

POWER SYSTEM OPERATING INCIDENT REPORT – TRIP OF DAVENPORT – NORTHERN POWER STATION No.2 275 KV LINE AND NORTHERN POWER STATION UNITS 1 AND 2 ON 26 FEBRUARY 2013

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DATE: 16 April 2013

FINAL

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Abbreviations and Symbols

Abbreviation	Term
CB	Circuit Breaker
CT	Current Transformer
EMMS	Electricity Market Management System
EMS	Energy Management System
kV	Kilovolt
MW	Megawatt
NEM	National Electricity Market
NOS	Network Outage Scheduler
PSS	Power System Stabiliser
s	Seconds; (ms = milliseconds)

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Incident summary

Date and time of incident	26 February 2013 at 0423 hrs
Region of incident	South Australia
Affected regions	South Australia
Event type	TG – Loss of transmission elements and generating units
Primary cause	PS – Power Station internal issues
Impact	VS – Very significant
Associated reports	Nil

1 Introduction

At 0423 hrs on 26 February 2013 the Davenport - Northern Power Station No.2 275kV Transmission Line tripped disconnecting the Northern Power Station Unit 2. The Northern Power Station Unit 1 also tripped some seconds later. This event resulted in a generation reduction of approximately 470 MW. There was no interruption to supply of load arising from this incident.

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 Alinta Energy and ElectraNet. Data from AEMO's Energy Management System (EMS) and Electricity Market Management System (EMMS) has also been used in analysing the incident.

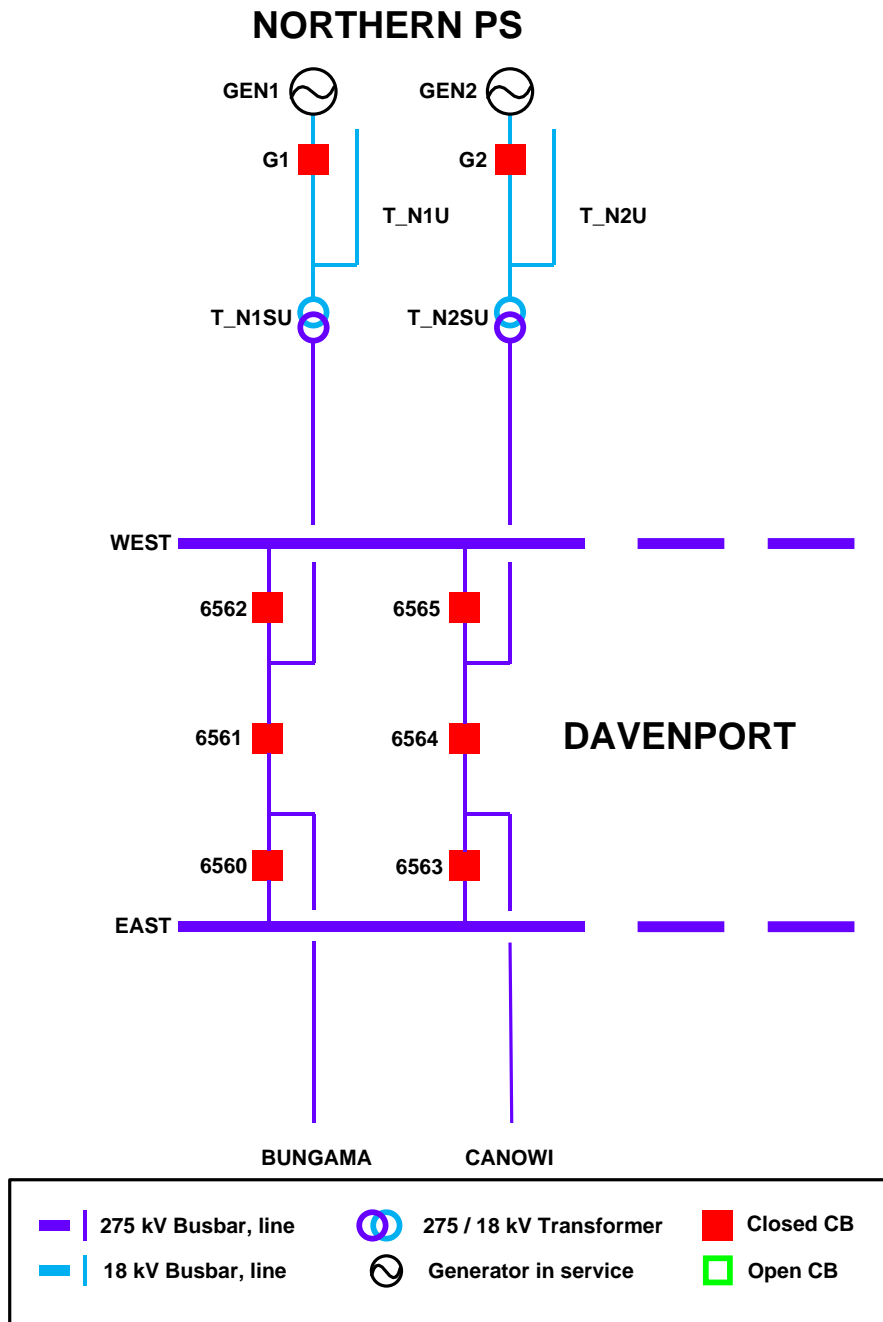
All references to time in this report are to National Electricity Market time (Australian Eastern Standard Time).

