AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Trip of 5A3 and 5A5 lines and Mount Piper No. 1 generating unit on 21 December 2019

July 2020

Reviewable Operating Incident Report under the National Electricity Rules

INCIDENT CLASSIFICATIONS

Classification	Detail
Time and date of incident	1958 hrs on 21 December 2019
Region of incident	New South Wales
Affected regions	New South Wales
Event type	Environmental – bushfire and protection mal-operation
Generation Impact	218 MW generation was disconnected as a result of this incident
Customer Load Impact	No customer load was disconnected as a result of this incident
Associated reports	Nil

ABBREVIATIONS

Abbreviation	Term
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time
kV	Kilovolt
NER	National Electricity Rules
RFS	Rural Fire Service
TNSP	Transmission Network Service Provider

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

AEMO has made every reasonable effort 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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1. Overview

This report relates to a reviewable operating incident[1] that occurred on 21 December 2019 in New South Wales. The incident involved the trip of Mount Piper – Bayswater 5A3 500 kilovolt (kV) transmission line (5A3 line), Mount Piper – Wollar 5A5 500 kV transmission line (5A5 line) and No. 1 generating unit at Mount Piper (No. 1 generating unit).

There was 218 megawatts (MW) of generation lost as a result of this incident. No load was lost as a result of this incident.

As this was a reviewable operating incident, AEMO is required to assess the adequacy of the provision and response of facilities and services and the appropriateness of actions taken to restore or maintain power system security[2].

AEMO has concluded that:

1. Prior to the event, AEMO had reclassified the simultaneous trip of the 5A3 and 5A5 lines as a credible contingency due to bushfire activity in the area.
2. The trip of the 5A3 and 5A5 lines at 1958 hrs was due to a fault caused by bushfires, and all protection systems operated as designed and as expected to clear the fault.
3. At 1959 hrs, the No. 1 generating unit tripped from 218 MW due to incorrect undervoltage relay settings causing the generator transformer oil pumps to trip.
4. The trip of the 5A3 and 5A5 lines resulted in constraint N-X_BWMP_TWO being invoked from 2015 hrs. The constraint was revoked at 2030 hrs on the same day.
5. Prior to the return to service of the No. 1 generating unit at 1100 on 28 December 2019, AEMO was satisfied that the reason the unit had tripped had been identified and corrected and a reoccurrence of this incident was unlikely, therefore the incident was not reclassified as a credible contingency.
6. The power system remained in a secure operating state throughout this incident.

This report is prepared in accordance with clause 4.8.15(c) of the National Electricity Rules (NER). It is based on information provided by TransGrid[3], EnergyAustralia[4], and AEMO.

National Electricity Market (NEM) time (Australian Eastern Standard Time [AEST]) is used in this report. At the time of this incident, local time in New South Wales was AEST plus one hour.

2. The incident

2.1 Pre-incident conditions

On 21 December 2019, New South Wales was experiencing widespread bushfires and extreme hot weather conditions. Several fires were resulting in faults on the network and there was a known fire in the vicinity of

[1] 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.

[2] See NER clause 4.8.15(b).

[3] TransGrid is the Transmission Network Service Provider (TNSP) for New South Wales.

[4] EnergyAustralia is the operator of the Mount Piper Power Station.

the 5A3 and 5A5 lines north of Lithgow. The 5A3 and 5A5 lines are a double-circuit transmission line and are on either side of the same towers.

Prior to the incident, the following events had occurred:

- At 1631 hrs on 21 December 2019, the 5A5 line and Muswellbrook No. 1 330/132kV transformer tripped.
- The 5A5 line successfully auto reclosed 15 seconds later and the No. 1 transformer was placed on-load at 1947 hrs on the same day.
- At 1633, two minutes after the 5A5 line and Muswellbrook No. 1 transformer independently tripped, the 5A3 line tripped and successfully auto reclosed.
- From 1640 hrs on 21 December 2019, AEMO had reclassified the simultaneous trip of the 5A3 and the 5A5 lines as a credible contingency.
- After the reclassification of the simultaneous trip of the 5A3 and the 5A5 lines as a credible contingency, the 5A5 line tripped at 1747 hrs and successfully auto reclosed.

