POWER SYSTEM OPERATING INCIDENT REPORT – TRIP OF ALL GENERATING UNITS AT URANQUINTY POWER STATION ON 05 OCTOBER 2012.

PREPARED BY: System Performance & Commercial

DATE: 13 December 2012

FINAL

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Abbreviations and Symbols

Abbreviation	Term
CB	Circuit Breaker
EMMS	Electricity Market Management System
EMS	Energy Management System
FCAS	Frequency Control Ancillary Service
kV	Kilovolt
MW	Megawatt
NEM	National Electricity Market
NOS	Network Outage Schedule
RTCA	Real Time Contingency Analysis
MSSS	Main Source Selection Switchboard.

Contents

Incident summary

Date and time of incident	5/10/2012 13:33hs.
Region of incident	NSW
Affected regions	NSW
Event type	GG – Loss of multiple generating units.
Primary cause	PS – Power Station internal issues.
Impact	VS – Very Significant.
Associated reports	N/A

1 Introduction

At 1333 hours on 5 October 2012, unit 12 at Uranquinty Power Station tripped followed by the simultaneous trip of units 13 and 14 at 1334 hours. The remaining Uranquinty Power Station unit, Unit 11, tripped at 1336 hours resulting in a total of 664 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 Origin Energy. Data from AEMO's Energy Management System (EMS) and Electricity Market Management System (EMMS) has also been used in analysing the incident.

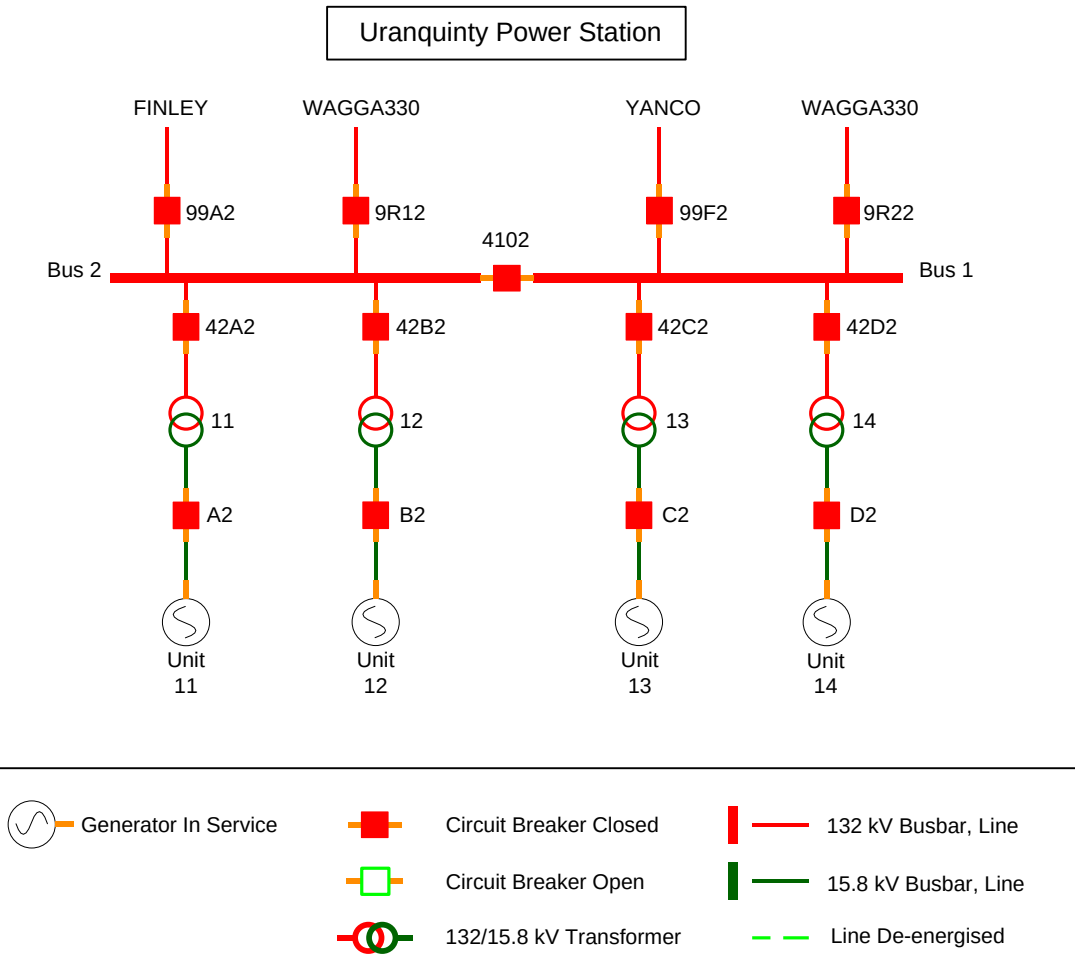
All references to time in this report are to National Electricity Market time (Australian Eastern Standard Time).