2 Pre-Contingent System Conditions

Prior to the event the Northern Power Station Unit 1 was generating 236 MW and the Northern Power Station Unit 2 was generating 232 MW.

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.

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



3 Summary of Events

At 0423 hrs a flashover on the Davenport – Northern Power Station No.2 275 kV Transmission Line caused the trip of the line and Northern Power Station Unit 2, initiated by the correct operation of the transmission line protection system. Northern Power Station Unit 1 also tripped approximately 10 seconds later, however the reason was not known at the time.

The key events that took place during this incident are summarised in Table 1.

Table 1: Summary of events

Time	Events / Comments
26/02/13 04:22:59	Davenport – Northern Power Station No.2 275 kV Transmission Line and Northern Power Station Unit 2 tripped.
04:23:09	Northern Power Station Unit 1 tripped.
05:14	ElectraNet advised of suspected flashover on the Davenport – Northern Power Station No.2 275 kV Transmission Line and submitted NOS entry for the line.
05:16	Market Notice No.41647 was issued informing of the non- credible contingency event.
05:20	Constraint sets S-DVNP_NP2 and F-S_NPS2_ZERO were invoked.
12:20	Northern Power Station Unit 1 returned to service.
14:17	275 kV CB 6565 at Davenport Substation was closed, energising the Davenport – Northern Power Station No.2 275 kV Transmission Line. 275 kV CB 6564 at Davenport Substation remained out of service due to leaking CT.
21:49	275 kV CB 6564 at Davenport Substation was closed after CT reparation.
28/02/13 10:00	Northern Power Station Unit 2 returned to service.
10:23	Market Notice No.41663 was issued reclassifying the trip of Northern Power Station Units 1 and 2 as credible contingency event ¹ .
10:25	AEMO invoked constraint sets F-S_NPS_N-2 and S-NPS_STN_N-2 ² to protect the system against the loss of both Northern Power Station Units.
21:38	Northern Power Station Unit 1 was taken out of service as per offers. Constraint sets F-S_NPS_N-2 and S-NPS_STN_N-2 were revoked at 2145 hrs.
01/03/13 09:33	Market Notice No.41694 was issued ceasing the reclassification of the trip of Northern Power Station Units 1 and 2 as credible contingency event due to the unavailability of Northern Power Station Units 1. The reclassification was not relevant under these conditions.
02/03/13 08:00	Northern Power Station Unit 1 was returned to service. Constraint sets F-S_NPS_N-2 and S-NPS_STN_N-2 were invoked again.
08:33	Market Notice No.41702 was issued, on return of Northern Power Station Unit 1 to service, reclassifying the trip of Northern Power Station Units 1 and 2 as a credible contingency event.
04/03/13 13:53	Market Notice No.41725 was issued ceasing the reclassification of the trip of Northern Power Station Units 1 and 2 as a credible contingency event after Alinta Energy informed AEMO that the cause for the trip of unit 1 was identified and corrected. Constraint sets F-S_NPS_N-2 and S-NPS_STN_N-2 were revoked at 1350 hrs.

