



TRIP OF LOY YANG POWER STATION No.1 AND No.3 500 KV BUSBARS ON 16 JUNE 2016

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

Published: **September 2016**





INCIDENT CLASSIFICATIONS

Classification	Detail
Time and date of incident	1106 hrs Thursday 16 June 2016
Region of incident	Victoria
Affected regions	Victoria
Event type	Busbar trip (BB)
Generation Impact	990 MW 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
AGL	AGL Energy – Operator of LYPSA
AusNet	AusNet Services – Operator of LYPS Switchyard
CB	Circuit Breaker
CBF	Circuit Breaker Fail
FCAS	Frequency Control Ancillary Service
kV	Kilovolt
LYPS-A	Loy Yang Power Station A
LYPS	Loy Yang Power Station Switchyard
MW	Megawatt
NER	National Electricity Rules
NOFB	Normal Operating Frequency Band
VPGS	Valley Power Gas Station



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.

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1. OVERVIEW

This report reviews a power system operating incident¹ that occurred on 16 June 2016 at Loy Yang Power Station Switchyard (LYPS) in Victoria. This incident involved the trip of LYPS No.1 and No.3 500 kV busbars, and generating units 1 and 3 at Loy Yang Power Station A (LYPS-A). The incident was caused by a circuit breaker (CB) not opening correctly.

There was no loss of 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, specifically 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 incident was caused by a faulty CB.
2. The subsequent trip of associated plant was as expected for this CB fault.
3. The provision and response of facilities and services were appropriate over the course of this incident.

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 (AusNet)³, AGL Energy (AGL)⁴, and AEMO. Australian Eastern Standard Time is used in this report.

2. THE INCIDENT

On Thursday 16 June 2016 at 1106 hrs LYPS-A generating unit 3 was tripped from 450 MW as part of a planned trip test. The test required the opening of the two generator 500kV CB in LYS. One of the CBs – the A3 Generator 1 Bus 500kV CB – failed to open correctly. As a result:

- LYPS No.1 and No.3 500 kV busbars (No.1 and 3 busbars) tripped.
- LYPS-A generating unit 1 was islanded and subsequently tripped.
- Hazelwood – Loy Yang No.2 500 kV line (HWTS–LYPS No.2 line) was off-loaded.
- Loy Yang – Valley Power 500 kV Line (LYPS–VPGS line) was disconnected.⁵

There was no loss of customer load, however there was an unplanned loss of 540 MW of generation.⁶

The minimum frequency during this event was 49.70 Hz in the mainland and 49.25 Hz in Tasmania. The frequency recovered to the Normal Operating Frequency Band (NOFB) in six minutes for both the mainland and Tasmania, and the frequency operating standards were met for this incident.

No.1 and No.3 busbars and HWTS-LYPS No.2 line were returned to service at 1127 hrs on 16 June, and the LYPS-VPGS line was returned to service at 1411 hrs the same day. AGL returned LYPS-A generating unit 3 to service at 2035 hrs on the same day, and LYPS-A generating unit 1 at 0145 hrs on 17 June.

The reason for reviewing this incident is that a busbar tripped. A busbar trip is a non-credible contingency event⁷, which means the event is a reviewable operating incident under the NER. See

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 AGL Energy is the operator of LYPSA.

⁵ Valley Power was not generating at the time of the event.

⁶ 990 MW of generation was lost in total: 450 MW was planned (trip of LYA3) and 540 MW was unplanned (trip of LYA1)

⁷ NER Clause 4.2.3 - Credible and non-credible contingency events; *AEMO Power System Security Guidelines*, Section 10 - Definition of a non-credible contingency event, available at <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Power-system-operation>.



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

3. AUSNET SERVICES INVESTIGATION

AusNet Services, as operator of LYPS, investigated this incident and has provided the following information.

At 1106 hrs on 16 June 2016 LYPS No.1 and No.3 500kV busbars tripped via protection.

Inspection of station apparatus and protection equipment at LYPS indicated that one phase of the A3 Generator No.1 bus 500kV CB did not open correctly in response to a trip signal from the power station. This resulted in operation of the CB fail protection to trip the LYPS No.1 and No.3 500kV busbars. This is the correct outcome for this type of fault.

