# Trip of four 220 kV transmission lines at Mt Beauty on 24 November 2014

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

PUBLISHED MARCH 2015

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

## VERSION RELEASE HISTORY

| VERSION | DATE | BY | CHANGES | CHECKED BY | AUTHORISED BY |
|---|---|---|---|---|---|
| 1 | 12 Mar 2015 | S Darnell | FINAL | J Lindley | J Lindley |

## INCIDENT CLASSIFICATIONS

| | |
|---|---|
| Time and date and of incident | 1852 hrs Monday 24 November 2014 |
| Region of incident | Victoria |
| Affected regions | Victoria |
| Event type | Loss of multiple transmission elements (TT) |
| Primary cause | Environmental and Lightning (ENVI & LN) |
| Cutomer Load Impact | Nil |
| Generation Impact | 12 MW of generation disconnected |
| Associated reports | Nil |

## ABBREVIATIONS

| Abbreviation | Term |
|---|---|
| AEMO | Australian Energy Market Operator |
| CB | Circuit Breaker |
| kV | Kilovolt |
| MW | Megawatt |
| MBTS | Mt Beauty Terminal Station |
| MBTS-BOPS/MKPS | MBTS-Bogong and McKay Creek Power Stations 220 kV transmission line |
| MBTS-WKPS | MBTS-West-Kiewa Power Station 220 kV transmission line |
| MBTS-DDTS No.1 line | MBTS-Dederang Terminal Station No. 1 220 kV transmission line |
| MBTS-DDTS No.2 line | MBTS-Dederang Terminal Station No. 2 220 kV transmission line |
| NER | National Electricity Rules |

## IMPORTANT NOTICE

### Purpose

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

### Disclaimer

This document or the information in it may be subsequently updated or amended. This document does not constitute legal or business advice, and should not be relied on as a substitute for obtaining detailed advice about the National Electricity Law, the National Electricity Rules, or any other applicable laws, procedures or policies. AEMO has made every effort to ensure the quality of the information in this document but cannot guarantee its accuracy or completeness.

Accordingly, to the maximum extent permitted by law, AEMO and its officers, employees and consultants involved in the preparation of this document:

- make no representation or warranty, express or implied, as to the currency, accuracy, reliability or completeness of the information in this document; and
- are not liable (whether by reason of negligence or otherwise) for any statements or representations in this document, or any omissions from it, or for any use or reliance on the information in it.

# 1. OVERVIEW

This report reviews a power system operating incident that occurred on Monday 24 November 2014 at Mt Beauty Terminal Station (MBTS) in Victoria. This incident involved the trip of four 220 kV transmission and was initiated by lightning. No customer load was disconnected as a result of this incident.

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

AEMO concluded that:

- Lightning strikes caused two of the lines to trip
- Interference on protection communications caused the other two lines trip
- Power system security was maintained over the course of the incident.

This report is based on information provided by AusNet Services (AusNet)[3] and AEMO. National Electricity Market time (Australian Eastern Standard Time) is used in this report.

# 2. THE INCIDENT

On Monday 24 November 2014 at 1852 hrs, during a severe lightning storm, the following four 220 kV transmission lines tripped:

- MBTS-Bogong and McKay Creek Power Stations (MBTS-BOPS/MKPS)
- MBTS-West-Kiewa Power Station (MBTS-WKPS)
- MBTS-Dederang Terminal Station No. 1 (MBTS-DDTS No.1 line)
- MBTS-Dederang Terminal Station No. 2 (MBTS-DDTS No.2 line)

The MBTS-DDTS No.1 and No.2 lines then auto reclosed and returned to service. The MBTS-BOPS/MKPS and MBTS-WKPS lines remained out of service and were returned to service, overnight and the following morning respectively, following line patrols. As a result of this incident 12MW of generation, at West Kiewa Power Station, was disconnected.

See Appendix 1 for a power system diagram illustrating the incident and Appendix 2 for a chronological log of the incident.

