TASMANIAN POWER SYSTEM INSECURE ON 27 OCTOBER 2014

AN AEMO POWER SYSTEM OPERATING INCIDENT REPORT FOR THE NATIONAL ELECTRICTY MARKET

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AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

VERSION RELEASE HISTORY

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1	22 June 2015	S Darnell	Final	J Lu	P Biddle

INCIDENT CLASSIFICATIONS

Time and date and of incident	0250-0325 hrs Monday 27 October 2014
Region of incident	Tasmania
Affected regions	Tasmania
Event type	PSS – Power System insecure for greater than 30 minutes
Primary cause	ENVI & LN – Environment and Lightning
Impact	Nil Impact
Associated reports	Nil

ABBREVIATIONS

Abbreviation	Term
AEMO	Australian Energy Market Operator
CB	Circuit Breaker
FA-SH Lines	Farrell-Sheffield No1 and No.2 220 kV transmission lines
FCAS	Frequency control ancillary services
kV	Kilovolt
MW	Megawatt
NER	National Electricity Rules

IMPORTANT NOTICE

Purpose

AEMO has prepared this document to provide information about this particular Power System Operating Incident.

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1. OVERVIEW

This report reviews a power system operating incident that occurred on 27 October 2014 in Tasmania. This incident involved the Tasmanian Power System being in an insecure operating state for 40 minutes.

AEMO is required to assess this incident because the power system was insecure for greater than 30 minutes.[1] Specifically, AEMO is required 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.[2]

AEMO concluded that the power system was insecure because of constraint violations that were caused by insufficient Raise Six Second (R6) Frequency Control Ancillary Service (FCAS) in Tasmania. The R6 FCAS was required to cover the potential loss of generation that had been put at risk due to a reclassified contingency. The constraint violations were resolved by a generator amending market offers. AEMO has since implemented new constraints that prevent this incident from reoccurring.

This report is based on information provided by AEMO. National Electricity Market time (Australian Eastern Standard Time) is used in this report.

2. THE INCIDENT

On Monday 27 October 2014 constraint F_T+FASH_N-2 TG_R6[3] violated for eight consecutive dispatch intervals (40 minutes in total). The constraint violated as a result of the reclassification of the Farrell-Sheffield No1 and No.2 220 kV transmission lines (FA-SH Lines) as a single credible contingency. The FA-SH Lines were reclassified as a result of lightning in the vicinity of the lines.

The constraint violated because there was insufficient R6 FCAS in Tasmania for the power system to recover from the loss of the generation if the two FA-SH lines had tripped. That is, should the single credible contingency have occurred, the power system frequency may have fallen below mandated levels.[4]

The reason for investigating this incident the power system was in an insecure state for greater than thirty minutes. AEMO is required to operate the power system in a secure state[5] and return the power system to a secure state within 30 minutes following an event.[6]

No customer load or generation was disconnected as a result of this incident. See Attachment 1 for a diagram illustrating the incident and Attachment 2 for a chronological log of the incident.

1 National Electricity Rules Clause 4.8.15(a)(1)(iv) and AEMC Reliability Panel Guidelines for Identifying Reviewable Operating Incidents.
2 NER Clause 4.8.15 (b)
3 F_T+FASH_N-2 TG_R6 determines the amount of raise 6 second FCAS required in Tasmania following the reclassification of the Farrell-Sheffield 220 kV lines.
4 FCAS arrest frequency deviations that can be caused by the sudden loss of large blocks of generation or load
5 AEMO is responsible for power system security in the NEM and is required to operate the power system in a secure operating state (NER Clause 4.2.4 (a)).
6 AEMO is required to return the power system to a secure state within thirty minutes following a contingency event - NER Clause 4.2.6 (b)

3. POWER SYSTEM SECURITY

This section assess power system security over the course of the incident.

AEMO investigated this incident and found that constraint F_T+FASH_N-2 TG_R6 violated for 40 minutes. The violation was as a result of insufficient R6 FCAS available for the contingent trip of the FA-SH lines.

AEMO reclassified the loss of Farrell-Sheffield No1 and No.2 transmission lines as a single credible contingency at 0230 hrs due to lightning in the vicinity of the lines. The reclassification involved AEMO invoking three constraint sets to prepare the power system for the possible trip of the FA-SH Lines in the event of a lightning strike.

At 0250 hrs constraint F_T+FASH_N-2 TG_R6 violated. This constraint was one of the constraints in the constraint sets invoked due to the reclassification. The constraint violated because at this time there was not enough R6 FCAS available in Tasmania to cover the loss of generation that would result if the FA-SH Lines tripped.

The main reason for this shortage of R6 FCAS was that one of the major sources of R6 FCAS in Tasmania was unavailable. Also Basslink was out of service and therefore unavailable to transfer FCAS from the mainland.

The only option available to AEMO to restore power system security was to constrain the generation at risk because there was no further R6 FCAS available. To do this AEMO had two options:

1. Write and enter a constraint to balance the generation at risk against the FCAS available.
2. Direct the generating units to a level that was compatible with the FCAS available.

The first option was unfeasible in the short term due to the time required to develop and test a dynamic constraint.

AEMO would have then acted on the second option, a direction, if the violations had been expected to continue. However, during this period the generator was submitting re-offers to reduce the generation at risk and remove the constraint violations. The violation degree significantly reduced following the third period of violation and relieved the violating constraint after forty minutes. See Table 1 below for constraint violation details.

