
Trip of Eildon – Mount Beauty
No. 1 and No. 2 220 kV lines,
10 January 2020

November 2020

Reviewable Operating Incident Report under the
National Electricity Rules

INCIDENT CLASSIFICATIONS

Classification	Detail
Time and date of Incident	1526 hours on 10 January 2020
Region of incident	Victoria
Affected regions	Victoria
Event type	Environmental (Bushfire, Other)
Generation impact	No 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
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time
BATS	Ballarat Terminal Substation
BETS	Bendigo Terminal Substation
CB	Circuit Breaker
DDTS	Dederang Terminal Substation
EPS	Eildon Power Station
GNTS	Glenrowan Terminal Substation
HOTS	Horsham Terminal Substation
kV	Kilovolt
MBTS	Mount Beauty Terminal Substation
NEM	National Electricity Market
NER	National Electricity Rules
PSSWG	Power System Security Working Group
SHTS	Shepparton Terminal Substation
SMTS	South Morang Terminal Substation
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 incident¹ that occurred on 10 January 2020 in Victoria. The incident involved the trip of both Eildon Power Station (EPS) to Mount Beauty Terminal Station (MBTS) No. 1 and No. 2 220 kV lines.

Prior to the event, AEMO had reclassified loss of Dederang Terminal Substation (DDTS) to South Morang Terminal Substation (SMTS) 330 kV lines as a credible contingency event due to bushfires, resulting in an unusual scenario where Victoria and New South Wales would have been interconnected via Bendigo and Red Cliffs 220 kV circuits only should a contingency on the SMTS-DDTS lines actually have occurred.

No generation or customer load was disconnected as a result of this incident.

As this is 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 security².

AEMO has concluded that:

1. The EPS-MBTS 220 kV lines tripped, auto reclosed, and tripped again to lockout.
2. No physical damage was identified. Adverse weather conditions associated with bushfires are the most likely cause of the repeated trip events.
3. AEMO correctly reclassified the trip of both lines as a credible contingency event.
4. AEMO determined the power system was not in a secure operating state for 1 hour 42 minutes.
5. Power system issues could have been resolved earlier by deliberately separating the Victorian and New South Wales regions.

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 AusNet Services³ and AEMO.

National Electricity Market (NEM) time (Australian Eastern Standard Time [AEST]) is used in this report. Local time in Victoria at the time of this incident was AEST plus one hour.

¹ See NER clause 4.8.15(a)(1)(i), as the event relates to a non-credible contingency event; and the Australian Energy Market Commission (AEMC) Reliability Panel Guidelines for Identifying Reviewable Operating Incidents.

² See NER clause 4.8.15(b).

³ AusNet Services is the Transmission Network Service Provider (TNSP) for Victoria. AusNet Services disclaimer – *AusNet Services is the Transmission Network Service Provider in the Victoria region. Information provided by AusNet Services has been provided on a without prejudice basis and nothing in this report is intended to constitute, or may be taken by any person as constituting, an admission of fault, liability, wrongdoing, negligence, bad faith or the like on behalf of AusNet Services (or its respective associated companies, businesses, partners, directors, officers or employees).*

2. The incident

2.1 Pre-incident conditions

Immediately prior to this incident, all major transmission network elements such as busbars and transmission lines were in service, however the loss of both Dederang Terminal Substation (DDTS)-South Morang Terminal Substation (SMTS) 330 kV lines was classified as a credible contingency event due to bushfires, in accordance with AEMO's Power System Security Guidelines⁴.

2.2 The incident

At 1526 hours on 10 January 2020, the EPS-MBTS No. 1 and No. 2 220 kV lines tripped simultaneously. Both lines auto-reclosed, then immediately tripped again and remained out of service.

The EPS-MBTS No. 1 220 kV line was restored to service at 1628 hours on 11 January 2020. The EPS-MBTS No. 2 220 kV line was restored to service at 1630 hours on 11 January 2020.

2.3 Analysis

The following is based on information provided by AusNet Services.

At 1526 hours on 10 January 2020, both EPS No. 1 and EPS No. 2 lines tripped on phase-to-phase faults.

