Ancillary Services Report for the WEM 2021

June 2021

System Management

Important notice

PURPOSE

AEMO publishes the Wholesale Electricity Market Ancillary Services report under clause 3.11.13 of the Wholesale Electricity Market Rules.

This publication has been prepared by AEMO using information available at 21 May 2021. Information made available after this date may be included in this publication where practicable.

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VERSION CONTROL

Version	Release date	Changes
1	31 May 2021	Submission to the ERA
2	25 June 2021	Minor edits in sections 2.2 and 5.6 to correct errors

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1. Introduction

Each year AEMO is required to publish an Ancillary Services report for the Wholesale Electricity Market (WEM), including the Ancillary Service Requirements for the next year and an Ancillary Services plan to meet those requirements.

1.1 Purpose

Clause 3.11.2 of the Wholesale Electricity Market Rules (WEM Rules) requires AEMO to update Ancillary Service Requirements on an annual basis. The Ancillary Service Requirements must be set based on the Facilities and configuration expected for the South West Interconnected System (SWIS) in the coming year.

Clause 3.11.6 of the WEM Rules requires AEMO to submit the Ancillary Service Requirements to the Economic Regulation Authority (ERA) for approval.

Clause 3.11.11 of the WEM Rules states:

> *By 1 June each year, AEMO must submit to the Economic Regulation Authority a report containing information on:*
>
> *(a) the quantities of each of the Ancillary Services provided in the preceding year, including Ancillary Services provided under Ancillary Service Contracts, and the adequacy of these quantities;*
>
> *(b) the total cost of each of the categories of Ancillary Services provided, including Ancillary Services provided under Ancillary Service Contracts, in the preceding year; and*
>
> *(c) the Ancillary Service Requirements for the coming year and the Ancillary Services plan to meet these requirements.*

Clause 3.11.12 of the WEM Rules requires the ERA to audit the Ancillary Services plan.

Clause 3.11.13 of the WEM Rules requires AEMO to publish the Ancillary Services report (including the Ancillary Services plan).

The Ancillary Service Standards and this report relate to the SWIS Operating Standards found in clause 2.2.1 and Table 2.1 of the Technical Rules, identified in clause 3.11.1 of the WEM Rules. The Normal Operating Frequency Band and the Credible Contingency Event Frequency Band of the Frequency Operating Standards in Appendix 13 of the WEM Rules, introduced from 1 February 2021, are aligned with these requirements. This applies to the 2020-21 Financial Year performance figures in Section 2, the 2021-22 requirements in Section 4, and the 2021-22 plan in Section 5.

Clause 3.11.1 of the WEM Rules requires AEMO to determine all Ancillary Service Requirements in accordance with the SWIS Operating Standards and the Ancillary Service Standards.

The SWIS Operating Standards are defined as "the standards for the operation of the SWIS including the frequency and time error standards and voltage standards set out in clause 3.1". Clause 3.1 of the WEM Rules states that the frequency, time error standards and voltage standards for a Network in the SWIS are as defined in the Technical Rules that apply to that Network.

Table 1 summarises the frequency operating standards for the SWIS as defined in the Technical Rules[1]. AEMO uses these frequency operating standards to assess SWIS frequency performance.

[1] Table 2.1 of the Technical Rules.

The Ancillary Service Standards are intended to enable AEMO to ensure the SWIS operates within normal frequency bands and to restore the SWIS to the normal frequency bands within the target recovery time following a contingency event.

Table 1 Frequency operating standards for the South West Interconnected Network

Condition	Frequency band	Target recovery time
Normal range: South West	49.8 to 50.2 Hz for 99% of the time	
Single Contingency Event	48.75 to 51 Hz	Normal range: within 15 minutes For over-frequency events: below 50.5 Hz within 2 minutes

There are different categories of frequency control Ancillary Services in the SWIS:

- The Load Following Service (LFAS) is used to continuously balance supply and demand.
  - While contingency reserves arrest the frequency change following a contingency event, LFAS will restore the frequency to 50 hertz (Hz)[2].
  - LFAS is dispatched using Automatic Generation Control (AGC).
  - Clause 3.10.1(a) of the WEM Rules sets the standard for LFAS as a level that is the greater of 30 megawatts (MW) and the capacity sufficient to cover 99.9% of the short-term fluctuations in load and output of Non-Scheduled Generators and uninstructed output fluctuations from Scheduled Generators.
  - While LFAS is provided by specific generators cleared in the LFAS market for provision of this service, the above standard is also partially met by the governor droop response of all other synchronous generators.
- Spinning Reserve (SRAS) and Load Rejection Reserve (LRR) are relied on as contingency reserves to arrest a frequency change following the unplanned loss of generation or demand.
  - While some SRAS is provided by Interruptible Loads, SRAS and LRR are mostly provided using the governor droop response on specific synchronous generators able to maintain the response for the period of service.

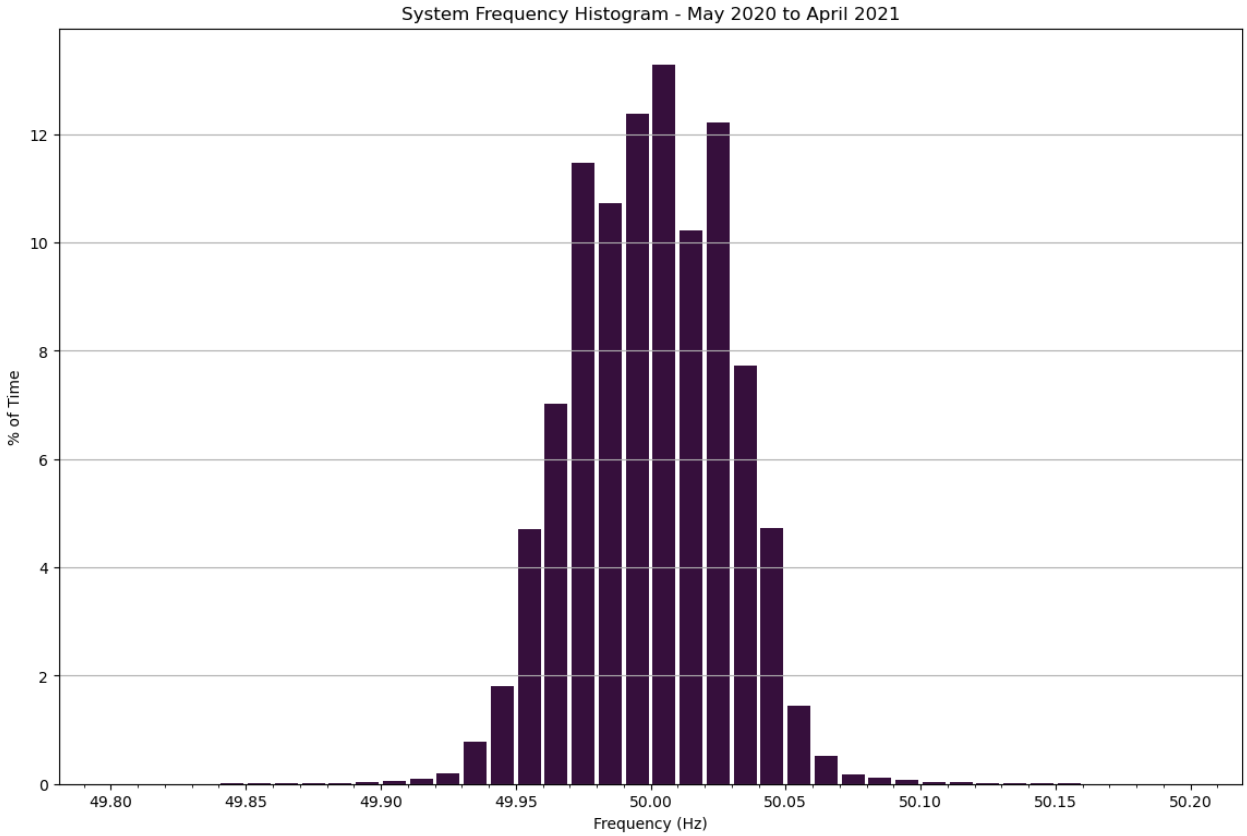
Figure 1 shows the frequency performance of the SWIS for the period under review (May 2020 to April 2021). The frequency remained in the normal operating band for 99.988% of the time. This meets the frequency operating standards specified in the Technical Rules[3].

This performance was a product of the combination of active frequency control of the LFAS generators via AGC and the governor responses from all online generators.

[2] Depending on the size of the contingency, rebalancing may be required to restore frequency to 50 Hz. Depending on the shortfall additional generation may be required to be brought on. This might be in or out of merit depending on the timeframe of response required.

