POWER SYSTEM OPERATING INCIDENT REPORT – LOSS OF MULTIPLE TRANSMISSION ELEMENTS ON 22 AND 23 OCTOBER 2012 IN QUEENSLAND REGION.

PREPARED BY: Systems Performance and Commercial

DATE: 18 January 2013

FINAL

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Abbreviations and Symbols

Abbreviation	Term
CB	Circuit Breaker
MW	Megawatt
kV	Kilovolts
Km	Kilometer
NOS	Network Outage Scheduler
Indji Watch	System used to monitor bushfires

Contents

Incident summary

Date and time of incident	22 October 2012 at 18:36 hrs 23 October 2012 at 12:17 hrs
Region of incident	QLD
Affected regions	QLD
Event type	TT – Loss of Multiple transmission elements BB – Busbar trip
Primary cause	TE – Transmission Equipment failure
Impact	VS - Very Significant
Associated reports	NIL

1 Introduction

This report covers two different but related events that occurred on 22 and 23 October 2012 in South Queensland.

- **22 October 2012: Loss of 805 Greenbank – Swanbank E and 806 Greenbank – Swanbank B 275kV Transmission Lines and runback of Swanbank E generating unit.**

  At 18:36 hrs, 805 Greenbank – Swanbank E and 806 Greenbank – Swanbank B 275kV Transmission lines tripped simultaneously.

  At 18:36 hrs, Swanbank E generating unit initiated a runback from 346 MW and subsequently disconnected from the network.

- **23 October 2012: Loss of 8844 Greenbank – Abermain and 8821 Greenbank – Blackwall 275kV Transmission Lines and trip of Greenbank No. 2 275kV busbar.**

  At 12:27 hrs, (with 275kV lines 805 and 806 still out of service), 8844 Greenbank – Abermain and 8821 Greenbank – Blackwall 275kV Transmission lines tripped. Simultaneously the Greenbank No. 2 275kV busbar also tripped.

There was no loss of supply as result of these events, however approximately 240 MW of load reduction was observed in South East Queensland during the event on 22 October and approximately 275 MW during the event on 23 October 2012.

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 Powerlink and Stanwell Corporation Limited. 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 Event on 22 October 2012

2.1 Pre-Contingent System Conditions

At 14:35 hrs, 805 Greenbank – Swanbank E 275kV Transmission line tripped and successfully auto reclosed. Powerlink reported an A phase fault 10 km from Swanbank but no cause was identified at that time.

At 17:12 hrs the same line tripped again to lock out. The line was manually closed at 17:32 hrs. No reason for this trip was identified.

At the time of the above events no bushfires or lightning were reported close to these lines.

Notification from Indji Watch was received by AEMO on 21 October 2012 at 14:28 hrs indicating fires detected in the vicinity of 20 lines in Queensland including lines 805 and 806. However no new notifications were received around the time of the events on 22 October[1].

