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Content

1. Introduction

This document has been revised in preparation for re-issuing of the tender enquiry for Weskusfleur substation. Changes since the previous revision are indicated in red.

1.1 Background

Koeberg Transmission Substation's (TS) 400kV and 132kV Gas Insulated Switchgear (GIS) has been in operation for almost 40 years and major refurbishment is required to improve the reliability of the system. The substation receives 1860MW generated by Koeberg Nuclear Power Station for onward transmission to load centres. The station's 2 x 250MVA, 400/132kV coupling transformers provide KNPS's auxiliary power supply through 2 x 30MVA, 132/6.9kV station transformers and also supply Distribution's 132kV load. The 132kV feeder between Koeberg TS and Acacia Power Station provides emergency off-site supply to KNPS's station transformers via the Koeberg TS 132kV busbars. Emergency off-site supply to KNPS via Koeberg TS will in future be provided from Ankerlig Power Station.

A new Transmission interface substation for KNPS called "Weskusfleur" will be established to the North of the existing Koeberg TS, connecting to KNPS via power cables of approximately 800m in length. The position of Weskusfleur in relation to Koeberg TS and KNPS is indicated in the Site General Arrangement drawing referenced below. Weskusfleur TS is to be located as close to the existing Koeberg TS as is practical, between the Access Control Point 1 (ACP1 - outer security perimeter) and Access Control Point 2 (ACP2 - inner security perimeter) of KNPS. Koeberg TS is located inside the KNPS ACP2 perimeter. Commissioning of Weskusfleur will allow for the decommissioning of existing Transmission equipment at Koeberg TS. The new Weskusfleur 400/132 kV substation will be constructed as a turnkey project utilising the "Breaker-and-a-half" GIS busbar topology at 400kV and 132kV.

To facilitate maintainability and compatibility with the existing installed Eskom PTM&C equipment, the successful tenderer shall source previously Eskom Transmission-approved PTM&C equipment only. 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 Transmission network.

This document shall be read in conjunction with:

- Weskusfleur Station Electric Diagram WKoe11P01-SE-D6-2 Rev.3; and
- Site General Arrangement Drawing WKoe11P01-SE-D7-1 Rev.3

1.2 Scope

The provision of a complete turnkey protection, tele-control, measurements, metering, DC, telecommunications and integrated physical security solution for the proposed Weskusfleur substation, aligned with Eskom's design philosophies and using approved and accepted equipment.

Standard previously tested and Eskom-approved solutions are to be utilised. Where specific schemes/solutions do not 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 work includes:

- engineering, to be accepted by Eskom;
- sourcing of standard solutions;
- where standard solutions do not 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; and

- anything else deemed necessary by the tenderer for the provision of a working solution.

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

1.3 Definitions and Abbreviations

1.3.1 Definitions

None.

1.3.2 Disclosure classification

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

1.3.3 Abbreviations

Abbreviation	Description
BMK	Breaker/Bay Marshalling Kiosk
CC	Coupling Capacitor
CVT	Capacitive Voltage Transformer
DRT	Design Review Team
EHV	Extra High Voltage
IED	Intelligent Electronic Device
KNPS	Koeberg Nuclear Power Station
kV	kiloVolt
LAN	Local Area Network
LME	Line Matching Equipment
OEM	Original Equipment Manufacturer
PIU	Process Interface Unit
PLC	Power Line Carrier
PTM&C	Protection, Telecommunications, Metering and Control
SHEQ	Safety, Health, Environment and Quality
SOW	Scope of Work
TPE	Teleprotection Equipment
TS	Transmission Substation

1.4 Normative References

Parties using this document shall apply the documents listed in the following paragraphs.

Protection

[P1] Eskom Standard 240-115276333, “Standard for EHV Transmission Line Model Power System Simulator Testing”

[P2] Eskom Standard 240-114810235, “Model Power Simulator Testing Report for the Breaker-and-a-Half & Double Busbar Transformer Protection Schemes”

[P3] Eskom Standard 240-96621430, “Standard Philosophy for the Breaker-and-a-Half Diameter Interface”

[P4] Eskom Standard 240-64685228, “Generic Specification for Protective Intelligent Electronic Devices (IEDs)”

[P5] Eskom Standard 240-58855759, “Transmission Generation Interface Standard”

[P6] Eskom Standard 240-56357419, “Generator Synchronising and Network Synchronism Check Standard”

[P7] Eskom Report 240-146288697, “Specification for the Interfacing of the new protection and control equipment to the GIS Bay Marshalling Kiosk”

[P8] Eskom Standard 240-96621426, “Standard philosophy for the Breaker-and-a-Half Line Protection”

[P9] Eskom Standard 240-99870095, “Protection Philosophy: Breaker-and-a-Half Transformers and Shunt Reactors”

[P10] Eskom Standard 240-60725641, “Specification for standard 19” equipment cabinets”

[P11] Eskom Standard 240-62629353, “Specification for panel labelling standard”

[P12] Eskom Standard 240-62773019, “Specification for low voltage electrical auxiliary components”

[P13] Eskom Standard 240-64100247, “Standard for earthing of secondary plant/Control plant equipment in substations”

[P14] Eskom Standard 240-64636794, “Standard for Wiring and Cable Marking in Substations”

[P15] Eskom Standard 240-65336348, “Specification for Transmission and Distribution protection schemes Common requirements”

[P16] Eskom Standard 240-70413291, “Specification for electrical terminal blocks”

[P17] Transmission Standard TSP 41-1043, “Specification for Control, Selector, Isolation and Test Switches”

[P18] Eskom Standard 240-75655504, “Corrosion protection specification for new indoor and outdoor equipment manufactured from steel”

[P19] Eskom Standard 240-46263618, “Labelling of Fibre-Optic Cables Standard”

[P20] Eskom Standard 240-119981735, “Koeberg Auto-Start Standard – 5KAS-3100”

Teleprotection

[TP1] 240-90353855, “Design Standard for Teleprotection Systems”

[TP2] 240-141828918, “Scope of Work Template for Teleprotection Projects”

[TP3] 240-75975613, “Standard for the Installation of Power Telecommunications Equipment”

[TP4] 240-91461878, “Teleprotection Trip Testing”

[TP5] 240-96651735, “Power Line Carrier and Associated Coupling Equipment: Commissioning and Major Maintenance Procedure”

[TP6] 240-122850198, “Secondary Plant Line Trap Maintenance (TPC 41-89)”

[TP7] 240-122859919, “PLC System Coupling Device Maintenance (TPC 41-84)”

[TP8] 240-103057370, “Application Design Standard for Teleprotection Systems”

[TP9] 240-77422828, “Teleprotection Equipment for use on Digital Telecommunications Channels or Dedicated Optical Fibre”

[TP10] 240-106920490, “Specification for Power Line Carrier & Integrated Teleprotection Equipment”

[TP11] 240-106920412, “Power Line Carrier – Line Matching Equipment”

[TP12] 240-57648739, “Power Line Carrier Line Traps and Associated Post Support Insulators Standard”

[TP13] 240- 64813646, “Data Cable Required for X.21 Interfaces”

[TP14] 240-64813538, “High Frequency Coaxial Cable for Power Line Carrier Applications”

[TP15] 240-64813692, “Miniature Control Cable Required for Teleprotection Signals (18Z Cables)”

[TP16] 240-64813568, “Standard Indoor and Outdoor Telephone Cable”

Fibre Optics

[FO1] NRS 088-1, “Duct and direct-buried underground fibre-optic cable – Part 1: Product specification”

[FO2] NRS 088-2, “Duct and direct-buried underground fibre-optic cable – Part 2: Installation guidelines”

[FO3] 240-46264031, “Fibre-Optic Design Standard Part 2 Substations”

[FO4] 240-70733995, “Optical Distribution Frame / Patch Panel”

[FO5] 240-60725641, “Specification for standard (19 inch) equipment cabinets”

[FO6] 240-70732888, “Fibre optic cable system acceptance testing procedure”

[FO7] 240-46263618, “Labelling of fibre optic cables”

[FO8] 240-722740830, “Multimode Fibre Optic Duct Cable Specification”

[FO9] 240-106030205, “Fibre Optic Gantry to Substation Control Room Scope of Work Guideline”

Protection Settings

[PS1] 342-242, “Protection settings management standard”

[PS2] SPF-0001, “Protection settings request form”

Telecontrol

[TC1] 240-95611784 “Transmission HV Yard to Generation DCS/SCADA HMI Interface Standard“

[TC2] 240-68111223 “Standard Networking Devices for the Substation Environment”

[TC3] 240-612689959 “Substation Automation – Network Architecture Standard for Transmission Substations”

[TC4] 240-1001176258: “Technical specification for GPS Time Synchronisation Device”

[TC5] 240-68234842 “Substation Gateway and Station RTU/IED standard specification for EHV substations”

[TC6] 240-170000601: “Standard for assigning physical device technical keys in Transmission”

[TC7] 240-170000395: “Substation Control and Automation application guide for Phase 6 Siemens solution”

DC Systems

[DC1] 240-57649110, “Sizing of DC Systems for Substation Applications Standard”

AC Systems

[AC1] 240-64139144, “AC Boards and Junction boxes for substations”

[AC2] 240-55151946, “AC Reticulation philosophy for substations”

[AC3] 240-76628687, “AC/DC Reticulation equipment for Breaker–and–a–half substations”

[AC4] Drawing 0.54/7106, “230 V AC Distribution Board”

[AC5] Drawing 0.54/08596, “400 V AC Substation Distribution Board Type 2”

[AC6] Drawing 0.52/20252, “Transformer Distribution Board Type 1”

[AC7] Drawing 0.52/20251, “Plug Boxes – 1PB0100”

Telecomms

[T1] PRJ11230_Weskusfleur Substation _TxTurnkey_rev3

[T2] 240-56362336, “Installation of a Telecoms Equipment Cabinet Standard”

[T3] 240-132190480, “Telecommunication Equipment Installation Standard”

[T4] 240-56872313, “Radio Station Earthing and Bonding”

[T5] 240-70732888, “Fibre Optic cable system ATP”

[T6] 240-62629353, “Specification for Panel Labelling Standard”

[T7] 240-67907017, “Fibre Optic Core Allocation Standard”

[T8] 240-70732902, “Fibre Optic Connectors”

[T9] 240-46263618, “Fibre-optic cables and ODF labelling standard”

[T10] 240-140642648, “Fibre Optic design standard – Part 1 Lines and Cables”

[T11] 240-46264031, “Fibre Optic Design and Installations - Substations”

[T12] 240-84979963, “DC Systems Design Guide for Telecommunications”

[T13] 240-118870219, “Standby Power Systems Topology and Autonomy for Eskom Sites”

[T14] 240-75975613, “Standard for the installation of Power Telecommunications Equipment”

[T15] 240-70732272, “MSAP Design Guide”

[T16] 240-70783066, “Telecoms Transport Network Design Standard for TDM circuits”

[T17] 240-56576361, “Telecommunications Transport Network Equipment Installation and Commissioning Standard”

[T18] 240-94136376, “IP Data Network Design Guide”

[T19] 240-164619548, “OTN High Level Design”

[T20] 240-150755516, “OTN OSN1800 AND OSN9800 Design Guide”

[T21] 240-170000419, “OT Voice Design Guide”

[T22] 240-110412152, “Generic QA tick sheet for projects”

Security

[S1] 240-170000258, “Scope of work for Integrated physical security systems”

[S2] 240-170000192, “Scope of work for Non-Lethal Energized Perimeter Detection System (NLEPDS)”

[S3] 240-170000257, “Technical evaluation for the integrated physical security system”

[S4] 240-134779125, “Technical evaluation criteria for Non-Lethal Energized Perimeter Detection System (NLEPDS)”

[S5] 240-102220945, “Specification for Integrated Access Control System for Eskom sites”

[S6] 240-91190304, “Specification for CCTV Surveillance with Intruder Detection”

[S7] 240-7890848, “Specification for Non-Lethal Energized Perimeter Detection System (NLEPDS) for protection of Eskom installations and its subsidiaries”

