

POWER SYSTEM INCIDENT REPORT TRIP OF BOTH TARONG – BLACKWALL 275 KV LINES ON 21 FEBRUARY

PREPARED BY: Electricity System Operations Planning and Performance

DATE: 3 June 2011

FINAL

Disclaimer

- (a) **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.
- (b) **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.
- (c) **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.

© 2011 - Australian Energy Market Operator Ltd. All rights reserved

1 Introduction

At 1440 hrs on 21 February 2011, a single phase of both 827 and 875 Tarong – Blackwall 275 kV transmission lines in Queensland tripped. Lightning activity was experienced in the area at the time. The tripped phases at the Blackwall end successfully auto-reclosed, however the two closed phases of each line at the Tarong end tripped due to an unexpected protection system operation. 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 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 to National Electricity Market time (Eastern Standard Time).

2 Pre-Contingent System Conditions

Prior to the incident all circuit breakers and transmission elements connecting the Tarong and Blackwall 275 kV substations were in service, as shown in Figure 1 below.

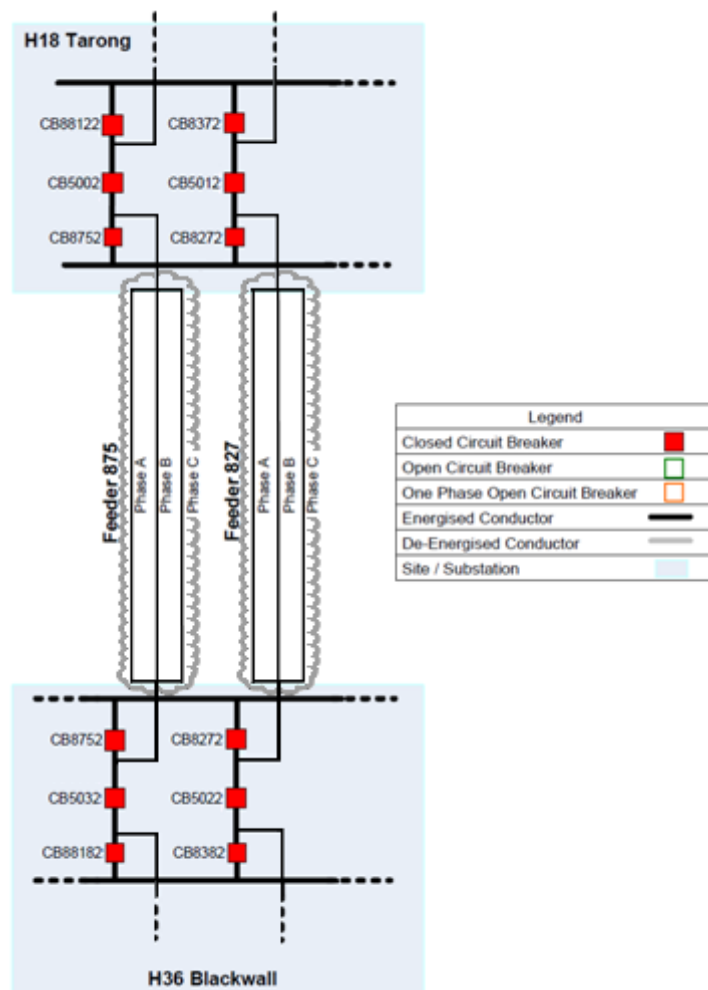


Figure 1 – Transmission line and circuit breaker status prior to the incident

3 Summary of Events

Both the 827 and 875 Tarong – Blackwall 275 kV lines share the same set of transmission towers. These transmission lines have the capability of single pole auto-reclose (SPAR), which allows one phase to be tripped to isolate and clear a fault and then auto-reclose to return the tripped phase to service.

At 14:40:05 on 21 February 2011, the phase C circuit breakers of both 827 and 875 Tarong – Blackwall 275 kV lines tripped at both ends due to the presence of a high voltage fault on those phases due to a lightning strike.

The phase C circuit breakers at both ends of the lines opened to isolate the fault from the power system. The circuit breakers connecting the transmission lines immediately to the busbars only opened on the faulted phase while all three phases of the centre circuit breakers correctly opened. These operations resulted in the two transmission lines remaining in service on two phases only. Figure 2 below shows the status of the relevant circuit breakers after the lightning strike.