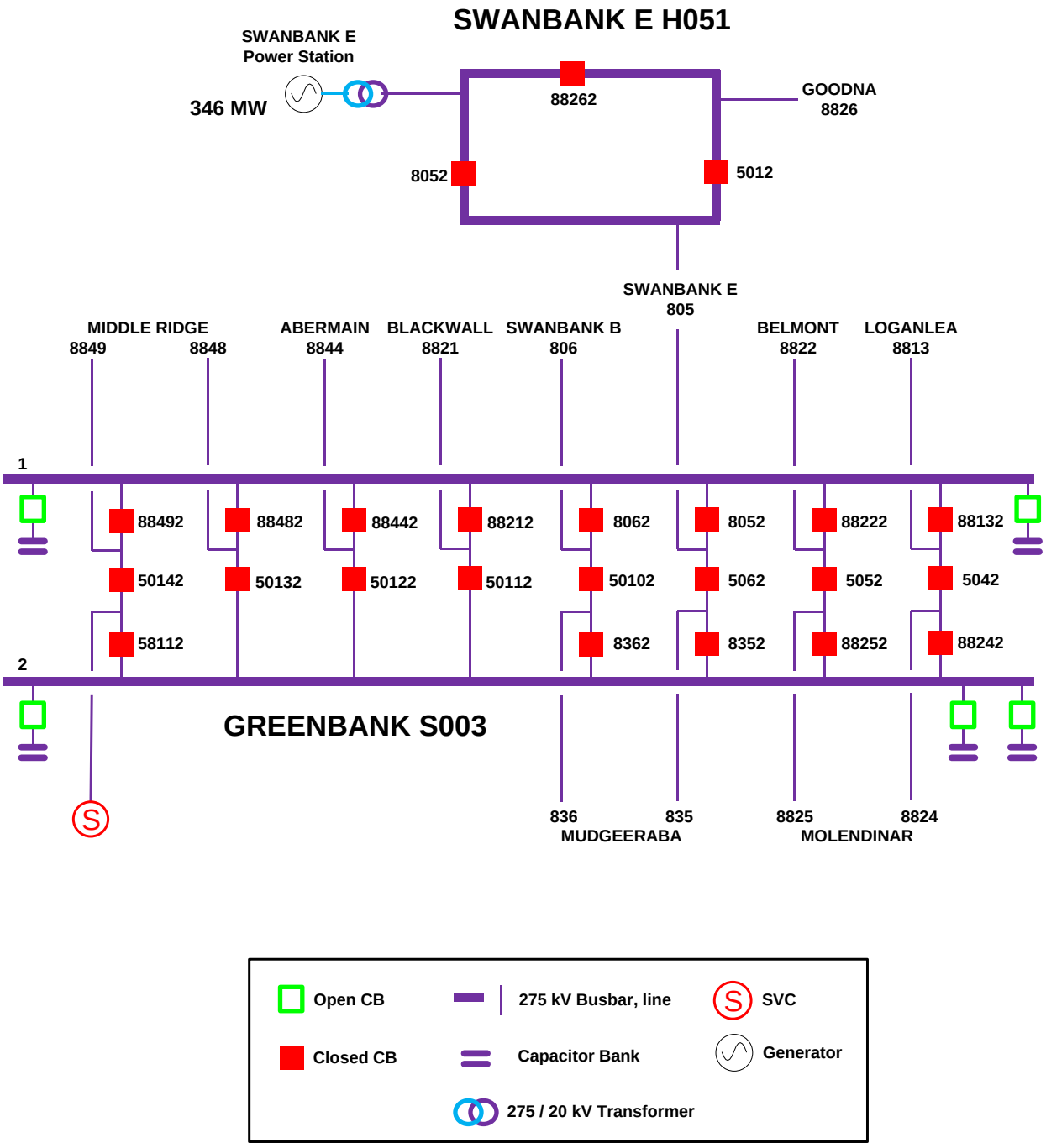
At 18:14 hrs Powerlink advised AEMO of fires in the vicinity of the 805 and 806 lines, but due to difficulties on gaining access to the area the information available at that time was limited. Powerlink indicated that more information would be provided when available.

[1] The Indji Watch system relies solely on satellite signals for Queensland monitoring. The satellites can fail to detect fires due to a number of reasons, including cloud cover, dense canopy or low intensity of the fire at the time the satellite passed overhead.

The status of the power system prior to the incident on 22 October 2012 at 18:36 hrs is shown in Figure 1.

For clarity only equipment relevant to these incidents has been included in the diagrams.

Figure 1 - Status of the power system prior to the incident on 22 October 2012



2.2 Summary of Events

At 14:35 hrs , 805 Greenbank – Swanbank E 275kV line tripped, and successfully auto reclosed. Powerlink reported an A phase fault 10 km from Swanbank but no cause was identified at that time.

At 17:12 hrs the same line tripped again to lock out. No reason for the trip was identified. The line was returned to service at 17:32 hrs.

At 18:14 hrs Powerlink advised of fires in the vicinity to both 805 and 806 275kV lines.

At around 18:36:45 hrs 805 Greenbank – Swanbank E and 806 Greenbank – Swanbank B 275kV lines tripped. 805 Greenbank – Swanbank E 275kV transmission line auto reclosed at 18:36:55 hrs, but tripped again to lock out at 18:37:08 hrs. In addition to this, Swanbank E generating unit initiated a runback from 346 MW. The unit was eventually shut down at 18:40 hrs.

Although AEMO had been advised of fires in the area AEMO had not completed an assessment to determine if re-classification was warranted prior to both lines tripping. It should be noted that even if a re-classification had occurred no constraints were required to be invoked to maintain power system security.

AEMO issued Market Notice No.40080 at 19:15 hrs, informing the participants about the non-credible event.

Stanwell Corporation advised AEMO that Swanbank E generating unit shut down due to cooling system failure and indicated a similar trip would most likely occur if there was a similar system disturbance.

Market Notice No.40082 was issue at 21:02 hrs reclassifying the loss of 805 Greenbank – Swanbank E, 806 Greenbank – Swanbank B 275 kV transmission lines and Swanbank E generating unit as credible contingency.

Powerlink confirmed that no load was lost during the event, but a reduction of approximately 240 MW was observed in South East Queensland.

