AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

NEM Lack of Reserve Framework Report

29 April 2020

Reporting period 1 January 2020 to 31 March 2020

Important notice

PURPOSE

AEMO has prepared this document under clause 4.8.4B of the National Electricity Rules to report on the operation of the NEM Lack of Reserve Framework for the period 1 January 2020 to 31 March 2020 (Quarter 1 2020).

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VERSION CONTROL

Version	Release date	Changes
1	29 April 2020	Initial version

Executive summary

This report has been published in accordance with clause 4.8.4B of the National Electricity Rules (NER).

In the reporting period 1 January 2020 to 31 March 2020 (Quarter 1 2020), AEMO declared 19 Lack of Reserve (LOR) conditions in the National Electricity Market (NEM)[1]:

- There were seven forecast LOR1 conditions.
- There was zero forecast LOR2 conditions.
- There were five actual LOR1 conditions.
- There were seven actual LOR2 conditions.

This compares with 14 LOR declarations in the previous reporting period (Quarter 4 2019), and 27 LOR declarations for the same period last year (Quarter 1 2019)[2].

Quarter 1 2020 covered the later summer months and first month of autumn. Continuing from the previous quarter, high temperatures resulted in high demand events in all regions of the NEM. Bushfire activity continued to impact the electricity network, particularly at the beginning of the quarter, and at times resulted in LOR conditions. Multiple unplanned transmission outages, regional separation events, and sudden loss of generation availability occurred throughout the period and significantly impacted available reserves. These power system incidents resulted in many unanticipated actual LOR1 and LOR2 conditions compared to previous quarters.

Of the 19 LOR declarations in Quarter 1 2020:

- For 17 declarations, the reserve requirement was set by the Largest Credible Risk (LCR, for LOR2 conditions) or the sum of the two Largest Credible Risks (LCR2, for LOR1 thresholds), while there were two declarations where the reserve requirement was set by the Forecast Uncertainty Measurement (FUM)[3].
- This means 11% of LOR conditions were declared when the reserve requirement was being set by the FUM. For comparison, in Quarter 4 2019, three of the 14 (21%) LOR conditions were set by the FUM, and in Quarter 1 2019, 10 of the 27 (37%) of LOR conditions were set by the FUM.

The next report on the NEM Lack of Reserve Framework, for the reporting period 1 April 2020 to 30 June 2020, will be published by 31 July 2020.

[1] Forecast or actual LOR1, LOR2, or LOR3. LOR is described in clause 4.8.4 of the NER. AEMO's considerations and methodology, and the LOR levels, are outlined in AEMO's Reserve Level Declaration Guidelines, at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Power-system-operation.

[2] Previously published reports are available at https://aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Power-system-operation/NEM-Lack-of-Reserve-Framework-Quarterly-Reports.

[3] LCR and FUM are also explained in detail in the Reserve Level Declaration Guidelines.

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1. Introduction

This report has been published in accordance with clause 4.8.4B of the National Electricity Rules (NER), to provide a high-level analysis of how the Lack of Reserve (LOR) framework is operating. This report covers the period from 1 January 2020 to 31 March 2020 (Quarter 1 2020).

Unless otherwise noted, all times in this report are National Electricity Market (NEM) time (Australian Eastern Standard Time [AEST]).

The report is divided into three sections:

- **Reserve Level Declaration Guidelines** – a summary of changes to the Guidelines over the past quarter, and the retraining of the Bayesian Belief Network (BBN).
- **LOR conditions declared** – details of all LOR conditions declared or revised during the past quarter (based on market notices), including an indication of the required reserve level and if the requirement was set by the Forecast Uncertainty Measure (FUM) or the largest credible risk/s (LCR) in the region. The reserve requirement can be set by the Largest Credible Risk (LCR, for LOR2 conditions) or the sum of the two Largest Credible Risks (LCR2, for LOR1 thresholds). The FUM value for the respective period is also provided.
- **Review of performance** – a review of the performance of the LOR framework and any observed trends, providing an assessment of FUM values compared to previous quarters, determinants of reserve level requirements, number of LOR declarations, and leading factors or causes of LOR declarations.

Please direct all LOR inquiries to www.aemo.com.au/Contact-us. In the inquiry form field '*What is your enquiry regarding?*', write "**LOR Framework Report**".

The next report on the NEM Lack of Reserve Framework, for the reporting period 1 April 2020 to 30 June 2020, will be published by 31 July 2020.

2. Reserve Level Declaration Guidelines

2.1 Changes in the reporting period

During the reporting period, there were no changes to the Guidelines[4].

2.2 Retraining of the Bayesian Belief Network

The BBN is the algorithm which determines the FUM, which in turn can determine LOR levels. This process is summarised in the Guidelines. The intention of retraining the BBN is to update the network to include recent historical data since the last retraining. AEMO commenced the retraining in April 2020 to include data up to 31 March 2020. The retraining involves a three-stage process:

1. An Extract-Transform-Load (ETL) stage, to extract historical data up to 31 March 2020, perform data validation and cleansing, and compile the data into the structured format required to incorporate into the network.
2. An analysis and modelling stage, to update the network and compile the network nodes.
3. A test and verification stage, to ensure the retrained network is suitable for production implementation.

AEMO is in the final stage of retraining and plans to implement the retrained BBN into production in May 2020, pending final verification and readiness checks in the pre-production environment.

2.2.1 Results from retraining

To verify the retraining, AEMO completed a backcast of all forecast intervals from January 2019 to December 2019 using the existing BBN and the retrained BBN. The results of this comparison indicate multiple changes to expected future FUM values. The results from the retrained BBN are:

- New South Wales – minimum FUM values increased for all forecast horizons, with the largest increase being 35 MW in the 2 hours ahead horizon. Mean FUM values decreased for forecast horizons less than or equal to 6 hours ahead, whereas they increased for longer horizons. The largest decrease in mean FUM values was in the 2 hours ahead forecast horizon, at 73 MW. Maximum FUM values decreased for the 2 hours ahead forecast horizon but increased for longer forecast horizons. The largest increase in maximum FUM values was 171 MW for the 12 hours ahead forecast horizon.
- Queensland – for most forecast horizons there was no significant change in minimum, mean, or maximum FUM values. The largest change was an 18 MW increase in maximum FUM values for the 2 hours ahead forecast horizon.
- South Australia – minor increases in minimum, mean and maximum FUM values were observed across most time horizons. Notable exceptions were minimums 60 hours ahead (31 MW increase) and maximums 24 hours ahead (27 MW increase).
- Tasmania – minimum, mean and maximum FUM values were relatively unchanged, with the exception of the 60 hours ahead maximum, which increased by 35 MW.
- Victoria – the minimum and mean FUM values did not appreciably change. Maximum FUM values increased for the 2 hours ahead and 6 hours ahead forecast horizons (by 57 MW and 91 MW respectively).