The A3 Generator No.1 bus 500kV CB was isolated pending further investigation.

Inspection of the CB mechanism revealed that the cause of the CB maloperation was a hydraulic leak in the vicinity of the trip coils. The hydraulic system was repaired, and subsequent operational and timing tests proved the CB operated in a satisfactory manner. The CB was returned to service at 1009 hrs on 28 June 2016.

4. AGL ENERGY INVESTIGATION

AGL, as operator of LYPS-A, investigated this incident and has provided the following information.

On Thursday 16 June 2016 at 1106 hrs, AGL initiated a trip of LYPS-A generating unit 3 as part of a planned test. The unit was generating 450 MW at the time of the trip, and this loss of generation was expected.

Approximately 0.12 seconds after the unit 3 CBs were opened, the 500 kV CB for LYPS-A generating unit 1 opened, which disconnected and thereby tripped the unit. This resulted in an unexpected generation loss of 540 MW.

Unit 3 was resynchronised at 2035 hrs on 16 June, and Unit 1 at 0145 hrs on 17 June.

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 state following a contingency event. This section assesses how AEMO managed power system security over the course of this incident.⁸

Following the event, AEMO invoked constraint sets V-HWLY_2⁹ and V-LY_TX¹⁰ within nine minutes and constraint sets V-LY-BUS1¹¹ and V-LY_BUS3¹² within 14 minutes. These actions ensured that the power system was restored to, and maintained in, a secure operating state. No further actions were required to maintain power system security.

⁸ AEMO is responsible for power system security in the NEM and is required to operate the 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.

⁹ Outage of Hazelwood to Loy Yang No.2 500 kV Line.

¹⁰ Outage of Loy Yang PS 500/220 kV Transformer.

¹¹ Outage of Loy Yang PS No 1 500 kV Bus.

¹² Outage of Loy Yang PS No 3 500 kV Bus.

