POWER SYSTEM OPERATING INCIDENT REPORT – NEW SOUTH WALES QUEENSLAND SEPARATION ON 13 NOVEMBER 2011

PREPARED BY: Electricity System Operations Planning and Performance

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FINAL

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Abbreviations and Symbols

Abbreviation	Term
AGC	Automatic Generation Control
kV	Kilovolt
MW	Megawatt
NER	National Electricity Rules
QNI	Queensland to New South Wales Interconnector

1 Introduction

On Sunday 13 November 2011, at 1848 hrs Queensland–New South Wales interconnector (QNI) opened. This was due to one phase to ground faults on 8C and 8E Armidale–Dumaresq 330kV transmission lines and the subsequent maloperation of protection at Dumaresq and Armidale, resulting in tripping and locking out of 8E line at both ends and 8C line at Dumaresq. Severe thunderstorms and lightning activity were in the area at the time.

No customer load was interrupted or generation disconnected during this incident.

This report has been prepared under clause 4.8.15 of the National Electricity Rules (NER) 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.

This report is largely based upon information provided by TransGrid. Data from AEMO's Energy Management System have also been used in analysing the incident.

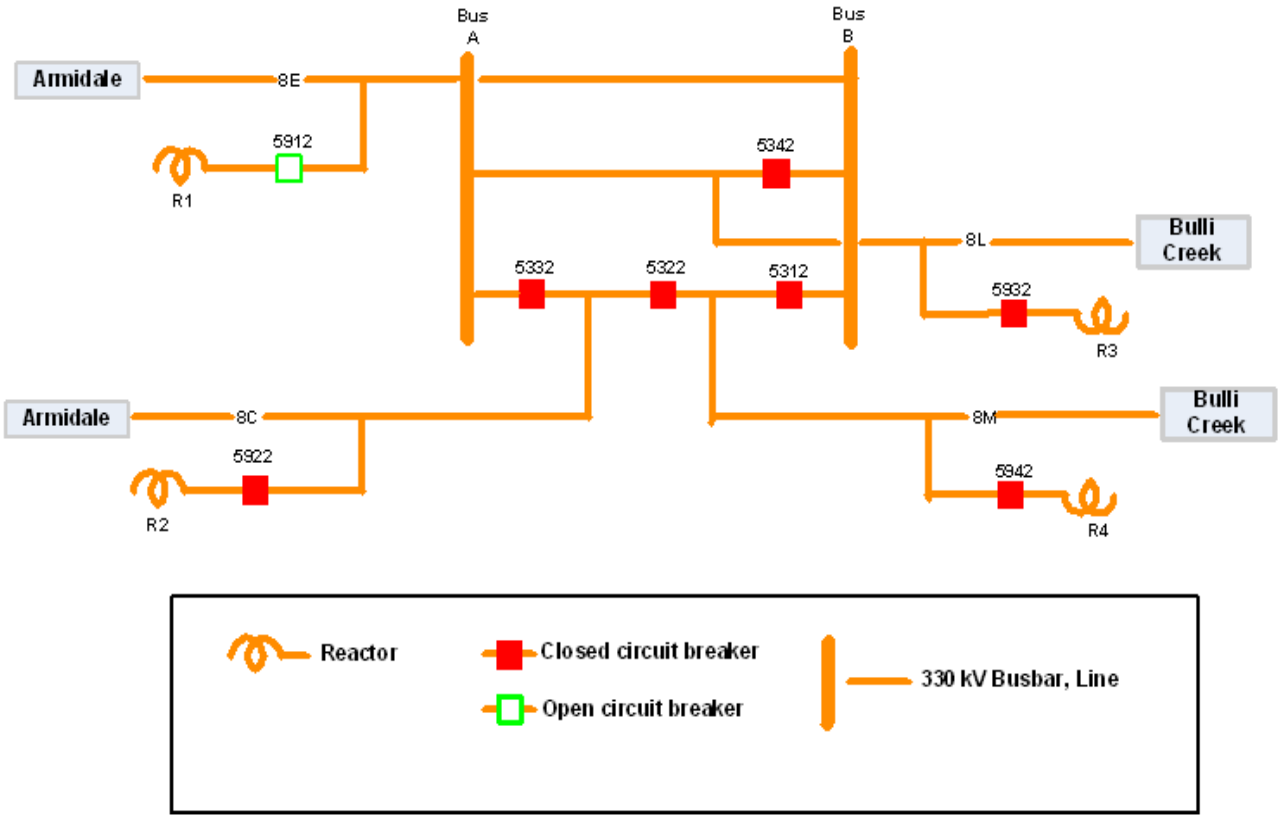
All references to time in this report refer National Electricity Market time (Eastern Standard Time).