EPS No. 2 220 kV line tripped to lockout within several seconds due to a persistent fault.

EPS No. 1 220 kV line tripped and auto-reclosed several times before ultimately tripping to lockout at 1530 hours.

A sequence of events for both lines is provided in Table 1 of Appendix A1.

Information retrieved from the protection relays indicated fault locations between 41 km and 49 km from MBTS. Based on these protection targets, AusNet Services conducted a helicopter line patrol of the relevant section of the lines and the surrounding area affected by bushfires. No defects were found, with the likely cause of the faults attributed to strong winds and smoke caused by nearby bushfires.

The EPS No. 1 and No. 2 220 kV lines were returned to service by AusNet Services on 11 January 2020 at 1628 hrs and 1630 hours respectively.

⁴ 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?la=en.

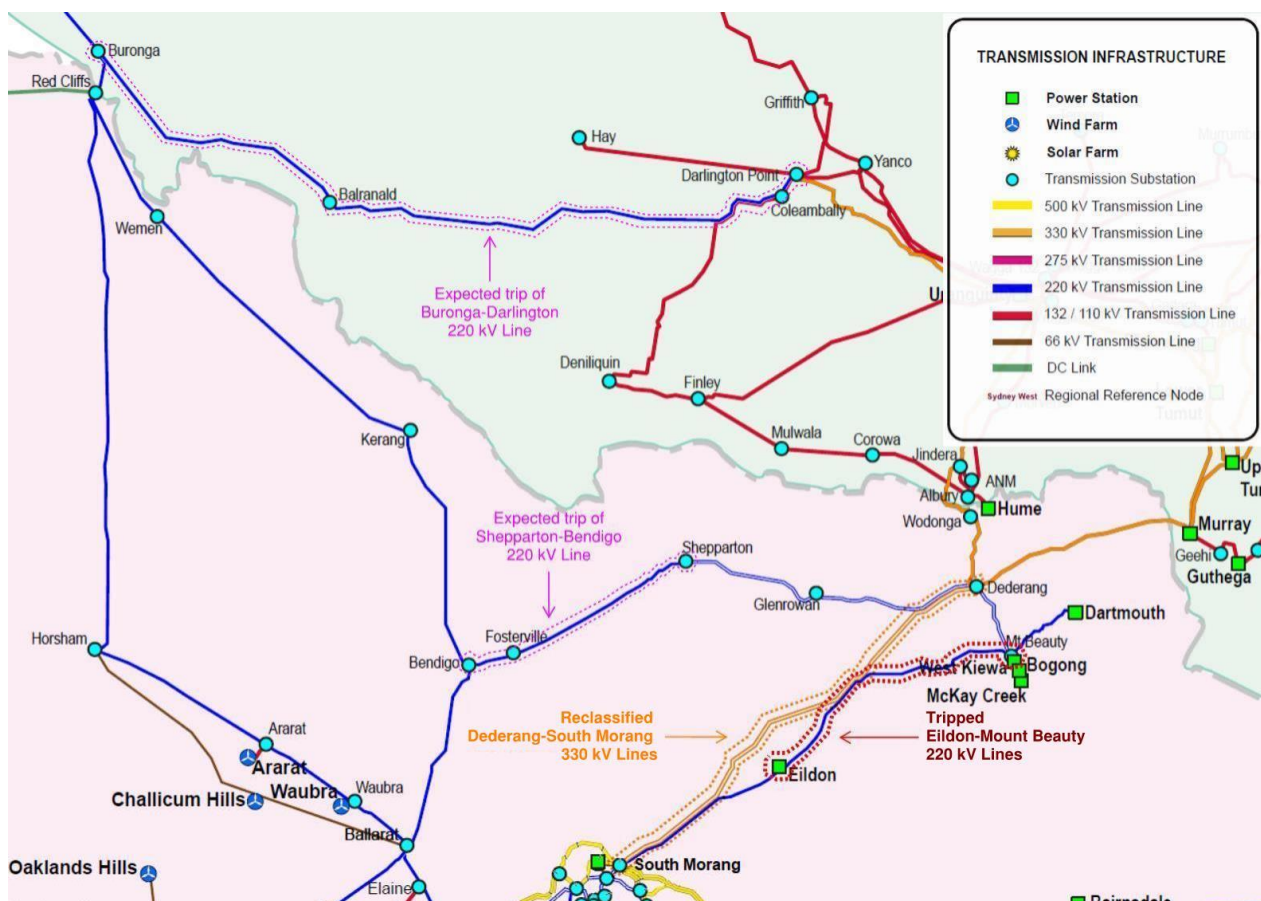
3. Power system security

AEMO is responsible for power system security in the NEM. This means AEMO is required to use reasonable endeavours to operate the power system in a secure operating state to the extent practicable, and take all reasonable actions to adjust operating conditions with a view to returning the power system to a secure state following a contingency event in accordance with the NER⁵.

3.1 Initial assessment

On 8 January 2020, prior to this non-credible contingency, the loss of both DDTS-SMTS 330 kV lines had been classified as a credible contingency event due to bushfires in the area, as highlighted in orange in Figure 1. No reclassification was in place for the EPS-MBTS 220 kV lines. The power system was in a secure operating state prior to this incident.

Figure 1 Geographic map illustrating the reclassified lines, faulted lines and expected line trips following credible trip



⁵ This is a summary only. Refer to AEMO’s functions in section 49 of the National Electricity Law and responsibilities under clause 4.3 of the NER and the power system security principles in clause 4.2.6 of the NER.

Following the incident, the power system was identified as not in a secure operating state for a duration of 1 hour and 42 minutes, with the reclassified DDTS-SMTS contingency flagged⁶ as either violated or unsolved from 1531 hours to 1713 hours on 10 January 2020.

At the time, AEMO concluded that loss of both DDTS-SMTS 330 kV lines would result in thermal overloading of the Ballarat Terminal Substation (BATS)-Bendigo Terminal Substation (BETS) 220 kV line, and low post-contingency voltages in the BETS to DDTS 220 kV network.