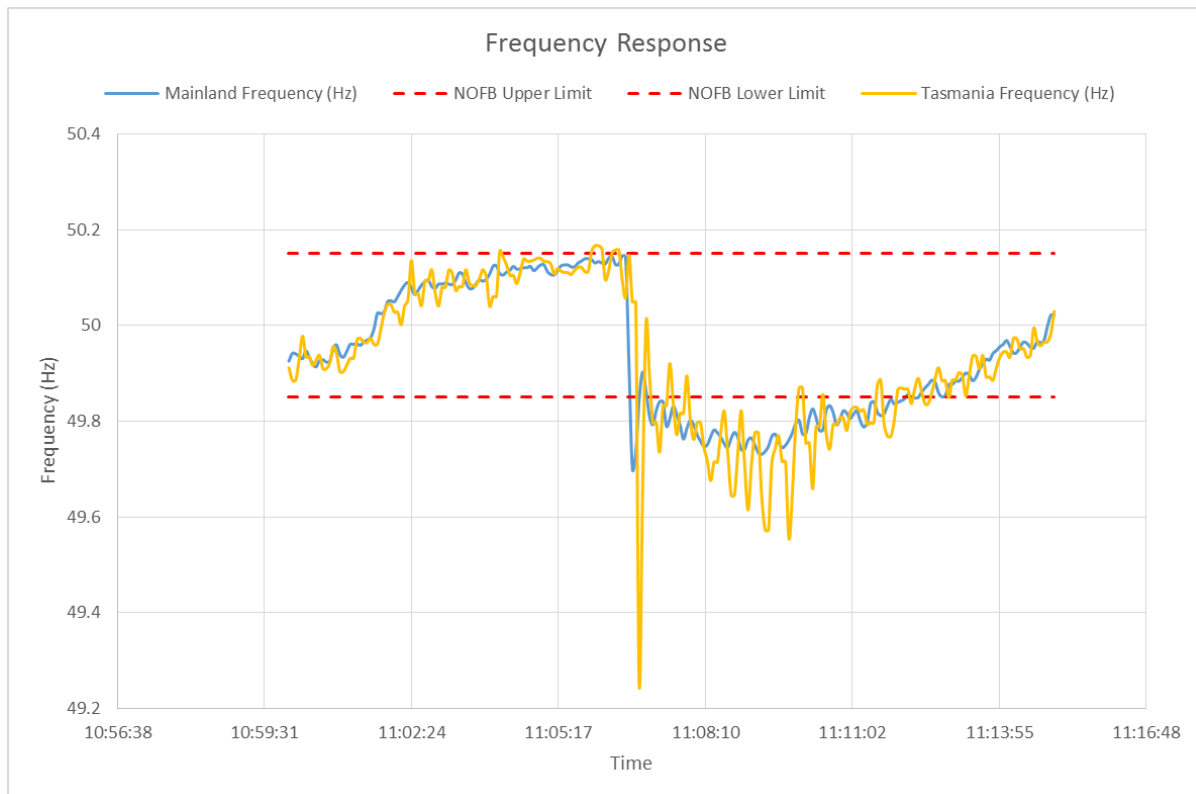
5.1 Frequency

The minimum frequency during this event was 49.70 Hz in the mainland and 49.25 Hz in Tasmania. As this was a multiple contingency event¹³ the following frequency standards apply:

- Mainland: frequency must not fall below 47 Hz, and must recover to above 49.5 Hz within two minutes and 49.85 Hz within 10 minutes.¹⁴
- Tasmania: frequency must not fall below 47 Hz, and must recover to above 48 Hz within two minutes and 49.85 Hz within 10 minutes.¹⁵

For this incident the frequency operating standards were met in both the mainland and Tasmania. Figure 1 illustrates the mainland and Tasmania frequency responses during the incident.

Figure 1 Mainland and Tasmania frequency



5.2 Reclassification

After the 500kV busbars had been returned to service, AEMO, in accordance with clause 4.2.3A of the NER, assessed whether or not to reclassify the event as a credible contingency event.¹⁶ As the cause of the contingency was identified and the faulty CB isolated, AEMO was satisfied that the non-credible contingency event was unlikely to reoccur, and did not reclassify it as a credible contingency event.

For this incident, AEMO took appropriate action to ensure the power system was returned to, and maintained in, a secure operating state.

¹³ As defined in the Frequency Operating Standards

¹⁴ See the AEMC Reliability Panel Frequency Operating Standards (Mainland).

¹⁵ See the AEMC Reliability Panel Frequency Operating Standards (Tasmania).

¹⁶ AEMO is required to assess whether or not to reclassify a non-credible contingency event as a credible contingency - NER Clause 4.2.3A (c) - and to report how re-classification criteria were applied - NER Clause 4.8.15 (ca). AEMO has to determine if the condition that caused the non-credible contingency event has been resolved.



6. 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 market¹⁷ 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.¹⁸
 - AEMO issued Market Notice 53981 at 1131 hrs – 25 minutes after the event.
2. Updates to the non-credible contingency event – as information becomes available.¹⁹
 - AEMO issued Market Notice 53982 at 1149 hrs – 43 minutes after the event, as notification that No.1 and 3 busbars and the HWTS-LYPS No.2 line had been returned to service.
3. Constraints invoked with interconnector terms on the LHS.²⁰
 - AEMO issued Market Notice 53980 at 1126 hrs – 20 minutes after the event – as notification that constraint sets V-HWLY_2, V-LY_TX, V-LY_BUS1 and V-LY_BUS3 had been invoked.

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

7. CONCLUSIONS

AEMO 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 incident was caused by a faulty CB.
2. The subsequent trip of associated plant was as expected for this CB fault.
3. The provision and response of facilities and services were appropriate and power system security was maintained over the course of this incident.

¹⁷ AEMO generally informs the market about operating incidents as they progress by issuing Market Notices – see AEMO website at <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Market-notices-and-events>.

¹⁸ 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.