[3] The Appendix A1 analysis of LFAS quantities illustrates the alignment between frequency keeping mechanisms use and LFAS requirements in 2020-21.

Figure 1 Frequency performance of the SWIS from May 2020 to April 2021



2. Ancillary Service quantities

This section describes the quantity of each Ancillary Service provided in the preceding year and the adequacy of those quantities. The period of reporting is May 2020 to April 2021.

2.1 Overview

Clause 3.9 of the WEM Rules defines the following Ancillary Services:

- Load Following Service (LFAS).
- Spinning Reserve Service (SRAS).
- Load Rejection Reserve Service (LRR).
- Dispatch Support Service (DSS).
- System Restart Service.

2.2 Load Following Service

The LFAS requirement approved for 2020-21 was 85 MW LFAS Upwards and Downwards between 5:30 AM and 7:30 PM, and 50 MW LFAS Upwards and Downwards between 7:30 PM and 5:30 AM to be enabled for each Trading Interval. This LFAS requirement was recommended by AEMO and approved by the ERA[4] subject to ongoing monitoring and assessment of adequacy of LFAS requirements due to the expected connection of 520MW of additional intermittent non-scheduled generation, expected to increase requirements for LFAS.

In September 2020, the ERA approved[5] a revised LFAS requirement, as recommended by AEMO, for the remainder of 2020-21. The revised LFAS requirement was up to 105 MW LFAS Upwards and Downwards between 5:30 AM and 7:30 PM, and up to 80 MW LFAS Upwards and Downwards between 7:30 PM and 5:30 AM, to be enabled for each Trading Interval.

The implementation of this revised requirement was conducted in a phased manner with an initial increase of 10 MW during the peak times (increasing the quantities to 95 MW) and 20 MW during off-peak times (increasing quantities to 70 MW) from late September 2020. This implementation was reviewed in early 2021. As the initial increase had proven effective, AEMO considered it appropriate to retain the initial figures of 95 MW during peak times and 70 MW during off-peak times for the remainder of 2020-21.

There are currently five certified LFAS providers in the WEM, and three of them actively participated in the LFAS Market in 2020-21.

Backup LFAS in the range of 25 MW to 50 MW was utilised on six occasions[6, 7], due to volatility in non-scheduled generation and rooftop distributed photovoltaic (PV).

[4] Refer to page 5 of the 2020 ERA decision for AEMO's Ancillary Services, at https://www.erawa.com.au/cproot/21342/2/2020-ERA-Decision-on-AEMO-s-Ancillary-Service-Report-Clean-Version-.pdf.

[5] Approval of revised 2020-21 LFAS Requirements, at https://www.erawa.com.au/cproot/21449/2/ERA-letter-to-AEMO---Approval-of-revised-2020-21-LFAS-requirements.PDF.

[6] There were a further 12 occasions where Backup LFAS was utilised when LFAS providers were unable to provide LFAS, however these are not indicative of a shortfall in LFAS requirements.

[7] Increased LFAS reduces the likelihood of some Backup LFAS being required, however increased volatility events will continue to occur.

The average quantity of LFAS Upwards and LFAS Downwards enabled by all providers in the reporting period is shown in Table 2.

Table 2 LFAS quantities from May 2020 to April 2021

	Requirement	LFAS Upwards	LFAS Downwards
Average quantity enabled[A] between 5:30 AM to 7:30 PM from 1 May 2020 up to 8:00 AM 25 September 2020[B]	85 MW	103 MW	108 MW
Average quantity enabled between 7:30 PM and 5:30 AM from 1 May 2020 up to 8:00AM 25 September 2020	50 MW	74 MW	74 MW
Average quantity enabled between 5:30 AM to 7:30 PM from 8:00 AM 25 September 2020 up to 30 April 2021	95 MW	111 MW	117 MW
Average quantity enabled between 7:30 PM and 5:30 AM from 8:00 AM 25 September 2020 up to 30 April 2021	70 MW	92 MW	95 MW
% of time requirement met[C]		99.55%	99.62%
Average number of minutes per day requirement not met		4.52 minutes	3.78 minutes
Frequency within normal operating range for > 99% of the time[D]	Met		

A. For non-Synergy providers, the quantity enabled is the LFAS Market cleared volume, while for Balancing Portfolio Facilities, it is the entire operating range of Synergy's Facilities enabled for LFAS. As such, the average quantities provided will always equal or exceed the requirement. For the purpose of this analysis, half of the quantity enabled for Balancing Portfolio Facilities is assumed to be LFAS Upwards and the other half is assumed to be LFAS Downwards.
B. LFAS requirements were changed at 8:00 AM on 25 September 2020.
C. While AEMO endeavours through its operational planning to have the required level of LFAS available at all times, real-time events result in less than 100% of this target being achieved.
D. Clause 3.1.1 of the WEM Rules states that the frequency and time error standards for a network in the SWIS are as defined in the Technical Rules that apply to that network. According to the Technical Rules, frequency should be within the normal band (49.8 Hz and 50.2 Hz) for 99% of the time.

AEMO enables specific Facilities to provide LFAS based on LFAS Market outcomes. A Facility may provide LFAS Upwards, LFAS Downwards, or both. If a non-Balancing Portfolio Facility is cleared in the LFAS Market, it is automatically enabled via AGC to provide LFAS Upwards, LFAS Downwards, or both, for the quantity at which it was cleared. It is therefore possible to specify the exact quantity of LFAS that is enabled from a non-Balancing Portfolio Facility.

The dispatch of the Balancing Portfolio, however, requires AEMO to manually select the Facilities. Balancing Portfolio Facilities enabled via AGC provide a combination of services, including LFAS and energy balancing services for the Balancing Portfolio. Therefore, each Facility in the Balancing Portfolio is enabled for its entire operating range, providing LFAS Upwards and LFAS Downwards depending on the output at the time[8].

Consequently, the LFAS contribution from individual generators in the Balancing Portfolio is not limited to a defined range, and the quantity of LFAS enabled may exceed the requirement.

Based on the observed frequency performance, the quantity of LFAS provided during the reporting period was adequate.

2.3 Spinning Reserve Service

Clause 3.10.2(a) of the WEM Rules requires the standard for SRAS to be a level that is sufficient to cover the greater of:

[8] See Appendix A1.1 of the 2019 Ancillary Services Report for further details, at https://www.aemo.com.au/-/media/files/electricity/wem/data/system-management-reports/2019-ancillary-services-report.pdf?la=en.

i. 70% of the total output, including Parasitic Load, of the generation unit synchronised to the SWIS with the highest total output at the time; and

ii. the maximum load ramp expected over a period of 15 minutes.

For 2020-21, SRAS was provided by Balancing Portfolio Facilities and by Interruptible loads under two Ancillary Service Contracts. Generation Facilities in the Balancing Portfolio are not specifically enabled to provide SRAS. The available quantity from Balancing Portfolio Facilities is based on the spare capacity of SRAS-capable Balancing Portfolio Facilities operating. The available quantity from a non-Balancing Portfolio Facility is based on the Ancillary Service Contract, which requires the non-Balancing Portfolio Facility to satisfy technical criteria and operate within a specific range. There was 63 MW provided under the two Ancillary Service Contracts. The SRAS requirement approved for 2020-21 was at least the maximum of:

- 70% of the largest generating unit; and
- 70% of the largest contingency event[9] that would result in generation loss.

AEMO may relax the SRAS requirement by up to 12% where it expects a shortfall will be for a period of less than 30 minutes[10].

In the case of a shortfall of up to 12% for a period of less than 30 minutes, the availability of SRAS was considered to be adequate.

During 2020-21, AEMO considered that the definition of a contingency event must include[11] a combination of simultaneous generation and load trips north of Northern Terminal following the loss of the 330 kilovolt (kV) line from Neerabup Terminal through to Three Springs Terminal, coupled with associated disconnection of rooftop distributed PV[12] (the MARNET Contingency). Monitoring of this increased SRAS requirement commenced on 8 January 2021, with the MARNET Contingency setting a new highest SRAS requirement on 17 January 2021 at 310 MW.

There was adequate SRAS for 99.73% of the time during the reporting period. The average shortfall was 19 MW.

Analysis has shown that about 75% of the time when there was a shortfall in SRAS, it was as a result of LFAS Upwards being utilised[13]. The inclusion of LFAS in SRAS means it is likely there will be times when the available SRAS is less than the requirement as some of the LFAS Upwards is utilised. In such situations, AEMO will assess the risk and where necessary take appropriate measures to minimise the risk to power system security.

