
Trip of the Wodonga Terminal Station No. 1 and No. 2 330 kV transformers on 8 September 2020

February 2021

Reviewable Operating Incident Report under the
National Electricity Rules

INCIDENT CLASSIFICATIONS

Classification	Detail
Time and date of incident	0839 hrs on 8 September 2020
Region of incident	Victoria
Affected regions	Victoria
Event type	Protection mal-operation
Generation Impact	No loss of generation
Customer Load Impact	44 MW lost at Wodonga Terminal Station
Associated reports	Nil

ABBREVIATIONS

Abbreviation	Term
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time
kV	Kilovolt
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 reasonable effort to ensure the quality of the information in this report but cannot guarantee its accuracy or completeness. Any views expressed in this report may be based on information given to AEMO by other persons.

Accordingly, to the maximum extent permitted by law, AEMO and its officers, employees and consultants involved in the preparation of this report:

- make no representation or warranty, express or implied, as to the currency, accuracy, reliability or completeness of the information in this document; and
- are not liable (whether by reason of negligence or otherwise) for any statements or representations in this document, or any omissions from it, or for any use or reliance on the information in it.

COPYRIGHT

© 2021 Australian Energy Market Operator Limited. The material in this publication may be used in accordance with the copyright permissions on AEMO's website.

CONTACT

If you have any questions or comments in relation to this report, please contact AEMO at system.incident@aemo.com.au.

Contents

1.	Overview	5
2.	The incident	5
2.1	Pre-incident conditions	5
2.2	The incident	5
2.3	Analysis	6
3.	Power system security	7
3.1	Reclassification	7
4.	Market information	7
5.	Conclusions	8
6.	Recommendations	8

1. Overview

This report relates to a reviewable operating incident¹ that occurred on 8 September 2020 in Victoria. The incident involved the trip of the No. 1 and No. 2 330/66/22 kilovolt (kV) transformers (No. 1 transformer and No. 2 transformer) at Wodonga Terminal Station (WOTS), resulting in the loss of the No. 1 and No. 2 330 kV busbars (No. 1 busbar and No. 2 busbar) at WOTS and disconnection of the Dederang – Wodonga (DDTS-WOTS) and Wodonga – Jindera (WOTS-Jindera) 330 kV lines.

There was no loss of generation as a result of this incident, however 44 MW of customer load was lost at WOTS.

As this was a reviewable operating incident, AEMO is required 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 security².

AEMO has concluded that:

1. The No. 1 and No. 2 transformers tripped due to the unexpected operation of their respective 'X' protection systems.
2. The 'X' transformer protection systems operated unexpectedly for a 66 kV feeder fault due to the application of incorrect protection settings.
3. The power system remained in a secure operating state throughout this incident.
4. AEMO correctly determined that reclassification of the loss of both the No. 1 and No. 2 transformers as a credible contingency event was not required.

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 AusNet Services³ (AusNet) and AEMO.

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

2. The incident

2.1 Pre-incident conditions

At the time of this incident, all substation equipment at WOTS was in service.

2.2 The incident

At 0839 hrs on 8 September 2020, a fault occurred on the WOTS to Wodonga (WO) 66 kV line. The 66 kV protection systems operated as expected to clear this fault. Coincident with the WOTS 66 kV line fault, the No. 1 and No. 2 WOTS transformers unexpectedly tripped via their respective X differential protection. As there are no circuit breakers between the transformer high voltage (HV) windings and the 330 kV busbars at

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.

