



TRIP OF MUDGEERABA No.2 AND No.4 110 KV BUSBARS ON 24 OCTOBER 2017

REVIEWABLE OPERATING INCIDENT REPORT UNDER THE
NATIONAL ELECTRICITY RULES

Published: **13 February 2018**





INCIDENT CLASSIFICATIONS

Classification	Detail
Time and date of incident	1511 hrs Tuesday 24 October 2017
Region of incident	Queensland
Affected regions	Queensland & New South Wales
Event type	Transmission equipment failure
Generation impact	26 MW of generation was lost.
Customer load impact	111 MW of customer load lost
Associated reports	Nil



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.

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CONTENTS

1. OVERVIEW	5
2. PRE-INCIDENT CONDITIONS	5
3. THE INCIDENT	5
4. POWERLINK INVESTIGATION	6
5. POWER SYSTEM SECURITY	6
5.1 Reclassification	7
6. MARKET INFORMATION	7
7. CONCLUSIONS	7
APPENDIX A. POWER SYSTEM DIAGRAMS	8
A.1 Prior to the incident	8
A.2 Immediately after the incident	9
APPENDIX B. SEQUENCE OF EVENTS	10

1. OVERVIEW

This report relates to a reviewable operating incident¹ that occurred on 24 October 2017 at the Mudgeeraba substation in Queensland. This incident involved the trip of the No.2 and No.4 110 kV busbars (110 kV 2/4 busbar) at Mudgeeraba, and occurred during planned switching of circuit breaker (CB) 78392 at Mudgeeraba.

There was a loss of 26 MW of generation and 111 MW of customer load as a result of this incident.

As this was 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 security².

AEMO has concluded that:

- The root cause of the fault was an internal mechanical failure of CB 78392 at Mudgeeraba.
- All protection systems operated correctly for this fault.
- The power system remained in a secure operating state during this incident.

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 Powerlink³ and from AEMO Energy Management Systems.

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

2. PRE-INCIDENT CONDITIONS

Immediately prior to this incident, 110 kV Feeder F839 from Mudgeeraba to Varsity Lakes (F839) was out of service for planned work by Energex. CB 78392 was open at Mudgeeraba.

Also as part of planned project work by Powerlink, all in service 110 kV transmission lines were switched to the 110 kV 2/4 busbar at Mudgeeraba.

Appendix A1 provides an overview of the Mudgeeraba substation and surrounding transmission network prior to the incident.

3. THE INCIDENT

On completion of the planned work by Energex, CB 78392 at Mudgeeraba was closed at 1443 hrs on 24 October 2017. At 1512 hrs, a fault developed internal to this CB, resulting in operation of the 110 kV 2/4 busbar protection tripping both busbars and all 110 kV transmission lines and transformers connected to these busbars.

This resulted in a loss of 111 MW of load at Mudgeeraba, Varsity Lakes, Burleigh Heads, and Terranora. The loss of the Mudgeeraba to Terranora 757 and 758 110 kV transmission lines also resulted in the outage of the Terranora interconnector and Directlink⁴. The Condong generating unit also tripped from 26 MW, due to the loss of supply to Terranora. (Refer to Appendix A2 for an overview of the Mudgeeraba substation and surrounding transmission network immediately after the incident.)

The 110 kV 2/4 busbar and associated transformers and transmission lines was restored by 1543 hrs on 24 October 2017. All load was restored by 1543 hrs on 24 October 2017. Directlink was returned to service at 1649 hrs on 24 October 2017.

After repairs to CB 78392, F839 was returned to service at 1602 hrs on 28 October 2017.

¹ See NER clause 4.8.15(a)(1)(i), as the event relates to a non-credible contingency event; and the AEMC Reliability Panel Guidelines for Identifying Reviewable Operating Incidents.

² See NER clause 4.8.15(b).

³ Powerlink is the transmission network service provider (TNSP) in the Queensland region.

⁴ Directlink is a DC connection between Terranora and Mullumbimby in New South Wales.



Appendix B provides a detailed sequence of events for this incident.

The reason for investigating this incident is that the probability of a busbar trip is very low, and is thereby an unexpected event known in power system security terms as a non-credible contingency⁵.

4. POWERLINK INVESTIGATION

The following is based on information provided by Powerlink as transmission network service provider (TNSP) of the area in question.

At 1512 hrs on 24 October 2017, the 110 kV 2/4 busbar at Mudgeeraba tripped as a result of the operation of the 110 kV 2/4 busbar protection systems.

