
New South Wales bushfires on 15 April 2018

February 2019

Reviewable Operating Incident Report under the
National Electricity Rules

INCIDENT CLASSIFICATIONS

Classification	Detail
Time and date of incident	Between 0752 hrs and 1130 hrs on 15 April 2018
Region of incident	New South Wales
Affected regions	New South Wales
Event type	Bushfires
Generation impact	No generator was disconnected or limited as a result of this incident
Customer load impact	No customer load was disconnected as a result of either incident
Associated reports	Nil

ABBREVIATIONS

Abbreviation	Term
AEMO	Australian Energy Market Operator
CB	Circuit Breaker
kV	Kilovolt
MW	Megawatt
NER	National Electricity Rules

Important notice

PURPOSE

AEMO has prepared this report in accordance with clause 4.8.15(c) of the National Electricity Rules, using information available as at the date of publication, unless otherwise specified.

DISCLAIMER

AEMO has made every effort to ensure the quality of the information in this report but cannot guarantee its accuracy or completeness. Any views expressed in this report are those of AEMO unless otherwise stated, and may be based on information given to AEMO by other persons.

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1. Overview

This report relates to a series of multiple¹ and non-credible contingencies that occurred due to bushfires in the Holsworthy area near the Sydney South substation in New South Wales on Sunday 15 April 2018. The bushfires impacted the following transmission elements:

- 11 Dapto – Sydney South 330 kV transmission line (11 line).
- 12 Sydney South – Liverpool 330 kV transmission line (12 line).
- 76 Wallerawang – Sydney South 330 kV transmission line (76 line).
- 78 Ingleburn – Sydney South 330 kV transmission line (78 line).
- 13 Sydney South – Kemps Creek 330 kV transmission line (13 line).
- Sydney West No. 1 Static var compensator (1 SVC).

No generation or customer load was lost as a result of the incident.

As this was a reviewable operating incident, AEMO is required to assess power system security over the course of each incident and assess the adequacy of the provision and response of facilities and services and the appropriateness of actions taken to restore or maintain power system security². AEMO has concluded that:

1. A series of non-credible and multiple contingency events occurred due to faults caused by bushfires.
2. AEMO made appropriate decisions in relation to reclassification of potential non-credible contingencies. These decisions were in accordance with the Power System Security Guidelines procedure.
3. In response to these incidents, AEMO and the Power System Security Working Group (PSSWG) are reviewing the guidelines for reclassification where multiple dual circuit lines are involved.
4. The outage of the 1 SVC was due to the loss of its 415 V cooling supply. A faulty change-over switch has been replaced.
5. The power system remained in a secure operating state during these incidents. Post event analysis also shows the power system would have remained in a satisfactory operating state if any four of the five lines that traverse the bushfire area to supply the Sydney South substation had been out of service at the same time. If all five lines had been out of service simultaneously the power system would not have been in a satisfactory operating state with voltage collapse in the 132kV network in the Sydney South area.
6. AEMO did not fully advise the market of all non-credible contingencies that occurred and when constraints had been invoked.

This report is prepared in accordance with clause 4.8.15(c) of the National Electricity Rules (NER). It is based on information provided by TransGrid³ and AEMO.

National Electricity Market time (Australian Eastern Standard Time) is used in this report.

¹ As defined by the AEMC Reliability Panel in the *Guidelines for identifying reviewable operating incidents*, available at <https://www.aemc.gov.au/sites/default/files/2018-02/Final-revised-guidelines.pdf>.

² See NER clause 4.8.15(b).

³ TransGrid is the Transmission Network Service Provider for the area in question.

2. Pre-event conditions

The 41 Sydney South – Beaconsfield South 330 kV transmission line was out of service for planned works by AusGrid. As part of this work, the No. 1 and No. 2 330/132 kV transformers at Rookwood substation were also out of service. At 1807 hrs on 14 April 2018, AEMO reclassified the simultaneous loss of the 12 and 76 lines as a credible contingency due to bushfires in the area.

TransGrid confirmed that the transmission line easements around the Sydney South substation had been regularly maintained in accordance with its easement maintenance plan to reduce the potential impact from fires.

3. The incident

On the afternoon of Saturday 14 April, there was a large bushfire in the Holsworthy area. In this area, the 12 and 76 lines run on one set of dual circuit towers, and the 13 and 78 lines run on another set of dual circuit towers. Both sets of towers are in the same easement. Refer to the diagram in Appendix A for more details. The fire started in the north-west corner of the burnt area and was travelling in a south-easterly direction.

