

Trip of Torrens Island 66 kV East busbar on 22 September 2021

March 2022

Reviewable Operating Incident
Report under the National
Electricity Rules





Important notice

Purpose

AEMO has prepared this report in accordance with clause 4.8.15(c) of the National Electricity Rules, using information available as at the date of publication, unless otherwise specified.

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Contact

If you have any questions or comments in relation to this report, please contact AEMO at system.incident@aemo.com.au.

The NEM operates on Australian Eastern Standard Time (AEST). All times in this report are in AEST.

Abbreviations

Abbreviation	Term
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time
CB	Circuit Breaker
CBF	Circuit Breaker Fail
kV	Kilovolt
NEM	National Electricity Market
NER	National Electricity Rules
QPS	Quarantine Power Station
TIPS	Torrens Island Power Station
TIN	Torrens Island North
TNSP	Transmission Network Service Provider

Incident review

This reviewable operating incident¹ report is prepared in accordance with clause 4.8.15(c) of the National Electricity Rules (NER). It has been prepared using information provided by ElectraNet², Origin Energy³ and from AEMO systems.

Table 1 Summary of event – Trip of Torrens Island 66 kilovolt (kV) East busbar on 22 September 2021

Details	
Reviewable operating incident type	Non-credible contingency event impacting critical transmission elements ⁴ .
Incident details	This report relates to a reviewable operating incident ⁵ that occurred on 22 September 2021 in South Australia. The incident was a non-credible contingency event involving the trip of the Torrens Island 66 kV East busbar.
Incident classification	Protection/control system mal-operation.
Generation impact	No generation was lost as a result of this incident.
Customer load impact	No load was lost as a result of this incident.
Pre-incident conditions	<p>Prior to the event, the Torrens Island Power Station A (TIPS A) 66 kV East busbar was in service.</p> <p>Torrens Island Power Station (TIPS) A – Torrens Island North (TIN) 2 66 kV line had been out of service for trip testing by ElectraNet and was to be restored. As this line connects Quarantine Power Station (QPS) units 1 to 4 to the power system, these QPS units were also out of service (see Figure 1).</p> <p>At 1730 hrs on 22 September 2021, QPS unit 5, which is connected to TIPS A 66 kV West busbar, was generating 52 megawatts (MW) and ramping up its output. The TIPS B unit 1 and unit 4 were online generating approximately 125 MW and 108 MW respectively. All other TIPS A and B units were offline.</p>
Incident key events	<ol style="list-style-type: none"> At 1730 hrs on 22 September 2021, during restoration of TIPS A – TIN 2 66 kV line (upon closing Circuit Breaker (CB) 6E7) the TIPS A 66 kV East busbar tripped. Circuit Breaker Fail (CBF) protection operated tripping all CBs connected to this busbar, which offloaded the TIPS A East Tie Transformer (see Figure 2). Following the TIPS A 66 kV East busbar trip, QPS was informed and identified a trip signal being sent from its QPS 3 generator. This trip signal was reset by QPS staff and equipment restoration commenced. At around 1846 hrs on 22 September 2021, TIPS A 66 kV East busbar was returned to service.
Incident cause	<p>ElectraNet's post incident investigation has confirmed that:</p> <ol style="list-style-type: none"> A previously sent inter-trip signal on TIPS A – TIN 2 66 kV line at 1458 hrs on 21 September 2021 from QPS was not reset and remained persistently in "initiated" status. The Set X protection CBF scheme logic at TIPS 66 kV substation did not have any signal conditioning (in the form of a current check element) on its CBF time delay initiation. This meant that the persistent inter-trip signal had pre-triggered CB 6E7 "CB Fail" protection timer at TIPS A. <p>Therefore, when the CB 6E7 closed, the Set X CBF protection immediately initiated a busbar trip.</p> <p>Origin Energy's initial investigation confirmed that:</p> <ol style="list-style-type: none"> On 21 September 2021, ElectraNet was conducting trip testing on the 6E7 66 kV line. As expected, during this testing, trip signals were sent to the 6E7 66 kV line protection systems, and to TIPS A and TIN 66 kV substations.

¹ Reviewable operating incidents are defined by NER clause 4.8.15(a) and the AEMC Reliability Panel Guidelines for Identifying Reviewable Operating Incidents.

