Eskom National Transmission Company South Africa ™	**Report**	**National Transmission Company South Africa**

Title: **Failure Investigation Report into Garona STATCOM No1 11kV Breaker Opened on 15 Nov 2024 TIPPS 87140**

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Content

Figures

1. Introduction

Garona substation is situated in Western Grid, Northern Cape province, outside Groblershoop town. The substation has 1x Transformer rated 275/132/22 kV 125 MVA, 2 x 275 kV lines (Lewensaar 1 275 kV, and Ferrum 1 275 kV), 2 x 275 kV Busbars with 1 x Bus coupler (Bus coupler A), a 275 kV Shunt Busbar Reactor (RX5), 1 x 275/11 kV STATCOM Transformer & VSC STACOM, and 1 x 275 kV Traction Feeder supplying a Traction Busbar with 2 x 275/50 kV Traction single phase Transformers. The substation has 2 x 132 kV Busbars with one Coupler (Bus Coupler A), 3 x 132 kV feeders (Gordonia 1, Groblershoop 1, and Bokpoort 1). The Traction transformers supply the Traction 1 and Traction 2 50kV networks. Figure 1 shows Garona substation linking diagram.

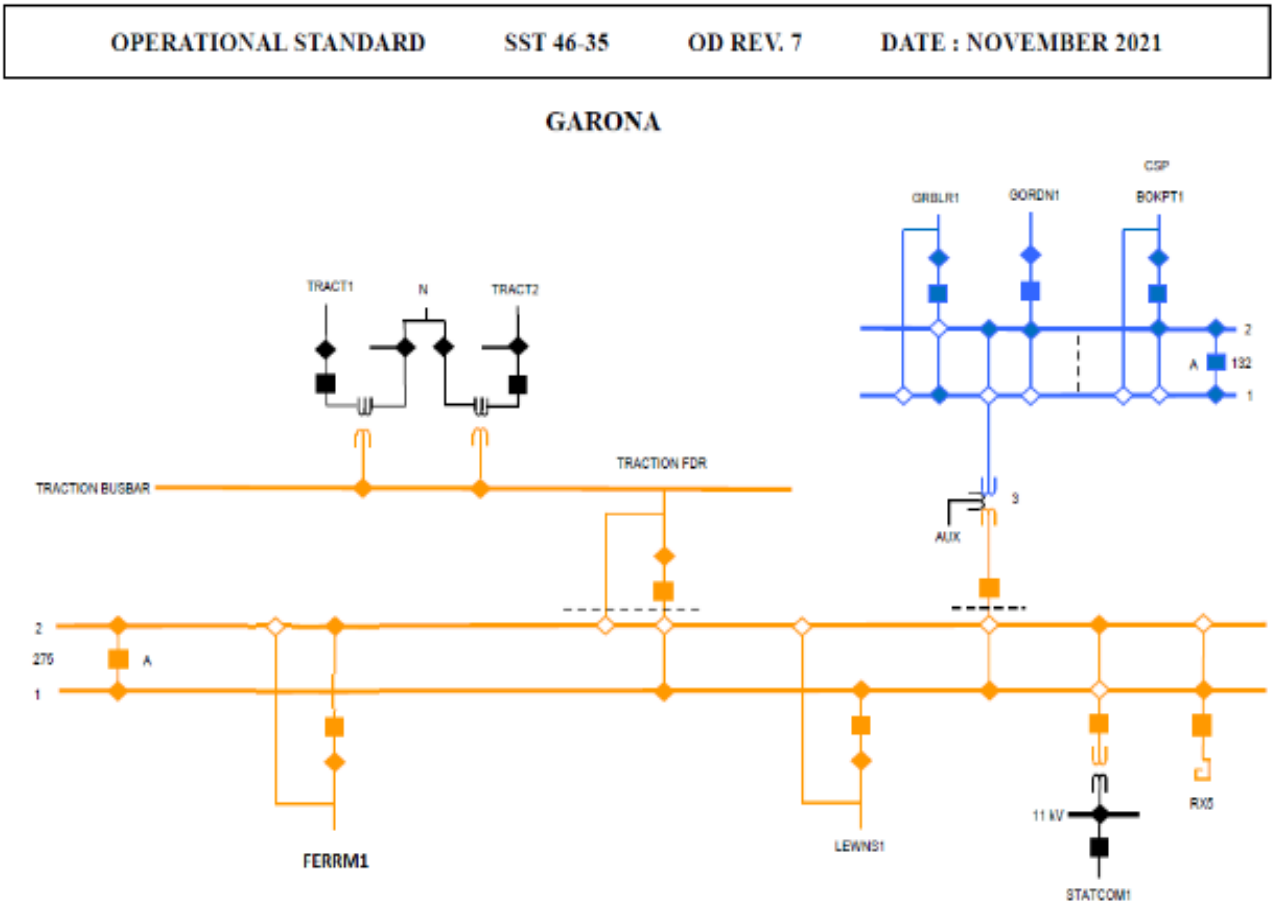

Figure 1: Single line diagram for Garona substation

The 275 kV STATCOM is a FACTS device with a dynamic range of -50 MVAr to +50 MVAr, manufactured, supplied, and installed by Rongxin Power Electronic Co. Ltd (RXPE). The STATCOM was first operational since mid-2013 as installed by RXPE and there has not been any major refurbishment to the FACTS device since its installation.

The STATCOM VSC Valves are operated at 11 kV and control the 275 kV HV busbar voltage through the 275/11 kV STATCOM transformer and influences and controls the unbalance on the 132 kV network where there are some critical IPP connections and sensitive customer loads on the Distribution networks. RXPE has now been taken over by Rongxin Huiko Electric Company Ltd (RXHK) as the OEM company legal successor and supplier of the STATCOM at Garona substation.

On 15 November 2024, at Garona substation, the 11 kV STATCOM was opened, isolated, and earthed (OIE) at 10:06:52 AM due to controller 1 and 2 both being offline. The controllers were rebooted, they became online and were able to function correctly. There was no interruption of supply to customers due to the 11 kV STATCOM being OIE. The opening of the 11 kV STATCOM breaker was recorded as a plant/equipment failure on TIPPS with incident number 87140, this report is registered on the Business Operations Centre (BOC) on SED25020603.