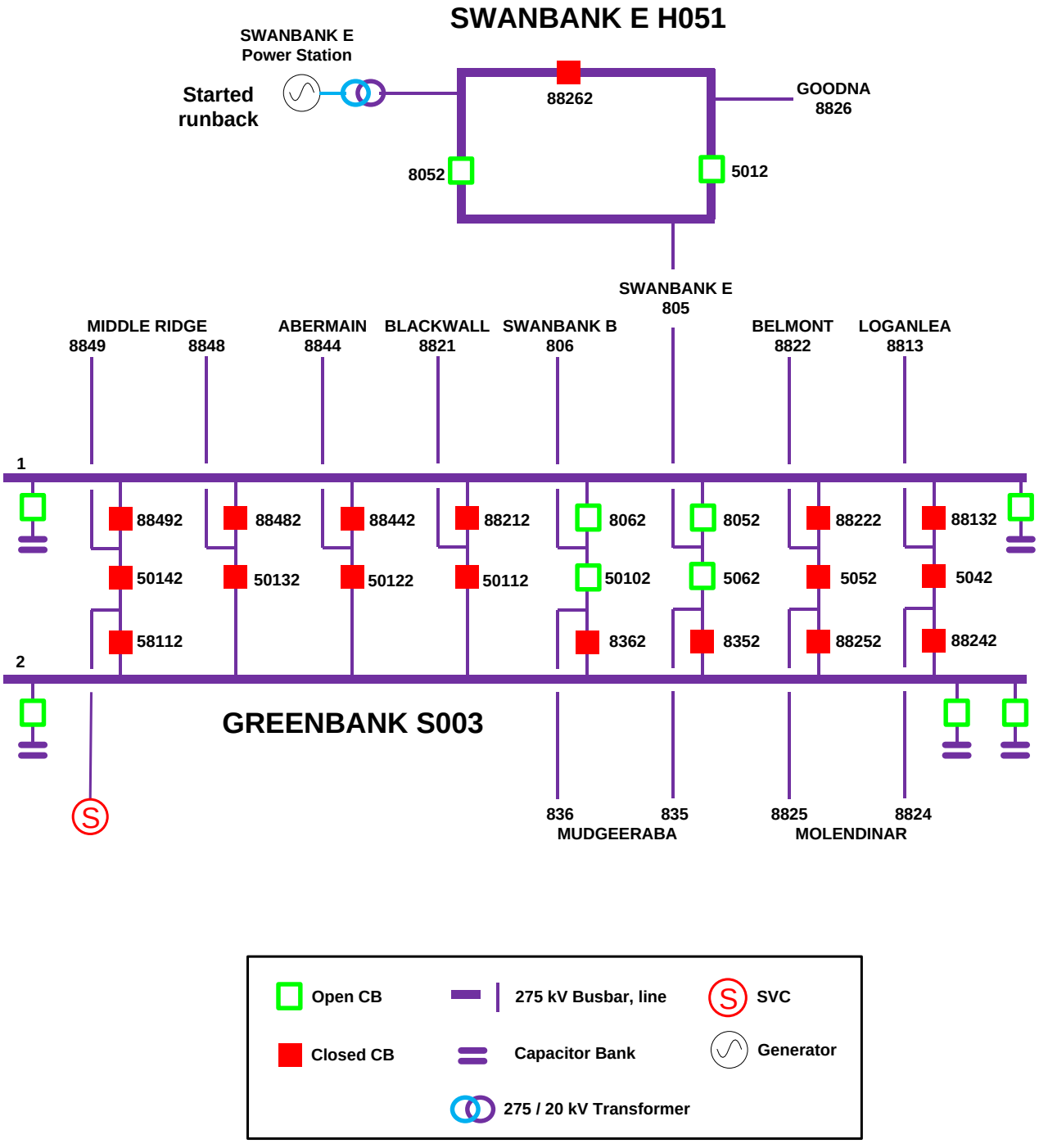
The key events that took place during the incident on 22 October are summarised in Table 1 below:

Table 1: Summary of events – 22 October 2012

Date/Time	Events	Comments
14:35:32	805 Greenbank – Swanbank E 275kV line tripped and successfully auto reclosed.	No bushfires or lightning detected in the vicinity of these lines. Powerlink reported an A phase fault 10 km from Swanbank but no cause was identified at that time.
17:12:18	805 Greenbank – Swanbank E 275kV line tripped to lock out.	No bushfires or lightning indicated detected in the vicinity of these lines. No reason for this trip was identified.
17:32:20	805 Greenbank – Swanbank E 275kV line returned to service	
18:14	Powerlink informed AEMO of bushfires in the vicinity of 805 and 806 lines.	
18:36:44	806 Greenbank – Swanbank B 275kV line tripped.	
18:36:45	805 Greenbank – Swanbank E 275kV line tripped, auto reclosed and tripped again at 18:37:08 hrs.	
18:36:45	Swanbank E generating unit runback initiated	From 346 MW, due to cooling system failure.
18:40:00	Swanbank E generating unit shuts down	
19:15	Market Notice No.40080 issued informing about the non-credible event.	
21:02	Market Notice No.40082 issued reclassifying the loss of 805 Greenbank – Swanbank E, 806 Greenbank – Swanbank B 275kV lines and Swanbank E generating unit as credible contingency.	