[S8] 240-55410927 “Cyber security standard for Operational Technology”

[S9] 240-79669677 “Demilitarized zone (DMZ) deigns for Operational Technology”

[S10] 32-373, “IT/OT Third Party Access Control Procedure”

[S11] 240-17000723, “Generic Technical requirements for physical security technologies contracts”

[S12] 240-86738968, “Specification for Integrated Security alarm system for protection of Eskom installations and subsidiaries”

[S13] 240-17000096, “Physical Security Integration Standard”

[S14] 240-170000614, “Cyber security controls guide for physical security systems”

[S15] 240-170000691, “Standard for intrusion pre-detection systems used at Eskom sites”

[S16] 240-170000098, “Security Public Address Systems for Substations and Telecoms High sites”

[S17] Drawing 0.52-30122, “Manufacturing detail of two-way energiser kiosk”

[S18] Drawing 0.52-30123, “Manufacturing detail of four-way energiser kiosk”

[S19] Drawing 0.52-30124-06, “Manufacturing detail of electric fence controller”

[S20] Drawing 0.52-30125, “Manufacturing detail of electric fence guard house kiosk”

[S21] Drawing 0.54-8282-5, “Non-lethal fence plan sections and details”

LV Control and Power Cables and Telephone cables

[CC1] Eskom Standard 240-56063805, “LV Power and Control cable with rated voltage 600/1000V standard”

[CC2] Eskom Cable Codes – Power & Control

[CC3] Eskom Cable Codes – Telephone

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

- Combination 1: Hitachi Energy (formerly ABB Power Grids) (Eskom contract number 4600005212) for the Phase V breaker-and-a-half protection equipment in combination with Eskom approved Siemens (Pty) Ltd (Eskom contract number 4600067750) telecontrol and automation equipment.
- Combination 2: Withdrawn by Eskom (Revision 2).
- Combination 3: Siemens (Pty) Ltd (Eskom contract number 4600067750) for the Phase VI breaker-and-a-half protection equipment in combination with the Siemens (Pty) Ltd (Eskom contract number 4600067750) telecontrol and substation automation equipment.
- Combination 4: Withdrawn by Eskom (Revision 2).

Notes for Combination 1:

- The interface between the protection equipment and the primary plant equipment (via BMK) is hardwired.
- The Phase V breaker-and-a-half protection equipment and corresponding IEDs for compatibility at remote line ends are based around the Relion 670-series version 1.2.3 Intelligent Electronic Devices (IEDs) which are in limited production phase and will shortly be discontinued by the OEM. The Relion 670-series version 2 is the new evolution of the platform, being identical form factor and pin-out and with identical or enhanced functionality. A Tenderer making use of Combination 1 shall cater for the use of Relion 670-series version 2 IEDs in the existing Phase V scheme designs, including the conversion of configuration and settings files to use the new platform. The project programme and costing shall include:
    - Documentation of new or altered features of the version 2 IEDs compared with version 1.2.3, including updating of the configurations and indicating required settings for new or altered features.
    - Model Power System Simulator testing of the breaker-and-a-half feeder including auto reclose (2 weeks) and transformer (1 week) protection IEDs at the OEM's overseas factory. Two or three Eskom technical staff shall witness the testing and Eskom shall cover their travel and subsistence expenses. The test scope shall be a subset of that documented in 240-115276333 "Standard for EHV Transmission Line Model Power System Simulator Testing" [P1] and 240-114810235 "Model Power Simulator Testing Report for the Breaker-and-a-Half & Double Busbar Transformer Protection Schemes" [P2].

Notes for Combination 3

- The interface between the Protection equipment and the primary plant equipment (via BMK) is hardwired (DC supplies and tripping). Process Interface Units shall be located within the BMKs or alternatively within a panel adjacent to the BMKs and shall be connected to IEDs in the substation control room via fibre, except that CT and VT interfacing with the protection & control schemes which shall be hardwired.
- Any Hitachi Energy Relion-670 series IEDs used in the design for feeder remote-end interoperability shall use platform version 2. The project programme and costing shall include:
  - Conversion of existing configuration and settings files to use the new platform.
  - Documentation of new or altered features of the version 2 IEDs, including updating of the configurations and indicating required settings for new or altered features.

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 extra 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 to Eskom Standard 240-96621430 [P3].

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, 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 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 bay marshalling kiosks (GIS application). 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 Eskom Standard 240-64685228 “Generic Specification for Intelligent Electronic Devices (IEDs)” [P4].

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

Diameter interface scheme requirements and option selections per 400 kV and 132 kV diameter are as follows. Each diameter shall have dedicated diameter interface panels with equipment as per the table below:

	Contract item	**Hitachi Energy**	**Siemens**
1.	Phase VI Main 1 Diameter Interface Scheme Mimics with local controls & indications and IED logics to be selected to match each diameter combination	-	6DIP-2110-M1 (0.52/30553)
2.	Phase VI Main 2 Diameter Interface Scheme Mimics with local controls & indications and IED logics to be selected to match each diameter combination	-	6DIP-2110-M2 (0.52/30554)
3.	Phase V Diameter Interface Schemes Mimics with local controls & indications and IED logics to be selected to match each diameter combination	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
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 adjacent to the BMK (all wiring is within scope of supply)	N/A	x 2 (Harting plug wiring as per 6JB-2100 -0.52/30444)
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
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
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
9.	Engineering: Large Bay Switch	x 1	x 2
10.	400 kV Busbar 1 VTJB (1JB-0700)	x 2	x 2

11.	400 kV Busbar 2 VTJB (1JB-0700)	x 2	x 2
12.	132 kV Busbar 1 VTJB (1JB-0700)	x 1	x 1
13.	132 kV Busbar 2 VTJB (1JB-0700)	x 1	x 1
14.	Connector 1 VTJB (1JB-0700)	x 1	x 1
15.	Connector 2 VTJB (1JB-0700)	x 1	x 1
16.	Diameters GC Connector 2 VTJB (1JB-0700)	x 2	x 2
17.	Diameters GD Connector 2 VTJB (1JB-0700)	x 2	x 2
18.	Line VTJB (1JB-0700) – where applicable (refer to the station electric diagram)	x 1	x 1
19.	GT House 1 VTJB (1JB-0700)	x 2	x 2
20.	GT House 2 VTJB (1JB-0700)	x 2	x 2

2.4.2 Generator transformer diameter scheme additional requirements

This section describes additional requirements for the 400kV Generator Transformer diameter interface schemes. The Generator Transformer feeders at Weskusfleur are connected via dedicated diameters and are thus of “Double Breaker” topology rather than Breaker-and-a-Half.

For an application using Hitachi Energy Phase V technology, the Generator Transformer diameter interface schemes shall be adapted to have a separate bay closing device per circuit-breaker bay (two bay closing devices per diameter), rather than one bay closing device for the diameter. The Diameter Marshalling Kiosk interface schemes for each bay of these diameters shall service primary plant in its bay, and both schemes shall monitor the status of the object isolator, and its associated earth switches. The overall design shall be such that failure of the bay closing device for one of the bay circuit-breakers should not prevent safe synchronised closing of the second bay circuit-breaker via its bay closing device. This stipulation does not apply to an application using Siemens Phase VI technology which already provides full redundancy of protection and control.

In addition to the requirements of a conventional diameter interface scheme (above), the diameter interface schemes for the two 400kV Generator Transformer feeds shall comply with Eskom Standard 240-58855759 “Transmission Generation Interface Standard” [P5], adapted appropriately in both respects for the double-breaker configuration of the Weskusfleur Generator Transformer diameters. Circuit-breaker open and close controls shall be routed via the generator protection and synchronising equipment at KNPS.

The diameter interface schemes shall provide separate dedicated closing circuits per bay circuit-breaker as per Figure 1. The closing circuit of each circuit-breaker shall accept a separate, dedicated closing signal from the synchronising equipment.

Koeberg Generation shall install synchronising equipment to Eskom standard 240-56357419 [P6] at KNPS to cater for synchronised closing of the 400kV bay circuit-breakers on the Weskusfleur Generator Transformer diameters. Koeberg Generation’s intention is to install new synchronising equipment prior to or during the construction of Weskusfleur. The Weskusfleur design shall provide the necessary interface to the synchronising equipment including control and interlocking signals. Critical signals as identified by Koeberg Generation shall be derived directly from the HV plant and not via IED output contacts and/or multiplication relays. The use of a digital interface between Weskusfleur and KNPS for the purposes of synchronising shall be subject to agreement between the parties.

The Eskom Generator synchronising standard 240-56357419 [P6] requires that the positive and negative legs of the circuit-breaker closing coil circuits are switched by the synchronising equipment (see Figure 1). For reliability, the Standard requires that auxiliary closing relays are not used, but KNPS and Eskom Generation Technology have agreed that auxiliary closing relays may be used at Weskusfleur to avoid voltage drops on long cable runs between Weskusfleur and KNPS. Any auxiliary closing relay (supplied by the contractor as part of the generator transformer diameter interface schemes at Weskusfleur) shall comply with the

requirements of Tripping relays in Eskom Standard 240-62773019 “Specification for low voltage auxiliary electrical components standard” [P12] and shall have a fixed, repeatable operating time.

Where auxiliary relays are employed in the closing circuits, the diameter interface schemes shall cater for local synchronism check as a condition of circuit-breaker closing.

Anti-pump functionality shall be provided in the circuit-breaker design and need not be duplicated in the protection/diameter interface schemes.

The diameter interface scheme shall include a non-volatile selection function indicating to KNPS which circuit-breaker (Bay 1 or Bay 2) shall be used for synchronising, and designating the second Bay circuit-breaker to be closed via synchronism check. The selection function shall be selectable from the scheme front panel, from the substation HMI and from remote control centres, subject to the SIS switch selection. For Siemens Phase VI schemes, the selection function shall be synchronised between Main 1 and Main 2 as are feeder bay Auto-Reclose Mode selections.

Section 3.1.2.25 of Eskom Standard 240-58855759 “Transmission Generation Interface Standard” [P5], describes a “Feeder prepared” signal which is provided to Generation indicating that the Transmission Generator Transformer bay is ready for synchronising. In the double-breaker arrangement at Weskusfleur, a “Bay X prepared” signal shall be sent per bay on the generator transformer diameters which, together with the synchronising bay selection status, shall be used by KNPS to enable and perform synchronising via the first Bay circuit-breaker and synchronism check when closing the second Bay circuit-breaker. Details of the philosophy will be agreed between the parties during the detailed design stage.

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. Substation-wide interlocking (i.e. interlocking based on equipment outside of the specific generator transformer diameter) shall be undertaken by the substation gateway and communicated to KNPS via the IEC 60870-5-101 protocol.

The design of the diameter interface schemes for the generator transformer feeds, with specific emphasis on the synchroniser interface, shall be subject to approval by Transmission, KNPS, Eskom Generation Technology and the Nuclear Regulator.

The wiring interface between Transmission and KNPS shall be a dedicated interface panel per generator transformer diameter located in the GT Houses, and/or interface IEDs installed within the Power Station, communicating with the Diameter Control Devices at Weskusfleur via fibre optic cable.

2.5 Generator transformer synchronisation scheme requirements

Synchronising equipment for the 400kV Generator Transformer diameter circuit-breakers shall be provided by Koeberg Generation and located within KNPS. Synchronising equipment is outside the scope of the Weskusfleur project, though the Weskusfleur designs must provide the required interfaces to the synchronising equipment.

The Weskusfleur project shall provide the following signals to the synchronising equipment at KNPS per generator transformer diameter:

1. Three phase GT House VT supply. Provided via a dedicated MCB in a dedicated VT Junction box. An MCB auxiliary contact shall be provided to Koeberg Generation;
2. Three phase busbar 1 VT supply. Provided via a dedicated MCB in a dedicated VT Junction box. An MCB auxiliary contact shall be provided to Koeberg Generation;
3. Three phase busbar 2 VT supply. Provided via a dedicated MCB in a dedicated VT Junction box. An MCB auxiliary contact shall be provided to Koeberg Generation;
4. Disconnector and earth switch open and closed status contacts, direct from the plant mechanism box (operated directly by cam switches);
5. Interface signals as per 240-58855759 “TX-GX Interface Standard [P5], notably “Bay 1 prepared” and “Bay 2 prepared” signals;
6. “Bay 1 Selected for Synch” and “Bay 2 Selected for Synch” signals; and
7. Additional signals reasonably required by KNPS.

