

# POWER SYSTEM INCIDENT REPORT TRIP OF TOWNSVILLE SOUTH 132 KV BUSBAR ON 13 OCTOBER 2009

PREPARED BY: ESOPP

FINAL

## 1 INTRODUCTION

At 13:05 hrs on 13 October 2009, Townsville South (T56) 132 kV No.1 busbar tripped. The trip occurred due to a fault in an item of equipment connected to No.1 busbar. There was a reduction in load supplied from T56 substation of approximately 100 MW. Mt. Stuart generating units were not in service at the time 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 & services and the appropriateness of actions taken to restore or maintain power system security.

Information for this report has been supplied to AEMO by Powerlink. Data from AEMO's Energy Management System has also been used in analysing the event.

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

## 2 SUMMARY OF EVENTS

At 13:05 hrs on 13 October 2009, protections systems associated with T56 substation operated to trip the 132 kV No.1 busbar.

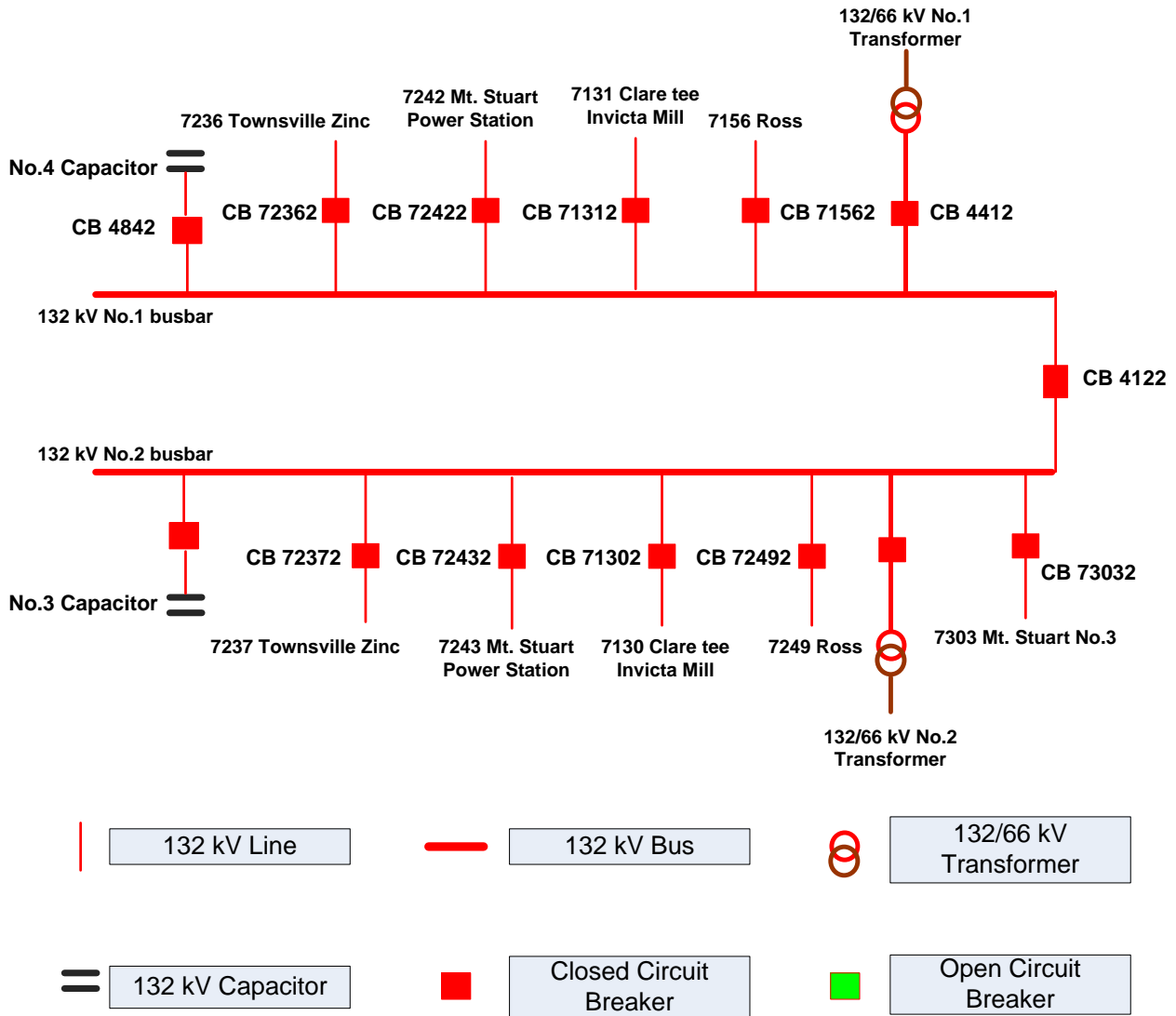
The transmission elements that were disconnected due to the No.1 busbar trip were Townsville South 132/66 kV No.1 transformer, 7242 Townsville South – Mt. Stuart 132 kV line, 7131 Townsville South – Clare 132 kV line, 7156 Townsville South – Ross 132 kV line, 7236 Townsville South – Townsville Zinc 132 kV No.1 line and Townsville South 132 kV No.4 capacitor.

