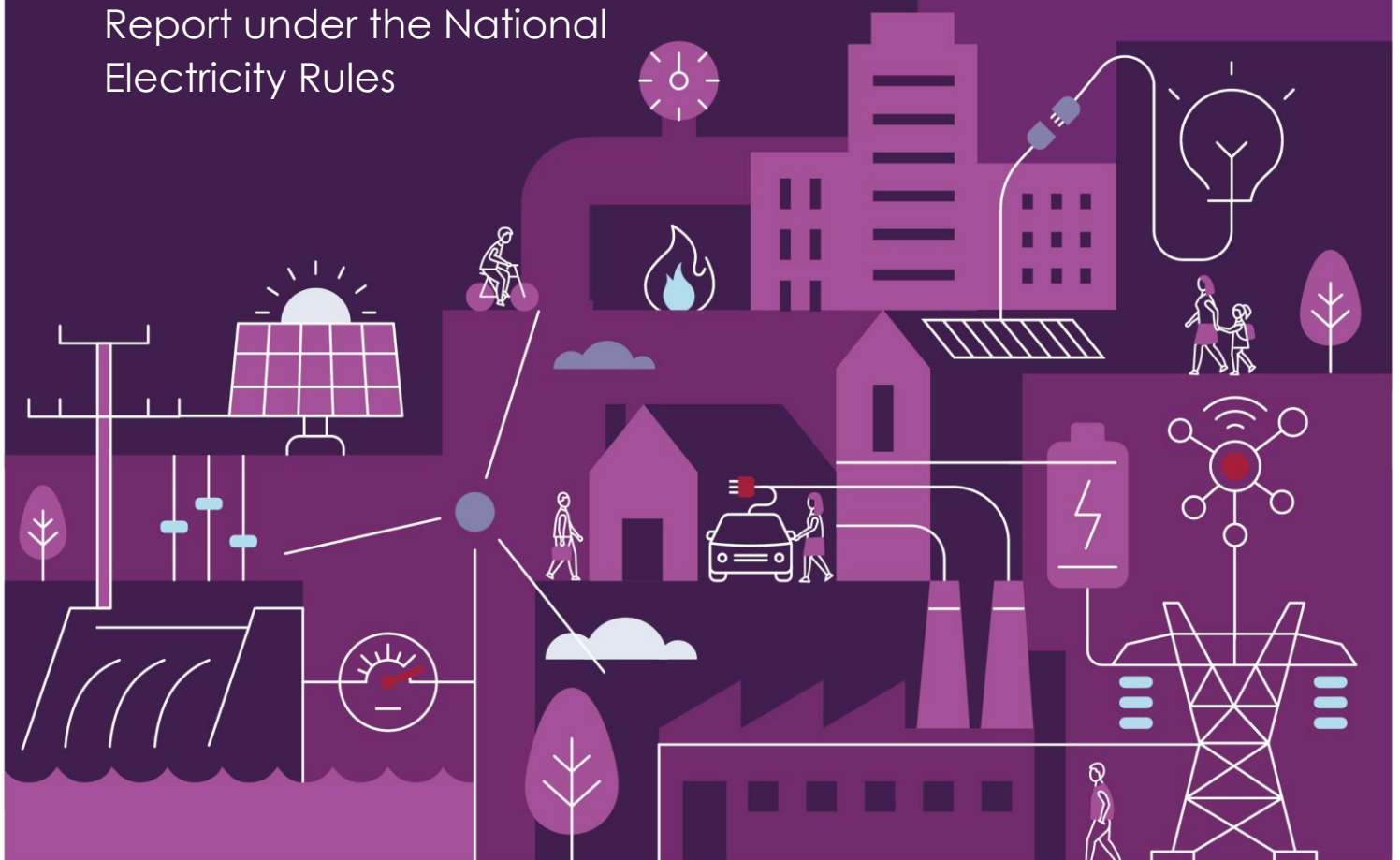


# Trip of Mortlake Power Station – Blue Gum substation 500 kV line and operation of circuit breaker fail protection on 9 July 2023

December 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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The NEM operates on Australian Eastern Standard Time (AEST). All times in this report are in AEST.

