



C1.1 Form of Offer & Acceptance

Offer

The Purchaser, identified in the Acceptance signature block, has solicited offers to enter into a contract for the procurement of:

Supply and Delivery of 3 kV Rectifiers for Traction Substations at Heidelberg and Standerton.

The tenderer, identified in the Offer signature block, has examined the documents listed in the Tender Data and addenda thereto as listed in the Returnable Schedules, and by submitting this Offer has accepted the Conditions of Tender.

By the representative of the tenderer, deemed to be duly authorised, signing this part of this Form of Offer and Acceptance the tenderer offers to perform all of the obligations and liabilities of the *Supplier* under the contract including compliance with all its terms and conditions according to their true intent and meaning for an amount to be determined in accordance with the *conditions of contract* identified in the Contract Data.

	The offered total of the Prices exclusive of VAT is	R
	Value Added Tax @ 14% is	R
	The offered total of the amount due inclusive of VAT is ¹	R
(in words)		

This Offer may be accepted by the *Purchaser* by signing the Acceptance part of this Form of Offer and Acceptance and returning one copy of this document including the Schedule of Deviations (if any) to the tenderer before the end of the period of validity stated in the Tender Data, or other period as agreed, whereupon the tenderer becomes the party named as the *Supplier* in the *conditions of contract* identified in the Contract Data.

Signature(s)

Name(s)

Capacity

For the tenderer:

Name & signature of witness

Date

¹ This total is required by the *Purchaser* for budgeting purposes only. Actual amounts due will be assessed in terms of the *conditions of contract*.



Acceptance

By signing this part of this Form of Offer and Acceptance, the *Purchaser* identified below accepts the tenderer's Offer. In consideration thereof, the *Purchaser* shall pay the *Supplier* the amount due in accordance with the *conditions of contract* identified in the Contract Data. Acceptance of the tenderer's Offer shall form an agreement between the *Purchaser* and the tenderer upon the terms and conditions contained in this agreement and in the contract that is the subject of this agreement.

The terms of the contract, are contained in:

- Part C1 Agreements and Contract Data, (which includes this Form of Offer and Acceptance)
- Part C2 Pricing Data
- Part C3 Scope of Work: Goods Information including Supply Requirements

and drawings and documents (or parts thereof), which may be incorporated by reference into the above listed Parts.

Deviations from and amendments to the documents listed in the Tender Data and any addenda thereto listed in the Returnable Schedules as well as any changes to the terms of the Offer agreed by the tenderer and the *Purchaser* during this process of offer and acceptance, are contained in the Schedule of Deviations attached to and forming part of this Form of Offer and Acceptance. No amendments to or deviations from said documents are valid unless contained in this Schedule.

The tenderer shall within two weeks of receiving a completed copy of this agreement, including the Schedule of Deviations (if any), contact the *Purchaser's Supply Manager* (whose details are given in the Contract Data) to arrange the delivery of any securities, bonds, guarantees, proof of insurance and any other documentation to be provided in terms of the *conditions of contract* identified in the Contract Data at, or just after, the date this agreement comes into effect. Failure to fulfil any of these obligations in accordance with those terms shall constitute a repudiation of this agreement.

Notwithstanding anything contained herein, this agreement comes into effect on the date when the tenderer receives one fully completed original copy of this document, including the Schedule of Deviations (if any).

Unless the tenderer (now *Supplier*) within five working days of the date of such receipt notifies the *Purchaser* in writing of any reason why he cannot accept the contents of this agreement, this agreement shall constitute a binding contract between the Parties.

Signature(s) _____

Name(s) _____

Capacity _____

for the
Purchaser

Transnet SOC Ltd
Transnet Freight Rail (RME)
Corner of Jetpark and North Reef Road
Elandsfontein

Name & signature of witness _____ Date _____

Note: If a tenderer wishes to submit alternative tenders, use another copy of this Form of Offer and Acceptance.



Schedule of Deviations to be completed by the Purchaser prior to contract award

Note:

1. This part of the Offer & Acceptance would not be required if the contract has been developed by negotiation between the Parties and is not the result of a process of competitive tendering.
2. The extent of deviations from the tender documents issued by the Purchaser prior to the tender closing date is limited to those permitted in terms of the Conditions of Tender.
3. A tenderer's covering letter must not be included in the final contract document. Should any matter in such letter, which constitutes a deviation as aforesaid be the subject of agreement reached during the process of Offer and Acceptance, the outcome of such agreement shall be recorded here and the final draft of the contract documents shall be revised to incorporate the effect of it.

No.	Subject	Details
1		
2		
3		
4		
5		

By the duly authorised representatives signing this Schedule of Deviations below, the *Purchaser* and the tenderer agree to and accept this Schedule of Deviations as the only deviations from and amendments to the documents listed in the Tender Data and any addenda thereto listed in the Tender Schedules, as well as any confirmation, clarification or changes to the terms of the Offer agreed by the tenderer and the *Purchaser* during this process of Offer and Acceptance.

It is expressly agreed that no other matter whether in writing, oral communication or implied during the period between the issue of the tender documents and the receipt by the tenderer of a completed signed copy of this Form shall have any meaning or effect in the contract between the parties arising from this Agreement.