It is possible, in such a scenario, that if the largest contingency were to occur during a time when there was inadequate SRAS and there was no other available response from other generators on the system, under-frequency load shedding could occur. In the new WEM[14], the requirements for Contingency Reserve (the current Spinning Reserve) will be separated from Regulation (the current LFAS Up). This will minimise the risk of this scenario occurring[15]. In the meantime, the Real-Time Frequency Stability tool[16] has been developed for the control room to assist in decision-making during these infrequent circumstances.

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[9] Clause 3.11.1 of the WEM Rules requires AEMO to ensure that the Ancillary Service Standards meet the requirements of the SWIS Operating Standards. Clause 3.1.1 states that the frequency and time error standards for a Network in the SWIS are as defined in the Technical Rules that apply to that Network. Clause 2.2.1 (d) of the Technical Rules for Western Power's Network requires that load shedding must not occur for any credible contingency.

[10] Clause 3.10.2(c) of the WEM Rules.

[11] To ensure Power System Security, AEMO considers Marnet a credible contingency. Further, it is necessary to treat the contingency and the consequential impact as one scenario, as AEMO's preliminary analysis indicates that, under certain conditions, it may occur. That is, the definition of the largest contingency, and the Spinning Reserve required to mitigate that contingency, must now include the consequential disconnection of DPV.

[12] Based on operational experience to date this is estimated as a net loss of generation equivalent to around 10% of rooftop distributed PV output at the time.

[13] This relates to LFAS provided by generators that is counted towards SRAS under the WEM Rules.

[14] Wholesale market reforms being delivered under the WA Government's Energy Transformation Strategy.

[15] See http://www.wa.gov.au/sites/default/files/2019-12/Information%20Paper%20-%20ESS%20Scheduling%20and%20Dispatch%20_final.pdf.

[16] A. Fereidouni, J. Susanto, P. Mancarella, N. Hong, T. Smit and D. Sharafi, "Online Security Assessment of Low-Inertia Power Systems: A Real-Time Frequency Stability Tool for the Australian South-West Interconnected System", ArXiV Preprint, , 2020, at https://arxiv.org/abs/2010.14016.

During the reporting period, 12 generator contingencies resulted in High Risk Operating States or Emergency Operating States. No under-frequency load shedding events occurred during the reporting period. Overall, the quantity of SRAS provided during the reporting period was adequate.

Table 3 SRAS availability

	Quantity
Highest minimum requirement (including the MARNET Contingency)[A]	310 MW
% of time requirement met[B]	99.73%
Average minutes per day requirement not met	3.91 minutes
Events resulting in a frequency excursion below 48.75 Hz[C]	0

A. The largest contingency in the SWIS was the MARNET Contingency.
B. While AEMO endeavours through its operational planning to have the required level of SRAS available, real-time events result in less than 100% of this target being achieved.
C. Clause 3.9.2 of the WEM Rules defines the purpose of SRAS as, among other things, to retard frequency drops following the failure of one or more generating works or transmission equipment. Table 2.1 of the Technical Rules sets the minimum frequency operating standard for a single contingency event as 48.75 Hz.

2.4 Load Rejection Reserve Service

LRR was provided by generation Facilities in the Balancing Portfolio that were capable of doing so. These generators are not specifically enabled to provide LRR. A generator can provide LRR when it is online and its output is in the correct range. The quantity of the available reserve is determined by the generator's output and its ability to respond when the frequency increases.

Following the successful trial of dynamic LRR from April 2019[17], AEMO adopted a dynamic LRR for 2020-21 that incorporated physical aspects of the power system, including setting the upper limit of the LRR requirement based on the largest credible contingency in real time[18]:

- Allowing for the consequential corresponding change in load as a result of an increase in frequency, known as load relief; and
- Where required by the Network Operator as a requirement of connection to the SWIS, allowing for the operation of Facility protection systems in response to frequency fluctuations.

The LRR requirement approved for 2020-21 was up to a maximum of 90 MW[19]. During the year, AEMO planned for 90 MW LRR in the planning horizon while operating with a dynamic requirement in real time. The dynamic LRR requirement is a significant improvement (lower quantity) than the static 90 MW that was previously applied. Given the dynamic LRR was a trial, some margins were included in the calculation. AEMO continues to improve its understanding of interaction between dynamic LRR and frequency response to refine the dynamic LRR approach.

The adequacy of LRR is described by the percentage of time that the quantity of LRR provided at each point in time was in the indicated dynamic range in real time.

Although adequate LRR was planned for and made available pre-dispatch, there were periods when the minimum requirement for LRR was not met in real time (approximately 1.21% of the time). Analysis has shown that about 90% of the time when there was a shortfall in LRR, it was as a result of LFAS Downwards being utilised. This was a consequence of changes in power system conditions, particularly where variability in

[17] Refer to Section 2.4 of the 2020 Ancillary Services report for a description of the dynamic LRR, at https://www.aemo.com.au/-/media/files/electricity/wem/data/system-management-reports/2020-ancillary-services-report.pdf?la=en.

[18] This has been set to a maximum of 120 MW.

[19] This is a dynamic requirement in response to a sudden drop of up to 120 MW load less a minimum of 30 MW load relief.

non-scheduled generation and load affected the availability of LFAS Downwards (which is considered as providing part of LRR).

Based on experience of past events and power system analysis, even when the quantity of LRR available was lower than the requirement, the standard for LRR service was still met, as the frequency would not have exceeded 51 Hz for credible load rejection events.

During the reporting period there were no frequency excursions greater than 51 Hz. Overall, the quantity of LRR provided during the reporting period was adequate.

Table 4 LRR availability

	Quantity
Approved LRR requirement	Up to 90 MW
LRR requirement in planning horizon	90 MW
Real time LRR requirement	Dynamic LRR
% of time dynamic LRR requirement met	98.79%
% of time less than dynamic requirement was provided[A]	1.21%
Frequency excursions above 51 Hz[B]	0

A. While AEMO endeavours through its operational planning to have the required level of LRR available, real-time events result in less than 100% of this target being achieved.
B. Clause 3.10.4(a) of the WEM Rules requires the LRR standard to be a level sufficient to keep over-frequency below 51 Hz for all credible load rejection events.

2.5 System Restart Service

The System Restart Service requirement for 2020-21 was three Facilities with system restart capability, to allow for one Planned Outage and one Forced Outage. There were three System Restart Ancillary Service Contracts in place during 2020-21 for three Facilities.

At least two services were available at all times during the reporting period, except for a period of two hours, where only one System Restart Service Facility was available due to two simultaneous, but unrelated, Forced Outages impacting two of the Facilities.

Restart tests for all three contracts were completed during the reporting period.

No events occurred during the reporting period that required a system restart.

Table 5 System Restart Service availability

Services	Availability requirement[A]
Three Facilities with system restart capability	Met
At least two System Restart services planned to be available at all times[A]	Met

A. AEMO plans to ensure there are at least two System Restart Services available at all times to cater for a Forced Outage of one service.

3. Cost of Ancillary Services provided

Clause 3.11.11(b) of the WEM Rules requires this report to include the total cost of each Ancillary Service category provided in the preceding year. The period of reporting is April 2020 to March 2021[20].

The costs of Ancillary Services as calculated by AEMO for the period from 1 April 2020 to 31 March 2021 are set out in Table 6. This period reflects the most recently available settlement data and costs are determined in accordance with the calculations specified in the WEM Rules. For comparative purposes, the costs of the previous reporting year are also provided.

For the purpose of this Chapter 3, the reporting periods for 1 April 2019 – 31 March 2020 and 1 April 2020 – 31 March 2021, will be referred to as 2019-20 and 2020-21 respectively.

