Buronga 220 kV isolator failure and trip of multiple transmission elements on 25 July 2022

May 2023

Reviewable Operating Incident Report under the 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.

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Incident classifications

Classification	Detail
Time and date of Incident	25 July 2022 0115 hrs
Region of incident	New South Wales
Affected regions	New South Wales, South Australia and Victoria
Event type	Transmission equipment failure and protection-control system failure or mal-operation
Generation impact	210 MW (Silverton Wind Farm and Kiata Wind Farm)
Customer load impact	40 MW

Abbreviations

Abbreviation	Term
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time
BESS	battery energy storage system
CB	circuit breaker
DNSP	Distribution Network Service Provider
DPV	distributed photovoltaic generation
FFT	fast Fourier transform
FOS	Frequency Operating Standard
GT	gas turbine
HOTS	Horsham Terminal Station
HVDC	high voltage direct current
Hz	hertz
kV	kilovolt/s
MLRC	Murraylink Red Cliffs
MN	Market Notice
ms	millisecond/s
MVAr	megavolt-amperes reactive
MW	megawatt/s
NEM	National Electricity Market
NER	National Electricity Rules
PMU	phasor measurement unit
RCTS	Red Cliffs Terminal Station
RMS	root mean square
SCADA	supervisory control and data acquisition
SCON	synchronous condenser
SVC	static var compensator
SF	solar farm
TNSP	Transmission Network Service Provider

Abbreviation	Term
TS	terminal station
VFRB	very fast run back scheme
WF	wind farm
X2	Buronga – Silverton wind farm 220 kV transmission line
X3	Buronga – Balranald 220 kV transmission line
X5	Balranald – Darlington Point 220 kV transmission line
X6	Broken Hill – Silverton wind farm 220 kV transmission line
X7	Balranald – Sunraysia solar farm 220 kV transmission line
X8	Balranald – Limondale 1 solar farm 220 kV transmission line
0X1	Red Cliffs Terminal Station – Buronga 220 kV transmission line

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1 Overview

This report relates to a reviewable operating incident[1] that occurred on 25 July 2022 following the failure of a 220 kilovolt (kV) isolator at the Buronga substation in south-west New South Wales. The incident involved:

- Trip of multiple transmission lines in the vicinity of the Buronga substation.
- Trip of Murraylink high voltage direct current (HVDC) interconnector.
- Trip of Silverton wind farm (WF) in New South Wales from 179 megawatts (MW).
- Trip of Kiata WF in Victoria from 31 MW.
- Disconnection of 40 MW of load in south-west New South Wales.

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 security[2].

AEMO's conclusions, recommendations and actions arising from its review are summarised in Table 1.

Table 1 Summary of conclusions and recommendations

Finding	Recommendations and actions
The initial trip at Buronga 220 kV busbar was caused by the failure of the Buronga 220 kV isolator X31 on the line side of the blue phase X3 circuit breaker (CB). Transgrid[3] has reviewed the failure mode of the isolator. This is the only known failure of this type on the Transgrid network, and consequently no trends exist based on isolator manufacturer, design, maintenance, or condition. As such Transgrid has confirmed to AEMO that a reoccurrence of the event is unlikely.	None
As isolator X31 is within the Buronga 220 kV busbar protection zone, the Buronga busbar protection correctly operated to clear the fault. Consistent with its design, the busbar protection tripped multiple lines connected to Buronga 220 kV substation, which caused the following control schemes to operate as designed: • Silverton transfer tripping scheme, to avoid islanding of Silverton WF with Broken Hill load. • Balranald fast voltage control scheme, tripping Balranald – Darlington Point 220 kV transmission line (X5) to mitigate overvoltage following trip of the Buronga – Balranald 220 kV transmission line (X3). Post-incident analysis has confirmed that a Buronga 220 kV busbar trip, and subsequent control scheme operation, has the potential to trip/run back greater than 650 MW of generation. Transgrid has reviewed the events surrounding the Buronga busbar outage and has determined that existing constraints adequately cater for the loss of generation within the area.	None

[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] Transgrid is the primary TNSP for New South Wales.