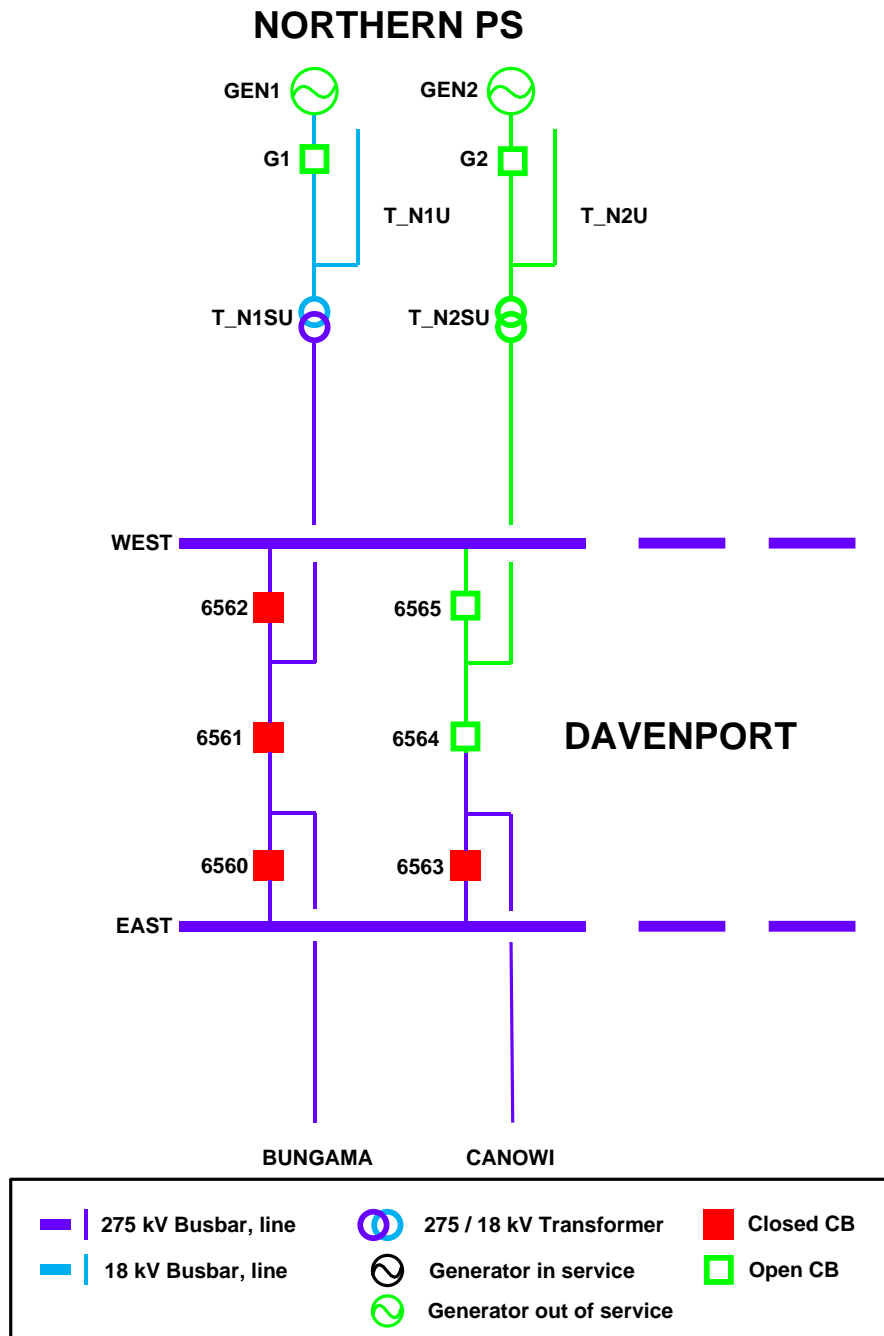
¹ Alinta Energy identified the cause for the trip of Northern Power Station unit 1 within 36 hours of the event, in the afternoon of 28 February, and the work completed to rectify the cause of the trip on 1 March. At the time that AEMO applied the reclassification, Alinta Energy was working in implementing the required solutions to the problem. AEMO received official notification from Alinta Energy that the problems was identified and fixed on 4 March 2013.