Table 6 Ancillary Service costs for 2019-20 and 2020-21

Ancillary Service	WEM Rule	1 April 2019 – 31 March 2020		1 April 2020 – 31 March 2021		Difference in Cost ($)
		Quantities	Cost ($)	Quantities	Cost ($)	
LFAS total[21]			79,768,570		73,571,786	-6,196,784
LFAS capacity	9.9.2(q)	• 72 MW (1 April 2019 to 27 August 2019) • 85 MW between 5:30 AM and 7:30 PM; 50 MW between 7:30 PM and 5:30 AM (28 August 2019 to 31 March 2020)	9,455,204	• 85 MW between 5:30 AM and 7:30 PM; 50 MW between 7:30 PM and 5:30 AM (1 April 2020– 24 September 2020) • 95 MW between 5:30 AM and 7:30 PM; 70 MW between 7:30 PM and 5:30 AM (25 September 2020 – 31 March 2021)	9,326,547	-128,657
LFAS Upwards	9.9.2(a)	• 72 MW (1 April 2019 to 27 August 2019) • 85 MW between 5:30 AM and 7:30 PM; 50 MW between 7:30 PM and 5:30 AM (28 August 2019 to 31 March 2020)	33,825,624	• 85 MW between 5:30 AM and 7:30 PM; 50 MW between 7:30 PM and 5:30 AM (1 April 2020– 24 September 2020) • 95 MW between 5:30 AM and 7:30 PM; 70 MW between 7:30 PM and 5:30 AM (25 September 2020 – 31 March 2021)	29,315,104	-4,510,520
LFAS Downwards	9.9.2(b)	• 72 MW (1 April 2019 to 27 August 2019). • 85 MW between 5:30 AM and 7:30 PM; 50 MW between 7:30 PM and 5:30	36,487,742	• 85 MW between 5:30 AM and 7:30 PM; 50 MW between 7:30 PM and 5:30 AM (1 April 2020– 24 September 2020) • 95 MW between 5:30 AM and 7:30 PM; 70 MW between 7:30 PM and 5:30	34,930,135	-1,557,607

[20] The period is one month earlier than that used in Section 2. This reflects the most recently available settlement data.

[21] LFAS total figures shown have been calculated using the rounded values for LFAS capacity, LFAS Upwards and LFAS Downwards.

Ancillary Service	WEM Rule	1 April 2019 – 31 March 2020		1 April 2020 – 31 March 2021		Difference in Cost ($)
		Quantities	Cost ($)	Quantities	Cost ($)	
		AM (28 August 2019 to 31 March 2020)		AM (25 September 2020 – 31 March 2021)		
Spinning Reserve Ancillary Service (SRAS peak & SRAS off-peak)	9.9.2(f)	SRAS peak • 224.1 MW (1 April 2019 to 30 June 2019) • 235.40 MW (1 July 2019 to 31 March 2020) SRAS off-peak • 189.0 MW (1 April 2019 to 30 June 2019). • 236.40 MW (1 July 2019 to 31 March 2020)	11,701,593	SRAS peak • 235.40 MW (1 April 2020 to 30 June 2020) • 252.03 MW (1 July 2020 – 31 March 2021) SRAS off-peak • 236.40 MW (1 April 2020 to 30 June 2020) • 240.66 MW (1 July 2020 – 31 March 2021)	14,103,228	2,401,635
Contract Load Rejection Reserve (LRR)	9.9.4(a)	AEMO did not enter into any LRR Ancillary Service contracts.	-	AEMO did not enter into any LRR Ancillary Service contracts.	-	-
Load Rejection Reserve (LRR)	9.9.1	Up to 120 MW	974,794	Up to 90 MW	1,153,381	178,587
Contract System Restart Service	9.9.4(a)	3 Facilities	3,044,429	3 Facilities	2,954,283	-90,146
System Restart Service paid via Synergy AS Payment22	9.9.1		1,782	Default payment for the System Restart Service component via the Synergy AS Payment.	0	-1,782
Dispatch Support Service	9.9.3A	AEMO did not enter into any Dispatch Support Service Ancillary Service contracts.	-	AEMO did not enter into any Dispatch Support Service Ancillary Service contracts.	-	-
Total			**95,491,168**		**91,782,678**	**-3,708,490**

3.1 Load Following Service Costs

LFAS is provided through a market mechanism, and the availability costs are driven by the combination of prices offered by Market Participants in the LFAS market and quantities cleared in the LFAS Market. The quantities cleared in the LFAS Market will be equal to the LFAS requirement set by AEMO.

[22] Default payment to Synergy for the System Restart Service component via the Synergy AS Provider Payment in accordance with clause 9.9.1 of the WEM Rules.

As discussed above, sculpted LFAS requirements were first introduced on 29 August 2019 and have been revised through the reporting periods. The LFAS requirements for LFAS Up and LFAS Down services applicable for the 2019-20 and 2020-21 periods are shown in Table 7.

Table 7 LFAS Requirements for 2019-20 and 2020-21

			LFAS Up Quantities		LFAS Down Quantities	
Reporting Year	**Reporting Dates Impacted from**	**Reporting Dates Impacted to**	**LFAS Off-Peak[A]**	**LFAS Peak[A]**	**LFAS Off-Peak[A]**	**LFAS Peak[A]**
2019-20	1/04/2019	27/08/2019	72 MW	72 MW	72 MW	72 MW
	28/08/2019	31/03/2020	50 MW	85 MW	50 MW	85 MW
2021-20	1/04/2020	24/09/2020	50 MW	85 MW	50 MW	85 MW
	25/09/2020	30/06/2021	70 MW	95 MW	70 MW	95 MW

A. LFAS Off-Peak is considered to be 7:30 PM to 5:30 AM. LFAS Peak is considered to be 5:30 AM to 7:30 PM.

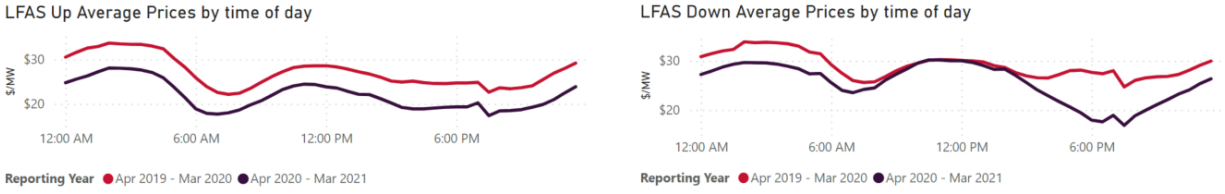
In 2020-21, despite an increase in the average LFAS requirement, there was an overall net reduction in total LFAS availability costs of $6.2 million compared to 2019-20. The key drivers for the reduction in total LFAS availability costs were:

- LFAS Up costs decreased by $4.51 million in 2020-21 compared to 2019-20, due to decreases in the LFAS Up Prices during LFAS Off-Peak and LFAS Peak periods. (Table 8). The average LFAS Up Price was consistently lower across all Trading Intervals in the Trading Day for the current reporting period compared to the previous reporting period (Figure 2).
- LFAS Down costs decreased by $1.56 million in 2020-21 compared to 2019-20, due to decreases in the LFAS Down Prices during LFAS Off-Peak and LFAS Peak periods (Table 8). The average LFAS Down Price was lower during the early morning, evening and overnight periods, but remained relatively unchanged between 9:00 AM to 2:00 PM, when compared to the previous reporting period (Figure 2).

Table 8 Weighted Average LFAS Up/Down price ($/MW) during LFAS Peak and LFAS Off-Peak Periods

LFAS Market	Period	Unit	2019-20	2020-21	Change
LFAS Down	Off-Peak	$/MW	30.63	25.55	-5.08
LFAS Down	Peak	$/MW	28.14	25.48	-2.66
LFAS Up	Off-Peak	$/MW	29.59	23.02	-6.57
LFAS Up	Peak	$/MW	25.55	20.73	-4.82

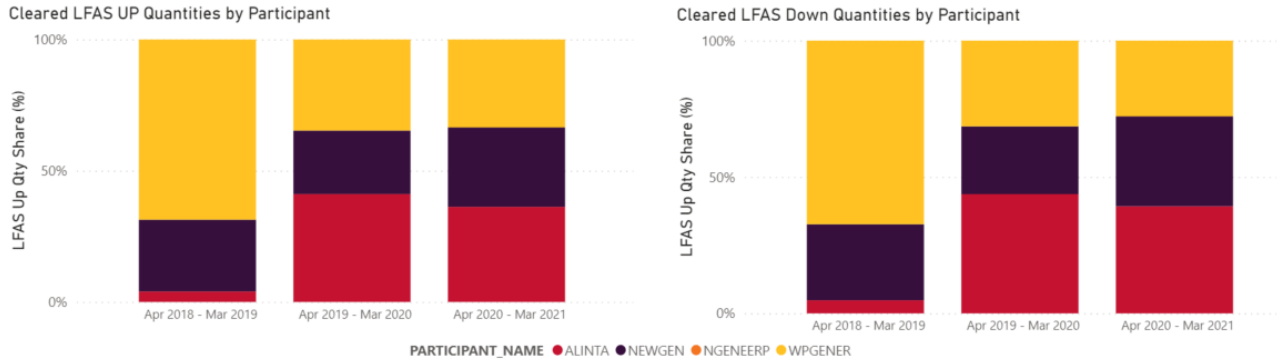
Figure 2 LFAS Up/Down Prices by time of day



Given that the average LFAS requirement increased compared to the previous reporting period, the key driver for lower LFAS cost were changes in prices offered by Market Participants. This is likely driven by increased competition and other external factors.

