POWER SYSTEM OPERATING INCIDENT REPORT - TRIP OF 76 AND 77 330KV TRANSMISSION LINES AND WALLERAWANG UNIT 8 ON 25 JANUARY 2013

PREPARED BY: System Performance & Commercial

DATE: 1 July 2013

FINAL

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Abbreviations and Symbols

Abbreviation	Term
AEMO	Australian Energy Market Operator
EMMS	Electricity Market Management System
EMS	Energy Management System
kV	Kilovolt
MW	Megawatt
NEM	National Electricity Market
NER	National Electricity Rules

Contents

Incident summary

Date and time of incident	25 January 2013 at 1328 hrs
Region of incident	New South Wales
Affected regions	New South Wales
Event type	Generator Trip and Multiple Transmission Line Trip (TG)
Primary cause	Other environmental issues (Bushfires) (ENVI and OTH)
Impact	Very Significant
Associated reports	Nil

1 Introduction

At 1328 hrs on 25 January 2013, the Sydney South-Wallerawang 76 330kV Transmission Line (’**76 Transmission Line**’) in New South Wales tripped and auto reclosed. Immediately following this Wallerawang Power Station Unit 8 tripped with a reduction in generation of 379 MW.

At 1328 hrs on 25 January 2013, the Ingleburn-Wallerawang 77 330 kV Transmission Line (’**77 Transmission Line**’) in New South Wales tripped. At 1329 hrs this line auto reclosed.

At the time bushfires were in progress near the two transmission lines. There was no interruption to supply of loads as a result of these events.

At 1450 hrs on 25 January 2013, Wallerawang Power Station Unit 8 was returned to service.

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 TransGrid and Energy Australia. Data from AEMO's Energy Management System (EMS) and Electricity Market Management System (EMMS) has also been used in analysing the incident.

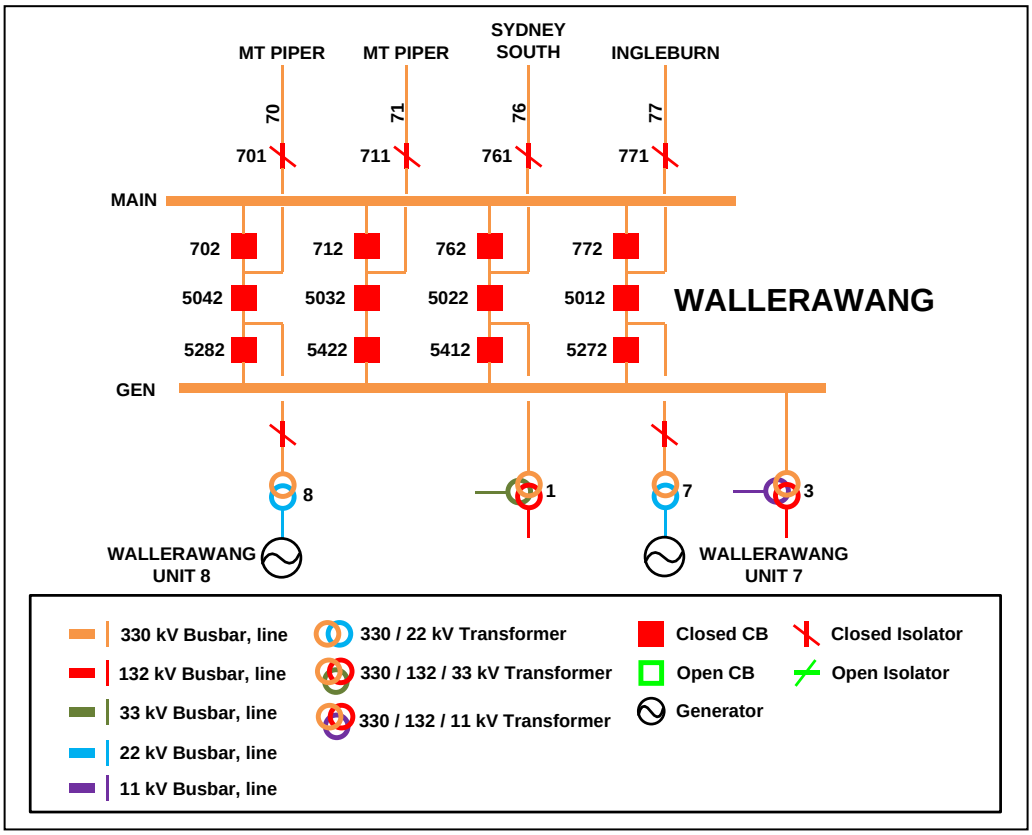
All references to time in this report are to National Electricity Market time (Australian Eastern Standard Time).