2. Supporting Clauses

2.1 Scope

This report covers the investigation conducted at Garona Substation for the 11 kV STATCOM that was opened, isolated, and earthed on 15 November 2024 at 10:06, the incident recorded on TIPPS 87140.

2.1.1 Purpose

The purpose of this report is to determine the root cause and make recommendations on the 11 kV breaker opening incident on the Garona substation 275 kV STATCOM on 15/11/2024 at 10:06.

2.1.2 Applicability

This document shall apply throughout National Transmission Company South Africa SOC Ltd Reg No 2021/539129/30, more specifically applicable to Garona 275 kV STATCOM in the Western Grid.

2.1.3 Effective date

The effective date of this report shall be the authorisation date as signed.

2.2 Normative/Informative References

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

2.2.1 Normative

[1] ISO 9001 Quality Management Systems

[2] NTCSA Technical incident preliminary report form: SP Report for 11kV STATCOM at Garona substation for the 15/11/2024 at 10:06 am (TIPPS 87140)

2.2.2 Informative

[3] 240-185000339 Failure investigation report into Garona STATCOM No1 11kV breaker opened on 02 July 2024 TIPPS 86151 (OEM report on previous STATCOM Control system failures)

[4] 240-17110002 Plant failure investigation on Garona No1 275kv STATCOM trip of 04 Feb 2023

[5] 240-171000337 Failure investigation report for Garona STATCOM No1 275kV breaker trip on 07 Oct 2023

2.3 Definitions

2.3.1 General

Definition	Description
STATCOM	A fast-acting device capable of providing or absorbing reactive current and thereby regulating the voltage at the point of connection to a power grid. It is a shunt connected FACTS device that is based on VSC technology semi-conductor valves to regulate the system voltage. It has phase reactors and a STATCOM transformer.

2.4 Abbreviations

Abbreviation	Description
AIP	Asset Investment Planning
FACTS	Flexible AC Transmission Systems
MVAR	Mega Volt-Ampere Reactive
NTCSA	National Transmission Company South Africa
OIE	Open, Isolated and Earthed
SEA	Senior Engineering Assistant
SED/SE&D	Substation Equipment and Diagnostics
STATCOM	Static Synchronous Compensator

2.5 Roles and Responsibilities

Western Grid PwP is responsible to ensure that any finding and/or action raised in this report gets loaded on SAP QIM.

