

POWER SYSTEM OPERATING INCIDENT REPORT - TRIP OF FARRELL 220 KV B BUSBAR ON 02 FEBRUARY 2013

PREPARED BY: Operations Planning

DATE: 9 April 2013

FINAL

Disclaimer

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Abbreviations and Symbols

| Abbreviation | Term |
|--------------|--------------------------------------|
| EMMS | Electricity Market Management System |
| EMS | Energy Management System |
| FCAS | Frequency Control Ancillary Service |
| kV | Kilovolt |
| MW | Megawatt |
| MWh | Megawatt hour |
| NEM | National Electricity Market |
| Pmax | Maximum Active Power |

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Incident summary

| | |
|----------------------------------|------------------------------------|
| Date and time of incident | 02 February 2013 at 1200 hrs |
| Region of incident | Tasmania |
| Affected regions | Tasmania |
| Event type | BB - Busbar trip |
| Primary cause | PTN & CTR - Protection and Control |
| Impact | Not Severe |
| Associated reports | Nil |

1 Introduction

At 1200 hrs on 2 February 2013, the 220 kV B Busbar at Farrell Substation in Tasmania tripped during generating unit testing being conducted at Bastyan Power Station. There was 40 MW reduction in generation at Bastyan Power Station but no interruption to load as a result of this incident. The busbar was returned to service at 1323 hrs.

This report has been prepared under clause 4.8.15 (c) 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 Transend and Hydro Tasmania. Data from AEMO's Energy Management System (EMS) and Electricity Market Management System (EMMS) has also been used in analysing the incident.

