

POWER SYSTEM OPERATING INCIDENT REPORT – TRIPPING OF FARRELL – SHEFFIELD NO 1 AND NO 2 220KV LINES ON 30 OCTOBER 2012.

PREPARED BY: System Performance and Commercial

DATE: 8 January 2013

FINAL

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Abbreviations and Symbols

Abbreviation	Term
CB	Circuit Breaker
DI	Dispatch Interval
FCAS	Frequency Control Ancillary Service
kV	Kilovolt
MW	Megawatt
MWh	Megawatt hour
NEM	National Electricity Market
RTU	Remote Terminal Unit

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Incident summary

Date and time of incident	30/10/2012 @ 13:46hrs.
Region of incident	Tasmania.
Affected regions	Tasmania.
Event type	TT – Loss of Multiple Transmission elements.
Primary cause	ENVI and LN - Environmental and Other
Impact	VS – Very Significant
Associated reports	Nil.

1 Introduction

On 30 October 2012 the Farrell to Sheffield No.2 transmission line tripped at 13:46:37hrs and at 13:47:15hrs the Farrell to Sheffield No.1 220kV transmission line tripped.

This resulted in the loss of 455MW of generation in the West Coast area and the islanding of the West Coast load within the Tasmanian region. Approximately 10MW of West Coast load was lost due to the resulting high frequency.

The line trips were due to a controlled burn off being managed by Forestry Tasmania which was being undertaken in the vicinity of these lines.

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

In the Tasmanian region the West Coast load (namely Newtown, Queenstown, Rosebury, Que and Savage River) is normally supplied by the two Farrell – Sheffield 220kV lines and where system conditions are appropriate also via a 110kV network called the Hampshire link.

At the time of the incident the Hampshire link was open. The West Coast load immediately prior to the incident was approximately 56MW.

Generation on the West Coast immediately prior to the incident was as per table 1.

Generating Unit	MW
Bastyan	70
John Butters	110
Mackintosh	70
Reece1	90
Reece 2	90
Tribute	68
Total	498

Table 1 – West Coast generation

AEMO was not advised or aware of any increased risk to the Farrell – Sheffield lines prior to this incident.

The status of the power system prior to the incident is shown in Figure 1.

For clarity only equipment relevant to this incident has been included in the diagram. Also only CBs associated with the tripping of apparatus/plant as a result of this incident have been shown.

