MASS Consultation - Second Stage Submission

Reposit Power

August 2021

1 Measurement of FCAS response

Reposit supports AEMO's MASS review draft report as it relates to the DER component of the review. Specifically, Reposit supports AEMO's reasoning and decision to leave the measurement sampling rate and metering point for Fast FCAS unchanged.

In its first submission, Reposit provided empirical evidence that showed how proposed changes to the metering requirements in the MASS would increase the uncertainty of Fast FCAS response. This uncertainty must result in either:

1. Decreased effectiveness of the Fast FCAS services and degraded system security; or
2. Increased Fast FCAS costs through additional Fast FCAS procurement to compensate for the increased uncertainty.

Both outcomes result in a decrease in the efficiency of the NEM and are clearly detrimental to the achievement of the NEO.

Reposit reasserts that the measurement and verification processes in the MASS should be consistent for all Participants regardless of capacity, technology type, market participation status or other differentiating factors.

1.1 Measurement sampling rate

Reposit supports AEMO's decision to leave the measurement sampling rate unchanged. Reposit reasserts that a change in measurement sampling rate is unnecessary from a cost perspective and is actively damaging to Fast FCAS service integrity.

1.1.1 MASS compliant metering is not cost prohibitive

MASS compliant metering at 50ms is cost-effective for deployment on residential connection points, and is currently deployed at thousands of connection points in the NEM.

Reposit has deployed over 4000 residential installations fitted with FCAS-compliant metering. Reposit is currently operating this DER capacity in all six Contingency FCAS markets, under market conditions with no relaxations or concessions.

Reposit provided information in its first submission that a single phase of FCAS compliant metering costs less than $120. Reposit currently sells its controller for $599 to selected partners. This includes three phases of FCAS-compliant metering, an additional three phases of non-FCAS compliant metering, 4G hardware, general purpose and vector computing hardware, five communications ports and supporting power supply and protection electronics. The controller (including metering) takes an inexperienced installer less than two hours to install.

Should FCAS-compliant metering for DER cost in the thousands or tens of thousands of dollars as contended by some respondents to the first stage consultation, it stands to reason that Reposit would not be able to retail its controller for under $600.

Reposit is also aware of other three-phase, 50ms capable metering that is available in the market at sub-$500 prices.

It is Reposit's opinion that at this point any party that advocates 50ms metering costing thousands of dollars either lacks effective procurement personnel or is intentionally misleading the market for unknown reasons.

1.1.2 Slower metering increases uncertainty of Fast FCAS delivery

Repost demonstrated in its first submission to this MASS consultation that 1Hz metering would contribute at least 16% error. This results from the mathematics used to compute Fast FCAS response from 1Hz instantaneous power readings.

AEMO completed its own analysis to validate Reposit's position and achieved results consistent with Reposit's. AEMO then commissioned independent analysis conducted by the University of Melbourne which validated the quantitative findings of both Reposit and AEMO.

University of Melbourne and AEMO also showed real world Fast FCAS responses computed with 10Hz (100ms) sampling and making use of the Right Riemann method to return errors of up to 2.3%. During the first stage consultation Reposit provided the mathematical upper bound of 3.3%[1] error contribution for FCAS delivery computations using 10Hz sampling and the Right Riemann method.

[1] https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2021/mass/meetings/mass-consultation-reposit.pdf - Section 2.4.1

Reposit notes that the use of the Right Riemann method is used by the FCASVT and AEMO has not suggested its replacement with a more accurate method.

The University of Melbourne analysis (and mathematical theory for errors, time integrals, and power systems) shows that the use of the Right Riemann only delivers sufficiently low-error results when used in conjunction with 20Hz metering. Error builds quickly as metering sampling rate is relaxed.

The University of Melbourne suggested that lower error could be achieved using a "Universal Window" to improve accuracy. Reposit asserts that this requires at least two technical assumptions that are not realistic:

1. Sub-second time synchronisation across all units participating in an FCAS response. This would most likely require GPS time synchronisation equipment to be installed at each DER site
2. Identical timestamp processing pipeline timing across all responding units, across all VPP providers.

It should be noted that Universal Windowing only decreases error when 1s sampling is used. A comparison of Figures 14 and 18 [2] of the University of Melbourne report illustrates that a Universal Window does not contribute error reduction at 100ms or 200ms sampling rates.

1.2 Measurement location

Reposit agrees with AEMO that moving the metering point for FCAS delivery does not benefit the power system or improve the integrity of the FCAS markets. This is consistent with Reposit's initial submission.

