# TRIP OF MULTIPLE TRANSMISSION ELEMENTS IN THE SOUTHERN NSW AREA, 11 FEBRUARY 2017

REVIEWABLE OPERATING INCIDENT REPORT UNDER THE NATIONAL ELECTRICITY RULES

Published: **15 September 2017**

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

# INCIDENT CLASSIFICATIONS

| Classification | Detail |
|---|---|
| **Time and date of incident** | 2123 hrs on Saturday 11 February 2017 |
| **Region of incident** | New South Wales |
| **Affected regions** | New South Wales |
| **Event type** | Protection and Control |
| **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 this incident |
| **Associated reports** | Trip of Lower Tumut – Upper Tumut 64 330 kV Line and Canberra – Lower Tumut 7 300 kV Line Open at Canberra End Only |

# 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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# TABLES

# 1. OVERVIEW

This report relates to a reviewable operating incident[1] that occurred on 11 February 2017 in the southern portion of the NSW region. This incident involved the trip of multiple transmission lines, caused by faulty protection operation coincident with high voltage faults due to a storm with lightning and high winds.

There was no loss of generation or customer load as a result of this incident.

As a reviewable operating incident, AEMO is required to assess power system security over the course of this 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 security.[2]

AEMO has concluded that:

1. The Lower Tumut – Murray 66 330 kV transmission line (66 line) tripped due to a fault likely caused by either wind-blown debris or lightning. Protection operated correctly to clear the fault on this line.
2. The fault on 66 line was seen at both Canberra and Wagga Substations and due to protection mal-operation at each site, the Canberra – Lower Tumut 07 330 kV transmission line (07 line) and the Wagga A 330 kV busbar tripped instantaneously.
3. The trip of the Wagga A 330 kV busbar offloaded the Darlington Point – Wagga 63 330 kV transmission line (63 line), the Lower Tumut – Wagga 051 330 kV transmission line (051 line), and the Wagga No.2 Transformer, and operated the Darlington Point X5 trip scheme, de-energising the Darlington Point 220 kV busbar and offloading the Darlington Point – Balranald X5/1 220 kV transmission line (X5/1 line), Darlington Point No.3 Transformer, and Darlington Point No.4 Transformer.
4. The power system was not in a secure operating state between 2123 hrs and 2241 hrs (78 minutes). Power system security was restored at 2241 hrs on 11 February via radialisation of the NSW south west 132 kV network.
5. AEMO reclassified the simultaneous trip of 051 line, 66 line and 07 line as credible from 0445 hrs on 12 February (cancelled at 1142 hrs). However it would have been more appropriate to do so earlier when 07 and 66 lines were returned to service from 2157 hrs on 11 February, and add 051 line when this was returned to service at 0118 hrs.
6. TransGrid has replaced or repaired all known faulty elements that resulted in the protection mal-operation, and has initiated programs to replace similar elements in their network.

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 TransGrid and AEMO's Energy Management Systems.

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

# 2. PRE-EVENT CONDITIONS

The Wagga North – Murrumbah 991 132 kV line was out of service, having tripped at 2003 hrs on 11 February 2017.

[1] See NER clause 4.8.15(a)(1)(i), as the event relates to a non-credible contingency event on the transmission system.
[2] See NER clause 4.8.15(b).

# 3. THE INCIDENT

At 2123 hrs on Saturday 11 February 2017, a storm with high wind and lightning was passing through the southern portion of the NSW region. Multiple transmission elements tripped:

- Lower Tumut – Murray 66 330 kV transmission line (66 line) – initiating fault.
- Canberra – Lower Tumut 07 330 kV transmission line (07 line) at the Canberra end only.
- Wagga A 330kV busbar (Wagga A busbar), which offloaded the:
    - Lower Tumut – Wagga 051 330 kV transmission line (051 line)
    - Darlington Point – Wagga 63 330 kV transmission line (63 line)
    - Wagga No.2 330/132 kV transformer (Wagga No.2 transformer).
- Darlington Point 220 kV busbar, which offloaded the:
    - Darlington Point – Balranald 220 kV X5/1 line (X5/1 line)
    - Darlington Point No.3 330/220 kV transformer (Darlington Point No.3 transformer)
    - Darlington Point No.4 330/220 kV transformer (Darlington Point No.4 transformer)
- Lower Tumut – Upper Tumut 64 330 kV transmission line (64 line)

As a result of this incident, the power system was not in a secure operating state for 78 minutes from 2123 hrs, as a contingency would have resulted in voltage collapse in the southern part of NSW or overloading of the parallel NSW south west 132 kV network. The power system was restored to a secure operating state at 2241 hrs when the 132 kV network in the NSW south west area was radialised[3].

