



Scope of Work

Technology

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1. General

1.1 Background

The Department of Mineral Resources and Energy released the 2019 Integrated Resource Plan (IRP 2019) in October 2019. The IRP 2019 will see around 6 GW of new solar PV capacity and 14.4 GW of new wind power capacity commissioned by 2030. Due to the favourable sun and wind in the Northern Cape, the province has around 3.3 GW of committed renewable generation with over 10 GW expected by 2030.

The objective of the study is to determine the transmission network requirements to enable the integration of the proposed renewable generation in the Northern Cape Province over a ten year period to 2030.

The proposed High Level Scope of Work (Entire Scheme) is as follows:

Upington – Ferrum 1st 400 kV line

- Establish/Equip 1 x 400 kV feeder bay at Ferrum Substation
- Establish/Equip 1 x 400 kV feeder bay at Upington Substation
- Construct 1 x 400 kV Upington – Ferrum 400 kV line

To facilitate maintainability and compatibility with the existing installed Eskom PTM&C equipment, the successful tenderer shall source the PTM&C equipment and schemes from Eskom approved suppliers. The items selected shall be those from Eskom PTM&C approved and accepted equipment and solutions which have been tested and are deemed acceptable for use on the Eskom network.

1.2 Scope

The provision to procure, install and commission of the protection, tele-control, measurements and teleprotection solution is aligned in this regard with Eskom's current methodologies. Further detail provided below.

Standard previously tested and Eskom approved solutions are to be utilised.

The scope of works includes the

- sourcing of standard solutions
- supply of all material,
- delivery, off-loading, erection, installation, cabling, application of configurations and settings, commissioning; to be accepted by Eskom
- provision of documentation, as-built drawings, configurations, protection settings; in Eskom standard format and to be accepted by Eskom
- anything else deemed necessary by the tenderer for the provision of a working solution

Note all engineering outputs and associated intellectual property shall become the property of Eskom

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1.3 Station Electric Diagram (SED)

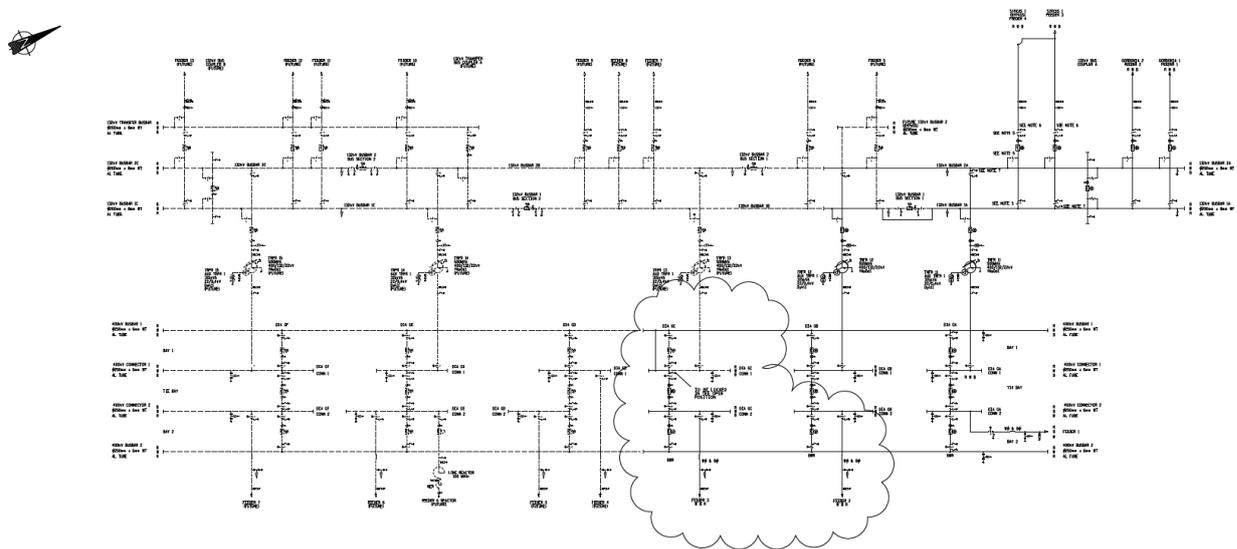


Figure 1: Upington SED

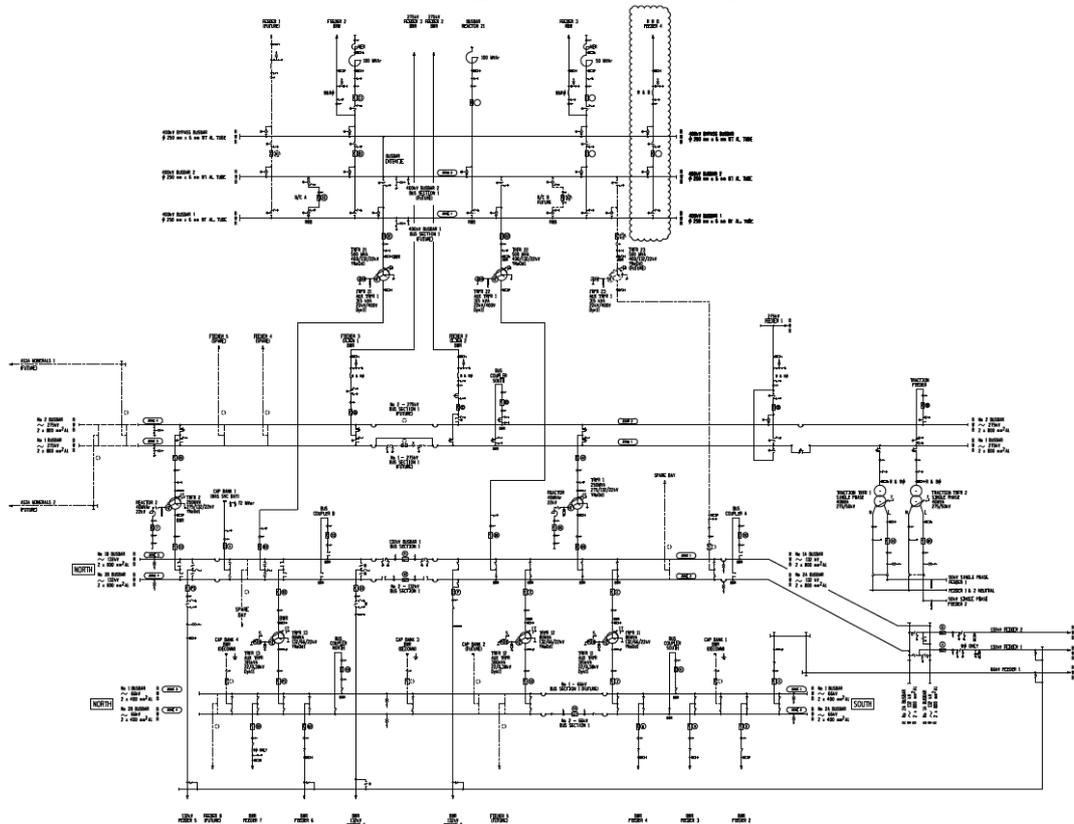


Figure 2: Ferrum SED

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2. Protection

2.1 Protection scope of work

This section describes the material required for the protection scope of the proposed Diameter GC 400 kV Feeder 3 at Upington substation and Double busbar 400 kV Feeder 4 at Ferrum substation.

