POWER SYSTEM OPERATING INCIDENT REPORT
TRIP OF NO. 1 GLADSTONE 275 KV BUSBAR ON 13 MAY 2011

PREPARED BY: Electricity System Operations Planning and Performance

VERSION: 1.0

DATE: 22 August 2011

FINAL

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.

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.

Abbreviations and Symbols

Abbreviation	Term
AEMO	Australian Energy Market Operator Ltd
CB	Circuit Breaker
EST	Eastern Standard Time
kV	kilovolt
MW	megawatt
MWh	megawatt hour (also MW·h)
NEM	National Electricity Market
NER	National Electricity Rules

1 Introduction

At 0822 hrs on 13 May 2011 the No. 1 275 kV busbar at Gladstone 275 kV substation in Queensland automatically tripped. The trip occurred on the unexpected operation of its busbar trip relay during planned work on protection systems at the substation. Because of a planned outage of high voltage equipment associated with this work, the busbar trip also off-loaded the Gladstone No. 2 275/132 kV bus tie transformer. No customer load was interrupted as a result of this incident.

This report has been prepared under clause 4.8.15 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 Powerlink. Data from AEMO's Energy Management System has also been used in analysing the incident.

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

2 Pre-Contingent System Conditions

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 Gladstone 275 kV switchyard is a breaker and a half electrical layout comprising two 275 kV busbars. Prior to the incident, the 813 Gladstone—Gin Gin 275 kV transmission line had been taken out of service and Gladstone 275 kV circuit breaker 5052 was open for planned work. The status of the Gladstone 275 kV switchyard prior to the incident is shown in Figure 1.