The status of the power system immediately after the event on 22 October is shown in Figure 2.

Figure 2 - Status of the power system immediately after the event on 22 October 2012



2.3 Immediate Actions Taken

AEMO issued Market Notice No.40080 at 19:15 hrs informing about the non-credible event and Market Notice No.40082 at 21:02 hrs reclassifying the loss of 805 Greenbank – Swanbank E, 806 Greenbank – Swanbank B 275kV lines and Swanbank E generating unit as credible contingency.

Powerlink advised that both lines would remain out of service until the fires had cleared the area of the lines.

No additional constraints or actions were required to keep the system in a secure state considering the new topology and conditions.

3 Event on 23 October 2012

3.1 Pre-Contingent System Conditions

At 10:48 hrs Powerlink informed AEMO that 8844 Greenbank – Abermain and 8821 Greenbank – Blackwall 275kV Transmission lines were at risk of tripping due to bushfires.

AEMO assessed the need for the reclassification of these lines due to the bushfire according to the process described in AEMO's Power System Security Guidelines (SO_OP_3715), obtaining a weighting value of 20.

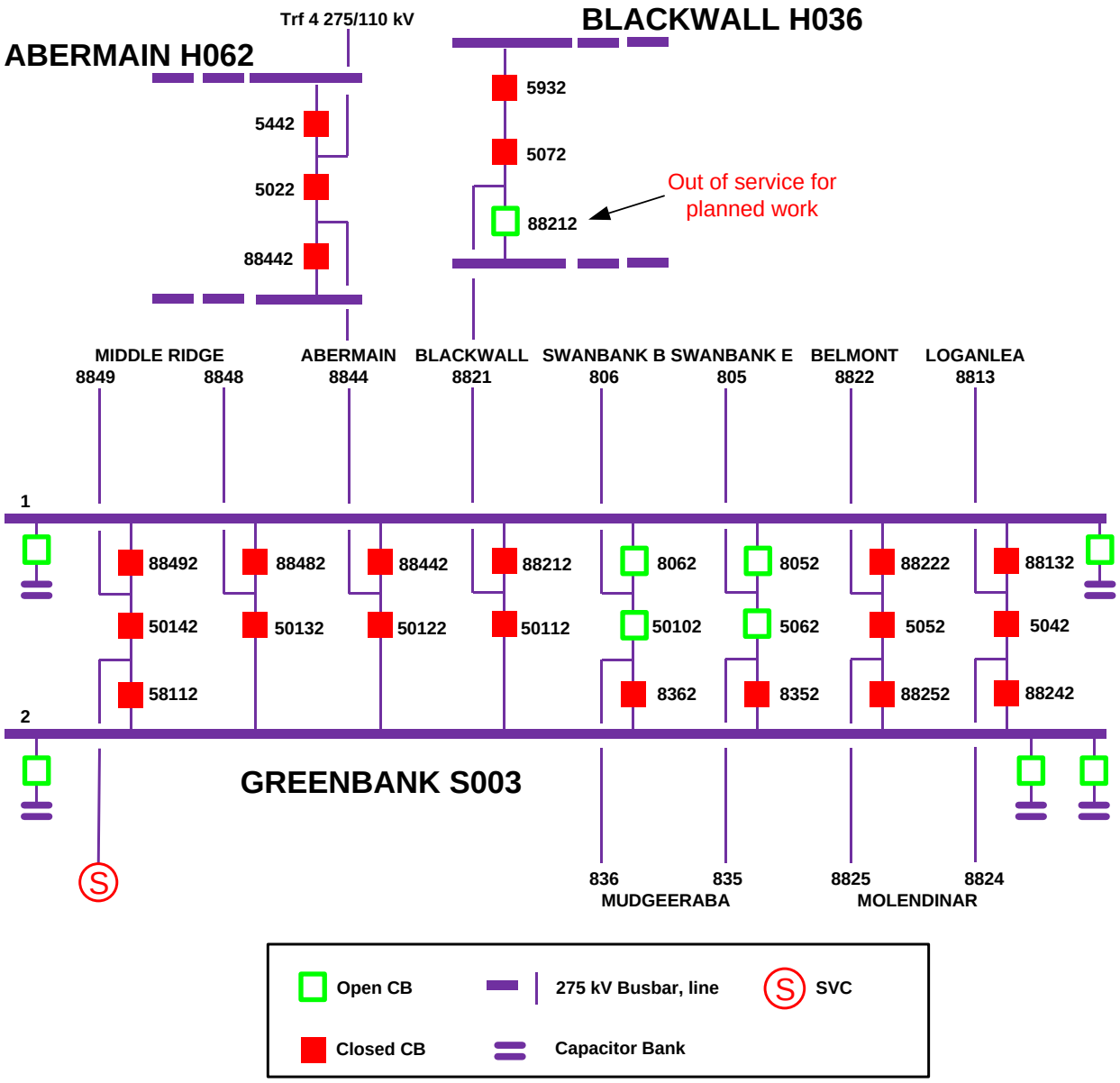
AEMO issued Market Notice No.40088 at 11:07 hrs reclassifying the loss of 8844 Greenbank – Abermain and 8821 Greenbank – Blackwall 275kV transmission lines as credible event due to bushfires.