The 110 kV 2/4 busbar protection systems operated due to a high voltage fault internal to CB 78392 at Mudgeeraba, resulting in the trip of the 110 kV 2/4 busbar. Due to the 110 kV busbar configuration at Mudgeeraba at the time of the fault, this also resulted in the trip of all 110 kV transmission lines connected to Mudgeeraba substation.

Operation of the 110 kV 2/4 busbar protection was an expected outcome for this type of fault.

The trip of the Mudgeeraba – Terranora 757 and 758 transmission lines resulted in the trip of Directlink due to loss of AC supply to Terranora⁶.

An investigation into the cause of the trip determined a high voltage internal fault in CB 78392 developed during a planned close operation on the CB. When the CB was closed at 1443 hrs, only the 'A' and 'C' phases closed successfully. The 'B' phase experienced a mechanical fault which subsequently resulted in a high voltage phase to ground fault at 1512 hrs.

Further analysis of the mechanical failure was undertaken and advice from the manufacturer is that the root cause of the failure is related to an assembly issue. The manufacturer advised this is an extremely rare one-off event and not a systemic issue with the type of CB.

5. POWER SYSTEM SECURITY

AEMO is responsible for power system security in the 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 NER⁷.

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

The power system was in a secure operating state prior to this event and remained in a secure operating state immediately after the event. No action was required by AEMO to restore or maintain power system security.

Due to the outage of the Terranora interconnector and Directlink, AEMO invoked constraint sets I-TE_ZERO⁸ and N-X_MBTE_3⁹ to ensure correct market outcomes.

⁵ NER Clause 4.2.3 – Credible and non-credible contingency events; *AEMO Power System Security Guidelines*, Section 10 – Definition of a non-credible contingency event.

⁶ Directlink, being a DC interconnector cannot operate unless an AC supply is available at both ends.

⁷ 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.

⁸ Out=Terranora Interconnector.

⁹ Out=all 3 Directlink cables.

5.1 Reclassification

AEMO assessed whether or not to reclassify the event as a credible contingency¹⁰.

AEMO was advised by Powerlink that the cause of the incident had been identified and the failed equipment had been isolated prior to restoration of any plant. As such, AEMO correctly did not classify this non-credible contingency as a credible contingency event.

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 market¹¹ over the course of this incident.

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

- A non-credible contingency event – notify within two hours of the event¹².
 - AEMO issued Market Notice 59591 at 1618 hrs, 67 minutes after the event.
- Constraints invoked with interconnector terms on the LHS¹³.
 - AEMO issued Market Notice 59591 at 1618 hrs, 67 minutes after the event.

Over the course of this incident AEMO issued appropriate, timely, and sufficiently detailed market information.

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:

- The root cause of the fault was an internal mechanical failure of CB 78392 at Mudgeeraba.
- All protection systems operated correctly for this fault.
- The power system remained in a secure operating state during this incident.

¹⁰ 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.

¹¹ AEMO generally informs the market about operating incidents as they progress by issuing Market Notices – see AEMO website: <http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Market-notice-and-events>.

