**TRF**, a division of

**TRANSNET SOC LTD**

Registration Number 1990/000900/30

[hereinafter referred to as **Transnet]**



**REQUEST FOR QUOTATION [RFQ] No RME CPT 280/2015**

**FOR THE SUPPLY AND DELIVERY OF: FEEDER PROTECTION PANEL**

**FOR DELIVERY TO: BELLVILLE SQUARE, ELECTRICAL STORES**

| | |
|---|---|
| **ISSUE DATE:** | **16.04.2015** |
| **CLOSING DATE:** | **30.04.2015** |
| **CLOSING TIME:** | **10:00** |

## Section 1

## NOTICE TO BIDDERS

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Quotations which must be completed as indicated in Section 2 of this RFQ are to be submitted as follows:

**METHOD:** [hand deliver, post and/or courier]

**CLOSING VENUE:** [see below for closing venue]

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Proposals must reach the Secretariat, Acquisition Council before the closing hour on the date shown below, and must be enclosed in a sealed envelope which must have inscribed on the outside:

**RFQ No:** **RME CPT 280/2015**

**Description:** **SUPPLY AND DELIVERY OF FEEDER PROTECTION PANEL**

**Closing date and time:** **30th April 2015 AT 10:00 Sharp**

**Closing address:** *[Refer to options in Delivery Instructions for RFQ below]*



All envelopes must reflect the return address of the Respondent on the reverse side.

### A. DELIVERY INSTRUCTIONS FOR RFQ

**Delivery by hand**

If delivered by hand, the envelope is to be deposited in the Transnet tender box which is located at the main entrance of Transnet Park, ROBERT SOBUKWE Road, Bellville, and should be addressed as follows:

THE SECRETARIAT
ACQUISITION COUNCIL
TRANSNET PARK
TENDER BOX (located in the foyer of the building)
ROBERT SOBUKWE ROAD
BELLVILLE 7535

a) The measurements of the "tender slot" are 400mm wide x 100mm high, and Respondents must please ensure that response documents or files are no larger than the above dimensions. Responses which are too bulky [i.e. more than 100mm thick] must be split into two or more files, and placed in separate envelopes, each such envelope to be addressed as above.

**Dispatch by courier**

If dispatched by courier, the envelope must be addressed as follows and delivered to the Office of The Secretariat, Acquisition Council and a signature obtained from that Office:

THE SECRETARIAT

TRANSNET ACQUISITION COUNCIL

6TH FLOOR

TRANSNET PARK

ROBERT SOBUKWE ROAD

BELLVILLE

Please note that this RFQ closes punctually at **10:00 on** 30th **April 2015.**

1. If responses are not delivered as stipulated herein, such responses will not be considered and will be treated as "NON-RESPONSIVE" and will be disqualified.
2. No email or facsimile responses will be considered, unless otherwise stated herein.
3. The responses to this RFQ will be opened as soon as practicable after the expiry of the time advertised for receiving them.
4. Transnet shall not, at the opening of responses, disclose to any other company any confidential details pertaining to the Proposals / information received, i.e. pricing, delivery, etc. The names and locations of the Respondents will be divulged to other Respondents upon request.

Envelopes must not contain documents relating to any RFQ other than that shown on the envelope.



## 1 Responses to RFQ

Responses to this RFQ [**Quotations**] must not include documents or reference relating to any other quotation or proposal. Any additional conditions must be embodied in an accompanying letter.

## 2 Broad-Based Black Economic Empowerment [B-BBEE]

Transnet fully endorses and supports the government's Broad-Based Black Economic Empowerment Programme and it would therefore prefer to do business with local business enterprises who share these same values. As described in more detail in the attached B-BBEE Claim Form Transnet will allow a "preference" to companies who provide a valid B-BBEE Verification Certificate.

The value of this bid is estimated to exceed R1 000 000 (all applicable taxes included); and therefore the **90/10** system shall be applicable.

Respondents are required to complete Annexure A [the B-BBEE Preference Point Claim Form] and submit it together with proof of their B-BBEE Status as stipulated in the Claim Form in order to obtain preference points for their B-BBEE status.

**Note: Failure to submit a valid and original B-BBEE certificate or a certified copy thereof at the Closing Date of this RFQ will result in a score of zero being allocated for B-BBEE.**

## 3 Communication

Respondents are warned that a response will be liable for disqualification should any attempt be made by a Respondent either directly or indirectly to canvass any officer(s) or employee of Transnet in respect of this RFQ between the closing date and the date of the award of the business.

A Respondent may, however, before the closing date and time, direct any written enquiries relating to the RFQ to the following Transnet employee:

Name: Troy Stevens Email: troy.stevens@transnet.net

Telephone: 021 940 1892

Respondents may also, at any time after the closing date of the RFQ, communicate with the Tender Admin of Transnet Freight Rail - RME on any matter relating to its RFQ response:

Name: Iwan Theron

Telephone 021 940 1896 Email: iwan.theron@transnet.net

## 4 Legal Compliance

The successful Respondent shall be in full and complete compliance with any and all applicable national and local laws and regulations.

## 5 Changes to Quotations

Changes by the Respondent to its submission will not be considered after the closing date and time.

## 6 Pricing

All prices must be quoted in South African Rand on a fixed price basis, excluding VAT.

## 7 Prices Subject to Confirmation

Prices quoted which are subject to confirmation will not be considered.

## 8 Binding Offer

Any Quotation furnished pursuant to this Request shall be deemed to be an offer. Any exceptions to this statement must be clearly and specifically indicated.

## 9 Disclaimers

Transnet is not committed to any course of action as a result of its issuance of this RFQ and/or its receipt of a Quotation in response to it. Please note that Transnet reserves the right to:

- modify the RFQ's goods / service(s) and request Respondents to re-bid on any changes;
- reject any Quotation which does not conform to instructions and specifications which are detailed herein;
- disqualify Quotations submitted after the stated submission deadline;
- not necessarily accept the lowest priced Quotation or an alternative bid;
- reject all Quotations, if it so decides;
- place an order in connection with this Quotation at any time after the RFQ's closing date;
- award only a portion of the proposed goods / service/s which are reflected in the scope of this RFQ;
- split the award of the order/s between more than one Supplier/Service Provider should it at Transnet's discretion be more advantageous in terms of, amongst others, cost or developmental considerations ; or
- make no award at all.

Should a contract be awarded on the strength of information furnished by the Respondent, which after conclusion of the contract, is proved to have been incorrect, Transnet reserves the right to cancel the contract.

Transnet reserves the right to award business to the highest scoring bidder/s unless objective criteria justify the award to another bidder.

Transnet reserves the right to conduct Post Tender Negotiations (PTN) with selected Respondents or any number of short-listed Respondents, such PTN to include, at Transnet's discretion, any evaluation criteria listed in the RFQ document.

Should the preferred bidder fail to sign or commence with the contract within a reasonable period after being requested to do so, Transnet reserves the right to award the business to the next highest ranked bidder, provided that he/she is still prepared to provide the required goods at the quoted price.

**10 Specification and Drawings**

- **Annexure C: Specification**
- **Annexure D: Drawings**

**Transnet urges its clients, suppliers and the general public to report any fraud or corruption to**

**TIP-OFFS ANONYMOUS: 0800 003 056**

**RFQ FOR THE SUPPLY AND DELIVERY OF: FEEDER PROTECTION PANEL**

**CLOSING VENUE: TRANSNET PARK**

**CLOSING DATE & TIME: 28 APRIL 2015 10:00am**

**VALIDITY PERIOD: 7 Business Days**

## SECTION 2

## EVALUATION CRITERA AND RETURNABLE DOCUMENTS

### 1 Evaluation Criteria

Transnet will utilise the following criteria [not necessarily in this order] in choosing a Supplier/Service Provider, if so required:

| Criterion/Criteria | Explanation |
|---|---|
| **Administrative responsiveness** | Completeness of response and returnable documents |
| **Substantive responsiveness** | Prequalification criteria, if any, must be met and whether the Bid materially complies with the scope and/or specification given. |
| **Functionality Threshold** | As prescribed in terms of the Preferential Procurement Policy Framework Act (PPPFA), Act 5 of 2000 and its Regulations, Respondents are to note that functionality is included as a threshold with a prescribed percentage threshold of **60%.** Compliance to specification, Previous related experience, Lead-time on delivery will be considered as part of the technical evaluation.**[Complete Annexure B – Technical Compliance Sheet]** |
| **Final weighted evaluation based on 90/10 preference point** | • Pricing and price basis [firm]<br>• B-BBEE status of company - Preference points will be awarded to a bidder for attaining the B-BBEE status level of contribution in accordance with the table indicated in Annexure A: B-BBEE Claim Form. |



### 2 Validity Period

Transnet desires a validity period of 30 [thirty] Business Days from the closing date of this RFQ.

This RFQ is valid until .....

### 3 Disclosure of Prices Quoted

Respondents must indicate here whether Transnet may disclose their quoted prices and conditions to other Respondents:

YES ☐ NO ☐

### 4 Returnable Documents

**Returnable Documents** means all the documents, Sections and Annexures, as listed in the tables below.

**All Returnable Sections, as indicated in the header and footer of the relevant pages, must be signed, stamped and dated by the Respondent.**

a) Respondents are required to submit with their Quotations the **mandatory Returnable Documents,** as detailed below.

***Failure to provide all these Mandatory Returnable Documents at the Closing Date and time of this RFQ will result in a Respondent's disqualification. Respondents are therefore urged to ensure that all these Documents are returned with their Quotations.***

Please confirm submission of these mandatory Returnable Documents by so indicating [Yes or No] in the tables below:

| Mandatory Returnable Documents | Submitted [Yes or No] |
|---|---|
| SECTION 3 : Quotation Form | |
| ANNEXURE B : Technical Compliance Sheet | |

b) In addition to the requirements of section (a) above, Respondents are further required to submit with their Quotations the following **essential Returnable Documents** as detailed below.

***Failure to provide all these Returnable Documents may result in a Respondent's disqualification. Respondents are therefore urged to ensure that all these documents are returned with their Quotations.***

| Essential Returnable Documents | Submitted [Yes or No] |
|---|---|
| SECTION 2 : Evaluation criteria and list of returnable document | |
| - SECTION 4 : RFQ Declaration and Breach of Law Form | |
| - Valid and original, or a certified copy, of your entity's B-BBEE Verification Certification as per the requirements stipulated in Annexure A: B-BBEE Claims Form<br>Note: failure to provide these required documents at the closing date and time of the RFQ will result in an automatic score of zero being allocated for preference | |
| - Original valid Tax Clearance Certificate [Consortia / Joint Ventures must submit a separate Tax Clearance Certificate for each party] | |
| ANNEXURE A – B-BBEE Preference Points Claim Form | |



**CONTINUED VALIDITY OF RETURNABLE DOCUMENTS**

The successful Respondent will be required to ensure the validity of all returnable documents, including but not limited to its Tax Clearance Certificate and valid B-BBEE Verification Certificate, for the duration of any contract emanating from this RFQ. Should the Respondent be awarded the contract [**the Agreement]** and fail to present Transnet with such renewals as and when they become due, Transnet shall be entitled, in addition to any other rights and remedies that it may have in terms of the eventual Agreement, to terminate such Agreement forthwith without any liability and without prejudice to any claims which Transnet may have for damages against the Respondent.

