
Simultaneous trip of both potlines at the Alcoa Portland aluminium smelter on 9 October 2019

February 2020

Reviewable Operating Incident Report under the National
Electricity Rules

INCIDENT CLASSIFICATIONS

Classification	Detail
Time and date of incident	0634 hrs on 9 October 2019
Region of incident	Victoria
Affected regions	Victoria
Event type	Secondary systems mal-operation
Generation impact	No generation was disconnected as a result of this incident
Customer load impact	468 MW of industrial 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
HV	High voltage
kV	Kilovolt
NEM	National Electricity Market
NER	National Electricity Rules
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.

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1. Overview

This report relates to a reviewable operating incident¹ that occurred on 9 October 2019 in Victoria. The incident involved the simultaneous trip of both potlines at the Alcoa Portland (APD) aluminium smelter.

This incident resulted in the disconnection of 468 megawatts (MW) of industrial customer load.

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 potlines at APD tripped due to the unexpected operation of the under-frequency load shedding relays at APD during planned switching. A faulty auto-changeover relay has been replaced.
2. AEMO correctly reclassified the simultaneous loss of both potlines as a credible contingency.
3. The power system remained in a secure operating state.

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 Alcoa Portland³ (Alcoa) 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.

2. The incident

2.1 Pre-incident conditions

Immediately prior to this incident, all power system equipment supplying APD was in service. However, switching was in progress to isolate the 500/220 kilovolt (kV) A2 Transformer at APD for planned works.

2.2 The incident

At 0634 hrs on 9 October 2019, the 500/220kV A2 Transformer at APD was de-energised as part of planned work. Coincident with the de-energising of the A2 Transformer, the 220/33kV W1 and W5 Transformers at APD tripped, resulting in the loss of all potline load at APD (approximately 468 MW). Refer to Appendix A1 for a diagram of APD immediately after the incident.

The W1 and W5 transformers were returned to service at 0655 hrs and 0700 hrs respectively on 9 October 2019. AEMO gave permission to commence load restoration at 0645 hrs, with actual load restoration commencing at 0654 hrs on 9 October 2019.

The A2 Transformer was returned to service at 1435 hrs on 9 October 2019, after the completion of the planned works.

AEMO has not been advised of any damage to the potlines at APD as a result of this incident.

¹ See NER clause 4.8.15, 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 Alcoa Portland is the owner of the aluminium smelter.

2.3 Analysis

The following is based on information provided by Alcoa.

The W1 and W5 Transformers tripped due to the operation of the under-frequency (U/F) load shed relays at APD when the A2 Transformer was de-energised. This was not an expected outcome of the planned switching.

The U/F load shed relays source their frequency reference signal from capacitive voltage transformers (CVTs) located on the 220 kV side of the A2 and A3 Transformers. The frequency reference signal to the U/F relays is normally selected to the CVT on the A2 transformer. If the input from the CVTs is lost, the relay will interpret this as a low frequency event and the relay will operate.

When supply to the A2 Transformer is lost, there is an auto-changeover scheme in place to switch to the reference signal from the CVT on the A3 Transformer. In this instance, as this was planned switching, the U/F supply was switched manually from the A2 Transformer to the A3 Transformer prior to the high voltage switching. However, although the operator had correctly moved the changeover switch to the A3 Transformer position, the changeover relay failed to operate, meaning that the frequency reference signal to the U/F relays remained sourced from the A2 Transformer CVT. The operator was not aware of this, because there is no indication provided from the change-over relay. When the A2 Transformer and associated CVT was isolated, this resulted in the loss of the frequency reference signal to the U/F relays and subsequent operation of the U/F relays, tripping both potlines.

Subsequent testing of the auto-changeover scheme by Alcoa showed the scheme to be operating unreliably. On 10 October 2019, Alcoa isolated the U/F load shed scheme at APD to prevent a recurrence of the incident.

On 11 October 2019, Alcoa replaced the auto-changeover relay with a new relay of the same type. After the auto-changeover scheme was retested and proven to be operating correctly, the U/F load shed scheme was returned to service.

Alcoa has updated its procedures for annual testing of the U/F load shed scheme to include testing of the auto-changeover scheme.

Alcoa also plans to further update the existing electro-mechanical auto-changeover relay with a new digital relay. This relay will also include external indication as to whether it is switched to the A2 or A3 Transformer. A timeframe for this work has not yet been identified.

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 NER⁴.

The power system was in a secure operating state prior to this incident and remained in a secure operating state for the duration of the incident. No action was required by AEMO in relation to power system security.

3.1 Frequency response

As a result of the loss of 468 MW of load, the frequency in the mainland NEM rose to 50.22 Hertz (Hz) and recovered to below 50.15 Hz within three minutes. The frequency in Tasmania rose to 50.19 Hz and recovered to below 50.15 Hz within three minutes.

⁴ 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.

The frequency standard in both the mainland NEM and Tasmania was met for this incident.

3.2 Potential FCAS requirement

As a result of this incident, AEMO has identified a potential requirement for additional frequency control ancillary services (FCAS) to be enabled during outages of either the A2 or A3 Transformers at APD.

Although dependant on the exact switchgear configuration at the time, the trip of the A3 Transformer during an outage of the A2 Transformer may result in the loss of the frequency reference signal to the U/F relays⁵ at APD, resulting in the trip of both potlines. The same would apply for an outage of the A3 Transformer and subsequent loss of the A2 Transformer.

AEMO will review each Transformer outage request to determine if additional FCAS is required to be enabled.

3.3 Reclassification

AEMO assessed whether to reclassify this incident as a credible contingency event⁶.

When the A2 transformer was returned to service, APD informed AEMO that there were procedures in place to ensure the potlines would not trip for planned outages of the A2 or A3 transformer. However, these procedures would not be effective for an unplanned outage of the A2 or A3 transformer.

Based on this information, AEMO determined that the simultaneous loss of both potlines as a result of a single credible contingency was likely, and correctly reclassified the loss of either the A2 or A3 Transformer and both potlines at APD as a credible contingency event at 1454 hrs on 9 October 2019. Constraint set F-I_ML_0500⁷ was invoked as part of this reclassification.

This reclassification was cancelled at 0751 hrs on 10 October 2019, after Alcoa advised AEMO that the under-frequency load shed relays had been isolated and a further loss of both potlines for an outage of either the A2 or A3 Transformer was unlikely. Constraint set F-I_ML_0500 was also revoked at this time.

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 70458 at 0731 hrs on 9 October 2019, 57 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.

⁵ There is no input to the U/F relays from the A4 Transformer.

⁶ 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).

⁷ Out = nil. FCAS for a NEM load event of 500 MW.

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.

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).

- AEMO issued Market Notice 70475 at 1454 hrs on 9 October 2019 to advise that AEMO had reclassified the incident as a credible contingency until further notice.
- AEMO issued Market Notice 70476 at 0751 hrs on 10 October 2019 to advise that AEMO had cancelled the reclassification.

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 potlines at APD tripped due to the unexpected operation of the under-frequency load shedding relays at APD during planned switching. A faulty auto-changeover relay has been replaced.
2. AEMO correctly reclassified the simultaneous loss of both potlines as a credible contingency.
3. The power system remained in a secure operating state.

A1. System diagram

The diagram below is a simplified overview of the switchgear at APD immediately after the outage of the A2 Transformer.