2 Pre-Contingent System Conditions

Prior to the incident, the 76 and 77 Transmission Lines were both in service and Wallerawang Power Station Unit 7 and Unit 8 were both in service.

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

Table 1 contains a summary of events.

Table 1: Summary of events

Time	Events
25/1/2013 1328 hrs	Trip of Sydney South-Wallerawang 76 330kV Transmission Line
25/1/2013 1328 hrs	Trip of Wallerawang Unit 8 due to operation of the Restricted Earth Fault protection system
25/1/2013 1328 hrs	Sydney South-Wallerawang 76 330kV Transmission Line in service (Auto reclose)
25/1/2013 1328 hrs	Trip of Ingleburn-Wallerawang 77 330kV Transmission Line
25/1/2013 1329 hrs	Ingleburn-Wallerawang 77 330kV Transmission Line in service (Auto reclose)
25/1/2013 1348 hrs	AEMO issued the Electricity Market Notice No. 41235 advising that simultaneous trip of the 76 and 77 Transmission Lines was reclassified as a credible contingency and of bushfires in the area.
25/1/2013 1409 hrs	AEMO issued the Electricity Market Notice No. 41236 advising of simultaneous trip of the 76 and 77 Transmission Lines and Wallerawang Unit 8, and reclassification of this event as a credible contingency.
25/1/2013 1450 hrs	Wallerawang Unit 8 returned to service

25/1/2013 1558 hrs	AEMO issued the Electricity Market Notice No. 41237 cancelling the reclassification of simultaneous trip of the 76 and 77 Transmission Lines as a credible contingency.
15/4/2013 1405 hrs	AEMO issued the Electricity Market Notice No. 42177 cancelling the reclassification of simultaneous trip of the 76 and 77 Transmission Lines and Wallerawang Unit 8 as a credible contingency.

On 25 January 2013, a bushfire was in progress in the vicinity of the 76 and 77 Transmission Lines. The bushfire was not observed on Transgrid's INDJI[1] (fire monitoring system) display until 1328 and AEMO's INDJI display until 1330, and consequently AEMO and Transgrid were not aware of the fire prior to the trip of the two transmission lines.