Finding	Recommendations and actions
Murraylink very fast run back scheme (VFRB) was initiated, however the scheme did not reduce Murraylink flow. The scheme then correctly initiated back up trip of Murraylink. AEMO Victorian Planning and AusNet are investigating why Murraylink failed to run back.	• AEMO in conjunction with AEMO Victorian Planning and AusNet[4] finalise review into why Murraylink VFRB failed to run back Murraylink, including any recommended settings changes to runback speed or backup trip time delay settings.
Powercor[5] line overvoltage protection scheme on Horsham Terminal Station (HOTS) to Kiata WF 66 kV line sent a trip signal to the Kiata WF 66 kV circuit breakers after 50 milliseconds (ms) which tripped and disconnected the Kiata WF. Post-incident review by Powercor has confirmed that this trip signal time delay was not correctly set due to a procedural error in the relay settings configuration. Powercor completed an update to the HOTS to Kiata WF 66 kV line overvoltage protection settings on 30 November 2022. In addition, Powercor has updated practices and procedures associated with the setting of protection relay stage 2 overvoltage trip parameters. As this was a procedural error, Powercor is completing an audit of the relay settings at other sites within its network to determine whether overvoltage protection settings changes are required.	• Powercor complete its audit on overvoltage protection settings within its network to identify any additional settings which require update, and share details of any required settings updates with AEMO.
The power system remained in a secure operating state and the Frequency Operating Standard (FOS) was met throughout the incident.	None
AEMO correctly identified that there was no requirement to reclassify this event as a credible contingency.	None
AEMO advised the market of the occurrence of the non-credible contingency within the timeframe indicated in the Power System Security Guidelines.	None
AEMO implemented varied constraint sets which had a non-material impact on transfer limits on the Victoria - New South Wales interconnector. The Power System Security Guidelines (SO_OP_3715)[6] indicate that AEMO should issue a market notice in these circumstances, which did not occur in this case. As many constraint sets are unlikely to cause a material variance to interconnector transfer limits, a materiality threshold for notification may be appropriate.	• During the next review of SO_OP_3715, AEMO will consider whether the section on advice of variance to interconnector transfer limits requires additional clarification, in consultation with the Power System Security Working Group and impacted stakeholder representatives.

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, AusNet, Powercor, and the Kiata WF operator, and data gathered from AEMO systems.

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

2 The incident

2.1 Pre-event conditions

Prior to the event all transmission elements in the south-western New South Wales and north-western Victoria were in service. A diagram of the pre-incident network configuration is shown in Figure 4 of Appendix A1. Table 2

[4] AusNet is the Victorian Declared Transmission System Operator.

[5] Powercor is a Victorian Distribution Network Service Provider (DNSP).

[6] See Section 19 of the Power System Security Guidelines at https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3715%20Power-System-Security-Guidelines.pdf.

summarises key pre-event network conditions of the affected regions. The dispatch conditions for the units disconnected in the incident are listed in Table 3. Prior to the incident, a total of 40 MW of load was connected to Balranald, Broken Hill, Buronga and Silverton substations. Distributed photovoltaic generation (DPV) output was 0 MW as the event occurred at night.

Table 2 Pre-event network conditions

Element	Value (MW)
NSW demand	7,721
SA demand	1,545
VIC demand	4,578

Table 3 Pre-event dispatch

Unit	DUID	Region	Dispatch (MW)	Max. Capacity (MW)
Broken Hill SF	BROKENH1	NSW	0	53
Broken Hill GT	GB01	NSW	0	50
Limondale 1 SF	LIMOSF11	NSW	0	220
Limondale 2 SF	LIMOSF21	NSW	0	29
Silverton WF	STWF1	NSW	179	198
Sunraysia SF	SUNRSF1	NSW	0	200
Kiata WF	KIATAWF1	VIC	31	31

2.2 The incident

At 0115 hrs on 25 July 2022, the X31 isolator at Buronga substation failed, resulting in a 220 kV phase to ground fault on blue phase. Based on the location of the isolator, the Buronga 220 kV busbar tripped, disconnecting 220 kV lines from Buronga to Red Cliffs, Balranald and Broken Hill, and as a result initiated a number of control schemes and subsequent line trips in south-western New South Wales and north-western Victoria as well as the trip of Kiata WF. A total of 40 MW of load was disconnected at Balranald, Broken Hill, Buronga and Silverton substations. Table 4 contains the sequence of events and the network restoration process. A diagram of the post-incident network configuration is shown in Figure 5 of Appendix A1.

Table 4 Sequence of events

Time (hhmm or hh:mm.ss)	Event	Comment
25 July 2022		
01:15.43	The following elements tripped: • Red Cliffs Terminal Station (RCTS) – Buronga 220 kV transmission line (0X1) tripped at the Buronga end only • Buronga – Broken Hill 220 kV transmission line (X2) • Buronga – Balranald 220 kV transmission line (X3) • Buronga synchronous condenser No. 1, No. 2 and No. 3	Due to operation of Buronga 220 kV busbar protection. See Section 2.3.2 for details.

