Power System Operating Incident Report - Trip of Bayswater-Mt Piper 500 kV Transmission Line and Wallerawang Unit 7 on 13 October 2013

PREPARED BY: Systems Capability

DATE: 20 December 2013

FINAL

Contents

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Version Release History

VERSION	DATE	BY	CHANGES	CHECKED BY	AUTHORISED BY
1	20 Dec 2013	B Bizoev	FINAL	S Darnell	P Biddle

Incident Classifications

Time and date and of incident	01:30 hrs Sunday 13 October 2013
Region of incident	New South Wales
Affected regions	New South Wales
Event type	TG – Loss of transmission element(s) and generating unit(s)
Primary cause	UNK – Unknown reason
Impact	VS – Very significant
Associated reports	1. Power System Operating Incident Report – Trip of 76 and 77 330 kV Transmission Lines and Wallerawang Unit 7 on 25 January 2013 2. Power System Operating Incident Report – Trip of Wallerawang Unit 7 and Wallerawang-Orange North 132 kV Line on 2 July 2012

Abbreviations

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

1 Introduction

This report reviews a power system operating incident that occurred on 13 October 2013 in New South Wales. AEMO is required to review this incident as it is classified as a non-credible contingency that satisfies the requirements of a reviewable operating incident under the National Electricity Rules[1] (NER).

The purpose of this incident review is to assess power system security over the course of the incident. The NER requires AEMO 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[2].

This report is based upon information provided by TransGrid and EnergyAustralia. 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 The Incident

On 13 October 2013 at 01:30 hrs the Bayswater to Mt Piper (5A3) 500 kV transmission line tripped and auto-reclosed. The trip was a red phase to ground fault. Subsequently Wallerawang Unit 7 tripped from approximately 278 MW. There was no load interruption as a result of this incident.

The primary reason for this investigation is the trip of Wallerawang Unit 7 following a fault on the power system. Generally, generating units should not trip for a power system fault that is correctly cleared.

3 Participant Investigations

TransGrid[3] could not definitively identify the cause of the trip of the Bayswater to Mt Piper (5A3) 500 kV transmission line. There have been historical incidences of this line, and others of similar construction, tripping in a similar manner due to debris from bird nests. However there was insufficient evidence to confirm this.

EnergyAustralia[4] found that Wallerawang Unit 7 tripped on Restricted Earth Fault (REF) of the Generator Transformer No.2 Differential Protection. The cause of the REF operation was a loose connection in the transformer neutral current circuit. This resulted in an imbalanced current in the restricted earth fault circuit under fault conditions.