No load or generation was lost as a result of this incident. See Appendix A for a power system diagram illustrating the incident and Appendix B for a chronological log of the incident.

This incident was a non-credible contingency event with the tripping of multiple transmission elements and is thus a reviewable incident under the NER.

The transmission elements were returned to service as detailed in Table 1.

**Table 1 Time transmission elements were returned to service**

| Element | Time returned to service |
|---|---|
| 07 line | 2134 hrs 11 February 2017 |
| 66 line | 2157 hrs 11 February 2017 |
| Wagga A busbar and Wagga No.2 transformer | 2301 hrs 11 February 2017 |
| 051 line | 0118 hrs 12 February 2017 |
| 63 line | 0334 hrs 12 February 2017 |
| Darlington Point 220 kV busbar, X5/1 line, and Darlington Point transformers | 0337 hrs 12 February 2017 |
| 132 kV network returned to normal | 0347 hrs 12 February 2017 |

[3] Radialisation of an area refers to switching the configuration of the grid to have load centres connected to the grid by only one line as opposed to the usual meshed configuration. In this configuration, the loss of a single line (a credible contingency) leads to disconnection of a single load centre only, and avoids overloading other interconnected lines.

# 4. TRANSGRID INVESTIGATION

TransGrid is the Transmission Network Service Provider (TNSP) for the lines in question and as such investigated this incident. The following section is based on information provided by TransGrid.

At approximately 2123 hrs on Saturday 11 February 2017, a fault on 66 line resulted in the outage of that line. As a consequence of this fault, a series of unexpected protection operations also resulted in the outage of several other transmission lines and transformers in the Southern NSW area. Shortly after this, a fault on 64 line resulted in the outage of that line.

During the incident, a storm with high winds and lightning was in the area.

Table 2 details the sequence of events that lead to the outages of the lines, as observed by TransGrid. The brief explanatory comments in the table are further described below the table. A complete sequence of events is included in Appendix B.

**Table 2 Sequence of events**

| Time | Event | Comment |
|---|---|---|
| **21:22:46.941-21:22:46.990** | 66 line tripped at Lower Tumut and Murray. | Initiating fault on 'blue' phase. Protection operated correctly to clear this fault. |
| **21:22:46.998** | 07 line tripped at Canberra. Remained energised from Lower Tumut. | Zone 3 protection on 07 line was initiated at Canberra with fault on 66 line. Due to a faulty timer at Canberra, protection immediately operated to open the 07 CB at Canberra. |
| **21:22:48*** | Wagga 330kV A busbar de energised (051 line, 63 line and Wagga No.2 330/132kV transformer off-loaded). | Zone 3 protection on 051 line was initiated at Wagga with fault on 66 line. Due to a faulty timer, protection immediately operated to attempt to open the 051 CB at Wagga. |
| **21:22:47.506** | 051 line tripped at Lower Tumut. | A faulty pallet switch for the bypass disconnector at Wagga, meant the busbar protection scheme was directly operated with the attempted trip of line 051 at Wagga, and the Wagga A busbar tripped. This offloaded the 051 and 63 lines (at both ends) and the Wagga No.2 330/132 kV transformer. |
| **21:22:49*** | 63 line tripped at Darlington Point.<br>Darlington Point 220 kV busbar de energised (No.3 transformer, No.4 transformer, X5/1 line off-loaded). | Trip of 63 line caused operation of the Darlington Point 220 kV Split Scheme. |
| **21:22:52.181-21:22:52.249** | Auto-reclose attempt on 66 line initiated at Murray failed. | Fault still on line. |
| **21:23:03.537-21:23:03.548** | 64 line tripped at Upper and Lower Tumut. | Two structures on 64 line were found to have collapsed by a later line patrol. Protection operated correctly to clear this fault. |
| **21:23:18.927-21:23:18.999** | Auto-reclose attempt on 64 line initiated at Upper Tumut failed. | |
| **21:23:05** | CB 051B on 051 line at Lower Tumut substation auto-reclosed and immediately opened. | The CB cycled through approximately 80 reclose cycles before it was stopped via the de-energisation of the bus at 2154 hrs. |

* Millisecond timestamps are not available at Wagga or Darlington Point.