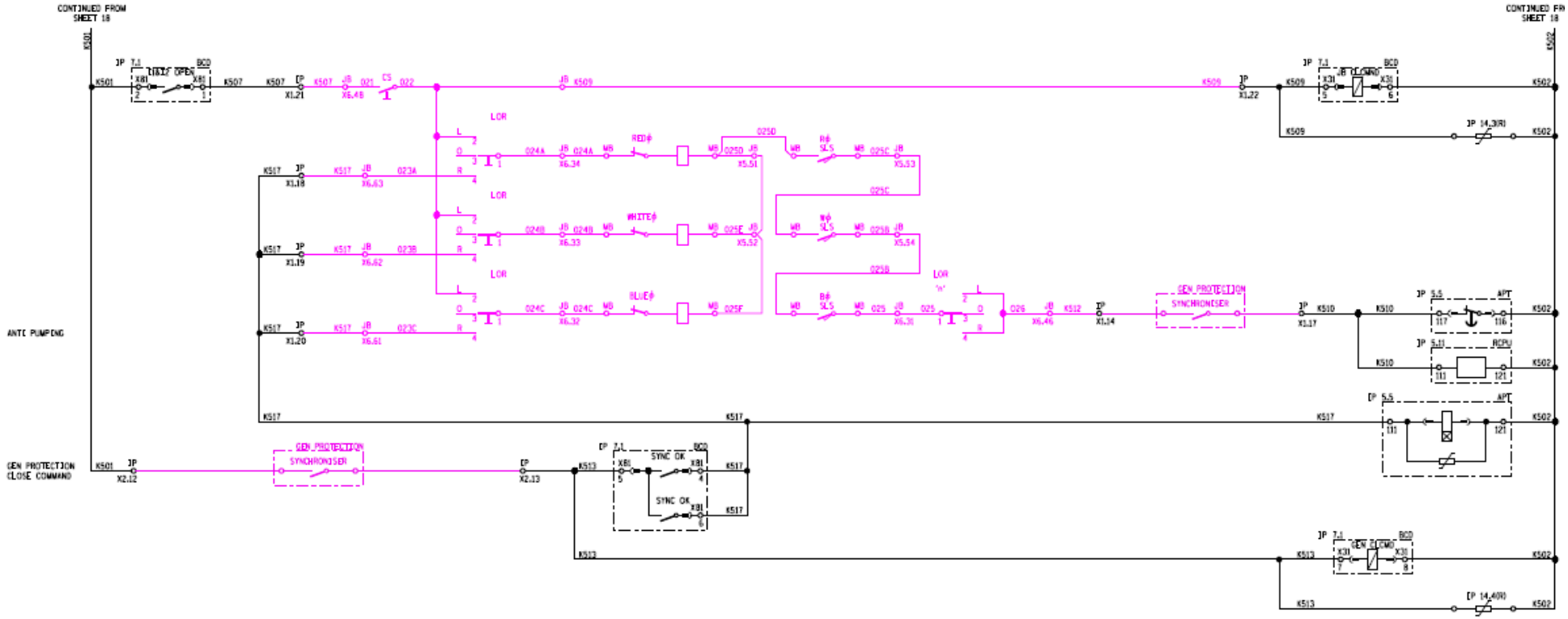

Figure 1: Example Transmission-Generation interface circuit-breaker closing circuit design

2.6 Marshalling kiosks

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

The Transformer marshalling kiosks are required to provide for and interface with the equipment as per the 6JB-#200 junction box (0.52-30425) for transformer and on load tap change PIU functionality.

In the event that the marshalling kiosks are unable to provide for the required equipment and interfaces then marshalling kiosk interface panels that shall be located in close proximity to the marshalling kiosks, shall be included within the Weskusfleur scope.

2.7 Marshalling kiosk panel

Marshalling kiosk panels are required for the Siemens solution 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 shall not be limited to:

- Marshalling kiosk panel main label;
- Main 1 PIU with Male and Female half Harting Plugs, coding pins & wiring tails;
- Main 2 PIU with Male and Female half Harting Plugs, coding pins & wiring tails;
- Panel Not Healthy Indication (supplied by 230 VAC);
- Main 1 DC Isolating MCB;
- Main 1 PIU DC Isolating MCB;
- Main 2 DC Isolating MCB;
- Main 2 PIU DC Isolating MCB;
- Main 1 DC supply monitoring relay;
- Main 2 DC supply monitoring relay;
- Secure supply chop over circuit as per 6IJB-#300 (0.52-30571);
- Secure supply monitoring relay;
- Common DC Isolating MCB (located within secure supply circuit);
- Common DC supply monitoring relay;
- Motorised isolator control DC Isolating MCB (located within secure supply circuit);
- Motorised isolator control DC supply monitoring relay;
- The breaker bay marshalling kiosk panel wiring interface with the bay marshalling kiosk shall be as per 6IJB-#300 (0.52-30571);
- 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 Eskom Report 240-146288697 “Specification for the Interfacing of the new protection and control equipment to the GIS Bay Marshalling Kiosk” [P7].

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 in accordance with Eskom Standard 240-96621426 [P8].

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 close 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 Eskom Standard 240-64685228 “Generic Specification for Intelligent Electronic Devices (IEDs)” [P4].

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	**Hitachi Energy**	**Siemens**
1.	Phase VI Main 1 Line Protection Scheme Mimics to be selected to match each diameter combination	-	6FZDB-2110-M1(0.52/30551)
2.	Phase VI Main 2 Line Protection Scheme Mimics to be selected to match each diameter combination	-	6FZDB-2110-M2 (0.52/30552)
3.	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

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)
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
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
8.	Duplex Multi mode 50/125 fibre optic patch 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.	Included	x 4
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
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

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

Rated voltage	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). Main 1 Differential, Main 2 Impedance.
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	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.
Remote Line end Main 1 Current Differential Protection	RED670-ZA11 (Hitachi Energy) Procure and deliver to Transmission Grid West for installation and commissioning.
Remote Line end Main 2 Impedance Protection	REL670-ZA11 (Hitachi Energy) 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: • 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: • 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.
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

Rated voltage	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). Main 1 Differential, Main 2 Impedance.
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	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.
Remote Line end Main 1 Current Differential Protection	RED670-ZA11 (Hitachi Energy) 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: • Line Traps • LMEs • Coaxial Cables • Carrier Combiner Unit • PLC Terminal Equipment • Z Cables • Telephone Cables Notes: Line Trap phase positions and PLC frequencies to be determined by Eskom. The Teleprotection Interface voltage shall be compatible with Protection.
Remote Line end Main 2 Teleprotection	Power Line Carrier equipment which includes the following: • Line Traps • LMEs • Coaxial Cables • Carrier Combiner Unit • PLC Terminal Equipment • Z Cables • Telephone Cables Notes: Line Trap phase positions and PLC frequencies to be determined by Eskom. The Teleprotection Interface voltage shall be compatible with Protection.
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”.	

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

Rated voltage	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). Main 1 Impedance, Main 2 Impedance.
Panel main labels	Panel main labels – Front and Rear: Label size: 340 x 35 mm Text height: 12 mm Labelling standard: 240-62629353 Specification for panel labelling standard.
Main 1 Teleprotection	Teleprotection Equipment (will be installed in the protection cabinet) Communications module: X.21 Note: The Teleprotection Interface voltage needs to be compatible with Protection.
Remote Line end Main 1 Teleprotection	Teleprotection Equipment (will be installed in the protection cabinet) Communications module: X.21 Note: The Teleprotection Interface voltage needs to be compatible with Protection.
Main 2 Teleprotection	Power Line Carrier equipment which includes the following: • Line Traps • LMEs • Coaxial Cables • Carrier Combiner Unit • PLC Terminal Equipment • Z Cables • Telephone Cables Notes: Line Trap phase positions and PLC frequencies to be determined by Eskom. The Teleprotection Interface voltage shall be compatible with Protection.

Remote Line end Main 2 Teleprotection	Power Line Carrier equipment which includes the following: • Line Traps • LMEs • Coaxial Cables • Carrier Combiner Unit • PLC Terminal Equipment • Z Cables • Telephone Cables Notes: Line Trap phase positions and PLC frequencies to be determined by Eskom. The Teleprotection Interface voltage shall be compatible with Protection.
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”.	

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

Rated voltage	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). Main 1 Differential, Main 2 Differential.
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	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.
Main 2 Current Differential Protection – Required for Siemens	RED670-ZA11 (Hitachi Energy) Procure, install, wiring 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: 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 cable shall be in different trenches.	

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

Rated voltage	400 kV
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). Main 1 Differential, Main 2 Differential.
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	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.
Main 2 Current Differential Protection – Required for Siemens	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.
Remote Line end Main 1 Current Differential Protection	RED670-ZA11 (Hitachi Energy) Procure and deliver to Transmission Grid West for installation and commissioning.
Remote Line end Main 2 Current Differential Protection	RED670-ZA11 (Hitachi Energy) 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 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 cable shall be in different trenches.

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

Rated voltage	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). Main 1 Differential, Main 2 Differential.
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	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.
Main 2 Current Differential Protection – Required for Siemens	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.
Remote Line end Main 1 Current Differential Protection	RED670-ZA11 (Hitachi Energy) Procure and deliver to Transmission Grid West for installation and commissioning.
Remote Line end Main 2 Current Differential Protection	RED670-ZA11 (Hitachi Energy) 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 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 cable shall be in different trenches.	

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

Rated voltage	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). Main 1 Differential, Main 2 Differential.
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	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.
Main 2 Current Differential Protection – Required for Siemens	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.
Koeberg Feeder 1 (Acacia 2) Main 1 Current Differential Protection	RED670-ZA11 (Hitachi Energy) Procure and deliver to Transmission Grid West for installation and commissioning.
Koeberg Feeder 1 (Acacia 2) Main 2 Current Differential Protection	RED670-ZA11 (Hitachi Energy) 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: 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 cable shall be in different trenches.	

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

Rated voltage	400 kV
Feeder No.	Feeder 8 (Future Transformer 13)
Feeder name	Interconnecting Feeder 2
Line protection scheme	Refer to the Breaker-and-a-half line protection schemes and options section on the scheme selection (Dual main protection). Main 1 Differential, Main 2 Differential.
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	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.
Main 2 Current Differential Protection – Required for Siemens	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.
Koeberg Feeder 2 (Acacia 1) Main 1 Current Differential Protection	RED670-ZA11 (Hitachi Energy) Procure and deliver to Transmission Grid West for installation and commissioning.
Koeberg Feeder 2 (Acacia 1) Main 2 Current Differential Protection	RED670-ZA11 (Hitachi Energy) 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 TS. 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 TS. 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: 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 cable shall be in different trenches.	

2.8.10 132 kV Feeder 7 (Duine) local and remote line protection requirements

Voltage level	132kV
Feeder no.	Feeder 7
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). Main 1 Differential, Main 2 Differential (to be confirmed at detail design phase).
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	RED670-ZA11 (Hitachi Energy). Procure and deliver to Transmission Grid West for installation and commissioning.
Main 2 Current Differential Protection – Required for Siemens	RED670-ZA11 (Hitachi Energy). Procure and deliver to Transmission Grid West for installation and commissioning.
Remote Line end Main Current Differential Protection	5FZD-3220 Dual Main, 3 pole tripping, including PIU JB with PIUs – Procure and deliver to Distribution Western Cape OU for installation and commissioning. Replace the Main 1 & 2 RED670 L3CPDIF Line Diff function with L6CPDIF and add second LDCM 1310nm SM fibre optic module.
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.
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

Rated voltage	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). Main 1 Differential, Main 2 Differential (to be confirmed at detail design phase).

