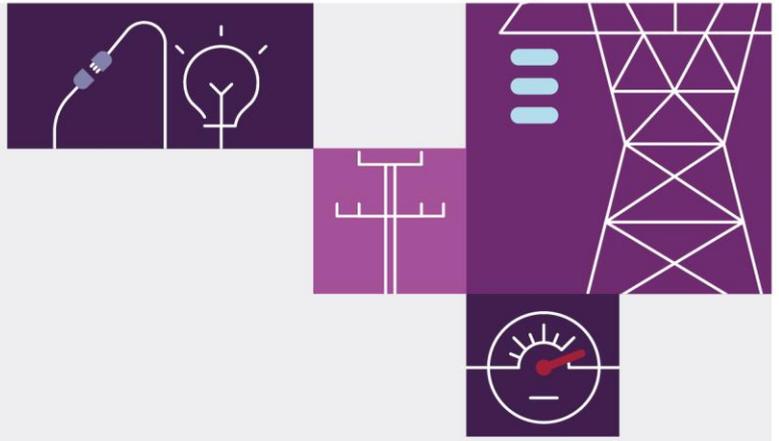


Trip of Middle Ridge 275 kV CB 5432 and CB 5422 on 21 December 2023

May 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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Contact

If you have any questions or comments in relation to this report, please contact AEMO at system.incident@aemo.com.au.

The NEM operates on Australian Eastern Standard Time (AEST). All times in this report are in AEST.

Abbreviations

Abbreviation	Term
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
NER	National Electricity Rules
No.	number
TNSP	Transmission Network Service Provider

Incident review

This reviewable operating incident¹ 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 Powerlink² 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 that occurred on 21 December 2023 in Queensland. The incident involved the trip of two Middle Ridge 275 kV circuit breakers (CBs), 5432 and 5422, which in turn offloaded the Middle Ridge 275/110 kV No. 2 and No. 3 transformers (see Figure 1).
Incident classification	Environmental – lightning.
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.
Incident key events	On 21 December 2023: 1. At 1424 hrs, the Middle Ridge 275 kV CB 5432 and CB 5422 tripped, which subsequently offloaded the Middle Ridge 275/110 kV No. 2 and No. 3 transformers (see Figure 1). 2. At 1443 hrs, Middle Ridge 275 kV CB 5432 and CB 5422 were returned to service.
Incident cause	Post-incident investigation by Powerlink has confirmed that: <ul style="list-style-type: none"> • Coincident with a high intensity lightning strike in the immediate vicinity of the Middle Ridge 275 kV substation, Middle Ridge 275 kV CB 5432 and CB 5422 tripped. The lightning strike did not result in a power system fault. Whilst blind spot protection relays associated with both transformers did not operate as there was no high voltage fault in either transformer, the momentary assertion of the digital inputs to the 275/110 kV No. 2 and No. 3 transformer Y protection relays did result in CB 5432 and CB 5422 tripping. • This high-intensity lightning strike in the vicinity of the Middle Ridge 275 kV substation may have caused an earth potential rise within the substation earthing grid, and possibly induced a voltage on the associated protection wiring of the transformers, sufficient to cause the momentary assertion described above. • Powerlink’s investigation into how the induced voltage affected the protection wiring is ongoing.
Power system response (facilities and services)	There was no other material impact on the broader power system, load, or generation.
Rectification	<ul style="list-style-type: none"> • At 1443 hrs on 21 December 2023, CB 5432 at Middle Ridge 275 kV substation was closed to return 275/110 kV No. 2 and No. 3 transformers to service. • At 1443 hrs on 21 December 2023, CB 5422 at Middle Ridge 275 kV substation was closed.
Power system security	The power system remained in a secure operating state throughout this incident and the Frequency Operating Standard ³ (FOS) was met for this incident.
Reclassification	AEMO assessed whether to reclassify this incident as a credible contingency event ⁴ .

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 Frequency Operating Standard: <https://www.aemc.gov.au/sites/default/files/2023-04/FOS - CLEAN.pdf>.

⁴ 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	
	<p>The cause of this event was not initially known, and AEMO was not satisfied that the event was unlikely to re-occur. Therefore, AEMO appropriately applied the reclassification criteria and reclassified this event as a credible contingency event.</p> <p>Post-incident investigation identified that the cause of this incident was lightning. AEMO was satisfied another occurrence of this event was unlikely in the absence of lightning in the vicinity of Middle Ridge 275 kV substation. Therefore, AEMO updated the reclassification for this event (Market Notice (MN) 112581) to only apply when there is lightning in the vicinity of Middle Ridge substation.</p>
Market information	<p>For this incident, AEMO issued the following MNs (all MNs for this incident were issued in accordance with NER requirements):</p> <ul style="list-style-type: none"> • AEMO issued MN 112579 at 1512 hrs on 21 December 2023 to advise the market of the non-credible contingency event involving the trip of the H14 Middle Ridge 275 kV CB 5432 and CB 5422, and the subsequent offloading of the H14 Middle Ridge 275/110 kV No. 2 and No. 3 transformers. The MN also advised the market that AEMO did not instruct load shedding nor was AEMO advised of any bulk load disconnections. The cause was not known at this stage. • AEMO issued MN 112581 at 1517 hrs on 21 December 2023 to advise the market that AEMO had reclassified this event as a credible contingency event until further notice. • AEMO issued MN 112884 at 1556 hrs on 29 December 2023 to advise the market of the cancellation of the reclassification of this event as a credible contingency. • AEMO issued MN 112974 at 0958 hrs on 1 January 2024 to advise the market of the special reclassification of transmission equipment during lightning. The cause of the trip was identified as due to lightning.
Conclusions	<p>AEMO has concluded that:</p> <ul style="list-style-type: none"> • At 1424 hrs on 21 December 2023, the Middle Ridge 275 kV CB 5432 and CB 5422 tripped, which subsequently offloaded the Middle Ridge 275/110 kV No. 2 and No. 3 transformers. • At 1443 hrs on 21 December 2023, Middle Ridge 275 kV CB 5432 and CB 5422 were returned to service. • The cause of the incident was identified by Powerlink and AEMO was satisfied that the event was unlikely to recur under conditions of no lightning in the vicinity. • In accordance with SO_OP_3715, AEMO now considers the Middle Ridge 275/110 kV No. 2 and No. 3 transformers to be vulnerable due to lightning. The reclassification for this event (MN 112581) will only apply when there is lightning in the vicinity of Middle Ridge substation.
Recommendations	<ol style="list-style-type: none"> 1. AEMO and Powerlink to share the findings of this incident with the Power System Security Working Group (PSSWG) by Q2 2024. 2. AEMO supports Powerlink's plan to investigate how the induced voltage affected the protection wiring and recommends Powerlink shares the findings of its investigation for consideration. 3. AEMO supports Powerlink's consideration of options such as the installation of an Active Burden Module (ABM) on the 275/110 kV No. 1, No. 2 and No. 3 transformer Y protection relay inputs. 4. Based on the outcome of recommendation 3, AEMO will review whether the Middle Ridge 275/110 kV No. 2 and No. 3 transformers continue to be considered vulnerable to lightning.

Figure 1 Post-incident diagram

