# Trip of Dederang-Mount Beauty No.1 and No.2 220 kV transmission lines on 13 Aug 2014

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

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AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

# VERSION RELEASE HISTORY

| VERSION | DATE | BY | CHANGES | CHECKED BY | AUTHORISED BY |
|---|---|---|---|---|---|
| 1 | 19 Sept 2014 | S Darnell | FINAL | R Burge | P Biddle |

# INCIDENT CLASSIFICATIONS

| | |
|---|---|
| Time and date and of incident | 2014 hrs Wednesday 13 August 2014 |
| Region of incident | Victoria |
| Affected regions | Victoria |
| Event type | TT – Loss of multiple transmission elements |
| Primary cause | UKN – Unknown reason |
| Impact | Nil |
| Associated reports | Nil |

# ABBREVIATIONS

| Abbreviation | Term |
|---|---|
| AEMO | Australian Energy Market Operator |
| CB | Circuit Breaker |
| DEF | Directional Earth Fault |
| kV | Kilovolt |
| MW | Megawatt |
| NER | National Electricity Rules |
| No.1 Line | The Dederang to Mount Beauty No.1 220 kV transmission line |
| No.2 Line | The Dederang to Mount Beauty No.2 220 kV transmission line |

# IMPORTANT NOTICE

## Purpose

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

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# 1. INTRODUCTION

This report reviews a power system operating incident[1] that occurred on Wednesday 13 August 2014 in Victoria on the Dederang-Mt Beauty 220 kV transmission lines.

The purpose of this incident review is to assess power system security over the course of the incident. The NER requires AEMO 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].

This report is based upon information provided by AEMO[3] and AusNet Services[4] (AusNet). National Electricity Market time (Australian Eastern Standard Time) is used in this report.

# 2. THE INCIDENT

On Wednesday 13 August 2014, at 2014 hrs, the Dederang-Mount Beauty No.1 and No.2 transmission lines (No.1 Line and No.2 Line) simultaneously tripped. The No.1 Line tripped at both ends due to a transient single phase to earth fault, then auto-reclosed at both ends and returned to service. The No.2 Line tripped at the Mount Beauty end, as a result of the transient fault on No.1 Line, and then remained open at the Mount Beauty end.

No load or generation was lost as a result of this incident. See Appendix 1 for a power system diagram illustrating the incident and a chronological log of the incident.

The reason for investigating this incident is that the No.2 Line tripped for a fault associated with No.1 Line. 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 two lines is an unexpected event and is identified in power system security terms as a non-credible contingency[5].

# 3. AUSNET SERVICES INVESTIGATION

AusNet investigated this incident and found that No.1 Line tripped due a transient phase to earth fault, and No.2 line tripped due to an inadequate time delay setting on the Directional Earth Fault (DEF) function of a protection relay. No.1 Line auto-reclosed and returned to service immediately. No.2 Line remained open at the Mount Beauty end and was manually reclosed shortly after the event.

No.1 Line tripped due to an unidentified[6] single phase to earth fault which was correctly detected and cleared by protection relays at each end of the line. The No.1 Line auto-reclose scheme then successfully reclosed the circuit breakers at both ends which returned No.1 Line to service. AusNet patrolled the line the following day and identified three flashed insulators each on different towers. AusNet will replace these insulators at the next No.1 Line outage opportunity.

[1] AEMO is required to review this incident as it is classified as a non-credible contingency that satisfies the requirements of a reviewable operating incident under the National Electricity Rules 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] In Victoria AEMO is both the National Electricity Market operator and the Victorian Transmission Network Service Planner.
[4] Information provided by AusNet Services is 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] 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
[6] Lightning and wind were present in the vicinity of the lines at the time of the incident

At the time of the phase to earth fault on No. 1 Line there was lightning and wind in the vicinity of the line, however the reason for the fault could not be definitively determined.

No.2 Line tripped at the Mount Beauty end as a result of a Y directional earth fault (DEF) relay operation (X protection[7] DEF did not operate). The relay operated due to a change in direction of fault current flow on No.2 Line when the No.1 Line circuit breaker opened at Mount Beauty.

Whilst the fault was present on No.1 Line, the fault current on No.2 Line initially flowed from Dederang to Mount Beauty because the Dederang end was the stronger source. The Y DEF at Dederang detected a forward fault current and sent a signal (fault present) to Mount Beauty. At Mount Beauty the Y DEF detected a reverse fault and did not send a signal to Dederang. At this stage the Y DEF protection relay at each end of No.2 Line had operated correctly[8] and no circuit breaker operation had been initiated.

The No.1 Line circuit breaker at Mount Beauty then opened, momentarily, before the No.1 Line circuit breaker at Dederang. This caused the fault current on No.2 Line to change direction and flow from Mount Beauty to Dederang. The Y DEF at Mount Beauty now correctly detected a forward fault current, however the signal from Dederang had not yet dropped off so the trip condition was fulfilled. The Y DEF at Mount Beauty operated to trip No.2 Line at Mount Beauty. This overlap of a forward fault current and the presence of the remote signal (which should have dropped off due to the fault current reversal at Dederang) was incorrect.