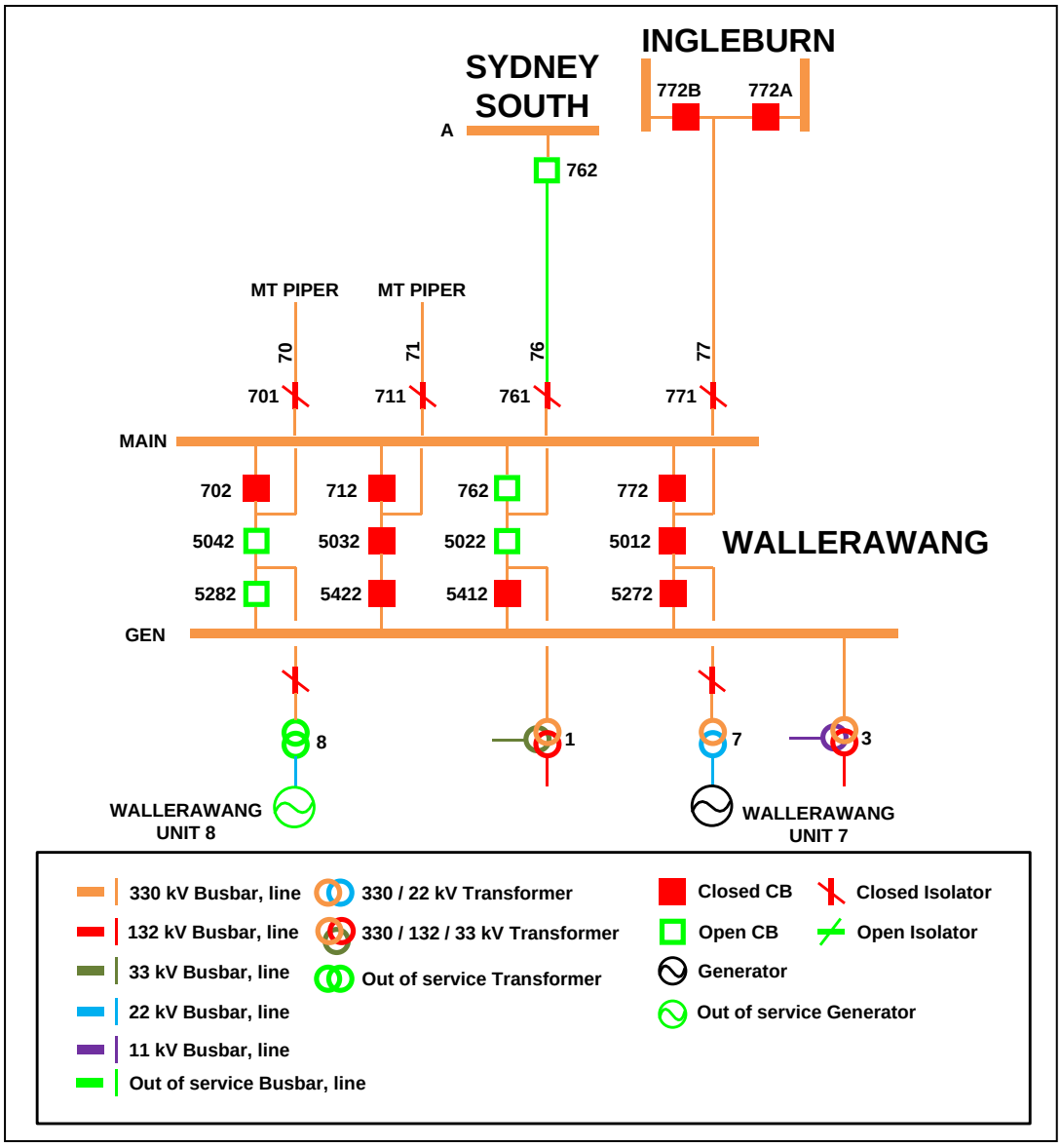
At 1328, the 76 Transmission Line tripped on a single (red) phase to earth fault.

Immediately following the trip of the 76 Transmission Line, the Wallerawang Unit 8 Generator tripped due to the operation of a restricted earth fault protection system. The operation of this protection system was not an expected result of the transmission event.

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

[1] The INDJI Watch system can fail to detect fires due to a number of reasons, including cloud cover, dense canopy or low intensity of the fire at the time the satellite passed overhead.

