

Project Name : Transnet Saldanha NMD
Upgrade - New Ystervark S/S

Project ID : 153272156

Job Name : Iscor 66 kV Breakers &
Protection Upgrade

Job ID : 153272156-00004

Final Design Package: Book 1



Prepared for
TRANSNET GROUP CAPITAL

Prepared by
Colin Pym

In association with
Johann Wolmarans & Danus Dippenaar

2022-11-02


© AECOM

The information contained in this document is solely for the use of the client identified on the cover sheet, and for the purposes specified herein. AECOM accepts no responsibility and undertakes no duty to any third party who may rely on this document.

All rights reserved. No section or element of this document may be removed from this document, reproduced, electronically stored, or transmitted in any form without the written permission of AECOM.

AECOM **AGILITY**
CLIENTS
EMPLOYEES
EXCELLENCE
INNOVATION
INTEGRITY
PROFITABLE
GROWTH
SAFETY

Quality Information

| | | | |
|-----------------|--|---|------------------------------------|
| Document | Final Design Package: Iscor 66 kV Breakers & Protection Upgrade - Book 1 | | |
| Ref | Eskom Job Number: 153272156-00004 | Date | 2022-11-02 |
| Prepared by | Colin Pym | Reviewed by | Johann Wolmarans & Danus Dippenaar |
| Document Number | 1924701-2-300-E-RPT-0007 |  Wolmarans, Johann J. <small>Digitally signed by Johann J. Wolmarans, DN: cn=Johann J. Wolmarans, o=AECOM, email=Johann.J.Wolmarans@aecom.com, c=ZA</small> | |


ISSUED FOR USE

Revision History

Authorized  Pym, Colin
 2022.11.02
 15:04:42
 +02'00'

| Revision | Revision Date | Details | Name/Position | Signature | Date |
|------------------------|---------------|----------------|---------------|-----------|------|
| Addendum No. 01 Rev 02 | 2022-11-02 | Issued for Use | Colin Pym | | |

**Additional Signatories
 for Transnet SOC Ltd**

Authorized  02/11/2022

| Revision | Revision Date | Details | Name/Position | Signature | Date |
|------------------------|---------------|----------------|--|-----------|------|
| Addendum No. 01 Rev 02 | 2022-11-02 | Issued for Use | Richard Shandu (Transnet Group Capital) | | |

Authorized

| Revision | Revision Date | Details | Name/Position | Signature | Date |
|------------------------|---------------|----------------|---|-----------|------|
| Addendum No. 01 Rev 02 | 2022-11-02 | Issued for Use | Tonny Mhondiwa (Transnet Port Terminals) | | |

Authorized

| Revision | Revision Date | Details | Name/Position | Signature | Date |
|------------------------|---------------|----------------|---|-----------|------|
| Addendum No. 01 Rev 02 | 2022-11-02 | Issued for Use | Jabulani Nkanyani (Transnet National Ports Authority) | | |

Table of Contents

| | | |
|------|---|----|
| 1. | ABBREVIATIONS | 1 |
| 2. | VOLUME 3 DOCUMENTATION CHECKLIST | 5 |
| 3. | TECHNICAL TEAM | 8 |
| 4. | ASSUMPTIONS, AGREEMENTS, ACCEPTANCES AND ADDITIONAL NOTES.... | 10 |
| 5. | PROJECT DETAILS..... | 11 |
| 5.1. | INTRODUCTION | 11 |
| 5.2. | SCOPE OF WORKS..... | 13 |
| 5.3. | SITE/ENVIRONMENTAL CONDITIONS..... | 14 |
| 5.4. | CREDIT BILL OF MATERIAL | 15 |
| 5.5. | EXISTING NETWORK CONFIGURATION | 16 |
| 5.6. | PROPOSED NETWORK CONFIGURATION..... | 20 |
| 6. | CIVIL | 22 |
| 6.1. | OVERVIEW | 22 |
| 6.2. | SPECIFICATION | 22 |
| 6.3. | FINAL BILL OF MATERIALS..... | 24 |
| 6.4. | FINAL BILL OF QUANTITIES | 25 |
| 6.5. | DETAILED DRAWINGS | 26 |
| 7. | STRUCTURAL | 27 |
| 7.1. | OVERVIEW | 27 |
| 7.2. | SPECIFICATIONS..... | 27 |
| 7.3. | FINAL BILL OF QUANTITIES | 29 |
| 8. | ARCHITECTURAL | 30 |
| 9. | POWER PLANT | 31 |
| 9.1. | OVERVIEW | 31 |
| 9.2. | SPECIFICATION | 32 |
| 9.3. | LONG LEAD TIME BILL OF MATERIALS | 35 |
| 9.4. | FINAL BILL OF MATERIALS..... | 36 |

| | | |
|--------------|--|-----------|
| 9.5. | DETAILED DRAWINGS | 39 |
| 9.6. | NON-STANDARD MATERIAL SPECIFICATIONS | 40 |
| 10. | CONTROL PLANT | 41 |
| 10.1. | OVERVIEW | 41 |
| 10.2. | SPECIFICATION | 41 |
| 10.3. | LONG LEAD TIME BILL OF MATERIALS | 46 |
| 10.4. | FINAL BILL OF MATERIALS..... | 47 |
| 10.5. | LABEL SCHEDULE | 48 |
| 10.6. | DETAILED DRAWINGS | 49 |
| 10.7. | NON-STANDARD MATERIAL SPECIFICATIONS..... | 50 |
| 11. | EXECUTION PLAN AND TEMPORARY ARRANGEMENTS | 51 |
| 11.1. | CONSTRUCTABILITY PLAN | 51 |
| 11.2. | TEMPORARY ARRANGEMENTS..... | 53 |
| 11.3. | SPECIFICATION | 54 |
| 11.4. | BILL OF MATERIALS | 55 |
| 11.5. | BILL OF QUANTITIES | 56 |
| 11.6. | DETAILED DRAWINGS | 57 |
| 11.7. | NON-STANDARD MATERIAL SPECIFICATIONS..... | 58 |
| 12. | HV LINES | 59 |
| 13. | MV LINES..... | 60 |

1. Abbreviations

The abbreviations as listed in [Table 1](#) below shall be applicable throughout this document.

Table 1 – Table of Abbreviations

| Abbreviation | Meaning Given to the Abbreviation |
|--------------|--|
| A | Ampere |
| AAC | All Aluminium Conductor |
| AASHTO | American Association of State Highway and Transportation Officials |
| AC | Alternating Current |
| ACSR | Aluminium Conductor Steel Reinforced |
| ADSS | All-dielectric Self-supporting |
| Al | Aluminium |
| AMSL | Above Mean Sea Level |
| BIL | Basic Insulation Level |
| BoM | Bill of Materials |
| BoQ | Bill of Quantities |
| BTU | Battery Terminal Unit |
| CD | Compact Disc |
| CT | Current Transformers |
| Cu | Copper |
| dB | Decibel |
| DB | Distribution Board |
| DC | Direct Current |
| DCI | Direct Current Isolator Switch |
| DP MCB | Double Pole Miniature Circuit Breaker |
| DTF | Distance to Fault |
| DT | Definite Time |
| E/F | Earth Fault |
| FDP | Final Design Package |
| FO | Fibre Optic |
| ECSA | Engineering Council of South Africa |

| Abbreviation | Meaning Given to the Abbreviation |
|--------------|--|
| ENC | Eskom National Contract |
| GPR | Ground Potential Rise |
| GPS | Global Positioning System |
| HD | High Density |
| Hz | Hertz |
| HV | High Voltage |
| ICEW | Insulated Copper Earth Wire |
| ICT | Information and Communication Technology |
| IDMT | Inverse Definite Minimum Time |
| IEC | Independent Electrotechnical Commission |
| IED | Intelligent Electronic Device |
| IEEE | Institute of Electrical and Electronic Engineers |
| In | Nominal Current Rating |
| I/O | Input - Output |
| IP | Ingress Protection |
| IP | Internet Protocol |
| IR | Infra-Red |
| ISO | International Standards Organisation |
| JB | Junction Box |
| kA | Kilo Ampere |
| K | Kelvin |
| kVA | Kilo Volt Ampere |
| kV | Kilo Volt |
| LAN | Local Area Network |
| LAP | List of Accepted Products |
| LC | Lucent Connector |
| LCD | Liquid Crystal Display |
| LED | Light Emitting Diode |
| LOR | Local/Off/Remote Switch |
| LPL | Lightning Protection Level |

| Abbreviation | Meaning Given to the Abbreviation |
|--------------|--|
| LV | Low Voltage |
| MCB | Miniature Circuit Breaker |
| mm | Millimetre |
| ms | Milliseconds |
| MS | Microsoft |
| MTTR | Mean Time To Repair |
| MV | Medium Voltage |
| MVA | Mega Volt Ampere |
| MW | Mega Watt |
| Native | Original electronic file format of documentation |
| NC | Normally Closed |
| NMD | Notified Maximum Demand |
| NO | Normally Open |
| OEM | Original Equipment Manufacturer |
| O/C | Overcurrent |
| OHL | Overhead Line |
| OHS | Occupational Health and Safety |
| O&M | Operating and Maintenance |
| OPGW | Optical Ground Wire |
| °C | Degree Celsius |
| PC | Personal Computer |
| pC | Pico Coulomb |
| PCD | Pitch Circle Diameter |
| PFC | Power Factor Correction |
| PPS | Pulse Per Second |
| PTP | Precision Timing Protocol |
| p.u. | Per Unit |
| PVC | Polyvinyl Chloride |
| QA | Quality Assurance |
| QoS | Quality of Supply |

| Abbreviation | Meaning Given to the Abbreviation |
|-----------------|--|
| RE/F | Restricted Earth Fault |
| RIO | Remote Input Output device |
| r.m.s | Root Mean Square |
| RTC | Real Time Clock |
| s | seconds |
| SA | Surge Arrester |
| SABS | South African Bureau of Standards |
| SANS | South African National Standards |
| SAT | Site Acceptance Tests |
| SED | Station Electric Diagram |
| SEF | Sensitive Earth Fault |
| SF ₆ | Sulphur Hexafluoride |
| SHE | Safety, Health and Environment |
| SHEQ | Safety, Health and Environment and Quality |
| SLD | Single Line Diagram |
| SOC | State Owned Company |
| SWA | Steel Wire Armour |
| TEF | Technical Evaluation Forum |
| USB | Universal Serial Bus |
| uPVC | Unplasticized Polyvinyl Chloride |
| UV | Ultra-violet |
| V | Volt |
| VA | Volt Ampere |
| VT | Voltage Transformer |
| W | Watt |
| kWhr | Kilowatt Hours |
| XLPE | Cross Linked Polyethylene |

2. Volume 3 Documentation Checklist

The Eskom standard Substation FDP template was used for the order creation of this document, with certain alterations made to the layout to suit the FDP application where applicable. The checklist below is the aforementioned template in order to confirm the information included, and those not included due to applicability.