For 2019-20 and 2020-21, the LFAS Up and LFAS Down market share was more evenly distributed between the active providers of LFAS, in comparison to 2018-19 (Figure 3). The main driver in the shift in LFAS market share from 2019-20, was ALINTA_PNJ_U1 and ALINTA_PNJ_U2 facilities, which both commenced participation in January 2019. In 2020-21 NewGen increased their LFAS Up and Down market share, with consequential reductions in market share from Alinta and Synergy.

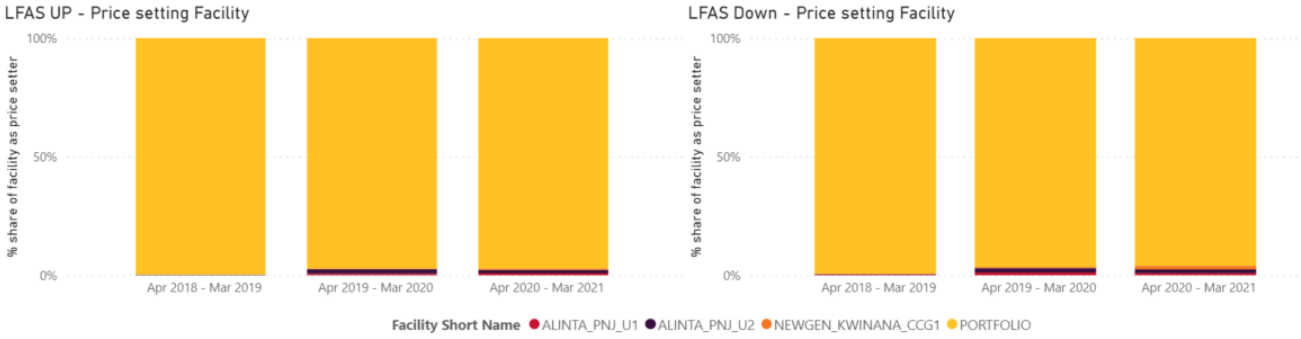
Figure 3 LFAS Market Share



Note: There are currently five certified LFAS providers in the WEM; three of them actively participated in the LFAS Markets in 2020-21. NGENEERP cleared in the LFAS Markets for the purposes of LFAS certification tests under an approved Commissioning Test Plan.

Despite the changes in market share, Figure 4 shows that the Synergy Balancing Portfolio was the price setter in both LFAS Up and Down for the majority of Trading Intervals and this has not changed significantly between 2019-20 and 2020-21.

Figure 4 LFAS Price Setting Facility



Backup LFAS can be used by AEMO from time to time when additional or replacement LFAS is required. Backup LFAS is provided by Synergy at a price nominated in its LFAS Submissions[23]. The Backup LFAS enablement quantities and LFAS enablement costs[24] reduced by 2,670 MW and $204,071 respectively, from 2019-20 to 2020-21. Back-up LFAS enabled and costs are shown in Figure 5.

The LFAS capacity cost is calculated by multiplying the LFAS capacity requirement by the administered Reserve Capacity Price[25]. In 2020-21, the decrease in LFAS capacity costs of $128,657 was due to the lower Reserve Capacity Price for the 2020 Capacity Year, which applied from October 2020[26].

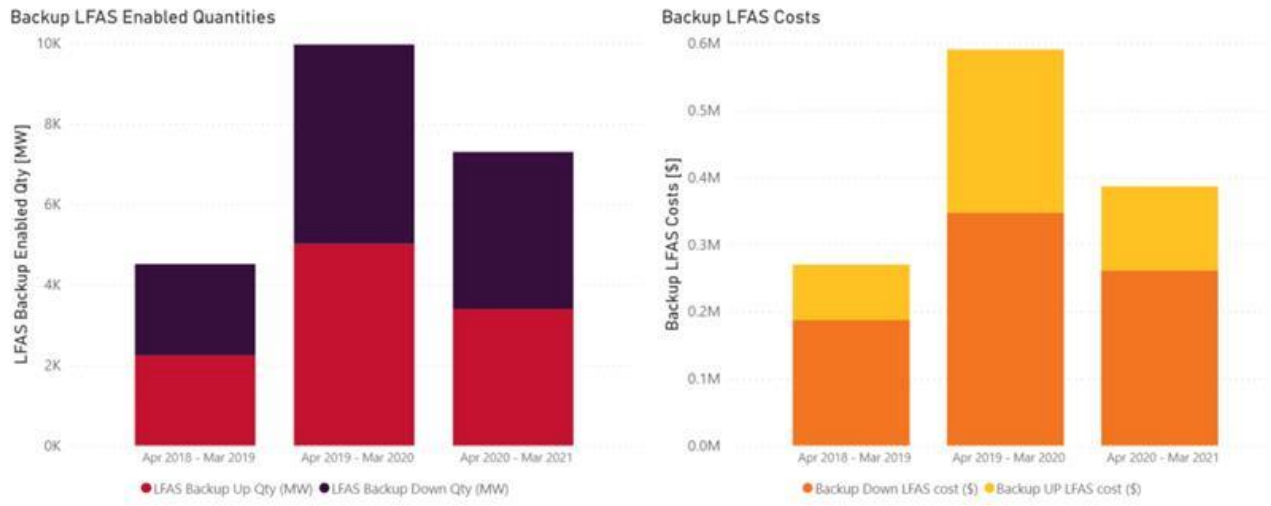
[23] In accordance with clause 7B.2.6 of the WEM Rules.

[24] Backup LFAS costs have been included in the reported LFAS Upwards and LFAS Downwards costs for 2019-20 and 2020-21.

[25] In accordance with clause 9.9.2 of the WEM Rules.

[26] The administered Reserve Capacity Price ($/MW per year) for Capacity Years are 2020–21: $114,134.15, 2019–20: $126,683.47, 2018–19: $138,760.39.

Figure 5 Backup LFAS enabled and costs



3.2 Spinning Reserve Service Costs

SRAS costs include services provided by Synergy, as the default provider, and those provided under Ancillary Service Contracts. As the default provider of SRAS under the WEM Rules, Synergy receives an administered payment.

SRAS costs are driven predominantly by the administrative payment process, known as the Margin Values review, which is summarised as follows:

- Each year AEMO submits a report with proposed Margin Values.[27]
- The ERA makes a determination, which sets the Margin Values to be applied to the Balancing Price[28].
- In accordance with the WEM Rules at the time of settlement, AEMO must apply the Margin Values and Balancing Price to the average SRAS requirement for peak periods and off-peak Trading Intervals assumed in the modelling performed for the Margin Values determination. The SRAS quantity attributed to Synergy for settlement of Trading Interval is calculated as the average SRAS requirement from Margin Values modelling and adjusted to subtract any available contracted SRAS quantity and subtract any LFAS Up quantity.

The Margin Values and SRAS requirement determined by the ERA[29] are as follows:

Table 9 Margin Values and SRAS Requirements determined by the ERA

Reporting Year	Reporting Dates Impacted from	Reporting Dates Impacted to	Margin Value % – Peak	Margin Value % - Off Peak	SR Requirement Peak	SR Requirement Off-Peak
2019-20	1/04/2019	30/06/2019	0.25	0.5	224.10 MW	189.0 MW
	1/07/2019	31/03/2020	0.1732	0.1292	235.40 MW	236.40 MW
2020-21	1/04/2020	30/06/2020	0.1732	0.1292	235.40 MW	236.40 MW
	1/07/2020	31/03/2021	0.2546	0.2142	252.03 MW	240.66 MW

[27] Margin_Peak, Margin_Off-Peak, SR_Capacity_peak and SR_Capacity_Off-peak.

[28] The Margin Values process is outlined in clause 3.13.3A of the WEM Rules. Further information on how SRAS costs are calculated is in clause 9.9.1 of the WEM Rules.

[29] At https://www.erawa.com.au/electricity/wholesale-electricity-market/ancillary-services-parameters/spinning-reserve-margin-peak-and-off-peak-load-rejection-reserve-and-system-restart-cost_lr.

The SRAS quantity paid to other Market Participants is based on their negotiated SRAS contracts. Payment for these are also subject to the availability of the service and must be based on a contract price that is lower than Synergy's administered payment[30].

SRAS costs increased by $2.4 million for 2020-21 compared with 2019-20. The SRAS costs and the average input variables from settlements are shown in Table 10.

