



Preliminary Report – Victoria and South Australia Separation Event, 31 January 2020

April 2020

A preliminary operating incident report for the National Electricity Market –
information as at 8 April 2020

Important notice

PURPOSE

AEMO has prepared this preliminary report as part of its review of the reviewable operating incident separating the Victorian and South Australian regions on 31 January 2020, as a first step in reporting under clause 4.8.15(c) of the National Electricity Rules.

The observations in this report will be updated in AEMO's final operating incident report, where new information becomes available.

DISCLAIMER

AEMO has been provided with preliminary data by Registered Participants as to the performance of some equipment leading up to, during, and after the separation event in accordance with clause 4.8.15 of the National Electricity Rules. In addition, AEMO has collated preliminary information from its own systems. Any analysis and conclusions expressed in this document are also preliminary in nature.

While AEMO has made every reasonable effort to ensure the quality of the information in this report, its investigations are incomplete, and the findings expressed in it may change as further information becomes available and further analysis is conducted. 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.

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

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- are not liable (whether by reason of negligence or otherwise) for any statements or representations in this report, or any omissions from it, or for any use or reliance on the information in it.

ABBREVIATIONS

Abbreviation	Term
AEMO	Australian Energy Market Operator Limited
AEST	Australian Eastern Standard Time
APD	Alcoa Portland aluminium smelter
HGTS	Haunted Gully Terminal Station
HYTS	Heywood Terminal Station
kV	Kilovolt
LOR 2	Lack of Reserve level 2
MLTS	Moorabool Terminal Station
MOPS	Mortlake Power Station
MW	Megawatt
NEM	National Electricity Market
NER	National Electricity Rules
OFGS	Over-frequency generation shedding
RERT	Reliability and Emergency Reserve Trader
TNSP	Transmission Network Service Provider
TRTS	Tarrone Terminal Station

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1. Overview

This report relates to a reviewable operating incident¹ that occurred on 31 January 2020 in the Victoria region which involved the non-credible loss of both the Moorabool – Mortlake and the Moorabool – Haunted Gully – Tarrone 500 kV transmission lines resulting in the separation of the Victoria and South Australia regions.

Immediately after the incident the Mortlake Power Station (MOPS) generating units and the Alcoa Portland (APD) aluminium smelter remained connected to the South Australia region but disconnected from the rest of Victoria. At the same time both potlines at APD tripped resulting in the loss of around 450 MW of load.

AEMO worked with participants to urgently devise a mode of power system operation, which had not previously been configured, to use MOPS (the only thermal generator located to the west of the damaged transmission towers) to restore supply to APD while maintaining secure and reliable operation of the South Australian power system.

This loss of the MOPS generation to the rest of the Victoria region coupled with the loss of interconnection to South Australia resulted in a Lack of Reserve (LOR) level 2 condition in Victoria. In response to the LOR 2 condition AEMO activated available capacity reserves under its Reliability and Emergency Reserve Trader (RERT) contracts in Victoria.

The Moorabool – Haunted Gully line was restored using temporary towers on 17 February 2020 and the Moorabool – Mortlake line was restored in 3 March 2020. AEMO has been advised that it will take up to 12 months for replacement towers to be constructed.

Under the National Electricity Rules (NER), 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 following this reviewable operating incident².

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

2. Pre-event conditions

Prior to the event, all relevant transmission equipment in Victoria was in service (shown in Appendix A1).

For the 13:25 hrs dispatch interval on 31 January 2020, just prior to the separation event, the system conditions in the NEM were as shown in Error! Reference source not found. and Error! Reference source not found..

Table 1 Regional demand and generation for Dispatch Interval ending 13:25 hrs

Region	Scheduled demand (MW)	Dispatched generation (MW)
Queensland	7,480	8,825
New South Wales	12,200	10,322

¹ See NER clause 4.8.15(a)(1)(i) and the AEMC Reliability Panel Guidelines for Identifying Reviewable Operating Incidents.

² See NER clause 4.8.15(b).

Region	Scheduled demand (MW)	Dispatched generation (MW)
Victoria	8,762	8,376
South Australia	2,368	3,029
Tasmania	1,167	1,631

Table 2 Interconnector flow for Dispatch Interval ending 13:25 hrs

Interconnector	Actual flow (MW) ^A	Target flow (MW)
Queensland – New South Wales (QNI)	-1,119	-1,119
Terranora	-195	-169
Victoria – New South Wales	575	647
Victoria – South Australia	-522	-550
Murraylink	-86	-79
Basslink	437	445

A. A positive value is flow heading north or west.

2.1 Weather conditions

The following is based on information provided by the Australian Bureau of Meteorology (BoM)³.