## SECTION 3

## QUOTATION FORM

I/We_____

hereby offer to supply the goods/services at the prices quoted in the Price Schedule below, in accordance with the conditions related thereto.

I/We agree to be bound by those terms and conditions in:

- the Standard RFQ Terms and Conditions for the Supply of Goods or Services to Transnet; and
- any other standard or special conditions mentioned and/or embodied in this Request for Quotation.

I/We accept that, unless Transnet should otherwise decide and so inform me/us, this Quotation [and, if any, its covering letter and any subsequent exchange of correspondence], together with Transnet's acceptance thereof, shall constitute a binding contract between Transnet and me/us.

I/We further agree that if, after I/we have been notified of the acceptance of my/our Quotation, I/we fail to deliver the said goods/services within the delivery lead-time quoted, Transnet may, without prejudice to any other legal remedy which it may have, cancel the order and recover from me/us any expenses incurred by Transnet in calling for Quotations afresh and/or having to accept any less favourable offer.



### Price Schedule

I/We quote as follows for the Supply and delivery of Feeder Protection Panel for delivery to Bellville Square, Electrical Stores, excluding VAT:

| Item No | Description of Goods /Services | Unit of Measure | Quantity | Unit Price (ZAR) | Total Price (ZAR) |
|---|---|---|---|---|---|
| 1 | Feeder panel<br>Supply duel track feeder protection panel as per attached design & spec<br>to quality control process<br>-Training on protection<br>-Site acceptance and commissioning | EACH | 4 | | |

**Delivery Lead-Time from date of purchase order: _____ [days/weeks]**

**Notes to Pricing:**

a) All Prices must be quoted in South African Rand, exclusive of VAT

b) To facilitate like-for-like comparison bidders must submit pricing strictly in accordance with this price schedule and not utilise a different format. Deviation from this pricing schedule could result in a bid being disqualified.

Please note that should you have offered a discounted price(s), Transnet will only consider such price discount(s) in the final evaluation stage if offered on an unconditional basis.

**By signing this Quotation Form the Respondent is deemed to acknowledge that he/she has made himself/herself thoroughly familiar, and agrees, with all the conditions governing this RFQ,**

**including those contained in any printed form stated to form part hereof, including but not limited to the documents stated below and Transnet SOC Ltd will recognise no claim for relief based on an allegation that the Respondent overlooked any such condition or failed properly to take it into account for the purpose of calculating tendered prices or otherwise:**

1. Specifications and drawings included in this RFQ
2. The following documents all of which are available on Transnet's website or upon request:
   2.1. General Bid Conditions;
   2.2. Standard RFQ Terms and Conditions for the Supply of Goods or Services to Transnet;
   2.3. Supplier Integrity Pact;
   2.4. Non-disclosure Agreement; and
   2.5. Vendor Application Form and all supporting documents (first time vendors only)

   Alternatively, for all existing vendors, please provide vendor number(s) here:

| Transnet Operating Division | Unique Vendor Number | Yes / No |
|---|---|---|
| Transnet Group | | |
| TFR, etc. | | |
| | | |
| | | |

In the Yes/No column above, please confirm that all the information e.g. company address and contact details, banking details etc. are still correct as at the time of allocation of the vendor number(s). Alternatively, Respondents are required to provide the updated information with their bid submission.



SIGNED at _____ on this _____ day of _____ 20___

SIGNATURE OF WITNESSES

ADDRESS OF WITNESSES

1 _____

Name _____

_____

_____

2 _____

Name _____

_____

_____

SIGNATURE OF RESPONDENT'S AUTHORISED REPRESENTATIVE: _____

NAME: _____

DESIGNATION: _____

## SECTION 4

## RFQ DECLARATION AND BREACH OF LAW FORM

NAME OF ENTITY: _____

We _____ do hereby certify that:

1. Transnet has supplied and we have received appropriate responses to any/all questions [as applicable] which were submitted by ourselves for RFQ Clarification purposes;

2. we have received all information we deemed necessary for the completion of this Request for Quotation [**RFQ**];

3. we have been provided with sufficient access to the existing Transnet facilities/sites and any and all relevant information relevant to the Supply of the Goods as well as Transnet information and Employees, and has had sufficient time in which to conduct and perform a thorough due diligence of Transnet's operations and business requirements and assets used by Transnet. Transnet will therefore not consider or permit any pre- or post-contract verification or any related adjustment to pricing, service levels or any other provisions/conditions based on any incorrect assumptions made by the Respondent in arriving at his Bid Price.

4. at no stage have we received additional information relating to the subject matter of this RFQ from Transnet sources, other than information formally received from the designated Transnet contact(s) as nominated in the RFQ documents;

5. we are satisfied, insofar as our entity is concerned, that the processes and procedures adopted by Transnet in issuing this RFQ and the requirements requested from Bidders in responding to this RFQ have been conducted in a fair and transparent manner, and

6. furthermore, we declare that a family, business and/or social relationship **exists / does not exist** [delete as applicable] between an owner / member / director / partner / shareholder of our entity and an employee or board member of the Transnet Group including any person who may be involved in the evaluation and/or adjudication of this Bid.

7. In addition, we declare that an owner / member / director / partner / shareholder of our entity **is / is not** [delete as applicable] an employee or board member of the Transnet Group.

8. If such a relationship as indicated in paragraph 6 and/or 7 exists, the Respondent is to complete the following section:

FULL NAME OF OWNER/MEMBER/DIRECTOR/
PARTNER/SHAREHOLDER: ADDRESS:

_____

_____

Indicate nature of relationship with Transnet:

_____

_____

*[Failure to furnish complete and accurate information in this regard will lead to the disqualification of a response and may preclude a Respondent from doing future business with Transnet]*

9. We declare, to the extent that we are aware or become aware of any relationship between ourselves and Transnet [other than any existing and appropriate business relationship with Transnet] which could unfairly advantage our entity in the forthcoming adjudication process, we shall notify Transnet immediately in writing of such circumstances.

**BREACH OF LAW**

10. We further hereby certify that *I/we* ***have/have not been*** [delete as applicable] found guilty during the preceding 5 [five] years of a serious breach of law, including but not limited to a breach of the Competition Act, 89 of 1998, by a court of law, tribunal or other administrative body. The type of breach that the Respondent is required to disclose excludes relatively minor offences or misdemeanours, e.g. traffic offences. This includes the imposition of an administrative fine or penalty.
Where found guilty of such a serious breach, please disclose:
NATURE OF BREACH:
_____
_____
_____
DATE OF BREACH:_____
Furthermore, I/we acknowledge that Transnet SOC Ltd reserves the right to exclude any Respondent from the bidding process, should that person or entity have been found guilty of a serious breach of law, tribunal or regulatory obligation.



SIGNED at _____ on this _____ day of _____ 20___

| | |
|---|---|
| For and on behalf of<br>_____<br>duly authorised hereto | AS WITNESS: |
| Name: | Name: |
| Position: | Position: |
| Signature: | Signature: |
| Date: | Registration No of Company/CC<br>_____ |
| Place: | Registration Name of Company/CC<br>_____ |

# ANNEXURE – B

**TECHNICAL COMPLIANCE SHEET FOR FEEDER PROTECTION PANEL (SPECIFICATION NO. CEE.0111.99).**

The compliance response is to contain ONLY the following statements, "**Comply**", **or "Do not comply**".

Noted is to be applied against statements and either of the other responses for all other clauses. Where either "Partial Compliance" is inserted, remarks as to the reason for the deviation from the requirement is required



| Main Specification: | | | |
|---|---|---|---|
| **Item** | **Specification Clause No.** | **Compliance Response** | **Explanation / Deviation / Reason** |
| 1 | 26.1 | | |
| 2 | 26.1.1 | | |
| 3 | 26.1.2 | | |
| 4 | 26.1.3 | | |
| 5 | 26.1.4 | | |
| 6 | 26.2.1 | | |
| 7 | 26.2.2 | | |
| 8 | 26.2.3 | | |
| 9 | 26.2.4 | | |
| 10 | 26.2.5 | | |
| 11 | 26.2.6 | | |
| 12 | 26.2.7 | | |
| 13 | 26.2.8 | | |
| 14 | 26.2.9 | | |
| 15 | 26.2.10 | | |
| 16 | 26.2.11 | | |
| 17 | 26.2.12 | | |
| 18 | 26.2.13 | | |

| | | | |
|---|---|---|---|
| 19 | 26.2.14 | | |
| 20 | 26.2.15 | | |
| 21 | 26.2.16 | | |
| 22 | 26.3.1 | | |
| 23 | 26.3.2 | | |
| 24 | 26.3.3 | | |
| 25 | 26.3.4 | | |
| 26 | 26.3.5 | | |



**Note to tenderers:**

Tenderers are required to demonstrate their experience in the manufacturing, supply and delivery of similar goods and to this end shall supply a sufficiently detailed reference list (minimum 5) with contact details of previous and existing customers. Must have supplied and erected similar projects successfully in the past 2 years

**List of References**

| Name of Company | Contact Person & Contact Details | Project Name | Contract Period |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

| Technical Qualifying Criteria | Sub criteria maximum number of points | Number of weeks |
|---|---|---|
| Lead Time on Delivery | 15 | ..... Weeks |
| **Technical Qualifying Criteria** | **Sub criteria maximum number of points** | **Checklist for submission Yes / No** |
| Previous related experience | 15 | |
| Compliance to specification | 70 | |
| **Maximum possible score for quality** | 100 | |



**NB: The minimum threshold of 60% must be met or exceeded for a Bidder's proposal to progress to the next stage of evaluation.**

**Respondent's Signature** **Date & Company Stamp**

# SPOORNET

# (INFRASTRUCTURE)(ELECTRICAL)

THIS ISSUE CANCELS SPECIFICATION NO. CEE.0111.84



## SPECIFICATION FOR 25KV AC TRACTION SUBSTATIONS

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

# INDEX

**SECTION 1: - SUBSTATION DESIGN INFORMATION**



**SECTION 2: - TRACTION SUBSTATION EQUIPMENT**



**SECTION 3: - INSTALLATION OF EQUIPMENT**



**SECTION 4: - TESTING AND COMMISSIONING**

# SECTION 1 - SUBSTATION DESIGN INFORMATION

## 1.0 SCOPE

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

## 2.0 STANDARDS

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

The following publications are referred to in this specification:

### 2.2 South African Bureau of Standards

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

### 2.3 International Electrotechnical Commission

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

### 2.4 British Standards Institution

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

### 2.5 Spoornet

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

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

3.0 **APPENDICES**

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

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

APPENDIX 2 : Schedule of requirements for AC traction substations.

APPENDIX 3 : Schedule of drawings supplied by Spoornet.

4.0 **DEFINITIONS**

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

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

4.3 “Substation” refers to a traction substation

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

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

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

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

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

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

5.0 **TENDERING PROCEDURE**

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

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

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

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

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

6.0 **GENERAL REQUIREMENTS**

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

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

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

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

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

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

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

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

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

## 7.0 SERVICE CONDITIONS

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

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

## 8.0 INSULATION LEVELS

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

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

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

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

## 9.0 CLEARANCES

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

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

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

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

## 10.0 CREEPAGE DISTANCES

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

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

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

| Nominal system voltage | 66kV | 88kV | 132kV | 220kV |
|---|---|---|---|---|
| Highest voltage for equipment | 72,5kV | 100kV | 145kV | 245kV |
| Normal or light pollution | 1150mm | 1600mm | 2320mm | 3920mm |
| Heavy Pollution | 1660mm | 2300mm | 3240mm | 5640mm |

## 11.0 PREVENTION OF CORROSION

### 11.1 Preparation of outdoor structural steelwork.

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

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

### 11.2 Preparation of steel buildings.

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

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

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

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

11.3.3 The following table specifies the colours to be used:

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

12.0 **SUBSTATION OPERATIONAL PROTOCOLS**

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

12.1 **PRIMARY ISOLATOR**

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

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

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

12.2 **PRIMARY CIRCUIT BREAKERS**

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

12.2.1.1 Inverse Definite Minimum time operation. (primary)

12.2..1.2 Transformer winding and or oil temperature.

