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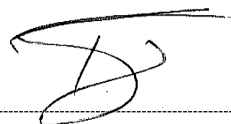
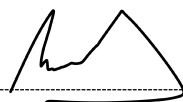
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1. General

1.1 Background

Koeberg 400kV GIS busbar has been in operation for almost 30 years; over 8 failures related to post insulators have been experienced since commissioning. The greatest concern with these types of failures is that they result in long duration outages.

Koeberg MTS main 2x250MVA, 400/132kV transformers priority is to supply Koeberg Nuclear Power Station (KNPS) auxiliary power supply through 2x29MVA, 132/6.6kV station transformers and Distribution's 132kV load. Load forecast indicate that the 2x250MVA, 400/132kV transformers will not be N-1 compliant by year 2022.

The load forecast shows that the total peak demand for Koeberg MTS will be approximately 150MVA in 2012 and the firm capacity of 250MVA would be exceeded in 2022. It is envisaged that a new MTS in the Sandown area would be required around 2022, therefore load shift from Koeberg MTS to the new MTS will de-load Koeberg MTS.

Koeberg Nuclear Power Station (KNPS) also intends to increase the sent-out power through the project called Thermal Power Up-rating. The upgrade would increase unit 1 and 2 from 900MW to 1060MW by end 2016 and end 2017 respectively. The Koeberg power uprate project will cause overloading under abnormal operation of the existing 400kV GIS busbar and the outgoing transmission lines under N-2 contingency.

To address the long term reliability improvement of the existing 400kV gas insulated busbar (GIS) and the future 400/132kV transformation requirements, the decision was taken to replace the GIS with AIS and use a different busbar configuration i.e. breaker and a half, this will take into account future transmission network expansions in the Western Grid transmission network.

Due to space constraints on the Koeberg site Weskusfleur MTS will be established 3,5km to the East of Koeberg adjacent to the R27.

The new Weskusfleur 400/132 kV Substation will be constructed under the Eskom self-build option (240-61713594 Tx Self Build Procedure) 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.

1.2 Scope

The provision of a complete turnkey protection, tele-control, remote-engineering / monitoring, measurements, metering, DC, telecommunications and security solution for the proposed Weskusfleur substation (station electric diagram) below, aligned with Eskom's current methodologies in this regard. Further detail provide below.

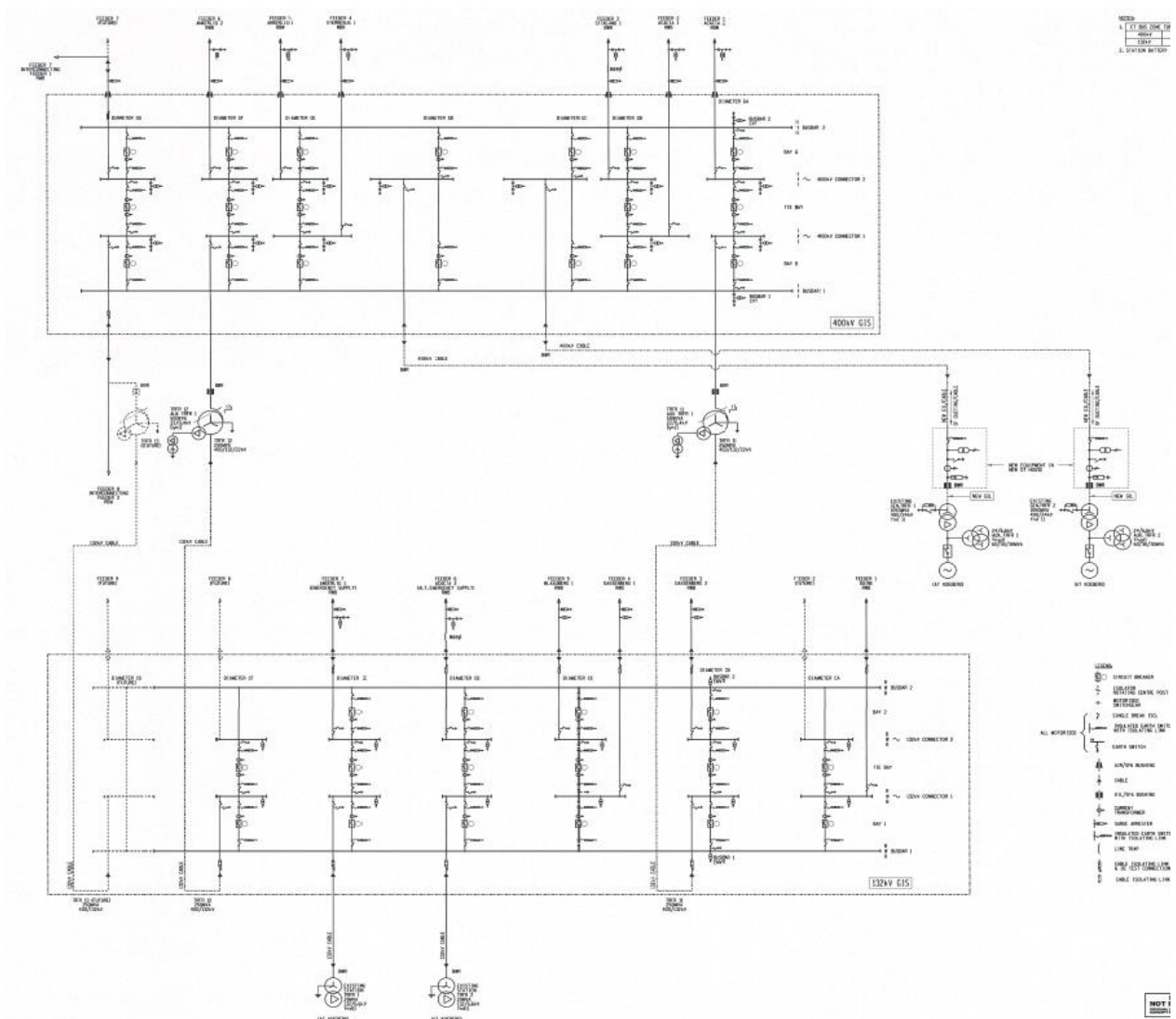
Standard previously tested and Eskom approved solutions are to be utilised. Where specific schemes / solutions don't exist and development is required, this shall be kept to a minimum and based as much as possible on the existing platforms.

The scope of works includes the

- engineering, to be accepted by Eskom.
- sourcing of standard solutions
- 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
- 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

1.3 Station Electric Diagram



Weskusfleur Substation

2. Protection

2.1 Protection Scope

This section describes the material required for the protection scope for the proposed Weskusfleur 400/132kV 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 intertripping equipment (for impedance protection) is included elsewhere within this document.

2.2 Sourcing

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

The 400 kV and 132 kV Phase VI protection & automation equipment shall be sourced from one of the Eskom approved Protection and Control suppliers.

The 400 kV and 132 Phase V protection & automation equipment / schemes shall be sourced from a combination of the Eskom approved Protection suppliers and the Eskom approved Telecontrol supplier.

The following protection and telecontrol and substation automation equipment combinations will be permitted:

- Combination 1: ABB South Africa (Eskom contract number 4600005212) for the Phase V breaker-and-a-half protection equipment in combination with Eskom approved Siemens (Pty) Ltd (Eskom development contract 4600059995) telecontrol and automation equipment.
- Combination 2: ABB South Africa (Eskom contract number 4600005212) for the Phase V breaker-and-a-half protection equipment in combination with Eskom approved CONCO telecontrol and automation equipment.
- Combination 3: Siemens (Pty) Ltd (Eskom development contract 4600059995) for the Phase VI breaker-and-a-half protection equipment in combination with the Siemens (Pty) Ltd (Eskom development contract 4600059995) telecontrol and substation automation equipment.
- Combination 4: CONCO Energy Solutions (Pty) Ltd (Eskom development contract number 4600060000) for the Phase VI breaker-and-a-half protection equipment in combination with the CONCO Energy Solutions (Pty) Ltd (Eskom development contract 4600060000) telecontrol and substation automation equipment.

Note for combinations 1 or 2: the interface between the protection equipment and the primary plant equipment (via BMK) is hardwire.

Note that for Combination 3 or 4: the interface between the Protection equipment and the primary plant equipment (via BMK) is hardwire (DC supplies and tripping) and fibre that is connected to the process interface units (PIUs) that shall be located within the BMKs or alternatively within a panel adjacent to the BMKs (hardwire interface between BMKs and the PIUs). CT and VT interfacing with the protection & control schemes shall be hardwire.

The 7VE63 Synchroniser (Generation approved synchroniser) shall be sourced from Siemens, to meet Eskom's approval.

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. Each diameter interface solution shall comprise a closing control and management system, supplied from an independent DC source, receive its analogue inputs from separate CT cores and separately protected VT cores (busbar 1, connector 1, line 1, connector 2, line 2 and busbar 2, 3 phase VTs) and be directly connected (via the process interface unit) to one trip-coil of the bay 1 circuit-breaker, to one trip-coil of the tie bay circuit breaker, one trip-coil of the bay 2 circuit-breaker, closing-coil of the bay 1 circuit-breaker, closing-coil of the tie bay circuit-breaker, closing-coil of the bay 2 circuit-breaker and open and close coils of all the isolators associated with that diameter. The two bay closing and bay management systems shall operate in a one-out-of-two mode. The auto-reclosing functions within the two systems shall operate in a master / slave mode.

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.

The breaker-and-a-half diameter interface scheme shall comprise all the required diameter control functions, manual closing, auto-reclose and synch check functions, ethernet switch, MCBs, test blocks, switches, pushbuttons and indications. The IED(s), MCBs, switches, indications, test blocks, indications and pushbuttons shall be located at the front of the panel. The management system shall provide for the required primary plant equipment controls (local and remote), primary plant equipment status indications (local and remote) and data logging and display (local and remote). All the equipment shall have the capability to be mounted in a flush mount 19" rack system. The breaker-and-a-half diameter interface control system shall not adversely affect the availability and performance of any other in-service diameter interface control system.

Within a single closing control and management system, all the required functions shall reside within a single hardware device. This hardware device shall comprise the single node through which all controls and auto-reclosing shall occur for all internally generated commands, as well as through which all externally generated commands shall be routed. The closing control and management systems will be housed within a cubicle within the control room building. The closing control and management system shall interface with the diameter primary equipment through IEC61850 process interface units located in close proximity to the primary plant equipment. The closing control and management system shall interface with object 1 and object 2 protection systems through IEC61850 for the purpose of auto-reclosing and control of the primary plant equipment.

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. A separate IED for the closing control and management of the transformer MV side (double busbar interface) primary plant equipment is permissible.

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 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 and 132 kV diameters shall have dedicated diameter interface schemes.

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 and 132 kV diameter. Each diameter shall have dedicated diameter interface panels with equipment as per the table below:

	Contract item	ABB	Siemens	Conco
1.	Phase VI Main 1 Diameter Interface Scheme <i>Mimics with local controls & indications and IED logics to be selected to match each diameter combination</i>	-	6DIP-2110-M1 (0.52/30553)	6DIP-7110-M1 (0.52/30600)
2.	Phase VI Main 2 Diameter Interface Scheme <i>Mimics with local controls & indications and IED logics to be selected to match each diameter combination</i>	-	6DIP-2110-M2 (0.52/30554)	6DIP-7110-M2 (0.52/30601)
3.	Phase V Diameter Interface Schemes <i>Mimics with local controls & indications and IED logics to be selected to match each diameter combination</i>	5DIP-3100 (0.52/30274) & 5DIP-3210 (0.52/30367)	-	-
4.	Fixed frame, rear entry panel for Protection schemes (2400x800x600, 19" rack mount)	Included	x 2	x 2
5.	Supply, install and wiring of Tie Bay Breaker PIUs (Male and Female half Harting Plugs, coding pins & wiring tail) within the BMK or panel	N/A	x 2 (Harting plug	x 2 (Harting plug

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	adjacent to the BMK (all wiring are within scope of supply)		wiring as per 6JB-2100 - 0.52/30444)	wiring as per 6JB-7100 - 0.52/30424)
6.	Large Bay Switch (supply, fitment and wiring) Ruggedcom RSG-2100: 6GK6021-0AS23-3DB0-Z05+B05+C05+D05+E02+F00+G05+H00+J00+K01	Included	x 2	x 2
7.	Duplex Multi mode 50/125 fibre optic patch cord (3 meter), Non-Ruggedized for connection between the DCD and the Ethernet Switches and between the Fibre Patch Panels and the ethernet switches.	Included	x 6	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)	Included	x 2	x 2
9.	Engineering: Large Bay Switch	x 1	x 2	x 2
10.	400 kV Busbar 1 VTJB (1JB-0700)	x 2	x 2	x 2
11.	400 kV Busbar 2 VTJB (1JB-0700)	x 2	x 2	x 2
12.	132 kV Busbar 1 VTJB (1JB-0700)	x 1	x 1	x 1
13.	132 kV Busbar 2 VTJB (1JB-0700)	x 1	x 1	x 1
14.	Connector 1 VTJB (1JB-0700)	x 1	x 1	x 1
15.	Connector 2 VTJB (1JB-0700)	x 1	x 1	x 1
16.	Diameters GC Connector 2 VTJB (1JB-0700)	x 2	x 2	x 2
17.	Diameters GD Connector 2 VTJB (1JB-0700)	x 2	x 2	x 2
18.	Line VTJB (1JB-0700) – where applicable (refer to the station electric diagram)	x 1	x 1	x 1
19.	GT House 1 VTJB (1JB-0700)	x 2	x 2	x 2
20.	GT House 2 VTJB (1JB-0700)	x 2	x 2	x 2

2.4.2 Generator transformer diameter scheme additional requirements

The local and remote breaker and isolator controls via the diameter interface schemes for the generator transformers shall be from Koeberg power station and as per document ST_240-61377036 Rev 2, approved by the nuclear regulator. All bay 1 and bay 2 breaker closing commands shall be routed via the applicable synchroniser located within the synchroniser scheme.

The diameter control device for the generator transformers diameters shall include the required generation bay interlocking rules. These interlocking rules shall be obtained from Koeberg generation. The schemes shall include an interlock override key switch per scheme.

The generator transformer diameter control devices shall include single mode fibre communications interface to communicate with the IEDs within the schemes housed within the GT1 and GT2 equipment rooms.

2.5 Generator transformer synchronisation scheme requirements

Bay 1 and bay 2 breakers synchronisers (diameters GC and GD) are required to monitor the closure of these circuit-breakers for paralleling of the generators to the Transmission network. Local or remote (SCADA) closure of the circuit-breaker shall only be via the synchroniser. The synchronisers, per generator transformer, shall be located on the 6SYNC-#100 scheme that is located within the Weskusfleur control room. The two 6SYNC-#100 schemes shall be located next to GC and GD diameter interface panels on the right hand side of the diameter interface panels.

The tenderer shall involve Eskom PTM&C, Koeberg Generation and Nuclear Regulator with the development of the scheme solution, factory acceptance testing, configuration, setting and commissioning.