² F-S_NPS_N-2 covers FCAS requirements when the loss of both Northern Power stations units is declared credible contingency event.

S-NPS_STN_N-2 includes equations for transient stability limits, thermal limits and voltage stability limits when the loss of both Northern Power stations units is declared credible contingency event.

The status of the power system immediately after the incident is shown in Figure 2.

Figure 2 - Status of the power system immediately after the incident



4 Immediate Actions Taken

At 0514 hrs, ElectraNet informed AEMO of a flashover on the Davenport – Northern Power Station No.2 275 kV Transmission Line and submitted a NOS entry for the line.

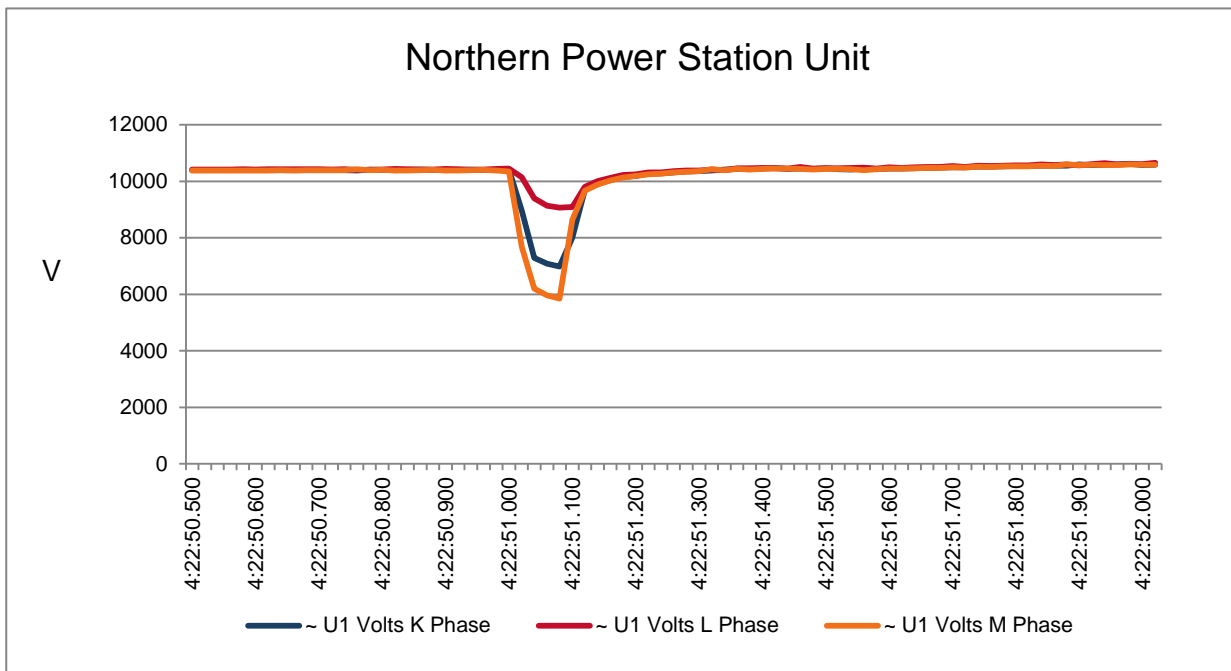
Market Notice No.41647 was issued by AEMO at 0516 hrs informing the market of the non-credible contingency event.

AEMO invoked constraint sets S-DVNP_NP2 and F-S_NPS2_ZERO at 0520 hrs.