From the fourth dispatch interval onwards the constraint violations were generally small, and thereby did not impose a material power system security risk. If AEMO had directed the generating units, as per NER clause 4.8.9, to reduce output, the time taken to remove the constraint violations would have been no shorter.

Following on from this event, AEMO has implemented fully co-optimised constraint equations to manage FCAS risk when FA-SH Lines are reclassified a single credible contingency. This means that the NEM dispatch system will co-optimise the value of generation and FCAS to enable a viable dispatch solution.

Table 1 Constraint violation details

Date and Time	Constraint ID	LHS	RHS	Marginal Value	Violation Degree
27/10/2014 02:50	F_T+FASH_N-2_TG_R6	75	120	108000	-45
27/10/2014 02:55	F_T+FASH_N-2_TG_R6	75	240	108000	-165
27/10/2014 03:00	F_T+FASH_N-2_TG_R6	80	185	108000	-105

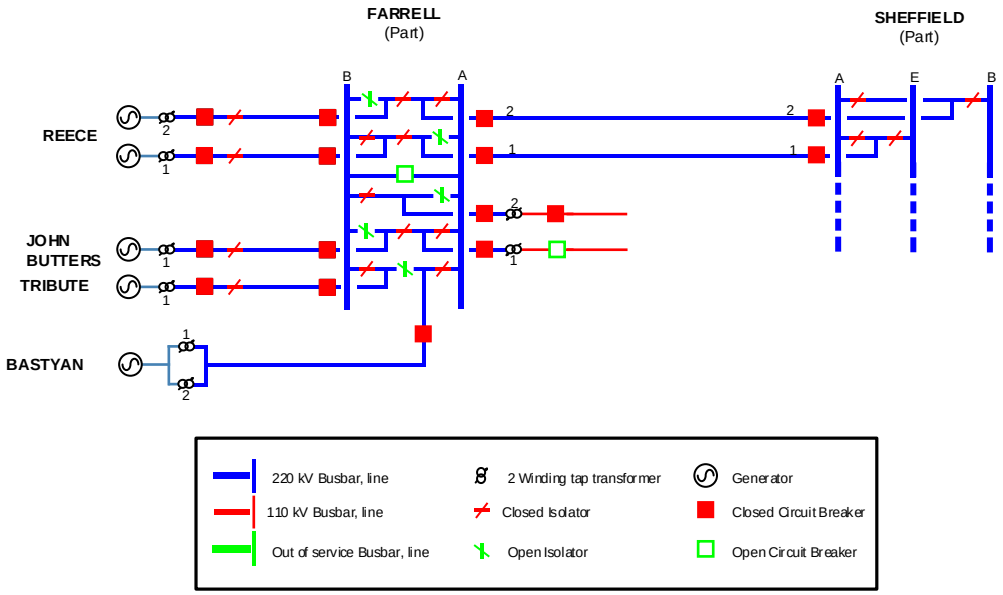
Date and Time	Constraint ID	LHS	RHS	Marginal Value	Violation Degree
27/10/2014 03:05	F_T+FASH_N-2_TG_R6	80	94	108000	-14
27/10/2014 03:10	F_T+FASH_N-2_TG_R6	80	88	108000	-8
27/10/2014 03:15	F_T+FASH_N-2_TG_R6	80	87	108000	-7
27/10/2014 03:20	F_T+FASH_N-2_TG_R6	80	98	108000	-18
27/10/2014 03:25	F_T+FASH_N-2_TG_R6	90	94	108000	-4

4. CONCLUSIONS

AEMO concluded that:

1. AEMO did not return the power system to a secure state within thirty minutes as required by NER Clause 4.2.6 (b).
2. AEMO has since implemented fully co-optimised constraints to manage power system security for this type of risk.

APPENDIX A. – DIAGRAM ILLUSTRATING THE INCIDENT



If the Farrell to Sheffield lines trip (both at the same time) then generators connected to Farrell bus bar A - Reece 2, John Butters and Bastyan – will be islanded and trip. The loss of this generation block to the rest of the system will require FCAS services to maintain frequency. For this incident there were insufficient Raise six second FCAS services (R6) to compensate for the risk of this generation block.

APPENDIX B. – INCIDENT EVENT LOG

Table 2 Incident Log

Time and Date	Event
0230 Mon 27 Oct 2014	Due to lightning AEMO reclassifies the Farrell-Sheffield No.1 and No.2 220 kV transmission lines as a credible contingency
0230 Mon 27 Oct 2014	AEMO invokes constraint sets F-T-FASH_N_2, T-FASH _N_2, and T-NIL_HM_CLOSE
0246 Mon 27 Oct 2014	AEMO issues Market Notice 46716 to notify the market of the reclassification
0245-0325 hrs 27 Oct 2014	Constraint equation F_T+FSASH_N_2TG_R6 violates for eight consecutive dispatch intervals (40 minutes)
0445 hrs 27 Oct 2014	AEMO cancels the reclassification of Farrell-Sheffield No.1 and No.2 220 kV transmission lines as a credible contingency
0448 hrs 27 Oct 2014	AEMO issues Market Notice 46716 to notify the market that AEMO had cancelled the reclassification at 0045 hrs