2 Pre-Contingent System Conditions

Immediately prior to the incident the power transfer on QNI was 308 MW from Queensland to New South Wales. There were severe thunderstorms and lightning in the area.

The status of the Dumaresq substation prior to the incident is shown in Figure 1.

Figure 1 – Status of the Dumaresq substation and its connections prior to the incident



3 Summary of Events

Table 1 shows the sequence of events immediately following the trip.

Table 1 Initial sequence of events

Time		Operation	Comment
1848	t=0	R phase to earth trip on 8C and 8E lines	Single phase trip[1] on both lines at both ends
	+ 560 ms	3 phase trip and lock out on 8C at Dumaresq	8C de-energised
	+ 800 ms	3 phase trip and lock out on 8E at both ends	8E de-energised 8L and 8M remained energised from Bulli Creek
	+ 1 s	8C red phase reclose at Armidale	8C energised from Armidale
1902		8C closed at Dumaresq	Queensland synchronised with rest of the power system

At a time of severe thunderstorm and lightning activity on 13 November, the 8C and 8E Armidale-Dumaresq lines experienced one phase to ground fault on the R phase of each of the lines. The faulted phase of the two lines tripped. 560 ms later, the 8C line experienced a three phase trip and lock out at Dumaresq. A further 240 ms later, 8E line experienced a three phase trip and lock out at both ends opening QNI interconnector. This action also offloaded both Dumaresq – Bulli Creek lines.

The R phase of the 8C line auto-reclosed at Armidale further 200 ms later leaving 8C energised from Armidale.

The Queensland power system was synchronised to the rest of the NEM power system at 1902 hrs on the same day.

The frequency operation of Queensland, other mainland regions and Tasmania power systems are shown in Figure 3.

The maximum frequency of 50.27Hz was experienced in Queensland and the frequency was recovered to below 50.15Hz within 8.85 minutes. The minimum frequency experienced in the other mainland regions was 49.77Hz, with recovery to above 49.85 Hz within 6.82 minutes. Tasmanian frequency reached a minimum of 49.77 Hz and was recovered to above 49.85 Hz within 5.28 minutes.

The status of the Dumaresq substation immediately after the incident is shown in Figure 2.

[1] The 330 kV lines between Armidale and Dumaresq are equipped with high-speed single phase protection.

Figure 2 – Status of the Dumaresq substation and its connections immediately after the incident