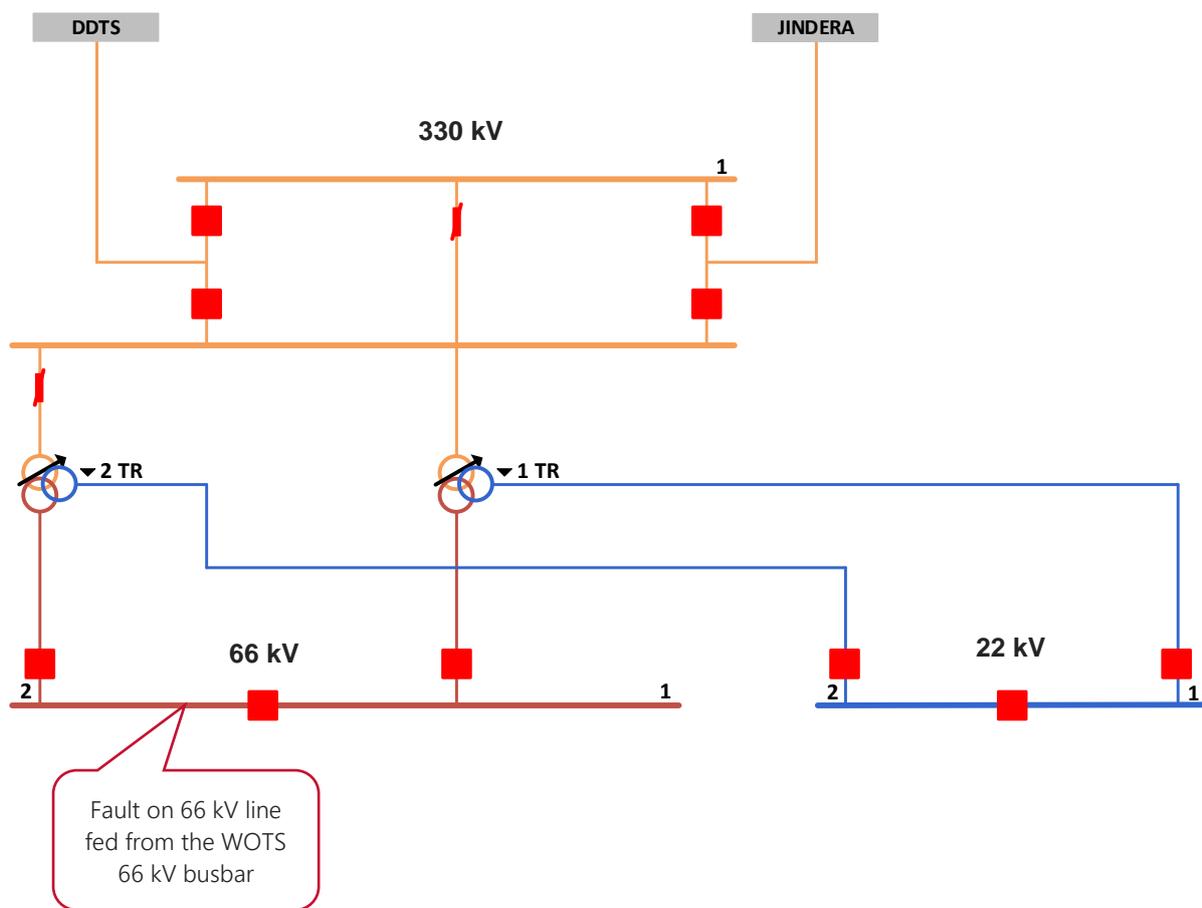
² See NER clause 4.8.15(b).

³ AusNet Services is a transmission network service provider (TNSP) for Victoria.

WOTS (see Figure 1 for the WOTS layout), this transformer trip caused the disconnection of the WOTS No. 1 and No. 2 330kV busbars, and the DDTS-WOTS and WOTS-Jindera 330kV lines.

At 0851 hrs on 8 September 2020, the DDTS-WOTS and WOTS-Jindera lines were returned to service. The No. 1 and No. 2 transformers were restored at 0954 hrs and 0956 hrs respectively on 8 September 2020 with the 'X' protection systems for both transformers isolated. The restoration of the No. 1 WOTS transformer restored supply to the customer load which was disconnected as a result of this incident. Supply was restored to the customer load around 63 minutes after the load had originally been disconnected. Updates to the 'X' protection settings were made on 9 September 2020 and these protection systems were then placed into service. The WOTS-WO 66 kV line was patrolled but no fault was found.

Figure 1 Substation topology at WOTS



2.3 Analysis

The following is based on information provided by AusNet.

A fault occurred on the WOTS to Wodonga (WO) 66 kV line, and the 66 kV protection systems operated as expected to clear this fault. Coincident with the WOTS 66 kV line fault, the No. 1 and No. 2 WOTS transformers tripped via their respective X differential protection.

The operation of the 'X' transformer protection was unexpected, and Ausnet has determined it was due to incorrect protection settings.

