Power System Operating Incident Report – Trip of Calvale No.2 275kV busbar and Calvale-Halys 8810 and 8811 transmission lines on 30 March 2014

PREPARED BY:	Systems Capability
DATE:	6 June 2014
STATUS:	FINAL

Version Release History

VERSION	DATE	BY	CHANGES	CHECKED BY	AUTHORISED BY
1	6 June 2014	Alanah Makin	FINAL	S Darnell	P Biddle

Incident Classifications

Time and date and of incident	2136 hrs Sunday 30 March 2014
Region of incident	Queensland
Affected regions	Queensland
Event type	TT – Loss of multiple transmission elements
Primary cause	TE – Transmission Equipment Failure
Impact	Nil
Associated reports	N/A

Abbreviations

Abbreviation	Term
AEMO	Australian Energy Market Operator
CB	Circuit Breaker
CT	Current Transformer
kV	Kilovolt
Line 8810	Calvale - Halys 8810 275 kV transmission line
Line 8811	Calvale - Halys 8811 275 kV transmission line
MW	Megawatt
NER	National Electricity Rules
No. 2 Busbar	Calvale No.2 275kV Busbar

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.

CONTENTS

1 Introduction

This report reviews a power system operating incident that occurred on Sunday 30 March 2014 at Calvale Substation in Queensland.

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].

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 Powerlink[3] and AEMO. National Electricity Market time (Australian Eastern Standard Time) is used in this report.

2 The Incident

On Sunday 30 March 2014, at 2136 hrs, the Calvale No.2 275kV Busbar (No.2 Busbar) tripped due to a fault on a 275 kV current transformer (CT). As a result of the CT fault, the Calvale - Halys 8810 and 8811 275 kV transmission lines also tripped (Line 8810 and Line 8811). During this power system disturbance there was no loss of load or generation.

The reason for investigating this incident is that a transmission busbar tripped and two transmission lines tripped at both ends. Generally for a power system fault, just the power system element bearing the fault should trip. Other power system elements should remain connected to the power system.

3 Powerlink Investigation

Powerlink investigated this incident and found that an internal high voltage fault on CT at Calvale Substation caused the No. 2 Busbar to trip. The No.2 Busbar and Line 8811 tripped immediately as a result of the failed CT. These trips were expected for this type of event.

The failed CT was associated with the 275kV CB 88112 at Calvale substation. The CT supplied the protection systems for both the No.2 Busbar and the Line 8811.

Line 8810 tripped three seconds after the CT fault. The trip was due to a high voltage fault on Line 8810 caused by ionised air particles as a result of the CT failure.

Powerlink found that protection systems for No.2 busbar and Lines 8810 and 8811 operated correctly, and in accordance with the NER, for this type of event.

Powerlink removed the failed CT from the power system, and by 2323 hrs on the same day had returned Lines 8810 and 8811 to service.

