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Content

1. Introduction

The City of Cape Town (CoCT) Strengthening Report (GP_08/70) of 2008 highlighted the problems experienced in the Peninsula Area, especially the supply of power to the CoCT's network. The preferred option to address this is the establishment of a Transmission substation (Erica Substation) next to the existing CoCT's Mitchells Plain Substation. Erica Substation will de-load Philippi Substation and also cater for load growth due to new projects within the CoCT network. Eskom Distribution has also planned several projects which are dependent on Erica Substation.

Phase 1 of the project is to integrate Erica Substation to the 400kV network as per the Addendum Report of May 2013 (GP_13/47) by looping the Stikland-Pinotage 400kV line into Erica Substation via a 12.5km 400kV double circuit line.

Phase 2 of the project as per the Philippi Substation Extension Report of February 2014 (GP_14/01) is to extend Philippi Substation, establish a 400kV busbar, cater for a future 3rd 400/132kV 500MVA transformer and construct a 10km 400kV line from Philippi Substation to Erica Substation.

Challenges are currently being experienced with the EIA and servitude acquisition for the Erica Substation project. The delayed commissioning of Erica Substation poses a risk to the security of supply to the CoCT because the Mitchells Plain load is currently supplied from Philippi substation, which has been unfirm since 2004.

In 2016, CoCT and Eskom jointly explored an interim solution to reduce the risk at Philippi under contingency. This would be achieved by providing an additional injection into Mitchells Plain by looping one of the Steenbras – Mitchells Plain 132kV lines into Pinotage Substation, which is currently under construction. Studies found this can alleviate loading at Philippi Substation, however, it does not result in Philippi Substation being firm. Thus additional mitigation measures are sought to ensure security of supply for the City of Cape Town due to the delays in the commissioning of Erica Substation. This report proposes the establishment of a 400kV busbar at Philippi and the installation of the 3rd transformer as a solution.

This scope forms part of Phase 2 of the approved City of Cape Town Strengthening project, except where one of the Erica transformers will now be installed at Philippi Substation in the interim and can later be deployed to Erica Substation once it has been constructed; alternatively, it can serve as a replacement for one of the Philippi transformers if they are in poor condition at the time.

Therefore, the proposed scope of work at Philippi Substation is as follows:

Phase 1:

- Establish a 400kV GIS busbar
- Install a 3rd 400/132kV 500 MVA transformer (run as hot standby)
- Install a Jericho (chop-over) scheme for this transformer

Furthermore, construct a 10km 400 kV line from Philippi Substation to Erica Substation once Erica Substation is complete.

The normalization/strengthening of Philippi 400/132 kV Substation will be executed under the Turnkey strategy utilising the more reliable "Circuit Breaker and a half" philosophy.

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 contracted 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.

2. Supporting clauses

2.1 Scope

2.1.1 Purpose

The purpose of the document is to outline / stipulate the PTM&C requirements for the strengthening/upgrade of the Philippi substation.

2.1.2 Applicability

This document shall apply to Eskom Transmission's Western Grid.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1] ISO 9001 Quality Management Systems.

[2] ISO 14001 Environmental Management System.

[3] ISO 45001 Occupational Health and Safety Management System.

[4] OHSA – Occupational Health and Safety Act, 85 of 1993 and Regulations.

2.2.2 Informative

[5] 240-75757022 Overview of Requirements for Transmission Protection, Telecontrol and Substation Automation Equipment.

2.3 Definitions

2.3.1 General

Definition	Description
Breaker and a half	The breaker and a half bus arrangement consist of two main busbars, each normally energised. Between each of the main busbars are similar arranged "bays" of three circuit breakers configured such that the two lines or a combination transmission line and transformer position share the centre circuit breaker.
Extra High Voltage	Nominal AC voltages above 220 kV up to and including 765 kV.
Intelligent Electronic Device	A microprocessor-based device that encompasses all or some of the following functionalities: protection, control and automation, metering, tele control, substation DC and auxiliary supply systems, quality of supply monitoring, and disturbance and event recording.
Process Interface Unit	Also referred to as a 'digital merging unit' or 'binary input/output device'; an Intelligent Electronic Device (IED) that collects binary data from process devices, typically electrical primary plant equipment, by way of status contacts, and processes and publishes this data to other IEDs in a digital format (e.g. IEC 61580 based communication). The device similarly converts digital commands from other IEDs into electrical control signals to the primary equipment. PIUs are typically installed on or near the primary equipment with which they exchange data.

2.3.2 Disclosure classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 Abbreviations

Abbreviation	Description
AC	Alternating Currect
BMK	Breaker Marshalling Kiosk
COCT	City of Cape Town
DC	Direct Current
DIP	Diameter Interface Panel
EHV	Extra High Voltage
FAT	Factory Acceptance Test
GIS	Gas Insulated System
HV	High Voltage
IED	Intelligence Electronic Device
JB	Junction Box
LAN	Local Area Network
LME	Line Matching Equipment
M/M	Multimode
MV	Medium Voltage
PIU	Process Interface Unit
PLC	Power Line Carrier
PTM&C	Protection Telecommunication Metering & Control
RTU	Remote Terminal Unit
SAT	Site Acceptance Test
S/M	Single mode
TC	Tap-change Control
TPE	Teleprotection Equipment
TCP	Tap Change Panel

2.5 Roles and responsibilities

N/A.

2.6 Process for monitoring

N/A.

2.7 Related/supporting documents

- 240-170000101 Technical Evaluation Criteria - Philippi PTM&C Equipment.

3. Scope of Work

The provision of a complete turnkey solution for the protection, tele-control, measurements, metering, teleprotection & telecommunications and auxiliary supplies (DC and AC) for the proposed Philippi substation, aligned with Eskom's current methodologies in this regard. Refer to the station electric diagram in Annex A.

Standard tested and Eskom approved products are to be utilised. Where specific schemes / solutions don't exist and development is required, this shall be kept to a minimum and based as much as possible on the existing platforms.

The scope of works includes the:

- Application design to meet the intent as stipulated in the Master drawing, and associated Standards and Specifications.
- sourcing and supply of the Eskom approved products and cables.
- where standard solutions don't exist, scheme design and manufacture, testing at works (FAT), in-situ testing (SAT), development of user documentation and training; to be accepted by Eskom.
- 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.

4. Protection

4.1 Protection scope of work

This section describes the material required for the protection scope for the proposed Erica 400/132 kV substation.

The scope includes all power system protection equipment and directly related infrastructure including networking equipment for the substation automation LAN, such as terminal patch panels / boxes and fibre optic cables between the bay Ethernet switches and the IEDs.

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

4.1.1 Sourcing

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

The Phase VI protection & automation and associated equipment can be sourced from the Eskom approved suppliers. Note products that are not sourced from Eskom approved suppliers, for the specific product, will be required to undergo full acceptance testing and approval, to be witnessed by Eskom. To this end all proposed testing and test specifications shall be approved by Eskom prior to testing taking place. Typically, the development and approval of products by Eskom can take up to 2 years and more in certain instances.

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

The protection and telecontrol & substation automation equipment from the supplier below will be permitted:

- **Siemens (Pty) Ltd (Contract No. 4600067750)**

Product standardisation forms the backbone of Eskom Transmission's efforts to reduce the burden associated with sustaining the infrastructure and as such the above contracting may typically be extended for periods up to 10 years. Manufacturer specific interfacing may also dictate that only specific supplier's products can be used for infrastructure extension projects to ensure compatibility with the existing installed base.

Eskom's specification and adjudication criteria for PTM&C equipment in this enquiry are based on Eskom's deemed optimal approach (time and cost) to procure / engineer accepted products that are compatible with existing infrastructure and is prescriptive only in this regard. Products other than those previously accepted, as discussed above and sourced from the Eskom approved supplier, would necessitate an extensive testing and acceptance process as well as the development of associated design base documentation to support the configuration, operation and maintenance of the products. In addition, experience has shown that constructive involvement by Eskom during development greatly accelerates the development timeframes and, as such, this has also been specified where relevant in this scope of work.