[4] The Guidelines are at http://aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Power-system-operation.

3. Lack of Reserve conditions declared

Table 1 provides a high-level summary of the count of forecast and actual LOR conditions based on the declaration count principles.

Table 2 lists all market notice declarations of forecast and actual LOR conditions over the reporting period 1 January 2020 to 31 March 2020. Table 2 also identifies the market notices that communicated updates to, and cancellation of, either forecast or actual LOR conditions.

Declaration count principles

For each reporting period, AEMO determines the total count for LOR conditions based on the following principles:

- All market notices making the initial declaration of a forecast or actual LOR condition with an effective date during the reporting period were counted.
- Any market notices which updated previously issued forecast or actual LORs for a given effective date (in relation to the reserve requirement, reserve capacity available, or effective period) were not counted, to prevent double counting of a continuing condition.
- In cases where forecast LORs were cancelled but subsequently re-issued with approximately the same effective period, re-issues were not counted, to prevent double counting of effective periods.
- Updates to existing LOR conditions where the LOR level changed were counted as separate LOR conditions.
- Any forecast LORs which were subsequently declared as actual LORs at the same LOR level are counted once. In Table 1, these are shown as actual conditions only.

For example, where a forecast LOR1 was issued and later an actual LOR1 was declared for a similar period, only the actual LOR1 is counted. But if the initial forecast was for a forecast LOR2 condition and this was later declared as an actual LOR1, this would be counted as two LOR conditions, due to the differing LOR levels.

Table 1 Summary of forecast and actual LOR conditions, with causing factors

Effective date*	Region	LOR1		LOR2		LOR3		Cause and resolution
		Actual	Forecast	Actual	Forecast	Actual	Forecast	
04/01/2020	NSW			1				An actual LOR2 condition was declared without being forecast due to rapidly changing network conditions. Multiple transmission lines in southern New South Wales tripped, resulting in the separation of the NEM into two islands. Major bushfires were considered the cause of this incident. The incident resulted in a significant reduction of generation availability, quickly reducing the available reserve level in the region. Reliability and Emergency Reserve Trader (RERT) services were activated. The actual LOR2 condition was cancelled when generation availability increased and forecast demand decreased after the effective period.

Effective date*	Region	LOR1		LOR2		LOR3		Cause and resolution
		Actual	Forecast	Actual	Forecast	Actual	Forecast	
20/01/2020	NSW		1					A forecast LOR1 was declared. Available reserves were generally low on the effective date, due to decreased generation availability. Forecast demand was fluctuating and a sudden increase in forecast demand resulted in a shallow forecast LOR1. The forecast LOR1 condition was subsequently cancelled due to decreasing forecast demand.
22/01/2020	NSW	1						An actual LOR1 was declared without being forecast. Generation availability gradually decreased throughout the effective date, which resulted in an actual LOR1. The actual LOR1 condition was cancelled due to increased generation availability.
23/01/2020	NSW	1		1				A forecast LOR1 was declared then cancelled in the Short Term Projected Assessment of System Adequacy (ST PASA) timeframe, due to fluctuating forecast demand and generation availability. A forecast LOR1 was then declared in Pre-Dispatch due to decreased generation availability. A forecast LOR2 was then declared due to a significant increase in forecast demand. RERT services were activated. An actual LOR1 was declared as generation availability did not increase after market notification. An actual LOR2 was declared earlier than forecast due to a significant and rapid decrease in generation availability. The actual LOR2 condition was cancelled when available reserve increased after the effective period.
28/01/2020	NSW	1						An actual LOR1 was declared without being forecast. A combination of generation loss and decreased generation availability throughout the effective date caused this condition. The actual LOR1 condition was cancelled as forecast demand decreased after the effective period.

Effective date*	Region	LOR1		LOR2		LOR3		Cause and resolution
		Actual	Forecast	Actual	Forecast	Actual	Forecast	
30/01/2020	VIC	1		1				An actual LOR1 and actual LOR2 were declared without being forecast. The actual LOR1 was declared due to a sudden increase in forecast demand. The actual LOR2 was declared due to the unplanned loss of a major generator, which quickly and significantly decreased generation availability. The time of the unplanned outage aligned with the forecast demand peak in Victoria, which was high due to extreme temperatures. This event affected both Victoria and South Australia regions due to interconnector restrictions. Actual LOR1 and actual LOR2 conditions were cancelled as forecast demand decreased and net import increased after the effective period.
30/01/2020	SA		1	1				A forecast LOR1 was declared then cancelled in the ST PASA timeframe due to fluctuating generation availability. An actual LOR2 was declared without being forecast due to the event in Victoria. Net import into South Australia decreased suddenly and significantly to balance supply across Victoria and South Australia. The event aligned with the forecast demand peak in South Australia, which was high due to extreme temperatures. The actual LOR2 condition was cancelled as forecast demand decreased and net import increased after the effective period.
31/01/2020	VIC		1	1				A forecast LOR1 was declared then cancelled in Pre-Dispatch, due to fluctuating forecast demand and net import. On the effective date, an unplanned transmission network outage resulted in the disconnection of the South Australian region, Alcoa Portland (APD) aluminium smelter and Mortlake Power Station (MOPS) from the rest of the NEM. The sudden loss of MOPS generation in Victoria and the loss of interconnection to South Australia resulted in a forecast LOR2 and subsequent actual LOR2 condition being declared in Victoria. RERT services were activated. The actual LOR2 condition was cancelled due to decreased forecast demand after the effective period.

Effective date*	Region	LOR1		LOR2		LOR3		Cause and resolution
		Actual	Forecast	Actual	Forecast	Actual	Forecast	
31/01/2020	NSW		1	1				A forecast LOR1 was declared then cancelled in Pre-Dispatch, due to fluctuating generation availability and net import. An actual LOR2 was declared without being forecast due to the Victoria – South Australia separation event. The New South Wales – Victoria Interconnector was constrained significantly during this event, which resulted in an actual LOR2 condition in New South Wales. RERT services were activated. The actual LOR2 condition was cancelled due to increased net import and increased generation availability after the effective period.
01/02/2020	NSW	1		1				A forecast LOR1 was originally declared due to decreased generation availability. Forecast demand gradually increased over the days leading up to this event, subsequently resulting in an actual LOR1, since generation availability remained reasonably constant over this time. During actual LOR1 conditions, a sudden decrease in generation availability decreased available reserve further, causing an actual LOR2 declaration. The actual LOR2 condition was cancelled due to increased generation availability after the effective period.
02/02/2020	NSW		1					A forecast LOR1 was declared due to decreased generation availability and increased forecast demand. The forecast LOR1 was cancelled due to a decrease in forecast demand, and slightly increased net import.
10/02/2020	SA		1					A forecast LOR1 was declared then cancelled in the ST PASA timeframe, due to increased generation availability.
02/03/2020	SA		1					A forecast LOR1 was declared after available reserve decreased due to network constraints invoked because of low demand following a South Australia – Victoria separation event. The constraints decreased generation availability during this period. The forecast LOR1 condition was cancelled after demand increased and network constraints were revoked.
Total		**5**	**7**	**7**	**0**	**0**	**0**	

* Effective date is the date on which the condition occurred or was expected to occur, and may differ from the date on which a market notice advising of the forecast or actual condition was issued.