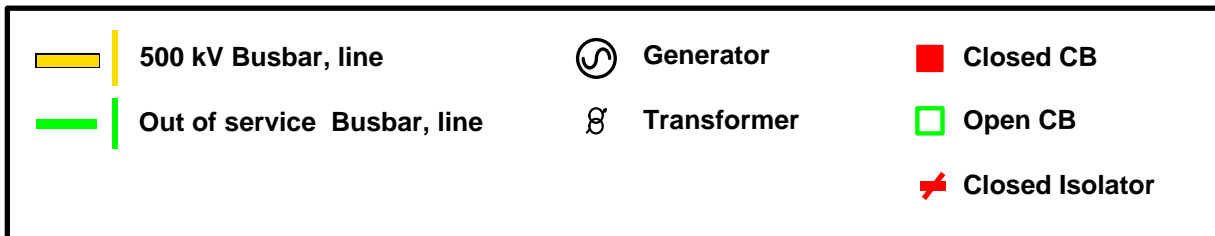
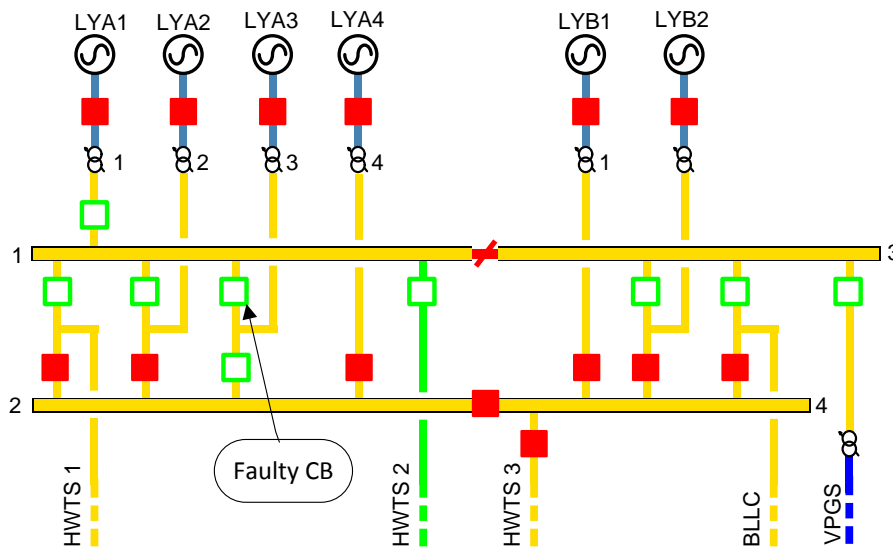
¹⁹ AEMO is required to notify the Market as it becomes aware of new and material information – NER Clause 4.2.3A(d).

²⁰ 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 power system at Loy Yang Power Station Switchyard immediately after the incident.

Loy Yang Power Station Switchyard





APPENDIX B. INCIDENT EVENT LOG

Chronological Log of Incident

Time and Date	Event
1106 hrs Thu 16 Jun 2016	Planned trip of LYPS-A3
1106 hrs	Tripped: <ul style="list-style-type: none"> • LYPS No.1 and 3 500 kV busbars, • LYPS-A 1 and LYPS-A 3 generating units Off-loaded: <ul style="list-style-type: none"> • Hazelwood to Loy Yang No.2 500 kV line. Disconnected: <ul style="list-style-type: none"> • LYGS.
1112 hrs	System frequency recovered to within the NOFB
1115 hrs	Constraint sets invoked: <ul style="list-style-type: none"> • V-HWLY_2 • V-LY_TX.
1120 hrs	Constraint sets invoked: <ul style="list-style-type: none"> • V-LY_BUS1 • V-LY_BUS3.
1126 hrs	Market Notice 53980 issued.
1128 hrs	Returned to service: <ul style="list-style-type: none"> • LYPS No.1 and No.3 500 kV busbars • Hazelwood to Loy Yang No.2 500 kV line returned to service.
1131 hrs	Market Notice 53981 issued.
1145 hrs	Constraint sets revoked: <ul style="list-style-type: none"> • V-HWLY_2 • V-LY_TX • V-LY_BUS1 • V-LY_BUS3
1149 hrs	Market Notice 53982 issued.
1411hrs	LYGS reconnected
2035 hrs	Returned to service: <ul style="list-style-type: none"> • LYPS-A 3 generating unit
0145 hrs 17 Jun 2016	Returned to service: <ul style="list-style-type: none"> • LYPS-A 1 generating unit
1009 hrs 28 Jun 2016	Returned to service: <ul style="list-style-type: none"> • Failed CB (LYPS-A 3 No.1 bus 500 kV CB).