Suppliers are advised that if they have alternative technology which they may deem appropriate for the current scope of works, they are at liberty to bring this to Eskom's attention as an alternative proposal (but not an alternative tender), which will be assessed at evaluation stage. The use of technology which has not been tested and accepted by Eskom may delay the project and may have cost implications, which delays will impact the delivery timelines, and which additional costs will be for the supplier's account. No product which is proposed as an alternative technology as contemplated shall be supplied or used in respect of the works unless accepted by Eskom.

4.1.2 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 including breaker and a half.

4.1.3 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 breaker-and-a-half diameter interface scheme shall have one IED with all the required closing control and management functions integrated within a single IED.

The breaker-and-a-half diameter interface scheme shall be designed that the two object panels can be mounted on either the left hand or right hand or both sides of the diameter interface panel. The breaker-and-a-half diameter interface scheme shall be an independent design with an own set of scheme diagrams.

Process interface units (PIU) are required to interface (binary inputs and outputs) between the primary plant equipment and the diameter control IEDs. The PIUs shall be located within the relevant JB(s) or bay/breaker marshalling kiosks (GIS applications). The circuit-breaker PIU (breaker, isolator, earth switches, CT SF6 alarms, JB/BMK AC and DC supply monitoring, LOR switches, PIU health, Anti-pump, Trip circuit supervision and GIS alarms) shall be used to interface (IEC61850) with the diameter control IEDs.

GIS alarms that are not included within the standard scheme designs shall be reported via the station RTU/IED to the gateway(s) and the station HMI(s).

The IEDs (protection and PIU) shall comply with the Generic Specification for Intelligent Electronic Devices (IEDs) Standard, Unique Identifier 240-64685228.

Each of the 400 kV diameters shall have dedicated diameter interface schemes.

4.1.3.1 Breaker-and-a-half diameter interface scheme requirements and options

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

	Contract item	**Scheme Code & Drawing No.**
1.	Phase VI Main 1 Diameter Interface Scheme *Mimics with local controls & indications and IED logics to be selected to match each diameter combination*	6DIP-2110-M1 (0.52/30553)
2.	Phase VI Main 2 Diameter Interface Scheme *Mimics with local controls & indications and IED logics to be selected to match each diameter combination*	6DIP-2110-M2 (0.52/30554)
3.	Fixed frame, rear entry panel for Protection schemes (2400x800x600, 19” rack mount). Refer to 240-60725641.	x 2
4.	Supply, install and wiring of Tie Bay Breaker PIUs (Male and Female half Harting Plugs, coding pins & wiring tail) within the BMK or panel adjacent to the BMK (all wiring is within scope of supply)	x 2 (Harting plug wiring as per 6IJB-#300 (0.52/30571)
5.	Large Bay Switch (supply, fitment and wiring) Ruggedcom RSG-2100: 6GK6021-0AS23-3DB0-Z05+B05+C05+D05+E02+F00+G05+H00+J00+K01	x 2
6.	Duplex Multi mode 50/125 fibre optic patch cord (2 meter), LC-LC Non-Ruggedized for connection between the IEDs and the Ethernet Switches	x 2
7.	Duplex Multi mode 50/125 fibre optic patch cord (3 meter), LC-LC Non-Ruggedized for connection between the Fibre Patch Panels and the ethernet switches.	x 6
8.	1U 19" rack mount fibre optic patch panels. (Each box to accept 2 fibre optic cables. Per main in the DIP and per main in the JB/BMK)	x 2
9.	Engineering: Large Bay Switch	x 2
10.	Supply, install and wiring of 400 kV Busbar 1 VTJB within the BMK or panel adjacent to the BMK (all wiring is within scope of supply)	x 1 wiring as per 1JB-0700 (0.54/6731)

11.	Supply, install and wiring of 400 kV Busbar 2 VTJB within the BMK or panel adjacent to the BMK (all wiring is within scope of supply)	x 1 wiring as per 1JB-0700 (0.54/6731)
12.	Supply, install and wiring of 400 kV Diameter GA Connector 1 & 2 VTJB within the BMK or panel adjacent to the BMK (all wiring is within scope of supply)	x 2 wiring as per 1JB-0700 (0.54/6731)
13.	Supply, install and wiring of 400 kV Diameter GB Connector 1 & 2 VTJB within the BMK or panel adjacent to the BMK (all wiring is within scope of supply)	x 2 wiring as per 1JB-0700 (0.54/6731)
14.	Supply, install and wiring of 400 kV Diameter GC Connector 1 & 2 VTJB within the BMK or panel adjacent to the BMK (all wiring is within scope of supply)	x 2 wiring as per 1JB-0700 (0.54/6731)

4.1.4 Breaker-and-a-half line protection schemes

For all breaker-and-a-half EHV and HV transmission line protection applications, the line protection solution shall comprise of a Fault Clearance System (ST_240-96621426_Rev_1).

Each Protection System shall provide the requisite primary, back-up, system and auxiliary protection functions. Within a single Protection System, all protection functions shall reside within a single hardware device. The Protection Scheme is that portion of the Fault Clearance System housed within a cubicle within

the control room building. The Protection System shall interface with the diameter primary equipment through IEC61850 process interface units located in close proximity to the primary plant equipment. The Protection System shall interface with other diameter primary equipment through IEC61850 process interface units for the purpose of transferring tripping and status signals between primary plant object connected to different diameters.

The breaker-and-a-half line protection scheme shall have one IED with all the required protection (distance and current differential protection) functions fully integrated within the IED. A maximum of two line protection IEDs is permissible.

Process interface units (PIU) are required to interface (binary inputs and outputs) between the primary plant equipment and the line protection IEDs. The PIUs shall be located within the relevant JB(s) or bay/breaker marshalling kiosks (GIS applications). The circuit-breaker PIU (breaker, isolator and earth switches) shall be used to interface (IEC61850) with the protection IEDs.

The IEDs (protection and PIU) shall comply with the Generic Specification for Intelligent Electronic Devices (IEDs) Standard, Unique Identifier 240-64685228.

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

Following is the line protection scheme requirements and option selections per 400 kV line. Each line shall have dedicated line protection panels with equipment as per the table and sections below:

	Contract item	**Scheme Code & Drawing No.**
1.	Phase VI Main 1 Line Protection Scheme *Mimics to be selected to match each diameter combination*	6FZDB-2110-M1 (0.52/30551)
2.	Phase VI Main 2 Line Protection Scheme *Mimics to be selected to match each diameter combination*	6FZDB-2110-M2 (0.52/30552)
3.	Fixed frame, rear entry panel for Protection schemes (2400x800x600, 19" rack mount). Refer to 240-60725641.	x 2
4.	Supply, install and wiring of Bay Breaker PIUs (Male and Female half Harting Plugs, coding pins & wiring tail) within the BMK or panel adjacent to the BMK (all wiring within scope of supply)	x 2 (Harting plug wiring as per 6IJB-#300 (0.52/30571)
5.	1U 19" rack mount multi-mode fibre optic patch panel. (Each patch panel can accept 2 fibre optic cables. One Per main panel).	x 2
6.	Duplex Multi mode 50/125 fibre optic patch cord (5 meter), LC-LC Non-Ruggedized for connection between the line protection IED and the Ethernet Switch and between the Fibre Patch Panels and the ethernet switch within the diameter interface panel. Two per main panel.	x 4
7.	Supply, Install & Commission the Line VTJB – where applicable (refer to the station electric diagram)	x 1 wiring as per 1JB-0700 (0.54/6731)
8.	Procure, supply, fitment, wiring and commissioning of the teleprotection interface device per main protection at Philippi and the remote line end.	Per line, to be determined

4.1.4.2 400 kV Feeder 1 (Acacia 1) local and remote line protection requirements

kV	400 kV
Feeder No.	Feeder 1
Feeder name	Acacia 1

Line protection scheme	Refer to the Breaker-and-a-half 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 – Current Differential Protection – Required for Siemens scheme	RED670-ZA11 (Hitachi previously ABB) Procure, install, wiring and commissioning.
Main 1 – Fibre Route for Current Differential Protection communication	Philippi - Acacia 1 400 kV Line Refer to the fibre optic section.
Main 1 – Current differential protection fibre requirements	S/M Duct cable from Feeder Gantry to Fibre Optic Cabinet including patch panel where necessary. S/M Duct cable from Fibre Optic Cabinet to corresponding Protection Panel including complete S/M patch panel and patch leads.
Remote end Line – Main 1 Current Differential Protection	RED670-ZA11 (Hitachi previously ABB). Procure and deliver to Transmission Grid (Western) for installation and commissioning.
Remote Line end Main 2 Impedance Protection	REL670-ZA11 (Hitachi previously ABB). Procure and deliver to Transmission Grid (Western) for installation and commissioning.
Main 2 – Teleprotection	Power Line Carrier equipment which includes the following: • 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.
Main 2 – Remote end Line Teleprotection	Power Line Carrier equipment which includes the following: • 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: • Fibre cables shall be in different trenches. • The steelwork (shell) for the S/M patch panel in the protection panel to be the same as the multimode steelwork. • The Instelec S/M patch panel applicable only to protection panels. • 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”.	

