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# Trip of Ross – Chalumbin 857 and 858 feeders on 25 January 2020

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**September 2020**

Reviewable Operating Incident Report under the  
National Electricity Rules

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## INCIDENT CLASSIFICATIONS

<b>Classification</b>	<b>Detail</b>
Time and date of Incident	00:19:58 hrs on 25 January 2020
Region of incident	Queensland
Affected regions	Queensland
Event type	Lightning
Generation impact	5 MW of generation was disconnected as a result of this incident
Customer load impact	228 MW of customer load was disconnected as a result of this incident
Associated reports	Nil

## ABBREVIATIONS

<b>Abbreviation</b>	<b>Term</b>
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time
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.

## **DISCLAIMER**

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# 1. Overview

This report relates to a reviewable operating incident<sup>1</sup> that occurred on 25 January 2020 in Queensland. The incident involved the simultaneous trip of Ross – Chalumbin 275 kilovolt (kV) feeders 857 and 858 (feeder 857 and feeder 858). This resulted in consequential trip of Tully – Woree 7301 132 kV feeder (feeder 7301), Innisfail – Edmonton 7139 132 kV feeder (feeder 7139) also between Tully and Woree, and subsequent islanding of northern Queensland. The incident triggered operation of the Mt Emerald runback scheme and also resulted in disconnection of Units 1-4 at Kareeya Power Station.

There was 5 MW of actual generation, along with 228 MW of customer load, disconnected 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<sup>2</sup>.

AEMO has concluded that:

1. Ross – Chalumbin 275 kV lines 857 and 858 tripped due to a high magnitude lightning strike; both lines successfully auto reclosed 5 seconds later.
2. Feeders 7301 and 7139 tripped due to the encroachment of load impedance into the tripping zones of the protection relays; 7301 and 7139 feeders successfully auto reclosed after 5 and 10 seconds respectively (as per design).
3. Walkamin – Mount Emerald Wind Farm 275 kV feeder 8903 tripped due to successful operation of the Mount Emerald Wind Farm generator runback scheme; connection was restored approximately 2 hours after the event.
4. Generating Units 1, 2, 3 and 4 were online at Kareeya Power Station and tripped on voltage controlled overcurrent protection as the load in the resulting network island exceeded the combined generator output. All units were resynchronised approximately 2 hrs after the event.
5. All protection systems operated correctly for this event.
6. 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 Powerlink and AEMO.

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

## 2. The incident

### 2.1 Pre-incident

Generating units at Barron Gorge were offline at the time of the incident. The Mount Emerald Wind Farm units was online but was generating zero MW at the time of the incident. All units at Kareeya substation were

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<sup>1</sup> See NER clause 4.8.15(a)(1)(i), as the event relates to a non-credible contingency event; and the AEMC Reliability Panel Guide feeders for Identifying Reviewable Operating Incidents.

<sup>2</sup> See NER clause 4.8.15(b).

synchronised with Unit 1 generating 5 MW and remaining units generating zero MW. All other major transmission elements such as busbars and transmission lines were in service.

## 2.2 The incident

At around 00:20 hrs on 25 January 2020, Ross – Chalumbin 857 and 858 275 kV feeders, Tully – Woree 7301 and Innisfail – Edmonton 7139 132 kV feeders, and Walkamin – Mount Emerald Wind Farm 8903 275 kV feeder tripped. There was lightning in the area reported by Powerlink. As a result of the trip of these circuits, a part of FNQ was effectively islanded.

At the time of the incident, generating units 1, 2, 3 and 4 were online at Kareeya Power Station. All units tripped on voltage controlled overcurrent protection.

As a result of separation and loss of generation, supply to 228 MW of Far North Queensland (FNQ) load was momentarily interrupted.

Feeders 857, 858, 7301, 7139 successfully auto reclosed to return to service and to restore the supply to load. All Kareeya units and feeder 8903 returned to service approximately 2 hrs after the event.

The sequence of events is summarised in Table 1 of Appendix A1.

## 2.3 Analysis

The following is based on information provided by Powerlink.