The industrial load supplied from Townsville South substation via 7236 Townsville South – Townsville Zinc and 7237 Townsville South – Townsville Zinc 132kV lines reduced from 120 MW to 20 MW immediately after the trip.

Townsville South 132 kV No.1 busbar was re-energised at 16:49 hrs and all affected transmission elements with the exception of T56 132 kV No.4 capacitor were reconnected to No.1 busbar by 16:59 hours.

### 3 SEQUENCE OF EVENTS

The transmission network configuration at Townsville South substation including the status of circuit breakers prior to the event is shown in Figure 1.



**Legend**

**Figure 1: T56 Townsville South single line diagram prior to the event**

<b><u>TIME</u></b>	<b><u>EVENTS</u></b>	<b><u>COMMENTS</u></b>
13:05	Busbar section circuit breaker 4122 open	Circuit breaker connecting busbar No.1 and No.2
	Line circuit breaker 71312 open	7131 Townsville South – T42 Clare 132 kV line
	Line circuit breaker 71562 open	7156 Townsville South – H13 Ross 132 kV line
	Transformer circuit breaker 4412 open	Townsville South 132/66 kV No.1 transformer
	Line circuit breaker 72362 open	7236 Townsville South – Townsville Zinc 132 kV line (Industrial load No.1)
	Line circuit breaker 72422 open	7242 Townsville South – Mt. Stuart 132 kV line
	Capacitor circuit breaker 4842 open	Townsville South 132 kV No.4 capacitor
	T56 Townsville South 132 kV No.1 busbar tripped	
13:06	Industrial load decreases from 120 MW to 20 MW	Under voltage protection systems operate within customer systems to reduce load
13:34	Industrial load increases from 20 MW to ~65 MW	Load increased via 7237 line
14:10	Capacitor circuit breaker 3822 closed	Townsville South 66 kV No.2 capacitor
14:10	Industrial load increases from ~65 MW to ~112 MW	Load increased via 7237 line
16:49	Busbar section circuit breaker 4122 closed, energising the No.1 132kV busbar	Circuit breaker connecting busbar No.1 and No.2
16:49	Line circuit breaker 71562 closed	7156 Townsville South – H13 Ross 132 kV line
16:50	Line circuit breaker 71312 closed	7131 Townsville South – T42 Clare 132 kV line
16:51	Transformer circuit breaker 4412 closed	Townsville South 132/66 kV No.1 transformer
16:57	Line circuit breaker 72362 closed	7236 Townsville South – Townsville Zinc 132 kV line
16:59	Line circuit breaker 72422 closed	7242 Townsville South – Mt. Stuart 132 kV line
16:59	Powerlink informed AEMO on the cause of the busbar trip	Townsville South 132 kV No.4 capacitor circuit breaker 4842.