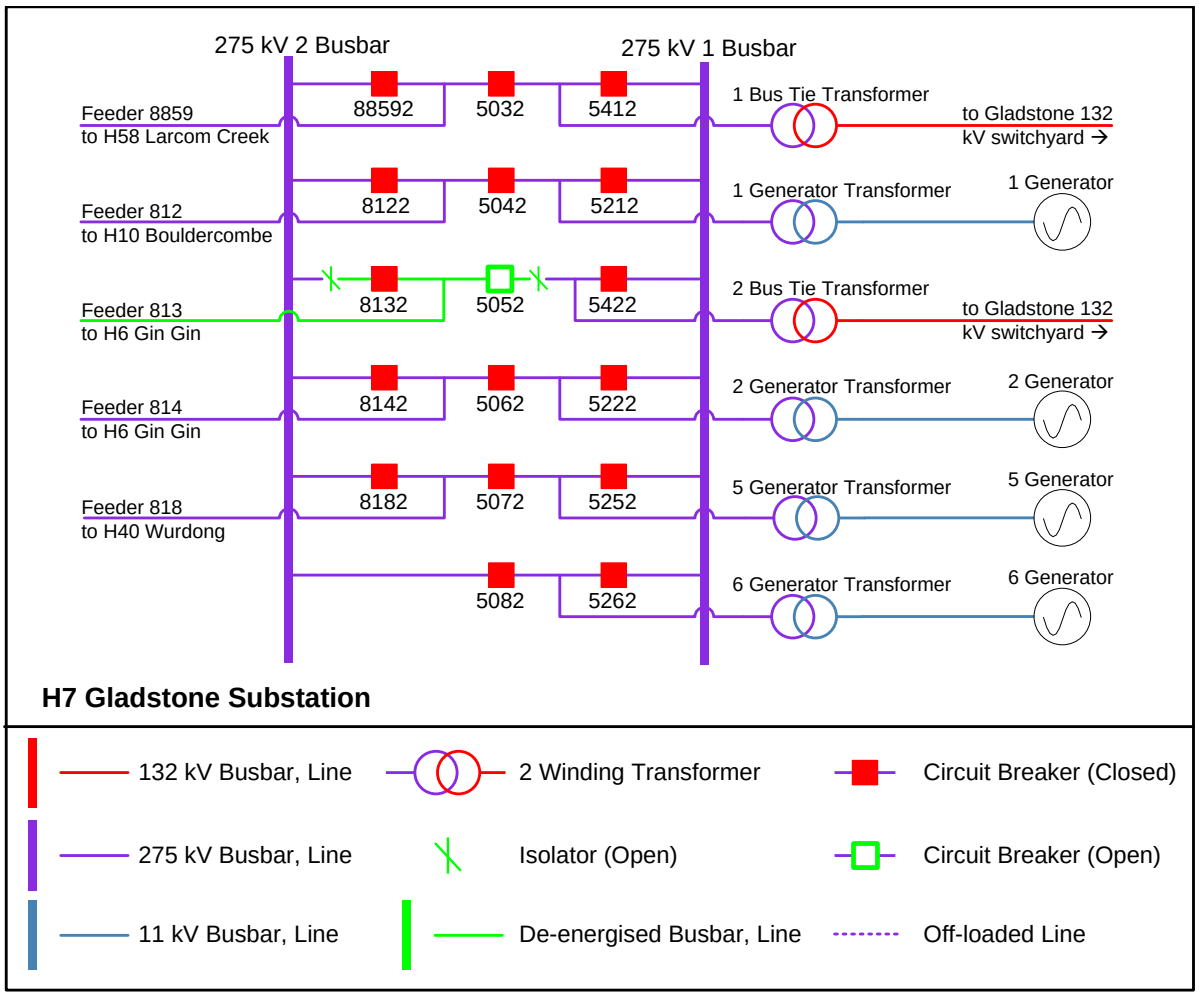

Figure 1 – Status of the Gladstone 275 kV switchyard prior to the incident

3 Summary of Events

At 0822 hrs on 13 May 2011 the No. 1 275 kV busbar trip relay[1] operated at Gladstone substation during planned work on protection systems. The operation of this relay opened all of the circuit breakers connected to the Gladstone No. 1 275 kV busbar. A high voltage fault was not experienced at the time and the operation of the busbar trip relay was unexpected.

Circuit breaker 5052 at Gladstone was open for planned work prior to the incident. The combination of this outage and the busbar trip caused the Gladstone No. 2 275/132 kV bus tie transformer to be off-loaded. The transformer remained energised from the Gladstone 132 kV switchyard.

The status of the Gladstone 275 kV switchyard immediately after the incident is shown in Figure 2.

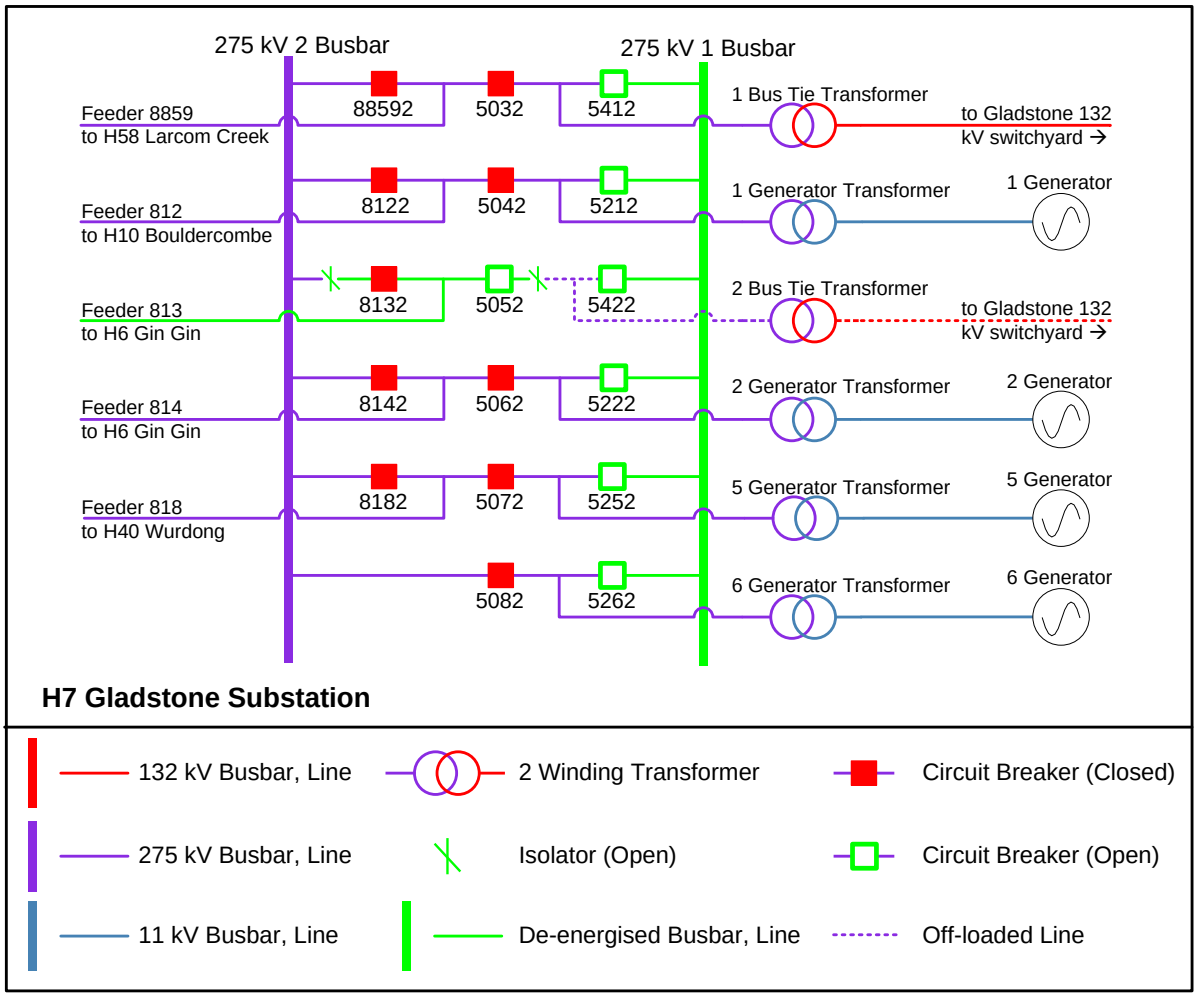

Figure 2 - Status of the Gladstone 275 kV switchyard immediately after the incident

4 Immediate Actions Taken

After the busbar trip, AEMO identified that the No. 1 275/132 kV bus tie transformer at Gladstone substation would be overloaded if the 865 Wurdong—Boyne Island 275 kV transmission line tripped.

