

POWER SYSTEM OPERATIONS EVENT REPORT

MULTIPLE GENERATOR DISCONNECTION AND UNDER FREQUENCY LOAD SHEDDING THURSDAY 2ND JULY 2009

PREPARED BY: Power System Operations

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1. Summary

At 1047 hrs on Thursday 2nd July 2009 the bay coupler circuit breaker 5042 current transformer failed at the Bayswater Power Station switch yard in the Hunter Valley, NSW. The failure resulted in multiple disconnections of transmission lines and generators and under frequency load shedding.

A total of **3205 MW** of generation disconnected automatically resulting in under frequency load shedding across the NEM interconnected system. A total of **1131 MW** of load was interrupted. AEMO commenced load restoration at 1058hrs. Permission to restore the last of the interrupted load was given at 1114hrs and interrupted load was largely restored by 1150 hrs.

This report has been prepared to provide an operational overview of the event. AEMO has commenced the preparation of the operating incident report for this event as required by the National Electricity Rules, clause 4.8.15, in order to assess the adequacy of the provision and response of facilities or services, and the appropriateness of actions taken to restore or maintain power system security. Data used in this document is derived from the AEMO SCADA and may differ slightly to high speed data measurements.

2. Definitions

AEMO - Australian Energy Market Operator

CB - Circuit Breaker

CT – Current Transformer

FCAS - Frequency Control Ancillary Service

FOS - Frequency Operating Standard

NEM – National Electricity Market

PS - Power Station

UFLS – Under Frequency Load Shedding Scheme

3. Generation and Load Disconnection Summary

GENERATION	DELTA MW	LOAD	DELTA MW
Bayswater Unit 1	474	Rio Tinto	100
Bayswater Unit 2	480	Nyrstar	83
Bayswater Unit 3	477	Tomago 2	287
Bayswater Unit 4	617	Kurri 2	97
Mt Piper Unit 2	234	QLD other ¹ load	60
Yallourn Unit 3	387	SA other load	30
Tarong Unit 4	346	VIC other load	150
Gladstone Unit 5	190	NSW other load	324
Total	3205	Total	1131

Table 1: Generation and Load Disconnection Summary

4. Chronology of Events

DATE	TIME HRS	EVENTS	COMMENTS	GEN LOSS (MW)	LOAD LOSS (MW)
02/07/2009	10:45	Auto Reclose Trip Test of 32 Bayswater – Sydney West line	Test completed successfully		
02/07/2009	10:47	System Disturbance - Trip of 32 Bayswater – Sydney West 330 kV transmission line opened auto	Failure of CT associated with CB 5042. CB 322A unsuccessful reclose at Sydney West.		
02/07/2009	10:47	Bayswater Unit 4 opened auto	Cause currently under investigation.	617	
02/07/2009	10:47	34 Bayswater – Liddell 330kV transmission line opened auto	Opened at Liddell end only		
02/07/2009	10:47	33 Bayswater - Liddell 330kV transmission line opened auto	Opened at both ends then reclosed at Bayswater on CB 332 remained opened at		

¹ Note - Other load includes domestic, commercial and smaller industrial loads. These values are estimates taken from the AEMO SCADA.

