Power System Operating Incident Report – Trip of Bannaby - Mount Piper 500 kV Transmission Line and Bayswater Unit 4 Generator Transformers on 19 March 2014

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Version Release History

VERSION	DATE	BY	CHANGES	CHECKED BY	AUTHORISED BY
1	28 May 2014	Alanah Makin	FINAL	S Darnell	P Biddle

Incident Classifications

Time and date and of incident	1752 hrs Wednesday 19 March 2014
Region of incident	New South Wales
Affected regions	New South Wales
Event type	TG – Loss of transmission element(s) and generating units
Primary cause	UNK – Unknown Reason
Impact	VS (Very Significant)
Associated reports	N/A

Abbreviations

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

1 Introduction

This report reviews a power system operating incident that occurred on 19 March 2104 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[3] and Macquarie Generation[4]. Data from AEMO's Energy Management System (EMS) and Electricity Market Management System (EMMS) has also been used in analysing the incident.

National Electricity Market time (Australian Eastern Standard Time) is used in this report.

2 The Incident

On Wednesday 19 March 2014 at 1752 hours, the Bannaby - Mt Piper 5A7 500kV transmission line (Line 5A7) tripped and reclosed. At the same time the Bayswater Unit 4 Generator Transformers 4A and 4B (Unit 4 Transformers) tripped, disconnecting Bayswater Unit 4 (Unit 4) from 625MW.

No load was lost as a result of this incident.

The primary reason for investigating this incident is that Unit 4 tripped for a fault on the power system. For power system faults, generating units are generally expected to remain connected to the power system whilst protection systems react and clear the fault. The trip of Unit 4 for a fault on Line 5A7 is thereby a non-credible contingency and is also a possible non-compliance of Unit 4 Generator Performance Standards (GPS).

3 Investigations

TransGrid investigated this incident and concluded that lightning most likely caused the trip of Line 5A7. TransGrid found that the transmission line protection operated correctly for this type of incident.

TransGrid also concluded that the Bayswater Unit 4 Transformer Differential Protection scheme opened the TransGrid circuit breakers (CBs 6242M and 6242G) which tripped Unit 4. TransGrid found that transmission protection did not operate to cause the trip of Unit 4.

Macquarie Generation also investigated this incident and found that Unit 4 tripped because of the operation of the X Generator Transformer A and B Differential Protection Relay (X Relay). This relay protects the two parallel 23/500kV generator step up transformers. The duplicate Y Generator Transformer A and B Differential Protection Relay, and the protection on other Bayswater Power Station generating units, did not operate at the time of the incident.

When the X Relay operated it sent an inter-zone trip signal to open the 2 x 500kV TransGrid Circuit Breakers (CBs 6242M and 6242G) connected to the high voltage side of the transformers. The relay also tripped the 22 kV generator circuit breaker and the auxiliary transformer circuit breaker. These events were expected for an X Relay operation.

[1] NER Clause 4.8.15(a)(1)(i) and AEMC Reliability Panel Guidelines for Identifying Reviewable Operating Incidents.
[2] NER Clause 4.8.15 (b)
[3] TransGrid is the Transmission Network Service Provider New South Wales
[4] Macquarie Generation is the operator of Bayswater Power Station

Macquarie Generation tested the Unit 4 Transformers for the presence of a genuine in-zone fault. No fault was present. The X Relay was tested in accordance with the Bayswater GPS compliance program and met the 'Pass' criteria in each instance. The compliance program tests and additional testing failed to identify why the X Relay operated. Further testing is planned during the next maintenance outage in late 2014.

4 System Diagrams

The status of the power system prior to the incident is shown in Figure 1 and after the incident in Figure 2. For clarity only equipment relevant to this incident, at Mount Piper and Bayswater, has been included in the diagrams. Line 5A7 successfully auto-reclosed shortly after it tripped.