Time (hhmm or hh:mm.ss)	Event	Comment
Approximately 01:15.43	The following elements tripped: • Balranald – Darlington Point 220 kV transmission line (X5) This disconnected the following elements from the power system: • Balranald – Sunraysia solar farm (SF) 220 kV transmission line (X7) • Balranald – Limondale 1 SF 220 kV transmission line (X8) • Sunraysia SF, Limondale 1 SF, Limondale 2 SF, which were not generating at the time	X5 tripped due to operation of the Balranald fast voltage control scheme. This series of trips occurred over a period of approximately 2 seconds. See Section 2.3.3 for details.
01:15.44	• RCTS – Buronga 220 kV transmission line (0X1) tripped at RCTS	Due to operation of Buronga 220 kV busbar protection. See Section 2.3.2 for details.
Approximately 01:15.45	The following elements tripped: • Silverton WF – Broken Hill 220 kV transmission line (X6) • Silverton WF, which was generating 179 MW at the time • Broken Hill SF which was not generating at the time	Due to operation of the Silverton transfer tripping scheme A and anti-islanding protection. This series of trips occurred over a period of approximately 2 seconds. See Section 2.3.4 for details.
01:15.46	• Red Cliffs – Murraylink transmission line and DC link tripped, which was importing 40 MW from VIC to SA at the time	Due to operation of the Murraylink VFRB scheme. See Section 2.3.5 for details.
01:15.46	• Kiata WF tripped, which was generating 31 MW at the time	Due to operation of Powercor line overvoltage protection scheme on HOTS – Kiata WF 66 kV line. See Section 2.3.6 for details.
01:15.49	• RCTS 66 kV 15 Megavolt-amperes reactive (MVAr) reactor No. 2 switched into service • RCTS 66 kV 15 MVAr reactor No. 1 switched into service	Triggered by automatic voltage control. See Section 3.2 for details.
0230	• Murraylink Red Cliffs (MLRC) 220 kV circuit breakers (CBs) at RCTS were reclosed	-
0320	• Balranald – Darlington Point 220 kV transmission line (X5) was returned to service	-
0356	• Kiata WF supply was restored	-
0417	• RCTS – Buronga 220 kV transmission line (0X1) was returned to service at the RCTS end	-
0450 to 0455	The following elements were returned to service: • RCTS – Buronga 220 kV transmission line (0X1) at the Buronga end • Buronga – Broken Hill 220 kV transmission line (X2)	-
0820 to 0845	The following elements were returned to service: • Buronga synchronous condenser No. 1, No. 2 and No. 3 • Silverton WF – Broken Hill 220 kV transmission line (X6) • Balranald – Sunraysia SF 220 kV transmission line (X7) • Balranald – Limondale 1 SF 220 kV transmission line (X8)	-
26 July 2022		
1316	• Buronga – Balranald 220 kV transmission line (X3) was returned to service	-

2.3 Analysis

Based on information provided by registered participants and available from AEMO systems, AEMO has outlined its findings in the following section.

2.3.1 Failure of isolator X31 at Buronga substation

The initial trip of the Buronga 220 kV busbar was caused by the failure of the Buronga – Balranald 220 kV transmission line (X3) isolator X31 (see Figure 1) on the line side of the blue phase. Transgrid has advised that there is insufficient physical evidence left from the isolator to test. Based on the available information, Transgrid concluded isolator X31 most likely failed as it had not locked into place correctly when it was last closed approximately eight months prior. Over time the isolator contacts heated to a point where contact pressure was lost and created a feedback loop where loss of contact pressure created more heat causing further contact pressure loss, and at this point, minor arcing contributed to contact tip erosion, thermal runaway and ultimately isolator failure. This is the only known failure of this type on the Transgrid network, and consequently no trends exist based on isolator manufacturer, design, maintenance, or condition. As such there are no other assets that Transgrid believes are currently at risk of similar failure.

As isolator X31 was located within the Buronga 220 kV busbar protection zone, the protection operated as expected and tripped the Buronga 220 kV busbar to clear the fault (see Section 2.3.2).

Figure 1 Isolator X31 at Buronga 220 kV substation after the incident

2.3.2 Trip of Buronga 220 kV busbar

The trip of the Buronga 220 kV busbar resulted in tripping of the following:

- RCTS – Buronga 220 kV transmission line (0X1) at the Buronga end only.
- Buronga – Broken Hill 220 kV transmission line (X2) at the Buronga end only (no CB at the Broken Hill end).
- Buronga – Balranald 220 kV transmission line (X3) at both ends.
- Buronga Synchronous Condenser No. 1, No. 2 and No. 3.

