.5 Where specified a 11kV/6,6kV to 400V distribution transformer will be installed to supply the traction substation in the event of substation failure or when the substation is taken off load.

45.5.1 The 3 phase 400V supply from the above transformer shall be connected to the control circuitry via a automatic change over switching system.

45.5.2 The change over switching system shall be mechanically and electrically interlocked.

45.5.3 Transnet Freight Rail shall supply and install a suitably rated 4core armoured cable from the 11kV/6,6kV to 400V distribution transformer to the change over switching unit.

45.5.4 A 1:1 ratio isolation transformer shall be installed between the 11kV/6.6kV to 400V distribution transformer and change over switching system.

45.5.5 The isolation transformer shall comply with specification BBC 0330.

45.5.6 The successful tenderer shall supply the isolation transformer unless otherwise specified.

##### **EMERGENCY LIGHTING.**

45.6 Fluorescent light fittings with its own battery back up supply shall be supplied for emergency lighting.



- 45.6.1 A minimum of three fittings shall be installed in a single unit substation and four in a double unit substation.
- 45.6.2 The light fittings shall be installed at the following locations:
- In single unit substations two in the main walkway between the control panels and rectifier unit. One flameproof fitting in the battery room
  - In a double unit substation three in the main walkway and one flameproof fitting in the battery room.
  - In additional locations where requested by the Project Manager/Engineer.
- 45.6.3 The light switch shall be clearly labelled " EMERGENCY LIGHTNING".

#### **MOULDED CASE CIRCUIT BREAKERS**

- 45.7 All low voltage circuits and equipment shall be protected by moulded case circuit breakers, which comply with specification SANS 156.

#### **SECURITY LIGHTS**

- 45.8 Where outdoor security lights are specified 400W high-pressure sodium fittings shall be installed at locations specified by the "Scope of Work".

#### **46.0 COOLING AND VENTILATION**

- 46.1 Where specified, 3 phase cooling fans shall be supplied and installed in the substation building.
- 46.2 The required filters, louvres and guards shall be provided and installed.

#### **47.0 BATTERY ROOM**

- 47.1 A three/single phase non-sparking extraction fan shall be installed for the battery room.
- 47.2 Only Ex non-sparking light fittings shall be installed in the battery room.
- 47.3 Light switches and plug sockets shall not be installed in the battery room.
- 47.4 No-smoking, naked flames and hand protection warning signs shall be fitted to the battery room doors.
- 47.5 A wooden stand treated with acid proof paint shall be provided for the batteries.
- 47.6 A hydrometer and logbook shall be supplied by the contractor for each installation.
- 47.7 The floor of the battery room shall be painted with acid proof paint.

#### **48.0 CLEARING OF SITE**

- 48.1 All rubble which is left over as a direct result of work performed by the Contractor shall be removed from the substation building and yard and disposed of by the Contractor. The substation floors and walls shall be left in a clean condition. All cable, wire and conductor cut-offs and surplus material shall be removed from site.

### **SECTION 4: SITE TESTING AND COMMISSIONING**

#### **49.0 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.

#### **49.1 ON-SITE TESTS**

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

- 49.1.2 The successful tenderer shall submit a detailed list of on-site tests for the approval of the Project Manager/Engineer at least six weeks before tests are due to commence at the first substation.
- 49.1.3 The successful tenderer shall arrange for the Project Manager/Engineer or his representative to be present to witness the on-site tests at each substation.
- 49.1.4 On-site tests and subsequent commissioning shall 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.
- 49.1.5 On-site tests shall include the following;
- Polarity tests on all CT's.
  - Ratio tests on all 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.
  - The operation of both mechanical and electrical interlocking.
  - Tests on primary circuit breakers and other primary equipment in accordance with manufacturer's instructions.
- 49.1.6 At the completion of the on-site tests the Project Manager/Engineer 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.
- 49.1.7 Upon rectification of defects the successful tenderer shall arrange for the Project manager/Engineer or his representative to certify satisfactory completion of on-site tests for that particular substation.
- 49.1.8 Acceptance by the Project Manager/Engineer 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.
- 49.2 COMMISSIONING OF EQUIPMENT**
- 49.2.1 Commissioning will include the energising of equipment from the AC disconnects to the OHTE track feeder switches. The successful tenderer must prove the satisfactory operation of all equipment under live conditions.
- 49.2.2 On completion of commissioning the successful tenderer will hand the substation over to the Project Manager/Engineer in terms of the relevant instructions.
- 49.2.3 Tenderers shall allow a period of at least three days per substation between satisfactory completion of on-site tests and commissioning of equipment.
- 49.2.4 During this period the Transnet Freight Rail's Test staff will test the operation of all protective relays and circuits and set the protection relays at each substation.
- 49.2.5 The contractor shall rectify any faults found during the testing and setting of the protection relays.
- 49.2.6 The final testing of the substation must commence at least three days ahead of the contract completion date.
- 49.2.7 The commissioning of the protection equipment by Transnet Freight Rail 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.

- 49.2.8 The commissioning dates for the substations will be dependent on the availability of power supplies from the supply utility as well as Transnet Freight Rail's electrification program and will be defined by the Project Manager/Engineer.

## **SECTION 5: GENERAL**

### **50.0 QUALITY ASSURANCE**

- 50.1 Transnet Freight Rail reserves the right to carry out inspection and tests on the equipment at the works of the supplier/manufacturer.
- 50.2 Arrangements must be made timeously for such inspections and type/routine tests in accordance with the equipment specifications are carried out before delivery of the equipment to the site.
- 50.3 Type/routine test sheets of the equipment shall be forwarded to the Project Manager.

### **51.0 GUARANTEE AND DEFECTS**

- 51.1 The contractor shall guarantee the satisfactory operation of the complete electrical installation supplied and installed by him and accept liability for maker's defects, which may appear in design, materials and workmanship.
- 51.2 The guarantee period shall commence from the date of successful commissioning of the substation.
- 51.3 The guarantee period for all substations shall expire after a period of 12 months commencing from the date of successful completion of the contract or the date the equipment is handed over to Transnet Freight Rail whichever is the later.
- 51.4 If urgent repairs have to be carried out by Transnet Freight Rail staff to maintain supply during the guarantee period the contractor shall inspect such repairs to ensure that the guarantee period is not affected and should they be covered by the guarantee, reimburse Transnet Freight Rail the cost of material and labour.
- 51.5 The cost of training shall be included in the tenderers quotation.

### **52.0 DRAWINGS, INSTRUCTION MANUALS AND SPARES LISTS**

- 52.1 Drawings, instruction manuals and catalogues shall be supplied in accordance with Transnet Freight Rail specification CEE.0224.
- 52.2 The tenderer shall supply three copies of an instruction/maintenance manuals, schematic and wiring diagrams.
- 52.3 The contractor shall submit details of spares required in accordance with Transnet Freight Rail's specification no. CEE.0224.
- 52.4 All spares recommended for normal maintenance purposes that are not available locally (requires importation) must be highlighted.

### **53.0 SPECIAL TOOLS AND/OR SERVICING AIDS**

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

### **54.0 TRAINING**

- 54.1 The contractor shall submit details with the tender of the training courses which will be conducted by the contractor for the training of Transnet Freight Rail maintenance staff in the operation and maintenance of the equipment supplied. The courses shall include theoretical as well as practical tuition. The date and venue of this training course shall be arranged with the Maintenance manager.

### **55.0 PACKAGING AND TRANSPORT.**

- 55.1 The contractor shall ensure that the equipment be packed in such a manner that it will be protected during handling and transport.
- 55.2 The contractor shall provide transport for the delivery of the equipment to the site where required.

### **56.0 BIBLIOGRAPHY**

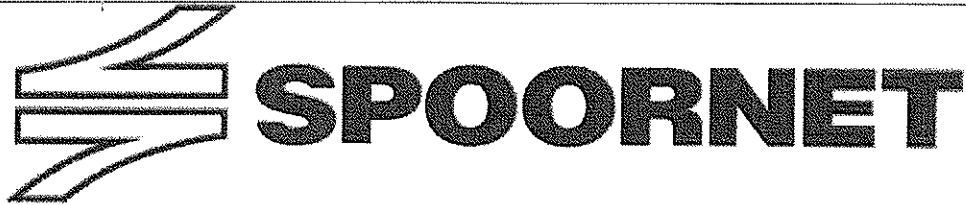
- [1] SANS 1019: 2008 Edition 2.5 Standard voltages, currents and insulation levels for electricity supply

## APPENDIX 1

## DRAWINGS ISSUED WITH THIS SPECIFICATION

DRAWING NUMBER	AMENDMENT	DESCRIPTION.
CEE-TDF-0016		Concrete fencing
CEE-TBD-7		Earthing Arrangements Traction Substations.
CEE-TU-41		Negative Return Cable Terminating Box.
CEE-TCK-1		Reactor 1,84mH, 1 500 A. (For reference purposes only)
CEE-TBP-1		Wiring diagram for auto reclosure for HSCB.
CEE-TBP-39		Circuit diagram for auto reclosure for HSCB
CEE-TBP-35		Connection diagram for HSCB and electronic control relay
CEE-TBP-38		Schematic Diagram of 3kV HV Protection.
CEE-TCL-63		3kV Busbar Chamber Arrangement: Cable Feeders.
CEE-TCQ-208		DC High Speed Circuit Breaker Cell Panel (Cell slabs) (sheets 1 to 10)
CEE-TBP-33		DC Track Breaker and Truck Wiring Diagram.
BBB 0938		Surge arresters mounted on traction transformer.
BBB 3620		3kV Earthing arrangement for traction substation
BBF 1615		Busbar connection assembly

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A division of Transnet limited

**ENGINEERING AND TECHNOLOGY  
TECHNOLOGY MANAGEMENT**

**SPECIFICATION**

**REQUIREMENTS FOR THE SUPPLY OF ELECTRIC  
CABLES**

(Appendix to be filled in by client)

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## 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-XLPE distribution cables,  
Part 5-Halogen free distribution cables.

## 3.0 APPENDIX

The following appendix forms an integral part of this specification.

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

## 4.0 TENDERING PROCEDURE

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

## 5.0 MEDIUM VOLTAGE CABLES

### 5.1 IMPREGNATED PAPER INSULATED.

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

- 5.1.5 The armouring shall be galvanised steel wire with outer extruded PVC over sheath over the armouring.
- 5.1.6 The cable shall be so manufactured that it is fully protected against the effect of electrolysis.
- 5.1.7 Single core cables used for 3 kV DC application shall withstand a test voltage of 10,5 kV for one minute.
- 5.1.8 Cables shall be suitable for laying directly in soil and concrete trenches.
- 5.1.9 The cables shall withstand exposure to water, corrosive conditions as well as high ultra violet conditions caused by direct sunlight.
- 5.1.10 The cables shall be tested in accordance with SANS 97. Type test certificates shall be submitted with the cables offered.
- 5.1.11 The packing, marking and sealing of cables and cable drums shall be in accordance with SANS 97.
- 5.2 CROSS – LINKED POLYETHYLENE INSULATED (XLPE).**
- 5.2.1 XLPE cables used for reticulation systems, 3kV DC traction feeders and traction power supplies and other applications shall be in accordance with SANS 1339.
- 5.2.2 The voltage range for the cables shall be between 3,8kV and 33kV.
- 5.2.3 Cables shall be single or three core with stranded copper conductors.
- 5.2.4 The cables shall be type A (armoured) for single and three core cables.
- 5.2.5 Single core type A cable shall be copper tape screened, aluminium wire armoured and provided with a PVC outer sheath.
- 5.2.6 Single core cables shall be rated for 3,8/6,6kV.
- 5.2.7 Single core cables used for 3 kV DC application shall withstand a test voltage of 10,5 kV for one minute.
- 5.2.8 Three core type A cable shall be copper tape screened, galvanised steel wire armoured and provided with a PVC outer sheath.
- 5.2.9 The manufacture of the single and three core cables shall be such that the cables are fully protected against the effect electrolysis.
- 5.2.10 The cables shall be suitable for laying directly in soil and concrete trenches.
- 5.2.11 The cables shall withstand exposure to water, corrosive conditions as well as high ultra violet conditions caused by direct sunlight.
- 5.1.12 The cables shall be tested in accordance with SANS 1339. Type test certificates shall be submitted with the cables offered.
- 5.2.12 Where specified flame-retardant and halogen free cables shall be in accordance with SANS 1339.
- 5.2.13 The packing, marking and sealing of cables and cable drums shall be in accordance with SANS 1339.
- 6.0 CABLES FOR FIXED INSTALLATIONS**
- 6.1 Unless otherwise specified single and multi-core, wire armoured, extruded PVC insulated cables shall be used for fixed installations. The cables shall be in accordance with SANS 1507 part 1 and part 3.
- 6.2 The voltage range is between 300/500 V to 1900/3300 V.
- 6.3 Cables shall have stranded annealed copper conductors.



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

**7.0 QUALITY ASSURANCE**

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

**8.0 INSPECTION AND TESTING**

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

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**SCHEDULE OF REQUIREMENTS**

(To be completed by the client)

- 1.0 MEDIUM VOLTAGE CABLES**
- 1.1 PAPER IMPREGNATED LEAD SHEATHED (PILC)**
  - 1.1.1 Rated Voltage (V): .....
  - 1.1.2 Number of cores: .....
  - 1.1.3 Length of cables (m): .....
  - 1.1.4 Size of conductors (mm<sup>2</sup>): .....
- 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<sup>2</sup>): .....
  - 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<sup>2</sup>): .....