4.1.4.3 400 kV Feeder 2 (Acacia 2) local and remote line protection requirements

kV	400 kV
Feeder No.	Feeder 2
Feeder name	Acacia 2
Line protection scheme	Refer to the Breaker-and-a-half 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 – Current Differential Protection – Required for Siemens scheme	RED670-ZA11 (Hitachi previously ABB) Procure, install, wiring and commissioning.
Main 1 – Fibre Route for Current Differential Protection communication	Philippi - Acacia 2 400 kV Line Refer to the fibre optic section.
Main 1 – Current differential protection fibre requirements	S/M Duct cable from Feeder Gantry to Fibre Optic Cabinet including patch panel where necessary. S/M Duct cable from Fibre Optic Cabinet to corresponding Protection Panel including complete S/M patch panel and patch leads.

Remote end Line – Main 1 Current Differential Protection	RED670-ZA11 (Hitachi previously ABB). Procure and deliver to Transmission Grid (Western) for installation and commissioning.
Remote Line end Main 2 Impedance Protection	REL670-ZA11 (Hitachi previously ABB). Procure and deliver to Transmission Grid (Western) for installation and commissioning.
Main 2 – Teleprotection	Power Line Carrier equipment which includes the following: • 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.
Main 2 – Remote end Line Teleprotection	Power Line Carrier equipment which includes the following: • 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:

- Fibre cables shall be in different trenches.
- The steelwork (shell) for the S/M patch panel in the protection panel to be the same as the multimode steelwork.
- The Instelec S/M patch panel applicable only to protection panels.
- 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”.

4.1.4.4 400 kV Feeder 3 (Erica 1) line protection requirements

kV	400 kV
Feeder No.	Feeder 3
Feeder name	Erica 1
Line protection scheme	Refer to the Breaker-and-a-half 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 – Fibre Route for Current Differential Protection communication	Philippi - Erica 1 400 kV Line Refer to the fibre optic section.
Main 1 – Current differential protection fibre requirements	S/M Duct cable from Feeder Gantry to Fibre Optic Cabinet including patch panel where necessary. S/M Duct cable from Fibre Optic Cabinet to corresponding Protection Panel including complete S/M patch panel and patch leads.
Main 2 – Fibre Route for Current Differential Protection communication	Philippi - Erica 1 400 kV Line Refer to the fibre optic section.
Main 2 – Current differential protection fibre requirements	S/M Duct cable from Feeder Gantry to Fibre Optic Cabinet including patch panel where necessary. S/M Duct cable from Fibre Optic Cabinet to corresponding Protection Panel including complete S/M patch panel and patch leads.
Notes: • Fibre cables shall be in different trenches. • The steelwork (shell) for the S/M patch panel in the protection panel to be the same as the multimode steelwork. • The Instelec S/M patch panel applicable only to protection panels. • The construction of the Erica-Philippi 400 kV Line & OPGW will be covered under the Erica 400/132 kV substation project.	

4.1.5 Breaker-and-a-half auto transformer protection schemes

For all breaker-and-a-half EHV transmission auto transformer protection applications, the transformer protection solution shall comprise of a Fault Clearance System (ST_240-99870095_Rev _1).

Each Protection System shall provide the requisite unit, back-up, system and auxiliary protection functions. Within a single Protection System, all protection functions shall reside within a single hardware device. The Protection Scheme is that portion of the Fault Clearance System housed within a cubicle within the control room building. The Protection System shall interface with the diameter primary equipment and transformer through IEC61850 process interface units located near the primary plant equipment.

The Protection System shall interface with other diameter primary equipment through IEC61850 process interface units for the purpose of transferring tripping and status signals between primary plant object connected to different diameters.

The breaker-and-a-half auto transformer protection scheme shall have one IED with all the required protection functions integrated within the IED. An independent integrated REF is applied per main IED.

Breaker process interface units (PIU) (400 kV bay, 400 kV tie bay and 132 kV bay) are required to interface (binary inputs and outputs) between the primary plant equipment and the transformer protection IEDs. The PIUs shall be located within the relevant JB(s) or bay/breaker marshalling kiosks (GIS applications). Transformer process interface units (PIU) are required to interface between the transformer and the transformer protection IEDs. The PIUs shall be located within the relevant transformer JB(s). The circuit-breaker PIUs (breaker, isolator and earth switches) and transformer PIUs shall be used to interface (IEC61850) with the protection IEDs.

The IEDs (protection and PIU) shall comply with the Generic Specification for Intelligent Electronic Devices (IEDs) Standard, Unique Identifier 240-64685228.

4.1.5.1 Breaker-and-a-half auto transformer protection scheme requirements and options

Following is the auto transformer (400/132/22 kV) protection scheme requirements and option selections per transformer. Each auto transformer shall have dedicated transformer protection panels with equipment as per the table below:

	Contract item	**Scheme Code & Drawing No.**
1.	Phase VI Main 1 Auto Transformer Protection Scheme *Mimics to be selected to match each diameter combination*	6TAB-2300-M1 (With Low Imp REF) (0.52/30440)
2.	Phase VI Main 2 Auto Transformer Protection Scheme *Mimics to be selected to match each diameter combination*	6TAB-2300-M2 (With High Imp REF, Metrosil & Resistor) (0.52/30492)
3.	Fixed frame, rear entry panel for Protection schemes (2400x800x600, 19” rack mount). Refer to 240-60725641.	x 2
4.	Disturbance recorder test block	x 2
5.	Supply, install and wiring of 400 kV Bay Breaker PIUs (Male and Female half Harting Plugs, coding pins & wiring tail) within the BMK or panel adjacent to the BMK (all wiring within scope of supply)	x 2 (Harting plug wiring as per 6IJB-#300

		(0.52/30571)
6.	Supply, install and wiring of 132 kV Bay Breaker PIUs (Male and Female half Harting Plugs, coding pins & wiring tail)	x 2 (Harting plug wiring as per 6JB-#300 (0.52/30795) or (0.52/30798
7.	132 kV Breaker JB *Breaker PIUs to be installed/fitted in the JB*	x 1 (6JB-#300 (0.52/30795) or (0.52/30798
8.	Supply, install and wiring of Transformer PIUs (Male and Female half Harting Plugs, coding pins & wiring tail) within the Transformer JB (all wiring within scope of supply)	x 2 (Harting plug wiring as per 6JB-#200 (0.52/30794) or (0.52/30797)
9.	Supply, install and wiring of Transformer Tap Change PIU (Male and Female half Harting Plugs, coding pins & wiring tail) within the Transformer JB (all wiring within scope of supply)	x 1 (Harting plug wiring as per 6JB-#200 (0.52/30794) or (0.52/30797)
10.	Transformer JB *Transformer PIUs to be installed/fitted in the JB*	x 1 6JB-#200 (0.52/30794) or (0.52/30797)
11.	132 kV Transformer VTJB (1JB-0700) – where applicable (refer to the station electric diagram)	x 1

12.	1U 19" rack mount multi-mode fibre optic patch panel. (Each patch panel can accept 2 fibre optic cables). Two per main panel for connection to the HV breaker PIU, MV breaker PIU and transformer PIU per main transformer panel).	x 4
13.	Din mount fibre optic patch boxes. (The patch boxes to be installed in the Transformer JB)	x 2
14.	Duplex Multi mode 50/125 fibre optic patch cord (5 meter), LC-LC Non-Ruggedized for connection between the transformer protection IED and the Ethernet Switch and between the Fibre Patch Panels and the ethernet switch within the diameter interface panel.	x 8
15.	Duplex Multi mode 50/125 fibre optic patch cord (3 meter), LC-LC Non-Ruggedized for connection between the transformer PIU and the fibre patch boxes. One per main transformer PIU.	x 2
16.	Supply, install and wiring of 132 kV Transformer VTJB within the BMK or panel adjacent to the BMK (all wiring is within scope of supply) – where applicable (refer to the station electric diagram)	x 1 wiring as per 1JB-0700 (0.54/6731)

4.1.5.2 Breaker-and-a-half auto transformer 3 auto-insertion in the event that transformer 1 or 2 becomes unavailable

Following is the auto transformer 3 (400/132/22 kV) auto-insertion requirements.