The trip of the Buronga – Broken Hill 220 kV transmission line (X2) at the Buronga end islanded the following network:

- Buronga – Broken Hill 220 kV transmission line (X2).
- Broken Hill – Silverton WF 220 kV transmission line (X6).
- Silverton WF, which was generating 179 MW at the time.
- Broken Hill SF and Broken Hill gas turbine (GT), which were not generating at the time.

The trip of Buronga – Balranald 220 kV transmission line (X3) caused an increase in voltage at Balranald 220 kV, which triggered the operation of the Balranald fast voltage control scheme (see Section 2.3.3). The islanding of X2/X6 network caused the operation of the Silverton transfer tripping scheme and Silverton WF anti-islanding protection (see Section 2.3.4). The Buronga busbar protection also sent a trip signal to the RCTS end of the RCTS – Buronga 220 kV transmission line (0X1), this caused the Murraylink VFRB, (see Section 2.3.5) to operate.

2.3.3 Balranald fast voltage control scheme operation

As a result of the Buronga – Balranald 220 kV transmission line (X3) trip, the Balranald 220 kV voltage exceeded 1.1 p.u.. In response, the Balranald fast voltage control scheme operated as designed, tripping the Balranald – Darlington Point 220 kV transmission line (X5). The tripping of X5 disconnected the following elements as per the network design:

- Balranald substation 220 kV busbar.
- Balranald – Sunraysia SF 220 kV transmission line (X7).
- Balranald – Limondale 1 SF 220 kV transmission line (X8).
- Sunraysia SF, Limondale 1 SF, Limondale 2 SF, which were not generating at the time.

2.3.4 Silverton transfer tripping scheme and anti-islanding protection

The trip of RCTS – Buronga 220 kV transmission line (0X1), the Buronga – Broken Hill 220 kV transmission line (X2) and the Buronga – Balranald 220 kV transmission line (X3) are all triggers for the Silverton transfer tripping scheme. The scheme operated correctly to these inputs and initiated the trip of the Broken Hill – Silverton WF 220 kV transmission line (X6) (noting X6 was already islanded), the Silverton WF 33 kV circuit breakers and the Broken Hill SF 22 kV circuit breakers.

2.3.5 Murraylink very fast run back scheme (VFRB) operation

The Buronga busbar protection operation sent a trip signal to the RCTS end of the Buronga – RCTS 220 kV transmission line (0X1), and this triggered the Murraylink VFRB. Murraylink did not run back in response to the signal and the scheme then initiated back up tripping and tripped Murraylink. AEMO Victorian Planning and AusNet are presently investigating why Murraylink failed to run back as expected for this event.

2.3.6 Trip of Kiata WF

During this incident, overvoltage was experienced on the HOTS – Kiata WF 66 kV sub-transmission line. After approximately 50 milliseconds (ms), the Powercor line overvoltage protection scheme on HOTS – Kiata WF 66 kV sent an overvoltage trip signal to the 66 kV circuit breakers at Kiata WF tripping the wind farm.

Post-incident investigation by Powercor has confirmed that due to a procedural error the protection design did not include a stage 2 overvoltage trip parameter setting. In this relay type, the absence of a stage 2 overvoltage trip parameter causes the relay to send a trip signal in response to an overvoltage condition (exceeding its settings) after 50 ms. A subsequent protection review has determined that the parameter should have been set to trip Kiata WF after 1 second for an overvoltage above 1.1 p.u..

In response to this incident, the following actions have been or are being taken:

- Powercor completed an update to the HOTS to Kiata WF 66 kV line overvoltage protection settings on 30 November 2022.
- Powercor has updated relevant practices and procedures associated with the setting of protection relay stage 2 overvoltage settings.
- Powercor is completing an audit on the relay settings at other sites within its network to determine whether overvoltage protection settings changes are required.

2.3.7 Potential impact of incident

This incident was initiated by a busbar trip at the Buronga 220 kV substation and directly resulted in disconnection of the Broken Hill SF, Broken Hill GT, Limondale 1 SF, Limondale 2 SF, Silverton WF and Sunraysia SF connection points. During this incident 210 MW of wind generation was disconnected (including 31 MW at Kiata WF), however, as the event occurred at night, no solar units were generating. Instantaneous aggregate generation from these generating systems (excluding Kiata WF) has previously reached over 650 MW. It is expected that if this incident had occurred during daylight hours in a period of high generation for the affected generators, the implications for the power system would have been more severe. Transgrid has reviewed the events surrounding the Buronga busbar outage and has determined that existing constraints adequately cater for the loss of generation within the area.