At 00:19:58 hrs on 25 January 2020, Ross – Chalumbin 857 and 858 275 kV feeders tripped and successfully auto reclosed due to operation of feeder protection systems. High voltage B and C phase to ground faults occurred on conductors of both 857 and 858 feeders during a period of electrical storm activity near the feeders. The fault location systems indicated that the faults occurred at similar physical locations on each feeder in the area of the electrical storm and were consistent with a lightning strike detected by the lightning tracking system. The cause of the high voltage faults on both feeders 857 and 858 is attributed to high magnitude lightning strike with a lightning current of 73.5 kilo amperes.

Immediately after the trip of feeders 857 and 858, and during the auto reclose dead time (5 seconds), 132 kV feeders 7301 and 7139 tripped due to operation of the feeder protection systems. The protection relays on feeders 7301 and 7139 operated due to the encroachment of load impedance into the relay operating zone.

The loss of 857 and 858 lines also triggered the operation of the Mount Emerald runback scheme which is currently designed to trip the feeder 8903 to disconnect Mt Emerald Wind Farm.

Generating Units 1, 2, 3 and 4 were online at Kareeya Power Station and tripped on voltage controlled overcurrent protection since the load in the resulting network island was far in excess of the generator output. During the auto reclose dead time of the 857 and 858 feeders, there was a loss of approximately 228 MW of load in FNQ. Supply to the load was restored in 5 seconds and approximately 100MW of load picked up immediately with the remaining load restored in approximately 1 hour.

All impacted feeders, except for 275 kV feeder 8903, successfully auto reclosed to restore the feeders to normal service. Powerlink confirmed that all protection and control systems operated as expected and according to their design.

Feeder 8309 and generating Units 1, 2, 3, and 4 at Kareeya Power Station were restored approximately 2 hrs after the event.

# 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<sup>3</sup>.

- The power system was in a secure operating state prior to this incident.
- The non-credible trip of both 857 and 858 feeders resulted in the tripping of 132 kV feeders 7139 and 7301 due to the encroachment of load impedance into the tripping zones of the protection relays.
- This partial FNQ separation event further resulted in the tripping of four Kareeya power station generating units due to voltage controlled overcurrent protection relay operation.
- Immediately after 857 and 858 feeders were returned to service, AEMO reclassified the loss of both feeders as a credible contingency event. To maintain the power system in a secure operating state during this reclassification, both 7139 and 7301 feeders were offloaded at 00:57 hrs on 25 January 2020. The 7139 and 7301 feeders were returned to service at 05:06 hrs on 25 January 2020 and 22:47 hrs on 26 January 2020 respectively, after the reclassification had been cancelled.

## 3.1 Reclassification

AEMO assessed whether to reclassify this incident as a credible contingency event<sup>4</sup>.

Ross – Chalumbin 857 and 858 275 kV feeders had been included in the Vulnerable Transmission Lines list<sup>5</sup> until 22 January 2020 when the Lightning Trip Time Window (LTTW)<sup>6</sup> ended. These feeders were not reclassified during the lightning events on 25 January 2020 as there was no evidence to consider them as ‘reasonably possible’ for the reclassification purposes under the NER<sup>7</sup>.

After the cause of this non-credible contingency event had been identified as lightning, AEMO was not satisfied that this non-credible event was unlikely to re-occur. AEMO therefore correctly reclassified the trip of 857 and 858 feeders as a credible contingency event due to lightning at 00:31 hrs on 25 January 2020.

At 04:34 hrs on 25 January 2020, AEMO cancelled the reclassification as the lightning activity in the vicinity of these feeders was no longer present. AEMO has subsequently put these feeders back in the proven list of vulnerable feeders in SO\_OP 3715.

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<sup>3</sup> 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.

<sup>4</sup> 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).

<sup>5</sup> Power System Security Guidelines- SO\_OP\_3715 – see [https://aemo.com.au/-/media/Files/Electricity/NEM/Security\\_and\\_Reliability/Power\\_System\\_Ops/Procedures/SO\\_OP\\_3715---Power-System-Security-Guidelines.pdf](https://aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3715---Power-System-Security-Guidelines.pdf).

