
Trip of the Farrell – John Butters
and Farrell – Roseberry – Newton –
Queenstown lines on 28 May and
21 August 2019

December 2019

Reviewable Operating Incident Report under the
National Electricity Rules

INCIDENT CLASSIFICATIONS

Classification	Detail
Time and date of incident	2113 hrs on 28 May 2019 and 0400 hrs on 21 August 2019
Region of incident	Tasmania
Affected regions	Tasmania
Event type	Lightning
Generation impact	135 MW of generation was disconnected as a result of the incident on 28 May 2019 25 MW of generation was disconnected as a result of the incident on 21 August 2019
Customer load impact	12 MW of customer load was disconnected as a result of the incident on 28 May 2019 7 MW of customer load was disconnected as a result of the incident on 21 August 2019
Associated reports	Nil

ABBREVIATIONS

Abbreviation	Term
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time
CB	Circuit Breaker
HV	High voltage
kV	Kilovolt
LAZ	Lightning attachment zone
LWZ	Lightning warning zone
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 two near-identical reviewable operating incidents¹ that occurred on 28 May 2019 and 21 August 2019 in Tasmania. The incidents involved the simultaneous trip of the Farrell – John Butters 220 kilovolt (kV) transmission line (FA-JB line) and the Farrell – Roseberry – Newton – Queenstown 110 kV transmission line (FA-RB-NT-QT line). Refer to Appendix A1 for a geographic overview of the area these transmission lines traverse.

These incidents resulted in the disconnection of 135 megawatts (MW) of generation and 12 MW of customer load on 28 May 2019, and 33 MW of generation and 7 MW of customer load on 21 August 2019.

As these were reviewable operating incidents, 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 trip of the FA-JB and FA-RB-NT-QT lines was likely caused by lightning on both occasions, however this could not be conclusively determined for the incident on 28 May 2019.
2. All protection operated correctly to clear the faults.
3. AEMO correctly reclassified the simultaneous trip of the FA-JB and FA-RB-NT-QT lines as a credible contingency after both incidents.
4. There is an increased probability of a three-phase fault occurring on the FA-RB-NT-QT line during periods of lightning activity. AEMO has amended its reclassification process accordingly.
5. The frequency standard in Tasmania was met for both incidents.
6. The power system remained in a secure operating state throughout both incidents.

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 TasNetworks³ and AEMO.

National Electricity Market (NEM) time (Australian Eastern Standard Time [AEST]) is used in this report.

2. The incident

2.1 28 May 2019

At 2113 hrs on 28 May 2019, the FA-JB line and the FA-RB-NT-QT line tripped simultaneously.

The trip of the FA-JB line resulted in the disconnection of the John Butters generating unit from 135 MW. The trip of the FA-RB-NT-QT line resulted in the loss of all customer load at Newton and Queenstown, totalling approximately 12 MW.

The FA-RB-NT-QT line successfully auto-redlosed within 11 seconds with all load restored by 2158 hrs on 28 May 2019. Auto-reclose is not installed on the FA-JB line, and the line was manually restored by

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 TasNetworks is a Transmission Network Service Provider (TNSP) in Tasmania.

TasNetworks at 2119 hrs on 28 May 2019. Generation was restored at John Butters by 2135 hrs on 28 May 2019.

2.2 21 August 2019

At 0400 hrs on 21 August 2019, the FA-JB line and the FA-RB-NT-QT line tripped simultaneously.

The trip of the FA-JB line resulted in the disconnection of the John Butters generating unit from 33 MW. The trip of the FA-RB-NT-QT line resulted in the loss of all customer load at Newton and Queenstown, totalling approximately 7 MW.

The FA-RB-NT-QT line successfully auto-redosed within 11 seconds with all load restored by 0432 hrs on 21 August 2019. Auto-reclose is not installed on the FA-JB line, and the line was manually restored by TasNetworks at 0408 hrs on 21 August 2019. Generation was restored at John Butters by 0420 hrs on 21 August 2019.

2.3 TasNetworks investigation

The following is based on information provided by TasNetworks.

2.3.1 28 May 2019

At 2113 hrs on 28 May 2019, the FA-JB line tripped due to a two-phase to earth fault. At the same time, the FA-RB-NT-QT line tripped due to a three-phase fault.

All protection operated correctly to isolate the faulted lines.