The transmission elements were returned to service as was detailed in Table 1, Section 3.

## 4.1 Review of the causes

**Initiating Fault**

The initiating fault occurred on the 'blue' phase of 66 line. Investigation found that this fault was likely to be due to wind-blown debris contacting the line. There is also evidence of a lightning strike approximately 200m from 66 line within 0.5 seconds of the trip time. The fault was cleared within mandated clearance times[4] via CB operation tripping all three phases.

**Faulty Timer Relays at Canberra (07) and Wagga (051)**

The protection on 07 and 051 lines is an older discrete component protection relay. The memory trip timers at both Canberra and at Wagga were stuck, leading to a "switch onto fault" condition at both locations. As such, when the 07 line saw the fault on 66 line in its Zone 3 protection at Canberra, the CBs at Canberra tripped immediately. However, when the 051 line saw the fault in its Zone 3 protection at Wagga, the CBs at Wagga did not trip immediately due to a faulty disconnector pallet switch (see section regarding Disconnector Pallet Switch Fault at Wagga below).

Maintenance of the protection on both lines has been performed in the normal six-year period, and no problems were identified with the memory timer relays during these maintenance checks.

A similar incident occurred on 11 July 2015, when the 07 line tripped at the Canberra end only when Zone 3 protection operated immediately as a result of a fault on 64 line[5]. While the same memory timer was involved, AEMO is satisfied the mechanism for the trips was different.

Both faulty timers have now been replaced. A review of protection schemes involving similar relays has also been completed and TransGrid has initiated a program of work to stage the replacement of all protection schemes that include this relay in the 2018/19 to 2023/24 regulatory period.

**Disconnector Pallet Switch Fault at Wagga**

The bypass disconnector (0514) used for carrying out works on the Wagga CB 0512 was in the open position, but the pallet switch of this disconnector was faulty and indicated the disconnector was closed. As a consequence, the protection was effectively operating as though CB 0512 at Wagga was not in service. As such, the relay treated the connected busbar section as part of the 051 line, and directly tripped the busbar with the 051 line when the Wagga 051 protection saw the fault on 66 line. Given CB 0512 was not in service as far as the busbar protection was concerned due to the faulty pallet switch, an intertrip signal was sent to Lower Tumut to also trip the 051 line at that end to clear the busbar at Wagga.

This faulty pallet switch has now been repaired. A review of similar disconnector pallet switches has resulted in the de-commissioning of some of these switches and TransGrid is developing a strategy for managing the replacement of those remaining.

**Darlington Point 220 kV Split Scheme**

In the event of a trip of 63 line, the resulting power flow through the parallel 132 kV interconnection could result in voltage collapse and line overloads. To avoid this result, the Darlington Point 220 kV split scheme has been implemented to trip X5/1 line in the event of a trip of 63 line. When the Wagga A busbar de-energised, offloading 63 line, the Darlington Point 220kV split scheme operated as intended to offload X5/1 line and Darlington Point No.3 and No.4 transformers.

**Auto-reclose cycle of the 051B CB at Lower Tumut substation**

051B CB at Lower Tumut substation auto-reclosed and opened approximately 80 times from 2123 hrs until the Lower Tumut B 330 kV busbar was de-energised at 2154 hrs. The auto-reclose cycle of the 051B CB has been found to be due to the configuration of the auto-reclose scheme. For the Lower Tumut substation, an auto-reclose was initiated from any trip on 051 line. This differs from TransGrid's standard practice, which is to start auto-reclose from distance and directional earth fault schemes and

[4] NER Schedule 5.1a System Standards Clause S5.1a.8

[5] Report available on AEMO's website, access 3 August 2017 <http://aemo.com.au/media/Trip%20of%20Lower%20Tumut%20Upper%20Tumut%2064%20330%20kV%20Line%20and%20Canberra%20Lower%20Tumut%207%20330%20kV%20Line%20on%2011%20July%20201.pdf>

inhibit auto-reclose for switch onto fault and circuit breaker fail conditions. As such, even though protection at Wagga A busbar was sending an intertrip signal to the CB, the auto-reclose at Lower Tumut was not inhibited and cycled until the Lower Tumut B busbar was de-energised.

TransGrid have identified a total of seven schemes of this type in their network and three have now been replaced. The remaining have been reviewed and prioritised for replacement.

**Collapse of 64 line structures**

64 line structures are rated for approximately 110 km/h and TransGrid therefore estimates that the wind gust that caused the structures on 64 line to collapse was in excess of 110 km/h.

