TRIP OF YALLOURN POWER STATION NO.2 220 KV BUSBAR ON 6 DECEMBER 2015

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

Published: March 2016

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

VERSION RELEASE HISTORY

VERSION	DATE	BY	CHANGES	CHECKED BY	AUTHORISED BY
1	17 Mar 2016	N Modi	Initial	P Biddle	M.Stedwell

INCIDENT CLASSIFICATIONS

Classification	Detail
Time and date of incident	2157 hrs Sunday 6 December 2015
Region of incident	Victoria
Affected regions	Victoria
Event type	Busbar trip (BB)
Generation Impact	732 MW of generation 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
No.2 Line	Yallourn to Hazelwood No.2 220kV transmission line
No.2 Busbar	YTS No.2 220kV busbar
No. 8 Line	Yallourn to Rowville No.8 220kV transmission line
YPS	Yallourn Power Station switchyard
YWPS	Yallourn West Power Station

IMPORTANT NOTICE

Purpose

AEMO has prepared this document to provide information about this particular Power System Operating Incident.

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1. OVERVIEW

This report reviews a power system operating incident that occurred on 6 December 2015 at Yallourn Power Station (YPS) switchyard in Victoria. This incident involved the trip of a 220 kV bus bar and Yallourn West Power Station (YWPS) generating units 1 and 2. There was no loss of customer load as a result of this incident.

AEMO is required to assess power system security over the course of this incident as the incident was a non-credible contingency event[1] under the National Electricity Rules (NER).[2] Specifically, 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.[3]

For this incident AEMO concluded that:

1. The incident was initiated by a circuit breaker (CB) at YPS that did not open correctly, resulting in the trip of a busbar at YPS and two generating units at YWPS.
2. Power system security was maintained over the course of the incident.

This report is based on information provided by AusNet Services[4], EnergyAustralia[5] and AEMO. National Electricity Market time (Australian Eastern Standard Time) is used in this report.

2. THE INCIDENT

On Sunday, 6 December 2015 at 2157 hrs, the YPS No.2 220kV busbar (No.2 busbar) and YWPS generating unit 2 tripped. At the time YWPS generating unit 3 was being taken out of service. As a consequence of the busbar trip, the Yallourn to Rowville No.8 220kV transmission line (No. 8 Line) was offloaded. Three minutes later, at 2200 hrs, YWPS generating unit 1 also tripped, offloading the Yallourn to Hazelwood No.2 220kV transmission line (No.2 Line).

As a result of this incident 732 MW of generation was lost, however there was no loss of customer load. The minimum frequency during this event was 49.75Hz and the frequency operating standards were not exceeded.

No.2 busbar, No.8 Line and No.2 Line were returned to service by 2347 hrs the same day.

See Appendix A for a power system diagram illustrating the incident and Appendix B for a chronological log of the incident.

The reason for investigating this incident is that a busbar trip is a non-credible contingency event. 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 event.[6]

[1] The power system is operated such that it will remain in a satisfactory operating state (NER clause 4.2.2) for the loss of single elements in the transmission network. Such events are defined as credible contingency events (NER clause 4.2.3). AEMO considers the occurrence of these events to be reasonably possible and ensures contingency plans are in place to minimise the impact on the power system following a credible contingency event. A non-credible contingency event is a contingency event other than a credible contingency event and usually involves multiple elements.

[2] NER Clause 4.8.15(a)(1)(i) and AEMC Reliability Panel Guidelines for Identifying Reviewable Operating Incidents.

[3] NER Clause 4.8.15(b)

[4] 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).

[5] EnergyAustralia is the operator of Yallourn Power Station

[6] 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 owner of the 220kV busbars and associated switchgear at YPS, investigated this incident and have provided the following information.

At 2157hrs 6 December 2015, the YPS No.2 220kV busbar tripped via protection. At the time of this event, YWPS operators were in the process of shutting down unit 3.

Inspection of station apparatus and protection targets at YPS indicated that one phase of the Yallourn 3 Generator 2B 220kV CB did not open correctly in response to a trip signal from the Power Station. This resulted in operation of the CB fail protection tripping the YPS No.2 220KV busbar. This is an expected outcome for this type of fault.

The busbar outage resulted in the offloading of the Yallourn – Rowville No.8 220kV line and the YWPS 'A" and 'D' auxiliary transformers. YWPS unit 2 was also islanded.

The No.2 220KV bus and the Yallourn – Rowville No.8 line were returned to service at 2343hrs. The 'D' and 'A' auxiliary transformers were returned to service at 2359 hrs and 0008 hrs respectively.