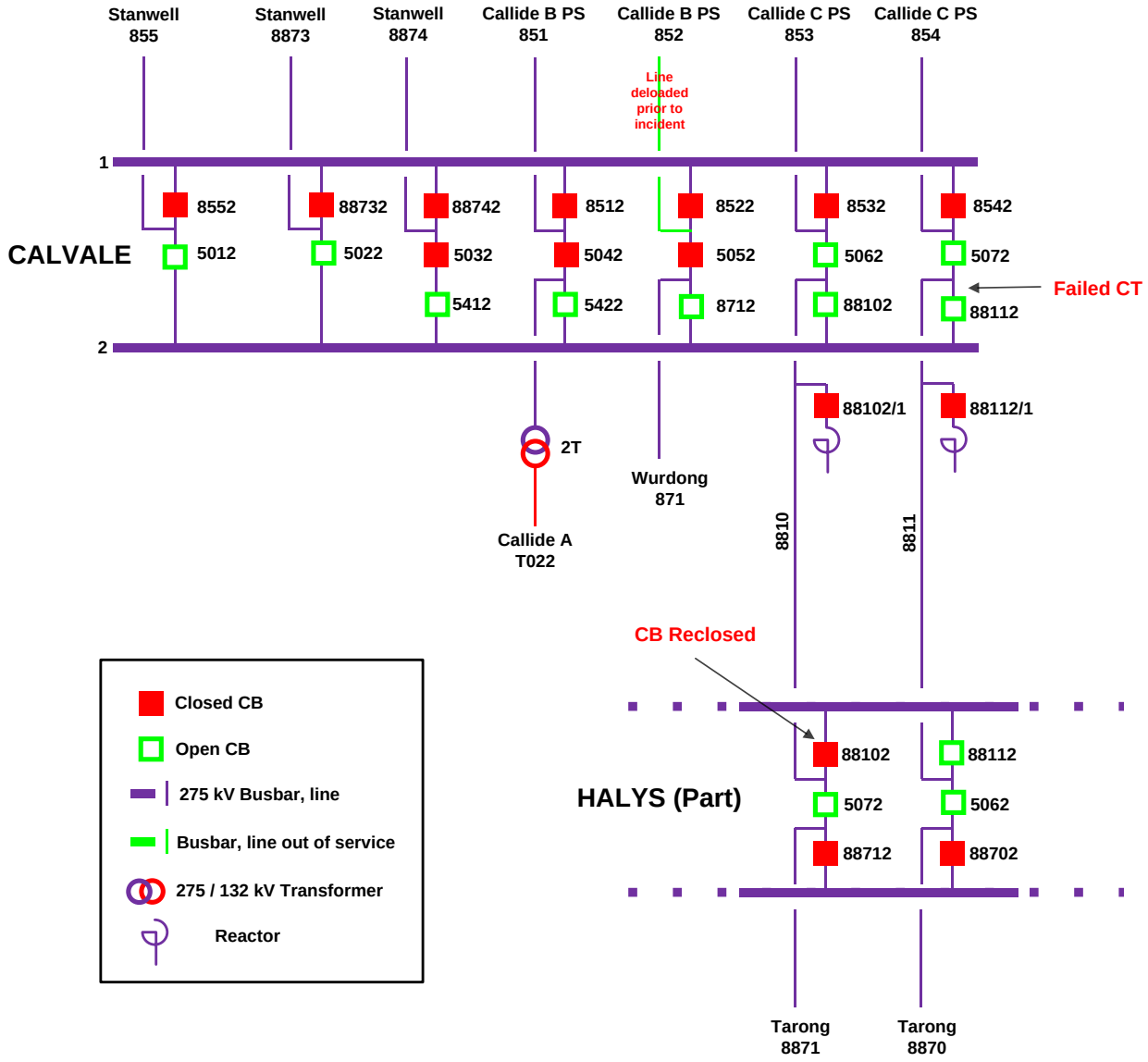
Powerlink has yet to identify the cause of the CT failure. The investigation is expected to be complete by the end of July 2014. The investigation is necessary to identify if this type of CT has a systemic problem. If the CT has a systemic problem, then remedial work on similar CTs may be required to maintain power system security.

4 System Diagram

Figure 1 shows the status of the power system at Calvale substation after the incident. The diagram shows the circuit breakers (CBs) that opened as a result of the incident.

[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] Powerlink is the Transmission Network Service Provider in Queensland region

Figure 1 - Status of the power system immediately after the incident



5 Immediate Response

This section assess the immediate response to the incident.

Immediately after the incident the power system was in a secure state[4]. To maintain an ongoing secure state AEMO invoked constraint set Q-HACL[5] approximately 9 minutes after the CT fault. This constraint set alone however was not sufficient to ensure power system security whilst both 8810 and 8811 lines were out of service. Constraint set Q-HACL is designed for a single line outage. If the power system had progressed to an insecure state then AEMO would have invoked additional constraints. Once Line 8810 had returned to service (11 minutes after the CT fault) constraint set Q_HACL was sufficient to ensure the power system was in a secure state.

No further immediate actions were required.

[4] AEMO is required to return the power system to a secure state within thirty minutes following a contingency event - NER Clause 4.2.6 (b)

[5] Constraint set Q-HACL constrains the power system for an outage of either Line 8810 or Line 8811

6 Follow-up Response

This section assess the follow-up response to resolve the incident.