AEMO and TransGrid were monitoring forecast wind speeds, and as the forecast wind speeds for that day were below the ratings of the structures, no action to reconfigure the power system or to reclassify the potential loss of multiple transmission elements as a credible contingency was taken.

The fault on 64 line was cleared within mandated clearance times. The tripping of 64 line did not contribute to the other line trips.

# 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 NER.[6]

This section assesses how AEMO managed power system security over the course of this incident.

Immediately after this incident, the power system was in a satisfactory operating state but was not in a secure operating state. From 2140 hrs, AEMO invoked the constraint sets shown in Table 3.

**Table 3 Constraint sets invoked immediately after the incident.**

| Constraint Set | Invoke Time | Reason |
|---|---|---|
| **N-LTWG_RADIAL** | 21:40 11/02/2017 | Out = 051 line |
| **N-UR_ZERO** | 21:40 11/02/2017 | Limit output of Uranquinty power station to zero MW to manage power flows on the 132kV network. |
| **N-WAGGA_330_BUSA** | 21:40 11/02/2017 | Out=Wagga 330kV bus A. Wagga-Yass 132 kV network Split, X5 opened and with 2 Yass Transformer in service |
| **N-LTUT_30M** | 21:45 11/02/2017 | Out = 64 line |
| **I-LTMS** | 21:50 11/02/2017 | Out = 66 line |

No constraint set was required to be invoked for the outage of 07 line as this line was returned to service at 2134 hrs, 12 minutes after the line tripped.

Due to the complex nature of this incident the above constraint sets were not sufficient to restore the power system to a secure operating state, and nor was AEMO's constraint automation tool able to handle the complex nature of the outages on the day. There was still a risk of voltage collapse and potential overloading of lines in the parallel 132 kV interconnection with the credible loss of a number of parallel lines that were still in service. Even when 07 line and 66 line were returned to service (at 2134 hrs and 2157 hrs respectively), the power system was not in a secure operating state. Lines 051, 64, 63 and X5/1 remained out of service.

[6] 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

The power system returned to a secure operating state when the 132 kV NSW south west system was radialised between 2231 hrs and 2241 hrs on 11 February 2017. Radialisation is standard practice for when 051 line is out of service.

AEMO also requested AusNet Services to disable the Dederang bus splitter scheme (DBUSS) between 2133 hrs on 11 February 2017 and 0211 hrs on 12 February 2017, due to the outage of 051 line. V-DBUSS_L[7] and V-DBUSS_T[8] were invoked from 2140 hrs to 0220 hrs.

As the elements were returned to service, AEMO continued to manage power system security by invoking and revoking the appropriate constraints.

- When Wagga A busbar was returned to service at 2301 hours via the 330/132 kV No.2 transformer, AEMO left constraint N-WAGGA_330_BUSA invoked as this constraint was considered best to manage the continued multiple outage of 051 line and 63 line.
- The Lower Tumut B busbar was re-energised at 0108 hrs on 12 February 2017. Ten minutes later, at 0118 hrs, 051 line was returned to service, with CB 051B[9] isolated. Constraint sets N-LTWG_RADIAL, N-UR_ZERO, and N-WAGGA_330_BUSA were revoked at 0125 hrs, seven minutes after LTWG line 051 was returned to service.
- Constraint sets N-DPWG_63_X5[10] and N-X_WGYS_132_OPEN[11] were invoked from 0125 hrs to manage the continued outage of 63 line and radialised configuration.
- 63 line was returned to service at 0334 hrs on 12 February 2017 once the cause of the trip had been identified. The Darlington Point 220 kV busbar and X5/1 line were returned three minutes later. Switching was completed in the Wagga 132 kV area to make it solid at 0347 hrs.
- AEMO revoked constraint sets N-DPWG_63_X5 and N-X_WGYS_132_OPEN from 0345 hrs.

## 5.1 Reclassification

In accordance with the NER, AEMO is required to assess whether or not to reclassify the simultaneous tripping of multiple transmission elements as a credible contingency[12].

### 5.1.1 Prior to the incident

AEMO did not reclassify the simultaneous loss of any lines in the area as a credible contingency prior to the incident, as although AEMO was aware of lightning in the area, none of the transmission lines impacted were listed as vulnerable in the *Power System Security Guidelines*[13].

Similarly, the forecasts of the day did not indicate there was an increased risk of damage to transmission equipment and nor did AEMO receive advice from TransGrid under NER clause 4.8.1[14] indicating an increased risk.