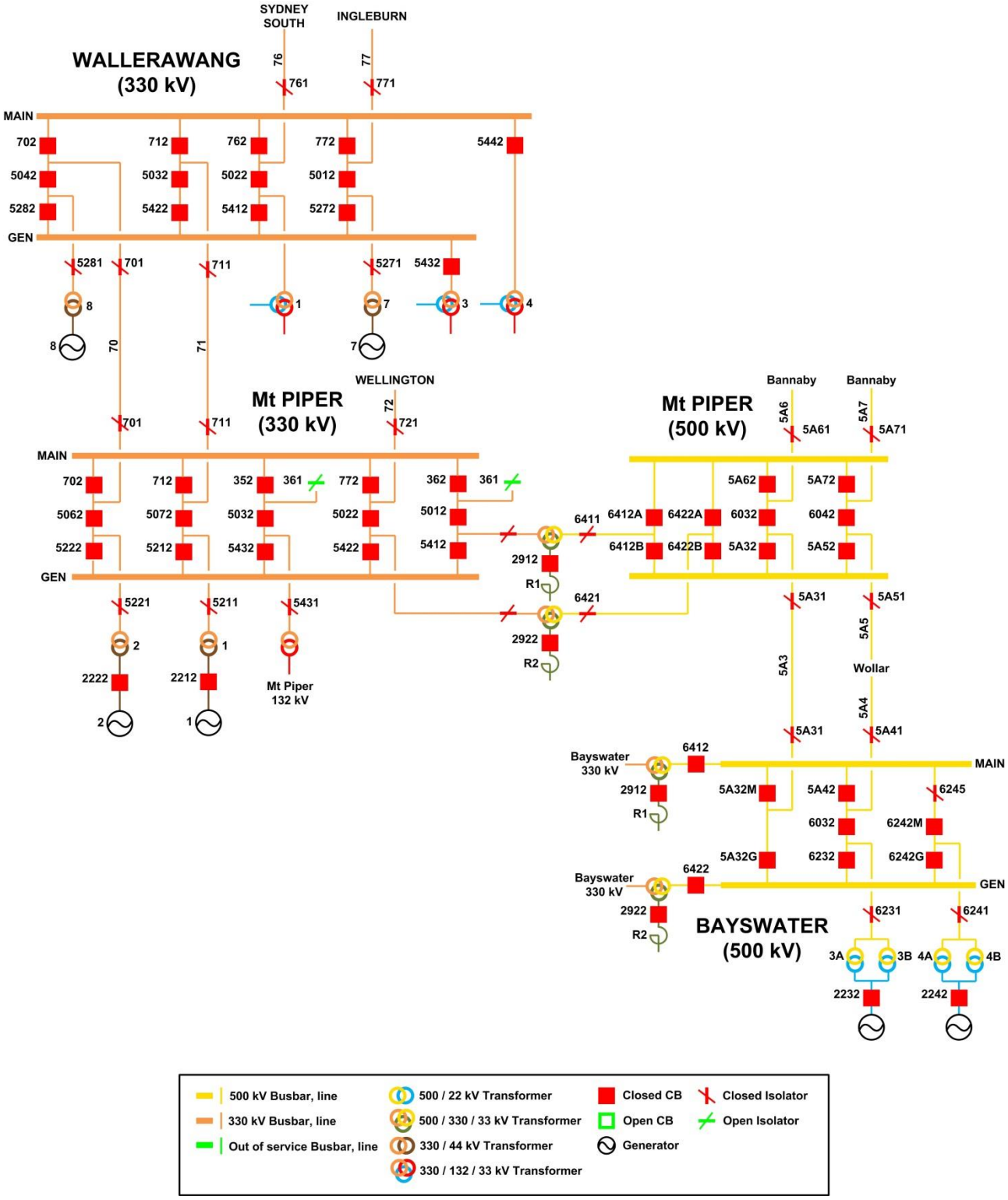
EnergyAustralia submitted a Generator non-compliance notification on 30 October 2013. The notice identified the reason for trip and the how the problem was rectified. The non-compliance was cancelled on the same day.

4 Pre-Incident State

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. The diagram shows both the Bayswater - Mt Piper (5A3) 500 kV transmission line and Wallerawang Unit 7 in service.

[1] *NER* v59 Clause 4.8.15(a)(1)(i) and AEMC Reliability Panel Guidelines for Identifying Reviewable Operating Incidents.
[2] *NER* v59 Clause 4.8.15 (b)
[3] TransGrid is the Transmission Network Service Provider in New South Wales
[4] EnergyAustralia is the owner of Wallerawang Power Station

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



5 Incident Event Log

The sequence of events comprising the incident are itemised in Table 1. The incident spanned approximately 6 hours and 25 minutes from the trip of the Bayswater to Mt Piper (5A3) 500 kV transmission line trip to the power system being returned to the pre-incident state.

Table 1 – Event Log

Date and Time	Event
13 October 2013 01:30 hrs	Bayswater to Mt Piper (5A3) 500 kV transmission line tripped and auto-reclosed Wallerawang Unit 7 tripped
13 October 2013 01:45 hrs	Market Notice 43584 issued to notify the market of a non-credible contingency event
13 October 2013 07:55 hrs	Wallerawang Unit 7 returned to service
13 October 2013 07:57 hrs	Market Notice 43587 issued to notify the market of the re-classification of the Bayswater to Mt Piper (5A3) 500 kV transmission line and simultaneous trip of Wallerawang Unit 7 as a credible contingency
30 October 2013 14:03 hrs	Market Notice 43754 issued to notify the market of the cancellation of the reclassification of the trip of the Bayswater to Mt Piper (5A3) 500 kV transmission line and simultaneous trip of Wallerawang Unit 7

6 Post-Incident State

The status of the power system after the incident is shown in Figure 2. The diagram shows the tripped Bayswater to Mt Piper (5A3) 500 kV transmission line and Wallerawang Unit 7 out of service. The Bayswater to Mt Piper (5A3) 500 kV transmission line then successfully auto-reclosed.

