AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Trip of Tamworth No. 3 330 kV Busbar on 20 February 2018

November 2018

Reviewable operating incident report under the National Electricity Rules

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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INCIDENT CLASSIFICATIONS

Classification	Detail
Time and date of incident	0735 hrs on 20 February 2018
Region of incident	New South Wales
Affected regions	New South Wales
Event type	Equipment failure
Generation Impact	Nil
Customer load impact	Nil
Associated reports	AEMO, *Trip of Both 330 kV Transmission Lines Supplying Ingleburn Substation, 20 November 2015*, published August 2016, available at http://www.aemo.com.au/-/media/Files/Electricity/NEM/Market_Notices_and_Events/Power_System_Incident_Reports/2016/Trip-of-two-330-kV-TLs-at-Ingleburn-on-Friday--20-November-2015.pdf.

Contents

1. Overview

This report relates to a reviewable operating incident[1] that occurred on 20 February 2018 in New South Wales. This incident involved the outage of the No. 3 330 kV busbar at Tamworth.

There was no loss of generation or customer load as a result of this incident.

As this was a reviewable operating incident, AEMO is required to assess power system security over the course of this incident and 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. This non-credible contingency was caused by a faulty current transformer (CT) at Tamworth. All protection operated as designed to clear the fault.
2. The faulty CT was part of a batch due for replacement due to age and deterioration. TransGrid has increased the monitoring regime on the remaining CTs in this batch prior to full replacement.
3. The power system remained in a secure operating state during this incident.
4. AEMO was not required to reclassify this non-credible contingency as a credible contingency event.

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 TransGrid[3] and from AEMO's Energy Management Systems.

National Electricity Market Time (Australian Eastern Standard Time) is used in this report. Local time in New South Wales at the time of this incident is Market Time plus one hour.

2. The incident

At 0735 hrs on Tuesday 20 February 2018, Tamworth No. 3 330 kV busbar (No. 3 busbar) tripped. This resulted in the outage of the following equipment:

- 85 Armidale–Tamworth 330 kV line (85 line).
- 88 Tamworth–Muswellbrook 330 kV line (88 line).
- No. 2 330/132 kV transformer at Tamworth.
- No. 3 330/132 kV transformer at Tamworth.
- No. 1 330 kV reactor[4].

The 88 line and No. 3 busbar were returned to service at 0859 hrs on 20 February. The No. 3 transformer was returned to service at 0901 hrs and No. 2 transformer was returned to service at 1226 hrs on 20 February.

The 85 line was returned to service at 1830 hrs on 20 February, after a faulty CT was replaced.

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[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] TransGrid is the transmission network service provider (TNSP) for the area in question.

[4] The outage of No. 3 busbar also resulted in the unavailability of the No. 2 330 kV reactor and the No. 1 330 kV capacitor which were not in service at the time of the incident.

Refer to Appendix A1 for a diagram of Tamworth both before and immediately after this incident.

As the trip of a busbar is not an expected event, this is a non-credible contingency and hence a reviewable operating incident. In accordance with clause 4.8.15 of the NER, AEMO is required to review and report on any reviewable operating incident.

3. Incident analysis

The following is based on information provided by TransGrid as transmission network service provider (TNSP) for the area in question.

The No. 3 busbar at Tamworth tripped as the result of an internal failure of one phase of a CT on the 85 line at Tamworth, resulting in the operation of 85 line protection and the No. 3 busbar protection to trip the No. 3 busbar, 85 and 88 lines, and No. 2 and No. 3 330/132 kV transformers. Operation of the line and busbar protection for this type of fault was an expected outcome. All protection operated according to design.

The failed CT was replaced and 85 line returned to service at 1830 hrs on 20 February.

The failed CT was from the same batch of CTs that has a history of failure due to age and deterioration. An incident at Ingleburn in November 2015 was caused by the failure of the same type of CT[5]. In response to previous failures, TransGrid initiated a replacement program. The CTs deemed by TransGrid as high risk were replaced by the end of 2016. An asset management program was put in place to monitor the remaining CTs prior to replacement in the 2019-23 regulatory period. This asset management program included oil sampling at three-monthly intervals.

The CT at Tamworth failed slightly over three months after its last oil sample, with the sample due to be taken the week after the CT failed. The delay in sampling was due to constraints on programming outages during this period. The results from the last oil sample taken prior to the failure did not show any significant further deterioration from the previous sample, and it is not known whether an oil sample taken at the three-month interval would have shown any further changes.

At the time of this incident there were 39 CTs requiring replacement. Following this incident, these CTs have had an additional oil sample taken and cleared for service with no imminent danger of failure. These CTs will continue to be sampled at monthly intervals until replaced.

TransGrid has provided AEMO a list of the locations where CTs are still to be replaced and TransGrid and AEMO have determined there is no additional risk to power system security.