Table 2 LOR notices declared during the reporting period 1 January 2020 to 31 March 2020

Effective date and time	Market Notice ID	Issue date and time	Level	Actual, forecast, update or cancel	Comments	Reserve requirement (MW)[A]		FUM value (MW)[B]	Reserve requirement set by
						Required	Available		
New South Wales region									
04/01/2020 16:00	72297	04/01/2020 16:05	LOR2	Actual	Actual LOR2 declared. Trip of multiple transmission lines due to bushfires resulted in rapid decrease of generation availability. RERT services were activated.	852	475	362	LCR
04/01/2020 16:00	72315	04/01/2020 16:35	LOR2	Actual	Update to MN 72297. Available reserve increased due to increased net import. Actual LOR2 condition remained.	877	800	357	LCR
04/01/2020	72339	04/01/2020 21:06	LOR2	Cancelled	This cancelled MN 72315. Actual LOR2 cancelled due to increased generation availability and decreased forecast demand after effective period.	797	2,157	319	LCR
20/01/2020 15:30-18:00	72779	20/01/2020 14:20	LOR1	Forecast	Forecast LOR1 declared due to decreased generator availability and sudden increase in forecast demand.	1,387	1,076	570	LCR2
20/01/2020	72781	20/01/2020 14:44	LOR1	Cancelled	This cancelled MN 72779. Forecast LOR1 cancelled due to decreased forecast demand.	1,388	1,513	558	LCR2
22/01/2020 16:00-17:00	72859	22/01/2020 16:03	LOR1	Actual	Actual LOR1 declared. Generation availability gradually decreased and forecast demand gradually increased leading up to this event. A forecast LOR1 was not observed prior to this event.	1,360	1,240	370	LCR2
22/01/2020	72866	22/01/2020 17:22	LOR1	Cancelled	This cancelled MN 72859. Actual LOR1 cancelled due to increased generation availability.	1,360	1,478	333	LCR2
23/01/2020 15:00-18:00	72725	19/01/2020 14:28	LOR1	Forecast	Forecast LOR1 declared due to an increase in forecast demand.	1,469	911	n/a – forecast > 72 hrs ahead	LCR2

Effective date and time	Market Notice ID	Issue date and time	Level	Actual, forecast, update or cancel	Comments	Reserve requirement (MW)[A]		FUM value (MW)[B]	Reserve requirement set by
						Required	Available		
23/01/2020	72782	20/01/2020 15:03	LOR1	Cancelled	This cancelled MN 72725. Forecast LOR1 cancelled due to increased generation availability.	1,474	1,726	n/a – forecast > 72 hrs ahead	LCR2
23/01/2020 15:30-17:00	72846	22/01/2020 13:12	LOR1	Forecast	Forecast LOR1 declared due to decreased generation availability. Market notice covers period of both forecast LOR1 and LOR2. Forecast LOR1 existed between 1530 and 1630 hrs.	1,349	1,109	1,119	LCR2
23/01/2020 16:30-17:00	72847	22/01/2020 13:14	LOR2	Forecast	Correction to MN 72845. Forecast LOR2 declared at the same time as forecast LOR1 in MN 72847. Forecast LOR2 existed between 1630 and 1700 hrs.	1,119	1,110	1,119	FUM
23/01/2020 15:30-17:30	72851	22/01/2020 14:17	LOR2	Update	Update to MN 72847. Effective period in forecast LOR2 increased and generation availability decreased.	1,074	766	1,074	FUM
23/01/2020 14:30-18:00	72852	22/01/2020 14:24	LOR1	Update	Update to MN 72846. Market notice covers period of both forecast LOR1 and LOR2. Forecast LOR1 existed for 1430 – 1530 hrs and 1730 – 1800 hrs.	1,344	766	1,074	LCR2
23/01/2020	72857	22/01/2020 16:12	LOR2	Cancelled	This cancelled MN 72851. Forecast LOR2 cancelled due to increased generation availability.	922	941	922	FUM
23/01/2020 12:30-18:00	72882	23/01/2020 10:41	LOR1	Update	Update to MN 72852. Effective period in forecast LOR1 increased.	1,371	796	674	LCR2
23/01/2020 15:30-17:00	72883	23/01/2020 11:16	LOR2	Forecast	Forecast LOR2 declared due to increased forecast demand coinciding with decreased generation availability. RERT services were activated.	721	463	719	LCR

Effective date and time	Market Notice ID	Issue date and time	Level	Actual, forecast, update or cancel	Comments	Reserve requirement (MW)[A]		FUM value (MW)[B]	Reserve requirement set by
						Required	Available		
23/01/2020 13:30-18:30	72890	23/01/2020 13:34	LOR1	Actual	Actual LOR1 declared. Generation availability did not increase after market notification. The required and available reserve level published in MN 72890 referred to the time of minimum reserve in Pre-Dispatch, and not the first trading interval in Pre-Dispatch where the actual LOR1 existed.	1,452	542	634	LCR2
23/01/2020 14:35-17:00	72923	23/01/2020 14:37	LOR2	Actual	Actual LOR2 declared. Increased forecast demand and decreased generation availability resulted in earlier and longer actual condition than forecast.	742	568	595	LCR
23/01/2020	72951	23/01/2020 19:00	LOR2	Cancelled	This cancelled MN 72923. Actual LOR2 cancelled as condition cleared after effective period.	796	827	342	LCR
23/01/2020	72957	23/01/2020 20:48	LOR1	Cancelled	This cancelled MN 72890. Actual LOR1 cancelled as condition cleared after effective period.	1,367	1,682	213	LCR2
28/01/2020 16:30-17:00	73069	28/01/2020 16:44	LOR1	Actual	Actual LOR1 declared. Significant generation availability decreased quickly causing a shallow actual LOR1 condition.	1,300	1,196	374	LCR2
28/01/2020	73070	28/01/2020 17:07	LOR1	Cancelled	This cancelled MN 73069. Actual LOR1 condition cancelled as forecast demand decreased after effective period.	1,300	1,678	374	LCR2
31/01/2020 16:00-16:30	73094	30/01/2020 13:15	LOR1	Forecast	Forecast LOR1 declared due to an increase in forecast demand.	1,360	1,301	955	LCR2
31/01/2020	73096	30/01/2020 14:49	LOR1	Cancelled	This cancelled MN 73094. Forecast LOR1 cancelled due to slightly increased generation availability.	1,360	1,376	941	LCR2
31/01/2020 16:00-16:30	73164	30/01/2020 22:09	LOR1	Forecast	Forecast LOR1 declared due to slight decrease in generation availability.	1,360	1,280	701	LCR2
31/01/2020 15:30-17:00	73167	31/01/2020 07:22	LOR1	Update	Update to MN 73164. Effective period in forecast LOR1 increased. Available reserve decreased due to decreased generation availability and decreased net import.	1,300	1,135	717	LCR2

