TRIP OF RICHMOND No.2 & No.4 220kV BUSBARS ON 7 JUNE 2016

AN AEMO POWER SYSTEM OPERATING INCIDENT REPORT FOR THE NATIONAL ELECTRICITY MARKET

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AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

INCIDENT CLASSIFICATIONS

Classification	Detail
Time and date of incident	1611 hrs Tuesday 7 June 2016
Region of incident	Victoria
Affected regions	Victoria
Event type	Transmission equipment failure
Generation Impact	No generator was disconnected as a result of this incident
Customer Load Impact	No customer load was disconnected as a result of this incident
Associated reports	Nil

ABBREVIATIONS

Abbreviation	Term
AEMO	Australian Energy Market Operator
CB	Circuit Breaker
kV	Kilovolt
MW	Megawatt
NER	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

AEMO has made every effort to ensure the quality of the information in this report but cannot guarantee its accuracy or completeness. Any views expressed in this report are those of AEMO unless otherwise stated, and may be based on information given to AEMO by other persons.

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1. OVERVIEW

This report relates to a reviewable operating incident[1] that occurred on 7 June 2016 at Richmond Terminal Station (RTS) in Victoria. This incident involved the simultaneous trip of the No.2 and No.4 220kV busbars and was caused by the failure of a current transformer (CT).

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

As 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. The trip of the No.2 and No.4 220kV busbars at RTS was caused by the failure of a CT.
    - All similar CTs have subsequently been replaced.
2. The power system was maintained in a secure operating state during this incident.
3. There were omissions in the provision of information and notices to market participants.

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 AusNet Services[3] and AEMO.

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

2. THE INCIDENT

On Tuesday 7 June 2016 at 1611 hrs the failure of a CT on the No. 4 bus side of the 2-4 220kV Bus Tie circuit breaker resulted in the outage of the No.2 and No.4 220kV busbars at RTS. This resulted in off-loading of the Richmond – Brunswick 220kV transmission line, B2 & B4 220/66kV and L3 220/22kV transformers at RTS. This is an expected outcome for this fault type and location.

The Richmond – Rowville No.1 220kV line was already out of service on a planned outage. Refer to Appendix A for a diagram of RTS immediately after the event, and Appendix B for chronological list of events during this incident.

AusNet Services recalled the Richmond – Rowville No.1 220kV line and returned it to service at 1635 hrs. Other equipment was returned to service at the following times on 7 June 2016:

- No.2 220kV busbar – 2214 hrs.
- B2 220/66kV transformer – 2222 hrs.
- L3 220/22kV transformer – 2229 hrs.
- Richmond – Brunswick 220kV line – 2236 hrs.

Following replacement of the failed CT, the No.4 220kV bus was returned to service at 2322 hrs on 26 June 2016. The B4 220/66kV transformer was returned to service at 1955 hrs on 28 June 2016.

The reason for investigating this incident is that the probability of a busbar fault is very low and is thereby an unexpected event known in power system security terms as a non-credible contingency[4].AEMO is required to investigate and report on non-credible contingencies.

[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] Information provided by AusNet Services has been provided on a without prejudice basis and nothing in this report is intended to constitute, or may be taken by any person as constituting, an admission of fault, liability, wrongdoing, negligence, bad faith or the like on behalf of AusNet Services (or its respective associated companies, businesses, partners, directors, officers or employees).

[4] NER Clause 4.2.3 - Credible and non-credible contingency events; *AEMO Power System Security Guidelines,* Section 10 - Definition of a non-credible contingency events

3. AUSNET SERVICES INVESTIGATION

AusNet Services as the Transmission Network Service Provider (TNSP) for Victoria investigated the incident and provided the following information.

The fault was caused by the failure of the blue phase 220kV CT associated with the No.2 – No.4 220kV Bus Tie circuit breaker at RTS. The failure also resulted in a fire which was contained to the CT and was extinguished by the fire brigade after the equipment was isolated.

Information from fault recording equipment indicated the fault current was around 30kA peak[5] and the fault was cleared by both 'X' and 'Y' protection on both the No.2 and No.4 busbars. All protection and transmission equipment operated correctly to clear the fault in approximately 80 ms[6].

The failed CT and the other two CTs in the same set were replaced and the busbar returned to service at 2322 hrs on 26 June 2016.

The failed CT was an oil filled CT manufactured by ASEA and was installed in the late 1960s. The failed CT was planned to be removed from service as part of RTS upgrade works in June 2017. After inspection, AusNet Services determined that the CT failed due to moisture ingress as a result of corrosion in the CT top cap.

Subsequent to this event, AusNet Services identified a further three sets of the same type of CT at RTS. All of these CTs have since been replaced. There are no other CTs of this type installed on the AusNet Services network.

4. 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 and return the power system to a secure state following a contingency event. This section assesses how AEMO managed power system security over the course of this incident[7].

AEMO invoked constraint set V-BTRT_R[8] between 1620 hrs and 2250 hrs. This ensured the power system was returned to and maintained in a secure operating state during this incident. As no constraint equations in this constraint set bound during the incident, there was no resulting market impact. No other actions were required by AEMO to maintain power system security during this incident.

4.1 Reclassification

After the No.2 220kV busbar at RTS had been returned to service, AEMO then assessed whether or not to reclassify the event as a credible contingency event[9]. For this incident, AEMO was satisfied that the cause had been identified and isolated and that the incident was unlikely to reoccur.

For this incident the power system remained in a secure operating state over the course of the incident. Power system frequency[10] and voltage[11] remained within limits and the fault was cleared within required timeframes. AEMO correctly assessed the incident and did not reclassify the incident as a credible contingency event.

