AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Bayswater – Mt Piper 5A3 500 kV line Trip and Bayswater No. 4 Generator Trip on 10 August 2021

December 2021

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.

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

Abbreviations

Abbreviation	Term
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time
CT	Current Transformer
FOS	Frequency Operating Standard
Hz	Hertz
kV	Kilovolt
MW	Megawatts
NEM	National Electricity Market
NER	National Electricity Rules
REF	Restricted Earth Fault
TNSP	Transmission Network Service Provider

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 Transgrid[2], AGL[3] and from AEMO systems.

Table 1 Simultaneous trip of Bayswater – Mt Piper 5A3 500 kV line and Bayswater No. 4 (BW04) generator

	Details
Reviewable operating incident type	Non-credible contingency event impacting critical transmission elements.
Incident details	This report relates to a reviewable operating incident[4] that occurred on 10 August 2021 in New South Wales. The incident was a non-credible contingency event involving the trip and auto reclose of the Bayswater – Mt Piper 5A3 500 kilovolt (kV) and simultaneous trip of Bayswater Unit No. 4 (BW04).
Incident classification	Other causes – human error.
Generation impact	440 megawatts (MW) of generation was lost at 0306 hrs.
Customer load impact	No load was lost as a result of this incident.
Pre-incident conditions	Prior to this event, the Bayswater – Mt Piper 500 kV circuit was in service. At Bayswater Power Station, a 23/11 kV auxiliary transformer associated with BW04 was out of service for maintenance. BW04 was in service and following dispatch targets (see Figure 1).
Incident key events	1. On 10 August 2021 at 0306 hrs: – Bayswater – Mt Piper 5A3 500 kV line tripped and auto-reclosed 17 seconds later. – BW04 generator tripped from 440 MW. 2. At 2030 hrs Transgrid confirmed 5A3 Line tripped due to a fault on the line.
Incident cause	Post-event, Transgrid confirmed that a fault had occurred on 5A3 line, approximately 89 km from Bayswater on the red phase. Terrain in the area of the fault is generally steep undulating terrain where no damage was found and no vegetation encroachment hazard was identified. The fault caused the trip and auto-reclose of the line. Simultaneously BW04 tripped unexpectedly due to operation of the unit's restricted earth fault protection.
Power system response (facilities and services)	A fault on the red phase of line 5A3 caused protection no. 1 and protection no. 2 on line 5A3 to operate, tripping the line. Line 5A3 successfully auto-reclosed 17 seconds later. Transgrid has completed an aerial inspection of this circuit but has been unable to identify the cause of the fault. In addition, Transgrid's inspection did not identify any damage on the circuit. Simultaneously BW04 unexpectedly tripped due to operation of its Restricted Earth Fault (REF) protection. Prior to this incident at BW04, one of its 23/11 kV auxiliary transformers was in the process of being reinstalled. During these works, a Current Transformer (CT) from the de-energised transformer was incorrectly connected to an active protection system.

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

[2] Transgrid is a Transmission Network Service Provider (TNSP) for New South Wales.

[3] AGL is the owner of the Bayswater Power Station

[4] See NER clause 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
	The incorrect connection resulted in a short between the B phase CT and the neutral phase CT at Bayswater. The 5A3 line fault caused a circulating current in the shorted CTs at BW04, causing the unit's REF protection to operate. This protection should not have operated for the external 5A3 line fault.
Rectification	Transgrid was unable to identify the cause of the 5A3 line fault, however this circuit's protection operated as per design to clear the fault. Bayswater Power Station personnel identified and resolved the cause of the BW04 trip on 10 August 2021. The bridge between the two shorted CTs was removed prior to BW04's return to service. AGL also confirmed that the generator will not trip for similar events in the future.
Power system security	The power system remained in a secure operating state throughout this incident and the Frequency Operating Standard (FOS[5]) was met for this incident. The minimum system frequency during this incident was approximately 49.83 hertz (Hz) at 3:06:55 and returned to above 49.85 Hz by 3:06:57 (see Figure 2).
Reclassification	AEMO assessed whether to reclassify this incident as a credible contingency event[6]. AEMO correctly did not reclassify this event as a credible contingency, as Bayswater Power Station identified the cause of the trip and rectified it before returning BW04 to service. The Bayswater team also advised that the unit will not trip for a similar type of fault.
Market information	For this incident, AEMO issued the following market notices (all market notices for this incident were issued in accordance with NER requirements): • AEMO issued Market Notice 89358 at 0322 hrs on 10 August 2021 – Advice of non-credible contingency event – New South Wales region. • AEMO issued Market Notice 89371 at 2043 hrs on 10 August 2021 – Update – Non-credible contingency event – New South Wales region.
Conclusions	AEMO has concluded that: 1. There was a fault on line 5A3 on the red phase which caused the trip and auto-reclose of the line. Transgrid has been unable to identify the cause of this fault. 2. The trip of BW04 was caused by incorrect earthing configuration of an auxiliary transformer. 3. The power system remained within a secure operating state throughout this incident and the FOS was met. 4. AEMO correctly identified there was no requirement to reclassify this incident as a credible contingency. The cause of the BW04 trip has been identified and rectified by removing the bridge between two shorted CTs.
Recommendations	AGL to review maintenance procedures to reduce the likelihood of similar events.