² ElectraNet is a Transmission Network Service Provider (TNSP) for South Australia.

³ Origin Energy is the owner of Quarantine Power Station.

⁴ Elements at 66 kV around Torrens are considered critical (for the purpose of identifying reviewable operating incidents) due to the potential to affect significant amount of generation in the area.

⁵ See NER clause 4.8.15(a)(1)(i), as the event relates to a non-credible contingency event; and the AEMC Reliability Panel Guidelines for Identifying Reviewable Operating Incidents.

Details	
	<p>2. QPS uses lockout relays to prevent reclosing of the generators onto faulted lines. Further investigation has revealed an unknown wiring issue between ElectraNet and Origin Energy that was introduced during a protection scheme change in 2008. The non-standard operating situation present during trip testing combined with this wiring issue caused the QPS protection relays to unexpectedly start, sending a persistent intertrip signal.</p>
Power system response (facilities and services)	<ul style="list-style-type: none"> • CBF protection activated, and all lines and transformers connected to TIPS A 66 kV East busbar were disconnected as shown in Figure 2.
Rectification	<p>On 21 September 2021, prior to CB 6E7's return to service, QPS staff reset the persistent trip signal being sent from the QPS 3 generator.</p> <p>On 30 September 2021, the TIPS A 66 kV East busbar CBF logic in the Set X protection was modified to include a current check requirement before the CBF time delay (see Figure 3).</p> <p>This modification was applied to the Set X protection on the TIPS A – TIN 2 line and the TIPS A – TIN 1 line, which had identical functionality.</p> <p>With the above modification, the CBF timer is reset when the line CB is open. Therefore, for future similar situations, only the TIPS A – TIN 2 line will trip (a credible contingency event). Once the line CB is tripped, the CBF timer will reset automatically, and the CBF protection at TIPS A will not operate.</p> <p>Origin Energy is working with ElectraNet to rectify the identified wiring issue which caused the persistent intertrip signal. The rectification of this wiring issue is planned for the next available outage window on the affected assets, in Q2 2022.</p>
Power system security	<p>The power system remained in a secure operating state throughout this incident and the Frequency Operating Standard⁶ was met for this incident.</p>
Reclassification	<p>AEMO assessed whether to reclassify this incident as a credible contingency event⁷.</p> <p>The cause of this non-credible contingency event had been identified as the persistent intertrip signal from the QPS 3 generator, this trip signal was reset prior to the return to service of CB 6E7. In addition, AEMO is satisfied that another occurrence of this event is unlikely to occur again under the current circumstances.</p> <p>Therefore, AEMO correctly did not reclassify this incident as a credible contingency.</p>
Market information	<p>For this incident, AEMO issued the following market notices (all market notices for this incident were issued in accordance with NER requirements):</p> <ul style="list-style-type: none"> • 90963 at 1814 hrs on 22 September 2021 – Advice of non-credible contingency event. • 90966 at 1944 hrs on 22 September 2021 – Update on non-credible contingency event.
Conclusions	<p>AEMO has concluded that:</p> <ol style="list-style-type: none"> 1. The cause of the trip of TIPS A 66 kV East bus has been identified as a pre-triggered Set X protection CBF Timer signal on TIPS A – TIN 2 line. The CBF Timer was pre-triggered as its logic did not include conditioning (in the form of a current check). This logic arrangement combined with a persistent intertrip signal being sent from QPS, due to a wiring issue, caused the incident. 2. The power system remained in a secure operating state throughout this incident and the Frequency Operating Standard was met. 3. AEMO correctly identified there was no requirement to reclassify this incident as a credible contingency. 4. ElectraNet modified the Circuit Breaker Fail logic in the Set X protection to include a current check requirement before the CBF time delay (as illustrated in Figure 3). This modification avoids CBF maloperations under similar circumstances in the future. <p>Origin Energy has identified the root cause of the persistent inter-trip signal from QPS as a wiring issue introduced during a protection scheme update in 2008. This wiring issue is scheduled for rectification during the next available outage of the affected equipment in Q2 2022.</p>
Recommendations	<p>Origin Energy plans to rectify the identified wiring issue in Q2 2022.</p>

⁶ See <https://www.aemc.gov.au/sites/default/files/2020-01/Frequency%20operating%20standard%20-%20effective%201%20January%2020%20-%20TYPO%20corrected%2019DEC2019.PDF>.