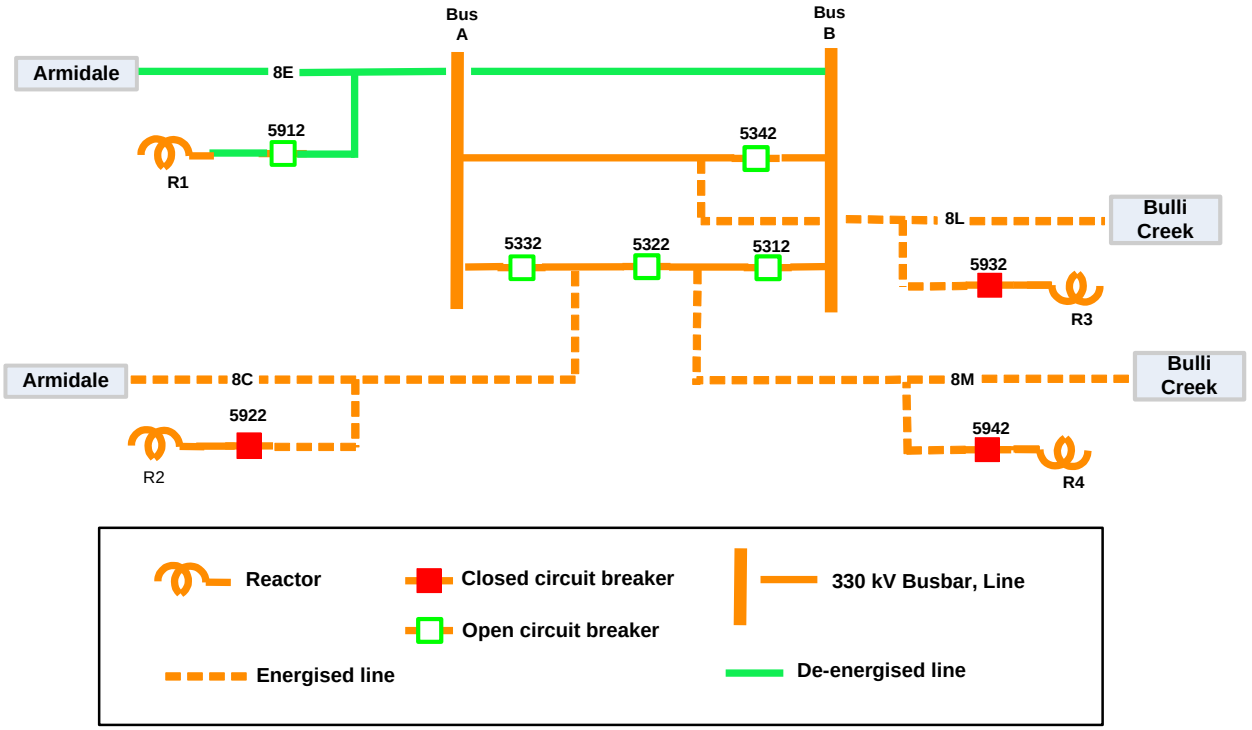
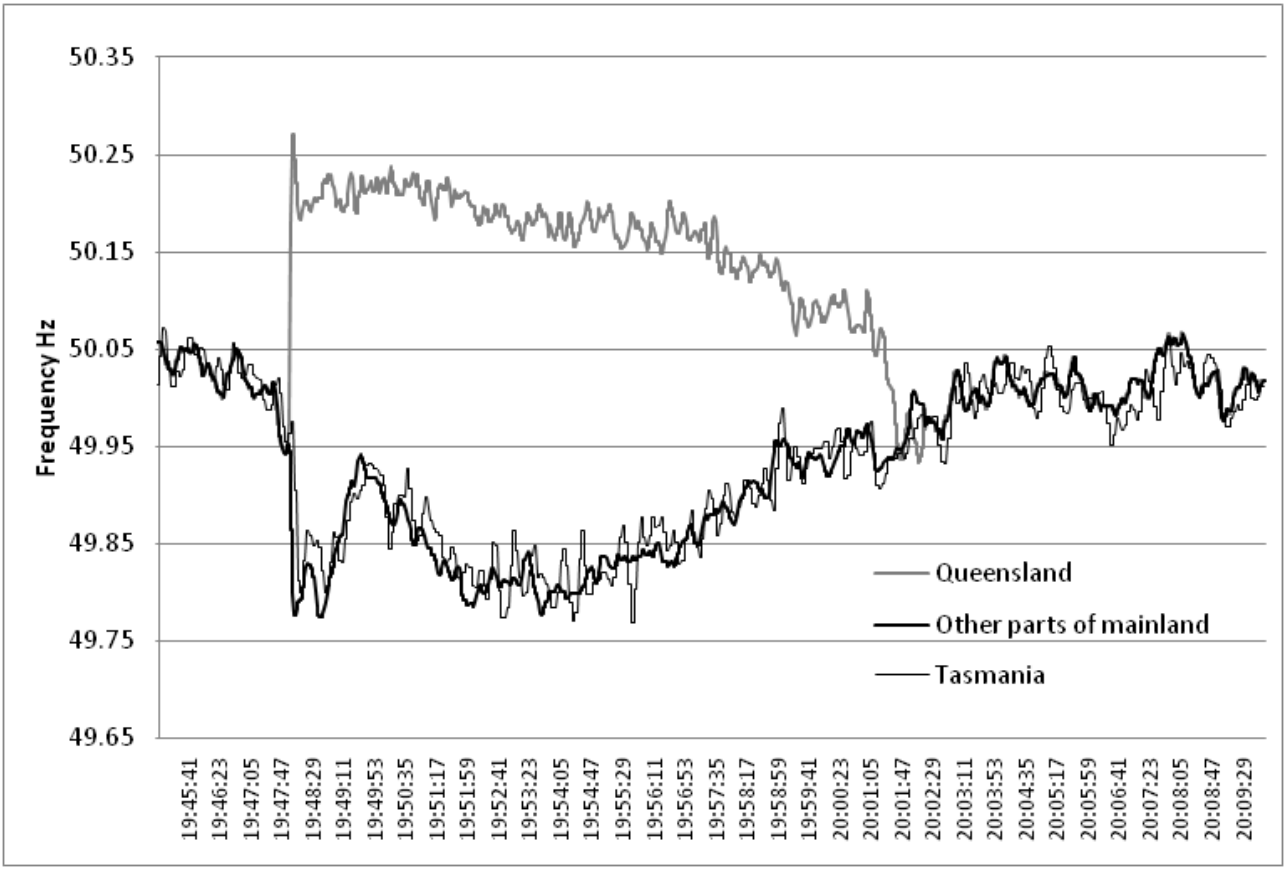