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	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.
Main 2 Current Differential Protection – Required for Siemens	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.
Remote Line end Main Current Differential Protection	5FZD-3220 Dual Main, 3 pole tripping, including PIU JB with PIUs– Procure and deliver to Distribution Western Cape OU for installation and commissioning. Replace the Main 1 & 2 RED670 L3CPDIF Line Diff function with L6CPDIF and add second LDCM 1310nm SM fibre optic module.
Fibre Routes for Current Differential Protection communication	Weskusfleur – Dassenberg double circuit (feeders 1 and 2) 132 kV Line Fibre 1 and 2 Refer to the fibre optic section.
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

Rated voltage	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). Main 1 Differential, Main 2 Differential (to be confirmed at detail design phase).
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	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.
Main 2 Current Differential Protection – Required for Siemens	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.

Remote Line end Main Current Differential Protection	5FZD-3220 Dual Main, 3 pole tripping, including PIU JB with PIUs– Procure and deliver to Distribution Western Cape OU for installation and commissioning. Replace the Main 1 & 2 RED670 L3CPDIF Line Diff function with L6CPDIF and add second LDCM 1310nm SM fibre optic module.
Fibre Route for Current Differential Protection communication	Weskusfleur – Dassenberg double circuit (feeders 1 and 2) 132 kV Line Fibre 1 & 2 Refer to the fibre optic section.
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 (Blaauwberg 1) local and remote line protection requirements

Rated voltage	132 kV
Feeder No.	Feeder 5
Feeder name	Blaauwberg 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	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.
Remote Line end Main Current Differential Protection	5FZD-3220 Dual Main, 3 pole tripping, including PIU JB with PIUs– Procure and deliver to Distribution Western Cape OU for installation and commissioning. Replace the Main 1 & 2 RED670 L3CPDIF Line Diff function with L6CPDIF and add second LDCM 1310nm SM fibre optic module.
Main – Fibre Route for Current Differential Protection communication	Weskusfleur – Blaauwberg 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 (Ankerlig 1 – Emergency supply) local and remote line protection requirements

Rated voltage:	132kV
Feeder No.	Feeder 6
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	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.
Main 2 Current Differential Protection – Required for Siemens	RED670-ZA11 (Hitachi Energy) Procure, install, wiring and commissioning.
Remote Line end Main 1 Current Differential Protection	RED670-ZA11 (Hitachi Energy). Procure and deliver to Transmission Grid West for installation and commissioning.
Remote Line end Main 2 Current Differential Protection	RED670-ZA11 (Hitachi Energy). 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 to Eskom Standard 240-99870095 [P9].

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 (PIUs) (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 (PIUs) 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 Eskom Standard 240-64685228 “Generic Specification for Intelligent Electronic Devices (IEDs)” [P4].

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	**Hitachi Energy**	**Siemens**
1.	Phase VI Main 1 Auto Transformer Protection Scheme Mimics to be selected to match each diameter combination	-	6TAB-2300-M1 (with Low Imp REF) (0.52/30440)
2.	Phase VI Main 2 Auto Transformer Protection Scheme Mimics to be selected to match each diameter combination	-	6TAB-2300-M2 (with High Imp REF, Metrosil & Resistor) (0.52/30492)
3.	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
5.	Disturbance recorder test bock	Included	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	N/A	x 4 (Harting plug wiring as per 6JB-2100 - 0.52/30444)

	adjacent to the BMK (all wiring within scope of supply)		
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)
8.	Transformer JB	N/A	x 1 (6JB-2200 - 0.52/30445)
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 PIU per main transformer panel).	Included	x 4
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

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 (Refer to Eskom Standard 240-99870095 [P9]). The principal use of OLTC equipment is for the voltage regulation within the network and for the control of MW and MVAr flows across interconnectors. Location of the tapped part of a winding is partly a construction question. It is generally done on that winding which is placed outside. Bushing insulators are required when tapping is done at the line ends. With tappings near the line ends, the number of bushing insulators is reduced and with tappings near the neutral ends, the phase-to-phase insulation conditions are eased.

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

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	**Hitachi Energy**	**Siemens**
1.	Auto Transformer on load tap change Scheme	Integrated within the 5TAB-3100Main 2 IEDs	6TCP-2101 with 6TC2101-1 and 6TC2101-2 modules (0.52/30367, 0.52/30586, 0.52/30653)
2.	Fixed frame, rear entry panel for Protection schemes (2400x800x600, 19” rack mount)	N/A	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
4.	Ethernet Switch and the Fibre Patch Panels	N/A	Contractor to determine

			requirement.
5.	Supply, install and wiring of Tap Change PIUs (Male and Female half Harting Plugs, coding pins & wiring tail) within the Transformer JB (all wiring within scope of supply)	N/A	x 1 (Harting plug wiring as per 6JB-2200 - 0.52/30445)
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
7.	Engineering: Large Bay Switch	N/A	x 1
8.	Tap Change Documentation	N/A	x 1

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

The Transmission Generation interface shall consist of protection and control schemes (located within the Transmission relay room at Weskusfleur) to provide for the protection, including the GIL protection, and interface between the Transmission equipment and the Koeberg generator protection & control equipment. It is preferred that no IEDs are installed at the GT Houses due to access limitations and sub-optimal environmental conditions for IEDs. The generator transformer interface schemes/GIL protection 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 Fault Clearance System shall provide for low impedance three-terminal differential protection of the GIL/400kV cable between Weskusfleur and the GT Houses, and TX-GX Interface functionality in accordance with Eskom Standard 240-58855759 “Transmission Generation Interface Standard” [P5] and example scheme drawing 0.52-30290 (5FZ-3910), suitably adapted for the double-breaker diameter configuration at Weskusfleur.

Each Tripping System shall comprise a Protection System, which is supplied from an independent DC source. It receives the following analogue inputs:

1. 3-phase Bay 1 CTs
2. 3-phase Bay 2 CTs
3. 3-phase GT House CTs
4. 3-phase connector CVT protection winding

Each tripping system is connected to one trip-coil of each of the two 400 kV bay circuit-breakers and shall provide a potential-free hardwired trip output to the 24kV generator transformer circuit-breaker at KNPS. The two Tripping Systems shall operate in a one-out-of-two tripping mode.

Each Protection System shall provide the requisite primary, back-up and auxiliary protection functions for the GIL/400kV cable and backup protection functions as per Eskom Standard 240-58855759 “Transmission Generation Interface Standard” [P5] notably backup impedance and Switch-on-to-Standstill protection.

Refer to Section 2.4.2 for details of the bay closing system.

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 signal interface to KNPS shall be via interface panels/junction boxes to be installed at the GT Houses as part of the Weskusfleur scope. KNPS shall design and install the cable interface from the GT House to the Power Station. An alternative arrangement, if feasible, will be to provide non-critical signals to KNPS via a Transmission-owned interface IED to be installed within the Power Station and communicating with the Generator Transformer protection IEDs at Weskusfleur via fibre optic cable. Such an IED and associated module wiring shall be included in the Weskusfleur scope and issued to KNPS for installation.

Any Interface panels/junction boxes installed within the GT houses shall be rated to IP55 and shall be resistant to corrosion in the marine environment (less than 250m from the sea) for the 20-year design life of the equipment.

The protection and control schemes (set per generator transformer bay) shall be developed by the successful Tenderer with participation and approval by: Eskom PDE PTM&C, Koeberg Generation and Transmission Grid West. 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.

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

The GIL/400kV cable protection schemes and Generator Transformer interface protection scheme requirements and option selections per generator transformer are as follows.

	Contract item	**Hitachi Energy**	**Siemens**
1.	Phase VI Main 1 Generator transformer interface protection scheme – housed within Weskusfleur Transmission relay room (per generator transformer diameter)	-	6FZD-2930-M1 (Contractor to design based on 5FZ-3910 -0.52-30290)
2.	Phase VI Main 2 Generator transformer interface protection scheme – housed within Weskusfleur Transmission relay room (per generator transformer diameter)	-	6FZD-2930-M2 (Contractor to design based on 5FZ-3910 -0.52-30290)
3.	Phase V Dual Main Generator transformer interface protection scheme – housed within Weskusfleur Transmission relay room (per generator transformer diameter)	5FZD-3930 Tailored from 5FZ-3910 (0.52-30290)	-
4.	~~Generator transformer high impedance REF with metrosil and stabilising resistor.~~ (Withdrawn)	~~x 2~~	~~x 2~~
5.	#FZ-#930 schemes shall be fixed frame, rear entry panel for Protection schemes (2400x800x600, 19” rack mount) – Weskusfleur.	Included	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.
7.	Interface junction boxes/panels for the GT Houses. Suitable for marine environment.	As required	As required

8.	Main 1 and Main 2 Master Trip Latching Relays/Non-volatile IED Set-Rest function (resettable with a push button). Operation of the master trip relay will be from the following functions: • Cable differential protection; • Generator transformer trip signal; and • Any unit protection operation.	Included	x2
9.	~~Large Bay Switch (#FZ-#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~~
10	~~#FC-#940 schemes shall be swing frame, front entry panel for Protection schemes (2400x800x600, 19" rack mount) – Koeberg GT house.~~	~~Included~~	~~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)
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
13	Documentation	x 1	x 1

The required scheme designs, IED logics and functionality shall use the following standards:

- 240-64685228, "Generic Specification for protective Intelligent Electronic Devices (IEDs)" [P4];
- 240-60725641, "Specification for standard 19" equipment cabinets" [P10];
- 240-62629353, "Specification for panel labelling standard" [P11];
- 240-62773019, "Specification for low voltage electrical auxiliary components" [P12];
- 240-64100247, "Standard for earthing of secondary plant/Control plant equipment in substations" [P13];
- 240-64636794, "Standard for Wiring and Cable Marking in Substations" [P14];
- 240-65336348, "Specification for Transmission and Distribution protection schemes Common requirements" [P15];
- 240-70413291, "Specification for electrical terminal blocks" [P16];
- TSP 41-1043, "Specification for Control, Selector, Isolation and Test Switches" [P17];
- 240-75655504, "Corrosion protection specification for new indoor and outdoor equipment manufactured from steel" [P18];
- 240-46263618, "Labelling of Fibre-Optic Cables Standard" [P19];

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

The #FC-#910 schemes (Weskusfleur relay room) and interface IEDs in KNPS (where applied) shall interface via single mode ruggedised redundant fibres. Each generator transformer shall have independent ruggedised fibres per generator transformer.

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 protection and control schemes located in the Transmission relay room at Weskusfleur to provide for the protection of the 132kV power cable, including the Station transformer HV windings, and interface between the Transmission equipment and the KNPS 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 neutral CT from the Station Transformer HV winding 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.

Each Protection System shall provide the requisite primary, back-up and auxiliary protection functions, including Restricted Earth Fault protection of the 132kV cable and transformer HV winding, and overcurrent and earth fault functions (instantaneous and time delayed)

The Bay Closing System shall comprise of the Closing Control System which shall be interlocked with the Koeberg Station transformer protection schemes.

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 interface between the Weskusfleur protection schemes and the KNPS station transformer protection schemes may be via hardwire and/or a digital interface to a Transmission-owned numerical IED within the station transformer control building, with a fibre optic interface to Weskusfleur. The communication channel 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 bus section 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. 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.