Reposit reasserts that moving the metering point increases FCAS delivery uncertainty and creates perverse incentives for Participants.

1.2.1 Measurement at the connection point is correct

Reposit agrees with AEMO's assessment that changes in distributed photovoltaic (DPV) and uncontrollable loads are not significant on an aggregate level during

[2] Fast FCAS Sampling Verification in Support of MASS Consultation - June 2021 -p.12-13

frequency disturbances, and that net flow across the connection point is the optimal method to analyze and ensure compliance for all FCAS participants.

Furthermore, AEMO is correct in its statement that all FCAS participants should establish appropriate processes to ensure the capacity bid in FCAS markets is representative of the actual capacity that can be delivered and not simply the nameplate registered capacity.

Reposit believes that AEMO's determination will appropriately prevent gaming of the FCAS markets through assets absorbing energy behind the connection point during frequency disturbances.

Additionally, this will further reduce requirements for additional meters at the asset level, which would have contributed to global inefficiencies in the market, the costs for which would ultimately be borne by electricity consumers.

Reposit considers AEMO's assessment that measurement at the connection point is optimal, and AEMO's position that there are no gains to FCAS service integrity are well considered.

1.2.2 Measurement at asset level is problematic

Reposit supports AEMO's assessment that there is no evidence confirming that FCAS measurement at the asset level would benefit the power system or improve the integrity of the FCAS markets.

Reposit firmly believes that measurement of FCAS at the asset level would be a departure from the Connection Point measurement of electricity services that has been used throughout the NEM since market start.

There is significant and profitable gaming that is possible where metering is not conducted at the connection point. Reposit asserts that gaming is inevitable because of this profitability.

Reposit suggests to AEMO that there has been large amounts of work done by all market bodies and others (ARENA, ANU, DNSPs) into the issues created by having multiple service providing devices behind-the-meter. This issue will be resolved in time, and it is pre-emptive for AEMO to move away from connection point measurement where this work is ongoing.

2 System security

Reposit considers the integrity of Fast FCAS services to be critical to the secure functioning of the NEM. As a result, Reposit supports AEMO's decision to maintain the integrity of these services by having DER metering requirements remain consistent with other providers of the Fast services.

Compromising the integrity of these services as a way to achieve the NEO is wrongheaded. 50ms, full accuracy, full precision metering costs are low with multiple participants indicating that they are in possession of this metering at sub $500 cost.

Reposit reasserts and agrees with AEMO that 50ms, high accuracy, connection point metering is essential for the wider security of the NEM. This is driven by the increasing likelihood that a large proportion of electricity services will be provided by DER in the future.

2.1 Visibility of DER response

Reposit supports AEMO's determination that 50ms/20Hz, connection point metering is essential to the management of the system where DER is providing security services. Reposit is prepared to work with AEMO to deliver high speed, connection point metering data to AEMO as required for measurement and verification of Fast FCAS responses and other system management tasks as necessary.

2.1.1 High speed metering

Reposit reasserts that 50ms metering, accompanied by the accuracy requirements in the MASS is the only way that Fast FCAS error can be deterministically maintained at its current reliability.

This is especially true as increasing proportions of Fast FCAS are provided by inverter-based technologies. These technologies are able to deliver relatively high-frequency power oscillations more easily than rotating machines. This is because the current sine waves are produced by power electronics. A 10Hz+ power oscillation is not difficult for these machines to provide.

DER is almost purely power electronics mediated and high-frequency power oscillations have been observed by Reposit on several occasions from

AS4777-compliant equipment under evaluation. This can be as a result of many control pathologies as were discussed in Section 3 of Reposit's initial submission. Reposit suggests that these oscillations are more prevalent during power ramping operations, such as those required of a Fast FCAS response. These oscillations can be detrimental to power system security where they result in a reduction of FCAS response, especially if they are unable to be detected by AEMO due to slow metering.

Power system security analysis is generally concerned with power transfers over time. The measurement of energy delivered or absorbed by DER is fundamental to the secure operation of the NEM as an increasing proportion of these power transfers are created by DER. Inaccurate measurement of energy delivered from or absorbed by these devices puts future system security analysis on weak foundations.

Where Riemann methods are used for measuring energy, any decrease in metering speed corresponds to a proportional increase in measurement error. Reposit notes that the right Riemann method is used by AEMO in the FCASVT and there is no mention of changing this. The use of 50ms metering during a 6-second response window negates much of the error introduced by the Right Riemann method by creating relatively small time slices.