The reason for investigating this incident that four transmission lines tripped for what appeared to be one fault caused by a lightning strike. Generally transmission lines are required to remain connected to the power system for faults that occur in other parts of the power system. The trip of four

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

transmission lines connected to Mount Beauty Terminal station is an unexpected event and is identified in power system security terms as a non-credible contingency.[4]

# 3. AUSNET SERVICES INVESTIGATION

AusNet Services investigated this incident a found that:

1. The MBTS-BOPS/MKPS and MBTS-WKPS lines tripped due to faults caused by simultaneous lightning strikes. The MBTS-BOPS/MKPS line tripped on a two phase to earth fault and the MBTS-WKPS tripped on a single phase to earth fault. The protection for the two lines correctly operated and cleared the faults within mandated clearance times. These lines were manually returned to service (no auto reclose on these lines) following line patrols. No damage was found on these lines as a result of the lightning strikes.
2. The MBTS-DDTS No.1 and No.2 lines tripped due to signalling interference between Mt Beauty and Dederang Terminal Stations. The interference caused protection at the Dederang end to operate for both lines and initiate circuit breakers to open at the Dederang. The circuit breakers then successfully auto reclosed.

The signalling interference between Mt Beauty and Dederang generated a Permissive Intertrip (PIT) signal on both sets of communication channels used by the line protection schemes between Mt Beauty and Dederang. These false signals initiated both X and Y protection to operate at Dederang.[5]

The X and Y protection relays at Dederang recorded several short pulses (the interference), however the communications equipment at Mount Beauty and Dederang did not register send or receive signals respectively. The protection relays at Mt Beauty did not record any such pulses. AusNet Services tested all relevant equipment but could not identify the source of the interference.

# 4. POWER SYSTEM SECURITY

This section assesses how the power system security was managed over the course of the incident.[6]

Immediately following the trip of the four transmission lines the power system was is a secure state so AEMO did not need to take any action to restore power system security.

AEMO then issued Market Notices 46939 and 46941, at 1935 and 1941 hrs, as notification of two non-credible contingency events:[7] the trip of the MBTS-DDTS No.1 and No.2 lines; and the trip of MBTS-BOS/MKPS and MBTS-WKPS lines. At this stage, AEMO was not aware that the four lines tripped as a result of the same lighting event and that the MBTS-DDTS No.1 and No.2 lines had tripped as a result of protection communication interference.

[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

[5] For a fault on the MBTS-DDTS line, the protection at Dederang require two conditions to initiate an instantaneous trip. One of the conditions is a fault in Zone 2 current flowing towards Mount Beauty (from Dederang) which was present due to the faults on the MBTS-WKPS and MBTS-BOPS/MKPS lines. The other condition is a PIT signal recieved from the opposite end (Mt Beauty) signalling that fault current at that end is (also) flowing into the line and fault detected in Zone 1. This was not the case for this incident as the fault current, for the fault on the MBTS-WKPS and MBTS-BOPS/MKPS lines, was flowing in the opposite direction. The protection equipment at Dederang should not have received a PIT signal. The interference generated a signal that simulated a PIT from Mt Beauty.

[6] 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.

[7] 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

AEMO issued Market Notice 46942 at 1948 hrs to reclassify the trip of the MBTS-DDTS No.1 and No.2 lines as a credible contingency due to lightning storm moving into in the region of the lines. AEMO considered these lines Vulnerable[8] to lightning due to the trip at 1852 hrs.

Following discussion with AusNet, AEMO issued Market Notice 46944 at 2100 hrs to notify the market that the four lines had tripped at the same time, and that the four lines were collectively Vulnerable to a lightning strike. At this stage AEMO considered that the four lines had tripped simultaneously as result of a lightning strike.

By 2109 hrs lightning activity was no longer present in the region of the MBTS-DDPS lines so AEMO cancelled the reclassification issued in Market Notice 46942.

AusNet returned to service the MBTS-BOPS/MKPS line at 2309 hrs the same day and the MBTS-WKPS line at 0930 hrs on Tuesday 25 November - the following morning.

