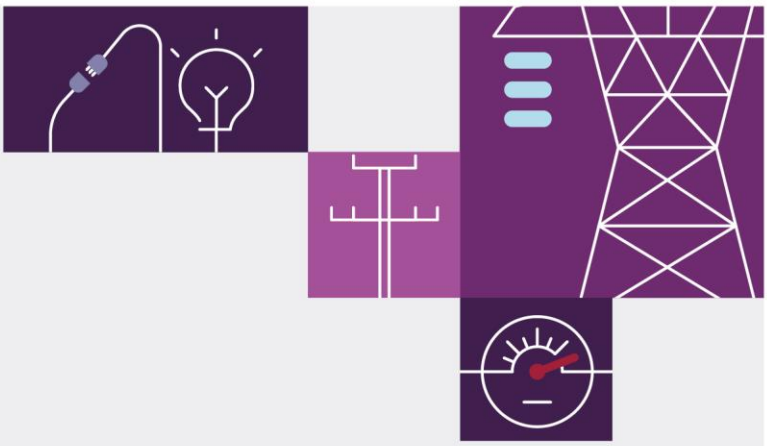
Trip of Ross No. 1 275 kV SVC during Switching of Ross No. 4 275/132 kV Transformer on 13 September 2023

March 2024

Reviewable Operating Incident Report under the National Electricity Rules



Important notice

Purpose

AEMO has prepared this report in accordance with clause 4.8.15(c) of the National Electricity Rules, using information available as at the date of publication, unless otherwise specified.

Disclaimer

To inform its review and the findings expressed in this report, AEMO has been provided with data by registered participants as to the status or response of some facilities before, during and after the reviewable incident, and has also collated information from its own observations, records and systems. Any views expressed in this report are those of AEMO unless otherwise stated, and may be based on information given to AEMO by other persons. AEMO has made reasonable efforts to ensure the quality of the information in this report but cannot guarantee its accuracy or completeness. Any views expressed in this report may be based on information given to AEMO by other persons.

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AEMO acknowledges the Traditional Owners of country throughout Australia and recognises their continuing connection to land, waters and culture. We pay respect to Elders past and present.

Abbreviations

Abbreviation	Term
AC	alternating current
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time
CB	circuit breaker
FOS	Frequency Operating Standard
kV	kilovolt/s
MW	megawatt/s
MN	market notice
NEM	National Electricity Market
NER	National Electricity Rules
NOS	Network Outage Schedule
OOS	out of service
PSSWG	Power System Security Working Group
RTS	return to service
s	second/s
SVC	static volt-ampere reactive power compensator
TNSP	Transmission Network Service Provider
V	volt/s

Incident review

This reviewable operating incident[1] report is prepared in accordance with clause 4.8.15(c) of the National Electricity Rules (NER). It has been prepared using information provided by Powerlink[2] and from AEMO systems.

Table 1 Summary of event

	Details
Reviewable operating incident type	Non-credible contingency event impacting critical transmission elements.
Incident details	This report relates to a reviewable operating incident[3] that occurred at 1204 hrs on 13 September 2023 in Queensland. The incident involved the trip of Ross No. 1 275 kilovolt (kV) static volt-ampere reactive compensator (SVC) during switching for the planned outage of Ross No. 4 275/132 kV transformer.
Incident classification	Procedural error/lack of procedure – Ross No. 1 275 kV SVC tripped due to the operation of the SVC thyristor valve cooling system protection as a result of loss of auxiliary alternating current (AC) supply to the SVC. The auxiliary AC supply was lost due to the Ross No. 4 275/132 kV transformer being switched out of service (OOS) for a planned outage without Powerlink arranging an alternate AC supply to the SVC.
Generation impact	No generation was lost as a result of this incident.
Customer load impact	No load was lost as a result of this incident.
Pre-incident conditions	Prior to the incident: • Ross No. 3 275/132 kV transformer was OOS for a long term planned outage from 11 August 2023 with an expected return to service (RTS) of 11 March 2024. • Bouldercombe – Nebo 275 kV No. 821 line was OOS. • Tumoulin – Woree 275 kV No. 877 line was OOS. • Ross standby diesel generator, which could supply the Ross No. 1 275 kV SVC changeover panel, was not pre-selected as an alternate AC auxiliary supply to the SVC or running. • Ross No. 1 275 kV SVC 415 volt (V) changeover panel was receiving supply through a 19/0.415 kV station service transformer connected to the tertiary of Ross No. 4 275/132 kV transformer. As the Ross No. 3 275/132 kV transformer was OOS, and the Ross standby diesel generator was not pre-selected or running, there was no alternate auxiliary supply to the Ross No. 1 275 kV SVC changeover panel (see Figure 1).
Incident key events	• At 1204.23 hrs on 13 September 2023, switching began to take the Ross No. 4 275/132 kV transformer OOS for a planned outage. During the switching process: – Circuit breaker (CB) 4442 was opened at 1204.23 hrs. – CB 5072 was opened at 1204.34 hrs. – CB 5422 was opened at 1204.44 hrs, disconnecting the Ross No. 4 275/132 kV transformer from the transmission system (see Figure 2). • At 1204.55 hrs on 13 September 2023, the Ross No. 1 275 kV SVC tripped (CBs 5022 and 5812 tripped).
Incident cause	Powerlink has confirmed that the Ross No. 1 275 kV SVC auxiliary AC supplies were able to be supplied from the Ross No. 3 or No. 4 275/132 kV transformer tertiaries, or via the Ross standby diesel generator if manually selected (see Figure 1). At the time of the incident the Ross No. 3 275/132 kV transformer was on a long-term planned outage, and Powerlink had not started or pre-selected the Ross standby diesel generator to retain redundancy of the SVC's auxiliary supplies. Powerlink did not arrange an alternate supply for Ross No. 1 275kV SVC when planning the outages of Ross No. 3 275/132 kV transformer or Ross No. 4 275/132 kV transformer as the impact of the SVC had not been identified through the outage management process. As this reconfiguration did not occur prior to 1204.55 hrs on 13 September 2023, auxiliary AC supplies to the Ross No. 1 275 kV SVC were lost when the Ross No. 4 275/132 kV transformer was switched OOS. Due to the loss of