The scope includes all power system protection equipment and directly related infrastructure including IEDs.

Telecommunication equipment and teleprotection inter-tripping equipment (for impedance protection) is included within this document.

The substation DC Voltage is 220 V DC (Protection) at Upington and 110 V DC (Protection) at Ferrum substation.

2.2 Sourcing

The generation of the protection equipment and solutions used shall be from Phase V & VI contracts, considering integration with control systems and remote end requirements as well as availability of products within the market.

The 400 kV Phase V & VI protection and telecontrol equipment shall be sourced from the Eskom approved Protection and Control suppliers.

The tenderer(s) shall engage with the Eskom approved suppliers to compile a detailed bill of material which shall be submitted with the proposal (tender).

2.3 Engineering Resources

Resources utilised for the scheme development and engineering of the protection and control solution must have previous experience developing and implementing protection and control solutions for Transmission high voltage networks.

2.4 Breaker-and-a-half diameter interface schemes

For all breaker-and-a-half EHV transmission applications, the diameter interface solution shall comprise of a diameter closing control (manual and auto-reclosing) and diameter management system (ST_240-96621430_Rev_1).

The diameter interface solution shall comprise two independent and galvanically isolated closing control and management systems, plus the bay 1 circuit-breaker, tie bay circuit-breaker and bay 2 circuit-breaker.

The diameter control system shall be capable of performing both single- and three-pole automatic reclosing. The allowed closing modes/conditions shall be determined by the required auto-reclose mode selections. The permitted closing conditions for manual closing and automatic reclosing shall be separately settable, allowing different closing conditions to apply.

2.4.1 Breaker-and-a-half diameter scheme requirements and options

Following is the diameter interface scheme requirements and option selections per 400 kV diameter. The diameter shall have a dedicated diameter interface panel with equipment as per the table below:

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| | Contract item | Scheme Code & Drawing No. |
|----|---|---|
| 1. | Phase V Diameter Interface Scheme <i>Mimics with local controls & indications and IED logics to be selected to match each diameter combination</i> | x 1 5DIP-3100 (0.52/30274) |
| 2. | Fixed frame, rear entry panel for Protection schemes (2400x800x600, 19" rack mount). | Refer to Doc 240-60725641 |
| 3. | Duplex Multi mode 50/125 fibre optic patch cord (3 meter) LC-LC, Non-Ruggedized for connection between the Fibre Patch boxes and the ethernet switch and between the Fibre Switching Panel 1 & 2 and the Backbone Switches. | x 4 |
| 4. | Din mount fibre optic patch boxes. (The patch boxes to be installed in the Diameter Interface Panel) | x 2 |
| 5. | 1U 19" rack mount fibre optic patch panels. (Each patch panel to be installed in the Fibre Switching Panel 1 & 2 | x 2 |
| 6. | Supply and Install 400 kV Diameter GC Connector 1 & 2 VTJB. | x 2 wiring as per 1JB-0700 0.54/6731 |

2.4.2 Breaker-and-a-half diameter scheme requirements and options

Following is the diameter interface scheme requirements and option selections per 400 kV diameter. The diameter shall have a dedicated 2nd diameter interface panel with equipment as per the table below:

| | Contract item | Scheme Code & Drawing No. |
|----|--|----------------------------------|
| 1. | Phase V 2 nd Diameter Interface Scheme | x 1 5DIP-3210 (0.52/30367) |
| 2. | Fixed frame, rear entry panel for Protection schemes (2400x800x600, 19" rack mount). | Refer to Doc 240-60725641 |
| 3. | Supply and Install Bay Junction Box | x 1 |

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| | |
|--|------------------------|
| | 1JB-0333 0.52/20249 |
|--|------------------------|

2.5 Breaker-and-a-half & Double Busbar line protection schemes

The breaker-and-a-half and double busbar line protection schemes shall have two IEDs (Main 1 and Main 2) with all the required protection functions integrated within the IEDs. A dual impedance protection scheme is selected and as such each IED will have a distance-based protection functionality fully integrated within the IED.

2.5.1 Breaker-and-a-half line protection scheme requirements and options

Following is the line protection scheme requirements and option selections per 400 kV line.

| | Contract item | Scheme Code & Drawing No. |
|----|---|----------------------------------|
| 1. | Phase V Line Protection Scheme <i>Mimics to be selected to match each diameter combination</i> | x 1 5FZB-3100 (0.52/30268) |
| 2. | Fixed frame, rear entry panel for Protection schemes (2400x800x600, 19" rack mount) | Refer to Doc 240-60725641 |
| 3. | Supply and Install Bay Junction Box | x 1 1JB-0333 0.52/20249 |
| 4. | Supply and Install Line VTJB | x 1 1JB-0700 0.54/6731 |
| 5. | Procure, supply, fitment, wiring and commissioning of the teleprotection interface device per main protection | Refer to Section 5 |

2.5.1.1 400 kV Feeder 3 (Ferrum 1) Local line protection requirements at Upington s/s

| | |
|-------------------------------|---|
| kV | 400 kV |
| Feeder No. | Feeder 3 |
| Feeder name | Ferrum 1 |
| Line protection scheme | Refer to the Breaker-and-a-half line protection schemes and options section on the scheme selection (Dual main protection). |