2.4 Post-event system operation

To maintain system security during the outage of the Buronga – Balranald 220 kV transmission line (X3) AEMO implemented network constraints limiting the MW dispatch or number of online inverters of several inverter-based generating systems in south-western New South Wales and north-western Victoria, as well as Murraylink flow. As per the outage limit advice provided by Transgrid and AEMO Victorian Planning and subsequent constraint equations, the limits in Table 5 were in place until 1335 hrs on 26 July 2022. The constraint equations were revoked following the restoration of the Buronga – Balranald 220 kV transmission line (X3) at 1316 hrs on 26 July 2022.

Table 5 Constrained dispatch due to the X3 outage

Region	Plant	Max. capacity (MW)	MW Limit	Inverter limit
NSW	Broken Hill SF	53	0	0
	Coleambally SF	150	50	Not limited
	Darlington Point SF	275	100	Not limited
	Finley SF	133	50	Not limited
	Limondale 1 SF	220	0	0
	Silverton WF	198	0	0
	Sunraysia SF	200	0	0
VIC	Bannerton SF	88	45	Not limited
	Bulgana WF	204	0	Can be operated in pause mode
	Bulgana BESS	20	0	0
	Gannawarra SF	50	30	Not limited

Region	Plant	Max. capacity (MW)	MW Limit	Inverter limit
	Karadoc SF	90	25	Not limited
	Kiamal SF	200	50	Not limited
	Murra Warra WF stage 1 and stage 2	225+203	90	Not limited
	Wemen SF	88	45	Not limited
	Yatpool SF	81	25	Not limited
SA to VIC	Murraylink	200	130	Not applicable

3 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[7]. The power system remained in a secure operating state throughout the incident.

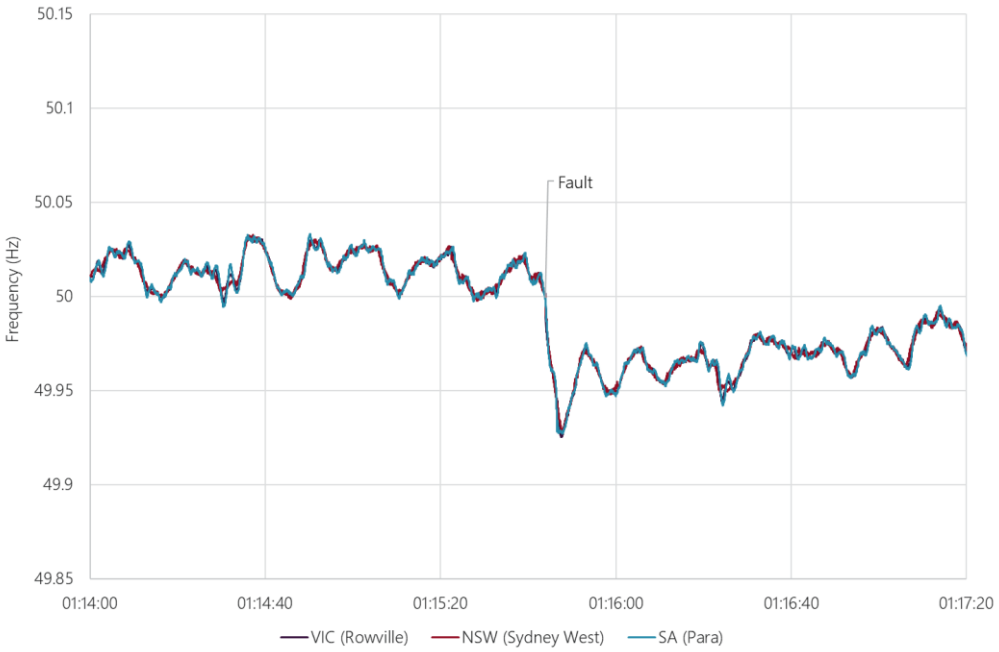
3.1 Frequency

As shown below in Figure 2, as a result of the non-credible contingency at 0115 hrs, the system frequency reached a minimum of 49.925 hertz (Hz). The frequency did not leave the normal operating frequency band throughout the incident. The power system remained in a secure operating state throughout this incident and the Frequency Operating Standard (FOS)[8] was met for this incident.

[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] Frequency Operating Standard, effective 1 January 2020, available at https://www.aemc.gov.au/media/87484.

