POWER SYSTEM INCIDENT REPORT STRATHMORE TO ROSS 879 & 880 275KV LINE DECLARED CREDIBLE

PREPARED BY: Electricity System Operations Planning and Performance

DOCUMENT NO:

VERSION NO: 1.0

Final

1. Introduction

On 4th October 2009 at 01:50hrs until 07:39hrs the simultaneous trip of the two 275 kV transmission lines from Strathmore to Ross 879 and 880 was reclassified as a credible contingency after two(2) earlier trip and reclose events on 879 line. Power system was considered insecure for more than 30 mins from 01:50hrs to 02:57 hrs.

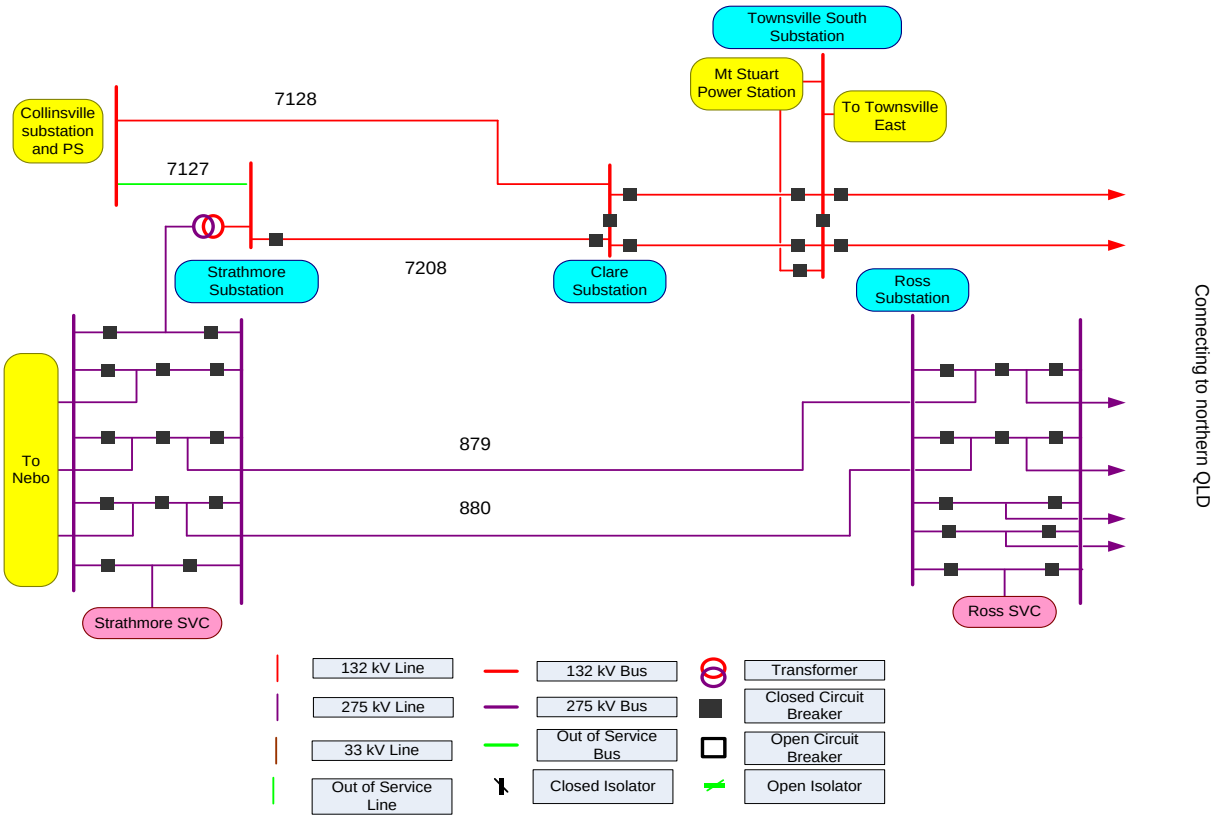
This report has been prepared under clause 4.8.15 of the Rules to assess the adequacy of the provision and response of facilities and services and the appropriateness of actions taken to restore or maintain power system security.