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

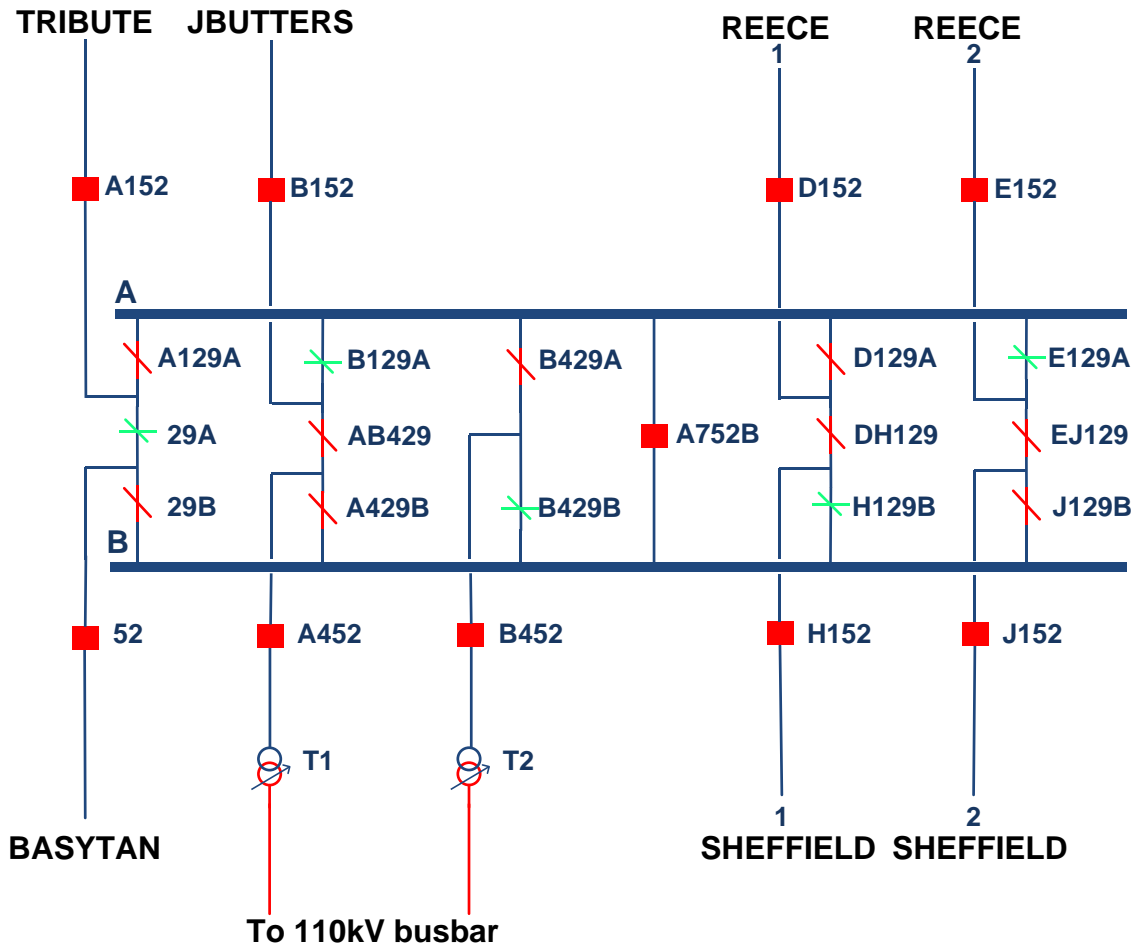
2 Pre-Contingent System Conditions

On the day of the incident, Hydro Tasmania was carrying out routine functional and performance tests at Bastyan Power Station. At the time of the incident, Bastyan Power Station was generating 40 MW. Mackintosh Power Station was generating 25 MW. There were no generation at Tribute, or John Butters Power Station or Reece 1 and 2¹ generating units. The West Coast load was approximately 59 MW.

The statuses of the power system at Farrell Substation and West Coast Parallel Network (110 kV network parallel to Farrell–Sheffield 220 kV lines) prior to the incident are shown in Figure 1 and Figure 2 respectively. For clarity only equipment relevant to this incident has been included in the diagram.

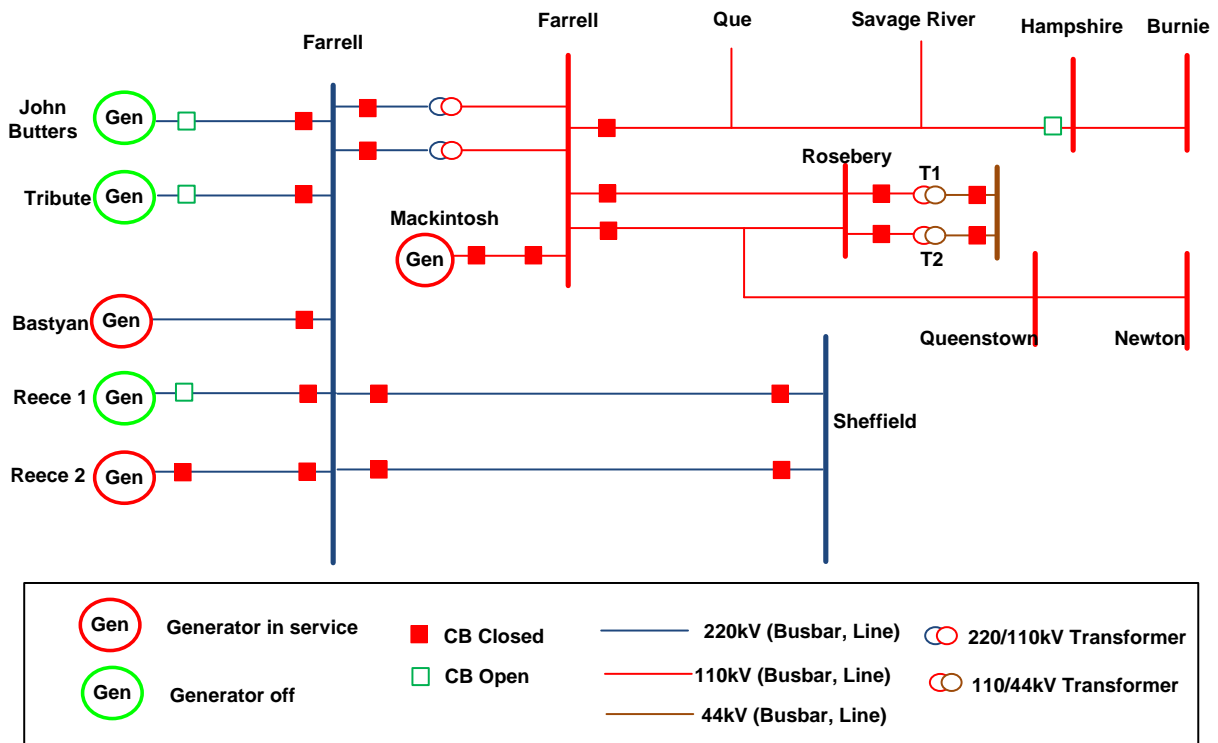
¹ Reece unit 2 was generating at a very low output of 3 MW or less with the dispatch target of 0 MW.