## **4 PROTECTION SYSTEM OPERATION**

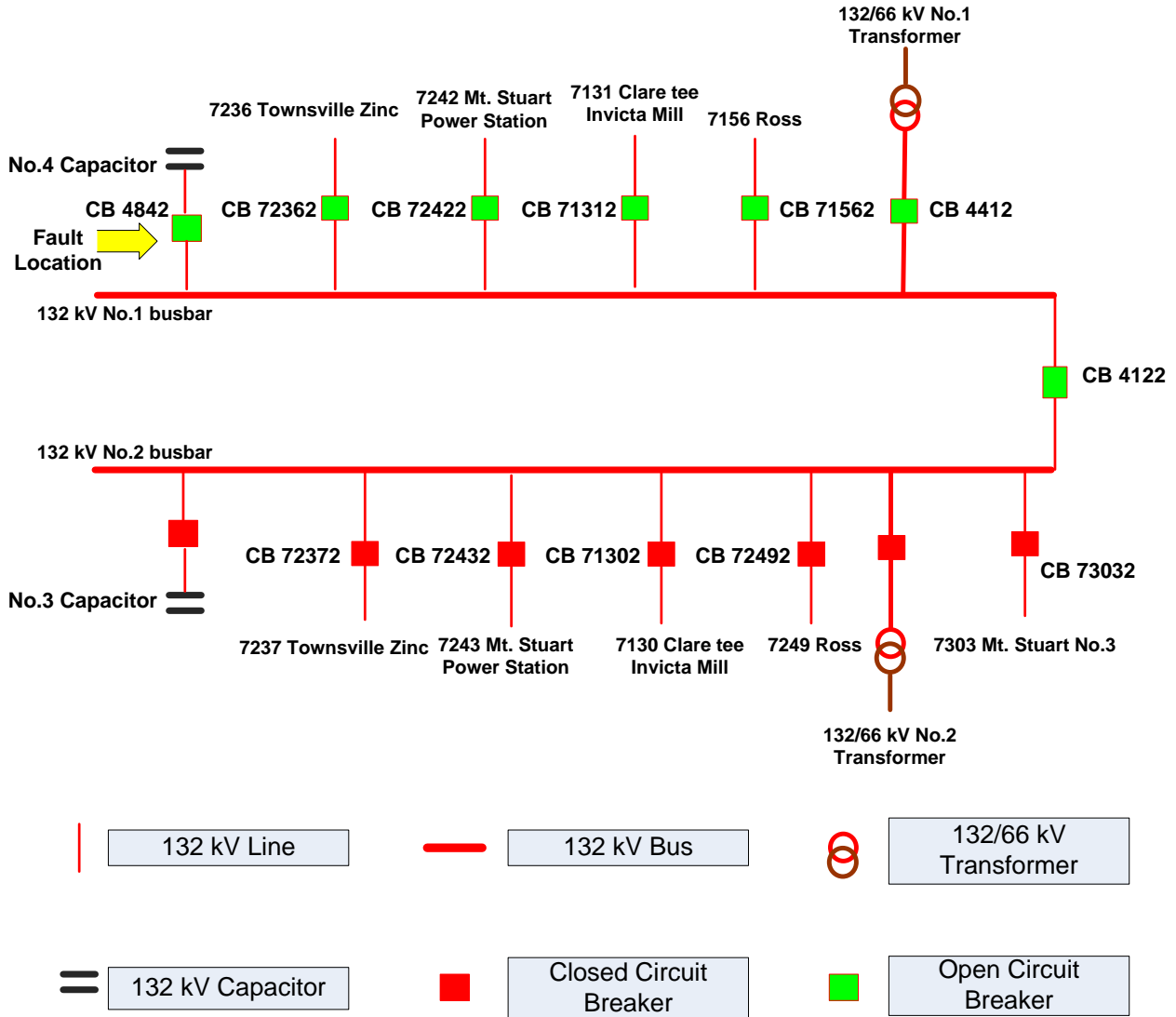
### **4.1 Trip of Townsville South 132 kV No.1 busbar**

Townsville South substation 132 kV No.1 busbar is protected by duplicate high speed protection systems. The protection systems are designed to isolate faulty equipment connected to the Townsville South 132 kV substation.