For the tenderer:	For the Purchaser
Signature _____	_____
Name _____	_____
Capacity _____	_____
On behalf of _____	Transnet SOC Ltd Transnet Freight Rail Corner of Jetpark and North Reef Road Elandsfontein
Name & signature of witness _____	_____
Date _____	_____



C1.2 SC3 Contract Data

Part one - Data provided by the *Purchaser*

Clause	Statement	Data
1	General	
	The <i>conditions of contract</i> are the core clauses and the clauses for Options	
		X7: Delay damages
	of the NEC3 Supply Contract (December 2009) ¹	
10.1	The <i>Purchaser</i> is (name):	Transnet SOC Ltd (Reg no. 1990/000900/30)
	Address	Carlton Centre, 150 Commissioner Street, Johannesburg, 2001
	Tel No.	011 308-3001
	Fax No.	011 308-2638
	Having elected its Contractual Address for the purposes of this contract as:	Transnet Freight Rail Corner of Jet Park and North Reef Road Elandsfontein
	Tel No.	011 878 7111
	Fax No.	011 878 7055
10.1	The <i>Supply Manager</i> is (name):	Mr. Sandile Magenuka
	Address	Corner of Jet Park and North Reef Road Elandsfontein
	Tel	011 878 7214
	e-mail	sandile.magenuka@transnet.net
11.2(13)	The <i>goods</i> are	Supply and Delivery of 3 kV Rectifiers for Traction Substations at Heidelberg and Standerton
12.2	The <i>law of the contract</i> is the law of	the Republic of South Africa

¹ Available from Engineering Contract Strategies Tel 011 803 3008 Fax 011 803 3009, www.ecs.co.za.



TRANSNET SOC LTD

CONTRACT NUMBER: EFT-2444086-002/2012-E

DESCRIPTION OF THE WORKS: THE SUPPLY AND DELIVERY OF 3 KV RECTIFIERS FOR TRACTION SUBSTATIONS AT HEIDELBERG AND STANDERTON

13.1	The <i>language of this contract</i> is	English
13.3	The <i>period for reply</i> is	1 day
2	The Supplier's main responsibilities	Data required by this section of the core clauses is provided by the <i>Supplier</i> in Part 2 and terms in italics used in this section are identified elsewhere in this Contract Data.
3	Time	
30.1	The <i>starting date</i> is:	28 September 2012
	The <i>completion date</i> is:	01 February 2013
30.1	The <i>delivery date of the goods</i> is:	As per Purchase Order
4	Testing and defects	
42	The <i>defects date</i> is	12 months after Installation.
43.2	The <i>defect correction period</i> is	4 weeks
5	Payment	
50.1	The <i>assessment interval</i> is monthly	On the 10th of each successive month.
51.1	The <i>currency of this contract</i> is the	South African Rand
51.2	The period within which payments are made is	Payment will be effected on or before the last day of the month following the month during which a valid Tax invoice and statement were received.
51.4	The <i>interest rate</i> is	0% per annum above the prime rate of the Standard Bank of South Africa.
6	Compensation events	No additional data is required for this section of the <i>conditions of contract</i>.
7	Title	No additional data is required for this section of the <i>conditions of contract</i>.
8	Risks, liabilities, indemnities and insurance	
80.1	These are additional <i>Purchaser's</i> risks	1. Nil
84.1	The <i>Supplier</i> provides these additional insurances	
	1. Insurance against	Motor Vehicle Liability Insurance comprising (as a minimum) "Balance of Third Party" Risks including Passenger and Unauthorised Passenger Liability indemnity with a minimum indemnity limit of R10,000,000.00
84.2	The minimum amount of cover for loss of or damage to any plant and materials provided by the <i>Purchaser</i> is:	Nil



TRANSNET SOC LTD

CONTRACT NUMBER: EFT-2444086-002/2012-E

DESCRIPTION OF THE WORKS: THE SUPPLY AND DELIVERY OF 3 KV RECTIFIERS FOR TRACTION SUBSTATIONS AT HEIDELBERG AND STANDERTON

84.2	The minimum limit of indemnity for insurance in respect of loss of or damage to property (except the <i>goods</i> , plant and materials and equipment) and liability for bodily injury to or death of a person (not an employee of the <i>Supplier</i>) caused by activity in connection with this contract for any one event is:	whatever the <i>Supplier</i> deems necessary.
84.2	The minimum limit of indemnity for insurance in respect of death of or bodily injury to employees of the <i>Supplier</i> arising out of and in the course of their employment in connection with this contract for any one event is:	As prescribed by the Compensation for Occupational Injuries and Diseases Act No. 130 of 1993 as amended.
88.1	The <i>Supplier's</i> liability to the <i>Purchaser</i> for indirect or consequential loss, including loss of profit, revenue and goodwill is limited to	R0.0 (zero Rand)
9	Termination and dispute resolution	
94.2(3)	The <i>Adjudicator nominating body</i> is:	the Chairman of The Association of Arbitrators (Southern Africa)
94.4(2)	The <i>tribunal</i> is:	Arbitration
94.4(5)	The <i>arbitration procedure</i> is	the latest edition of Rules for the Conduct of Arbitrations published by The Association of Arbitrators (Southern Africa).
94.4(5)	The place where arbitration is to be held is	Johannesburg
	The person or organisation who will choose an arbitrator	
	- if the Parties cannot agree a choice or	the Chairman for the time being or his nominee
	- if the arbitration procedure does not state who selects an arbitrator, is	of the Association of Arbitrators (Southern Africa).
10	Data for Option clauses	
X7	Delay damages	
X7.1	Delay damages for Delivery are	R4000.00 per day



C1.2 Contract Data

Part two - Data provided by the Supplier

Notes to a tendering supplier:

1. Please read both the NEC3 Supply Contract (December 2009) and the relevant parts of its Guidance Notes (SC3-GN)¹ in order to understand the implications of this Data which the tenderer is required to complete.
2. The number of the clause which requires the data is shown in the left hand column for each statement however other clauses may also use the same data
3. Where a form field like this [] appears, data is required to be inserted relevant to the option selected. Click on the form field **once** and type in the data. Otherwise complete by hand and in ink.