Information for this report has been supplied to AEMO by Powerlink, data from AEMO's Energy Management System (EMS) has also been used in analysing the event.

All references to time in this report refer to Market time (Australian Eastern Standard Time)

2. Summary of Events

The North Queensland network configuration in the Strathmore/Ross area is shown below:



On Sunday 4th October 2009 at 01:50 hrs, the simultaneous trip of both Strathmore to Ross 879 and 880 275kV transmission lines was declared as a credible contingency after two (2) earlier trip and auto-reclose events on 879 line at 01:40 hrs and 01:48 hrs respectively.

The market notices listed in Table 1, including the declaration of tripping of both 879 and 880 275kV lines as credible, were issued.

TABLE 1 : MARKET/PARTICIPANT NOTICES

TIME	NOTICE	MARKET / PARTICIPANT	DETAIL (EXTRACTED FROM MARKET NOTICE)
02:05	28061	Market	Reclassification of a non-credible contingency event – Loss of Ross to Strathmore 879 and 880 275kV Lines as a credible contingency
02:39	28062	Market	AEMO intervention event in QLD Region
02:39	28063	Participant	Direction to Origin Energy to dispatch Mount Stuart generating units 1 and 2

TIME	NOTICE	MARKET / PARTICIPANT	DETAIL (EXTRACTED FROM MARKET NOTICE)
05:36	28064	Market	Update – Reclassification of a Non Credible Contingency Event – Ross to Strathmore 879 and 880 275kV Lines
07:39	28067	Market	Cancellation of reclassification of a non-credible contingency event – Ross to Strathmore 879 and 880 275kV lines
07:47	28065	Market	Cancellation – Direction – Queensland Region
07:49	28066	Participant	Cancellation – Direction to Origin Energy for dispatch of Mount Stuart generating units 1 and 2

AEMO control room real time contingency analysis (RTCA)reported unsolved contingencies during the period 01:50 hr to 02:42 hr. The reasons for this could have been the modelling differences in AEMO EMS and/or severe under-voltage/thermal overloading on line/s on the loss of 879 and 880 lines making the solving of powerflow difficult.

In response to the RTCA violations AEMO control room directed Mount Stuart generating units 1 & 2 to be dispatched and invoked constraint equations. The constraint equations invoked are listed in Table 2 below:

TABLE 2: CONSTRAINTS MANAGEMENT

START TIME	END TIME	CONSTRAINT	COMMENTS
02:05	02:30	#MSTUART1_E	QMSP1.ENERGY * 1 >= 100 (Wt = 20)
		#MSTUART2_E	QMSP2.ENERGY * 1 >= 100 (Wt = 20)
02:25	03:55	#MSTUART1_DE	QMSP1.ENERGY * 1 = 100 (Wt = 360)
		#MSTUART2_DE	QMSP2.ENERGY * 1 = 100 (Wt = 360)
03:55	05:45	#MSTUART1_DE	QMSP1.ENERGY * 1 = 110 (Wt = 360)
		#MSTUART2_DE	QMSP2.ENERGY * 1 = 110(Wt = 360)
05:45	06:45	#MSTUART1_DE	QMSP1.ENERGY * 1 = 120 (Wt = 360)
		#MSTUART2_DE	QMSP2.ENERGY * 1 = 120 (Wt = 360)
06:45	07:25	#MSTUART1_DE	QMSP1.ENERGY * 1 = 144 (Wt = 360)
		#MSTUART2_DE	QMSP2.ENERGY * 1 = 144 (Wt = 360)

Table 3 below shows a list of all the contingency analysis (CA) results for the contingency trip of the 879 and 880 lines. At 18:55 hrs on 3rd October 2009 Powerlink advised AEMO that it may be possible to increase the rating of the 7208, 7128, 7134, 7130 and 7253 132kV lines if required. However, these re-ratings were only confirmed and subsequently hand-dressed into AEMO's EMS system at 03:02 hrs on 4th October 2009. The red text in Table 3 indicates periods where CA results determined that the load shed (LDSH)[1] rating would be exceeded assuming the increased rating of these lines had been available, i.e., the power system would have been insecure even with these higher ratings. The blue text indicates periods where the CA results determined that, had the increased ratings been available, the

LDSH rating would not have been exceeded, i.e., the power system would have been secure had these higher ratings applied.