At 13:05 hours, both protection systems detected a high voltage phase to ground fault within transmission elements connected to No.1 busbar. The protection systems operated to trip the following circuit breakers at T56 substation:

- Busbar section circuit breaker 4122
- 7131 line circuit breaker 71312
- 7156 line circuit breaker 71562
- No.1 transformer circuit breaker 4412
- 7236 line circuit breaker 72362
- 7242 line circuit breaker 72422
- No.4 capacitor circuit breaker 4842

The transmission network configuration at Townsville South substation including the status of circuit breakers after the event is shown in Figure 2.



**Figure 2: T56 Townsville South single line diagram after the event**

## 5 IMMEDIATE ACTIONS

Immediately after the trip of T56 132 kV No.1 busbar, Powerlink undertook an investigation and found that there were no records of other power system events at the time of this incident. The analysis suggested that the operation of No.1 busbar protection systems was in response to a fault that occurred within No.4 capacitor circuit breaker. Subsequently, Powerlink staff determined that the fault occurred within the C phase of No.4 capacitor circuit breaker.

The AEMO control room invoked constraint set Q-MSPTS\_7242 at 13:25 hours. Mt. Stuart generating unit No.2 was available but not in service at the time of this incident.

At 13:40 hours, Powerlink confirmed the reduction in load was due to the operation of under voltage load shedding scheme within the industrial load. Powerlink informed AEMO of a contingency plan enabled at Ergon Energy's Stuart substation. This involved use of an over-current protection at Stuart substation to protect against overloading the 132/66 kV No.2 transformer for the loss of 7249 Townsville South – Ross 132 kV line during the outage of the No.1 busbar at T56 substation. Powerlink also informed AEMO that there was no increased risk of further tripping of the busbars at T56 Townsville South substation. Following this event circuit breaker 4842 was disconnected from No.1 busbar.

At 15:46 hours, AEMO control room issued a Market Notice 28220, advising the occurrence of this incident.

All affected transmission elements with the exception of T56 132 kV No.4 capacitor were returned to service by 16:59 hours. The No.1 busbar was returned to service at 16:49 hours without obtaining a "Permission to Restore" clearance from AEMO.

## 6 FOLLOW UP ACTIONS

Powerlink completed reviewing its procedures to ensure operational communications including the requirement to obtain "Permission to restore" before restoring transmission elements.

Powerlink have initiated an investigation with the manufacturer of No.4 capacitor circuit breaker to identify the cause of fault that occurred within the circuit breaker.

## 7 POWER SYSTEM SECURITY ASSESSMENT

The power system frequency remained within the frequency operating standard during the incident. Transmission line and interconnector flows remained within limits during and after the event. Further investigation showed that there were no binding or violating constraints associated with the network outage that took place during this incident.

There were power system security violations attributable to this event. At 13:06 hours, 7237 Townsville South – Townsville Zinc 132 kV line picked up load after the trip of No.1 busbar. Subsequently, AEMO's real time contingency analysis identified that the power system was not in a secure operating state for the contingent loss of 7249 Townsville South – Ross 132 kV line which could potentially have resulted in voltage collapse at Townsville south substation.

There were no further security violations after the reduction of Industrial load due to the operation of under voltage load shedding scheme.

## **8 CONCLUSIONS**

The trip of the No.1 132kV busbar at T56 Townsville South can be attributed to a high voltage phase to ground fault within No.4 capacitor circuit breaker. The relevant protection systems at T56 substation operated as designed.

The No.1 132kV busbar at T56 Townsville south was returned to service without obtaining a "Permission to Restore" clearance.

Powerlink have reviewed and updated their operating procedures addressing the operational issue highlighted from this event.

## **9 RECOMMENDATIONS**

Powerlink will provide AEMO an update on its investigation with the circuit breaker manufacturer on the fault in the circuit breaker in question, by May 2010.