The generator transformer synchronisation scheme shall comprise all the bay 1 and bay 2 synchronisers and the synchronising functions, MCBs, test blocks, switches, pushbuttons and indications. The IED(s), MCBs, switches, indications, test blocks, indications and pushbuttons shall be located at the front of the panel. All the equipment shall have the capability to be mounted in a flush mount 19" rack system. The generator transformer synchronisation scheme shall not adversely affect the availability and performance of any other in-service systems. The synchronisers, bay 1 and bay 2, shall comprise the single node through which all breaker closing commands, local and remote, shall be routed.

The 6SYNC-#100 scheme will be a single-panel suite which consist of the relay panel (RP) cubicle. The dimensions of the RP panel shall be 800mm x 600mm x 2400mm (Width x Depth x Height), with rear access to the scheme wiring, relay terminals, rail-mounted scheme terminals, etc., by means of a hinged rear door. Access to the front of the RP shall also be by way of a hinged door. The relay panel shall provide for the standard 19" rack mount facility on the front. The 6SYNC-#100 shall be located in the Weskusfleur control room.

The synchronisation and panel design and equipment requirements shall be as per the Ingula document 240-61377036. The breaker close commands shall be hardwired to the relevant breaker closing coil. Master trip relay normally close contacts shall be wired in series with each breaker closing coils to prevent closing of the breakers when the master trip relay has operated.

The synchronisers shall interface with the relevant diameter control devices for the interface with Koeberg power station.

The Busbar 1, busbar 2 and connector VT MCB normally close auxiliary contacts shall be hardwired from the relevant VT JB to the synchroniser protection scheme for connection to the relevant synchroniser.

The synchroniser schemes (set per gen transformer bay) shall be developed by the successful tenderer with participation and approval by: Eskom PTM&C, Koeberg Generation and Transmission Grid West region. The basic and final designs shall be submitted to the PTM&C Design Review Team and Nuclear Regulator for review and approval prior construction and commissioning.

The tenderer shall submit a design proposal for this solution and time lines with the tender submission.

The synchroniser scheme shall include but not limited to:

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- Panel Not Healthy Indication (230 VAC);
- Bay 1 Synchroniser;
- Bay 2 Synchroniser;
- Bay 1 Synchroniser – Busbar 1 Voltage Transformer Test Block;
- Bay 1 Synchroniser – Connector Voltage Transformer Test Block;
- Bay 2 Synchroniser – Busbar 1 Voltage Transformer Test Block;
- Bay 2 Synchroniser – Connector Voltage Transformer Test Block;
- Test Normal selection switch (Normal and Test);
- Main 1 DC Isolating MCB;
- Main 1 DC Isolating MCB;
- Main 1 DC supply monitoring relay;
- Main 2 DC supply monitoring relay;
- Secure supply chop over circuit as per 5FC-3910 (0.52-30338) and document 240-61377036;
- Secure supply monitoring relay;
- Bay 1 Synchroniser DC Isolating MCB;
- Bay 2 Synchroniser DC Isolating MCB;
- Bay 1 Synchroniser close command isolating selector switch;
- Bay 2 Synchroniser close command isolating selector switch;
- Ruggedcom RS900 Ethernet switch for multimode connection to bay 1 synchroniser and bay 2 synchroniser, and single mode fibre interface for connection to Koeberg Power Station via the fibre patch panel; and,
- 19" Single mode Fibre patch panel.

2.5.1 Generator transformer synchronisation scheme requirements and options

Following is the generator transformer synchronisation scheme requirements. Each generator transformer synchronisation shall have dedicated with equipment as per the table below:

	Contract item	ABB	Siemens	Conco
1.	Phase VI generator transformer synchronisation scheme	6SYNC-#100	6SYNC-#100	6SYNC-#100
2.	Fixed frame, rear entry panel for Protection schemes (2400x800x600, 19" rack mount)	x1	x1	x1
3.	Procure, Supply, install and wiring of the generator transformer synchronisation scheme	x2 Schemes	x2 Schemes	x2 Schemes
4.	Procure, supply, fitment, wiring and commissioning of the Siemens 7VE63 Synchroniser (generation approved synchroniser).	x2 Per scheme	x2 Per scheme	x2 Per scheme

5.	Duplex Single mode 50/125 fibre optic patch cord (3 meter), Non-Ruggedized for connection between the Synchronisers, Ethernet Switch and the Fibre Patch Panel	x2 Per scheme	x2 Per scheme	x2 Per scheme
6.	1U 19" rack mount single mode fibre optic patch panel. (Each box to accept 2 fibre optic cables. Per panel for connection to Koeberg generation.	x1 Per scheme	x1 Per scheme	x1 Per scheme
7.	400 kV Busbar 1 VTJB (1JB-0700) – Gx	x 2	x 2	x 2
8.	400 kV Connector VTJB (1JB-0700) – Gx	x 2	x 2	x 2
9.	400 kV Busbar 1 VTJB (1JB-0700) – Gx	x 2	x 2	x 2

2.6 Marshalling kiosks

The breaker marshalling kiosks are required to provide for and interface with the equipment as per 6JB-#300 (0.52-30550)

The Transformer marshalling kiosks are required to provide for and interface with the equipment as per 6JB-#200 (0.52-30425), transformer and on line tap changer functionality.

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

2.7 Marshalling kiosk panel

Marshalling kiosk panels are required for the Siemens and Conco solutions in the event that the GIS marshalling kiosk does not cater for the installation and wiring of the main 1 and main 2 PIUs, and for the transformers the additional on load tap changer PIU. The marshalling kiosk panels shall also include 2 x fibre patch panels and for the transformer on load tap changer an additional fibre patch panel.

2.7.1 Marshalling kiosk panel requirements

The marshalling kiosk panel, per bay (breaker or transformer) 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;

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- 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);
- The transformer marshalling kiosk panel wiring interface with the bay marshalling kiosk shall be as per 6JB-7200 (0.52-30425);
- 2 x Duplex Multi mode 50/125 fibre optic patch cord (3 meter), per bay, Non-Ruggedized for connection between the PIUs and the Fibre Patch Panels.
- 2 x Multi mode Fibre patch panels (breaker and transformer PIUs); and,
- 2 x Multi mode Fibre patch panels (transformer on load tap changer PIU).

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 submit a design proposal for this solution and time lines with the tender submission.

2.8 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).

The Fault Clearance System shall comprise two independent and galvanically isolated Tripping Systems, plus the bay circuit-breaker and tie bay circuit-breaker. Each Tripping System shall comprise a Protection System, supplied from an independent DC source, receive its analogue inputs from a separate CT core and a separately protected VT core (line VT), interface to its own dedicated teleprotection equipment, and be directly connected (via the process interface unit and via hardwire) to one trip-coil of the bay circuit-breaker and to one trip-coil of the tie bay circuit breaker. The two Tripping Systems shall operate in a one-out-of-two tripping mode.

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 integrated within the IED. A maximum of two line protection IEDs, where the distance based IED protection functionality is fully integrated within the one IED and the current differential based IED functionality is fully integrated within the second IED 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 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.

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

Following is the line protection scheme requirements and option selections per 400 kV and 132 kV line. Each line shall have dedicated line protection panels with equipment as per the table and sections below:

	Contract item	ABB	Siemens	Conco
1.	Phase VI Main 1 Line Protection Scheme <i>Mimics to be selected to match each diameter combination</i>	-	6FZDB-2110-M1 (0.52/30551)	6FZDB-7110-M1 (0.52/30629)
2.	Phase VI Main 2 Line Protection Scheme <i>Mimics to be selected to match each diameter combination</i>	-	6FZDB-2110-M2 (0.52/30552)	6FZDB-7110-M2 (0.52/30630)
3.	Phase V Dual Main Line Protection Scheme	5FZ/D/CB-3100 (0.52/30274, 0.52/30334, 0.52/30352)	-	-
4.	Fixed frame, rear entry panel for Protection schemes (2400x800x600, 19" rack mount)	Included	x 2	x 2
5.	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)	N/A	x 2 (Harting plug wiring as per 6JB-2100 - 0.52/30444)	x 2 (Harting plug wiring as per 6JB-7100 - 0.52/30424)
6.	1U 19" rack mount multi-mode fibre optic patch panel. (Each box can accept 2 fibre optic cables. One Per main panel).	Included	x 2	x 2
7.	1U 19" rack mount single-mode fibre optic patch panel. (Each box can accept 2 fibre optic cables. One Per main panel if required for differential protection function).	Included	x 2	x 2
8.	Duplex Multi mode 50/125 fibre optic patch	Included	x 4	x 4

	cord (5 meter), Non-Ruggedized for connection between the line protection IED and the Ethernet Switch within the diameter interface panel. One per main line protection IED.			
9.	Duplex Single mode 50/125 fibre optic patch cord (3 meter), Non-Ruggedized for connection between the line protection IED and the single mode fibre patch panel (if required for the differential protection function, one per main line protection IED).	Included	x 2	x 2
10.	Procure, supply, fitment, wiring and commissioning of the teleprotection interface device per main protection at Weskusfleur and the remote line ends.	Per line, to be determined	Per line, to be determined	Per line, to be determined

2.8.2 400 kV Feeder 1 (Acacia 2) local and remote line protection requirements

kV	400 kV
Feeder No.	Feeder 1
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 and Conco	RED670-ZA11 (ABB) Procure, install, wiring and commissioning.
Remote Line end Main 1 Current Differential Protection	RED670-ZA11 (ABB). Procure and deliver to Transmission Grid West for installation and commissioning.
Remote Line end Main 2 Impedance Protection	REL670-ZA11 (ABB). Procure and deliver to Transmission Grid West for installation and commissioning.
Main 1 – FIBRE Route for Current Differential Protection communication	Weskusfleur - Acacia 1 400 kV Line Refer to the fibre optic section.

Main 1 – Current differential protection fibre requirements	SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary. SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.
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.
Remote Line end 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: <ul style="list-style-type: none"> • Line Trap phase positions and PLC frequencies to be determined by Eskom.
Note: 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”.	

2.8.3 400 kV Feeder 2 (Acacia 1) local and remote line protection requirements

kV	400 kV
Feeder No.	Feeder 2
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	<p>Panel main labels – Front and Rear:</p> <p>Label size: 340 x 35 mm</p> <p>Text height: 12 mm</p> <p>Labelling standard: 240-62629353 Specification for panel labelling standard.</p>
Main 1 Current Differential Protection – Required for Siemens and Conco	<p>RED670-ZA11 (ABB)</p> <p>Procure, install, wiring and commissioning.</p>
Remote Line end Main 1 Current Differential Protection	<p>RED670-ZA11 (ABB).</p> <p>Procure and deliver to Transmission Grid West for installation and commissioning.</p>
Main 1 – FIBRE Route for Current Differential Protection communication	<p>Weskusfleur - Acacia 1 400 kV Line</p> <p>Refer to the fibre optic section.</p>
Main 1 – Current differential protection fibre requirements	<p>SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary.</p> <p>SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.</p>
Main 2 Teleprotection	<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><u>Notes:</u></p> <ul style="list-style-type: none"> • Line Trap phase positions and PLC frequencies to be determined by Eskom. • The Teleprotection Interface voltage with Protection shall to be compatible.
Remote Line end Main 2 Teleprotection	<p>Power Line Carrier equipment which includes the following:</p> <ul style="list-style-type: none"> • Line Traps • LMEs • Coaxial Cables

	<ul style="list-style-type: none"> Carrier Combiner Unit PLC Terminal Equipment Z Cables Telephone Cables <p><u>Notes:</u></p> <ul style="list-style-type: none"> Line Trap phase positions and PLC frequencies to be determined by Eskom. The Teleprotection Interface voltage with Protection shall be compatible.
<p>Note: 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>	

2.8.4 400 kV Feeder 3 (Stikland 1) local and remote line protection requirements

kV	400 kV
Feeder No.	Feeder 3
Feeder name	Stikland 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	<p>Panel main labels – Front and Rear:</p> <p>Label size: 340 x 35 mm</p> <p>Text height: 12 mm</p> <p>Labelling standard: 240-62629353 Specification for panel labelling standard.</p>
Main 1 Teleprotection	<p>Teleprotection Equipment (will be installed in the protection cabinet)</p> <p>Communications module: X.21</p> <p><u>Note:</u></p> <p>The Teleprotection Interface voltage with Protection needs to be compatible.</p>
Remote Line end Main 1 Teleprotection	<p>Teleprotection Equipment (will be installed in the protection cabinet)</p> <p>Communications module: X.21</p> <p><u>Note:</u></p> <p>The Teleprotection Interface voltage with Protection needs to</p>

	be compatible.
Main 2 Teleprotection	<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><u>Note:</u></p> <ul style="list-style-type: none"> • Line Trap phase positions and PLC frequencies to be determined by Eskom. • The Teleprotection Interface voltage with Protection shall be compatible.
Remote Line end Main 2 Teleprotection	<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><u>Note:</u></p> <ul style="list-style-type: none"> • Line Trap phase positions and PLC frequencies to be determined by Eskom. • The Teleprotection Interface voltage with Protection shall be compatible.
<p>Note: 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>	

2.8.5 400 kV Feeder 4 (Sterrekus 1) local and remote line protection requirements

kV	400 kV
Feeder No.	Feeder 4
Feeder name	Sterrekus 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 and Conco	RED670-ZA11 (ABB) Procure, install, wiring and commissioning.
Main 2 Current Differential Protection – Required for Siemens and Conco	RED670-ZA11 (ABB) Procure, install, wiring and commissioning.
Remote Line end Main 2 Current Differential Protection	RED670-ZA11 (ABB). Procure and deliver to Transmission Grid West for installation and commissioning.
Main 1 – FIBRE Route for Current Differential Protection communication	Weskusfleur – Sterrekus 1 400 kV Line Refer to the fibre optic section.
Main 2 – FIBRE Route for Current Differential Protection communication	Weskusfleur – Ankerlig 2 – Sterrekus 2 400 kV Lines Refer to the fibre optic section.
Main 1 – Current differential protection fibre requirements	SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary. SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.
Main 2 – Current differential protection fibre requirements	SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary. SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.
Notes: <ul style="list-style-type: none"> 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”. Fibre cables shall be in different trenches. 	

2.8.6 400 kV Feeder 5 (Ankerlig 1) local and remote line protection requirements

kV	400 kV
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Feeder No.	Feeder 5
Feeder name	Ankerlig 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 and Conco	RED670-ZA11 (ABB) Procure, install, wiring and commissioning.
Main 2 Current Differential Protection – Required for Siemens and Conco	RED670-ZA11 (ABB) Procure, install, wiring and commissioning.
Remote Line end Main 1 Current Differential Protection	RED670-ZA11 (ABB). Procure and deliver to Transmission Grid West for installation and commissioning.
Remote Line end Main 2 Current Differential Protection	RED670-ZA11 (ABB). Procure and deliver to Transmission Grid West for installation and commissioning.
Main 1 – FIBRE Route for Current Differential Protection communication	Weskusfleur – Ankerlig 1 400 kV Line (Alternative route: Weskusfleur – Ankerlig 132 kV line) Refer to the fibre optic section.
Main 2 – FIBRE Route for Current Differential Protection communication	Weskusfleur – Ankerlig 2 400 kV Line Refer to the fibre optic section.
Main 1 – Current differential protection fibre requirements	SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary. SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.
Main 2 – Current differential protection fibre requirements	SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary. SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.

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".
- Fibre cables shall be in different trenches.