END

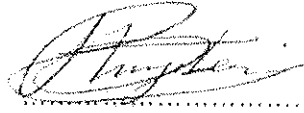



A Division of Transnet SOC Limited


# TECHNOLOGY MANAGEMENT

## SPECIFICATION

### INSTALLATION OF LOW AND MEDIUM VOLTAGE CABLES

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Date: 31 May 2012

Circulation Restricted To:  
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**1.0 SCOPE**

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

**2.0 APPENDICES**

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

- 2.1 Appendix 1 - "Scope of Work" - to be completed by Transnet Freight Rail (Client).  
 2.2 Appendix 2 - "Schedule of Requirements" – (to be completed by Tenderer).  
 2.3 Appendix 3 – "Normative SANS references"

**3.0 STANDARDS, PUBLICATIONS AND DRAWINGS**

Unless otherwise specified this specification must be read in conjunction with the current edition of the relevant SANS, BS and Transnet Freight Rail's specifications.

**3.1 British Standards**

BS 5467: Electric cables – thermosetting insulated, armoured cables for voltages of 600/1000V and 1900/3300V.

BS 6480: impregnated paper – installed lead or lead alloy sheathed electric cables of rated voltages up to and including 33 000V

**3.2 South African National Standards**

SANS 32: Internal and/or external protective coatings for steel tubes - Specification for hot dip galvanized coatings applied in automatic plants.

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 121: Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods.

SANS 1339: Electric cables - Cross-linked polyethylene (XLPE) insulated cables for rated voltages 3,8/6,6 kV to 19/33 kV

SANS 10142-1: The wiring of premises Part 1: Low-voltage installations.

SANS 10142-2: The wiring of premises Part 2: Medium-voltage installations above 1 kV A.C not exceeding 22 kV A.C and up to and including 3 000 kW installed capacity.

**3.3 Transnet Freight Rail Instructions**

BBD 8210 - General work and works on, over, under or adjacent to a railway lines and near high voltage equipment

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.

Electrical Safety Instructions 2012 - High Voltage Electrical Equipment

**3.4 Transnet Freight Rail Drawings**

CEE PA-0105 - Precast concrete slab cover for cable protection.

CEE-PK-14 - Electrical cable route marker.

CEE-MA-307 – Route marker electrical cables.

FG 263 - Accommodation of cables in Railway formations

**3.5 Statutory Requirements**

Occupational Health and Safety Act and Regulations, Act 85, 1993

- 3.6 Any items offered in accordance with other standards will be considered at the sole discretion of Transnet Freight Rail. 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.

#### 4.0 TENDERING METHODS

- 4.1 Tenderer shall indicate clause by clause compliance with the specification. This shall take the form of a separate document listing all the specifications clause numbers indicating the individual statement of compliance or non-compliance. This document can be used by tenderer to elaborate on their response to a clause.
- 4.2 A statement of non-compliance shall be motivated by the tenderer.
- 4.3 Tenderer shall complete Appendix 2 – “Schedule of requirements”.
- 4.4 Tenderer shall submit descriptive literature consisting of detailed technical specifications, general constructional details and principal dimensions, together with clear illustrations of the equipment offered.
- 4.5 Failure to comply with clauses 4.1, 4.2, 4.3 and 4.4 could preclude a tender from consideration.

#### 5.0 SERVICE CONDITIONS

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

Altitude:	0 to 1800m above sea level.
Ambient temperature:	-10°C to +55 °C.
Relative humidity:	10% to 90%
Lightning Conditions:	12 ground flashes per square kilometre per annum.
Pollution:	Heavily salt laden or polluted with smoke from industrial sources.

#### 6.0 GENERAL REQUIREMENTS

- 6.1 The tenderer shall submit all drawings in accordance with Transnet Freight Rails Specification CEE.0089
- 6.2 Where joints and terminations are to be done by others, the contractor shall submit detailed instructions regarding the procedure recommended by the cable manufacturer.
- 6.3 The electrical installation shall conform to the requirements of SANS 10142 part 1 and 2 and shall be to the satisfaction of Transnet Freight Rail.
- 6.4 Galvanising where specified shall be in accordance with SANS 32 and SANS 121.
- 6.5 Work on the high voltage equipment shall be carried out in accordance with the Transnet Freight Rail's Safety Instructions 2012 - High Voltage Electrical Equipment.
- 6.6 All work done must comply with the requirements of Occupational Health and Safety Act and Regulations, Act 85, 1993

#### SURVEYS

- 6.7 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 Transnet Freight Rail's drawings to determine a suitable route.
- 6.8 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 Depot Maintenance Manager (Electrical) for approval.
- 6.9 The Contractor shall submit in triplicate plans of the cable routes selected to the Depot Maintenance Manager (Electrical) for approval. Plans may be submitted in sections as the survey progresses.

- 6.10 No excavation of any section of the cable route shall commence before the Contractor is in possession of the relevant approved plans and the Depot Maintenance Manager (Electrical) has authorised the commencement of work on the section concerned.
- 6.11 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.
- 6.12 The cable route plans shall include the following information:
- 6.12.1 Overall length, type, size and voltage of each cable.
- 6.12.2 Accurate indication of the position of each cable joint by indicating two distances to each joint from permanent structures.
- 6.12.3 Pipes and chambers provided.
- 7.0 EXCAVATIONS**
- 7.1 Excavations shall be carried out in strict compliance with the specification BBD 8210 for general work and works on, over, under or adjacent to a railway lines and near high voltage equipment.
- 7.2 Trenching procedure shall be programmed in advance, approved by the Depot Maintenance Manager (Electrical) and shall not be departed from except with the consent of the Depot Maintenance Manager (Electrical).
- 7.3 The Contractor will be advised of any known buried services such as cables, pipes, etc. in the vicinity of the cable route.
- 7.3.1 When trenching the contractor shall take all necessary precautions to prevent damage to underground services.
- 7.3.2 On encountering any uncharted service, the Contractor shall promptly advise the Depot Maintenance Manager (Electrical) who will give the necessary instructions. Additional excavations shall be paid for at scheduled rates.
- 7.4 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 Depot Maintenance Manager (Electrical), who shall arrange for the necessary repairs. The Contractor shall be responsible for the cost of repairs.
- 7.5 The removal of obstructions along the cable routes shall be subject to the approval of the Depot Maintenance Manager (Electrical) and shall be paid for at the agreed rates.
- 7.6 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 Depot Maintenance Manager (Electrical) to arrange for the necessary supervision. The cost of such supervision shall not be charged to the Contractor.
- 7.7 Excavations crossing oil pipe lines shall not commence until an authorised representative is present on site. The Depot Maintenance Manager (Electrical) shall be advised 14 days in advance when such excavations will take place.
- 7.7.1 Cable crossings of oil pipe lines shall only be at right angles.
- 7.8 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.
- 7.9 Power driven mechanical excavators may be used for trenching operations. Transnet Freight Rail shall not be responsible for any damage to other Services in close proximity when using mechanical excavators.
- 7.10 The Contractor shall provide shuttering in places where the danger exists of the trench collapsing, and causing damage to formations or other nearby structures.
- 7.10.1 Shuttering shall be paid for at scheduled rates.

- 7.11 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.
- 7.11.1 Trenches shall have no sharp objects which may cause damage to the cable during laying or backfilling.
- 7.12 The unfinished depth of trenches unless otherwise stated shall be as follows:
- 7.12.1 HV cables and associated pilot cables = 1 000 mm.
- 7.12.2 LV cables and separate pilot cables = 750 mm.
- 7.13 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.
- 7.13.1 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 SANS 97 and SANS 1339.
- 7.13.2 Trenching in railway formations shall be in accordance with Transnet Freight Rail's drawing FG 263.
- 7.14 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.
- 7.14.1 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.
- 7.15 When excavating close to railway tracks, the ballast must be covered by tarpaulins or other sheeting to prevent soiling.
- 7.16 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.
- 7.17 Transnet Freight Rail 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.

## **8.0 CABLE LAYING**

### **8.1 GENERAL**

- 8.1.1 All possible care shall be exercised in handling cables on site.
- 8.1.2 Any drum of cable showing signs of damage shall not be used.
- 8.1.3 The outer covering (insulation) of cables shall not be damaged in any way and cables shall not be bent at radii less than allowed by the manufacturer.
- 8.1.4 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 the contractor.
- 8.1.5 Cable pulling and laying shall be done manually unless otherwise approved by the Depot Maintenance Manager (Electrical). No cable shall be subjected to a tension exceeding that stipulated by the cable manufacturer.

### **8.2 IN TRENCHES**

- 8.2.1 High Voltage cables shall be spaced at a minimum of 300 mm apart (centre to centre).
- 8.2.2 Low Voltage cables shall be spaced at a minimum of 150 mm apart (centre to centre).
- 8.2.3 Pilot cables shall be laid beside the associated power cables.
- 8.2.4 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.



- 8.2.5 Pilot cables, when they are routed separately from their associated power cables, may be run next to one another.
- 8.2.6 Single core low voltage cables to be clamped in trefoil formation.
- 8.2.7 Where the cable cannot be laid down at the specified depth, prior authority shall be obtained from the Depot Maintenance Manager (Electrical) 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.
- 8.2.8 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.
- 8.2.9 Suitable rollers may be used during the laying of cables.
- 8.2.10 Cables shall be visually inspected for damage during and after laying. Any damage shall be reported immediately to the Depot Maintenance Manager (Electrical) who will issue the necessary instructions.
- 8.3 IN SLEEVE PIPES
- 8.3.1 All cables crossing beneath roads and pavements shall be enclosed in cement or PVC pipes with a minimum internal diameter of 150mm. The Depot Maintenance Manager (Electrical) 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.
- 8.3.2 Pipes shall maintain or exceed the specified cable spacing.
- 8.3.3 Only one High Voltage cable shall be laid per pipe.
- 8.3.4 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.
- 8.3.5 All cables crossings underneath railway tracks shall be in pipes in accordance with Transnet Freight Rail's drawing FG 263.
- 8.4 IN DUCTS AND BUILDINGS
- 8.4.1 Concrete ducts and pipes within buildings will be provided by others.
- 8.4.2 Before installing cables, the ducts are to be inspected to ensure that they are suitable and clean as not to damage the cables.
- 8.4.3 The cables are to be neatly positioned and cross overs are to be avoided.
- 8.4.4 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.
- 8.4.5 The Contractor shall supply all cable trays, racks, wooden cleats or other supports required to adequately support cables not laid in ducts.
- 8.4.6 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 SANS 32 and SANS 121 when used within 50 km of the sea or inland exposed conditions.
- 8.4.7 Where cable enters buildings sufficient measures shall be installed to ensure no moisture/water is digressing into the ducts. A sealing system based rubber modules from multi removable layers may be used.
- 8.5 UNDER BRIDGES AND IN TUNNELS
- 8.5.1 Where a cable route can only be against the concrete wall of a bridge or tunnel the cable shall be supported on:
- 8.5.1.1 Suitable brackets at 750 mm intervals or.

- 8.5.1.2 Straining wire secured at maximum 1 200 mm intervals.
- 8.5.2 Brackets shall be of robust design and shall be galvanised and painted in accordance with Transnet Freight Rail's specification CEE.0045.
- 8.5.3 The height of the cable route on the brackets or strain wire shall be determined and agreed upon on site.
- 8.5.4 The brackets or strain wire shall be supplied and installed by the contractor.
- 8.6 CROSSING OF PIPELINES AND OTHER CABLES
- 8.6.1 Cables shall pass beneath pipelines with a 300 mm minimum clearance between the top of any cable and the bottom of any oil pipe.
- 8.6.1.1 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.
- 8.6.2 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 Transnet Freight Rail's drawing CEE PA-0105 shall be placed between the two cables parallel to the lower cable.
- 8.7 IN RAILWAY FORMATIONS
- 8.7.1 Cables to be accommodated in railway formations shall be laid in accordance with Transnet Freight Rail's drawing FG 263.
- 8.8 SECURED TO POLES
- 8.8.1 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.
- 8.8.2 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.
- 8.8.3 Straps and pipes shall be supplied and installed by the Contractor.
- 8.9 EXPOSED CONDITIONS
- 8.9.1 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 SANS 32 and SANS 121.
- 8.9.2 These pipes or boxed sections shall be firmly secured to the bank or cut, at regular intervals.
- 8.9.3 All such material shall be supplied and installed by the Contractor.
- 8.9.4 Stake routes shall only be supplied when specifically called for in Appendix 1.
- 9.0 CABLE TERMINATIONS
- 9.1 GENERAL
- 9.1.1 All cables shall be terminated and connected to the respective equipment, whether provided by the Contractor or by others.
- 9.1.2 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.
- 9.1.3 Termination of cables on outdoor equipment shall not be done during inclement weather conditions.

- 9.1.4 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.
- 9.1.5 All materials necessary for cable termination shall be provided by the Contractor.
- 9.1.6 The contractor shall ensure that correct phase rotation is maintained throughout.
- 9.1.7 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.
- 9.2 HV Cables
- 9.2.1 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 Depot Maintenance Manager (Electrical). This bond shall be easily removable for testing purposes.
- 9.2.2 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.
- 9.3 LV Cables (and Pilot Cables)
- 9.3.1 All cut ends of cables are to be sealed with suitable tape, or other approved means until they are ready to be terminated.
- 9.3.2 The cables shall terminate in compression type glands, brass or bronze, suitable for PVC SWA ECC cables.
- 9.3.2.1 The glands shall be fitted with neoprene shrouds or corrosion guard to prevent the ingress of moisture and dust at the point of cable entry.
- 10.0 CABLE JOINTS**
- 10.1 General
- 10.1.1 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.
- 10.1.2 Jointing shall not be carried out during inclement weather.
- 10.1.3 The cores of cables shall be jointed number to number or colour to colour.
- 10.1.4 The joints shall not impair the anti-electrolysis characteristics of the cables.
- 10.1.5 The conductor bridging the armouring shall be adequate to carry the prospective earth fault current.
- 10.1.6 A through joint shall only be permitted after every full drum length of cable.
- 10.1.7 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.
- 10.1.8 Transnet Freight Rail reserves the right to be present during jointing operations to familiarise themselves with any special techniques.
- 10.1.9 No joint shall be situated inside a cable pipe.
- 11.0 COVERING, BACKFILLING AND REINSTATEMENT**
- 11.1 Filling of trenches shall not commence before the Depot Maintenance Manager (Electrical) or his authorised representative has inspected and approved the cables and cable joints in situ in the section of trench concerned.