Completion of the data in full, according to Options chosen, is essential to create a complete contract.

Clause	Statement	Data
10.1	The <i>Supplier</i> is (Name): Address Tel No. Fax No.	
11.2(8)	The Goods Information for the <i>Supplier's</i> design is in:	C3.1
11.2(11)	The tendered total of the Prices is	R (in words)
11.2(12)	The <i>price schedule</i> is in:	C2.2
11.2(14)	The following matters will be included in the Risk Register	N/A
30.1	The <i>delivery date</i> of the goods is:	As per Purchase order

¹ Available from Engineering Contract Strategies Tel 011 803 3008 Fax 011 803 3009 www.co.za



PART C2: PRICING DATA

NEC3 Supply Contract

Document reference	Title	No of pages
C2.2	<i>The price schedule</i>	2

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TRANSNET SOC LTD
 CONTRACT NUMBER: EFT-2444086-002/2012-E
 DESCRIPTION OF THE WORKS: THE SUPPLY AND DELIVERY OF 3 KV RECTIFIERS FOR TRACTION
 SUBSTATIONS AT HEIDELBERG AND STANDERTON

C2.2 the price schedule

The quantity stated in the price schedule is an estimate only of Transnet's projected consumption and is based on the previous year's usages. Transnet gives no assurance of the quantities to be purchased over the contract period.

Tenders are to ensure that prices quoted per item are inclusive of Transport to the Delivery points as per Pricing Schedule.

Transnet Material No.	Description	Delivery Point	Estimated Quantity.	Unit	Price per item (Excl. VAT)
TBA	3 KV RECTIFIER (SEE ATTACHED SPECIFICATIONS - ANNEXURE A)	Heidelberg	2	EACH	R
TBA	3 KV RECTIFIER (SEE ATTACHED SPECIFICATIONS - ANNEXURE A)	Standerton	5	EACH	R

The total of the Prices by quantity

R



PART 3: GOODS INFORMATION

Document reference	Title	No of pages
	This cover page	1
C3.1	<i>Purchaser's Goods Information</i>	2
Total number of pages		3

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C3.1: PURCHASER'S GOODS INFORMATION

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1 Overview of the goods

Supply and Delivery of 3 kV Rectifiers for Traction Substations at Heidelberg and Standerton on an as and when required basis as per Purchase Order received.

2 Specifications of the goods

- a. Specifications of goods to be as per Specifications of Transnet SOC Ltd for 3Kv Rectifiers for Traction Substations.
(see attached Annexure A)

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**TRANSNET**

Freight rail

A Division of Transnet SOC Limited

TECHNOLOGY MANAGEMENT SPECIFICATION

3kV RECTIFIER FOR TRACTION SUBSTATIONS

Author: Chief Engineering Technician B.L. Ngobeni
Technology Management

Approved: Senior Engineer L.O. Borchard
Technology Management

Authorised: Principal Engineer W.A. Coetzee
Technology Management

Date: 02nd March 2012

Circulation Restricted To:

Transnet Freight Rail – Chief Engineer Infrastructure
– Technology Management

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1.0 SCOPE

- 1.1 This specification covers Transnet Freight Rail's requirements for the design, manufacture, supply and installation of 3 kV Direct Current (DC) rectifier units for DC traction substations.

2.0 STANDARDS AND PUBLICATIONS

- 2.1 Unless otherwise specified all materials and equipment supplied shall comply with the current edition of the relevant SANS, IEC or Transnet Freight Rail's publication where applicable.

- 2.2 The following publications are referred to in this specification:

2.2.1 INTERNATIONAL ELECTROTECHNICAL COMMISSION

- IEC 60051: Direct acting indicating analogue electrical-measuring instruments and their accessories
- IEC 60146-2: Semiconductor converters - Part 2: Self-commutated semiconductor converters including direct dc converters.

2.2.2 SOUTH AFRICAN NATIONAL STANDARDS

- SANS 1019: Standard voltages, currents and insulating levels for electrical supply

2.2.3 TRANSNET FREIGHT RAIL

- CEE.0224. Drawings, catalogues, instruction book and spares lists for electrical equipment supplied under contract.
- BBB 2721 AC Primary Circuit Breaker Control Panel and AC/DC Distribution Panel for 3kV Traction Substations.
- BBB 5452 Transnet Freight Rail's Requirements for the Installation of Electrical Equipment for 3kV DC Traction Substations.
- Transnet Freight Rail Electrical Safety Instructions.

- 2.3 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.

3.0 TENDERING PROCEDURE

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

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

- 3.3 Tenderer shall submit for each type of rectifier a filled in form as per Appendix 1.

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

- 3.5 Failure to comply with clauses 3.1, 3.2, 3.3 and 3.4 could preclude a tender from consideration.

4.0 SERVICE CONDITIONS

4.1 ATMOSPHERIC 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.

4.2 MECHANICAL SERVICE CONDITIONS.

4.2.1 The rectifiers are installed in substations next to or within close proximity of railway tracks and will be subjected to vibration from the trains.

