TRIP OF 330 KV A AND C BUSBARS AT CAPITAL SUBSTATION ON 3 MAY 2017 AND 28 JUNE 2017

REVIEWABLE OPERATING INCIDENT REPORT UNDER THE NATIONAL ELECTRICITY RULES

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AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

INCIDENT CLASSIFICATIONS

Classification	Detail
Time and date of incident	A. 1241 hrs Wednesday 3 May 2017 B. 1810 hrs Wednesday 28 June 2017
Region of incident	New South Wales
Affected regions	New South Wales
Event type	BB – Busbar trip
Generation Impact	A. No generator was disconnected or limited as a result of this incident B. Capital Wind Farm tripped from 25 MW as a result of this incident.
Customer Load Impact	No customer load was disconnected as a result of either incident
Associated reports	Trip of Capital Wind Farm A and C 330kV buses on 27 May 2015

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 two reviewable operating incidents[1] that occurred on 3 May 2017 and 28 June 2017 at Capital substation in New South Wales. Both incidents involved the trip of the A and C 330 kV busbars and were caused by procedural issues during planned maintenance.

No load or generation was lost as a result of the incident on 3 May. Capital Wind Farm tripped from 25 MW when the busbars tripped on 28 June, and no load was lost.

As reviewable operating incidents, 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 security.[2]

AEMO has concluded that:

1. On 3 May 2017, the Capital A and C 330 kV busbars were inadvertently tripped while performing planned maintenance on the tap changer of the Capital No1 330/33 kV transformer.
2. On 28 June 2017, the Capital A and C 330 kV busbars were inadvertently tripped while reinstating the Woodlawn 330/33 kV transformer[3] following maintenance on its associated Neutral Earthing Transformer.
3. The power system remained in a secure operating state over the course of both incidents.
4. There are no outstanding issues to resolve as a result of these incidents.

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 Infigen Energy[4] and AEMO.

The reason for reviewing these incidents is that there have been three incidents involving the inadvertent trip of Capital A and C busbars within about two years. The trip of Capital A and C busbars is credible for a trip of any of the transformers, due to the network configuration at Capital substation[5]. As each incident involved inadvertent protection operation causing the trip of the busbars, which was not expected in the circumstances, AEMO has reviewed and is reporting on these incidents.

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

2. 3 MAY 2017 INCIDENT

2.1 Pre Event Conditions

Both Woodlawn[6] and Capital Wind Farms[7] were offline on 3 May 2017 for annual high voltage maintenance.

2.2 The Incident

On Wednesday 3 May 2017 at 1214 hrs, maintenance on the tap changer of the No1 330/33 kV transformer at Capital Windfarm resulted in an intertrip signal being sent to trip the A and C busbars at Capital substation.

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

[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] Denoted in the diagram in Appendix A as the No3 transformer
[4] Infigen Energy is the operator of Capital Wind Farm and Woodlawn Wind Farm.
[5] At Capital substation, there are no circuit breakers (CBs) on the 330 kV side of the transformers via which the wind farms connect to the network. See Appendix A for a diagram of the configuration of the network.
[6] Woodlawn Wind Farm consists of 23 x 2.1 MW wind turbines.
[7] Capital Wind Farm consists of 67 x 2 MW wind turbines.

The busbars were returned to service at 1349 hrs on 3 May 2017.

2.3 Infigen Energy investigation

The following information is based on that provided by Infigen Energy.

Infigen Energy found the trip at 1241 hrs at the TransGrid Capital Substation was a result of inadvertent protection operation when maintenance personnel were working on the tap changer associated with the No.1 Transformer at Capital Wind Farm. Maintenance personnel were refilling the tap changer with oil, and this triggered the oil flow switch tripping the protection relay and therefore the busbars at the substation.

The contractor maintenance personnel identified to Infigen Energy that they had not isolated this trip signal as they believed the instrument was not installed in this transformer. All other trip signals from the transformer were isolated before they commenced work.

2.4 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.[8]

For this incident, the power system remained in a secure operating state over the course of the incident and no action was required by AEMO. Power system frequency[9], and voltage[10] remained within limits.

As the tripping of the busbars was an unexpected occurrence for this incident, AEMO treated the incident as a non-credible contingency[11] until AEMO understood that the trip of the busbars was as a result of the trip of the transformer. AEMO issued Market Notice 58465 at 1321 hrs accordingly to notify the market that a non-credible contingency event had occurred. At 1340 AEMO received information from TransGrid[12] and issued Market Notice 58467 at 1425 hrs to notify the market that AEMO was satisfied that the cause had been identified and the incident was unlikely to reoccur.

2.5 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[13] over the course of this incident.