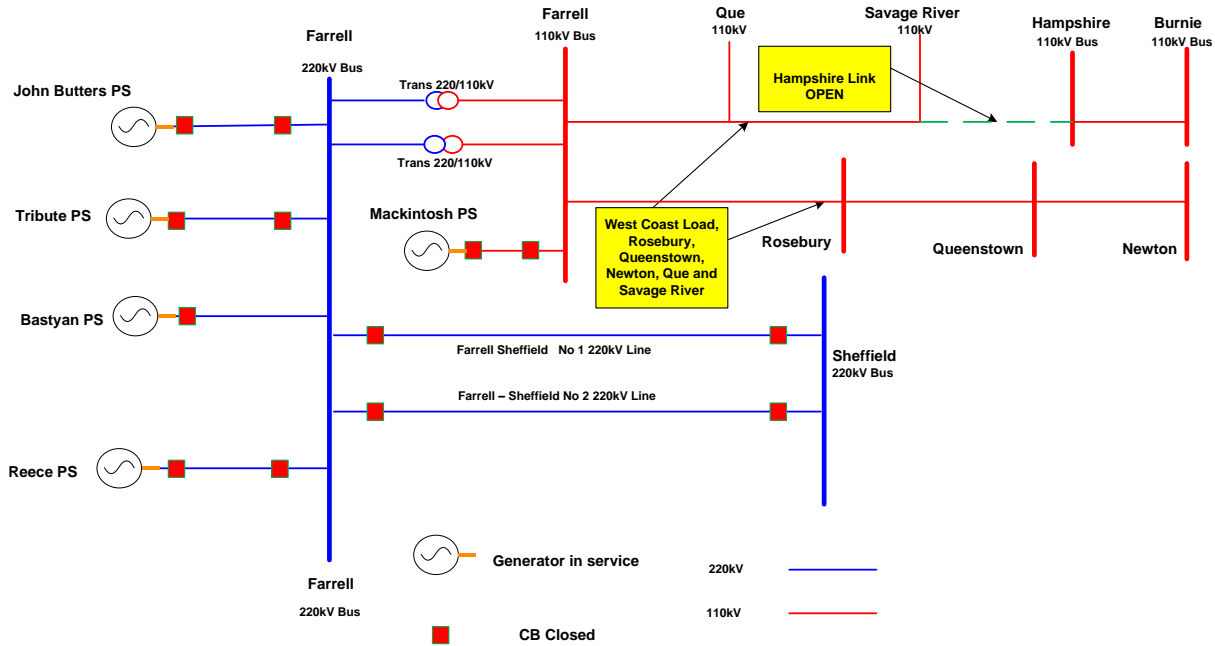


Figure 1 - Status of the power system prior to the incident

3 Post-Contingent System Conditions

Post the tripping of both the Farrell – Sheffield No 1 and No 2 lines, the over frequency generating shedding scheme (OFGSS) tripped the Bastyan, John Butters, Mackintosh, and Tribute generating units¹. Reece units 1 and 2 remained on line forming an island of approximately 45MW with the remaining West Coast load. Transend advised that approximately 10MW of load was lost within the West Coast region due to the resulting high frequency. Figure 2 provides an overview of the West Coast generation.

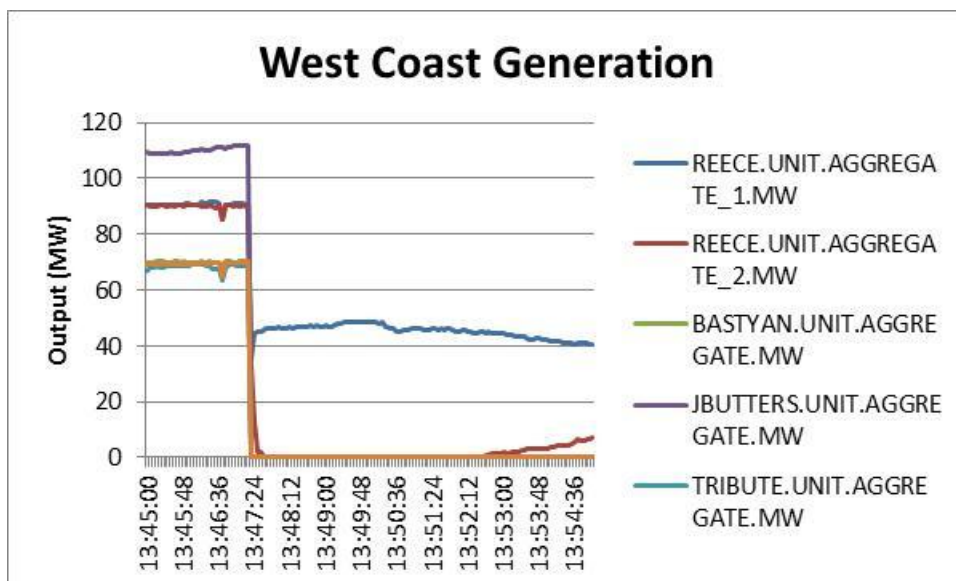


Figure 2 – West Coast generation

¹ The OFGSS is designed to trip the line CBs at Farrell where installed.

4 Summary of Events

Table 2 below provides a summary of events and Figure 3 shows the status of the power system immediately after the incident.