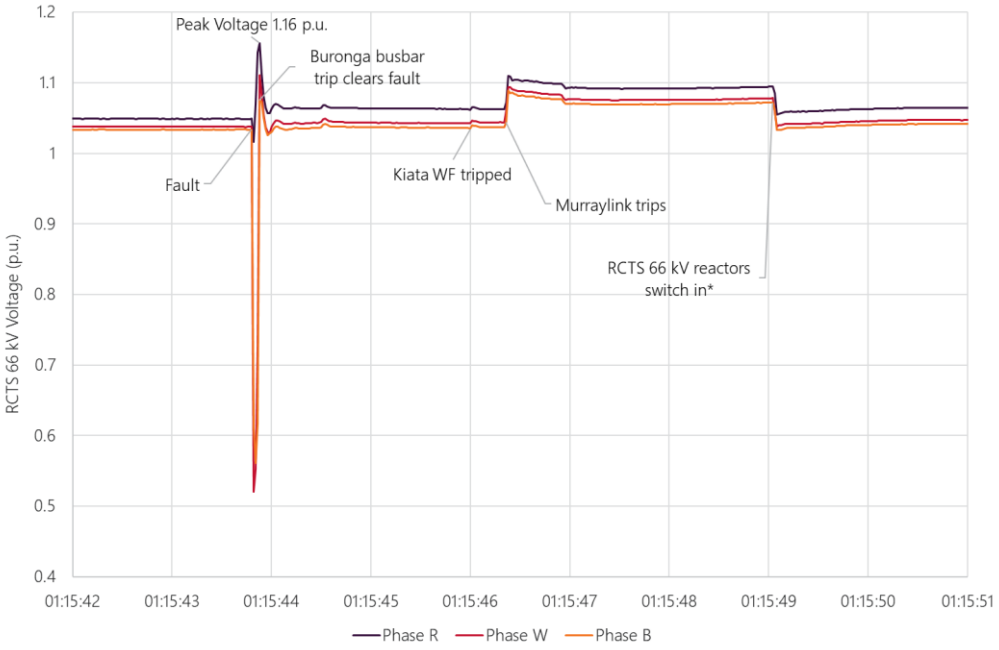
Figure 2 Power system frequency on 25 July 2022



3.2 Voltage

At no point during this incident were transmission system voltages outside of relevant voltage limits defined in the NER, or specified by NSPs in their limits advice to AEMO. Figure 3 shows the voltage at RCTS 66 kV as recorded by high speed monitoring. It can be seen that voltage increased following trip of Murraylink, and reduced following subsequent automatic voltage control switching of RCTS 66 kV reactor No. 1 and No. 2.

Figure 3 Voltage at RCTS 66 kV busbar on 25 July 2022 – high speed monitor data



* Supervisory control and data acquisition (SCADA) on the CBs at RCTS recorded that RCTS 66 kV 15 MVAr reactor No. 2 switched in at 01:15.52 and RCTS 66 kV 15 MVAr reactor No. 1 switched in at 01:15.54. Based on the high speed monitor data, AEMO has concluded that both reactors switched in at 01:15.49.

3.3 Power system oscillations

Post-incident analysis has confirmed that power system oscillations were observed intermittently at RCTS 220 kV between 1149 hrs and 1320 hrs on 25 July 2022, during the Buronga – Balranald 220 kV transmission line (X3) outage. Primarily, the oscillations were measured in the root mean square (RMS) voltage at RCTS 220 kV. The measured oscillation frequencies in RMS voltage at RCTS 220 kV were observed to be around 19 Hz[9] with a magnitude reaching up to 0.35% peak-to-peak. The oscillations were not persistent and ranged from a few seconds to few minutes during various instances in the above timeframe. Due to the lack of local phasor measurement units (PMUs), AEMO was unable to identify the source of these oscillations.

For information on the actions AEMO has recommended to assist with the investigation and management of power system oscillations, please see the West Murray Zone Power System Oscillations report and Power System Oscillations in South Australia incident reports, and AEMO's subsequent update on sub-synchronous oscillations in the West Murray area[10].

[9] The 19 Hz oscillation frequency data mentioned in this report refers to the RMS aliased frequency as measured in the phasor variables at the various measurement points. The fast Fourier transform (FFT) of the instantaneous three-phase voltages and currents would indicate the actual frequency components to be modulated as 50Hz ± the measured RMS frequency. For more explanation please see Appendix A1 of the West Murray Zone Power System Oscillations 2020 – 2021 report at https://aemo.com.au/energysystems/electricity/national-electricity-market-nem/system-operations/power-system-oscillations.

[10] AEMO, West Murray Zone Power System Oscillations report, February 2023 at https://aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/power_system_incident_reports/2023/west-murray-zone-power-system-oscillations.pdf?la=en. AEMO, Power System Oscillations in South Australia Report at https://aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/power_system_incident_reports/2022/south-australia-power-system-oscillations.pdf?la=en. AEMO, Sub-synchronous oscillations in the West Murray area – Update, March 2023 at https://www.aemo.com.au/-/media/files/electricity/nem/network_connections/west-murray/west-murray-zone-power-system-oscillations-march-2023-update.pdf?la=en.

