

POWER SYSTEM INCIDENT REPORT: TRIP OF NO 1 AND 2 NEW OSBORNE 66 KV BUSBARS ON 26 SEPTEMBER 2010

PREPARED BY: Electricity System Operations Planning and Performance

FINAL

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1 Introduction

At 1119 hrs on 26 September 2010 a busbar fault caused busbars 1 and 2 at the 66 kV New Osborne substation to trip. Both the gas and steam turbines of Osborne power station tripped resulting in 116 MW of generation being disconnected from the power system. Approximately 29 MW of load was also interrupted in the Adelaide region.

The 66 kV New Osborne substation was restored by 1326 hrs on 26 September 2010. At 1100 hrs on 27 September Osborne power station was available for dispatch at maximum availability.

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

ElectraNet and Origin Energy have provided relevant information to AEMO for this power system incident investigation. Data from AEMO’s Energy Management and Market Systems has also been used in investigating the event.

2 Pre-Contingent System Conditions

Prior to the incident at 1119 hrs on 26 September 2010 all network elements connected to the New Osborne 66 kV busbar at the New Osborne substation were in service. The pre-incident state of the busbar can be seen in figure 1.

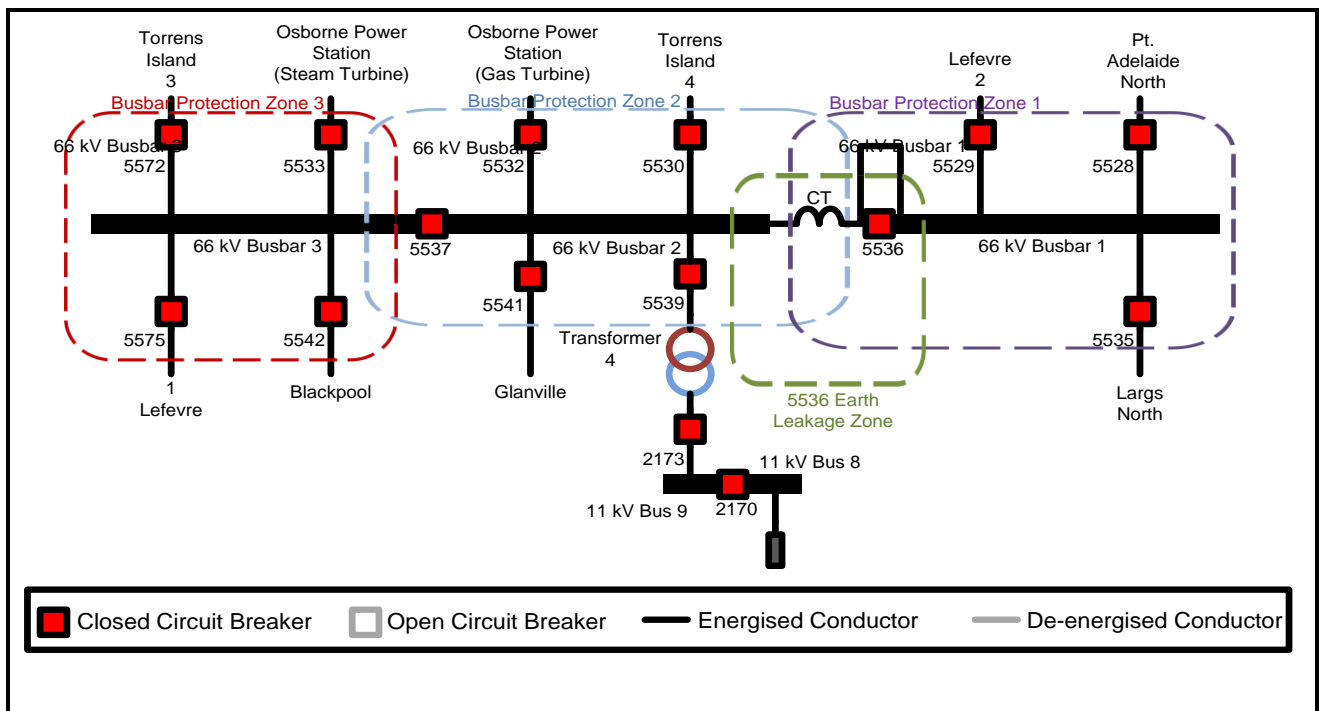


Figure 1 - New Osborne 66 kV substation at 1119 hrs on 26 September 2010 prior to the incident

Prior to the incident the Osborne power station gas turbine was generating at approximately 91 MW and the Osborne power station steam turbine generating at 27 MW.

3 Summary of Events

At 1119 hrs on 26 September 2010 busbars 1 and 2 at the 66 kV New Osborne substation tripped due to faults.