The 'X' protection settings were determined on the basis that a measurement of the power transformer neutral current, via a current transformer (CT) in the transformer neutral, was used as an input to the protection relay. However, at WOTS there is no CT in the transformer neutral connection. The absence of the expected neutral current measurement resulted in the protection operating unexpectedly for an out of zone

earth fault. The substation topology at WOTS meant the tripping of the transformers disconnected the No. 1 and No. 2 busbars and the DDTs-WOTS and WOTS-Jindera lines (see Figure 1).

The No. 1 and No. 2 transformers were restored to service approximately 90 minutes after the initial trip, but with the 'X' protection systems isolated on both transformers. Since the occurrence of this incident, AusNet advised that the transformer 'X' protection settings at WOTS have been corrected to take into consideration the fact that no neutral CT is available, thereby avoiding a recurrence of this event in future. This correction occurred on 9 September 2020, at which point the 'X' protection on the No. 1 and No. 2 transformers was placed into service.

AusNet Services has advised it is conducting an audit of protection settings to ensure similar issues do not exist elsewhere.

3. 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 NER⁴.

The power system was in a secure operating state throughout this incident. However, the incident involved the loss of the 330 kV DDTs-WOTS and WOTS-Jindera lines, which required disabling the DBUSS Line and DBUSS Transformer special protection schemes at DDTs⁵. This action necessitated invoking constraint sets V-DBUSS_L and V-DBUSS_T, which are further discussed in Section 4. No further action was required by AEMO to restore or maintain power system security.

3.1 Reclassification

AEMO assessed whether to reclassify this incident as a credible contingency event⁶.

Prior to restoring the out of service equipment at WOTS, AusNet advised AEMO that the cause of the incident had been identified as an unexpected protection operation and precautions had been put in place to avoid recurrence of the event (in particular the isolation of the 'X' transformer protection systems). Based on this advice, AEMO determined the incident was unlikely to reoccur and therefore correctly determined that reclassification as a credible contingency event was not required.

4. 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 market⁷ over the course of this incident.

For this non-credible contingency event, AEMO was required to notify the market on the following matters:

⁴ 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 The DBUSS schemes are designed to split the 330 kV busbars at Dederang in response to specific contingencies to prevent post-contingent overloading of transmission lines or transformers at Dederang. The scheme is required to be disabled under certain power system conditions.

⁶ AEMO is required to assess whether or not to reclassify a non-credible contingency event as a credible contingency event – NER clause 4.2.3A(c) – and to report how the reclassification criteria were applied – NER clause 4.8.15(ca).

⁷ AEMO generally informs the market about operating incidents as the progress by issuing Market Notices – see <https://www.aemo.com.au/Market-Notices>.

1. A non-credible contingency event – notify within two hours of the event⁸.
 - AEMO issued Market Notice 77594 at 0929 hrs on 8 September 2020, 48 minutes after the event, to advise of the non-credible contingency event.
2. For unplanned outages, AEMO is required to advise the market of variances to interconnector transfer limits as per section 19 of AEMO’s Power System Security Guidelines.
 - Although AEMO invoked constraint sets V-DBUSS_L and V-DBUSS_T which contain constraint equations with interconnector terms⁹ on the left hand side (LHS), AEMO did not include this information in Market Notice 77594. These constraints did not bind and therefore had no impact on market outcomes for the duration of the outage.

While AEMO did not meet the requirements of Section 19 of the Power System Security Guidelines for this event, AEMO has formed a view that this type of market notice may no longer be required or provide value to participants, especially when the outage or constraint invocation is of short duration. AEMO, in consultation with market participants, will review the requirement to issue this type of Market Notice, particularly in regard to short term outages with interconnector terms on the LHS. In the meantime, operations staff have been reminded of the continuing requirement to issue a market notice as required by the Power System Security Guidelines.

5. 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. The No. 1 and No. 2 transformers tripped due to the unexpected operation of their respective ‘X’ protection systems.
2. The ‘X’ transformer protection systems operated unexpectedly for a 66 kV feeder fault due to the application of incorrect protection settings.
3. The power system remained in a secure operating state throughout this incident.
4. AEMO correctly determined that reclassification of the loss of both the No. 1 and No. 2 transformers as a credible contingency event was not required..

6. Recommendations

AEMO to review the requirements of Section 19 of the Power System Security Guidelines for short-term outages that require invoking constraints with interconnector terms on the LHS. The expected completion date for this review is October 2021.

⁸ 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, 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.

⁹ Murraylink and Victoria – New South Wales interconnectors.