Figure 1 - Status of the power system at Farrell Substation prior to the incident



| | | | | | |
|--|---------------------|--|------------------------|--|-----------------|
| | 220 kV Busbar, Line | | 220/110 kV Transformer | | Isolator Closed |
| | 110 kV Busbar, Line | | CB Closed | | Isolator Open |

Figure 2 Status of the power system at west Coast Parallel network prior to the incident



3 Summary of Events

A summary of the events is shown in Table 1.

Table 1. Summary of events

| Time | Events |
|----------|--|
| 12:00:23 | The 220 kV B Busbar at Farrell Substation tripped, opening CB B152, CB E152, CB A752B, CB A452 and CB J152 . As the result, the following lines and equipment were out of service: <ul style="list-style-type: none"> • Farrell–John Butter 220 kV line • Farrell–Reece No. 2 220 kV line • Farrell–Sheffield No.2 220 kV line • 220/110 kV T1 transformer |
| 12:00:28 | At Farrell Substation CB 52 opened, offloading Bastyan generation. |
| 12:07 | Transend made unsuccessful attempt to close Farrell Bus tie CB A752B. |
| 12:12 | Transend made second unsuccessful attempt to close Farrell Bus tie CB A752B. |
| 12:45 | AEMO invoked energy and FCAS constraints to generating units at John Butters, and Bastyan Power Stations and Reece 2 generating unit. |
| 12:50 | AEMO invoked a constraint to manage the Farrell - Sheffield No. 2 220 kV Transmission Line out with West Coast 110/220 kV parallel ² open |
| 13:11 | AEMO issued Market Notice No 41348 advising of the non-credible contingency event |
| 13:13:15 | Transend closed West Coast 110/220 kV parallel ² |
| 13:23:08 | At Farrell Substation Bus Tie CB A752B closed |
| 13:24:55 | At Farrell Substation CB J152 closed, energising Farrell–Sheffield No.2 220 kV line |
| 13:25 | AEMO revoked the constraint relating to Farrell - Sheffield 220 kV Transmission Line out with West Coast 110/220 kV parallel ² open |
| 13:25 | AEMO invoked constraints to manage the Farrell - Sheffield 220 kV Transmission Line out with West Coast 110/220 kV parallel ² closed |
| 13:25:07 | At Farrell Substation CB E152 closed, energising Farrell–Reece No.2 220 kV line |
| 13:25:13 | At Farrell Substation CB B152 closed, energising Farrell–John Butter 220 kV line |

² The 110kV transmission lines which forms a parallel path with the Farrell–Sheffield 220kV lines. This 110kV parallel path is closed or opened at the Hampshire end of the Hampshire–Waratah Tee line. Refer also to figure 2.

| | |
|----------|---|
| 13:25:29 | At Farrell Substation CB A452 closed, energising 220/110 kV T1 transformer. |
| 13:34 | AEMO issued Market Notice No 41349 advising that the 220 kV B Busbar at Farrell was returned to service. |
| 13:35 | AEMO revoked the constraint relating to Farrell - Sheffield 220 kV Transmission Line out with West Coast 110/220 kV parallel closed and, energy and FCAS constraints relating to the generating unit at John Butters and Reece 2 generating unit. |
| 13:50 | Bastyan rebid 0 MW. AEMO revoked energy and FCAS constraints to Bastyan Power Station |

At 1200 hrs on 2 February 2013, Hydro Tasmania was performing an online (40 MW – 50%Pmax) test at Bastyan generating unit. The expected outcome of the test was tripping of the 220 kV circuit breaker (CB 52) at Farrell Substation via the fire protection relay 4C and the generating unit to continue to run offline.

The trip was initiated by bridging an input to the protection relay 4C as per the test procedure. However, the fire protection relay 4C is not designed to trip by direct injection or to trip the CB 52.