BOOK 1

| Item | Description | Applicable and Included | Not Applicable |
|------|--|-------------------------|----------------|
| 1. | Technical Team | ✓ | |
| 2. | Additional Notes | ✓ | |
| 3. | Scope of Works | ✓ | |
| 4. | Execution Plan | ✓ | |
| 5. | Credit Bill of Materials | | ✓ |
| 6. | Existing Network Diagram | ✓ | |
| 7. | Proposed Network Diagram | ✓ | |
| 8. | Civil: <i>Specifications</i> | | ✓ |
| 9. | Geotechnical Report | | ✓ |
| 10. | Civil: <i>Bill of Schedules</i> | | ✓ |
| 11. | Civil: <i>Detailed Drawings</i> | | ✓ |
| 12. | Architectural: <i>Specifications</i> | | ✓ |
| 13. | Architectural: <i>Detailed Drawings</i> | | ✓ |
| 14. | Power Plant: <i>Specifications</i> | ✓ | |
| 15. | Power Plant: <i>Long Lead Time Bill of Materials</i> | ✓ | |
| 16. | Power Plant: <i>Final Bill of Materials</i> | ✓ | |
| 17. | Power Plant: <i>Final Bill of Quantities</i> | ✓ | |
| 18. | Power Plant: <i>Label Schedule</i> | ✓ | |

| Item | Description | Applicable and Included | Not Applicable |
|------|--|-------------------------|----------------|
| 19. | Power Plant: <i>Detailed Drawings</i> | ✓ | |
| 20. | Power Plant: <i>Non Standard Material Specifications</i> | | ✓ |
| 21. | Control Plant: <i>Specifications</i> | ✓ | |
| 22. | Control Plant: <i>Long Lead Time Bill of Materials</i> | | ✓ |
| 23. | Control Plant: <i>Final Bill of Materials</i> | ✓ | |
| 24. | Control Plant: <i>Final Bill of Quantities</i> | ✓ | |
| 25. | Control Plant: <i>Detailed Drawings</i> | ✓ | |
| 26. | Control Plant: <i>Non Standard Material Specifications</i> | | ✓ |
| 27. | Execution Plan and Temporary Arrangements: <i>Specifications</i> | | ✓ |
| 28. | Execution Plan and Temporary Arrangements: <i>Bill of Materials</i> | | ✓ |
| 29. | Execution Plan and Temporary Arrangements: <i>Bill of Quantities</i> | | ✓ |
| 30. | Execution Plan and Temporary Arrangements: <i>Detailed Drawings</i> | | ✓ |
| 31. | Execution Plan and Temporary Arrangements: <i>Non Standard Material Specifications</i> | | ✓ |
| 32. | HV Lines: <i>Design Philosophy</i> | | ✓ |
| 33. | HV Lines: <i>Templated Profile</i> | | ✓ |
| 34. | HV Lines: <i>Staking Table</i> | | ✓ |
| 35. | HV Lines: <i>Bill of Materials and Quantities</i> | | ✓ |
| 36. | HV Lines: <i>Structure Drawings</i> | | ✓ |
| 37. | HV Lines: <i>Hardware Assembly Drawings</i> | | ✓ |
| 38. | HV Lines: <i>Foundations</i> | | ✓ |
| 39. | HV Lines: <i>Stringing Charts</i> | | ✓ |

| Item | Description | Applicable and Included | Not Applicable |
|------|---|-------------------------|----------------|
| 40. | HV Lines: <i>Buy Out Specification</i> | | ✓ |
| 41. | HV Lines: <i>Construction Checklist</i> | | ✓ |
| 42. | MV Lines: <i>Specifications</i> | | ✓ |
| 43. | MV Lines: <i>Network Overview</i> | | ✓ |
| 44. | MV Lines: <i>Bill of Materials</i> | | ✓ |
| 45. | MV Lines: <i>Bill of Quantities</i> | | ✓ |
| 46. | MV Lines: <i>Structural Drawings</i> | | ✓ |
| 47. | MV Lines: <i>Sag & Tension Tables</i> | | ✓ |

3. Technical Team

ESKOM

| | Name | Telephone |
|----------------------------------|--|--------------|
| Project Initiator: | Sicelo Ngxonono | 021 980 3445 |
| Project Engineer: | Garth van Heerden | 021 980 3369 |
| Project Co-ordinator: | Aldrey Africa | 021 980 3688 |
| Programme Manager: | Shamiel Jacobs | 021 983 3472 |
| Electricity Delivery: | Llewellyn Floris | |
| Field Services: | Beryl Swano Ryan Ali | |
| Plant: | Laurence Myburgh Hennie Mostert (Area Plant Engineer if not Initiator) | |
| Project Engineering: | Nicolaas Mostert | |
| Land Development: | Owen Peters Justine Wyngaardt | |
| MEW | Marlyn Hendriks | |
| Network Operations: | Nwabisa Mjoli Elsje Basson | |
| Network Planning: | Ahilan Kailasanathan | |
| Technology & Quality: | TBC | |

Control Plant Key Role Players

| Name | Discipline |
|-------------------------|-----------------------|
| Llewellyn Floris | Protection |
| Christine Van Schalkwyk | DC |
| Juan Atkinson | Metering |
| Juan Atkinson | Security |
| Tertius Hyman | Substation Automation |
| Gregory Pieterse | Tele-control |
| Zeyaad Pandey | Telecomms |

AECOM

| | Name | Telephone |
|---|---------------------|------------------|
| Project Manager: | Werner Schneeberger | 012 421 3500 |
| Practice Area Lead (Electrical): | Colin Pym | 021 950 7500 |
| Lead Project Engineer: | Colin Pym | 021 950 7500 |
| Electrical Engineer: | Danus Dippenaar | 021 950 7500 |
| Practice Area Lead (Structural): | Schalk Marais | 021 950 7500 |
| Structural Engineer: | Claire Kleynhans | 021 950 7500 |
| Civil Engineer (Associate): | Francois Ricketts | 021 950 7500 |
| Civil Engineer: | Jochem van Bruggen | 021 950 7500 |
| Document Controls Lead: | Carline Pienaar | 021 950 7500 |

TRANSNET

| | Name | Telephone |
|------------------------------------|-----------------------|------------------|
| Senior Project Manager: | Lehlohonolo Tsotetsi | 022 703 2470 |
| Engineering Manager: | Richard Shandu | 083 242 7546 |
| Senior Electrical Engineer: | Bonga Ntshangase | 078 861 6686 |
| Document Controls Lead: | Adrian Ford | 022 703 2460 |
| Document Controller: | Rolivhuwa Nematikonde | 022 703 2460 |

4. Assumptions, Agreements, Acceptances and Additional Notes

The current EA & EMPr do not cover the scope of works as defined in this document, due to the fact that the study was conducted prior to TEF approval for these works. At present the process is underway to amend the EA & EMPr respectively.

Design verification of the works for environmental compliance, including the commencing of construction thereof, is subject to the finalisation & conditions of the amended EA & EMPr.

5. Project Details

5.1. Introduction

Transnet SOC Ltd is undertaking a major programme of projects in Cape Town, Saldanha and Postmasburg to upgrade and expand the capacity of their infrastructure, as part of their Market Demand Strategy.

The purpose of the Tippler 3 project at the Port of Saldanha is to sustain the materials handling capacity at the Port of Saldanha by the addition of a third tippler. As part of the Tippler 3 project, new bulk electrical supply infrastructure is to be provided to increase the capacity of the existing power supply to meet current and future demands at the Port of Saldanha.

In order to facilitate the abovementioned increase in capacity, there is a requirement for the provision of new infrastructure for Eskom, including upgrades & modifications to their existing 66 kV supply network in the region. The works has been registered with Eskom as a self-build project and subdivided into four jobs respectively, which are as follows:

| <u>Project Name</u> | <u>Project ID</u> |
|---|-------------------|
| Transnet Saldanha NMD Upgrade - New Ystervark S/S | 153272156 |
| <u>Job Name</u> | <u>Job ID</u> |
| Ystervark Branch Lines - Iscor/Blouwater 66 kV Lines | 153272156-00001 |
| Blouwater Substation - Ystervark Feeder Control Plant | 153272156-00002 |
| Ystervark 66 - 132 kV Substation | 153272156-00003 |
| Iskor 66 kV Breakers & Protection Upgrade | 153272156-00004 |

This addendum to the final design package covers the design principles and approach for the supply and installation of new, including associated protection upgrades, voltage transformers at Iscor 66/11 kV Substation.

This document must be read in conjunction with the other abovementioned projects' FDPs. ***Each FDP document consists of three books respectively.***

Figure 1 overleaf depicts the location of Iscor Substation.



Figure 1 - Iscor Substation Location

5.2. Scope of Works

This Addendum must be read in conjunction with Rev 01, dated 2020-04-24, being the approved Final Design Package, which details the extent of the complete works associated with this work package. This addendum only defines the additional works introduced after production and approval of the initial issue, and furthermore only details the repositioning of the voltage transformers within the existing HV yard which was addressed in Addendum No.1, Rev 01. The scope of works associated with the installation of the 2 x 66 kV circuit breakers remains unchanged and must be implemented in accordance with the approved FDP.

Iscor Substation is fed via two 66 kV overhead lines from Blouwater Substation. Due to the tie-in of the new Ystervark 66 - 132 kV Substation onto the existing Blouwater-Iscor 66 kV overhead lines immediately before Iscor Substation, it will necessitate amongst other works, the following:

- New 4FZD3920 protection schemes, equipped with 3 terminal differential protections, all associated interface wiring and commissioning.
- Installation 6 x 66 kV voltage transformers (VTs) in the existing transformer-feeder bays.
- Installation of new 6 x 2.5 m medium voltage steel supports.
- Construction of 6 x new support structure foundations.
- Installation of VT junction boxes.
- VTs must be connected to the existing 66 kV OHL gantry stringers using Chicadee conductor jumpers, with new clamps to suit terminal connection.
- Labels for the new equipment.

5.3. Site/Environmental Conditions

Refer to Rev 01 of the Approved FDP

5.4. Credit Bill of Material

NOT APPLICABLE

5.5. Existing Network Configuration

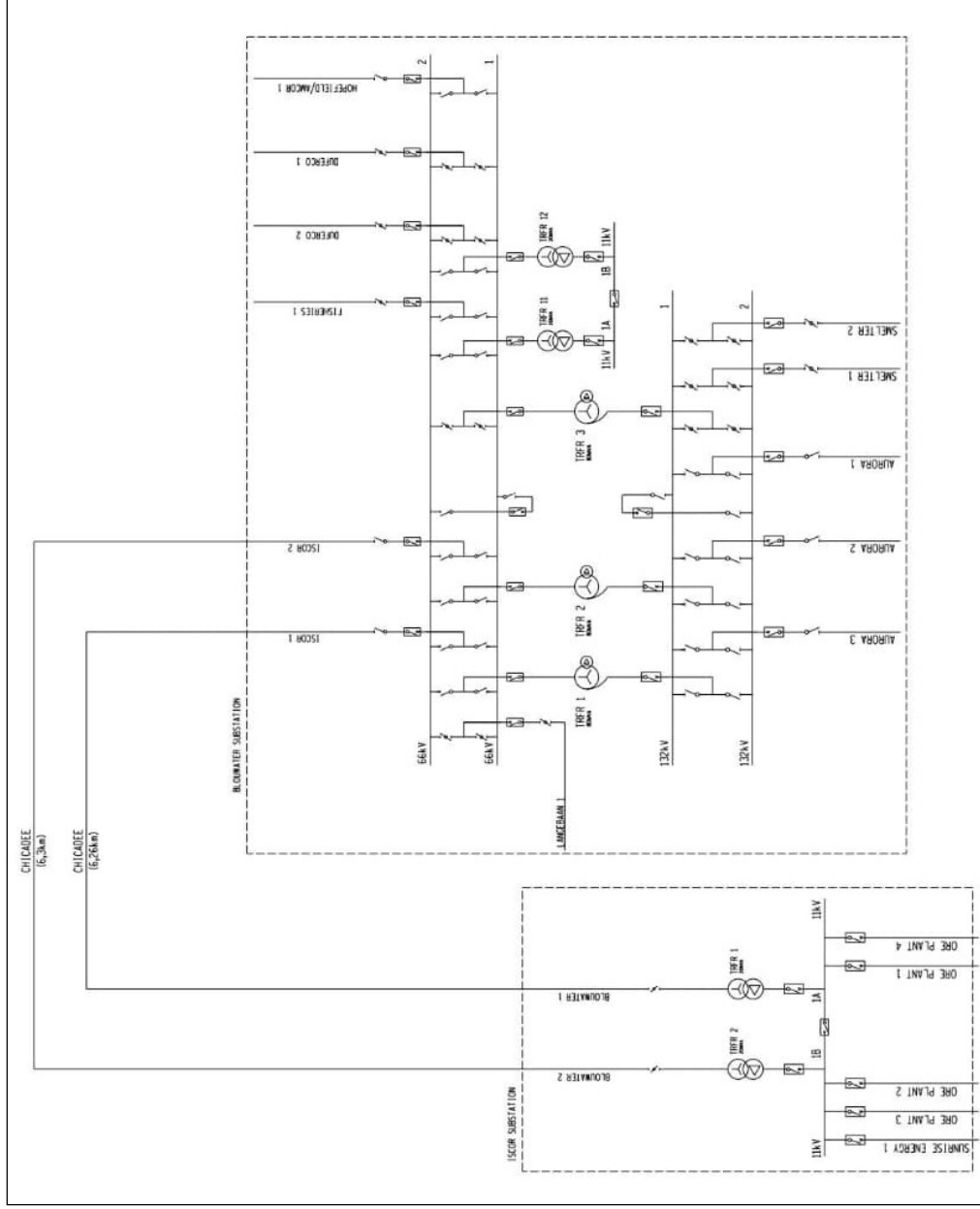


Figure 2 - Existing Electrical Network Configuration - Blowerwater to Iscor Substation