### 5.1.2 Following the incident

AEMO received information from TransGrid at 0445 hrs on 12 February that the simultaneous trip of 051 line and the Wagga A busbar was unlikely to reoccur as the faulty pallet switch had been repaired. However, AEMO understood TransGrid was further investigating the cause of the simultaneous trip of 051 line, 66 line and 07 line. As such, AEMO reclassified the simultaneous trip of these lines as a credible contingency from 0445 hrs and issued Market Notice 57458 at 0454 hrs on 12 February 2017.

However as AEMO had a lack of information on the cause of the trip of 07 line when this line and 66 line were returned to service at 2157 hrs, the more appropriate action would have been to reclassify the

[7] Outage = Dederang DBUSS-Line control scheme
[8] Outage = Dederang DBUSS-Transformer control scheme
[9] This is the CB that had been cycling through an auto-reclose cycle
[10] Out = Darlington Point to Wagga (63) 330 kV line + line X5 opened
[11] Wagga-Yass 132 Parallel lines Opened
[12] AEMO is required to assess whether or not to reclassify a non credible contingency event as a credible contingency - NER Clause 4.2.3A (c) - and to report how re-classification criteria were applied - NER Clause 4.8.15 (ca). AEMO has to determine if the condition that caused the non-credible contingency event has been resolved.
[13] As per the *Power System Security Guidelines*, vulnerable transmission lines are double circuit transmission lines which fall into the categories for Probable or Proven. A double circuit transmission line in this category is eligible to be reclassified as a credible contingency event during a lightning storm if a cloud to ground lightning strike is detected within a specified distance of the vulnerable lines.
[14] 4.8.1 requires a Registered Participant to advise AEMO of any circumstance which could be expect4ed to adversely affect the secure operation of the power system.

loss of these lines as a credible contingency from 2157 hrs. Similarly when 051 line was returned to service at 0118 hrs on 12 February, the more appropriate action would have been to reclassify the loss of 66 line, 07 line and 051 line as a credible contingency from 0118 hrs also due to a lack of information at that stage. AEMO has reiterated to operational staff the importance of reclassifying credible events in cases when an incident has occurred due to unknown causes, and incorporated two reclassification exercises in the latest skills and simulator training for operational staff.

At 0930 hrs on 12 February 2017, AEMO received further information from TransGrid that the cause of the 051 line trip had been identified and had now been rectified. AEMO removed 051 line from the reclassification from 0935 hrs and issued Market Notice 57464 at 1014 hrs to notify the market. After 051 line had been removed from the reclassification, AEMO revoked the constraint set N-LTUT_30M and invoked N-LTUT_64_15M from 0955 hrs as advised in the Network Outage Schedule from 0549 hrs on 12 February 2017[15].

At 1142 hrs on 12 February, AEMO received further information from TransGrid that the cause of 07 line opening at the Canberra end only had been identified and had now been rectified. AEMO cancelled the reclassification from 1145 hrs and issued Market Notice 57468 at 1218 hrs.

Immediately following this non-credible contingency, the power system was in a satisfactory operating state, with power system frequency[16] and voltage[17] within limits, but not in a secure operating state. AEMO and TransGrid took appropriate and timely action to restore the power system to a secure operating state as soon as reasonably practicable. AEMO correctly reclassified the incident as a credible contingency, although it would have been more appropriate to reclassify the incident earlier as the lines returned to service. Appropriate notifications regarding reclassification were issued throughout.

# 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 market[18] over the course of this incident.

For this incident, AEMO was required to inform the market on the following matters:

1. A non-credible contingency event - notify within two hours of the event.[19]

   AEMO issued Market Notice 57439 at 2235 hrs– 73 minutes after the event

2. Constraints invoked with interconnector terms on the LHS.[20]

   Table 4 details the Market Notices AEMO issued to notify the market that constraints had been invoked or revoked that vary the inter-regional transfer limit.