Between 0752 hrs and 1130 hrs on Sunday 15 April 2018, there were 10 separate incidents involving the 330 kV transmission lines supplying the Sydney South substation. Table 1 provides a summary of these incidents. A more detailed sequence of events is provided in Appendix A2.

Table 1 Summary sequence of events

Incident number	Time	Incident
1	0752	11 line trip and auto reclose.
	0753	11 line trip (reclosed by TransGrid at 0806 hrs).
2	0931	12 line trip and auto reclose.
		76 line trip and auto reclose.
3	0933	12 line trip and auto reclose.
		76 line trip and auto reclose.
		12 line trip (reclosed by TransGrid at 0938 hrs).
4	0936	78 line trip and auto reclose.
5	0937	78 line trip and auto reclose.
6	0938	13 line trip and auto reclose.
		78 line trip and auto reclose.
7	0939	78 line trip and auto reclose.
8	0944	78 line trip (reclosed by TransGrid at 0945 hrs).
	0945	78 line trip (reclosed by TransGrid at 0950 hrs).

Incident number	Time	Incident
9	0950	13 line trip (reclosed by TransGrid at 1000 hrs).
10	1130	12 line and 1 SVC trip. 12 line auto reclosed.
	1339	1 SVC returned to service.

There was no loss of customer load or generation because of these incidents.

4. Analysis

This section is based on information provided by TransGrid.

Incident 1

The 11 line tripped, auto-reclosed, and then tripped again. The second trip occurred within the protection lockout time and auto-reclose was not initiated. A review of protection operation showed a high resistance single phase to earth fault likely caused by fire/smoke. All protection operated correctly. The line was manually restored to service by TransGrid.

Incidents 2 and 3

Both the 12 line and the 76 line tripped within approximately two seconds of each other for both incidents. Both the 12 line and the 76 line auto-reclosed successfully. For incident 3, the 12 line tripped a second time and an auto-reclose was not initiated as the trip was within the protection lockout time. The line was manually restored to service by TransGrid.

Protection records show single phase to earth faults on the lowest conductor of both lines very close to the Sydney South substation. Both faults were likely caused by fire/smoke. All protection operated correctly.

Incidents 4 and 5

The 78 line tripped and auto-reclosed successfully on two occasions. A review of protection records shows a single phase to earth fault on the lowest conductor. All protection operated correctly. Both faults were likely caused by fire/smoke.

Incident 6

Both the 13 line and the 78 line tripped and auto-reclosed successfully. A review of protection records shows a single phase to earth fault on the lowest conductor of each line. All protection operated correctly. Both faults were likely caused by fire/smoke.

Incidents 7 and 8

The 78 line tripped three times. After the first trip the line auto-reclosed successfully. In response to this incident and the previous trips of the 13 line and the 78 line TransGrid disabled the auto-reclose on both lines. The line was reclosed manually by TransGrid after the second and third trip.

Protection records show a single phase to earth fault on the lowest conductor for all three incidents. All protection operated correctly. The faults were likely caused by fire/smoke.

Incident 9

The 13 line tripped and was manually reclosed by TransGrid. Protection records show a two phase to fault. All protection operated correctly. The fault was likely caused by fire/smoke.

Incident 10

The 12 line tripped and auto-reclosed successfully. There was a significant voltage disturbance associated with this incident with voltages collapsing to approximately 41% of normal before the fault was cleared. Approximately 12 seconds after the line trip, the 1 SVC tripped.

Protection records show a phase/phase/earth fault on the 12 line. The line protection operated correctly, and the fault was likely caused by fire/smoke.

The 1 SVC was returned to service after being inspected by TransGrid. After the 1 SVC had been returned to service, AEMO was not satisfied that the cause of the trip had been identified and resolved, and consequently reclassified the simultaneous trip of the 12 line and the 1 SVC as a credible contingency.

Investigations by TransGrid after the incident showed the 1 SVC tripped due to the failure of the 415 V supply to the 1 SVC cooling system. The 1 SVC cooling system is supplied via one of two 415 V switchboards, with an auto-changeover if one supply fails. These 415 V switchboards are in turn supplied from the auxiliary supply transformers at Sydney West substation. At the time of this incident, the No. 1 415 V switchboard was being fed from the No. 1 and No. 3 auxiliary supply transformers, and No. 2 415 V switchboard was being fed from the No. 3 and No. 4 auxiliary supply transformers. The auto-changeover was out of service at the time of this incident due to a failed changeover switch⁴. The 1 SVC cooling supply was being supplied by the No. 1 415 V switchboard at the time of this incident.