Figure 3: Power system frequency



4 Immediate Actions Taken

AEMO reconfigured its Automatic Generation Control (AGC)[2] system to manage the power system frequency of the islanded Queensland region.

AEMO invoked constraint sets at 1855 hrs to manage power system security while the Queensland power system remained separated from the other parts of the mainland power system. The Queensland power system was synchronised to the rest of the power system at 1902 hrs and the relevant constraint sets were revoked at 1910 hrs.

TransGrid informed AEMO that this non-credible contingency event was caused by lightning activity in the area at the time. Based on this advice, at 1930 hrs AEMO classified the loss of both 8C and 8E Armidale to Dumaresq transmission lines as a credible contingency, as lightning activity was continuing. Refer market notice 36607.

The lightning activity in the vicinity of 8C and 8E transmission lines receded and at 0205 hrs on the following day (14 November 2011) AEMO declared that the loss of both 8C and 8E lines were no longer considered a credible contingency. Refer market notice 36617.

Details of the constraint sets AEMO invoked in its dispatch systems to manage power system security during the incident are shown in Table 2 below.

Table 2 Constraint sets invoked in dispatch systems to manage power system security

Constraint Set	Start Date	End Date	Description
F-QLD_ISLE	13/11/2011 18:55	13/11/2011 19:10	Queensland separation between Armidale and Bulli Creek (8C and 8E or 8L and 8M) – FCAS Contingency Requirements
F-QLD_STHN _ISLE_REG	13/11/2011 18:55	13/11/2011 19:10	Queensland / Southern separation between Armidale and Bulli Creek (8C and 8E or 8L and 8M) – FCAS Regulation Requirements
F-STHN_ISLE	13/11/2011 18:55	13/11/2011 19:10	Southern separation between Armidale and Bulli Creek (8C and 8E or 8L and 8M) – FCAS Contingency Requirements
QLD_STHN_ISL E	13/11/2011 18:55	13/11/2011 19:10	Queensland / Southern separation between Armidale and Bulli Creek (8C and 8E or 8L and 8M)
N-ARDM_ONE	13/11/2011 19:10	13/11/2011 19:30	Out= one Armidale to Dumaresq (8C or 8E) 330kV line
F-N-ARDM_ONE	13/11/2011 19:10	14/11/2011 02:05	Out = one Armidale to Dumaresq (8C or 8E) 330kV line - FCAS Requirements