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

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

12.2.2.2 Transformer Bucholtz operation

12.2.2.3 Transformer restricted earth fault

12.2.2.4 Transformer biased differential

12.3 **SECONDARY ISOLATOR (25kV)**

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

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

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

12.4.1 **Incomer circuit breaker**

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

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

12.4.2.2 Inverse Definite Minimum time operation. (secondary overcurrent)

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

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

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

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

12.4.5 **Track feeder circuit breakers**

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

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

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

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

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

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

# SECTION 2: - TRACTION SUBSTATION EQUIPMENT

13.0 **STEELWORK**

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

13.2 Structural steel shall comply with BS 4360.

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

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

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

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

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

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

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

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

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

14.0 **PRIMARY AND SECONDARY ISOLATORS**

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

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

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

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

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

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

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

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

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

## 15.0 LIGHTNING ARRESTERS

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

15.2 Heavy duty station class arresters shall be provided.

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

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

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

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

16.0 **PRIMARY CIRCUIT BREAKERS**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

## 17.0 TRACTION TRANSFORMER

### 17.1 GENERAL

17.1.1 The transformer shall comply with IEC 76.

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

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

### 17.2 TECHNICAL REQUIREMENTS.

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

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

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

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

17.2.3 Transformer oil shall conform to SABS 555.

17.3 **ANCILLARY EQUIPMENT**

The following shall be provided :-

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

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

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

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

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

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

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

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

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

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

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

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

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

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

17.4 **TANK AND COOLING RADIATORS**

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

17.4.2 The transformer tank shall have a welded top cover.

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

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

17.5 **RATING PLATES**

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

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

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

17.6 **TESTING**

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

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

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

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

18.0 **CURRENT TRANSFORMERS**

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

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

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

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

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

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

19.0 **VOLTAGE TRANSFORMERS**

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

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

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

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

20.0 **AUXILIARY POWER TRANSFORMERS**

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

20.2 The transformers shall comply with SABS 780.

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

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

21.0 **BUSBAR COUPLER**

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

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

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

22.0 **SECONDARY CIRCUIT BREAKERS**

**GENERAL REQUIREMENTS**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

22.14 The operating voltage shall be 110V DC.

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

22.16 The following shall be provided within the enclosure:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**23.0** TRACTION substation building

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

HEATING AND VENTILATION

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

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

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

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

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

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

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

24.0 **AUXILIARY POWER SUPPLIES**

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

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

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

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

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

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

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

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

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

**LIGHTING**

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

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

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

25.0 **REQUIREMENTS FOR TELECONTROL**

25.1 Telecontrol and telemetering equipment will be provided by Spoornet.

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

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

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

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

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

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

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

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

25.7.2 A voltage transducer to monitor each secondary busbar voltage.

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

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

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

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

## 26.0 CONTROL PANELS

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

### 26.1 PANEL CONSTRUCTION

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

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

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

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

### 26.2 EQUIPMENT INSTALLED IN THE PANELS

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

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

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

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

26.2.5 The control equipment provided shall be capable of correct operation within the voltage limits specified in BS 5312 : Part 3 : 1976. In addition the coils of all devices operated from the substation auxiliary transformer AC supply shall be capable of satisfactorily operating under the harmonic voltage conditions encountered in an AC traction system.

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

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

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

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

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

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

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

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

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

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

26.2.15 No anti condensation heaters are required inside the panels.

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

26.3 INDICATING INSTRUMENTS

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

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

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

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

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

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

27.0 **DC BATTERY AND CHARGER**

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

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

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

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

28.0 **PROTECTION**

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

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

28.2 **PRIMARY CIRCUIT BREAKER TRIPPING**

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

28.2.1.1 Buchholz.

28.2.1.2 Restricted earth fault on both primary and secondary windings.

28.2.1.3 Transformer percentage biased differential.

28.2.1.4 Primary circuit breakers SF6 low gas.

28.2.1.5 Traction transformer pressure relief valve.

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

28.2.2.1 Transformer winding and oil temperature.

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

28.2.2.3 Circuit breaker tripping supply undervoltage detection.

28.3 **SECONDARY CIRCUIT BREAKER TRIPPING**

28.3.1 Secondary circuit breaker protection relays shall be circuit specific:

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

28.3.3 **Incomer circuit breaker**

28.3.3.1 Inverse Definite Minimum Time (IDMT) overcurrent relay.

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

28.3.4 **Track feeder circuit breaker**

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

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

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

28.3.4.4 Low SF6 Gas pressure detection.

28.4 **AUXILIARY TRANSFORMER PROTECTION**

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

28.5 **RELAYS AND CIRCUITRY PROTECTION**

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

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

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

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

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

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



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

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

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

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

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

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

# SECTION 3: - INSTALLATION OF EQUIPMENT

30.0 **SUBSTATION SITES**

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

30.1 SITE PREPARATION

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

30.2 SITE LEVELS

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

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

30.2.3 The site must be flat.

30.3 MATERIAL

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

30.3.2 Material of quality G5 must be used for earthworks.

30.4 COMPACTION

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

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

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

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

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

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

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

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

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

31.0 **FOUNDATIONS**

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

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

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

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

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

31.6 All support foundations shall be at the same level.

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

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

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

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

32.0 **CONCRETE**

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

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

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

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

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

33.0 **INSTALLATION OF SUBSTATION EQUIPMENT**

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

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

Requirements for the installation of substation equipment are as follows:

33.4 **PRIMARY ISOLATOR**

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

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

33.5 **MAIN TRANSFORMER**

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

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

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

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

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

33.6 **VOLTAGE TRANSFORMER**

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

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

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

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

33.7 **AUXILIARY TRANSFORMER**

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

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

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

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

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

33.8 **SECONDARY ISOLATOR**

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

33.9 **SECONDARY CIRCUIT BREAKERS**

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

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

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

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

33.10 **SECONDARY LIGHTNING ARRESTORS**

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

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

33.11 **25kV BUSBAR**

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

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

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

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

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

33.12 **SUBSTATION BUILDING**

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

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

33.13 **EQUIPMENT INSTALLED IN THE SUBSTATION BUILDING**

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

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

33.14 **CABLES**

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

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

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

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

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

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

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

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

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

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

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

33.15 **INTERCONNECTION OF EQUIPMENT**

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

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

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

33.15.4 All dissimilar metal connections (Cu to Al) shall be made using bi-metallic clamps that are specifically designed and manufactured to make that particular connection (ad hoc fabricated clamps are not acceptable).

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

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

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

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

33.16 **FENCING AND KERBING**

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

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

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

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

## 33.17 "RETURN" CURRENT AND SUBSTATION EARTHING

### 33.17.1 RETURN CURRENT

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

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

### 33.17.2 SUBSTATION EARTH

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

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

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

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

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

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

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

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

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

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

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

**33.17.3** EARTHING DEVICES

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

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

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

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

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

33.18 **NAMEPLATES AND LABELS**

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

33.18.2 Danger warning notices as per Drawing CEE-TA-96 shall be supplied and fitted to the substation building access door, on each half of the substation gate, one notice on the narrow side substation fence and two notices on the long side substation fence.

33.18.3 All nameplates and labels shall be in English.

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

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

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

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

33.18.8 The following is a list of approved labels.

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

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

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

# SECTION 4: - TESTING AND COMMISSIONING

34.0 **TYPE AND ROUTINE TESTING REQUIREMENTS**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

35.0 **SITE TESTS AND COMMISSIONING**

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

35.1 **ON-SITE TESTS**

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

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

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

35.1.4 The on-site tests and subsequent commissioning will not commence until all construction work has been completed. Construction staff, material and equipment shall be removed from site prior to the commencement of testing. Testing and commissioning of the substation equipment will not be allowed to take place in a construction site environment.

35.1.5 On-site tests shall include the following ;

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

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

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

35.1.8 Acceptance by the Technical Officer of satisfactory completion of on-site tests in no way relieves the contractor of his obligation to rectify defects which may have been overlooked or become evident at a later stage.

35.2 **COMMISSIONING OF EQUIPMENT**

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

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

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

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

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

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

35.2.7 The commissioning of the protection equipment by Spoornet will in no way absolve the successful tenderer from any of his responsibilities during the guarantee period. It is the successful tenderers responsibility to satisfy himself that the commissioning of the protection equipment has been carried out in a satisfactory manner and in no way compromises the proper operation of the equipment supplied in terms of the contract.

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

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

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

36.1 **DRAWINGS**

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

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

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

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

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

36.2 **INSTRUCTION MANUALS**

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

36.3 **SPARES LISTS**

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

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

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

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

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

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

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

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

38.0 **TRAINING**

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

39.0 **GUARANTEE AND DEFECTS**

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

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

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

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

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

**APPENDIX 1**

## SUBSTATION SITES (NAMES AND LOCATIONS) AND DEGREE OF POLLUTION

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

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

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

**APPENDIX 2**

# SCHEDULE OF REQUIREMENTS FOR AC TRACTION SUBSTATIONS

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

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

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

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

NOTE 1:

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

**APPENDIX 3**

**SCHEDULE OF DRAWINGS SUPPLIED BY SPOORNET**

| DRAWING No. | TITLE |
|---|---|
| CEE-TCA-92 | Key box 25kV AC traction substation |
| CEE-TDB-41 sht 1 | Double unit switch gantry 25kV AC traction substation |
| CEE-TDB-41 sht 2 | Single unit switch gantry 25kV AC traction substation |
| CEE-TDC-10 | Cable tray details in yard 25kV AC traction substation |
| CEE-TDF-15 sht 1 | Substation security fence detail 25kV AC traction substation |
| CEE-TDF-15 sht 2 | Gate detail for security fence 25kV AC traction substation |
| CEE-TDF-16 | Substation Palisade fencing detail 25kV AC traction substation |
| CCE-TYPE 1-45 | Boundary / stock fencing |
| CEE-TEA-1 | Kerbing for substation 25kV AC traction substation |
| CEE-TEA-2 | Traction substation nameboard |
| CEE-TEB-177 | Antra substation yard layout - 25kV AC traction substation |
| CEE-TEB-178 | Intshamanzi substation yard layout - 25kV AC traction substation |
| CEE-TEB-179 | Nseleni substation yard layout - 25kV AC traction substation |
| CEE-TEB-180 | Ekupheleni substation yard layout - 25kV AC traction substation |
| CEE-TEE-173 sht 1 | Pipe and earth details in small foundation 25kV AC traction substation |
| CEE-TEE-173 sht 2 | Pipe and earth details in large foundation 25kV AC traction substation |
| CEE-TEE-173 sht 3 | Pipe and earth details for transformer plinth 25kV AC traction substation |
| CEE-TEC-28 | Substation building detail and layout 25kV AC traction substation |
| CEE-TBK-27 | No volt coil for circuit breakers |
| CEE-TBB-109 | Single line diagram and protection requirements 25kV AC traction substation |
| CEE-TBD-8 | Earthing arrangement 25kV AC traction substation |
| CEE-TA-196 | Sign warning, electric shock hazard 25kV AC traction substation |
| CEE-PFB-30 | Typical mounting arrangement for Aux transformer on track structures |
| CCE-FG-203 | Details of cables in Spoornet's formation |