- 11.2 Trenches in railway formations shall be backfilled and reinstated in accordance with Transnet Freight Rail's drawing FG 263.
- 11.3 All other trenches shall be backfilled and reinstated as follows:
- 11.3.1 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.
- 11.3.1.1 Only soil with a thermal resistivity of 1,5 degrees C.m/watt, or lower may be used for this purpose.
- 11.3.1.2 When necessary imported fill shall be arranged by the Contractor and paid for at scheduled rates.
- 11.3.1.3 The backfill material shall be free from rubble/stones or foreign material.
- 11.3.2 HV cables shall, where likely to be mechanically damaged as decided by the Depot Maintenance Manager (Electrical), be protected by concrete slabs (to Drawing CEE PA-0105) 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.
- 11.3.3 Reinforced resin protection trench covers might also be used instead of concrete slabs. These covers shall be made of material which is flame retardant, non toxic and corrosion resistant.
- 11.3.4 The minimum dry densities of backfilling after compaction shall be not less than 1600 kg/cubic metre.
- 11.3.5 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 Depot Maintenance Manager (Electrical). 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.
- 11.3.5.1 Backfilling at pipe entries shall be such as not to stress or damage the cable during compaction from the top.
- 11.3.6 A continuous plastic cable warning tape, to drawing 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.
- 11.4 The back filled trench shall be maintained in a thoroughly safe condition by the contractor for the duration of the contract.
- 11.5 All back filling of road crossings shall be mechanically rammed.
- 11.6 Final surfacing of roads shall be restored by others unless called for under "Scope of Work", Appendix 1.
- 11.7 Concrete cable route markers shall be provided and installed by the contractor in accordance with drawing CEE-PK-14.
- 11.8 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.
- 12.0 MEASUREMENTS**
- 12.1 All measurements for payment purposes shall be made jointly by representatives of the Contractor and Transnet Freight Rail and shall be agreed upon by both parties. The Contractor shall be responsible for obtaining the Depot Maintenance Manager (Electrical)'s signed approval of such measurements.

- 12.2 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.
- 12.3 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".
- 12.4 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.
- 12.5 The classification of different types of ground for measurement purposes shall be as follows:
- 12.5.1 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.
- 12.5.2 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.

### **13.0 TESTS**

- 13.1 The costs of all post-installation tests shall be borne by the Contractor.
- 13.2 The Contractor shall be responsible for remedial work necessary due to damages caused during tests.
- 13.3 Transnet Freight Rail 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.
- 13.4 Test instruments shall be of the accuracy class. Calibration certificates from a recognised testing authority shall be available for inspection and shall not be older than one year.
- 13.5 Time measurements shall be carried out using an approved digital timer.
- 13.6 The final commissioning site tests will be carried out by Transnet Freight Rail.
- 13.6.1 A suitably qualified staff member of the Contractor shall assist Transnet Freight Rail during the tests and shall carry out any remedial work where necessary.
- 13.7 The contractor shall notify the Depot Maintenance Manager (Electrical) in writing 4 weeks before the commissioning date and shall have carried out the following site tests before such date:
- 13.7.1 Prove the continuity and insulation resistance of the multicore pilot cables.
- 13.7.2 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.
- 13.7.3 The following voltages withstand tests on each completed cable run:
- 13.7.3.1 Paper insulated cables:
- (i) Rating up to 12,7/22 kV shall be tested in accordance to SANS 97.
  - (ii) Rating 19/33 kV shall be tested in accordance to BS 6480.
- The extruded PVC impermeable serving shall withstand a test voltage of 10 kV DC between armouring and earth for 1 minute.
- The insulation between armouring and lead sheath shall withstand a test voltage of 4 kV DC for 1 minute.

### 13.7.3.2 XLPE Insulated Cables:

All cables rated up to 19/33 kV shall be tested in accordance to SANS 1339, and cables rated up to 1,9/3,3 kV shall be tested in accordance to BS 5467.

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.

- 13.7.4 The Contractor shall submit three copies of certified test reports to the Depot Maintenance Manager (Electrical) within three weeks after completion of the tests.

## 14.0 GUARANTEE

- 14.1 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.
- 14.2 The guarantee period shall commence the day the installation is formally handed over to and accepted by Transnet Freight Rail.
- 14.3 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.
- 14.4 Any defects that may become apparent during the guarantee period shall be rectified to the satisfaction of, and free of cost to Transnet Freight Rail.
- 14.5 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 Transnet Freight Rail of such defects.
- 14.6 Should the Contractor fail to comply with the requirements stipulated above, Transnet Freight Rail shall be entitled to undertake the necessary repair work or effect replacement of defective apparatus or materials, and the Contractor shall reimburse Transnet Freight Rail the total cost of such repair or replacement, including the labour costs incurred in replacing defective material.

Preview Copy Only

15.0 APPENDIX 1

**SCOPE OF WORK**

(To be filled by the client)

1.0 Site inspection required (Yes/No).....

Date : .....

Time : .....

Client's Signature: .....

Preview copy only.

## 16.0 APPENDIX 2

## SCHEDULE OF REQUIREMENTS

(To be filled by Tenderer)

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
1.0	Route surveys		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		/m		
5.0	Concrete slabs supplied and installed		each		
6.0	Plastic cable warning tape supplied and installed		/m		
7.0	150 mm dia. half round concrete pipes supplied and installed		/m		
8.0	150 mm dia. Cement or PVC pipes supplied and installed		/m		
9.0	Cutting of checker Plates		/m cut		
10.0	Backfilling of trenches with soil		/cubic metre		
11.0	Backfilling of trenches with 10:1 soil/cement mix		/cubic metre		
12.0	Importation of soil		/cubic metre		
13.0	Concrete cable route markers		each		
14.0	Reinststate tarred Surface		/cubic metre		
15.0	Reinststate concrete Surface		/cubic metre		



ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
16.0	Installation of cables				
16.1	Installed in trenches				
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				
16.2.1	High Voltage Cables		/m		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				
16.2.2	Low Voltage Cables		/m		
	..... Core.....		mm sq		
	..... Core.....		mm sq		
	..... Core.....		mm sq		
	..... Core.....		mm sq		
16.3	Installed in ducts				
16.3.1	High Voltage Cables		/m		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
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				
17.1.1	High Voltage Cables		/m		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				
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				
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		

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
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				
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).				

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
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				
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		

Preview copy only.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
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				
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				

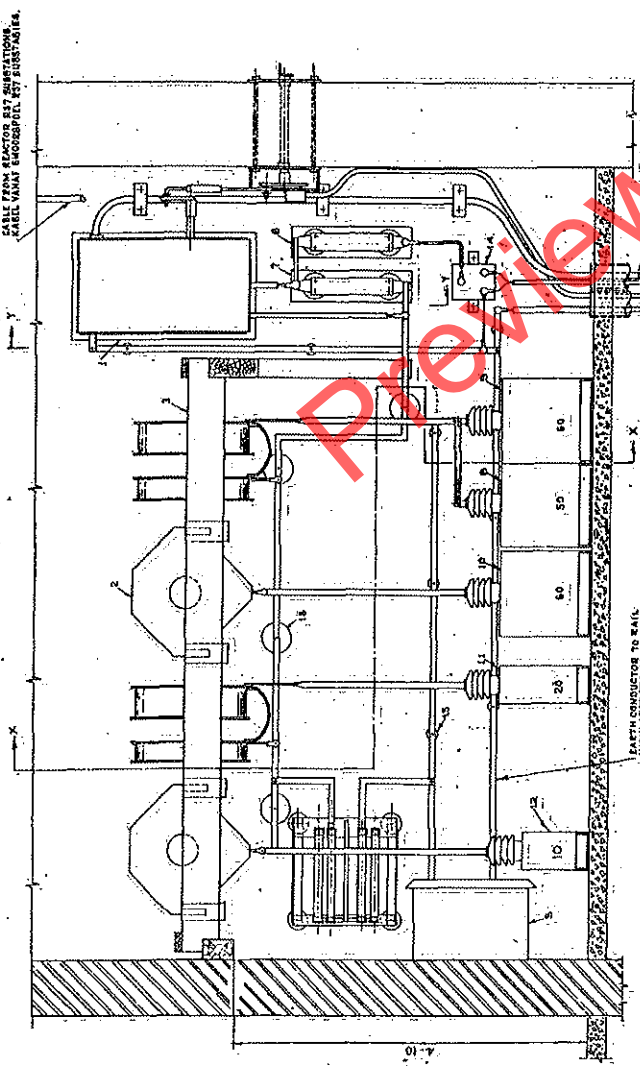
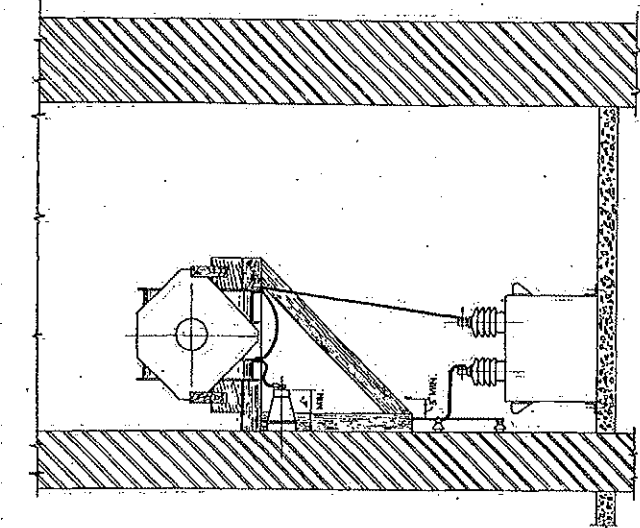
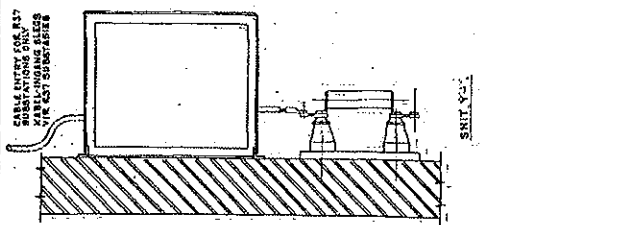
TENDERER'S SIGNATURE.....

DATE.....

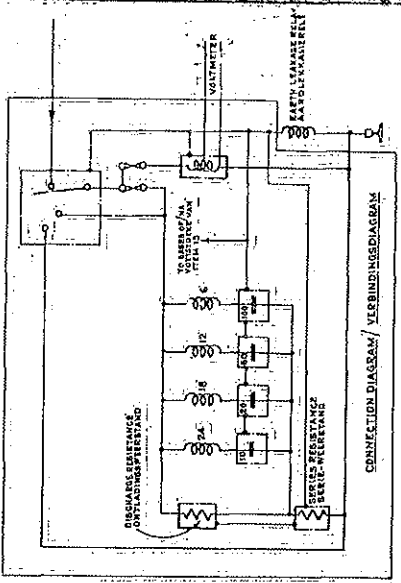
**17.0 APPENDIX 3**

- SANS 1411 – 1: Materials of insulated electric cables and flexible cords Part 1: Conductors.
- SANS 1411 – 2: Materials of insulated electric cables and flexible cords Part 2: Polyvinyl chloride (PVC).
- SANS 1411 – 3: Materials of insulated electric cables and flexible cords Part 3: Elastomers.
- SANS 1411 – 4: Materials of insulated electric cables and flexible cords Part 4: Cross-linked polyethylene (XLPE).
- SANS 1411 – 5: Materials of insulated electric cables and flexible cords Part 5: Halogen-free, flame-retardant materials.
- SANS 1411 – 6: Materials of insulated electric cables and flexible cords Part 6: Armour.
- SANS 1411 – 7: Materials of insulated electric cables and flexible cords Part 7: Polyethylene (PE).
- SANS 1507 – 1: Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) Part 1: General.
- SANS 1507 – 2: Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) Part 2: Wiring cables.
- SANS 1507 – 3: Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) Part 3: PVC Distribution cables
- SANS 1507 – 4: Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) Part 4: XLPE Distribution cables
- SANS 1507 – 5: Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) Part 5: Halogen-free distribution cables.
- SANS 10198 – 1: The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 1: Definitions and statutory requirements.
- SANS 10198 – 2: The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 2: Selection of cable type and methods of installation.
- SANS 10198 – 3: The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 3: Earthing systems - General provisions.
- SANS 10198 – 4: The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 4: Current ratings.
- SANS 10198 – 5: The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 5: Determination of thermal and electrical resistivity of soil.
- SANS 10198 – 6: The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 6: Transportation and storage.
- SANS 10198 – 7: The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 7: Safety precautions.