2 Pre-Contingent System Conditions

Prior to the incident, all four generating units at Uranquinty Power Station were generating 166 MW respectively to give a combined output of 664 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

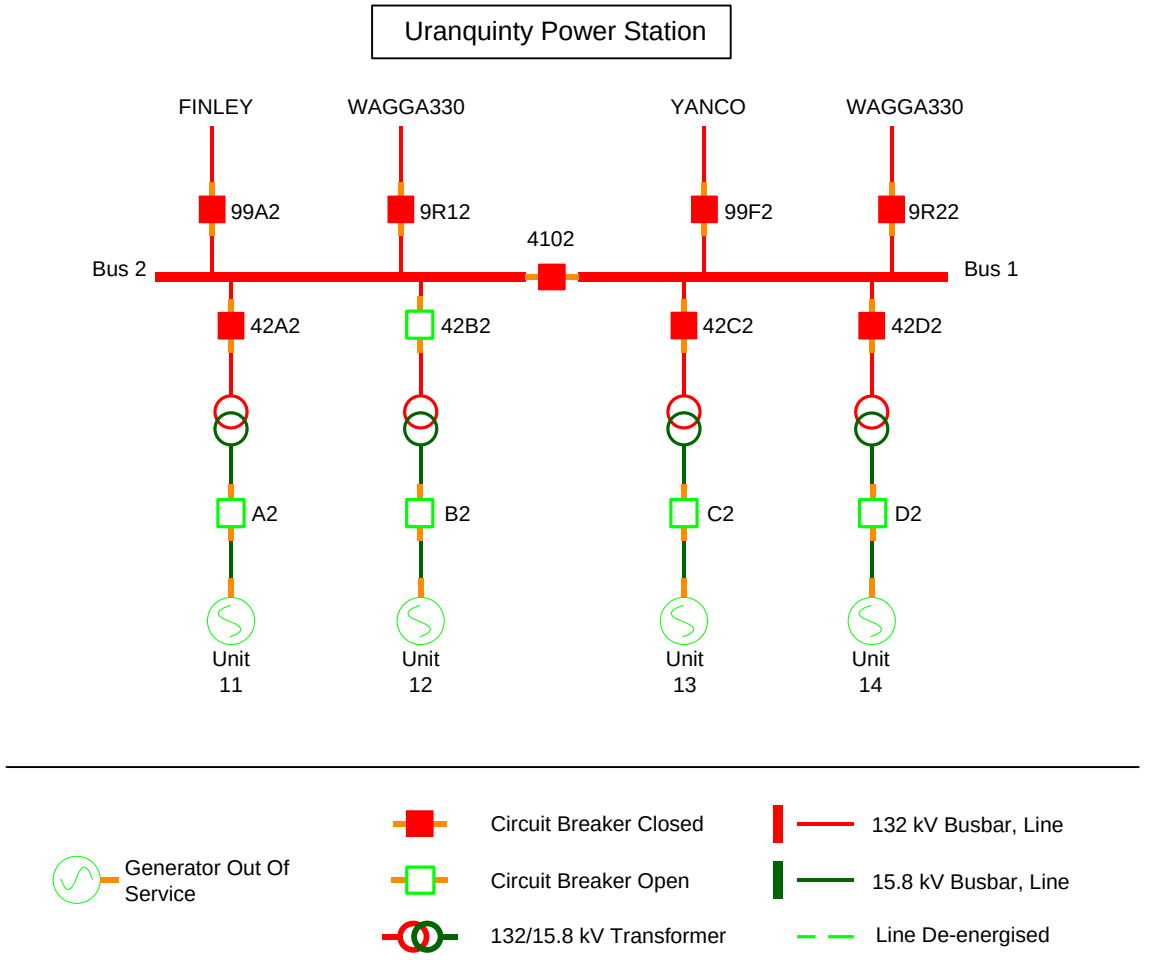
The key events that took place during the incident are summarised in Table 1 below.