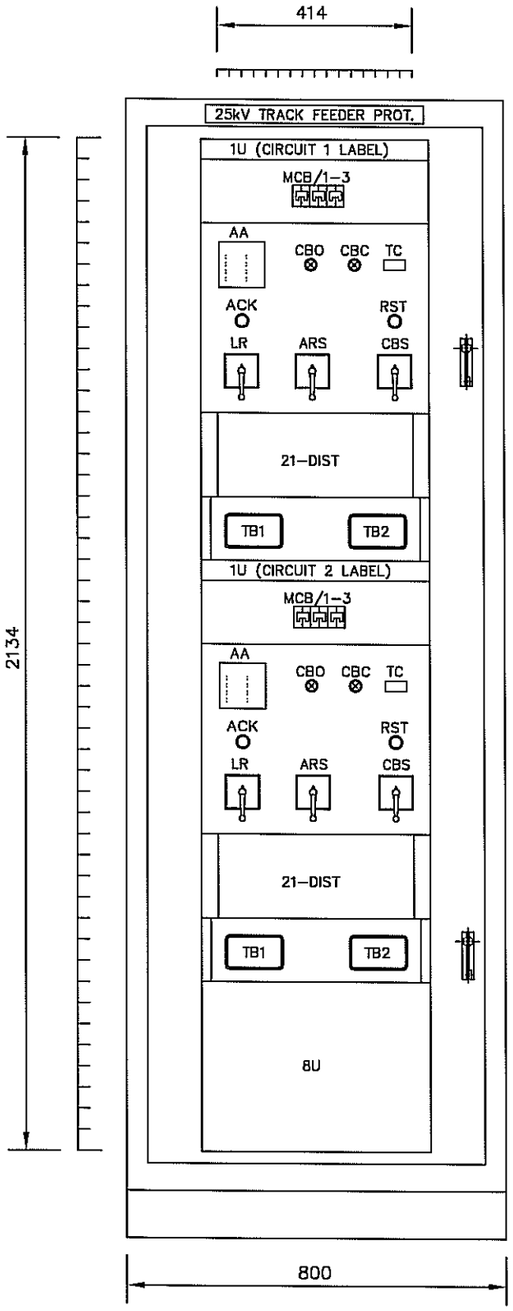


**SKETCHES**

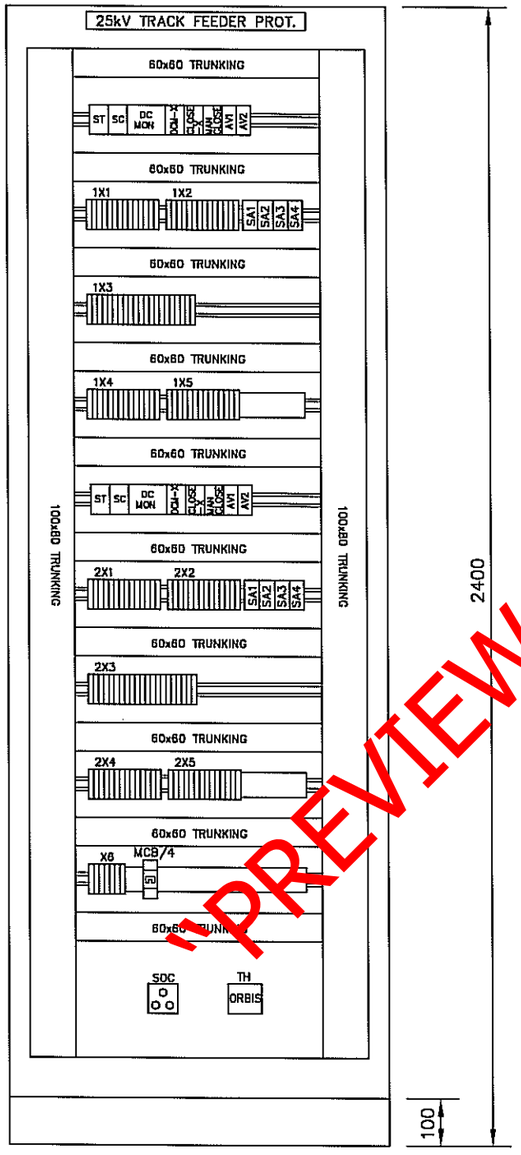
The following sketches are part of this appendix and are referred to in the specification:

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

NOTES:
1. PANEL TYPE : SWING FRAME, FRONT ACCESS, 600 DEEP, TOP AND BOTTOM CABLE ENTRY.
2. PANEL COLOUR: LIGHT GREY G29, TEXTURED FINISH.




FRONT VIEW




INTERNAL VIEW

| DESIGNATION | RELAY REFERENCE | RELAY/EQUIPMENT/ DESCRIPTION/FUNCTION | SUPPLIER |
|---|---|---|---|
| 1U | 1U | 1U 19" BLAKING PLATE | GE |
| MCB/1 | EP102UCC16 | TRIP/CLOSE SUPPLY MCB, 2 POLE 16A | GE |
| MCB/2 | EP102UCC06 | INDICATION AND ALARM SUPPLY MCB, 2 POLE 6A | GE |
| MCB/3 | G102C02+CAH | 110V AC SUPPLY MCB , 2 POLE 6A + CAH AUXILIARY | GE |
| AA | ADDA 8X | 8 POINT ALARM ANNUNCIATOR | MIMIC CRAFT |
| CBO | ND22 | CB OPEN LED, GREEN | MIMIC CRAFT |
| CBC | ND22 | CB CLOSED LED, RED | MIMIC CRAFT |
| TC | ZR6–2600 | TRIP COUNTER, 8 DIGIT | FOX |
| ACK | YSF2 | ALARM ACCEPT PUSHBUTTON | MIMIC CRAFT |
| RST | YSF2 | ANNUNCIATOR/RELAY RESET PUSHBUTTON | MIMIC CRAFT |
| LR | 2 POS/4 POLE | LOCAL/REMOTE SELECTOR SWITCH | ACTOM |
| ARS | 2 POS/2 POLE | AUTO RECLOSE ON/OFF SWITCH | ACTOM |
| CBS | 3 POS/2 POLE | CB CONTROL SWITCH | ACTOM |
| 21–DIST | DRFP– | DIGITAL RAILWAY FEEDER PROTECTION RELAY | PROTECTA |
| TB1 | PK2 4 WAY | DISTANCE PROTECTION CT/VT TEST BLOCK | ALBRO |
| TB2 | PK2 4 WAY | THERMAL PROTECTION CT TEST BLOCK | ALBRO |
| 8U | 8U | 8U 19" BLANKING PLATE | ACTOM |
| | | | |
| | | OTHER/INTERNAL EQUIPMENT | |
| ST | RELE C4–3 | SUPERVISORY TRIP RELAY 110V DC | AC/DC DYNAMICS |
| SC | RELE C4–3 | SUPERVISORY CLOSE RELAY 110V DC | AC/DC DYNAMICS |
| DC MON | SP201 | DC MONITORING RELAY 110V DC | RHOMBERG |
| DCM–X | RELE C4–3 | DC MONITORING AUXILIARY RELAY 110V DC | AC/DC DYNAMICS |
| CLOSE–X | RELE C4–3 | CLOSE AUXILIRY RELAY 110V DC | AC/DC DYNAMICS |
| MAN CLOSE | RELE C4–3 | MANUAL CLOSE RELAY 110V DC | AC/DC DYNAMICS |
| AV1 | DSA9/KCH | AVALANCHE DIODE, 12A, 1.6kV PIV | ABB |
| AV2 | DSA9/KCH | AVALANCHE DIODE, 12A, 1.6kV PIV | ABB |
| SA1 | DG MOD 275 | 230V AC CIRCUIT SURGE PROTECTION – PHASE | DEHNGUARD |
| SA2 | DG MOD NPE | 23V AC CIRCUIT SURGE PROTECTION – NEUTRAL | DEHNGUARD |
| SA3 | DG MOD 150 | 110V AC CIRCUIT SURGE PROTECTION – PHASE | DEHNGUARD |
| SA4 | DGP C MOD | 110V AC CIRCUIT SURGE PROTECTION – NEUTRAL | DEHNGUARD |
| MCB/4 | G102C02 | 230V PANEL AC SUPPLY MCB , 2 POLE 2A | GE |
| SOC | 16A | 16A SWITCHED SOCKET | CRABTREE |
| TH | ORBIS MLW | THERMOSTAT | AC/DC DYNAMICS |



| REVISION | DESCRIPTION | DRAWN | APP'D | DATE | REVISION | DESCRIPTION | DRAWN | APP'D | DATE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Second submission | DS | .. | 03/03/15 | | | | | |

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CONTRACT: ..

| | | | |
|---|---|---|---|
| DRN | DS | DATE | 12/02/15 |
| CHD | VD | DATE | 24/03/15 |
| APP'D | | DATE | 24/03/15 |
| PROJN | | SCALE | DO NOT SCALE |