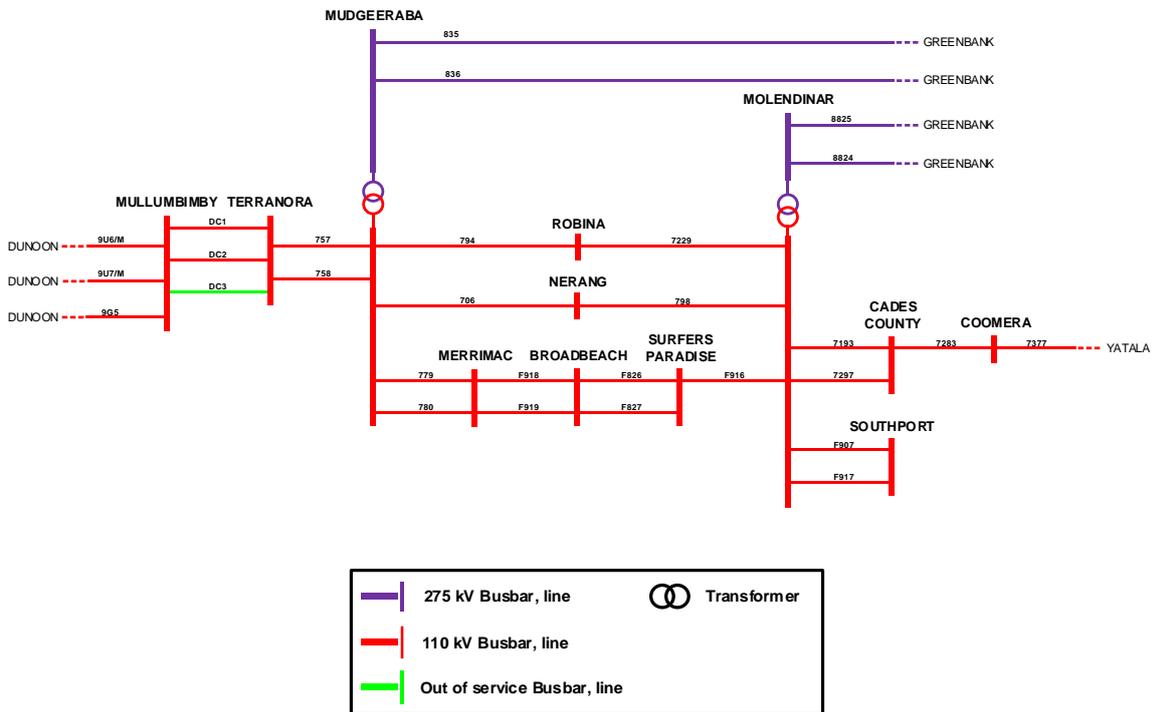
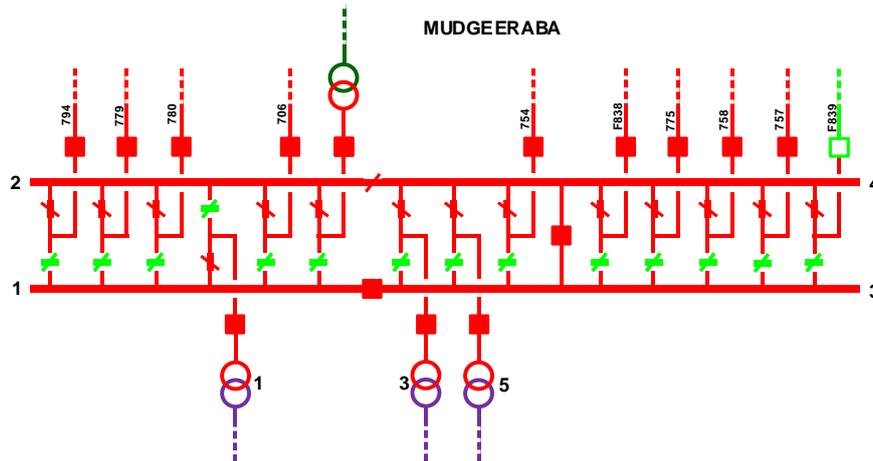
¹² AEMO is required to notify the Market of a non-credible contingency event within two hours of the event – AEMO, *Power System Security Guidelines*, Section 10.3.

¹³ For short-term outages AEMO is required to notify the market of variances to interconnector transfer limits – AEMO, *Power System Security Guidelines*, Section 22.