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	**Hitachi Energy**	**Siemens**
1.	Phase VI Main 1 Station transformer interface protection scheme – housed within the Transmission relay room (per station transformer diameter)	-	6FCB-2950-M1 (Contractor to design based on 5FCB-3110 -0.52/30352)

2.	Phase VI Main 2 Station transformer interface protection scheme – housed within the Transmission relay room (per station transformer diameter)	-	6FCB-2950-M2 (Contractor to design based on 5FCB-3110 -0.52/30352)
3.	Phase V Dual Main Station transformer interface protection scheme – housed within the Transmission relay room (per station transformer diameter)	5FCB-3950 Tailored from 5FCB-3110 (0.52/30352)	-
4.	Deleted (Revision 2)		
5.	#FC-#950 schemes shall be fixed frame, rear entry panel for Protection schemes (2400x800x600, 19" rack mount)	Included	x 2
6.	Deleted (Revision 2)		
7.	Main 1 and Main 2 Master Trip Relays (Latching relays which is resettable with a push button)/Non-volatile IED Set-Rest function. Operation of the master trip relay will be from the following functions: • Cable differential protection; • Station transformer trip signal; and, • Any unit protection operation.	Included	x2
8.	Deleted (Revision 2)		
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.
10	Deleted (Revision 2)		
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)	-	x 4 (Harting plug wiring as per 6JB-2100 -0.52/30444)
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

Note:

The required scheme designs, IED logics and functionality shall use the following standards:

- 240-64685228, "Generic Specification for protective Intelligent Electronic Devices (IEDs)" [P4];
- 240-60725641, "Specification for standard 19" equipment cabinets" [P10];
- 240-62629353, "Specification for panel labelling standard" [P11];
- 240-62773019, "Specification for low voltage electrical auxiliary components" [P12];
- 240-64100247, "Standard for earthing of secondary plant/Control plant equipment in substations" [P13];
- 240-64636794, "Standard for Wiring and Cable Marking in Substations" [P14];
- 240-65336348, "Specification for Transmission and Distribution protection schemes Common requirements" [P15];
- 240-70413291, "Specification for electrical terminal blocks" [P16];

- TSP 41-1043, “Specification for Control, Selector, Isolation and Test Switches” [P17];
- 240-75655504, “Corrosion protection specification for new indoor and outdoor equipment manufactured from steel” [P18];
- 240-46263618, “Labelling of Fibre-Optic Cables Standard” [P19];

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

The #FC-#950 schemes (Weskusfleur relay room) and interface IEDs at the KNPS Station Transformer Control Room (where applied) shall interface via single mode ruggedised redundant fibres. Each station transformer shall have independent ruggedised fibres per station transformer.

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

2.13 6.6kV/400V Auxiliary transformer protection cubicles/modules

The two 6.6kV/400V auxiliary transformers are supplied by 6.6kV cables from the KNPS station transformers. The cables are protected by circuit-breakers that are owned and operated by KNPS, and which are outside the scope of the Weskusfleur project.

Each 6.6kV/400V auxiliary transformer shall be provided with a protection cubicle/module with a bistable latching relay, operated by the oil temperature and Buchholz protection devices. The latching relay shall provide a potential-free trip contact to the 6.6kV circuit-breaker supplying the transformer (at KNPS). The protection cubicle shall include a “trip” indication lamp and a reset button. Tripping of the auxiliary transformers shall be indicated to the Weskusfleur Gateway and Station HMIs via a station RTU.

It must be noted that the protection interface for the 22kV/400V auxiliary transformers that are supplied from the Weskusfleur 400/132/22kV coupling transformers is catered for in the coupling transformer protection schemes (standard design feature).

2.14 Koeberg auto-start interface scheme

2.14.1 Koeberg and 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 TS and Ankerlig Power Station. 5KAS-3100 is located at Koeberg and 5KAS-3200 at Ankerlig. The control schemes comprise 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 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 at Koeberg TS is housed within a two panel suite.

2.14.2 Weskusfleur–Ankerlig auto-start interface schemes

A new auto-start interface scheme is required at Weskusfleur to interface with Ankerlig, replacing the scheme at Koeberg TS. The interfacing between Weskusfleur and Ankerlig shall be via single mode fibre. These schemes are Eskom Transmission assets and will be set, commissioned, maintained and periodic in-service tested by Eskom Transmission. The in-service testing will be done in conjunction with KNPS.

The Weskusfleur scheme (5KAS-3300) shall be developed by the successful tenderer with participation and approval by: Eskom Transmission 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 Hitachi Energy South Africa to ensure compatibility with the existing REC670 fibre interface on 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 as per Eskom Standard 240-119981735 [P20] and shall interface with the existing Ankerlig 5KAS-3200. With reference to Figure 2, the proposed high-level design, to be verified and finalised by the contractor at detail design stage, is:

1) A KAS event shall be sensed by undervoltage/underfrequency on both 132kV Diameter CE Connector 1 and 132kV Diameter CD Connector 1 (i.e. loss of supply to both Station Transformers).

2) An Auto-start event shall cause Weskusfleur 132kV Feeder 6 (Ankerlig 1 Emergency supply) to be dedicated to the supply of Station Transformers 1 and 2 via the Gas Turbines at Ankerlig.

3) The Auto-start sequence trips the Weskusfleur Diameter CE Bay 2 and Tie Bay circuit breakers in readiness for the Ankerlig 1 Feeder to be re-energised via the Gas Turbines at Ankerlig.

4) In an Auto-start event, 132kV Busbar 1 and Busbar 2 at Weskusfleur shall be dedicated to the connection of 132kV Feeder 6 (Ankerlig 1 Emergency supply) to the two Station Transformer connectors. When the Ankerlig 1 feeder is detected to be re-energised from Ankerlig, the 5KAS-3300 scheme shall trip the Bay 1 and Bay 2 circuit-breakers of 132kV Diameters CF, CC and CB.

5) When the Ankerlig 1 feeder is detected to be re-energised from Ankerlig, the Weskusfleur Diameter CE Bay 2 and Tie Bay circuit breakers shall be automatically re-closed to energise the Weskusfleur 132kV busbars and Station Transformers. Reclosure of each circuit-breaker shall be dependent on the applicable circuit-breaker having been closed immediately prior to the start of the Auto-start event.

6) During an Auto-start test, which shall implement the KAS sequence as if there was an Auto-start event at Weskusfleur, 132kV loads shall be maintained via the Coupling transformer connections to their feeders in Diameters CF and CB.

7) In detailed design, consideration shall be given to swapping the Blaauwberg 1 and Duine 1 feeders such that Coupling Transformer 1 can supply the Blaauwberg 1 load during an Auto-start test. It is possible to backfeed Duine from the Blaauwberg 1 feeder. The other major Weskufleur load, Dassenberg, will be supplied via Coupling Transformer 2 on Diameter CB

The switching sequence and timing shall otherwise be as per Eskom Standard 240-119981735 [P20].

The 132 kV line protection schemes 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 Weskusfleur auto-start control scheme. The 132kV bay 1, bay 2 & tie bay breakers & isolators and feeder line isolators shall have contacts available for direct interfacing with the Weskusfleur auto-start system.

The latest proposed sequence of construction for Weskusfleur has the 132kV Ankerlig feeder and Station transformer feeders commissioned first. The Weskusfleur auto-start scheme shall be commissioned at this time, allowing for the de-commissioning of the 5KAS-3100 scheme at Koeberg TS. The sequence of construction shall ensure that KNPS is always provided with an emergency off-site supply with auto-start capability.

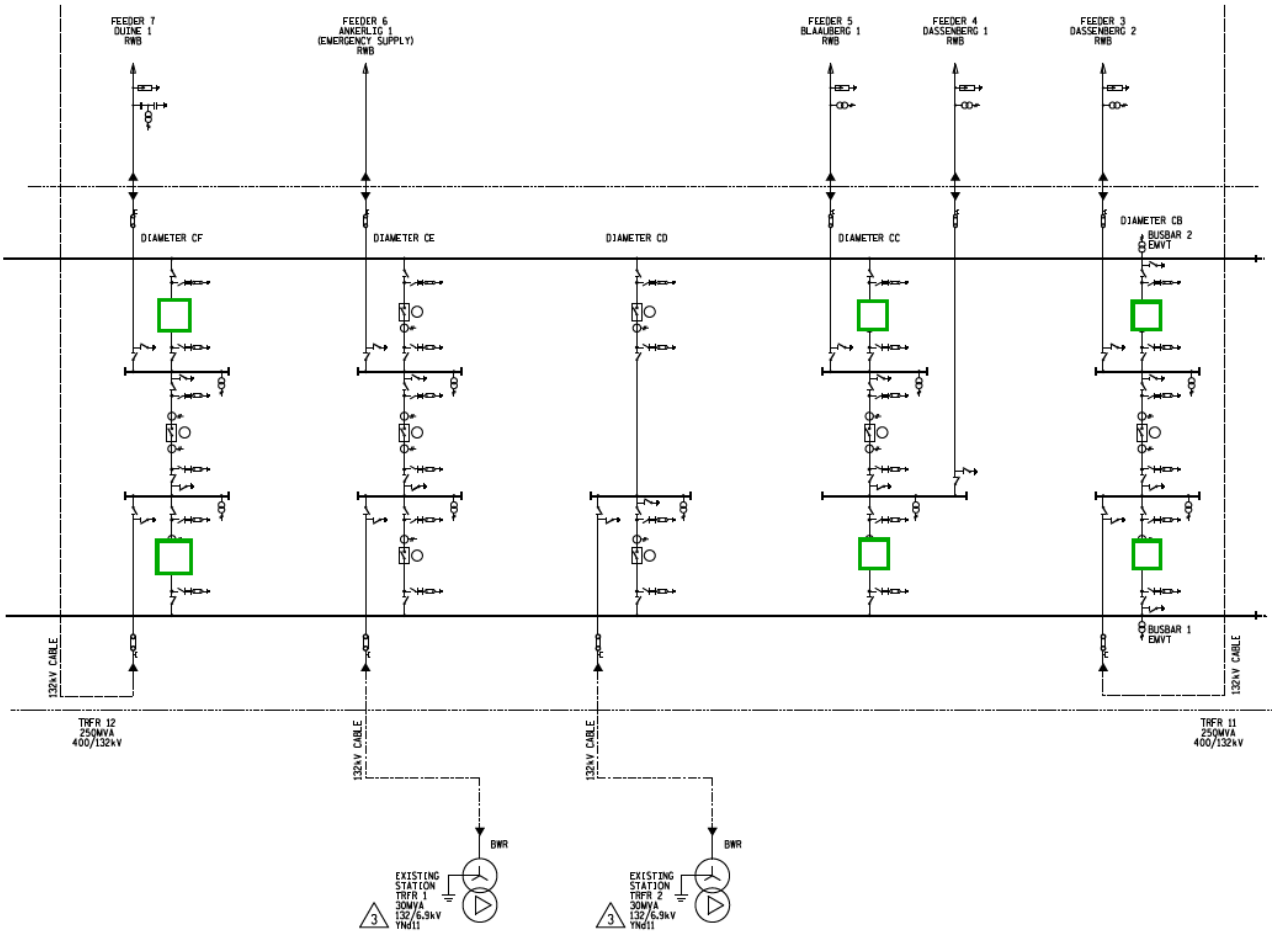

Figure 2: Extract of Weskusfleur Station Electric Diagram showing "load" circuit-breakers to be tripped by the Auto-Start scheme

2.14.3 Weskusfleur auto-start interface scheme requirements

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

	Contract item	**Hitachi Energy**
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

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:

- Koeberg TS 5KAS-3100_0.46-42606 – Scheme design drawings including applications interface;
- 240-64685228, "Generic Specification for protective Intelligent Electronic Devices (IEDs)" [P4];
- 240-60725641, "Specification for standard 19" equipment cabinets" [P10];
- 240-62629353, "Specification for panel labelling standard" [P11];
- 240-62773019, "Specification for low voltage electrical auxiliary components" [P12];

- 240-64100247, “Standard for earthing of secondary plant/Control plant equipment in substations” [P13];
- 240-64636794, “Standard for Wiring and Cable Marking in Substations” [P14];
- 240-65336348, “Specification for Transmission and Distribution protection schemes Common requirements” [P15];
- 240-70413291, “Specification for electrical terminal blocks” [P16];
- TSP 41-1043, “Specification for Control, Selector, Isolation and Test Switches” [P17];
- 240-75655504, “Corrosion protection specification for new indoor and outdoor equipment manufactured from steel” [P18];
- 240-46263618, “Labelling of Fibre-Optic Cables Standard” [P19];

2.14.4 Weskusfleur auto-start interface scheme fibre interface

The 5KAS-3300 scheme (Weskusfleur relay room) shall interface with the Ankerlig auto-start scheme IEDs (Ankerlig Power Station) via single mode 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) shall interface with the Ankerlig end via independent fibre routes.