7 Immediate Actions

AEMO issued Market Notice 43584 approximately 15 minutes after the trip of the Bayswater to Mt Piper (5A3) 500 kV transmission line to notify the market of a non-credible contingency event. AEMO is required to notify the market of a non-credible contingency event within two hours of the event[5].

No immediate actions were required of TransGrid as the Bayswater to Mt Piper (5A3) 500 kV transmission line correctly auto-reclosed and remained in service.

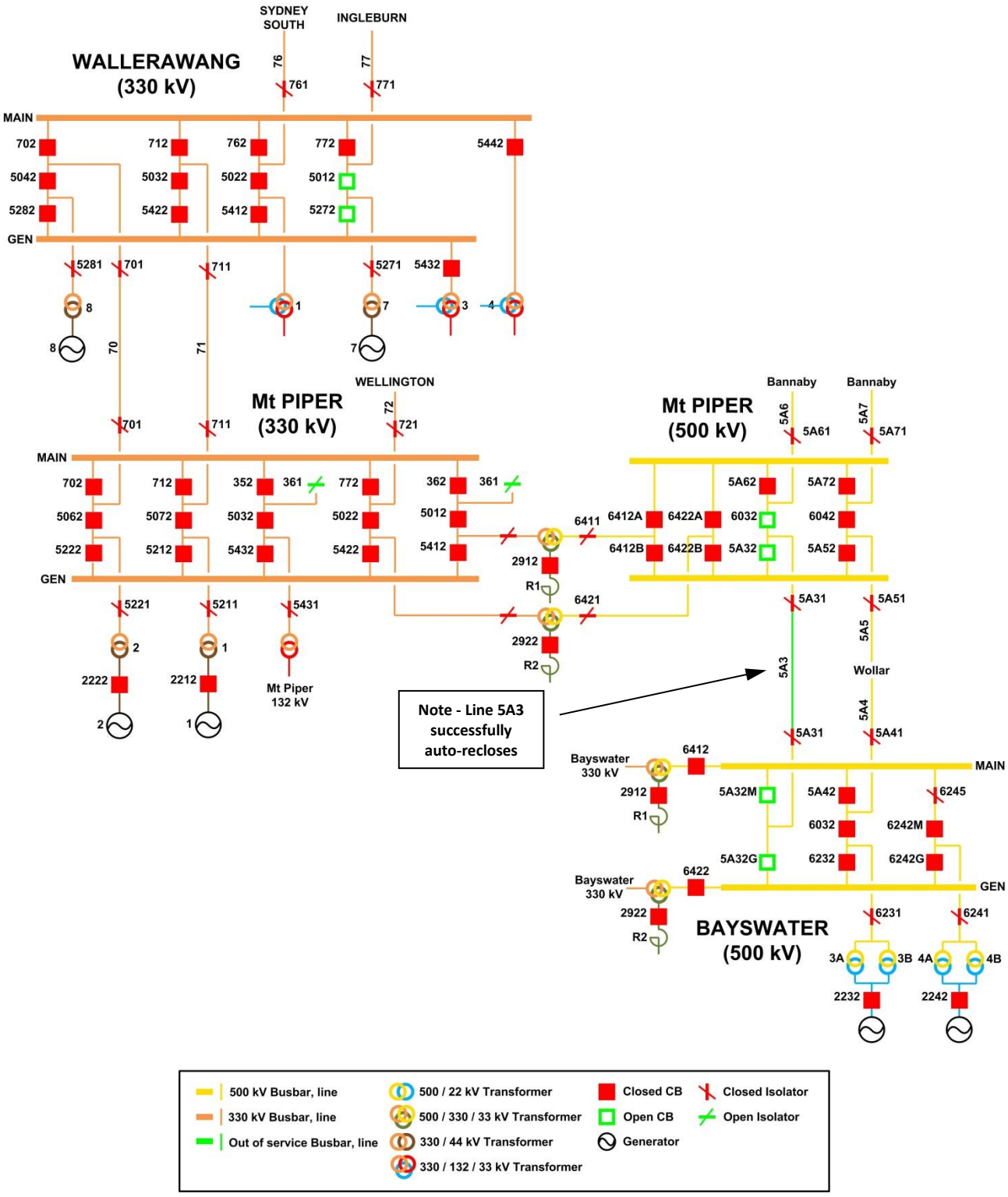
8 Follow-up Actions

AEMO is required to assess whether or not to reclassify a non-credible contingency event as a credible contingency[6] and to report how re-classification criteria were applied[7]. AEMO has to determine if the condition that caused the non-credible contingency event has been resolved.

Following the initial trip of Wallerwang Unit 7 the root cause of the trip was unknown. AEMO thereby issued Market Notice 43587 at 07:57 hrs on 13 October 2013. The market notice notified the market that the Bayswater to Mt Piper (5A3) 500 kV transmission line and the simultaneous trip of Wallerawang Unit 7 was re-classified as a credible contingency because the cause of the non-credible contingency had not been identified.

[5] AEMO, *Power System Security Guidelines,* v54 Section 10.3
[6] *NER* v59 Clause 4.2.3A (c)
[7] *NER* v59 Clause 4.8.15 (ca)

Figure 2 - Status of the power system after the incident



On 25 October 2013 EnergyAustralia notified AEMO that the cause of the Wallerawang Unit 7 trip was most likely due to a loose connection in the Generator Transformer No. 2 Differential Protection Restricted Earth Fault Relay. The loose connection effectively modified a protection setting, via higher impedance, which subsequently caused Unit 7 to trip under fault conditions. EnergyAustralia submitted a report to AEMO on 6 November 2013 confirming the reason for the trip.

Based on this information AEMO considered that the cause of the non-credible contingency had been resolved and was unlikely to reoccur. AEMO issued Market Notice 43754 at 14:03 hrs on 30 October 2013 to advise the market that the reclassification had been cancelled.