- SRAS peak costs increased by $1.85 million for reporting year 2020-21 compared with 2019-20. This increase was driven by the increase in the Spinning Reserve attributed to Synergy, which increased from an average of 94.1 MW to 105.11 MW, and the increase in Margin_Peak values, with the time-weighted average Margin_Peak value increased from 0.1923 to 0.2343 (Table 10).
- SRAS off-peak costs increased by $548,126 for 2020-21 compared with 2019-20. This increase was driven by the increase in the Spinning Reserve attributed to Synergy, which increased from an average of 97.65 MW to 113.32 MW (Table 10).

Further information on the drivers for changes in Spinning Reserve and Margin Values can be found in the ERA's determination of the Margin Values for Financial Year 2019-20[31] and 2020-21[32] respectively.

Table 10 Summary of Total SRAS Costs (contracted and uncontracted) and Input Variables from Settlements

Reporting Year	Reporting Dates Impacted from	Reporting Dates Impacted to	Total SRAS Costs for Market ($)	Time-weighted Average Margin Value %	Average SRAS Attributed to Synergy for Settlement (MW)	Average Balancing Price ($/MWh)
Peak						
2019-20	1/04/2019	30/06/2019	7,213,801	0.1923	94.1	51.46
	1/07/2019	31/03/2020				
2020-21	1/04/2020	30/06/2020	9,067,311	0.2343	105.11	50.03
	1/07/2020	31/03/2021				
Change from previous year			1,853,510	0.0420	11.01	-1.43
Off-Peak						
2019-20	1/04/2019	30/06/2019	4,487,792	0.2214	97.65	44.34
	1/07/2019	31/03/2020				
2020-21	1/04/2020	30/06/2020	5,035,918	0.193	113.32	42.52
	1/07/2020	31/03/2021				
Change from previous year			548,126	-0.0284	15.67	-1.82

[30] In accordance with clause 3.11.8 of the WEM Rules.

[31] See https://www.erawa.com.au/electricity/wholesale-electricity-market/ancillary-services-parameters/spinning-reserve-margin-peak-and-off-peak-load-rejection-reserve-and-system-restart-cost_lr/margin-peak-and-margin-off-peak-parameters-for-201920.

[32] See https://www.erawa.com.au/electricity/wholesale-electricity-market/ancillary-services-parameters/spinning-reserve-margin-peak-and-off-peak-load-rejection-reserve-and-system-restart-cost_lr/margin-peak-and-margin-off-peak-parameters-for-202021.

3.3 System Restart Service and Load Rejection Reserve Service Costs

AEMO has entered into System Restart Service contracts with Market Participants. The System Restart Service (SRS) costs reduced by $90,146 in 2020-21 compared to 2019-20 (Table 11) in line with these contracts. The decrease in cost is mainly attributed to outages of the facilities providing SRS in 2020-21.

The Load Rejection Reserve (LRR) cost is calculated relative to the Cost_LR parameter less any payments for LRR contracts and System Restart Service contracts[33]. AEMO submits a report with the proposed Cost_LR parameter and the ERA makes a determination on the Cost_LR parameter to be used. AEMO did not enter into any LRR contracts for either 2019-20 or 2020-2021. Instead, all LRR costs were paid to Synergy as the default provider, and settled through the Synergy AS Provider Payment, in accordance with clause 9.9.1 of the WEM Rules. Under clauses 9.9.1 and 9.9.3A of the WEM Rules, the LRR costs are relative to the Cost_LR parameter determined by the ERA and the contract System Restart Service costs. For a Trading Month, if the contract System Restart Services costs exceed the 'R' parameter in the Cost_LR parameter determined by the ERA, it will result in a decrease[30] in the LRR cost which is paid to compensate to Synergy as the default of LRR provider.

The LRR cost increased by $178,587 in 2020-21 compared to 2019-20 (Table 11) in line with the changes to the Cost_LR value and settlement equations. For a given Trading Month, if the contracted SRS costs exceeds the 'R' parameter in the Cost_LR parameter determined by the ERA, it will result in a decrease in the LRR cost which is paid to compensate to Synergy as the default of LRR provider. The LRR Payments to Synergy increased in 2020-21 compared to 2019-20 mainly due to an increase in the 'R' parameter value in Cost_LR determined by the ERA in 2020-21 compared to 2019-20. This resulted in a lower net adjustment downwards to the LRR Payments for the 2020-21 compared to 2019-20 (Table 11).

Table 11 COST_LR Parameters, SRS and LRR Payments

Reporting Year	COST_LR	'R' Component of COST_LR	'L' Component of COST_LR	Contracted SRS Payments	Net adjustment applied to LRR payments[A]	LRR Payments[B]
2019-20[C]	$3,737,104	$2,337,104	$1,400,000	$3,044,429	-$425,206	$974,794
2020-21[D]	$4,107,664	$2,882,414	$1,225,250	$2,954,283	-$71,869	$1,153,381
Change from previous year	$370,560	$545,310	-$174,750	-$90,146	$353,337	$178,587

A. Monthly Net adjustment downwards made to LRR payments = min(0, ('R' Component of COST_LR/12 months) – Monthly Contracted System Restart Service Costs)

B. LRR Payments is the sum of all Monthly LRR Costs. Where, Monthly LRR Costs = Max[0, min(0, ('R' Component of COST_LR/12 months) – Monthly Contracted System Restart Service Costs) + ('L' Component of COST_LR/12)]

C. The 2019-20 reporting year includes relevant monthly values from the ERA approved COST_LR, 'R' Component of COST_LR and 'L' Component of COST_LR from the 2018-19 and 2019-20 financial years.

D. The 2020-21 reporting year includes relevant monthly values from the ERA approved COST_LR, 'R' Component of COST_LR and 'L' Component of COST_LR from the 2019-20 and 2020-21 financial years.

3.4 Dispatch Support Service Costs

AEMO did not incur costs for Dispatch Support Service in 2020-21, as there were no Dispatch Support Service contracts.

[33] In accordance with clause 9.9.3A of the WEM Rules any decrease to LRR costs which is caused by excess contract System Restart Service costs must be capped to monthly amount attributed to "L" component of the Cost_LR parameter.

4. Ancillary Services Requirements for 2021-22

Clause 3.11.11(c) of the WEM Rules requires this report to include the Ancillary Services Requirements for the coming year, and the Ancillary Services plan to meet those requirements. Clause 3.11.12 of the WEM Rules requires the ERA to audit this plan.

Clause 3.10 of the WEM Rules defines the Ancillary Services Standards. Clause 3.11.1 of the WEM Rules requires that AEMO determine all Ancillary Service Requirements in accordance with the SWIS Operating Standards (defined in clause 3.1 of the WEM Rules) and the Ancillary Services Standards.

4.1 Load Following Service

As indicated in Section 2.2 of this report, from a power system security perspective, the provision of LFAS for the previous year has been adequate. Due to increasing rooftop distributed PV penetration and commissioning of additional wind farms on the SWIS, the response from generators providing LFAS has increased. As has previously been the case, in the current environment, additional sources of frequency response contribute to the ability to manage frequency within the normal operating band. Although the volatility of rooftop distributed PV generation and wind generation has increased, power system security continues to be maintained. Based on increasing rooftop distributed PV connections, this trend is expected to continue through 2021-22.

Since the last report, about 520 MW of intermittent generation has been connected to the SWIS, including 390 MW of wind generation and 130 MW of grid-scale PV Facilities. With the commissioning of these Facilities completed in Q3 of 2020-21, AEMO has used actual supply information to develop the proposals for 2021-22. If the operation of these Facilities changes, resulting in a shortfall of LFAS going forward, AEMO will reassess the LFAS requirement as contemplated by clause 3.11.3 of the WEM Rules[34].

Analysis of LFAS utilisation and operational experience continues to highlight the need for peak and off-peak sculpting of LFAS requirements. Sculpting of the LFAS requirement requires assessment of quantities, volatility and time frames. To get the best global outcome for the SWIS, all three parameters need to be considered and, therefore, AEMO has elected to amend the timeframes of the sculpting to improve the quantity and volatility fit[35].

Operational experience has indicated that the peak to off-peak transition occurs 1 hour before volatility reduces in the evening. It can also be seen in Figure 6 of Appendix A1 that the peak to off-peak transition, currently at 7:30 PM, occurs before volatility has reduced. For 2021-22, the peak time requirements will be extended until 8:30 PM to improve sculpting and reduce both peak and off-peak LFAS quantities.

[34] WEM Rule 3.11.3: If it considers that a considerable shortfall of any Ancillary Service relative to the applicable Ancillary Service Standard is occurring, or is likely to occur before the next update under clause 3.11.2, AEMO may reassess the level of the Ancillary Service Requirements for that Ancillary Service at that time.