Effective date and time	Market Notice ID	Issue date and time	Level	Actual, forecast, update or cancel	Comments	Reserve requirement (MW)[A]		FUM value (MW)[B]	Reserve requirement set by
						Required	Available		
31/01/2020 15:00	73188	31/01/2020 15:01	LOR2	Actual	Actual LOR2 declared. Significant net import decreased quickly due to transmission line outages resulting in an actual LOR2 condition. RERT services were activated.	775	500	540	LCR
31/01/2020	73231	31/01/2020 19:21	LOR2	Cancelled	This cancelled MN 73188. Actual LOR2 condition cancelled as net import was restored and generation availability increased.	777	2,176	336	LCR
31/01/2020	73234	31/01/2020 19:50	LOR1	Cancelled	This cancelled MN 73167. Forecast LOR1 cancelled due to increased generation availability.	1,480	2,376	213	LCR2
01/02/2020 16:00-17:30	73170	31/01/2020 12:47	LOR1	Forecast	Forecast LOR1 declared due to decreased generation availability.	1,320	1,235	953	LCR2
01/02/2020 15:30-17:30	73238	31/01/2020 21:48	LOR1	Update	Update to MN 73170. Effective period in forecast LOR1 increased.	1,300	1,140	701	LCR2
01/02/2020 16:30-17:30	73252	01/02/2020 06:17	LOR1	Update	Update to MN 73238. Effective period in forecast LOR1 decreased and available reserve increased due to increased generation availability.	1,300	1,244	676	LCR2
01/02/2020 15:00-18:00	73270	01/02/2020 08:07	LOR1	Update	Update to 73252. Effective period in forecast LOR1 increased and available reserve decreased due to decreasing generation availability.	1,300	1,011	733	LCR2
01/02/2020 13:45-18:30	73324	01/02/2020 13:50	LOR1	Actual	Actual LOR1 declared. Forecast demand increased and generation availability continued to decrease leading up to the event.	1,300	861	572	LCR2
01/02/2020 16:55	73367	01/02/2020 17:03	LOR2	Actual	Actual LOR2 declared. The actual LOR1 event became an actual LOR2 declaration when significant generation availability quickly decreased.	650	331	344	LCR
01/02/2020	73376	01/02/2020 20:17	LOR2	Cancelled	Correction to MN 73375. This cancelled 73367. Actual LOR2 cancelled as generation availability was restored.	660	1,671	213	LCR

Effective date and time	Market Notice ID	Issue date and time	Level	Actual, forecast, update or cancel	Comments	Reserve requirement (MW)[A]		FUM value (MW)[B]	Reserve requirement set by
						Required	Available		
01/02/2020	73377	01/02/2020 20:26	LOR1	Cancelled	This cancelled MN 73324. Actual LOR1 cancelled as condition cleared after effective period.	1,320	1,671	213	LCR2
02/02/2020 14:00-16:00	73357	01/02/2020 16:02	LOR1	Forecast	Forecast LOR1 declared due to decreased generation availability and increased forecast demand.	1,320	1,171	978	LCR2
02/02/2020 14:30-15:00	73378	01/02/2020 20:27	LOR1	Updated	Update to MN 73357. Effective period in forecast LOR1 decreased and available reserve increased due to increased generation availability.	1,320	1,293	737	LCR2
02/02/2020 15:30-16:00	73495	02/02/2020 13:11	LOR1	Updated	Update to MN 73378. Effective period in forecast LOR1 decreased.	1,300	1,225	595	LCR2
02/02/2020	73518	02/02/2020 14:45	LOR1	Cancelled	This cancelled MN 73495. Forecast LOR1 cancelled due to large decrease in forecast demand.	1,280	1,930	470	LCR2
Queensland region									
Nil									
South Australia region									
30/01/2020 18:00-18:30	72970	24/01/2020 15:27	LOR1	Forecast	Forecast reserves slightly under LOR1 due to decreased generation availability and increased forecast demand.	579	562	n/a – forecast > 72 hrs ahead	LCR2
30/01/2020	73067	28/01/2020 15:33	LOR1	Cancelled	This cancelled MN 72970. Forecast LOR1 cancelled due to significantly increased generation availability.	600	1,188	431	LCR2
30/01/2020 18:20	73131	30/01/2020 18:32	LOR2	Actual	Actual LOR2 declared. Sudden loss of generation in VIC significantly decreased net import. Actual LOR2 was not forecast in pre-dispatch due to rapidly changing conditions.	235	70	n/a	LCR
30/01/2020	73147	30/01/2020 19:12	LOR2	Cancelled	This cancelled MN 73131. Actual LOR2 cancelled due to increased net import.	238	514	101	LCR

Effective date and time	Market Notice ID	Issue date and time	Level	Actual, forecast, update or cancel	Comments	Reserve requirement (MW)[A]		FUM value (MW)[B]	Reserve requirement set by
						Required	Available		
10/02/2020 18:00-19:30	73793	04/02/2020 14:55	LOR1	Forecast	Forecast LOR1 declared due to decreased generation availability.	457	391	n/a – forecast > 72 hrs ahead	LCR2
10/02/2020	73847	05/02/2020 15:03	LOR1	Cancelled	This cancelled MN 73793. Forecast LOR1 cancelled due to increased generation availability and decreased forecast demand.	457	1,005	n/a – forecast > 72 hrs ahead	LCR2
02/03/2020 14:00-14:30	74637	02/03/2020 14:29	LOR1	Forecast	Forecast LOR1 declared. Available reserve decreased due to network constraints invoked to manage low demand during SA extended island condition.	443	314	119	LCR2
Tasmania region									
Nil									
Victoria region									
30/01/2020 17:00-18:30	73101	30/01/2020 17:12	LOR1	Actual	Actual LOR1 declared. Sudden increase in forecast demand resulted in a shallow actual LOR1.	1,125	1,039	190	LCR2
30/01/2020 18:20	73130	30/01/2020 18:32	LOR2	Actual	Actual LOR2 declared. Sudden loss of generation availability in VIC significantly decreased reserve. Actual LOR2 was not forecast in pre-dispatch due to rapidly changing conditions.	565	70	n/a	LCR
30/01/2020	73159	30/01/2020 19:38	LOR2	Cancelled	This cancelled MN 73130. Actual LOR2 cancelled due to reduced forecast demand and increased net import.	578	1,373	246	LCR
30/01/2020 17:00-20:00	73160	30/01/2020 19:44	LOR1	Updated	Update to MN 73101. Actual LOR1 remained after actual LOR2 was cancelled.	1,138	971	214	LCR2
30/01/2020	73161	30/01/2020 20:08	LOR1	Cancelled	This cancelled MN 73160. Actual LOR1 cancelled due to decreased demand forecast and increased net import.	1,138	1,612	160	LCR2