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

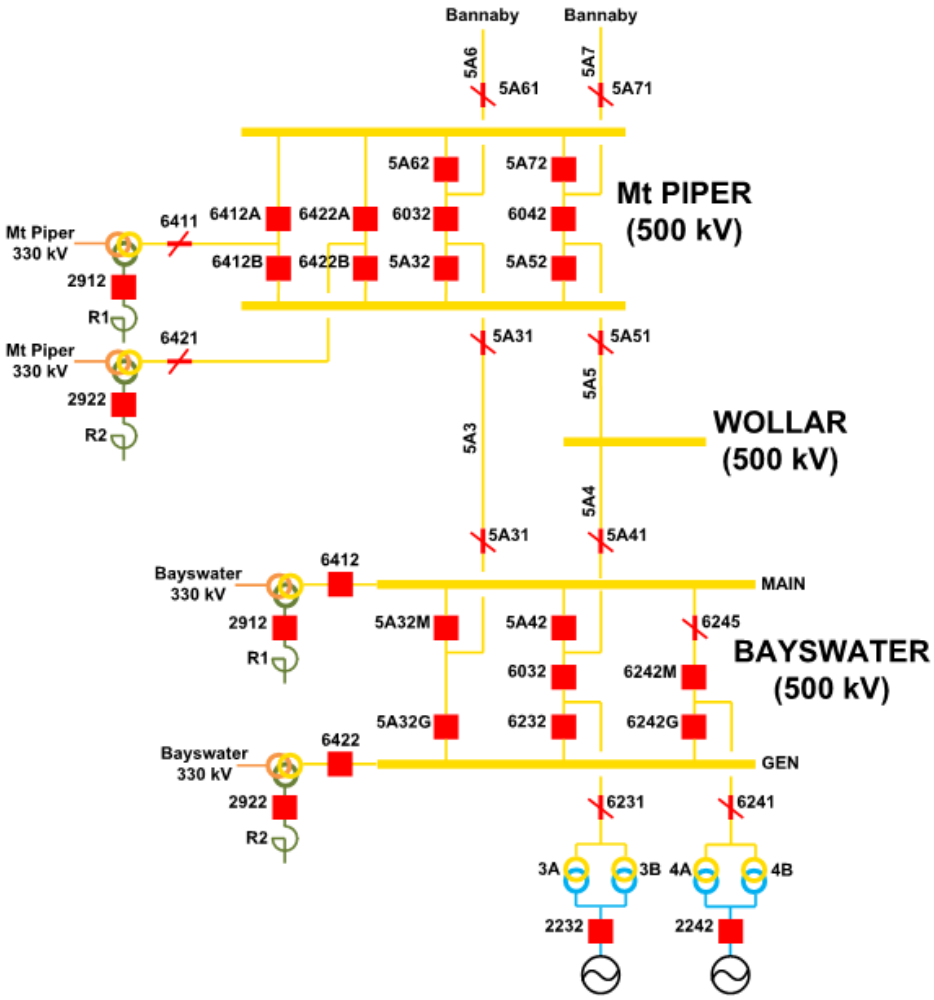
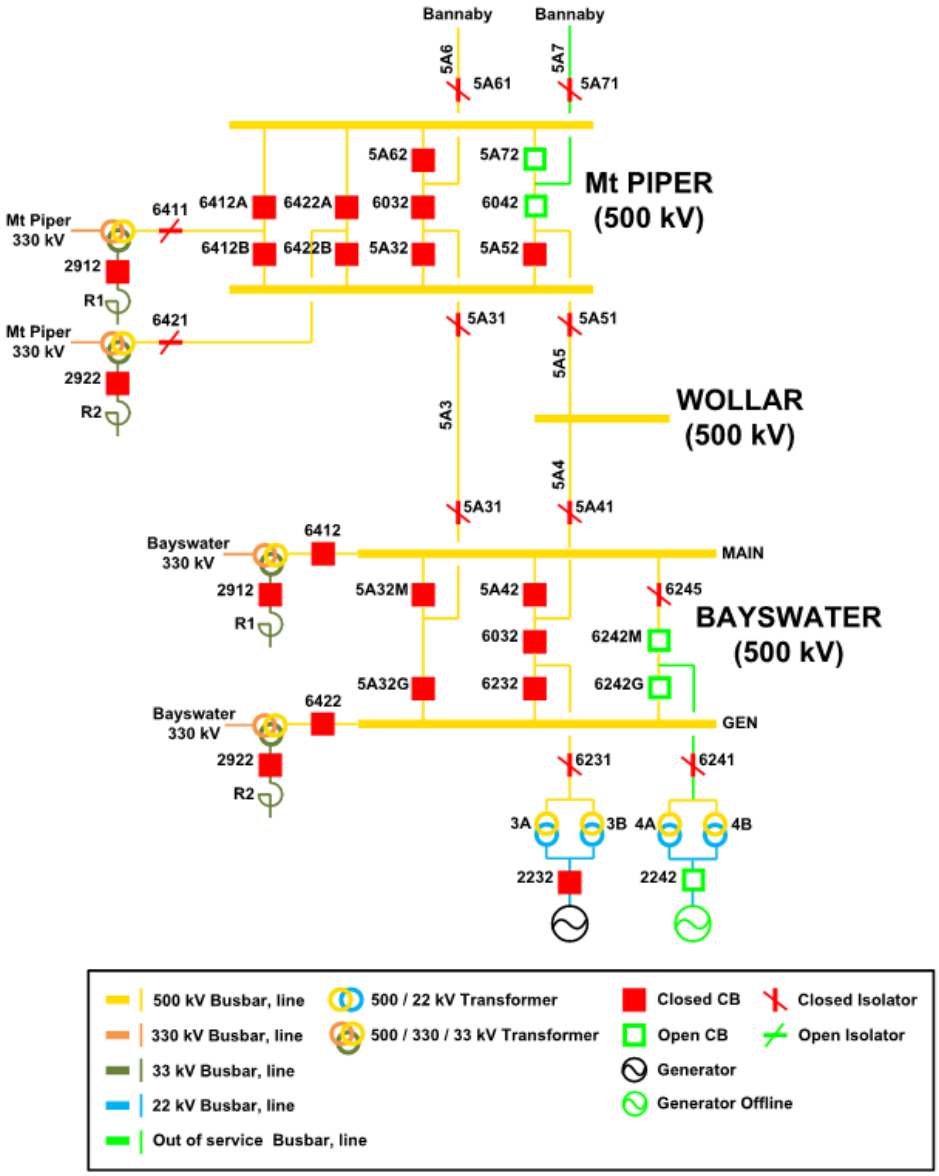