The fault on the 12 line caused a large voltage disturbance, resulting in the trip of the 415 V circuit breakers on the No. 1 and No. 3 auxiliary supply transformers due to low voltage. This caused a loss of supply to the No. 1 415 V switchboard. As the auto-changeover system on the 415 V switchboards was out of service, this resulted in the loss of 415 V supply to the 1 SVC cooling system and subsequent trip of the 1 SVC.

TransGrid staff restored the 415 V supply to the No. 1 switchboard and returned the 1 SVC to service at 1339 hrs on 15 April 2018. TransGrid advised AEMO on 15 November 2018 that the failed changeover switch has been replaced and the auto-changeover scheme was fully operational.

After the above incidents, TransGrid patrolled the lines in the fire area. No damage requiring repair was identified.

5. Power system security

AEMO is responsible for power system security in the National Electricity Market (NEM). This means AEMO is required to operate the power system in a secure operating state to the extent practicable and take all reasonable actions to return the power system to a secure state following a contingency event in accordance with the NER⁵.

The power system remained in a secure operating state throughout these incidents. At any time, there was a maximum of two transmission lines out of service. Post event analysis has shown the power system would have remained in a secure operating state for the outage of any three of 12 line, 13 line, 76 line, and 78 line. After the loss of all four of these lines, the power system would have been in a satisfactory but not a secure operating state. If all five lines had been out of service simultaneously the power system would not have been in a satisfactory operating state with voltage collapse on the 132kV network around the Sydney South area.

⁴ This had failed prior to this incident and TransGrid were waiting for a replacement switch.

⁵ Refer to AEMO's functions in section 49 of the National Electricity Law and the power system security principles in clause 4.2.6 of the NER.

5.1 Reclassification

At approximately 1600 hrs on 14 April 2018, AEMO became aware of a fire in the Holsworthy area with the potential to impact the 12/76 and 13/78 transmission lines supplying Sydney South substation. At the time, AEMO conducted an assessment, in accordance with the Power System Security Guidelines procedure, of the likelihood of the fires impacting the lines. Based on advice from the Rural Fire Service that the fire was moving away from the lines, the assessment indicated that reclassification was not required.

At approximately 1800 hrs on 14 April 2018, AEMO carried out a further assessment and determined that reclassification of the 12/76 and 13/78 lines was now required. If there are multiple transmission circuits within an easement, the Power System Security Guidelines⁶ require AEMO to only manage the double circuit most exposed to the bushfire front. Based on advice from TransGrid, AEMO reclassified the simultaneous loss of the 12 and 76 lines as a credible contingency at 1807 hrs on 14 April 2018. On the basis that the lines on both sets of double circuit towers (12 & 76 lines and 13 & 78 lines) tripped during this incident and not just the lines closest to the fire front, AEMO, in consultation with the PSSWG, is reviewing potential reclassification requirements where there is more than one set of dual circuits within a single easement. This review is expected to be completed by the end of February 2019.

No constraints were required to be invoked for the reclassification of 12 and 76 lines⁷. At the same time as this reclassification, AEMO set up its contingency analysis application to monitor both the loss of 12 and 76 lines or 13 and 78 lines. No contingency violations were recorded during the period of these incidents.

At 0806 hrs on 15 April 2018, shortly after the trip of the 11 line, TransGrid advised AEMO there was no risk to the other lines in the area. At 0943 hrs on 15 April 2018, after multiple trips of the 12, 76, 13, and 78 lines, AEMO reclassified the simultaneous loss of both the 13 line and the 78 line as a credible contingency. Constraint set N-KCSS_IGSS_N-2⁸ was invoked at 1010 hrs on 15 April 2018.

After the 1 SVC was returned to service at 1339 hrs on 15 April 2018, TransGrid advised AEMO that the cause of the trip was still not known. On the basis of this advice, AEMO was not satisfied that a further trip of the 1 SVC in conjunction with a trip of the 12 line was unlikely, and reclassified the simultaneous loss of both these elements as a credible contingency from 1514 hrs on 15 April 2018. No constraints were required to be invoked for this reclassification.