A 3rd transformer will ensure that all load is supplied should either of the existing two transformers be unavailable together with non-availability of Steenbras generation.

It was envisaged that this 3rd transformer would be on 'hot standby' with a predictable 'time to connect'. Supply shall be available in a very short time in comparison to executing on-site work to make physically the electrical connection at 132kV after the contingency.

An automatic close facility is required for transformer 3.

Modification to the 6DIP-#110 scheme and breaker junction box 6JB-#300 (0.52/30795 or 0.52/30798) is required.

- Auto-closing local indications are required.
- Remote indication is required.
- Auto closing "ON" and "OFF" selection, both local and remote via supervisory is required

For the Auto-close to start or initiate the following conditions shall be met:

- Transformer 3 must be linked on both sides. Only 132kV isolator statuses are required
- Transformer 3 400kV circuit breaker closed.
- Transformer 3 132kV circuit breaker open.
- Transformer 3, no master trip relay operated.
- Transformer 3, no earth applied active signal.
- Auto close ON selected

- Both Transformer 1 and 2 linked. Only 132kV isolator statuses are required
- Both Transformer 1 and 2 132kV circuit breakers closed
- Transformer 1 or 2 tripped or opened.

With Transformer 3, Auto-close “OFF” selected:

- Only manual closing of the 132kV breaker is allowed.

The permitted closing conditions for manual closing and automatic closing/insertion shall be separately settable, allowing different closing conditions to apply.

4.1.5.3 Breaker-and-a-half auto transformer 3 MV Switchgear interface – Cable protection addition

The transformer 3 at Philippi substation will be connected to the MV GIS switchgear via an HV cable, which will be installed in a trench that will be longer than 100m. The isolation point between the transformer and the cable portion is an additional isolator located close to the transformer.

The standard breaker–and–a–half protection shall remain applied across the transformer and the cable i.e. using CT’s on the GIS MV switchgear. The existing breaker–and–a–half standard schemes do not include provision for cable protection as an option. This raised concern from operating point of view regarding the identification of the location of the fault, especially if the fault is located in the cable portion of the installation, which could result in delayed restoration of the transformer as well as unnecessary testing of healthy transformer.

In order to shorten the restoration of the tripped transformer, make it quick and easier sanctioning of the transformer by eliminating the unnecessary re-testing of the transformer for cable faults external to the transformer, the following modification shall be applied to the Main 1 of the standard scheme without changing the standard configuration.

- High impedance Differential Relay shall be applied across the cable (Simple relay with Trip with indication facility).
- The Cable differential relay tripping shall be routed through the standard scheme main IED as an external input.
- The Cable Differential relay shall trip both the circuit breakers directly and shall not operate Master trip relays.
- The Cable Differential relay shall be equipped with indication facility that can be easily labelled for local display.
- The Cable Differential relay shall be locally and remotely reported.
- The Cable Differential relay shall be rated at 110/220Vdc, 1A

This modification requires an additional Ring-Core CT’s installed in each phase on one side only that shall be used together with transformer MV bushing CT’s. These CT cores shall be installed close to the MV end of the cable. The specification for the ring – core CT shall be as follows:

Application	Number	Ratio or IP	Turns Ratio	Across	VA or Vk/1m	Class & ALF	Rs at 75 deg C
Cable Diff	2a;2b;2c	2400	2400/1	S1/S2	750	TPS	< 9.6

4.1.6 Breaker-and-a-half auto transformer on load tap change control scheme

Within the Eskom electrical supply networks practically all transformers of 10 MVA and above have on load tap-changing equipment fitted (ST_240-99870095_Rev_1). The principle use of OLTC equipment is for the voltage regulation within the network and for the control of MW and MVAr flows across interconnectors. Location of the tapped part of a winding is partly a construction question. It is generally done on that winding which is placed outside. Bushing insulators are required when tapping is done at the line ends. With tappings near the line ends, the number of bushing insulators is reduced and with tappings near the neutral ends, the phase-to-phase insulation conditions are eased.

The tap changer compartment is normally segregated from the main transformer tank in order to prevent the contaminated oil from the tap changer mixing with that of the transformer in this way separate oil actuated protection is provided for within the tap changer.

4.1.6.1 Breaker-and-a-half auto transformer on load tap change scheme requirements and options

Following is the auto transformer (400/132/22 kV) on load tap change scheme requirements and option selections per transformer. Each on load tap change scheme shall have the equipment and requirements as per the table below:

	Contract item	**Scheme Code & Drawing No.**
1.	Auto Transformer on load tap change Scheme	6TCP-2101 with 6TC2101-1 and 6TC2101-2 modules (0.52/30637, 0.52/30586, 0.52/30653)
2.	Fixed frame, rear entry panel for Protection schemes (2400x800x600, 19” rack mount). Refer to 240-60725641.	x 2
3.	Large Bay Switch (supply, fitment and wiring) Ruggedcom RSG-2100: 6GK6021-0AS23-3DB0-ZA05+B05+C05+D05+E02+F00+G05+H00+J00+K01	x 1
4.	Duplex Multi mode 50/125 fibre optic patch cord, Non-Ruggedized (LC-LC) for connection between the all the IEDs within the diameter (including the protection IEDs and the PIUs) and Ethernet Switch and the Fibre Patch Panels	Contractor to determine requirement.
5.	Supply, install and wiring of Tap Change PIUs (Male and Female half Harting Plugs, coding pins & wiring tail) within the Transformer JB (all wiring within scope of supply)	x 1 (Harting plug wiring as per 6JB-#200 (0.52/30794) or (0.52/30797)
6.	1U 19'' rack mount Multi mode fibre optic patch panels. (Each patch panel can accept 2 fibre optic cables).	x 1
7.	Din mount fibre optic patch box. (The patch box to be installed in the Transformer JB for tap change PIU). One per tap change in the transformer JB.	x 2
8.	Engineering: Large Bay Switch	x 1
9.	Tap Change Documentation	x 1

4.1.7 Junction Box / Marshalling kiosks

The breaker marshalling kiosks (GIS application) are required to provide for and interface with the equipment as per 6IJB-#300 (0.52/30571).

The transformer junction boxes are required to provide for and interface with the equipment as per 6JB-#200 (0.52/30794 or 0.52/30797), transformer and online tap changer functionality.

The breaker junction boxes are required to provide for and interface with the 132 kV equipment as per 6JB-#300 (0.52/30795 or 0.52/30798). The JBs shall be located close to the perimeter fence that is the demarcation between CoCT and Eskom Transmission.

If the GIS marshalling kiosk is unable to provide for the required equipment and interfaces, then the marshalling kiosk panels shall be located in close proximity to the GIS marshalling kiosks. This shall be included within the scope of supply. The tenderer shall submit the GIS marshalling kiosk layouts and designs with the required equipment and interfaces or the marshalling kiosk panels shall be required and included to provide for the required equipment and interfaces.

The junction boxes shall be sourced from the following approved suppliers:

Sivtek Holdings (Contract No. 460067641)

Vithale Electrical CC (Contract No. 4600067642)

Siemens (Pty) Ltd

4.1.8 Marshalling kiosk panel

Marshalling kiosk panel(s) is required to be manufactured and factory tested for the Siemens solutions if the GIS marshalling kiosk does not cater for the installation and wiring of the bay/breaker main 1 and main 2 PIUs. The marshalling kiosk panels shall also include 2 x fibre patch boxes.