[35] The underlying volatility profile of the power system has not changed from previous years, however we are electing to improve the sculpting fit.

New intermittent generation and increasing rooftop distributed PV connections[36] have caused increased volatility over the last two years and this trend is expected to continue. While the amount of LFAS procured in 2020-21 was considered adequate for that period, AEMO's analysis of the LFAS utilisation and operational experience for 2020-21 and expectations for 2021-22 indicated that increased LFAS quantities will be required. The proposed new requirements are up to 110 MW Upwards/Downwards between 5:30 AM and 8:30 PM. A staged approach is proposed below, to implement an increase to 100 MW and then monitor and assess adequacy as required.

It was also evident in this analysis that LFAS requirements between 8:30 PM and 5:30 AM can be reduced to 65 MW.

Appendix A1 contains further supporting information related to the calculation of LFAS requirements.

The following LFAS requirement is proposed for 2021-22:

1. LFAS Upwards up to 110 MW between 5:30 AM and 8:30 PM, 65 MW between 8:30 PM and 5:30 AM.
2. LFAS Downwards up to 110 MW between 5:30 AM and 8:30 PM, 65 MW between 8:30 PM and 5:30 AM.

The new requirement will be implemented in a staged approach, with 100 MW initially implemented between 5:30 AM and 8:30 PM for both LFAS Upwards and LFAS Downwards. AEMO will monitor the adequacy of LFAS requirements and assess whether further adjustments are required.

4.2 Spinning Reserve Service

The SRAS requirement must meet the SWIS Operating Standards and the Ancillary Service Standards. The SWIS Operating Standards require that the frequency remain within the band of 48.75-51 Hz for a single contingency event. Clause 3.10.2(a) of the WEM Rules requires the standard for SRAS to be a level that is sufficient to cover the greater of:

i. 70% of the total output, including Parasitic Load, of the generation unit synchronised to the SWIS with the highest total output at the time; and

ii. the maximum load ramp expected over a period of 15 minutes.

The MARNET Contingency (described in Section 2.3), is likely to be the largest generation contingency event for a significant number of intervals. AEMO continues to investigate the impact of rooftop distributed PV disconnection and will continue to manage SRAS to match the operational conditions for power system security.

The maximum load ramp over a 15 minute period during the last year, during a rooftop distributed PV cloud cover event, was 249 MW. A 53 MW increase from the 196 MW maximum load ramp over a 15 minute period reported in the 2019 Ancillary Services Report. AEMO will monitor expected and maximum load ramps through 2021-22 and, if appropriate, may seek approval from the ERA to implement additional SRAS requirements related to the maximum load ramp expected.

The SRAS requirement proposed for 2021-22 is at least the maximum of:

1. 70% of the largest generating unit; and
2. 70% of the largest contingency event that would result in generation loss.

4.3 Load Rejection Reserve Service

The LRR Requirement must meet the SWIS Operating Standards and the Ancillary Service Standards. The SWIS Operating Standards[37] require that frequency be maintained below 51 Hz and be restored below 50.5 Hz within two minutes following a single contingency event. Clause 3.10.4(a) of the WEM Rules requires

[36] About 290 MW of rooftop distributed PV has been installed since the last report, sourced at https://aemo.com.au/energy-systems/electricity/wholesale-electricity-market-wem/data-wem/data-dashboard#generation-der, 24 May 2021.

[37] See clause 2.2.1 and Table 2.1 of the Technical Rules.

the standard for LRR to be the level sufficient to keep over-frequency below 51 Hz for all credible load rejection events (this requirement may be relaxed by up to 25% if AEMO considers that the probability of transmission faults is low).

The largest credible load rejection event is approximately 120 MW[38], and is typically the loss of a transmission line. This may be a radial line feeding the Eastern Goldfields region under specific conditions, or a single line supplying a particular customer.

LRR provides a power system response to a sudden drop in load. The mandatory generator governor droop response capability required by the Technical Rules for all generators operating above their minimum stable load will also act to mitigate the loss of load as the frequency initially increases.

In 2020-21, AEMO adopted the dynamic LRR requirement that was trialled from April 2019. This dynamic LRR calculation incorporated elements such as load relief (change in load as a result of increase in frequency) and Facility protection systems. Use of this dynamic requirement will continue in 2021-22.

The proposed LRR requirement for 2021-22 remains at up to a maximum of 90 MW[39].

4.4 Dispatch Support Service

While there were no current requirements for DSS at the time of writing this report, given the rate of change in the SWIS, AEMO may identify opportunities for early implementation of the WA Market Reforms, including services such as Rate of Change of Frequency (RoCoF) Service. AEMO will consider requirements for DSS through the year and, if appropriate, will seek to implement these services in accordance with clauses 3.11.8A and 3.11.8B of the WEM Rules.

4.5 System Restart Service

AEMO requires three System Restart Facilities, to ensure service provision following a failure of one Facility while another is undergoing a Planned Outage. The three system restart facilities should not be in the same location, to mitigate the risk of common failure in the same geographic or electrical area.

The proposed System Restart Service requirement for 2021-22 remains at three Facilities with system restart capability.

[38] This is based on loss of the Eastern Goldfields region or the Boddington Gold Mine, which are connected to the SWIS by a single transmission line.

[39] This is a dynamic requirement in response to a sudden drop of up to 120 MW load less a minimum of 30 MW load relief.

5. Ancillary Services Plan for 2021-22

While this report focuses on the requirements for 2021-22 and the plan to meet these requirements, it should be noted that as part of the government's Energy Transformation Strategy, a key focus will be a move to co-optimised energy and Ancillary Services. This will result in a clearer definition of services, improving the ability to more accurately determine requirements. It is also worth noting that the current requirement setting and approval process, including this report, will not be required in the new WEM.

5.1 Load Following Service

To meet the requirements for 2021-22, LFAS will be sourced through the LFAS Market up to the values shown in Section 4.1. The effectiveness of this approach will be monitored through the year, and may be reassessed if required.

AEMO will implement process changes to implement the new LFAS thresholds outlined in Section 4.1 as follows:

1. Maintain existing approach until step 2 below is implemented;
2. Implement the new LFAS requirements as soon as practicable; and
3. Monitor the adequacy of LFAS requirements and assess whether further adjustments are required.

The cost of LFAS will depend on the clearing price in the LFAS Market.

5.2 Spinning Reserve Service

For 2021-22, SRAS will be sourced as follows:

1. 42 MW will be sourced from a long-term interruptible load contract.
2. An additional quantity is expected to be sourced[40] from a short-term spinning reserve contract at a discount to the Synergy administered price.
3. The remainder of the real-time requirements will be provided by the Balancing Portfolio.

5.3 Load Rejection Reserve Service

A maximum of 90 MW of LRR will be provided by the Balancing Portfolio. AEMO will use a dynamic LRR requirement in real time[41].

5.4 Dispatch Support Service

AEMO is not currently party to any DSS Ancillary Services Contracts.

No new DSS has been identified at the time of writing this report. However, AEMO may seek approval from the ERA for a DSS Ancillary Service Contract should emerging challenges threaten power system security.

[40] The commercial process is underway to source a short-term Spinning Reserve contract for 2021-22.

[41] The administrative payment to provide this service for FY22 has been determined through Cost_LR. To develop contractual arrangements for this period would incur additional costs.

5.5 System Restart Service

The North Metropolitan System Restart Service and South Metropolitan System Restart Service contracts end on 30 June 2021. The commercial process to procure new contracts is underway and the contracts are expected to be in place for 2021-22. The South Country System Restart contract will continue to apply for 2021-22. This contract ends in October 2028.