5 Follow-up Actions

Further investigations from Alinta Energy have indicated that during the transmission fault the connection voltage on one phase at Northern Power Station appeared to have fallen to about 60% of the nominal value, also reducing the voltages of power station and unit auxiliary supplies. The fault was cleared in approximately 85 ms and the voltage returned to normal values. Northern Power Station Unit 1 tripped a few seconds later from a boiler trip caused by multiple coal feeder trips, which were subsequently revealed to have been initiated by false indication of low coal bunker levels. Figure 3 below shows the phase voltages at the Northern Power station Unit 1 terminals during the event.

Figure 3 – Northern Power Station Unit 1 phase voltages



Further investigations from Alinta Energy have revealed that the mentioned voltage depression initiated a 415 V phase failure relay³ in the Boiler Instrumentation Power Distribution Cubicles for Unit 1, triggering a change-over to the 415 V standby supply.

Additional time delay associated with the change back to the normal supply after the fault was cleared, continued to interrupt the 240 V supply to the external boiler instrumentation, in particular the Unit 1 coal bunker level switches. This voltage interruption resulted in a false indication of low coal bunker levels, tripping all coal feeders and their associated coal mills, and causing the subsequent boiler and unit trip.

The under-voltage relay for the 415 V supply changeover on Northern Power Station Unit 1 has been changed to provide an appropriate delay to ensure that the Boiler Instrument Controls Switchboard continues to be supplied from the normal 415 V supply under these significant network earth fault circumstances, albeit at a reduced voltage for a short period.

Alinta Energy has confirmed that the under-voltage relay settings on Unit 2 already included a time delay before switching over the standby supply, therefore the issue that caused the trip of Unit 1 on 26 February is no longer present on Unit 1 or Unit 2.

Primarily, the logic circuit supplying the low coal bunker level signal to the coal mill and feeder protection systems has been modified on both units to include an appropriate time delay to provide additional security.

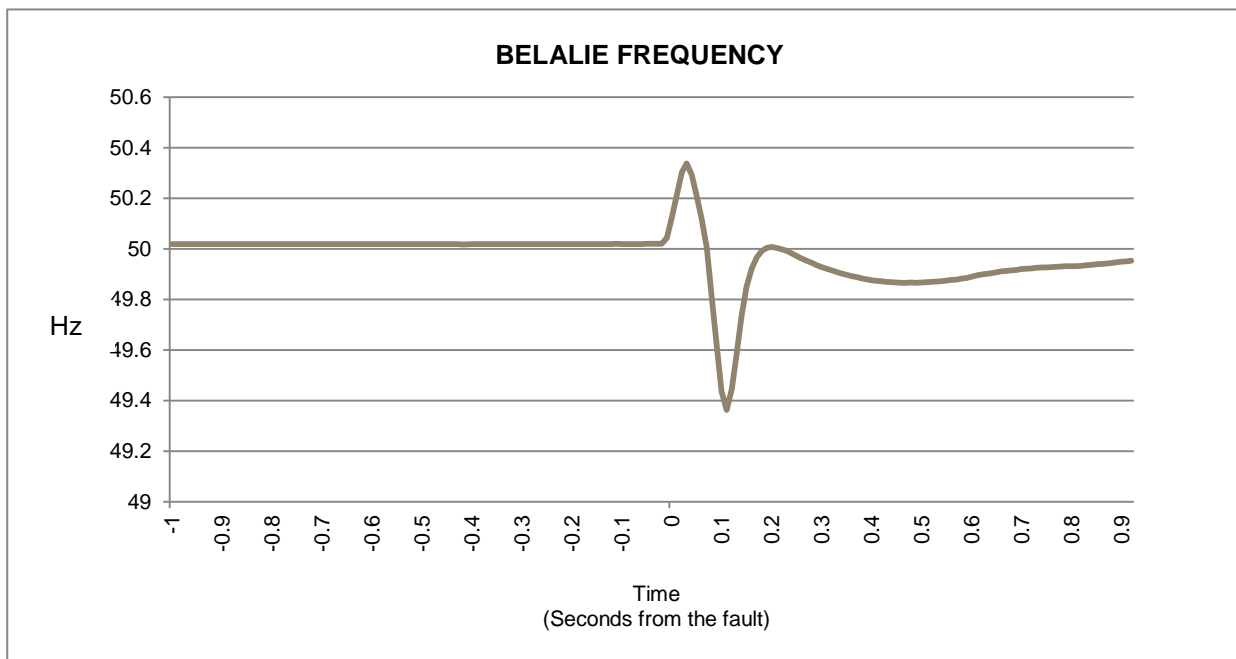
³ 415 V phase failure relay was initiated when the voltage dropped below 80 % of its nominal value.