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| | |
|---|---|
| <p>Panel main labels</p> | <p>Panel main labels – Front and Rear: Label size: 340 x 35 mm Text height: 12 mm Labelling standard: 240-62629353 Specification for panel labelling standard.</p> |
| <p>Main 1 Teleprotection</p> | <p>Equipment includes the following:</p> <ul style="list-style-type: none"> • Teleprotection Equipment • X.21 Cable <p>Note: To be installed in the Protection Panel</p> |
| <p>Main 2 Teleprotection</p> | <p>Power Line Carrier equipment which includes the following:</p> <ul style="list-style-type: none"> • Line Traps • LMEs • Coaxial Cables • Carrier Combiner Unit • PLC Terminal Equipment • Z Cables • Telephone Cables <p>Note: Line Trap phase positions and PLC frequencies to be determined by Eskom. See Annexure A & B.</p> |
| <p>Notes: The supplier/contractor to complete the detailed teleprotection scope of work for this line/feeder using the document 240-141828918, “Scope of Work Template for Teleprotection Projects”.</p> | |

2.5.2 Double busbar line protection scheme requirements and options

Following is the line protection scheme requirements and option selections per 400 kV line.

| | Contract item | Scheme Code & Drawing No. |
|----|---|--------------------------------------|
| 1. | Phase VI Main 1 Line Protection Scheme | 6FZD-2110-M1 (0.52/30555) |
| 2. | Phase VI Main 2 Line Protection Scheme | 6FZD-2110-M2 (0.52/30556) |
| 3. | Fixed frame, rear entry panel for Protection schemes (2400x800x600, 19” rack mount) | x 2 Refer to Doc 240-60725641 |

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| | | |
|-----|--|--|
| 4. | Duplex Multi mode 50/125 fibre optic patch cord (2 meter) LC-LC, Non-Ruggedized for connection between the line protection IED and the Ethernet Switch. | x 2 |
| 5. | Duplex Multi mode 50/125 fibre optic patch cord (3 meter) LC-LC, Non-Ruggedized for connection between the fibre optic patch panels and the ethernet switches and between the fibre optic patch boxes and the process interface units (PIU). | x 6 |
| 6. | 1U 19" rack Multi mode mount fibre optic patch panels. To be installed in the protection panels. (Each patch panel can take two fibre optic cables) | x 2 |
| 7. | 1U 19" rack Multi mode mount fibre optic patch panels. (Each patch panel to be installed in the Fibre Switching Panel 1 & 2) | x 2 |
| 8. | Din mount Multi mode fibre optic patch boxes. (The patch boxes to be installed in the bay breaker junction box) | x 2 |
| 9. | Supply, install and wiring of Bay Breaker PIUs Junction Box (Male and Female half Harting Plugs, coding pins & wiring tail) | x 1 wiring as per 6JB-#100 0.52/30793 or 0.52/30796 |
| 10. | Supply and Install Line VTJB | x 1 1JB-0602 0.52/1186 |
| 11. | Procure, supply, fitment, wiring and commissioning of the teleprotection interface device per main protection. | Refer to Section 5 |

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2.5.2.1 400 kV Feeder 4 (Upington 1) Remote line protection requirements at Ferrum s/s

| | |
|--|---|
| kV | 400 kV |
| Feeder No. | Feeder 4 |
| Feeder name | Upington 1 |
| Line protection scheme | Refer to the Double busbar line protection schemes and options section on the scheme selection (Dual main protection). |
| Panel main labels | Panel main labels – Front and Rear: Label size: 340 x 35 mm Text height: 12 mm Labelling standard: 240-62629353 Specification for panel labelling standard. |
| Main 1 Teleprotection | Equipment includes the following: <ul style="list-style-type: none"> • Teleprotection Equipment • X.21 Cable Note: To be installed in the Protection Panel (Main 1) |
| Main 2 Teleprotection | Power Line Carrier equipment which includes the following: <ul style="list-style-type: none"> • Line Traps • LMEs • Coaxial Cables • Carrier Combiner Unit • PLC Terminal Equipment • Z Cables • Telephone Cables Note: Line Trap phase positions and PLC frequencies to be determined by Eskom. |
| Notes: The supplier/contractor to complete the detailed teleprotection scope of work for this line/feeder using the document 240-141828918, "Scope of Work Template for Teleprotection Projects". | |

3. Disturbance recorder and travelling wave fault locator

The digital fault recorder and travelling wave fault locator equipment and scheme shall be sourced from an Eskom approved supplier which is DLO Energy Solutions (Pty) Ltd. The scheme will be applicable for the DDB 400 kV Feeder 4 at Ferrum s/s. At Upington s/s, the tenderer shall interface to the planned DFR & TWS scheme (6DRB-7100).

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3.1 400kV Scheme 1

The following equipment for the 400 kV scheme 1 shall be sourced, factory tested, delivered, installed and commissioned:

| Item Description | Quantity |
|--|----------|
| Scheme: 2 x Feeder Double Busbar - 110 VDC | 1 |
| Additional Card for Traveling Wave Fault Locator | 1 |
| Internal GPS Receiver | 1 |
| Ethernet Switch: RSG2100 (RSG2100-6GK6021-0AS23-3DB0-Z-A05+B05+C05+D05+E00+F00+G01+H01+J01+K01) | 1 |
| Fibre Optic Patch Panel (12-way Fibre Optic Splice and Patch Panel (Multimode including 12 Duplex LC Mid-Couplers with Pigtails) | 1 |
| PC Communications cable for DFRs (RJ45 for PC connection) | 1 |
| Offloading & positioning in control room - per panel | 1 |
| Delivery: 301 - 700km (Ferrum s/s) | 1 |

3.1.1 400 kV scheme 1 type, drawing application levels and bay allocations

| | |
|---|---|
| Scheme Type: | 6DR-7100 |
| Master Drawing No.: | 0.52/30112 |
| Applicable drawing application levels: | 1, 2, 10, 17, 18, 36, 39, 68, 69, 70 & 71 |
| DFR1-DAU1-1: | 400 kV Feeder 4 |
| DFR1-DAU1-2: | Spare |

The scheme diagrams with only the applicable levels shall be provided to the approved supplier when the order for the equipment is placed.

4. Metering and measurements

4.1 Metering

- N/A

4.2 Measurements

Measurements functions are performed in the diameter control device, applicable to Upington s/s.

Measurements functions are performed in the Main 1 protection IED for the scheme, applicable to Ferrum s/s.