[1] Load Shed rating – 15 mins rating of the line provided by TNSP

TABLE 3: LIST OF AEMO EMS CA VIOLATIONS

CA RUN TIME	CTG DESCRIPTION	AFFECTED PLANT	VALUE AFTER CTG	LDSH LIMIT	HEAD ROOM	RE-RATING	HEADROOM WITH RE-RATING
01:51 to 02:42	879+880 H35 - H13 275 LINES	CONTINGENCY UNSOLVED	0	0	0		
02:47	879+880 H35 - H13 275 LINES	132KV_7208 @H35_STHM	253	138	-115	240	-13
	879+880 H35 - H13 275 LINES	132KV_7208 @T193_CLS	-230	138	-92	240	10
	879+880 H35 - H13 275 LINES	132KV_7130/2 @T56_TV_S	-198	141	-57	153	-45
	879+880 H35 - H13 275 LINES	132KV_7131 @T56_TV_S	-182	108	-74	137	-45
	879+880 H35 - H13 275 LINES	132KV_7131 @T42_CLRE	169	108	-61	137	-32
	879+880 H35 - H13 275 LINES	132KV_7130/1 @T193_CLS	161	141	-20	153	-8
02:52	879+880 H35 - H13 275 LINES	132KV_7208 @H35_STHM	195	138	-57	240	45
	879+880 H35 - H13 275 LINES	132KV_7208 @T193_CLS	-185	138	-47	240	55
	879+880 H35 - H13 275 LINES	132KV_7130/2 @T56_TV_S	-148	141	-7	153	5
	879+880 H35 - H13 275 LINES	***132KV_7131 @T56_TV_S***	***-133***	***108***	***-25***	137	4
	879+880 H35 - H13 275 LINES	***132KV_7131 @T42_CLRE***	***131***	***108***	***-23***	137	6
	879+880 H35 - H13 275 LINES	132KV_7130/1 @T193_CLS	121	108	-13	153	32
02:57	879+880 H35 - H13 275 LINES	132KV_7208 @H35_STHM	187	138	-49	240	53
	879+880 H35 - H13 275 LINES	132KV_7208 @T193_CLS	-177	138	-39	240	63
	879+880 H35 - H13 275 LINES	132KV_7130/2 @T56_TV_S	-145	141	-4	153	8
	879+880 H35 - H13 275 LINES	132KV_7131 @T56_TV_S	-130	108	-22	137	7

CA RUN TIME	CTG DESCRIPTION	AFFECTED PLANT	VALUE AFTER CTG	LDSH LIMIT	HEAD ROOM	RE-RATING	HEADROOM WITH RE-RATING
	879+880 H35 - H13 275 LINES	132KV_7131 @T42_CLRE	128	108	-20	137	9
	879+880 H35 - H13 275 LINES	132KV_7130/1 @T193_CLS	118	108	-10	153	35