On 31 January 2020, a high pressure system over the Tasman Sea, combined with an approaching cold front, resulted in north to northwest winds and very hot humid conditions across southeast Australia. Thunderstorms were forecast to develop over western and central Victoria during the afternoon, with the risk of severe thunderstorms bringing damaging winds and heavy rain.

The BoM issued thunderstorm forecasts at 0028 hrs on 31 January 2020, and at 1018 hrs on 31 January 2020, advising of the potential for thunderstorms over most of Victoria. The BoM issued Severe Thunderstorm Warnings at 1214 hrs and 1321 hrs on 31 January 2020, advising that severe thunderstorms with damaging winds could develop over western Victoria. Damaging winds are between 90 and 125 km/h, which is less than the wind speed rating of transmission assets in Victoria.

2.2 Reserve

On the morning of 31 January 2020, AEMO issued a media statement requesting consumers in Victoria reduce their energy usage between approximately 1pm and 8pm (Melbourne Time) due to extreme temperatures combined with unusually high humidity. Victorian electricity demand was forecasted to be the highest since January 2014,

AEMO had issued Market Notice 73169 at 1241 hrs on 31 January 2020, to advise the market of a forecast LOR level 1 condition in Victoria for the period 1500-1700 hrs on 31 January 2020.

³ Report into the meteorological aspects of severe thunderstorm impacts near Cressy, Victoria on 31 January 2020.

3. Event

At approximately 1324 hrs on 31 January 2020, the collapse of a number of steel transmission towers on the Moorabool – Mortlake and Moorabool – Haunted Gully 500 kV lines (MLTS-MOPS and MLTS-HGTS lines), resulted in these lines tripping and remaining unavailable for service.

The outage of the MLTS-MOPS and MLTS-HGTS lines resulted in the separation of the South Australia region from Victoria⁴. This left generation at Mortlake Power Station, Macarthur Wind Farm, and Portland Wind Farm connected to the South Australia network.

The Haunted Gully – Tarrone 500 kV line (HGTS-TRTS line) also tripped at the same time. The cause of this line trip is not clear at this stage as there was no damage to the transmission towers on this line and requires further investigation.

Analysis provided by the BoM⁵ suggests a severe convective downburst occurred in the location of the damaged transmission towers during thunderstorm activity. The BoM's initial investigation indicates damaging wind speeds of over 90 km/h and potentially destructive winds of over 125km/h occurred based on wind gusts observed at the nearest weather station (Mount Gellibrand). Both the BoM and AusNet Services are undertaking further detailed investigations to understand the weather event and the failure mechanism of the the transmission towers.

Coincident with the faults on the MLTS-MOPS and MLTS-HGTS lines, both potlines at the APD aluminium smelter tripped resulting in the loss of approximately 450 MW of load. AEMO will review the mechanism for the tripping of the APD pot lines in the final report.

3.1 Frequency

The separation of Victorian and South Australia caused the frequency in South Australia to rise to 51.11 Hz, as shown in Figure 1.