4.3 ELECTRICAL SERVICE CONDITIONS.

4.3.1 INPUT VOLTAGE

4.3.1.1 The rectifier AC input voltages for six-pulse configuration is in the order of 2450V AC per phase. For 12-pulse configuration the AC input voltages can be in the order of 1150V to 1375V phase to phase.

4.3.1.2 The rectifier receives its supply from a 3.3 MVA or 5 MVA rectifier transformers (and 6 MVA where transformers are replaced).

4.3.2 OUTPUT VOLTAGE.

4.3.2.1 The nominal busbar output voltage rating of the system is 3150 Volts but can vary between 2500 V DC and 3900V DC.

5.0 DESIGN OF EQUIPMENT

5.1 The rectifier unit and its associated control equipment should be built up to form an independent unit.

5.2 The rectifier design shall be suitable for operation for existing or new traction substations, the details of which shall accompany this specification.

5.3 For multiple unit substations it shall be possible for each unit to operate completely independently of each other.

5.4 For single transformer, multi-group arrangements, it shall be possible to isolate and switch off one group without affecting the other group.

5.5 Six or twelve pulse operation is used depending on the configuration of the transformers.

5.6 This specification includes all the required control and protection circuits which shall be installed and wired to existing substation control panels by the supplier.

5.7 The control circuitry for tripping and indication purposes shall operate at 110 volt DC.

5.8 RATINGS

5.8.1 The DC output of the equipment shall be rated at 3.3 MW, 4.5 MW, 5 MW or 6 MW full load continuously with overload ratings related to full load as follows:

- 2 x full load for 30 minutes
- 3 x full load for 1 minute
- 3.5 x full load for 10 seconds.
- 4.25 x full load instantaneous tripping.

5.8.2 The equipment shall withstand a short circuit for 200 milli-seconds.

5.8.3 The ratings of the rectifier with its configuration shall be displayed on a silkscreen label fixed on the rectifier unit.

5.9 The rectifiers and associated equipment shall be designed to minimise any tendency to resonate or to produce high voltage surges when operating in conjunction with DC smoothing equipment.

5.10 Lightning, transients, surges and tripping are present in the substation environment.

6.0 INSULATION LEVELS

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

6.2 The nominal 1.5kV and 3kV insulation to earth shall be so designed that the complete rectifier assembly shall be able to withstand a test voltage of 10.5kV 50Hz AC for one minute.

6.3 Where PVC trunking is used for the routing of cables it shall be so installed that there can be no danger of a flash over or tracking occurring between the trunking and high voltage circuitry.

7.0 CLEARANCES AND CREEPAGE DISTANCES

7.1 The following minimum safety clearances shall be maintained:

For the nominal DC system voltage, the minimum indoor clearance shall not be less than 150mm from any conductor or metal normally live and ground level.

7.2 Ribbed insulators and standoff bushings shall be used for 3kV DC and shall have a creepage distance of not less than 150mm.

8.0 RECTIFIER UNIT

8.1 RECTIFIER DESIGN REQUIREMENTS.

8.1.1 The silicon rectifier diode assemblies shall comply with SANS 60146-2.

8.1.2 The rectifier unit shall comprise silicon semiconductor-diodes and be of the hockey puck capsule type.

8.1.3 All materials used shall be flame retardant.

8.1.4 To prevent flashovers no insulation material shall be used between rectifier branches. The minimum clearance of 150mm is required between diode modules as well as between diode modules and any earthed metal.

8.1.5 The minimum distance between the incoming supply phases to the rectifier shall not be less than 150mm

8.1.6 It is required that the equipment offered be designed to remain in service in the event of any individual diode in a branch becoming defective.

8.1.7 The rated repetitive peak reverse voltage of a series connected branch of diodes shall be such that should a diode in that branch become defective, the rated repetitive peak reverse voltage of the remaining diodes will be at least twice the value of the applied reverse voltage. The peak inverse voltage shall be not less than 4000V DC or higher for a 24 diode bank.

8.1.8 The creepage distance across the resistor capacitor (RC) circuit components shall be commensurate with the creepage distance across the diode insulation.

8.1.9 Tenderers shall provide a full description of the over voltage and surge protection circuits offered illustrating how this circuit has been designed.

8.1.10 Each rectifier unit shall be provided with a DC voltmeter, range 0-4 000 volts and a DC ammeter range 0-4000 amperes. These shall be mounted on the front of the rectifier unit.