At 11:07:06 hrs, 8821 Greenbank – Blackwall 275kV Transmission line tripped due to fire/smoke in the area. The line was returned to service at 11:08:57 hrs.

Figure 3 represents the status of the power system prior to the incident on 23 October at 12:17 hrs. CB 88212 at Blackwall was taken out of service from 09:58 to 16:26 hrs on 23 October due to a planned outage, and 275kV lines 805 and 806 remained out of service after the events on 22 October.

For clarity only equipment relevant to these incidents has been included in the diagrams.

Figure 3 - Status of the power system prior to the incident on 23 October 2012



3.2 Summary of Events

At 10:48 hrs, Powerlink advised AEMO that 8844 Greenbank – Abermain and 8821 Greenbank – Blackwall 275kV transmission lines were at risk of tripping due to bushfires. Based on that information, AEMO assessed the situation and reclassified the loss of 8844 Greenbank – Abermain and 8821 Greenbank – Blackwall 275kV transmission lines as credible contingency. Market Notice No.40088 was issued at 11:07 hrs.

The 8821 Greenbank – Blackwall 275kV transmission line tripped at 11:07:06 hrs due to fire/smoke in the area and was returned to service at 11:08:57 hrs.

At 12:17:31 hrs, the 8844 Greenbank - Abermain 275kV transmission line tripped but 275 kV CB 50122 at Greenbank failed to open causing its breaker fail protection to operate tripping Greenbank No 2 275kV busbar. As the CBs associated to 805 Greenbank – Swanbank E and 806 Greenbank –Swanbank B 275kV lines remained open after the events on 22 October, this event also offloaded 835 and 836 Greenbank - Mudgeeraba 275kV transmission lines.

275kV CBs 88442 at Abermain and Greenbank auto-reclosed and restored the 8844 Greenbank – Abermain line to service. The reclosing of CB 88442 at Greenbank also re-energised busbar 2 at Greenbank via CB 50122 which had failed to open.

At 12:17:37 hrs the 8821 Greenbank – Blackwall 275kV transmission line tripped due to bushfires and auto-reclosed at the Greenbank end only as CB 88212 at Blackwall was isolated for planned work. CB 5072 at Blackwall was closed at 12:19hrs to return the line to service.

Powerlink confirmed that no load was lost during the event, but a reduction of approximately 275 MW was observed in South East Queensland

The key events that took place during the incident on 23 October are summarised in Table 2 below:

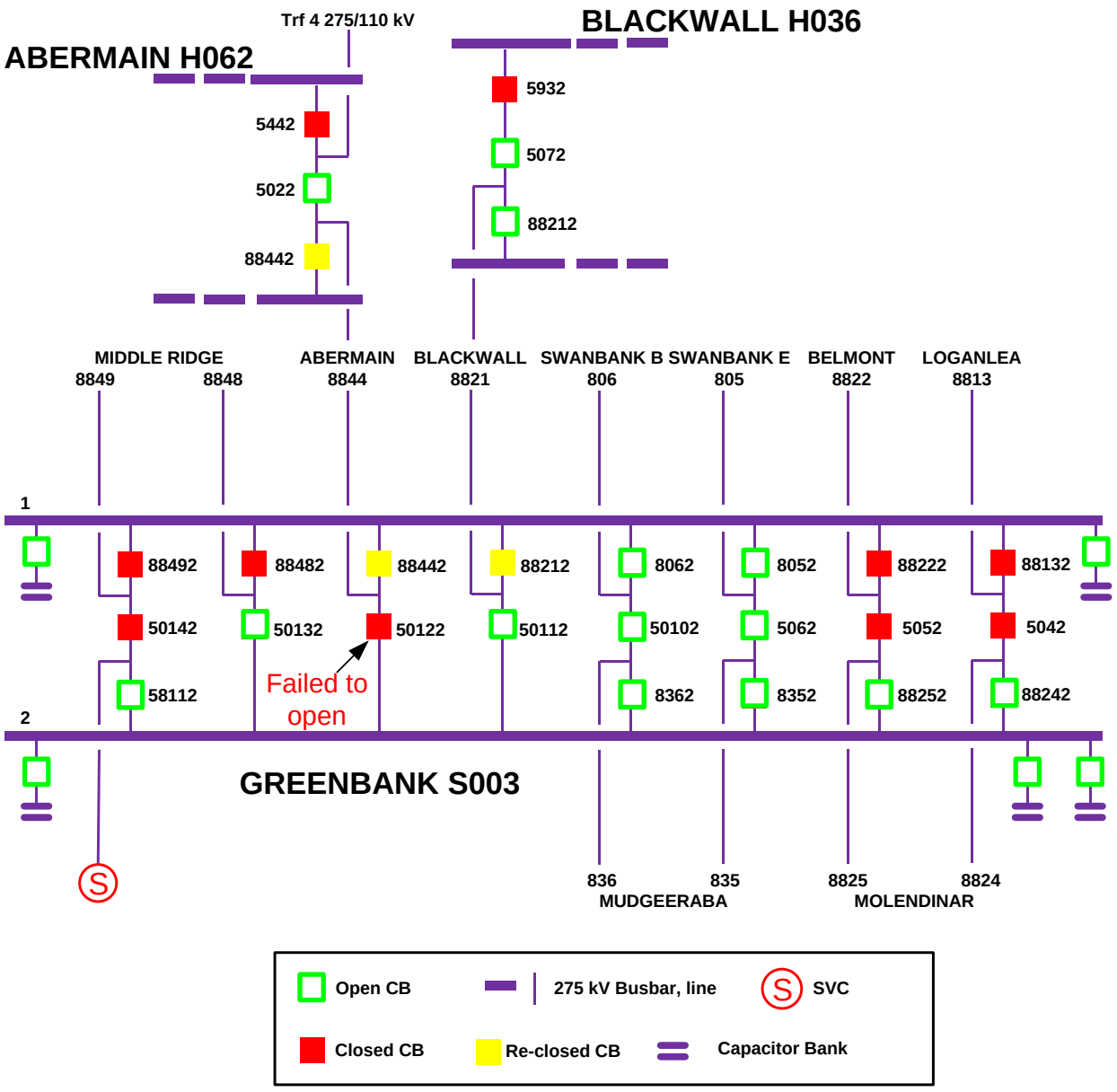
Table 2: Summary of events – 23 October 2012

Time	Events	Comments
10:48	Powerlink informed that 8844 Greenbank – Abermain and 8821 Greenbank – Blackwall 275kV lines were at risk of tripping due to bushfires.	
11:07	Market Notice No.40088 issued reclassifying the loss of 8821 Greenbank – Blackwall and 8844 Greenbank - Abermain 275kV lines as a credible contingency.	
11:07:06	8821 Greenbank – Blackwall 275kV line tripped	Bushfire reported
11:08:57	8821 Greenbank – Blackwall 275kV line returned to service	
12:17:31	8844 Greenbank – Abermain 275kV line tripped. 275kV CB 50122 at Greenbank failed to open causing Greenbank No. 2 275kV busbar to trip (CBs 88442, 88242, 88252, 8352, 8362, 50112, 50132, 58112)	Bushfire reported This offloaded 835 and 836 Greenbank – Mudgeeraba lines.
12:17:37	8821 Greenbank – Blackwall 275kV line tripped	Bushfire reported
12:17:42	CB 88442 at Abermain auto reclose	Line re-energised
12:17:42	CB 88212 at Greenbank auto reclose	Line re-energised
12:17:43	CB 88442 at Greenbank auto reclose	Line restored to service. Greenbank busbar 2 re-energised via CB 50122 that failed to open.