4. Power system security

AEMO is responsible for power system security in the National Electricity Market (NEM). This means AEMO is required to operate the power system in a secure operating state to the extent practicable and take all

[5] AEMO, *Trip of Both 330 kV Transmission Lines Supplying Ingleburn Substation, 20 November 2015*, published August 2016, available at http://www.aemo.com.au/-/media/Files/Electricity/NEM/Market_Notices_and_Events/Power_System_Incident_Reports/2016/Trip-of-two-330-kV-TLs-at-Ingleburn-on-Friday--20-November-2015.pdf.

reasonable actions to return the power system to a secure state following a contingency event in accordance with the NER[6].

This section assesses how AEMO managed power system security over the course of this incident.

The power system was in a secure operating state prior to and immediately after this incident. To ensure the power system remained in a secure operating state, AEMO took the following actions.

- AEMO invoked the following constraint sets at 0740 hrs on 20 February:
  - N-TW_330_BUS3[7].
  - F-N-MUTW_88[8].
  - N-MUTW_88[9].
  - F-N-ARTW_85[10].
  - N-ARTW_85[11].
- In accordance with TransGrid procedures, AEMO requested that the 132 kV network between Armidale and Tamworth be split at Moree to avoid potential overloading of this parallel network if the 86 Armidale–Tamworth 330 kV line tripped. This was completed by 0754 hrs on 20 February[12].

Constraint sets N-TW_330_BUS3, F-N-MUTW_88, and N-MUTW_88 were revoked at 0915 hrs on 20 February, after the No. 3 busbar and 88 line had been returned to service.

Constraint sets F-N-ARTW_85 and N-ARTW_85 were revoked at 1950 hrs on 20 February, after 85 line had been returned to service.

4.1 Reclassification

After the No. 3 busbar had been returned to service, AEMO considered whether to reclassify this non-credible contingency as a credible contingency. As TransGrid had identified the cause of the contingency and had isolated the faulty CT, AEMO considered a recurrence of this incident as unlikely and correctly did not reclassify the contingency.

5. 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[13] over the course of this incident.

For this incident, AEMO was required to inform the market on the following matters:

[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] Out=Tamworth No. 3 330 kV bus.

[8] Out=88 line, FCAS requirements.

[9] Out=88 line.

[10] Out=85 line, FCAS requirements.

[11] Out=85 line.

[12] The 964 Port Macquarie – Taree 132 kV line was already open.

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

1. A non-credible contingency event - notify within two hours of the event[14].
   - AEMO issued Market Notice 61401 at 0748 hrs – 13 minutes after the event.
2. Constraints invoked with interconnector terms on left hand side[15].
   - AEMO issued Market Notice 61403 at 0801 hrs on 20 February to advise Participants that interconnector flows may be impacted by constraints invoked during this incident.
3. Updates to the non-credible contingency event[16].
   - AEMO issued Market Notice 61407 at 0910 hrs on 20 February to advise participants that the cause of the non-credible contingency had been identified and that AEMO would not reclassify this incident as a credible contingency event.

Over the course of this incident, AEMO issued appropriate, timely, and sufficiently detailed market information.

6. 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. This non-credible contingency was caused by a faulty CT at Tamworth. All protection operated as designed to clear the fault.
2. The faulty CT was part of a batch due for replacement due to age and deterioration. TransGrid has increased the monitoring regime on the remaining CTs in this batch prior to full replacement.
3. The power system remained in a secure operating state during this incident.
4. AEMO was not required to reclassify this non-credible contingency as a credible contingency event.

7. Pending actions

TransGrid has replaced all the remaining suspect CT's in the NSW transmission network.

[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 10.3. Available 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.

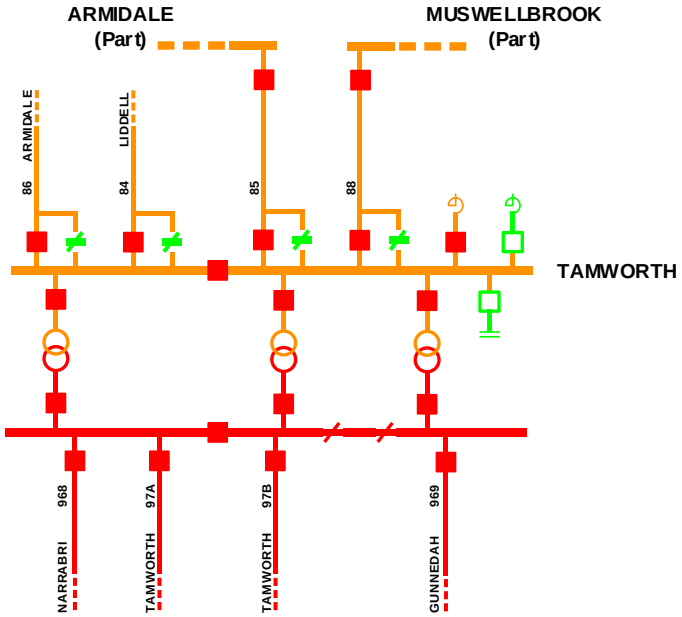
[15] For short-term outages, AEMO is required to notify the Market of variances to interconnector transfer limits according to Section 22 of AEMOs Power System Security Guidelines.

[16] AEMO is required to notify the market as it becomes aware of new and material information – NER clause 4.2.3A(d).

A1. Power system diagram

The following diagrams show the power system at Tamworth before and immediately after the incident.

Before



After