The reclassification on the 12/76 and 13/78 lines was cancelled at 1000 hrs on 16 April 2018, after advice from TransGrid that the fire was at least 7 km from the lines and no longer likely to impact the lines. Constraint set N-KCSS_IGSS_N-2 was revoked at the same time.

The reclassification of the 12 line and the 1 SVC as a credible contingency was cancelled at 1630 hrs on 21 November 2018, after advice from TransGrid that the change-over switch on the 415 V switchboards at Sydney West had been replaced.

6. Market information

AEMO is required by the NER and operating procedures to inform the market about incidents as they progress. This section assesses how AEMO informed the market⁹ over the course of this incident.

For this incident, AEMO informed the market on the following matters:

⁶ Refer to Section 11.3 of AEMO, *Power System Security Guidelines*, 4 September 2018, available at https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3715---Power-System-Security-Guidelines.pdf.

⁷ Similarly no constraints would have been required if 13 and 78 lines were reclassified.

⁸ Out = Nil. Loss of Kemps Creek – Sydney South (13) line and Ingleburn – Sydney South (78) line declared credible.

⁹ AEMO generally informs the market about operating incidents as the progress by issuing Market Notices – see <https://www.aemo.com.au/Market-Notices>.

1. Reclassification, details, and cancellation of a non-credible contingency – notify as soon as practical¹⁰.
 - AEMO issued Market Notice 62319 at 1826 hrs on 14 April 2018 to advise of the reclassification of the 12 line and the 76 line as a credible contingency. This notification was published 19 minutes after the reclassification decision was made.
 - AEMO issued Market Notice 62332 at 1057 hrs on 15 April 2018 to advise of the reclassification of the 13 line and the 78 line as a credible contingency. This notification was published 14 minutes after the reclassification decision was made.
 - AEMO issued Market Notice 62339 at 1514 hrs on 15 April 2018 to advise of the reclassification of the 12 line and the 1 SVC as a credible contingency. This notification was published 95 minutes after the 1 SVC was returned to service.
2. A non-credible contingency event – notify within two hours of the event¹¹.
 - AEMO issued Market Notice 62333 at 1056 hrs on 15 April 2018 to advise of the non-credible contingency event involving the 13 line and the 78 line. This notification was published 78 minutes after the incident.
 - AEMO issued Market Notice 62338 at 1514 hrs on 15 April 2018 to advise of the non-credible contingency event involving the 12 line and the 1 SVC. This notification was published 3 hours and 44 minutes after incident.
3. Updates in relation to non-credible contingency events – as information becomes available¹².
 - AEMO issued Market Notices 62347 and 62348 at 1014 hrs on 16 April 2018 to advise the reclassifications on the 12 and 76 lines and the 13 and 78 lines had been cancelled. These notifications were published 14 minutes after the decision to cancel the reclassifications was made.

AEMO should also have issued Market Notices to advise of the non-credible contingency involving the 12 and 76 lines, and that constraints involving interconnector terms on the left hand side had been invoked¹³. AEMO operations staff have been reminded of the requirement for timely and appropriate reporting to the Market.

7. Conclusions

AEMO has assessed this incident in accordance with clause 4.8.15(b) of the NER. In particular, AEMO has assessed the adequacy of the provision and response of facilities or services, and the appropriateness of actions taken to restore or maintain power system security. AEMO has concluded that:

1. A series of non-credible and multiple contingency events occurred due to faults caused by bushfires.
2. AEMO made appropriate decisions in relation to reclassification of potential non-credible contingencies. These decisions were in accordance with the Power System Security Guidelines procedure.
3. In response to these incidents, AEMO and the PSSWG are reviewing the guidelines for reclassification where multiple dual circuit lines are involved.
4. The outage of the 1 SVC was due to the loss of its 415 V cooling supply. A faulty change-over switch has been replaced.

¹⁰ AEMO is required to notify the market of a reclassification NER clause 4.2.3A(g), details of the reclassification 4.2.3A(c) and when AEMO cancels the reclassification 4.2.3A(h)

¹¹ AEMO is required to notify the Market of a non-credible contingency event within two hours of the event – AEMO, *Power System Security Guidelines*, Section 10.3.

¹² AEMO is required to notify the Market as it becomes aware of new and material information – NER Clause 4.2.3A(d).

¹³ Constraint set N-KCSS_IGSS_N-2 contains equations with interconnector terms on the LHS. For short term outage AEMO is required to notify the Market of variances to interconnector transfer limits. AEMO, *Power System Security Guidelines*, Section 22.