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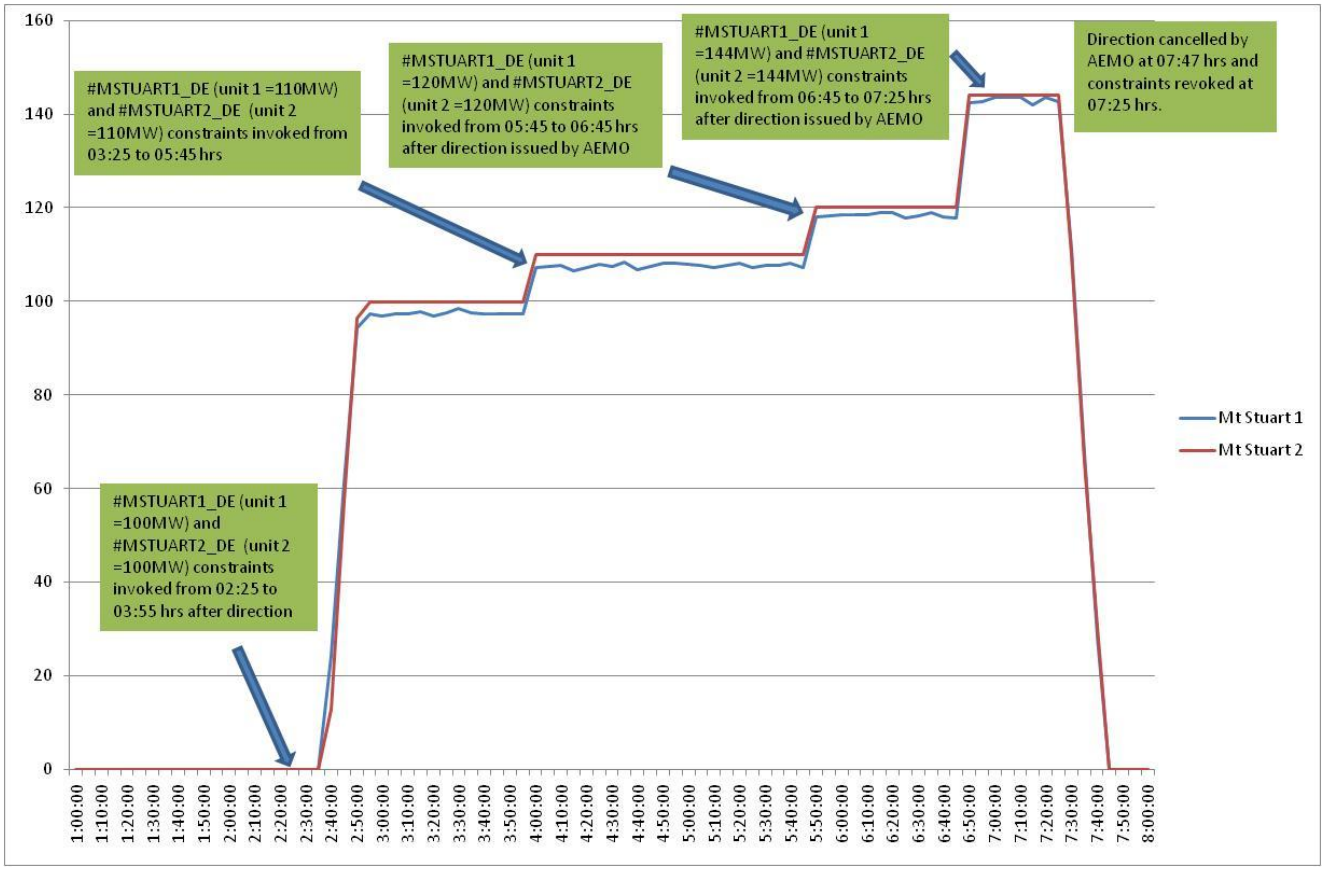
Mt. Stuart unit 1 and 2 were directed to be dispatched from 02:25 hrs and the corresponding generation from the two generating units was as shown in graph 1 below.

Graph 1 - Mt Stuart unit 1 & 2 generation



With two (2) Mt Stuart units generating, the severity of power system security violations reduced, as detailed in Table 3. At 07:39 hrs, reclassification of both 275kV lines was cancelled and at 07:47 hrs the direction to Mt Stuart 1 & 2 units was cancelled.

3. Immediate Actions Taken

Immediately following the reclassification of the trip of both Strathmore – Ross 275 kV (879 & 880) lines as a credible contingency at 01:50 hr:

- AEMO control room set the EMS contingency for the simultaneous trip of both Strathmore to Ross 275kV lines to MUSTRUN in RTCA.

- AEMO EMS RTCA failed to solve for the trip of both lines.

- AEMO control room contacted Yabulu station at 01:53 hrs and Mt. Stuart station at 01:55 hrs. It was decided to issue direction to Mt Stuart units to synchronise at 02:25 hrs in order to manage the system conditions.

- AEMO invoked constraint sets #MSTUART1_E and #MSTUART2_E at 02:05 hrs 4th Oct 09 to manage power system security by constraining on Mt. Stuart generating units 1 & 2. These two constraint sets were revoked at 02:30 hrs after referring to AEMO constraint policy document SO_OP3715 section 4 .