8.1.11 The DC voltmeter shall be connected to the more negative side of the voltage divider.

8.1.12 For the DC ammeter a 4000 ampere 50 mV shunt shall be fitted on the negative busbar of the rectifier.

- 8.1.13 The DC voltmeter and ammeter shall be class 1.5 or better. The dimensions of the analogue face of the meters fitted on the rectifier unit shall not be less than 144mm x 144mm with a 90 degree display.
- 8.1.14 A high voltage fuse and potential divider shall be provided for the voltmeter.
- 8.1.14.1 The potential divider shall of the encapsulated type or consist of not less than ten separate vitreous enamel resistance elements connected in series. These shall be spaced to provide a clearance distance of not less than 150 mm to any earthed metal.
- 8.1.15 The DC output of the rectifier unit shall be protected from external voltage transients by means of fused resistance capacitance parallel metal oxide varistor circuitry. The fuse shall be fitted with a trip contact, which can be utilised for indication and control.
- 8.2 DIODES**
- 8.2.1 For 3.3 MW and 4.5 MW rectifiers the Westcode type W2899MC480 and INFINEON (EUPEC) D1809 N40 or N46 diodes (exact equivalent or approved types) shall be used.
- 8.2.2 For 5 MW and 6 MW rectifiers the Semikron 2P 3000/68 (exact equivalent or approved types) shall be used.
- 8.2.3 Proof of origin of the diodes and certified test certificates shall be supplied with the diodes.
- 8.2.4 The forward voltage drop of the diodes shall be within $\pm 5\%$ variations.
- 8.2.5 Tenderers shall submit fully detailed data sheets of the type of diode offered.
- 8.2.6 Each individual diode shall form an integrated module with its heatsink, snubber circuit and parallel voltage- equalising resistor circuit. The module shall contain no connection wires or lugs. All connections shall be made directly through the mounting of the snubber printed circuit board busbar terminations. The design of the module shall enable it to be removed within 10 minutes, without disturbing any other modules.
- 8.2.7 The pre-load pressure exerted by the fixing clamps or other methods must be easily checked. Fixed indicating torque washers or other methods of obtaining the correct pre-load pressure using torque wrench spanners must be used for assembly of the diode module.
- 8.2.8 The rectifier design shall be such that only the diode module securing bolts need to be removed for replacement of a module. No busbars or other parts shall obstruct the removal of the diode module.
- 8.2.9 For identification of the diode polarity, the rectifier symbol shall be clearly marked on the heatsink module and on the diode.
- 8.2.10 Tenderers shall indicate the recommended intervals between the testing of diodes and their RC snubber components so as to establish their soundness.
- 8.2.11 Where 3kV DC rectifiers are installed within a distance of 15km from the coast, the profile of the heat sinks shall be tapered by machining, to allow for easy access to remove any salt spray condensation formed on the diode.
- 8.3 SNUBBER (RC) AND VOLTAGE EQUALISING CIRCUITRY.**
- 8.3.1 The capacitors and resistors employed in the snubber RC circuits shall be of the highest quality and shall be suitably rated for high voltage applications encountered. Vitreous enamel wire wound resistors or similar shall be used and high voltage suitable capacitors shall be used.
- 8.3.2 If standoff posts are used to support sensing circuits they shall be securely fixed to the main diode module by means of lock washers and nuts to ensure that no sparking occurs due to poor contact.
- 8.4 DIODE MONITORING EQUIPMENT**
- 8.4.1 DIODE SENSOR TRANSMITTER MONITORING MODULE**
- 8.4.1.1 Sensing circuitry shall be incorporated to monitor each individual diode for open or short circuit conditions.

- 8.4.1.2 Specific attention shall be given to the protection of the diode monitoring circuit boards in the event of the diode going open circuit and destroying the monitoring modules.
- 8.4.1.3 Protection circuitry shall be provided for each sensor module.
- 8.4.1.4 The sensor module shall be powered from the snubber RC circuit of the diode and shall be designed so as not to change the characteristics of the RC circuit across which it is connected.
- 8.4.1.5 The snubber RC circuitry, and the diode sensing circuitry, shall be removable as a unit with the diode module when the diode module is removed for replacement or repair.
- 8.4.1.6 The components used to manufacture the diode sensor transmitter module shall be of the highest quality.
- 8.4.1.7 If resistors are employed they shall be vitreous enamel insulated or similar and shall withstand at least 700 volts across them.
- 8.4.1.8 The diode sensing circuit board shall be removable from the diode module as an individual circuit board for repair or replacement.
- 8.4.1.9 The diode sensing circuit board shall be so constructed that it will be protected against reverse polarity on installation after repair or replacement.
- 8.4.1.9.1 The output signal from the diode sensor transmitter board shall be fibre optic transmitted. Wire conductors are not acceptable.
- 8.4.1.9.2 Diode monitoring systems utilising Programmable Logic Controllers (PLC) is not acceptable.
- 8.4.2 RECTIFIER DIODE MONITORING PANEL AND DISPLAY.**
- 8.4.2.1 The rectifier unit shall be fitted with a diode monitoring panel for monitoring the condition of each diode.
- 8.4.2.2 Each diode shall be clearly numbered on the front display cover of the diode monitoring panel as well as on the diode module. The markings shall be silk screened engraved or similar.
- 8.4.2.3 The panel shall be fitted with Light Emitting Diodes (LED's) to indicate the condition of the diodes. The LED's shall be green for a healthy diode and red for an open circuit or short circuit diode.
- 8.4.2.4 A remote reset switch or button to reset the LED's and the diode monitoring panel shall be fitted in the primary circuit breaker control panel.
- 8.4.3 ELECTRONICS**
- 8.4.3.1 All printed circuit boards shall be constructed from high quality fibreglass material.
- 8.4.3.2 All printed circuit boards shall slide in high quality edge connectors and shall be easily removed for replacement or repairs.
- 8.4.3.3 All printed circuit boards with its components shall be coated for protection against moisture, corrosion and dust.
- 8.4.3.4 Each printed circuit board shall be polarised to prevent the card from being plugged into the wrong socket and to prevent the card from being inserted upside down.
- 8.4.3.5 The control unit shall be built into a rack mounted unit or similar and shall be able to be removed or installed as a unit.
- 8.4.3.6 The control unit shall be designed to fail to safe in the event of power supply failure or printed circuit board failure. Contacts shall be provided which can be utilised for lockout signals.
- 8.4.4 POWER SUPPLY SYSTEM.**
- 8.4.4.1 The power supply shall be of the switch mode design and shall be able to operate within the range of the voltages available in the substation.