Date/Time	Events
30/10/2012 13:46:37hrs	Farrell – Sheffield No 2 220kV line tripped.
30/10/2012 13:47:15hrs	Farrell – Sheffield No 1 220kV line tripped.
30/10/2012 13:47hrs	Generating units at Bastyan, John Butters, Mackintosh and Tribute tripped. 450MW of generation tripped plus 10MW of West Coast load.
30/10/2012 13:55.hrs	Constraints F_T_X-FASH and T_X-FASH were invoked
30/10/2012 14:03hrs	AEMO issued Market Notice No.40153, advising the market of a non-credible contingency.
30/10/2012 14:05hrs	Farrell – Sheffield No 1 220kV line returned to service.
30/10/2012 14:06hrs	Farrell – Sheffield No 2 220kV line returned to service.
30/10/2012 14:10hrs	Constraints F_T_X-FASH and T_X-FASH were revoked
30/10/2012 14:36hrs	AEMO issued Market Notice No.40154 advising that the West Coast area of Tasmania was resynchronised to the rest of Tasmania at 1405 hrs.

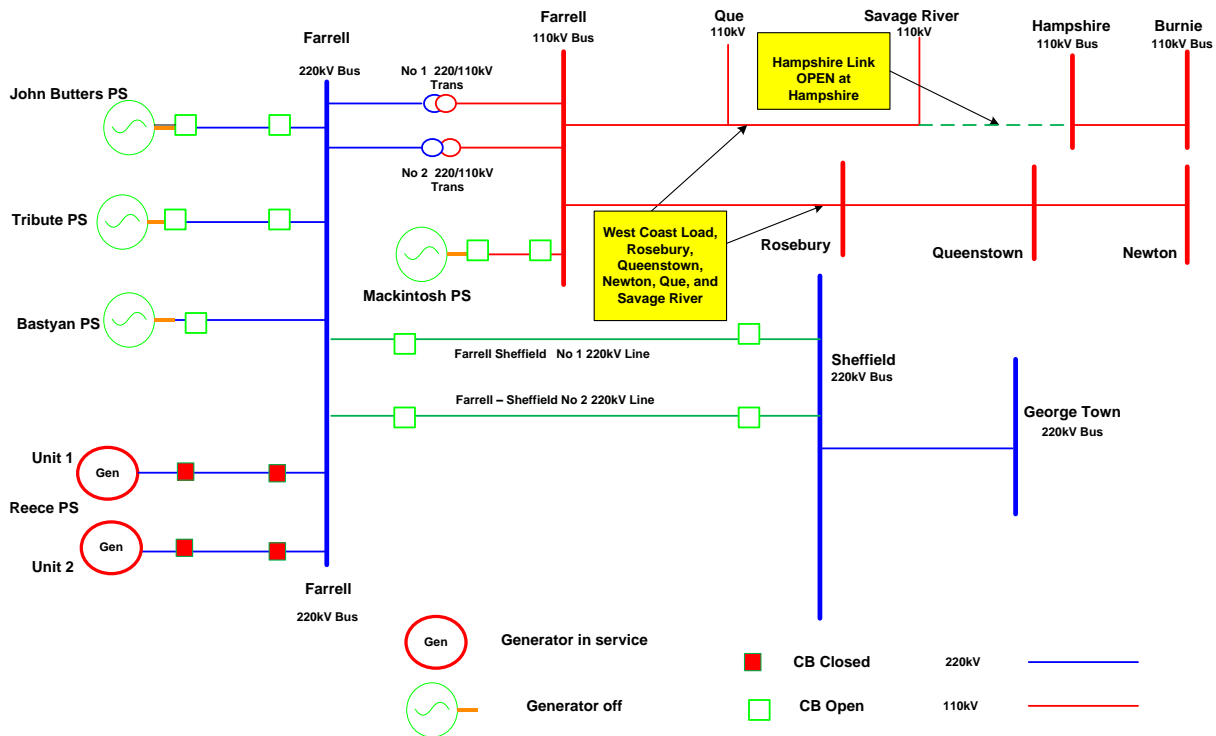


Figure 3 - Status of the power system immediately after the incident

5 Immediate Actions Taken

At 13:55 hrs AEMO invoked constraints F_T_X-FASH² and T_X_FASH³ to manage the generation in the West Coast island.