The initial high voltage fault occurred on circuit breaker 5536 C phase current transformer. Following the initial fault another high voltage fault developed on the B-phase current transformer.

Both faults were initially located within the bus section 2 protection zone. Consequently bus section 2 protection operated to trip all network elements connected to it.

The high voltage fault on the B phase current transformer then spread to bus section 1 protection zone. Busbar 1 protection then operated to trip all network elements connected to bus section 1.

The state of the 66 kV busbar at the New Osborne substation after tripping of No.1 and 2 busbar sections is shown in figure 2.

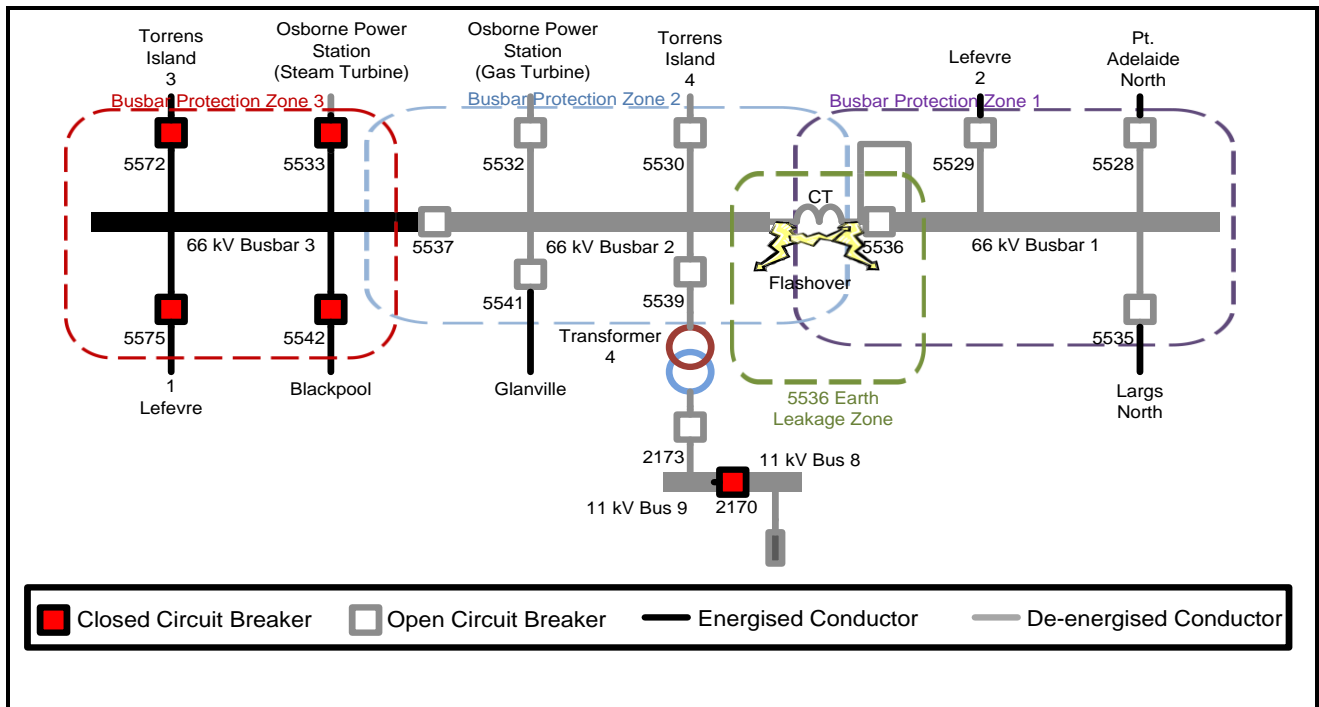


Figure 2 - New Osborne 66 kV Substation at 1119 hrs on 26 September 2010 after the operation of busbar 1 and 2 protection systems

Protection systems also operated to trip Torrens Island No.4 line at the Torrens Island end.

The operation of the busbar 2 protection disconnected the Osborne Power Station gas turbine from the power system. This caused the Osborne Power Station steam turbine also to be disconnected. At the time of disconnection Osborne power station was generating 116 MW.

Approximately 29 MW of load was also interrupted within the ETSA Utilities network following tripping of busbar 1 and busbar 2 at New Osborne Substation.

All connections to the New Osborne busbar were restored by 1326 hrs on 26 September 2010. All load interrupted in the ETSA Utilities network was restored by 1149 hrs on 26 September 2010.

Osborne Power Station was made available for dispatch by 1100 hrs on 27 September.

4 Management of Power System Security

A bird nest on circuit breaker 5536 C phase current transformer caused a flashover on the primary terminals of the current transformer. This flashover caused another flashover on the primary terminals of the B-phase current transformer. Both flashovers were external to the current

transformer and caused phase-to-ground faults. Both faults were located in the busbar section 2 protection zone.