2.14.5 Weskusfleur re-synchronising following auto-start test

Following an auto-start test whereby Weskusfleur 132kV Feeder 6 (Ankerlig 1 Emergency Supply) is islanded with the Station Transformer feeders at Weskusfleur and supplied by the Ankerlig gas turbines, it is required that the Ankerlig power island be re-synchronised to the Transmission grid at Weskusfleur. The Weskusfleur Diameter CB and CF Bay 1 circuit-breakers shall be used for synchronising. These circuit-breakers shall be equipped with synchronising equipment to Eskom Standard 240-56357419 [P6]. The proposed high-level design, to be verified and finalised by the contractor at detail designed stage, is:

1) The synchronising IEDs/schemes are Eskom Transmission assets and will be set, commissioned, maintained and periodically in-service tested by Eskom Transmission. The in-service testing will be done in conjunction with KNPS.
2) The synchronising IEDs shall be from Eskom Generation’s approved product list, being the Siemens SIPROTEC 5 7VE85 or approved alternative.
3) Synchronising IEDs to use three phase Busbar 2 and three phase Connector VTs for synchronising.
4) Dedicated synchronising IEDs to be provided per diameter. Redundant synchronising IEDs are not required in each diameter since the two diameters provide alternative re-synchronising options.
5) Ankerlig gas turbine governor and voltage regulation commands will be communicated manually by telephone from KNPS control room to Ankerlig Power Station. The Weskusfleur synchronising IEDs shall provide the requisite signals to KNPS to enable this interface. The signal interface shall be via IEC 60870-5-101 (refer to Section 8).
6) The KNPS Controller will issue circuit-breaker closing requests to the Weskusfleur synchronising IEDs which will issue closing commands when synchronising conditions are fulfilled.

The synchronising schemes/IEDs shall be provided in dedicated panels which may be locked.

The synchronising schemes shall be developed by the successful tenderer with participation and approval by: Eskom Transmission 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.

2.15 400kV Bus zone

The 400 kV Bus zone protection scheme shall be sourced from one of the following options:

1. Siemens (Eskom contract number 4600067750).
2. Hitachi Energy (Eskom contract number 4600071130).

For the Siemens option:

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

Item Description	Qty
Individual Bay Unit (Complete)	16
1 - 16 Bay 2 Panels	1
Configure 14 Bay Breaker and Half	1
16 Bay Central Unit. 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.

For the Hitachi Energy option:

The 5BP-3500 bus zone scheme design which is tailored for a double busbar configuration shall be adapted by the tenderer to cater for the busbars in the breaker-and-a-half arrangement. This bus zone caters for 18 CT/Bay breaker-bays, allowing for expansion of the 400kV busbars at Weskusfleur with two additional diameters.

The following provisions apply to both options:

AC and DC shall not be in the same cable. Therefore, the CTs shall have their own cable and the Isolators shall have their 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 to factory testing.

The tenderer shall compile a factory and site commissioning test plan which 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 interfaces 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 scheme's cable schedule.

2.16 132kV Bus zone

The 132 kV Bus zone protection scheme shall be sourced from one of the following options:

1. Siemens (Eskom contract number 4600067750).
2. Hitachi Energy (Eskom contract number 4600071130).

For the Siemens option:

The 132 kV Bus zone protection scheme shall be sourced from Siemens which is the Eskom approved supplier. The Eskom contract number is: 4600067750.

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

Item Description	Qty
Individual Bay Unit (Complete)	16
1 - 16 Bay 2 Panels	1
Configure 10 Bay Breaker and Half	1
16 Bay Central Unit. 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 form left or right.

For the Hitachi Energy option:

The 5BP-3500 bus zone scheme design which is tailored for a double busbar configuration shall be adapted by the tenderer to cater for the busbars in the breaker-and-a-half arrangement. This bus zone caters for 18 CT/Bay breaker-bays, allowing for expansion of the 132kV busbars at Weskusfleur with four additional diameters.

The following provisions apply to both options:

AC and DC shall not be in the same cable. Therefore, the CTs shall have their own cable and the Isolators shall have their 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 which 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 interfaces 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 scheme's cable schedule.

2.17 Open phase detection of generator and station transformer feeders

This requirement was included in the original Weskusfleur tender via the clarification bulletin: -

Open Phase events have been identified as a risk to nuclear safety, particularly when occurring on "off-site power supplies" – backup power feeds to the nuclear power station. Open Phase events involve the open-circuiting of one or two of the three phase conductors, which may or may not contact earth. Open phase events may occur as a result of failure to open or close of one or two poles of three phase disconnectors or circuit-breakers or due to broken jumpers, lines, cables, connectors etc... Open phase events on off-site power supplies to nuclear power stations internationally have resulted in inoperability of components in safety-related systems (sometimes providing a common mode of failure to multiple systems) including reactor cooling.

Tenderers shall make provision for effective detection of open phase events on the two 400kV generator transformer feeds, and the two 132kV station transformer feeds to Koeberg Nuclear Power station. These feeds all supply transformers of Wye-Delta vector group with the result that an open phase on in-feeding supply cables may not result in a detectable voltage unbalance at the transformer primary-side bushings. The Open Phase Detection system should be sufficient to detect an open phase condition under no-load conditions on the applicable power transformer. The Open Phase Detection system shall operate as an alarm function to KNPS and shall not trip any plant. The Tenderer shall indicate how the detection of open phase conditions shall be achieved.

In addition to the Open Phase Detection systems, each disconnector and circuit-breaker at Weskusfleur shall include a pole discrepancy function to alarm opening or closing of only one or two of the three poles. It must be noted that the Hitachi Energy Phase V and Siemens Phase VI protection schemes that are to be used provide for circuit-breaker and disconnector pole discrepancy functionality as standard, provided that the GIS primary plant makes available open and closed circuit-breaker/disconnector status contacts per pole. Where

the GIS primary plant does not provide per-pole status contacts, a “broken conductor” or current asymmetry measurement/protection function in the Phase V or VI protection schemes may be used as a means of pole discrepancy detection.

3. Teleprotection

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

- 240-90353855, “Design Standard for Teleprotection Systems” [TP1]
- 240-141828918, “Scope of Work Template for Teleprotection Projects” [TP2]
- 240-75975613, “Standard for the Installation of Power Telecommunications Equipment” [TP3]
- 240-91461878, “Teleprotection Trip Testing” [TP4]
- 240-96651735, “Power Line Carrier and Associated Coupling Equipment: Commissioning and Major Maintenance Procedure” [TP5]
- 240-122850198, “Secondary Plant Line Trap Maintenance (TPC 41-89)” [TP6]
- 240-122859919, “PLC System Coupling Device Maintenance (TPC 41-84)” [TP7]
- 240-103057370, “Application Design Standard for Teleprotection Systems” [TP9]
- 240-77422828, “Teleprotection Equipment for use on Digital Telecommunications Channels or Dedicated Optical Fibre” [TP9]
- 240-106920490, “Specification for Power Line Carrier & Integrated Teleprotection Equipment” [TP10]
- 240-106920412, “Power Line Carrier – Line Matching Equipment” [TP11]
- 240-57648739, “Power Line Carrier Line Traps and Associated Post Support Insulators Standard” [TP12]
- 240- 64813646, “Data Cable Required for X.21 Interfaces” [TP13]
- 240-64813538, “High Frequency Coaxial Cable for Power Line Carrier Applications” [TP14]
- 240-64813692, “Miniature Control Cable Required for Teleprotection Signals (18Z Cables)” [TP15]
- 240-64813568, “Standard Indoor and Outdoor Telephone Cable” [TP16]

2) 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.

3) 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.

4) The Teleprotection and Power Line Carrier (PLC) terminal equipment are ‘links’ and need to be compatible at both station ends. Therefore, there could be a requirement to refurbish/replace the teleprotection and/or PLC equipment at the distant stations.

5) 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.

6) 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.

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

8) 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”.

9) The TPE equipment shall be installed in the corresponding Protection cabinet. If installation in a protection cabinet is not possible, the contractor would need to plan for this requirement in the control room which would require Eskom to support this application.

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

11) The installation of the LME is detailed in the document 240-141828918, “Scope of Work Template for Teleprotection Projects”.

12) 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.

13) The 132kV CC or CVT or insulator shall be compatible with the 132 kV Line Trap and might require adapting plates.

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

15) The contractor must submit a list of test equipment available.

16) The ‘sequence of events’ for the commissioning of the new station shall be as agreed by Eskom.

17) 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.

18) 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. KNPS and the System Operator would need to evaluate this risk.

19) 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.

20) 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 Works Planning & Centralised Services (WP&CS) shall witness the commissioning and testing as well as accept the test results.

21) 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.

22) Eskom previously-accepted equipment and suppliers are as follows:

- LME: Supplier – Hitachi Energy/ABB LME (High Pass).
- PLC: Supplier – Hitachi Energy/ABB ETL 651 or ETL 6101 PLCs.
- Teleprotection Equipment: Supplier – Hitachi Energy/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, Arteche, 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 Optical Distribution Frames/Patch Panels/Boxes shall be sourced from an Eskom previously-accepted 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”

- NRS 088-1, “Duct and direct-buried underground fibre-optic cable – Part 1: Product specification” [FO1]
- NRS 088-2, “Duct and direct-buried underground fibre-optic cable – Part 2: Installation guidelines” [FO2]
- 240-46264031, “Fibre-Optic Design Standard Part 2 Substations” [FO3]
- 240-70733995, “Optical Distribution Frame / Patch Panel” [FO4]
- 240-60725641, “Specification for standard (19 inch) equipment cabinets” [FO5]
- 240-70732888, “Fibre optic cable system acceptance testing procedure” [FO6]
- 240-46263618, “Labelling of fibre optic cables” [FO7]
- 240-722740830, “Multimode Fibre Optic Duct Cable Specification” [FO8]
- 240-106030205, “Fibre Optic Gantry to Substation Control Room Scope of Work Guideline” [FO9]

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 12, 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 Type A.
- The substation installation shall follow 240-46264031.

Multimode Duct Cable

- Multimode duct cable shall adhere to 240-722740830.
- No armoured duct cables shall be installed.
- Multimode duct cable shall be 12 cores.
- Multimode cables are installed for telecontrol purposes. Hence, they will be installed between the HV yard and the Control room.
- Multimode cables for Main 1 and Main 2 from the same Junction Box/Kiosk, in the HV Yard, shall follow diverse routes to the control room.
- These cables will terminate in the Fibre switching cabinet in the control room. The patch panel shall adhere to 240-70733995 Type B. The patch box, installed in the HV yard Protection junction box, shall adhere to 240-7073395 Type D.
- The substation installation shall follow 240-46264031.

Suppliers/OEMs

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

- Approved Multimode Patch Box sourced from Instelec.

Requirements for SM or MM duct fibre optic cable within the Weskusfleur GIS building, between Weskusfleur and the GT Houses, between Weskusfleur and KNPS relaying rooms, between Weskusfleur and the existing Koeberg Transmission substation and between Weskusfleur and the Station Transformer Control building shall be determined based on the final detailed designs, and all fibre optic cables required shall be installed by the contractor, including termination in patch panels/boxes. Main 1 and Main 2 protection shall use separate fibre optic cables which use diverse routes. The contractor shall install a MM duct fibre cable to KNPS for the IEC60870-5-101 Telecontrol interface as per Section 8, terminating in a patch panel.

The successful tenderer/contractor shall provide all fibre optic patch leads required in the designs. A reasonable number of spare fibre cores shall be spliced to patch panels/boxes.

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 shall be provided based on the Eskom accepted product (currently Qualitrol devices).