Asset Investment Planning (NTCSA Asset Management) will raise a refurbishment project for the STATCOM's Control systems and ensure that the project is on the capital plan.

Western Grid Secondary Plant Manager will implement the recommendation(s) made in this report as may be applicable.

2.6 Process for Monitoring

The implementation and monitoring of actions and recommendations will be via SAP QIM system.

2.7 Related/Supporting Documents

[6] 240-78325782 Health appraisal report for FACTS Devices installed in the Transmission network for March 2023

[7] 240-171000055 Asset management plan for SVC and STATCOM installations 2022/2023

3. Garona STATCOM No 1 11 kV Breaker Opened incident on 15/11/2024

3.1 Background

At Garona substation in the Western Grid at 10:06 on 15 November 2024 STACOM No.1 11 kV Breakers were opened for fault investigations on the STATCOM Controllers that were all offline at Control centre. The Grid investigated the incident and found that the fault was due to Controller 1 and 2 both stalling / freezing. The controllers were rebooted and were operational again. There was no interruption of supply to NTCSA customers.

3.2 Investigations findings

NTCSA Asset Management Substation Equipment & Diagnostics (SED), together with the Western Grid, visited the substation on 13 February 2025 to conduct site investigations.

The investigation site visit coincided with the site visit by the Grid and PTM&C Lab personnel for the investigations into the failure of the Universal Power supply (UPS) following a complete replacement of the UPS battery replacement done by the NTCSA DC Workshop.

3.2.1 Operating log and Senior Engineering Assistant (SEA) recall

It was found and confirmed during the SE&D site investigation on 13/02/2025 that the SEA operated and opened the STATCOM's 11 kV Breaker on the 15 November 2024 on instructions from Control to further conduct inspections and investigate the reasons why the two STATCOM Controllers (Controller 1 and Controller 2) were both offline. The SEA confirmed that following the repairs and maintenance done by RXHK and Mega HVT on incident number 240-185000339 [3], the Control system number 1 kept failing and going offline.

The Grid reset /rebooted both Controllers tested them, and it was found that Controller number 2 was the one that could be reliably used while Controller 1 should be switched out. Controller 2 was set as the Active controller and the STATCOM was then returned the STATCOM back to service with Controller 2 active. Controller 1 kept on issuing false alarms and this was consistent with the recommendations made by the OEM on [3] that the Control systems are at their end of life and recommended for an upgrade together with the HMI of the STATCOM.

It was also found that the performance trend on the 2023/2024 Asset Management Plan (AMP) for the STATCOM at Garona showed that the majority of the STATCOM failures and trips, during the period 2017 – 2023, were largely caused by Control cards, PSU and IEGTs. The AMP recommended that a Life extension phase of the FACTS, critical upgrades or refurbishment should be done to the STATCOM Control as part of the Life cycle management plant to improve reliability and availability of the STATCOM and to avoid Control systems obsolescence resulting in spares shortages and major STATCOM equipment failures. The STATCOM has been operational since for over 12 years.

3.2.2 Analysis of Garona STATCOM Fault

On the day of the incident, the two Controllers on the STATCOM went offline and Control informed the Snr EA to attend to the fault and to investigate. On further inspections, the SEA found that the Control System was not showing any analogues or indications of the STATCOM's HMI. Figure 2 below shows the HMI STATCOM Single line diagram with no analogue readings. The STATCOM (11 kV breakers) was then opened, isolated, and earthed (OIE) and the investigations were conducted on the STATCOM and the alarm logs in Figure 3 showed the flags found.