At 14:03 hrs AEMO issued Market Notice No.40153 advising the market of a non-credible contingency.

Transend advised AEMO that the incident was as a result of a planned burn off under the supervision of Forestry Tasmania and smoke from this burn off had entered the easement containing the Farrell – Sheffield lines. Although Transend were aware of this fire and had an observer on site Transend had lost contact with the on-site observer due to limitations of the mobile phone network in the area and were unaware of the change in risk.

On advice from Transend that the smoke had cleared and that the risk to the lines had passed AEMO gave permission for the lines to be returned to service.

As the West Coast load and generation had formed an island it was necessary to re-synchronise this island to the rest of the Tasmanian system. Due to discrepancies in information available to Transend staff they were unsure of the synchronising capability of the line CBs at Sheffield. Although this information is normally displayed on their Network Operations Control System (NOCS) screens this information was only displayed if the CB was closed. If the CB was open the information was not shown. Transend operations staff were required to review operational documentation to establish the synchronising capability

² Constraint F_T_X-FASH prevents the West Coast generation from providing FCAS services to the Tasmanian region.

³ Constraint T_X_FASH limits the FCAS R6 enablement of Reece unit 2 during Tasmanian network outages, prevents transient overvoltage at George Town for the loss of Basslink and limits the West Coast Generation to +/- 10% of the West coast load.

prior to restoring the lines to service. This delayed the restoration process for approximately 5 minutes.

At 14:05 hrs the Farrell – Sheffield No 1 line was returned to service.

At 14:06 hrs the Farrell – Sheffield No 2 line was returned to service .

At 14:36 hrs AEMO issued Market Notice No 40154 advising that the West Coast region of Tasmania was resynchronised to the rest of Tasmania at 14:05 hrs, and associated constraints were revoked

6 Power System Security Assessment

This incident resulted in the formation of two islands within the Tasmanian Region, (1) West Coast load and the two Reece generating units only and (2) the remainder of the Tasmanian region.

As consequence of this incident the Over Frequency Generator Shedding Scheme (OFGSS)⁴ initiated, which tripped generation at Bastyan, John Butters, Makintosh and Tribute power stations, as designed, but failed to trip Reece units 1 and 2.

Table 2 below provides the frequency tripping thresholds for the listed generating units.

Station	Frequency tripping threshold	Comments
John Butters	Freq > 52.7Hz	Unit tripped
Reece 1	Freq > 53.0Hz	Reece 1 did not trip
Reece 2	Freq > 53.2Hz	Reece 2 did not trip
Tribute	Freq > 54.7Hz	Unit tripped
Bastyan	Freq > 55.0Hz	Unit tripped
Macintosh	Freq > 55.0Hz	Unit tripped

Although the frequency monitoring provided by Transend at Farrell Substation did not capture the frequency excursion as the transducer saturated at 55Hz, information from Hydro Tasmania for the Reece 1 generating unit showed that frequency on the West Coast island peaked at approximately 59.43Hz.

The two OFGSS relays connected to the Reece units failed to operate correctly and investigation by Transend has determined that the relays were operating in synchronous condenser mode, which effectively blocks their operation. The selection of the mode of operation for these relays is the responsibility of Transend, and at the time of the incident the relays showed as selected to normal operating mode in Transend’s control room. The discrepancy in their operating mode was traced to an inverted point in the remote terminal unit (RTU). The inversion of the RTU control point for the Reece OFGSS relays is suspected to have occurred during project work undertaken at Farrell Substation that included augmentation of the remote terminal unit configuration. This fault has subsequently been corrected by Transend.

⁴ The Tasmanian Over Frequency Generation Shedding Scheme (OFGSS) is an automatic control scheme designed to maintain the Tasmanian frequency to within the Tasmanian frequency operating standard should a separation occur between north and south Tasmania due to tripping of transmission circuits.