DATE	TIME HRS	EVENTS	COMMENTS	GEN LOSS (MW)	LOAD LOSS (MW)
			Liddell.		
02/07/2009	10:47	31 Bayswater – Regentville 330 kV transmission line opened auto	Remained open at both ends		
02/07/2009	10:47	Bayswater Unit 3 opened auto	Inter-zone protection	477	
02/07/2009	10:47	Bayswater Unit 1 opened auto	Loss of supply to boiler flame monitoring equipment.	474	
02/07/2009	10:47	Bayswater Unit 2 opened auto	Inter-zone protection	480	
02/07/2009	10:47	Loss of all Bayswater 500kV SCADA	Situation awareness compromised.		
02/07/2009	10:47	Mt Piper Unit 2 opened auto		234	
02/07/2009	10:47	Rio Tinto TAS Region. Load reduction of 100MW	Full load restored at 11:23 hrs		100
02/07/2009	10:48	Nystar TAS Region. Load reduction of 83MW	Full load restored at 11:36 hrs		83
02/07/2009	10:48	Gladstone Unit 5 Generator opened auto		190	
02/07/2009	10:49	Kurri potline No2 NSW Region. Opened auto	PTR given at 1114 hrs. Full load restored at 1150 hrs		97
02/07/2009	10:49	Tomago potline No2 NSW Region. Opened auto.	PTR given at 1107 hrs. Full load restored at 1121 hrs		287
02/07/2009	10:53	Yallourn Unit 3 opened auto		387	
02/07/2009	10:53	Tarong Unit 4 opened auto		346	
02/07/2009	10:59	Rio Tinto load returned to service	Returned to full load at 1123 hrs		
02/07/2009	11:06	Nystar load returned to service	Returned to full load at 1136 hrs		
02/07/2009	11:10	Tomago potline No2 returned to service	Full load restored at 1121 hrs		
02/07/2009	11:27	Kurri potline No 2 returned to service	Returned to full load 1150 hrs		
02/07/2009	11:33	33 Bayswater – Liddell 330 kV transmission line returned to service			
02/07/2009	12:04	31 Bayswater - Regentville 330kV transmission line returned to service			

DATE	TIME HRS	EVENTS	COMMENTS	GEN LOSS (MW)	LOAD LOSS (MW)
02/07/2009	12:40	Bayswater 500kV SCADA returned to service.			
02/07/2009	12:48	Tarong Unit 4 returned to service			
02/07/2009	13:03	Yallourn Unit 3 returned to service			
02/07/2009	13:35	34 Bayswater - Liddell line returned to service			
02/07/2009	13:40	Gladstone Unit 5 returned to service			
02/07/2009	14:57	Bayswater Unit 1 returned to service			
02/07/2009	17:14	Mt Piper Unit 2 returned to service			
02/07/2009	19:26	Bayswater Unit 3 returned to service			
02/07/2009	20:34	Bayswater Unit 2 returned to service			
02/07/2009	22:58	Bayswater Unit 4 returned to service			
03/07/2009	04:58	32 Bayswater – Sydney West 330kV transmission line returned to service			

Table 2: Chronology of events

5. Constraints

The following three tables are a summary of the constraint sets that were invoked following the multiple contingency event.

Table 3 details the outage constraints that were invoked for the multiple contingency event.

CONSTRAINT SET	START TIME	END TIME	DESCRIPTION
N-BWMP_5A3	02/07/2009 10:55	02/07/2009 11:45	Out= Bayswater to Mt Piper (5A3) 500kV line. Line in-service to energised busbars no connection available for power flow.
N-BWWW_74	02/07/2009 11:00	02/07/2009 11:45	Out= Bayswater to Wallerawang (74) line. Line in-service to energised busbars no connection available for power flow.
N-BWRG_31	02/07/2009 10:55	02/07/2009 12:10	Out= Bayswater - Regentville (31)
N-BWLD_ONE	02/07/2009 10:55	02/07/2009 15:45	Out= Bayswater to Liddell (33 or 34)
N-BWSW_32	02/07/2009 10:55	03/07/2009 05:10	Out= Bayswater - Sydney West (32)
N-BWLD_TWO	02/07/2009 11:15	02/07/2009 11:45	Out= both Bayswater to Liddell (33 and

			34)
N-BWSW_TWO	02/07/2009 11:15	02/07/2009 12:10	Out= both Bayswater to Regentville/Sydney West (32 + 31/38)

Table 3: Invoked Outage constraint sets

The QNI and Terranora interconnectors were constrained, using discretionary constraints, to manage post contingent flows for the loss of either 81 or 82 transmission lines. Table 4 lists the discretionary constraint sets invoked.