12:19:13	8821 Greenbank – Blackwall 275kV line loaded	CB 5072 at Blackwall closed (CB 88212 at Greenbank already reclosed since 12:17:43 hrs)
12:20:57	CB 50112 at Greenbank closed	
12:22:46	CB 8352 at Greenbank closed	835 Greenbank – Mudgeeraba line returned to service
12:23:48	CB 8362 at Greenbank closed	836 Greenbank – Mudgeeraba line returned to service
12:26:26	Greenbank No. 2 275kV busbar normalised (CBs 88242, 88252, 50132, 58112 closed)	Faulty CB 50122 at Greenbank remained closed due to inability to open it or isolate it remotely.
12:31:25	8821 Greenbank – Blackwall 275kV line tripped	Bushfire reported
12:35	805 Greenbank – Swanbank E and 806 Greenbank – Swanbank B lines were isolated and related CBs at Greenbank closed	This to prevent the loss of 835 and 836 Greenbank – Mudgeeraba lines for another CB Fail operation on CB 50122 for loss of 8844 Greenbank – Abermain 275kV line.
12:47	Market Notice No.40090 issued informing participants about the non-credible event, affecting 8844 Greenbank – Abermain 275kV line, Greenbank No 2 275kV busbar and offloading of 835 and 836 Greenbank – Mudgeeraba lines.	
13:00	Market Notice No.40091 issued reclassifying the loss of 8844 Greenbank - Abermain 275kV line and No 2 275kV busbar at Greenbank as credible contingency due to issues with CB 50122 at Greenbank.	
14:01:46	8821 Greenbank – Blackwall line returned to service.	
15:39	Market Notice No.40092 issued ceasing the reclassification of 8844 Greenbank - Abermain 275kV line and No 2 275kV busbar at Greenbank as credible contingency.	CB 50122 at Greenbank isolated
15:44	Market Notice No.40093 issued ceasing the reclassification of 8844 Greenbank - Abermain and 8821 Greenbank - Blackwall lines as credible contingency.	Bushfires have passed the easement of the lines
15:50:35	806 Greenbank – Swanbank B and 805 Greenbank – Swanbank E 275kV lines returned to service	
15:59	Market Notice No.40094 issued ceasing the reclassification of 806 Greenbank – Swanbank B, 805 Greenbank – Swanbank E lines and Swanbank E generating unit as credible contingency.	Bushfires have passed the easement of the lines. **Note: The reclassification of a non credible contingency event for the trip of lines 805, 806 and Swanbank E as credible contingency remains anytime lines 805 and 806 are reclassified.**

Figure 4 shows the condition of the power system immediately after the event on 23 October.

Figure 4 - Status of the power system immediately after the event on 23 October 2012



3.3 Immediate Actions Taken

The reclosing of 275kV CB 88442 at Greenbank resulted in the re-energisation of Greenbank busbar No. 2 275 kV via CB 50122 that had failed to open. As Powerlink were unable to open or isolate this CB remotely, Powerlink and AEMO agreed to fully restore the busbar to enable the Greenbank – Mudgeeraba lines to be returned to service prior to crews arriving at Greenbank to isolate CB 50122. This was done with the knowledge that a further fault on the 8844 Greenbank – Abermain line may result in a further loss of the Greenbank 2 busbar.

275kV CB 50112 at Greenbank was reclosed and 835 and 836 Greenbank – Mudgeeraba Transmission lines returned to service at 12:22:46 hrs and 12:23:48 hrs respectively.

At 12:26 hrs, No 2 275kV busbar at Greenbank was normalised (remaining CBs closed).

805 Greenbank – Swanbank E and 806 Greenbank – Swanbank B 275kV Transmission lines were isolated and their bays closed at Greenbank at 12:36 hrs to avoid losing 835 and 836 Greenbank –

Mudgeeraba 275kV Transmission lines for another CB Fail operation on CB 50122 for loss of 8844 Greenbank – Abermain 275kV line.

To manage the possibility of CB 50122 failing to trip, AEMO reclassified the loss of the 8844 Greenbank - Abermain 275kV line and No 2 275kV busbar at Greenbank as credible contingency. Market Notice No.40091 was issued 13:00 hrs.

No additional constraints or actions were required to keep the system in a secure state considering the new conditions.

At 15:39 hrs AEMO issued Market Notice No.40092 ceasing the reclassification of 8844 Greenbank - Abermain 275kV line and No 2 275kV busbar at Greenbank as credible contingency, after Powerlink isolated CB 50122 at Greenbank.

4 Follow-up Actions

4.1 Swanbank E

Following investigations by Stanwell Corporation it was determined that the cause for the runback of the unit on 22 October was associated with the multiple disturbances on that day.

At 18:36:44 hrs the first disturbance caused an under voltage on the unit auxiliary 6.6kV and 415V switchboards. This disturbance did not result in any control system response and the unit rode through the fault successfully.

At 18:36:45 hrs the second system disturbance also caused an under voltage on unit auxiliary 6.6kV and 415V switchboard. When the under voltage occurred the control system executed a changeover to the standby plant and a controlled shut down of the 6.6kV plant motors. The 6.6kV plant motors restarted when the system voltage recovered. The unit and all auxiliary plant and equipment remained in service following this disturbance.