[5] The FOS can be accessed via https://www.aemc.gov.au/australias-energy-market/market-legislation/electricity-guidelines-and-standards/frequency-0.

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

Figure 1 BW04 active power trace

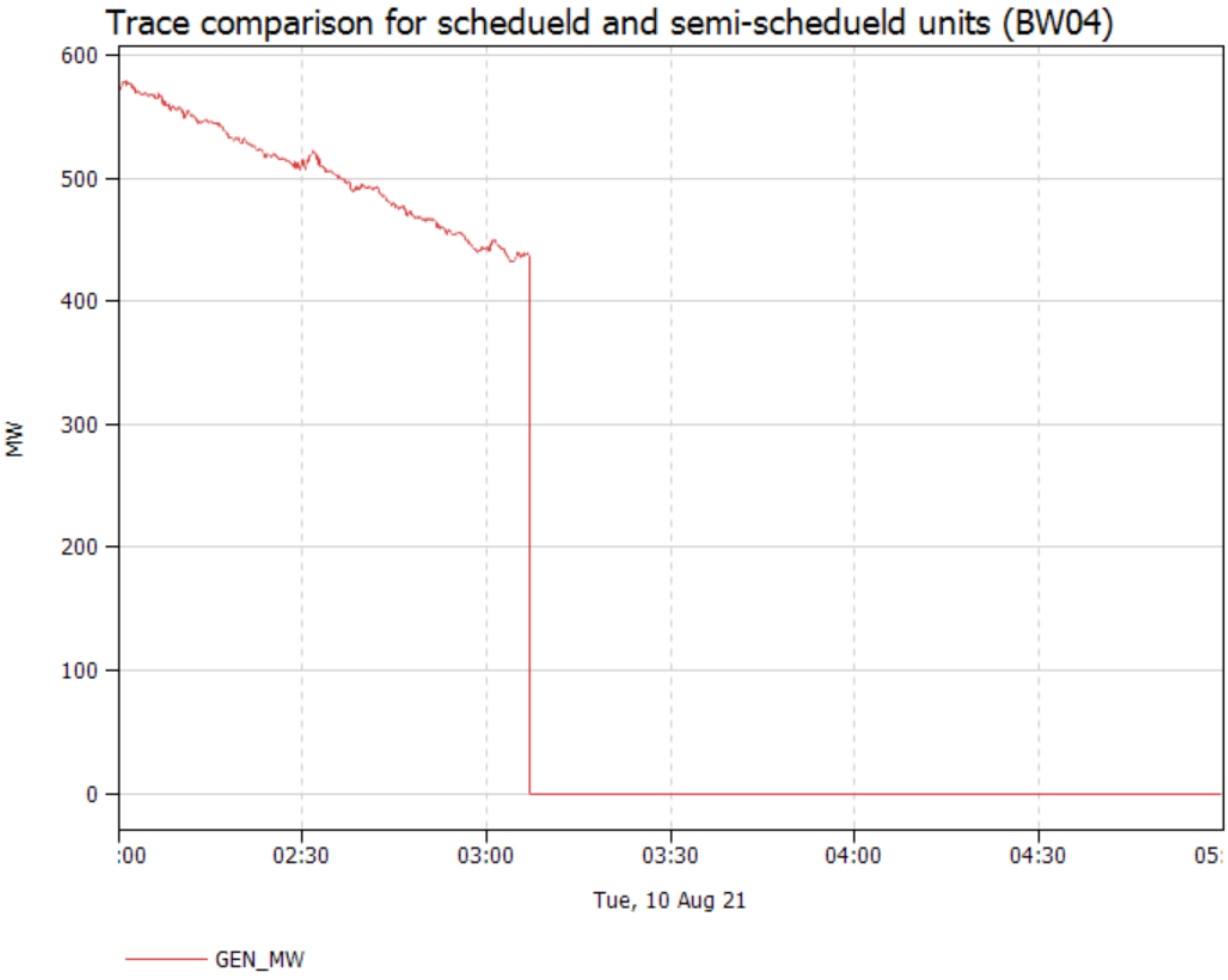

Figure 2 Mainland frequency performance