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5. Teleprotection

All required teleprotection equipment shall be sourced from an Eskom approved supplier. All work shall be done in accordance with the standards and specifications listed below:

- 240-141828918: Scope of Work Template for Teleprotection Projects.
- 240-75975613: Standard for the Installation of Power Telecommunications Equipment.
- 240-91461878: Teleprotection Trip Testing
- 240-96651735: Power Line Carrier and Associated Coupling Equipment: Commissioning and Major Maintenance Procedure.
- 240-90353855: Design Standard For Teleprotection Systems
- 240-103057370: Application Design Standard for Teleprotection Systems.
- 240-77422828: Teleprotection Equipment for use on Digital Telecommunications Channels or Dedicated Optical Fibre.
- 240-106920490: Specification for Power Line Carrier & Integrated Teleprotection Equipment.
- 240-106920412: Power Line Carrier – Line Matching Equipment.
- 240-57648739: Power Line Carrier Line Traps and Associated Post Support Insulators Standard.
- 240- 64813646: Data Cable Required for X.21 Interfaces.
- 240-64813538: High Frequency Coaxial Cable for Power Line Carrier Applications.
- 240-64813692: Miniature Control Cable Required for Teleprotection Signals (18Z Cables).
- 240-64813568: Standard Indoor and Outdoor Telephone Cable.

The teleprotection project scope (design) shall follow the scope of works template listed in the document 240-141828918, "Scope of Work Template for Teleprotection Projects". This scope of work document shall adhere to the standards, 240-90353855, "Design Standard for Teleprotection Systems" and 240-103057370, "Application Design Standard for Teleprotection Systems". The scope of works template for teleprotection shall be completed for each of the affected lines/feeders.

The scope of works and/or design for teleprotection shall be supported by Eskom. The scope of works shall include the 400 kV Feeder 3 at Upington s/s and 400 kV Feeder 4 at Ferrum s/s and follow the scope of works template (240-141828918).

The Teleprotection and Power Line Carrier (PLC) terminal equipment are 'links' and need to be compatible at both station ends. The standard DC voltage for Teleprotection (PLC) is 50V DC.

The PLC terminal equipment, Line Matching Equipment (LMEs) and Line Traps require the allocated PLC frequencies before any of the equipment can be ordered refer to Annexure B. This is to ensure the correct equipment is ordered.

The Teleprotection and PLC equipment installed in the cabinet/s shall comply with the standard 240-75975613 "Standard for the Installation of Power Telecommunications Equipment".

The Teleprotection equipment (TPE) shall be installed in the corresponding Protection cabinet.

The X.21 circuits from Eskom Telecomms shall be connected to the TPE.

The installation of the LME is detailed in the document 240-141828918, "Scope of Work Template for Teleprotection Projects"

The installation of the Line Traps shall be detailed in the Substations scope of works document.

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The tenderer must submit a list of test equipment available together with their current calibration test certificates.

The 'sequence of events' for the commissioning of the new teleprotection equipment shall be discussed with Eskom.

The contractor shall note that the Teleprotection, PLCs and Fibre requirements and installation affects/involves Lines and Substations and therefore a commissioning plan should be developed to mitigate the associated risks. A 'sequence of events for commissioning shall be drafted by the contractor and discussed with Eskom.

The tenderer shall supply, install, terminate and test the teleprotection units and/or Line Traps and/or LME and/or PLC equipment. Since teleprotection and PLCs operate as a link, the contractor shall be required to supply, install, terminate and test the teleprotection and PLC equipment at the distant stations from the connecting feeders/lines.

All teleprotection equipment must be tested in accordance with the latest revision of Eskom's standard, 240-91461878: Teleprotection Trip Testing and 240-96651735: Power Line Carrier and Associated Coupling Equipment: Commissioning and Major Maintenance Procedure. The Tx Grid and/or WP&CS shall witness the commissioning and testing as well as accept the test results.

The tenderer shall comply to all Eskom's SHEQ (Safety, Health, Environment and Quality) requirements as stipulated by the Project Manager and/or Transmission Grid.

Eskom approved equipment shall be sourced from Approved suppliers and it is as follows:

- Line Matching Equipment – LME High Pass (Hitachi Energy South Africa)
- Power Line Carrier (PLC) – ETL 6101 (Hitachi Energy South Africa)
- Teleprotection Equipment – NSD 570 (Hitachi Energy South Africa)
- Line Trap (To be selected in line with the Circuit Breaker Nameplate spec/info) and to use the following Technical Bulletins:
 - 240-151857940: Technical Bulletin of Trench Line Traps Supplied by HVT
 - 240-170000183: Technical Bulletin of Artech Line Traps Supplied by Mega HVT (Artech)
 - 240-170000184: Technical Bulletin for GE Line Traps Supplied by Actom

6. Fibre optic requirements

All fibre optic cables and ODFs shall be sourced from an Eskom approved supplier. All work shall be done in accordance with the standards and specifications listed below:

- IEC 61073-1: Fibre optic interconnecting devices and passive components — Mechanical splices and fusion splice protectors for optical fibres and cables
- 240-46264031: Fibre-Optic Design Standard and Installations - Substations
- 240-70733995: Optical Distribution Frame / Patch Panel
- 240-70732888: Fibre optic cable system acceptance testing procedure
- 240-46263618: Labelling of fibre optic cables
- 240-72274830: Multimode Fibre Optic Duct Cable Specification
- 240-70732902: Fibre Optic Connector
- NRS 088-1: Duct and direct-buried underground fibre-optic cable – Part 1: Product specification
- NRS 088-2: Duct and direct-buried underground fibre-optic cable – Part 2: Installation guidelines

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- NRS 081: Single mode non dispersion – shifted optical fibres
- 240-106030205, Fibre Optic Gantry to Substation Control Room Scope of Work Guideline

Single Mode Duct Cable

- Single mode duct cable shall adhere to NRS 088-1 and 240-46264031 and where there is a discrepancy, 240-46264031 shall take precedence.
- No armoured duct cables shall be installed.
- Between Substations, single mode cable shall be installed within an HDPE pipe.
- Single mode duct cables shall be 8, 24 or 48 cores dependant on application.
- Single mode cables are installed for teleprotection and Eskom telecommunication purposes, hence they will be installed between Joint boxes on gantry towers and the control room as well as between control rooms.
- Single mode cables for Main 1 and Main 2, from the same gantry feeder, shall follow diverse routes to the control room.
- These cables will terminate in the Fibre Optic Cabinet in the control/carrier room. The patch panel shall adhere to 240-70733995 Option A.
- The substation installation shall follow 240-46264031.

Multimode Duct Cable

- Multimode duct cable shall adhere to 240-72274830.
- No armoured duct cables shall be installed.
- Multimode duct cable shall be 12 cores.
- Multimode cables are installed for telecontrol purposes. Hence, they will be installed between the HV yard and the Control room.
- Multimode cables for Main 1 and Main 2 from the same Junction Box/Kiosk, in the HV Yard, shall follow diverse routes to the control room.
- These cables will terminate in the Protection Panel and then the Fibre Switching Panel 1 & 2 in the control room. The Multimode patch panel shall adhere to 240-70733995, Option B. The Multimode patch box, installed in the HV yard Protection junction box, shall adhere to 240-70733995, Option C.
- The substation installation shall follow 240-46264031.