2.2 The incident

At 1958 hrs on 21 December 2019, the 5A5 line tripped and 15 seconds later auto-reclosed and tripped immediately.

At 1958 hrs, three seconds after the 5A5 line trip, the 5A3 line tripped and 15 seconds later also auto-reclosed and tripped immediately after doing so.

At 1959 hrs, approximately 60 seconds after the 5A5 initial trip, the No. 1 generating unit tripped from 218 MW. The event did not result in exceedance of the frequency operating standard, with a minimum recorded frequency of 49.8 Hz.

2.3 TransGrid and EnergyAustralia investigation

The following is based on information provided by TransGrid and EnergyAustralia.

2.3.1 Trip of 5A3 and 5A5 lines

Both faults on the 5A3 line were caused by a white to blue phase flashover. Distance to fault location indicated that the fault was at approximately 45 km from Mount Piper.

Both faults on the 5A5 line were caused by a red to white phase flashover. Distance to fault location indicated that the fault was at approximately 41 km from Mount Piper.

The fault locations for all faults occurred in an area that at the time was severely impacted by bushfires, and the primary cause of the faults on the 5A3 and 5A5 lines was linked to the bushfires. The faults were caused either by smoke or flame bridging the air gap on the transmission lines. The fire and/or smoke was still present 15 seconds later and the transmission lines tripped on reclosing. Protection systems operated as expected and as designed for all faults.

In accordance with its operating procedures, TransGrid is required to wait at least 15 minutes or to obtain verification from the Rural Fire Service (RFS) that the fire front has passed the easement before manually attempting to close the transmission lines. After the fires had subsided, both lines were successfully returned to service at 2023 hrs.

Aerial patrols were also subsequently carried out to survey the 5A3 and 5A5 lines. This was completed during the last week of February 2020, and TransGrid advised that no obvious signs of damage were observed.

2.3.2 Trip of Mount Piper Power Station No. 1 Generating unit

The trip of the No. 1 generating unit was not an expected outcome for the faults on the 5A3 and 5A5 lines. Generating units are normally expected to ride through transmission faults in accordance with registered performance standards. EnergyAustralia advised that the generating unit tripped due to loss of the generating unit transformer cooling pumps. The cooling pumps tripped in response to the voltage disturbance caused by the faults on the 5A3 and 5A5 lines. Investigation by EnergyAustralia determined that the cooling pumps tripped due to an incorrect setting on the cooling pump undervoltage relays.

The No. 2 generating unit at Mount Piper Power Station (No. 2 generating unit) was in service at the time of this event and did not trip in response to the line faults. Investigations showed that the undervoltage trip settings on the transformer cooling pumps on the No. 2 generating unit had been set correctly. EnergyAustralia advised that it has now applied the same settings to the No. 1 generating unit. The undervoltage relays were then tested and proven to be operating correctly.

The No. 1 generating unit returned to service at 1100 hrs on 28 December 2019.

In response to trip of the No. 1 generating unit, EnergyAustralia submitted a non-compliance notice to AEMO[5] on 29 January 2020. EnergyAustralia advised AEMO that the undervoltage relay settings were corrected, and non-compliance resolved on 21 December 2019.

3. Power system security

AEMO is responsible for power system security in the NEM. This means AEMO is required to operate the power system in a secure operating state to the extent practicable and take all reasonable actions to return the power system to a secure state following a contingency event in accordance with the NER[6].

The power system was in a secure operating state throughout this incident. No action was required by AEMO to restore or maintain power system security.

3.1 Reclassification

Prior to the return to service of the No. 1 generating unit AEMO assessed whether or not to reclassify the simultaneous trip of either the 5A3 or 5A5 lines and the No. 1 generating unit as a credible contingency event[7].

