POWER SYSTEM OPERATING INCIDENT REPORT – TRIP OF MULTIPLE GENERATING UNITS AT MILLMERRAN POWER STATION ON 9 MARCH 2013

PREPARED BY: Systems Capability

DATE: 1 May 2013

FINAL

Disclaimer

Purpose

This report has been prepared by the Australian Energy Market Operator Limited (**AEMO**) for the sole purpose of meeting obligations in accordance with clause 4.8.15 (c) of the National Electricity Rules (NER).

No reliance or warranty

This report contains data provided by third parties and might contain conclusions or forecasts and the like that rely on that data. This data might not be free from errors or omissions. While AEMO has used due care and skill, AEMO does not warrant or represent that the data, conclusions, forecasts or other information in this report are accurate, reliable, complete or current or that they are suitable for particular purposes. You should verify and check the accuracy, completeness, reliability and suitability of this report for any use to which you intend to put it, and seek independent expert advice before using it, or any information contained in it.

Limitation of liability

To the extent permitted by law, AEMO and its advisers, consultants and other contributors to this report (or their respective associated companies, businesses, partners, directors, officers or employees) shall not be liable for any errors, omissions, defects or misrepresentations in the information contained in this report, or for any loss or damage suffered by persons who use or rely on such information (including by reason of negligence, negligent misstatement or otherwise). If any law prohibits the exclusion of such liability, AEMO's liability is limited, at AEMO's option, to the re-supply of the information, provided that this limitation is permitted by law and is fair and reasonable.

Abbreviations and Symbols

Abbreviation	Term
CB	Circuit Breaker
EMS	Energy Management System
EMMS	Electricity Market Management System
kV	Kilovolt
MW	Megawatt
NEM	National Electricity Market
PLC	Programmable Logic Controller
UPS	Uninterruptible Power Supply

Contents

Incident summary

Date and time of incident	9 March 2013 at 2207 hrs.
Region of incident	QLD
Affected regions	QLD
Event type	GG – Loss of multiple generating units
Primary cause	PS – Power Station internal issues
Impact	Very Significant
Associated reports	N/A

1 Introduction

At 2207 hours on 9 March 2013, Units 1 and 2 at Millmerran Power Station in Queensland Region tripped simultaneously resulting in a total of 823 MW loss of generation.

This report has been prepared under clause 4.8.15 (c) 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 Intergen. Data from AEMO's Energy Management System (EMS) and Electricity Market Management System (EMMS) has also been used in analysing the incident.

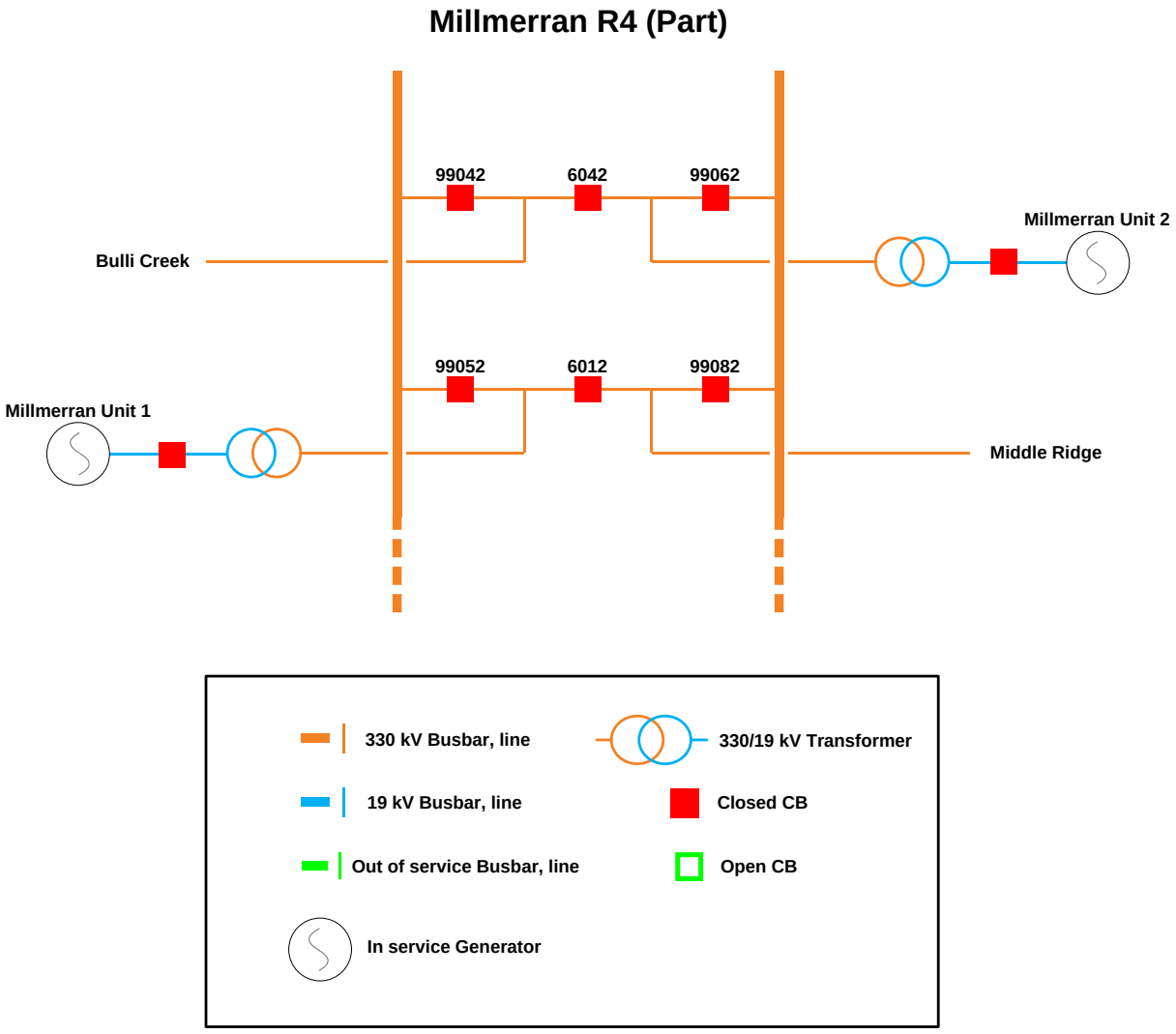
All references to time in this report are to National Electricity Market time (Australian Eastern Standard Time).