Figure 2 - Status of the power system immediately after the incident



5 Incident Event Log

The sequence of events comprising the incident are itemised in Table 1.

Table 1 – Event Log

Time and Date	Event
1752 hrs 19 Mar 2014	Bannaby to Mt Piper (5A7) 500kV line tripped and auto-reclosed.
1752 hrs 19 Mar 2014	Circuit breakers 6242M, 6242G & 2242 opened to trip Bayswater Generator Transformers 4A & 4B and Unit 4 from 625MW.
1955 hrs 19 Mar 2014	Market Notice 45396 Issued informing the market about the non-credible event.
2040 hrs 21 Mar 2014	Bayswater Unit 4 returned to service.
2052 hrs 21 Mar 2014	Market Notice 45418 Issued. Event reclassified as a credible contingency.

6 Immediate Response

For this incident no immediate response was required. Line 5A7 successfully auto-reclosed and the power system was in a secure state.

7 Follow-up Response

This section assesses follow-up actions taken to resolve the incident.

AEMO issued Market Notice 45396 at 1955 hrs, 123 minutes after the incident, to notify the market of a non-credible contingency event. This was just over the two hours in which AEMO is required to notify the market of a non-credible contingency event[5].

When Unit 4 returned to service on 21 March, AEMO issued Market Notice 45418 to reclassify the incident a credible contingency[6]. This action was required because the cause of the generator trip was not yet known and could thereby potentially reoccur. The reclassification of the incident as a credible contingency will be removed when the cause of the incident has been identified and that AEMO considers the event is unlikely to reoccur.

The Macquarie Generation investigation remains ongoing and will report by 31 December 2014.

8 Power System Security

The power system remained secure over the course of this incident. Power system frequency, and voltage remained within limits and the fault was cleared within required timeframes.

AEMO correctly assessed the incident and reclassified the incident as a credible contingency and appropriate notifications were issued.

9 Conclusions

1. The trip of Line 5A7 was most likely due to a lightning strike.
2. The reason for the trip of Unit 4 has not yet been identified and remains under investigation.
3. The trip of the Bayswater Unit 4 is a possible GPS non-compliance.

10 Pending Actions

Macquarie Generation to determine what initiated trip of Unit 4 and advise AEMO by 31 December 2014.

[5] AEMO, *Power System Security Guidelines,* v56 Section 10.3

[6] For a non credible contingency event AEMO is required to assess whether or not to reclassify a non credible contingency event as a credible contingency (NER Clause 4.2.3A (c)) and to report how re-classification criteria were applied NER Clause 4.8.15 (ca). AEMO has to determine if the condition that caused the non-credible contingency event has been resolved.