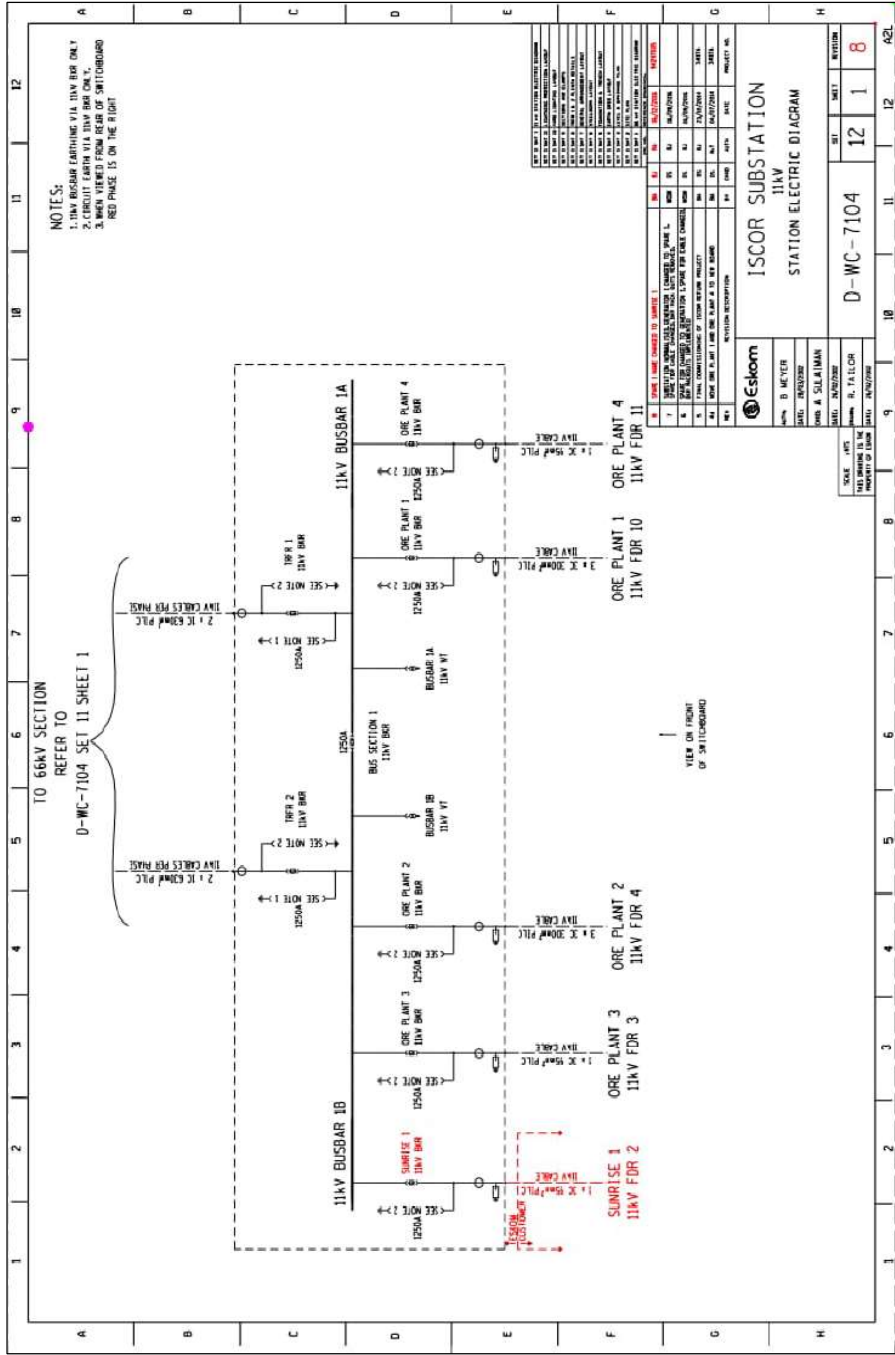


Figure 3 – SED: Iscor 66/11 kV Substation (Existing)

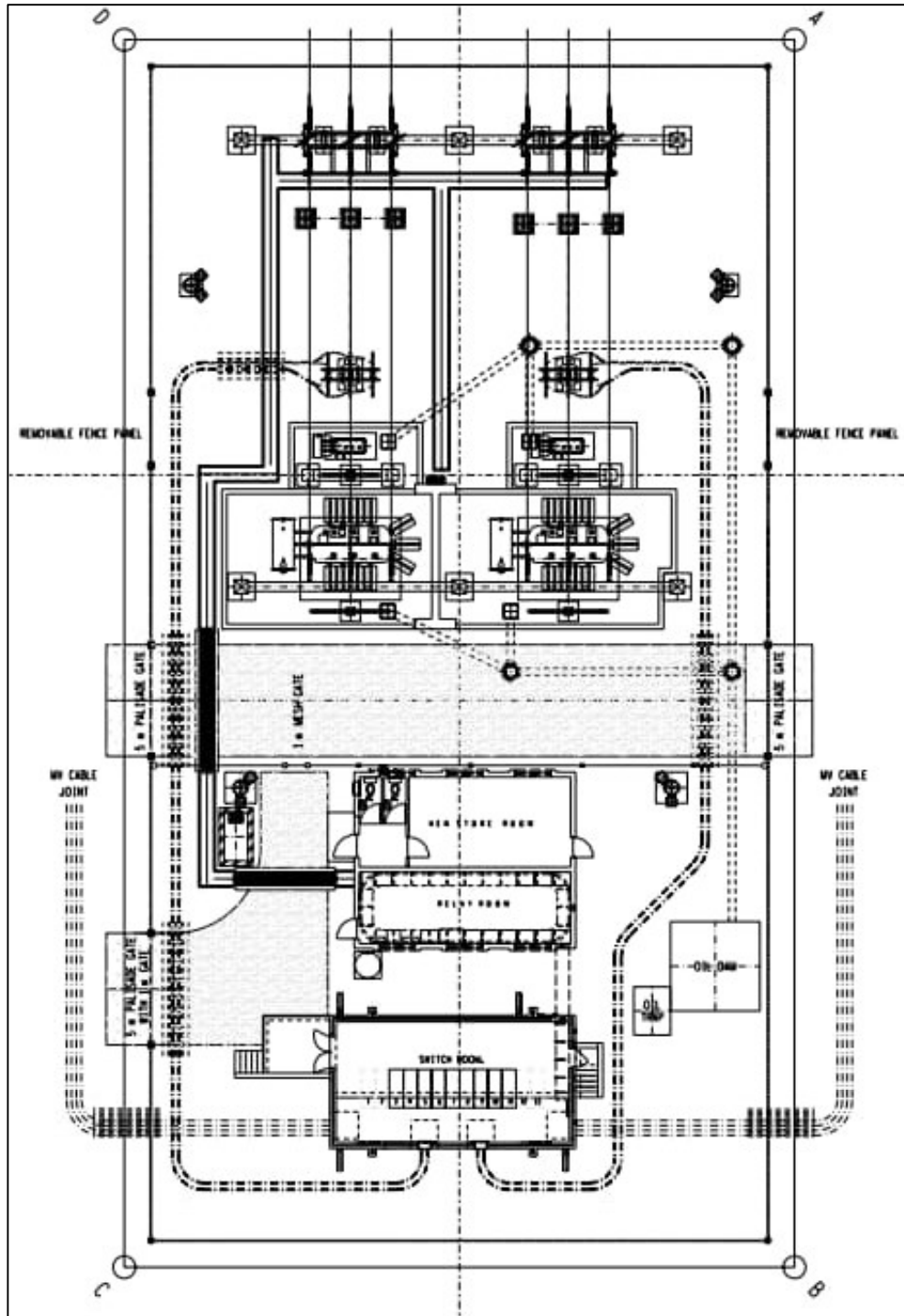


Figure 4 - Layout - Iscor 66/11 kV Substation (Existing)

5.5.1. Existing ISCOR SS Design & Operating Philosophy

The existing bulk electrical supply to the Port of Saldanha is fed from Iscor 66/11 kV Substation. This Substation includes 2 x 20 MVA transformers, which in turn is fed by 2 x single-circuit 66 kV overhead lines from Blouwatter Substation, with each line terminating separately onto the transformers. There is no busbar interconnecting the incoming feeds with the transformers. The current firm capacity of the Substation is 20 MVA, equating to the rating of a single transformer.

On the 11 kV side the network consists of indoor type switchgear inside the control building, which supplies the Port's existing main supply Substations, Substations A and H, with an allocated 20 MVA NMD to Sub A and 5 MVA NMD to Sub H respectively, providing a total allocated NMD of 25 MVA to the Port. All 11 kV indoor switchgear panels within the Iscor Substation are fully allocated with no available spare panels to provide the additional loads required at the Port, including Tippler 3. There is also no space within the control building to add new switchgear.

The maximum power rating of the 11 kV switchgear is 1250 A, ie, 23.8 MVA, which is the ultimate final maximum load that Iscor Substation can supply. Adding new switchgear will thus not resolve the upper limit of power supply, hence the required disconnection and removal of the 4 x 11 kV feeds supplying the Port.

5.6. Proposed Network Configuration

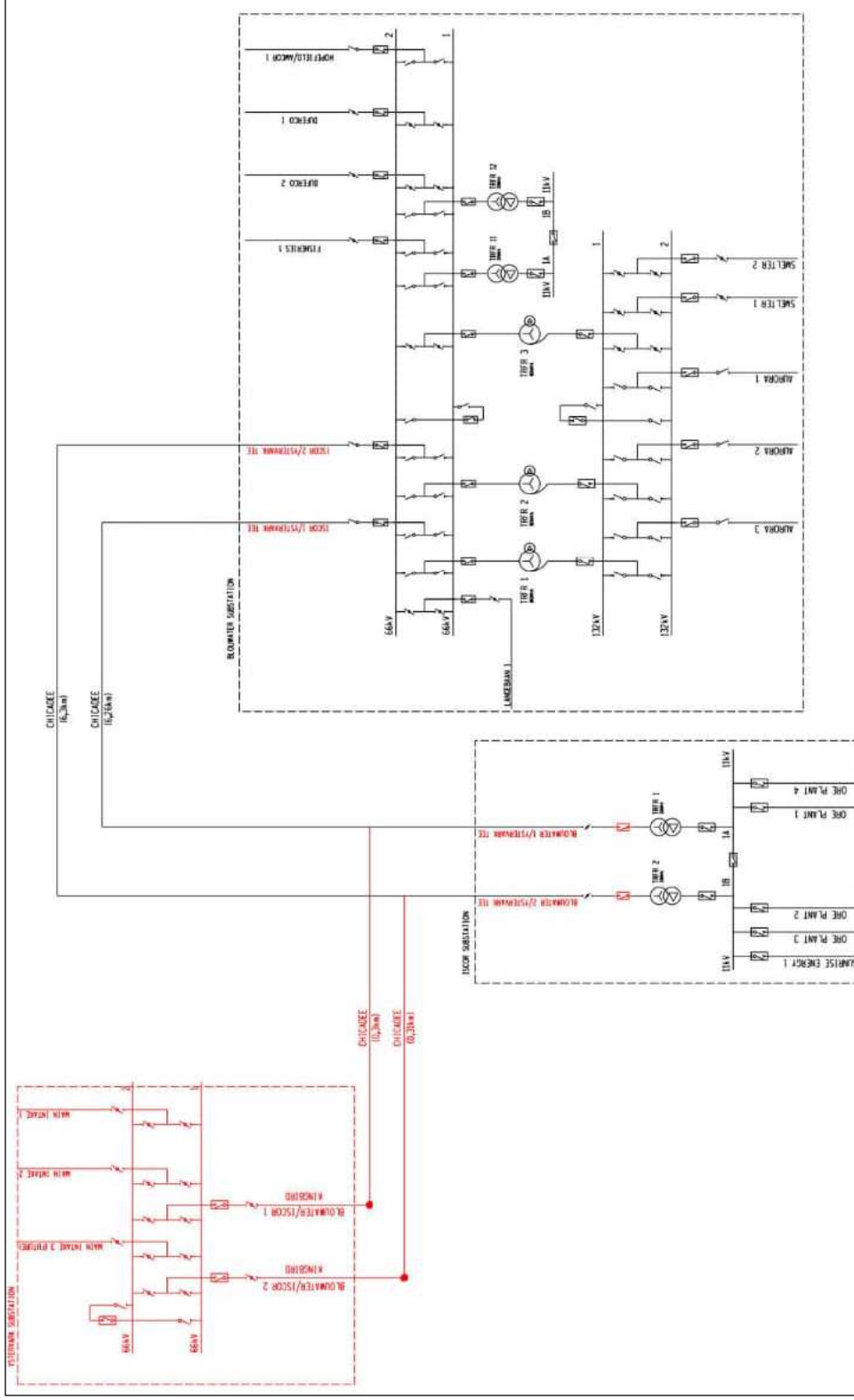


Figure 5 - Proposed New Electrical Network Configuration - Blouwater to Iscor/Ystervark Substations