5. The power system remained in a secure operating state during these incidents. Post event analysis also shows the power system would have remained in a satisfactory operating state if any four of the five lines that traverse the bushfire area to supply the Sydney South substation had out of service at the same time. If all five lines had been out of service simultaneously the power system would not have been in a satisfactory operating state with voltage collapse in the 132kV network in the Sydney South area..
6. AEMO did not fully advise the market of all non-credible contingencies that occurred and when constraints had been invoked.

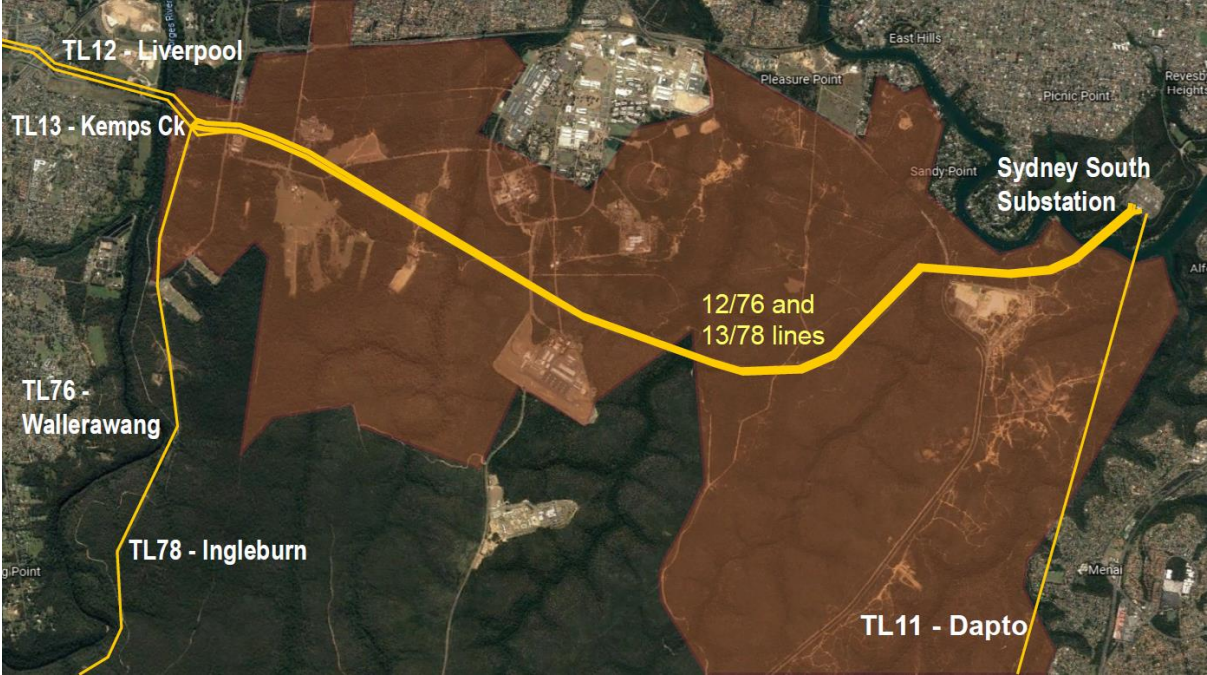
8. Pending actions

8.1 Review of reclassification guidelines

AEMO, in consultation with the PSSWG, will review the potential reclassification requirements where there is more than one set of dual circuits within a single easement. This review will be completed by the end of February 2019.

A1. Fire area

The diagram below, provided by TransGrid, shows the transmission corridors for the 11, 12, 13, 76, and 78 lines in relation to the fire area (shaded in red).



A2. Sequence of events

The following table provides a detailed sequence of events covering the incidents.