⁷ AEMO is required to assess whether or not to reclassify a non-credible contingency event as a credible contingency event – NER clause 4.2.3A(c) – and to report how the reclassification criteria were applied – NER clause 4.8.15(ca).

Figure 1 Incident diagram – Pre incident configuration

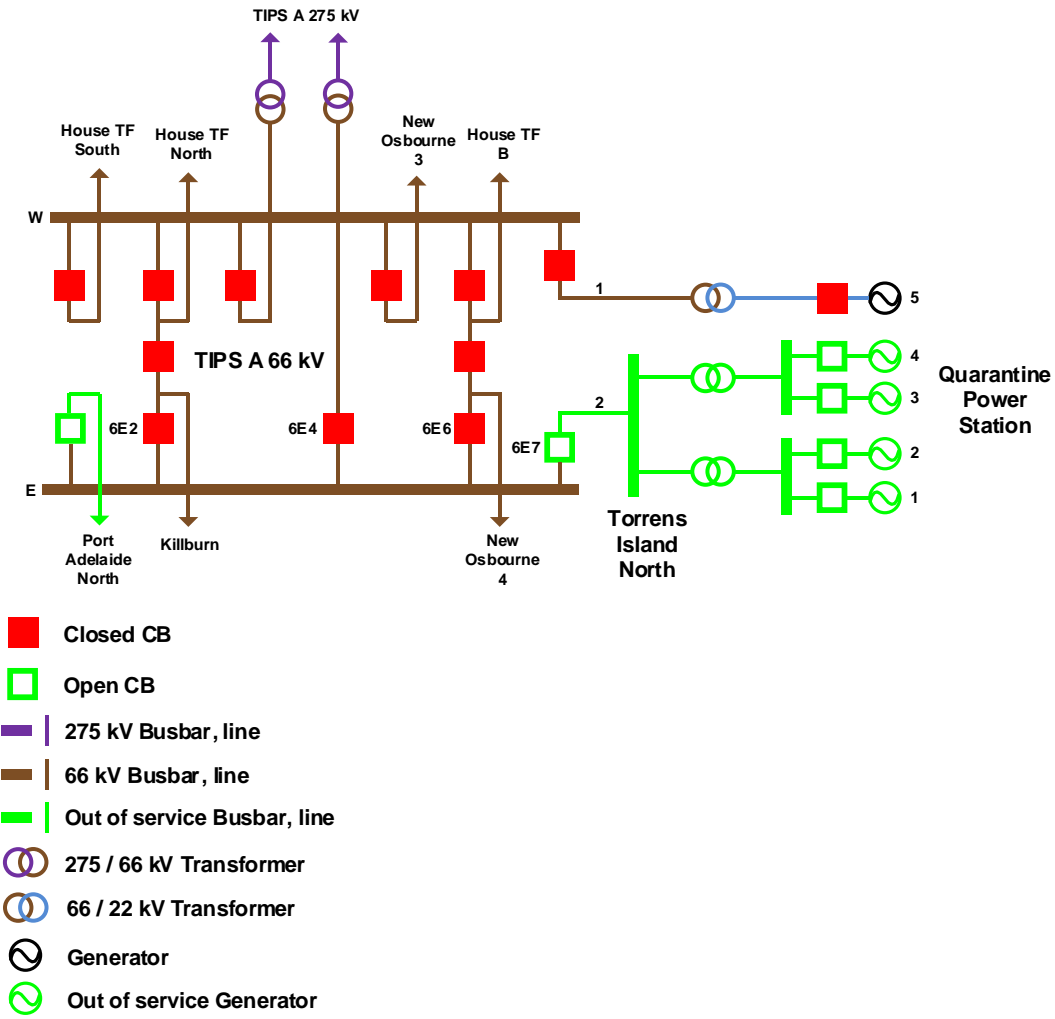




Figure 2 Incident diagram – Post incident configuration