CONSTRAINT SET	START TIME	END TIME	DESCRIPTION
I-QNS_0400	02/07/2009 11:10	02/07/2009 11:25	Qld to NSW summated QNI + Terranora upper transfer limit of 400 MW
I-QN_300	02/07/2009 11:25	02/07/2009 11:55	Qld to NSW on QNI limited to 300 MW
I-QN_500	02/07/2009 11:55	02/07/2009 12:05	Qld to NSW on QNI limited to 500 MW

Table 4: Invoked discretionary constraint sets on QNI and Terranora Interconnectors

Table 5 details the FCAS constraint sets that were invoked to manage the time error and to facilitate load restoration.

CONSTRAINT SET	START TIME	END TIME	DESCRIPTION
F-MAIN_RREG_0350	02/07/2009 10:55	02/07/2009 11:40	Mainland Raise Regulation Requirement greater than 350 MW
F-MAIN_RREG_0400	02/07/2009 11:20	02/07/2009 12:10	Mainland Raise Regulation Requirement greater than 400 MW
F-MAIN_RREG_0300	02/07/2009 12:10	02/07/2009 12:25	Mainland Raise Regulation Requirement greater than 300 MW

Table 5: Invoked FCAS constraint sets

6. Market Notices and Emergency SMS Messages

The market notices that were issued during the event are detailed in Table 6.

ID	ISSUE DATE	CONTENT
26789	02/07/2009 11:23	Multiple Contingency NSW Thursday 02 July 2009
26791	02/07/2009 12:14	UPDATE MN 26789: Multiple Contingency NSW Thursday 02 July 2009
26793	02/07/2009 12:41	Ref: System Incident 2nd July 2009 AEMO Market Notice identification.

Table 6: Market Notices

At 1103 hrs an emergency SMS was issued via the AEMO Emergency Communication System as follows:

Subject: NEM Power System Event

NEM Power System Event: NSW region at 10:50 hrs 02/07/09 1000 MW load shed 2500MW generation tripped market notice to follow.

7. Frequency and Time Error

7.1 Mainland

The minimum frequency was 49.00 Hz at 10:49 hrs. Frequency remained within the normal band for the duration of the load restoration period.

CONDITION	MAINLAND FREQUENCY (HZ)	TIME BELOW THRESHOLD (SECONDS)	COMMENTS
Containment	47	0	
Stabilisation	49.5	282 178 from minimum or last contingency.	FOS 120 seconds
Recovery	49.85	664	FOS 600 seconds
	49.0	0	UFLS threshold

Table 7: Mainland Frequency

The time error for the Mainland exceeded 5.0 seconds from 10:55 hrs to 11:38 hrs (43 minutes and 14 seconds).