Eskom approved fibre optic equipment/cables shall be sourced from Approved supplier/s and it is as follows:

- Approved Fibre optic duct cables are sourced from CBi, MTEC (SA) & AMhengtong
- Approved Single mode Patch Panels are sourced from World Telecoms & Data CC, Prysmian SA and Cable Feeder Systems
- Approved Multimode Patch Panels / Patch Boxes are sourced from Instelec Services

| | Multimode Fibre Optic Cables | Fibre Requirements for Double Busbar Schemes |
|----|---|--|
| 1. | Between Junction Boxes in HV yard and Control Rooms | MM Duct cable (50/125 µm) from Junction Box in HV yard to Protection Schemes in the control room shall be terminated in the patch panels installed in the Protection Schemes and patch boxes installed in the Junction Box(es). See Annexure D |

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| | | |
|----|--|---|
| | | & E. |
| 2. | Between Panels within the Control Room | MM Duct cable (50/125 µm) shall be terminated in the installed patch panels from Protection Schemes M1 & 2 and Fibre Switching Panel (FSP) 1 & 2 in the control room. See Annexure D & E. |

Note: All work to be done shall complete scopes of work according to 240-106030205, Fibre Optic Gantry to Substation Control Room Scope of Work Guideline. A working template can be requested from the Project Manager.

7. Telecontrol and substation automation

The tenderer shall make use of the existing telecontrol equipment for the integration of the new protection schemes at Upington and Ferrum substations. The existing equipment is as follows D400 with iHMI, D20 and Fibre Optic Switching Panels with Backbone switches.

The following requirements for the telecontrol and substation automation equipment shall apply:

- The network architecture shall comply with the Substation Automation – Network Architecture Standard for Transmission Substations: 240-61268959.
- The integration of the of the new protection in the existing telecontrol equipment will be implemented as per the Standard 240-150557600 Integration of the New Protection and Telecontrol Equipment with GE D400 in Transmission Substations.
- The control interlocking must be performed by the Gateway as per the Substation Gateway and Station RTU/IED Standard 240-68234842 and Interlocking Guideline for Eskom HV Yard SCADA HMI Equipment 240-70412803 (applicable to Ferrum s/s).
- The adopted practice at Brownfields substations is interlocking shall only be applied for the entire substation with the commissioning of the last bay. However the implementation of the interlocking shall be discussed and finalized with Eskom in this instance.
- The existing telecontrol and substation automation configurations shall be updated by Eskom PTM&C. This shall include the D400, D20, D25, ethernet network equipment etc.
- The tenderer shall be responsible for the application of configuration to all telecontrol, substation automation equipment. This shall include but is not limited to the Ethernet network equipment, the GPS equipment, the Gateway, iHMI or HMI and the Station RTU.
- The SND will be required from the Approved supplier in-order to allocate Device IP Addresses (applicable to Upington s/s).
- Device IP Addresses will be allocated by Eskom PTM&C. Three weeks' notice is required to complete IP address & issue.
- The IEC60870-5-101 signal database for National Control, Standby National Control and Regional Control Centres shall be done by the Eskom PTM&C.

8. Auxiliary supplies (AC/DC systems)

The tenderer shall make use of the existing auxiliary supplies at Upington and Ferrum substations. The selected load circuits (AC/DC) shall be indicated on the application drawings. A plug box is required on Diameter GC at Upington. The equipment shall be sourced from an Eskom approved supplier(s). The following documents are applicable:

- 240-64139144: AC Boards and Junction boxes for substations

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- 240-55151946: AC Reticulation Philosophy for substations
- Supply, Install and Commission a Plug box (1PB-0100) – 0.52/20251

9. LV cables and Cable works

The LV Power and Control cables shall be procured from the Approved supplier/s in accordance with the standard approved cables indicated in the cable block/s, buyers guide and/or 240-56063805 specification.

The installation of cables shall be in strict accordance with the law, SANS codes of practice and Eskom standards. The scope of work shall comprise the following activities:

- Installing, Testing, Glanding & Terminating of new cables as per the approved cabling and cable block diagrams provided in the final application drawings for primary and secondary plant equipment.

The following standard shall be used:

- 240-56063805 – LV Power and Control Cables with Rated Voltage Standard 600/1000 V
- 240-56030637 – General Information and Requirements for Low Voltage Cable Systems
- 240-64813568 – Standard Indoor and Outdoor Telephone Cable
- 240-64636794 – Standard for Wiring and Cable Marking in Substations
- 240-46425213 – Cable Testing Control Plant

Note: All documents listed above are also applicable to Transmission.

10. Protection settings

Eskom will be responsible to calculate, verify and issue of protection equipment settings. The standard Eskom settings process shall be followed. The tenderer shall be responsible for the implementation and testing of the settings.

The request for settings shall be submitted once all the necessary documentation is available. There is a minimum 6 weeks lead time for project settings.

The following standard shall be used:

- 240-163532881 – Protection settings management standard
- 240-161003995 – Digital Fault Recorder Settings Guideline
- SPF-0001 – Protection setting request form (Projects)

11. Factory testing

The tender shall submit a project schedule which shall include all the required factory testing requirements and activities for the PTM&C equipment.

The successful tenderer shall compile a detailed factory test plan, which include the standard developed schemes, 8 weeks prior commencement of the individual scheme testing, and shall be agreed between the tenderer and the Eskom representative prior to the commencement of any of the required factory tests. It shall be noted that Eskom representatives shall witness all the tests. The tenderer shall on conclusion of the factory testing produce a signed factory testing report.

The successful tenderer's engineers shall carry out functional tests to verify each individual scheme's wiring and overall scheme functionality with Eskom participation.

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The primary plant equipment (breakers and isolators) as per the station electric diagram shall be simulated for all the factory testing activities and requirements and shall be connected to the individual PTM&C schemes prior the individual scheme testing, factory acceptance testing and shall remain connected for the integrated substation solution testing.

12. Commissioning

The assets shall be commissioned to Eskom's standards and specifications. This is intended to protect the safety, integrity, and security of the Transmission system.

The pre-commissioning and commissioning activities shall be the responsibility of the tenderer (appointed contractor), and shall be witnessed and the results verified, accepted and approved by the Eskom Transmission Grid representative(s). The tenderer (appointed contractor) shall utilise the Eskom approved pre-commissioning and commissioning procedures and shall compile the required documentation for handover purposes prior energisation.