2.8.7 400 kV Feeder 6 (Ankerlig 2) local and remote line protection requirements

kV	400 kV
Feeder No.	Feeder 6
Feeder name	Ankerlig 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 and Conco	RED670-ZA11 (ABB) Procure, install, wiring and commissioning.
Main 2 Current Differential Protection – Required for Siemens and Conco	RED670-ZA11 (ABB) Procure, install, wiring and commissioning.
Remote Line end Main 1 Current Differential Protection	RED670-ZA11 (ABB). Procure and deliver to Transmission Grid West for installation and commissioning.
Remote Line end Main 2 Current Differential Protection	RED670-ZA11 (ABB). Procure and deliver to Transmission Grid West for installation and commissioning.
Main 1 – FIBRE Route for Current Differential Protection communication	Weskusfleur – Ankerlig 1 400 kV Line (Alternative route: Weskusfleur – Ankerlig 132 kV line) Refer to the fibre optic section.
Main 2 – FIBRE Route for Current Differential Protection communication	Weskusfleur – Ankerlig 2 400 kV Line Refer to the fibre optic section.

Main 1 – Current differential protection fibre requirements	SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary. SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.
Main 2 – Current differential protection fibre requirements	SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary. SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.
Notes: <ul style="list-style-type: none"> 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". Fibre cables shall be in different trenches. 	

2.8.8 400 kV Feeder 7 (Interconnecting Feeder 1) local and remote line protection requirements

kV	400 kV
Feeder No.	Feeder 7
Feeder name	Interconnecting Feeder 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 and Conco	RED670-ZA11 (ABB) Procure, install, wiring and commissioning.
Main 2 Current Differential Protection – Required for Siemens and Conco	RED670-ZA11 (ABB) Procure, install, wiring and commissioning.
Koeberg Feeder 1 (Acacia 2) Main 1 Current Differential Protection	RED670-ZA11 (ABB). Procure and deliver to Transmission Grid West for installation and commissioning.
Koeberg Feeder 1 (Acacia 2) Main 2 Current Differential Protection	RED670-ZA11 (ABB). Procure and deliver to Transmission Grid West for installation

	and commissioning.
Main 1 – FIBRE Route for Current Differential Protection communication	Redundant single mode fibre cable between Weskusfleur and Koeberg. Main 1 and main 2 protection shall not be within the same fibre. Refer to the fibre optic section.
Main 2 – FIBRE Route for Current Differential Protection communication	Redundant single mode fibre cable between Weskusfleur and Koeberg. Main 1 and main 2 protection shall not be within the same fibre. Refer to the fibre optic section.
Main 1 – Current differential protection fibre requirements	SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary. SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.
Main 2 – Current differential protection fibre requirements	SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary. SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.
Notes: <ul style="list-style-type: none"> 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". Fibre cables shall be in different trenches. 	

2.8.9 400 kV Feeder 8 (Interconnecting Feeder 2) local and remote protection requirements

kV	400 kV
Feeder No.	Feeder 8 (Future Transformer 13)
Feeder name	Interconnecting Feeder 2
Transformer protection scheme	Refer to the Breaker-and-a-half transformer 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 –	RED670-ZA11 (ABB)

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Required for Siemens and Conco	Procure, install, wiring and commissioning. Engineering required to add the RED670-ZA11 to the transformer protection scheme(s).
Main 2 Current Differential Protection – Required for Siemens and Conco	RED670-ZA11 (ABB) Procure, install, wiring and commissioning. Engineering required to add the RED670-ZA11 to the transformer protection scheme(s).
Koeberg Feeder 1 (Acacia 2) Main 1 Current Differential Protection	RED670-ZA11 (ABB). Procure and deliver to Transmission Grid West for installation and commissioning.
Koeberg Feeder 1 (Acacia 2) Main 2 Current Differential Protection	RED670-ZA11 (ABB). Procure and deliver to Transmission Grid West for installation and commissioning.
Main 1 – FIBRE Route for Current Differential Protection communication	Redundant single mode fibre cable between Weskusfleur and Koeberg. Main 1 and main 2 protection shall not be within the same fibre. Refer to the fibre optic section.
Main 2 – FIBRE Route for Current Differential Protection communication	Redundant single mode fibre cable between Weskusfleur and Koeberg. Main 1 and main 2 protection shall not be within the same fibre. Refer to the fibre optic section.
Main 1 – Current differential protection fibre requirements	SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary. SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.
Main 2 – Current differential protection fibre requirements	SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary. SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.
Notes: <ul style="list-style-type: none"> 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”. Fibre cables shall be in different trenches. 	

2.8.10 132 kV Feeder 1 (Duine) local and remote line protection requirements

kV	132 kV
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Feeder No.	Feeder 1
Feeder name	Duine
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.
Koeberg Feeder 1 (Duine 1) Main Current Differential Protection	RED670-ZA11 (ABB). Procure and deliver to Transmission Grid West for installation and commissioning.
Remote Line end Main Current Differential Protection	4FZD-3920 – Procure and deliver to Transmission/Distribution Grid West for installation and commissioning. Replace the Distribution RED670 with a RED670-ZA11 (ABB). RED670-ZA11, functional composition, I/O card positions and logics shall be tailored to the Distribution RED670.
Main – FIBRE Route for Current Differential Protection communication	Procure and install a single mode fibre cable between Weskusfleur and Duine. The fibre to follow the same route as the existing pilot wire. Pilot wire to be decommissioned and removed Refer to the fibre optic section.
Main – Current differential protection fibre requirements	SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary. SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.
Note: 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”.	

2.8.11 132 kV Feeder 3 (Dassenberg 2) local and remote line protection requirements

kV	132 kV
Feeder No.	Feeder 3
Feeder name	Dassenberg 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 Current Differential Protection – Required for Siemens and Conco	RED670-ZA11 (ABB) Procure, install, wiring and commissioning.
Remote Line end Main Current Differential Protection	RED670-ZA11 (ABB). Procure and deliver to Transmission/Distribution Grid West for installation and commissioning. RED670-ZA11, functional composition, I/O card positions and logics to be tailored to the Distribution RED670.
Main – FIBRE Route for Current Differential Protection communication	Weskusfleur – Dassenberg double circuit (feeders 1 and 2) 132 kV Line FIBRE 1 Refer to the fibre optic section.
Main – Current differential protection fibre requirements	SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary. SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.
Note: 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”.	

2.8.12 132 kV Feeder 4 (Dassenberg 1) local and remote line protection requirements

kV	132 kV
Feeder No.	Feeder 4
Feeder name	Dassenberg 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 Current Differential Protection – Required for Siemens and Conco	RED670-ZA11 (ABB) Procure, install, wiring and commissioning.
Remote Line end Main Current Differential Protection	RED670-ZA11 (ABB). Procure and deliver to Transmission/Distribution Grid West for installation and commissioning. RED670-ZA11, functional composition, I/O card positions and logics to be tailored to the Distribution RED670.
Main – FIBRE Route for Current Differential Protection communication	Weskusfleur – Dassenberg double circuit (feeders 1 and 2) 132 kV Line FIBRE 2 Refer to the fibre optic section.
Main – Current differential protection fibre requirements	SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary. SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.
Note: 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”.	

2.8.13 132 kV Feeder 5 (Blaauberg 1) local and remote line protection requirements

kV	132 kV
Feeder No.	Feeder 5
Feeder name	Blaauberg 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 Current Differential Protection – Required for Siemens and Conco	RED670-ZA11 (ABB) Procure, install, wiring and commissioning.
Remote Line end Main Current Differential Protection	RED670-ZA11 (ABB). Procure and deliver to Transmission/Distribution Grid West

	for installation and commissioning. RED670-ZA11, functional composition, I/O card positions and logics to be tailored to the Distribution RED670.
Main – FIBRE Route for Current Differential Protection communication	Weskusfleur – Blaauberg Refer to the fibre optic section.
Main – Current differential protection fibre requirements	SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary. SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.
Note: 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”.	

2.8.14 132 kV Feeder 6 (Acacia 2 – Emergency supply) local and remote line protection requirements

kV	132 kV
Feeder No.	Feeder 6
Feeder name	Acacia 2 (Emergency supply)
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.
Notes: <ul style="list-style-type: none"> For the teleprotection requirements refer, to section 2.7.2 400 kV Feeder 1 (Acacia 2) local and remote line protection requirements. 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”. 	

2.8.15 132 kV Feeder 7 (Ankerlig 1 – Emergency supply) local and remote line protection requirements

kV	132 kV
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Feeder No.	Feeder 7
Feeder name	Ankerlig 1 (Emergency supply)
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 and Conco	RED670-ZA11 (ABB) Procure, install, wiring and commissioning.
Main 2 Current Differential Protection – Required for Siemens and Conco	RED670-ZA11 (ABB) Procure, install, wiring and commissioning.
Remote Line end Main 1 Current Differential Protection	RED670-ZA11 (ABB). Procure and deliver to Transmission Grid West for installation and commissioning.
Remote Line end Main 2 Current Differential Protection	RED670-ZA11 (ABB). Procure and deliver to Transmission Grid West for installation and commissioning.
Main 1 – FIBRE Route for Current Differential Protection communication	Weskusfleur – Ankerlig 1 132 kV Line (Alternative route: Weskusfleur – Ankerlig 400 kV line) Refer to the fibre optic section.
Main 2 – FIBRE Route for Current Differential Protection communication	Weskusfleur – Ankerlig 2 400 kV Line Refer to the fibre optic section.
Main 1 – Current differential protection fibre requirements	SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary. SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.
Main 2 – Current differential protection fibre requirements	SM Duct cable from FDR Gantry to Fibre Optic Cabinet including patch panel where necessary. SM Duct cable from Fibre Optic Cabinet to corresponding Protection Panel where necessary.

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".
- Fibre cables shall be in different trenches.

2.9 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).

The Fault Clearance System shall comprise two independent and galvanically isolated Tripping Systems, plus the 400 kV bay circuit-breaker, 400 kV tie bay circuit-breaker, 132 kV bay circuit-breaker and 132 kV tie bay circuit-breaker. Each Tripping System shall comprise a Protection System, supplied from an independent DC source, receive its analogue inputs from a separate bay and tie bay CT core and separate CT cores within the transformer tank and be directly connected (via the process interface units and via hardwire) to one trip-coil of the 400 kV bay circuit-breaker, to one trip-coil of the 400 kV tie bay circuit breaker, to one trip-coil of the 132 kV bay circuit-breaker and to one trip-coil of the 132 kV tie bay circuit breaker. The two Tripping Systems shall operate in a one-out-of-two tripping mode.

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 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 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, 132 kV bay and 132 kV tie 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 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) or transformer marshalling kiosks (GIS applications). 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.

2.9.1 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	ABB	Siemens	Conco
1.	Phase VI Main 1 Auto Transformer Protection Scheme <i>Mimics to be selected to match each diameter combination</i>	-	6TAB-2300-M1 (With Low Imp REF) (0.52/30440)	6TAB-7300-M1 (With Low Imp REF) (0.52/30420)
2.	Phase VI Main 2 Auto Transformer Protection Scheme <i>Mimics to be selected to match each diameter combination</i>	-	6TAB-2300-M2 (With High Imp REF, Metrosil & Resistor) (0.52/30492)	6TAB-7300-M2 (With High Imp REF, Metrosil & Resistor) (0.52/30505)
3.	Phase V Dual Main Auto Transformer Protection Scheme	5TAB-3100 (additional IOM required for M2)	-	-
4.	Fixed frame, rear entry panel for Protection schemes (2400x800x600, 19" rack mount)	Included	x 2	x 2
5.	Disturbance recorder test bock	Included	x 2	x 2
6.	Supply, install and wiring of 400 kV & 132 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)	N/A	x 4 (Harting plug wiring as per 6JB-2100 - 0.52/30444)	x 4 (Harting plug wiring as per 6JB-7100 - 0.52/30424)
7.	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)	N/A	x 2 (Harting plug wiring as per 6JB-2200 - 0.52/30445)	x 2 (Harting plug wiring as per 6JB-7200 - 0.52/30425)
8.	Transformer JB	N/A	x 1 (6JB-2200 - 0.52/30445)	x 1 (6JB-7200 - 0.52/30425)
9.	1U 19" rack mount multi-mode fibre optic patch panel. (Each box can accept 2 fibre optic cables. Two per main panel for connection to the HV breaker PIU, MV breaker PIU and transformer	Included	x 4	x 4

	PIU per main transformer panel).			
10.	Duplex Multi mode 50/125 fibre optic patch cord (5 meter), Non-Ruggedized for connection between the transformer protection IED and the Ethernet Switch within the diameter interface panel. One per main transformer protection IED.	Included	x 10	x 10

2.10 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 tapplings near the line ends, the number of bushing insulators is reduced and with tapplings 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.

2.10.1 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	ABB	Siemens	Conco
1.	Auto Transformer on load tap change Scheme	Integrated within the 5TAB-3100 Main 2 IEDs	6TCP-2101 with 6TC2101-1 and 6TC2101-2 modules (0.52/30367, 0.52/30586, 0.52/30653)	6TCP-7100 (with 2x 6TC7100 modules) (0.52/30532 0.52/30423)
2.	Fixed frame, rear entry panel for Protection schemes (2400x800x600, 19" rack mount)	N/A	x 2	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	N/A	x 1	x 1
4.	Duplex Multi mode 50/125 fibre optic patch cord, Non-Ruggedized for connection between the all the IEDs within the diameter (including the protection IEDs and the PIUs) and	N/A	Contractor to determine requirement.	Contractor to determine requirement.

	Ethernet Switch and the Fibre Patch Panels			
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)	N/A	x 1 (Harting plug wiring as per 6JB-2200 - 0.52/30445)	x 1 (Harting plug wiring as per 6JB-7200 - 0.52/30425)
6.	1U 19" rack mount fibre optic patch panels. (Each box can accept 2 fibre optic cables. Per main in the DIP and per main in the Transformer JB)	N/A	x 2	x 2
7.	Engineering: Large Bay Switch	N/A	x 1	x 1
8.	Tap Change Documentation	N/A	x 1	x 1

2.11 Breaker-and-a-half generator transformer interface protection schemes

The Transmission Generation interface shall consist of two protection and control schemes (one located within the Transmission relay room and the other within the Koeberg GT house per generator) to provide for the protection, including the GIL protection, and interface between the Transmission equipment and the Koeberg generator protection & control equipment. These schemes are Eskom Transmission assets and will be set, commissioned and maintained by Eskom Transmission.

The protection and control schemes will comprise of a Fault Clearance System, a Bay Closing System, and a Bay Management System.

The Fault Clearance System shall comprise two independent and galvanically isolated Tripping Systems, plus the two bay circuit-breakers. Each Tripping System shall comprise of a Protection System, which is supplied from an independent DC source. It receives its analogue inputs from a separate CT core (2x bay CTs used independently and the summated quantity) and a separately protected CVT core and is directly connected to one trip-coil of the two 400 kV bay circuit-breakers. The two Tripping Systems shall operate in a one-out-of-two tripping mode. The protection scheme located within the Koeberg GT room shall interface with the post type CTs and CVTs at the Generator Transformer terminals within the GT houses.

Each Protection System shall provide the requisite primary, back-up and auxiliary protection functions.