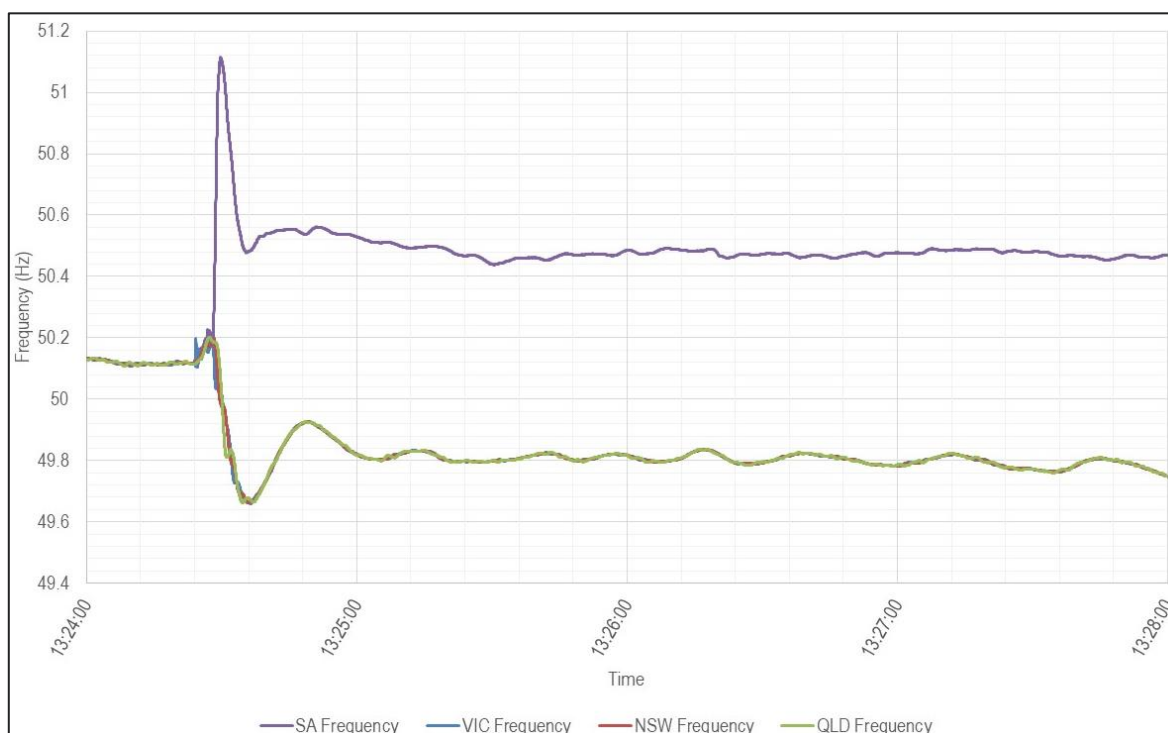
The frequency in South Australia met the NEM frequency operating standard for a multiple contingency event in terms of the containment level. However, the stabilisation and recovery timeframes were longer than expected⁶. AEMO intends to further review frequency outcomes.

⁴ See Appendix A2 for a map showing the location of the faults and a diagram of the power system immediately after separation.

⁵ Report into the meteorological aspects of severe thunderstorm impacts near Cressy, Victoria on 31 January 2020.

⁶ The Frequency Operating Standard indicates that the stabilisation and recovery times are subject to "reasonable endeavours".

Figure 1 Frequency before and after separation



3.1.1 Generation

In response to the high frequency in South Australia, several generating units and batteries in South Australia either tripped or reduced output under a wide area Emergency Frequency Control Scheme response, as well as some unit protection schemes, some of which are part of an over frequency generation shedding scheme (OFGS).

Scheduled generation in South Australia reduced by approximately 640 MW immediately following the separation event.

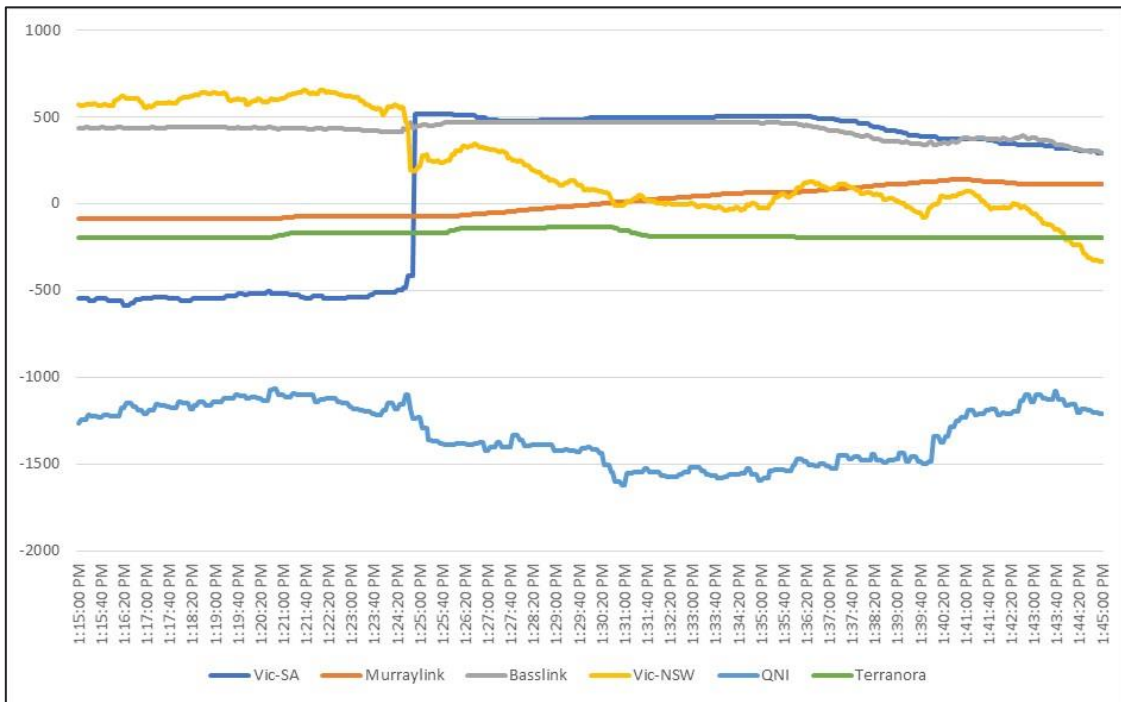
The South Australian OFGS was installed on a number of wind farms in South Australia in 2018-19. This scheme will initiate tripping of wind farms when the frequency exceeds 51 Hz. AEMO will further review available performance data from scheduled and semi-scheduled generating systems and batteries across the NEM to confirm compliance with their registered performance standards including OFGS requirements.