[5] 30kA peak equates to approximately 21kA RMS which is below the design limit of 26.2kA RMS.
[6] Clause S5.1a.8 of the NER requires faults of this type to be cleared within a maximum of 120ms.
[7] AEMO is responsible for power system security in the NEM and is required to operate the power system in a secure operating state (NER Clause 4.2.4 (a)). AEMO must thereby ensure that the power system is maintained in, or returned to, a secure operating state following a contingency event.
[8] Required for the outage of the Richmond to Brunswick 220kV line
[9] 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 re-classification criteria were applied - NER Clause 4.8.15 (ca)
[10] Operating Frequency Tolerance Band specified in AEMC Reliability Panel Frequency Operating Standards
[11] NER Schedule 5.1a System Standards Clause S5.1a.4 - Power frequency voltage

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[12] over the course of this incident.

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

1. The occurrence of a non-credible contingency event - notify within two hours of the event.[13]
    - AEMO issued Market Notice 53677 at 1639 hrs on 7 June – 29 minutes after the event
2. Constraints invoked with interconnector terms on the LHS.[14]
    - AEMO is required to advise the market whenever a constraint is invoked for a short notice or unplanned outage, if that constraint has interconnector terms on the left hand side. AEMO did not advise the market that constraint set V-BTRT_R had been invoked. Constraint equations within this constraint set have interconnector terms on the left hand side.

No other notifications were required.

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.

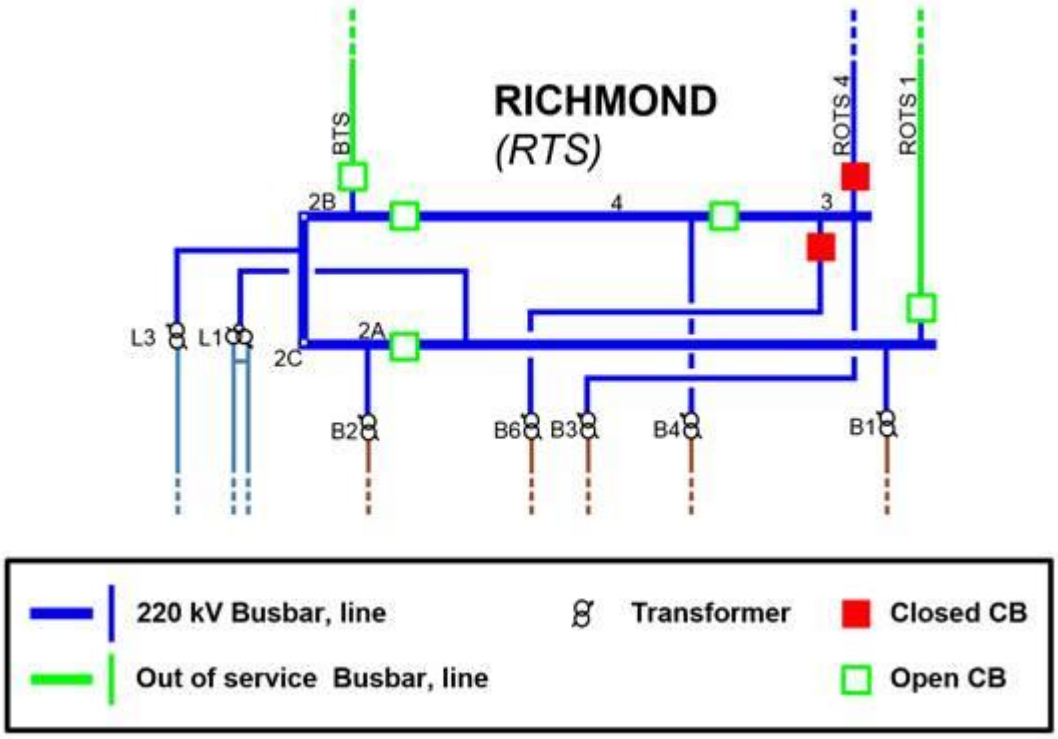
AEMO has concluded that:

1. The trip of the No.2 and No.4 220kV busbars at RTS was caused by the failure of a current transformer.
    - All similar CTs have subsequently been replaced.
2. The power system was maintained in a secure operating state during this incident.
3. There were some omissions in the provision of information and notices to market participants.

[12] AEMO generally informs the market about operating incidents as the progress by issuing Market Notices – see AEMO website
[13] 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
[14] For short term outage AEMO is required to notify the Market of variances to interconnector transfer limits AEMO, *Power System Security Guidelines,* Section 22

APPENDIX A. – POWER SYSTEM DIAGRAM

The diagram below shows the status of the 220kV switchgear at Richmond Terminal Station immediately after the event.



APPENDIX B. – INCIDENT EVENT LOG

Chronological Log of Incident

Time and Date	Event
7 June 2016 1611 hrs	RTS 2 & 4 220kV busbars tripped. RTS – BTS 220kV line de-loaded B2 & B4 220/66kV transformers de-loaded L3 220/22kV transformer de-loaded
1620 hrs	Constraint set V-BTRT_R invoked
1635 hrs	RTS – ROTS No1 220kV line returned to service
1639 hrs	Market Notice 53677 issued. Advice of a non-credible contingency.
2214 hrs	No.2 220kV busbar returned to service
2222 hrs	B2 220/66kV transformer returned to service
2229 hrs	L3 220/22kV transformer returned to service
2236 hrs	RTS-BTS 220kV line returned to service
2250 hrs	Constraint set V-BTRT_R revoked
26 June 2016 2322 hrs	No.4 220kV busbar returned to service
28 June 2016 1955 hrs	B4 220/66kV transformer returned to service