The FA-RB-NT-QT line successfully auto-redosed within 11 seconds of the fault. The FA-JB line does not have auto-reclose installed and was restored to service manually by TasNetworks operators at 2119 hrs on 28 May 2019.

Protection systems indicated the faults on both lines were approximately 33 km south of the Farrell substation in the region of Towers 84 and 85. In this area, the FA-JB and FA-RB-NT-QT lines share common towers⁴ located in mountainous terrain approximately 460 metres above sea level. The lines are protected by an overhead earth wire in this area.

A ground patrol of the lines in the predicted fault area was conducted, with no evidence of a fault found.

A study undertaken by Entura⁵ in March-June 2016 found that transmission towers in this area are known to have poor (high) footing resistance, and as a result are at greater risk of experiencing back flashover⁶ resulting from lightning strikes.

Towers 82 and 83⁷, close to the predicted fault location, have historically experienced a high volume of lightning strike outages, and have recently undergone tower footing resistance works to improve the performance of the transmission line. Tower 84 has a relatively high footing resistance of 58 ohms, making it susceptible to back flashover, however, this tower does not have a history of incidents. Tower 85 has a much lower footing resistance of 12 ohms, making it less susceptible.

Although there was storm activity in the area at the time of the fault, there was no indication of lightning. Lightning was recorded in Bass Strait at the time of this incident, and it is suspected there was an isolated lightning strike in the area resulting in the fault, however this cannot be conclusively determined.

⁴ Tower 18 through Tower 103.

⁵ Power system consultants.

⁶ Back flashovers generally occur in transmission lines during lightning strikes when the potential of the tower rises in relation to the conductor. This causes the voltage across the insulators to increase beyond the withstand limits, resulting in a flashover. Lightning strikes can discharge thousands of amperes of current in very short time. This high current needs to be discharged quickly into the earth to prevent the potential of the tower from rising. Back flashover occurs when the lightning which has struck the tower is unable to discharge to the earth. This can occur when transmission towers have a high footing resistance.

⁷ Located approximately 620 metres above sea level.

2.3.2 21 August 2019

At 0400 hrs on 21 August 2019, the FA-JB line tripped due to a two-phase to earth fault. At the same time, the FA-RB-NT-QT line tripped due to a two-phase to earth fault.

All protection operated correctly to isolate the faulted lines.

The FA-RB-NT-QT line successfully auto-reclosed within 11 seconds of the fault. The FA-JB line does not have auto-reclose installed and was restored to service manually by TasNetworks operators at 0408 hrs on 21 August 2019.

At approximately 0400 hrs on 21 August 2019, a lightning strike was recorded approximately one kilometre from Tower 72 on the FA-RB-NT-QT line. This tower is 27 kilometres from Farrell substation, and in this area, the FA-JB and FA-RB-NT-QT lines share common towers. TasNetworks has confirmed that lightning was the cause of this incident.

Although there was severe weather in the area of these transmission lines at the time of the fault, no lightning strikes had been recorded in the Lightning Warning Zone (LWZ) or the Lightning Attachment Zone⁸ (LAZ) prior to the faults occurring.

Immediately after the incident, AEMO reclassified the simultaneous loss of the FA-JB and FA-RB-NT-QT lines as a credible contingency event (refer to Section 3.2 for details). While this reclassification was in place, a further simultaneous trip of the FA-JB and FA-RB-NT-QT lines occurred at 0527 hrs on 21 August 2019. The cause and outcomes of this event were similar to those of the event that occurred at 0400 hrs.

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 NER⁹.

The power system was in a secure operating state prior to these incidents and remained in a secure operating state for the duration of the incidents. AEMO was not required to take any actions in relation to power system security for these incidents.

3.1 Frequency response

As a result of the loss of generation at John Butters on 28 May 2019, the frequency in Tasmania fell to a minimum of 49.32 hertz (Hz) and recovered to above 49.85 Hz within 48 seconds.

The frequency standard in Tasmania was met for this incident.

The loss of generation at John Butters on 21 August 2019 had no discernible impact on the frequency in Tasmania.

3.2 Reclassification

AEMO assessed whether to reclassify these incidents as a credible contingency event¹⁰.

⁸ Refer to the Power System Security Guidelines (SO_OP3715) section 8 for details of the Lightning Detection Zones.

⁹ 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.

¹⁰ 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).

