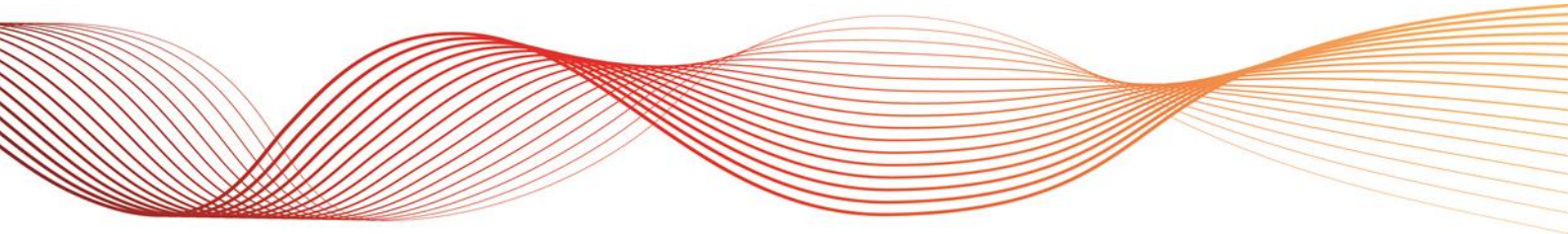




POWER SYSTEM INSECURE IN VICTORIA ON 13 JANUARY 2016

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

Published: April 2016





VERSION RELEASE HISTORY

VERSION	DATE	BY	CHANGES	CHECKED BY	AUTHORISED BY
1	14/04/2016	Tien Foong	Initial	Peter Biddle	Mark Stedwell

INCIDENT CLASSIFICATIONS

Classification	Detail
Time and date of incident	1509 hrs to 1550 hrs on Wednesday 13 January 2016
Region of incident	Victoria
Affected regions	Victoria
Event type	Power system not in a secure operating state
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
kV	Kilovolt
MW	Megawatt
NER	National Electricity Rules
BATS	Ballarat Terminal Station
BETS	Bendigo Terminal Station
DDTS	Dederang Terminal Station
GNTS	Glenrowan Terminal Station
SHTS	Shepparton Terminal Station
SOCS	System Overload Control Scheme



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 Wednesday 13 January 2016 in Victoria where the power system was not in a secure operating state for more than 30 minutes.

At the time of the incident, the potential for a simultaneous trip of Dederang – Glenrowan (DDTS – GNTS) No. 1 & 3 220 kV transmission lines was reclassified as a single credible contingency due to lightning in the vicinity.

The power system was in a satisfactory but not secure operating state during this incident because the Dederang – Shepparton (DDTS – SHTS) 220 kV line would have been overloaded if the DDTS – GNTS No.1 & 3 220 kV lines had tripped.

This incident is a reviewable operating incident under the National Electricity Rules (NER)¹ as the power system was not in a secure operating state for more than 30 minutes. 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

For this incident, AEMO concluded that:

1. Reclassification of the DDTS – GNTS No. 1 & 3 220 kV lines was done in accordance with the National Electricity Rules (NER) and AEMO procedures.
2. The power system was not in a secure operating state for 40 minutes. AEMO's actions are considered appropriate under the weather and market conditions at the time of the event.

This report is based on information from AEMO's Energy and Market Management Systems. National Electricity Market time (Australian Eastern Standard Time) is used in this report.

¹ NER Clause 4.8.15(a)(1)(iv) and AEMC Reliability Panel Guidelines for Identifying Reviewable Operating Incidents.

² NER Clause 4.8.15 (b)

2. THE INCIDENT

2.1 Incident Circumstances

On Wednesday 13 January 2016, lightning activity was observed in the vicinity of DDTS – GNTS No.1 & 3 220 kV transmission lines. In accordance with operating procedures³, AEMO reclassified the potential of a simultaneous trip of these lines as a single credible contingency event at 1509 hrs due to lightning. As a result of this reclassification, constraint set V-DDGN_N-2 was invoked to prevent overloading of the DDTS – SHTS and Ballarat – Bendigo (BATS – BETS) 220 kV transmission lines in the event of the DDTS - GNTS No. 1 & 3 220 kV lines tripping simultaneously.

During this reclassification the constraint equation associated with the DDTS – SHTS line violated⁴, indicating that the DDTS – SHTS 220 kV line would have been overloaded if the DDTS – GNTS No.1 & 3 220 kV lines had tripped. The potential overload of the DDTS – SHTS line meant that the power system was not in a secure operating state from 1510 to 1550 hrs (40 minutes).