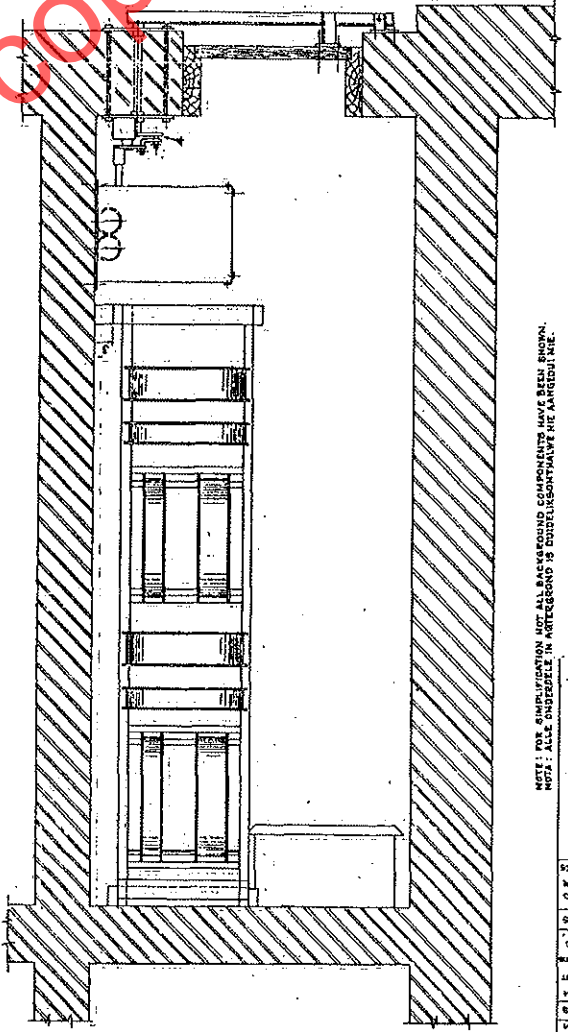


SECTION X-X



ITEM	QTY	DESCRIPTION/REMARKS
1	1	LINE SWITCH
2	1	DISCHARGE RESISTANCE
3	1	SERIES RESISTANCE
4	1	WATTMETER
5	1	SAFETY LEAKAGE RELAY
6	1	DISCHARGE RESISTANCE
7	1	SERIES RESISTANCE
8	1	WATTMETER
9	1	SAFETY LEAKAGE RELAY
10	1	DISCHARGE RESISTANCE
11	1	SERIES RESISTANCE
12	1	WATTMETER
13	1	SAFETY LEAKAGE RELAY
14	1	DISCHARGE RESISTANCE
15	1	SERIES RESISTANCE
16	1	WATTMETER
17	1	SAFETY LEAKAGE RELAY

† ITEMS 8, 9, 10 FOR USE ON TYPE R33 SUBSTANCES ONLY. ALTERNATIVE DESIGN OF TYPE R33 SUBSTANCES (SUPPLIED BY VERNY DEUR OERLIKON).



NOTE: FOR SIMPLICITY NOT ALL BACKGROUND COMPONENTS HAVE BEEN SHOWN.  
NOTA: ALLE ONDERDEEL IN ACHTERGROND IS DUIDELIJKHOUTALWIJDE AANGEGEVEN.

WAVE FILTER CELL LAYOUT  
 UITLEG VAN GOLFFILTERSEL  
 SUBSTANTIONS TIJDES/ SUBSTANTIES TIJDES R33 & R37

DRG. NO. DEE  
 TEK. NO. TCR  
 4

DATE: 1948  
 DRAWN BY: [Signature]  
 CHECKED BY: [Signature]  
 APPROVED BY: [Signature]

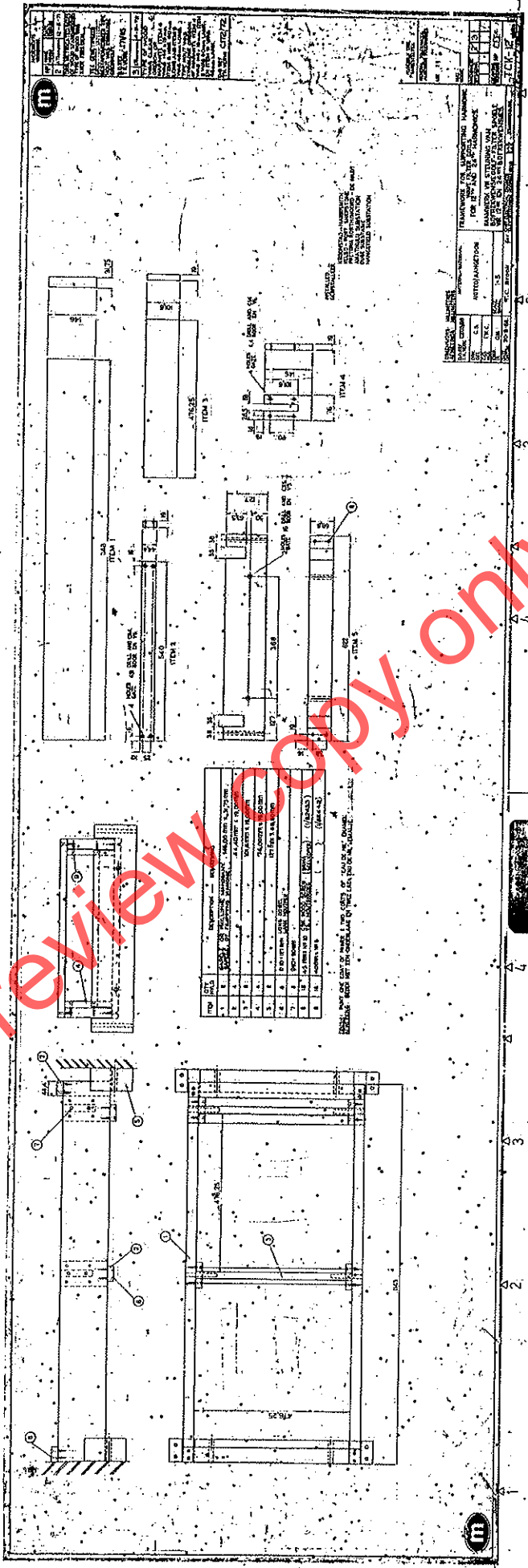
ELECTRICAL ENGINEERING  
 S.A.E. - S.A.E.  
 JOHANNESBURG

APPROVED BY: [Signature]  
 DATE: [Date]  
 DRAWN BY: [Signature]  
 CHECKED BY: [Signature]

ELECTRICAL ENGINEERING  
 S.A.E. - S.A.E.  
 JOHANNESBURG



Preview Copy Only



REV	DATE	BY	CHKD	APP'D
1				
2				
3				
4				
5				

ITEM NO.	DESCRIPTION	QTY	UNIT
1	ITEM 1	1	EA
2	ITEM 2	1	EA
3	ITEM 3	1	EA
4	ITEM 4	1	EA
5	ITEM 5	1	EA

NO.	QTY	DESCRIPTION	UNIT
1	1	ITEM 1	EA
2	1	ITEM 2	EA
3	1	ITEM 3	EA
4	1	ITEM 4	EA
5	1	ITEM 5	EA

NOTE: THIS DRAWING IS A PRELIMINARY DRAWING. IT IS SUBJECT TO CHANGE WITHOUT NOTICE.



*freight rail*

**MINIMUM COMMUNAL HEALTH REQUIREMENTS IN AREAS OUTSIDE THE JURISDICTION OF A LOCAL AUTHORITY : TEMPORARY FACILITIES FOR CONTRACTOR'S PERSONNEL**

**1. CAMPS**

- 1.1 Prior to the erection of any camp, the Contractor shall submit to the Employer's Deputy, for his approval, details of his proposals as to the site, water supply, sanitation, and size and type of buildings. Where the site is on private land, the Contractor shall submit the written approval for the use of the site of the relevant statutory authority and of the owner and occupier of the land (as applicable).
- 1.2 Camps must not be erected on land infested with field rodents.
- 1.3 Adequate drainage shall be provided to carry off storm and waste water.
- 1.4 Buildings shall be built to a neat and orderly pattern.
- 1.5 All buildings shall have smooth, hard, impervious floors, graded to provide effective drainage and to permit washing.
- 1.6 Camps shall be maintained by the Contractor at his own expense in a clean and tidy condition. The Contractor shall take such steps as the Employer's Deputy and landowner/occupier may demand to prevent the creation of a nuisance.
- 1.7 When so instructed by the Employer's Deputy, the Contractor shall, at his own expense, erect suitable screens between the camp and any public road, thoroughfare or railway line.
- 1.8 After removal of a camp, the Contractor shall, at his own expense, restore the site to its original condition to the satisfaction of the Employer's Deputy and of the landowner and occupier where the site is on private land.

**2. HOUSING**

- 2.1 Every living room shall have cross ventilation, both constant and occasional. Where only one window is provided, it shall not be in the same wall as the door.
- 2.2 Dimensions of living rooms shall be sufficient to allow 3.5 square metres of floor area and 11 cubic metres of air space for each person over the age of 10 years. The floor area of any living room shall not be less than 7,8 square metres.

- 2.3 Flat-roofed quarters shall have a minimum roof height of 3 metres above floor level. For quarters with pitched roofs, the wall height shall be not less than 2,6 metres above the floor with a minimum height above floor of 3 metres at the top of the pitch.
- 2.4 Doors shall not be less than 2m x 0,75m and must be halved.
- 2.5 Windows of each living room shall have an area not less than one twelfth of the floor area and shall be capable of opening to at least half their full area.
- 2.6 In areas where malaria is prevalent, doors and windows must be fitted with gauze screens.
- 2.7 Cooking shelters shall comprise roofed structures, three sides of which shall be enclosed by a weatherproof material, approved by the Employer's Deputy to a height of at least 1m above ground level.
  - 2.7.1 Sleeping quarters shall not accommodate more than 8 persons per room.
  - 2.7.2 Pegboards shall be carried on metal or concrete supports and shall be separated by partitions not less than 0,4 metres high extending to within 150mm of the end of the bunk. Pegboards shall be removable for cleaning.

### 3. WATER SUPPLY AND ABLUTION FACILITIES

- 3.1 The Contractor shall ensure that an adequate and conveniently situated supply of potable water is provided.
- 3.2 Separate buildings for ablution facilities shall be provided. Where approval has been obtained for the housing of both males and females, separate facilities for each sex shall be provided. The proportion shall be 1 cubicle for 20 persons.
- 3.3 Waste water shall be hygienically disposed of.

### 4. SANITATION

- 4.1 Separate buildings for latrine facilities shall be provided. Where housing are provided for both males and females, separate facilities for each sex shall be provided. The proportions shall be at least one squatting seat for every 15 persons or less in the case of pit latrines, or one for every 10 persons or less in case of pail latrines.

Latrines shall be fly proof and sited at least 10 metres from any other building, and shall not face on any public road, thoroughfare, railway line or residential property. Pits shall not be less than 2,5 metres deep and sited not less than 120 metres from nearest underground water source.

- 4.2 Latrines shall be so constructed, situated and maintained, and night soil so disposed of as to prevent access by animals, breeding of flies, pollution of streams and domestic water supplies, and other nuisances. Where a night soil removal service is operated by a competent authority, use of such service shall be obligatory, and the use of pit latrines and atria pits will not be permitted.

- 4.3 At least one refuse bin of adequate size with close fitting lid shall be provided for each building. Refuse bins shall be emptied and cleaned out daily.
- 4.4 Labour shall be employed on camp sanitation duties on the following basis:-
  - 4.4.1 Where the number of persons living at the camp is 20 or less - one unit.
  - 4.4.2 For additional numbers over 20 living at the camp - one unit per 100 or part thereof.
- 4.5 Unless refuse is removed by a competent authority, it shall be disposed of in pits and covered over daily with a layer of earth or ash of sufficient thickness to prevent depredations by rodents and the breeding of flies.
- 4.6 Adequate measures shall be taken against all vermin and insects responsible for the spread of disease. Any instructions of a competent health authority shall be carried out promptly and implicitly.
- 4.7 Buildings and bed boards shall be treated whenever necessary with an approved insecticide.
- 4.8 The Contractor shall permit and facilitate inspection of the camp and structures on the site by the staff of Transnet or any other competent authority, and shall comply with any reasonable request by such staff or any other competent authority to eliminate any unsanitary condition.
- 4.9 Any outbreak of infectious disease shall immediately be reported telephonically and confirmed in writing to the Employer's Deputy.
- 4.10 The keeping of animals of any sort is not permitted.
- 4.11 The Contractor shall have on hand at the camp the necessary tools, disinfectants and cleaning materials to maintain and clean the sanitary facilities.

## 5. RATIONS

Rations, where supplied by the Contractor, shall be stored in a suitable and rodent proof building with sufficient shelving.

**P02b-06 (JLH)**

## TRANSNET SOC LIMITED

(Registration no. 1990/000900/30)

### SAFETY ARRANGEMENTS AND PROCEDURAL COMPLIANCE WITH THE OCCUPATIONAL HEALTH AND SAFETY ACT (ACT 85 OF 1993) AND APPLICABLE REGULATIONS

#### 1. General

- 1.1 The Contractor and Transnet SOC Limited (hereinafter referred to as "Transnet") are individual employers, each in its own right, with their respective duties and obligations set out in the Occupational Health and Safety Act, Act 85 of 1993 (the Act) and applicable Regulations.
- 1.2 The Contractor accepts, in terms of the General Conditions of Contract and in terms of the Act, his obligations as an employer in respect of all persons in his employ, other persons on the premises or the Site or place of work or on the work to be executed by him, and under his control. He shall, before commencement with the execution of the contract work, comply with the provisions set out in the Act, and shall implement and maintain a Health and Safety Plan as described in the Construction Regulations, 2003 and as approved by Transnet, on the Site and place of work for the duration of the Contract.
- 1.3 The Contractor accepts his obligation to complying fully with the Act and applicable Regulations notwithstanding the omission of some of the provisions of the Act and the Regulations from this document.
- 1.4 Transnet accepts, in terms of the Act, its obligations as an employer of its own employees working on or associated with the site or place of work, and the Contractor and Project Manager or his deputy shall at all times, co-operate in respect of the health and safety management of the site, and shall agree on the practical arrangements and procedures to be implemented and maintained during execution of the Works.
- 1.5 In the event of any discrepancies between any legislation and this specification, the applicable legislation will take precedence.