Table 1 - Summary of events

Time	Events
05/10/2012 13:33 hrs.	Unit 12 tripped.
05/10/2012 13:34 hrs.	Units 13 and 14 tripped.
05/10/2012 13:36 hrs.	Unit 11 tripped.
05/10/2012 14:01 hrs.	AEMO issued Electricity Market Notice No.39938 advising the market of a non-credible contingency.
05/10/2012 14:48 hrs.	Units 11, 13 and 14 returned to service.
10/10/2012 15:38 hrs.	Unit 12 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



3.1 Auxiliary supply configuration at Uranquinty Power Station

Some critical unit auxiliary loads are supplied from a Main Source Selection Switchboard (MSSS) (refer Figure 3) which consists of 415V Busbar's No.1 and No.2 and a Common Services Switchboard. The two busbars are separated by a bus tie breaker which is normally in the open position. The normal operating mode is to supply Busbar No.1 from either unit 11 or unit 12, and Busbar No.2 from either unit 13 or unit 14. That is, unit 11 or 12 are unable to supply Busbar No.2 and units 13 and 14 are unable supply Busbar No.1, when the bus tie breaker is open.

The Common Services Switchboard can be supplied from either Busbar No.1 or Busbar No.2 with the default being Busbar No.1. In the event that supply is lost to the Common Services Switchboard, there is an automatic changeover system in place to switch the auxiliary loads over to Busbar No.2.

Prior to the incident, the auxiliary supply configuration at Uranquinty Power Station was as follows:

- Unit 12 was supplying Busbar No.1 and the Common Services Switchboard.

  (Note: Busbar No.1 was supplying the Ventilation fans for units 11 and 12, and the Common Services Switchboard was supplying the Gas Valves for units 11, 12, 13 and 14.)

- Unit 14 was supplying Busbar No.2.

  (Note: Busbar No.2 was supplying the Ventilation fans for units 13 and 14.)

3.2 Trip sequence of events

Origin Energy advised that unit 12 tripped on transformer protection as a result of a blocked transformer breather[1]. The trip of unit 12 resulted in the consequential loss of supply to the critical auxiliary loads of the remaining online units being 11, 13 and 14, which eventually resulted in the trip of all these units.

The following is applicable for units 13 and 14.