The Bay Closing System shall comprise of the Closing Control System. It receives its analogue inputs from separately protected CVT connector cores and busbar CVTs, and is directly connected to the synchronizing device and subsequent to the close-coils of the two 400 kV bay circuit-breakers. Each of the bay circuit-breakers shall have independent synchronisers controlled from Koeberg generation. The synchronisers shall be as per the Koeberg generation requirements (generation approved synchroniser). The synchronisers shall be connected to dedicated generation VTJBs.

The Bay Management System shall provide the required substation automation functionality, local controls and indications.

Within a single Protection System, all protection functions shall reside within a single hardware device. The Bay Management System shall integrate within the Closing Control System device and is permitted to be integrated or separate from the Protection Systems.

The Protection and Control Scheme is that portion of the Fault Clearance System, Bay Closing System, and Bay Management System shall be housed within the panels. The Protection and Control Scheme housed within the Transmission relay room shall be housed within a two panel suite. The Protection and Control Scheme housed within the Koeberg GT room shall be housed within a single swing frame panel with front access only (mounted against the wall within the GT rooms). The scheme IEDs within the Transmission relay room and the Koeberg GT room shall interface via single mode independent (redundant) fibres.

The generator transformer high impedance REF with metrosil and stabilising resistor shall be fitted within the #FC-#940 schemes (GT house) and interface back to the #FC-#930 schemes (Transmission relay room).

The protection and control schemes (set per gen transformer bay) shall be developed by the successful tenderer with participation and approval by: Eskom PDE PTM&C, Koeberg Generation and Transmission Grid West region. The basic and final designs shall be submitted to the PTM&C Design Review Team and Nuclear Regulator for review and approval prior construction and commissioning.

The tenderer shall submit a design proposal for this solution and time lines with the tender submission.

2.11.1 Breaker-and-a-half generator transformer interface protection scheme requirements and options

Following is the generator transformer interface protection scheme requirements and option selections per generator transformer. Each generator transformer interface protection schemes shall have dedicated protection panels with equipment as per the table below:

	Contract item	ABB	Siemens	Conco
1.	Phase VI Main 1 Generator transformer interface protection scheme – housed within Weskusfleur Transmission relay room (per generator transformer diameter)	-	6FC-2930-M1 (Contractor to design based on 5FC-3910 - 0.52/30338)	6FC-7930-M1 (Contractor to design based on 5FC-3910 - 0.52/30338)
2.	Phase VI Main 2 Generator transformer interface protection scheme – housed within Weskusfleur Transmission relay room (per generator transformer diameter)	-	6FC-2930-M2 (Contractor to design based on 5FC-3910 - 0.52/30338)	6FC-7930-M2 (Contractor to design based on 5FC-3910 - 0.52/30338)
3.	Phase V Dual Main Generator transformer interface protection scheme – housed within Weskusfleur Transmission relay room (per generator transformer diameter)	5FC-3930 Tailored from 5FC-3910 (0.52/30338)	-	-
4.	Generator transformer high impedance REF with metrosil and stabilising resistor.	x 2	x 2	x 2
5.	#FC-#930 schemes shall be fixed frame, rear entry panel for Protection schemes (2400x800x600, 19" rack mount) – Weskusfleur	Included	x 2	x 2

6.	Duplex Multi mode 50/125 fibre optic patch cord, Non-Ruggedized 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	Included	Contractor to determine requirement.	Contractor to determine requirement.
7.	Phase V or 6 Dual Main Generator transformer interface protection scheme – housed within the Koeberg GT room (per generator transformer).	5FC-3940 Tailored from 5FC-3920 (0.52/30339)	6FC-2940 (Contractor to design based on 5FC-3920 - 0.52/30339)	6FC-7940 (Contractor to design based on 5FC-3920 - 0.52/30339)
8.	Main 1 and Main 2 Master Trip Relays (Latching relays which is resettable with a push button). Operation of the master trip relay will be from the following functions: <ul style="list-style-type: none"> ▪ Cable differential protection; ▪ Generator transformer trip signal; and, ▪ Any unit protection operation. 	Included	x2	x2
9.	Large Bay Switch (#FC-#940 schemes) (supply, fitment and wiring) Ruggedcom RSG-2100: 6GK6021-0AS23-3DB0-ZA05+B05+C05+D05+E02+F00+G05+H00+J00+K01	N/A	x 1	x 1
10.	#FC-#940 schemes shall be swing frame, front entry panel for Protection schemes (2400x800x600, 19" rack mount) – Koeberg GT house	Included	x 1	x 1
11.	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)	N/A	x 4 (Harting plug wiring as per 6JB-2100 - 0.52/30444)	x 4 (Harting plug wiring as per 6JB-7100 - 0.52/30424)
12.	1U 19" rack mount fibre optic patch panels. (Each box can accept 2 fibre optic cables. Per main in the DIP and per main in the JB/BMK)	Included	x 2	x 2
13.	Documentation	x 1	x 1	x 1

The required scheme designs, IED logics and functionality shall be based on the Ingula scheme designs. The following documents and standards shall be used:

- ST_240-61377036 Rev 2 – Transmission Generation Interface Standard for Ingula Pumped Storage Scheme;
- 5FC-3910_0.52-30338 – Scheme design drawings including applications interface;
- 5FC-3920_0.52-30339 – Scheme design drawings including applications interface;
- Ingula Signal list as Reference – Information interface between Transmission and Generation;

- 240-60725641 – Specification for standard 19" equipment cabinets;
- 240-62629353 – Specification for panel labelling standard;
- 240-62773019 – Specification for low voltage electrical auxiliary components;
- 240-64100247 – Standard for earthing of secondary plant equipment in substations;
- 240-64636794 – Standard for Wiring and Cable Marking in Substations;
- 240-64685228 – Generic Specification for protective Intelligent Electronic Devices (IEDs);
- 240-65336348 – Specification for Transmission and Distribution protection schemes Common requirements;
- 240-70413291 – Specification for electrical terminal blocks;
- 240-70975231 Specification for current and voltage transformer test blocks;
- Drawing 0.53-1833 – Standard equipment cabinet;
- Drawing 0.53-30077 – Swing frame standard equipment cabinet;
- DSP 34-1658 – Corrosion protection specification for new indoor and outdoor equipment manufactured from steel;
- TSP 41-1043 – Specification for Control, Selector, Isolation and Test Switches;
- 240-46263618 – Labelling of Fibre-Optic Cables Standard;
- 240-42066934 – IEC61850 Protocol implementation document for the purposes of substation automation.

2.11.2 Breaker-and-a-half generator transformer scheme fibre interface

The #FC-#930 (Weskusfleur relay room) and #FC-#940 (Koeberg GT house(s)) schemes shall interface via single mode ruggedised redundant fibres. Each generator transformer shall have independent ruggedised fibres per main protection and per generator transformer.

Two single mode ruggedised redundant fibres shall be installed between the Koeberg GT houses 1 & 2. The metering equipment, for summation purposes, shall be via this fibre interface.

The required fibres are within the tenderer's scope of supply.

2.12 Breaker-and-a-half station transformer interface protection schemes

The station transformer interface shall consist of two protection and control schemes (one located within the Transmission relay room and the other within the Koeberg Station Transformer Control Room) to provide for the protection, including the power cable protection, and interface between the Transmission equipment and the Koeberg station transformer protection and control equipment. These schemes are Eskom Transmission assets and will be set, commissioned and maintained by Eskom Transmission.

The protection and control schemes will comprise of a Fault Clearance System, a Bay Closing System, and a Bay Management System.

The Fault Clearance System shall comprise two independent and galvanically isolated Tripping Systems, plus the two bay breakers circuit-breaker. Each Tripping System shall comprise of a Protection System, which is supplied from an independent DC source. It receives its analogue inputs from a separate CT core (2x bay CTs used independently and the summated quantity) and a separately protected CVT core and is directly connected to one trip-coil of the two HV bay circuit-breakers. The two Tripping Systems shall operate in a one-out-of-two tripping mode. The protection scheme located within the Koeberg Station Transformer Control Room shall interface with the bushing CTs of the Station Transformer.

Each Protection System shall provide the requisite primary, back-up and auxiliary protection functions.

The Bay Closing System shall comprise of the Closing Control System. It receives its analogue inputs from separately protected CVT connector cores and busbar CVTs, and is directly connected to the synchronizing device and subsequent to the close-coils of the 2x Bay HV circuit-breakers.

The Bay Management System shall provide the required substation automation functionality, local controls and indications.

Within a single Protection System, all protection functions shall reside within a single hardware device. The Bay Management System shall integrate within the Closing Control System device and is permitted to be integrated or separate from the Protection Systems.

The Protection and Control Scheme is that portion of the Fault Clearance System, Bay Closing System, and Bay Management System shall be housed within the panels. The Protection and Control Scheme housed within the Transmission relay room shall be housed within a two panel suite. The Protection and Control Scheme housed within the Koeberg Station Transformer Control Room shall be housed within a single swing frame panel with front access only. The scheme IEDs within the Transmission relay room and the Koeberg Station Transformer Control Room shall interface via single mode independent (redundant) fibres. These schemes shall also be utilised for the routing of the Koeberg Auto-start signals to and from the station transformer 6.6 kV breakers and the 6.6 kV Bussection breaker.

The protection and control schemes (set per station transformer interface) shall be developed by the successful tenderer with participation and approval by: Eskom PDE PTM&C, Koeberg Generation and Transmission Grid West region. The basic and final designs shall be submitted to the PTM&C Design Review Team and Nuclear Regulator for review and approval prior construction and commissioning.

The tenderer shall submit a design proposal for this solution and time lines with the tender submission.

2.12.1 Breaker-and-a-half station transformer interface protection scheme requirements and options

Following is the station transformer interface protection scheme requirements and option selections per station transformer. Each station transformer interface protection schemes shall have dedicated protection panels with equipment as per the table below:

	Contract item	ABB	Siemens	Conco
1.	Phase VI Main 1 Station transformer interface protection scheme – housed within the Transmission relay room (per station transformer diameter)	-	6FC-2950-M1 (Contractor to design based on 5FC-3910 - 0.52/30338)	6FC-7950-M1 (Contractor to design based on 5FC-3910 - 0.52/30338)

2.	Phase VI Main 2 Station transformer interface protection scheme – housed within the Transmission relay room (per station transformer diameter)	-	6FC-2950-M2 (Contractor to design based on 5FC-3910 - 0.52/30338)	6FC-7950-M2 (Contractor to design based on 5FC-3910 - 0.52/30338)
3.	Phase V Dual Main Station transformer interface protection scheme – housed within the Transmission relay room (per station transformer diameter)	5FC-3950 Tailored from 5FC-3910 (0.52/30338)	-	-
4.	Station Transformer REF to be located within the #FC-#950 and interface within the station transformer neutral CT (neutral CT connected to the #FC-#96#0 protection IEDs).	x 2	x 2	x 2
5.	#FC-#950 schemes shall be fixed frame, rear entry panel for Protection schemes (2400x800x600, 19" rack mount)	Included	x 2	x 2
6.	Phase V & 6 Dual Main Station transformer interface protection scheme – housed within the Koeberg Station Transformer Control Room (per station transformer)	5FC-3960 Tailored from 5FC-3920 (0.52/30339)	6FC-2960 (Contractor to design based on 5FC-3920 - 0.52/30339)	6FC-7960 (Contractor to design based on 5FC-3920 - 0.52/30339)
7.	Main 1 and Main 2 Master Trip Relays (Latching relays which is resettable with a push button). Operation of the master trip relay will be from the following functions: <ul style="list-style-type: none"> ▪ Cable differential protection; ▪ Generator transformer trip signal; and, ▪ Any unit protection operation. 	Included	x2	x2
8.	Large Bay Switch (#FC-#960 schemes) (supply, fitment and wiring) Ruggedcom RSG-2100: 6GK6021-0AS23-3DB0-Z A05+B05+C05+D05+E02+F00+G05+H00+J00+K01	N/A	x 1	x 1
9.	Duplex Multi mode 50/125 fibre optic patch cord, Non-Ruggedized 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	Included	Contractor to determine requirement.	Contractor to determine requirement.
10.	#FC-#960 schemes shall be swing frame, front entry panel for Protection schemes (2400x800x600, 19" rack mount)	Included	x 1	x 1
11.	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	-	x 4 (Harting plug wiring as per	x 4 (Harting plug wiring as per

	within scope of supply)		6JB-2100 - 0.52/30444)	6JB-7100 - 0.52/30424)
12.	1U 19" rack mount fibre optic patch panels. (Each box can accept 2 fibre optic cables. Per main in the DIP and per main in the JB/BMK)	Included	x 2	x 2

Note:

The required scheme designs, IED logics and functionality shall be based on the Ingula scheme designs. The following documents and standards shall be used:

- ST_240-61377036 Rev 2 – Transmission Generation Interface Standard for Ingula Pumped Storage Scheme;
- 5FC-3910_0.52-30338 – Scheme design drawings including applications interface;
- 5FC-3920_0.52-30339 – Scheme design drawings including applications interface;
- Ingula Signal list as Reference – Information interface between Transmission and Generation;
- 240-60725641 – Specification for standard 19" equipment cabinets;
- 240-62629353 – Specification for panel labelling standard;
- 240-62773019 – Specification for low voltage electrical auxiliary components;
- 240-64100247 – Standard for earthing of secondary plant equipment in substations;
- 240-64636794 – Standard for Wiring and Cable Marking in Substations;
- 240-64685228 – Generic Specification for protective Intelligent Electronic Devices (IEDs);
- 240-65336348 – Specification for Transmission and Distribution protection schemes Common requirements;
- 240-70413291 – Specification for electrical terminal blocks;
- 240-70975231 Specification for current and voltage transformer test blocks;
- Drawing 0.53-1833 – Standard equipment cabinet;
- Drawing 0.53-30077 – Swing frame standard equipment cabinet;
- DSP 34-1658 – Corrosion protection specification for new indoor and outdoor equipment manufactured from steel;
- TSP 41-1043 – Specification for Control, Selector, Isolation and Test Switches;
- 240-46263618 – Labelling of Fibre-Optic Cables Standard;
- 240-42066934 – IEC61850 Protocol implementation document for the purposes of substation automation;
- The Station transformer solution shall make provision for the Koeberg auto-start signals between Koeberg power station, KAS scheme at Koeberg and the KAS scheme at Weskusfleur.

2.12.2 Breaker-and-a-half station transformer scheme fibre interface

The #FC-#950 (Weskusfleur relay room) and #FC-#960 (Koeberg Station Transformer Control Room) schemes shall interface via single mode ruggedised redundant fibres. Each station transformer shall have independent ruggedised fibres per main protection and per station transformer.

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The required fibres are within the tenderer's scope of supply.

2.13 6.6kV/380V Auxiliary transformer protection scheme

For the 6.6kV/380V auxiliary transformer protection application, the auxiliary transformer protection solution shall comprise of a Fault Clearance System (ST_240-67712833_Rev 1).

The Fault Clearance System shall comprise two independent and galvanically isolated Tripping Systems (main and back-up), plus the circuit-breakers. Each Tripping System shall comprise a Protection System, supplied from an independent DC source, receive its analogue inputs from a separate CT cores and be directly connected (via the process interface units and via hardware) to one trip-coil of the circuit-breakers. The two Tripping Systems shall operate in a one-out-of-two tripping mode. The Main Protection System shall provide the requisite unit and auxiliary protection functions. All the protection functions shall reside within a single hardware device. The Back-up Protection System shall provide the requisite non-unit and back-up protection functions. All the 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 Main and Back-up Protection Systems shall interface with the auxiliary transformer breakers and equipment through IEC61850 process interface units located in close proximity to the primary plant equipment.