The YPS 3 Generator No2 bus CB was isolated for repairs and returned to service on 7 December.

4. ENERGYAUSTRALIA INVESTIGATION

EnergyAustralia, as operator of YWPS, investigated this incident and has provided the following information.

On Sunday 6 December 2015, Yallourn unit 3 was being taken out of service for a controlled shutdown. When a turbine trip was initiated at 13 MW, an open command was sent to both the Unit 3 YPS No1 220kV busbar CB and the Unit 3 YPS No2 220kV busbar CB. This resulted in the unexpected trip of the No2 220KV busbar at YPS.

At the time, YWPS Unit 2 was online and generating 382 MW. As a result of the No.2 Busbar trip, YWPS Unit 2 was islanded and subsequently tripped.

About three minutes after the No.2 220KV busbar trip, YWPS unit 1 ran back from 350MW and tripped due to loss of auxiliary supplies as a result of the trip of the YPS No.2 220kB busbar.

At the time of the incident, the auxiliary supplies for YWPS unit 1 were being fed via auxiliary transformer 'A', which is connected to the YPS No.2 220KV busbar. Auxiliary transformer 'B ' fed from the YPS No.1 220KV bus was out of service at the time of the incident. Auxiliary supplies normally fed from the 'B' transformer were being fed from auxiliary transformer 'C'. Appendix A shows the 220KV connections of the YWPS auxiliary supply transformers.

When auxiliary transformer 'A' tripped, there would normally be an automatic changeover to auxiliary transformer 'C'. However, this did not happen as auxiliary transformer 'C' was already supplying the loads normally supplied by auxiliary transformer 'B' and the auto-changeover was blocked.

While a manual change-over facility is available, this was not used as the station operators were unable to find the 'interlock' bypass facility to enable them to override the auto-changeover block. This is because it was not located on the operator control screens like other interlocks. EnergyAustralia has subsequently modified its control screens to include the interlock by-pass facility.

5. 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 operating state following a contingency event. This section assesses how AEMO managed how power system security over the course of this incident[7].

To ensure the power system was returned to and maintained in a secure operating state[8] AEMO invoked constraint sets V-YP_BUS2[9], V-ROYP78_R[10] and V-HWYP2[11] within an acceptable 13 minutes of the incident. No further actions were required to maintain power system security.

5.1 Reclassification

In accordance with clause 4.2.3A of the NER, AEMO considered whether to reclassify this non-credible contingency event as a credible contingency event. As the cause of the contingency was known, AEMO was satisfied that the non-credible contingency event was unlikely to re-occur, and so did not reclassify it as a credible contingency event.

For this incident, AEMO took appropriate action to ensure the power system returned to a secure operating state following the No.2 Busbar trip. No further action was required to maintain power system security.

6. MARKET INFORMATION

AEMO is required by the NER to inform the market about incidents as they progress. This section assesses how AEMO informed the market[12] over the course of this incident.

AEMO issued three market notices in relation to this incident:

1. At 2308hrs AEMO issued market notice 50843 to advise the market of the occurrence of the non-credible contingency event and the constraint sets invoked.
2. At 2334hrs AEMO issued market notice 50844 as a correction to market notice 50843 (incorrect date in the original market notice)
3. At 0012hrs AEMO issued market notice 50845 to advise the cause of the non-credible contingency event had been identified and that the contingency would not be reclassified.

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

[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] AEMO is required to return the power system to a secure state within thirty minutes following a contingency event - NER Clause 4.2.6 (b)
[9] Outage of Yallourn PS No2 220KV Bus
[10] Outage of Yallourn to Rowville No7 or No 8 220KV line.
[11] Outage of Yallourn to Hazelwood No2 220KV line
[12] AEMO generally informs the market about operating incidents as the progress by issuing Market Notices – see AEMO website