3.2 Interconnector flows

Immediately following the separation of Victoria and South Australia, the flow on the Victoria – South Australia (Heywood) interconnector changed from approximately 500 MW into Victoria to 500 MW into South Australia, a step change of approximately 1,000 MW (see Figure 2). This was a result of the trip of the APD potlines and generation remaining online at Mortlake Power Station and the Macarthur and Portland wind farms. AEMO constrained Mortlake generation to zero commencing 1345 hrs on 31 January 2020.

High flows were also recorded on the Queensland – New South Wales interconnector in the Queensland to New South Wales direction as a result of the loss of transfer from South Australia into Victoria. The operation of the interconnector following this non-credible event will be investigated in the final report, noting that no limits were exceeded for more than 30 minutes

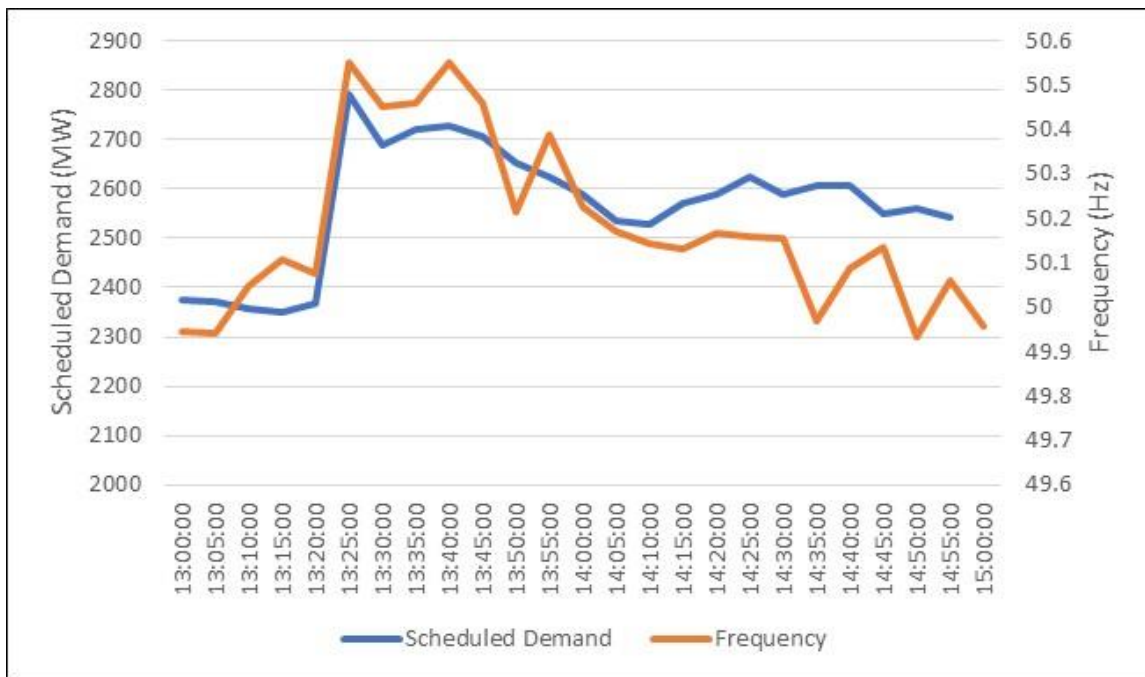
Figure 2 Interconnector flows



3.3 Region demand

Immediately following the separation of Victoria and South Australia, the South Australia region scheduled demand increased, as shown in Figure 3. This was likely caused by the reduction in output from rooftop solar photovoltaic (PV) generation and other non-scheduled generation in response to the high frequency in South Australia.

Figure 3 Scheduled demand in South Australia



3.4 Reserve

Reserve levels in Victoria fell sharply following separation from South Australia, due to loss of import capability from South Australia and the unavailability of generation at Mortlake Power Station, Macarthur, and Portland Wind Farms to the Victoria region.

At 1347 hrs on 31 January 2020, a forecast LOR 2 condition for the Victoria Region was declared for the period 1500-1800 hrs on 31 January.

4. Restoration

4.1 Reserve

At 1351 hrs, after declaring the forecast LOR 2 condition for Victoria, AEMO advised the market it was commencing negotiations for the provision of RERT to address the reserve shortfall. At 1416 hrs AEMO advised the market of an actual LOR 2 condition in Victoria for the period commencing 1400 hrs on 31 January. Between 1530 and 2130 hrs on 31 January AEMO dispatched up to 185 MW of RERT in Victoria.

4.2 Supply to APD

At approximately 1500 hrs on 31 January, AusNet advised AEMO that there had been severe damage to at least six towers on the MLTS-MOPS and MLTS-HGTS lines and that the lines were not expected to return to service for at least one week.