At the time of this incident, Victoria was experiencing temperatures exceeding 40 °C, resulting in a very high operational demand of approximately 9,400 MW⁵.

The power system was returned to a secure operating state at 1550 hours after the reclassification was cancelled due to a change in weather conditions.

The following sections provide detailed information about this incident.

2.2 Cause of the power system incident

During the incident, the power system was not in a secure operating state because the DDTS – SHTS 220 kV line would have been overloaded if the DDTS – GNTS No.1 & 3 220kV lines had tripped. Constraint equation V->DDSH_DDGN_N-2⁶ was violating, indicating that AEMO’s market systems could not find a solution to prevent the overload. The magnitude of the constraint violations and potential loading of the DDTS – SHTS 220 kV line are given in Table 1.

Table 1 Constraint violation and potential loading of the DDTS – SHTS 220 kV transmission line

Dispatch interval ending	Violation (MW)	Potential loading of DDTS - SHTS line (% of line rating)
13/01/2016 15:15	375	134%
13/01/2016 15:20	372	129%
13/01/2016 15:25	338	126%
13/01/2016 15:30	319	128%
13/01/2016 15:35	281	125%
13/01/2016 15:40	246	124%

³ AEMO Power System Security Guidelines SO_OP3715. http://www.aemo.com.au/Electricity/Policies-and-Procedures/System-Operating-Procedures/Power-System-Security-Guidelines-SO_OP3715

⁴ A constraint violation is an indication that the National Electricity Market Dispatch Engine (NEMDE) was not able to determine a solution to meet the limits defined by the constraint equation.

⁵ Average operational demand in VIC is approximately 5,500 MW. The highest operational demand ever recorded in VIC is 10,576 MW, which occurred on 29 January 2009.

⁶ Avoid overload of DDTS - SHTS line on trip of both DDTS-GNTS lines. Part of constraint set V-DDGN_N-2

Dispatch interval ending	Violation (MW)	Potential loading of DDTS - SHTS line (% of line rating)
13/01/2016 15:45	231	123%
13/01/2016 15:50	218	121%

Constraint equation V>>DDSH_DGDN_N-2 was designed to prevent overloading of the DDTS – SHTS 220 kV line in the event of the DDTS - GNTS No. 1 & 3 220 kV lines tripping. To achieve this, the constraint sought to limit power flow across the DDTS - SHTS and DDTS – GNTS lines, such that post-contingent flow on the DDTS - SHTS 220 kV line remained within operational limits. This was done by applying limits to the output of specific generating units in Victoria as well as power flow on selected interconnectors, which collectively influenced power flow across these lines.

Due to the high temperatures in Victoria and resulting high demand, the output of most generating units in Victoria and interconnector flows into Victoria were at high levels at the time of the incident. As such, limited options were available to AEMO’s market systems to quickly change the dispatch of generation to remove the potential line overload:

1. Generation options

Generation options that would normally be used to relieve the constraint violation and thereby reduce the potential overloading of the DDTS – SHTS 220 kV line are:

- Decrease generation in north east Victoria. This option only had limited impact as these generating units were either off-line or ramping down at their maximum available ramp rate.
- Increase generation in south and west Victoria to either directly influence line flows or to replace generation that was limited due to the constraint action. This option also had limited impact as these generating units were either:
 - Already generating at the maximum available output; or
 - Unable to increase generation quickly due to either their ramp rate limitations or fast start inflexibility profiles. This included generating units at Somerton, Jeeralang and Valley Power power stations, which were dispatched to start generating during this incident.

2. Interconnector flow options

Interconnector flow options that would normally be used to relieve the constraint violation are:

- Increase interconnector flow from SA to Victoria: An increase in the interconnector flow from SA to Victoria would have reduced potential overloading of the line. This option was not available because both the Heywood and Murraylink interconnectors were already at their maximum transfer limit into Victoria.
- Decrease interconnector flow from NSW to Victoria. Reducing the flow on this interconnector would have helped relieve potential line overload. However, as discussed above, this option was also limited because a reduction in flow on the NSW-Victoria interconnector would need to be replaced by increased generation in the south and west of Victoria.

If the DDTS – GNTS No.1 & 3 220 kV lines had tripped the DDTS – SHTS 220 kV line would have been overloaded up to 134% of the line rating (see Table 1). A cascade failure impacting the entire



north-west area of Victoria could have occurred due to line overloading under such circumstances. The magnitude of this potential loading however was decreased to 121% of the line rating by the end of the incident.

