TRIP OF HORSHAM-REDCLIFFS 220 KV TRANSMISSION LINE AND MURRAYLINK INTERCONNECTOR ON 12 NOVEMBER 2015

AN AEMO POWER SYSTEM OPERATING INCIDENT REPORT FOR THE NATIONAL ELECTRICITY MARKET

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AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

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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INCIDENT CLASSIFICATIONS

Classification	Detail
Time and date of incident	0844 hrs Thursday 12 November 2015
Region of incident	Victoria
Affected regions	Victoria and South Australia
Event type	Protection/control system
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	Nil

ABBREVIATIONS

Abbreviation	Term
AEMO	Australian Energy Market Operator
CB	Circuit Breaker
HOTS	Horsham Terminal Station
kV	Kilovolt
MLRC	Murraylink Red Cliffs (convertor station)
MW	Megawatt
NER	National Electricity Rules
RCTS	Red Cliffs Terminal Station
VFRB	Very Fast Runback (scheme)

CONTENTS

1. OVERVIEW

This report relates to a reviewable operating incident[1] that occurred on Thursday 12 November 2015 that resulted in the unexpected outage of the Murraylink interconnector[2] (Murraylink) between Victoria (VIC) and South Australia (SA) following a transient fault on the Horsham – Red Cliffs (HOTS-RCTS) 220 kV transmission line.

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.[3]

AEMO concluded that:

1. The trip and auto-reclose of the HOTS-RCTS 220 kV transmission line trip was a correct operation likely due to lightning. The Murraylink Very Fast Runback (VFRB) scheme operated correctly in response to the line trip.
2. The trip of Murraylink Red Cliffs WT_Q1 CB was due to the loss of auxiliary supplies to the RCTS end of Murraylink. The reason why neither auxiliary supply was selected by the auxiliary supply control system could not be verified.
    - A subsequent upgrade of the auxiliary supply control system has reduced the probability of complete auxiliary power loss in a similar event.
3. The power system was returned to, and then maintained in, a secure operating state during this event.

This report is based on information provided by APA Group[4], AusNet Services[5], and AEMO.

Australian Eastern Standard Time is used in this report.

2. THE INCIDENT

At 0844 hours on Thursday 12 November 2015, the HOTS-RCTS 220kV transmission line in Victoria tripped and auto reclosed. There was lightning activity in the area at the time. The trip of the HOTS-RCTS transmission line correctly triggered the operation of the Murraylink Very Fast Runback (VFRB) Scheme, which reduced Murraylink flow from 134 MW from Victoria to South Australia to 0 MW. Following the VFRB operation, circuit breaker WT_Q1 at the Murraylink Red Cliffs Converter Station (MLRC) tripped resulting in an outage of Murraylink. This was not an expected outcome.

Murraylink was returned to service at 0943 hrs on 12 November 2015.

No generation or customer load was lost as a result of this 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] Murraylink is a 220 MW direct current interconnector between Red Cliffs in Victoria and Monash in South Australia.
[3] See NER clause 4.8.15(b).
[4] APA Group is the operator of Murraylink
[5] Information provided by AusNet Services has been provided on a without prejudice basis and nothing in this report is intended to constitute, or may be taken by any person as constituting, an admission of fault, liability, wrongdoing, negligence, bad faith or the like on behalf of AusNet Services (or its respective associated companies, businesses, partners, directors, officers or employees).

See Appendix A for a power system diagram illustrating the Murraylink interconnector.

This event is being investigated because it involved the tripping of two transmission elements, which as a simultaneous disruptive event, is classified under the NER as a non-credible contingency event[6]

3. PARTICIPANT INVESTIGATIONS

3.1 AusNet Services investigation

AusNet Services, the Transmission Network Service Provider (TNSP) for Victoria, investigated this incident and provided the following information.

On 12 November 2015 at 0844 hrs the HOTS-RCTS 220 kV transmission line tripped due to a transient two phases to earth fault. The fault was cleared within the mandated clearance times.[7] Following the trip, the line successfully auto-reclosed. This operation was in accordance with system design. The line was patrolled on 15 November 2015 and no cause for the fault was found. Lightning, rain, and high winds were reported in the area at the time of the incident.

Following the trip and auto-reclose of the HOTS-RCTS line, the Murraylink Very Fast Runback (VFRB) scheme operated to reduce the flow on the Murraylink interconnector. This is an expected outcome for a trip of the HOTS-RCTS line. The operation of the VFRB did not directly result in the trip of Murraylink.

Around six seconds after the trip and reclose of the HOTS-RCTS 220kV transmission line, the WT_Q1 circuit breaker at the Red Cliffs end of Murraylink interconnector opened, resulting in Murraylink being unavailable.

3.2 APA Group investigation

APA Group, the owner of Murraylink investigated the trip of the WT_Q1 circuit breaker and found that this incident was due to the loss of auxiliary supplies to the circuit breaker cooling system.