#### 2. Definitions

- 2.1 In this Specification any word or expression to which a meaning has been assigned in the Construction Regulations, shall have the meaning so assigned to it, unless the context otherwise indicates: -
- 2.2 The work included in this Contract shall for the purposes of compliance with the Act be deemed to be "**Construction Work**", which, in terms of the Construction Regulations, 2003 means any work in connection with: -
- (a) the erection, maintenance, alteration, renovation, repair, demolition or dismantling of or addition to a building or any similar structure;

- (b) the installation, erection, dismantling or maintenance of fixed plant where such work includes the risk of a person falling;
  - (c) the construction, maintenance, demolition or dismantling of any bridge, dam, canal, road, railway, runway, sewer or water reticulation system or any similar civil engineering structure; or
  - (d) the moving of earth, clearing of land, the making of an excavation, piling, or any similar type of work;
- 2.3 **“competent person”** in relation to construction work, means any person having the knowledge, training and experience specific to the work or task being performed: Provided that where appropriate qualifications and training are registered as per the South African Qualifications Authority Act, 1995 these qualifications and training shall be deemed to be the required qualifications and training;
- 2.4 **“contractor”** means principal contractor and **“subcontractor”** means contractor as defined by the Construction Regulations, 2003.
- 2.5 **“fall protection plan”** means a documented plan, of all risks relating to working from an elevated position, considering the nature of work undertaken, and setting out the procedures and methods applied to eliminate the risk;
- 2.6 **“health and safety file”** means a file, or other record in permanent form, containing the information required to be kept on site in accordance with the Act and applicable Regulations;
- 2.7 **“Health and Safety Plan ”** means a documented plan which addresses the hazards identified and include safe work procedures to mitigate, reduce or control the hazards identified;
- 2.8 **“Risk Assessment”** means a programme to determine any risk associated with any hazard at a construction site, in order to identify the steps needed to be taken to remove, reduce or control such hazard;
- 2.9 **“the Act”** means the Occupational Health and Safety Act No. 85 of 1993.

### 3. Procedural Compliance

3.1 The Contractor who intends to carry out any construction work shall, before carrying out such work, notify the Provincial Director in writing if the construction work:-

- (a) includes the demolition of a structure exceeding a height of 3 metres; or
- (b) includes the use of explosives to perform construction work; or
- (c) includes the dismantling of fixed plant at a height greater than 3m,

and shall also notify the Provincial Director in writing when the construction work exceeds 30 days or will involve more than 300 person days of construction work and if the construction work:-

- (a) includes excavation work deeper than 1m; or

- (b) includes working at a height greater than 3 metres above ground or a landing.
- 3.2 The notification to the Provincial Director shall be on a form similar to Annexure A of the Construction Regulations, 2003, also shown in Annexure 1 of this Specification. The Contractor shall ensure that a copy of the completed notification form is kept on site for inspection by an inspector, Project Manager or employee.
- 3.3 The Contractor shall, in accordance with the Act and applicable Regulations, make all the necessary appointments of competent persons in writing on a form similar to Annexure 2 of this Specification and deliver copies thereof to the Project Manager. Copies should also be retained on the health and safety file.
- 3.4 Subcontractors shall also make the above written appointments and the Contractor shall deliver copies thereof to the Project Manager.
- 3.5 In the case of a self-employed Contractor or any subcontractor who has the appropriate competencies and supervises the work himself, the appointment of a construction supervisor in terms of regulation 6.1 of the Construction Regulations, 2003 will not be necessary. The Contractor shall in such a case execute and sign a declaration, as in Annexure 3, by which he personally undertakes the duties and obligations of the "Chief Executive Officer" in terms of section 16(1) of the Act.
- 3.6 The Contractor shall, before commencing any work, obtain from the Project Manager an access certificate as in Annexure 4 executed and signed by him, permitting and limiting access to the designated site or place of work by the Contractor and any subcontractors under his control.
- 3.7 Procedural compliance with Act and Regulations, as above, shall also apply to any subcontractors as employers in their own right. The Contractor shall furnish the Project Manager with full particulars of such subcontractors and shall ensure that they comply with the Act and Regulations and Transnet's safety requirements and procedures.

#### **4. Special Permits**

Where special permits are required before work may be carried out such as for hotwork, isolation permits, work permits and occupations, the Contractor shall apply to the Project Manager or the relevant authority for such permits to be issued. The Contractor shall strictly comply with the conditions and requirements pertaining to the issue of such permits.

#### **5. Health and Safety Programme**

- 5.1 The Tenderer shall, with his tender, submit a Health and Safety Programme setting out the practical arrangements and procedures to be implemented by him to ensure compliance by him with the Act and Regulations and particularly in respect of: -
- (i) The provision, as far as is reasonably practical, of a working environment that is safe and without risk to the health of his employees and subcontractors in terms of section 8 of the Act;

- (ii) the execution of the contract work in such a manner as to ensure in terms of section 9 of the Act that persons other than those in the Contractor's employment, who may be directly affected by the contract work are not thereby exposed to hazards to their health and safety;
  - (iii) ensuring, as far as is reasonably practical, in terms of section 37 of the Act that no employee or subcontractor of the Contractor does or omits to do any act which would be an offence for the Contractor to do or omit to do.
- 5.2 The Contractor's Health and Safety Programme shall be based on a risk assessment in respect of the hazards to health and safety of his employees and other persons under his control that are associated with or directly affected by the Contractor's activities in performing the contract work and shall establish precautionary measures as are reasonable and practical in protecting the safety and health of such employees and persons.
- 5.3 The Contractor shall cause a risk assessment contemplated in clause 5.2 above to be performed by a competent person, appointed in writing, before commencement of any Construction Work and reviewed during construction. The Risk Assessments shall form part of the Health and Safety programme to be applied on the site and shall include at least the following:
- (a) The identification of the risks and hazards that persons may be exposed to;
  - (b) the analysis and evaluation of the hazards identified;
  - (c) a documented Health and Safety Plan, including safe work procedures to mitigate, reduce or control the risks identified;
  - (d) a monitoring and review plan.
- 5.4 The Health and Safety Plan shall include full particulars in respect of: -
- (a) The safety management structure to be instituted on site or place of work and the names of the Contractor's health and safety representatives and members of safety committees where applicable;
  - (b) the safe working methods and procedures to be implemented to ensure the work is performed in compliance with the Act and Regulations;
  - (c) the safety equipment, devices and clothing to be made available by the Contractor to his employees;
  - (d) the site access control measures pertaining to health and safety to be implemented;
  - (e) the arrangements in respect of communication of health and safety related matters and incidents between the Contractor, his employees, subcontractors and the Project Manager with particular reference to the reporting of incidents in compliance with Section 24 and General Administrative Regulation 8 of the Act and with the pertinent clause of the General Conditions of Contract forming part of the Contract and



- (f) the introduction of control measures for ensuring that the Safety Plan is maintained and monitored for the duration of the Contract.
- 5.4 The Health and Safety programme shall be subject to the Project Manager's approval and he may, in consultation with the Contractor, order that additional and/or supplementary practical arrangements and procedures be implemented and maintained by the Contractor or that different working methods or safety equipment be used or safety clothes be issued which, in the Project Manager's opinion, are necessary to ensure full compliance by the Contractor with his obligations as an employer in terms of the Act and Regulations. The Project Manager or his deputy shall be allowed to attend meetings of the Contractor's safety committee as an observer.
- 5.5 The Contractor shall take reasonable steps to ensure that each subcontractor's Health and Safety Plan is implemented and maintained on the construction site: Provided that the steps taken, shall include periodic audits at intervals mutually agreed to between the them, but at least once every month.
- 5.6 The Contractor shall stop any subcontractor from executing any construction work, which is not in accordance with the Contractor's, and/or subcontractor's Health and Safety Plan for the site or which poses a threat to the health and safety of persons.
- 5.7 The Contractor shall ensure that a copy of the Health and Safety Plan is available on site for inspection by an inspector, Project Manager, agent, subcontractor, employee, registered employee organisation, health and safety representative or any member of the health and safety committee.
- 5.8 The Contractor shall consult with the health and safety committee or, if no health and safety committee exists, with a representative group of employees, on the development, monitoring and review of the Risk Assessment.
- 5.9 The Contractor shall ensure that all employees under his control are informed, instructed and trained by a competent person regarding any hazard and the related work procedures before any work commences, and thereafter at such times as may be determined in the Risk Assessment.
- 5.10 The Contractor shall ensure that all subcontractors are informed regarding any hazard as stipulated in the Risk Assessment before any work commences, and thereafter at such times as may be determined in the Risk Assessment.
- 5.11 The Contractor shall ensure that all visitors to a construction site undergoes health and safety induction pertaining to the hazards prevalent on the site and shall be provided with the necessary personal protective equipment.
- 6. Fall Protection Plan**
- 6.1 In the event of the risk and hazard identification, as required in terms of clause 5.3 of this Specification, revealing risks relating to working from an elevated position the contractor shall cause the designation of a competent person, responsible for the preparation of a fall protection plan;

6.2 The Contractor shall implement, maintain and monitor the fall protection plan for the duration of Contract. The Contractor shall also take such steps to ensure the continued adherence to the fall protection plan.

6.3 The fall protection plan shall include:-

- (a) A Risk Assessment of all work carried out from an elevated position;
- (b) the procedures and methods to address all the identified risks per location;
- (c) the evaluation of the employees physical and psychological fitness necessary to work at elevated positions;
- (d) the training of employees working from elevated positions; and
- (e) the procedure addressing the inspection, testing and maintenance of all fall protection equipment.

## 7. Hazards and Potential Hazardous Situations

The Contractor and the Project Manager shall immediately notify one another of any hazardous or potentially hazardous situations which may arise during performance of the Contract by the Contractor or any subcontractor and, in particular, of such hazards as may be caused by the design, execution and/or location and any other aspect pertaining to the contract work.

## 8. Health and Safety File

8.1 The Contractor shall ensure that a health and safety file is opened and kept on site and shall include all documentation required as per the Act and applicable regulations, and made available to an inspector, the Project Manager, or subcontractor upon request.

8.2 The Contractor shall ensure that a copy of the both his Health and Safety Plan as well as any subcontractor's Health and Safety Plan is available on request to an employee, inspector, contractor or the Project Manager.

8.3 The Contractor shall hand over a consolidated health and safety file to the Project Manager upon completion of the Construction Work and shall in addition to documentation mentioned in the Act and applicable Regulations include a record of all drawings, designs, materials used and other similar information concerning the completed structure.

**ANNEXURE 1**

**OCCUPATIONAL HEALTH AND SAFETY ACT, 1993**

**Regulation 3(1) of the Construction Regulations**

**NOTIFICATION OF CONSTRUCTION WORK**

- 
- 
- 1(a) Name and postal address of principal contractor:  
\_\_\_\_\_
  - (b) Name and tel. no of principal contractor's contact person:  
\_\_\_\_\_
  2. Principal contractor's compensation registration number:  
\_\_\_\_\_
  - 3.(a) Name and postal address of client:  
\_\_\_\_\_
  - (b) Name and tel no of client's contact person or agent:  
\_\_\_\_\_
  - 4.(a) Name and postal address of designer(s) for the project:  
\_\_\_\_\_
  - (b) Name and tel. no of designer(s) contact person:  
\_\_\_\_\_
  5. Name and telephone number of principal contractor's construction supervisor on site appointed in terms of regulation 6(1).  
\_\_\_\_\_
  6. Name/s of principal contractor's construction sub-ordinate supervisors on site appointed in terms of regulation 6(2).  
\_\_\_\_\_  
\_\_\_\_\_
  7. Exact physical address of the construction site or site office:  
\_\_\_\_\_  
\_\_\_\_\_
  8. Nature of the construction work:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
  9. Expected commencement date: \_\_\_\_\_
  10. Expected completion date: \_\_\_\_\_

Preview copy only.

11. Estimated maximum number of persons on the construction site:

---

12. Planned number of contractors on the construction site accountable to the principle contractor:

---

13. Name(s) of contractors already chosen.

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---

---

---

---

**Principal Contractor**

---

**Date**

---

**Client**

---

**Date**

\* THIS DOCUMENT IS TO BE FORWARDED TO THE OFFICE OF THE DEPARTMENT OF LABOUR PRIOR TO COMMENCEMENT OF WORK ON SITE.

\* ALL PRINCIPAL CONTRACTORS THAT QUALIFY TO NOTIFY MUST DO SO EVEN IF ANOTHER PRINCIPAL CONTRACTOR ON THE SAME SITE HAD DONE SO PRIOR TO THE COMMENCEMENT OF WORK.

Preview copy only.

**ANNEXURE 2**

**(COMPANY LETTER HEAD)**

**OCCUPATIONAL HEALTH AND SAFETY ACT, 1993 (ACT 85 OF 1993) :**

**SECTION/REGULATION:** \_\_\_\_\_

**REQUIRED COMPETENCY:** \_\_\_\_\_

In \_\_\_\_\_ terms of \_\_\_\_\_  
I, \_\_\_\_\_

representing the Employer) do hereby  
appoint \_\_\_\_\_

As the Competent Person on the  
premises at \_\_\_\_\_

(physical address) to assist in compliance with the Act and the applicable Regulations.

Your designated area/s is/are as follows :-

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Date :** \_\_\_\_\_

**Signature :-** \_\_\_\_\_

**Designation :-** \_\_\_\_\_

**ACCEPTANCE OF DESIGNATION**

I, \_\_\_\_\_ do hereby accept this Designation and  
acknowledge that I  
understand the requirements of this appointment.