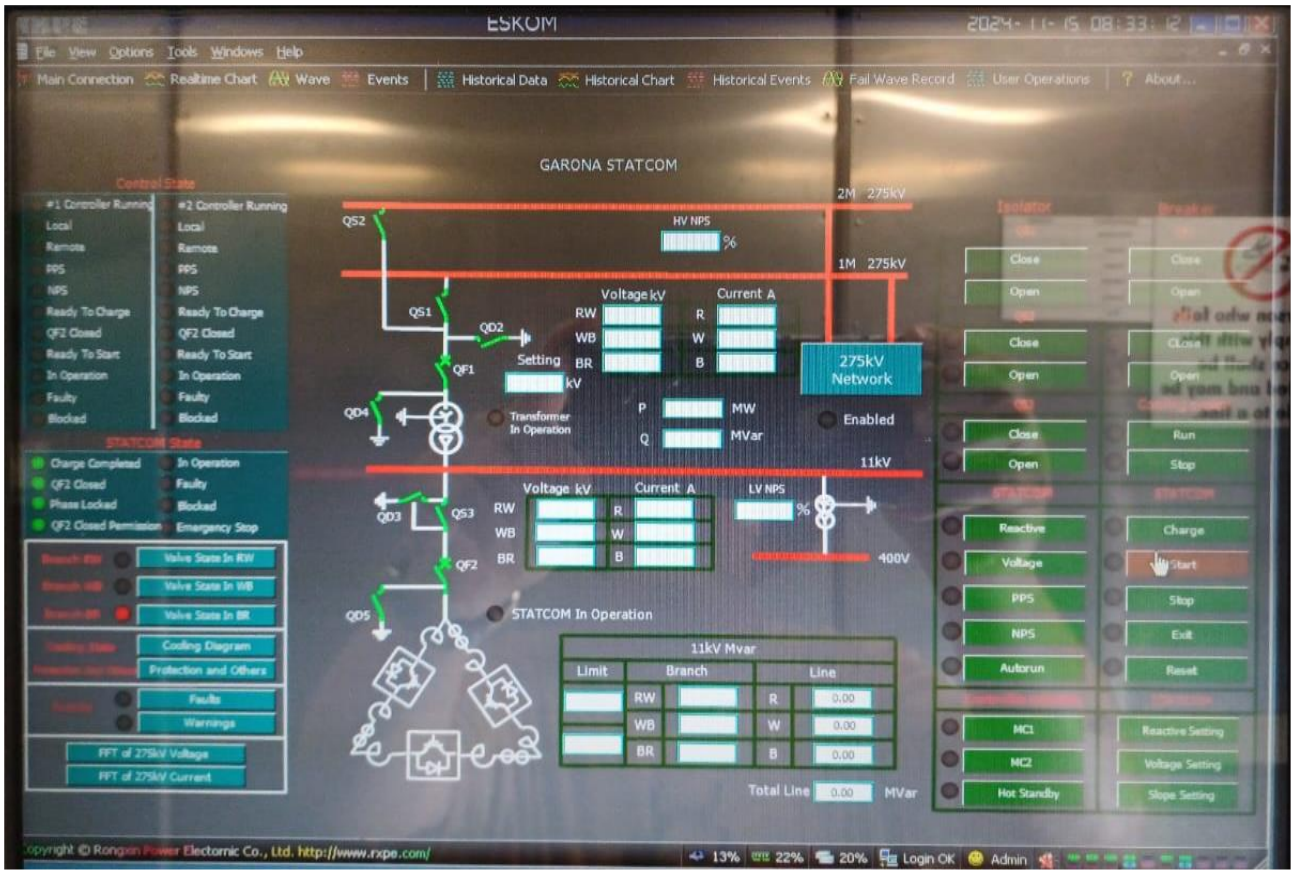

Figure 2: Garona STATCOM Single line diagram – Controllers offline and no analogues

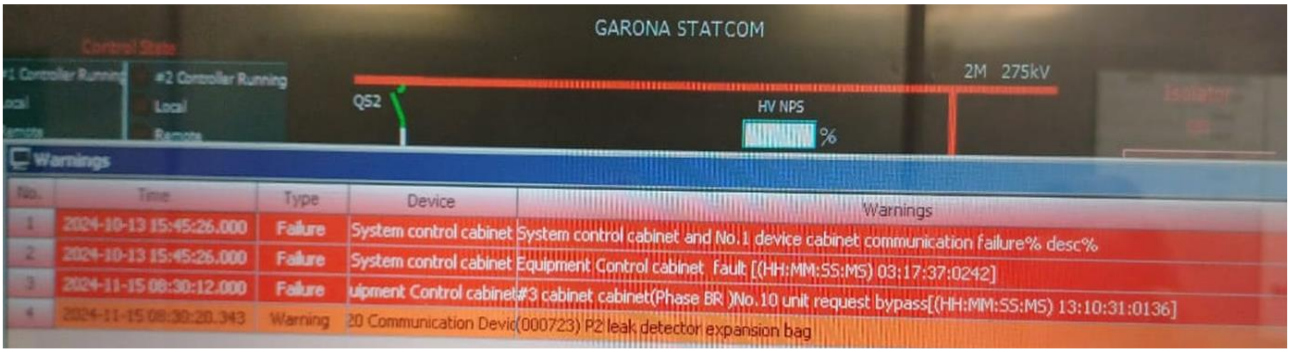

Figure 3: STATCOM Event logs, Communication alarm event logs

After the STATCOM was OIE, the Senior EA rebooted the Controllers and they became online, were able to communicate and function correctly.