# Abbreviations

Abbreviation	Term
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time
BGS	Blue Gum Substation
CB	circuit breaker
CBF	circuit breaker fail
CT	current transformer
DDWF	Dundonnell Wind Farm
HYTS	Heywood Terminal Station
kV	kilovolt/s
MLTS	Moorabool Terminal Station
MOPS	Mortlake Power Station
ms	millisecond/s
MW	megawatt/s
NEM	National Electricity Market
NER	National Electricity Rules
OEM	original equipment manufacturer
PMU	phasor measurement unit
PSSWG	Power System Security Working Group
RMS	root mean squared
VNI	Victoria – New South Wales Interconnector
WF	Wind Farm

# Incident review

This reviewable operating incident<sup>1</sup> report is prepared in accordance with clause 4.8.15(c) of the National Electricity Rules (NER). It has been prepared using information provided by AusNet Services<sup>2</sup>, Tilt Renewables<sup>3</sup>, Mt Mercer Windfarm Pty Ltd<sup>4</sup>, Pacific Blue<sup>5</sup>, Acciona<sup>6</sup>, and from AEMO systems.

**Table 1 Summary of event**

Details	
<b>Reviewable operating incident type</b>	Non-credible contingency event impacting critical transmission elements.
<b>Incident details</b>	This report relates to a reviewable operating incident <sup>7</sup> that occurred on 9 July 2023 at 0653 hrs in Victoria, involving: <ul style="list-style-type: none"> <li>The trip of the Mortlake Power Station (MOPS) – Blue Gum Substation (BGS) 500 kilovolt (kV) line and BGS A1 500/220 kV transformer, resulting in islanding of Dundonnell Wind Farm (DDWF) from 254 megawatts (MW).</li> <li>Operation of circuit breaker fail (CBF) protection including the disconnection of the MOPS G11 500/20 kV transformer (see Figure 1).</li> </ul>
<b>Incident classification</b>	Transmission equipment failure - internal flashover within the blue phase current transformer (CT) housing associated with the MOPS BGS line/G11 500/20 kV transformer 500 kV circuit breaker (CB).
<b>Generation impact</b>	Approximately 379 MW of generation was tripped. In addition, Mortlake South Wind Farm reduced output by 60 MW over 22 seconds before returning to full output.
<b>Customer load impact</b>	<ul style="list-style-type: none"> <li>No load was disconnected as a result of this incident.</li> <li>19 MW of load was shaken off at Alcoa Portland.</li> </ul>
<b>Pre-incident conditions</b>	Mortlake gas generators G11 and G12 were not generating at the time of this incident, and the MOPS G11 and G12 20 kV CBs were open. DDWF was generating 254 MW. Given the event occurred in the early morning, there was no material distributed photovoltaic generation at the time of the incident.  There was sufficient system strength at the time of the incident, including four Loy Yang A units, two Loy Yang B units and three Yallourn units in service.
<b>Incident key events</b>	<ol style="list-style-type: none"> <li>At 0653 hrs on 9 July 2023: <ul style="list-style-type: none"> <li>The MOPS – BGS 500 kV line and the BGS A1 500/220 kV transformer tripped following operation of MOPS BGS Line No. 1 Bus 500 kV CB and MOPS BGS line/G11 Transformer 500 kV CB.</li> <li>The MOPS G11 No. 2 Bus 500 kV CB tripped, which disconnected the MOPS G11 500/20 kV transformer.</li> <li>DDWF tripped from 254 MW.</li> <li>Salt Creek Wind Farm (WF) tripped from 47 MW.</li> <li>24 of 64 turbines at Mt Mercer WF tripped, which reduced the output from 120 MW to 72 MW.</li> <li>15 of 22 turbines at Portland Cape Nelson South WF tripped, which reduced the output from 40 MW to 10 MW.</li> <li>Mortlake South WF reduced output from 103 MW to 43 MW in 22 seconds. After reaching 43 MW, Mortlake South WF increased back to 101 MW over the next 46 seconds.</li> </ul> </li> <li>At 1206 hrs on 9 July 2023, the MOPS G11 500/20 kV transformer was returned to service via the MOPS G11 No. 2 Bus 500 kV CB.</li> </ol>

<sup>1</sup> Reviewable operating incidents are defined by NER clause 4.8.15(a) and the Australian Energy Market Commission (AEMC) Reliability Panel Guidelines for Identifying Reviewable Operating Incidents.

<sup>2</sup> AusNet Services is the Victorian Declared Transmission System Operator.