6 Power System Security Assessment

Elsewhere in 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.

Figure 4 below shows the frequency measured at Belalie Substation (near Canowie) during the fault. This data was provided by ElectraNet.

Figure 4 – Frequency at Belalie Substation



Having both Northern Power Station Units out of service can severely impact the South Australia import capability depending on the number of units on line with Power System Stabiliser (PSS) in service. AEMO invoked the appropriate constraints to maintain system security at all times.

Northern Power Station Unit 1 returned to service at 1220 hrs on 26 February

Northern Power Station Unit 2 returned to service on 28 February at 1000 hrs. At 1023 hrs, when Unit 2 reached stable operation, AEMO issued Market Notice No.41663 reclassifying the loss of both Northern Power Station units as a credible contingency event. AEMO also invoked constraint sets F-S_NPS_N-2 and S-NPS_STN_N-2 at 10:25 hrs.

As normal practice, AEMO reclassifies the loss of the multiple elements as credible contingency event at the moment of returning the affected elements to service if the cause for the multiple event has not been identified and corrected.

According to the offers, Northern Power Station Unit 1 was taken out of service from 2138 hrs on 28 February until 02 March at 08:00 hrs. During this period AEMO revoked the constraints sets F-S_NPS_N-2 and S-NPS_STN_N-2 because the risk of losing both units was not applicable.

Constraint sets F-S_NPS_N-2 and S-NPS_STN_N-2 were invoked again at 0810 hrs on 02 March 2013 on return of Northern Power Station Unit 1 to service.

On 04 March 2013, Alinta Energy informed AEMO of the identification and correction of the cause for the trip of Northern Power Station Unit 1 initiated for the fault occurred on Davenport – Northern Power Station No. 2 275 kV Transmission Line. Based on that information AEMO issued Market Notice No.41725 at 13:53 hrs, ceasing the reclassification of the simultaneous trip of both Northern Power Station units as a credible contingency event. Constraint sets F-S_NPS_N-2 and S-NPS_STN_N-2 were revoked at the same time.

7 Conclusions

The trip of Davenport – Northern Power Station No.2 275 kV Transmission Line and the Northern Power Station Unit 2 was caused by a flashover on the Davenport – Northern Power Station No.2 275 kV Transmission Line.

Northern Power Station Unit 1 tripped some seconds later from a multiple coal feeder trip which was initiated by a false low coal bunker level signal.

The voltage depression caused by the 275 kV fault, initiated a 415 V phase failure relay in the Boiler Instrumentation Power Distribution Cubicles power supply, instigating a change-over operation to the standby 415 V supply. The delay in the change-over interrupted the 240 V supply to the external boiler instrumentation, in particular the Northern Power Station Unit 1 coal bunker level switches, resulting in the false low coal bunker level signal.

Alinta Energy has replaced the under-voltage relay for the 415 V supply change-over on Northern Power Station Unit 1 and has modified the logic circuit supplying the low coal bunker level signal to the coal mill and feeder protection systems on both units to include an appropriate time delay to provide additional security.

Alinta Energy has confirmed that the under-voltage relay settings on Unit 2 already included a time delay before switching over the standby supply, therefore the issue that caused the trip of Unit 1 on 26 February is no longer present on Unit 1 or Unit 2.

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

AEMO correctly applied the criteria published in section 12 of its Power System Security Guidelines in reclassifying the trip of both Northern Power Stations units and Davenport - Northern Power Stations No.2 275 kV Transmission Line as a credible contingency event.

8 Recommendations

There are no recommendations arising from this incident.