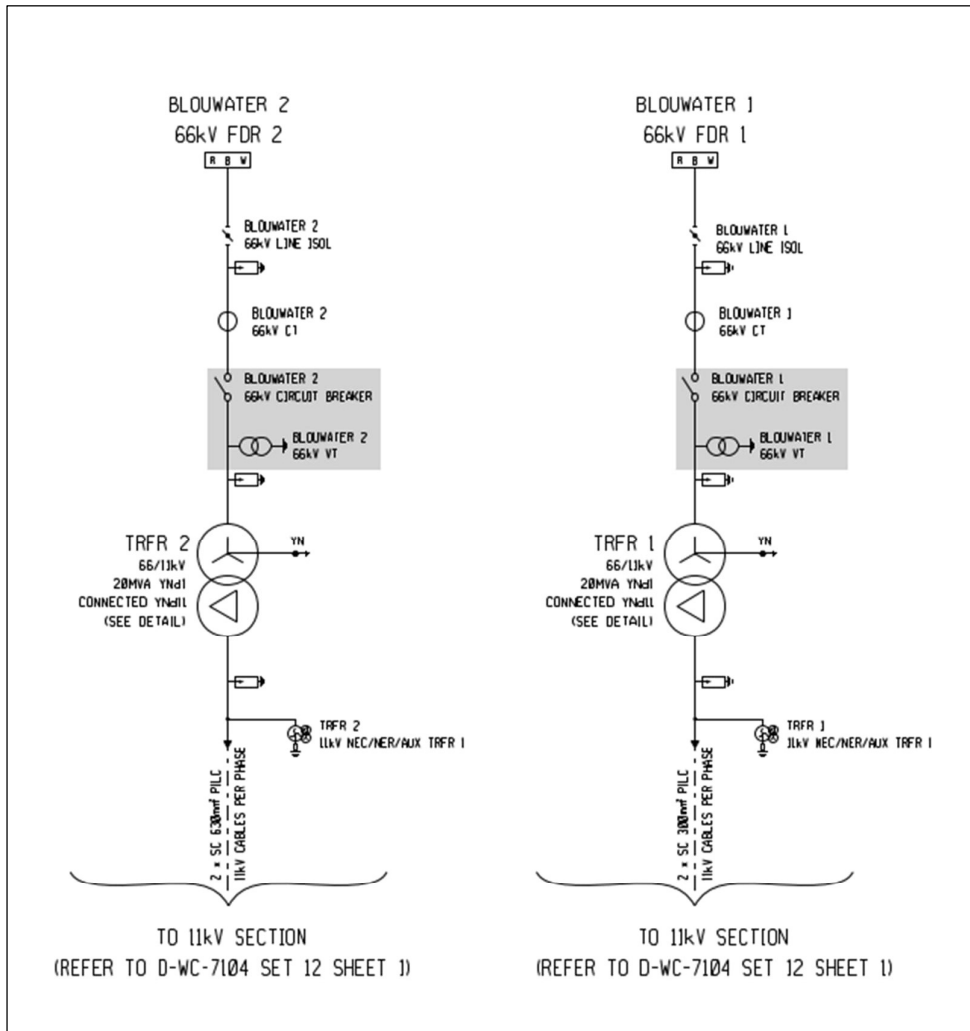


Figure 6 - SED - Iscor 66 kV Substation

6. Civil

6.1. Overview

The civil works to be undertaken at Iscor Substation will include, but not necessarily be limited to the following:

- Backfilling and compaction of the voltage transformers control cable.

6.2. Specification

6.2.1. Excavations & Backfilling

All excavations and backfilling shall be done in accordance with SANS 1200 D. The removed soil shall be re-used for backfilling, whereas all excess materials shall be disposed of at a designated stockpile area as instructed by Transnet. Backfilled soil shall be compacted to 93 % MOD AASHTO, in layers no thicker than 150 mm.

The existing 37.5 mm, 100 mm layer yard stone shall be reinstated from the point of installation of the VT's to the cable trenches, once the compaction of the soil has been completed.

Prior to the commencement of any excavation within the HV yard, the Contractor shall undertake a ground penetrating radar (GPR) scan of the area to establish the routing of any existing control (copper and/or fibre) and/or power cables which may route through the proposed area for installation of the new 2 x 66 kV CBs and 6 x 66 kV VTs.

The scanning shall cover the area as per [Figure 7](#), extending between the existing 66 kV CTs and 11 kV outdoor cable terminations.

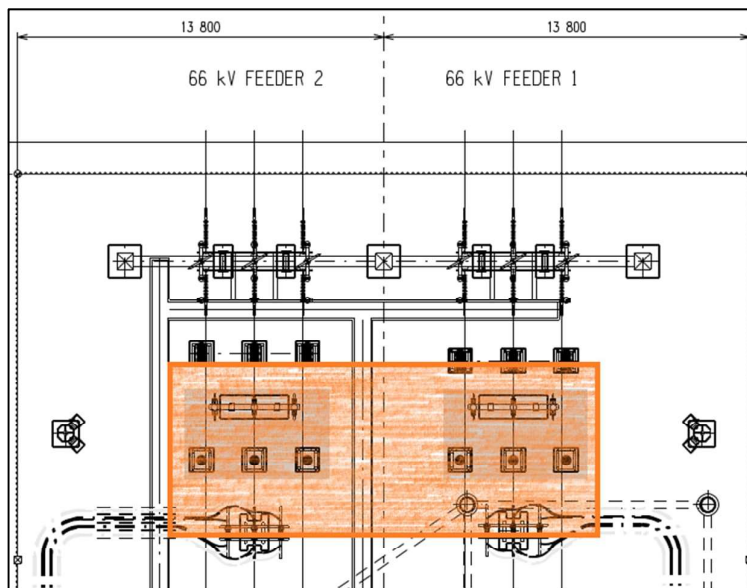


Figure 7 – GPR Scanning Area

No geotechnical study has been conducted inside Iscor Substation, as it is accepted that the existing Substation's platform will be able to cater sufficiently for the loadings of the new 66 kV voltage transformers – Refer further to Rev 01 of the Approved FDP.

6.2.2. Substation Access

The Iscor Substation access does not form part of the scope of work for this project.


6.2.3. Fencing and Security

The Iscor Substation fencing and security do not form part of the scope of work for this project.


6.2.4. Trenching

Existing trenching shall be used for the 66 kV circuit breakers control circuitry.

6.3. Final Bill of Materials

| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | | |
|---|--|-----------|---|-------------|--|
| POWER PLANT | | | | | |
| JOB NAME | Job Name: Iscor 66 kV Breaker & Protection Upgrade | | WCOU_BOM-18-04 | REV : | Addendum |
| JOB NUMBER: | Job Number: 153272156-00004 | |  | | This document is the property of Eskom |
| BOM TYPE: | FINAL BOM & BOQ | | | | |
| PREPARED BY : | Colin Pym | | | | |
| Tel No | Tel: 021 950 7500 | | | | |
| DATE PREP. : | Tuesday, 17 May 2022 | | | | |
| Civil | | | | | |
| QTY | SAP | REFERENCE | Rev | DESCRIPTION | |
| EARTHING | | | | | |
| 1m³ | 0503015 | D-DT-5240 | Add | Yard Stone | Total meters squared (100mm layer): 9 m² |

6.4. Final Bill of Quantities

| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | | | | | | | | |
|---|---|------|------|--|----------|-------------------------------------|----------------|--|-------------|--------------|--------------|
| JOB NAME | | | | Job Name: Iscor 66 kV Breaker & Protection | | | | LASTEST REV: 2 | | | |
| JOB NUMBER: | | | | Job Number: 153272156-00004 | | | |  | | | |
| BOM TYPE: | | | | FINAL BOM & BOQ | | | | | | | |
| PREPARED BY: | | | | Colin Pym | | | | | | | |
| Tel No | | | | Tel: 021 950 7500 | | | | | | | |
| DATE PREP.: | | | | Monday, 31 October 2022 | | | | | | | |
| BILL OF QUANTITIES | | | | | | BASED ON MEW SUBSTATION BOQ rev. 11 | | | | | |
| CODE | DESCRIPTION | UNIT | QTY. | ADD. QTY. | B, P&G % | RATE (R) | LABOUR & PLANT | | | | POINTS TOTAL |
| | | | | | | | POINTS/UNIT | HOURS | TOTAL HOURS | TOTAL (R) | |
| POWER PLANT ACTIVITIES | | | | | | | | | | | |
| CIVIL ACTIVITIES | | | | | | | | | | | |
| | Excavation: | | | | | | | | | | |
| | Excavations soft | m³ | 7.8 | | 12.35 | 906.50 | 0.75 | 3.00 | | 23.40 | |
| | Backfill and compact | | | | | | | | | | |
| | Backfill and compact (Normal) | m³ | 0.0 | | 12.35 | 226.62 | 0.1075 | 0.75 | | 2.25 | |
| | Clearing of excess material to spoil | | | | | | | | | | |
| | Clearing of excess material to spoil | m³ | 7.8 | | 12.35 | 302.17 | 0.25 | 1.00 | | | |
| | Stoning yard 100mm thick | | | | | | | | | | |
| | Stoning yard 100mm thick | m² | 9 | | 12.35 | 33.24 | 0.0275 | 0.11 | | 0.99 | |
| | Other Miscellaneous Activities | | | | | | | | | | |
| | Clearing & Stockpiling of existing Yard Stone | m² | 84 | | | | | | | | |
| | Locating existing services in HV Yard | m² | 84 | | | | | | | | |
| SUBTOTAL (CIVIL PP ACTIVITIES) | | | | | | | | | | 26.64 | |

6.5. Detailed Drawings

NOT APPLICABLE

7. Structural

7.1. Overview

The structural works to be undertaken at Iscor Substation shall include, but not be limited to the following:

- Foundations for the new 6 x 66 kV voltage transformers
- Steel support structures for the 6 x 66 kV new voltage transformers

The voltage transformers will be installed on new 2.5 m high medium voltage steel supports as per D-DT-5206-2C, which shall in turn be mounted on new concrete foundations as per D-DT-5206-1A.

The existing 66 kV yard has space for installation of the VTs alongside the new 66 kV circuit breakers (installed as per original approved FDP) and as further depicted elsewhere in this document.

7.2. Specifications

7.2.1. Foundations

All new foundations will be installed in accordance with SANS 1200 and SANS 2001 - CC1 latest revision. The new foundation HD bolts will be aligned for casting of concrete to a tolerance of ± 2 mm. Foundation tolerances to be in accordance with SANS 1200 G.6 degree of accuracy (DOA).


All new foundations will have 25 mm grout under base-plates only with SikaGrout 212. All HD bolts will have two nuts and two washers. The grout will be a feather finish to allow water to run free from the base-plate.


7.2.2. Steelwork


All structural steelwork galvanizing shall be in accordance to SANS 121 ISO 1461 - Heavy duty (Coastal) and Eskom standard 240-75655504 - Corrosion Protection Specification for New Indoor and Outdoor Distribution Equipment, Components, Materials and Structures Manufactured from Steel.

All bolted connections will be cleaned and filled with jointing compound. No paint barrier allowed.