4.1.8.1 Marshalling kiosk panel requirements

The marshalling kiosk panel, per bay (breaker) shall include but not limited to:

- Marshalling kiosk panel main label.
- Main 1 PIU with Male and Female half Harting Plugs, coding pins & wiring tails.
- Main 2 PIU with Male and Female half Harting Plugs, coding pins & wiring tails.
- Panel Not Healthy Indication (supplied by 230 VAC).
- Main 1 DC Isolating MCB.
- Main 1 PIU DC Isolating MCB.
- Main 2 DC Isolating MCB.
- Main 2 PIU DC Isolating MCB.
- Main 1 DC supply monitoring relay.
- Main 2 DC supply monitoring relay.
- Secure supply chop over circuit as per 6IJB-#300 (0.52/30571).
- Secure supply monitoring relay.
- Common DC Isolating MCB (located within secure supply circuit).
- Common DC supply monitoring relay.
- Motorised isolator control DC Isolating MCB (located within secure supply circuit).
- Motorised isolator control DC supply monitoring relay.

- The breaker bay marshalling kiosk panel wiring interface with the bay marshalling kiosk shall be as per 6IJB-#300 (0.52/30571).
- 2 x Duplex Multi mode (LC-LC) 50/125 fibre optic patch cord (3 meter), per bay, Non-Ruggedized for connection between the PIUs and the Fibre Patch boxes.
- 2 x Multi mode Fibre patch boxes (breaker PIUs).

The marshalling kiosk panel shall comply with the Specification for the Interfacing of the new protection and control equipment to the GIS Bay Marshalling Kiosk, Unique Identifier 240-146288697.

The tenderer shall finalize the right amount of the panel terminals as per the final design requirements and shall submit a design proposal for this solution and timelines with the tender submission.

4.1.9 400 kV Bus zone

A busbar protection system should dynamically replicate the bus topology and contain design flexibility to protect all existing bus arrangements. In general, the main requirements for busbar protection include security, dependability, speed, sensitivity and selectivity. The dominating protection principle of busbar protection is the differential principle, documented in 240-130892365 Phase VI Bus zone Protection Philosophy for Breaker and a Half and Double Busbar Transmission Networks.

The following equipment shall be sourced, configured, factory tested, delivered, installed and commissioned:

400 kV	
Contract item	**Scheme Code & Drawing No.**
6BZB-2810 Bus zone Protection scheme 8 bay (1 Panel) – 110Vdc	6BZB-2810 (0.52/30452)
1 - 8 Bay 1 Panel, swing frame front and rear entry, Eskom Drawing number 0.52-30616. Refer to 240-60725641.	x 1
Serial Device Server (supply, fitment and wiring) Ruggedcom RS-416: 6GK6041-6AT23-3DB0-Z A02+B00+C00+D00+E05+F01	x 1
1U 19" rack mount multi-mode fibre optic patch panel.	x 1
Duplex Multi mode 50/125 fibre optic patch cord (3 meter), LC-LC Non-Ruggedized for connection between the Ethernet switch and the fibre patch panel.	x 1
Configure 8 Bay Breaker and Half	x 1

The bay unit allocation shall follow the bus zone application guide 240-170000636 Phase VI Low Impedance Bus zone Protection Scheme.

In the breaker and a half busbar arrangement the bays are allocated as per scheme design. It does not matter if the diameter #A starts form left or right.

AC and DC shall not be in the same cable. Therefore the CT's shall have its own cable and the Isolators shall have its own cable. The M and N auxiliary contacts shall be used for isolator indication.

The configuration of the bus zone shall be done by the tenderer. The tenderer shall provide a comprehensive method statement on the bus zone scheme to comply with the working standards and philosophy in terms of Configuration, Settings, Testing and Commissioning.

The tenderer shall compile a factory and site commissioning test plan and shall be submitted to Eskom for review 4 weeks prior the testing activity.

The Bus zone scheme is fitted with an Ethernet switch. The ethernet switch shall be engineered and connected to the substation automation fibre network.

The Bus zone scheme, interface with the main 1 and main 2 protection systems via copper. The cabling between the protection bays (main 1 and main 2) shall appear on the specific protection bay's cable schedule.

The cabling to the DC board and the IDF shall be on the bus zone cable schedule.

4.2 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 or manufactured as per Eskom approved scheme design.

Disturbance recorders are used to monitor and record (i) analogue data (voltages and currents) and (ii) digital data from power system protection equipment (relays/IEDs and high voltage (HV) switching equipment), during faults or disturbances on the system. Travelling Wave System (TWS) fault locator devices are used to locate distance to faults on transmission lines.

In Eskom Transmission, the terms 'disturbance recorder' and 'digital fault recorder (DFR)' are both used to refer to the same device. The document 240-170000791 Transmission Disturbance Recorder Philosophy shall be used as a guide on disturbance recorder application requirements.

4.2.1 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 Feeders B&H - 110 VDC	1
Loose: IDM+6U with 27A/96B c/w Chassis Plate & Loom - 110 VDC	1
SecuControl 8 Way Test Block (FLTP08015AD-SL17F-1523)	1
Additional Card for Traveling Wave Fault Locator	3
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: 1201 - 1500km	1

4.2.1.1 400 kV scheme 1 type, drawing application levels and bay allocations

Scheme Type:	6DRB-7100
Master Drawing No.:	0.52/30114
Applicable drawing application levels:	1, 2, 10, 14, 15, 16, 33, 36, 46, 47, 64, 66
DFR1-DAU1:	400 kV Feeder 1
DFR1-DAU2:	400 kV Feeder 2
DFR2-DAU1:	400 kV Feeder 3

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

4.2.1.2 400 kV scheme 1, current transformer test block allocation and labelling

CTTB 1-1	400kV FDR 1 BAY CURRENT TEST BLOCK	**CTTB 1-2**	400kV FDR 1 TIE CURRENT TEST BLOCK
CTTB 2-1	400kV FDR 2 BAY CURRENT TEST BLOCK	**CTTB 2-2**	400kV FDR 2 TIE CURRENT TEST BLOCK
CTTB 3-1	400kV FDR 3 BAY CURRENT TEST BLOCK	**CTTB 3-2**	400kV FDR 3 TIE CURRENT TEST BLOCK

The current transformer test block allocations and label inscriptions shall be provided to the supplier when the order for the equipment is placed.

4.2.2 400kV Scheme 2

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

Item Description	Quantity
Scheme: 1 Transformer B&H (Trfr MV - DBB Config) - 110 VDC	1
Loose: IDM+6U with 27A/96B c/w Chassis Plate & Loom - 110 VDC	2
SecuControl 8 Way Test Block (FLTP08015AD-SL17F-1523)	4
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

4.2.2.1 400 kV scheme 2 type, drawing application levels and bay allocations

Scheme Type:	6DRB-7100
Master Drawing No.:	0.52/30114
Applicable drawing application levels:	1, 2, 10, 33, 35, 46, 47, 48, 49, 50, 67, 68, 69
DFR1-DAU1:	400/132 kV Transformer 1 – HV side
DFR1-DAU2:	400/132 kV Transformer 1 – MV side
DFR2-DAU1:	400/132 kV Transformer 2 – HV side
DFR2-DAU2:	400/132 kV Transformer 2 – MV side
DFR3-DAU1:	400/132 kV Transformer 3 – HV side
DFR3-DAU2:	400/132 kV Transformer 3 – MV side

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

4.2.2.2 400 kV scheme 2, current transformer test block allocation and labelling

CTTB 1-1	TRFR 1 HV BAY CURRENT TEST BLOCK	**CTTB 1-2**	TRFR 1 HV TIE CURRENT TEST BLOCK
CTTB 2-1	TRFR 1 MV BAY CURRENT TEST BLOCK	**CTTB 2-2**	NOT USED
CTTB 3-1	TRFR 2 HV BAY CURRENT TEST BLOCK	**CTTB 3-2**	TRFR 2 HV TIE CURRENT TEST BLOCK
CTTB 4-1	TRFR 2 MV BAY CURRENT TEST BLOCK	**CTTB 4-2**	NOT USED
CTTB 5-1	TRFR 3 HV BAY CURRENT TEST BLOCK	**CTTB 5-2**	TRFR 3 HV TIE CURRENT TEST BLOCK
CTTB 6-1	TRFR 3 MV BAY CURRENT TEST BLOCK	**CTTB 6-2**	NOT USED

The current transformer test block allocations and label inscriptions shall be provided to the supplier when the order for the equipment is placed.