- A direction was subsequently given to Origin Energy at 02:39hrs hr to dispatch Mount Stuart generating units 1 and 2

- Associated with the direction, constraint sets #MSTUART1_DE and #MSTUART2_DE were invoked from 02:25 hrs to 07:25 hrs with target MW values for Mt Stuart generating units 1 & 2 respectively varying during this period as shown in table 2.

- Reclassification of the simultaneous loss of 879 and 880 lines as a credible contingency event was cancelled at 07:39 hrs and directions to Mt Stuart generating units unit 1 & 2 were cancelled at 07:49 hrs.

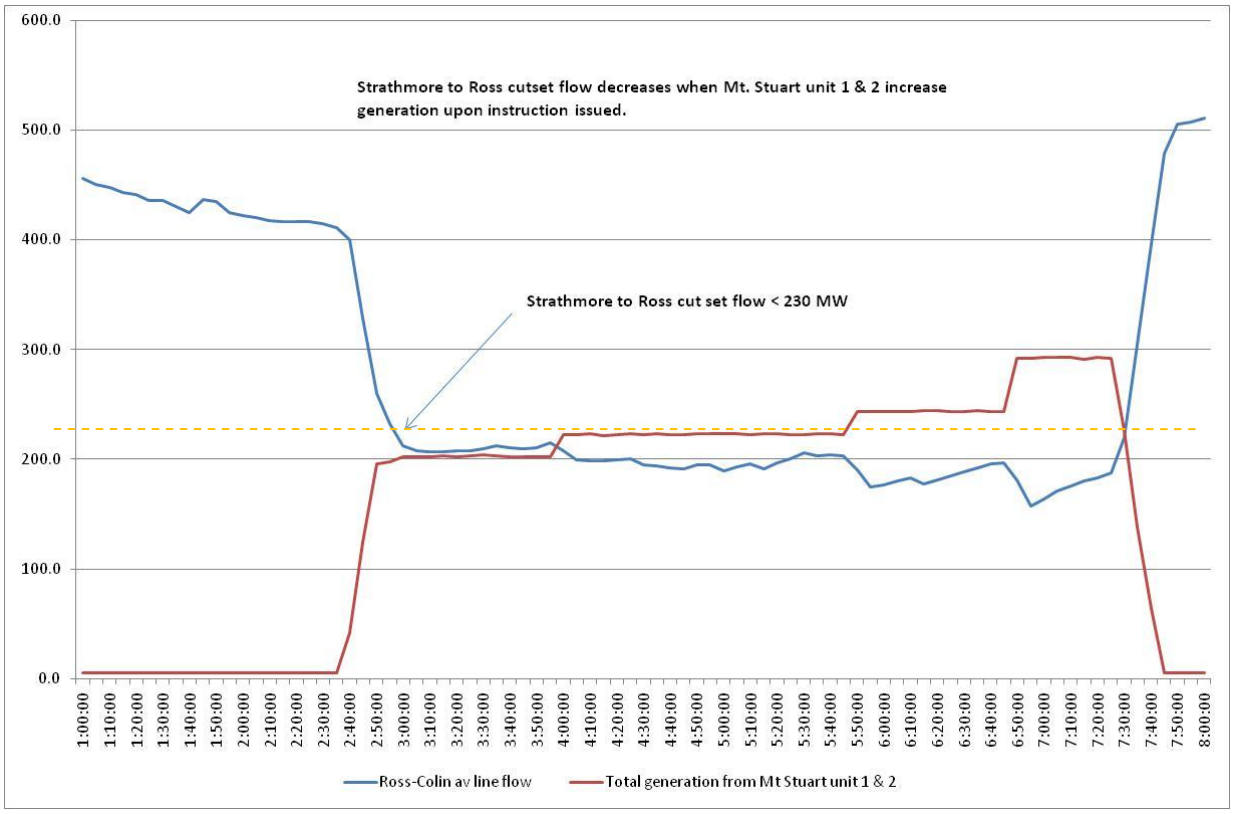
4. Power System Security Assessment

In accordance with the AEMO operating procedure, SO_OP3715, section 10.1, following a re-classification, AEMO must ensure that it fulfils its power system security obligations to achieve and maintain the secure operating state of the power system for the revised technical envelope.