9 Power System Security

AEMO is responsible for power system security in the NEM and is required to operate the power system in a secure operating state[8]. AEMO must thereby ensure that the power system is maintained in, or returned to, a secure operating state following a contingency event. For this incident AEMO took appropriate action by reclassifying the incident as a credible contingency until the cause had been identified and rectified.

The power system remained in a secure state throughout the incident. The fault was cleared as required by the NER fault clearance limits, and power system frequency remained within frequency operating standards[9]. The provision and response of facilities and services were adequate to maintain power system security over the course of the incident.

Additionally, AEMO considered two past incidents concerning Wallerawang Units that tripped as a result of power systems faults. For both cases, Unit 7 on 2 July 2013 and Unit 8 on 25 January 2013, the units tripped via restricted earth fault protection. The cause in the first case was incorrect wiring, and the cause in the second case was an inadvertent open circuit in the wiring. Based on this information, and that other power system faults have not caused Wallerawang Units to trip, AEMO considers that there is no identifiable systemic problem with the restricted earth fault protection at Wallerawang Power Station and that no further action is required.

10 Conclusions

1. The Bayswater to Mt Piper (5A3) 500 kV transmission line tripped due to an unidentified power system fault and then correctly auto-reclosed.
2. The power system fault caused Wallerawang Unit 7 to trip from approximately 278 MW. A loose secondary circuit connection caused the inadvertent trip. The loose connection was later identified and rectified.
3. Power system security was maintained over the course of the incident.

11 Recommendations

There are no recommendations arising from this incident.

[8] *NER* v59 Clause 4.2.4 (a)

[9] Frequency Operating Standards (Mainland) available from the AEMC website at http://www.aemc.gov.au/Panels-and-Committees/Reliability-Panel/Guidelines-and-standards.html