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

1. A non-credible contingency event - notify within two hours of the event.[14]

   AEMO issued Market Notice 58465 at 1321 hrs – 40 minutes after the event

2. Updates to the non-credible contingency event – as information becomes available[15]

   AEMO issued Market Notice 58467 at 1425 hrs – 104 minutes after the event with information that the cause of the non-credible contingency event has been identified and AEMO was satisfied that another occurrence of this event is unlikely under the current circumstance.

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

[8] 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
[9] Operating Frequency Tolerance Band specified in AEMC Reliability Panel Frequency Operating Standards
[10] NER Schedule 5.1a System Standards Clause S5.1a.4 - Power frequency voltage
[11] The probability of a busbar fault is very low and is thereby an unexpected event, known in power system security terms as a non-credible contingency – NER Clause 4.2.3 - Credible and non-credible contingency events; AEMO, *Power System Security Guidelines,* Section 10.
[12] TransGrid is the Transmission Network Service Provider in the region.
[13] AEMO generally informs the market about operating incidents as the progress by issuing Market Notices – see AEMO website
[14] 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
[15] AEMO is required to notify the Market as it becomes aware of new and material information – NER Clause 4.2.3A(d)

3. 28 JUNE 2017 INCIDENT

3.1 Pre Event Conditions

Woodlawn Wind Farm was offline on 28 June 2017 for maintenance.

Capital Wind Farm was generating 25 MW immediately prior to the incident.

3.2 The Incident

On Wednesday 28 June 2017 at 1810 hrs, the Woodlawn Wind Farm transformer was reinstated after maintenance. However, an active trip signal had not been properly reset prior to reinstatement and resulted in an intertrip signal being sent to trip the A and C busbars at Capital substation.

Capital Wind Farm tripped from 25 MW. The power system ended up in the same configuration as the incident on 3 May 2017, see Appendix A.

The busbars were returned to service at 0141 hrs on 29 June 2017.

3.3 Infigen Energy investigation

The following information is based on that provided by Infigen Energy.

The Woodlawn Wind Farm Neutral Earthing Transformer had been isolated for oil filtering. Following completion, the transformer was slightly over-pressurised during testing, leading to the pressure trip switch on the transformer activating.

Maintenance personnel took action to reset the switch, however there was a cover over the switch, meaning it was not clear to them that a further mechanism required resetting to remove the trip signal to the protection relay prior to re-instatement. Hence, when the trip links to TransGrid were closed at 1810 hrs as part of the re-instatement of the plant, the trip signal was still active and the TransGrid breakers were opened as per normal protection operation, clearing busbars A and C.

3.4 Power System Security

For this incident, the power system also remained in a secure operating state over the course of the incident and no action was required by AEMO. Power system frequency[16], and voltage[17] remained within limits.

For this incident, AEMO correctly assessed the trip of the busbars as credible for a trip of the transformer with regard to the configuration of Capital substation. AEMO appropriately communicated with TransGrid to confirm the trip of the busbar was due to a fault on the transformer. AEMO was satisfied that the cause had been identified and that the incident was unlikely to reoccur in current circumstances.

3.5 Market Information

No Market Notices were issued for the incident on 28 June 2017 as the trip of the busbars was assessed as credible.

4. PREVIOUS INCIDENT

Another similar event had occurred at Capital substation on 27 May 2015 during the annual high voltage maintenance. In this case, transformer overcurrent protection was inadvertently triggered. After this event, to prevent similar issues from occurring again, Infigen Energy modified their test procedures

[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

to ensure the protection trip links are opened prior to the connection of any test equipment. However, these procedures did not cover work of the type that resulted in the trips in 2017.

As a result of the 3 May 2017 incident, Infigen Energy has further modified its procedures to require job procedures to identify all required protection isolations for any activity. All isolation of HV protection functions will also be incorporated into any switching instructions to ensure adequate isolation as well as correct re-instatement.

Further, as a result of the 28 June 2017 incident, Infigen Energy will implement procedures to require maintenance personnel to test the status of trip signal form relays and at the links before reclosing links prior to any future planned maintenance. Additional training for Operators will also be conducted to ensure they are aware of the protective functions and procedures and methods for resetting trips, before any further planned maintenance is carried out.

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. On 3 May 2017, the Capital A and C 330 kV busbars were inadvertently tripped while performing planned maintenance on the tap changer of the Capital No1 330/33 kV transformer.
2. On 28 June 2017, the Capital A and C 330 kV busbars were inadvertently tripped while reinstating the Woodlawn 330/33 kV transformer following maintenance on its associated Neutral Earthing Transformer.
3. The power system remained in a secure operating state over the course of both incidents.
4. There are no outstanding issues to resolve as a result of these incidents.

APPENDIX A. – POWER SYSTEM DIAGRAM

The power system immediately after the incident