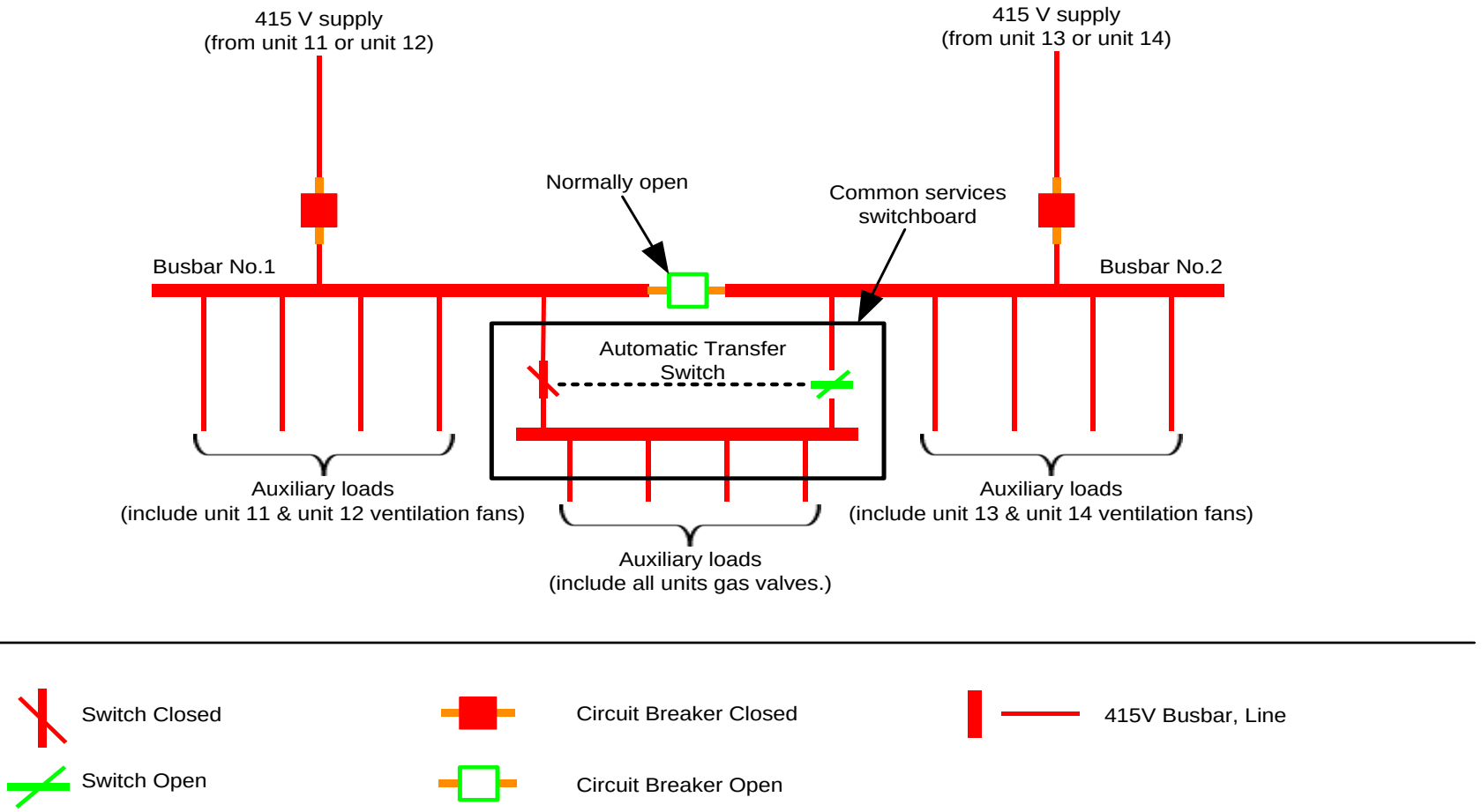
> With the trip of unit 12, supply was lost to Busbar No.1 and the Common Services Switchboard resulting in the loss of supply to units 13 and 14 gas valves, causing them to commence closing. While this was happening, the auxiliary supply changeover for the Common Services Switchboard operated to restore the supply from Busbar No.2, but due to the time of the changeover the gas valves for these units closed completely before this changeover occurred. With no gas supply, the units eventually tripped on low inlet gas pressure.

The following is applicable for unit 11.

> With the trip of unit 12, supply was lost to Busbar No.1 and the Common Services Switchboard resulting in the loss of supply to unit 11 gas valve causing it to commence closing. Unlike for units 13 and 14, the auxiliary supply changeover took place before the gas valve had closed completely (i.e. the gas valve for unit 11 took longer to close than for units 13 and 14) thus the unit remained being supplied with gas and consequently the unit remained in service. Unit 11 eventually tripped (130 seconds later as designed) as a result of there being no supply to its Ventilation fans.

[1] A transformer breather allows air to enter and leave the transformer sealed tank as the transformer oil contacts or expands.