**Date :** \_\_\_\_\_

**Signature :-** \_\_\_\_\_

**Designation :-** \_\_\_\_\_

**ANNEXURE 3**

**(COMPANY LETTER HEAD)**

**OCCUPATIONAL HEALTH AND SAFETY ACT, 1993 (ACT 85 OF 1993) :**

**DECLARATION**

In terms of the above \_\_\_\_\_ am personally assuming the  
Act I, \_\_\_\_\_ duties  
and obligations as Chief Executive Officer, defined in Section 1 of the Act and in terms of  
Section 16(1), I will, as far as is reasonably practicable, ensure that the duties and obligations  
of the Employer as contemplated in the above Act are properly discharged.

**Signature :-** \_\_\_\_\_

**Date :** \_\_\_\_\_

Preview copy only.

**ANNEXURE 4**

**(LETTER HEAD OF BUSINESS DIVISION OR UNIT OF TRANSNET SOC LIMITED)**

**SITE ACCESS CERTIFICATE**

Access to : \_\_\_\_\_ (Area)  
Name of \_\_\_\_\_  
Contractor/Builder :- \_\_\_\_\_  
Contract/Order No.: \_\_\_\_\_

The contract works site/area described above are made available to you for the carrying out of associated works  
In terms of your contract/order  
with  
(company  
) \_\_\_\_\_

Kindly note that you are at all times responsible for the control and safety of the Works Site, and for persons under your control having access to the site.

As from the date hereof you will be responsible for compliance with the requirements of the Occupational Health and Safety Act, 1993 (Act 85 of 1993) as amended, and all conditions of the Contract pertaining to the site of the works as defined and demarcated in the contract documents including the plans of the site or work areas forming part thereof.

Signed : \_\_\_\_\_ Date : \_\_\_\_\_

\_\_\_\_\_  
**PROJECT MANAGER**

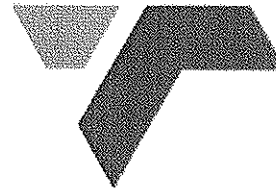
**ACKNOWLEDGEMENT OF RECEIPT**

Name of \_\_\_\_\_ I,  
Contractor/Builder :- \_\_\_\_\_  
do hereby acknowledge and accept  
the duties  
and obligations in respect of the Safety of the site/area of Work in terms of the  
Occupational Health and Safety Act; Act 85 of 1993.

Name : \_\_\_\_\_ Designation : \_\_\_\_\_

Signature : \_\_\_\_\_ Date : \_\_\_\_\_

**TRANSNET**



Transnet SOC Limited Registration Number 1990/00900/06

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## **TRANSNET SPECIFICATION**

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# **E7/1 - SPECIFICATION FOR GENERAL WORK AND WORKS ON, OVER, UNDER OR ADJACENT TO RAILWAY LINES AND NEAR HIGH VOLTAGE EQUIPMENT**

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(This specification shall be used in network operator contracts)

**Preview Copy Only**

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## 1.0 SCOPE

- 1.1 This specification covers the network operator's requirements for general work and works on, over, under or adjacent to railway lines and near high voltage equipment.

## 2.0 DEFINITIONS

The following definitions shall apply:

"Authorised Person" - A person whether an employee of the network operator or not, who has been specially authorised to undertake specific duties in terms of Transnet' publication Electrical Safety Instructions, and who holds a certificate or letter of authority to that effect.

"Barrier" Any device designed to restrict access to "live" high-voltage electrical equipment.

"Bond" - A short conductor installed to provide electrical continuity.

"Contractor" - Any person or organisation appointed by the network operator to carry out work on its behalf.

"Contract Supervisor" - The person or juristic person appointed by the network operator from time to time as the Contract Supervisor, to administer the Contractor's performance and execution of the Works according to the powers and rights held by and obligations placed upon the Contract Supervisor in terms of the Contract.

"Dead" - Isolated and earthed.

"Electrical Officer (Contracts)" - The person appointed in writing by the Project Manager in terms of this specification as the person who shall be consulted by the Contractor in all electrical matters to ensure that adequate safety precautions are taken by the Contractor.

"Executive Officer" - The person appointed by the network operator from time to time as the Executive Officer to act according to the rights and powers held by and obligations placed upon him in terms of the Contract.

"High-Voltage" - A voltage normally exceeding 1000 volts.

"Live" - A conductor is said to be "live" when it is at a potential different from that of the earth or any other conductor of the system of which it forms a part.

"Near" - To be in such a position that a person's body or the tools he is using or any equipment he is handling may come within 3 metres of "live" exposed high-voltage electrical equipment.

"Occupation" - An authorisation granted by the network operator for work to be carried out under specified conditions on, over, under or adjacent to railway lines.

"Occupation Between Trains" - An occupation during an interval between successive trains.

"Optical Fibre Cable" - Buried or suspended composite cable containing optical fibres used in:

- telecommunication networks for transmission of digital information and
- safety sensitive train operations systems.

"Project Manager" - As defined in the special conditions of the contract. The person or juristic person appointed by the network operator from time to time as the Project Manager, to administer the Contract according to the powers and rights held by and obligations placed upon him in terms of the Contract.

"Responsible Representative" - The responsible person in charge, appointed by a contractor, who has undergone specific training (and holds a certificate) to supervise (general or direct) staff under his control who perform general work or to work on, over, under or adjacent to railway lines and in the vicinity of high-voltage electrical equipment.

"Total Occupation" - An occupation for a period when trains are not to traverse the section of line covered by the occupation.

"Work on" - Work undertaken on or so close to the equipment that the specified working clearances to the "live" equipment cannot be maintained.

"Work Permit" - A combined written application and authority to proceed with work on or near dead electrical equipment.

"Works" - The contractual intent for the work to be done as defined in the contract at a defined work site.

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**PART A - GENERAL SPECIFICATION****3.0 AUTHORITY OF OFFICERS OF TRANSNET**

- 3.1 The Contractor shall co-operate with the officers of the network operator and shall comply with all instructions issued and restrictions imposed with respect to the Works which bear on the existence and operation of the network operator's railway lines and high-voltage equipment.
- 3.2 Without limiting the generality of the provisions of clause 3.1, any duly authorised representative of the network operator, having identified himself, may stop the work if, in his opinion, the safe passage of trains or the safety of the network operator's assets or any person is affected. **CONSIDERATIONS OF SAFETY SHALL TAKE PRECEDENCE OVER ALL OTHER CONSIDERATIONS.**

**4.0 CONTRACTOR'S REPRESENTATIVES AND STAFF**

- 4.1 The Contractor shall nominate Responsible Representatives of whom at least one shall be available at any hour for call-out in cases of emergency. The Contractor shall provide the Contract Supervisor with the names, addresses and telephone numbers of the representatives.
- 4.2 The Contractor guarantees that he has satisfied himself that the Responsible Representative is fully conversant with this specification and that he shall comply with all his obligations in respect thereof.
- 4.3 The Contractor shall ensure that all contractor staff receives relevant awareness, educational and competence training regarding safety as prescribed.

**5.0 OCCUPATIONS AND WORK PERMITS**

- 5.1 Work to be done during total occupation or during an occupation between trains or under a work permit shall be done in a manner decided by the Contract Supervisor and at times to suit the network operator requirements.
- 5.2 The Contractor shall organise the Works in a manner which will minimise the number and duration of occupations and work permits required.
- 5.3 The network operator will not be liable for any financial or other loss suffered by the Contractor arising from his failure to complete any work scheduled during the period of an occupation or work permit.
- 5.4 The Contractor shall submit to the Contract Supervisor, in writing, requests for occupations or work permits together with details of the work to be undertaken, at least 21 days before they are required. The network operator does not undertake to grant an occupation or work permit for any particular date, time or duration.
- 5.5 The network operator reserves the right to cancel any occupation or work permit at any time before or during the period of occupation or work permit. If, due to cancellation or change in date or time, the Contractor is not permitted to start work under conditions of total occupation or work permit at the time arranged, all costs caused by the cancellation shall be born by the Contractor except as provided for in clauses 5.6 to 5.8.
- 5.6 When the Contractor is notified less than 2 hours before the scheduled starting time that the occupation or work permit is cancelled, he may claim reimbursement of his direct financial losses caused by the loss of working time up to the time his labour and plant are employed on other work, but not exceeding the period of the cancelled occupation or work permit.
- 5.7 When the Contractor is notified less than 2 hours before the scheduled starting time, or during an occupation or work permit, that the duration of the occupation or work permit is reduced, he may claim reimbursement of his direct financial losses caused by the loss of working time due to the reduced duration of the occupation or work permit.
- 5.8 Reimbursement of the Contractor for any loss of working time in terms of clause 5.6 and 5.7, shall be subject to his claims being submitted within 14 days of the event with full details of labour and plant involved, and provided that the Contract Supervisor certifies that no other work on which the labour and plant could be employed was immediately available.
- 5.9 Before starting any work for which an occupation has been arranged, the Contractor shall obtain from the Contract Supervisor written confirmation of the date, time and duration of the occupation.
- 5.10 Before starting any work for which a work permit has been arranged, the Responsible Representative shall read and sign portion C of the Work Permit, signifying that he is aware of the work boundaries within which work may be undertaken. After the work for which the permit was granted has been completed, or when the

work permit is due to be terminated, or if the permit is cancelled after the start, the same person who signed portion C shall sign portion D of the Work Permit, thereby acknowledging that he is aware that the electrical equipment is to be made "live". The Contractor shall advise all his workmen accordingly.

## 6.0 SPEED RESTRICTIONS AND PROTECTION

6.1 When speed restrictions are imposed by the network operator because of the Contractor's activities, the Contractor shall organise and carry out his work so as to permit the removal of the restrictions as soon as possible.

6.2 When the Contract Supervisor considers protection to be necessary the Contractor shall, unless otherwise agreed, provide all protection including flagmen, other personnel and all equipment for the protection of the network operator's and the Contractor's personnel and assets, the public and including trains.

6.2.1 The network operator will provide training free of charge of the Contractor's flagmen and other personnel performing protection duties. The Contractor shall consult with the Contract Supervisor, whenever he considers that protection will be necessary, taking into account the minimum permissible clearances set out in the Manual for Track Maintenance (Document no. BBB0481):

- Drawing no. BE-97 Sheet 1: Horizontal Clearances: 1065mm gauge (Annexure 1 sheet 1)
- Drawing no. BE-97 Sheet 2: Vertical Clearances: 1065mm gauge (Annexure 1 sheet 2)
- Drawing no. BE-97 Sheet 3: Clearances: Platform (Annexure 1 sheet 3)
- Drawing no. BE-97 Sheet 5: Clearances: 610mm Gauge (Annexure 1 sheet 5)

6.3 The Contractor shall appoint a Responsible Representative to receive and transmit any instruction which may be given by the network operator personnel providing protection.

## 7.0 ROADS AND ROADS ON THE NETWORK OPERATOR'S PROPERTY

7.1 The Contractor shall take every reasonable precaution to prevent damage to any roads or bridges used to obtain access to the site, and shall select routes, use vehicles, and restrict loads so that any extraordinary traffic as may arise from the moving of plant or material to or from the site shall be limited as far as is reasonably possible.

7.2 The Contractor shall not occupy or interfere in any way with the free use of any public or private road, right-of-way, path or street unless the Contract Supervisor has obtained the approval of the road authority concerned.

## 8.0 CLEARANCES

8.1 No temporary works shall encroach on the appropriate minimum clearances set out in the Manual for Track Maintenance (Document no. BBB0481):

- Drawing no. BE-97 Sheet 1: Horizontal Clearances: 1065mm gauge (Annexure 1 sheet 1)
- Drawing no. BE-97 Sheet 2: Vertical Clearances: 1065mm gauge (Annexure 1 sheet 2)
- Drawing no. BE-97 Sheet 3: Clearances: Platform (Annexure 1 sheet 3)
- Drawing no. BE-97 Sheet 5: Clearances: 610mm Gauge (Annexure 1 sheet 5)

## 9.0 STACKING OF MATERIAL

9.1 The Contractor shall not stack any material closer than 3m from the centre line of any railway line without prior approval of the Contract Supervisor.

## 10.0 EXCAVATION, SHORING, DEWATERING AND DRAINAGE

10.1 Unless otherwise approved by the Contract Supervisor any excavation adjacent to a railway line shall not encroach on the hatched area shown in Figure 1.