TITLE:
TRACTION SUBSTATION
25kV DUAL TRACK FEEDER PROTECTION
PANEL LAYOUT AND LEDGEND

CAD REF. 5068_01_01
SHEET: 01 NEXT: 02
DRG. NO. A3SE5068PM1ES001
A1

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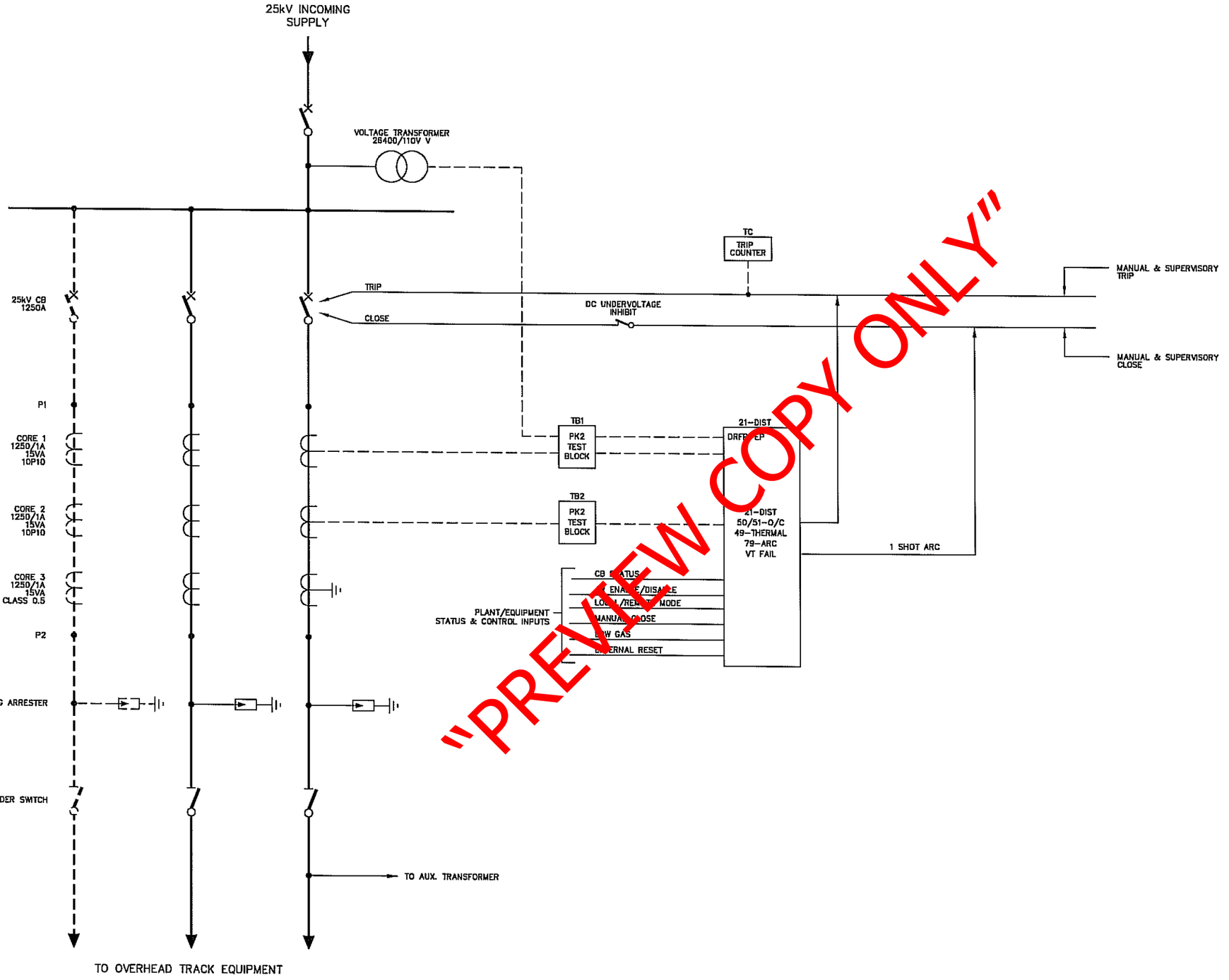




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|---|---|---|---|---|---|---|---|---|---|
| 1 | Second submission | DS | .. | 03/03/15 | | | | | |

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| DRN | DS | DATE | 12/02/15 |
| CHD | VD | DATE | 24/03/15 |
| APP'D | | DATE | 24/03/15 |
| PROJN | | SCALE | DO NOT SCALE |

TITLE: TRACTION SUBSTATION 25kV DUAL TRACK FEEDER PROTECTION LOGIC DIAGRAM

CAD REF. 5068_01_02 | SHEET: 02 | NEXT: 03 | DRG. NO. A3SE5068PM1ES001 | A1

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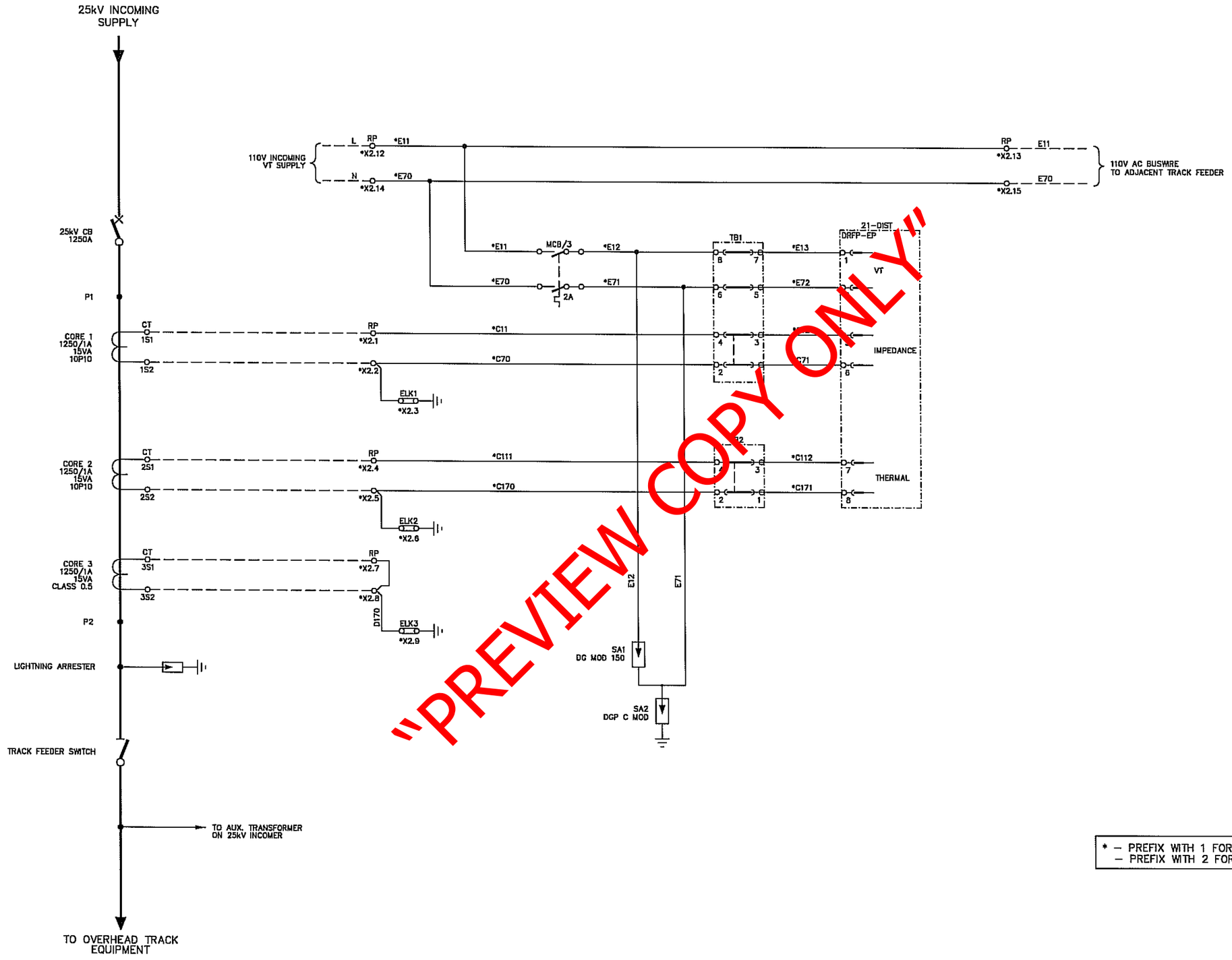




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| 1 | Second submission | DS | .. | 03/03/15 | | | | | |

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|---|---|---|---|
| DRN | DS | DATE | 12/02/15 |
| CHD | VD | DATE | 24/03/15 |
| APP'D | | DATE | 24/03/15 |
| PROJN | | SCALE | DO NOT SCALE |

TITLE:
TRACTION SUBSTATION
25kV DUAL TRACK FEEDER PROTECTION
AC KEY DIAGRAM

CAD REF. 5068_01_03
SHEET: 03
NEXT: 04
DRG. NO. A3SE5068M1ES001
A1

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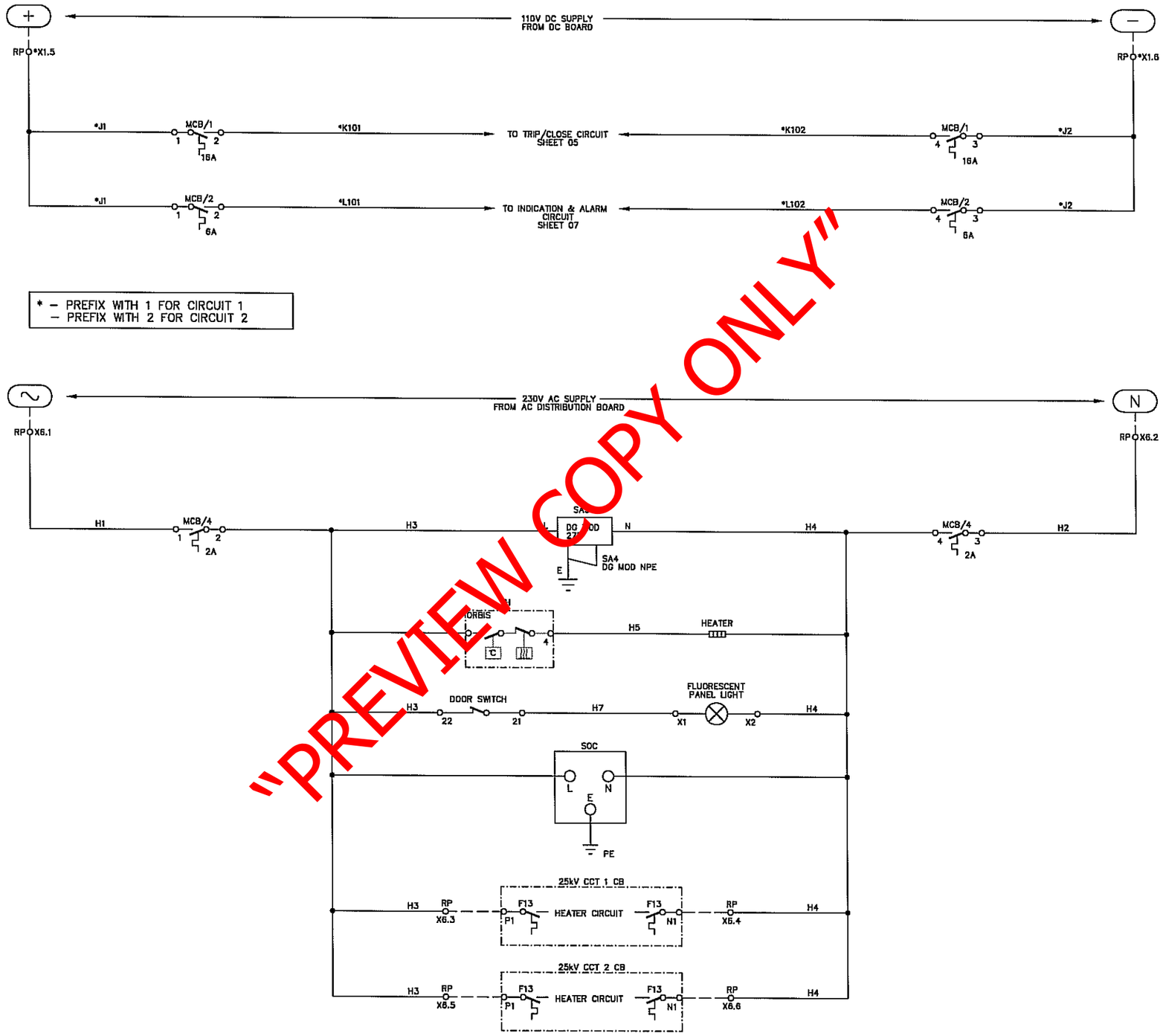




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|---|---|---|---|---|---|---|---|---|---|
| 1 | Second submission | DS | .. | 03/03/15 | | | | | |

ACTOM
PROTECTION & CONTROL
2 Magnet Road, Knights, Gauteng, South Africa
PO Box 24, Primrose, 1416, Gauteng
Tel: (011) 820-5111 Fax: (011) 820-5323