Figure 3 - Auxiliary supply configuration at Uranquinty Power Station at the time of the incident.



4 Immediate Actions Taken

Immediately after the incident, Origin Energy undertook an investigation to determine the cause of the trip. Once the cause of the trip for units 11, 13 and 14 was determined, the units were returned to service at 14:48 hrs on 5 October 2012 whilst unit 12 remained out of service for further investigations.

At 1401 hours on 5 October 2012, AEMO issued Electricity Market Notice No.39938 advising of the occurrence of this non-credible contingency event. The cause of the trip was not available to AEMO at the time the Market Notice was issued, therefore AEMO made the decision to reclassify the simultaneous trip of all four generating units at Uranquinty Power Station as a credible contingency from 1334 hours on 5 October 2012 until further notice as per AEMO's Power System Security Guidelines SO_OP3715.

5 Follow-up Actions

Following the incident and subsequent reclassification, AEMO identified the requirement to develop a Frequency Control Ancillary Service (FCAS) constraint to manage the loss of the 4 generating units at Uranquinty Power Station. The FCAS constraint (F-N_UR_ALL_N-2) was made available on 9 October 2012 at 1625 hrs and was invoked immediately. AEMO met the Frequency Operating Standards requirement from the time of the incident involving the trip of all the 4 units at Uranquinty Power Station to the time the FCAS constraint was invoked.

Origin Energy performed a full electrical test on unit 12 transformer including the functional testing of its cooling circuit. Origin Energy discovered that the breather of the transformer was blocked and caused the transformer protection to operate which then led to the trip of unit 12. Origin Energy cleared the blocked breather which enabled unit 12 to return to service at 15:58 hrs on 10 October 2012.

During Origin Energy's investigation, they identified some auxiliary supply configuration issues being:

- Unit gas valves – All the units' gas valves were supplied from a single source. Although there was an automatic supply changeover system in place to provide alternative supply, the changeover operation took longer than the required changeover time. Thus the gas valve would close completely before the changeover operation was completed and subsequently cause the unit gas turbine to trip due to low inlet gas pressure. This was what happened to units 13 and 14 during the incident.
- Unit Ventilation fan system – Each units ventilation fan system consists of two fans and both fans were supplied from the same auxiliary supply. Thus loss of the shared auxiliary supply would stop the unit's entire Ventilation fan system to operate and subsequently cause the unit to trip. This was what happened to unit 11 during the incident.

To resolve the auxiliary supply configuration issues, Origin completed the following actions:

- Unitised the auxiliary supply for the gas valves so that they are supplied directly from their respective units.
- Supply one fan for each unit Ventilation fan system from different sources of supply. Origin Energy has advised that each unit only requires one ventilation fan to operate.

Origin Energy has also identified that the gas valve closure time for unit 11 was longer than the other units and has rectified this problem.

The FCAS constraint (F-N_UR_ALL_N-2) was revoked at 1130 hrs on 29 November 2012 after Origin energy had completed their works on their auxiliary supply reconfiguration.

AEMO advised the market of the removal of the reclassification by the issue of Market Notice No 40440 at 1126 hrs on 29 November 2012.

