AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Trip of the Nebo No. 2 275 kV busbar on 25 August 2019

November 2019

Reviewable Operating Incident Report under the National Electricity Rules

INCIDENT CLASSIFICATIONS

Classification	Detail
Time and date of incident	1409 hrs on 25August 2019
Region of incident	Queensland
Affected regions	Queensland
Event type	Human error
Generation impact	No generation was disconnected as a result of this incident
Customer load impact	No 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
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.

DISCLAIMER

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1. Overview

This report relates to a reviewable operating incident[1] that occurred on 25 August 2019 in Queensland. The incident involved the trip of the Nebo No. 2 275 kilovolt (kV) busbar (No. 2 busbar).

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 security[2].

AEMO has concluded that:

1. The trip of the No. 2 busbar was caused by human error during planned secondary systems maintenance work on the Nebo No. 1 275/132 kV transformer (No. 1 Transformer) 'X' protection system.
1. Powerlink has put in place remedial actions to prevent a recurrence of this incident.
2. AEMO correctly determined that reclassification of this incident as a credible contingency event was not required.
3. The power system was returned to and maintained in a secure operating state in accordance with clause 4.2.6 of the National Electricity Rules (NER).

This report is prepared in accordance with clause 4.8.15(c) of the NER. It is based on information provided by Powerlink[3] and AEMO.

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

2. The incident

2.1 Pre-incident conditions

At the time of this incident, the Nebo – Broadsound 834 275 kV transmission line (834 line) was out of service, with the relevant circuit breakers open at Nebo and Broadsound. This outage was related to planned secondary systems work by Powerlink. Constraint set Q-BSNE[4] was invoked by AEMO during this outage.

Additionally, the No. 1 Transformer 'X' protection was out of service for planned secondary systems maintenance by Powerlink.

2.2 The incident

At 1409 hrs on 25 August 2019, the No. 2 busbar tripped during planned secondary system maintenance on the No. 1 Transformer 'X' protection. There was no high voltage (HV) fault on the power system and the trip of the No. 2 busbar was not an expected outcome during the secondary system maintenance.

[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] Powerlink is a Transmission Network Service Provider (TNSP) in Queensland.

[4] Out = any one of either 834, 8846 or 8847 Nebo – Broadsound 275kV lines

The outage of the No. 2 busbar also resulted in the offloading of the Nebo – Strathmore 822 275 kV transmission line (822 line), due to the existing outage of the 834 line[5].

The No. 2 busbar and the 822 line were returned to service at 1556 hrs and 1557 hrs respectively on 25 August 2019.

2.3 Investigation

The following is based on information provided by Powerlink.

At 1409 hrs on 25 August 2019, the No. 2 busbar tripped as a result of the operation of circuit breaker fail protection during planned secondary system maintenance on the No. 1 Transformer 'X' protection system. This was not an expected outcome of the planned maintenance work and there was no HV fault on the power system.

The No. 1 Transformer 'X' protection system remained out of service until completion of a review of the unexpected operation by Powerlink.

A review of the protection operation by Powerlink determined the No.1 Transformer 'X' protection had been correctly isolated for the intended work, and that the unexpected protection operation was caused by test equipment being used as part of the secondary system maintenance being connected in the wrong location. The review also determined that a contributing factor was a minor difference in the circuit breaker fail protection circuitry for the No. 1 Transformer, compared to other breaker fail protection systems at Nebo.

The No. 1 Transformer 'X protection was returned to service at 1710 hrs on 26 August 2019.

To reduce the risk of a future similar incident, additional training has been provided to field crews with regards to the connection of secondary systems test equipment. Additionally, a label has been added to the relevant protection system to alert field crews of the different circuitry.

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 prior to this incident. Immediately after the incident, Powerlink advised AEMO that it expected to be able to return the No. 2 busbar and the 822 line to service within 15 minutes. Based on this advice, AEMO took no immediate action in relation to power system security[7].

At 1424 hrs on 25 August 2019, Powerlink advised AEMO that additional time was required to determine the cause of the trip. Therefore, to return and maintain the power system in a secure operating state, AEMO, in accordance with its operating procedures, invoked the following constraint sets at 1430 hrs on 25 August 2019:

- Q-NESTM – any one of the Nebo – Strathmore 822/878/8845 275 kV lines out of service. Manage voltage stability limits in Queensland and limit output of Solar/Wind Farms in north Queensland.

[5] The 834 line and 822 line are connected to the same switchgear bay at Nebo substation.

[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] If AEMO had of taken immediate action the earliest that any constraint set could be invoked would have been by 1420 hrs.

  - None of the constraint equations within this constraint set bound in the Market Management System (MMS) and therefore it did not impact market outcomes.
- Q-X_BSNE_NESM – any one of the Broadsound – Nebo 834/8846/8847 and any one of the Nebo – Strathmore 822/878/8845 275 kV lines out of service concurrently. Manage voltage stability limits in Queensland.
  - None of the constraint equations within this constraint set bound in the MMS, and therefore it did not impact market outcomes.
- Q-HASMME_RAMP_ZERO – reduce the combined output of Haughton Solar Farm, Sun Metals Solar Farm, and Mt. Emerald Wind Farm to zero. Manage system strength in Queensland.

The power system was returned to a secure operating state by 1435 hrs on 25 August 2019 after the output of the Haughton Solar Farm, Sun Metals Solar Farm, and Mt. Emerald Wind Farm had been reduced to zero, and AEMO was not required to take any further actions to maintain the power system in a secure operating state.

The above constraint sets were revoked at 1615 hrs on 25 August 2019 after the No. 2 busbar and the 822 line were returned to service.

3.1 Reclassification

AEMO assessed whether to reclassify this incident as a credible contingency event[8].

Prior to returning the No. 2 busbar and the 822 line to service, Powerlink had advised AEMO that the cause of the incident was related to the No. 1 Transformer 'X' protection system, and that this protection remained isolated with a further recurrence of the incident considered unlikely. Based on this information, AEMO correctly determined that reclassification of the loss of the No. 2 busbar and the 822 line as a credible contingency was not required. Prior to returning the No. 1 Transformer 'X' protection to service, Powerlink advised AEMO the cause of the incident was related to human error and there was no fault with the protection system.

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[9] 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[10].
   - AEMO issued Market Notice 69476 at 1532 hrs on 25 August 2019, 83 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 practical[11].

[8] 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).

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

[10] 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.

[11] 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 69477 at 1636 hrs on 25 August 2019 to advise that the No. 2 busbar had been returned to service, the cause of the incident had been identified, and reclassification was not required.

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 No. 2 busbar was caused by human error during planned secondary systems maintenance work on the No. 1 Transformer 'X' protection system.
2. Powerlink has put in place remedial actions to prevent a recurrence of this incident.
3. AEMO correctly determined that reclassification of this incident as a credible contingency event was not required.
4. The power system was returned to and maintained in a secure operating state in accordance with clause 4.2.6 of the NER.