5.6 Summary Ancillary Services plan for 2021-22

Table 12 Summary of Ancillary Services requirements and plan to procure for 2021-22

	Requirement	Requirement compared to previous year	Method to procure	Cost
LFAS Upwards	Up to 110 MW between 5:30 AM and 8:30 PM 65 MW between 8:30 PM and 5:30 AM	Peak to off-peak transition move from 7:30 PM to 8:30 PM Higher LFAS requirement during peak time to address increasing volatility Lower LFAS requirement during off-peak time as volatility is reduced during the new off-peak time Staged approach with initial 100 MW LFAS Upwards with AEMO to monitor adequacy	LFAS Market	LFAS Market clearing price
LFAS Downwards	Up to 110 MW between 5:30 AM and 8:30 PM 65 MW between 8:30 PM and 5:30 AM	Peak to off-peak transition move from 7:30 PM to 8:30 PM Higher LFAS requirement during peak time to address increasing volatility Lower LFAS requirement during off-peak time as volatility is reduced during the new off-peak time Staged approach with initial 100 MW LFAS Downwards with AEMO to monitor adequacy	LFAS Market	LFAS Market clearing price
SRAS	At least the maximum of 70% of largest generating unit and 70% of largest contingency event that would result in generation loss	Unchanged, but inclusion of MARNET Contingency with the associated disconnection of rooftop distributed PV	42 MW from long-term interruptible load contract	Contract price
			Quantity from short-term contracts currently being finalised	Contract price as discount of Synergy administered price
			Remainder provided by Balancing Portfolio	Administered price to be paid based on the ERA's Margin Values determination.
LRR	Up to 90 MW[A]	Unchanged	A maximum of 90 MW of LRR will be provided by the Balancing Portfolio.	Annual price paid based on the ERA's Cost_LR determination for 2021-22
DSS	None	Unchanged		N/A
System Restart Service	Three Facilities	Unchanged	Contracts with three providers	Contract price

A. AEMO will plan for 90 MW but use a dynamic LRR requirement in real time.

A1. 2021 LFAS requirement calculation methodology

Clause 3.11.1 of the WEM Rules requires that AEMO determine all Ancillary Service Requirements in accordance with the SWIS Operating Standards (defined in clause 3.1 of the WEM Rules) and the Ancillary Services Standards. The standard for LFAS is defined in clause 3.10.1 of the WEM Rules as the level sufficient to provide Minimum Frequency Keeping Capacity, where the Minimum Frequency Keeping Capacity is the greater of:

i. 30 MW; and

ii. the capacity sufficient to cover 99.9% of the short term fluctuations in load and output of Non-Scheduled Generators and uninstructed output fluctuations from Scheduled Generators, measured as the variance of 1 minute average readings around a thirty minute rolling average.

Consistent with the discussion in the 2019 Ancillary Services Report[42], AEMO considers the results of the methodology in clause 3.10.1(a)(ii) of the WEM Rules to be inefficient and not accurately represent current operational practices, including the 10 minute dispatch cycle. As a result, AEMO has utilised the approach taken for the new WEM[43] to determine the LFAS requirements for 2021-22. This approach is also aligned with the methodology AEMO utilised to determine the increased requirements during 2020-21, which was approved by the ERA.

The approach developed a time series that estimated the impact of frequency keeping mechanisms at each 5-minute interval of the period 1 March 2018 to 28 February 2021, divided equally into three consecutive analysis periods. Analysis of this data was created to capture 98%[44] of the frequency keeping mechanisms use[45] over each year. Annual peak/off-peak values are shown below in Table 13.

Table 13 Annual peak and off-peak values

Analysis periods	Peak (5:30 AM to 8:30 PM)	Off-peak (8:30 PM to 5:30 AM)
Mar 2018 to Feb 2019	84 MW	57 MW
Mar 2019 to Feb 2020	95 MW	59 MW
Mar 2020 to Feb 2021	119 MW	65 MW

AEMO's analysis indicates that there is an increasing trend of frequency keeping mechanisms use during peak times and a recent increase in frequency keeping mechanisms use during off-peak times.

[42] Refer to Appendix A3.1, at https://www.aemo.com.au/-/media/files/electricity/wem/data/system-management-reports/2019-ancillary-services-report.pdf?la=en.

[43] Refer to the Frequency Control Technical Arrangements Information paper, at https://www.wa.gov.au/sites/default/files/2019-08/Information-paper-Frequency-Control-Technical-Arrangements.pdf.

[44] To determine 98% figures, the result of 99% of FKM Upwards and 99% of FKM Downwards are averaged.

[45] Frequency keeping mechanisms use is defined as deviation of Facilities dispatched for LFAS and/or balancing portfolio output from its base point.

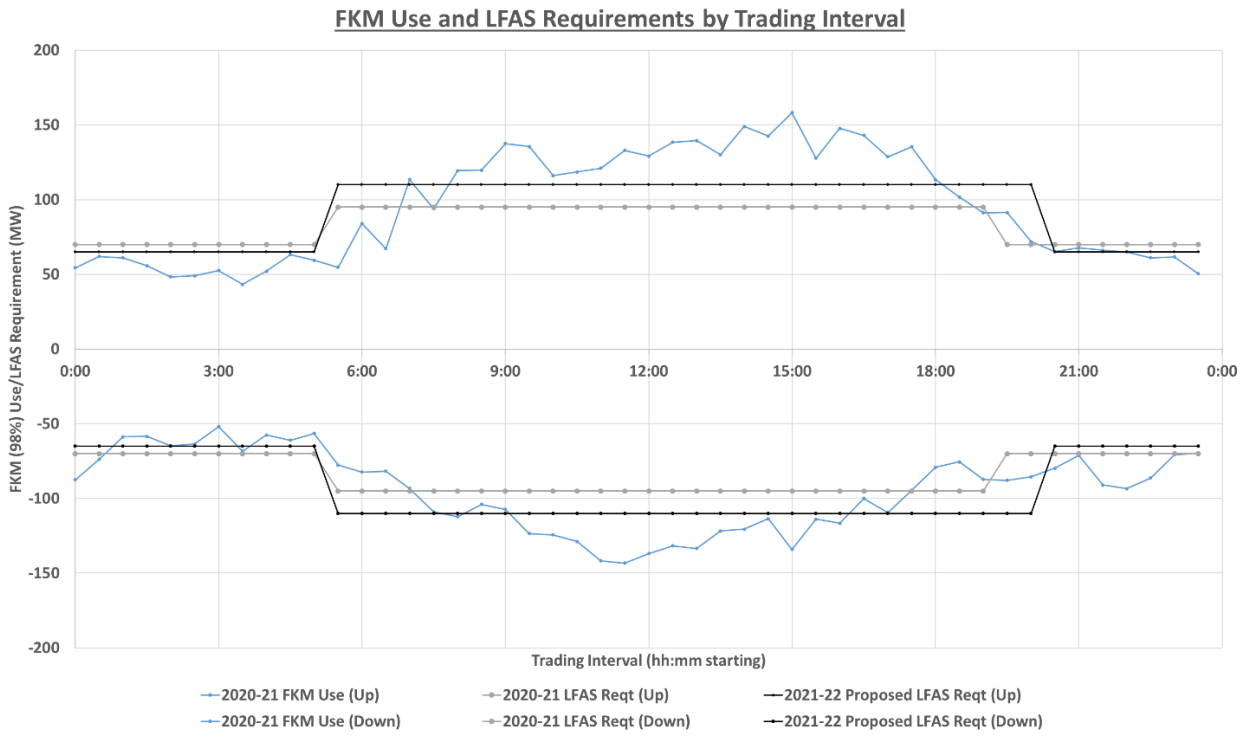
Frequency keeping mechanisms use during peak times has increased by approximately 10 MW and 25 MW over the past two years respectively and this trend is expected to continue in line with the increasing pace of rooftop distributed PV connections. Operational experience indicates that the required peak figure is slightly lower than the calculated requirement due to other frequency response available on the system in the current environment. Applying this operational experience to the calculated figure of 119 MW indicates that the new requirement should be 110 MW, so there is an increased requirement of 15 MW from the current procured LFAS of 95 MW.

Frequency keeping mechanisms use during off-peak times has increased 2 MW and 6 MW over the past two years respectively. Further analysis for the last three months of the analysis period indicates the frequency keeping mechanism use shifts up to 78 MW with further commissioning of the large wind Facilities. While other frequency response continues to support frequency management, the higher requirement after commissioning of the new wind Facilities supports a requirement of 65 MW. The reduction in requirement from that proposed and approved last year is due to a greater data set available to better estimate the actual output of the new wind Facilities.

Analysis of LFAS utilisation and operational experience continues to highlight the need for peak and off-peak sculpting of LFAS requirements. Sculpting of the LFAS requirement requires assessment of quantities, volatility and time frames. Considering the interaction of these factors, the appropriate approach for the SWIS was to amend the timeframe of the sculpting to provide a better fit of quantity and volatility, considering operational implications[46].

Operational experience indicates that the peak to off-peak transition currently occurs 1 hour before volatility in demand reduces in the evening. It can also be seen in Figure 6 that the peak to off-peak transition, currently at 7:30 PM, occurs before volatility has reduced. For 2021-22, the peak time requirements will be extended until 8:30 PM to improve sculpting and reduce both peak and off-peak LFAS quantities.

Figure 6 Interval by Interval FKMs use with existing and proposed LFAS requirements



[46] The underlying volatility profile of the power system has not changed from previous years, however we are electing to improve the sculpting fit.