**Table 4 Market Notices informing the market of variations to the inter regional transfer limit**

| Time | Market Notice | Constraint Set | Invoked / Revoked | Interconnectors |
|---|---|---|---|---|
| **11 February 2017 23:28** | 57440 | N-WAGGA_330_BUSA | Invoked 2140 hrs | VIC1-NSW1[21]<br>NSW1-QLD1[22]<br>N-Q-MNSP1[23] |

[15] The Network Outage Schedule is available on AEMO's website here: https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Data/Network-Data/Network-Outage-Schedule
[16] Operating Frequency Tolerance Band specified in AEMC Reliability Panel Frequency Operating Standards
[17] NER Schedule 5.1a System Standards Clause S5.1a.4 - Power frequency voltage
[18] AEMO generally informs the market about operating incidents as the progress by issuing Market Notices – see AEMO website
[19] 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
[20] For short term outage AEMO is required to notify the Market of variances to interconnector transfer limits AEMO, *Power System Security Guidelines,* Section 22
[21] Victoria to New South Wales
[22] NSW to QLD (QNI) Interconnector
[23] Terranora Interconnector

| Time | Market Notice | Constraint Set | Invoked / Revoked | Interconnectors |
|---|---|---|---|---|
| **23:31** | 57441 | N-LTUT_30M | Invoked 2145 hrs | VIC1-NSW1<br>V-S-MNSP1[24] |
| | 57442 | N-LTWG_RADIAL | Invoked 2140 hrs | VIC1-NSW1<br>V-S-MNSP1<br>V-SA[25]<br>T-V-MNSP1[26]<br>NSW1-QLD1 |
| **23:32** | 57444 | I-LTMS | Invoked 2150 hrs | VIC1-NSW1<br>V-S-MNSP1<br>NSW1-QLD1 |
| **12 February 2017 02:03** | 57447 | N-LTWG_RADIAL | Revoked 0145 hrs | VIC1-NSW1<br>V-S-MNSP1<br>V-SA<br>T-V-MNSP1<br>NSW1-QLD1 |
| **02:04** | 57448 | N-WAGGA_330_BUSA | Revoked 0125 hrs | VIC1-NSW1<br>NSW1-QLD1<br>N-Q-MNSP1 |
| | 57449 | N-DPWG_63_X5<br>N-X_WGYS_132_OPEN | Invoked 0125 hrs | VIC1-NSW1<br>V-S-MNSP1<br>N-Q-MNSP1<br>NSW1-QLD1 |
| **03:46** | 57457 | N-DPWG_63_X5L<br>N-X_WGYS_132_OPEN | Revoked 0345 hrs | VIC1-NSW1<br>V-S-MNSP1<br>N-Q-MNSP1<br>NSW1-QLD1 |

AEMO did not issue a notice for constraint sets V-DBUSS-L or V-DBUSS-T which relate to the disabling the Dederang Bus Splitting Scheme. Both of these contain equations with interconnector terms on the left hand side. These were invoked from 2140 hrs on 11 February 2017 to 0220 hrs on 12 February 2017, and did not bind. AEMO has reiterated the importance of following standard procedures to operational staff and this will be specifically covered in upcoming skills maintenance and simulator training.

3. Reclassification, details, and cancelation of a non-credible contingency – notify as soon as practical.[27]

[24] Murraylink
[25] Heywood Interconnector
[26] Basslink
[27] AEMO is required to notify the market of a reclassification NER clause 4.2.3(g), details of the reclassification 4.2.3(c) and when AEMO cancels the reclassification 4.2.3(h)

- AEMO issued Market Notice 57458 at 0454 hrs on 12 February 2017 to inform the market the simultaneous trip of 051 line, 66 line and 07 line has been reclassified as a credible contingency.
- AEMO issued Market Notice 57464 at 1014 hrs on 12 February 2017 to take 051 line out of the reclassified credible contingency.
- AEMO issued Market Notice 57468 at 1218 hrs on 12 February 2017 to cancel the reclassification.