The generating units involved are all West Coast generation specifically Bastyan, John Butters, Makintosh, Reece 1 and 2 and Tribute which manage the high frequencies in north of Tasmania, and Gordon units 2 and 3 manage the high frequencies in south Tasmania when required .

The frequency is measured locally to each generating unit.

6.1 West Coast Frequency

Figure 4 shows the frequency recorded at the Reece 1 generating unit⁵. Frequency peaked at 59.43Hz.

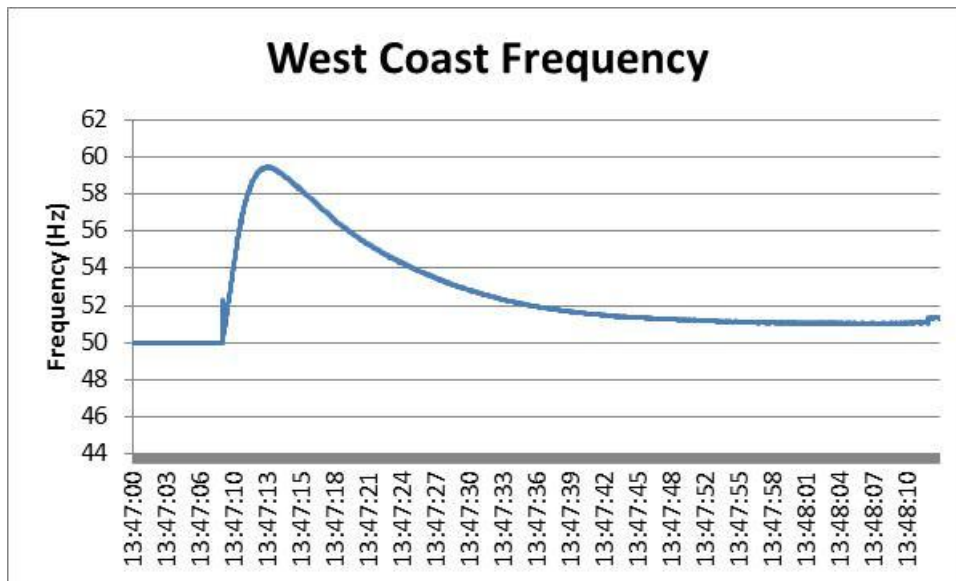


Figure 4 – West Coast frequency

The frequency in the West Coast island post incident was reviewed according to the Tasmanian frequency operating standard for a multiple contingency event;

1. Containment range: 47.0 – 55.0Hz
2. Stabilisation range: 48.0 – 52.0Hz (has to be achieved within 2 minutes) and
3. Recovery range: 49.0 – 51.0Hz (has to be achieved within 10 minutes).

The frequency standard in relation to containment was not met for this event for the West Coast island.

6.2 Tasmanian Frequency (South region post incident)

Figure 5 shows the frequency response in the major portion of the Tasmania region. The lowest frequency recorded was approximately 48.5Hz. The frequency standard in relation to a multiple contingency event was met primarily due to the response of Basslink.