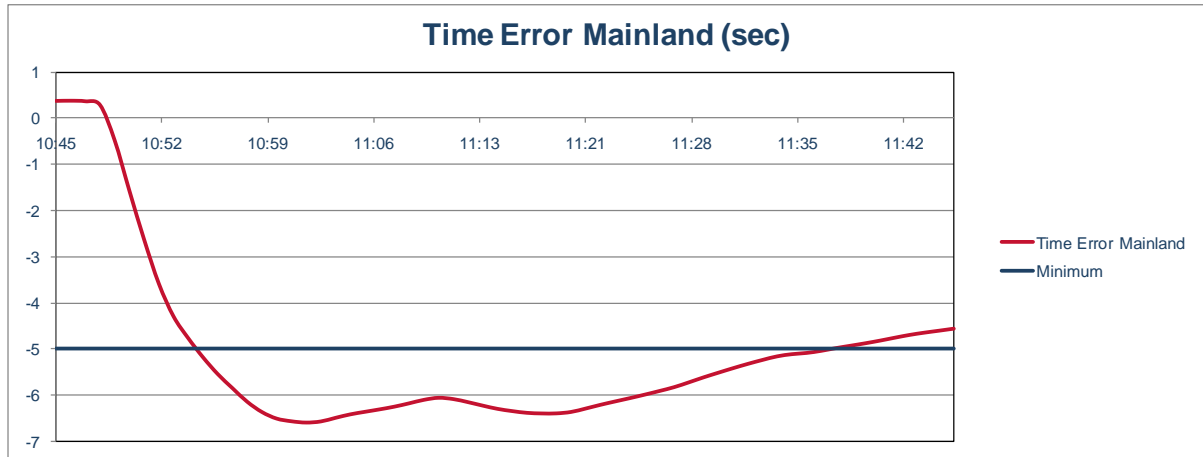


Figure 1: Mainland time error 10:45 to 11:45hrs

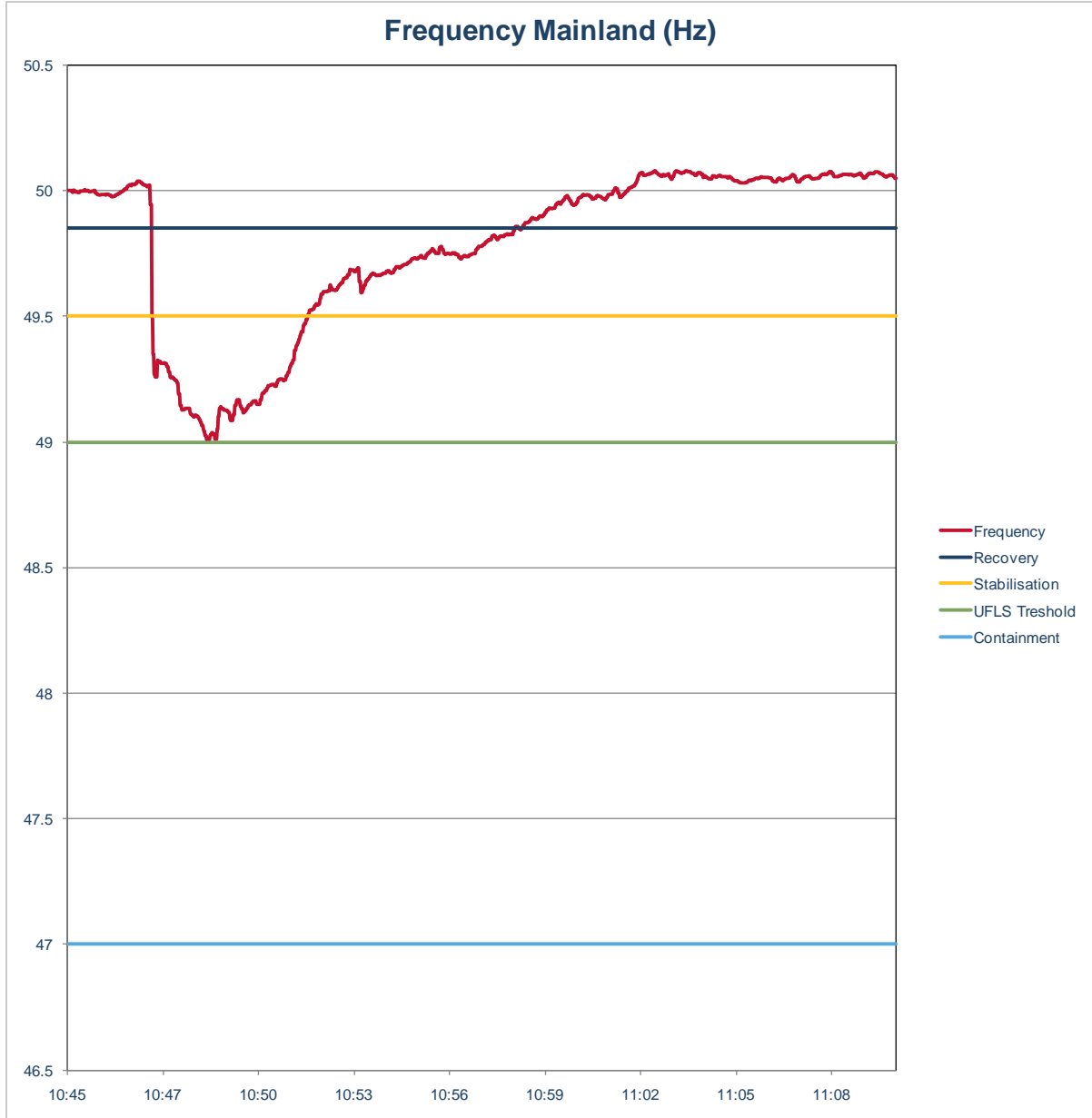


Figure 2: Mainland frequency 1045 hrs to 11:09 hrs

7.2 Tasmania

The minimum frequency was 47.27 Hz at 10:47:40 hrs. Frequency remained within the normal band for the duration of the load restoration period.

CONDITION	TASMANIAN FREQUENCY (HZ)	TIME BELOW THRESHOLD (SECONDS)	COMMENTS
Containment	46	0	
Stabilisation	47.5	4	FOS 120 seconds
Recovery	49.85	32	FOS 600 seconds
	47.4	4	UFLS threshold

Table 8: Tasmanian Frequency

The time error for Tasmania satisfied the FOS.