# 7. CONCLUSIONS

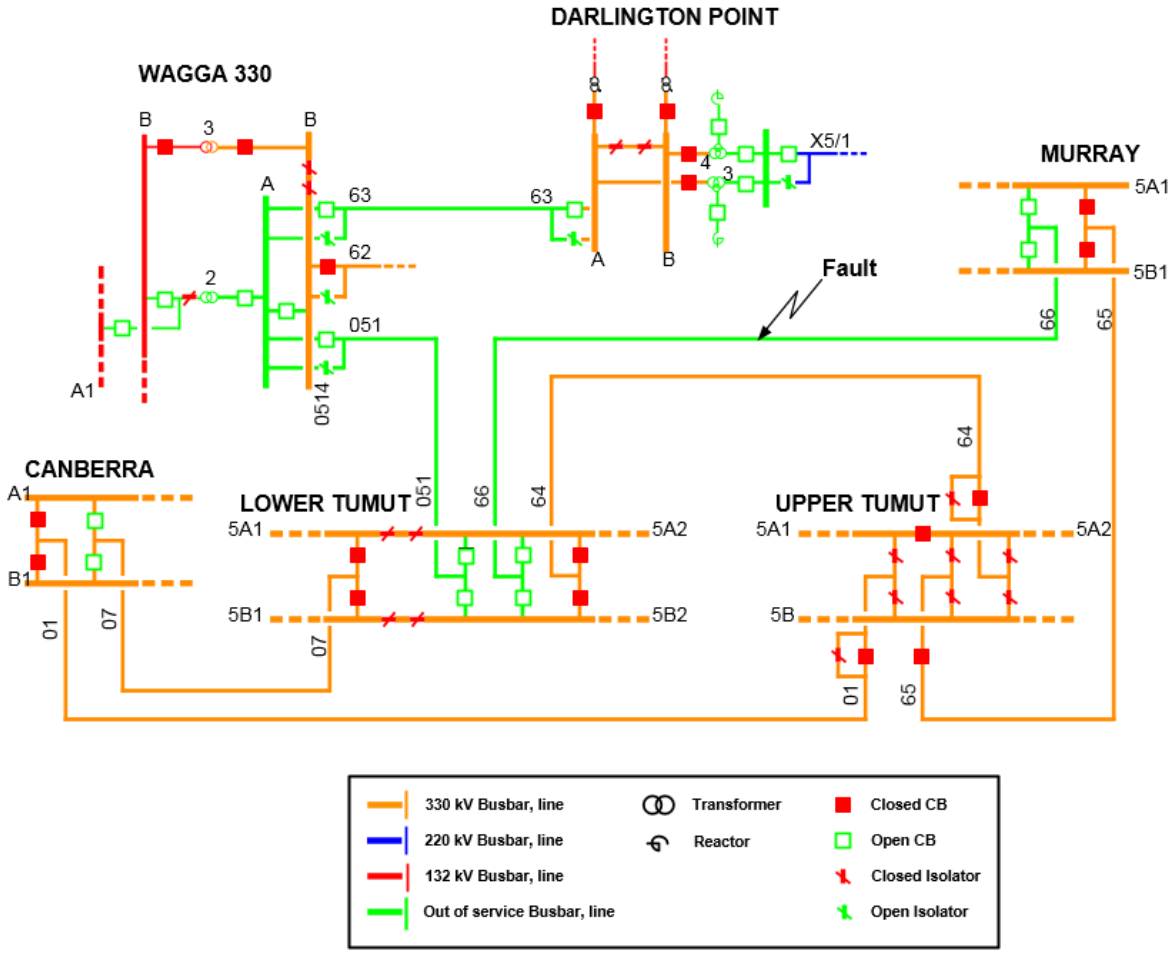
AEMO has assessed this incident in accordance with clause 4.8.15of the NER. In particular, AEMO has assessed the adequacy of the provision and response of facilities or services, and the appropriateness of actions taken to restore or maintain power system security.

AEMO has concluded that:

1. The Lower Tumut – Murray 66 330 kV transmission line (66 line) tripped at approximately 2123 hrs due to a fault likely caused by either wind-blown debris or lightning. Protection operated correctly to clear the fault on this line.
2. The fault on 66 line was seen at both Canberra and Wagga Substations and due to protection mal-operation at each site, the Canberra – Lower Tumut 07 330 kV transmission line (07 line) and the Wagga A 330 kV busbar tripped instantaneously.
3. The trip of the Wagga A 330 kV busbar offloaded the Darlington Point – Wagga 63 330 kV transmission line (63 line), the Lower Tumut – Wagga 051 330 kV transmission line (051 line), and the Wagga No.2 Transformer and operated the Darlington Point X5 trip scheme, de-energising the Darlington Point 220 kV busbar and offloading the Darlington Point – Balranald X5/1 220 kV transmission line (X5/1 line), Darlington Point No.3 Transformer, and Darlington Point No.4 Transformer.
4. The power system was not in a secure operating state between 2123 hrs and 2241 hrs (78 minutes). Power system security was restored at 2241 hrs on 11 February via radialisation of the NSW south west 132 kV network.
5. AEMO reclassified the simultaneous trip of 051 line, 66 line and 07 line as credible from 0445 hrs on 12 February (cancelled at 1142 hrs). However it would have been more appropriate to do so earlier when 07 and 66 lines were returned to service from 2157 hrs on 11 February, and add 051 line when this was returned to service at 0118 hrs.
6. TransGrid has replaced or repaired all known faulty elements that resulted in the protection mal-operation, and has initiated programs to replace similar elements in their network.