- 8.4.4.2 The power supply as well as the remainder of the unit shall be extensively protected from lightning, transients and surges. Extensive use of gas arresters, inductors and capacitors will be required.
- 8.4.5 FIBRE OPTIC MONITORING BOARD.**
- 8.4.5.1 The annunciator shall be fitted with fibre optic receivers for signals transmitted from the diode sensor transmitter module.
- 8.4.6 INTERFACE INPUT-OUTPUT PRINTED CIRCUIT-BOARD**
- 8.4.6.1 The diode monitoring main board shall be able to communicate the condition of the diodes by means of relay contacts.
- 8.4.6.1.1 Provision shall be made for one diode failure to lockout the substation with a remote flag indication and give a signal to the telecontrol system.
- 8.4.6.2 The relays shall function in the fail safe mode, i.e. the relays will be energised and will de-energise under faulty conditions.
- 8.5 COOLING**
- 8.5.1 The rectifier unit shall be fitted cooling fans with temperature sensors for the control of the cooling fan, temperature monitoring and rectifier over-temperature protection.
- 8.5.2 The direct heat sink temperature sensing method shall be used with multiple sensors connected in series.
- 8.5.3 Two thermal control switches shall be fitted to the rectifier for the energising of the cooling fans at a temperature of 50°C. Provision shall be made to prevent the fan from cycling at the energising temperature.
- 8.5.3.1 Suitable fan control circuitry shall be provided by the supplier.
- 8.5.4 The rectifier unit shall be provided with two over temperature sensing switches which shall be set at 80°C.
- 8.5.5 The rectifier over temperature protection shall be used for tripping purposes. The circuitry shall be provided by the supplier.
- 8.5.6 The wiring from the sensors to the fan controller should be of the plastic fibre optic type and the sensors should obtain their supply from the RC circuit.
- 8.5.7 Fan airflow failure circuitry (vane switches) and relays shall be provided for control and indication purposes. A fan test switch which is spring loaded to the off position shall be provided and installed in the primary circuit breaker control panel.
- 8.5.8 Adequate measures shall be taken to ensure that the rectifier equipment does not overheat during periods of high loading. Details of the over temperature protective scheme shall be submitted with the tender.
- 8.5.9 Provision shall be made for adjustable current sensing to control the operation of the cooling fan(s). The fan(s) shall be energised when the main current reaches a value of 700 amps (adjustable.) The current sensing circuitry shall be sufficiently isolated and shall be installed in the primary circuit breaker control panel.
- 9.0 INSTALLATION.**
- 9.1 The contractor shall be responsible for the transport to site, off-loading, handling, storage and security of all material required for the installation of the rectifier unit.
- 9.2 The rectifier shall be installed within the substation building and shall be totally insulated from the floor by means of channel insulation or other high voltage insulating material.

10.0 EARTHING

- 10.1 The metal framework of the rectifier shall be connected to the existing DC earth leakage earthing system in accordance to drawing No. CEE-TBD-7. Should the existing earth strap not be suitable for re-use a new copper earth strap of least cross-section area or a stranded insulated copper conductor with a cross-sectional area of at least 95mm² shall be used.

11.0 CABLES

- 11.1 Armoured cables shall be used for the wiring of the cooling fans and any other external power circuitry.
- 11.2 All cables shall terminate in compression type glands. These glands shall be fitted with neoprene shrouds.
- 11.3 Screened cables and conductors shall be used for electronic screening and noise reduction techniques where required.
- 11.4 The fibre optic cables between the rectifier and the annunciator panel shall be protected from damage by means of conduit or trunking or other suitable means. Open fibre optic cables are not acceptable.
- 11.5 All cabling shall be clearly marked with high quality permanent markers. Sticker marking numbers will not be acceptable.

12.0 INTERCONNECTION OF EQUIPMENT

- 12.1 Suitably rated copper busbars shall be used for the interconnection of the rectifier to the secondary winding of the traction transformer. The busbars between separately mounted equipment shall incorporate a degree of flexibility to avoid any over stressing of these connections due to movement caused by conductor expansion/contraction and to facilitate alignment of equipment.
- 12.2 High conductive silicon grease shall be liberally applied to all connections.
- 12.3 All dissimilar metal connections copper to aluminium (Cu to Al) shall be made using bi-metallic clamps that are specifically designed and manufactured to make that particular connection (ad hoc fabricated clamps are not acceptable).
- 12.4 All copper connections to steel (galvanised) shall be tinned or silver coated.

13.0 INSPECTION, SITE TESTS AND COMMISSIONING.

- 13.1 Transnet Freight Rail reserves the right to carry out inspection and any tests on the equipment at the works of the supplier/ manufacture.
- 13.2 Arrangements must be made timeously for such inspections to be carried out before delivery of the equipment to the client.
- 13.3 The contractor shall be responsible for carrying out on-site functional tests before the commissioning of the rectifier unit.
- 13.4 The testing of the rectifier shall include type tests for new design of rectifier units and routine tests which shall be conducted on all units.
- 13.4.1 The testing shall include the following: -
- Insulation tests.
 - Light load tests.
 - Functional tests on the associated control equipment and circuitry of the rectifier.
 - Temperature rise tests i.e. temperature measurements on diode heatsinks. Maximum temperature rise shall not exceed 75° C.
 - Checking of auxiliary and protective devices and control equipment.