Breaker process interface units (PIU) 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 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) or transformer marshalling kiosks (GIS applications). The circuit-breaker PIUs 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.

2.13.1 6.6kV/380V Auxiliary transformer protection scheme requirements and options

Following is the auxiliary transformer protection scheme requirements and option selections. The auxiliary transformer shall have dedicated transformer protection panels with equipment as per the table below:

	Contract item	ABB	Siemens	Conco
1.	Phase VI Main 1 Auxiliary Transformer Protection Scheme	-	6TM-2200 (0.52/30435)	6TM-7200 (0.52/30415)
2.	Phase V Auxiliary Transformer Protection Scheme	5TAB-3200	-	-
3.	Fixed frame, rear entry panel for Protection schemes (2400x800x600, 19" rack mount)	Included	x 1	x 1
4.	Supply, install and wiring of 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)	N/A	x 2 (Harting plug wiring as per 6JB-2100 -	x 2 (Harting plug wiring as per 6JB-7100 -

			0.52/30444)	0.52/30424)
5.	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)	N/A	x 2 (Harting plug wiring as per 6JB-2200 - 0.52/30445)	x 2 (Harting plug wiring as per 6JB-7200 - 0.52/30425)
6.	Transformer JB	N/A	x 1 (6JB-2200 - 0.52/30445)	x 1 (6JB-7200 - 0.52/30425)
7.	1U 19" rack mount multi-mode fibre optic patch panel. (Each box 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).	Included	x 2	x 2
8.	Duplex Multi mode 50/125 fibre optic patch cord (3 meter), Non-Ruggedized for connection between the auxiliary transformer protection IEDs, Fibre Patch Panels and the Ethernet Switch within the protection panel.	Included	x 10	x 10
9.	Duplex Multi mode 50/125 fibre optic patch cord (3 meter), Non-Ruggedized for connection between the auxiliary transformer breaker PIUs, Transformer PIUs and Fibre Patch Panels.	Included	x 4	x 4

Note:

Any additional requirement for the protection and integration of the auxiliary transformer shall be within the scope of the successful tenderer.

2.14 Koeberg auto-start interface scheme**2.14.1 Koeberg and Ankerlig auto-start interface scheme**

The existing Koeberg auto-start interface consists of two control schemes (5KAS-3100 and 5KAS-3200) to provide for the interface between Koeberg and Ankerlig. 5KAS-3100 is located at Koeberg and 5KAS-3200 at Ankerlig. These schemes are Eskom Transmission assets and will be set, commissioned, maintained and periodic in-service testing by Eskom Transmission. The in-service testing will be done in conjunction with Koeberg power station.

The control schemes comprises of a control system (auto-start) and a Bay Management System.

The control system comprises two independent and galvanically isolated systems. Each control system includes a REC670 which is supplied from an independent DC source will receives its analogue inputs from separate VT cores and is directly connected to the trip coils and closing coils of the 132 kV circuit-breakers, as determined by the auto-start sequence. The two control systems operate in a one-out-of-two mode.

Each control system includes the requisite undervoltage, overvoltage, under frequency and logic functions required for the auto-start sequence.

The bay management system provides for the required information and local indications, supplied from the secure supply DC derived from the main 1 and the main 2 DC sources. The bay management system includes a panel HMI to display the status, per station, of each 132 kV bay. Included within the Ankerlig control scheme is an additional REC670 for connection to generator bays 1, 2 and 3 CTs, VTs, busbar 1 status, busbar 2 status and the breaker status for display on the panel HMI.

The control system and bay management system is housed within a two panel suite.

2.14.2 Weskusfleur–Koeberg–Ankerlig auto-start interface schemes

The existing Koeberg auto-start interface consists of two control schemes (5KAS-3100 and 5KAS-3200) to provide for the interface between Koeberg and Ankerlig. 5KAS-3100 is located at Koeberg and 5KAS-3200 at Ankerlig. An additional auto-start interface scheme is required at Weskusfleur to interface with Koeberg and Ankerlig. The interfacing shall be via fibre. These schemes are Eskom Transmission assets and will be set, commissioned, maintained and periodic in-service testing by Eskom Transmission. The in-service testing will be done in conjunction with Koeberg power station.

The Weskusfleur scheme (5KAS-3300) shall be developed by the successful tendered with participation and approval by: Eskom PDE PTM&C, Koeberg Generation and Transmission Grid West region. The basic and final designs shall be submitted to the PTM&C Design Review Team and Nuclear Regulator for review and approval prior construction and commissioning. The Weskusfleur auto-start scheme (5KAS-3300) shall be sourced from ABB South Africa to ensure compatibility with the existing REC670 fibre interface between the Koeberg and the Ankerlig schemes.

The scheme design for the 5KAS-3300, IED logics and functionality shall be based on the existing Koeberg auto-start scheme solution 5KAS-3100 and shall interface with Ankerlig 5KAS-3200 and Koeberg 5KAS-3100.

The 132 kV line protection schemes, the auto transformer protection schemes (132 kV) and station transformer protection schemes shall make provision for independent tripping and closing (where applicable) of the bay 1, bay 2 and tie bay circuit-breakers from the Koeberg auto-start control schemes. The 132kV bay 1, bay 2 & tie bay breakers & isolators and feeder line isolators shall have contacts available for direct interfacing with the Koeberg auto-start system.

The tenderer shall submit a design proposal for this solution and time lines with the tender submission.

This permutation can be removed from the scope of work, dependent of the commissioning of the Ankerlig 132 kV off site supply.

2.14.3 Weskusfleur auto-start interface scheme requirements

Following is the Weskusfleur auto-start interface scheme requirements as per the table below:

	Item	ABB
1.	Weskusfleur auto-start interface scheme	5KAS-3300 Tailored from 5KAS-3100 (0.52/30365)

2.	5KAS-3300 schemes shall be fixed frame two panel suite, rear entry (2400x800x600, 19" rack mount)	Included
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The required scheme designs, IED logics and functionality shall be based on the Koeberg and Ankerlig auto-start scheme designs. The following documents and standards shall be used:

- 5KAS-3100_0.52-30365 – Scheme design drawings including applications interface;
- 240-60725641 – Specification for standard 19" equipment cabinets;
- 240-62629353 – Specification for panel labelling standard;
- 240-62773019 – Specification for low voltage electrical auxiliary components;
- 240-64100247 – Standard for earthing of secondary plant equipment in substations;
- 240-64636794 – Standard for Wiring and Cable Marking in Substations;
- 240-64685228 – Generic Specification for protective Intelligent Electronic Devices (IEDs);
- 240-65336348 – Specification for Transmission and Distribution protection schemes Common requirements;
- 240-70413291 – Specification for electrical terminal blocks;
- 240-70975231 Specification for current and voltage transformer test blocks;
- Drawing 0.53-1833 – Standard equipment cabinet;
- DSP 34-1658 – Corrosion protection specification for new indoor and outdoor equipment manufactured from steel;
- TSP 41-1043 – Specification for Control, Selector, Isolation and Test Switches;
- 240-46263618 – Labelling of Fibre-Optic Cables Standard;
- 240-42066934 – IEC61850 Protocol implementation document for the purposes of substation automation.

2.14.4 Weskusfleur auto-start interface scheme fibre interface

The 5KAS-3300 scheme (Weskusfleur relay room) shall interface with the Koeberg auto-start scheme IEDs (Koeberg relay room) via single mode ruggedised redundant fibres. Each IED within the schemes shall have independent ruggedised fibres per IED. The required fibres are within the tenderer's scope of supply.

The 5KAS-3300 scheme (Weskusfleur relay room) or 5KAS-3100 scheme (Weskusfleur relay room) shall interface with the Ankerlig end via independent fibre routes.

2.15 400kV Bus zone

The 400 kV Bus zone protection scheme shall be sourced from Siemens which is the Eskom approved supplier. The Eskom contract number is: 4600001551.

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

Item Description	Quantity
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Weskusfleur Substation

Individual Bay Unit Complete addition to any Central unit (with scheme)	16
1 - 16 Bay 2 Panels	1
Configure 14 Bay Breaker and Half	1
Configure 3 Bays as Line Busbar between Koeberg & Weskusfleur	1
Individual Bay Unit Complete addition to any Central unit to be installed on the 400kV Koeberg Buszone	1
Additional CT from the 400kV Koeberg FDR to additional Bay Unit	1
Dedicated fibre between Koeberg 400kV BZ & 400kV Weskusfleur BZ	1
24 Bay Central Unit only. 220V DC Auxiliary Supply Operation	1

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 from 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 buszone will be done by Eskom. The tenderer shall request from Eskom the configuration file 5 weeks prior factory testing.

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

The Buszone 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 buszone cable schedule.

2.16 132kV Bus zone

The 400 kV Bus zone protection scheme shall be sourced from Siemens which is the Eskom approved supplier. The Eskom contract number is: 4600001551.

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

Item Description	Quantity
Individual Bay Unit Complete addition to any Central unit (with scheme)	16
1 - 16 Bay 2 Panels	1
Configure 14 Bay Breaker and Half	1

Weskusfleur Substation

16 Bay Central Unit only. 220V DC Auxiliary Supply Operation	1
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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 from 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 buszone will be done by Eskom. The tenderer shall request from Eskom the configuration file 5 weeks prior factory testing.

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

The Buszone 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 buszone cable schedule.

3. 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.
- 240-122850198: Secondary Plant Line Trap Maintenance (TPC 41-89).
- 240-122859919: PLC System Coupling Device Maintenance (TPC 41-84).
- 240-141828918: 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.

Weskusfleur Substation

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 132 kV and 400kV 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 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 these 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 TPE equipment shall be installed in the corresponding Protection cabinet.

The X.21 circuits from ET shall be detailed in ET's SOW and shall be connected to the TPE equipment.

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

For a 132kV line trap, a CC or CVT or insulators will be required. The Line Trap, CC and/or CVT shall be detailed in the Substations scope of works document..

The 132kV CC or CVT or insulator shall be ordered with the Line Trap from the same supplier or the Line Trap and CC/CVT suppliers to ensure compatibility between Line Trap and CC/CVT.

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

The contractor 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 station shall be discussed by Eskom.

The contractor shall note that the Teleprotection, PLCs and Fibre requirements and installation are affected by 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.

If a bypass or underpass is to be used for commissioning/installation process, then there is a risk the PLC might be required to be 'switched off'. This would result in Main 2 teleprotection not being available. Koeberg and System Operator would need to evaluate this risk.

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

The supplier to note that the 132 kV Line Traps can be mounted on a coupling capacitor or capacitive voltage transformer (CVT).

Eskom approved equipment and suppliers are as follows:

- LME: Supplier – ABB LME (High Pass).
- PLC: Supplier – ABB ETL 651 or ABB ETL 6101 PLCs.
- Teleprotection Equipment: Supplier – ABB NSD 570
- Line Trap Supplier – High Voltage Technologies, Trench Line Traps:
 - U2: 132 kV, 2500A, 40kA, 0.2mH
 - S3H: 275 kV, 2500A, 50 kA, 0,5 mH - Heavy Creep (25mm/kV)
 - S3HH: 275 kV, 2500A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)
 - Q1H: 400 kV, 2500A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)
 - Q1HH: 400 kV, 2500A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)
 - Q3H: 400 kV, 2500A, 50 kA, 1,2 mH LT - Heavy Creep (25mm/kV)
 - Q3HH: 400 kV, 2500A, 50 kA, 1,2 mH LT - Extra Heavy Creep (31mm/kV)
 - Q6H: 400 kV, 3150A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)
 - Q6HH: 400 kV, 3150A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)
 - Q7H: 400 kV, 3150A, 63 kA, 0,5 mH LT - Heavy Creep (25mm/kV)
 - Q7HH: 400 kV, 3150A, 63 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)
 - Q9H: 400 kV, 3150A, 63 kA, 1,2 mH LT - Heavy Creep (25mm/kV)
 - Q9HH: 400 kV, 3150A, 63 kA, 1,2 mH LT - Extra Heavy Creep (31mm/kV)
 - Q10H: 400 kV, 4000A, 63 kA, 0,5 mH LT - Heavy Creep (25mm/kV)
 - Q10HH: 400 kV, 4000A, 63 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)
- Line Trap Supplier – Actom, Trench Line Traps
 - U4: 132 kV, 2500A, 40 kA, 0,5 mH LT – (Without PI)
 - S8H: 275 kV, 3150A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)
 - S8HH: 275 kV, 3150A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)
 - S9H: 275 kV, 3150A, 50 kA, 1,2 mH LT - Heavy Creep (25mm/kV)
 - S9HH: 275 kV, 3150A, 50 kA, 1,2 mH LT - Extra Heavy Creep (31mm/kV)

- S10H: 275 kV, 4000A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)
- S10HH: 275 kV, 4000A, 50 kA, 0,5 mH LT - Extra Heavy Creep (31mm/kV)
- Q8H: 400 kV, 3150A, 50 kA, 1,2 mH LT - Heavy Creep (25mm/kV)
- Q8HH: 400 kV, 3150A, 50 kA, 1,2 mH LT - Extra Heavy Creep (31mm/kV)
- QB1H: 765 kV, 5000A, 50 kA, 0,5 mH LT - Heavy Creep (25mm/kV)
- QB1HH: 765 kV, 5000A, 50 kA, 0,5 mH LT – Extra Heavy Creep (31mm/kV)
- Line Trap Supplier – MegaHVT, Artech, Trench Line Traps
 - U5HH: 132 kV Post Insulators – Extra Heavy Creep (31mm/kV)
 - S1H: 275 kV, 2500A, 50 kA, 0,2 mH LT - Heavy Creep (25mm/kV)
 - S1HH: 275 kV, 2500A, 50 kA, 0,2 mH LT - Extra Heavy Creep (31mm/kV)
 - S5H: 275 kV, 2500A, 50 kA, 1,2 mH LT - Heavy Creep (25mm/kV)
 - S5HH: 275 kV, 2500A, 50 kA, 1,2 mH LT - Extra Heavy Creep (31mm/kV)

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	

4. 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
- 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
- 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 either 2 (4/8?), 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 24 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 Fibre switching cabinet in the control room. The patch panel shall adhere to 240-70733995 Option B. The patch box, installed in the HV yard Protection junction box, shall adhere to 240-7073395 Option C.
- The substation installation shall follow 240-46264031.