6 Power System Security Assessment

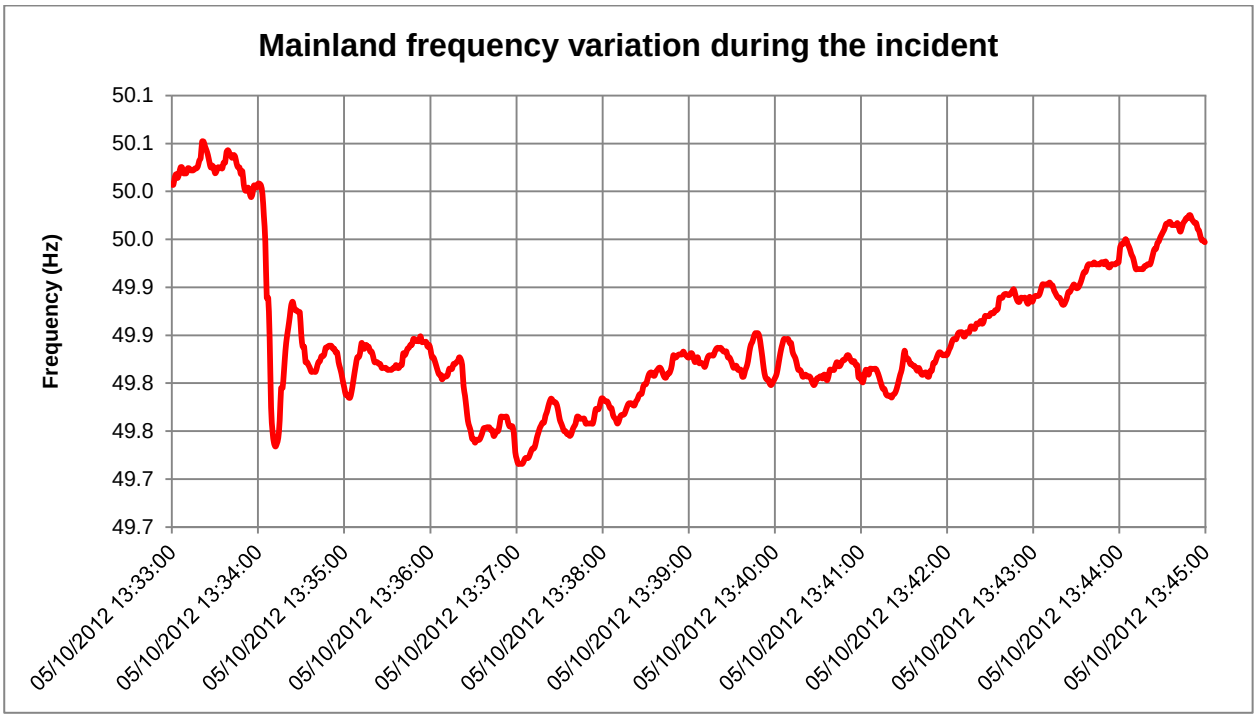
6.1 Mainland Frequency

The incident was classified as a multiple contingency event and the Mainland Frequency Operating Standard specifies a frequency containment range of 47.0 Hz - 52.0 Hz, a frequency stabilisation range of 49.50 Hz - 50.50 Hz (within 2 minutes) and a frequency recovery range of 49.85 - 50.15 Hz (within 10 minutes) for such an incident

During the incident the Mainland frequency dropped to a minimum of 49.72 Hz. A review of the Mainland frequency response was undertaken and it was concluded that its response satisfied the Mainland Frequency Operating Standard for all 3 categories as detailed above.

The power system frequency variation for the mainland region is shown in Figure 4.