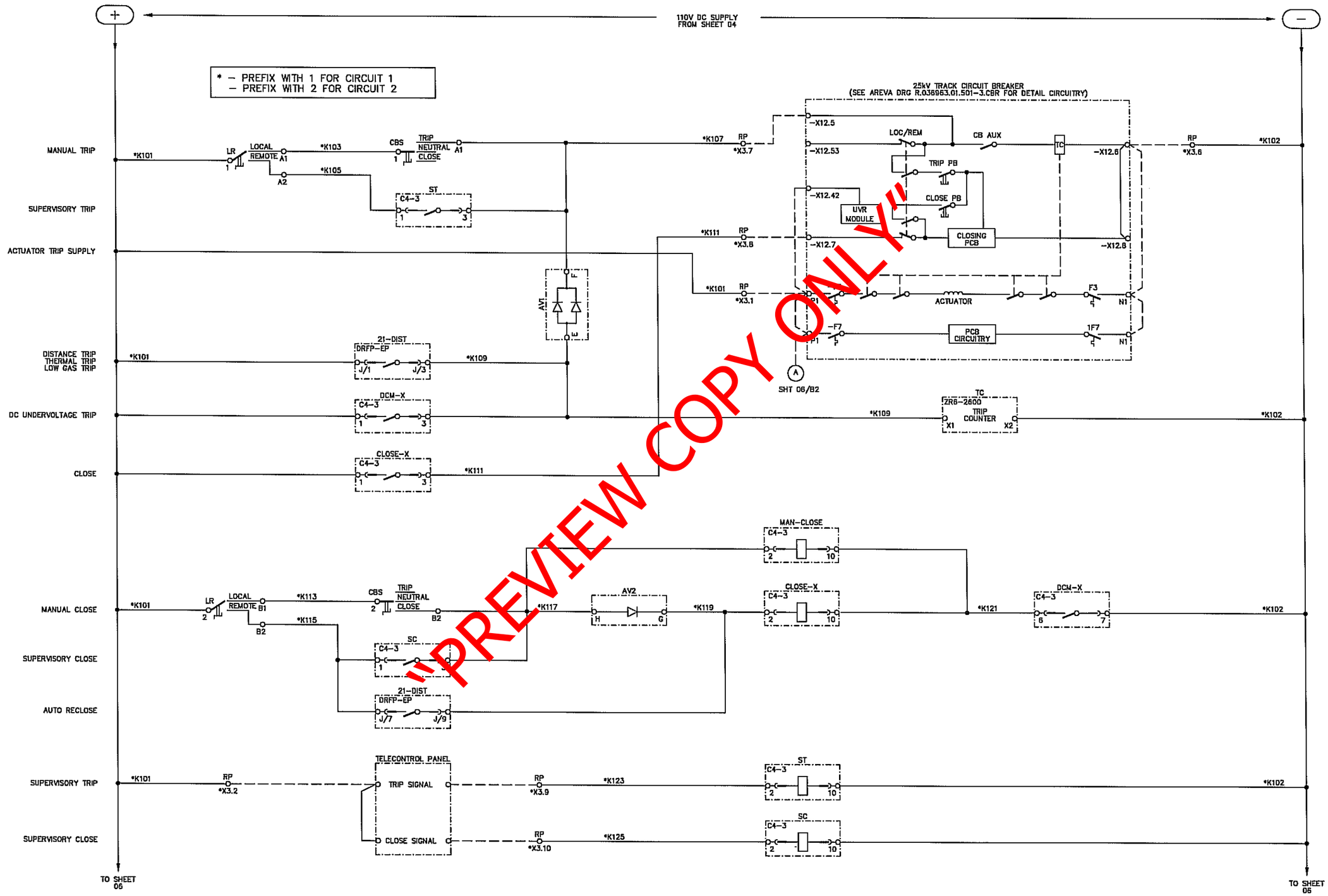
CUSTOMER: SPOORNET
CONTRACT: ..

| | | | |
|---|---|---|---|
| DRN | DS | DATE | 12/02/15 |
| CHD | VD | DATE | 24/03/15 |
| APP'D PROJN | | DATE | 24/03/15 |
| | | SCALE | DO NOT SCALE |

TITLE:
TRACTION SUBSTATION
25kV DUAL TRACK FEEDER PROTECTION
DC AND AC SUPPLIES

CAD REF. 5038_01_04
SHEET: 04
NEXT: 05
DRG. NO. A1SE4072PM1ES001
A1

0 10 20 30 40 50 100 150 200






| REVISION | DESCRIPTION | DRAWN | APP'D | DATE | REVISION | DESCRIPTION | DRAWN | APP'D | DATE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Second submission | DS | .. | 03/03/15 | | | | | |

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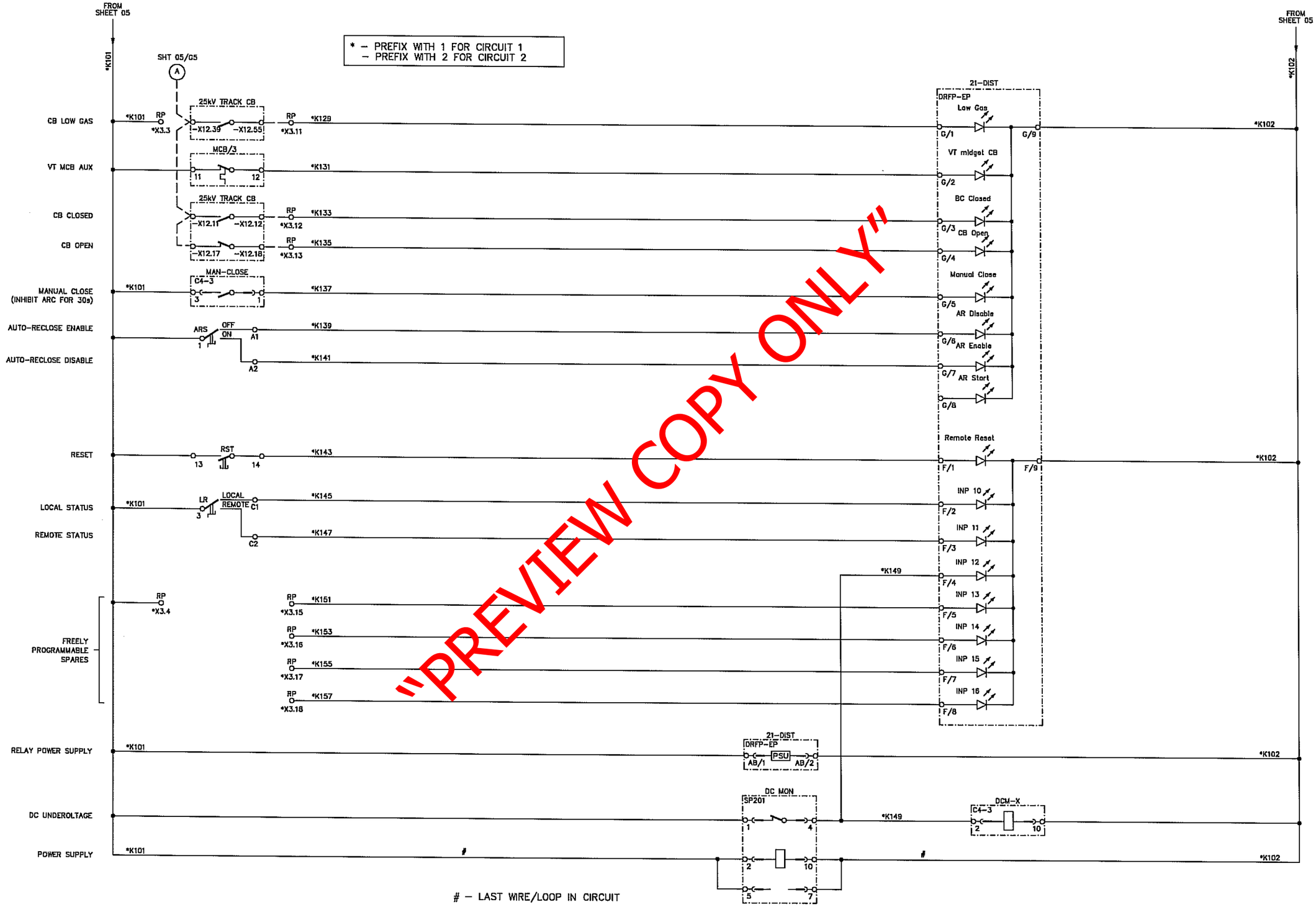
| | | | |
|---|---|---|---|
| CUSTOMER: SPOORNET | | | CONTRACT: .. |
| DRN: DS | DATE: 24/03/11 | TITLE: | |
| CHD: VD | DATE: 24/03/15 | TRACTION SUBSTATION | |
| APP'D: | DATE: 24/03/15 | 25kV DUAL TRACK FEEDER PROTECTION | |
| PROJN: | SCALE: DO NOT SCALE | TRIP/CLOSE CIRCUIT | |
| CAD REF: 4072_01_05 | SHEET: 05 NEXT: 06 | DRG. NO. A1SE5068PM1ES001 | A1 |

0 10 20 30 40 50 100 150 200






# – LAST WIRE/LOOP IN CIRCUIT

| REVISION | DESCRIPTION | DRAWN | APP'D | DATE | REVISION | DESCRIPTION | DRAWN | APP'D | DATE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Second submission | DS | .. | 03/03/15 | | | | | |

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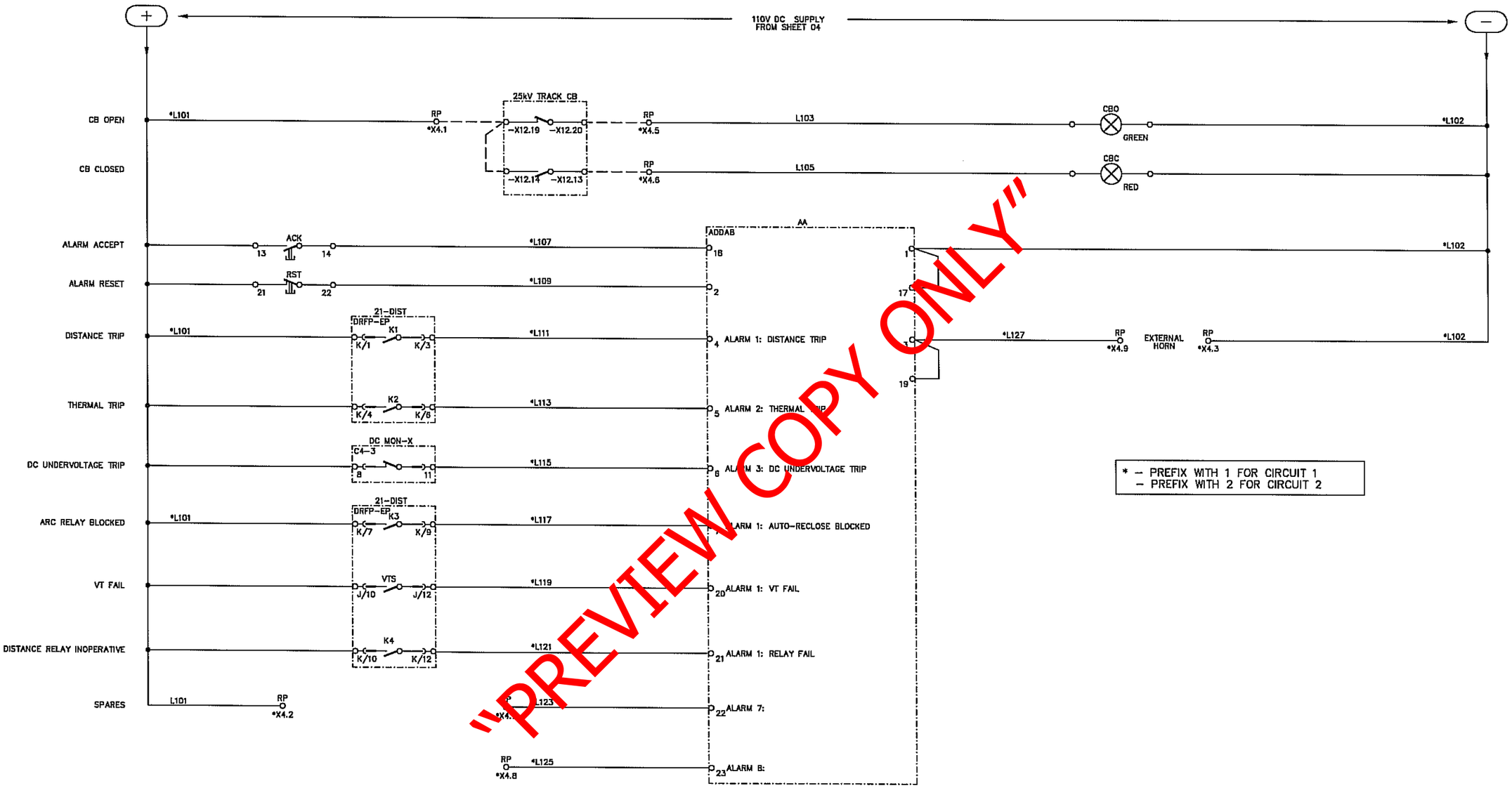
CUSTOMER: SPOORNET
CONTRACT: ..