Suppliers/OEMs

- Approved Fibre optic duct cables are sourced from CBi and MTEC (SA).
- Approved Patch Panel sourced from Prysmian (SA).
- Approved Multimode Patch Panel sourced from Instelec
- Approved Multimode Patch Box sourced from Instelec

	General	Fibre Requirements
1.	Between 132kV and 400kV Control Rooms	SM Duct cable from Fibre Optic Cabinet 132kV control to Fibre Optic Cabinet 400kV control room. Including termination in the patch panels shall be installed in the Fibre Optic cabinet.
2.	Between Gen TRFR and Control Room	4 x SM Duct cable between the GEN TRFRS within the HV yard to terminate within Patch panels in the Control Room Fibre Optic Panel.
3.	Between Gen TRFRs	SM Duct cable between the GEN TRFRS within the HV yard to terminate within Patch Boxes

	Multimode Fibre Optic Cables	Fibre Requirements for Breaker and a Half Schemes
1.	Between Junction Boxes in HV yard and Control Rooms	MM Duct cable (50/125 μ m) from Junction Box in HV yard to Fibre Switching Cabinet in 400kV control room. Including termination in the patch panels shall be installed in the Fibre

		Switching Cabinet. Including termination in the patch boxes in the Junction Boxes.
2.	Between Panels within the Control Room	MM Duct cable (50/125 µm) from Fibre Switching Cabinet/s to Protection/Control and Fibre Switching Cabinets according to requirements from Control (section xxx).

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.

5. Disturbance recorder and travelling wave fault locator

The digital fault recorder and travelling wave fault locator equipment and scheme shall be sourced from Conco which is the Eskom approved supplier. The Eskom contract number is: 4600066654.

5.1 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 - 220 VDC	1
Loose: IDM+6U with 36A/128B c/w Chassis Plate & Loom - 220 VDC	2
SecuControl 8 Way Test Block (FLTP08015AD-SL17F-1523)	4
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 (CONCO 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)	2

5.1.1 400 kV scheme 1 type, drawing application levels and bay allocations

Scheme Type:	6DRB-7100
Master Drawing No.:	0.52/30114
Applicable drawing application levels:	1,2,5,9,10,14,15,16,34,36,46,47,48,49,50
DFR1-DAU1:	400 kV Feeder 2

DFR1-DAU2:	400 kV Feeder 3
DFR2-DAU1:	400 kV Feeder 1
DFR2-DAU2:	400 kV side of Generator Transformer 2
DFR3-DAU1:	400/132 kV Transformer 11 – HV side
DFR3-DAU2:	400/132 kV Transformer 11 – MV side

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

5.1.2 400 kV scheme 1, current transformer test block allocation and labelling

CTTB 1-1	400kV FDR 2 BAY CURRENT TEST BLOCK	CTTB 1-2	400kV FDR 2 TIE CURRENT TEST BLOCK
CTTB 2-1	400kV FDR 3 BAY CURRENT TEST BLOCK	CTTB 2-2	400kV FDR 3 TIE CURRENT TEST BLOCK
CTTB 3-1	400kV FDR 1 BAY CURRENT TEST BLOCK	CTTB 3-2	400kV FDR 1 TIE CURRENT TEST BLOCK
CTTB 4-1	GEN TRFR 2 HV BAY 1 CURRENT TEST BLOCK	CTTB 4-2	GEN TRFR 2 HV BAY 2 CURRENT TEST BLOCK
CTTB 5-1	TRFR 11 HV BAY CURRENT TEST BLOCK	CTTB 5-2	TRFR 11 HV TIE CURRENT TEST BLOCK
CTTB 6-1	TRFR 11 MV BAY CURRENT TEST BLOCK	CTTB 6-2	TRFR 11 MV TIE CURRENT TEST BLOCK

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

5.2 400kV Scheme 2

The following equipment for the 400 kV scheme 2 shall be sourced, factory tested, delivered, installed and commissioned:

Item Description	Quantity
Scheme: 2 Feeders B&H - 220 VDC	1
Loose: IDM+6U with 36A/128B c/w Chassis Plate & Loom - 220 VDC	2
SecuControl 8 Way Test Block (FLTP08015AD-SL17F-1523)	4
Additional Card for Traveling Wave Fault Locator	3

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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 (CONCO 12-way Fibre Optic Splice and Patch Panel (Multimode including 12 Duplex LC Mid-Couplers with Pigtails)	1

5.2.1 400 kV scheme 2 type, drawing application levels and bay allocations

Scheme Type:	6DRB-7100
Master Drawing No.:	0.52/30114
Applicable drawing application levels:	1,2,5,9,10,14,15,16,34,36,46,47,48,49,50
DFR1-DAU1:	400 kV Feeder 4
DFR1-DAU2:	400 kV Feeder 5
DFR2-DAU1:	400 kV Feeder 6
DFR2-DAU2:	400 kV side of Generator Transformer 1
DFR3-DAU1:	400/132 kV Transformer 12 – HV side
DFR3-DAU2:	400/132 kV Transformer 12 – MV side

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

5.2.2 400 kV scheme 2, current transformer test block allocation and labelling

CTTB 1-1	400kV FDR 4 BAY CURRENT TEST BLOCK
CTTB 2-1	400kV FDR 5 BAY CURRENT TEST BLOCK
CTTB 3-1	400kV FDR 6 BAY CURRENT TEST BLOCK
CTTB 4-1	GEN TRFR 1 HV BAY 1 CURRENT TEST BLOCK
CTTB 5-1	TRFR 12 HV BAY CURRENT TEST BLOCK
CTTB 6-1	TRFR 12 MV BAY CURRENT TEST BLOCK

CTTB 1-2	400kV FDR 4 TIE CURRENT TEST BLOCK
CTTB 2-2	400kV FDR 5 TIE CURRENT TEST BLOCK
CTTB 3-2	400kV FDR 6 TIE CURRENT TEST BLOCK
CTTB 4-2	GEN TRFR 1 HV BAY 2 CURRENT TEST BLOCK
CTTB 5-2	TRFR 12 HV TIE CURRENT TEST BLOCK
CTTB 6-2	TRFR 12 MV TIE CURRENT TEST BLOCK

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

5.3 132kV Scheme 3

The following equipment for the 132 kV scheme 3 shall be sourced, factory tested, delivered, installed and commissioned:

Item Description	Quantity
Scheme: 2 Feeders B&H - 220 VDC	1
Loose: IDM+6U with 36A/128B c/w Chassis Plate & Loom - 220 VDC	2
SecuControl 8 Way Test Block (FLTP08015AD-SL17F-1523)	2
Additional Card for Traveling Wave Fault Locator	2
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 (CONCO 12-way Fibre Optic Splice and Patch Panel (Multimode including 12 Duplex LC Mid-Couplers with Pigtails)	1

5.3.1 132 kV scheme 3 type, drawing application levels and bay allocations

Scheme Type:	6DRB-7100
Master Drawing No.:	0.52/30114
Applicable drawing application levels:	1,2,5,9,10,14,15,16,34,36,46,47,48,49,50
DFR1-DAU1:	400 kV Feeder 6
DFR1-DAU2:	400 kV Station Transformer 2
DFR2-DAU1:	400 kV Feeder 7
DFR2-DAU2:	400 kV Station Transformer 1
DFR3-DAU1:	400/132 kV Koeberg auto start
DFR3-DAU2:	400/132 kV Koeberg auto start

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

5.3.2 132 kV scheme 3, current transformer test block allocation and labelling

CTTB 1-1	400kV FDR 6 BAY CURRENT TEST BLOCK
CTTB 2-1	STN TRFR 2 BAY CURRENT TEST BLOCK
CTTB 3-1	132kV FDR 7 BAY CURRENT TEST BLOCK
CTTB 4-1	STN TRFR 1 HV BAY 1 CURRENT TEST BLOCK

CTTB 1-2	400kV FDR 6 TIE CURRENT TEST BLOCK
CTTB 2-2	STN TRFR 2 TIE CURRENT TEST BLOCK
CTTB 3-2	132kV FDR 7 TIE CURRENT TEST BLOCK
CTTB 4-2	STN TRFR 1 HV BAY 2 CURRENT TEST BLOCK

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

5.4 Telecommunication connection requirements

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

6. 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:

- 342-242 – Protection settings management standard.
- SPF-0001 – Protection settings request form

7. Metering and measurements**7.1 Metering**

The Eskom approved suppliers are:

- Wirconn – Eskom contract number: 4600061645.
- IST – Eskom contract number: 4600062256
-

7.2 400 kV Generator transformer 1 and 2 metering equipment

The following equipment for 400 kV generator transformer 1 and 2 shall be sourced, factory tested, delivered, installed and commissioned. The Wircon panel with all the required modules and equipment shall be delivered to and be installed at Weskusfleur. The IST meters shall be delivered to Weskusfleur and inserted within the Wircon panel meter racks.

Item Description	Quantity	Supplier
Panel: (600 x 600 x 2400mm panel)	2	Wirconn
Module: Metering 19" rack mount 6-way CT test blocks	5	Wirconn
Module, Modem, D9404	1	Wirconn
Plate: Blanking 3U, D9141	4	Wirconn
Plate, Blanking 7U, D9141	4	Wirconn
ION 8800 Meter 3 PH, 1A, CL0.2, RS232, 485 & ETH 110V PORG - 6 OUT	10	IST

Generator transformer 1 metering equipment shall be used and configured to summate and report the total metering quantities.

7.3 132 kV Station transformer 1 and 2 metering equipment

The following equipment for 132 kV station transformer 1 and 2 shall be sourced, factory tested, delivered, installed and commissioned. The Wircon panel with all the required modules and equipment shall be delivered to and be installed at Weskusfleur. The IST meters shall be delivered to Weskusfleur and inserted within the Wircon panel meter racks.

Item Description	Quantity	Supplier
Panel: (600 x 600 x 2400mm panel)	1	Wirconn
Module: Metering 19" rack mount 6-way CT test blocks	4	Wirconn
Plate: Blanking 3U, D9141	2	Wirconn
Plate, Blanking 7U, D9141	2	Wirconn
ION 8800 Meter 3 PH, 1A, CL0.2, RS232, 485 & ETH 110V PORG - 6 OUT	8	IST

Station transformer 1 metering equipment shall be used and configured to summate and report the total metering quantities.

7.4 132 kV Feeders 1, 3, 4 and 5 metering equipment

The following equipment for 132 kV feeders 1, 3, 4 and 5 shall be sourced, factory tested, delivered, installed and commissioned. The Wircon panel with all the required modules and equipment shall be delivered to Weskusfleur. The ISTmeters shall be delivered to Weskusfleur and inserted within the Wircon panel meter racks.

Item Description	Quantity	Supplier
Panel: (600 x 600 x 2400mm panel)	2	Wirconn
Module: Metering 19" rack mount 6-way CT test blocks	8	Wirconn
Module, Modem, D9404	1	Wirconn
Plate: Blanking 3U, D9141	4	Wirconn
Plate, Blanking 7U, D9141	4	Wirconn
ION 8800 Meter 3 PH, 1A, CL0.2, RS232485,& ETH 110V PROG - 6OUT	16	IST

7.5 Measurements

Measurements functions are performed by the diameter control devices.

8. Telecontrol and substation automation

The telecontrol and automation solution to be utilised will depend on which Eskom approved protection equipment and solution is chosen. The following protection and telecontrol and substation automation equipment combinations will be permitted:

- Combination 1: ABB South Africa (Eskom contract number 4600005212) for the Phase V breaker-and-a-half protection equipment in combination with Eskom approved Siemens (Pty) Ltd (Eskom development contract 4600059995) telecontrol and automation equipment.
- Combination 2: ABB South Africa (Eskom contract number 4600005212) for the Phase V breaker-and-a-half protection equipment in combination with Eskom approved CONCO telecontrol and automation equipment.
- Combination 3: Siemens (Pty) Ltd (Eskom development contract 4600059995) for the Phase VI breaker-and-a-half protection equipment in combination with the Siemens (Pty) Ltd (Eskom development contract 4600059995) telecontrol and substation automation equipment.
- Combination 4: CONCO Energy Solutions (Pty) Ltd (Eskom development contract number 4600060000) for the Phase VI breaker-and-a-half protection equipment in combination with the CONCO Energy Solutions (Pty) Ltd (Eskom development contract 4600060000) telecontrol and substation automation equipment.

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

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- Should Combination 1 or 2 above be chosen by the contractor, the contractor shall be responsible for the application and integration of the ABB protection equipment with Siemens or CONCO telecontrol and substation automation equipment. Once the application and integration has been completed, a full Factory Acceptance Test (FAT) shall be conducted by the contractor with Eskom personnel witnessing the FAT. Only on successful completion of the FAT shall the integrated protection and control solution be approved and accepted by Eskom.
- Eskom requirements in respect of switches and routers must be applied as per the Standard Networking Devices for the Substation Environment Standard: 240-68111223 and the network architecture shall comply with the Substation Automation – Network Architecture Standard for Transmission Substations: 240-612689959.
- GPS time synchronisation equipment must be provided for the time synchronisation of all Transmission Protection and Automation equipment as per Standard 240-1001176258.
- The control interlocking must be performed by the Gateway as per the Substation Gateway and Station RTU/IED Standard 240-68234842.
- 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 contractor 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 and HMIs and the Station IEDs.
- The contractor shall be responsible for the IEC61850 engineering and configuration of all the protection and substation automation equipment.
- The contractor shall be responsible for the configuration of all the ethernet switches at Weskusfleur, Koeberg GT houses and the Station Transformer Control Room.
- The contractor shall be responsible for the assignment of the technical key names for IEDs as per the Eskom guide : Substation IEC61850 Physical Device Naming Structure Rev 13
- The contractor 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 Contractor shall supply a completed application form on the ESKOM PTM&C standard template provided with a substation network diagram. Three weeks' notice is required following receipt of a complete IP address application form.
- The contractor shall update the substation network diagram with the IP addresses provided by Eskom.
- The tenderer shall compile the database for the gateway, station HMI and Koeberg. 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 aforementioned 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.
- Transmission HV yard to Generation SCADA Interface Standard - 240-95611784.

8.1 Telecontrol and substation automation equipment

The telecontrol and substation automation equipment shall comprise the following approved schemes for the Siemens and CONCO respectively:

8.1.1 Siemens telecontrol and substation automation equipment

The telecontrol and substation automation equipment shall be as per document: Substation Control and Automation Application Guide for SIEMENS Solution.

The tenderers shall engage with Siemens 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.

Note: The KVM modules are no longer used in the Gateway Panel and the HMI server has been relocated from the Gateway Panel to a standalone HMI Panel. These changes have not been effected in the Application Guide.

8.1.2 Conco telecontrol and substation automation equipment

The telecontrol and substation automation equipment shall be as per document: Automation Application Design Guide for CONCO Solution.

The tenderers shall engage with Conco 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.

Note: The KVM modules are no longer used in the Gateway Panel and the HMI server has been relocated from the Gateway Panel to a standalone HMI Panel. These changes have not been effected in the Application Guide.

9. Engineering and Data Server

The Engineering and Data Server DTC and Workstation shall be sourced from Conco which is the Eskom approved supplier. The Eskom contract number is: 4600060527

The tenderer(s) shall provide the complete Engineering and Data server solution. This entails the equipment for the EADS substation panels, HMI as well as the physical and logical interfacing to the data sources within the station. The tenderer (s) shall also provide all EADS related as-built drawings. The following requirements for the EADS solution shall apply:

- All end devices (data sources) to be connected to the EADS system shall be made available on the substation network.
- A 2Mbs IP Telecoms circuit shall be provided to allow communication between Eskom telecoms circuit and the substation router.
- All EADS system Alarms shall be wired to the IDF and interface to the common equipment panel. M/M Fibre Optic cable shall be installed from the EADS to the gateway panels.
- The tenderer shall compile the database for all data sources within the station. The database shall be based on the standard EADS commodity database templates and signal list.
- The signal lists for each of the data sources to be used for the aforementioned signal database must be provided to Eskom PTM&C at least 6 months prior to the factory testing of EADS.