With these lines not available for service, there was no way available to restore the connection between Victoria and South Australia or APD. AEMO – in conjunction with AusNet, ElectraNet, Origin Energy and Alcoa – quickly developed and implemented a plan to restore limited supply to APD, with APD and Mortlake generation connected to the South Australia network but disconnected from the Victorian network.

The plan involved:

- Using Mortlake generation to supply the APD load.
- Portland, Macarthur, Canunda and Lake Bonney wind farms to be out of service to ensure control over flows on the Victoria - South Australia (Heywood) interconnector.
- Constraining the Victoria to South Australia flow on the Victoria – South Australia (Heywood) interconnector to a maximum of 100 MW.
- Lake Bonney, Dalrymple, and Hornsdale batteries being constrained to zero MW output but remaining at a state of charge sufficient to allow provision of raise and lower contingency frequency control ancillary services (FCAS).

At 1604 hrs on 31 January, AEMO gave clearance to Alcoa to restore up to 70 MW of load at APD. At 1626 hrs on 31 January, AEMO cleared APD load up to 210 MW. Further clearance was given to increase to 350 MW and then 400 MW at 1834 hrs and 2041 hrs respectively on 31 January.

To maintain supply to APD with the power system remaining in a secure operating state, this plan was revised commencing around 2052 hrs on 31 January as follows:

- The Tarrone-Heywood-APD (TRTS-HYTS-APD) No.1 500 kV line taken out of service
- The Victoria-South Australia (Heywood interconnector) was constrained to zero MW in both directions
- Changes were made to protection settings at HYTS such that if the flow on the Heywood interconnector exceeded 160 MVA then the interconnection would be tripped.

The net effect of this plan was that Mortlake generation was supplying the APD load via the MOPS-HYTS-APD No. 2 500 kV line, with minor changes in generation/load being picked up on the Victoria – South Australia interconnector. For the loss of either a potline at APD or a generating unit at Mortlake, the flow on the Victoria – South Australia interconnector would exceed the 160 MVA limit and trip. A loss of the MOPS-HYTS-APD No. 2 line would result in the loss of APD load and Mortlake generation.