Constraint automation was used to manage the reported violations. The first constraints were applied to adjust interconnector power flows between Tasmania, Victoria, South Australia and New South Wales at 1540 hrs. Additional constraint sets applied at 1645 hrs and 1700 hrs further adjusted interconnector power flows between Victoria, South Australia and New South Wales. This ultimately resulted in correctly weighted changes to the applicable interconnectors across the south-east of Australia to relieve the violation.

Additional actions taken by AEMO to resolve the underlying security issues included placing capacitor banks in service at BATS, BETS, Horsham Terminal Substation (HOTS), Shepparton Terminal Substation (SHTS), and Glenrowan Terminal Substation (GNTS).

3.2 Post-incident review

Following the incident, AEMO determined that in practice, the thermal constraint violations would likely have been pre-empted by separation of the Victorian and New South Wales regions.

AEMO modelling of a credible double circuit trip of DDTS-SMTS 330 kV lines showed a voltage collapse could have occurred, indicative of a momentary load imbalance and corresponding voltage angle shift across the remaining in-service lines. In these circumstances, it could be expected that distance protection would result in tripping of the Shepparton-Bendigo and Buronga-Darlington Point 220 kV lines, as highlighted in magenta in Figure 1. This would have effectively separated the Victoria and New South Wales regions, and modelling of protection actions showed the network should have returned to a secure operating state with no damage to equipment or significant customer impact.

AEMO reviews have identified that the deliberate operator-initiated separation of the networks would have resolved the identified power system issues more promptly. Training has since been delivered to the AEMO Operations team to prepare for possible similar future incidents.

AEMO is also working with the Power System Security Working Group (PSSWG) to review how cascade trip events such as this are classified with respect to power system security.

3.3 Reclassification

AEMO assessed whether to reclassify these incidents as a credible contingency event⁷.

After the lines were restored to service at 1630 hours on 11 January 2020, AusNet Services confirmed that the bushfire that caused the non-credible contingency remained a probable threat to the transmission lines.