⁵ Based on 50Hz data supplied by Hydro Tasmania

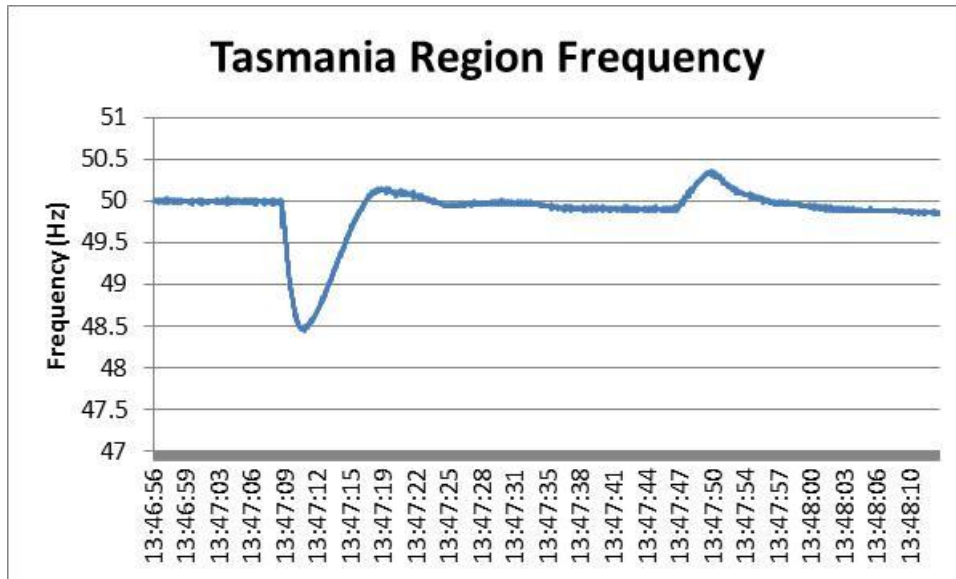


Figure 5 – Tasmania region frequency response.

6.3 Basslink

Prior to the incident Basslink was exporting approximately 477MW to the Victorian region. With the loss of generation in the West Coast area the Basslink frequency controller responded to reduce the export to approximately 100MW as shown in Figure 6.



Figure 6 – Basslink response

Apart from the violation of the frequency standard in the West Coast island the power system remained in a secure state.

7 Re-classification of non-credibly contingency.

As previously stated AEMO were not aware of any increased risk to the power system prior to this incident and as such had no grounds to consider a reclassification.

Although Transend were aware of the fire they had conducted an assessment using the reclassification guidelines in section 12.3 of SO_OP3715⁶ to establish that the risk of a trip was low and as such chose not to advise AEMO. This section of the procedure deals with assessment of the conditions that may lead to a reclassification rather than when/if AEMO should be advised. Clause 4.3.3 of the NER outlines the obligations of System Operators in relation to advising AEMO of potential risks to the power system.

Prior to restoration of the lines Transend advised AEMO that the risk of further trips had passed and as such AEMO did not reclassify the loss of the Farrell – Sheffield lines as a credible contingency.

8 Conclusions

The loss of the Farrell – Sheffield No 1 and No.2 lines was the result of a controlled burn off adjacent to the lines. Although Transend were aware of the fire, AEMO was not made aware as Transend considered the risk as low.

Immediately prior to the trip Transend were not aware of any increased risk due to loss of communication with the on-site observer.

The loss of the two lines resulted in the operation of the over frequency generation shedding scheme in the West Coast area to trip approximately 450MW of generation. The failure of this scheme to trip the two Reece generating units resulted in the West Coast load being islanded on to the Reece generating units. Approximately 10MW of load in the West Coast island was lost due to the high frequency.

The failure of the OFGSS to trip the Reece generating units resulted from an incorrect setting in an RTU. This has subsequently been corrected.

As a result of this islanding the frequency standards in the West Coast island were not met. The frequency standards in the remainder of the Tasmania region were met.

Apart from the frequency in the West Coast island the power system remained in a secure state.

There was a delay of approximately five minutes in restoring the Farrell – Sheffield lines due to uncertainty in relation to the synchronising capability of the Sheffield circuit breakers.

After receiving advice from Transend, AEMO correctly applied the criteria published in section 12 of its Power System Security Guidelines in assessing that the circumstances of a further trip of both the Farrell – Sheffield 220kV lines did not warrant reclassifying as a credible contingency event.

⁶ SO_OP3715 Power System Security Guidelines available at http://www.aemo.com.au/Electricity/Policies-and-Procedures/System-Operating-Procedures/~/_media/Files/Other/SystemOperatingProcedures/so_op3715v049.ashx

9 Recommendations

1. Transend to review the information available to their control room staff in relation to synchronising capabilities of circuit breakers. This is expected to be completed by 31 January 2013.
2. Transend to review the communication requirements for on-site observers by 31 January 2013.
3. Transend to review the capability of the frequency recorders at Farrell by 31 January 2013.