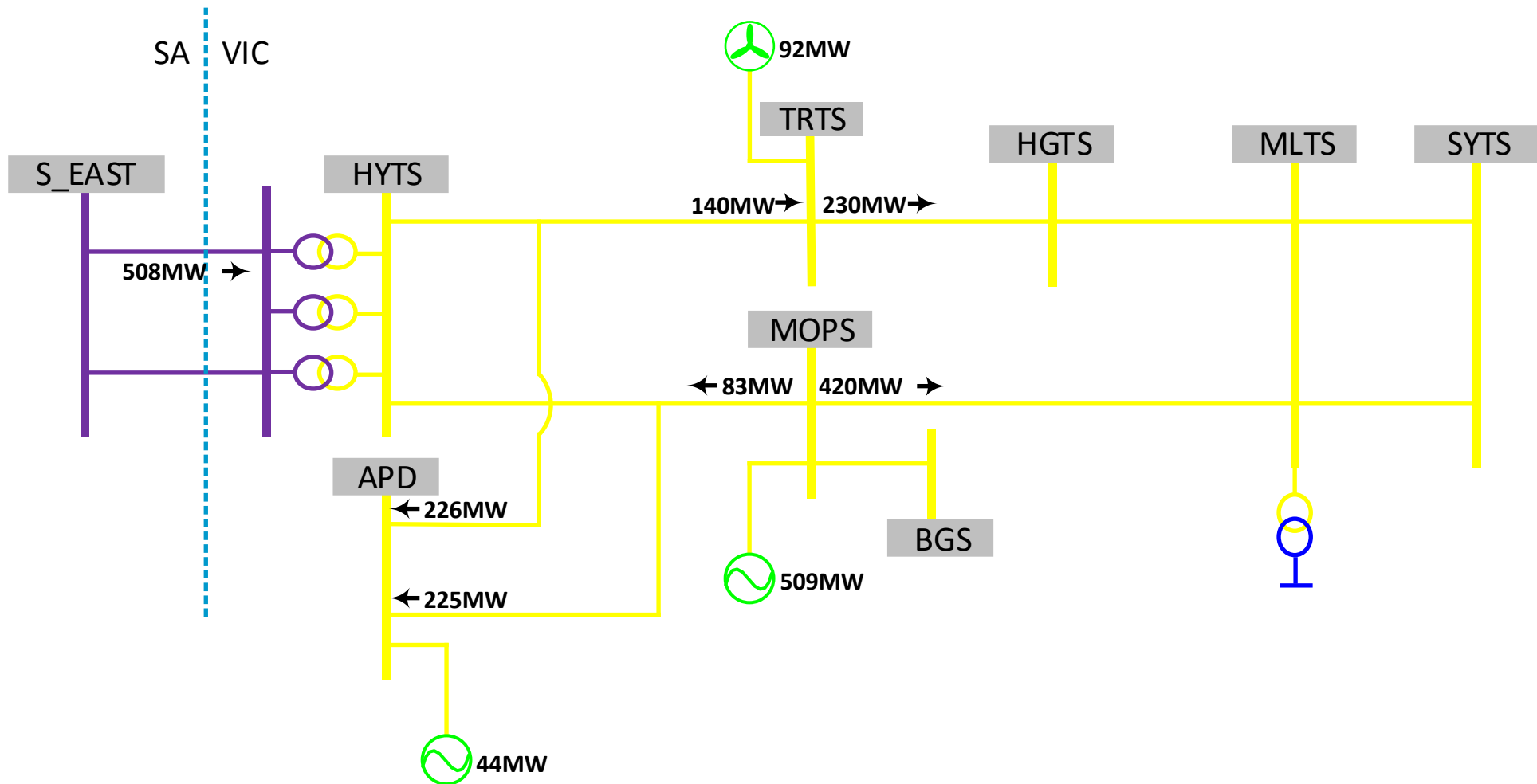
5. Next steps

AEMO will continue its investigation into how each relevant component of the NEM responded under the circumstances of this event. Points for further investigation include:

- The response of components in the transmission system to the event, in particular the trip of the HGTS-TRTS line.
- The mechanism for the collapse of the transmission towers.
- The response of the APD load.
- The response of generating units/batteries to the high frequency in South Australia.
- The delivery of FCAS and frequency recovery in South Australia.
- The impact of high frequency in South Australia on rooftop PV.
- The high post-contingent flows on the Queensland – New South Wales interconnector.

AEMO will investigate these points and include any additional findings in its final report on this event.

A1. Status of major transmission elements immediately prior to separation



A2. Location of faults and status of major transmission elements immediately after separation