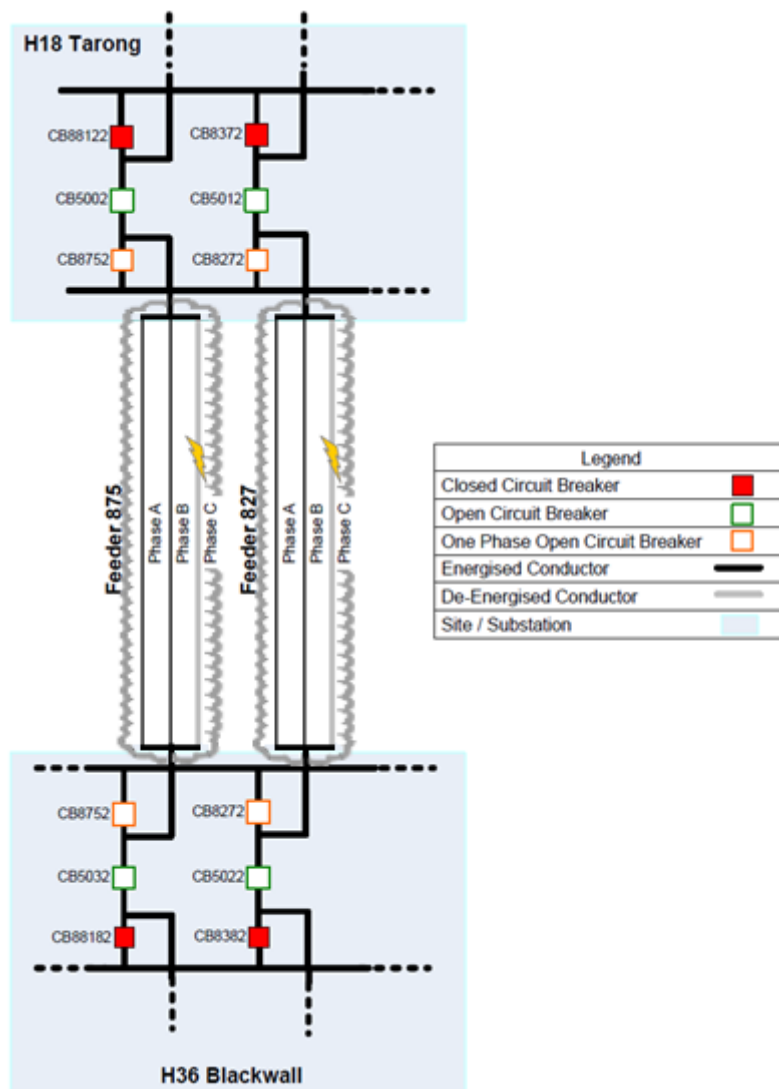


Figure 2 – Transmission line and circuit breaker status after the lightning strike

At 14:40:06, the open phase C of circuit breaker 8272 at the Blackwall 275 kV substation successfully auto-reclosed, resulting in phase C of the 827 Tarong – Blackwall 275 kV line being energised from the Blackwall end only.

At 14:40:08, the two closed phases of circuit breaker 8272 at the Tarong 275 kV substation tripped on operation of pole discrepancy protection, resulting in the 827 Tarong – Blackwall 275 kV line being off-loaded but still energised from the Blackwall end. The operation of the pole discrepancy protection was unexpected.

At 14:40:09, the two closed phases of circuit breaker 8752 at the Tarong 275 kV substation tripped on operation of pole discrepancy protection, resulting in the 875 Tarong – Blackwall 275 kV line being off-loaded but still energised from the Blackwall end. Again, the operation of the pole discrepancy protection was unexpected.

At 14:40:14, the open phase C of circuit breaker 8752 at the Blackwall 275 kV substation successfully auto-reclosed, resulting in all three phases of the 875 Tarong – Blackwall 275 kV line being energised from the Blackwall end but remaining off-loaded. Figure 3 below shows the status of the equipment at this time.