5 Follow-up Actions

AEMO further liaised with TransGrid on the following morning to determine whether the operation of protection systems during this incident was appropriate and to establish whether there was an ongoing risk of trip of 8C line on the trip of 8E line. As TransGrid was still investigating the operation of its protection systems, they were unable to confirm whether an above normal risk of trip of 8C line on the trip of 8E line existed.

At 0735 hrs on 14 November 2011, AEMO reclassified the simultaneous trip of 8C and 8E transmission lines as a credible contingency event in accordance with its operating procedure

[2] AGC serves two purposes:

- Energy market dispatch of generating units: Generating units are ramped to their dispatch targets.
- Frequency regulation: Units enabled for frequency control ancillary services (FCAS) are dispatched away from their energy market dispatch to control frequency and time error to desired values.

SO_OP 3715 Power System Security Guidelines.[3] Refer market notice 36626. AEMO invoked the constraint set N-ARDM_ONE consistent with this reclassification.

At 1300 hrs, TransGrid confirmed that there had been simultaneous one phase to ground faults involving R phase on both 8E and 8C lines causing the incident. TransGrid advised that there is no longer a need to consider trip of 8E and 8C lines as a credible contingency unless lightning activity is present in the vicinity of the two lines. Based on this advice AEMO cancelled the contingency reclassification at 1310hrs and revoked the constraint set N-ARDM_ONE.

AEMO updated its power system security procedures to include the 8E and 8C transmission lines in the list of vulnerable lines.

Further investigations by TransGrid revealed that a number of the distance relays used in the No.2 protections of the 8C and 8E transmission lines operated incorrectly. Following further investigations, TransGrid revealed that a calibration setting associated with single phase trip operations installed by the distance relay manufacturer was required to prevent maloperation. TransGrid completed the required changes to manufacturer's calibration settings of No. 2 protection of 8C, 8E, 8L & 8M transmission lines at Armidale and Dumaresq on 20 December 2011. AEMO then removed 8C and 8E lines from the list of vulnerable lines in its power system security procedures.

TransGrid confirmed that there is no risk of similar protection maloperation because TransGrid has not implemented protection systems for single phase tripping on any of the other transmission lines in New South Wales.

6 Power System Security Assessment

The power system voltages, frequencies and power flows remained within the normal operating limits and applicable frequency operating standards for a separation event. The minimum frequency and time taken for frequency recovery were within the applicable frequency operating standards[4].

The provision and response of facilities and services were adequate to restore power system security.

7 Conclusions

The facilities provided to manage one phase to ground faults between Armidale and Dumaresq are adequate for the condition experience at the time. However, AEMO concludes that maloperation of protection on those lines was the principle cause of this event. AEMO is satisfied that TransGrid carried out the appropriate work to mitigate the risk of a similar incident occurring in future.

AEMO correctly applied the criteria required by clause 4.2.3B of the NER and published in section 11 of its Power System Security Guidelines in assessing that the circumstances of this incident did not warrant reclassifying similar incidents as a credible contingency event.

8 Recommendations

There are no recommendations arising from this incident.

[3] Clause 4.2.3B of the NER requires that AEMO establish criteria to use when considering whether a non-credible contingency event is reasonably possible. This is published in AEMO operating procedure SO_OP 3715 Power System Security Guidelines, which is available at: http://www.aemo.com.au/electricityops/3715.html

[4] The frequency operating standards applicable for the mainland and Tasmania power systems are available at: http://www.aemc.gov.au/Panels-and-Committees/Reliability-Panel/Guidelines-and-standards.html.