| | | | |
|---|---|---|---|
| DRN | DS | DATE | 12/02/15 |
| CHD | VD | DATE | 24/03/15 |
| APP'D | | DATE | 24/03/15 |
| PROJN | | SCALE | DO NOT SCALE |

TITLE:
TRACTION SUBSTATION
25kV DUAL TRACK FEEDER PROTECTION
TRIP/CLOSE CIRCUIT

CAD REF. 5068_01_06
SHEET: 06
NEXT: 07
DRG. NO. A1SE5068PM1ES006
A1

0 10 20 30 40 50 100 150 200






| REVISION | DESCRIPTION | DRAWN | APP'D | DATE | REVISION | DESCRIPTION | DRAWN | APP'D | DATE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Second submission | DS | .. | 03/03/15 | | | | | |

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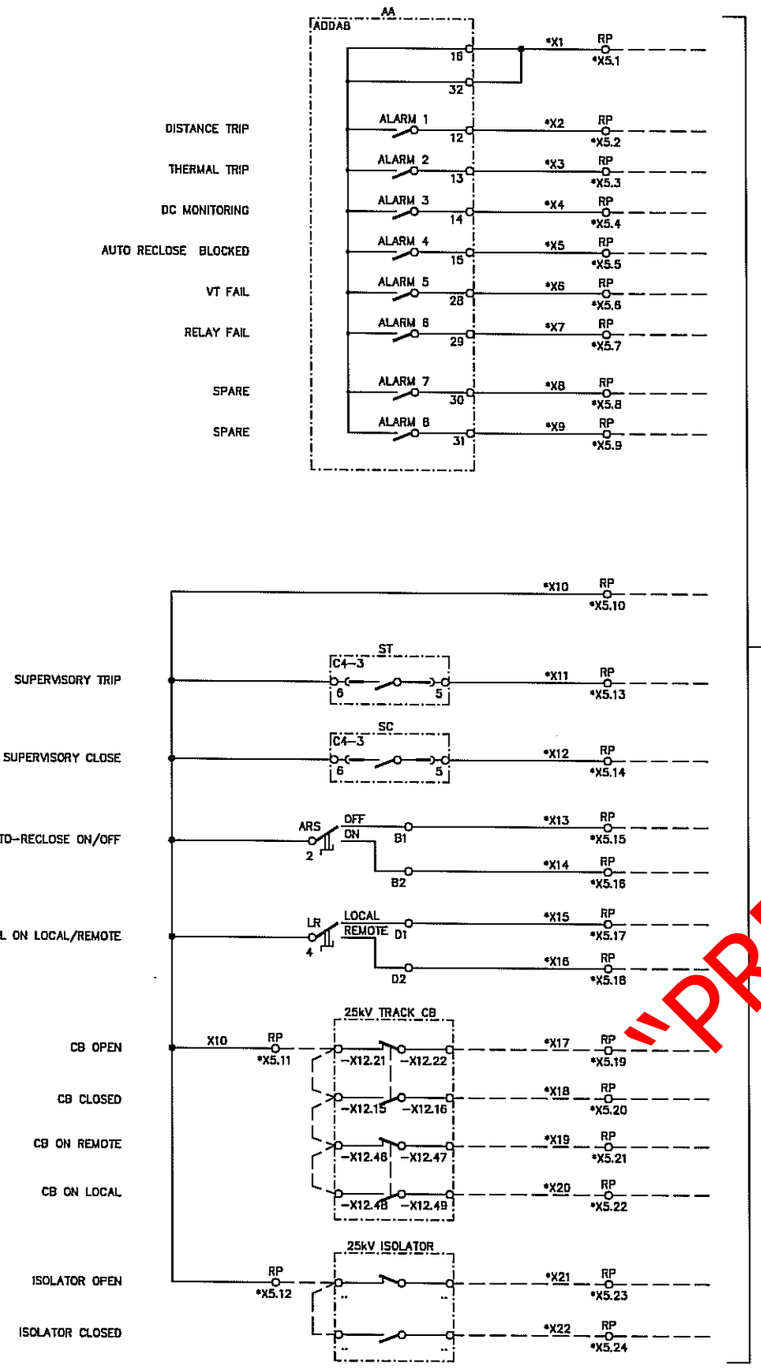
| | | | | | |
|---|---|---|---|---|---|
| CUSTOMER: SPOORNET | | | | CONTRACT: .. | |
| DRN DS | DATE 12/02/15 | TITLE: TRACTION SUBSTATION 25kV DUAL TRACK FEEDER PROTECTION INDICATION AND ALARM CIRCUIT | | | |
| CHD VD | DATE 24/03/15 | | | | |
| APP'D | DATE 24/03/15 | | | | |
| PROJN | SCALE DO NOT SCALE | | | | |
| CAD REF. 5068_01_07 | SHEET: 07 NEXT: 08 | DRG. NO. A1SE5068PM1ES001 | | | A1 |

0 10 20 30 40 50 100 150 200




PROVISION FOR HARD WIRED SIGNALS TO SCADA SYSTEM

* – PREFIX WITH 1 FOR CIRCUIT 1
– PREFIX WITH 2 FOR CIRCUIT 2



| REVISION | DESCRIPTION | DRAWN | APP'D | DATE | REVISION | DESCRIPTION | DRAWN | APP'D | DATE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Second submission | DS | .. | 03/03/15 | | | | | |

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Tel: (011) 820-5111 Fax: (011) 820-5323

CUSTOMER: SPOORNET
CONTRACT: ..

| | | | |
|---|---|---|---|
| DRN | DS | DATE | 12/02/15 |
| CHD | VD | DATE | 24/03/15 |
| APP'D | | DATE | 24/03/15 |
| PROJN | | SCALE | DO NOT SCALE |
| CAD REF. | 5068_02_08 | SHEET: | 08 |
| | | NEXT: | 09 |

TITLE:
TRACTION SUBSTATION
25kV DUAL TRACK FEEDER PROTECTION
SUPERVISORY CIRCUIT

DRG. NO. A1SE5068PM1ES008 A1

0 10 20 30 40 50 100 150 200

| 1X4 | DESTINATION/FUNCTION |
|---|---|
| 1 | 1L101 CB +110V DC – LED COMMON |
| 2 | 1L101 +110V DC SPARE |
| 3 | 1L102 EXT. HORN – |
| 4 | SPARE |
| 5 | 1L103 CB – OPEN LED |
| 6 | 1L105 CB – CLOSED LED |
| 7 | 1L123 SPARE ALARM |
| 8 | 1L125 SPARE ALARM |
| 9 | 1L127 EXT HORN + |
| 10 | SPARE |
| 11 | SPARE |

| 1X5 | DESTINATION/FUNCTION |
|---|---|
| 1 | 1X1 ALARM COMMON (2–9) |
| 2 | 1X2 DISTANCE TRIP |
| 3 | 1X3 THERMAL TRIP |
| 4 | 1X4 DC MONITORING |
| 5 | 1X5 AUTO RECLOSE BLOCKED |
| 6 | 1X6 VT FAIL |
| 7 | 1X7 RELAY FAIL |
| 8 | 1X8 SPARE |
| 9 | 1X9 SPARE |
| CT CORE 10 | 1X10 ALARM COMMON (13–24) |
| CT CORE 11 | 1X10 CB COMMON |
| 12 | 1X10 ISOLATOR COMMON |
| 13 | 1X11 SUPV TRIP |
| 14 | 1X12 SUPV CLOSE |
| 15 | 1X13 AUTO RECLOSE OFF |
| 16 | 1X14 AUTO RECLOSE ON |
| 17 | 1X15 PANEL ON LOCAL |
| 18 | 1X16 PANEL ON REMOTE |
| 19 | 1X17 CB OPEN |
| 20 | 1X18 CB CLOSED |
| 21 | 1X19 CB ON REMOTE |
| 22 | 1X20 CB ON LOCAL |
| 23 | 1X21 ISOLATOR OPEN |
| 24 | 1X22 ISOLATOR CLOSED |

| 2X4 | DESTINATION/FUNCTION |
|---|---|
| 1 | 2L101 CB +110V DC – LED COMMON |
| 2 | 2L101 +110V DC SPARE |
| 3 | 2L102 EXT. HORN – |
| 4 | SPARE |
| 5 | 2L103 CB – OPEN LED |
| 6 | 2L105 CB – CLOSED LED |
| 7 | 2L123 SPARE ALARM |
| 8 | 2L125 SPARE ALARM |
| 9 | 2L127 EXT HORN + |
| 10 | SPARE |
| 11 | SPARE |

| 2X5 | DESTINATION/FUNCTION |
|---|---|
| 1 | 2X1 ALARM COMMON (2–9) |
| 2 | 2X2 DISTANCE TRIP |
| 3 | 2X3 THERMAL TRIP |
| 4 | 2X4 DC MONITORING |
| 5 | 2X5 AUTO RECLOSE BLOCKED |
| 6 | 2X6 VT FAIL |
| 7 | 2X7 RELAY FAIL |
| 8 | 2X8 SPARE |
| 9 | 2X9 SPARE |
| 10 | 2X10 ALARM COMMON (13–24) |
| 11 | 2X10 CB COMMON |
| 12 | 2X10 ISOLATOR COMMON |
| 13 | 2X11 SUPV TRIP |
| 14 | 2X12 SUPV CLOSE |
| 15 | 2X13 AUTO RECLOSE OFF |
| 16 | 2X14 AUTO RECLOSE ON |
| 17 | 2X15 PANEL ON LOCAL |
| 18 | 2X16 PANEL ON REMOTE |
| 19 | 2X17 CB OPEN |
| 20 | 2X18 CB CLOSED |
| 21 | 2X19 CB ON REMOTE |
| 22 | 2X20 CB ON LOCAL |
| 23 | 2X21 ISOLATOR OPEN |
| 24 | 2X22 ISOLATOR CLOSED |