7. CONCLUSIONS

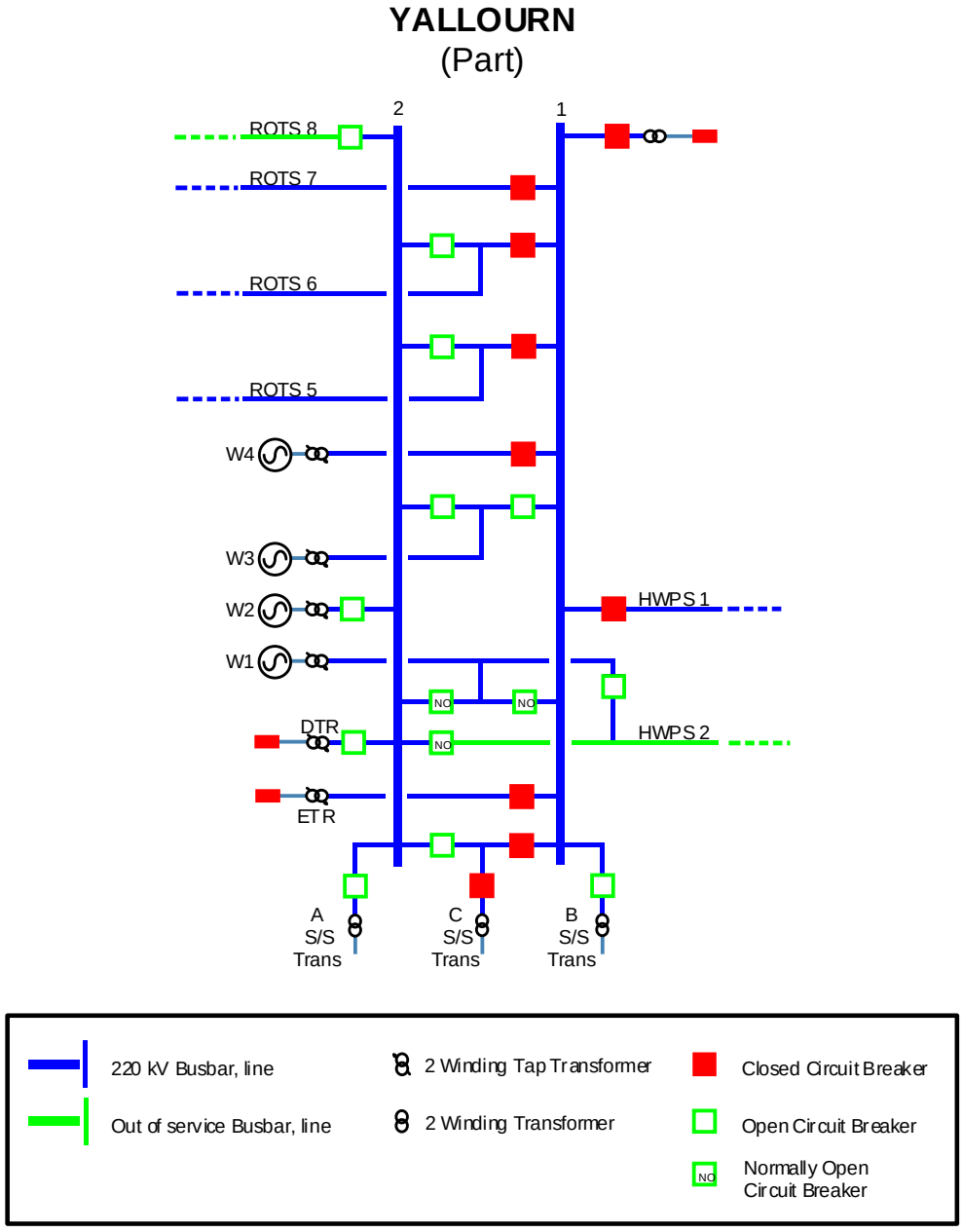
AEMO concluded that:

1. The Yallourn Power Station No. 2 220KV busbar tripped when a circuit breaker failed to open correctly.
2. Yallourn Power Station unit 1 tripped due to loss of auxiliary supplies associated with the trip of the No.2 220KV busbar.
3. The provision and response of facilities and services were appropriate and power system security was maintained over the course of the incident

The are no outstanding issues to resolve as a result of this incident.

APPENDIX A. – POWER SYSTEM DIAGRAM

The power system immediately after the incident



APPENDIX B. – INCIDENT EVENT LOG

Chronological Log of Incident

Time and Date	Event
21:56 – 6 December 2015	YWPS Unit 3 preparing to come off line.
21:57 – 6 December 2015	YPS No.2 220kV bus, YWPS Unit 2 and Yallourn PS Auxiliary transformers A, & D tripped. Yallourn to Rowville No.8 220kV line offloaded
22:00 – 6 December 2015	YWPS Unit 1 tripped. Yallourn to Hazelwood No.2 220kV line offloaded.
22:05 – 6 December 2015	Constraint Sets V-YP_BUS2 and V-ROYP78_R invoked.
22:10 – 6 December 2015	Constraint Set V-HWYP2 invoked.
23:43 – 6 December 2015	YPS No.2 220kV bus and Yallourn to Rowville No.8 220kV line returned to service.
23:47 – 6 December 2015	Yallourn to Hazelwood No.2 220kV line returned to service.
00:10 – 7 December 2015	Constraint Sets V-YP_BUS2, V-ROYP78_R and V-HWYP2 revoked.