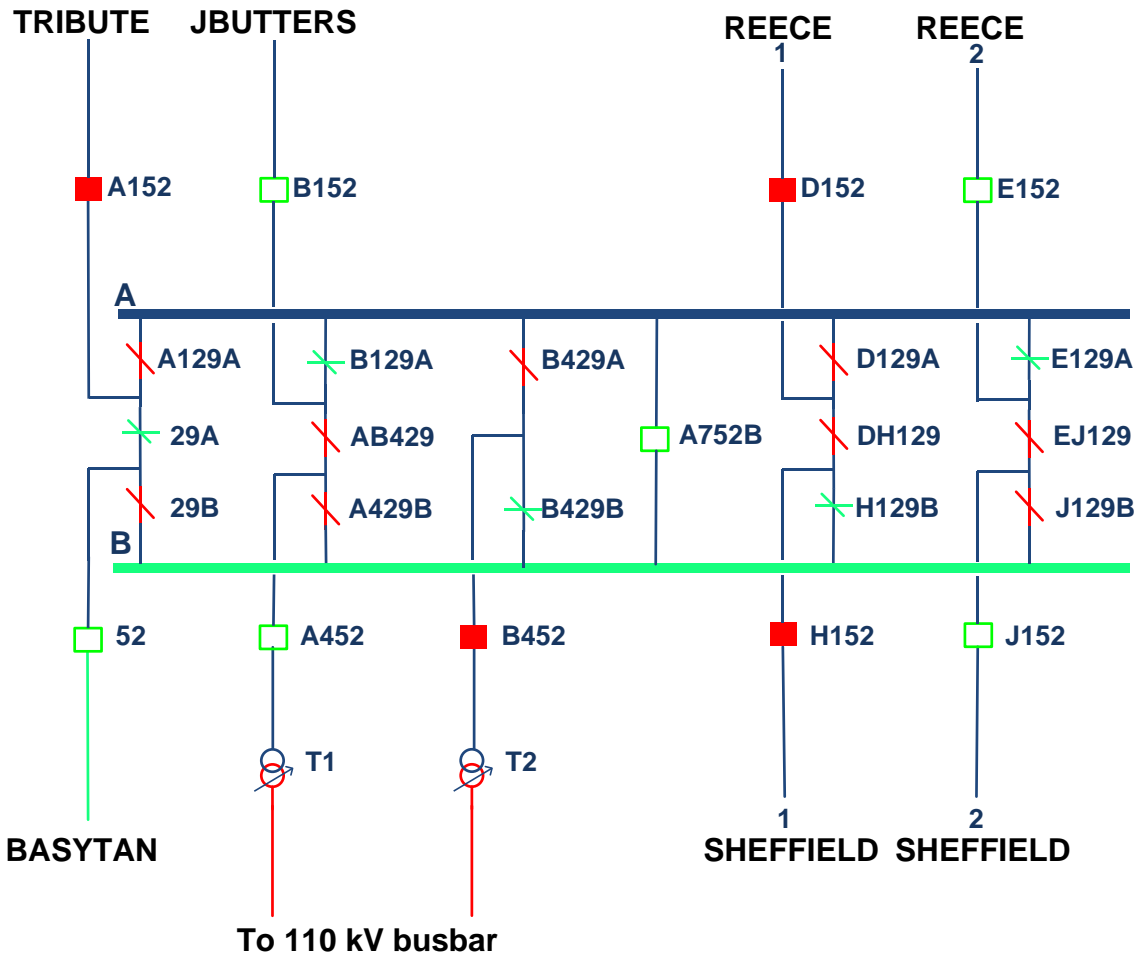
As a part of the Bastyan alternator fire protection design, the 4C relay is designed to be operated by intermediate relays to initiate CB fail at Farrell busbar protection scheme. In the event of fire, the alternator stator earth fault or differential protection relay would directly trip the CB 52 and operate the 4C relay. This would cause the 4C relay to initiate CB fail at Farrell busbar protection scheme which will detect CB 52 open and will not trip the Farrell busbar. The deficient design allows the protection relay 4C to initiate CB 52 fail signal without ensuring CB52 status.

During the test, the trip of the 4C relay initiated a Farrell circuit breaker fail protection timer. As the CB52 was closed, the circuit breaker fail protection timer expired and initiated the Farrell B busbar zone protection, clearing the busbar, and sending an inter trip to the CB 52.

The trip of CB 52 offloaded the Bastyan generation of 40 MW. There was no reduction in regional load due to the incident. Mackintosh Power Station connects to the 110 kV Busbars at Farrell Substation and was not affected.

Figure 3 shows the status of relevant circuit breakers and transmission lines after the incident.