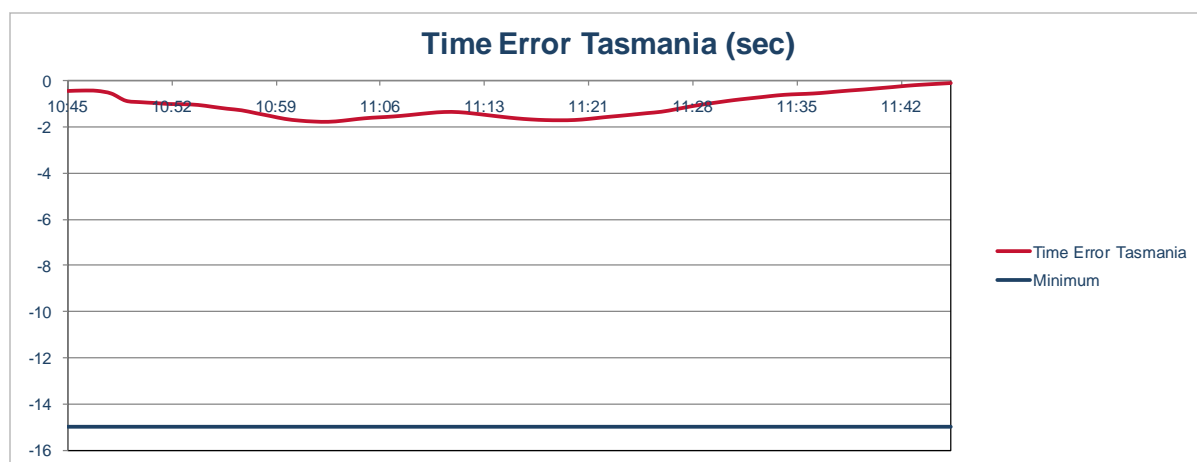


Figure 3: Tasmanian time error 1045 hrs to 1145 hrs

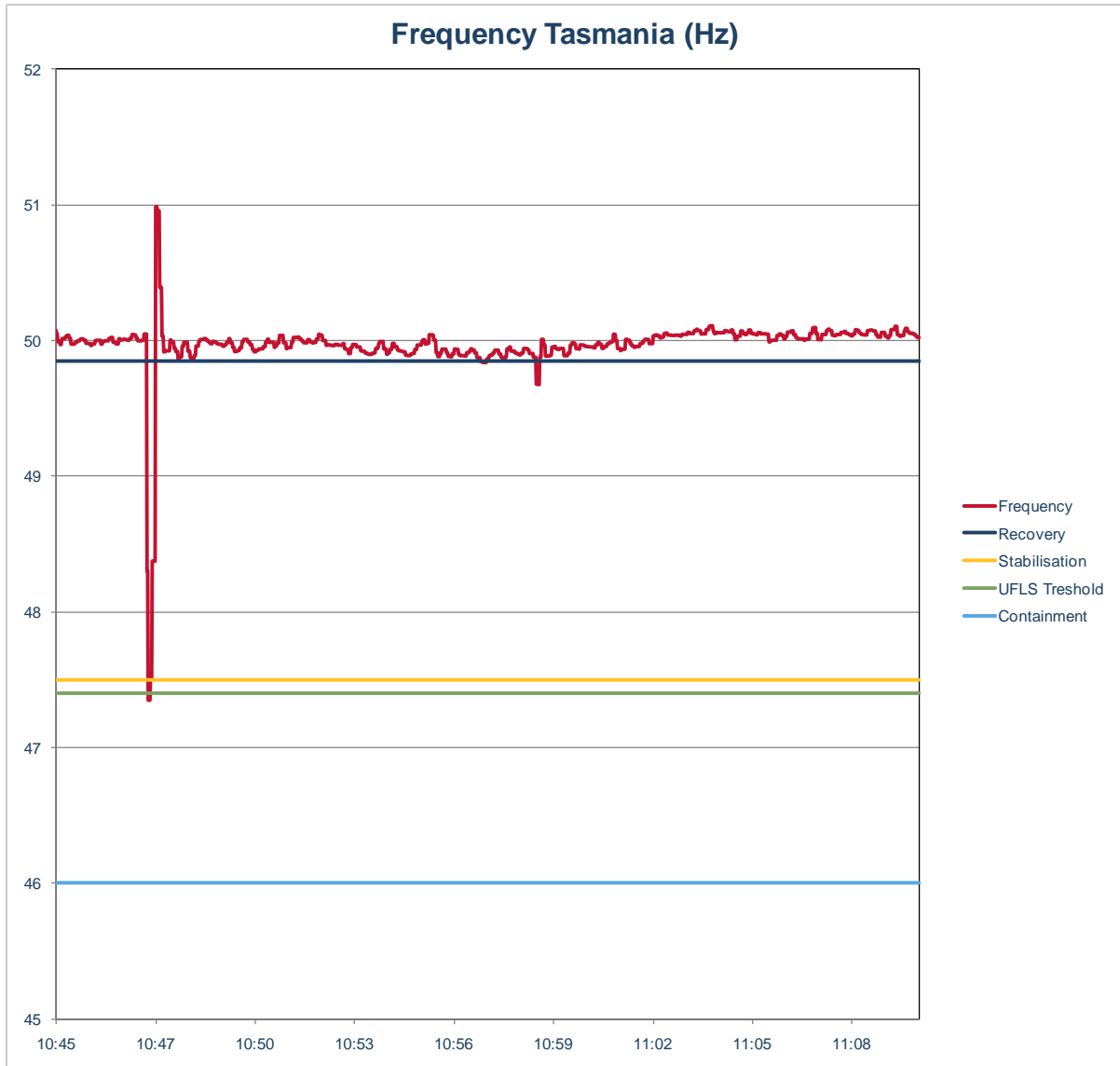


Figure 4: Tasmanian frequency 1045 hrs to 1109 hrs

8. Interconnector Operation

8.1 QNI

At the time of the event QLD to NSW MW transfer on the QNI interconnector was 400 MW. The maximum transfer reached was 988.22 MW @ 10:48:13 hrs.