2 Pre-Contingent System Conditions

Prior to the incident, Units 1 and 2 at Millmerran Power Station were generating 399 MW and 424 MW respectively to give a combined output of 823 MW.

The status of the power system prior to the incident is shown in Figure 1. For clarity only equipment relevant to this incident has been included in the diagram.

Figure 1 - Status of the power system prior to the incident



3 Summary of Events

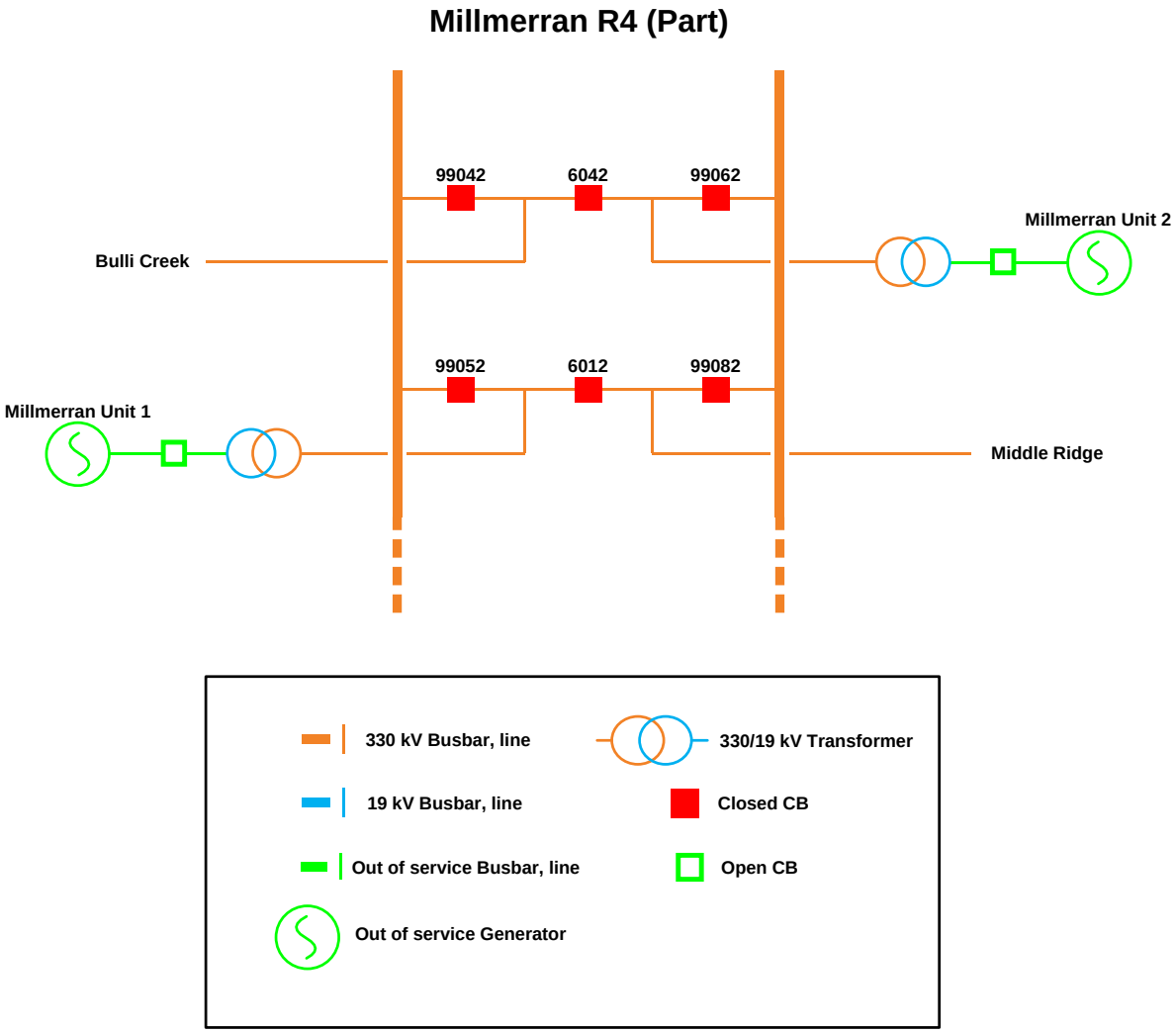
The key events that took place during the incident are summarised in Table 1 below.