# APPENDIX A. – POWER SYSTEM DIAGRAM

The power system immediately after the incident (prior to the trip of 64 line)



# APPENDIX B. – INCIDENT EVENT LOG

## Chronological Log of Incident

| Time and Date | Event |
|---|---|
| **Pre event** | Wagga North – Murrumbah 991 132 kV line out of service. |
| **11 February 2017 21:22:46-9** | Fault on 66 line, 66 line trip at both ends, 07 line trip at Canberra end only.<br>051 line trip. Wagga A busbar de-energised (offloading 051 line, 63 line, Wagga No.2 Transformer, bus coupler CB 4022 at Wagga)<br>63 line trip, initiating Darlington Point 220 kV Split Scheme. Darlington Point 220 kV busbar de-energised (Darlington Point No.3 transformer, Darlington Point No.4 transformer, X5/1 line)<br>Power system not in a secure operating state |
| **21:22:52** | Autoreclose on 66 line failed. |
| **21:23:04** | Fault on 64 line, 64 line trip. |
| **21:23:19** | Autoreclose on 64 line failed. |
| **21:23:05** | 051 line CB 0512B at Lower Tumut Substation reclosed and immediately opened. The auto-reclose cycle of this CB continued until 21:54. |
| **21:34:17** | 07 line returned to service. |
| **21:40** | Following constraint sets invoked:<br>• N-LTWG_RADIAL<br>• N-UR_ZERO<br>• N-WAGGA_330_BUSA<br>• V-DBUSS_L<br>• V-DBUSS_T |
| **21:45** | Constraint set N-LTUT_30M invoked |
| **21:50** | Constraint set I-LTMS invoked. |
| **21:54** | CB 0512B hunting cycle stopped via de-energisation of Lower Tumut B Busbar (CB 072B and 032B opened) |
| **21:55** | Reclose attempt on 64 line, tripped on closing. |
| **21:57** | 66 line returned to service. |
| **22:05** | Constraint set I-LTMS revoked |
| **22:31** | Switching to radialise 132 kV Wagga area begins:<br>• ANM - Wagga 996 132kV line opened at Wagga<br>• Finley - Mulwalla 9R4 132kV line opened at Finley<br>• Wagga132 – Yass 990 132kV line opened at Yass<br>• Murrumbarah - WaggaNth 991 132kV line already de-energised<br>• Gadara – Tumut132 99P 132kV line at Gadara |
| **22:35** | Market Notice 57439 issued |
| **22:41** | Switching to radialise 132 kV Wagga area complete, power system returned to secure state. |
| **23:01** | Wagga No.2 transformer returned to service, and Wagga A bus re-energised.<br>Constraint set N-Wagga_330_BUSA remains invoked to manage continued outage of 051 line and 63 line. |
| **23:28** | Market Notice 57440 issued |
| **23:31** | Market Notices 57441 and 57442 issued |
| **23:32** | Market Notice 57444 issued |
| **12 February 2017 01:09** | Lower Tumut B busbar re-energised (CB 032B and 072B closed). |
| **01:18** | 051 line returned to service via Lower Tumut Substation (CB 0512A closed, CB 0512B isolated). |

| Time and Date | Event |
|---|---|
| **01:25** | Following constraint sets revoked:<br>• N-LTWG_RADIAL<br>• N-UR_ZERO<br>• N-WAGGA_330_BUSA<br>Following constraint sets invoked:<br>• N-DPWG_63_X5<br>• N-X_WGYS_132_OPEN |
| **02:03** | Market Notice 57447 issued |
| **02:04** | Market Notices 57448 and 57449 issued |
| **02:20** | Following constraint sets revoked:<br>• V-DBUSS_L<br>• V-DBUSS_T |
| **03:34** | 63 line returned to service. |
| **03:37** | X5/1 line returned to service (Darlington Point busbar re-energised). |
| **03:45** | Following constraint sets revoked:<br>• N-DPWG_63_X5<br>• N-X_WGYS_132_OPEN |
| **03:46** | Market Notice 57457 issued |
| **03:47** | Wagga 132 kV area made solid. |
| **04:54** | Market Notice 57458 issued |
| **10:14** | Market Notice 57464 issued |
| **12:18** | Market Notice 57468 issued |
| **2 March 2017 12:22:34** | 64 line returned to service. |