



Outage of Lismore SVC on 30 March 2017

REVIEWABLE OPERATING INCIDENT REPORT UNDER THE
NATIONAL ELECTRICITY RULES

Published: **18 May 2017**





INCIDENT CLASSIFICATIONS

Classification	Detail
Time and date of incident	1734 hrs on 30 March 2017
Region of incident	New South wales
Affected regions	New South Wales and Queensland
Event type	Power system not secure
Generation Impact	There was no loss of generation as a result of this incident
Customer Load Impact	No customer load was disconnected as a result of this incident
Associated reports	Nil

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 relates to a reviewable operating incident¹ that occurred on Thursday 30 March 2017, where the Lismore static VAR compensator (SVC) was taken out of service when the Lismore substation flooded. As a result of the SVC outage, the power system in northern New South Wales and southern Queensland was not in a secure operating state for more than 30 minutes. The flooding at Lismore substation resulted from heavy rain associated with ex-cyclone Debbie.

There was no loss of customer load or generation as a result of this incident.

As a reviewable operating incident, AEMO is required to assess power system security over the course of this incident, and 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 has concluded that:

- The power system was not in a satisfactory operating state³ for 15 minutes.
- The power system was not in a secure operating state for 66 minutes.
- The combination of outages and constraints sets invoked to manage these outages resulted in a situation where the National Electricity Market Dispatch Engine (NEMDE) was not able to determine a feasible solution.
- The actions taken by AEMO to return the power system to a satisfactory and secure operating state were reasonable and timely.

This report is prepared in accordance with clause 4.8.15 of the National Electricity Rules (NER). It is based on information from AEMO's energy and market management systems.

Australian Eastern Standard Time (AEST) is used in this report.

2. PRE-EVENT CONDITIONS

At the time of this incident, there were planned outages of the Coffs Harbour – Koolkhan 96H 132kV transmission line (96H line) which commenced on 10 January 2017 and the Mudgeeraba – Terranora 757 110kV transmission line (757 line) which commenced on 28 March 2017. There was also an unplanned outage of Directlink⁴ DC Pole 2 which commenced on 27 February 2017. As a result of these outages the following constraint sets were invoked:

- N-CHKK_96H.
- I-MUTE_757.
- N-MBTE_1.

During the assessment process for the 757 line outage, it was noted that this outage may cause a conflict in relation to the flow required across the Terranora Interconnector⁵ and Directlink, where the outage of 757 line would restrict flow south on the Terranora interconnector while the outage of 96H line would restrict flow north. Based on network studies by AEMO before the outage, AEMO determined that such a conflict was unlikely and that power system security would be maintained. As well, to prevent voltage collapse in northern New South Wales, a control scheme (the Directlink Emergency Control Scheme) is in place that trips Directlink if either the Armidale – Coffs Harbour 87 330kV line or Coffs Harbour 89 330kV line trips and Directlink flow is towards Queensland. On this basis, the outage of 757 line was allowed to proceed.

¹ See NER clause 4.8.15

² See NER clause 4.8.15(b).

³ See NER clause 4.2.2

⁴ Directlink is a DC connection between Terranora and Mullumbimby substations in New South Wales.

⁵ The Terranora Interconnector is the 110kV interconnector between Queensland and New South Wales and consists of the two Mudgeeraba to Terranora 757 and 758 110kV transmission lines.

3. THE INCIDENT

At 1734 hrs on Thursday 30 March, TransGrid removed the Lismore SVC from service when Lismore substation flooded. Refer to Appendix A for a diagram of the relevant part of the power system.

The Lismore SVC was returned to service at 2055 hrs on 30 March 2017.

4. POWER SYSTEM SECURITY

AEMO is responsible for power system security in the National Electricity Market (NEM). This means AEMO is required to operate the power system in a secure operating state to the extent practicable and take all reasonable actions to return the power system to a secure state following a contingency event in accordance with the NER.⁶