Table 2 Detailed sequence of events

Date / Time	Details
14/04/2018	
16:22:00	Rural Fire Services (RFS) advises fire is moving away from 76/78 lines. Fire reclassification assessment by AEMO indicates reclassification not required.
18:07:00	AEMO carries out a further reclassification assessment and 12 line and 76 line reclassified as a credible contingency.
18:26:00	Market Notice 62319 is issued to advise of the reclassification of 12/76 lines.
20:18:00	TransGrid advises AEMO that RFS is unable to advise if fire will impact 12/76 or 13/78 lines. TransGrid and AusGrid looking to move load away from Sydney South.
20:55:00	TransGrid advises AEMO that RFS says fire heading for Heathcote Road and Sandy Point. AusGrid moving 30 MW of load away from Sydney South.
15/04/2018	
07:52:30	11 line trips.
07:52:45	11 line auto-recloses.
07:53:26	11 line trips. As this is within the lockout time from previous trip, there is no auto-reclose.
08:06:00	11 line auto-reclose is disabled by TransGrid.
08:06:00	11 line is returned to service by TransGrid.
08:06:00	TransGrid advises AEMO no current risk to other lines in the area. AEMO conducts a reclassification assessment for 13/78 lines. No reclassification required.
08:59:00	11 line auto-reclose function enabled by TransGrid.
09:31:06	12 line trips.
09:31:09	76 line trips.
09:31:22	12 line auto-recloses.
09:31:24	76 line auto-recloses.
09:33:24	12 line trips.
09:33:26	76 line trips.
09:33:41	12 line auto-recloses.
09:33:41	76 line auto-recloses.
09:33:56	12 line trips.
09:34:00	AEMO advises TransGrid of a severe weather warning issued by the Bureau of Meteorology for damaging winds in the South Coast, Snowy Mountains, and parts of the Illawarra and Central Tablelands districts.

Date / Time	Details
09:34:32	76 line auto-reclose is disabled by TransGrid.
09:36:22	78 line trips.
09:36:40	78 line auto-recloses.
09:37:38	78 line trips.
09:37:55	78 line auto-recloses.
09:38:11	13 line trips.
09:38:14	78 line trips.
09:38:26	13 line auto-recloses.
09:38:31	78 line auto-recloses.
09:38:43	12 line is reclosed by TransGrid.
09:39:21	78 line trips.
09:39:39	78 line auto-recloses.
09:40:13	78 line auto-reclose is disabled by TransGrid.
09:40:57	13 line auto-reclose is disabled by TransGrid.
09:43:00	AEMO reclassifies the simultaneous loss of both 13 line and 78 line as a credible contingency due to bushfires.
09:44:02	78 line trips.
09:45:16	78 line is reclosed by TransGrid.
09:45:34	78 line trips.
09:50:18	13 line trips.
09:50:51	78 line is reclosed by TransGrid.
10:00:34	13 line is reclosed by TransGrid.
10:10:00	Constraint set N-KCSS_IGSS_N-2 is invoked (for reclassification of 13/78 lines).
10:23:03	12 line auto-reclose is disabled by TransGrid.
10:56:00	Market Notice 62333 is issued to advise of the occurrence of a non-credible contingency on 13/78 lines.
10:57:00	Market Notice 62332 is issued to advise of the reclassification of 13/78 lines from 0943 hrs.
10:59:39	12 line auto-reclose is enabled by TransGrid.
11:00:24	78 line auto-reclose is enabled by TransGrid.
11:00:57	13 line auto-reclose is enabled by TransGrid.
11:01:28	76 line auto-reclose is enabled by TransGrid.
11:14:00	TransGrid advises AEMO that fire is still under 13/78 and 12/76 lines and heading for 11 line.
11:30:30	12 line trips.
11:30:42	1 SVC trips.

Date / Time	Details
11:30:47	12 line auto-recloses.
13:39:00	1 SVC returns to service.
13:44:00	TransGrid advises AEMO the fire has passed 11 line but 13/78 and 12/76 lines still at risk.
13:44:00	TransGrid advises AEMO that the trip of 1 SVC is likely due to voltage disturbance from the fault on 12 line.
15:14:00	Market Notice 62338 is issued to advise of the occurrence of a non-credible contingency involving 12 line and 1 SVC.
15:14:00	Market Notice 62339 is issued to advise of the reclassification of 12 line and 1 SVC as a credible contingency.
16:09:00	TransGrid advises AEMO that fire near Sydney South is subsiding but 13/78 and 12/76 lines still at risk.
19:00:00	AEMO reviews the reclassification for 13/78 and 12/76 lines and determines that the reclassifications should remain in place.
23:00:00	Based on advice from the RFS, reclassifications on 13/78 and 12/76 lines are extended to 0200hrs on 16/4/18.
16/04/2018	
08:21:00	TransGrid advises fires are a long way from 13/78 and 12/76 lines.
10:00:00	Reclassification on 13/78 and 12/76 lines is cancelled.
10:00:00	Constraint set N-KCSS_IGSS_N-2 is revoked.
10:14:00	Market Notices 62347 and 62348 are issued to cancel reclassification on 12/76 and 13/78 lines.