[1] Reviewable operating incidents are defined by NER clause 4.8.15(a) and the Australian Energy Market Commission (AEMC) Reliability Panel Guidelines for Identifying Reviewable Operating Incidents.

[2] Powerlink is a Transmission Network Service Provider (TNSP) for Queensland.

[3] See NER 4.8.15(a)(1)(i), as the event relates to a non-credible contingency event; and the AEMC Reliability Panel Guidelines for Identifying Reviewable Operating Incidents.

	Details
	auxiliary AC supplies, the Ross No. 1 SVC thyristor valve cooling system protection system operated and tripped Ross No. 1 275 kV SVC.
Power system response (facilities and services)	There was no other material impact on the broader power system, load, or generation.
Rectification	Following the incident, at 1211 hrs on 13 September 2023, Ross No. 4 275/132 kV transformer was re-energised to restore the auxiliary AC supply to the SVC changeover panel. At 1407 hrs on 13 September 2023, the Ross No. 1 275 kV SVC was returned to service. There was a delay to Powerlink returning the SVC to service due to circuit breaker issues. On 11 December 2023, Powerlink temporarily replaced the supply to Ross No. 1 275 kV SVC from Ross No. 3 275/132 kV transformer with the supply from a mobile diesel generator, which will run continuously. Powerlink advised AEMO that the Ross No. 1 275 kV SVC was now expected to remain in service for any outage (planned or unplanned) of Ross No. 4 275/132 kV transformer due to the supply redundancy. Powerlink advised AEMO that this solution will remain in place until the Ross No. 3 275/132 kV transformer is returned to service. As the present arrangement is temporary: • Powerlink has added notes to its energy management system and outage management system to alert operators and operations planners to a loss of supply redundancy to the Ross No. 1 275 kV SVC during a Ross No. 3 275/132 kV transformer or Ross No. 4 275/132 kV transformer outage. • AEMO has added standing notes for future outages of the Ross No. 3 or No. 4 275/132 kV transformers in the Network Outage Schedule (NOS). These notes remind AEMO to ask Powerlink about the risk of a non-credible trip of the remaining transformer and SVC.
Power system security	The power system remained in a secure operating state throughout this incident and the Frequency Operating Standard (FOS)[4] was met for this incident. AEMO invoked the constraint set(s): • Q-H13RS_SVC between 1215 hrs and 1435 hrs on 13 September 2023 to manage outage of the Ross No. 1 275 kV SVC. • Q-STR_KBWF_ZERO and Q-X_NQ_275_FDR_SVC between 1220 hrs and 1310 hrs on 13 September 2023 to manage the simultaneous outage of Ross No. 1 275 kV SVC and Bouldercombe – Nebo 275 kV No. 821 line. • Q-X_NQ_275_FDR3+SVC between 1220 hrs and 1435 hrs on 13 September 2023 to manage the simultaneous outage of Ross No. 1 275 kV SVC, Bouldercombe – Nebo 275 kV No. 821 line and Tumoulin – Woree 275 kV No. 877 line. During the incident, Powerlink clarified to AEMO the applicable limits advice for the operational conditions on the day. Powerlink clarified that Q-X_NQ_275_FDR3+SVC was adequate to cover the operational conditions and that Q-STR_KBWF_ZERO and Q-X_NQ_275_FDR_SVC could be revoked. AEMO subsequently revoked Q-STR_KBWF_ZERO and Q-X_NQ_275_FDR_SVC at 1310 hrs on 13 September 2023 and removed Q-STR_KBWF_ZERO and Q-X_NQ_275_FDR_SVC from the constraint management system for this outage condition. These actions that were taken by AEMO to maintain power system security as per NER 4.8.15(b).
Reclassification	AEMO assessed whether to reclassify this incident as a credible contingency event[5]. The root cause of this non-credible contingency event was identified. Powerlink advised AEMO that Ross No. 1 275 kV SVC tripped due to loss of auxiliary AC supply to the SVC which triggered operation of the SVC thyristor valve cooling system protection. The auxiliary AC supply was lost as the Ross No. 4 275/132 kV transformer was switched OOS for planned outage without Powerlink arranging an alternate AC supply to the 275 kV SVC. Ross No. 4 275/132 kV transformer was re-energised at 1211 hrs on 13 September 2023 to restore the auxiliary AC supply to the SVC changeover panel. AEMO was unable to obtain the appropriate level of assurance to determine that re-occurrence of this incident was not reasonably possible. AEMO appropriately applied the reclassification criteria and reclassified the trip of Ross No. 4 275/132 kV transformer and Ross No. 1 275 kV SVC from 1435 hrs on 13 September 2023 until further notice. On 15 December 2023, Powerlink advised AEMO that Powerlink had temporarily replaced the SVC AC changeover panel supply from the OOS Ross No. 3 275/132 kV transformer to a mobile diesel generator, which run continuously. This temporary arrangement will remain in place until the Ross No. 3 275/132 kV transformer is returned to service. This restored redundancy of supply to the Ross No. 1 275 kV SVC. Based on this advice, AEMO was able to obtain the appropriate level of assurance to determine that re-occurrence of this incident was not reasonably possible. AEMO appropriately applied the reclassification criteria and cancelled the reclassification of the trip of Ross No. 4 275/132 kV transformer and Ross No. 1 275 kV SVC from 1630 hrs on 15 December 2023.