7.2.3. Final Bill of Materials

| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | | | | |
|---|--|--------------|-----|---|-------|--|---------|
| POWER PLANT | | | | | | | |
| JOB NAME: | Job Name: Isocr 66 kV Breaker & Protection Upgrade | | | WCOU_BOM-18-04 | REV : | 2 | |
| JOB NUMBER: | Job Number: 153272156-00004 | | |  | | This document is the property of Eskom | |
| BOM TYPE: | FINAL BOM & BOQ | | | | | | |
| PREPARED BY : | Colin Pym | | | | | | |
| Tel No | Tel: 021 950 7500 | | | | | | |
| DATE PREP. : | Monday, 31 October 2022 | | | | | | |
| CONCRETE WORKS | | | | | | | |
| QTY | SAP | REFERENCE | Rev | DESCRIPTION | | | |
| MAIN EQUIPMENT SUPPORT FOUNDATIONS | | | | | | | |
| 6 | | D-DT-5206-1A | 9 | Medium Equipment Support Foundation (Soil Type 1 & 2) | | | 0183872 |

| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | | | | |
|---|--|--------------|-----|---|--|--|-----------------|
| POWER PLANT | | | | | | | |
| JOB NAME: | Job Name: Isocr 66 kV Breaker & Protection Upgrade | | | WCOU_BOM-18-04 | REV : | 2 | |
| JOB NUMBER: | Job Number: 153272156-00004 | | |  | | This document is the property of Eskom | |
| BOM TYPE: | FINAL BOM & BOQ | | | | | | |
| PREPARED BY : | Colin Pym | | | | | | |
| Tel No | Tel: 021 950 7500 | | | | | | |
| DATE PREP. : | Monday, 31 October 2022 | | | | | | |
| STEELWORK | | | | | | | |
| QTY | SAP | REFERENCE | Rev | kV | DESCRIPTION | | |
| MAIN EQUIPMENT SUPPORTS | | | | | | | |
| 6 | 0102752 | D-DT-5206-2C | 9 | | Medium Equipment Support Steelwork(2.5m) | | 125 kg |
| | | | | | | Mass (kg) | Total Mass (kg) |
| | | | | | | | 750 kg |

| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | | | | |
|---|--|--------------|-----|---|-------|--|-------------|
| POWER PLANT | | | | | | | |
| JOB NAME: | Job Name: Isocr 66 kV Breaker & Protection Upgrade | | | WCOU_BOM-18-04 | REV : | 2 | |
| JOB NUMBER: | Job Number: 153272156-00004 | | |  | | This document is the property of Eskom | |
| BOM TYPE: | FINAL BOM & BOQ | | | | | | |
| PREPARED BY : | Colin Pym | | | | | | |
| Tel No | Tel: 021 950 7500 | | | | | | |
| DATE PREP. : | Monday, 31 October 2022 | | | | | | |
| HD BOLTS | | | | | | | |
| QTY | SAP | REFERENCE | Rev | DESCRIP | N | Lengt | Bolts / FND |
| HD BOLTS FOR STANDARD FOUNDATIONS | | | | | | | |
| 6 | | D-DT-5206-1A | 9 | Medium Equipment Support Foundation (Soil Type 1 & 2) | | MK 19 | 500 mm |
| | | | | | | | 4 |
| | | | | | | | M24 |

7.3. Final Bill of Quantities

| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | | | | | | | | |
|---|--|------|------|---|----------|----------|----------------|--|-------------|--------------|--------------|
| JOB NAME JOB NUMBER: BOM TYPE: PREPARED BY : Tel No DATE PREP. : | | | | Job Name: Isocr 66 kV Breaker & Protection Upgrade Job Number: 153272156-00004 FINAL BOM & BOQ Colin Pym Tel: 021 950 7500 Monday, 31 October 2022 | | | | LASTEST REV : 0  | | | |
| BILL OF QUANTITIES | | | | | | | | | | | |
| BASED ON MEW SUBSTATION BOQ rev. 11 | | | | | | | | | | | |
| CODE | DESCRIPTION | UNIT | QTY. | ADD. QTY. | B. P&G % | RATE (R) | LABOUR & PLANT | | | | |
| | | | | | | | POINTS/UNIT | HOURS | TOTAL HOURS | TOTAL (R) | POINTS TOTAL |
| POWER PLANT ACTIVITIES | | | | | | | | | | | |
| STRUCTURAL ACTIVITIES | | | | | | | | | | | |
| | Foundations | | | | | | | | | | |
| | Setting & Marking of foundations | each | 6 | | 12,35 | 226,62 | 0,1875 | 0,75 | 4,50 | | |
| | Concrete formwork | m² | 5 | | 12,35 | 302,17 | 0,25 | 1,00 | 5,40 | | |
| | Place concrete | m³ | 5 | | 12,35 | 453,25 | 0,375 | 1,50 | 8,10 | | |
| | Finishing: | | | | | | | | | | |
| | Finishing Foundation | each | 6 | | 12,35 | 75,54 | 0,0625 | 0,25 | 1,50 | | |
| | Layout of structures: | | | | | | | | | | |
| | Layout Structures - Lattice | ton | 0,75 | | 12,35 | 3021,65 | 2,5 | 10,00 | 7,50 | | |
| | Assemble Structures | | | | | | | | | | |
| | Assemble Structures - Lattice | ton | 0,75 | | 12,35 | 3021,65 | 2,5 | 10,00 | 7,50 | | |
| | Erect Structures | | | | | | | | | | |
| | Erect Structures | ton | 0,75 | | 12,35 | 3021,65 | 2,5 | 10,00 | 7,50 | | |
| | Finishing: | | | | | | | | | | |
| | Finishing Handing Over Documentation | stru | 6 | | 12,35 | 120,87 | 0,1 | 0,40 | 2,40 | | |
| | Finishing Torque nuts | each | 24 | | 12,35 | 24,17 | 0,02 | 0,08 | 1,92 | | |
| | SUBTOTAL (STRUCTURAL PP ACTIVITIES) | | | | | | | | | 46,32 | |

8. Architectural

NOT APPLICABLE

9. Power Plant

9.1. Overview

The existing Iscor Substation consists of two 66 kV feeder bays with two 66/11 kV 20 MVA transformers, which is fed from Blouwater Substation via the 66 kV Blouwater-Iskor overhead feeder lines (refer to **Figures 2 & 3** in Section 5.5).

Due to the tie-in of the new Ystervark 66 - 132 kV Substation onto the existing Blouwater-Iskor 66 kV overhead lines immediately before Iscor Substation, Iscor SS will necessitate the installation of, amongst other equipment, 6 x 66 kV voltage transformers (VTs).

The new 66 kV VTs will be installed on new medium voltage structures, installed after the 66 kV circuit breakers.

Figure 8 depicts in further detail the positions of the new 66 kV voltage transformers. It should be noted that label changes will also have to be done on the respective existing and new HV equipment to ensure the current naming convention of 'Blouwater' is changed to Blouwater/Ystervark TEE.

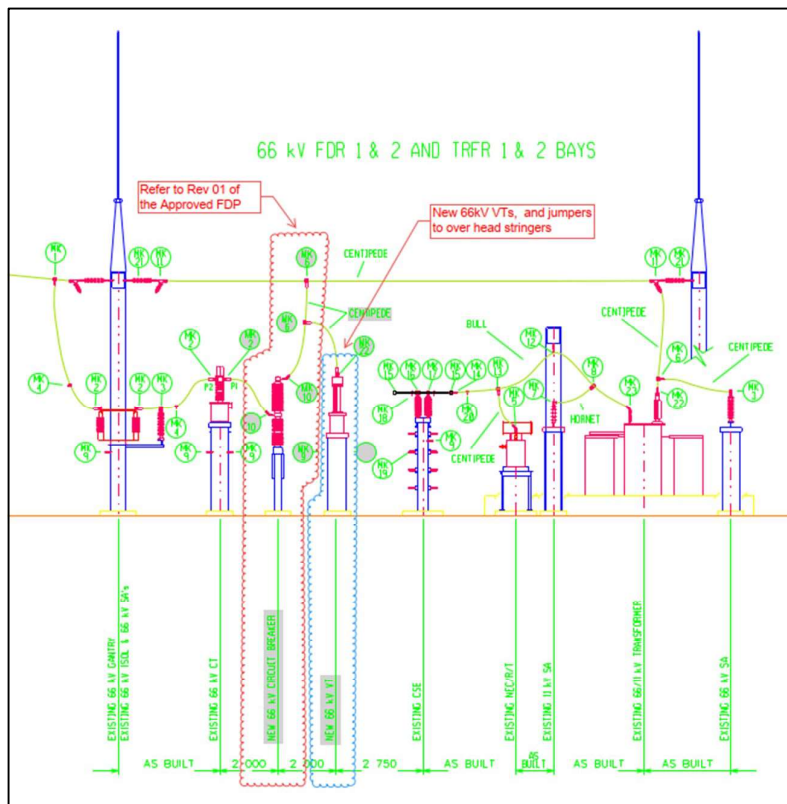


Figure 8 - Proposed solution and position of new VTs

The fault levels at Iscor Substation were provided by Eskom Western Cape Operating Unit (WCOU) Network Planning Department, which are as follows:

Table 2 – Iscor Substation Fault Levels

| Busbar Name | I - 1 Ø (kA) | I - 3 Ø (kA) |
|----------------------|--------------|--------------|
| 66 kV Busbar (Iscor) | 6.4 | 6.9 |

The 6 x 66 kV VT's must be accommodated within the existing substation site in order to implement the introduction of the three terminal differential protection.

- The new VTs are to be installed onto new medium voltage supports; and
- New overhead conductor jumpers and clamps to be installed between the existing 66 kV overhead gantry stringers and the new VTs. The jumper to the VT shall tie into the jumper rising from the new circuit breaker, as per [Figure 8](#).

9.2. Specification

9.2.1. 66 kV Voltage Transformer

All primary plant will comply with the 31 mm/kV creepage insulation levels. The specification of the new 66 kV voltage transformer is as follows and shall be in accordance with D-DT-6176. It should be noted that certain data listed in the schedule below may differ from those of the actual units to be supplied, based on Eskom's latest requirements at that time of provision of the equipment by the Contractor.

Table 3 - Technical Schedule for 66 kV Voltage Transformer

| Item | Description | Specified |
|----------|--|-----------------|
| 1 | Service Conditions | |
| 1.1 | Altitude | 1 800 m |
| 1.2 | Climate conditions | Coastal |
| 1.3 | Ambient Temperature | -10 °C to 45 °C |
| 1.4 | Level of pollution that equipment will be subjected to | High |
| 1.5 | Lightning area | Yes |
| 2 | General requirements | |
| 2.1 | Nominal system voltage (Un) | 66 kV |
| 2.2 | Maximum system voltage (line-to-line) (Um) | 72.5 kV |
| 2.3 | Frequency | 50 Hz |
| 2.4 | Number of single phase Voltage Transformers per set | 3 |
| 2.5 | Rated Burden per Phase | 100 / 50 VA |
| 2.6 | Accuracy Class | 3P / 0.2 |
| 2.7 | Primary Voltage | 66 / $\sqrt{3}$ |

| Item | Description | Specified |
|----------|---|------------------|
| 2.8 | Secondary Voltage | 110 / $\sqrt{3}$ |
| 2.9 | Power frequency short-duration withstand voltage | 140 |
| 2.10 | Lightning impulse withstand voltage | 350 |
| 2.11 | Power Winding required | No |
| 3 | Creepage distance | |
| 3.1 | Minimum creepage distance for other than medium pollution (IEC 60815) | 31 mm/kV |
| 4 | Secondary Protection | |
| 4.1 | Method | Fuses |
| 4.2 | Current rating of fuses | 32 A |
| 4.3 | Maximum permissible duration of secondary short circuit current | 1 |
| 5 | Primary Terminal | |
| 5.1 | Type | Stem |
| 5.2 | Orientation | Vertical |
| 5.3 | Size | 26 mm |

9.2.2. Earthing Material

All earthing will be done in accordance with Eskom standard 240-134369472 - Substation Earth Grid Design Standard and D-DT-5240. All supports will be earthed using two earth tails.

The existing earth grid/mat does not form part of this project. The new 66 kV voltage transformer steel support structures will be connected to the existing earth grid/mat.

Table 4 - Technical Schedule for Copper Straps

| Flat Copper Straps | |
|-------------------------|-------------------|
| Material Type | Black Annealed Cu |
| Insulated or Bare | Bare |
| Width (mm) | 50 |
| Thickness (mm) | 3 |
| Area (mm ²) | 150 |
| kA/1 sec | 26.4 |

9.2.3. Clamps & Conductors

Table 5 - Clamp Technical Schedules

| Type | Dimensions |
|---------------------------|---------------------------------|
| EXC-B: Bolted/Compression | Stem: 26 mm; Conductor: 26.5 mm |
| ETC-C: Bolted/Compression | Run: 26.5 mm; Tap: 26.5 mm |
| EPC-B: Bolted/Compression | PALM 45 DG; Conductor 26.5 mm |

Table 6 - Technical Schedule for Centipede AAC

| Centipede AAC Characteristics | |
|--|-----------------------|
| Conductor overall diameter (mm) | 26.46 |
| Area Total (mm ²) | 415.22 |
| Aluminium wire stranding/diameter (mm) | 37/3.78 |
| Conductor linear mass (kg/km) | 1150 |
| Ultimate Tensile strength (kN) | 67.2 |
| Resistance dc @ 20 °C (ohms/km) | 0.0694 |
| Modulus elasticity final (GPa) | 58.6 |
| Coefficient of Linear expansion (1/°C) | 23 x 10 ⁻⁶ |

9.2.4. Substation HV Equipment Labels

The existing Blouwater 1 & 2 feeder bay equipment labels will be renamed and shall be labelled with new fibre glass equipment labels in accordance with the following standards and specifications:

- 240-75660336 - Substation and network equipment label specification.
- 240-120804300 - Standard for the labelling of electrical equipment within Eskom wired network.