3. POWER SYSTEM SECURITY

AEMO is responsible for power system security in the NEM⁷. This means AEMO is required to operate the power system in a secure operating state and return the power system to a secure state as soon as it is practical to do so, and in any event within 30 minutes following a contingency event⁸.

This section assesses how AEMO managed power system security over the course of this incident.

As described, the power system was not in a secure operating state for 40 minutes.

During this period AEMO considered what options were available to restore power system security.

3.1 Generation solution

At 1533 hrs, it was determined that a viable generation and interconnector flow solution was unavailable to sufficiently relieve the potential overloading of the DDTS – SHTS 220 kV line (see Section 2.2 for more detail).

3.2 Line ratings

As the constraint violation was based on the thermal rating for the DDTS – SHTS line, AEMO contacted AusNet Services⁹ to confirm the rating and see if an increased rating was possible. AusNet advised that an increase in the line rating was not possible under the current weather conditions.

3.3 Post-contingent load shedding

In Victoria a control scheme known as the System Overload Control Scheme (SOCS) is available on some transmission lines. This control scheme allows use of a short term thermal rating on the basis that if the line overloads, then customer load is automatically shed to immediately remove the overload. AEMO confirmed with AusNet that the SOCS scheme was not available for the DDTS – SHTS line.

3.4 Pre-contingent load shedding

The only remaining option available to AEMO was to shed customer load in the Shepparton and Glenrowan areas to remove the potential to overload the DDTS – SHTS line and restore the power system to a secure operating state. AEMO did not implement load shedding because it was determined that the threat posed by the weather situation was reducing, such that reclassification of the DDTS-GNTS lines could be cancelled.

At 1547 hrs, the weather system was assessed to be no longer a threat to the power system. Based on this assessment, AEMO cancelled the reclassification of the DDTS - GNTS No. 1 & 3 220 kV lines as a single credible contingency and revoked constraint set V-DDGN_N-2. This action returned the power system to a secure operating state.

The combination of system conditions, including very high demand and weather conditions resulted in an unlikely situation where AEMO was not able to return the power system to a secure state within the

⁷ NER clause 4.3.1

⁸ NER clause 4.2.6(b)

⁹ As owner and operator of the DDTS-SHTS line.



defined time frame. At the time, very limited solutions/options (other than pre-contingent manual load shedding) were available to alleviate this situation. To manage future events of this type, AEMO will discuss with AusNet the option of adding the DDTS - SHTS line to the SOCS.

3.5 Review of constraint formulation

Following this incident, AEMO reviewed constraint equation $V \gg \text{DDSH_DDGN_N-2}$ and concluded that its formulation and performance were appropriate. The formulation of this constraint equation was based on the physical limits of the network infrastructure involved (i.e. the line rating of each 220 kV line), and hence was independent of the market condition.

4. 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 market¹⁰ over the course of this incident.

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

1. Reclassification of the DDTS - GNTS No. 1 & 3 220 kV lines as a single credible contingency event due to lightning – AEMO must notify market participants as soon as practicable.¹¹

AEMO issued Market Notice 51316 at 1516 hrs (7 minutes after the event) to notify market participants about the reclassification and the constraint set V-DDGN_N-2 that was invoked following the reclassification.

2. Cancellation of the reclassification of the DDTS - GNTS No. 1 & 3 220 kV lines as a single credible contingency event due to lightning - AEMO must notify market participants as soon as practicable.

AEMO issued Market Notice 51323 at 1552 hrs to notify market participants that AEMO had cancelled the reclassification at 1550 hrs because there was no further lightning activity in the vicinity, and that the constraint set V-DDGN_N-2 had been revoked.

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

¹⁰ AEMO generally informs the market about operating incidents by issuing Market Notices

¹¹ NER 4.2.3A



5. CONCLUSIONS

Over the course of this incident, the power system was not in a secure operating state for 40 minutes. This was because the DDTS – SHTS 220 kV transmission line would have been overloaded if the DDTS – GNTS No. 1 & 3 220 kV transmission lines had tripped due to the lightning activity in the vicinity. The cause of the constraint violation was the lack of a viable generation and interconnector flow solution that could sufficiently relieve the potential line overloading. A key contributing factor was the very high demand in Victoria at the time of this incident.