New Osborne 66 kV busbar 2 earth leakage protection tripped circuit breakers 5530, 5532, 5539, 5541, 5536, 5537 and 2173. This caused busbar 2 to be disconnected from, respectively, the:

- No.4 Torrens Island-New Osborne 66 kV line
- Osborne Power Station gas turbine
- New Osborne No.4 66/11 kV transformer
- No.2 Glanville-New Osborne 66 kV line
- New Osborne 66 kV busbar 1
- New Osborne 66 kV busbar 3

The fault was cleared from busbar 2 in 34 ms.

The flashover on the B phase current transformer extended to the busbar 1 causing a phase-to-ground fault in the busbar 1 protection zone. Busbar 1 earth leakage protection tripped circuit breakers 5528, 5529 and 5535. This caused busbar 1 to be disconnected from, respectively, the:

- No.2 LeFevre-New Osborne 66 kV line
- Port Adelaide North - New Osborne 66 kV line
- Largs North - New Osborne 66 kV line

The fault was cleared from busbar 1 in a further 31 ms. Total fault clearance time for the New Osborne 66 kV substation was 65 ms. Fault clearance times met the requirements specified by the National Electricity Rules¹.

The “Set 2” protection on the No.4 New Osborne-Torrens Island 66kV line operated unexpectedly to trip the line from the Torrens Island end. The trip was initiated by the “Set 2” protection at the Torrens Island substation. At the time of publication of this report ElectraNet was investigating the operation of the “Set 2” protection during the incident.

At 1218 hrs on 26 September ElectraNet staff arrived at the New Osborne substation to carry out a visual inspection of the faulted equipment. At 1323 hrs ElectraNet began re-energising busbars 1 and 2 of the New Osborne 66 kV substation.

By 1338 all circuit breakers connected to New Osborne 66 kV busbar 1 and busbar 2 had been closed with the exception of circuit breaker 5536. Circuit breaker 5536 was isolated so that the faulted equipment could be inspected and repaired. Both the steam and gas turbines of Osborne Power Station remained out of service.

When circuit breaker 5532 opened as a result of the fault in New Osborne Substation the Osborne Power Station control systems initiated an “islanding” sequence. The “islanding sequence allows the gas turbine to remain in operation whilst being disconnected from the power system. Whilst islanded the gas turbine operates at minimum load and supplies the power station’s house load. The “islanding” sequence also trips steam turbine as the steam turbine is not able to operate when the gas turbine is operating at minimum load.

At 1333 hrs permission was given to Osborne power station for the gas turbine to be resynchronised through circuit breaker 5532. However circuit breaker 5532 was not able to be closed due to a “synchronisation inhibit” signal being received by the station’s control system.

¹ See Schedule S5.1a.8(b) of the National Electricity Rules.

At 1340 hrs staff at Osborne Power Station attempted to synchronise through the generator circuit breaker rather than through circuit breaker 5532. The generator circuit breaker was opened and circuit breaker was 5532 closed to prepare for synchronisation through the generator circuit breaker.

Attempts to synchronise the gas turbine at 1350 hrs and 1439 hrs through the generator circuit breaker were not successful due to the continued presence of “synchronisation inhibit” signal.

At 2130 hrs the Osborne power station staff determined that the reason for the “synchronisation inhibit” signal associated with the generator circuit breaker was caused by a faulty relay switch. The generator circuit breaker and associated faulty relay switch are both located within the Osborne Power Station. By 2330 hrs the faulty relay had been repaired and tested.

The Gas Turbine was started at 0800 on 27 September and Osborne Power Station was made available for dispatch at 1100 hrs on 27 September.

5 Follow-up Actions

Circuit breaker 5536 B phase current transformer was replaced on 18 October 2010.

The top sections of circuit breaker 5537 current transformers were cleared of bird nests on 29 September 2010 and the top sections of circuit breaker 5536 current transformers were cleared of bird nests on 10 October 2010.

The Osborne power station “synchronisation inhibit” signal associated with the circuit breaker 5532 was found to be caused by the way the generator control system had been programmed. The “synchronisation inhibit” had been programmed in this manner to prevent the unintentional remote synchronisation of the gas turbine. Operating procedures at Osborne Power Station have since been updated to reflect the control system programming.

At the time of publication of this report ElectraNet was investigating the operation of the No.4 New Osborne-Torrens Island 66kV line “Set 2” protection during the incident. ElectraNet intend to complete the investigation by the end of January 2011.

6 Recommendations

ElectraNet will inform AEMO of the outcome of its investigation of the operation of the “Set 2” protection at Torrens Island by the end of January 2011. It is recommended that AEMO raise the outcomes of ElectraNet’s review of the operation of the “Set2” protection at Torrens Island with other transmission network service providers.