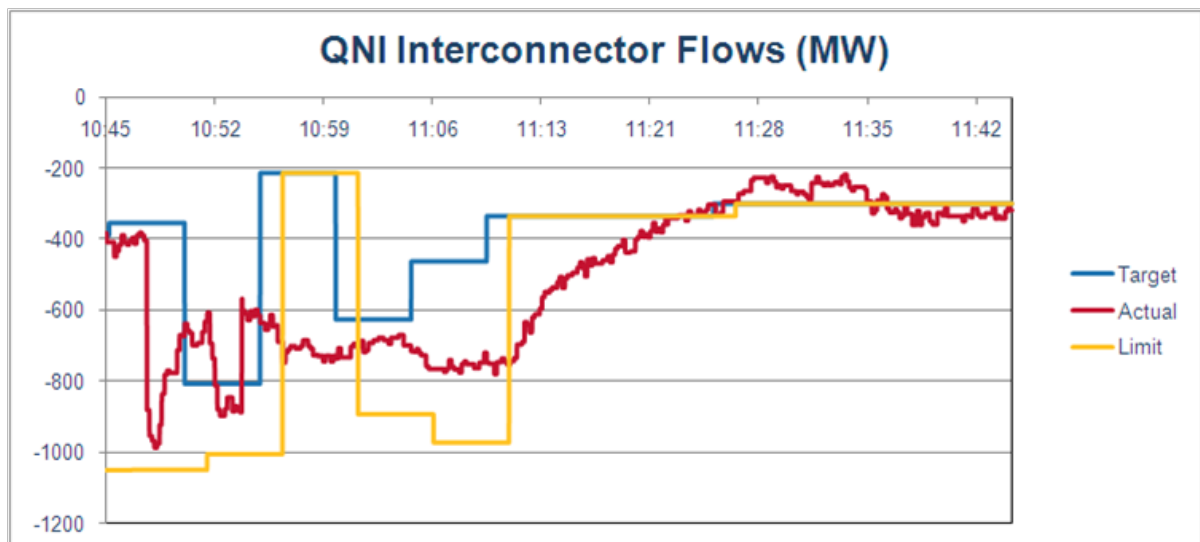


Figure 5: QNI Interconnector Flow

8.2 Terranora

At the time of the event QLD to NSW MW transfer on the Terranora interconnector was 72 MW. The maximum transfer reached was 105 MW @ 10:52:02 hrs.