Powerlink took appropriate actions to manage the post-contingent loading on that transformer by:

[1] The function of busbar trip relay is to trip all circuit breakers connected to the busbar when triggered by the operation of busbar protection, or circuit breaker failure protection of any of the circuit breakers connected to the busbar.

- re-directing flows through the 132 kV network, by opening the 7113 and 7114 Baralaba—Blackwater 132kV lines and closing the 7104 and 7105 Calvale—Gladstone South 132kV lines, and
- applying higher short-term thermal ratings to the transformer in conjunction with a post-contingent load shedding plan, and advising those arrangements to AEMO

The power system returned to a secure operating state at 0832 hrs when the above actions had been completed.

Further to the above actions, at 0829 hrs AEMO invoked constraint set "Q-GL_BTTX" for the off-loaded Gladstone No. 2 275/132 kV bus tie transformer, effective from dispatch interval ending 0840 hrs. However the constraint set was ineffective due to the prior outage of the 813 Gladstone—Gin Gin 275 kV line, for which the constraint set was not configured. At 0846 hrs AEMO prepared a constraint set for the current network configuration using its constraint automation facility[2]. However AEMO did not need to invoke that constraint set but instead gave Powerlink permission to restore the Gladstone No. 1 275 kV busbar to service.

At 0906 hrs Powerlink returned the Gladstone No. 1 275 kV busbar to service. At 0907 hrs Powerlink placed the Gladstone No. 2 275/132 kV bus tie transformer on load and at 0908 hrs AEMO revoked the constraint set "Q-GL_BTTX". By 0910 hrs all the affected network elements were reconnected to the Gladstone No. 1 275 kV busbar.

At 1024 hrs AEMO issued Market Notice No. 35236 advising the occurrence of this non-credible contingency event. The market notice also advised that AEMO would not reclassify the trip of the Gladstone No.1 275 kV busbar as a credible contingency event. This decision was based on Powerlink's advice that the work undertaken in the Gladstone 275 kV substation relay room would be suspended until the cause of the trip was identified, and hence a reoccurrence of the trip was unlikely.

5 Follow-up Actions

After the incident Powerlink undertook an investigation to determine the cause of the busbar trip. The investigation found that the busbar tripped on the operation of the busbar trip relay. The operation of this relay was unexpected.

The busbar trip relay operated during planned work on panel wiring associated with the replacement of protection systems for the 813 Gladstone—Gin Gin 275 kV line. Although the protection secondary circuits had been correctly isolated in accordance with the Powerlink procedures prior to commencing the work, inadvertent triggering of the busbar trip relay occurred resulting in the busbar trip.

Additional precautions have since been implemented in work practices to minimise the risk of similar events during planned work on these or similar protection systems.

6 Power System Security Assessment

At 0822 hrs the No.1 275 kV busbar at Gladstone unexpectedly tripped and off-loaded the Gladstone No. 2 275/132 kV bus tie transformer. This resulted in the power system being in an insecure operating state, as AEMO's contingency analysis studies identified that the Gladstone No. 1 275/132 kV bus tie transformer would be overloaded on contingent trip of the 865 Wurdong—Boyne Island 275 kV line.

[2] The constraint automation facility is a software application in AEMO's energy management system (EMS) that automatically generates thermal overload constraint equations based on the current or planned state of the power system.

After Powerlink reconfigured the 132 kV network and provided AEMO with higher short-term thermal ratings for the Gladstone No. 1 275/132 kV bus tie transformer the power system returned to a secure operating state at 0832 hrs, 10 minutes after the busbar trip.

The power system voltages and frequencies remained within the normal operating bands throughout the incident and the power system was returned to a secure operating state within 30 minutes[3].

7 Conclusions

At 0822 hrs on 13 May 2011 the No. 1 275 kV busbar at Gladstone 275 kV substation unexpectedly tripped and off-loaded the Gladstone No. 2 275/132 kV bus tie transformer during planned work associated with the replacement of protection systems for the 813 Gladstone—Gin Gin 275 kV line.

The power system was not in a secure operating state immediately following this non-credible contingency event, but corrective actions were taken to return the power system to a secure operating state within 30 minutes.

Additional precautions have been implemented in work practices to minimise the risk of a similar incident occurring during planned work on similar protection systems.

AEMO is satisfied that appropriate actions were taken to restore power system security, and that appropriate work has been done to mitigate the risk of a similar incident occurring in the future.

8 Recommendations

There are no recommendations arising from this incident.

[3] Clause 4.2.6(b)(1) in the National Electricity Rules states that after a contingency event, AEMO should take all reasonable actions to adjust the operating conditions with a view to returning the power system to a secure operating state as soon as it is practical to do so, and, in any event, within thirty minutes.