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

CTTB 1-2	400kV FDR 2 TIE CURRENT TEST BLOCK
CTTB 2-2	400kV FDR 3 TIE CURRENT TEST BLOCK
CTTB 3-2	400kV FDR 1 TIE CURRENT TEST BLOCK
CTTB 4-2	GEN TRFR 2 HV BAY 2 CURRENT TEST BLOCK
CTTB 5-2	TRFR 11 HV TIE 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 the supplier 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	**Qty**
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 (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 the supplier 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 the supplier 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	**Qty**
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 (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:	132 kV Feeder 6
DFR1-DAU2:	132 kV Station Transformer 2
DFR2-DAU1:	Spare
DFR2-DAU2:	132 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 the supplier 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	132kV FDR 6 BAY CURRENT TEST BLOCK
CTTB 2-1	STN TRFR 2 HV BAY CURRENT TEST BLOCK
CTTB 3-1	SPARE
CTTB 4-1	STN TRFR 1 HV BAY 1 CURRENT TEST BLOCK

CTTB 1-2	132kV FDR 6 TIE CURRENT TEST BLOCK
CTTB 2-2	STN TRFR 2 TIE CURRENT TEST BLOCK
CTTB 3-2	SPARE
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 the supplier when the order for the equipment is placed.

5.4 DFR 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 issuing 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 contractor is responsible for the configuration of all IEDs, and to indicate required settings for standard configuration features which do not vary between bay applications.

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 request for settings shall be submitted 6 weeks and available prior factory testing. The following standards shall be used:

- 342-242: “Protection settings management standard” [PS1]
- SPF-0001: “Protection settings request form” [PS2]

7. Metering and measurements

7.1 Metering

The Eskom accepted suppliers are:

- Metering Substation Panels and Modules – Sabi Switchboards (Contract Number 4600071721)
- Programmable Meters – Landis + Gyr (Contract Number 4600070082)
- Metering Modems – ADC Energy (Contract Number 4600068637)
- Power Quality Instruments – ACTOM (Contract Number 4600069855)

NB: The current accepted programmable meters from Landis + Gyr do not provide for summation metering, as required at Generation – Transmission (GENTRAN) metering points. Hence the previously accepted Schneider ION 8800 meters, as supplied by IST, should be utilized for the Weskusfleur 400kV and 132kV metering applications.

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 Sabi Switchboards 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 Sabi Switchboards panel meter racks. The proforma below includes Main and Check meters for Bay 1 and Bay 2 of the generator transformer diameters and an additional two meters for summation.

Item Description	Quantity	Supplier
Panel: (800 x 600 x 2400mm panel)	2	Sabi
Module: Metering 19” rack mount 6-way CT test blocks	5	Sabi
Module, Modem, D9404	1	Sabi
Plate: Blanking 3U, D9141	5	Sabi
Plate: Blanking 5U, D9141	2	Sabi
Plate, Blanking 7U, D9141	3	Sabi
Fitment of Module into panel	6	Sabi
ION 8800 Meter 3 PH, 1A, CL0.2, RS232, 485 & ETH (P8800-A2-E0-B5-E0-B1A)	10	IST
Advanced Cellular Chip SIM Modem	1	ADC Energy

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 Sabi Switchboards 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 Sabi Switchboards panel meter racks.

Item Description	Quantity	Supplier
Panel: (800 x 600 x 2400mm panel)	2	Sabi
Module: Metering 19” rack mount 6-way CT test blocks	4	Sabi
Module, Modem, D9404	1	Sabi
Plate: Blanking 3U, D9141	6	Sabi
Plate: Blanking 5U, D9141	2	Sabi
Plate, Blanking 7U, D9141	4	Sabi
Fitment of Module into panel	5	Sabi
ION 8800 Meter 3 PH, 1A, CL0.2, RS232, 485 & ETH (P8800-A2-E0-	8	IST

B5-E0-B1A)		
Advanced Cellular Chip SIM Modem	1	ADC Energy

7.4 132 kV Feeders 3, 4, 5 and 7 metering equipment

The following equipment for 132 kV feeders 3, 4, 5 and 7 shall be sourced, factory tested, delivered, installed and commissioned. The Sabi Switchboards panel with all the required modules and equipment shall be delivered to Weskusfleur. The IST meters shall be delivered to Weskusfleur and inserted within the Sabi Switchboards panel meter racks.

Item Description	Quantity	Supplier
Panel: (800 x 600 x 2400mm panel)	3	Sabi
Module: Metering 19" rack mount 6-way CT test blocks	7	Sabi
Module, Modem, D9404	1	Sabi
Plate: Blanking 3U, D9141	8	Sabi
Plate: Blanking 5U, D9141	3	Sabi
Plate, Blanking 7U, D9141	5	Sabi
Fitment of Module into panel	9	Sabi
Quality of Supply Module, D4903	1	Sabi
ION 8800 Meter 3 PH, 1A, CL0.2, RS232, 485 & ETH (P8800-A2-E0-B5-E0-B1A)	14	IST
PQ Monitoring Instrument – Permanent substation, 19" rack mounted	1	ACTOM
Advanced Cellular Chip SIM Modem	1	ADC Energy

7.5 6.6kV/400V Auxiliary Transformer 1 and 2 metering equipment

The 400V auxiliary supplies from the 6.6kV/400V Station Transformer Auxiliary transformers shall be metered to facilitate settlements and energy accounting between Generation and Transmission. The metering shall comply with 240-56364444 "Standard Minimum Requirements for the Metering of Energy and Demand" [M1]. A single (main meter) of accuracy class 0.5 (active energy), class 1 (reactive energy), three phase four wire meter is required per metering point and shall be sourced from the previously accepted products as listed above. The CTs and VTs utilised for metering the auxiliary supplies shall be of class 0.5 accuracy. The meters shall be equipped with communication equipment facilitating the remote acquisition of load profile metering data to Transmission's metering data acquisition system.

7.6 Measurements

Measurements functions are performed by the diameter control devices.

8. Telecontrol and substation automation

The telecontrol and automation solution shall use Eskom approved equipment from Siemens (Pty) Ltd (Eskom contract 4600067750) being a SiCAM PAS dual redundant gateway solution with redundant substation HMIs and Station IEDs. Ethernet networking equipment and GPS time synchronisation devices shall be provided as per the same contract.

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

- Should Combination 1 be chosen by the contractor in respect of the protection solution (Hitachi Energy equipment), the contractor shall be responsible for the application and integration of the Hitachi Energy protection equipment with Siemens 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.

- The Siemens Gateway solution for Weskusfleur shall be modified to accept a fourth control centre interface in addition to the standard control centre interfaces for National Control, Stand-by National Control and Regional Control. The fourth interface shall provide for indications and controls to/from the KNPS control room, with the Power Station being afforded the same visibility and control over Weskusfleur as the other control centres. The interface shall be provided via the IEC 60870-5-101 protocol via an RS422 port on each gateway. The contractor shall provide RS422 to Multimode fibre optic converters for Weskusfleur and KNPS. A multimode fibre optic cable shall be run between Weskusfleur gateway panel, via fibre switching panels at Weskusfleur to the control system interface enclosure within the Power Station, including applicable fibre patch panels and cable termination/splicing. The control system interface to KNPS shall be in accordance with 240-95611784 “Transmission HV Yard to Generation DCS/SCADA HMI Interface Standard“ [TC1]. The Koeberg Power Station control system is outside of the Weskusfleur project scope.
- Eskom requirements in respect of switches and routers must be applied as per the Eskom Standard 240-68111223 “Standard Networking Devices for the Substation Environment” [TC2] and the network architecture shall comply with Eskom Standard 240-612689959 “Substation Automation – Network Architecture Standard for Transmission Substations” [TC3].
- GPS time synchronisation equipment must be provided for the time synchronisation of all Transmission Protection and Automation equipment as per Eskom Standard 240-1001176258: “Technical specification for GPS Time Synchronisation Device” [TC4].
- The control interlocking must be performed by the Gateway as per Eskom Standard 240-68234842 “Substation Gateway and Station RTU/IED Standard” [TC5].
- All equipment must meet its functional and interface requirements as per Eskom Standard 240-68234842 “Substation Gateway and Station RTU/IED standard specification for EHV substations” [TC5].
- 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 and 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 assignment of the technical key names for IEDs as per Eskom Standard 240-170000601: “Standard for assigning physical device technical keys in Transmission” [TC6].
- 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 contractor shall compile the database for the gateway and station HMI. The database shall be based on the standard commodity database templates and the station IED signal list.
- The IEC60870-5-101 signal database for National Control, Standby National Control and Regional Control Centres and for Koeberg Power Station 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 system. Standard Eskom PTM&C templates are to be used and templates are to be created by the contractor for the schemes to be developed.

8.1 Telecontrol and substation automation equipment

The telecontrol and substation automation equipment shall comprise the following approved schemes:

8.1.1 Siemens telecontrol and substation automation equipment

The telecontrol and substation automation equipment shall be as per Eskom Transmission Guideline 240-170000395: “Substation Control and Automation application guide for Phase 6 Siemens solution” [TC7].

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.

8.1.2 CONCO telecontrol and substation automation equipment

Withdrawn by Eskom (Revision 2).

9. Engineering and Data Server

An Engineering and Data Server, Data Concentrator and Workstation are not required (Revision 2).

10. Auxiliary supplies (AC & DC systems)

10.1 DC systems

The tenderer shall procure Eskom accepted products, and 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 Eskom accepted suppliers and contract numbers are:

- Battery Chargers: COM10 – 4600062264; and
- Batteries and Stands: Kopana Power – 4600066662/4600068756.

10.1.1 Battery chargers

The tender shall utilize Eskom standard, 240-57649110 [DC1], for the sizing of DC systems for substation applications.

Item Description	Quantity
220V/***A Dual Battery Charger & Dual DC Board***A – Rating dependent on the required battery sizing.	1
50V/***A Dual Battery Charger & Dual DC Board***A – Rating dependent on the required battery sizing.	1

10.1.2 Batteries and Stands

The tender shall utilize the Eskom standard, 240-57649110[DC1], 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

Weskusfleur has four sources of auxiliary AC supply: Station Transformer 1 and 2 6.6kV/400V auxiliary transformers being the main supplies, and 400/132kV Coupling transformer 11 and 12 auxiliary transformers being backup. The AC distribution system at Weskusfleur shall allow for any of the four supplies to be selected for use. The Station Transformer supplies are prioritised as these are supplied in emergencies by the Weskusfleur-Ankerlig Auto-start scheme.

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

- 240-64139144, “AC Boards and Junction boxes for substations” [AC1];

- 240-55151946, “AC Reticulation philosophy for substations” [AC2];
- 240-76628687, “AC/DC Reticulation equipment for Breaker–and–a–half substations” [AC3];
- Drawing 0.54/7106, “230 V AC Distribution Board” [AC4];
- Drawing 0.54/08596, “400 V AC Substation Distribution Board Type 2” [AC5];
- Drawing 0.52/20252, “Transformer Distribution Board Type 1” [AC6];
- Drawing 0.52/20251, “Plug Boxes – 1PB0100” [AC7];

The basic and detailed design shall be presented to Eskom PTM&C DRT for acceptance prior purchase.

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_rev3 [T1]

Applicable standards:

- 240-56362336, “Installation of a Telecoms Equipment Cabinet Standard” [T2];
- 240-132190480, “Telecommunication Equipment Installation Standard” [T3];
- 240-56872313, “Radio Station Earthing and Bonding” [T4]. For earthing of the telecommunications equipment (indoor and outdoor);
- 240-70732888, “Fibre Optic cable system ATP” [T5]. Testing of fibre and recording the test results;
- 240-62629353, “Specification for Panel Labelling Standard” [T6];
- 240-67907017, “Fibre Optic Core Allocation Standard” [T7];
- 240-70732902, “Fibre Optic Connectors” [T8];
- 240-46263618, “Fibre-optic cables and ODF labelling standard” [T9];
- 240-140642648, “Fibre Optic design standard – Part 1 Lines and Cables” [T10];
- 240-46264031, “Fibre Optic Design and Installations - Substations” [T11];
- 240-84979963, “DC Systems Design Guide for Telecommunications” [T12];
- 240-118870219, “Standby Power Systems Topology and Autonomy for Eskom Sites” [T13];
- 240-75975613, “Standard for the installation of Power Telecommunications Equipment” [T14];
- 240-70732272, “MSAP Design Guide” [T15];
- 240-70783066, “Telecoms Transport Network Design Standard for TDM circuits” [T16];
- 240-56576361, “Telecommunications Transport Network Equipment Installation and Commissioning Standard” [T17];
- 240-94136376, “IP Data Network Design Guide” [T18];
- 240-164619548, “OTN High Level Design” [T19];
- 240-150755516, “OTN OSN1800 AND OSN9800 Design Guide” [T20];
- 240-170000419, “OT Voice Design Guide” [T21];
- 240-110412152, “Generic QA tick sheet for projects” [T22];
- 32-373, “Information Security-IT/OT Remote Access Standard” [S10].