<sup>6</sup> Lightning Trip Time Window is a rolling time period representing the previous three years or five years depending on the categories of vulnerable transmission lines – see Power System Security Guidelines-SO\_OP\_3715.

<sup>7</sup> Refer to Section 8.4 of the Power System Security Guidelines – SO\_OP\_3715.

# 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<sup>8</sup> 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<sup>9</sup>.
  - AEMO issued Market Notice 72990 at 00:58 hrs on 25 January 2020, to advise of the non-credible contingency event. AEMO subsequently issued Market Notice 72991 to correct an error in MN 72990.
2. Reclassification, details, and cancellation of a non-credible contingency – notify as soon as practical<sup>10</sup>.
  - AEMO issued Market Notice 72989 at 00:31 hrs on 25 January 2020, 11 minutes after the event, to advise that the cause of this non-credible contingency event was not known at that stage, and that AEMO was not satisfied that this non-credible event was unlikely to re-occur and therefore reclassified this event as a credible contingency event until further notice.
  - AEMO issued Market Notice 72995 at 03:12 hrs on 25 January 2020, to advise that the cause of this non-credible contingency event had been identified as lightning, AEMO was not satisfied that this non-credible event was unlikely to re-occur, and AEMO therefore reclassified the trip of 857 and 858 feeder event as a credible contingency event due to lightning.
  - AEMO issued Market Notice 72996 at 04:34 hrs on 25 January 2020, to advise that AEMO considered the simultaneous trip of the 857 and 858 feeders was no longer reasonably possible as there was no lightning activity in the vicinity of these feeders, and that accordingly, its classification had reverted to a non-credible contingency event.

# 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. Ross – Chalumbin 857 and 858 tripped 275 kV feeders due to a high current magnitude lightning strike; both lines successfully auto reclosed 5 seconds later.
2. Feeders 7301 and 7139 tripped due to the encroachment of load impedance into the tripping zones of the protection relays; 7301 and 7139 feeders successfully auto reclosed after 5 and 10 seconds respectively (as per design).

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

<sup>9</sup> AEMO is required to notify the market of a non-credible contingency event within two hours of the event – AEMO, Power System Security Guide feeders, Section 7.3.

<sup>10</sup> 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).

3. Walkamin – Mount Emerald Wind Farm 275 kV feeder 8903 tripped due to successful operation of the Mount Emerald Wind Farm generator runback scheme; connection was restored approximately 2 hours after the event.
4. Generating Units 1, 2, 3 and 4 were synchronised at Kareeya Power Station and tripped on voltage controlled overcurrent protection as the load in the resulting network island was far in excess of the generator output. All units were resynchronised approximately 2 hrs after the event.
5. All protection systems operated correctly for this event.
6. The power system remained in a secure operating state.

# A1. Sequence of events

**Table 1** Sequence of events on 25 January 2020

Time (hh:mm:ss)	Event	Comment
00:19:58	Feeders 857 and 858 tripped	Trip due to lightning
00:19:58	Feeder 8903 tripped	Trip due to operation of Mount Emerald Wind Farm runback scheme
00:19:59	Feeders 7301 and 7139 tripped	Trip due to load encroachment
00:20:01	All Kareeya PS Generators tripped	
00:20:03	Feeders 857 and 858 auto-reclosed and supply to FNQ load restored.	Supply to the load was restored in 5 seconds and approximately 100MW of load picked up immediately with the remaining load restored in approximately 1 hour.
00:20:04	Feeder 7301 auto reclosed	
00:20:09	Feeder 7139 auto reclosed	
01:54:50	Kareeya Generator 1 resynchronised	
02:01:00	Kareeya Generator 2 resynchronised	
02:06:31	Kareeya Generator 3 resynchronised	
02:11:47	Kareeya Generator 4 resynchronised	
02:15:31	Feeder 8903 returned to normal service	

# A2. System diagram

Figure 1 Single line diagram of the part of the North Queensland power system immediately prior to the incident discussed in this report.