- The tender (s) shall ensure that all relevant equipment and software are available to enable the successful factory acceptance testing of the EADS solution, include the enterprise engineering server. The EADS equipment shall be preloaded with all required software packages from subnet and Eskom. These software packages shall be licensed as per requirements of the substation.
- The tender (s) shall notify Eskom PTMC at 3 months prior to the commissioning of the EADS substation system to the Transmission Enterprise Engineering server.

10. Auxiliary supplies (AC & DC systems)

10.1 DC systems

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

- Dual 220 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 220 V battery banks;
- Dual 50 V battery banks; and,
- DC power distribution and control cables.

The tenderers shall engage with COM10 (battery chargers) and First National Batteries to determine the equipment required for the complete dual 220 VDC and dual 50 VDC DC systems. The complete DC systems, per system, bill of material shall be submitted with the tender.

The Eskom contract holders and number are:

- Battery Chargers: COM10 – 4600062264; and,
- Batteries and Stands: First National Batteries – 4600061271.

10.1.1 Battery chargers

The battery chargers for 220 VDC and 50 VDC DC systems shall be sourced Eskom approved supplier, factory tested, delivered, installed and commissioned at Weskusfleur.

The tender shall utilize the Eskom standard, 240-57649110, for the sizing of DC systems for substation applications.

Item Description	Quantity
220V/***A Dual Battery Charger & Dual DC Board <ul style="list-style-type: none">▪ ***A – Rating dependent on the required battery sizing.	1
50V/***A Dual Battery Charger & Dual DC Board <ul style="list-style-type: none">▪ ***A – Rating dependent on the required battery sizing.	1

10.1.2 Batteries and Stands

The batteries stands for 220 VDC and 50 VDC DC systems shall be sourced (from First National Batteries – Eskom approved supplier), factory tested, delivered, installed and commissioned at Weskusfleur.

The tender shall utilize the Eskom standard, 240-57649110, for the sizing of DC systems for substation applications.

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
RACK,MAINT AND SAFETY EQUIPMENT	1
BOOK,MAINT LOG LA BATT 108CELL	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
220 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 – 220 VDC ▪ # Quantity dependent on Amp Hour rating requirement	#
Connector, Battery Inter-row – 50 VDC ▪ # Quantity dependent on Amp Hour rating requirement	#
Terminating device – 220 VDC ▪ # Quantity dependent on Amp Hour rating requirement	#
Terminating device – 50 VDC ▪ # Quantity dependent on Amp Hour rating requirement	#
Battery, individual cells – 220 VDC ▪ # Quantity dependent on Amp Hour rating requirement	#
Battery, individual cells – 50 VDC ▪ # Quantity dependent on Amp Hour rating requirement	#

10.2 AC systems

All products shall be sourced from Eskom approved supplier (MEC-4600059969) and this shall be as per the following standards:

- AC Boards and Junction boxes for substations: 240-64139144;
- AC Reticulation philosophy for substations: 240-55151946;
- AC/DC Reticulation equipment for Breaker–and–a–half substations (240-76628687);
- 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);
- Supply, Install and commission Type 1 Transformer Distribution Boards (0.52/20252);
- Supply, Install and commission Plug Boxes – 1PB0100 (0.52/20251);
- The basic and detailed design shall be presented to Eskom PTM&C DRT for approval prior purchase; and,
- The Transmission Grid technicians shall witness the commissioning and testing as well as acceptance of the test results.

11. Telecommunications

Refer to Telecommunication Design Document for the scope of work and BOQ:

- PRJ11230_Weskusfleur Substation _TxTurnkey_rev2.pdf

Applicable standards:

- 240-56362336 - Installation of a Telecoms Equipment Cabinet Standard;
- 240-132190480 - Telecommunication Equipment Installation Standard;
- Earthing of the telecommunications equipment (indoor and outdoor), cabinets, shall be done according to the Technology specification 240-56872313 - Radio Station Earthing and Bonding;
- The testing of fibre and recording the test results based on Technology Document 240-70732888 - Fibre Optic cable system ATP;
- 240-62629353-Specification for Panel Labelling Standard;
- 240-67907017 Fibre Optic Core Allocation Standard; and,
- 240-70732902 - Fibre Optic Connectors.

12. Protection application design

12.1 Protection 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. 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 scheme design are permitted, the application design focus only on the interface between the primary plant and the standard protection schemes and equipment. 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 relay room shall be within the tenderer's scope of supply. The final set of application design for construction shall be available prior to energisation of the primary plant. The stringing, cabling, earthing and erection specification for transmission substations – 240-82736997 shall be adhere to. 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 final commissioning as revision 0 to be registered by the Eskom CAD Office.

The following standard shall be used:

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

12.2 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 subject to agreement between Eskom and the Contractor: either in a separate room or in a designated section of the control room

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.

13. 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 at Weskusfleur, the GT houses and the Station Transformer Control Room.

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 of 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 the Tx/Gx interface and station transformer interface schemes;
- Differential protection between the Tx/Gx interface and station transformer interface schemes;
- Signals between the KAS schemes and the 132 kV applicable breakers and relevant equipment;
- 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 and Conco equipment);
- Etc.

13.1 Factory acceptance testing requirements of the schemes to be developed

Factory acceptance testing are required for the Generator transformer interface schemes, station transformer interface schemes and the Koeberg auto-start scheme. These tests shall be witnessed and accepted by PTM&C technology, Transmission Grid West, Koeberg generation and the Nuclear Regulator.

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

Settings shall be requested from Eskom and implemented 8 weeks prior factory acceptance testing.

The scheme diagrams for the schemes to be developed shall be finalised (signed) prior 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 this standard and the offered equipment within the tender submission documentation;
- 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;

- Carry out performance tests to demonstrate its performance is in accordance with the functional requirements within this document and applicable standards. These performance tests shall be performed at 120% of the normal the DC voltage (264 VDC). The tenderer shall correct and retest any identified error or deviation from the requirements;
- Verify the required test templates. The tenderer shall ensure transfer of knowledge for the usage of these test templates, on the functioning of each of the IED functions and on how such functions need to be tested to yield the desired response.

13.1.1 Test template requirements of the schemes to be developed

The tenderer shall develop maintenance test templates, for the schemes to be developed, to be verified and accepted by Eskom during factory acceptance testing. The test templates shall be for the test equipment being utilised by Eskom. The test routine shall be designed for use by the commissioning and maintenance staff with minimal experience. The IED settings shall be imported automatically from the settings database and/or settings template into the test template without any user interaction. Note that the settings shall not be downloaded from the IED and then be dumped into the test template. Also no manual typing in of settings or any other form of manual interference is permissible while the settings are imported into the test template.

The test template shall be interactive and prompt the user with specific and complete instructions (e.g. 'Connect binary input 1 to relay panel terminal X4.1') whenever any action needs to be taken by the user, any wiring changes need to be made to the test set up.

The test template shall be non-intrusive, no settings changes or disabling/enabling of functions shall be permitted. The test execution shall be paused for any such user interaction, and the user must acknowledge having completed such instruction (e.g. click on 'OK' or 'Continue') before the test template shall continue execution.

If a function is disabled (not-used) in the IED via settings, the test template shall automatically disable all the tests associated with such a function.

When printing a test report, only the enabled test modules shall be printed.

If no automatic feedback can be obtained from the IED (e.g. if no pick-up contact is available / if only an indication on the HMI is given or a LED lights up), the user shall be prompted with a specific instruction for such manual feedback (e.g. 'Read XYZ on HMI and enter the value in this dialogue', before clicking on 'Continue').

All IEDs shall be tested by the use of IEC 61850 GOOSE messages. The test template shall make use of a 'TEST' GOOSE to 'trigger' for a specific test, i.e. the feedback from the IED to stop injection. The TEST GOOSE shall contain the pick-up (Instantaneous and delayed) of all functions within the IED. The benefit will be must faster testing by using instantaneous pick-up GOOSE messages as well as un-ambiguous results as one triggers on the GOOSE message issued by a specific logical node.

The purpose of testing is, that for each IED function the settings associated with this function needs to be 'checked' with a test at 10% below and 10% above the setting, i.e. to confirm that the settings have been entered and downloaded correctly to the IED. A test is assessed as passed if these two tests result in a definite pick-up for inside the zone and no pick-up for outside the zone, and failed if any of these two tests do not result in the expected response from the IED. Please note that no search test to find the actual level of pick-up (e.g. zone reaches for an impedance element) as well as no type tests (e.g. 'plotting' the whole impedance characteristic of an impedance element) should be conducted.

In addition to checking the pick-up setting, the trip time for each IED function shall be measured, compared to the nominal timer setting of this function and assessed for pass or fail.

The test report shall provide a summary of the number of test modules, number of test modules tested, number of passed tests, number of failed tests, and number of tests with errors (e.g. no connection to test set / manual assessment).

The test template shall include an application oriented power system test, i.e. to ensure that the IED operates for all types of in zone faults and stabilized for all types out of zone faults. For example this kind of test would simulate a transmission line with the appropriate source impedance and ensures that the IED pick-up and trips instantaneously for all types of fault on the primary transmission line and stabilizes (or trips in back-up time) for faults beyond the primary transmission line. Purpose of this kind of test is to not only verify the settings application process, but also the settings calculation process.

13.2 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) for Weskusfleur.

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;
- Signals to Koeberg power station;
- Controls from Koeberg power station;
- Etc.

14. 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. Test routines that are not available for IEDs within the schemes that will be designed by the appointed contractor shall be developed by the tenderer (appointed contractor).

The following standard shall be used:

- 240-54615413 – Standard for Commissioning Protection Assets;

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- 240-55197966 – Standard for the commissioning of metering installations (HV and MV); and,
- 240-137465740 – Standby Battery storage and commissioning in Eskom.

The commissioning and decommissioning sequence shall be developed and presented to Eskom for acceptance.

The Koeberg bays (per bay) shall be decommissioned and de-energized after being moved over to Weskusfleur. The de-energization shall be done using the accepted sequence.

14.1 Commissioning options

The OEM shall make provision for the two commissioning options:

14.1.1 Option 1

- The commissioning of Weskusfleur shall be commissioned by the OEM and Eskom (Western Grid Secondary Plant and PTM&C) commissioning teams shall oversee and witness the commissioning.
- The OEM shall submit a detailed training program and provided training that will include the installation, maintenance, operation of all the equipment.
- The commissioning training shall be provided by the OEM during the commissioning of the Weskusfleur substation.
- Commissioning at the remote ends will be executed by Eskom (PTM&C and Western Grid secondary plant) teams as integrated with the Weskusfleur GIS commissioning.

14.1.2 Option 2

- The commissioning of Weskusfleur shall be commissioned by the Eskom (Western grid secondary plant and PTM&C) commissioning teams. The OEM shall oversee and witness the commissioning.
- The OEM shall submit a detailed training program and provided training that will include the installation, maintenance, operation of all the equipment.
- Commissioning at the remote ends will be executed by Eskom (PTM&C and Western Grid secondary plant) teams as integrated with the Weskusfleur GIS commissioning.

After the evaluation of the tender, Eskom will advise which option will be selected for the commissioning the new GIS.

The final switching of the equipment and lines shall be with the carried under the permission of the National Control (Approved commissioning plan and outages).

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

15. 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 Weskusfleur, Koeberg GT houses and the Station Transformer Control Room.

16. Physical Security

16.1 General

This section provides an overview of Eskom's requirements for the design, supply, installation and commissioning of an Integrated Security System at Weskusfleur Substation. The Integrated Security System must be an integration of the CCTV system with intruder detection, Access Control System and Non-lethal Electrified fence. The document outlines business objectives to be fulfilled by the Integrated Security Solution and provides an overview of the envisaged system functionality. The Contractor shall use the documents listed below together with details outlined in this section when tendering for the Integrated Security project for Weskusfleur Refer to 240-170000066 for a detailed scope of work.

- [1] 240-102220945 Specification for Integrated Access Control System for Eskom sites.
- [2] 240-91190304 Specification for CCTV Surveillance with Intruder Detection.
- [3] 240-7890848 Specification for Non-Lethal Energized Perimeter Detection System (NLEPDS) for protection of Eskom installations and its subsidiaries
- [4] 240-55410927 Cyber security standard for operational Technology
- [5] 240-79669677 Demilitarized zone (DMZ) designs for operational Technology
- [6] 32-214 IT/OT Third Party Access Control Procedure
- [7] 240-170000066 Scope of Work for Integrated Security System – Weskusfleur Substation
- [8] 240-64720986 Emergency Preparedness Public Address System

16.2 Project services required for the security scope

The scope of work for the Contractor for the Integrated Security System will include the following services and tasks:

- Produce detailed design for the Integrated Security System. The detailed design must include detailed designs for the Access Control System, CCTV system with Intruder detection, Public Address (PA) system and the Non-Lethal Electrified fence. The design must also cover integration of these different systems into an Integrated Security System.
- Installation and configuration of substation security LAN.
- Installation, configuration and commissioning of the CCTV system with intruder detection in totality on site as per Eskom standard (240-91190304).
- Installation, configuration and commissioning of the Integrated Access Control System (IACS) in totality on site as per Eskom standard (240-102220945).
- Installation, configuration and commissioning of the Non-Lethal Electrified fence in totality on site as per Eskom standard (240-7890848).
- Installation, configuration and commissioning of the Public Address (PA) system in totality on site as per Eskom standard (240-64720986).
- Integration of the Integrated Access Control System, CCTV system with Intruder detection, PA system and Non-Lethal Electrified fence into an integrated security system.
- Provide and install a security cabinet(s) to house all new security equipment.
- Compile site as built drawings with electrical and engineering detail.

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- Create a Graphical User Interface (GUI) and behaviour models for the site.

16.3 Integrated Access Control System (IACS)

- The Integrated access control system will be used to manage access rights of Eskom employees, visitors and contractors in and out of different areas at site.
- The system will also be used to grant and limit access permissions in and out of areas such as secure and non-secure areas.
- The offered system shall comply with requirements of Specification for Integrated Access Control System (IACS) for Eskom sites (240-102220945).
- The system should support a tiered architecture which will allow monitoring of the site both locally and remotely comprising of field devices (biometric & card readers) at site level and system management servers at a security control room.