The fault was reported to the OEM, who suggested that the STATCOM Controllers at Garona should be replaced as they have reached their life span for the Control systems electronic components estimated between 12 and 15 years in service.

This recommendation was also made previously by Mega HVT (the then Sole urgent for RXPE and RXHK) as well as to refurbish the STATCOM's Protection and Control systems in full.

3.2.3 EMS Alarm logs for Garona 275 kV STATCOM on 15/11/2025

Time	Alarm
15-Nov-2024 10:05:46.121	GARONA STTCOM LOCAL/REMOTE LOCAL
15-Nov-2024 10:06:18.409	GARONA STATC_11_BKR BREAKER STATE **OPEN**
15-Nov-2024 10:10:37.221	GARONA STTCOM LOCAL/REMOTE REMOTE
15-Nov-2024 10:17:56.162	GARONA STTCOM CONTROLLER INDICATION **ALARM**
15-Nov-2024 10:17:56.190	GARONA STTCOM COOLER FAIL FAILED
15-Nov-2024 10:17:56.190	GARONA STTCOM WATER COOLING SYSTEM RUN O **ALARM**
15-Nov-2024 10:17:56.603	GARONA STTCOM DEVICE COMMUNICATION URGEN **ALARM**
15-Nov-2024 10:17:56.177	GARONA STTCOM EMERGENCY STOP **ALARM**
15-Nov-2024 10:17:56.177	GARONA STTCOM SYSTEM CONTROL CABINET EME **ALARM**
15-Nov-2024 10:17:56.261	GARONA STATC_SH_RX BUSBAR SHUNT RX INDIC FAILED
15-Nov-2024 10:17:56.318	GARONA STTCOM INTEGRATION FAULT **ALARM**
15-Nov-2024 10:17:56.267	GARONA STTCOM CONTROLLER BOARD FAULT
15-Nov-2024 10:17:56.273	GARONA STTCOM DEVICE CONTROL CABINET FAILED
15-Nov-2024 10:17:56.275	GARONA STATC_FER_LEW FEEDER INDICATION FAILED
15-Nov-2024 10:17:56.275	GARONA STTCOM COMMS FAULT SYS CONTROL AN **ALARM**
15-Nov-2024 10:17:56.275	GARONA STTCOM PPC COMMS FAIL **ALARM**
15-Nov-2024 10:17:56.371	GARONA STTCOM START/STOP IN PROGRESS STOP
15-Nov-2024 10:17:56.377	GARONA STTCOM STATCOM PRECHARGHING STOP
15-Nov-2024 10:17:56.383	GARONA STTCOM FAULT RESET STOP
15-Nov-2024 10:17:56.575	GARONA STTCOM CONTROLLER FAULT
15-Nov-2024 10:17:56.578	GARONA STTCOM CONTROLLER BLOCKED - SYSTE **ALARM**
15-Nov-2024 10:17:56.598	GARONA STTCOM SYSTEM CONTROL INDICATION **ALARM**
15-Nov-2024 10:17:56.430	GARONA STTCOM START UP SEQUENCE STOP
15-Nov-2024 10:17:56.500	GARONA STTCOM NORMAL VOLTAGE DECREASE *TRANSIT
15-Nov-2024 10:18:08.576	GARONA STTCOM PHASE OVERCURRENT FAULT
15-Nov-2024 10:19:13.071	GARONA STTCOM PHASE OVERCURRENT NORMAL
15-Nov-2024 10:19:13.499	GARONA STTCOM EMERGENCY STOP NORMAL
15-Nov-2024 10:19:13.499	GARONA STTCOM SYSTEM CONTROL CABINET EME NORMAL
15-Nov-2024 10:19:13.502	GARONA STTCOM CONTROLLER BOARD NORMAL
15-Nov-2024 10:19:13.504	GARONA STTCOM DEVICE CONTROL CABINET NORMAL
15-Nov-2024 10:19:13.507	GARONA STTCOM COMMS FAULT SYS CONTROL AN NORMAL
15-Nov-2024 10:19:13.507	GARONA STTCOM PPC COMMS FAIL NORMAL
15-Nov-2024 10:19:14.974	GARONA STTCOM CONTROLLER NORMAL
15-Nov-2024 10:19:14.976	GARONA STTCOM CONTROLLER BLOCKED - SYSTE NORMAL
15-Nov-2024 10:19:14.982	GARONA STTCOM INTEGRATION FAULT NORMAL
15-Nov-2024 10:19:17.029	GARONA STTCOM VALVE FAULT NORMAL
15-Nov-2024 10:19:14.986	GARONA STTCOM FAULT RESET START
15-Nov-2024 11:41:56.306	GARONA STTCOM STATCOM PRECHARGHING START