- Rated output tests.
 - Overcurrent capability test.
 - Measurement of output voltage
 - Power loss determination
- 13.4.2 Functional Acceptance by the Maintenance Manager 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.
- 13.5 Commissioning will only take place after all defects have been rectified to the satisfaction of the Maintenance Manager.
- 13.6 Commissioning will include the energising of equipment from the primary isolator to the track feeder circuits. The contractor must prove the satisfactory operation of equipment under live conditions.
- 13.7 On completion of commissioning the contractor will hand the equipment over to the Maintenance Manager in terms of the relevant engineering Instructions.
- 14.0 DRAWINGS, INSTRUCTION MANUALS AND SPARES LISTS**
- 14.1 Drawings, instruction manuals and spare parts catalogues shall be supplied in accordance with Transnet Freight Rail's specification CEE.0224
- 14.2 All drawings (paper prints) shall be submitted to the technical officer for approval. No Construction or manufacturing activity will be allowed prior to the associated drawings having been approved by the technical officer.
- 14.3 The tenderer shall supply three copies of an instruction/maintenance manuals, schematic diagrams, diode application notes and protection and filter ratings.
- 14.4 The contractor shall submit details of spares required in accordance with specification No. CEE.0224.
- 14.5 All spares recommended for normal maintenance purposes that are not available locally (requires importation) must be highlighted.
- 15.0 SPECIAL TOOLS AND/OR SERVICING AIDS**
- 15.1 Special tools or servicing aids necessary for the efficient maintenance, repair or calibration of the equipment shall be quoted for separately.
- 15.2 Tenderers shall submit detailed offers for special tools and servicing aids including all specialised equipment required for the servicing and maintenance of the equipment supplied.
- 16.0 TRAINING**
- 16.1 The tenderer shall submit details with the tender of the training courses, which will be conducted by the contractor for the training of Transnet Freight Rail's 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.
- 17.0 GUARANTEE AND DEFECTS**
- 17.1 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.
- 17.2 The guarantee period for all substations shall expire after: -
- A period of 12 months commencing on the date of completion of the contract or the date the equipment is handed over to Transnet Freight Rail whichever is the later.

- 17.3 Any specific type of fault occurring three times within the guarantee period and which cannot be proven to be due to other faulty equipment not forming part of this contract e.g., faulty locomotive or overhead track equipment, etc., shall automatically be deemed an inherent defect. Such inherent defect shall be fully rectified to the satisfaction of the Maintenance manager and at the cost of the Contractor.
- 17.4 If urgent repairs have to be carried out by Transnet Freight Rail's 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

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TECHNICAL DATA SHEET

(To be completed by Tenderer)

- 1.0 Rectifier ratings (MW): _____
- 2.0 Number of diodes per branch: _____
- 3.0 Type of Diode: _____
- 3.0 Full load current rating of diode. I_{FRMS} : _____
- 4.0 Average current rating of diode. I_{FAVM} : _____
- 4.0 Repetitive Peak Reverse Voltage of diode: _____
- 5.0 Surge forward current 10 milli second Sine Wave: _____
- 6.0 Method of cooling of rectifier: _____
- 7.0 Method of temperature sensing: _____
- 8.0 Type of insulation used for frame to floor: _____
- 9.0 Physical dimensions of rectifier unit:
 Height: _____ Breadth: _____ Width: _____
- 10.0 Name of suppliers where rectifier diodes can be sourced: _____

- 11.0 Method of correct torque adjustment for heat sinks: _____

- 12.0 Diode test certificate attached Yes/No: _____

REQUIREMENTS FOR THE SUPPLY OF 3KV DC RECTIFIERS, POSITIVE ISOLATORS AND
MODULAR TRACK BREAKERS

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REQUIREMENTS FOR THE SUPPLY OF 3kV DC RECTIFIERS, POSITIVE ISOLATORS AND MODULAR TRACK BREAKERS

1.0 3KV DC RECTIFIERS

1.1 7 off new 3kV DC rectifier units shall be supplied and allocated for installation as follows:

No.	Allocated Substation	Rectifier
1	Spruytsrus	1 x 6 MW
2	Sprucewell	1 x 6 MW
3	Cedarmont	1 x 6 MW
4	Elmtree	1 x 6 MW
5	Perdekop	1 x 6 MW
6	Sandspruit	1 x 6 MW
7	Landsend	1 x 6 MW

1.2 The rectifiers shall be supplied complete with diode monitoring system and fan control and fully comply with Transnet Freight Rail's specification BBB0496.

1.3 The rectifiers shall be rated **6 MW** full load continuously and as per section 5.8 (Ratings) of specification BBB0496.

1.4 In addition to section 4.3.1 (Input Voltage) of specification BBB0496 the rectifiers shall provide for full wave 12 pulse rectification from the 6 phase output of 6MVA traction transformers (new) with the following configuration:

Winding	Power MVA	Voltage(kV)	Group	Tap Changer
High Voltage	6	$88 \pm 2 \times 2.5\%$	Y	Off load
Low Voltage	2 x 3.0	1,220/1,220	d/y	-
Tertiary	0.1	2,360	yn	-
Vector group			Yd11Yy0Yyn0	

1.5 In addition to section 8.3 (Snubber Circuitry) of specification BBB0496 the Snubber circuits shall be properly sealed.