The tenderer (appointed contractor) shall submit to Eskom, the pre-commissioning and commissioning test plans and program, which shall comply with the Eskom requirements, for approval.

Eskom Transmission has test routines for the protection IEDs and these shall be obtained from Eskom and shall be used by the tenderer (appointed contractor) during commissioning, where applicable. The tenderer shall ensure the inspection sheets provided for the equipment pertains to Secondary Plant. (TCP 41-141).

The following standard shall be used:

- 240-54615413 – Standard for Commissioning Protection Assets.
- 240-11329030 – Western Grid In and Out Commissioning Sheets
- TCP 41-141 – Inspection Sheets for Substation Equipment to be Taken Over by the Asset Owner

12.1 Commissioning Sequence

- The commissioning of the protection assets including the telecontrol, teleprotection, measurements, auxiliary supplies etc shall be done by the Tenderer. The Eskom commissioning team/s (Western Grid Secondary Plant) shall oversee and witness the commissioning.
- All the outages pertaining to the final commissioning shall be arranged via the Grid to the National Control.
- The tenderer shall ensure the final switching procedure is drawn up with Grid and National Control
- The tenderer needs to provide a commissioning sequence. The commissioning sequence must be discussed with the Grid.
- The commissioning sequence may change based on the network constrains and requirements from the nation control.

13. Delivery, off-loading and installation

The tenderer shall include the delivery, off-loading and installation of all the PTM&C equipment within this scope of supply to Upington and Ferrum substation Control Rooms.

14. General

- The installation of cables shall be in strict accordance with the law, SANS codes of practice and standards, any deviations to be approved by Eskom;
- All work shall comply with

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- 240-64636794 – Standard for Wiring and Cable Marking in Substations
- 240-62629353 – Specification for Panel Labelling Standard
- 240-64100247 – Standard for Earthing of Secondary Plant Equipment in Substations
- 240-132496539 – Yard Digital Interface Junction Boxes for Transmission
- 240-64139144 – AC Boards and Junction Boxes for Substations
- 240-60725641 – Specification for Standard (19 Inch) Equipment Cabinets
- The tenderer shall be given all the applicable scheme drawings to aid with compiling the BOM/BOQ with the Approved supplier.
- The tenderer shall provide all the required information on time for the Upington and Ferrum s/s including but not limited to primary plant equipment etc;
- The tenderer shall comply to all Eskom’s SHEQ (Safety, Health, Environment and Quality) requirements as stipulated by the Project Manager and/or Transmission Grid.
- All "As built" drawings shall be submitted to Eskom
- Eskom’s Systems Operator requires minimum six weeks’ notice to provide protection settings. Finalised scheme application drawings and Primary Plant specification data (i.e. CB, CT and VT etc including photos) shall be provided to the System Operator together with the request for settings. Protection CT ratio selection shall be done in consultation with the System Operator.

15. Revision and tracking

| Rev No. | Description | Compiler | Date |
|---------|-----------------------|-----------------|---------|
| 1 | Initial Scope of Work | Lungiswa Nogela | 2023/03 |

16. Authorization

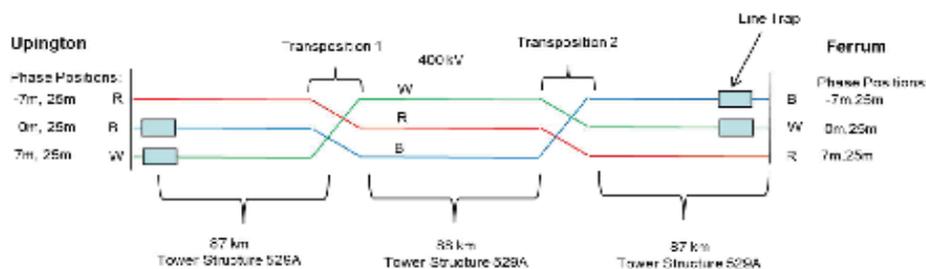
| Document seen and accepted by: | |
|--------------------------------|---|
| Name | Designation |
| Mario Petersen | PTM&C Planning & Project Support Manager (Acting) |
| Judith Malinga | PTM&C Engineering Senior Manager |

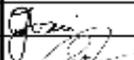
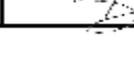
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17. Annexure A: Line Trap Coupling Arrangement

| | | | | |
|---|---|---------------------|---|----------------|
|  | PTM&C Line Trap Coupling Arrangement | | Unique Identifier | 240-102624748 |
| | | | Record Identifier | SOLP21P05-P-D8 |
| | | | Document Type | Design |
| | | | Revision | 1 |
| | | | Effective Date | 01 July 2014 |
| | | | Group Technology (Engineering) - PTM & C | |
| From: PTM & C Telecommunications Technology | To: PTM&C Planning & Support | Date: | 2021/11/26 | |
| Engineer: | Lungie Nogela | Tel: | 011 871 2634 | |
| Scheme name: | Upington Strengthening | | | |
| Project name: | Upington-Ferrum 400kV Line | | | |
| Project No.: | | | | |
| Cost Centre: | N/A | WBS/Internal Order: | N.ETSLPK1.C.NW.INT.TE | |
| Region / O.U. | Western | | | |
| Line Voltage: | 400 kV | Line Number: | 1 | |
| Substation A: | Upington | Substation B: | Ferrum | |
| Coupling Station A: | White/Blue | Coupling Station B: | White/Blue | |



| | Name | Designation | Signature | Date |
|--------------|-----------------|-------------------|---|------------|
| Compiled by: | Tejin Gosai | Chief Engineer |  | 29/11/2021 |
| Accepted by: | Lungiswa Nogela | PTM&C Project Eng |  | 2021/11/29 |
| Approved by: | Tony Sheerin | PTM&C P&S Manager |  | 29/11/2021 |