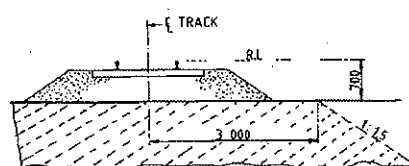


Fig. 1

- 10.2 The Contractor shall provide, at his own cost any shoring, dewatering or drainage of any excavation unless otherwise stipulated elsewhere in the Contract.
- 10.3 Where required by the Contract Supervisor, drawings of shoring for any excavation under or adjacent to a railway line shall be submitted and permission to proceed, obtained before the excavation is commenced.
- 10.4 The Contractor shall prevent ingress of water to the excavation but where water does enter, he shall dispose of it as directed by the Contract Supervisor.
- 10.5 The Contractor shall not block, obstruct or damage any existing drains either above or below ground level unless he has made adequate prior arrangements to deal with drainage.
- 11.0 FALSEWORK FOR STRUCTURES**
- 11.1 Drawings of falsework for the construction of any structure over, under or adjacent to any railway line shall be submitted to the Contract Supervisor and his permission to proceed obtained before the falsework is erected. Each drawing shall be given a title and a distinguishing number and shall be signed by a registered professional engineer certifying that he has checked the design of the falsework and that the drawings are correct and in accordance with the design.
- 11.2 After the falsework has been erected and before any load is applied, the Contractor shall submit to the Contract Supervisor a certificate signed by a registered professional engineer certifying that he has checked the falsework and that it has been erected in accordance with the drawings. Titles and numbers of the drawings shall be stated in the certificate. Notwithstanding permission given by the Contract Supervisor to proceed, the Contractor shall be entirely responsible for the safety and adequacy of the falsework.
- 12.0 PILING**
- 12.1 The Contract Supervisor will specify the conditions under which piles may be installed on the network operator's property.
- 13.0 UNDERGROUND SERVICES**
- 13.1 No pegs or stakes shall be driven or any excavation made before the Contractor has established that there are no underground services which may be damaged thereby.
- 13.2 Any damage shall be reported immediately to the Contract Supervisor, or to the official in charge at the nearest station, or to the traffic controller in the case of centralised traffic control.
- 14.0 BLASTING AND USE OF EXPLOSIVES**
- 14.1 When blasting within 500m of a railway line, the Contractor shall observe the requirements stipulated in this specification.
- 14.2 No blasting shall be carried out except with the prior written permission of the Contract Supervisor and under such conditions as he may impose.
- 14.3 On electrified lines the Contractor shall also obtain the permission of the Electrical Officer (Contracts) before blasting, and shall give at least 21 days notice of his intention to blast. No blasting shall be done in the vicinity of electrified lines unless a member of the network operator's electrical personnel is present.
- 14.4 The Contractor shall arrange for the supply, transport storage and use of explosives.
- 14.5 The Contractor shall have labour, tools and plant, to the satisfaction of the Contract Supervisor, available on the site to clear immediately any stones or debris deposited on the track or formation by blasting, and to repair any damage to the track or formation immediately after blasting. Repairs to the track shall be carried out only under the supervision of a duly authorised representative of the network operator.
- 14.6 The Contractor shall notify the Contract Supervisor of his intention to blast at least 21 days before the commencement of any blasting operations.
- 14.7 Before any blasting is undertaken, the Contractor and the Contract Supervisor shall jointly examine and measure up any buildings, houses or structures in the vicinity of the proposed blasting to establish the extent of any existing cracking or damage to such structures, etc. The Contractor, shall, subject to the provisions stipulated in the Contract Insurance Policy, make good any deterioration of such buildings, houses, or structures, which, in the opinion of the Contract Supervisor, was directly caused by the blasting.
- 14.8 After completion of the blasting the Contractor shall obtain a written clearance from each landowner in

the vicinity of the blasting operations to the effect that all claims for compensation in respect of damage caused by the blasting operations to their respective properties, have been settled.

14.9 The Contractor shall provide proof that he has complied with the provisions of clauses 10.17.1 to 10.17.4 of the Explosives Regulations (Act 26 of 1956 as amended).

14.10 Blasting within 500m of a railway line will only be permitted during intervals between trains. A person appointed by the Contract Supervisor, assisted by flagmen with the necessary protective equipment, will be in communication with the controlling railway station.

Only this person will be authorised to give the Contractor permission to blast, and the Contractor shall obey his instructions implicitly regarding the time during which blasting may take place.

14.11 The flagmen described in clause 14.10, where provided by the network operator, are for the protection of trains and the network operator's property only, and their presence does not relieve the Contractor in any manner of his responsibilities in terms of Explosives Act or Regulations, or any obligation in terms of this Contract.

14.12 The person described in clause 14.10 will record in a book provided and retained by the network operator, the dates and times:-

(i) when each request is made by him to the controlling station for permission to blast;

(ii) when blasting may take place;

(iii) when blasting actually takes place; and

(iv) when he advises the controlling station that the line is safe for the passage of trains.

14.13 Before each blast the Contractor shall record in the same book, the details of the blast to be carried out. The person appointed by the Contract Supervisor and the person who will do the blasting shall both sign the book whenever an entry described in clause 14.12 is made.

## 15.0 RAIL TROLLEYS

15.1 The use of rail trolleys or trestle trolleys on a railway line for working on high voltage equipment will be permitted only if approved by the Contract Supervisor and under the conditions stipulated by him.

15.2 All costs in connection with trolley working and any train protection services requested by the Contractor shall, be borne by the Contractor, unless otherwise agreed.

## 16.0 SIGNAL TRACK CIRCUITS

16.1 Where signal track circuits are installed, the Contractor shall ensure that no material capable of conducting an electrical current makes contact between rails of railway line/lines.

16.2 No signal connections on track-circuited tracks shall be severed without the Contract Supervisor's knowledge and consent.

## 17.0 PENALTY FOR DELAYS TO TRAINS

17.1 If any trains are delayed by the Contractor and the Contract Supervisor is satisfied that the delay was avoidable, a penalty will be imposed on the Contractor as stipulated in the contract, for the period and number of trains delayed.

## 18.0 SURVEY BEACONS AND PEGS

18.1 The Contractor shall not on any account move or damage any beacon, bench mark, reference mark, signal or trigonometrical station in the execution of the Works without the written approval of the Contract Supervisor.

Should the Contractor be responsible for any such occurrence, he shall report the circumstances to the Contract Supervisor who will arrange with the Director-General of Surveys for replacement of the beacon or mark at the cost of the Contractor.

18.2 The Contractor shall not move or damage any cadastral or mining beacon without the written approval of the Contract Supervisor and before it has been referenced by a registered land surveyor. Any old boundary beacon, which becomes an internal beacon on creation of new boundaries, shall not be moved without the written approval of the Contract Supervisor.

Should the Contractor move or damage any cadastral or mining beacon without authority, he shall be responsible for having it replaced, at his cost, by a land surveyor.

- 18.3 The Contractor shall preserve all pegs and bench marks. Such survey points shall not be removed without the written approval of the Contract Supervisor. Should any peg or benchmark be removed without authority, the Contract Supervisor will arrange for its replacement and the cost will be recovered from the Contractor. No claim will be considered for delay in replacing any such peg or bench mark. Each peg replaced shall be checked by the Contractor.
- 18.4 Where a new boundary has been established, beacons on the fence line shall not be disturbed, and fence posts or anchors may not be placed or excavations made within 0,6 m of any beacon without the prior written approval of the Contract Supervisor.

#### **19.0 TEMPORARY LEVEL CROSSINGS**

- 19.1 The Contract Supervisor may, on request of the Contractor, and if necessary for the purpose of execution of the Works, permit the construction of a temporary level crossing over a railway a line at a position approved by the Contract Supervisor and at the Contractor's cost. The period for which the temporary level crossing is permitted will be at the discretion of the Contract Supervisor.
- 19.2 The Contractor will provide protection and supervise the construction of the road over the track(s) and within the railway servitude at the level crossing, as well as the erection of all road signs and height gauges. All cost to be borne by the applicant.

The Contractor shall exercise extreme caution in carrying out this work, especially in respect of damage to tracks, services, overhead power and communications routes and prevent contact with "live" overhead electrical equipment.

Unless otherwise agreed, the Contractor will provide the service deviations or alterations to the network operator's track-, structure-, drainage-, electrical-, telecommunications- and train authorisation systems to accommodate the level crossing.

- 19.3 The Contractor shall take all necessary steps including the provision of gates, locks and, where necessary, watchmen to restrict the use of the temporary level crossing to himself and his employees, his subcontractors and their employees, the staff of the network operator and to such other persons as the Contract Supervisor may permit and of whose identity the Contractor will be advised. If so ordered by the Contract Supervisor, the Contractor shall provide persons to control road traffic using the temporary level crossing. Such persons shall stop all road traffic when any approaching train is within seven hundred and fifty (750) metres of the temporary level crossing, and shall not allow road traffic to proceed over it until the lines are clear.
- 19.4 The Contractor shall maintain the temporary level crossing within the railway servitude in good condition for the period it is in use. A temporary agreement with the road authority to be concluded for the maintenance of the level crossing outside the railway servitude.
- 19.5 When the temporary level crossing is no longer required by the Contractor, or permitted by the network operator, the Contractor shall at his own cost remove it and restore the site and the network operator's track-, structure-, drainage-, electrical-, telecommunications- and train authorisation systems to its original condition. Work over the tracks and within the railway servitude will be supervised by the network operator.

#### **20.0 COMPLETION OF THE WORKS**

- 20.1 On completion of the works, the Contractor shall remove all the remaining construction plant and material from the site, other than material which is the property of the network operator, and leave the site in a clean, neat and tidy condition. If material and plant is required for the liability and maintenance period the Contract supervisor must authorise it's retention on site.

#### **21.0 PROTECTION OF PERSONS AND PROPERTY**

- 21.1 The Contractor shall provide and maintain all lights, guards, barriers, fencing and watchmen when and where necessary or as required by the Contract Supervisor or by any statutory authority, for the protection of the Works and for the safety and convenience of the public.

Red, yellow, green or blue lights may not be used by the Contractor as they can be mistaken for signals. Red, yellow, green or white flags shall only be used for protection by the Contractor. Within the precincts of a port the Contractor shall obtain the permission of the Port Captain before installing any light.

- 21.2 The Contractor shall take all the requisite measures and precautions during the course of the Works to:
- (i) protect the public and property of the public,
  - (ii) protect the property and workmen of both the network operator and the Contractor,
  - (iii) avoid damage to and prevent trespass on adjoining properties, and
  - (iv) ensure compliance with any instruction issued by the Contract Supervisor or other authorised person, and with any stipulation embodied in the contract documents which affects the safety of any person or thing.
- 21.3 The network operator will provide, at its own cost, protection for the safe working of trains during such operations as the Contract Supervisor may consider necessary. Protection by the network operator for any purpose whatsoever, does not absolve the Contractor of his responsibilities in terms of the Contract.
- 21.4 The Contractor shall take all precautions and appoint guards, watchmen and compound managers for prevention of disorder among and misconduct by the persons employed on the Works and by any other persons, whether employees or not, on the work site and for the preservation of the peace and protection of persons and property in the direct neighbourhood. Any relocation of camps because of disorder shall be at the Contractor's expense.
- 21.5 All operations necessary for the execution of the Works, including the provision of any temporary work and camping sites, shall be carried out so as not to cause veldt fires, ground and environmental pollution, soil erosion or restriction of or interference with streams, furrows, drains and water supplies.
- If the original surface of the ground is disturbed in connection with the Works, it shall be made good by the Contractor to the satisfaction of the land owner, occupier or responsible authority.
- 21.6 The Contractor shall take all reasonable steps to minimise noise and disturbance when carrying out the Works, including work permitted outside normal working hours.
- 21.7 Dumping of waste or excess materials by the Contractor shall, in urban areas, be done under the direction and control of, and at sites made available by the local authority. Dumping outside local authority boundaries shall be done only with the express permission and under the direction and control of the Contract Supervisor.
- 21.8 The Contractor shall comply with environmental protection measures and specifications stipulated by the Contract Supervisor and/or local and environmental authorities.
- 22.0 INTERFERENCE WITH THE NETWORK OPERATOR'S ASSETS AND WORK ON OPEN LINES**
- 22.1 The Contractor shall not interfere in any manner whatsoever with an open line, nor shall he carry out any work or perform any act which affects the security, use or safety of an open line except with the authority of the Contract Supervisor and in the presence of a duly authorised representative of the network operator.
- 22.2 The Contractor shall not carry out any work or operate any plant, or place any material whatsoever nearer than three metres from the centre line of any open line except with the written permission of the Contract Supervisor and subject to such conditions as he may impose.
- 22.3 Care must be taken not to interfere with or damage any services such as overhead wire routes, cables or pipes and optical fibre cable, except as provided for the work specified. The Contractor will be held responsible for any damage to or interruption of such services arising from any act or omission on his part or of any of his employees, or persons engaged by him on the Works. The cost of repairing, replacing or restoring the services, as well as all other costs arising from any damage to services, shall be borne by, and will be recovered from the Contractor.
- 22.4 Authority granted by the Contract Supervisor and the presence of an authorised representative of the network operator in terms hereof, shall not relieve the Contractor of his duty to comply with this specification.
- 23.0 ACCESS, RIGHTS-OF-WAY AND CAMPSITES**
- 23.1 Where entry onto the network operator's property is restricted, permission to enter will be given only for the purpose of carrying out the Works and will be subject to the terms and conditions laid down by the network operator.
- 23.2 The Contractor shall arrange for campsites, workplaces and access thereto as well as for any right-of-



way over private property to the site of the Works, and for access within the boundaries of the network operator's property. The owners of private property to be traversed shall be approached and treated with tact and courtesy by the Contractor, who shall, if necessary, obtain a letter of introduction to such property owners from the Contract Supervisor.

The Contractor shall be responsible for the closing of all gates on roads and tracks used by him or his employees. Except with the prior approval of the Contract Supervisor and the owner or occupier of any private land to be traversed, the Contractor shall not cut, lower, damage, remove or otherwise interfere with any fence or gate which is either on the network operator's property or on private property and which restricts access to the Works. Where such approval has been given, the Contractor shall prevent entry of animals or unauthorised persons onto the network operator's or private property, and shall make the fences safe against trespass at the close of each day's work.

23.3 The Contractor shall take all reasonable steps to confine the movement of vehicles and plant to the approved right-of-way to minimise damage to property, crops and natural vegetation.

23.4 When access is no longer required, and before completion of the Works, the Contractor shall repair, restore or replace any fence or gate damaged during execution of the Works to the satisfaction of the Contract Supervisor and shall furnish the Contract Supervisor with a certificate signed by the owner and occupier of land over which he has gained access to a campsite, workplace and the Works, certifying that the owner and occupier have no claim against the Contractor or the network operator arising from the Contractor's use of the land. Should the Contractor be unable to obtain the required certificate, he shall report the circumstances to the Contract Supervisor.