Figure 2 - Status of the power system immediately after initial event

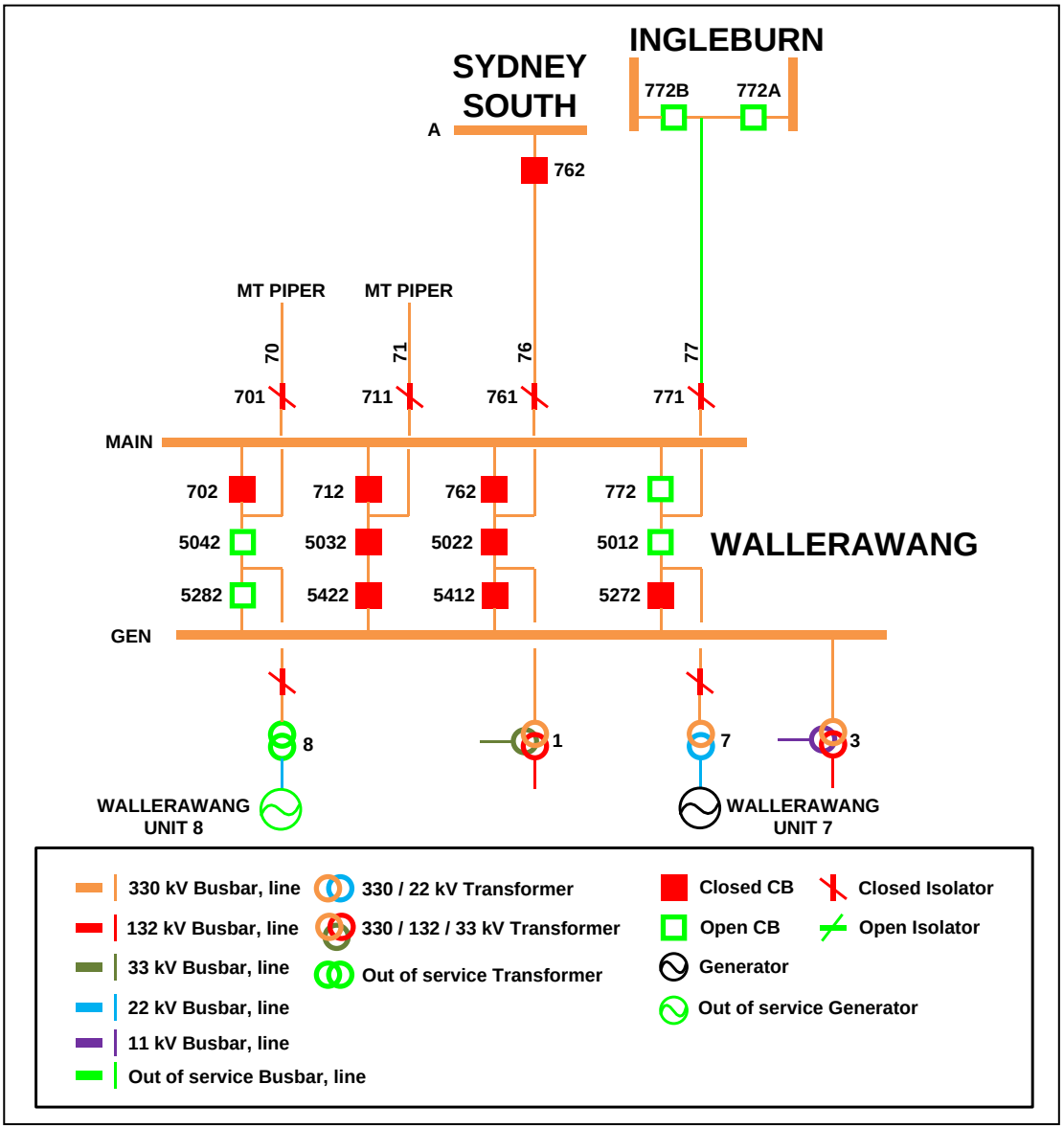


At 1328, the 76 Transmission Line auto reclosed, approximately 20 seconds after it was tripped.

At 1328, the 77 Transmission Line tripped on a single (blue) phase to earth fault, approximately 15 seconds after the reclosure of 76 Transmission Line.

The status of the power system immediately after this event is shown in Figure 3.

Figure 3 - Status of the power system immediately after secondary event



At 1329, the 77 Transmission Line auto reclosed, approximately 20 seconds after it was tripped.