Figure 3 - Status of the power system immediately after the incident



| | | | | | |
|--|---------------------|--|------------------------|--|------------------------|
| | 220 kV Busbar, Line | | 220/110 kV Transformer | | Isolator Closed |
| | 110 kV Busbar, Line | | CB Closed | | Isolator Open |
| | Out of Service Line | | CB Open | | Out of Service Bus Bar |

4 Immediate Actions Taken

At 1207 hrs and 1212 hrs, Transend made unsuccessful attempts to remotely reclose the 220 kV bus tie circuit breaker (CB A752B) at Farrell Substation to re-energise the B 220 kV Busbar at Farrell Substation.

At 1218 hrs Transend advised AEMO that they could not remotely close the 220 kV bus tie circuit breaker (CB A752B) at Farrell Substation.

AEMO invoked energy and FCAS constraints to John Butters, Reece 2 and Bastyan Power Station generating units to commence in the 1245 hrs dispatch interval. The outage of the 220 kV B Busbar at Farrell Substation meant that without reconfiguration, John Butters and Bastyan Power Stations and Reece 2 generating unit could not be connected to the power system.

AEMO invoked Farrell–Sheffield No. 2 220 kV Transmission Line outage constraint set (T-FASH_HM_OPEN) to commence in the 1250 hrs dispatch interval. This constraint set was appropriate as the West Coast parallel² was opened at the time.

At 1311 hrs AEMO issued Electricity Market Notice No. 41348 advising of the occurrence of a non-credible contingency in Tasmania and trip of the 220 kV B Busbar at Farrell Substation.

At 1313 hrs Transend closed CB B152 at Hampshire Substation to close the West Coast parallel² path.

AEMO revoked T-FASH_HM_OPEN constraint and invoked T-FASH_HM_CLOSE to commence in the 1325 hrs dispatch interval.

5 Follow-up Actions

Following the failure to remotely close the 220 kV bus tie circuit breaker (CB A752B) at Farrell Substation, Transend arranged with the Hydro Tasmania operator to check protection relays at Farrell Substation. The Hydro Tasmania operator identified that there were still some active trip signals on the busbar protection scheme which was the reason for failure to remotely reset the protection relays. The protection relays were manually reset and the 220 kV bus tie circuit breaker (CB A752B) at Farrell Substation was remotely closed after Transend was satisfied with the Hydro Tasmania operator's investigation and the confirmation that there was no fault remaining on the busbar. Transend considered the benefits of having remote resetting of the protection relays. However, it believed it was important for a person on site to investigate the trip signals before allowing a busbar to be re-energised.

At 1323 hrs Transend commenced restoration of the 220 kV B Busbar at Farrell Substation.

At 1334 hrs AEMO issued Electricity Market Notice No. 41348 advising that the 220 kV B Busbar at Farrell Substation was returned to service.

AEMO revoked all constraints except energy and FCAS constraints to Bastyan Power Station to commence in the 1335 hrs dispatch interval.

AEMO received 0 MW bids in relation to Bastyan Power Station generating unit and revoked constraints relating to Bastyan Power Station to commence in the 1350 hrs dispatch interval.

6 Power System Security Assessment

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

AEMO correctly assessed the situation as per section 12 of "SO_OP_3715 – Power System Security Guideline" and did not reclassify this incident as a credible contingency because Hydro Tasmania advised that the test will not be repeated without review and rectification.

7 Conclusions

The trip of the 220 kV B Busbar at Farrell Substation on 2 February 2013, occurred when Hydro Tasmania was performing an online trip test on Bastyan Power Station generating unit.

The incorrect test procedure and the deficient design of the 4C fire protection relay were identified as the causes of the incident.

Hydro Tasmania has advised that the test will not be repeated until the design and test procedure are rectified. The target date for review and update of the test procedure is the end of April 2013 and the target date for a review of the design is yet to be determined.

Transend discussed the benefits of having remote resetting of the trip signals. However, it determined the prudent approach was to have manual resetting to ensure trip signals were investigated before allowing a busbar to be re-energised.

8 Recommendations

Hydro Tasmania should review the Bastyan Power Station test procedure by 30 April 2013 and inform AEMO of the changes.

Hydro Tasmania should promptly review the Bastyan alternator fire protection design and inform AEMO of the outcome by 30 June 2013.