#### **24.0 SUPERVISION**

24.1 The Contract Supervisor will provide overall technical superintendence of the Works, and may direct the Contractor in terms of the provisions of the Contract or in respect of any measures which the Contract Supervisor may require for the operations of the network operator, the safety of trains, property and workmen of the network operator, and for the safety of other property and persons. The Contractor shall carry out the directions of the Contract Supervisor. The superintendence exercised by the Contract Supervisor, including any agreement, approval, refusal or withdrawal of any approval given, shall not relieve the Contractor of any of his duties and liabilities under the Contract, and shall not imply any assumption by the network operator or by the Contract Supervisor of the legal and other responsibilities of the Contractor in carrying out the Works.

24.2 The Contract Supervisor may delegate to any deputy or other person, any of his duties or functions under the Contract. On receiving notice in writing of such delegation, the Contractor shall recognise and obey the deputy or person to whom any such duties or functions have been delegated as if he were the Contract Supervisor.

24.3 The Contractor shall exercise supervision over the Works at all times when work is performed or shall be represented by an agent having full power and authority to act on behalf of the Contractor. Such agent shall be competent and responsible, and have adequate experience in carrying out work of a similar nature to the Works, and shall exercise personal supervision on behalf of the Contractor. The Contract Supervisor shall be notified in writing of such appointment which will be subject to his approval.

24.4 The Contractor or his duly authorised agent shall be available on the site at all times while the Works are in progress to receive the orders and directions of the Contract Supervisor.

#### **25.0 HOUSING OF EMPLOYEES**

25.1 The Contractor shall, where necessary, make his own arrangements for suitable housing of his employees. Where temporary housing is permitted by the Contract Supervisor on any part of the site, the Contractor shall provide suitable sanitation, lighting and potable water supplies in terms of the requirements of the local authority or the current network operator's specification; Minimum Communal Health Requirements in Areas outside the Jurisdiction of a Local Authority - E.4B, as applicable.

25.2 Fouling the area inside or outside the network operator's boundaries shall be prevented. The Contractor will be called upon by the Contract Supervisor to dispose of any foul or waste matter generated by the Contractor.

#### **26.0 OPTICAL FIBRE CABLE ROUTES**

26.1 The Contractor shall not handle, impact, move or deviate any optical fibre cable without prior approval.

26.2 Works that in any way affect the optical fibre cable requires prior approval from the Contract Supervisor

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who will determine the work method and procedures to be followed.

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**PART B - SPECIFICATION FOR WORK NEAR HIGH-VOLTAGE ELECTRICAL EQUIPMENT**
**27.0 GENERAL**

27.1 This specification is based on the contents of Transnet's publication ELECTRICAL SAFETY INSTRUCTIONS, as amended, a copy of which will be made available on loan to the Contractor for the duration of the contract.

These instructions apply to all work near "live" high-voltage equipment maintained and/or operated by the network operator, and the onus rests on the Contractor to ensure that he obtains a copy.

27.2 This specification must be read in conjunction with and not in lieu of the Electrical Safety Instructions.

27.3 The Contractor's attention is drawn in particular to the contents of Part I, Sections 1 and 2 of the Electrical Safety Instructions.

27.4 The Electrical Safety Instructions cover the minimum safety precautions which must be taken to ensure safe working on or near high-voltage electrical equipment, and must be observed at all times. Should additional safety measures be considered necessary because of peculiar local conditions, these may be ordered by and at the discretion of the Electrical Officer (Contracts).

27.5 The Contractor shall obtain the approval of the Electrical Officer (Contracts) before any work is done which causes or could cause any portion of a person's body or the tools he is using or any equipment he is handling, to come within 3 metres of any "live" high-voltage equipment.

27.6 The Contractor shall regard all high-voltage equipment as "live" unless a work permit is in force.

27.7 Safety precautions taken or barriers erected shall comply with the requirements of the Electrical Officer (Contracts), and shall be approved by him before the work to be protected is undertaken by the Contractor. The Contractor shall unless otherwise agreed, bear the cost of the provision of the barriers and other safety precautions required, including the attendance of the network operator's staff where this is necessary.

27.8 No barrier shall be removed unless authorised by the Electrical Officer (Contracts).

**28.0 WORK ON BUILDINGS OR FIXED STRUCTURES**

28.1 Before any work is carried out or measurements are taken on any part of a building, fixed structure or earthworks of any kind above ground level situated within 3 metres of "live" high-voltage equipment, the Electrical Officer (Contracts) shall be consulted to ascertain the conditions under which the work may be carried out.

28.2 No barrier erected to comply with the requirements of the Electrical Officer (Contracts) shall be used as temporary staging or shuttering for any part of the Works.

28.3 The shuttering for bridge piers, abutments, retaining walls or parapets adjacent to or over any track may be permitted to serve as a barrier, provided that it extends at least 2,5 metres above any working level in the case of piers, abutments and retaining walls and 1,5 metres above any working level in the case of parapets.

**29.0 WORK DONE ON OR OUTSIDE OF ROLLING STOCK, INCLUDING LOADING OR UNLOADING**

29.1 No person may stand, climb or work, whilst on any platform, surface or foothold:

29.1.1 higher than the normal unrestricted access way, namely -

29.1.1.1 external walkways on diesel, steam and electric locomotives, steam heat vans, etc. and

29.1.1.2 walkways between coaches and locomotives.

29.1.2 of restricted access ways in terms of the Electrical Safety Instructions namely -

29.1.2.1 the floor level of open wagons

29.1.2.2 external walkways or decks of road-rail vehicles, on-track maintenance machines and material trains.

29.1.3 Unauthorised staff working on these platforms must be directly supervised by duly authorised persons in terms of clause 607.1.3 of the Electrical Safety Instructions. These persons must attend the relevant electrical safety module training. A letter of training must then be issued by an accredited training authority. A Category C Certificate of Authority must be obtained from the

local depot examining officer.

- 29.2 When in the above positions no person may raise his hands or any equipment he is handling above his head.
- 29.3 In cases where the Contractor operates his own rail mounted equipment, he shall arrange for the walkways on this plant to be inspected by the Electrical Officer (Contracts) and approved, before commencement of work.
- 29.4 The handling of long lengths of material such as metal pipes, reinforcing bars, etc should be avoided, but if essential they shall be handled as nearly as possible in a horizontal position below head height.
- 29.5 The Responsible Representative shall warn all persons under his control of the danger of being near "live" high-voltage equipment, and shall ensure that the warning is fully understood.
- 29.6 Where the conditions in clauses 30.1 to 30.4 cannot be observed the Electrical Officer (Contracts), shall be notified. He will arrange for suitable Safety measures to be taken. The Electrical Officer (Contracts), may in his discretion and in appropriate circumstances, arrange for a suitable employee of the Contractor to be specially trained by the network operator and at the Contractor's cost, as an Authorised Person to work closer than 3 metres from "live" overhead conductors and under such conditions as may be imposed by the senior responsible electrical engineer of the network operator.

### **30.0 USE OF EQUIPMENT**

#### **30.1 Measuring Tapes and Devices**

- 30.1.1 Measuring tapes may be used near "live" high-voltage equipment provided that no part of any tape or a person's body comes within 3 metres of the "live" equipment.
- 30.1.2 In windy conditions the distance shall be increased to ensure that if the tape should fall it will not be blown nearer than 3 metres from the "live" high-voltage equipment.
- 30.1.3 Special measuring devices longer than 2 metres such as survey sticks and rods may be used if these are of non-conducting material and approved by the responsible Electrical Engineer of the network operator, but these devices must not be used within 3 metres of "live" high-voltage equipment in rainy or wet conditions.
- 30.1.4 The assistance of the Electrical Officer (Contracts) shall be requested when measurements within the limits defined in clauses 31.1.1 to 31.1.3 are required.
- 30.1.5 The restrictions described in 31.1.1 to 31.1.3 do not apply on a bridge deck between permanent parapets nor in other situations where a barrier effectively prevents contact with the "live" high-voltage equipment.

#### **30.2 Portable Ladders**

- 30.2.1 Any type of portable ladder longer than 2 metres may only be used near "live" high-voltage equipment under the direct supervision of the Responsible Representative. He shall ensure that the ladder is always used in such a manner that the distance from the base of the ladder to any "live" high-voltage equipment is greater than the fully extended length of the ladder plus 3 metres. Where these conditions cannot be observed, the Electrical Officer (Contracts) shall be advised, and he will arrange for suitable safety measures to be taken.

### **31.0 CARRYING AND HANDLING MATERIAL AND EQUIPMENT**

- 31.1 Pipes, scaffolding, iron sheets, reinforcing bars and other material which exceeds 2 metres in length shall be carried completely below head height near "live" high-voltage equipment. For maximum safety such material should be carried by two or more persons so as to maintain it as nearly as possible in a horizontal position. The utmost care must be taken to ensure that no part of the material comes within 3 metres of any "live" high-voltage equipment.
- 31.2 Long lengths of wire or cable shall never be run out in conditions where a part of a wire or cable can come within 3 metres of any "live" high-voltage equipment unless the Electrical Officer (Contracts) has been advised and has approved appropriate safety precautions.
- 31.3 The presence of overhead power lines shall always be taken account of especially when communications lines or cables or aerial cables, stay wires, etc. are being erected above ground level.

### **32.0 PRECAUTIONS TO BE TAKEN WHEN ERECTING OR REMOVING POLES, ANTENNAE, TREES ETC.**

- 32.1 A pole may be handled for the purpose of erection or removal near high-voltage equipment under the following conditions:

(i) If the distance between the point at which the pole is to be erected or removed and the nearest "live" high-voltage equipment is more than the length of the pole plus 3 metres, the work shall be supervised by the Responsible Representative.

(ii) If the distance described in (i) is less than the length of the pole plus 3 metres, the Electrical Officer (Contracts) shall be consulted to arrange for an Authorised Person to supervise the work and to ensure that the pole is earthed where possible. The pole shall be kept in contact with the point of erection, and adequate precautions shall be taken to prevent contact with "live" high-voltage equipment.

32.2 The cost of supervision by an Authorised Person and the provision of earthing shall, unless otherwise agreed, be borne by the Contractor.

32.3 The provisions of clauses 33.1 and 33.2 shall also apply to the erection or removal of columns, antennae, trees, posts, etc.

### 33.0 USE OF WATER

33.1 No water shall be used in the form of a jet if it can make contact with any "live" high-voltage equipment or with any person working on such equipment.

### 34.0 USE OF CONSTRUCTION PLANT

34.1 "Construction plant" entails all types of plant including cranes, piling frames, boring machines, excavators, draglines, dewatering equipment and road vehicles with or without lifting equipment.

34.2 When work is being undertaken in such a position that it is possible for construction plant or its load to come within 3 metres of "live" high-voltage equipment, the Electrical Officer (Contracts) shall be consulted. He will arrange for an Authorised Person to supervise the work and to ensure that the plant is adequately earthed. The Electrical Officer (Contracts) will decide whether further safety measures are necessary.

34.3 The cost of any supervision by an Authorised Person and the provision of earthing shall, unless otherwise agreed, be borne by the Contractor.

34.4 When loads are handled by cranes, non-metallic rope hand lines shall be used, affixed to such loads so as to prevent their swinging and coming within 3 metres of "live" high-voltage equipment.

34.5 Clauses 35.1 to 35.4 shall apply *mutatis mutandis* to the use of maintenance machines of any nature.

### 35.0 WORK PERFORMED UNDER DEAD CONDITIONS UNDER COVER OF A WORK PERMIT

35.1 If the Responsible Representative finds that the work cannot be done in safety with the high-voltage electrical equipment "live", he shall consult the Electrical Officer (Contracts) who will decide on the action to be taken.

35.2 If a work permit is issued the Responsible Representative shall-

(i) before commencement of work ensure that the limits within which work may be carried out have been explained to him by the Authorised Person who issued the permit to him, and that he fully understands these limits.

(ii) sign portion C of the permit before commencement of work;

(iii) explain to all persons under his control the limits within which work may be carried out, and ensure that they fully understand these limits;

(iv) care for the safety of all persons under his control whilst work is in progress; and

(v) withdraw all personnel under his control from the equipment on completion of the work before he signs portion D of the work permit.

### 36.0 TRACTION RETURN CIRCUITS IN RAILS

36.1 DANGEROUS CONDITIONS CAN BE CREATED BY REMOVING OR SEVERING ANY BOND.

36.2 Broken rails with an air gap between the ends, and joints at which fishplates are removed under "broken bond" conditions, are potentially lethal. The rails on either side of an air gap between rail ends on electrified lines shall not be touched simultaneously until rendered safe by the network operator personnel.

36.3 The Contractor shall not break any permanent bonds between rails or between rails and any structure. He shall give the Contract Supervisor at least 7 days written notice when removal of such bonds is necessary.

36.4 No work on the track which involves interference with the traction return rail circuit either by cutting or removing the rails, or by removal of bonds shall be done unless the Electrical Officer (Contracts) is consulted. He will take such precautions as may be necessary to ensure continuity of the return circuit before permitting the work to be commenced.

**37.0 HIGH-VOLTAGE ELECTRICAL EQUIPMENT NOT MAINTAINED AND/OR OPERATED BY THE NETWORK OPERATOR**

Where the work is undertaken on or near high-voltage electrical equipment which is not maintained and/or operated by the network operator, the Occupational Health and Safety Act No. 85 of 1993, and Regulations and Instructions, or the Mines Health and Safety Act (Act 29 of 1996), shall apply.

Such equipment includes:-

- (i) Eskom and municipal equipment;
- (ii) The Contractor's own power supplies; and
- (iii) Electrical equipment being installed but not yet taken over from the Contractor.

END

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**Contract Data**

**Site Information**

12.0 The works shall be performed at **Doornpoort** and **Bon accord** 3kV DC substations.

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