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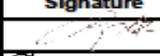
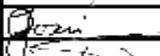
18. Annexure B: PLC Frequency Allocation

| | | | | | |
|---|---|--|---|---------------------------------|--------------|
|  | PTM&C PLC Frequency Allocation | | Unique Identifier | 240-102624748 | |
| | | | Record Identifier | XXXXXXXXXX | |
| | | | Document Type | Design | |
| | | | Revision | 1 | |
| | | | Effective Date | 01 July 2014 | |
| | | | Group Technology - PTM & C Engineering | | |
| From: PTM & C Telecomms Technology & Support | | To: PTM&C Project Engineering | Date: | 27/07/2022 | |
| Engineer: | Riyaz Gangat | Engineer: | Lungie Nogela | Tel: | 082 480 3238 |
| Scheme name: | | Upington Strengthening | | | |
| Project name: | | Ferrum - Upington 400kV Line | | | |
| Project Number: | | N.ETSLPK1.C.NW.INT.TE | | | |
| Cost Centre: | | N/A | WBS/Internal Order: | N/A | |
| Grid / O.U. | | Western Grid | | | |
| Station A: | | Ferrum | Station B: | Upington | |
| Line Voltage: | | 400 | kV | Circuit / Line Number: | 1 |
| Station A Feeder Number: | | 3 | | Station B Feeder Number: | 3 |
| PLC 1: Tx: | | 140 | kHz | PLC 1: Tx: | 142 kHz |
| PLC 1: Rx: | | 142 | kHz | PLC 1: Rx: | 140 kHz |

Power Line Carrier Frequency Allocations

400kV Ferrum – Upington Line 1



| | Name | Designation | Signature | Date |
|---------------------|--------------|---------------------|---|------------|
| Compiled by: | Riyaz Gangat | Senior Technologist |  | 27/07/2022 |
| Accepted by: | Tejin Gosai | Chief Engineer |  | 28/07/2022 |
| Approved by: | Tony Sheerin | PTM&C P&S Manager |  | 29/08/2022 |

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19. Annexure C: Eskom Application Drawings

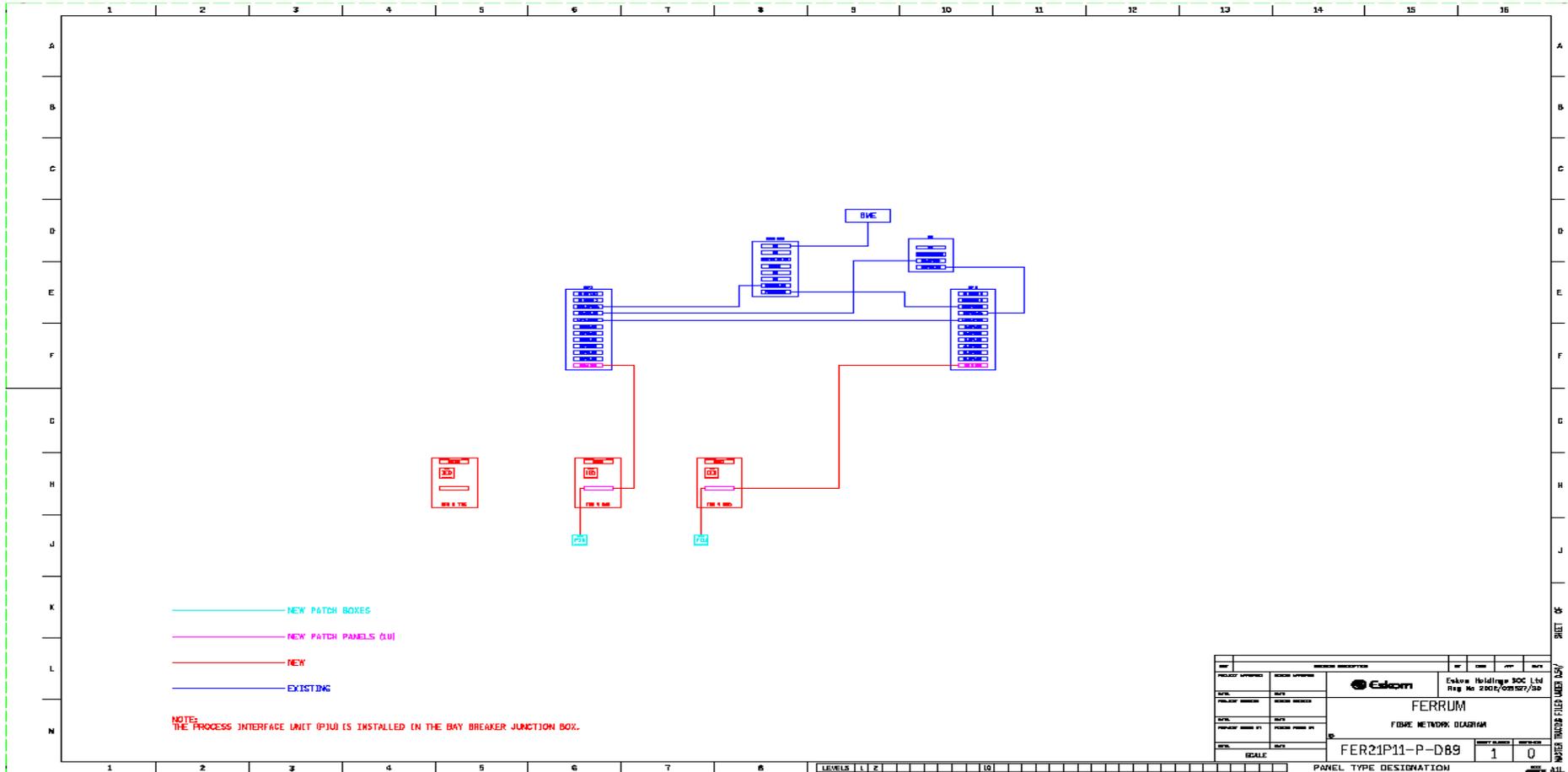
The listed drawings are not for construction. Item No. 6, 7, 8, 9, 15, 16, 17 & 18 is existing infrastructure and for information purposes.

| Substation Name | No. | Drawing Number | Drawing Title |
|-----------------|-----|----------------|--|
| Ferrum | 1. | 0.12/08316 | 400 kV Feeder 4 Main 1 |
| | 2. | 0.12/08317 | 400 kV Feeder 4 Main 2 |
| | 3. | 0.12/08318 | 400 kV Feeder 4 Junction Box |
| | 4. | 0.12/08319 | 400 kV Disturbance Fault Recorder Panel |
| | 5. | 0.12/08320 | 400 kV Feeder 4 Teleprotection |
| | 6. | 19.12/7547 | 400 V AC Board Type 1 |
| | 7. | 19.12/7558 | 50 V/100 A Dual Switch Mode DC System |
| | 8. | 19.12/7559 | 110 V/100 A Dual Switch Mode DC System |
| | 9. | 19.12/7553 | 400 kV Bus Zone |
| Upington | 10. | 0.12/08321 | 400 kV Diameter GC Feeder 3 |
| | 11. | 0.12/08322 | 400 kV Diameter GC Interface Panel 1 |
| | 12. | 0.12/08323 | 400 kV Diameter GC Interface Panel 2 |
| | 13. | 0.12/08325 | 400 kV Diameter GC Connector 2 |
| | 14. | 0.12/08326 | 400 kV Feeder 3 Diameter GC Teleprotection |
| | 15. | 0.12/7911 | 230 V AC Distribution Type 4 |
| | 16. | 0.12/7912 | 220 V/100 A Dual Switch Mode DC System |
| | 17. | 0.12/7913 | 50 V/100 A Dual Switch Mode DC System |
| | 18. | 0.12/7920 | 400 kV Bus Zone |