NOTE:

- It is important to note that the telecommunications department project approval process must be followed during the execution of the project and all necessary approvals must be obtained from the Telecomms Design Review Team.
- Changes in the network topology and technology changes must be taken into consideration during execution. Due diligence must be done to ensure that where technologies have changed, compliance with the network requirements (network interoperability) and the use of Eskom approved technologies are adhered to through the Eskom Design Change management process.

12. PTM&C application design

12.1 PTM&C application design requirements

The PTM&C application design, the interface between the standard PTM&C schemes/equipment 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 designs are permitted, the application design focuses only on the interface between the primary plant and the standard PTM&C schemes and equipment. Eskom will supply drawing numbers. The remote end feeder 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 Weskusfleur 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 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 packages 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. Application drawings shall be submitted as signed pdf files and as native editable *.dgn Microstation drawing files.

The following standards shall be used:

- 240-68980568, "Standard for the Application of Transmission and Distribution Protection Schemes" [PA1];
- 240-96632721, "Drawing Practice Standard" [PA2]; and
- 240-82736997, "Stringing, cabling, earthing and erection specification for Transmission substations" [PA3]

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 includes 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 shall develop a Factory Acceptance Test (FAT) procedure for each new scheme and shall document the results of the FAT in this document. Should Protection Combination 1 (Hitachi Energy equipment with Relion 670-series version 2 IEDs) be chosen, FAT procedures shall also be provided for the Model Power System Testing described in Section 2.2.

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 tests are required, including but not limited to:

- Scheme inputs and outputs, binary and analogue;
- Signals between Weskusfleur and KNPS
- 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 equipment).

13.1 Factory acceptance testing requirements of the schemes to be developed

Factory acceptance testing is required for the Generator transformer interface schemes, station transformer interface schemes and the Koeberg auto-start scheme, including the 132kV synchronising facilities. 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 DC voltage (264 VDC) and at 80% of nominal DC (176 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 imported 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 much 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 of 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 picks-up and trips instantaneously for all types of faults on the primary transmission line and stabilizes (or trips in back-

up time) for faults beyond the primary transmission line. The 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 tests are required, including but not limited to:

- Signals between the schemes, the gateway and the station HMI;
- Interlocking rules;
- SCADA controls;
- Signals to Koeberg power station; and
- Controls from Koeberg power station.

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 and accepted 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" [C1];
- 240-55197966, "Standard for the commissioning of metering installations (HV and MV)" [C2]; and,
- 240-137465740, "Standby Battery storage and commissioning in Eskom" [C3].

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

Only one commissioning option is applicable:

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

- Withdrawn (Revision 2).

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 described herein within his/her scope of supply.

16. Integrated Physical Security System

This section defines the requirements for an Integrated Physical Security System for Weskusfleur which includes provision and integration of the CCTV system, intruder detection system, Access Control System (ACS), alarm system, public address (PA) system, Intrusion pre-detection system and interfaces to the Physical Security Information Management (PSIM) system (includes IT infrastructure) at Eskom Zero Control, Simmerpan. A Non-lethal energised perimeter detection system (NLEPDS) is also required.

The Contractor shall use the documents listed below together with details outlined in the detailed scope of work documents:

[S1] 240-170000258, “Scope of work for Integrated physical security systems”. See Annex C for Weskusfleur-specific scope.

[S2] 240-170000192, “Scope of work for Non-Lethal Energized Perimeter Detection System (NLEPDS)”.

The Integrated Security System and NLEPDS for Weskusfleur shall be Transmission assets and shall be controlled by, and reported to Transmission. Section 3.8 “Site Monitoring” of 240-170000258 refers to a “security manager workstation at site” which refers to local monitoring facilities at Weskusfleur. In addition, the Integrated Security System and NLEPDS at Weskusfleur shall cater for interfaces to be used by KNPS site security to monitor, though not control, the security systems at Weskusfleur, including seeing CCTV video footage, receiving security-related alarms and broadcasting over the Weskusfleur public address system. The access control system at Weskusfleur shall be standalone from the KNSP access control system.

As part of the detailed design process (post tender award), the Tenderer shall submit schedules as per 240-134779125 and 240-170000257 for evaluation by Eskom:

[S3] 240-170000257, “Technical evaluation for the integrated physical security system”.

[S4] 240-134779125, “Technical evaluation criteria for Non-Lethal Energized Perimeter Detection System (NLEPDS)”.

The following references are applicable:

[S5] 240-102220945, “Specification for Integrated Access Control System for Eskom sites”.

[S6] 240-91190304, “Specification for CCTV Surveillance with Intruder Detection”.

[S7] 240-7890848, “Specification for Non-Lethal Energized Perimeter Detection System (NLEPDS) for protection of Eskom installations and its subsidiaries”.

[S8] 240-55410927 “Cyber security standard for Operational Technology”.

[S9] 240-79669677 “Demilitarized zone (DMZ) deigns for Operational Technology”.

[S10] 32-373, “IT/OT Third Party Access Control Procedure”.

[S11] 240-17000723, “Generic Technical requirements for physical security technologies contracts”.

[S12] 240-86738968, “Specification for Integrated Security alarm system for protection of Eskom installations and subsidiaries”.

[S13] 240-17000096, “Physical Security Integration Standard”.

[S14] 240-170000614, “Cyber security controls guide for physical security systems”.

[S15] 240-170000691, “Standard for intrusion pre-detection systems used at Eskom sites”.

[S16] 240-170000098, “Security Public Address Systems for Substations and Telecoms High sites”.

[S17] Drawing 0.52-30122, “Manufacturing detail of two-way energiser kiosk”.

[S18] Drawing 0.52-30123, “Manufacturing detail of four-way energiser kiosk”.

[S19] Drawing 0.52-30124-06, “Manufacturing detail of electric fence controller”.

[S20] Drawing 0.52-30125, “Manufacturing detail of electric fence guard house kiosk”.

[S21] Drawing 0.54-8282-5, “Non-lethal fence plan sections and details”.

17. General

- The basic and detailed designs shall be presented to Eskom PTM&C Design Review Team (DRT) for approval prior to purchasing;
- The tenderers shall provide high level designs and timelines for schemes to be developed;

18. LV Power and Control Cables and Telephone Cables

The tenderer shall apply the following standards in respect of LV Power and Control Cables for the PTM&C scope of work.

[CC1] Eskom Standard 240-56063805, “LV Power and Control cable with rated voltage 600/1000V standard”

[PA1] Eskom Standard 240-68980568, “Standard for the application of Transmission and Distribution Protection schemes”, Section 3.14

The successful tenderer shall supply and install all required LV Power and Control Cables and Telephone cables.

Eskom cable codes are defined in:

[CC2] Eskom Cable Codes – Power & Control

[CC3] Eskom Cable Codes – Telephone

The following cable codes may be used, with alternatives being subject to Eskom approval:

- BVX2ECV – 2 -core, 4sqmm power/control cable
- BVX4DCV – 4 -core, 2.5sqmm power/control cable
- BVX4ECV – 4 -core, 4sqmm power/control cable
- BVX7DCV – 7 -core, 2.5sqmm power/control cable

- BVX12DCV – 12 -core, 2.5sqmm power/control cable
- BVX19DCV – 19 -core, 2.5sqmm power/control cable
- BVX37DCV – 37 -core, 2.5sqmm power/control cable
- TPH10AX – 10-pair telephone cable
- TPH25AX – 25-pair telephone cable
- TPH50AX – 50-pair telephone cable

Cables shall be steel wire armoured. Earthing of cable armouring and spare cores shall be in accordance with Eskom Standard 240-64100247, “Standard for earthing of secondary plant/control plant equipment in substations” [P13]

Cables shall be marked at each end in accordance with Eskom Standard 240-64636794 “Standard for wiring and cable marking in substations” [P14].

Cabling shall be neatly routed in cable trenches or on cable racks in accordance with best industry practice.

19. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Reginald George	Secondary Plant Manager, Transmission Western Grid
Evan Kerr	Senior Advisor, Koeberg Nuclear Power Station

20. Revisions

Date	Rev.	Compiler	Remarks
March 2024	2	Stuart van Zyl	Revision to update requirements. Changes indicated in Red. Main changes as follows: Section 1.1. Latest station drawings referenced. Section 2.2. Use of the Hitachi Energy (formally ABB) protection solution will require migration to the 670-series version 2 platform, including model power system testing. CONCO/SEL protection option removed as this solution is not fully developed yet. Section 2.4.2. 400kV Generator Transformer interface schemes will be based on the conventional TX/GX interface and not the interface scheme at Ingula Pumped Storage Scheme. Scheme requirements indicated for interface with synchronising equipment at KNPS. Section 2.5. Generator synchronising will be undertaken by KNPS, closing the 400kV Generator Transformer circuit-breakers at Weskusfleur. Section 2.8. 132kV feeder remote-end protection changed from 4FZD schemes to 5FZD schemes. Section 2.11. 400kV Generator Transformer Cable/GIL protection to be located at Weskusfleur, and not distributed to the GT Houses. Section 2.12. Station transformer interface protection schemes to be located at Weskusfleur, and not distributed to the Station Transformer relay house.

Date	Rev.	Compiler	Remarks
			Section 2.13. 6.6kV/400V aux transformers to be protected using custom cubicles. Section 2.14. Auto start requirements updated. Section 2.14.5. Requirement added for 132kV re-synchronising at Weskusfleur following auto start test. Section 2.15 & 2.16. Second bus zone scheme option added. Section 2.17. Open phase detection requirement added (included as clarification question on original tender). Section 7. Metering requirements updated based on latest Station Electric Diagram. Requirement for 6.6kV/400V Aux transformer supply metering added. Section 8. Telecontrol. Requirement for KNPS to interface with Wesksfleur as a fourth control centre added. CONCO automation solution deleted as this is not yet fully developed. Section 9. Requirement for Engineering and Data Server withdrawn. Section 10. Battery supplier and contract details updated. Section 14. Option for commissioning by Transmission Grid West removed. Weskusfleur to be commissioned by OEM, witnessed by Eskom representatives. Section 16. Physical security requirements refer to companion specifications. Section 18. LV Power and Control Cables and Telephone Cables section added.
May 2020	1	Vusi Msibi	First issue.

21. Development team

The Revision 1 of this document was developed by Thys Bower, Bongani Qwabe, Ian Naicker, Tejin Gosai, Vanessa Naidu, Vusi Msibi and Donald Moshoeshoe.

Revision 2 was compiled by Stuart van Zyl and Mario Petersen with input from Bongani Qwabe, Ian Naicker, Quinton Labuschagne, Mohamed Omar, Tejin Gosai, Vanessa Naidu, Fefe Ngalonkulu, Lester Geldenhuis, Gerhard de Kock, Ettienne Scholtz and Donald Moshoeshoe.

Synchronising requirements for the 400kV Generator Transformer circuit-breakers were workshopped by Generation specialists including Murray van Niekerk, Johann Jordaan, Thelrick Meyer, Jean-Pierre Oosthuizen and Jacques Strydom.

Evan Kerr co-ordinated inputs from KNPS and was a key contributor in respect of interface requirements.

Riccardo Mosia facilitated technical discussions between Koeberg, Generation Technology, Transmission PTM&C and Transmission Western Grid.

The authors apologise to any contributor not mentioned by name.