16.3.1 IACS devices layout

The envisaged Integrated Access Control devices for the site and their locations are shown in Table 1 below:

Area	Point	Device	Status Contact	Lock	Evacuation Device	Bypass
Main Gate (Inbound traffic)	Exterior Perimeter Fence (Gooseneck Mount)	Card Reader	Gate Status Contact	Electro Mechanical Lock	Emergency Exit Button	Mechanical Bypass
	Energized Fence Gate	Integrated with exterior gate automation	Gate Status Contact	Electro Mechanical Lock	None	Mechanical Bypass
	Inner Perimeter Fence (Gooseneck Mount)	Card + Biometric Reader	Gate Status Contact	Electro Mechanical Lock	None	Mechanical Bypass
Outbound Traffic	Exterior Perimeter Fence (Gooseneck Mount)	Card + Biometric Reader	Gate Status Contact	Electro Mechanical Lock	None	Mechanical Bypass
	Energized Fence Gate	Integrated with interior gate automation	Gate Status Contact	Electro Mechanical Lock	None	Mechanical Bypass
	Inner Perimeter Fence (Gooseneck Mount)	Card Reader	Gate Status Contact	Electro Mechanical Lock	Emergency Exit Button	Mechanical Bypass

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Area	Point	Device	Status Contact	Lock	Evacuation Device	Bypass
Guard House	Entrance Door	Card + Biometric Reader (In) & Card Reader (Out)	Door Status Contact	Magnetic Lock	Emergency Exit Button	Mechanical Bypass
	Equipment Room Door (Inside)	Card + Biometric Reader (In) & Card Reader (Out)	Door Status Contact	Magnetic Lock	Emergency Exit Button	Mechanical Bypass
Control Room Building	Office Door	Card Reader (In) & Card Reader (Out)	Door Status Contact	Magnetic Lock	Emergency Exit Button	Mechanical Bypass
	Control Room Entrance Door	Card + Biometric Reader	Door Status Contact	Magnetic Lock	Emergency Exit Button	Mechanical Bypass
	Control Room Back Door (Emergency Exit)	Emergency exit break-bar	Door Status Contact	Magnetic Lock	Emergency Exit Button	Mechanical Bypass
	Control Room Double Door	Card Reader (Inside only)	Door Status Contact	Magnetic Lock	Emergency Exit Button	Mechanical Bypass
	Battery Room	Card + Biometric (In) & Card Reader (Out)	Door Status Contact	Magnetic Lock	Emergency Exit Button	Mechanical Bypass
	Carrier Room	Card + Biometric (In) & Card Reader (Out)	Door Status Contact	Magnetic Lock	Emergency Exit Button	Mechanical Bypass

16.4 CCTV system with Intruder detection

- a) A CCTV system shall be installed and the proposed system for the site is intended to provide the guards/ control room operators with a single point from where they can view and verify alarm events from the Intrusion detection system and energized fence triggers without having

to physically respond to the alarm event in the case of a false/nuisance alarm and correctly assess and verify positive alarm events in the event of an attempted or successful intrusion attempt.

- b) The offered system shall comply with requirements of Eskom standard for CCTV system (240-91190304).
- c) The CCTV system shall be integrated with video analytics and automatically record any alarm event by means of the 30 seconds pre-event buffer, the actual event (for however long motion is detected by the camera) and at least a 30 seconds post event time period. The system shall utilize a video analytics system as pre-detection to automatically generate alarms and perform event recording.
- d) It is proposed that 9 static CCTV cameras with video motion detection be installed along the perimeter of the Substation to provide both surveillance and detection functionality. In addition it is proposed that 2 PTZ cameras be installed for zooming and recognition functionality.
- e) The CCTV system shall be connected to the security LAN to enable event driven video streaming to the local security room.
- f) A video intercom system must be installed at the main gate entrance and the audio feed and Camera feed from the unit must be integrated into the local DVR to ensure both visual and audio recording of events. The purpose of this unit is to enable the security control room to interact with unannounced visitors and non-Eskom staff. The communication will be point-to-point between the gate and the security control room and will not be integrated with the gate control system.

16.4.1 CCTV System devices layout

The areas identified where CCTV devices (cameras) are to be installed are listed in Table 2 below. The cameras are to be positioned as per the site layout.

Area	Point	Device(s)	Quantity
Perimeter and Main Access Gate	Perimeter fence	Static thermal Camera	9
		PTZ Camera	2
	Access Gate	Static Camera	2
		Video Intercom	1
	Guard House	Interior Static Camera	2
Control Room Building	Outside Battery Room entrance	Exterior static Camera	1
	Control Room Door	Interior Static Camera	1
	Control Room Emergency Exit	Interior Static Camera	1
	Control Room Double Door	Exterior Static Camera	1
	Carrier Room	Interior Static Camera	1

16.5 Intruder detection system

Intrusion detection units shall be installed in identified areas so as to effectively detect intrusion into the protected (secured) area. Intrusion detection shall be in the form of movement detection (using passive infrared sensors / PIRs) and/or video analytics as well as door and window contacts, where applicable. The intrusion detection system is to be integrated with the Access Control System. The system will predominantly focus on the securing of specific areas with two primary purposes, namely;

- i. to detect if entry is gained into a secure area by any unauthorized manner; or
- ii. to verify that operational procedures are adhered to from a safety perspective (areas such as the Battery Room).
- iii. The offered system shall comply with requirements of Eskom standard for CCTV system with intruder detection (240-91190304).

The areas identified where intrusion detection devices are to be installed are depicted in Table 3 below:

Area	Point	Device(s)	Quantity
Gates	Exterior Perimeter Gate	Heavy Duty Gate Contact	1
	Energized Fence Gate	Heavy Duty Gate Contact	1
	Inner Perimeter Gate	Heavy Duty Gate Contact	1
Guard House	Exterior Door	Door Contact	1
	Server Room Door	Door Contact	1
	Server Room	Interior PIR (90°)	1
Control Room Building	Office Door	Door Contact	1
	Office Interior	Interior PIR	1
	Battery Room Door	Door Contact	2
	Battery Room	Interior PIR (90°)	1
	Control Room Door	Door Contact	1
	Control Room Emergency Exit	Door Contact	1
	Control Room Double Door	Door Contact	2
	Control Room	Interior PIR (360°)	2
	Carrier Room Door	Door Contact	2
	Carrier Room	Interior PIR (90°)	1
	Workshop Room	Interior PIR (90°)	1
	Workshop Store Room	Door Contact	1
	Flammables Store Room	Interior PIR (90°)	1

16.6 Non-Lethal Electrified Fence

The energized fence shall be installed in accordance with the Standard for Non-Lethal Energised Perimeter Detection System (NLEPDS) (240-78980848). The detection side of the energized fence must be incorporated into the site security system as an alarm indicating which zone has been triggered and should also allow for the remote monitoring of system status i.e. output voltage, battery status, short conditions etc. Clear zone number indication must be done per zone on the fence line and attached to the fence as per standard. The fence GUI must be integrated with the security management system to be installed at the local security control room.

The Contractor shall ensure that the design complies with all relevant standards in order for a Certification of Compliance (COC) to be issued. An electric fence certificate of compliance shall be in accordance with the Electrical Machinery Regulations, 2011 as contained in the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

- a) At the entrance area Install and commission an automatic sliding gate's associated equipment i.e. electric motors with suitable enclosure and mechanical disengage mechanism, status detector mechanisms, obstruction detector mechanisms, conductor wires, IR units and anti-theft brackets (Refer to section 3.5.4 of 240-78980848) .
- b) At the Access Control Building install the following:
 - i. System configuration PC/Controller used to configure the electric fence system. Refer to section 3.1.1.2 of 240-78980848.
 - ii. User interface/display unit to display the configured zones of the fence including alarms. Refer to section 3.1.1.3 and 3.1.9 of 240-78980848.
 - iii. Install and commission relay cards (where applicable) to configure the system alarms as well as interfacing the Non-Lethal Electrified Fence with other security systems deployed at site. Refer to section 3.1.1.4 and 3.1.7 of 240-78980848
 - iv. Install and commission the energizers. This shall include installation of synchronisation mechanism where required. Refer to section 3.1.1.6, 3.2.2 and 3.2.5 of 240-78980848
 - v. Integrate the Non-Lethal Electrified Fence with other security systems installed at site (where applicable) such as security lighting and CCTV system such that requirements of integrated intrusion alarm management can be achieved as outlined in section 3.1.8 of 240-78980848.
 - vi. Supply and install the required equipment housing/cabinets for all the electronic equipment in the ACB. Refer to section 3.1.1.6 of 240-78980848.
- c) Along the site perimeter install the fence HT cables, fence conductors, fence posts, anti-tunneling, vegetation control slab, warning signs and zoning signs.
- d) Install and commission a 20 pair communication cable from the Access Control Building to the Main control room to enable the security alarms to be sent to the remote monitoring centre.

16.7 Public Address (PA) system

The installation of a PA system is required in order to engage potential intruders and issue warnings before the intrusion takes place as a deterrence measure. The system must be scalable and operable remotely in future via the responsible control rooms to warn would be attackers of the restriction of access to the site.

The proposed system shall comply with requirements of the specification for emergency preparedness public address system (240-64720986) and functionality listed below.

- a) Emergency conditions “all-call” announcement shall be made from the security building (guard house) on site. There shall be capability to extend this capability to a remote security control building in future.
- b) 2 microphones shall be installed, a remote microphone shall be installed in the guard house and the Fireman’s microphone shall be located near the PA system rack housing the components.
- c) The system shall be provided with all the necessary software and licensing.
- d) The system zoning shall be configured to align to the electric fence zones and site zones.
- e) The system shall have the necessary redundancy for cabling (fibre), network and power supply.
- f) The system shall have interfaces to accommodate external inputs from other security systems installed at site (e.g. electric fences, access control system), also be capable of providing.
- g) The Voice/Alarm system shall be integrated with the thermal cameras on site whereby a pre-recorded message is automatically broadcast over the speakers should the thermal cameras detect movement.
- h) The system event logs shall be accessed locally from the security control building, but the system shall be expandable to enable remote accessibility in future.
- i) 22 speakers shall be installed. 20 horn speakers: 109dB @1w @1m shall be installed along the site perimeter mounted either on the light posts or on the inner barrier fence, 1 speaker (Wall-mount speaker: 90dB - 94dB @ 1w @ 1m) in the main control building and 1 speaker (Wall-mount speaker: 90dB - 94dB @ 1w @ 1m) in the carrier room. SPL measurements shall be used to determine the exact speaker ratings that will result in good sound propagation.
- j) A non-proprietary HMI (laptop) for on-site management, supporting rapid execution of maintenance and reporting routines shall be installed in the security control building at site.
- k) Management / Administrative software and licensing shall execute maintenance routines of the entire system, monitor the operational status of all components of the system (including speakers), and changing the configuration parameters of the system shall be through site security LAN.
- l) The system shall be expandable to allow remote management via Eskom WAN in future

16.8 Power supply requirements

- 1) Power shall be supplied from one central point to all security equipment that needs to be powered.
- 2) The security system shall be powered by site power supply with an appropriately sized Uninterruptable Power Supply (UPS).
- 3) MCB on the AC panel shall be clearly labelled ‘Security’ to indicate the use.
- 4) The contractor shall be responsible for the sizing of the UPS sufficient to power all the devices for the Integrated Security System.

16.9 Integrated Security System functionality

- 1) Outdoor intrusion events shall be triggered by video analytics on outdoor cameras and exterior PIRs.
 - 2) Applicable PTZ cameras to zoom in on triggered zones within their range of visibility
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- 3) Perimeter lights shall be triggered by either perimeter cameras and/or the electric fence
- 4) Indoor cameras shall be triggered by Video Motion Detection and PIRs shall be triggered by interior movement.
- 5) The intrusion detection system for buildings (for which access is granted) shall disarm upon granting of access by the access control system and arm upon the exiting of the person who was granted access.
- 6) The access control door and gates access control devices shall also create an alarm if there are unauthorised access attempts.
- 7) PTZ CCTV Cameras shall be installed at strategic positions (taking into consideration the location of power plant equipment and the proximity limitations to this equipment) on site to provide the best possible coverage of the site. A controllable interface from where specific activities can be monitored remotely shall be provided.
- 8) At the site gates entrance area an electronic Access Control reader consisting of a card and fingerprint/card reader shall be installed as initial verification of authorized personnel. Upon positive verification all the gates should simultaneously open allowing the vehicle/person to enter the site. The gates should automatically close simultaneously 10 seconds after opening. If an object is detected preventing the gates from closing, an alarm should be triggered.
- 9) When exiting the site, at the entrance area an electronic Access Control reader consisting of a card and fingerprint reader should be installed as initial verification of authorized personnel. Upon positive verification all the gates should simultaneously open allowing the vehicle/person to exit the site. The gates should automatically close 10 seconds after opening. If an object is detected preventing the gates from closing, an alarm should be triggered.

Note: The contractor is required to submit details outlining how the integrated system will be configured for handling of the above use cases:

16.9.1 Integration Functional Specification/System Design Report

The Contractor is required to produce and submit an Integration Functional Specification and a System Design Report covering the integration of the disparate systems into a unified security solution. The Integration Functional Specification details Eskom's functional requirements in the context of the product(s) that is offered by the Tenderer. The Integrated System Design Report documents the design that has been developed in order to meet the requirements as specified in the listed security specifications and security sections above. At minimum, the Integration Functional Specification and the Integration System Design Report shall cover the functional and interconnection details of system components as outlined below.

- 1) System architecture: Submit integrated system architecture including description of functions of system components and modules.
- 2) General integration functionality: Submit details of how integration functionality requirements have been incorporated in the integrated system design.
- 3) Alarming Requirements: Include details of how alarming requirements have been incorporated in the integrated system design.
- 4) Monitoring: Include details of how monitoring requirements have been incorporated in the integrated system design.
- 5) Communications requirements: Include details of how communication requirements have been incorporated in the integrated system design.
- 6) Power supply requirements: Include details of how power supply requirements have been incorporated in the integrated system design.

16.10 System evaluation, demonstration and design presentation

- a) The proposed system(s) will be evaluated as per the evaluation criteria for the security solution (refer to 240-170000065).
- b) The appointed contractor will be required to demonstrate how the different functional and technical requirements have been incorporated in the system design. For this demonstration the Contractor shall use the offered equipment/system to demonstrate how Eskom's requirements are incorporated in the system designs. The demonstrated system shall be configured so as to represent the architecture envisaged for the complete solution. The demonstration shall be conducted at the local OEM's/Tenderer's test facilities or an existing similar installation.
- c) The appointed contractor will also be required to present the proposed design to the PTM&C Design Review Team (DRT) for approval of the design before construction can start.

Note: The system demonstration and design presentation do not contribute towards the scoring of the Tenderers. The demonstration and presentation will happen after the Contractor is appointed to show how the proposed system and design have incorporated the required functionality.

17. General

- The basic and detailed designs shall be presented to Eskom PTM&C DRT for approval prior purchasing;
- 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 time lines for schemes to be developed;
- All work shall comply with
 - 240-64636794 – Generic Equipment Specification Wire, Wire Marking, Cable Numbering, Fibre Optical Cable Installation and Labelling
 - 240-62629353 – Labelling
 - 240-64100247 – Earthing
 - 240-96632721 – Eskom Drawings
 - 240-132496539 – JB specs
 - 240-60725641 – Panel spec
 - 240-82736997 – The stringing, cabling, earthing and erection specification for transmission substations

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as and where required.

- 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 tender shall request drawing numbers from Eskom;
- The tenderer shall be given all the scheme drawings accompanied with the relevant application & drawing standards;
- Eskom will not checking or reviewing of the application drawings during the construction phase of the project;
- The tenderer shall provide all the required information on time for the remote ends including but not limited to primary plant equipment, relays etc.;
- Eskom will be responsible for the remote end application drawings;
- The tenderer shall provide all the PTM&C plant 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 at six weeks' notice will 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.
- The appointed contractor shall submit detailed designs for the Integrated Security System to the technical team for review and technical approval before any construction can commence.

18. Revision and tracking

Rev No	Description	Compiler	Date
1	Initial Scope of Work		

19. Acknowledgement

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