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

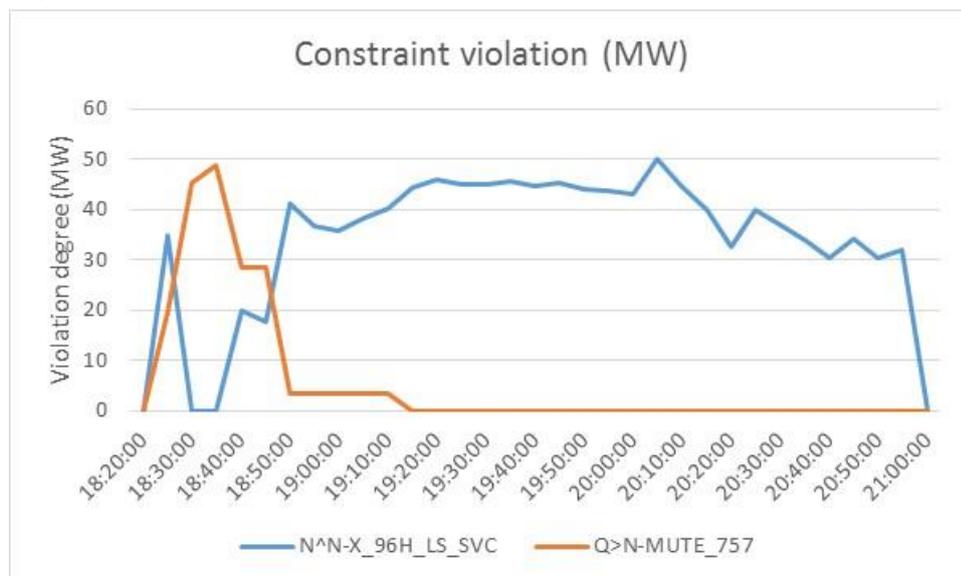
In response to the SVC outage, AEMO invoked constraint set N-LS_VC1⁷ from the 1740 dispatch interval. None of the constraint equations within this constraint set bound during the outage of the SVC, that is, the constraint set had no impact on dispatch results.

Despite the fact that constraint equations within constraint set N-LS_VC1 did not bind, AEMO’s contingency analysis tools showed low voltage violations in the surrounding area if the Coffs Harbour – Lismore No.89 330kV line tripped. Between 1735 hrs and 1826 hrs, AEMO took a number of actions including switching out of reactors at Lismore and setting the 330/132kV transformer tap-changer at Lismore to manual, to improve the voltage profile. All contingency analysis violations ceased at 1826 hrs.

Constraint set N-X_96H_LS_SVC⁸ was invoked from the 1825 dispatch interval after AEMO confirmed the constraint set was appropriate for power system conditions at the time.

From the 1825 dispatch interval, constraint equations N^N-X_96H_LS_SVC⁹ and Q>N-MUTE_757¹⁰ started to violate as shown in Figure 1.

Figure 1: Constraint violations



⁶ Refer to AEMO’s functions in section 49 of the National Electricity Law and the power system security principles in clause 4.2.6 of the NER

⁷ Out = Lismore SVC. Avoid voltage collapse for loss of Liddell – Muswellbrook No. 83 330kV line or large generating units in Queensland.

⁸ Out = Coffs Harbour – Koolkhan (96H) 132kV line and Lismore SVC. Avoid voltage collapse for loss of Coffs Harbour – Lismore (89) 330kV line.