Table 1: Summary of Events

Date/Time	Event
09/03/2013 22:07 hrs.	Units 1 and 2 tripped.
09/03/2013 23:05 hrs.	AEMO issued Market Notice No.41808 advising the occurrence of the non-credible contingency event. The cause of the event was unknown at the time.
10/03/2013 03:03 hrs.	AEMO issued Market Notice No.41809 informing that the cause of the event has been identified. AEMO is satisfied that another occurrence of a similar event is unlikely; therefore it will not reclassify this event as a credible contingency event.
10/03/2013 09:52 hrs.	Unit 1 was returned to service.
10/03/2013 12:39 hrs.	Unit 2 was returned to service.

The status of the power system immediately after the incident is shown in Figure 2.

Figure 2 - Status of the power system immediately after the incident



4 Immediate Actions Taken

Immediately after the incident, Intergen undertook investigations to determine the cause of the trip and steps to return the tripped units to service. Units 1 and 2 at Millmerran Power Station remained unavailable until 0952 hours and 1239 hours respectively on 10 March 2013.

At 2305 hours on 9 March 2013, AEMO issued Market Notice No.41808 advising the occurrence of the simultaneous trip of Units 1 and 2 at Millmerran Power Station. The market notice also advised that the cause of the trip was unknown at the time.

5 Follow-up Actions

At 0200 hours on 10 March 2013, Intergen advised that a fault in the Programmable Logic Controller (PLC) associated with the Emergency Diesel Generator tripped the supply to the station 6.6 kV common board and ultimately led to the tripping of the Units 1 and 2. Intergen also advised that the faulty PLC was isolated, so the risk of the generating units experiencing a similar simultaneous trip was eliminated.

At 0303 hours on 10 March 2013, AEMO issued Market Notice No.41809 informing that the cause of the simultaneous trip of Units 1 and 2 at Millmerran Power Station was identified and a similar event is unlikely to re-occur. The market notice also advised that AEMO will not reclassify this event as a credible contingency event.

5.1 Intergen Actions

Intergen reported that prior to the incident the power supply to the Emergency Diesel Generator PLC was found to be powered down and faulty. Intergen operator was dispatched to investigate the power supply issue. Following closing of the front plastic cover on the PLC processor unit, the PLC unexpectedly powered up on its own and simultaneously triggered a number of outputs which subsequently tripped the supply to the station 6.6 kV common board.

The loss of supply to the station 6.6 kV common board resulted in the shutdown of all in-service and standby station air compressors. It was expected the air compressors would remain unaffected by the loss of supply to the station common board. However investigation found that the 240 V control supply for the air compressors was sourced from a common plant low voltage distribution board which was supplied by the dead station 6.6 kV common board. The shutdown of the air compressors subsequently triggered the “Boiler Master Fuel” trip which led to the tripping of the generating units.

Intergen conducted further investigations and reported a number of findings as detailed below.

1) **Unit tie breakers to station common board** – The station 6.6 kV common board can be supplied from Unit 1, Unit 2 or the Emergency Diesel Generator by closing the relevant tie breaker. Prior to the incident, Unit 1 was supplying the station common board via its tie breaker while the tie breakers for Unit 2 and Emergency Diesel Generator were in open position.