Effective date and time	Market Notice ID	Issue date and time	Level	Actual, forecast, update or cancel	Comments	Reserve requirement (MW)[A]		FUM value (MW)[B]	Reserve requirement set by
						Required	Available		
31/01/2020 15:30-17:00	73091	30/01/2020 13:02	LOR2	Forecast	Forecast LOR2 declared due to Increased forecast demand.	916	852	916	FUM
31/01/2020 17:00-17:30	73093	30/01/2020 13:13	LOR1	Forecast	Correction to MN 73092. Forecast LOR1 decreased due to Increased forecast demand.	1,060	1,016	914	LCR2
31/01/2020 15:30-17:00	73100	30/01/2020 15:59	LOR2	Updated	Correction to MN 73099. Update to MN 73091. Available reserved decreased.	836	748	836	FUM
31/01/2020	73162	30/01/2020 22:08	LOR2	Cancelled	This cancelled MN 73100. Forecast LOR2 cancelled due to decreased forecast demand and increased generation availability.	711	846	711	FUM
31/01/2020 15:30-18:30	73163	30/01/2020 22:09	LOR1	Updated	Update to MN 73093. Effective period in forecast LOR1 increased and available reserve decreased.	1,060	846	711	LCR2
31/01/2020 16:00-17:00	73165	31/01/2020 05:07	LOR1	Updated	Update to MN 73163. Effective period in forecast LOR1 decreased and available reserve increased.	1,060	979	593	LCR2
31/01/2020	73166	31/01/2020 07:15	LOR1	Cancelled	This cancelled MN 73165. Forecast LOR1 cancelled due to increased net import.	1,070	1,137	602	LCR2
31/01/2020 15:00-17:00	73169	31/01/2020 12:41	LOR1	Forecast	Forecast LOR1 declared due to fluctuating net import and forecast demand.	1,120	1,058	475	LCR2
31/01/2020 15:00-18:00	73181	31/01/2020 14:04	LOR2	Forecast	Correction to MN 73173. Forecast LOR2 declared after the loss of the interconnector between South Australia and Victoria caused a sudden and significant decrease in available reserve.	560	406	374	LCR
31/01/2020 14:00	73183	31/01/2020 14:16	LOR2	Actual	Actual LOR2 declared. Available reserves continued to decrease after separation event. RERT services were activated.	560	200	493	LCR
31/01/2020	73232	31/01/2020 19:34	LOR2	Cancelled	This cancelled MN 73183. Actual LOR2 cancelled due to decreased forecast demand after effective period.	568	1,894	370	LCR

Effective date and time	Market Notice ID	Issue date and time	Level	Actual, forecast, update or cancel	Comments	Reserve requirement (MW)[A]		FUM value (MW)[B]	Reserve requirement set by
						Required	Available		
31/01/2020	73236	31/01/2020 19:55	LOR1	Cancelled	This cancelled MN 73169. Forecast LOR1 cancelled due to decreased forecast demand after effective period.	1,128	1,894	370	LCR2

A. Reserve Required and Reserve Available are the values that correspond to the trading interval in the effective period with the lowest reserve available.
B. The value in this field represents the FUM value for the trading interval during which the minimum available reserve occurred (see Reserve Requirement (MW) – Available field).

4. Review of performance

4.1 Forecast Uncertainty Measure values

This section compares the average, minimum, and maximum FUM values for this reporting period to those for Quarter 1 2019 through Quarter 1 2020 (see Figures 1 through 5 below).

Changes in FUM values relative to Quarter 4 2019 are summarised below. For forecast horizons not mentioned below, the changes relative to Quarter 4 2019 are minor:

- New South Wales – the maximum FUM values increased for the 60 hours ahead forecast horizon. Average FUM values increased for the 48 hours ahead and 60 hours ahead forecast horizons.
- Queensland – the maximum and average FUM values decreased for the 24, 48 and 60 hours ahead forecast horizons. Maximum FUM values increased for the 12 hours ahead forecast horizon.
- South Australia – the maximum FUM values increased most notably in the 6, 12, 24 and 60 hours ahead forecast horizons. The FUM range increased for the 6 hours ahead forecast horizon.
- Tasmania – the FUM range increased for the 6 hours ahead forecast horizon.
- Victoria – the FUM range reduced for the 12 hours ahead forecast horizon. The maximum FUM reduced for the 6 hours ahead forecast horizon and increased for the 60 hours ahead forecast horizon.

Figure 1 New South Wales region: maximum, minimum, and average FUM values for the reporting period, and compared to previous four quarters