| 1X3 | DESTINATION/FUNCTION |
|---|---|
| 1 | 1K101 CB +110VDC |
| 2 | 1K101 SUPV +110V DC |
| 3 | 1K101 SPARE +110VDC |
| 4 | 1K101 SPARE +110VDC |
| 5 | SPARE |
| 6 | 1K102 CB –110VDC |
| 7 | 1K107 CB TRIP |
| 8 | 1K111 CB CLOSE |
| 9 | 1K123 SUPV TRIP |
| 10 | 1K125 SUPV CLOSE |
| 11 | 1K129 CB LOW GAS OPTO |
| 12 | 1K133 CB CLOSED OPTO |
| 13 | 1K135 CB OPEN OPTO |
| 14 | SPARE |
| 15 | 1K151 WIRED SPARE OPTO |
| 16 | 1K153 WIRED SPARE OPTO |
| 17 | 1K155 WIRED SPARE OPTO |
| 18 | 1K157 WIRED SPARE OPTO |
| 19 | SPARE |
| 20 | SPARE |

| 2X3 | DESTINATION/FUNCTION |
|---|---|
| 1 | 2K101 CB +110VDC |
| 2 | 2K101 SUPV +110V DC |
| 3 | 2K101 SPARE +110VDC |
| 4 | 2K101 SPARE +110VDC |
| 5 | SPARE |
| 6 | 2K102 CB –110VDC |
| 7 | 2K107 CB TRIP |
| 8 | 2K111 CB CLOSE |
| 9 | 2K123 SUPV TRIP |
| 10 | 2K125 SUPV CLOSE |
| 11 | 2K129 CB LOW GAS OPTO |
| 12 | 2K133 CB CLOSED OPTO |
| 13 | 2K135 CB OPEN OPTO |
| 14 | SPARE |
| 15 | 2K151 WIRED SPARE OPTO |
| 16 | 2K153 WIRED SPARE OPTO |
| 17 | 2K155 WIRED SPARE OPTO |
| 18 | 2K157 WIRED SPARE OPTO |
| 19 | SPARE |
| 20 | SPARE |

| 1X1 | DESTINATION/FUNCTION |
|---|---|
| 1 | 1J1 + 110V DC |
| 2 | 1J2 – 110V DC |
| 3 | SPARE |
| 4 | SPARE |
| 1X2 | |
| 1 | 1C11 CT CORE 1 |
| 2 | 1C70 CT CORE 1 |
| 3 | ELK |
| 4 | 1C111 CT CORE 2 |
| 5 | 1C170 CT CORE 2 |
| 6 | ELK |
| 7 | 1D170 CT CORE 3 |
| 8 | 1D170 CT CORE 3 |
| 9 | ELK |
| 10 | SPARE |
| 11 | SPARE |
| 12 | 1E11 VT (L) |
| 13 | 1E11 VT (L) |
| 14 | 1E70 VT (L) |
| 15 | 1E70 VT (L) |
| 16 | SPARE |
| 17 | SPARE |

| 2X1 | DESTINATION/FUNCTION |
|---|---|
| 1 | 2J1 + 110V DC |
| 2 | 2J2 – 110V DC |
| 3 | SPARE |
| 4 | SPARE |
| 1X2 | |
| 1 | 2C11 CT CORE 1 |
| 2 | 2C70 CT CORE 1 |
| 3 | ELK |
| 4 | 2C111 CT CORE 2 |
| 5 | 2C170 CT CORE 2 |
| 6 | ELK |
| 7 | 2D170 CT CORE 3 |
| 8 | 2D170 CT CORE 3 |
| 9 | ELK |
| 10 | SPARE |
| 11 | SPARE |
| 12 | 2E11 VT (L) |
| 13 | 2E11 VT (L) |
| 14 | 2E70 VT (N) |
| 15 | 2E70 VT (N) |
| 16 | SPARE |
| 17 | SPARE |

| X6 | DESTINATION/FUNCTION |
|---|---|
| 1 | H1 230V AC (L) |
| 2 | H2 230V AC (N) |
| 3 | H3 CCT 1 CB 230V AC (L) |
| 4 | H4 CCT 1 CB 230V AC (N) |
| 5 | H3 CCT 2 CB 230V AC (L) |
| 6 | H4 CCT 2 CB 230V AC (N) |
| 7 | SPARE |
| 8 | SPARE |



NOTE: ELK AND X5 (SUPERVISORY) TERMINALS TO BE ALSTOM DISCONNNECT TYPE KULTD6
ALL OTHER TERMINALS TO BE ALSTOM KULT1

| REVISION | DESCRIPTION | DRAWN | APP'D | DATE | REVISION | DESCRIPTION | DRAWN | APP'D | DATE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Second submission | DS | .. | 03/03/15 | | | | | |

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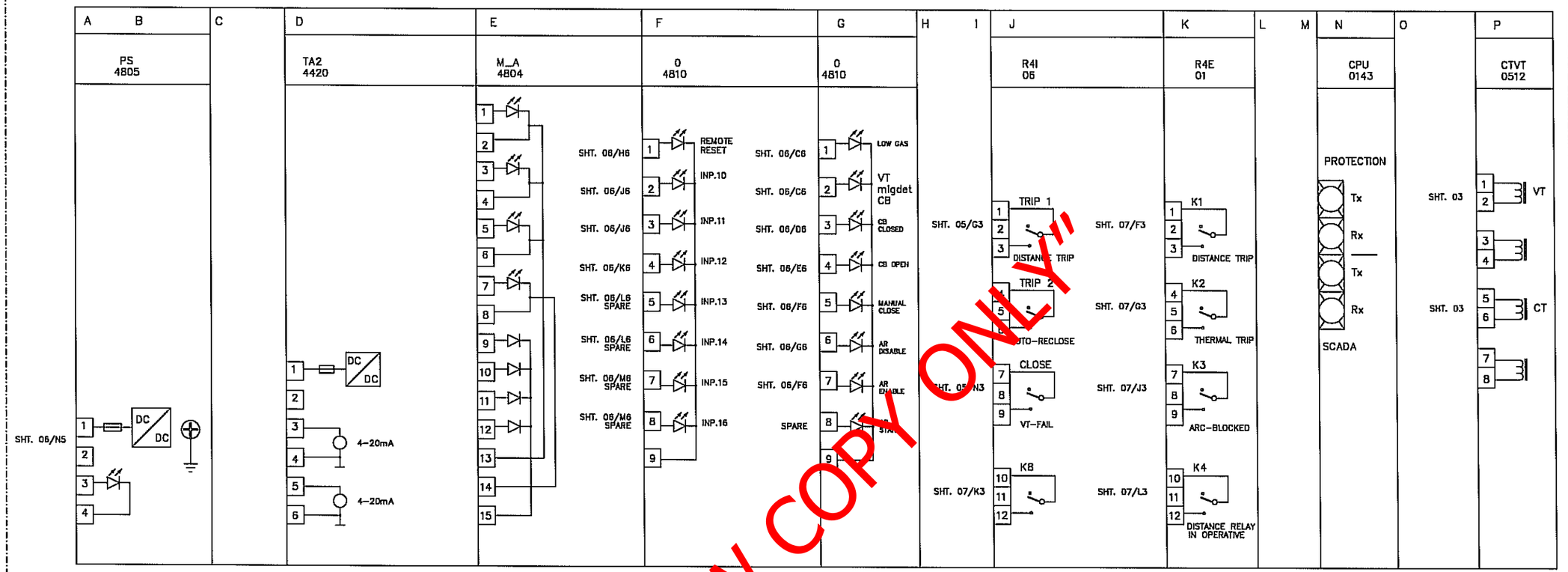
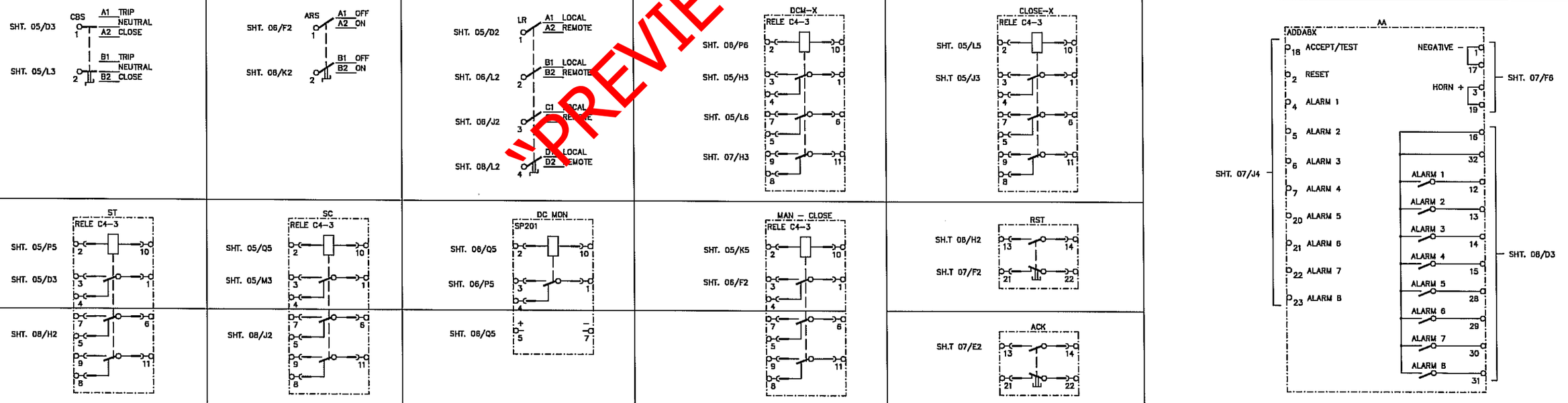
CUSTOMER: SPOORNET
CONTRACT: ..
DRN DS DATE 12/02/15
CHD VD DATE 24/03/15
APP'D DATE 25/03/15
PROJN
SCALE DO NOT SCALE
TITLE: TRACTION SUBSTATION 25kV DUAL TRACK FEEDER PROTECTION TERMINAL LAYOUT
CAD REF. 5068_01_09
SHEET: 09 NEXT: 10
DRG. NO. A1SE5068PM1ES009
A1

0 10 20 30 40 50 100 150 200

21-DIST

DRFP-EP






| REVISION | DESCRIPTION | DRAWN | APP'D | DATE | REVISION | DESCRIPTION | DRAWN | APP'D | DATE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Second submission | DS | .. | 03/03/15 | | | | | |

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| | | | | |
|---|---|---|---|---|
| CUSTOMER: SPOORNET | | | CONTRACT: .. | |
| DRN DS | DATE 12/02/15 | TITLE: TRACTION SUBSTATION 25kV TRACK FEEDER PROTECTION REFERENCE SHEET | | |
| CHD VD | DATE 24/03/15 | | | |
| APP'D | DATE 24/3/15 | | | |
| PROJN | SCALE DO NOT SCALE | | | |
| CAD REF. 5068_01-01 | SHEET: 10 NEXT: — | DRG. NO. A3SE5068PM1ES001 | | A1 |

0 10 20 30 40 50 100 150 200