4.2.3 Telecommunication connection requirements

2 x Ethernet circuit (copper) at 128 kbps per scheme for use by national control.

5. Teleprotection

All required teleprotection equipment shall be sourced from an Eskom approved supplier(s). 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 all the 400 kV Feeders 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 position of Line Traps shall be allocated by Eskom Technology. The information listed in Table 1 shall be provided to Eskom for each feeder/line before the study can be completed. The information shall include the existing line as well as the new line or loop-in sections. Once all information is provided, 4 months is required to complete the Line Trap allocation study.

The PLC frequency allocation shall be completed by Eskom Technology. The information listed in Table 2 shall be provided before the study can be completed. Once all information is provided, 4 months is required to complete the PLC frequency allocation. Important to note, that the PLC frequencies can only be allocated after the Line Trap positions have been determined.

The PLC terminal equipment, Line Matching Equipment (LMEs) and Line Traps require the allocated PLC frequencies before any of the equipment can be ordered. 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, if applicable.

The X.21 circuits from Eskom Telecomms (ET) shall be detailed in the ET’s SOW document and shall be connected to the TPE, if applicable.

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.

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 tenderer 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 651 or ETL 6101 (Hitachi Energy South Africa)
- Teleprotection Equipment (TPE) – 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 Arteche Line Traps Supplied by Mega HVT (Arteche)
  - 240-170000184: Technical Bulletin for GE Line Traps Supplied by Actom

Table 1: Line Parameters

Tower Type(s)	
Line Length (km)	
Line Voltage (kV)	
Phase Conductors (Type)	
Earth Conductors (Type)	
Number of Phase Conductors in Bundle	
Bundle Spacing (mm)	
Attachment Position (Horizontal (x) & Vertical (y)) for all 3 Phase Conductors (Red/White/Blue) (m)	
Attachment Position (Horizontal (x) & Vertical (y)) for all Earth Conductors (m)	
Sag Phase Conductors (if available) (m)	
Sag Earth Conductors (if available) (m)	
Number of Transpositions	
Transposition locations (km)	
Transposition Swap sequences	

Phasing drawing displaying the Line Phasing which corresponds to the substation phasing diagrams at both ends of the line. (Should be provided by Substations department)	

Table 2: Checklist for requesting PLC frequencies from PTM&C Telecomms

Checklist of Required Information when requesting PLC Frequencies			
No.	**Item**	**Comments**	**Check Y/N**
1	Powerline Network diagram	A diagram showing the power network topology.	
2	Project Execution Plan	The sequence of events for project execution	
3	Teleprotection plan for new project	To determine the new requirements	
4	As-built PLC frequency allocations at local and remote substations	Photographs of all Carrier Panels at local and Remote Substations clearly displaying the frequencies	

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 Part 2 Substations
- 240-70733995, Optical Distribution Frame / Patch Panel
- 240-60725641, Specification for standard (19 inch) equipment cabinets
- 240-70732888, Fibre optic cable system acceptance testing procedure
- 240-46263618, Labelling of fibre optic cables
- 240-722740830, 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
- 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 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 240-722740830.
- 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.

Suppliers/OEMs

- Approved Fibre optic duct cables are sourced from CBi, MTEC (SA) & AMhengtong.
- Approved Single mode Patch Panel (Prysmian type) sourced from Adenco, Golden Dynasty SA, Prysmian (SA) & Cable Feeder Systems.
- Approved Multimode and Single mode Patch Panel sourced from Instelec
- Approved Multimode Patch Box sourced from Instelec.

	Multimode Fibre Optic Cables	**Fibre Requirements for BAH & Automation Schemes**
1.	Between Junction Boxes or Bay/Breaker Marshalling Kiosk (GIS application) in HV yard and Control Room	MM Duct cable (50/125 µm) from JB/BMK in the 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 JB/BMK.
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.
	Single mode Fibre Optic Cables	**Fibre Requirements for Feeder bays**
1.	Between Gantry in the HV yard and Control Room	SM Duct cable (9/125 µm) from the gantry (dome-joint box) in the HV yard to the Fibre Optic Panel in the control room shall be terminated in the patch panel(s) installed in the Fibre Optic Panel.

2.	Between Panels within the Control Room	SM Duct cable (9/125 µm) shall be terminated in the installed patch panels from Fibre Optic Panel and Protection Schemes M1 & M2 in the control room.

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. Metering and measurements

7.1 Metering

7.1.1 400/132 kV Auto transformers and Distribution metering equipment

The following equipment for 400/132 kV Auto transformer 1, 2 & 3 and 132 kV Bulk supply shall be sourced from an Eskom Approved supplier(s), factory tested, delivered, installed and commissioned. The selection and installation of the appropriate metering commodities shall be done in accordance with the standard listed below:

- 240-132226392: Application Guideline for Transmission Metering Commodities.
- S8-Master Drawing: 0.52/30131
- Distribution Master Drawing: 3MM01C

7.1.1.1 Panel 1 (Transformers)

Item Description	Quantity
Panel: (800 x 600 x 2400mm)	1
Module: Metering 19” rack mount 6-way CT test blocks	3
Module, Modem, D9404	1
Module, Quality of Supply, D9403	3
Plate: Blanking 3U, D9141	2
Plate: Blanking 5U, D9141	1
Plate, Blanking 7U, D9141	1
Fitment of module into panel	7
Meter 3 PH, 1A, CL0.2, 2 x RS485 & ETH 110V PROG - 6 OUT	6
Modem: Advanced Cellular Removable SIM Modem; 3G	1
PQ monitoring instrument – Permanent substation, 19" rack mounted	3

7.1.1.2 Panel 2 (Distribution metering panel)

SAP	Reference	Rev	Item Description	Quantity
0569918	D-DT-9400	0	3MM01C Meter Module	3
0230645	D-DT-5804	4	Modem Module	1
0686396	D-DT-9420	6	Meter ZMD 1A 3PH CL0.2 2xRS485 (ZMD402CT44.0607.B2)	6
0661604			Modem: Advanced Cellular Chip SIM Modem; 3G	1
0606351	D-DT-9503	5	Webb ESKANT Antenna	1
0402613			Panel: (800 x 600 x 2400mm)	1

Note: The commissioning of the metering equipment for Eskom Distribution shall be done by Distribution CPM metering section.

7.2 Measurements

Measurements functions are performed in the diameter control devices for BAH and protection IED for DBB schemes.

8. Telecontrol and substation automation

The telecontrol and substation automation equipment shall be sourced from an Eskom approved supplier which is:

- **Siemens (Pty) Ltd (Contract No. 4600067750)**

8.1 Telecontrol and substation automation equipment

The telecontrol and substation automation equipment for a Siemens solution shall comprise the approved schemes in the application guide document: 240-170000395 Substation Control and Automation Application Guide for Phase VI Siemens Solution.

The tenderer(s) is encouraged to engage with the Eskom approved supplier and utilise this document to determine the equipment required for the complete substation automation system. The complete substation automation bill of material shall be submitted with the tender.

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

- Eskom requirements in respect of switches and routers must be applied as per the Standard Networking Devices for the Substation Environment Standard: 240-68111223, the network architecture shall comply with the Substation Automation – Network Architecture Standard for Transmission Substations: 240-612689959 and the configuration shall comply with the guide, 240-170000091 Networking Devices Configuration Guide for the Transmission Substations.
- GPS time synchronisation equipment must be provided for the time synchronisation of all Transmission Protection and Automation equipment as per Standard 240-100176258.
- 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.
- The tenderer must develop and provide a report document prescribing the detailed interlocking rules for Philippi substation.