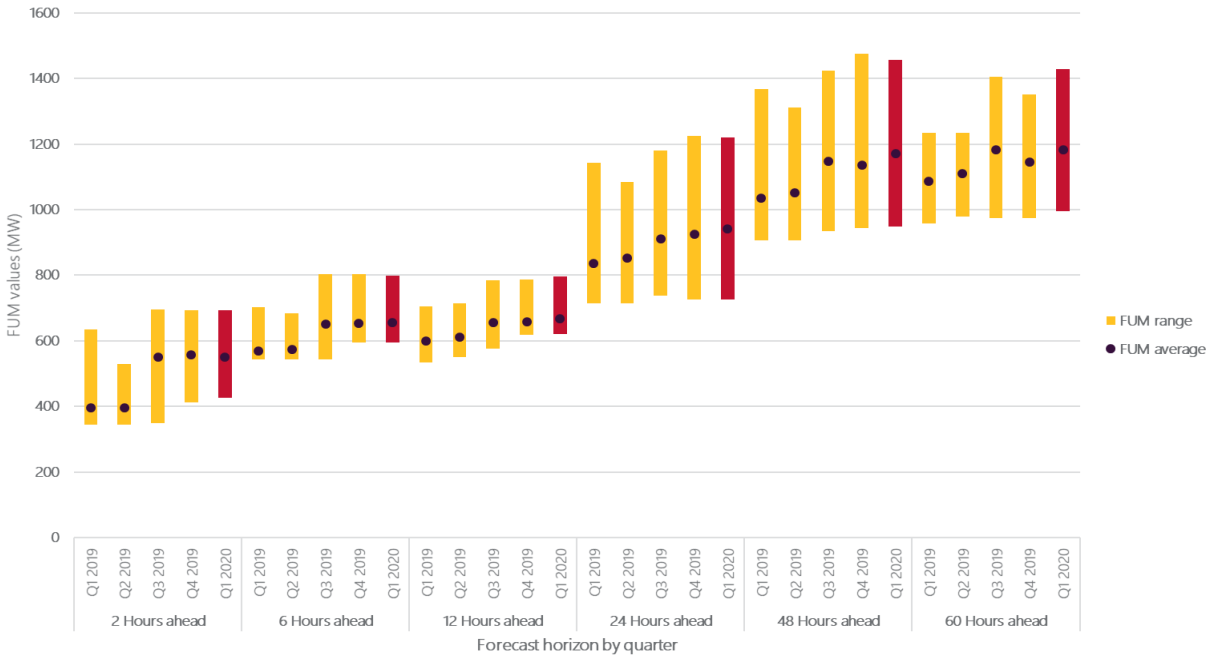


Figure 2 Queensland region: maximum, minimum, and average FUM values for the reporting period, and compared to previous four quarters

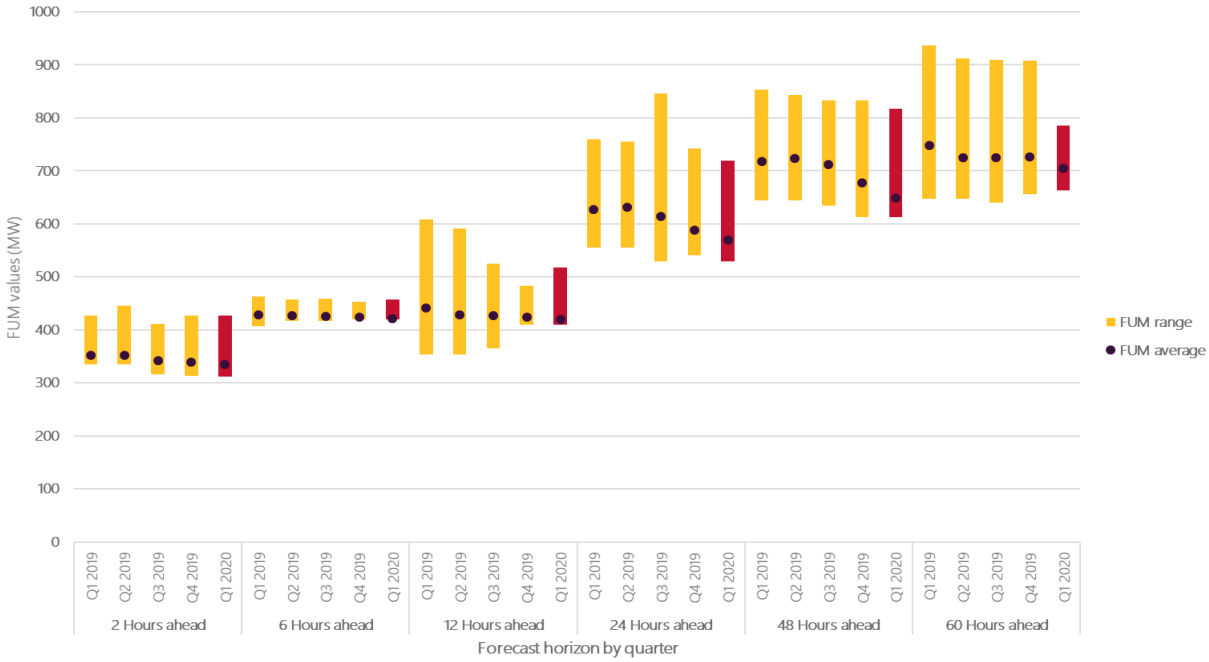


Figure 3 South Australia region: maximum, minimum, and average FUM values for the reporting period, and compared to previous four quarters

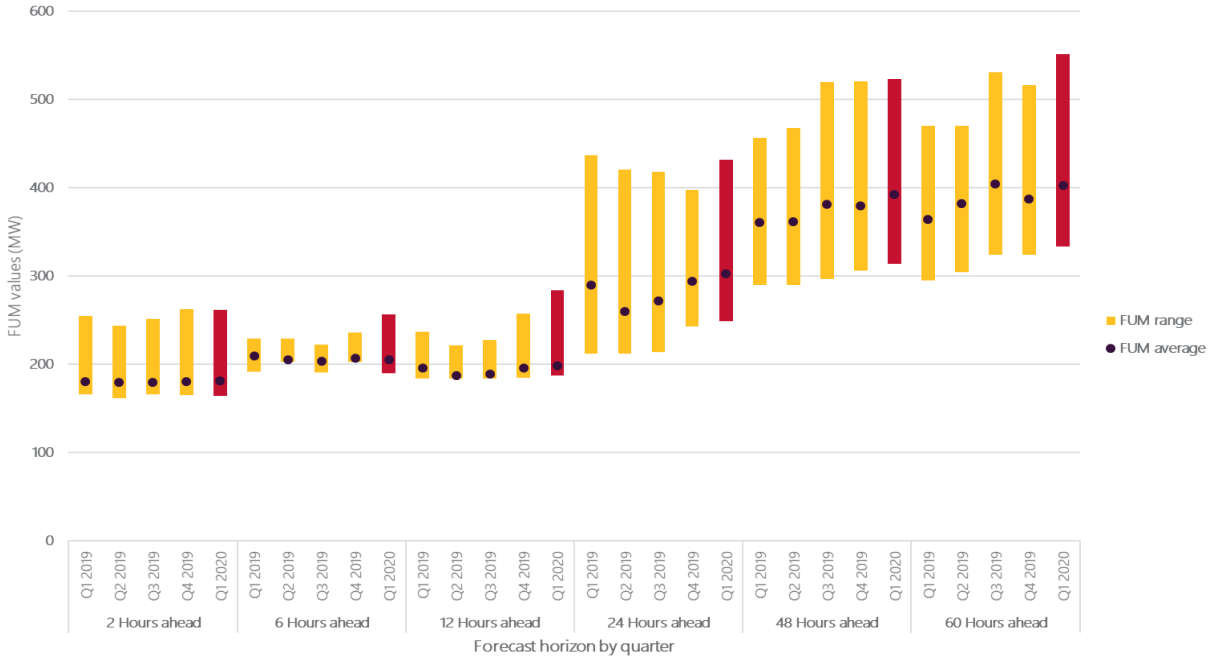


Figure 4 Tasmania region: maximum, minimum, and average FUM values for the reporting period, and compared to previous four quarters