Figure 4 – Mainland frequency variation during the incident



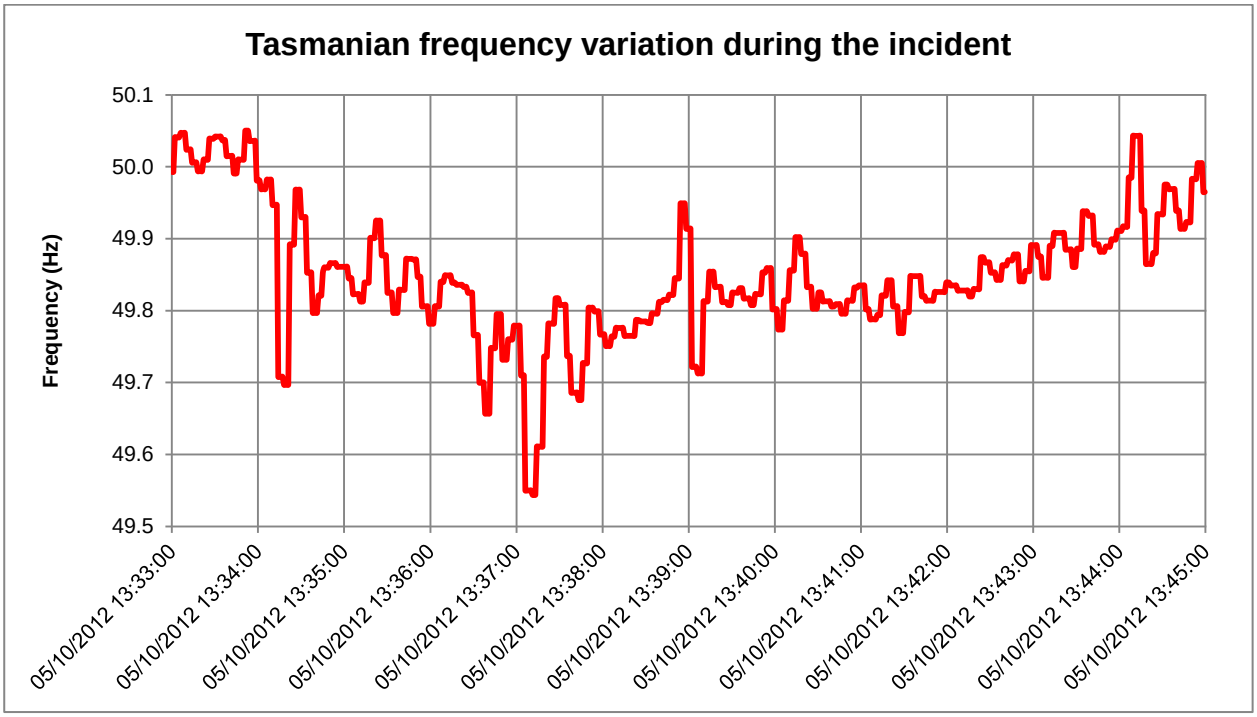
6.2 Tasmanian Frequency

In relation to the Tasmanian Frequency Operating Standard it specifies a frequency containment range of 47.0 Hz - 55.0 Hz, a frequency stabilisation range of 48.0Hz - 52.0Hz (within 2 minutes) and a frequency recovery range of 49.85 - 50.15Hz (within 10 minutes) for such an incident.

During the incident the Tasmanian frequency dropped to a minimum of 49.54 Hz. A review of the Tasmanian frequency response was undertaken and it was concluded that Tasmanian frequency response satisfied the Tasmanian Frequency Operating Standard for all 3 categories as detailed above.

The power system frequency variation in the Tasmania region is shown in Figure 5.

Figure 5 - Power system frequency variation during the incident



6.3 Thermal Violations

Real Time Contingency Analysis (RTCA) flagged post-contingent thermal rating violations of Victoria to New South Wales interconnector transmission lines, as Murray-Lower Tumut 330 kV Transmission Line was out of service at the time of the incident for a planned outage. All violations were cleared by 1345 hours on 5 October 2012. Therefore the power system was in an in secure operating state for approximately 12 minutes, from 13.33 to 13:45 hrs on 5 October 2012.

There were no voltage or transient stability violations as a result of the incident.

7 Conclusions

Between 1333 and 1334 hours on 5 October 2012, units 12, 13 and 14 at Uranquinty Power Station tripped followed by the trip of unit 11 at 1336 hours. This caused a full station outage resulting in a loss of 664 MW of generation.

Unit 12 tripped by transformer protection which was triggered by a blocked transformer breather.

Units 11, 13 and 14 tripped due to the loss of the shared auxiliary supply to the critical equipment for their operations as a result of the trip of unit 12.

AEMO is satisfied with the works performed by Origin Energy to resolve the auxiliary supply configuration issues at Uranquinty Power Station and that these works will prevent the similar incident from happening in the future.

AEMO's correctly applied the criteria published in section 12 of its Power System Security Guidelines in assessing the reclassification of the units at Uranquinty Power Station as a credible contingency event until works had been completed on the power stations auxiliary supply.

8 Recommendations

Given the works Origin Energy has undertaken there are no further recommendations arising from this incident.