<sup>3</sup> Tilt Renewables is the owner of Dundonnell Wind Farm (DDWF) and Salt Creek Wind Farm (WF).

<sup>4</sup> Mt Mercer Windfarm Pty Ltd is the owner of Mt Mercer WF.

<sup>5</sup> Pacific Blue is the owner of Portland Cape Nelson South WF.

<sup>6</sup> Acciona is the owner of Mortlake South WF.

<sup>7</sup> 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.

Details	
	<p>3. At 1458 hrs on 9 July 2023, the MOPS – BGS 500 kV line and the BGS A1 500/220 kV transformer were returned to service via the MOPS BGS Line No. 1 Bus 500 kV CB. The MOPS BGS line/G11 transformer 500 kV CB remained out of service.</p> <p>4. On 24 August 2023, following replacement of the faulty CT, the MOPS BGS line/G11 transformer 500 kV CB was returned to service.</p>
<b>Incident cause</b>	<p>AusNet Services' post-incident investigation has confirmed that:</p> <ul style="list-style-type: none"> <li>There was an internal flashover within the blue phase CT housing associated with the MOPS BGS line/G11 transformer 500 kV CB (see Figure 1).</li> <li>As the flashover occurred between the CT and the CB, the fault was within the MOPS – BGS 500 kV line protection zone and outside the MOPS G11 500/20 kV differential protection zone. The MOPS – BGS 500 kV line protection operated as expected and tripped the MOPS – BGS 500 kV line and the BGS A1 500/220 kV transformer. The fault remained uncleared as it was located outside the area disconnected by the CBs, and the MOPS – BGS 500 kV line protection continued to measure an in zone fault. As a result, the CBF protection operated and tripped the MOPS G11 No. 2 Bus 500 kV CB after 117 milliseconds (ms) (greater than the requirement of 80/100 ms for primary protection, but less than 175 ms for circuit breaker fail operation), disconnecting the MOPS G11 500/20 kV transformer.</li> <li>All protection referred to in this section operated as expected.</li> </ul>
<b>Power system response (facilities and services)</b>	<p>Following the trip of the MOPS – BGS 500 kV line and the BGS A1 500/220 kV transformer, DDWF was disconnected from the system and tripped as expected due to operation of DDWF anti-islanding protection. AEMO identified that the following generators (see Figure 2) had unexpected performance during the incident:</p> <ul style="list-style-type: none"> <li>Salt Creek WF – AEMO has confirmed that turbines at Salt Creek WF tripped due to a turbine parameter settings issue. The parameter was corrected by the proponent in consultation with AEMO on 30 August 2023.</li> <li>Mt Mercer WF – Mt Mercer Windfarm Pty Ltd has confirmed that 24 turbines at Mt Mercer WF tripped due to a converter parameter issue. AEMO is continuing to work with Mt Mercer Windfarm Pty Ltd regarding the correction of the converter parameter issue.</li> <li>Portland Cape Nelson South WF – AEMO has confirmed that 15 turbines at Portland Cape Nelson South WF tripped due to a converter timer fault. The fault was corrected by the proponent in consultation with AEMO on 1 November 2023.</li> <li>Mortlake South WF – Acciona has confirmed that the generation reduction during this event was caused by a fault ride through settings issue. AEMO is continuing to work with Acciona regarding the correction of the settings issue.</li> </ul> <p>There was no further impact on the broader power system, load or generation attributed to the response of these generators.</p> <p>The event highlights the potential for power system faults to result in unexpected response of generating facilities and the impact on overall contingency size.</p>
<b>Rectification</b>	<p>The MOPS BGS line/G11 Transformer 500 kV CB was isolated until AusNet Services replaced the associated faulty CT on 24 August 2023. AusNet Services is working with the original equipment manufacturer (OEM) of the faulty CT to identify the root cause of the failure.</p> <p>AEMO and AusNet Services have shared the findings of this incident with the Power System Security Working Group (PSSWG) at the Q4 2023 meeting.</p>
<b>Power system security</b>	<p>The power system remained in a secure operating state throughout this incident and the power system frequency remained within the Frequency Operating Standard<sup>8</sup>. As shown in Figure 3, a single phase voltage dip to 0.57 p.u. was recorded by a phasor measurement unit (PMU) on the 500 kV at Moorabool Terminal Station (MLTS).</p> <p>AEMO invoked the constraint sets:</p> <ul style="list-style-type: none"> <li>V-MOPS_GT1_B2CB and V-MORTLAKE1_ZERO between 0710 hrs and 1220 hrs on 9 July 2023 to manage the disconnection of the MOPS G11 connection point.</li> <li>V-MO_CB, V-DUNDWF1_ZERO, V-DUNDWF2_ZERO and V-DUNDWF3_ZERO between 0710 hrs and 1535 hrs on 9 July 2023 to manage the disconnection of the DDWF connection point.</li> </ul> <p>AEMO's post-incident review has confirmed that constraint sets V-MOPS_GT1_B2CB and V-MO_CB were not required for this event and are only required during a single CB outage at MOPS. These constraints normally monitor DDWF output and constrain dispatch to maintain Victoria – New South Wales Interconnector (VNI) stability<sup>9</sup>, however, as DDWF was isolated from the system during this incident, these constraints could not bind and therefore could not influence power system dispatch. AEMO has updated the descriptions of V-MOPS_GT1_B2CB and V-MO_CB to clarify the applicable conditions for invoking V-MOPS_GT1_B2CB and V-MO_CB.</p>