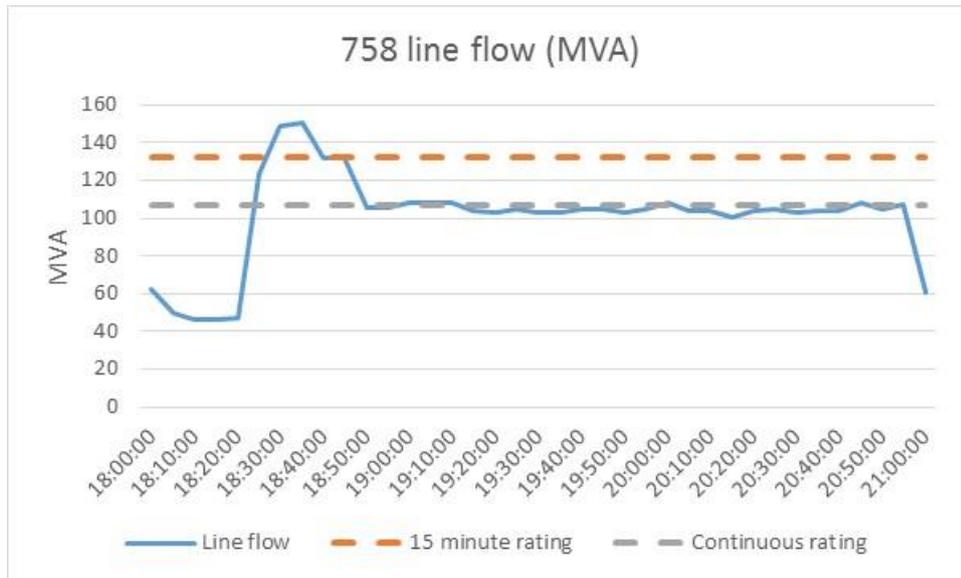
⁹ Part of constraint set N-X_96H_LS_SVC

¹⁰ Part of constraint set I-MUTE_757

Constraint N^N-X_96H_LS_SVC is to prevent voltage collapse in northern New South Wales on the loss of the Coffs Harbour – Lismore No.89 330kV transmission line. The constraint required an increased flow south from Queensland across the Terranora Interconnector. At the same time, constraint Q>N-MUTE_757 is to prevent thermal overloading on the Mudgeeraba – Terranora 758 line during the outage of the 757 line, and was limiting flow south from Queensland on the Terranora Interconnector. The combination of these conflicting constraint requirements meant the National NEMDE could not determine a feasible solution to meet the requirements of both constraints simultaneously.

AEMO determined the most urgent issue was the actual overloading of the 758 line as shown in Figure 2. The actual overloading of the 758 line meant the power system was not in a satisfactory operating state.

Figure 2: 758 line flow



AEMO considered recalling the 757 line to service. However this outage had a 90 minute recall time and action to return the power system to a satisfactory operating state was required much sooner than this to avoid damage to equipment.

To bring the flow on the 758 line to within its rating, AEMO invoked constraint set #N-Q_MNSP1_E¹¹ from the 1835 dispatch interval to limit the flow south on the Terranora Interconnector as shown in Table 1.

Table 1: Terranora limit

Dispatch intervals	Limit (MW)
1835 - 1845	130
1845 - 1910	105
1910 - 2055	101

The flow on the 758 line returned to below the 15 minute rating by ~1840 hrs and to below the continuous rating by ~1850 hrs. The power system was not in a satisfactory operating state between 1825 hrs to 1840 hrs, a period of 15 minutes.

AEMO then considered the violation of constraint equation N^N-X_96H_LS_SVC. Based on results from its online network analysis tools, AEMO determined that the power system was in a secure operating state despite the constraint violation. AEMO considered blocking the constraint equation but determined the constraint was still required to ensure flow on Directlink was in a southerly direction to

¹¹ This constraint had a constraint violation penalty (CVP) factor of 360 which ensured this constraint was not violated.



prevent the operation of the Directlink Emergency Control Scheme on the loss of either the 87 or 89 lines.

The power system was not in a secure operating state from when the SVC was taken out of service at 1734 hrs until 1840 hrs when power flow on the 758 line was reduced to its rated capacity, a period of 66 minutes.

Subsequent to this event, AEMO has reviewed the N^N-X_96H_LS_SVC constraint equation and has determined it was formulated in accordance with advice received from TransGrid. AEMO has asked TransGrid to review this advice.

4.1 Reclassification

Reclassification was not required, as the outage of any single piece of transmission equipment such as a SVC is always considered as a credible contingency.

5. 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 market¹² over the course of this incident.

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

- Constraints invoked with interconnector terms on the LHS.¹³
 - AEMO issued Market Notice 58308 at 1744 hrs to advise participants that constraint set N-LS_VC1 had been invoked
 - AEMO issued Market Notice 58311 at 1845 hrs to advise participants that constraint set #N-Q-MNSP1 had been invoked.
 - AEMO issued Market Notice 58313 at 2054 hrs to advise participants that constraint sets invoked for the Lismore SVC outage had been revoked.

AEMO was not required to provide any other advice to the market in relation to this incident. Over the course of this incident, AEMO issued appropriate, timely and sufficiently detailed market information.

6. CONCLUSIONS

AEMO has assessed this incident in accordance with clause 4.8.15 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:

- The power system was not in a satisfactory operating state for 15 minutes.
- The power system was not in a secure operating state for 66 minutes.
- The combination of outages and the constraints sets invoked to manage these outages resulted in a situation where NEMDE was not able to determine a feasible solution.
- The actions taken by AEMO to return the power system to a satisfactory and secure operating state were reasonable and timely.

¹² AEMO generally informs the market about operating incidents as the progress by issuing Market Notices – see AEMO website

¹³ For short term outage AEMO is required to notify the Market of variances to interconnector transfer limits AEMO, *Power System Security Guidelines*, Section 22



7. PENDING ACTIONS

TransGrid is reviewing the limit advice provided to AEMO associated with the combined outage of the 96H line and the Lismore SVC. AEMO will then update constraint equations accordingly. This action will be completed by 30 June 2017.



APPENDIX A. POWER SYSTEM DIAGRAM

Section of the power system in northern New South Wales and southern Queensland. Some equipment not related to this incident has been omitted for clarity.