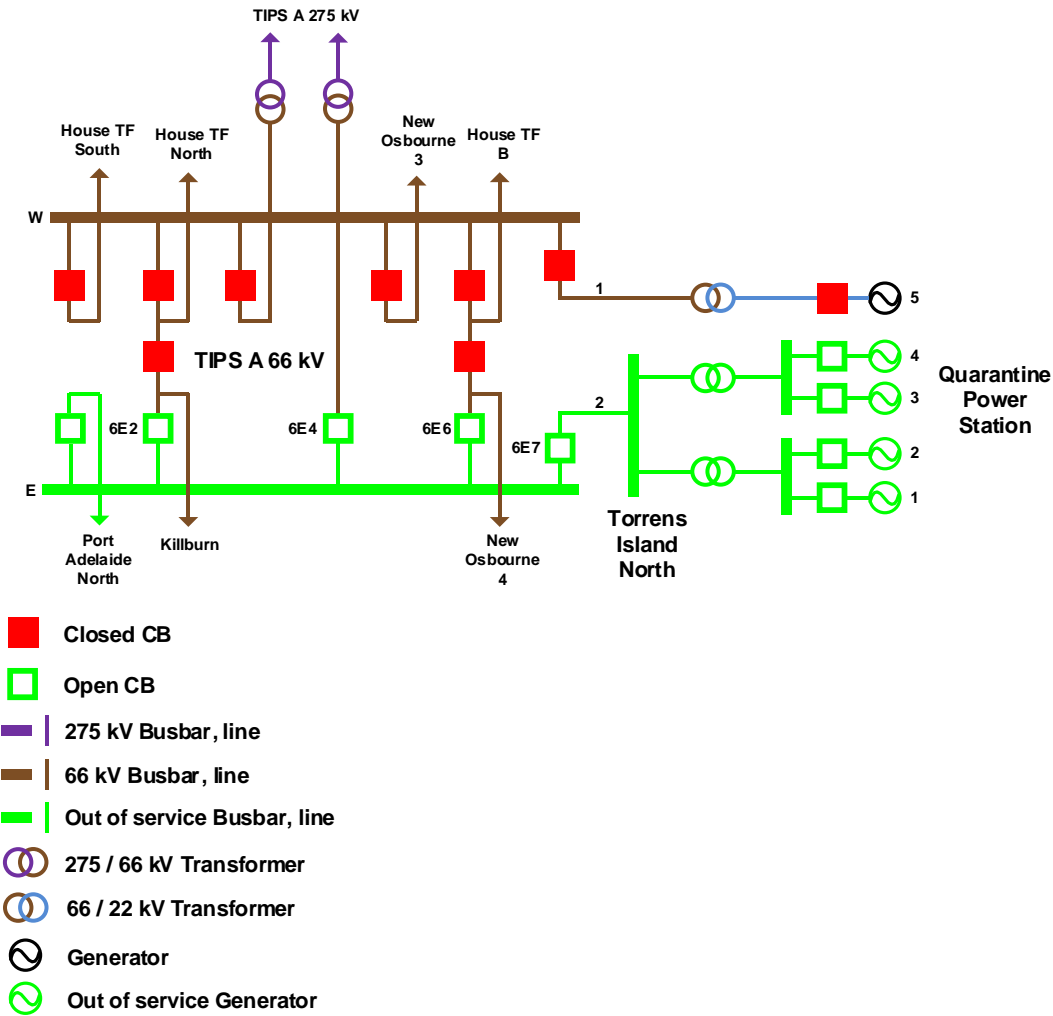
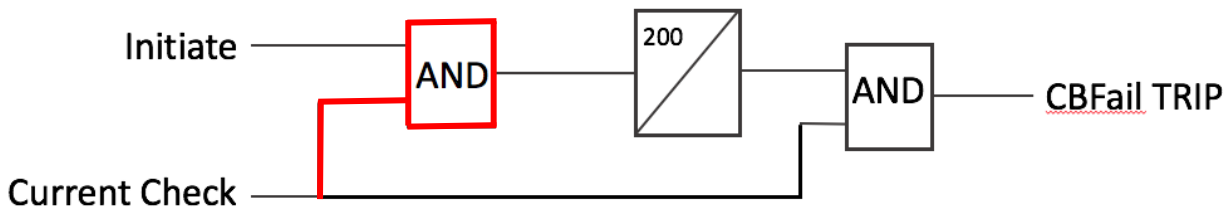


Figure 3 Incident diagram – Representation of modified Circuit Breaker Fail logic



Note: the highlighted section of Figure 3 is the logic added to existing TIPS A 66 kV East busbar Circuit Breaker Fail protection. In the Original logic, the “Initiate” signal goes directly to the timer with no conditioning.