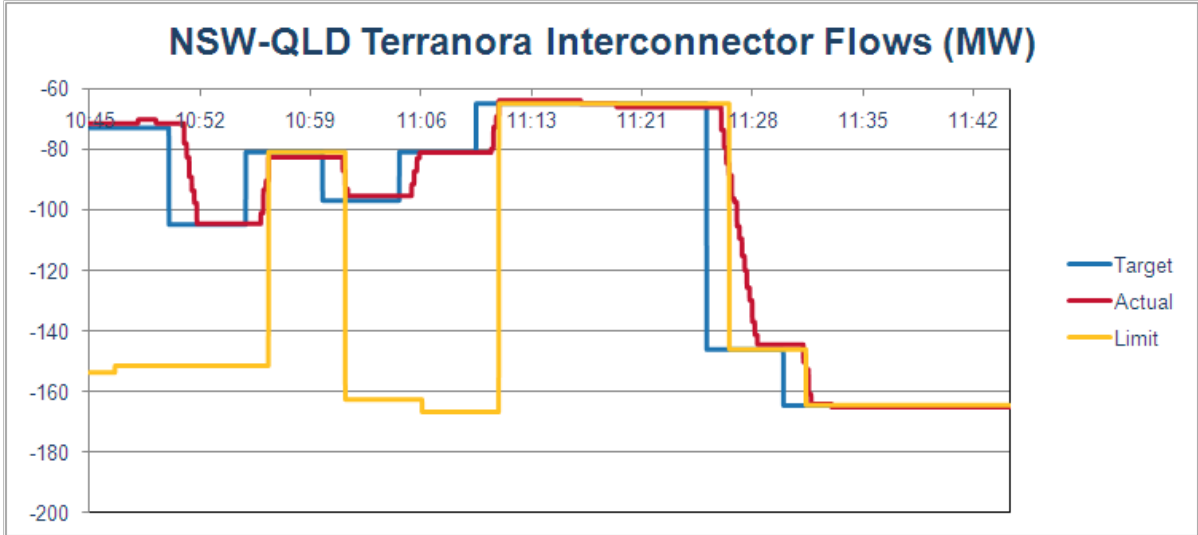


Figure 6: Terranora Interconnector Flow

8.3 VIC-NSW

At the time of the event VIC to NSW MW transfer was 200 MW. The maximum transfer reached was 1132.15 MW @ 10:49:20 hrs.

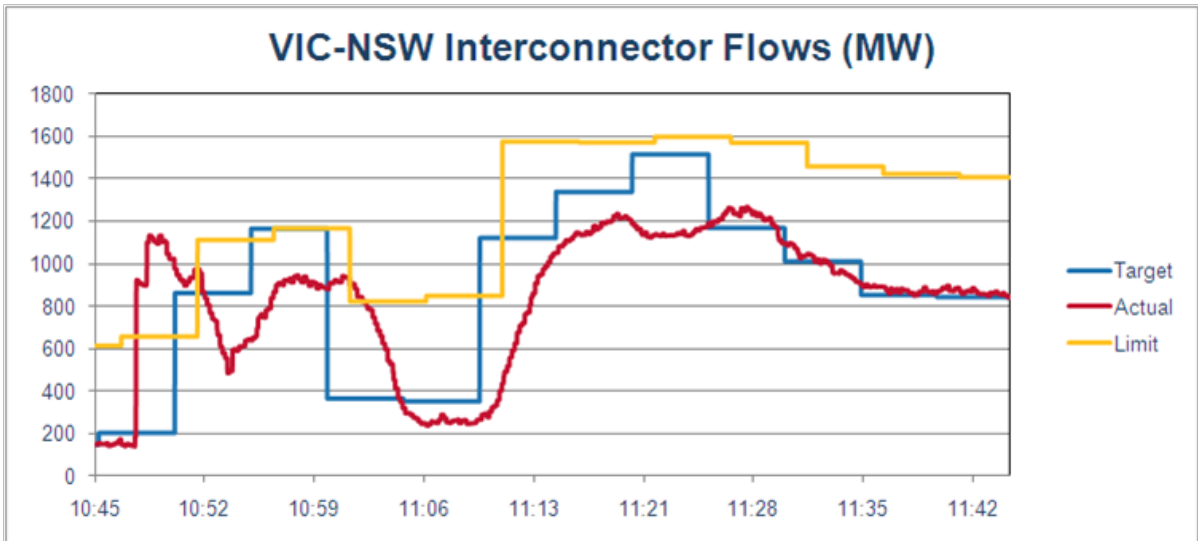


Figure 7: VIC-NSW Interconnector flow

9. Conclusion

The faulted current transformer produced a large system disturbance resulting in multiple disconnections of generators and transmission lines along with operation of the UFLS. Bayswater PS output was reduced to zero and connections to the Liddell and the Sydney load areas were severed. The Bayswater PS switchyard 330 kV and 500 kV busbars remained energised from Mt Piper PS and Wallerawang PS through 5A3 500 kV transmission line and 74 330 kV transmission line respectively.

Preliminary information from Macquarie Generation indicates that the four units at Bayswater PS did not trip simultaneously and tripped for a variety of reasons with all but one linked to faults in the Bayswater PS switchyard.

At this stage AEMO does not believe that it is necessary to reclassify the loss of multiple generating units at Bayswater PS as a credible contingency. The information does not suggest that the cause of the disconnection of the generating units at Bayswater PS is related to the power system event that occurred on Friday 13 August 2004.

AEMO is continuing investigations into the reasons for the tripping of the other generating units during this system incident.