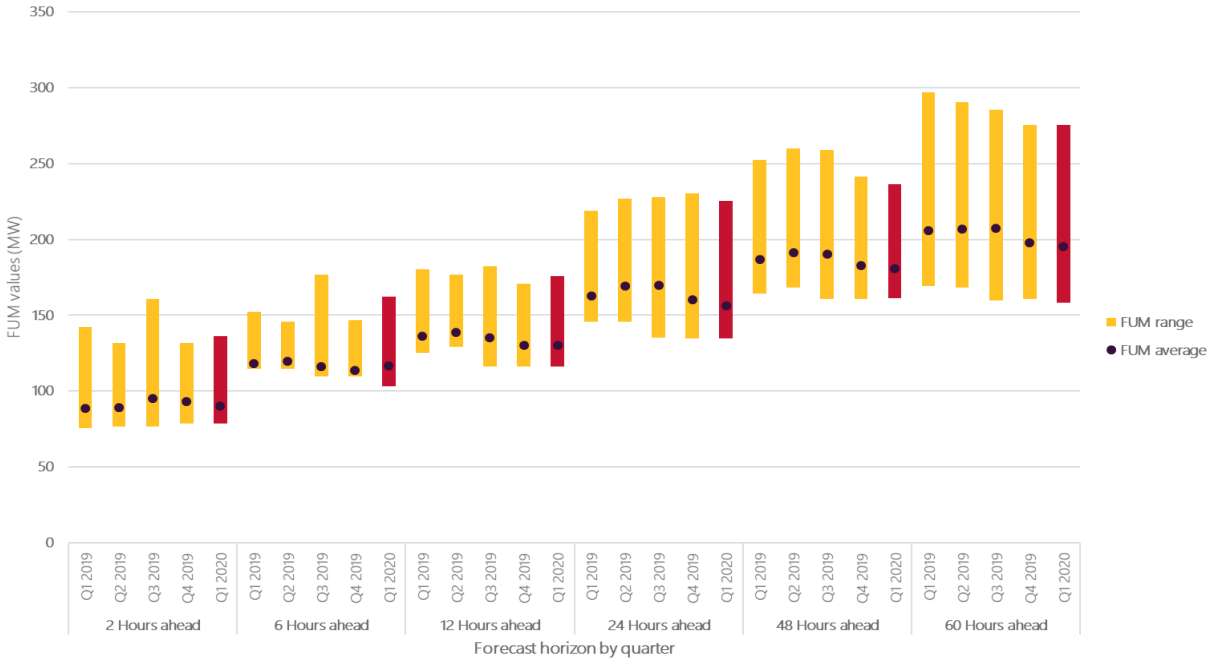
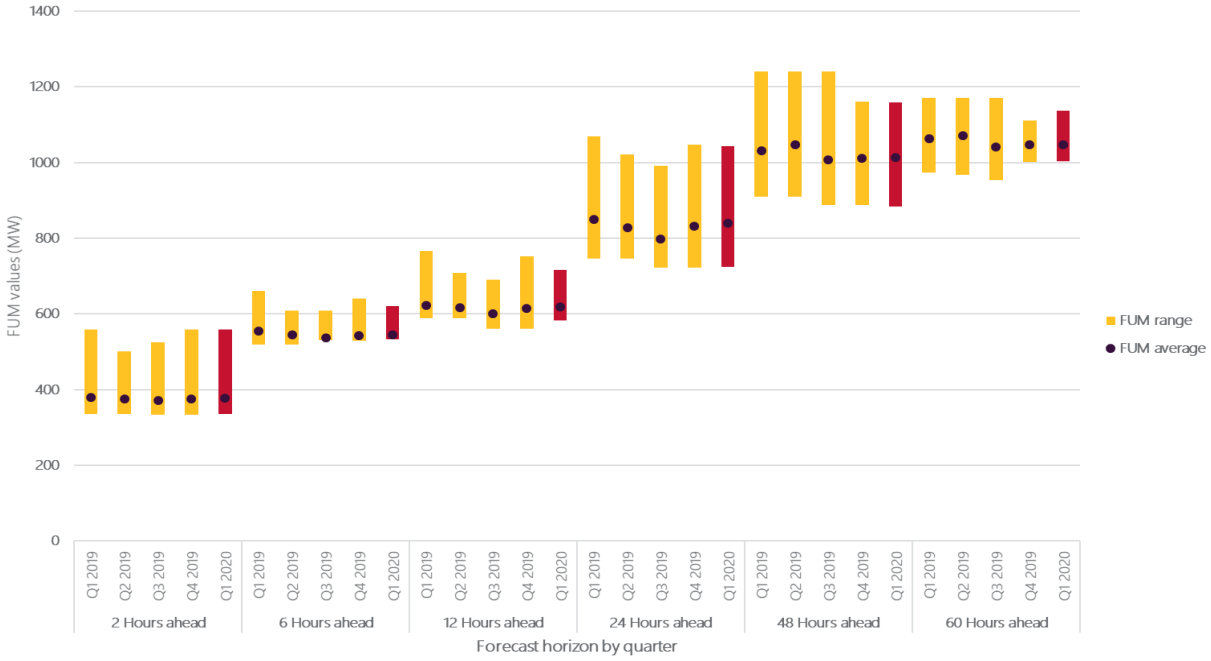


Figure 5 Victoria region: maximum, minimum, and average FUM values for the reporting period, and compared to previous four quarters



4.2 Forecast and actual LOR declarations

A summary of the count and causes of forecast and actual LOR declarations can be found in Table 1 in Section 3 of this report.

During the reporting period 1 January 2020 to 31 March 2020, there were 19 LOR declarations. Of these declarations, seven were for forecast LOR conditions:

- All forecast declarations were for LOR1 conditions.
- All forecast LOR2 events declared were subsequently updated to actual events and therefore not counted as forecast declarations.

These do not include forecast LOR events that were subsequently declared as actual LOR events, however, do include forecast LOR1 events that were later updated to forecast LOR2 events, and LOR2 events that were later downgraded to LOR1 events.

A total of 12 actual LOR declarations were made during the reporting period, including five actual LOR1 and seven actual LOR2 events:

- Only three actual declarations, either LOR1 or LOR2, were forecast in Short Term Projected Assessment of System Adequacy (ST PASA) or Pre-Dispatch.
- Three of the actual LOR1 events and five of the actual LOR2 events were declared without first being forecast in ST PASA or Pre-Dispatch.

The high number of unanticipated actual events was due to various power system incidents quickly reducing available reserve.

On 30 January 2020, a sudden and significant loss of generation in Victoria coincided with very high demand in Victoria and South Australia and resulted in deep actual LOR2 declarations in both regions. These events were declared using near real-time data as they occurred within the first interval of Pre-Dispatch and thus Pre-Dispatch data could not be used to determine reserve levels.