15-Nov-2024 11:42:03.680	GARONA STATC_11_BKR BREAKER STATE **CLOSED**
15-Nov-2024 11:42:06.519	GARONA STTCOM SHUT DOWN SEQUENCE STOP
15-Nov-2024 11:43:08.752	GARONA STTCOM START/STOP IN PROGRESS START
15-Nov-2024 11:43:08.760	GARONA STTCOM START UP SEQUENCE START
15-Nov-2024 11:43:40.761	GARONA STTCOM SUPERVISORY SWITCH ON

3.2.3.1 Analysis of the STATCOM EMS logs for OIE and Restoration on 15 Nov 2024

- The 11 kV STATCOM Breakers were opened on 15-Nov-2024 at 10:06:18.409.
- Investigations were conducted on the STATCOM Controllers, and several alarms were set and cleared on the STATCOM Control systems between 10:06 and 10:19.
- The STATCOM Controllers were reset and the STATCOM was returned back to service on 15-Nov-2024 at 11:42:03.680.

3.3 OEM's recommendations from previous failures and last maintenance

- The STATCOM HMI computer in monitoring cabinet usually shuts down automatically and it needs to be replaced with new one urgently.
- The supplier, RXHK, suggests sending the existing old spare electronic cards to China for inspections, testing, and possible repairs.
- Should any card replacement in the Controllers be required, NTCSA must inform RXHK in advance to support with the programming of the cards for the specific slot.
- Refurbish the existing Controllers for the Plant and HMI at Garona on the 275 kV STATCOM.

3.4 Conclusions and Incident classification

- The 11 kV STATCOM breakers were opened and the STATCOM isolated and earthed during a forced outage to attend to the fault on the STATCOM Controllers that were both offline.
- Asset Management SE&D accepts the STATCOM plant equipment to have failed as the two Controllers were both reset/rebooted after the incident. The STATCOM Controllers and their electronic cards have been in service for over 12 years.

3.4.1 Root Cause of the STATCOM 11 kV Breaker Opening

- The root cause of the 11 kV STATCOM breaker opening was the STATCOM Controller 1 and Controller 2 that failed and went offline.
- The contributory cause to the Controller going offline is the aging electronic cards on the Control systems.
- The direct cause for opening the STATCOM's 11 kV breakers was Control after identifying that the STATCOM's Controllers were all offline.

3.4.2 Incident classifications

The STATCOM plant equipment failed, as the Controllers 1 and 2 were reset during a forced outage.

3.4.3 Recommendations made

The following recommendations are made from findings and conclusions made:

Finding	Recommendation (Action)	Responsible	Due Date
The STATCOM's Control system has reached end of life and required urgent upgrade to avoid obsolescence.	AIP to raise a refurbishment project for the STACTCOM's Control systems in consultation with Western Grid.	Nicolaas De Klerk	30 Sept 2025
	Western Grid to replace both the STATCOM Controller 1 and STATCOM Controller 2 (Hardware and software) at Garona substation.	Regi George	31 Mar 2026

4. Acceptance

This document has been seen and accepted by:

Name	Designation
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Rocco Van Den Heever	Snr Engineering Assistant – HV Plant (Western Grid)
Selby Mudau	Chief Engineer – SE&D Power Electronics & FACTS
Stuart Van Diemen	Middle Manager – HV Plant (Western Grid)
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5. Revisions

Date	Rev.	Compiler	Remarks
April 2025	1	DS Mudau	This is a new document

6. Development Team

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

- Selby Mudau

7. Acknowledgements

Rocco Van Den Heever.