AEMO determined that the power system oscillations during the above timeframe, as observed in RMS voltage at RCTS 220 kV, remained within power system security limits.

3.4 Reclassification

AEMO assessed whether to reclassify this incident as a credible contingency event[11].

The cause of this incident was identified, and the faulty isolator was bypassed prior to the Buronga – Balranald 220 kV transmission line's (X3's) return to service. Transgrid advised that protection systems in New South Wales operated as designed and there were no similar issues on remaining isolators at Buronga or Balranald. AEMO was satisfied that another occurrence of this event was unlikely under the current circumstances. Therefore, AEMO correctly identified that reclassification 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 market[12] over the course of this incident.

1. Occurrence of non-credible contingency event occurring
   - AEMO issued Market Notice (MN) 100476 at 0212 hrs on 25 July 2022 to advise of the occurrence of this non-credible contingency event. Notification was made 27 minutes after the event, within the two hour period required by the Power System Security Guidelines[13].
2. Non-reclassification decision
   - AEMO issued MN 100516 at 1318 hrs on 26 July 2022 to advise the market that the cause of this non-credible contingency event had been identified and AEMO was satisfied that another occurrence of this event is unlikely under the current circumstances.
3. Changes to network constraints
   - A number of constraints were invoked due to the unplanned outage with the Victoria – New South Wales interconnector term on the left hand side. The impact of the constraints on interconnector transfer limits was not material, and AEMO did not publish a market notice of variance of these constraints as indicated in the Power System Security Guidelines[14]. As many constraint sets are unlikely to cause a material variance to interconnector transfer limits, AEMO will consider whether to include a materiality qualification for notification of interconnector constraint variations as part of its next review of the Power System Security Guidelines.

[11] 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).

[12] AEMO generally informs the market about operating incidents as they progress by issuing Market Notices – see https://www.aemo.com.au/Market-Notices.

[13] AEMO, Power System Security Guidelines, Section 7.3 - https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/power_system_ops/procedures/so_op_3715-power-system-security-guidelines.pdf?la=en.

[14] AEMO, Power System Security Guidelines, Section 19 - https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3715%20Power-System-Security-Guidelines.pdf.

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's conclusions, recommendations and actions arising from its review are summarised in Table 6.

Table 6 Summary of conclusions and recommendations

Finding	Recommendations and actions
The initial trip at Buronga 220 kV busbar was caused by the failure of the Buronga 220 kV isolator X31 on the line side of the blue phase X3 CB. Transgrid has reviewed the failure mode of the isolator. This is the only known failure of this type on the Transgrid network, and consequently no trends exist based on isolator manufacturer, design, maintenance, or condition. As such Transgrid has confirmed to AEMO that a reoccurrence of the event is unlikely.	None
As isolator X31 is within the Buronga 220 kV busbar protection zone, the Buronga busbar protection correctly operated to clear the fault. Consistent with its design, the busbar protection tripped multiple lines connected to Buronga 220 kV substation, which caused the following control schemes to operate as designed: • Silverton transfer tripping scheme, to avoid islanding of Silverton WF with Broken Hill load. • Balranald fast voltage control scheme, tripping Balranald – Darlington Point 220 kV transmission line (X5) to mitigate overvoltage following trip of the Buronga – Balranald 220 kV transmission line (X3). Post-incident analysis has confirmed that a Buronga 220 kV busbar trip, and subsequent control scheme operation, has the potential to trip/run back greater than 650 MW of generation. Transgrid has reviewed the events surrounding the Buronga busbar outage and has determined that the existing constraints adequately cater for the loss of generation within the area.	None
Murraylink VFRB was initiated, however the scheme did not reduce Murraylink flow. The scheme then correctly initiated back up trip of Murraylink. AEMO Victorian Planning and AusNet are investigating why Murraylink failed to run back.	• AEMO in conjunction with AEMO Victorian Planning and AusNet finalise review into why Murraylink VFRB failed to run back Murraylink, including any recommended settings changes to runback speed or backup trip time delay settings.
Powercor line overvoltage protection scheme on HOTS to Kiata WF 66 kV line sent a trip signal to the Kiata WF 66 kV circuit breakers after 50 ms which tripped and disconnected the Kiata WF. Post-incident review by Powercor has confirmed that this trip signal time delay was not correctly set due to a procedural error in the relay settings configuration. Powercor completed an update to the HOTS to Kiata WF 66 kV line overvoltage protection settings on 30 November 2022. In addition, Powercor has updated practices and procedures associated with the setting of protection relay stage 2 overvoltage trip parameters. As this was a procedural error, Powercor is completing an audit of the relay settings at other sites within its network to determine whether overvoltage protection settings changes are required.	• Powercor complete its audit on overvoltage protection settings within its network to identify any additional settings which require update, and share details of any required settings updates with AEMO.
The power system remained in a secure operating state and the FOS was met throughout the incident.	None
AEMO correctly identified that there was no requirement to reclassify this event as a credible contingency.	None