Table 7 - Yard Equipment Label Changes Required - Feeder 1

| Existing | New |
|----------|---------------------------------------|
| N/A | BLOUWATER 1/YSTERVARK TEE 66 kV VT |


Table 8 - Yard Equipment Label Changes Required - Feeder 2

| Existing | New |
|----------|---------------------------------------|
| N/A | BLOUWATER 2/YSTERVARK TEE 66 kV VT |


9.3. Long Lead Time Bill of Materials


| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | | | | | | | |
|---|---------|--|-----|---------|---------------|---|--------|--------|----------|--|
| POWER PLANT | | | | | | | | | | |
| JOB NAME | | Job Name: Iscor 66 kV Breaker & Protection Upgrade | | | | WCOU_BOM-18-04 | | REV : | Addendum | This document is the property of Eskom |
| JOB NUMBER: | | Job Number: 153272156-00004 | | | |  | | | | |
| BOM TYPE: | | FINAL BOM & BOQ | | | | | | | | |
| PREPARED BY : | | Colin Pym | | | | | | | | |
| Tel No | | Tel: 021 950 7500 | | | | | | | | |
| DATE PREP. : | | 2022/05/17 | | | | | | | | |
| MAIN EQUIPMENT | | | | | | | | | | |
| QTY | SAP | REFERENCE | Rev | Voltage | DESCRIPTION | Class | Stud | LEAD | | |
| VOLTAGE TRANSFORMERS | | | | | | | | | | |
| 6 | 0180091 | D-DT-6176 | 8 | 66 kV | Voltage Trfr. | 100/50VA class 3P/0.2 | 26.0 ø | 6 mnth | | |
| NOTE: Unless otherwise stated, all equipment creepage is 31mm/kV | | | | | | | | | | |


9.4. Final Bill of Materials


| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | | | | | | | |
|---|---------|--|-----|---------|---------------|---|--------|--------|----------|--|
| POWER PLANT | | | | | | | | | | |
| JOB NAME | | Job Name: Iscor 66 kV Breaker & Protection Upgrade | | | | WCOU_BOM-18-04 | | REV : | Addendum | This document is the property of Eskom |
| JOB NUMBER: | | Job Number: 153272156-00004 | | | |  | | | | |
| BOM TYPE: | | FINAL BOM & BOQ | | | | | | | | |
| PREPARED BY : | | Colin Pym | | | | | | | | |
| Tel No | | Tel: 021 950 7500 | | | | | | | | |
| DATE PREP. : | | 2022/05/17 | | | | | | | | |
| MAIN EQUIPMENT | | | | | | | | | | |
| QTY | SAP | REFERENCE | Rev | Voltage | DESCRIPTION | Class | Stud | LEAD | | |
| VOLTAGE TRANSFORMERS | | | | | | | | | | |
| 6 | 0180091 | D-DT-6176 | 8 | 66 kV | Voltage Trfr. | 100/50VA class 3P/0.2 | 26,0 ø | 6 mnth | | |


NOTE: Unless otherwise stated, all equipment creepage is 31mm/kV


| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | | | | | | | |
|---|---------|--|-----|-----------------------------|--|---|--|-------|---|--|
| POWER PLANT | | | | | | | | | | |
| JOB NAME | | Job Name: Iscor 66 kV Breaker & Protection Upgrade | | | | WCOU_BOM-18-04 | | REV : | 0 | This document is the property of Eskom |
| JOB NUMBER: | | Job Number: 153272156-00004 | | | |  | | | | |
| BOM TYPE: | | FINAL BOM & BOQ | | | | | | | | |
| PREPARED BY : | | Colin Pym | | | | | | | | |
| Tel No | | Tel: 021 950 7500 | | | | | | | | |
| DATE PREP. : | | Tuesday, 17 May 2022 | | | | | | | | |
| EARTHING | | | | | | | | | | |
| QTY | SAP | REFERENCE | Rev | DESCRIPTION | | | | | | |
| EARTHING | | | | | | | | | | |
| 0,5 coils | 0400772 | D-DT-6045 | 3 | kg Flat Copper Bar (3x50mm) | | | | | | Total Meters : 10,00 m Meters : 18 m |


| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | | | | | | | |
|---|---------|--|-----|----------------------------------|--|---|--|-------|---|--|
| POWER PLANT | | | | | | | | | | |
| JOB NAME | | Job Name: Iscor 66 kV Breaker & Protection Upgrade | | | | WCOU_BOM-18-04 | | REV : | 0 | This document is the property of Eskom |
| JOB NUMBER: | | Job Number: 153272156-00004 | | | |  | | | | |
| BOM TYPE: | | FINAL BOM & BOQ | | | | | | | | |
| PREPARED BY : | | Colin Pym | | | | | | | | |
| Tel No | | Tel: 021 950 7500 | | | | | | | | |
| DATE PREP. : | | Tuesday, 17 May 2022 | | | | | | | | |
| CONDUCTOR | | | | | | | | | | |
| QTY | SAP | REFERENCE | Rev | DESCRIPTION | | | | | | |
| CONDUCTOR AND BUSBAR TUBE | | | | | | | | | | |
| CONDUCTOR | | | | | | | | | | |
| 30 m | 0403041 | D-DT-3136 | 13 | COND. AAC CENTIPEDE 26.46D UNGRS | | | | | | kg/m 1.15 |


| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | | | | | | | |
|---|---------|--|-----|--|--|---|--|-------|---|--|
| POWER PLANT | | | | | | | | | | |
| JOB NAME | | Job Name: Iscor 66 kV Breaker & Protection Upgrade | | | | WCOU_BOM-18-04 | | REV : | 0 | This document is the property of Eskom |
| JOB NUMBER: | | Job Number: 153272156-00004 | | | |  | | | | |
| BOM TYPE: | | FINAL BOM & BOQ | | | | | | | | |
| PREPARED BY : | | Colin Pym | | | | | | | | |
| Tel No | | Tel: 021 950 7500 | | | | | | | | |
| DATE PREP. : | | Tuesday, 07 June 2022 | | | | | | | | |
| MISCELLANEOUS | | | | | | | | | | |
| QTY | SAP | REFERENCE | Rev | DESCRIPTION | | | | | | |
| MISCELLANEOUS | | | | | | | | | | |
| 48 | 0163641 | D-DT-3082 | 15 | Stainless Steel Bolt & Nut : M12 x 65mm with 1 x flat washers & 1 x spring washer | | | | | | Used for Palm clamps |
| 2 | 0186950 | D-DT-5405 | 0 | VRW20 Junction Box, with 8 circuit VT insert (Fitted) (Complete JB) 304 stainless steel option | | | | | | |
| 24 | 0163812 | D-DT-6097 | 4 | Stainless Steel Bolt & Nut : M16 x 75mm | | | | | | To attach Post Type VT to steel |
| Signage | | | | | | | | | | |
| 6 | Buy Out | D-DT-5047 | 0 | Equipment/Bay Labels | | | | | | Label - New VTs |
| OTHER SPECIFIED EQUIPMENT | | | | | | | | | | |
| 6 | Buy Out | 240-56062705 | 2 | RTV SILICONE RUBBER INSULATOR COATING | | | | | | Buyer Standard |

| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | | | | | | | |
|---|---------|--|-----|-------------|--------------|---|---------|-------|----------|--|
| POWER PLANT | | | | | | | | | | |
| JOB NAME | | Job Name: Iscor 66 kV Breaker & Protection Upgrade | | | | WCOU_BOM-18-04 | | REV : | Addendum | This document is the property of Eskom |
| JOB NUMBER: | | Job Number: 153272156-00004 | | | |  | | | | |
| BOM TYPE: | | FINAL BOM & BOQ | | | | | | | | |
| PREPARED BY : | | Colin Pym | | | | | | | | |
| Tel No | | Tel: 021 950 7500 | | | | | | | | |
| DATE PREP. : | | Tuesday, 17 May 2022 | | | | | | | | |
| CLAMPS | | | | | | | | | | |
| QTY | SAP | REFERENCE | Rev | DESCRIPTION | | Compression | Bolted | Angle | | |
| Bolted - Compression | | | | | | | | | | |
| 6 | 0401766 | D-DT-6006 | 8 | EXC-B | B/Comp | 26,5 mm | 38 mm | 0° | | |
| 6 | 0401754 | D-DT-6010 | 10 | ETC-C | T/Comp | 26,5 mm | 26,5 mm | 0° | | |
| 6 | 0400420 | D-DT-6018 | 8 | EPC-B | B/Comp 50x50 | 26,5 mm | Palm | 45° | | |

| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | | | | | | | |
|---|-----|--|-----|---|--|---|--|-------|---------|--|
| POWER PLANT | | | | | | | | | | |
| JOB NAME | | Job Name: Isocr 66 kV Breaker & Protection Upgrade | | | | WCOU_BOM-18-04 | | REV : | 2 | This document is the property of Eskom |
| JOB NUMBER: | | Job Number: 153272156-00004 | | | |  | | | | |
| BOM TYPE: | | FINAL BOM & BOQ | | | | | | | | |
| PREPARED BY : | | Colin Pym | | | | | | | | |
| Tel No | | Tel: 021 950 7500 | | | | | | | | |
| DATE PREP. : | | Monday, 31 October 2022 | | | | | | | | |
| CONCRETE WORKS | | | | | | | | | | |
| QTY | SAP | REFERENCE | Rev | DESCRIPTION | | | | | | |
| MAIN EQUIPMENT SUPPORT FOUNDATIONS | | | | | | | | | | |
| 6 | | D-DT-5206-1A | 9 | Medium Equipment Support Foundation (Soil Type 1 & 2) | | | | | 0183872 | |

| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | | | | | | | |
|---|---------|--|-----|----|--|---|--|-----------|-----------------|--|
| POWER PLANT | | | | | | | | | | |
| JOB NAME | | Job Name: Isocr 66 kV Breaker & Protection Upgrade | | | | WCOU_BOM-18-04 | | REV : | 2 | This document is the property of Eskom |
| JOB NUMBER: | | Job Number: 153272156-00004 | | | |  | | | | |
| BOM TYPE: | | FINAL BOM & BOQ | | | | | | | | |
| PREPARED BY : | | Colin Pym | | | | | | | | |
| Tel No | | Tel: 021 950 7500 | | | | | | | | |
| DATE PREP. : | | Monday, 31 October 2022 | | | | | | | | |
| STEELWORK | | | | | | | | | | |
| QTY | SAP | REFERENCE | Rev | kV | DESCRIPTION | | | Mass (kg) | Total Mass (kg) | |
| MAIN EQUIPMENT SUPPORTS | | | | | | | | | | |
| 6 | 0182752 | D-DT-5206-2C | 9 | | Medium Equipment Support Steelwork(2.5m) | | | 125 kg | 750 kg | |

| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | | | | | | | | |
|---|--|--|------|-----------|----------|---|-------------|-------|---------------|--|--------------|
| WCOU_BOM-18-04 | | | | | | | | | | | |
| JOB NAME | | Job Name: Iscor 66 kV Breaker & Protection Upgrade | | | | LASTEST REV : | | 0 | | This document is the property of Eskom | |
| JOB NUMBER: | | Job Number: 153272156-00004 | | | |  | | | | | |
| BOM TYPE: | | FINAL BOM & BOQ | | | | | | | | | |
| PREPARED BY : | | Colin Pym | | | | | | | | | |
| Tel No | | Tel: 021 950 7500 | | | | | | | | | |
| DATE PREP. : | | Tuesday, 17 May 2022 | | | | | | | | | |
| BILL OF QUANTITIES | | | | | | | | | | | |
| BASED ON MEW SUBSTATION BOQ rev. 11 | | | | | | | | | | | |
| CODE | DESCRIPTION | UNIT | QTY. | ADD. QTY. | B, P&G % | RATE (R) | POINTS/UNIT | HOURS | TOTAL HOURS | TOTAL (R) | POINTS TOTAL |
| POWER PLANT ACTIVITIES | | | | | | | | | | | |
| ELECTRICAL ACTIVITIES | | | | | | | | | | | |
| | Earthing | | | | | | | | | | |
| | Earthing of steel structures (per tail) | each | 6 | | | 12,35 | | 0,125 | 0,50 | 3,00 | |
| | Bond and earth equipment | each | 6 | | | 12,35 | | 0,375 | 1,50 | 9,00 | |
| | Erect 132/66/44 kV equipment | | | | | | | | | | |
| | Erect 132/66/44 kV VT's post type | set | 6 | | | 12,35 | | 10 | 40,00 | 240,00 | |
| | Stringing HV | | | | | | | | | | |
| | Conductor Run Out & Hang - Single | phm | 30 | | | 12,35 | | 0,03 | 0,12 | 3,60 | |
| | Con Tension Reg. & Terminate - Single | phm | 30 | | | 12,35 | | 0,25 | 1,00 | 30,00 | |
| | SUBTOTAL (ELECTRICAL PP ACTIVITIES) | | | | | | | | 273,60 | | |
| DISMANTLING ACTIVITIES | | | | | | | | | | | |
| | Dismantle | | | | | | | | | | |
| | Loosen/Lacking of conductor/earth | each | 6,0 | | | 12,35 | | 0,2 | 0,80 | 4,80 | |
| | SUB TOTAL (DISMANTLING ACTIVITIES) | | | | | | | | | | |

| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | | | | | | |
|---|--|--------------|-----|---|---|--------|-------------|--------|--|
| POWER PLANT | | | | | | | | | |
| JOB NAME | Job Name: Isocr 66 kV Breaker & Protection Upgrade | | | | WCOU_BOM-18-04 | REV : | 2 | | This document is the property of Eskom |
| JOB NUMBER: | Job Number: 153272156-00004 | | | |  | | | | |
| BOM TYPE: | FINAL BOM & BOQ | | | | | | | | |
| PREPARED BY : | Colin Pym | | | | | | | | |
| Tel No | Tel: 021 950 7500 | | | | | | | | |
| DATE PREP. : | Monday, 31 October 2022 | | | | | | | | |
| HD BOLTS | | | | | | | | | |
| QTY | SAP | REFERENCE | Rev | DESCRIP | N | Length | Bolts / FND | Thread | |
| HD BOLTS FOR STANDARD FOUNDATIONS | | | | | | | | | |
| 6 | | D-DT-5206-1A | 9 | Medium Equipment Support Foundation (Soil Type 1 & 2) | | MK 19 | 500 mm | 4 | M24 |