<sup>8</sup> Frequency Operating Standard; see <https://www.aemc.gov.au/sites/default/files/2020-01/Frequency%20operating%20standard%20-%20effective%201%20January%202020%20-%20TYPO%20corrected%2019DEC2019.PDF>.

<sup>9</sup> These constraints can limit VNI flows to maintain interconnector stability following the largest generation contingency in Victoria.

Details	
	AEMO appropriately invoked constraint sets V-MORTLAKE1_ZERO, V-DUNDWF1_ZERO, V-DUNDWF2_ZERO and V-DUNDWF3_ZERO during this incident.
<b>Reclassification</b>	<p>AEMO assessed whether to reclassify this incident as a credible contingency event<sup>10</sup>.</p> <p>The root cause of the incident was identified, and the CB remained out of service until the CB CT was replaced on 24 August 2023. AEMO was able to obtain the appropriate level of assurance to determine that re-occurrence of this incident was not reasonably possible. AEMO appropriately applied the reclassification criteria and determined the reclassification criteria were not met based on the information available to AEMO at the time.</p> <p>During the period where MOPS BGS line/G11 Transformer 500 kV CB was out of service, trip of the Heywood Terminal Station (HYTS) – MOPS 500 kV line and MOPS generators G11 and G12 together was considered a credible contingency based on the network configuration.</p>
<b>Market information</b>	<p>For this incident, AEMO issued the following market notices:</p> <ul style="list-style-type: none"> <li>Market Notice 108846 at 0834 hrs on 9 July 2023 to advise the market of the non-credible contingency event.</li> <li>Market Notice 108849 at 1535 hrs on 9 July 2023 to advise the market that the assets had been returned to service, the cause of the non-credible contingency had been identified, AEMO was satisfied that another occurrence of this event was unlikely under the current circumstances, and AEMO would not reclassify this event as a credible contingency event.</li> </ul> <p>AEMO invoked constraint N<sup>AV</sup>_MOGT1_B2CB_1 between 0710 hrs and 1220 hrs and N<sup>AV</sup>_MO_CB_1 between 0710 hrs and 1535 hrs. Both N<sup>AV</sup>_MOGT1_B2CB_1 and N<sup>AV</sup>_MO_CB_1 have VNI and Murraylink DC Interconnector terms on the left hand side. The Power System Security Guidelines (SO_OP_3715)<sup>11</sup> indicate that AEMO should issue a market notice in these circumstances, however, AEMO did not issue the relevant market notice during this incident. These constraints normally monitor DDWF output and constrain dispatch to maintain VNI stability, however, as DDWF was islanded from the system during this incident these constraints could not bind and therefore could not influence power system dispatch or interconnector limits.</p> <p>AEMO has reinforced with its operators the requirement to publish market notices to advise the market of potential variance to interconnector transfer limits, regardless of actual or forecast impact.</p>
<b>Recommendations</b>	<ol style="list-style-type: none"> <li>AEMO supports AusNet Services' plan to continue engaging with the CT OEM to understand the root cause of the CT's failure and to share key findings with AEMO and, where relevant, the PSSWG.</li> <li>AEMO plans to continue to work with Mt Mercer Windfarm Pty Ltd on the rectification of the trip of turbines at Mt Mercer WF.</li> <li>AEMO plans to continue to work with Acciona on the rectification of the reduction in generation output at Mortlake South WF during this event.</li> </ol>

<sup>10</sup> AEMO is required to assess whether or not to reclassify a non-credible contingency event as a credible contingency event – NER 4.2.3A(c) – and to report how the reclassification criteria were applied – NER 4.8.15(ca).