The simultaneous loss of 879 and 880 275kV lines was declared credible from 01:50 hrs and subsequent EMS Real Time Contingency Analysis did not solve for this contingency till 02:42 hrs. This was largely due to the trip of both 879 and 880 lines overloading the two remaining 132kV lines 7128 and 7208 connecting Strathmore to Ross and/or causing substantial under-voltage conditions in the area. The system was considered insecure for a period of more than 30 mins between 01:50 to 02:57 hrs.

Graph 2 below shows the variation of flow across the Strathmore to Ross cutset due to the generation from Mt Stuart & Kareeya power stations (Kareeya was generating at a constant 5 MW throughout the incident).

Graph 2 – Strathmore to Ross cutset flow vs generation in the area.

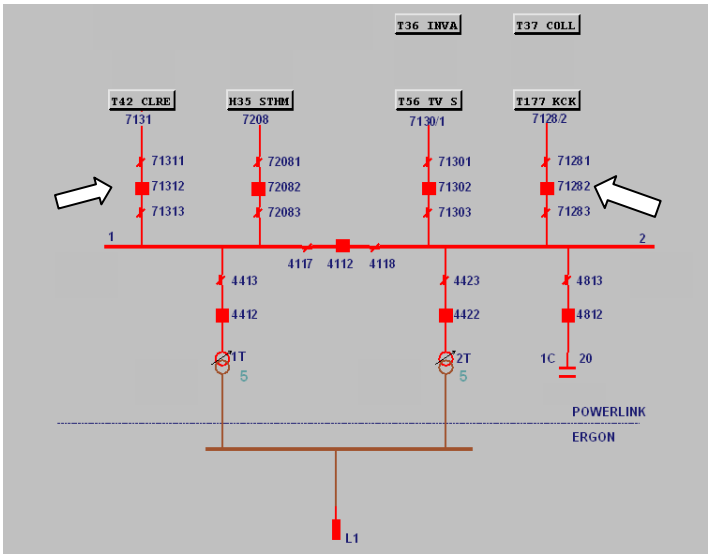


Graph 2 above demonstrates that as the generation from the Mt Stuart units increased, the flow across the cutset decreased. Once the flow across the cutset reduced below 230MW, the power system was in a secure operating state. This occurred after 03:00 hr dispatch interval. RTCA violations have ceased at 03:02 hrs run.

5. Follow up action

It has been stated in AEMO Operating Procedure SO_OP3715 that AEMO is responsible for maintaining power system security including during reclassification events.

After the event, on-line staff became aware that the 7128 and 7131 132kV lines connected to Clare South substation were incorrectly modelled as being closed in the CA results, This resulted in CA producing a lower post-contingent flow than would have been the case had the lines been correctly modelled as open. As CA was already indicating security issues, this modelling error did not have significant impact. This issue was resolved through a subsequent update of EMS database.



T 193 Clare South substation configuration during the event

A standing contingency plan, previously agreed with the TNSP for managing Ross-Strathmore cut set flow was not followed in this case. The plan provides a Ross limit of 230 MW and a constraint equation Q_RS_230 was available as detailed in Table 4.

TABLE 4 – CONSTRAINT **Q_RS_230** LHS.

GENERATING UNITS INCLUDED IN THE LHS OF CONSTRAINT EQUATION Q_RS_230:	
Mt. Stuart 1	Kareeya 3
Mt. Stuart 2	Kareeya 4
Barron 1	Barron 2
Kareeya 1	Townsville GT (Yabulu)
Kareeya 2	Townsville 2 (Yabulu)

The objective of the constraint equation is to reduce the flow on Strathmore to Ross cutset to below 230MW by constraining on all available generating units north of this cutset.

Invoking the constraint set may not provide an immediate solution to the power system security violation as it depends on the market availability and response of the generators listed in Table 4. During this event the two market generators that were constrained on, rebid to zero market availability, necessitating the need for the power system security direction and increasing the amount of time the system remained insecure.

6. Recommendations

AEMO will ensure that on-line staff are regularly refreshed regarding the steps involved in the process of issuing directions to maintain power system security. This will be addressed through the AEMO on-line staff refresher training which is conducted on a regular basis.

AEMO will review its process for updating the network model and displays in the EMS system in light of the outcomes of this investigation. This action will be completed by the end of March 2010.