Based on this advice, AEMO determined the simultaneous trip of the EPS-MBTS No. 1 and No. 2 220 kV circuits to be reasonably possible, and correctly reclassified the trip of both lines as a credible contingency event at 1640 hours on 11 January 2020. No constraint set was invoked as part of this reclassification.

This reclassification was cancelled at 2305 hours on 14 January 2020, after the bushfire threat was deemed to no longer present a probable threat to the transmission lines.

⁶ In AEMO's Contingency Analysis (CA) tool.

⁷ AEMO is required to assess whether 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 market⁸ 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 event⁹.
 - AEMO issued Market Notice 72443 at 1601 hours on 10 January 2020, 35 minutes after the event, to advise of the non-credible contingency event.
2. Reclassification, details, and cancellation of a non-credible contingency – notify as soon as practical¹⁰.
 - 2.1. EPS-MBTS 220 kV lines:
 - AEMO issued Market Notice 72445 at 1602 hours on 10 January 2020 to advise that AEMO had invoked constraint sets V-DBUSS_L and V-X_EPMB_R at 1526 hours on 10 January 2020 until further notice.
 - AEMO issued Market Notice 72450 at 1649 hours on 10 January 2020 to advise that AEMO had invoked constraint sets CA_BRIS_4D2AA9D0 from 1645 hours until 1500 hours on 11 January 2020.
 - AEMO issued Market Notice 72451 at 1711 hours on 10 January 2020 to advise that AEMO had invoked constraint set CA_BRIS_4D2AA9D0 from 1645 hours until 1700 hours on 10 January 2020 and CA_BRIS_4D2AAD32 from 1700 hours until 1500 hours on 11 January 2020.
 - AEMO issued Market Notice 72484 at 1640 hours on 11 January 2020 to advise that AEMO had reclassified the simultaneous trip of EPS-MBTS No. 1 220 kV and EPS-MBTS No. 2 220 kV lines as a credible contingency until further notice.
 - AEMO issued Market Notice 72538 at 2302 hours on 14 January 2020 to advise that AEMO had cancelled the reclassification.
 - 2.2. DDTS-SMTS 330 kV lines:
 - AEMO issued Market Notice 72418 at 2020 hours on 8 January 2020 to advise that AEMO had invoked constraint sets V-DDSM at 2200 hours on 8 January 2020 until further notice.
 - AEMO issued Market Notice 72537 at 2301 hours on 14 January 2020 to advise that AEMO had cancelled the reclassification.

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 7.3.

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

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. The EPS-MBTS 220 kV lines tripped, auto reclosed and tripped again to lockout.
2. No physical damage was identified. Adverse weather conditions associated with bushfires are the most likely cause of the repeated trip events.
3. AEMO correctly reclassified the trip of both lines as a credible contingency event.
4. AEMO determined the power system was not in a secure operating state for 1 hour 42 minutes.
5. Power system issues could have been resolved earlier by deliberately separating the Victorian and New South Wales regions.

A1. Sequence of events

Table 1 Sequence of events, 10 January 2020

Time	Line, Fault Type ¹¹	MBTS circuit break (CB) Status	EPS CB Status
15h26m01s	EPS No2, W-B phase fault	CB tripped. Reclose attempt after 3s, fault still persisting, tripped to lock out.	CB tripped. No reclose as line voltage unavailable for sync check after reclose time (4s).
	EPS No1, R-W phase fault	CB tripped. Reclose successful after 3s.	CB tripped. Reclose successful after 4s.
+0m09s	EPS No1, R-E fault to unbalanced RWB-E fault	CB tripped. Reclose successful after 3s.	CB tripped. Reclose successful 4s, tripped and auto-reclosing locked out after fault within reclaim time (30s). Manually closed by Transmission Operations Centre at +0m37s.
+1m19s	EPS No1, R-W phase fault	CB tripped. Reclose successful after 3s.	CB tripped. Reclose successful after 4s.
+4m07s	EPS No1, R-W phase fault	CB tripped. Reclose attempt after 3s, fault still persisting, tripped to lock out.	CB tripped. No reclose as line voltage unavailable for sync check after reclose time (4s).

¹¹ All faults were detected by both X (7SA522 relay) and Y (SEL321) distance protections in Zone 1.