1.6 All components, especially diodes shall be easy accessible for maintenance and replacement purposes.

1.7 Only rectifiers approved by Transnet Freight Rail's Technology Management department will be accepted.

2.0 3KV DC POSITIVE ISOLATORS WITH EARTHING SWITCHES

2.1 12 off new 3kV DC positive isolators with earthing switches shall be supplied and allocated for installation as follows:

No.	Allocated Substation	Quantity
1	Spruytsrus	1
2	Sprucewell	1
3	Teakworth	1
4	Cedarmont	1
5	Elmtree	1
6	Firham	1
7	Platrand	1
8	Perdekop	1
9	Sandspruit	1
10	Landsend	1
11	Majuba	1
12	Glen Harte	1

- 2.2 The positive isolators with earthing switches shall fully comply with Transnet Freight Rail's specification BBB4724.
- 2.3 The positive isolator switch shall be rated at a minimum 3000A continuous as per 6.3 of specification BBB4724.
- 2.4 The earthing switch shall be rated at a minimum 1500A as per 6.10 of specification BBB4724.
- 2.5 The LV compartment shall include a under voltage relay, ammeter and voltmeter as per 6.21 of specification BBB4724.
- 2.6 The HV compartment shall include a potential divider for the under voltage relay and fuses for metering as per 6.28 of specification BBB4724.
- 2.7 The under voltage relays supplied shall fully comply with specification BBB3005 and be installed with the potential divider as per 28.0 of specification BB5452.
- 2.8 Only positive isolators approved by Transnet Freight Rail's Technology Management department will be accepted.

3.0 3KV DC HIGH SPEED CIRCUIT BREAKERS

- 3.1 100 off new 3kV DC high speed circuit breakers (HSCBs) shall be supplied and installed in the modular cell and track breakers as per 4.1.
- 3.2 The HSCBs shall fully comply with Transnet Freight Rail's specification CEE-0099. 2010.
- 3.3 The HSCBs shall be rated for service conditions for 3kV DC traction substations with a 6 MW rectifier capacity.
- 3.4 Only HSCBs approved by Transnet Freight Rail's Technology Management department will be accepted.
- 3.5 Should Secheron breakers be offered they shall be fitted with dirt cover plates as per drawing BBC5872 version 1.

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4.0 **MODULAR 3KV DC TRACK BREAKER CELLS AND TRUCKS**

4.1 100 off modular type, steel 3kV DC track breaker cells and trucks shall be supplied in banks of connected cells for installation at the allocated substations as follows:

Bank	Allocated Substation	Number of modular track breaker cells and trucks in bank
1	Rooikop	4
2	Heidelberg	4
3	Spruytsrus	4
4	Balfour North	4
5	Sprucewell	5
6	Greylingstad	4
7	Teakworth	4
8	Cedarmont	4
9	Elmtree	4
10	Firham	5
11	Kromdraai	4
12	Platrand	4
13	Rusthof	4
14	Perdekop	4
15	Beechwick	4
16	Sandspruit	4
17	Vooruitsig	6
18	Landsend	4
19	Majuba	4
20	Glenharte	4
21	Rietspruit	5
22	Clontarf	4
23	Wykom	5
24	Newcastle	5
	Total	100

4.2 The modular track breaker cells and trucks shall fully comply with Transnet Freight Rail's specification CEE-0227.95.

4.3 The modular track breaker cells and trucks shall be complete units and include the installation of the HSCB's supplied under 3.0.

4.4 Each modular track breaker cell and truck shall be installed with DC Feeder Protection Relays as per 5.0.

4.5 All required connecting busbars and earthing between the cells shall be provided for each bank of connected cells.

- 4.6 An earthing switch to earth the positive busbar shall be fitted to one end of each bank of connected cells. The earthing contacts shall be visible when applying the earth.
- 4.7 This earthing switch shall be robust and lockable in both positions (earthed and not earthed) and provision made to electrically interlock it with the HSCB and PCB to prevent accidental earthing of the live busbar. The electrical interlock shall cause the substation to trip and lock out.
- 4.8 The door of the earthing switch shall be provided with mechanically interlocking forming part of the isolating procedure of the substation.
- 4.9 The cell's shutter gear shall be robust and mechanically locked to prevent it from opening while the truck is withdrawn from the cell.
- 4.10 Only modular track breaker cells and trucks approved by Transnet Freight Rail's Technology Management department will be accepted.

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5.0 DC FEEDER PROTECTION RELAYS

- 5.1 On all HSCBs the automatic re-closing feature shall be replaced with DC Feeder Protection Relays.
- 5.2 The relay is required to operate in conjunction with the 3 kV DC HSCB.
- 5.3 The main functions of the relay is to be used as:
- 5.3.1 Protection of the overhead track equipment.
- Automatic line test function to determine if any fault is on the system and to prevent auto reclosing.
 - Over current protection (I^2t and di/dt discrimination).
 - Under voltage protection.
 - Frame fault protection.
 - Thermal protection of the Overhead Track.
- 5.3.2 Control of the breaker.
- Auto re- closure in the event of no fault on the system.
 - Auxiliary contacts.
 - Serial Communication port (RSR232/RSR485).
- 5.3.3 As a measurement/condition monitoring device on each track circuit.
- Measure Current (DC)
 - Measure Voltage (DC)
 - Measure Energy kWh (Export and Import)
 - Counting all Energy operations (Condition Monitoring).
- 5.4 The relay must operate from a 110 Volt DC supply.
- 5.5 If resistors, potential dividers and current transducers are used the clearance and insulation levels for 3 kV DC must be adhered to. It should also be noted due to spacing the size (physical) of the resistor used for testing the line shall be limited to Length 600 mm x Width 400mm x Height 500 mm.
- 5.6 The existing Transnet Freight Rail metering shunt may be used.
- 5.7 Only DC Feeder Protection Relays approved by Transnet Freight Rail's Technology Management department will be accepted.

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