During the reporting period RERT services were activated on 4 January (New South Wales), 23 January (New South Wales), and 31 January (New South Wales and Victoria)[5].

By comparison, 14 LOR declarations were made in Quarter 4 2019 (nine forecast LOR events and five actual LOR events) and 27 LOR declarations were made in Quarter 1 2019 (16 forecast LOR events and 11 actual LOR events).

4.3 LOR declaration of reserve requirement

The effective dates when LOR declarations were made, and the contingency types (LCR, LCR2 or FUM) which set the reserve requirement for these declarations, are provided in Table 3.

Of the 19 LOR declarations in Quarter 1 2020:

- There were two declarations where the reserve requirement was set by the FUM (11%); both were for LOR2 conditions:
  - On 23 January in New South Wales, a forecast LOR2 was declared in the Pre-Dispatch timeframe when the FUM was 1,119 MW. The condition was cancelled when the FUM was 929 MW and was setting the LOR2 reserve requirement. An actual LOR2 condition was later declared due to a sudden and significant decrease in generation availability while LCR was setting the reserve requirement.
  - On 31 January in Victoria, a forecast LOR2 was declared in the Pre-Dispatch timeframe when the FUM was 916 MW. The condition was cancelled when the FUM was 711 MW and was setting the LOR2 reserve requirement. A forecast and subsequent LOR2 condition was later declared due to a separation

[5] RERT reporting found at https://aemo.com.au/energy-systems/electricity/emergency-management/reliability-and-emergency-reserve-trader-rert/rert-reporting

event between Victoria and South Australia. The LCR was setting the reserve requirement during the actual condition.

  - The remaining five LOR2 conditions were declared on short notice due to unplanned transmission outages or sudden losses of generation. The FUM was either lower than the LCR or not applicable for these declarations.

- All 12 of the LOR1 declarations occurred when the reserve requirement was being set by the LCR2. Three of these events were initially forecast when the FUM did not apply as the forecast horizon was greater than 72 hours.

  For comparison, in Quarter 4 2019, three of the 14 (21%) LOR conditions were set by the FUM, and in Quarter 1 2019, ten of the 27 (37%) of LOR conditions were set by the FUM.

Table 3 LORs declared during the reporting period by trigger (FUM or LCR)

Effective date	LOR1	LOR2		LOR3
New South Wales (NSW)				
04/01/2020		Actual		
20/01/2020	Forecast			
22/01/2020	Actual			
23/01/2020	Forecast then Actual	Forecast	Actual	
28/01/2020	Actual			
31/01/2020	Forecast	Actual		
01/02/2020	Forecast then Actual	Actual		
02/02/2020	Forecast			
South Australia (SA)				
30/01/2020	Forecast	Actual		
10/02/2020	Forecast			
02/03/2020	Forecast			
Victoria (VIC)				
30/01/2020	Actual	Actual		
31/01/2020	Forecast	Forecast	Actual	

Note. Yellow shading indicates the requirement was set by the LCR or LCR2, and orange indicates the requirement was set by the FUM.

4.4 Number and cause of LOR declarations

A total of 19 LOR conditions were declared during Quarter 1 2020. This is an increase from 14 in Quarter 4 2019. While the total number of declarations are comparable between the quarters, this reporting period saw 12 actual LOR conditions, while the last period only saw five.

Quarter 1 2020 covered the later summer months and first month of autumn. Continuing from the previous quarter, high temperatures resulted in high demand events in all regions of the NEM. Bushfire activity continued to impact the electricity network, particularly at the beginning of the quarter, and at time caused in LOR conditions. Multiple unplanned transmission outages, regional separation events, and sudden loss of

generation availability occurred throughout the period and significantly impacted available reserves. These power system incidents resulted in many unanticipated actual LOR1 and LOR2 conditions compared to previous quarters.

A total of 65 market notices related to LOR conditions were issued through this reporting period. Of these, 16 market notices declared forecast conditions and 14 market notices declared actual conditions (or updated existing actual conditions), reflecting the high conversion of forecast to actual LOR conditions during this reporting period.

- New South Wales – 11 LOR declarations were made this reporting period, including four actual LOR1 and four actual LOR2 events. The major events resulting in actual LOR2 declarations were:
  - On 4 January, multiple transmission lines tripped due to the impact of bushfire activity. A separation event occurred which quickly decreased generation availability in the region and an actual LOR2 was declared.
  - On 23 January, increased forecast demand resulted in a forecast LOR2. A sudden and significant decrease in generation availability resulted in an actual LOR2 being declared earlier than forecast.
  - On 31 January, a separation event between Victoria and South Australia significantly constrained net import into New South Wales, resulting in an actual LOR2 declaration.
  - On 1 February, a sudden and significant decrease in generation availability resulted in an actual LOR2 declaration.
- South Australia – four LOR declarations were made this reporting period, including one actual LOR2 event:
  - On 30 January, a sudden loss of major generation availability in Victoria significantly decreased net import into South Australia. The event coincided with the forecast demand peak in South Australia, which was high due to extreme temperatures, and resulted in a deep actual LOR2 being declared.
- Victoria – four LOR declarations were made across two days this reporting period, including two actual LOR2 events:
  - On 30 January, a sudden loss of major generation availability significantly decreased available reserve. This event coincided with the evening peak operational demand in Victoria, which was high due to extreme temperatures, and resulted in a deep actual LOR2 being declared.
  - On 31 January, an unplanned transmission network outage resulted in the disconnection of the South Australian region, Alcoa Portland (APD) aluminium smelter and Mortlake Power Station from the rest of the NEM. The sudden loss of generation availability and net import resulted in an actual LOR2 being declared.

For forecast LOR1 conditions which were not subsequently declared actual conditions, the main reasons for their cancellations were increased generation availability, increased net import, and decreased forecast demand.

Glossary

This document uses many terms that have meanings defined in the National Electricity Rules (NER). The NER meanings are adopted unless otherwise specified.

For each of the terms below, refer to the Guidelines for further information.

Term	Definition
FUM	Forecast Uncertainty Measure (the number of MW representing the level of forecasting uncertainty)
Guidelines	The Reserve Level Declaration Guidelines published by AEMO under clause 4.8.4A of the NER
LCR	Largest Credible Risk – the single largest credible risk in the region
LCR2	Largest Credible Risk 2 – the sum of the two largest credible risks in the region
LOR1	Lack of Reserve level 1. The threshold for an LOR1 is determined by the larger value of either the FUM or the sum of the two largest credible risks in the region (LCR2).
LOR2	Lack of Reserve level 2. The threshold for an LOR2 is determined by the larger value of either the FUM or the largest credible risk in the region (LCR).
LOR3	Lack of Reserve level 3. The threshold for an LOR3 condition is when the forecast reserve for a region is at or below zero.