9.5. Detailed Drawings

| <u>Drawing No.</u> | <u>Drawing Title</u> | <u>Rev</u> |
|--------------------|---|------------|
| D-WC-7104-11-01 | 66 kV - Station Electric Diagram - Proposal A | 5A |
| D-WC-7104-11-02 | 66/11 kV - Site Plan | 01 |
| D-WC-7104-11-04 | 66/11 kV - Earth Grid Layout | 02 |
| D-WC-7104-11-07 | 66/11 kV - General Arrangement Layout | 02 |
| D-WC-7104-11-09 | 66/11 kV - Sections & Clamps | 02 |
| D-WC-7104-12-01 | 11 kV - Station Electric Diagram - Proposal A | 08A |

9.6. Non-Standard Material Specifications

NOT APPLICABLE

10. Control Plant

10.1. Overview

The Blouwater-Iscor 66 kV lines are protected using the line differential protection function of the ABB RED 670 line differential and impedance protection relays. Ystervark Substation will be connected to the 66 kV lines via two tee-in lines of approximately 300 m in length, immediately before Iscor Substation.

The existing line differential protection scheme for each feeder line will not operate correctly with the introduction of the tee-off line. To correct this, the existing differential protection schemes at Blouwater and Iscor Substations respectively will be retrofitted with the addition of a second teleprotection card and the three-terminal differential protection functionality selected for each of the existing respective ABB RED 670 relays at each Substation.

The existing transformer protection schemes for both transformers at Iscor Substation must also be modified to ensure the tripping of the new 66 kV circuit breakers.

Label changes will be undertaken on the respective feeder protection panels to ensure the current naming convention of 'Blouwater' is changed to Blouwater/Ystervark TEE.

Note: The fibre link for the differential protection between Blouwater and Ystervark Substations will be patched via Iscor Substation. No direct fibre optic circuit links will be in-place between Blouwater and Ystervark Substation.

10.2. Specification

10.2.1. Protection - 66/11 kV Transformer 1 4TM7100 (Modified)

Currently, a modified 4TM7100 transformer protection scheme is installed on transformer 1. The scheme has been modified to include a RED 670 line distance/differential protection relay, equipped with a single fibre teleprotection card to allow for line differential protection between Blouwater and Iscor Substation.

RED670 will be decommissioned in the transformer bay but will remain in the panel. Refer to the scheme drawing for further detail.

Blouwater 1/Ystervark TEE Feeder: 4FZD3920

The ABB 4FZD3920 three pole distance/differential scheme has a RED670 relay with current differential and impedance zones, directional overcurrent and earth fault protection, breaker fail, anti-pump timer, auto-reclose with sync check functions for the main protection and a REF615 directional backup relay with overcurrent and earth-fault functions.

This scheme comes standard with the following items:

- DNP3 on RS485 for SCADA
- RED670 internal fibre teleprotection card, 1550 nm, (100 km)
- Hardwired protection not healthy alarm
- External time synch on REF615

The following ordering options will be ordered with the scheme:

- Communication cable for the RED670 & REF615

- Additional hardwired signals card
- Three-terminal differential option
- IEC 61850 remote engineering access via Ethernet, including RuggedCom RS900-HI-D-MT-MT-MT-XX (6x 10/100Tx, 3x MM Fx, ST Connectors) switches which ABB will fit into the scheme
- Voltage selection
- Swing frame panel with dual entry ability

Notes regarding the design:

1. The scheme will be installed in a separate swing frame cabinet.
2. A 66 kV three-pole breaker will be installed on this feeder – Refer Rev 01 of the Approved FDPs.
3. No synch check line VT will be installed on this feeder.
4. A CT JB will be installed on the white phase CT steelwork.
5. A IS JB will be installed as indicated on the electrical equipment layout drawing.
6. All isolator open & closed indications must be wired to the scheme for supervisory indication. Double bit indication must be used; 'M' type contacts should be used for the close indication and 'N' type contacts should be used for the open indication.
7. Three-terminal differential protection will be used.
8. The switch(es) shall be wired into the protection scheme(s) as per the protection drawing. I.e. The RED670 protection relay(s) shall be connected to the Ethernet switch connected within the panel using multimode fibre with ST connectors and the REF615 protection relay shall be connected to the Ethernet switch using a standard RJ45 Ethernet cable.
9. Two Ethernet RJ45 links shall be connected between front panel and switch for ease of connection to the substation network.
10. The feeder IP addresses and related settings shall be supplied by the Substation Automation Control Plant design engineer(s) to the settings department to be issued with the standard settings.
11. The IEC 61850 option shall be enabled, and the regional IEC 61850 datasets loaded to allow integration to the SAS.

The Switch within the panel shall be linked to the substation automation network as detailed in the substation automation drawing.

The protection schematic diagram is shown in [Figure 9](#):

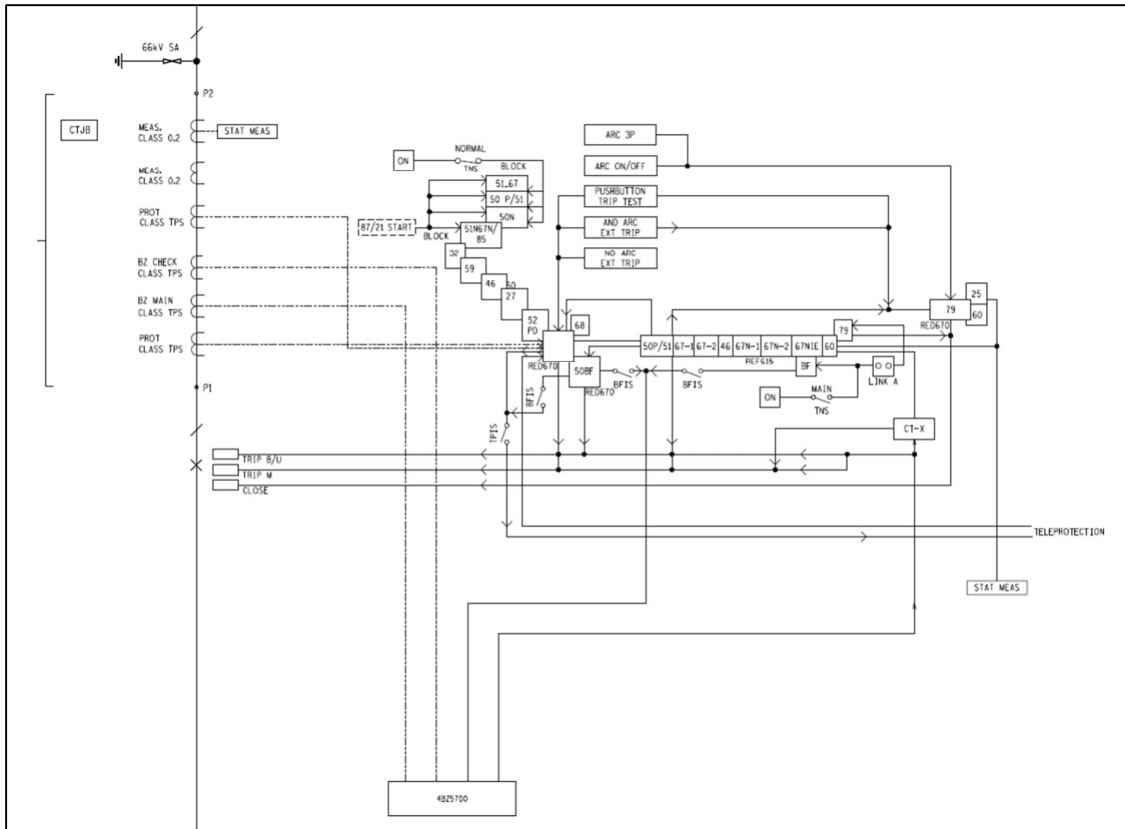


Figure 9 - Protection Schematic Diagram for the 4FZD3920 Feeder Distance/Differential Protection Scheme

10.2.2. Protection - 66/11 kV Transformer 2 4TM7100 (Modified)

Currently, a modified 4TM7100 transformer protection scheme is installed on transformer 1. The scheme has been modified to include a RED 670 line distance/differential protection relay, equipped with a single fibre teleprotection card to allow for line differential protection between Blouwater and Iscor Substation.

RED670 will be decommissioned in the transformer bay but will remain in the panel. Refer to the scheme drawing for further detail.

Blouwater 2/Ystervark TEE Feeder: 4FZD3920

The ABB 4FZD3920 three pole distance/differential scheme has a RED670 relay with current differential and impedance zones, directional overcurrent and earth fault protection, breaker fail, anti-pump timer, auto-reclose with sync check functions for the main protection and a REF615 directional backup relay with overcurrent and earth-fault functions.

This scheme comes standard with the following items:

- DNP3 on RS485 for SCADA

- RED670 internal fibre teleprotection card, 1550 nm, (100 km)
- Hardwired protection not healthy alarm
- External time synch on REF615

The following ordering options will be ordered with the scheme:

- Communication cable for the RED670 & REF615
- Additional hardwired signals card
- Three-terminal differential option
- IEC 61850 remote engineering access via Ethernet, including RuggedCom RS900-HI-D-MT-MT-MT-XX (6x 10/100Tx, 3x MM Fx, ST Connectors) switches which ABB will fit into the scheme
- Voltage selection
- Swing frame panel with dual entry ability

Notes regarding the design:

1. The scheme will be installed in a separate swing frame cabinet.
2. A 66 kV three-pole breaker will be installed on this feeder.
3. No synch check line VT will be installed on this feeder.
4. A CT JB will be installed on the white phase CT steelwork.
5. A IS JB will be installed as indicated on the electrical equipment layout drawing.
6. All isolator open & closed indications must be wired to the scheme for supervisory indication. Double bit indication must be used; 'M' type contacts should be used for the close indication and 'N' type contacts should be used for the open indication.
7. Three-terminal differential protection will be used.
8. The switch(es) shall be wired into the protection scheme(s) as per the protection drawing. I.e. The RED670 protection relay(s) shall be connected to the Ethernet switch connected within the panel using multimode fibre with ST connectors and the REF615 protection relay shall be connected to the Ethernet switch using a standard RJ45 Ethernet cable.
9. Two Ethernet RJ45 links shall be connected between front panel and switch for ease of connection to the substation network.
10. The feeder IP addresses and related settings shall be supplied by the Substation Automation Control Plant design engineer(s) to the settings department to be issued with the standard settings.
11. The IEC 61850 option shall be enabled, and the regional IEC 61850 datasets loaded to allow integration to the SAS.

The Switch within the panel shall be linked to the substation automation network as detailed in the substation automation drawing.

The protection schematic diagram is shown in [Figure 9](#).