[4] Frequency Operating Standard, effective 1 January 2020, available at https://www.aemc.gov.au/media/87484. This incident occurred prior to 9 October 2023, when an updated Frequency Operating Standard came into effect.

[5] AEMO is required to assess whether or not to reclassify a non-credible contingency event as a credible contingency event – NER 4.2.3A(c) – and to report how the reclassification criteria were applied – NER 4.8.15(ca).

	Details
Market information	For this incident, AEMO issued the following market notices (MNs – all market notices for this incident were issued in accordance with NER requirements): • AEMO issued MN 109789 at 1359 hrs on 13 September 2023 to advise the market of the non-credible contingency event. • AEMO issued MN 109794 at 1450 hrs on 13 September 2023 to advise the market of the reclassification of the trip of Ross No. 1 275 kV SVC and Ross No. 4 275/132 kV transformer. • AEMO issued MN 112391 at 1630 hrs on 15 December 2023 to advise the cancellation of reclassification of the trip of Ross No. 1 275 kV SVC and Ross No. 4 275/132 kV transformer.
Recommendations	AEMO and Powerlink plan to share findings of this event with the Power System Security Working Group (PSSWG) by Q2 2024.

Figure 1 Ross No. 1 275 kV SVC auxiliary AC supply system

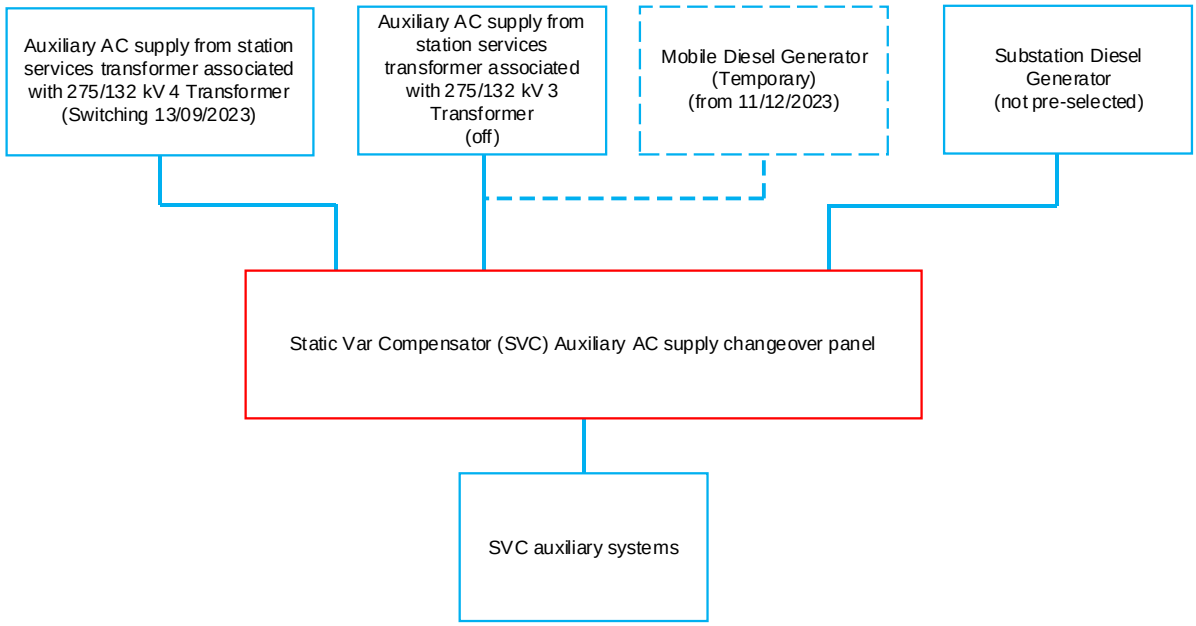

Figure 2 Post-incident diagram