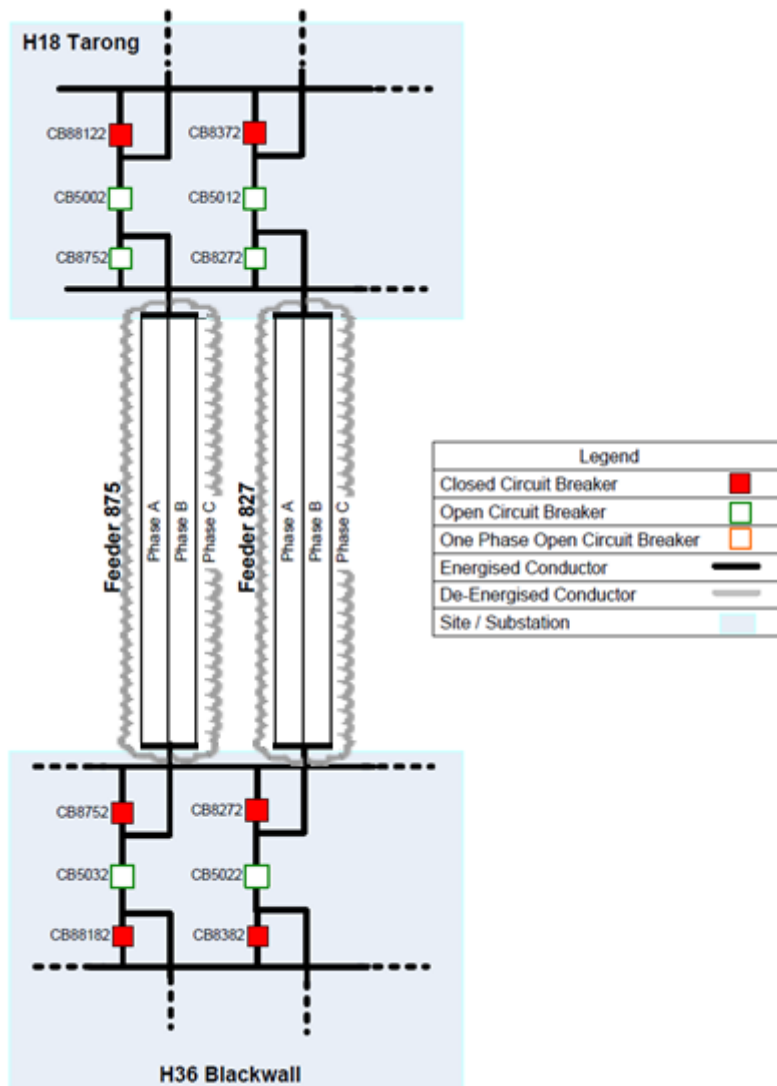


Figure 3 – Transmission line and circuit breaker status after the protection system operations

As shown in Figure 3, at this time both transmission lines were off-loaded but energised from the Blackwall end.

At 1450 hrs both transmission lines were manually closed from the Tarong end, returning them to service.

At 1607 hrs AEMO issued Electricity Market Notice No.34594, advising the occurrence of this incident as a non-credible contingency event.

4 Power System Security Assessment

The 827 and 875 Tarong – Blackwall 275 kV lines were out of service for less than 10 minutes.

The power system voltages and frequencies remained within the normal operating bands throughout the incident. The power system remained in a secure operating state throughout the incident.

5 Follow-up Actions

Following the incident, Powerlink investigated the circuit breaker auto-reclose performance. The investigation identified that, for a coincident single phase trip of the 827 and 875 275 kV transmission lines, there was a timing coordination issue between the auto-reclose dead time and the circuit breaker pole discrepancy time for circuit breakers 8272 and 8752 at Tarong 275 kV substation. This timing coordination issue caused the unexpected operation of the pole discrepancy protection systems, which resulted in the transmission lines being opened on all phases. Powerlink has since successfully tested and implemented new protection system settings.

Powerlink has investigated the possibility of this timing coordination issue existing on similar double circuit transmission lines and has confirmed to AEMO that the issue only existed for the 827 and 875 Tarong – Blackwall 275 kV lines.

Powerlink has also confirmed to AEMO that the single phase auto-reclose dead times observed in this incident were as designed.

At 1702 hrs on the day of the incident, AEMO issued Electricity Market Notice No.34595 advising that, pending further investigation, the 827 and 875 Blackwall – Tarong 275 kV lines are listed as ‘Vulnerable Transmission Lines’ with a category of “Probable” with respect to the likelihood of a simultaneous trip due to a lightning strike. This action is consistent with section 10.4.1 of AEMO Power System Operating Procedure SO_OP3715 “Power System Security Guidelines”¹.

Prior to the incident AEMO had not listed these double circuit transmission lines as ‘Vulnerable Transmission Lines’ and hence they did not qualify for reclassification as a credible contingency event on the occurrence of a lightning strike. Therefore AEMO did not have a constraint set to manage a multiple outage of these lines.

AEMO has since created a constraint set to manage this multiple outage. Subsequent analysis by AEMO has shown that this constraint set would not have had an impact on dispatch outcomes if it had been invoked during the incident.

¹ AEMO operating procedure SO_OP3715 “Power System Security Guidelines” is available at the following web page: <http://www.aemo.com.au/electricityops/3715.html>

At 1224 hrs on 11 March 2011, AEMO issued Electricity Market Notice No.34796 stating that the protection system issues associated with the 827 and 875 Tarong – Blackwall 275 kV lines had been rectified, and that those lines were no longer listed by AEMO as ‘Vulnerable Transmission Lines’ with respect of the likelihood of a simultaneous trip due to a lightning strike.

6 Conclusions

At 1440 hrs on 21 February 2011, both 827 and 857 Tarong – Blackwall 275 kV lines in Queensland experienced single phase trips after a lightning strike. The tripped phases at the Blackwall end successfully auto-reclosed, however the two closed phases of each line at the Tarong end tripped due to an unexpected protection system operation.

Powerlink has since successfully tested and implemented new protection system settings to rectify the issue.

7 Recommendations

There are no recommendations arising from this incident.