AEMO issued Market Notice 45480 at 2201 hrs approximately 25 minutes after the incident to notify the market of the non-credible contingency event. This notification was within two hours of the event in which AEMO is required to notify the market of a non-credible contingency event[6].

Powerlink isolated the failed CT and then returned No. 2 Busbar and Lines 8810 and 8811 to service. This was complete by 2323 hrs on the same day. The isolation of the failed CT does not impact other protection systems whilst CB 88112 is open. CB 88112 will remain open until the failed CT is replaced.

AEMO issued Market Notice 45483 at 2329 hrs to notify the market that the incident would not be reclassified as a credible contingency[7]. AEMO considered that the root cause of the incident had been identified and isolated, and that the incident was unlikely to reoccur.

7 Power System Security

This section assesses how power system security was managed over the course of the incident[8]. See Appendix 1 for a chronological log of events comprising the incident.

The power system was in a secure state over the course of the incident - power system frequency, and voltage remained within limits - and the fault was cleared within required timeframes.

AEMO issued appropriate notifications, and correctly assessed the incident by not reclassifying the incident as a credible contingency.

Over the course of the incident the provision and response of facilities and services were adequate to maintain power system security.

8 Conclusions

1. No. 2 Busbar and Line 8811 tripped due to a high voltage fault in a CT.
2. Line 8810 tripped due to ionised air particles as a result of the CT fault.
3. Power system security was maintained over the course of the incident.

9 Pending Actions

Powerlink to complete an investigation into the cause of the CT fault. The investigation is expected to be complete by the end of July 2014. Powerlink will provide results of the investigation to AEMO.

10 Recommendations

There are no recommendations arising from this review

[6] AEMO is required to notify the Market of a non-credible contingency event within two hours of the event - AEMO, *Power System Security Guidelines,* Section 10.3.

[7] 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.

[8] AEMO is responsible for power system security in the NEM and is required to operate the power system in a secure operating state (NER Clause 4.2.4 (a)). AEMO must thereby ensure that the power system is maintained in, or returned to, a secure operating state following a contingency event.

Appendix 1 – Incident Event Log

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

Table 1 – Event Log

Time and Date	Event
2136 hrs 30 March 2014	No.2 Busbar and Line 8811tripped. Line 8810 tripped 3 seconds later.
2136 hrs 30 March 2014	Line 8811 auto-reclosed and tripped again to lockout.
2136 hrs 30 March 2014	Line 8810 successfully auto-reclosed at Halys end only.
2145 hrs 30 March 2014	AEMO invoked Constraint set Q-HACL.
2147 hrs 30 March 2014	Line 8810 returned to service. CB 5062 manually closed at Calvale substation.
2201 hrs 30 March 2014	AEMO issued Market Notice 45480. Notification of the non-credible event and that Line 8810 had been returned to service.
2208 hrs 30 March 2014	AEMO issued Market Notice 45481. Notification that constraint set Q-HACL has been invoked.
2212 hrs 30 March 2014	AEMO issued Market Notice 45482. Notification that Line 8811 remains out of service.
2212 hrs 30 March 2014	Powerlink isolated the failed CT from the power system.
2319 hrs 30 March 2014	Powerlink returned Line 8811 to service.
2323 hrs 30 March 2014	Powerlink returned No.2 Busbar returned to service.
2325 hrs 30 March 2014	AEMO revoked constraint set Q-HACL.
2329 hrs 30 March 2014	AEMO issued Market Notice 45483. Notification that No.2 busbar, Line 8810 and Line 8811 have been returned to service, and that AEMO did not reclassify this event as a credible contingency.
2350 hrs 30 March 2014	AEMO issued Market Notice 45484. Notification of the likely cause of the non-credible contingency. At this time AEMO thought lightning was the cause of the incident.[9]
1542 hrs 31 March 2014	AEMO issued Market Notice 45486. Notification that the trip of Lines 8810 and 8811 were not simultaneous and that the trips were caused by equipment damage at Calvale substation.

[9] At the time of issuing Market Notice 45484 AEMO believed that the cause of the incident was a lightning strike. Later Powerlink identified that the trip of the busbar and lines were related to a CT fault.