At 1329, AEMO received advice of a fire in the vicinity of Ingleburn from Transgrid.

TransGrid has advised that the transmission system protection operated correctly and that the trip of both lines was directly related to the bushfire.

4 Immediate Actions Taken

At 1348 hrs on 25 January 2013, AEMO issued Electricity Market Notice No.41235 advising that the simultaneous trip of the following transmission lines was reclassified as a credible contingency based on bushfires in the area:

- Sydney South-Wallerawang 76 330kV Transmission Line
- Ingleburn-Wallerawang 77 330kV Transmission Line

This reclassification was based upon an assessment of the bushfire threat, including information provided by TransGrid following the trip of the lines, using SO_OP_3715 Power System Security Guidelines. This assessment determined a probability value (15) that exceeded the threshold for reclassification (9).

At 1409 hrs on 25 January 2013, AEMO issued Electricity Market Notice No.41236 advising that the following plant had tripped simultaneously:

- Sydney South-Wallerawang 76 330kV Transmission Line
- Ingleburn-Wallerawang 77 330kV Transmission Line
- Wallerawang Unit 8

Market Notice No. 41236 noted that lines 76 and 77 had been subsequently returned to service. The market notice further advised that the simultaneous tripping of the identified transmission lines (76 and 77) and generating unit (Unit 8) would be classified as a credible contingency event as the cause of the event was unknown.

5 Follow-up Actions

At 1558 hrs AEMO issued Electricity Market Notice No.41237 advising that AEMO had cancelled the reclassification (advised under Market Notice No. 41235) of the following Non Credible Contingency event:

- (simultaneous trip of) Sydney South-Wallerawang 330kV Transmission Line and Ingleburn-Wallerawang 77 330kV Transmission Line in New South Wales.

This reclassification cancellation was based upon a reassessment of bushfire threat at the time, using SO_OP_3715 Power System Security Guidelines. This assessment determined a probability value (4) that did not exceed the threshold for reclassification (9).

Energy Australia conducted an investigation of the trip of Wallerawang Power Station Unit 8. From their investigation it was identified that the local event associated with the (trip) event was the operation of the generator transformer protection system. Based on the design of this system, this was not an intended response to the triggering conditions (transmission system fault) present at the time of the event. The trip of Wallerawang Unit 8 in response to the transmission line fault was a non-compliance with the generator's performance standards[2]. This event was also found to be similar to a trip of Wallerawang Unit 7 that occurred on 2 July 2012, with respect to both: the event, being an activation of the transformer protection system; and the trigger, being a transmission line trip outside the protection zone of the protection system.

Following the Unit 7 event in 2012, incorrect wiring on the restricted earth protection system was found on both Unit 7 and Unit 8 generator transformers and identified as the most likely root cause of this event. This wiring was subsequently corrected and tested on both units prior to January 2013.

For the incident on 25 January 2013, equipment records indicate that the Unit 8 generator transformer restricted earth fault protection system relay detected an unexpected current that exceeded its threshold for tripping and so tripped. In contrast, the Unit 7 generator transformer restricted earth fault protection system relay experienced the same triggering conditions on the transmission system but did not experience the same local event (trip), and therefore rode through the transmission line fault as intended. Energy Australia disabled the restricted earth fault trip protection for Unit 8 and Unit 8 was returned to service at 1450 hrs. The restricted earth fault protection system is not necessary for compliance with generator performance standards therefore disabling this system for Unit 8 returned the generator to a compliant state.

Energy Australia conducted a subsequent investigation to review the root cause for the mal-operation of the restricted earth fault protection on the Unit 8 transformer. This investigation found that the wiring on the restricted earth protection system was open circuit and is considered to have caused a current imbalance that resulted in the system tripping.

Energy Australia has advised that the wiring has been repaired however, until testing is conducted on the protection during the next planned outage, the restricted earth fault protection system on Wallerawang Power Station Unit 8 has been deactivated.