10.2.3. Labelling

New relay panel labels will be manufactured for installation on the relay panels for Blouwater 1 and Blouwater 2 66 kV feeders. The label changes will be as follows:

Table 9 - Required Panel Label Changes

| Existing | New |
|-------------|---------------------------|
| BLOUWATER 1 | BLOUWATER 1/YSTERVARK TEE |
| BLOUWATER 2 | BLOUWATER 2/YSTERVARK TEE |

10.2.4. Telecommunication

Fibre optic patch leads will be installed between the retrofitted fibre teleprotection cards in the RED 670 relays of the 66/11 kV transformers 1 & 2 and the patch panels to allow for the differential protection communication.

Eskom Telecommunication department to indicate which fibre cores in the patch panel to terminate the patch leads to.


The following, but not necessarily limited to, Eskom standards shall apply as well:


- 240-132190480 - Telecommunications Equipment Installation Standard.
- 240-67907017 - Fibre Optic Core Allocation Standard.


10.3. Long Lead Time Bill of Materials

NOT APPLICABLE


10.4. Final Bill of Materials

| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | |
|---|--|-----------|---|---|
| CONTROL PLANT | | | | |
| JOB NAME: | Job Name: Iscor 66 kV Breaker & Protection Upgrade | | WCOU_BOM-18-04 | REV : Addendum |
| JOB NUMBER: | Job Number: 153272156-00004 | |  | |
| BOM TYPE: | FINAL BOM & BOQ | | | |
| PREPARED BY: | Colin Pym | | | |
| Tel No | Tel: 021 950 7500 | | | |
| DATE PREP.: | Tuesday, 17 May 2022 | | This document is the property of Eskom | |
| PROTECTION | | | | |
| QTY | SAP | REFERENCE | Rev | DESCRIPTION |
| HV FEEDER SCHEME | | | | |
| 2 | 0248558 | D-DT-9051 | 0 | 4FZD3920 Production unit for 110V dc (THREE-POLE) |
| HV Feeder Scheme Options | | | | |
| 2 | 0248587 | D-DT-9051 | Add | Three Terminal Diff Option |

| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | |
|---|--|-----------|---|--|
| CONTROL PLANT | | | | |
| JOB NAME: | Job Name: Iscor 66 kV Breaker & Protection Upgrade | | WCOU_BOM-18-04 | REV : Addendum |
| JOB NUMBER: | Job Number: 153272156-00004 | |  | |
| BOM TYPE: | FINAL BOM & BOQ | | | |
| PREPARED BY: | Colin Pym | | | |
| Tel No | Tel: 021 950 7500 | | | |
| DATE PREP.: | Tuesday, 17 May 2022 | | This document is the property of Eskom | |
| LV CABLE | | | | |
| QTY | SAP | REFERENCE | Rev | DESCRIPTION |
| CONTROL CABLES | | | | |
| 200 m | 0404118 | D-DT-3128 | 13 | Cable 1kV 19c 2.5mm ² Cu BVX19DCV |
| 200 m | 0404761 | D-DT-3128 | 13 | Cable 1kV 12c 2.5mm ² Cu BVX12DCV |
| 200 m | 0400646 | D-DT-3128 | 13 | Cable 1kV 4c 2.5mm ² Cu BVX4DCV |
| CABLE GLANDS | | | | |
| 8 | 0168280 | D-DT-3070 | 12 | Gland No 3 & Shroud |
| 8 | 0168279 | D-DT-3070 | 12 | Gland No 2 & Shroud |
| 4 | 0168367 | D-DT-3070 | 12 | Gland No 1 & Shroud |
| PLEASE NOTE: CABLE LENGTHS ARE APPROXIMATE ONLY, ACTUAL PHYSICAL LENGTHS ARE TO BE VERIFIED ON SITE. EXISTING CABLES TO BE REUSED WHERE POSSIBLE | | | | |

| WESTERN CAPE OPERATING UNIT PROJECT ENGINEERING - HV SUBSTATION BOM | | | | |
|---|--|-------------|---|---|
| CONTROL PLANT | | | | |
| JOB NAME: | Job Name: Iscor 66 kV Breaker & Protection Upgrade | | WCOU_BOM-18-04 | REV : Addendum |
| JOB NUMBER: | Job Number: 153272156-00004 | |  | |
| BOM TYPE: | FINAL BOM & BOQ | | | |
| PREPARED BY: | Colin Pym | | | |
| Tel No | Tel: 021 950 7500 | | | |
| DATE PREP.: | Tuesday, 17 May 2022 | | This document is the property of Eskom | |
| MISCELLANEOUS | | | | |
| QTY | SAP | DT referenc | Rev | DESCRIP N |
| 10 | BUY-OUT | - | - | FC, E9/125, 1310/1550nm, dB 5, Telegärtner, Order no. J08093A2205 |
| 2 | BUY-OUT | - | - | SC/APC - FC single Mode Patch Leads Ruggedised |

10.5. Label Schedule

| WCOU NED - HV SUBSTATION LABEL SCHEDULE | | | | | |
|--|----------|--|-------|--|----------|
| JOB NAME | | Job Name: Iscor 66 kV Breaker & Protection Upgrade | | LASTEST REV : Addendum | |
| JOB NUMBER: | | 153272156-00004 | |  | |
| BOM TYPE: | | FINAL | | | |
| PREPARED BY : | | Colin Pym | | | |
| Tel No | | 021 950 7500 | | | |
| DATE PREP. : | | Tuesday, 17 May 2022 | | | |
| Label Schedule | | | | | |
| QTY | MATERIAL | REFERENCE | RevNo | | LABEL NO |
| VOLTAGE TRANSFORMERS | | | | | |
| 3 | FG | D-DT-5047-4 | 3 | BLOUWATER 1/YSTERVARK TEE | 2 |
| | | D-DT-5047-2 | 3 | 66 kV VT | |
| 3 | FG | D-DT-5047-4 | 3 | BLOUWATER 2/YSTERVARK TEE | 2 |
| | | D-DT-5047-2 | 3 | 66 kV VT | |
| NOTE: All labels to be manufactured to ESKOM standard DST 34-254 (Latest Revision) | | | | | |

10.6. Detailed Drawings

| <u>Drawing No.</u> | <u>Drawing Title</u> | <u>Rev</u> |
|--------------------|---|------------|
| D-WC-7104-81-03 | 66/11 kV Transformer 1 - Scheme Logic Diagram | 02 |
| D-WC-7104-81-08 | 66/11 kV Transformer 1 - AC Key Diagram | 03 |
| D-WC-7104-81-12 | 66/11 kV Transformer 1 - Main DC Key Diagram | 03 |
| D-WC-7104-81-14 | 66/11 kV Transformer 1 - Back-Up DC Key Diagram | 03 |
| D-WC-7104-81-16 | 66/11 kV Transformer 1 - Back-Up DC Key Diagram | 03 |
| D-WC-7104-81-17 | 66/11 kV Transformer 1 - SPR Rewind DC, AC Key Diagram | 03 |
| D-WC-7104-81-20 | 66/11 kV Transformer 1 - Panel Cabling Diagram | 02 |
| D-WC-7104-81-22 | 66/11 kV Transformer 1 - Panel Cabling Diagram | 02 |
| D-WC-7104-81-23 | 66/11 kV Transformer 1 - HV CT JB Cabling Diagram | 02 |
| D-WC-7104-81-24 | 66/11 kV Transformer 1 - RED 670 AC, DC & Supervisory Key Diagram | 03 |
| D-WC-7104-81-25 | 66/11 kV Transformer 1 - RED 670 Reference Diagram | 02 |
| D-WC-7104-83-03 | 66/11 kV Transformer 2 - Scheme Logic Diagram | 02 |
| D-WC-7104-83-08 | 66/11 kV Transformer 2 - AC Key Diagram | 03 |
| D-WC-7104-83-12 | 66/11 kV Transformer 2 - Main DC Key Diagram | 03 |
| D-WC-7104-83-14 | 66/11 kV Transformer 2 - Back-Up DC Key Diagram | 03 |
| D-WC-7104-83-16 | 66/11 kV Transformer 2 - Back-Up DC Key Diagram | 03 |
| D-WC-7104-83-17 | 66/11 kV Transformer 2 - SPR Rewind DC, AC Key Diagram | 03 |
| D-WC-7104-83-20 | 66/11 kV Transformer 2 - Panel Cabling Diagram | 02 |
| D-WC-7104-83-22 | 66/11 kV Transformer 2 - Panel Cabling Diagram | 02 |
| D-WC-7104-83-23 | 66/11 kV Transformer 2 - HV CT JB Cabling Diagram | 02 |
| D-WC-7104-83-24 | 66/11 kV Transformer 2 - RED 670 AC, DC & Supervisory Key Diagram | 03 |
| D-WC-7104-83-25 | 66/11 kV Transformer 2 - RED 670 Reference Diagram | 02 |

10.7. Non-Standard Material Specifications

NOT APPLICABLE

11. Execution Plan and Temporary Arrangements

11.1. Constructability Plan

The proposed constructability plan below for the works at Iscor Substation covers the major tasks to be performed and is divided between pre-outage and outage works.

11.1.1. Protection

Pre - Outage Works:

- Procure new labels for 66 kV feeder protection panels.
- Procure control cabling as required.
- Procure 2 x new 4FZD3920 modified protection schemes.

Outage Works:

To be undertaken during the outage for the installation of the 66 kV breakers, surge arresters and voltage transformers.

Feeder 1:

- Install, lug and loom new control cables as required for the installation of the new 66 kV breaker and voltage transformer.
- Modify scheme wiring to include changes as required for the installation of the new 66 kV breaker and voltage transformer.
- Re-commission transformer protection scheme to prove all functionality except teleprotection and differential protection.

Feeder 2:

- Install, lug and loom new control cables as required for the installation of the new 66 kV breaker and voltage transformer.
- Modify scheme wiring to include changes as required for the installation of the new 66 kV breaker and voltage transformer.
- Re-commission transformer protection scheme to prove all functionality except teleprotection and differential protection.

The upgrade of the relays for the two feeders will be phased to prove the three-terminal differential logic on the first installation before upgrading the second line. **Note: To be undertaken on the same day as Blouwater and Ystervark Substation Energisation.**

Feeder 1:

- Install new labels for 66 kV feeder protection panel.
- Install 4FZD3920 protection scheme.
- Prove teleprotection circuits.
- Install fibre patch leads for second teleprotection link to Ystervark Substation.
- Prove three-terminal differential protection functionality.

Feeder 2:

- Install new labels for 66 kV feeder protection panel.
- Install 4FZD3920 protection scheme.
- Prove teleprotection circuits.
- Install fibre patch leads for second teleprotection link to Ystervark Substation.
- Prove three-terminal differential protection functionality.

Labels:

The labels for the relay panels will be changed during the outage to tie in the new Ystervark Substation.

11.1.2. Primary Plant**Pre - Outage Works:**

- Procure all new foundation materials
- Procure new 6 x 66 kV voltage transformers.
- Procure new 2 x VT Junction Boxes.
- Procure clamps, conductors, earthing material, bolts/nuts etc.

Outage Works:

Refer further to Rev 01 of the Approved FDPs.

- Barricade and make safe areas where foundations are to be installed.
- Open, isolate, test dead and earth the first 66 kV transformer feeder bay.
- Excavation for foundation and earth tail installation.

- Shoring excavated hole for foundation.
- Install rebar and case concrete for foundations.
- Install earth tails onto earth grid/mat and foundation rebar for structure to be used for mounting of the new VT.
- Backfill and compaction.
- Mount 66 kV voltage transformers on new 66 kV medium voltage support structure.
- Mount VT Junction Boxes.
- Connect new conductors and clamps.
- Complete commissioning of first 66 kV transformer-feeder bay.
- Repeat the process above to install the 66 kV voltage transformers in the adjacent 66 kV transformer-feeder bay.

The final execution/constructability plan shall be agreed to on-site between the Contractor, Transnet and Eskom, once the Contractor's work programme has been received.

11.2. Temporary Arrangements

At present there are no planned temporary arrangements. Given the dynamics of this project, and its criticality on the overall Transnet Tipler 3 project, it is foreseen that possible adhoc temporary arrangements will come to fruition during the construction phase. Should this occur, Transnet will engage with Eskom accordingly.

11.3. Specification

NOT APPLICABLE

11.4. Bill of Materials

NOT APPLICABLE

11.5. Bill of Quantities

NOT APPLICABLE

11.6. Detailed Drawings

NOT APPLICABLE

11.7. Non-Standard Material Specifications

NOT APPLICABLE

12. HV Lines

NOT APPLICABLE

13. MV Lines

NOT APPLICABLE

AECOM

www.aecom.com

To enhance and
sustain the world's
built, natural and
social environments