- The interlocking rules will be workshopped for acceptance with the respective Grid & Substation Automation Integration before implementation.
- The tenderer must develop an interlocking rules acceptance test procedure which will be used during the Integrated Substation Solution Factory Testing (section 14.2) to prove the correct operation of the implemented interlocking rules on the Gateway and SCADA HMI. The test procedure must:
    - Be shared with Eskom for review 4 weeks prior to Integrated Substation Solution Factory Test commencing.
    - Include a procedure to test all the equations for each of the pseudo parameters (No Earth Busbars, No Earth Lines, No Line Voltages, No Earth Transformers, etc) for both quality and status.
    - Include a test for every operable device's interlocking equations such that the status and quality of each equation element can individually be tested to validate the correct change between not interlocked, interlocked and not interlocked, as far as possible.
    - Include any other necessary test to ensure the correct implementation and operation of the interlocking rules on the Gateway and SCADA HMI.
- The tenderer shall follow the Eskom SCADA HMI interlocking design guidelines
- All equipment must meet its functional and interface requirements as specified in Substation Gateway and Station RTU/IED standard: 240-68234842
- GIS alarms that are not included within the standard scheme designs shall be reported via the station IED/RTU to the gateway(s) and the station HMI(s).
- The tenderer shall be responsible for the engineering and configuration of all telecontrol, substation automation equipment. This includes but is not limited to the Ethernet network equipment, the GPS equipment, the Gateways, HMIs and the Station IEDs.
- The tenderer shall be responsible for the IEC61850 engineering and configuration of all the protection and substation automation equipment.
- The tenderer shall be responsible for the assignment of the technical key names for IEDs as per the Eskom guide: 240-170000601 Standard for Assigning Physical Device Technical Keys in Transmission
- The tenderer shall produce a substation network diagram inclusive of technical key names for all IEDs that require an IP address. An example diagram may be requested from Eskom.
- Device IP Addresses will be allocated by Eskom PTM&C. The tenderer shall supply a completed application form on the ESKOM PTM&C standard template provided with a substation network diagram. Four weeks' notice is required following receipt of a complete IP address application form.
- The tenderer shall update the substation network diagram with the IP addresses provided by Eskom.
- The tenderer shall provide the I/O signal list for each scheme type.
- The tenderer shall compile the database for the gateway and station HMI. The database shall be based on the standard commodity database templates and the station IED signal list.
- The IEC60870-5-101 signal database for National Control, Standby National Control and Regional Control Centres shall be created by Eskom PTM&C. The signal lists for each of the protection schemes and station IEDs to be used for the signal database must be provided to Eskom PTM&C at least 6 months prior to the factory testing of the SCADA. Standard Eskom PTM&C templates to be used and templates to be created for the schemes to be developed.

9. Auxiliary supplies (AC & DC systems)

9.1 DC systems

The tenderer shall design, procure (from the Eskom approved suppliers), supply, install and commission:

- Dual 110 V DC system (2 x charger panels and 2 by DC distribution panels).
- Dual 50 V DC system (2 x charger panels and 2 by DC distribution panels).
- Dual 110 V battery banks.
- Dual 50 V battery banks.
- DC power distribution and control cables.

The sizing of the chargers and the calculation of the battery capacity shall be done as part of the design by the tenderer. The protection, telecontrol & automation equipment shall make use of the 110 VDC. The telecommunication and teleprotection (PLC) equipment shall make use of the 50 VDC.

The tenderer(s) is encouraged to engage the suppliers to determine the equipment required for the complete dual 110 VDC and dual 50 VDC DC systems. The complete bill of material per DC system and shall be submitted with the tender.

Eskom approved suppliers

- Battery Chargers: ACTOM (COM10) (Pty) Ltd, (Contract No. 4600070943)
- Batteries and Stands: Kopano Power (Pty) Ltd (Contract No. 4600068756)

The applicable standards shall apply:

- 240-91190310: Sizing of DC systems for substation applications
- 240-84979963: DC Systems Design Guide for Telecommunications.

9.1.1 Battery chargers

The battery chargers for 110 V and 50 V DC systems shall be sourced from the Eskom approved supplier, factory tested, delivered, installed and commissioned.

Item Description	Quantity
110V/***A Dual Battery Charger & Dual DC Board ▪ ***Ah – Rating dependent on the required battery sizing.	1
50V/***A Dual Battery Charger & Dual DC Board ▪ ***Ah – Rating dependent on the required battery sizing.	1

9.1.2 Batteries and Stands

The batteries and stands for 110 V and 50 V DC systems shall be sourced from an Eskom approved supplier, factory tested, delivered, installed and commissioned.

Item Description	Quantity
BOTTLE: LEAD ACID BATTERIES	1
FUNNEL: LEAD ACID BATTERIES D9260	1
HYDROMETER: AREOMETER LEAD ACID BATTERY	1
THERMOMETER LEAD ACID BATTERIES	1
JUG LEAD ACID BATTERIES	1
RACK, MAINT AND SAFETY EQUIPMENT	1

BOOK, MAINT LOG LA BATT 104CELL	4
PAINT: TOUCH UP;1000 ML;BATTERY STAND	1
BRUSH, PAINT:WD 50 MM	1
SIGN, DCSS1 - BATTERY ROOM	1
BOTTLE, EYE IRRIGATING:500 ML	1
110 VDC FRCT Battery Stands – ▪ Dependent on the number of batteries as per the Amp Hour rating requirement	2
50 VDC DRST Battery stands ▪ Dependent on the number of batteries as per the Amp Hour rating requirement	2
Connector, Battery Inter-row – 110 VDC ▪ # Quantity dependent on Amp Hour rating requirement	#
Connector, Battery Inter-row – 50 VDC ▪ # Quantity dependent on Amp Hour rating requirement	#
Terminating device – 110 VDC ▪ # Quantity dependent on Amp Hour rating requirement	#
Terminating device – 50 VDC ▪ # Quantity dependent on Amp Hour rating requirement	#
Battery, individual cells – 110 VDC ▪ # Quantity dependent on Amp Hour rating requirement	#
Battery, individual cells – 50 VDC ▪ # Quantity dependent on Amp Hour rating requirement	#

9.2 AC systems

The final calculation of the substation AC requirements shall be done as part of the design by the tenderer. All products shall be sourced from the Eskom approved supplier(s) listed below:

- Sabi Switchboards CC (Contract No. 4600071217)
- PPS JV Msebe (Contract No. 4600071274)

The following standards shall apply:

- 240-55151946: AC Reticulation philosophy for substations
- 240-55151908: AC Reticulation Application Design Guideline for Substations
- 240-64139144: AC Boards and Junction boxes for substations
- 240-76628687: AC/DC Reticulation equipment for Breaker–and–a–half substations
- 240-64139234: Compliance of LV Auxiliary Supply Networks in Substations
- Supply, Install and Commission 230 V AC Distribution Board (0.54/7106)

- Supply, Install and Commission 400 V AC Substation Distribution Board (0.54/08596) or (0.54/7468) or (0.52/20250)
- Supply, Install and Commission Transformer Distribution Boards (0.52/20252) or (0.54/7466)
- Supply, Install and Commission Plug Boxes – 1PB-0100 (0.52/20251)
- The Transmission Grid technicians shall witness the commissioning and testing as well as acceptance of the test results.

10. Telecommunications

Telecommunications provides operational and business telecommunication services to Eskom. The circuits provided by Telecommunications are used for operational services such as teleprotection, telecontrol (SCADA), metering, QOS, DFR & TWS, EADS, Security and direct voice lines etc. These circuits are provided based on contractually defined service levels that have associated performance requirements.

The project shall provide Eskom Transmission with telecoms services for the new substation for Tx to be able to monitor, manage and maintain electricity supply network with minimum or no disruptions to the safety of operations and supply.

The Telecommunication Design requirements shall be provided in a separate process and documented by Telecomms. Refer to Telecommunication Design Document (PRJ11229) for the scope of work and BOQ.

Note:

- It is important to note that the Telecommunication approval process must be followed during the execution of the project and all necessary approvals must be obtained from the TDRT.
- The changes in the network requirements and technology changes must be taken into consideration during execution. Due diligence must be done to ensure that where technologies have changed, compliance with the network requirements and the use of Eskom approved technologies are adhered to through the “Eskom Design Change Management Process”.

11. Application Engineering design

11.1 Application design requirements

The protection application design, interface between the Eskom standard protection schemes and the primary plant and secondary plant equipment, shall be the responsibility of the tenderer. The standard Eskom scheme design diagrams, which include applications levels and the interface requirements to the primary plant equipment and the substation control/relay room equipment, shall be used. Level 31 on the master drawings act as a guideline on how the primary plant equipment is going to be applied, however it is only done on a high level and the actual detailed plant information will only be added during the application design phase. No checking or reviewing of the application drawings will be done by Eskom before and/or during the construction phase of the project. No changes to the standard (master) scheme design are permitted, the application design focus only on the interface between the primary plant equipment and the standard protection schemes. The circuit breaker, isolator with earth switch and transformer cell (wiring) drawings shall form part of the final application drawing. Eskom will supply drawing numbers.