APPENDIX A. POWER SYSTEM DIAGRAMS

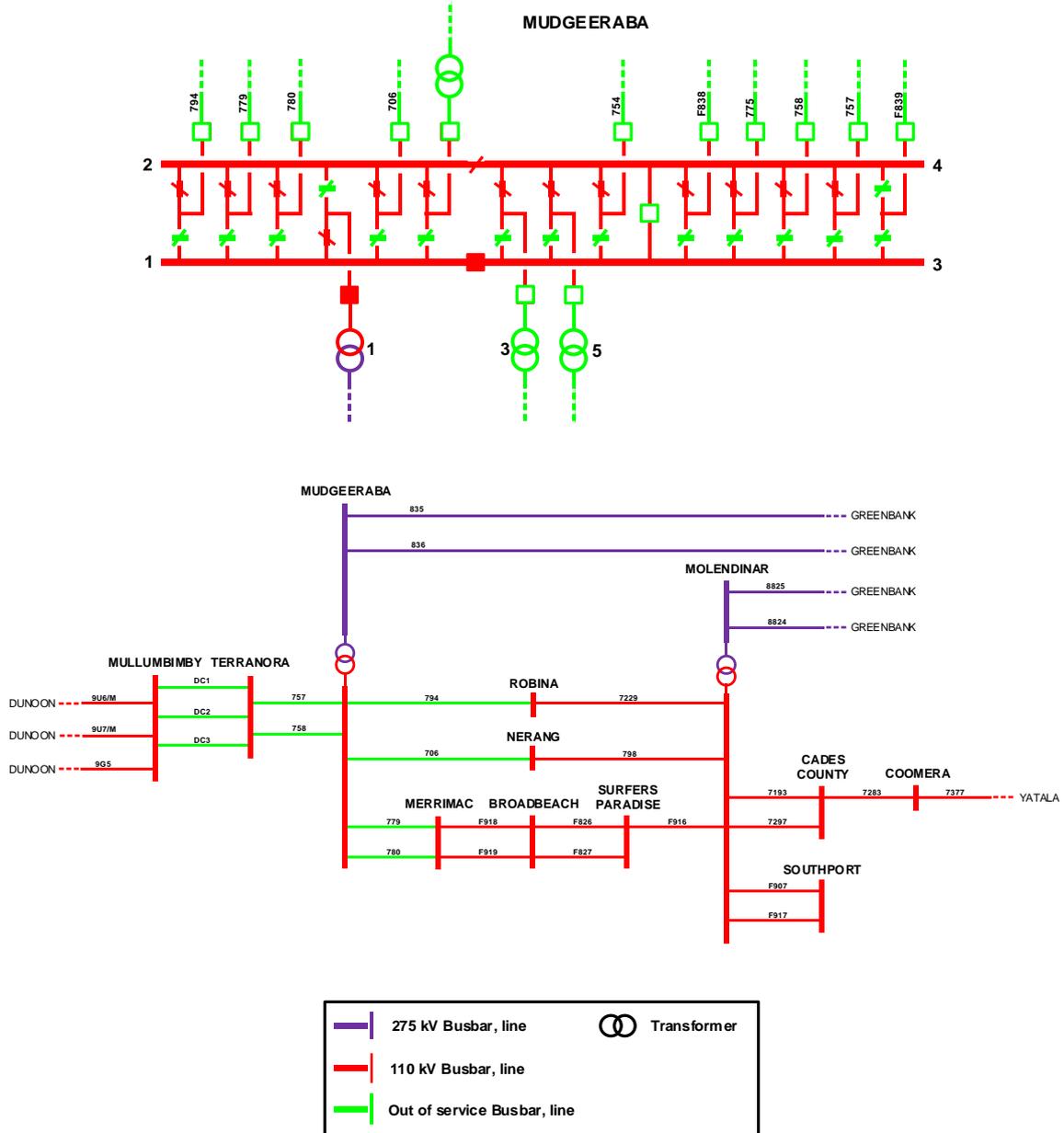
A.1 Prior to the incident

The figures below show the Mudgeeraba substation and surrounding transmission network prior to this incident.



A.2 Immediately after the incident

The figures below show the Mudgeeraba substation and surrounding transmission network immediately after this incident.





APPENDIX B. SEQUENCE OF EVENTS

Time hh:mm	Events/comments
24/10/2017 14:42	CB 78392 was closed during the restoration of planned outage of Mudgeeraba – Varsity Lakes F839 110 kV Line.
15:11	<p>Internal high voltage fault occurred on CB 78392.</p> <p>Bus protection operated and tripped No.2 and No.4 110 kV buses at Mudgeeraba, offloading/de-energising the following equipment:</p> <ul style="list-style-type: none"> • 757 Terranora – Mudgeeraba • 758 Terranora – Mudgeeraba • 794 Mudgeeraba – Robina • 779 Mudgeeraba – Merrimac • 780 Mudgeeraba – Merrimac • 706 Mudgeeraba – Nerang • 754 Mudgeeraba – Burleigh • F838 Mudgeeraba – Varsity Lakes • 755 Mudgeeraba – Burleigh • Mudgeeraba 4T 110/33 kV Transformer • Mudgeeraba 3T 275/110 kV Transformer • Mudgeeraba 5T 275/110 kV Transformer <p>111 MW of load lost at Mudgeeraba, Varsity Lakes, Burleigh Heads, and Terranora.</p>
15:11	Directlink DC1 and DC2 tripped due to loss of supply from Terranora. Directlink was transferring approximately 110 MW prior to the trip.
15:20	Constraint set I-TE_ZERO was invoked.
15:27	Faulted CB 78392 was disconnected from the system.
15:32	Mudgeeraba 110 kV buses were energised.
15:40	Constraint set N-X_MBTE_3 was invoked as restoration of the AC network was commencing from Mudgeeraba towards Directlink.
15:43	Powerlink confirmed that all TNSP switching to restore load was complete.
15:50	Constraint set I-TE_ZERO was revoked.
16:18	Market Notice 59591 (Non-credible contingency event – Mudgeeraba 110 kV bus – Queensland region – 24 October 2017) was issued.
16:49	Directlink DC1 and DC2 were restored.
16:55	Constraint set N-X_MBTE_3 was revoked.
28/10/2017 16:02	<p>Repair to faulted CB 78392 completed.</p> <p>CB 78392 and F838 Mudgeeraba – Varsity Lakes returned to service.</p>