EnergyAustralia advised AEMO that the cause of the trip of the No. 1 generating unit had been identified and rectified and the incident was unlikely to recur. Based on this advice, AEMO determined the incident was unlikely to reoccur and therefore correctly determined that reclassification as a credible contingency event was not required.

The reclassification of the simultaneous loss of both the 5A3 and 5A5 lines as a credible contingency that was in place prior to this event was cancelled at 1235 hrs on 7 January 2020, as there was no longer any bushfire activity in the vicinity of the lines.

[5] In accordance with NER clause 4.15(f)

[6] Refer to AEMO's functions in section 49 of the National Electricity Law and the power system security principles in clause 4.2.6 of the NER.

[7] 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).

4. Market information

AEMO is required by the NER and operating procedures to inform the market about incidents as they progress. This section assesses how AEMO informed the market[8] over the course of this incident.

For this incident, AEMO informed the market on the following matters:

1. A non-credible contingency event – notify within two hours of the event[9].
   - AEMO issued Market Notice 71999 at 2017 hrs on 21 December 2019, 19 minutes after the event, to advise of the non-credible contingency event. The trip of the 5A3 and 5A5 lines resulted in constraint N-X_BWMP_TWO being invoked from 2015 hrs as both lines were out of service. The constraint was revoked at 2030 hrs on the same day.
2. Reclassification, details, and cancellation of a non-credible contingency – notify as soon as practical[10].
   - AEMO had issued Market Notice 71991 at 1653 hrs on 21 December 2019 before the incident to advise that the simultaneous trip of the 5A3 and 5A5 lines had been reclassified as a credible contingency.
   - AEMO issued Market Notice 72093 at 1339 hrs on 27 December 2019 to advise that the cause of this non-credible contingency event has been identified and would not reclassify the simultaneous loss of 5A3 and 5A5 lines together with the No. 1 generating unit as a credible contingency event.
   - AEMO issued Market Notice 72394 at 1314 hrs on 7 January 2020 to advise that the reclassification of the simultaneous trip of the 5A3 and 5A5 lines had been cancelled, because a reoccurrence of the incident is no longer reasonably likely.

5. Conclusions

AEMO has assessed this incident in accordance with clause 4.8.15(b) of the NER. In particular, AEMO has assessed the adequacy of the provision and response of facilities or services, and the appropriateness of actions taken to restore or maintain power system security. AEMO has concluded that:

1. Prior to the event, AEMO had reclassified the simultaneous trip of the 5A3 and 5A5 lines as a credible contingency due to bushfire activity in the area.
2. The trip of the 5A3 and 5A5 lines at 1958 hrs was due to a fault caused by bushfires, and all protection systems operated as designed and as expected to clear the fault.
3. At 1959 hrs, the No. 1 generating unit tripped from 218 MW due to incorrect undervoltage relay settings causing the generator transformer oil pumps to trip.
4. The trip of the 5A3 and 5A5 lines resulted in constraint N-X_BWMP_TWO being invoked from 2015 hrs. The constraint was revoked at 2030 hrs on the same day.

[8] AEMO generally informs the market about operating incidents as the progress by issuing Market Notices – see https://www.aemo.com.au/Market-Notices.

[9] AEMO is required to notify the Market of a non-credible contingency event within two hours of the event – AEMO, Power System Security Guidelines, Section 10.3, available at https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3715---Power-System-Security-Guidelines.pdf..

[10] AEMO is required to notify the market of a reclassification – NER clause 4.2.3(g), details of the reclassification – 4.2.3(c), and when AEMO cancels the reclassification – 4.2.3(h).

5. Prior to the return to service of the No. 1 generating unit at 1100 on 28 December 2019, AEMO was satisfied that the reason the unit had tripped had been identified and corrected and a reoccurrence of this incident was unlikely, therefore the incident was not reclassified as a credible contingency.
6. The power system remained in a secure operating state throughout this incident.