This cooling system relies on two alternative 22 kV power supplies:

- A primary supply from the tertiary winding of the 220/165kV transformer.
- A secondary supply from the 22 kV distribution network.

If the primary supply is unavailable, there is an automatic changeover to the secondary supply. If neither supply is available the circuit breaker is automatically opened following a low flow trip issued by the cooling control system approximately 10 seconds after power is lost.

The reason for the loss of auxiliary power supplies is believed to be under-voltage in both auxiliary supplies however this could not be confirmed by APA.

At the time of the incident there were reports of lightning in the vicinity of Red Cliffs, which may have affected the availability or quality of the auxiliary equipment power supply.

APA Group have subsequently upgraded the older relay logic auxiliary supply control system with a current ABB programmable logic controller. This controller will select the best auxiliary supply to operate on and will not disconnect both supplies regardless of the voltage quality. This modification will reduce the likelihood of an auxiliary controller failure and ensure the cooling pumps continue to operate until the pump circuit breaker trips. This modification has introduced improved reliability and this

[6] NER clause 4.2.3(e).
[7] NER Clause S5.1a.8

improvement will significantly reduce the likelihood of a WT-Q1 CB protection system trip under the same circumstances. APA have also identified that the same problem exists with the auxiliary supplies at the Berri converter station. Given the success of the Red Cliffs modifications, APA will upgrade the auxiliary supply control system in the same manner at Berri by the end of 2016.

4. 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 and return the power system to a secure state following a contingency event. This section assesses how AEMO managed power system security over the course of this incident.[8]

At 0850 hrs, around six minutes after the operation of the Murraylink VFRB scheme, AEMO invoked constraint set I-ML_ZERO.[9] This limit on Murraylink resulted in two constraint equations[10] associated with a planned outage of one of the South East - Tailem Bend 275kV transmission lines violating for a single dispatch interval. The power system was returned to a secure operating state by 0855 hrs, an acceptable 11 minutes after the event occurred. AEMO is required to return the power system to a secure state within thirty minutes following a contingency event.[11]

4.1 Reclassification

After Murraylink had been returned to service, AEMO, in accordance with clause 4.2.3A of the National Electricity Rules, assessed whether or not to reclassify the event as a credible contingency event. For this incident, AEMO was not satisfied that the cause had been identified and therefore was not satisfied that the incident was unlikely to reoccur. As a result, AEMO reclassified the simultaneous trip of the HOTS-RCTS line and Murraylink as a credible contingency event at 1034 hrs on 12 November. The reclassification was cancelled on 15 August 2016.

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[12] over the course of this incident.

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

1. The occurrence of a non-credible contingency event - notify within two hours of the event.[13]
    - AEMO issued Market Notice 50501 at 0928 hrs, 44 minutes after the event.
2. Constraints invoked with interconnector terms on the LHS.

[8] AEMO is responsible for power system security in the NEM and is required to operate the power system in a secure operating state (NER Clause 4.2.4 (a)). AEMO must thereby ensure that the power system is maintained in, or returned to, a secure operating state following a contingency event.
[9] Limits flow on Murraylink to zero in both directions.
[10] V::S_SETB_SETB & V^^S_SETB_SETB – transient and voltage stability limits with a single South East-Tailem Bend line out of service.
[11] AEMO is required to return the power system to a secure state within thirty minutes following a contingency event - NER Clause 4.2.6 (b)
[12] AEMO generally informs the market about operating incidents as the progress by issuing Market Notices – see AEMO website at: http://www.aemo.com.au/Market-Notices.
[13] 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

- AEMO issued Market Notice 50497 at 0853 hrs, nine minutes after the event to advise that constraint set I-ML_ZERO had been invoked.

3. Reclassification of a non-credible contingency event[14] - AEMO is required to advise the market as soon as practicable.
    - AEMO issued Market Notice 50503 at 1034 hrs, 51 minutes after Murraylink was returned to service, to advise the market that the trip of the HOTS-RCTS line and Murraylink WT-Q1 circuit breaker was a credible contingency.
    - AEMO issued Market Notice 54738 on 15 August 2016 to advise that the reclassification had been cancelled.

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

6. 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 concluded that:

1. The trip and auto-reclose of the HOTS to RCTS 220 kV transmission line trip was a correct operation likely due to lightning. The Murraylink Very Fast Runback (VFRB) scheme operated correctly in response to the line trip.
2. The trip of Murraylink Red Cliffs WT_Q1 CB was due to the loss of auxiliary supplies to the RCTS end of Murraylink. The reason why neither auxiliary supply was selected by the auxiliary supply control system could not be verified.
    - A subsequent upgrade of the auxiliary supply control system has reduced the probability of complete auxiliary power loss in a similar event.
3. The power system was returned to, and then maintained in a secure operating state during this event.

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

APPENDIX A. – MURRAYLINK INTERCONNECTOR