At 18:37:07 hrs a third disturbance occurred on the local 275kV transmission system. This system disturbance also caused an under voltage on the unit auxiliary 6.6kV and 415V switchboards and the control system executed a changeover to the standby plant and controlled shut down and restart of the 6.6kV plant motors.

On this occasion the motor thermal protection relay on both the 6.6kV main cooling water pump motors inhibited their restart. The motor protection thermal limit for each motor had been exceeded during the previous disturbances and subsequent motor restarts. The short time between successive system disturbances was insufficient to enable the thermal state of the motor to reduce to a level to permit a restart of the motors. The thermal state reset to its normal limit within 4 minutes of the second event.

With the main cooling water pumps off and a subsequent lack of cooling water flow to the unit's steam condenser, the control system initiated a trip of the steam turbine. The plant operator subsequently initiated a controlled shut down of the gas turbine in response to the loss of steam turbine, disconnecting the unit at 18:40 hrs.

Stanwell Corporation has informed AEMO of a non-compliance of Swanbank E generating unit with its Generator Performance Standards and will review the auxiliary plant under voltage protection of the unit. Any required modification is expected to be completed by 31 May 2013.

4.1.1 Reclassification

On 22 October AEMO reclassified the loss of 805 Greenbank – Swanbank E, 806 Greenbank – Swanbank B 275kV transmission lines and Swanbank E generating unit as credible contingency according to the information available at that time. Further investigations indicated that the runback of Swanbank E generating unit was not strictly linked to the loss of both 805 and 806 lines, but with the occurrence of multiple faults in a short time period causing under voltage on the unit auxiliary 6.6kV and 415V switchboards at Swanbank E and multiple restarts of the 6.6kV plant motors.

However AEMO still considers that anytime the 805 and 806 lines are reclassified due to bushfires there is an increased risk of multiple faults that can affect the Swanbank E generating unit operation. Accordingly the reclassification will remain in place until modifications are carried out in the under voltage control system logic of Swanbank E generating unit.

4.2 CB 50122 at Greenbank

NOS entry Q12S/2368 was submitted on 23 October to repair CB 50122. A faulty operating mechanism was identified and replaced. The CB was returned to service on 26 October 2012.

5 Power System Security Assessment

AEMO and Powerlink performed continuous assessments of the conditions to determine the necessity of reclassification of multiple events and to ensure the secure operation of the power system at all times.

No additional constraints or special actions were needed to keep the system in a secure state.

6 Conclusions

- Bushfires were determined as the cause for the trips of the 806 Greenbank – Swanbank B and 805 Greenbank – Swanbank E 275kV transmission lines on 22 October 2012 as well as to the trips of 8844 Greenbank – Abermain and 8821 Greenbank – Blackwall 275kV transmission lines on 23 October 2012.
- The trip of Greenbank 275kV No 2 busbar was due to operation of circuit breaker fail protection when CB 50122 at Greenbank failed to open on presence of a fault on the 8844 Greenbank – Abermain 275kV transmission line. The CB was repaired and returned to service on 26 October 2012.
- According to the information provided by Powerlink, the CB fail protection on CB50122 at Greenbank operated properly and within the times indicated in the National Electricity Rules for this type of events.
- Swanbank E runback on 22 October was due to shut down of main cooling water pump motors after three faults on 805 Greenbank – Swanbank E and 806 Greenbank – Swanbank B 275kV transmission lines in a period of thirty seconds. With the main cooling water pump motors out of service, the control system initiated a trip of the steam turbine and subsequently the plant operator initiated a controlled shut down of the gas turbine in response to the loss of steam turbine.
- The reclassification of a non credible contingency event for the trip of 805 Greenbank – Swanbank E, 806 Greenbank – Swanbank B 275kV transmission lines and the Swanbank E generating unit as credible, remains anytime 805 Greenbank – Swanbank E and 806 Greenbank – Swanbank B 275kV lines are reclassified due to bushfires until modifications in the under voltage control system logic of Swanbank E unit are implemented. This is expected by 31 May 2013.
- While AEMO aims to assess the requirements for reclassification as soon as possible, the multiple contingency event at 18:36hrs on 22 October occurred prior to the completion of the assessment process.
- AEMO correctly applied the criteria published in its Power System Security Guidelines in assessing the circumstances for reclassifying the incidents occurred on 22 and 23 October 2012. The reclassifications were cancelled once the fires passed the easement of the lines and the assessment for bushfires indicated low risk.

7 Recommendation

Stanwell Corporation will review the under voltage control system logic for Swanbank E generating unit auxiliary plant and will implement any required modification by the 31 May 2013 to ensure compliance with its Generator Performance Standards.