The remote end application drawings shall be done by Eskom. The tenderer shall provide all the required information on time for the remote end including but not limited to primary plant equipment, relays etc.

The integration, cabling and wiring of all the Transmission PTM&C equipment within the control/relay room shall be within the tenderer’s scope of supply. The final set of application design for construction shall be made available prior to energisation of the primary plant for Settings and SCADA purposes. The stringing, cabling, earthing and erection specification for transmission substations – 240-82736997 shall be adhere to or a later version. The installation of cables and cable racking shall be in strict accordance with the law, SABS codes of practice and standards. The tenderer shall provide all the secondary plant package including but not limited to SOW, application drawings, primary plant equipment, BOM etc. during the project hand over phase.

The tenderer shall submit the application drawings 'As Built' after the final commissioning as revision 0 to be registered by the Eskom CAD Office. The tenderer shall submit all the 'As Built' configurations & settings to Eskom.

The following standard shall be used:

- 240-68980568 – Standard for the Application of Transmission and Distribution Protection Schemes
- 240-96632721 – Secondary Plant Drawing Practice Standard for Transmission and Distribution

11.2 Control room layout

Build control room according to Substation design standard and sizing will be determined by the station electric diagram (including all existing and future bays).

The Main 1 and Main 2 equipment shall be located in separate rows in the control room (Phase VI equipment only).

The location of the HMI workstations shall be located in a separate room in the control room. The HMI panels shall be floor mounted on a ≥100mm bracket if the HMI room is made of dry wall.

The control room layout shall make provision for equipment associated with all bays identified as "future" in the substation single line diagram. Control room layout shall be accepted by Eskom before construction.

12. Supply of Cables and Cable Installation

The LV Power and Control cables shall be sourced from the Eskom approved supplier(s) in accordance with the standard approved cables indicated in the buyer's guide and/or 240-56063805 specification.

The approved suppliers are listed below:

- CBI Electric African Cable (Contract No. 4600072801)
- M-TEC (Contract No. 4600072804)
- Aberdare Cables (Pty) Ltd (Contract No. 4600073210)

The approved suppliers for data and telephone cables are listed below:

- World Telecom and Data (Contract No. 4600069611)
- Sivtek (Contract No. 4600069639)

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 cabling and cable block diagrams provided in the final application drawings for construction.
- Decommissioning and Removing of old equipment & associated cables. The contractor shall ensure the panels are isolated and made safe for working before any work can commence.

The following standards 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
- 240-48887441 – Buyers Guide (D-DT-3128)
- 240-64813568 – Standard Indoor and Outdoor Telephone Cable
- 240-64636794 – Standard for Wiring and Cable Marking in Substations
- 240-46425213 – Cable Testing Control Plant
- 240-168928041 – Secondary Cable Removal Strategy in Western Grid

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

13. 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 final schemes, IED logic designs and IED documentation, for the schemes to be developed by the tenderer (appointed contractor), shall be submitted to Eskom 8 weeks prior factory testing for compilation of the settings templates.

The request for settings shall be submitted 6 weeks and available prior factory testing.

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)

14. Factory testing

The tenderer shall submit a project schedule which shall include all the required factory testing requirements and activities for the PTM&C equipment at Philippi substation. The successful tenderer shall compile a detailed factory test plan, which include the standard developed schemes and the new schemes to be developed, 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, IED logics and overall scheme functionality with Eskom participation prior the integrated substation factory testing. All the scheme IED settings shall be available 6 weeks prior functional testing per scheme and per bay.

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.

The following high level testing are required, but not limited to:

- Scheme inputs and outputs, binary and analogue
- Signals between main 1 and main 2 systems
- Signals between object protection systems within the same diameter
- Signals between the protection schemes and the process interface units (applicable to the Siemens equipment); Etc.

14.1 Factory acceptance testing requirements of the schemes to be manufactured

Factory acceptance testing is required for the schemes/panels to be manufactured. The tests shall be witnessed and accepted by PTM&C Technology and Transmission Grid West.

The tenderer shall submit to Eskom a detailed factory acceptance testing plan for verification 8 weeks prior commencement of factory acceptance testing.

The tenderer's engineers shall, with the participation of the Eskom representative(s):

- Verify that the equipment is of sound construction and, so far as can be ascertained, meets the requirements of the standard and the offered equipment.

- Carry out performance/functional tests to demonstrate its performance is in accordance with the functional requirements and applicable standards. The tenderer shall correct and retest any identified error or deviation from the requirements.

14.2 Integrated substation solution factory testing

The PTM&C equipment shall be pre-commissioned as an integrated substation solution in the factory environment before delivery to site. This will allow for the minimisation of site commissioning time and allow for the detection and resolution of problems prior to product delivery to site.

Factory testing shall include the testing of application-specific device settings and the configuration and testing of the gateway and HMI (including interlocking).

The integrated substation solution factory testing plan shall be submitted by the tenderer to Eskom 6 weeks prior start of the factory testing. The following high level testing are required, but not limited to:

- Signals between the schemes, the gateway and the station HMI.
- Interlocking rules.
- SCADA controls; Etc.

15. 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 Western 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 most of 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.
- 240-55197966: Commissioning of Metering Installations (HV and MV)
- 240-97931387: Commissioning MV and HV Metering R4
- 240-143813712: Battery Installation and Commissioning
- 240-170000055: Installation and Commissioning of Power Electronics Equipment
- 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

15.1 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) 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 needs to provide a commissioning sequence. The commissioning sequence must be discussed with the Grid.
- The tenderer shall ensure the final switching procedure is drawn up with Grid and National Control

The commissioning sequence may change based on the network constrains and requirements from the nation control.

16. Delivery, off-loading and site erection

The tenderer shall include the delivery, off-loading and site erection of all the PTM&C equipment within this scope of supply to Philippi substation Control Room.

17. General

- The basic and detailed designs shall be presented to Eskom PTM&C DRT for acceptance, and these designs are to be accepted by Eskom prior to proceeding to the next stage. Acceptance of designs by Eskom does not relieve the contractor of their accountability for the design.
- The tenderers shall submit a basic design, with proposed control room layout indicating each scheme / panel / item of equipment per discipline, with the tender.
- The tenderers shall provide high level designs and timelines for the panel to be developed.
- All work shall comply with the latest standards as and where required
    - 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
    - 240-96632721 – Secondary Plant Drawing Practice Standard for Transmission and Distribution
    - 240-68980568 – Standard for the Application of Transmission and Distribution Protection Schemes
    - 240-82736997 – The stringing, cabling, earthing and erection specification for transmission substations
- The IDF equipment and accessories shall be sourced from an Eskom approved supplier.
- The installation of cables and cable racking shall be in strict accordance with the law, SABS codes of practice and standards, any deviations to be approved by Eskom.
- Eskom will supply drawing numbers. The tenderer shall request drawing numbers from Eskom.
- The tenderer shall request the latest master (scheme) drawings for commodity sourcing & application engineering from the supplier for the Siemens products. The scheme drawings shall be supplied for the other commodities unless advised otherwise in advance.
- Eskom will not be checking or reviewing any of the application drawings during the construction phase of the project.
- Eskom will be responsible for the remote end application drawings.
- The tenderer shall provide all the PTM&C design package including but not limited to SOW, application drawings, primary plant equipment, BOM etc. during the project handing over phase.
- All "As built" drawings shall be submitted to Eskom as revision 0.
- Eskom's Systems Operator requires minimum six weeks' notice to provide protection settings. Finalised scheme application drawings and CT and VT specification data 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.

18. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Mario Petersen	Planning & Project Support Manager (Acting)
Judith Malinga	PTM&C Engineering Senior Manager

19. Revisions

Date	Rev.	Compiler	Remarks
Jan 2020	1	T. Bower	Initial Scope of Work.
Aug 2020	2	B. Qwabe	Added Section 4.1.5.3 & updated JB info to the latest scheme & drawing numbers.
Oct 2023	3	L. Nogela	New template, removed the UVLS, EADS & the 2nd supplier under protection scope.

20. Development team

The following people were involved in the development of this document:

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21. Acknowledgements

N/A.

Annex A – Station Electric Diagram