Finding	Recommendations and actions
AEMO advised the market of the occurrence of the non-credible contingency within the timeframe indicated in the Power System Security Guidelines.	None
AEMO implemented varied constraint sets which had a non-material impact on transfer limits on the Victoria - New South Wales interconnector. The Power System Security Guidelines (SO_OP_3715)[15] indicate that AEMO should issue a market notice in these circumstances, which did not occur in this case. As many constraint sets are unlikely to cause a material variance to interconnector transfer limits, a materiality threshold for notification may be appropriate.	• During the next review of SO_OP_3715, AEMO will consider whether the section on advice of variance to interconnector transfer limits requires additional clarification, in consultation with the Power System Security Working Group and impacted stakeholder representatives.

[15] See Section 19 of the Power System Security Guidelines at https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3715%20Power-System-Security-Guidelines.pdf.

A1. System diagrams

Figure 4 Pre-incident diagram

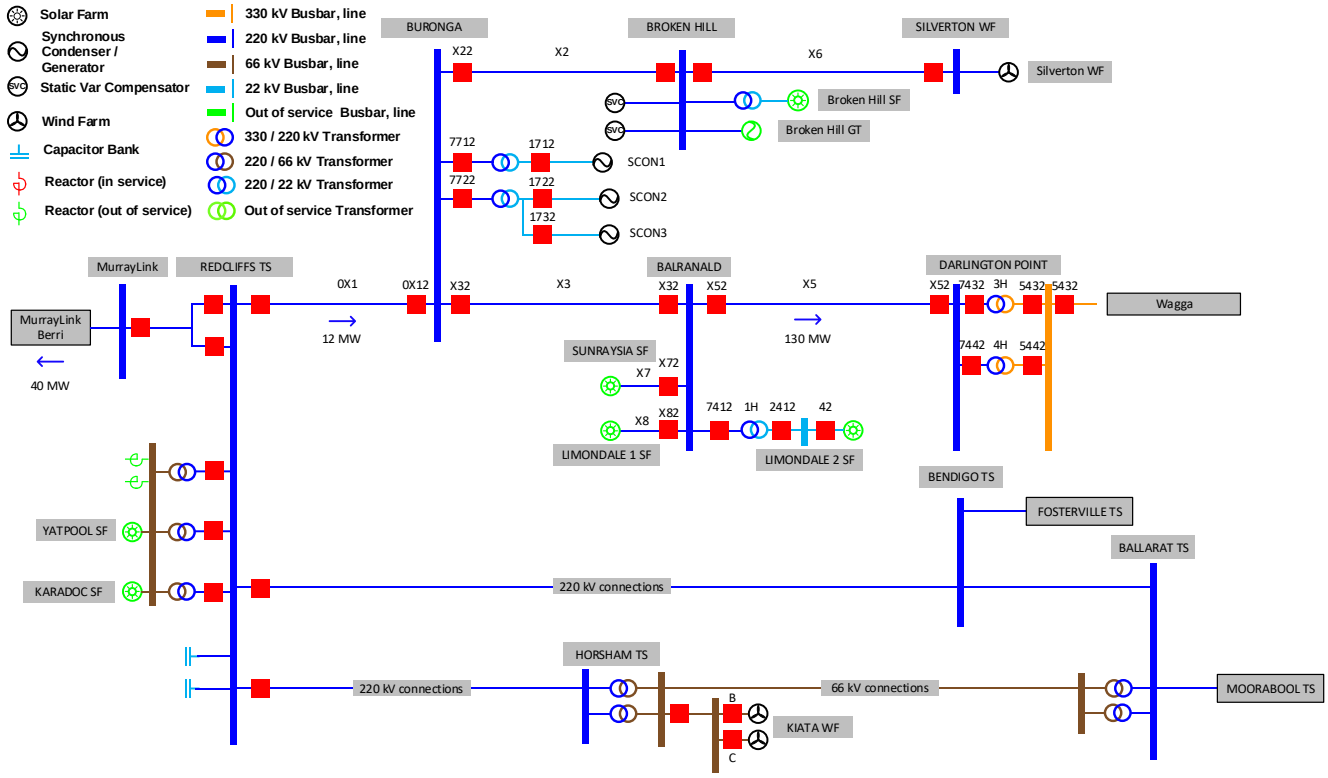


Figure 5 Post-incident diagram