At 0923 hrs, 25 November, AEMO issued Market Notice 46950 to notify the market that all four lines had returned to service and that the four lines are not collectively considered Vulnerable to lightning (reversing MN 46944). AusNet had notified AEMO that the MBTS-DDTS lines had not tripped as a result of a lightning strike and that the MBTS-BOPS/MKPS and MBTS-WKPS had tripped as a result of separate simultaneous lightning strikes.

At 0954 hrs AEMO issued Market Notice 46949 to reclassify the trip of the four lines as a single credible contingency. At this stage the reason why the MBTS-DDTS lines had tripped was unresolved so AEMO considered that the event could reoccur.

AEMO cancelled the reclassification on 6 March (Market Notice 48456) following consideration of the AusNet investigation into the incident. AEMO considered that although AusNet had not identified the source of the interference, AusNet had taken all reasonable measures to resolve the problem.

Over the course of the incident power system security was maintained and AEMO and AusNet took appropriate actions based upon the information available.

# 5. CONCLUSIONS

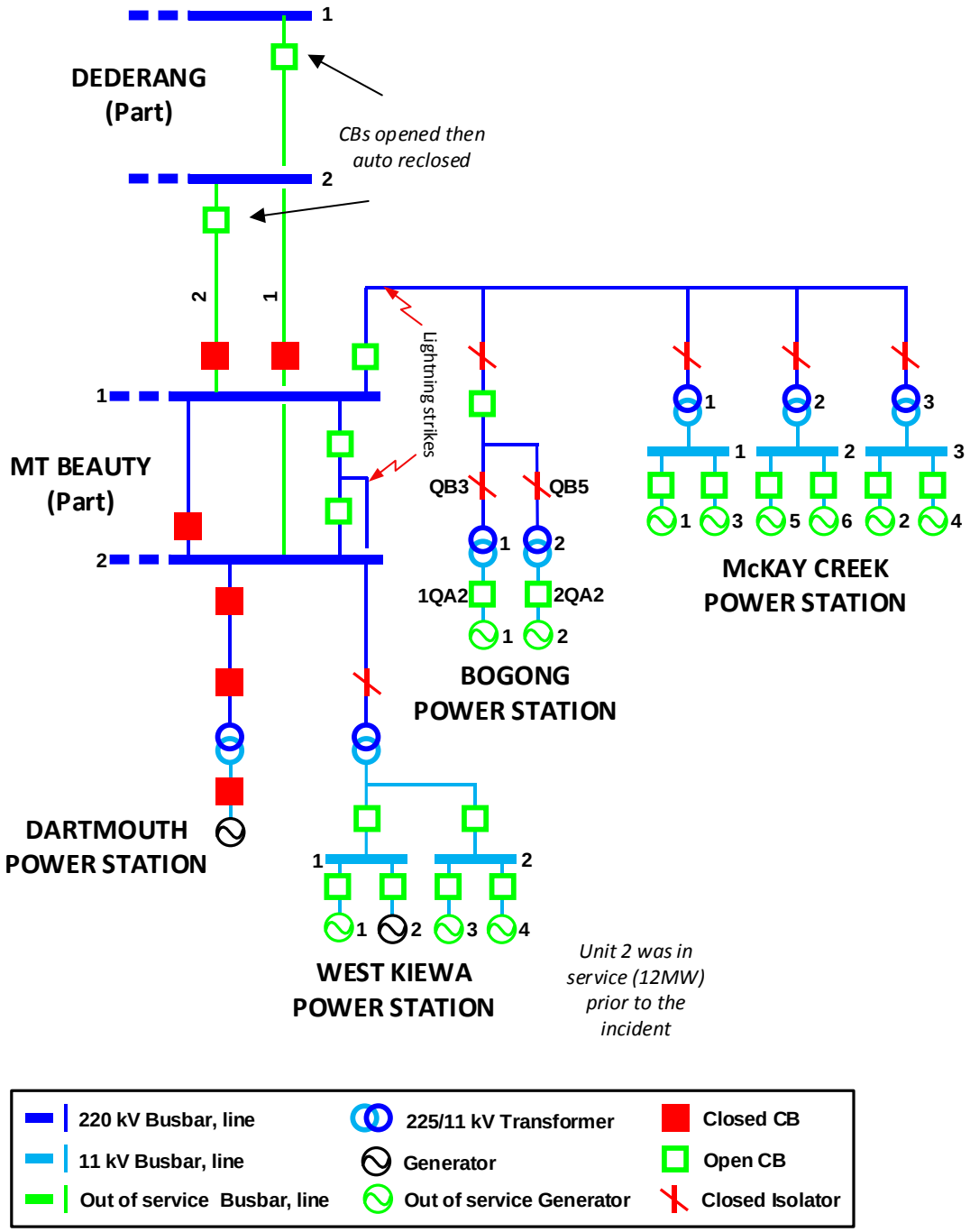
AEMO concluded that:

1. The MBTS-DDTS Lines tripped as a result of unidentified interference on protection communication links between Mt Beauty and Dederang Terminal Stations.
2. The MBTS-WKPS and MBTS-BOPS/MKPS lines tripped due to simultaneous lightning strikes close to Mt Beauty Terminal Station.
3. Power system security was maintained over the course of the incident

[8] Vulnerable double circuit transmission lines are lines considered by AEMO to be probable or proven to trip both circuits in the event of a lightning strike

# APPENDIX 1 – POWER SYSTEM DIAGRAM

## Diagram illustrating the incident



# APPENDIX 2 – INCIDENT EVENT LOG

## Incident Log

| Time and Date | Event |
|---|---|
| 1852 hrs 24 Nov | The MBTS-BOPS/MKPS, MBTS-WKPS, MBTS-DDTS No. 1 and No.2 lines tripped |
| 1852 hrs 24 Nov | The MBTS-DDTS No. 1 and No. 2 lines auto-reclosed |
| 1935 hrs 24 Nov | AEMO issued Market Notice 46939 to notify the market that:<br>• the MBTS-DDTS No. 1 and No. 2 lines had tripped and auto-reclosed<br>• this event was a non credible contingency caused by lightning |
| 1941 hrs 24 Nov | AEMO issued Market Notice 46941. Notification that:<br>• the MBTS-BOPS/MKPS and MBTS-WKPS lines had tripped<br>• this event was a non credible contingency caused by lightning. |
| 1948 hrs 24 Nov | AEMO issued Market Notice 46942 to reclassify as a credible contingency the trip of the MBTS-DDTS No. 1 and No. 2 lines due to lightning in the region (the two lines are deemed Vulnerable to lightning) |
| 2100 hrs 24 Nov | AEMO issued Market Notice 46944. Notification that:<br>• the MBTS-DDTS No. 1 and No. 2 lines and the MBTS-BOPS/MKPS and MBTS-WKPS lines tripped at the same time<br>• the MBTS-BOPS/MKPS and MBTS-WKPS lines remained out of service<br>• the (four) lines that tripped during event are now Vulnerable Lines and may be reclassified as a credible contingency during a lightning activity |
| 2109 hrs 24 Nov | AEMO issued Market Notice 46947 to cancel the reclassification issued in MN 46942 |
| 2309 hrs 24 Nov | MBTS-BOPS/MKPS line returned to service |
| 0930 hrs 25 Nov | MBTS-WKPS line returned to service |
| 0923 25 Nov | AEMO issued Market Notice 46950. Notification that:<br>• All lines had returned to service<br>• The lines are not deemed Vulnerable and will not be reclassified for lightning (ref: MN 46944) |
| 0954 hrs 25 Nov | AEMO issued Market Notice 46949 to reclassify as a single credible contingency the trip of the<br>• MBTS-DDTS No. 1 and No. 2 lines<br>• MBTS-BOPS/MKPS line<br>• MBTS-WKPS line |
| 1842 hrs 6 Mar | AEMO issued Market Notice 48456 to cancel the reclassification issued in MN 46949 |