AEMO concluded that:

1. The reclassification of the DDTS – GNTS No. 1 & 3 220 kV lines was done in accordance with the NER and AEMO's procedures. Formulation and performance of the reclassification constraint were appropriate.
2. The power system was not in a secure operating state for 40 minutes. AEMO was not able to return the power system to a secure operating state within 30 minutes as required by the NER. AEMO's actions are considered appropriate under the weather and market conditions at the time of the event.

6. RECOMMENDATIONS

AEMO will investigate the viability of implementing SOCS facilities for transmission lines in the Shepparton, Glenrowan and Dederang areas.

APPENDIX A. – POWER SYSTEM DIAGRAM

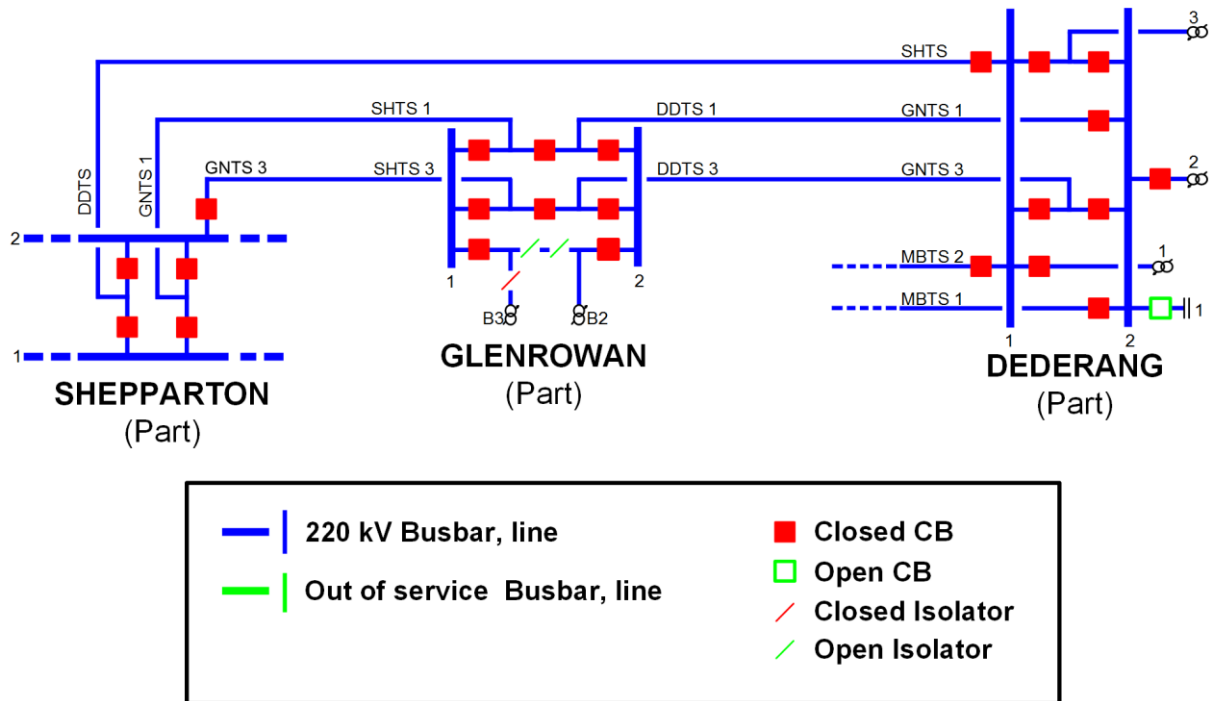


Figure 1. The status of affected power system elements at the beginning of the incident at 1515 hrs on 13 January 2016.



APPENDIX B. – AEMO’S INCIDENT EVENT LOG

Chronological Log of Incident

Time and Date	Event
1509 hrs Wed 13 Jan 2016	AEMO reclassified the Dederang - Glenrowan No. 1 & 3 220 kV lines as a single credible contingency due to lightning activity. Following this reclassification, the constraint V-DDGN_N-2 was invoked and subsequently violated.
1516 hrs	Market Notice 51316 was issued.
Between dispatch intervals 1515 and 1550 hrs	NEMDE indicated a viable generation or interconnector flow solution was unavailable. Following this, AEMO consulted AusNet Services on the possibility of re-rating of the Dederang – Shepparton 220 kV line. This option was unavailable.
1547 hrs	The reclassification of the Dederang - Glenrowan No. 1 & 3 220 kV lines as a single credible contingency was cancelled.
1552 hrs	Market Notice 51323 was issued.