   When the PLC was powered up on its own during the incident, it abnormally generated an output to close Unit 2 tie breaker onto the station common board. At this point, the station common board was supplied from two sources, Unit 1 and Unit 2. This operation was followed immediately by another abnormal PLC output operation to open both the Unit 1 and Unit 2 tie breakers tripping the supply to the station common board.

2) **PLC power supply** – Investigation into the health of the main 24 V DC power supply, which supplies the PLC, revealed a significant AC ripple component. At this stage Intergen does not believe that this ripple is a significant contributing factor to the incident but further investigation will be conducted to investigate the measured ripple.

3) **PLC processor** – PLC processor was found to be in a faulty state when it was powered up during the investigation. It is believed that this processor fault condition either contributed to

or directly led to the abnormal operation of the PLC outputs experienced during the event. As a short term measure, a new processor was installed to replace the faulty processor. This new processor is programmed for manual use in emergency situations only and this operational restriction will remain pending the replacement of the remaining PLC hardware and further testing of the PLC logic and hardware behaviour.

4) **Breaker local control mode** – The breaker open commands were directly wired from the PLC output to the trip coil on the unit tie breakers, not through the breaker control selector switch[1]. This means that the PLC was still able to open the breaker even when the control selector was selected to local control mode. This also delayed the restoration of power when attempts were made to manually close the tie breaker onto the station common board.

5) **PLC logic** – Review of PLC logic was carried out to investigate the abnormal operation of the PLC outputs which were triggered simultaneously during the event. Intergen found that there is no obvious logic related issue contributing to the abnormal operation of the PLC outputs. The review of the PLC logic supports the conclusion that the fault within the PLC processor led to the abnormal operation of the PLC outputs.

6) **Air compressors control supply** – Investigation found that the station air compressors had control supply which was sourced from a 240 V common board. Following the loss of supply to the station 6.6 kV common board, the 240 V common board which was downstream of the 6.6 kV common board also lost supply and subsequently tripped the station air compressors. Work will be carried out to modify the control supply to be sourced from either Uninterruptible Power Supply (UPS) or the respective generating unit.

5.2 AEMO Reclassification on 29 April 2013

Based on information provided to AEMO at the time of the incident AEMO considered there were no grounds to reclassify the loss of both units as a credible contingency. However as part of the investigation of this incident and on the basis of the information provided by Intergen to date, AEMO believes that there is still a risk where a single point of failure will result in the loss of supply to all the air compressors and eventually the loss of both Millmerran generating units. Therefore in accordance with the criteria for re-classifying contingency events established under NER clause 4.2.3B, AEMO issued Market Notice No.42255 at 1751 hours on 29 April 2013 and declared the simultaneous trip of both generating units as a credible contingency event. The market notice also advised that a Frequency Control Ancillary Service (FCAS) constraint (F-I_MPP_N-2) was invoked from 1745 hours until further notice, to manage the loss of both generating units. The Lack of Reserve Level 1 (LOR1) and Lack of Reserve Level 2 (LOR2) for Queensland Region were adjusted due to the reclassification.

Intergen advised that they will make changes to the compressed air system by 13 May to remove the single point of failure. On completion of this work AEMO will review the reclassification.

6 Power System Security Assessment

No reserve issues were identified in the Queensland Region with the Millmerran Power Station units tripping from 823 MW to 0 MW.

The power system voltages and frequencies remained within the normal operating bands and the power system remained in a secure operating state throughout the incident.

AEMO correctly applied the criteria published in section 12 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.

[1] The breaker control selector switch has two modes, local control mode and Emergency Diesel Generator control mode. Selection of local control mode should prevent the PLC of the Emergency Diesel Generator from operating both Unit 1 and Unit 2 tie breakers.

7 Conclusions

At 2207 hours on 9 March 2013, Units 1 and 2 at Millmerran Power Station in Queensland Region tripped simultaneously resulting in a total of 823 MW loss of generation.

The trip was caused by a hardware fault in the PLC of the Emergency Diesel Generator at Millmerran Power Station.

On the basis of the information provided by Intergen to date, AEMO correctly applied the criteria published in section 12 of its Power System Security Guidelines in assessing the reclassification of the simultaneous trip of both units at Millmerran Power Station as a credible contingency event.

8 Recommendations

Intergen is to complete the following action items and inform AEMO when they are completed.

- Modifications to the compressed air system to remove the common point of failure by 13 May 2013.
- Re-wire the Unit 1 and Unit 2 tie breaker open commands through the breaker control selector switch by 30 October 2013.
- Replace all the PLC hardware components to eliminate any potential intermittent hardware fault currently present by 30 June 2013.
- Bench test the PLC and its logic controller to ensure safe and reliable operation by 30 June 2013.
- Investigate the source of AC ripple on the main 24 V DC power supply by 30 June 2013.
- Investigate a more reliable PLC by 30 July 2013.