[2] N.B. the non-compliance with generator performance standards was separately assessed by AEMO and successfully resolved.

Although Energy Australia informed AEMO on 8 February 2013 that the cause for the trip of Wallerawang Unit 8 was identified and removed, AEMO did not cancel the reclassification advised in Market Notice No. 41236 (inducing the 76 and 77 Transmission Lines and Wallerawang unit 8) in a timely manner.

Market Notice No. 42177 was issued on 15 April 2013 cancelling the reclassification of the 76 and 77 Transmission Lines and Wallerawang Unit 8 advised in Market Notice No. 41236.

The delay in cancelling the reclassification of the 76 and 77 Transmission Lines and Wallerawang Unit 8 as a credible contingency event did not cause any market impact or system security issues.

No follow-up actions were required by TransGrid from either event during the incident on 25 January.

6 Power System Security Assessment

The power system voltages remained with limits, the power system frequency remained within the normal operating bands and the power system remained in a secure operating state throughout the incident.

Immediately following the incident an assessment was made by AEMO to determine appropriate actions to maintain power system security. At 1340 hrs AEMO invoked constraint set N-X76+77_N-2_OPEN, which manages the multiple contingency event including the 76 and 77 Transmission Lines. This was advised via Market Notice No. 41236.

It was further assessed that the expansion of the credible contingency to include a simultaneous trip of Wallerawang Power Station Unit 8 did not require a change in the status of constraints.

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

AEMO is satisfied that Energy Australia has taken appropriate measures to mitigate the risk of a similar event occurring in the future. Energy Australia's intentions for future use of the restricted earth protection system is beyond the scope of this report.

AEMO correctly applied the criteria published under NER clause 4.2.3B in section 12 of its SO_OP_3715 Power System Security Guidelines in assessing the circumstances of this incident in relation to the reclassification process. However AEMO was not timely in cancelling the reclassification informed in Market Notice No. 41236. A review of procedures associated with reclassifications was subsequently conducted by AEMO and changes were made to improve information management.

7 Conclusions

The trip of the 76 Transmission Line on 25 January 2013 was caused by a single phase to earth fault caused by bushfires near the line at the time of this event. The trip of Wallerawang Power Station Unit 8 immediately after the transmission line trip was caused by operation of the generator transformer restricted earth fault protection system for Unit 8 due to a faulty wiring condition.

The trip of the 77 Transmission Line on 25 January 2013, was caused by a single phase to earth fault caused by bushfires near the line at the time of this event. Although occurring less than one minute after the trip and re-closure of the 76 Transmission Line, there is no evidence to suggest that the trip of the 77 Transmission Line was caused by the trip of 76 Transmission Line or of Wallerawang Power Station Unit 8. As a result, the incident on 25 January 2013 consisted of two separate events.

No follow-up actions were required by TransGrid.

The actions taken by Energy Australia to date in response to the event have been appropriate. Further testing will be conducted by Energy Australia before returning the affected system to service.

AEMO correctly applied the criteria published in section 12 of its Power System Security Guidelines in assessing that the circumstances present at the time of this incident warranted reclassifying similar simultaneous tripping of the affected plant as credible contingency events. These circumstances included the threat posed to the 76 and 77 Transmission Lines by the present bushfire, and subsequently the unexplained performance and operation of the Wallerawang Power Station Unit 8 generator transformer restricted earth fault protection system.

AEMO correctly issued Market Notice No. 41237 to cancel the reclassification of the 76 and 77 Transmission Lines as credible contingency event informed on Market Notice No. 41235, however the reclassification informed in Market Notice No. 41236 (including the 76 and77 Transmission Lines and Wallerawang unit 8) was not clearly cancelled in a timely manner even though the cause for the trip of Wallerawang unit 8 was identified and removed. A review of procedures associated with reclassifications has been completed by AEMO.

8 Recommendations

There are no recommendations from this assessment.