<sup>11</sup> 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](https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3715%20Power-System-Security-Guidelines.pdf).

Figure 1 Post-incident diagram

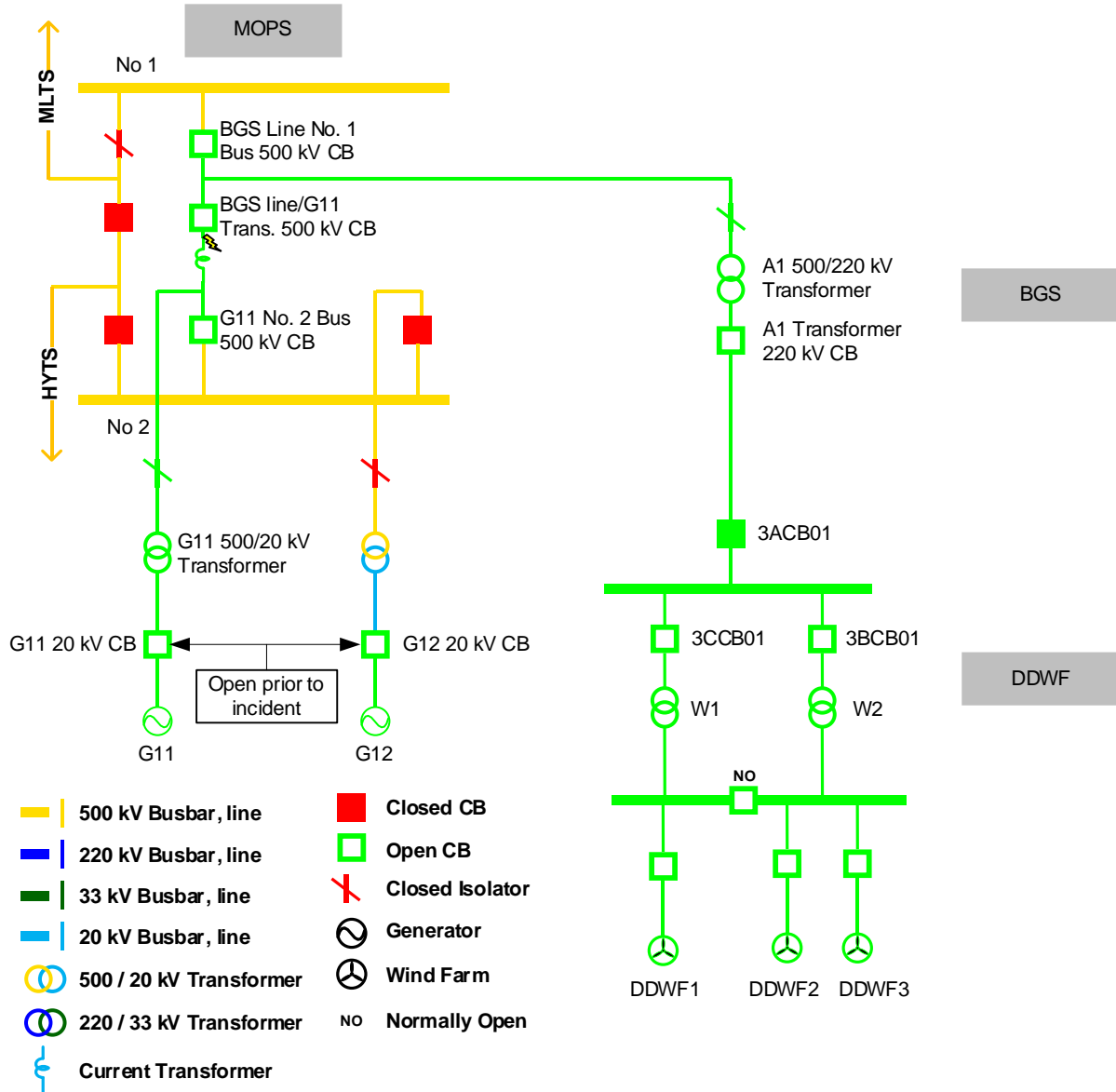


Figure 2 Map of generation in Victoria

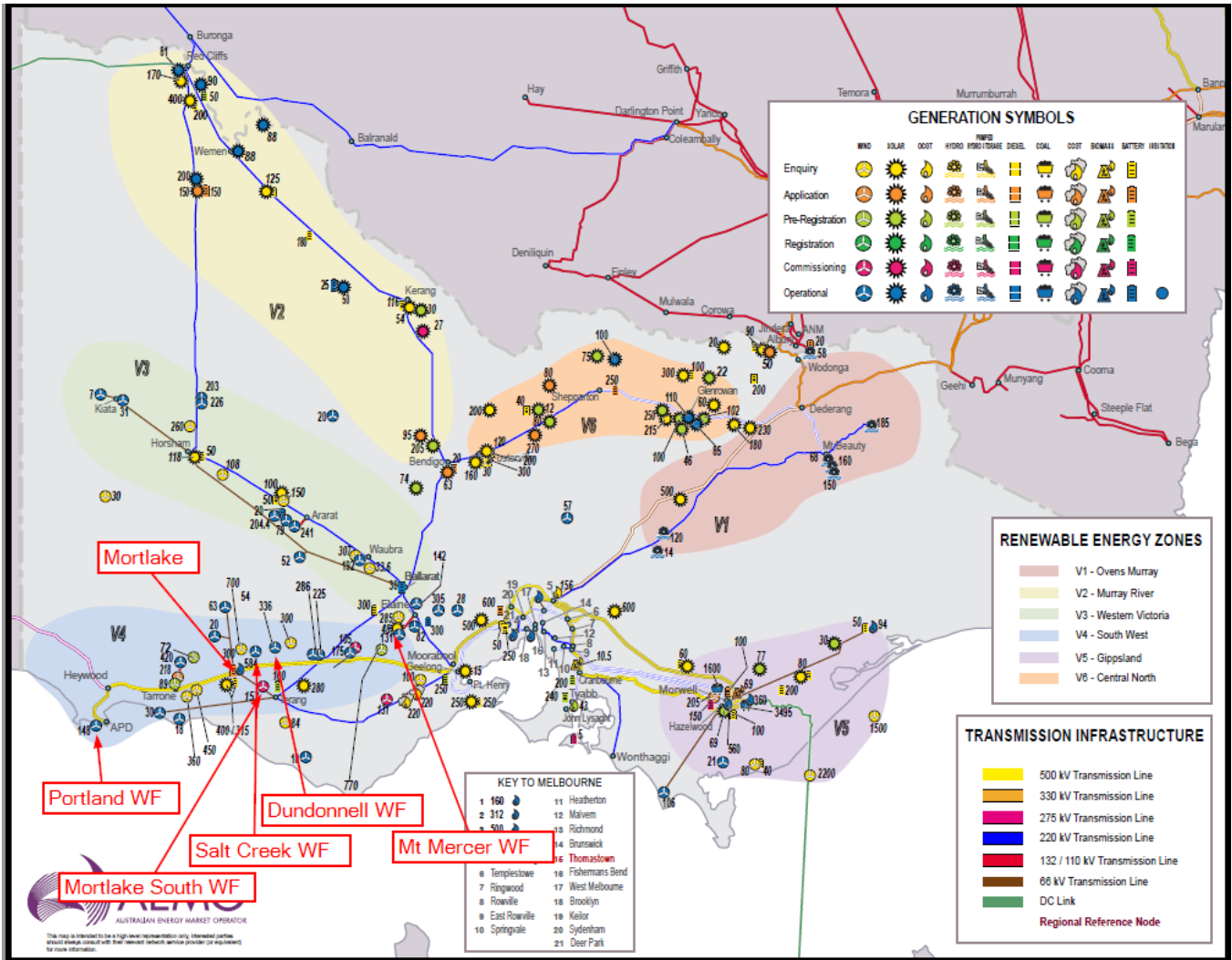




Figure 3 Voltage recorded by PMUs at MLTS 500 kV on 9 July 2023