No.2 Line was returned to service at 2019 hrs, five minutes after the event, by a manual reclose at Mount Beauty. On the 15 Aug 2014, two days after the event, the cause of the incorrect trip was identified and the Y DEF relays at each end of the No.2 Line were disabled. No.2 Line remained in service as sufficient protection is enabled despite the DEFs being disabled[9]. The DEF relays will be returned to service when revised protection settings have been applied.

# 4. POWER SYSTEM SECURITY

This section assesses how the power system security was managed over the course of the incident[10].

The first response to the event was the successful auto-reclose of No.1 Line and followed five minutes later by the manual close of No.2 Line by AusNet. No further immediate actions were required as the power system was secure[11].

AEMO issued Market Notice 46291 at 2102 hrs on 13 Aug 2014 to notify the market of the non-credible contingency event[12]. Shortly after at 2112 hrs AEMO issued Market Notice 46292 to notify the market that AEMO had reclassified the event as a credible contingency[13]. AEMO reclassified the event

[7] Protection schemes on transmission systems are usually replicated (two systems operating in parallel). Generally where two schemes are used they are notionally known as X and Y.

[8] The condition for a DEF operation is a forward fault current and a signal received for the remote end. This logic determines that the fault is somewhere between the two relays and a trip at each end is required.

[9] DEFs in this case are employed at the discretion of the network service provider as sufficient protection is elsewhere enabled to satisfy mandatory requirements

[10] 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.

[11] 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)

[12] 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

[13] 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.

because the cause of the event had not been identified and AEMO considered that the event could reoccur.

AusNet informed AEMO on 15 Aug 2014 that the cause of No.2 Line trip had been identified and that the Y DEF relays had been disabled at both ends of No.2 Line. AEMO then issued Market notice 46304 at 1721 hrs on 15 Aug 2014 to cancel this event as a credible contingency. AEMO was satisfied that the cause of the credible contingency had been identified and that it was unlikely to reoccur.

For this incident the power system remained secure, and the fault was cleared within required timeframes[14]. AEMO correctly assessed the incident and reclassified the incident as a credible contingency, and appropriate notifications were issued. The provision and response of facilities and services were adequate to maintain power system security over the course of the incident.

# 5. CONCLUSIONS

1. No.1 Line tripped due to a transient phase to earth fault. The line successfully auto-reclosed and immediately returned to service. The reason for the fault could not be determined.
2. No.2 Line tripped at the Mount Beauty end due to an inadequate time delay setting on the Y DEF protection relay. The Y DEF protection for No.2 Line has been disabled and will return to service when revised protections setting have been applied.
3. Power system security was maintained over the course of the incident.

# 6. PENDING ACTIONS

1. AusNet to replace flashed insulators on No.1 Line.

# 7. RECOMMENDATIONS

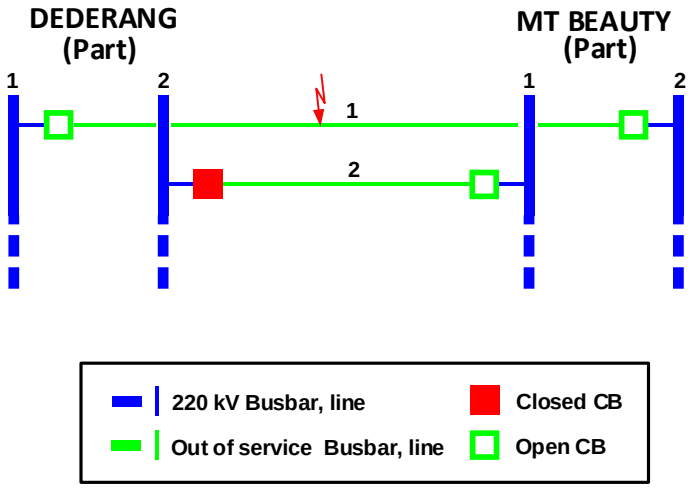
1. There are no recommendations arising from this incident.

[14] NER Schedule 5.1a System Standards Clause S5.1a.8 – Fault clearance times

# APPENDIX 1 – POWER SYSTEM DIAGRAM AND EVENT LOG

## Power System Diagram

The power system immediately after the incident before No.1 Line auto reclosed




## Incident Event Log

| Time and Date | Event |
|---|---|
| 2014 hrs 13 Aug 2014 | No.1 Line trips at both ends |
| 2014 hrs 13 Aug 2014 | No.2 Line trips at Mount Beauty end |
| 2014 hrs 13 Aug 2014 | No. 1 Line recloses at both ends |
| 2019 hrs 13 Aug 2014 | No. 2 Line manually reclosed at Mount Beauty end |
| 2102 hrs 13 Aug 2014 | Market Notice 46291 issued. Notification of a non-credible contingency event |
| 2112 hrs 13 Aug 2014 | Market Notice 46292 issued. Notification that the incident had been reclassified as a credible contingency |
| 14 Aug 2014 | AusNet patrols No.1 Line and identifies three flashed insulators |
| 15 Aug 2014 | AusNet determines the cause of No.2 Line trip and notifies AEMO |
| 1721 hrs 15 Aug 2014 | Market Notice 46304 issued. Notification of a non-credible contingency event |