Although the FA-JB and FA-RB-NT-QT lines are considered as vulnerable to lightning¹¹, AEMO was not required to reclassify the simultaneous loss of both lines as a credible contingency event prior to either of these incidents, because there was no lightning reported in the LWZ or the LAZ.

Immediately after the incident on 28 May 2019, TasNetworks could not confirm the cause of the incident. Consequently, AEMO reclassified the simultaneous loss of the FA-JB and FA-RB-NT-QT lines as a credible contingency event from 2123 hrs on 28 May 2019. No constraint sets were required to be invoked as a result of this reclassification.

The reclassification was cancelled at 1704 hrs on 29 May 2019, after TasNetworks advised the likely cause was lightning and there was no longer any lightning activity in the area.

Immediately after the incident on 21 August 2019, and on the basis that lightning was now being recorded within the LAZ, AEMO reclassified the simultaneous loss of the FA-JB and FA-RB-NT-QT lines as a credible contingency event from 0405 hrs on 21 August 2019. No constraint sets were required to be invoked as a result of this reclassification.

This reclassification was cancelled at 0509 hrs after no lightning strikes had been recorded in the LAW or LAZ for 30 minutes. However, shortly after the reclassification was cancelled, further lightning strikes occurred in the LAZ, resulting in AEMO reinstating the reclassification at 0513 hrs on 21 August 2019.

The reclassification was cancelled at 0814 hrs on 31 August 2019, as there was no longer any lightning activity in the area.

Subsequent to these incidents, TasNetworks advised AEMO that there is an increased probability of a three-phase fault occurring on the FA-RB-NT-QT line during periods of lightning activity, due to the high tower footing resistance in some locations. Accordingly AEMO will reclassify a three-phase fault on the FA-RB-NT-QT line as a credible contingency¹² during periods of lightning activity as determined in accordance with its Power System Security Guidelines¹¹. TasNetworks has also advised AEMO that no additional or revised constraint sets will be required as a result of this reclassification.

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 market¹³ over the course of this incident.

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

4.1 28 May 2019

1. A non-credible contingency event – notify within two hours of the event¹⁴.
 - AEMO issued Market Notice 68500 at 2208 hrs on 28 May 2019, 55 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 practical¹⁵.

¹¹ Refer to AEMO's Power System Security Guidelines (SO_OP_37150) section 8.4, available at [SO_OP3715 Power System Security Guidelines](#).

¹² Under clause 4.3.3(e) of the NER a three-phase fault is normally considered as a non-credible contingency.

¹³ AEMO generally informs the market about operating incidents as they progress by issuing Market Notices – see <https://www.aemo.com.au/Market-Notices>.

¹⁴ 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.

¹⁵ 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 68499 at 2123 hrs on 28 May 2019 to advise that AEMO had reclassified the incident as a credible contingency.
- AEMO issued Market Notice 68545 at 1704 hrs on 29 May 2019 to advise that AEMO had cancelled the reclassification.

4.2 21 August 2019

1. A non-credible contingency event – notify within two hours of the event¹⁶.
 - AEMO issued Market Notice 69332 at 0541 hrs on 21 August 2019, 101 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 practical¹⁷.
 - AEMO issued Market Notice 69325 at 0405 hrs on 21 August 2019 to advise that AEMO had reclassified the incident as a credible contingency.
 - AEMO issued Market Notice 69329 at 0509 hrs on 21 August 2019 to advise that AEMO had cancelled the reclassification.
 - AEMO issued Market Notice 69331 at 0513hrs on 21 August 2019 to advise that AEMO had reclassified the incident as a credible contingency.
 - AEMO issued Market Notice 69337 at 0814 hrs on 21 August 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 trip of the FA-JB and FA-RB-NT-QT lines was likely caused by lightning on both occasions, however this could not be conclusively determined for the incident on 28 May 2019.
2. All protection operated correctly to clear the faults.
3. AEMO correctly reclassified the simultaneous trip of the FA-JB and FA-RB-NT-QT lines as a credible contingency after both incidents.
4. There is an increased probability of a three-phase fault occurring on the FA-RB-NT-QT line during periods of lightning activity. AEMO has amended its reclassification process accordingly.
5. The frequency standard in Tasmania was met for both incidents.
6. The power system remained in a secure operating state throughout both incidents.

¹⁶ 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.

¹⁷ 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).

A1. Geographic overview

The diagram below shows the geographic relationship between the FA-JB line (in blue) and the FA-RB-NT-QT line (in red).