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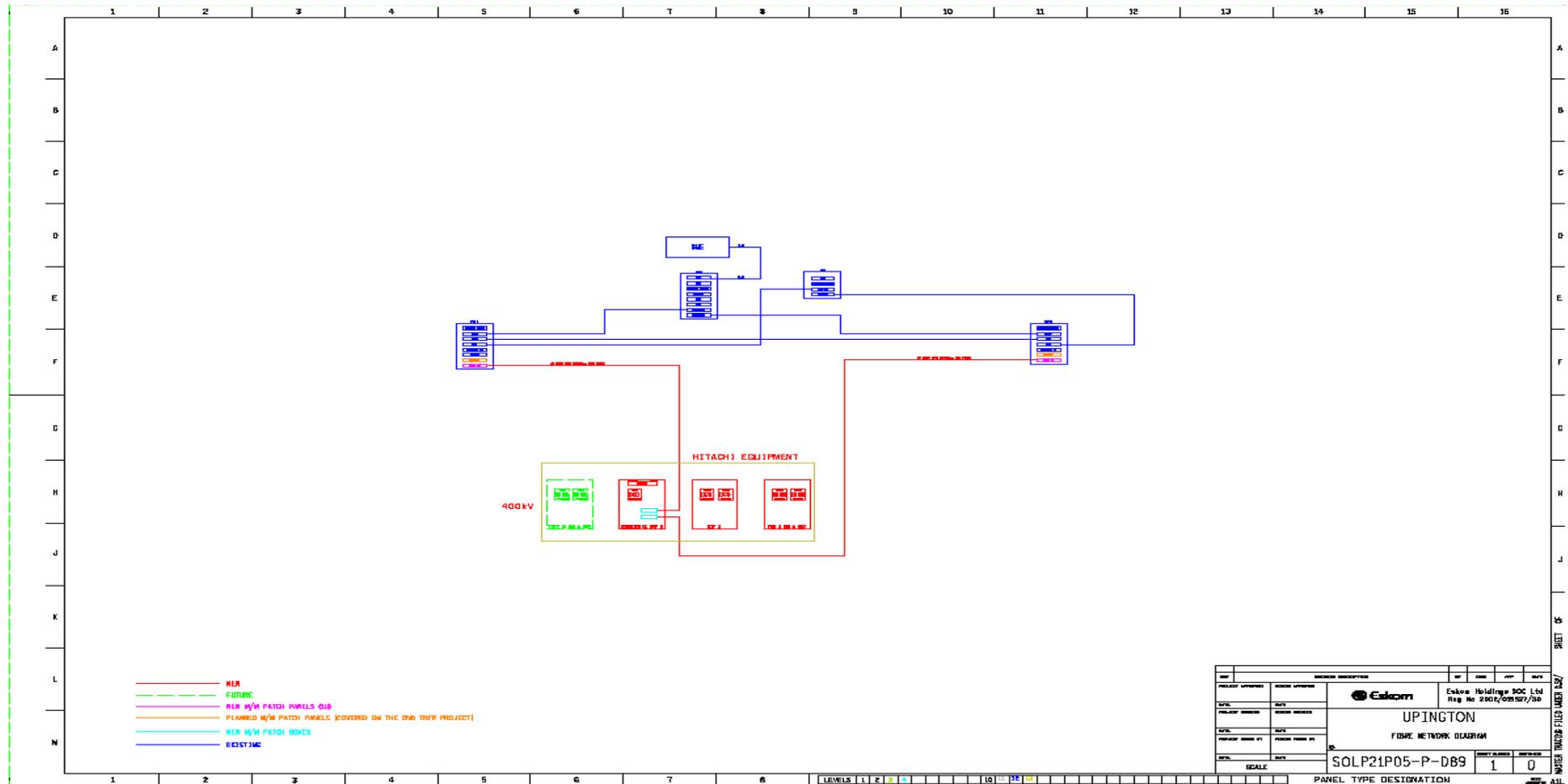
20. Annexure D: High Level Fibre Network Diagram



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21. Annexure E: High Level Fibre Network Diagram



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22. Annexure F: Summarized List of Approved Equipment & Suppliers

| Name of Equipment/ Material | Description of the Equipment/ Material | Suppliers from which the Equipment/ material will be sourced |
|---|--|---|
| 6FZD-2110 with PIUs | EHV Feeder Protection Scheme (M1 & M2) PIU IED: 2 x 6MD85 with Test Plugs/Harting-type connectors | Siemens |
| Fibre accessories | Multimode Patch Leads | |
| 6DR-7100 | Disturbance Fault Recorder | DLO Energy Solutions |
| 5FZB-3100 | EHV BAH Feeder Protection Scheme | Hitachi Energy South Africa |
| 5DIP-3100 | EHV BAH Diameter Interface Panel | |
| 5DIP-3210 | EHV BAH 2 nd Diameter Interface Panel | |
| TPE | NSD570 | |
| PLC | ETL6101 | |
| LME | | |
| Line Trap | | HVT |
| Optical Distribution Frame (i.e. Fibre Patch Panel/Box) | Multimode Fibre Patch Panels & Boxes | Instelec Services CC |
| Optical Distribution Frame (i.e. Fibre Patch Panel) | Single mode Fibre Patch Panel (Prysmian Type) | Prysmian (SA) or Cable Feeder Systems or World Telecoms & Data CC |
| 6JB-8100 or 6JB-9100 | Yard Digital Interface Junction Box | Sivtek and |

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Document Classification: Controlled Disclosure

HIGH LEVEL SCOPE OF WORK – PTM&C EQUIPMENT FOR UPINGTON AND FERRUM SUBSTATIONS

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| | | |
|---------------------------------------|----------------------|---------------------------------------|
| | | Vithale Electrical |
| 1PB-0100 | Plug box | Sabi Switchboards CC and PPS JV Msebe |
| 1JB-0700 | Voltage Junction box | |
| 1JB-0333 | Bay Junction box | |
| 1JB-0602 | Voltage Junction box | World Telecoms & Data CC |
| Intermediate Distribution Frame (IDF) | IDF accessories | |

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