Reposit asserts that this is important as the Right Riemann is the simplest method available and is used by people almost all of the time. Future AEMO power system security analysts need to be protected from error. Only 50ms or better metering can keep total connection point measurement error below 2% when using the Right Riemann. This amount of error has proven to be acceptable to the designers and operators of Fast FCAS services for 20 years.

2.1.2 Connection point visibility

Only energy that crosses the connection point can be considered as being applied to a contingency event. Measurement of power transfer at any other point introduces new uncertainty to the maintenance of a contingency event.

FCAS measurement and verification for a site cannot be done where the connection point is not being analysed. Laboratories exist for the analysis of inverters and other power electronics, and they can be used to determine inverter responses at the AC terminals. But the net effect of the interactions behind the connection point are what is important for FCAS.

Interactions between devices behind-the-meter are becoming increasingly complex. This complexity is not for AEMO to manage, but it does and will increasingly affect FCAS delivery. AEMO must have visibility of the connection point to understand when and by how much this is happening.

Reposit considers the increasing number of site-level, no-interruption, battery backup installations to create particular problems for AEMO. These installations will show a "valid" FCAS response at an asset level even where the connection point becomes de-energised after the frequency event. This is because the FCAS enablement will trigger an FCAS response that will most likely be absorbed by assets behind the now islanded connection point. This response does not contribute to the maintenance of the contingency event, but will present asset-level data that indicates a power transfer.

Reposit reasserts that only measurement at the connection point presents AEMO with the correct data required to manage system security.

2.2 FCAS clawback mechanism

The NER has provided AEMO with a powerful penalty mechanism against under-delivery of FCAS. This "clawback" mechanism delivers a substantial and increasing penalty cost that works to incentivise FCAS participants to guarantee FCAS delivery. The power system security concerns raised by AEMO in the draft report are already addressed by VPPs that are sensitive to the clawback mechanism.

Reposit suggests that VPP Demonstrations Trial Participants are not being subjected to the clawback mechanism and hence do not have the incentive to manage the well-understood power system security concerns raised by AEMO. As a result these Participants are most likely ignoring these concerns and AEMO has detected the results of this.

Reposit has managed all of the power system security concerns that AEMO has raised since its VPP participation in FCAS in markets beginning in 2018 (pre-VPP Demonstrations). This is evident in our FCAS delivery performance even with a 10x increase in capacity. This is because of the very strong incentive provided to Reposit by the clawback mechanism.

Reposit suggests that the widespread application of the FCAS clawback mechanism to VPP operators will be sufficient to manage these and other power system security concerns. Reposit goes further and suggests that VPP operators will be aware of other power system security concerns and their urgency before AEMO is. Some of these will be systematic to DER, and some will be specific to the particular hardware and software operating the VPP. This is undoubtedly the case with non-DER FCAS providing plants.

Reposit asserts that 20Hz/50ms metering at the connection point will provide sufficiently accurate information for AEMO to execute low-error measurement and verification (M&V) processes. Low-error M&V allows for the clawback mechanism to be operated equitably and with high confidence. This will provide VPP operators with the incentive to manage power system security concerns as they arise.

2.2.1 Description of operation

The clawback mechanism for VPPs is enabled by 2.3.5(i) of the NER, which reads:

> (i) A *Market Ancillary Service Provider* or *Market Customer* (as applicable) is not entitled to receive payment from *AEMO* for *market ancillary services* except where those *market ancillary services* are produced using an *ancillary service load* in accordance with Chapter 3 or pursuant to a *direction* or *clause 4.8.9 instruction*.

This is interpreted by AEMO Settlements and Prudentials to mean that payments that have been made to an FCAS provider during a period where an under-delivery would have occurred are invalid. In response AEMO Settlements and Prudentials "adjusts" the payment for the current settlement period. This adjustment subtracts the FCAS revenue earned during the under-delivery period from the current period, and continues to do so until the full amount (sometimes with interest) is repaid - or "clawed back".

AEMO Operations does not have a documented mechanism by which the beginning of the under-delivery period is determined. Reposit assumes that this under-delivery period is calculated to have begun immediately after the last successful delivery into an FCAS service. Reposit suggests that a formal mechanism for the beginning of a clawback period is formulated and documented by AEMO in the MASS.

The clawback mechanism relies completely on low-error and reliable M&V processes. It is irrelevant as to why there was an under-delivery, only that there was an under-delivery. That is, if the FCAS provider does not respond to the contingency event as bid then they are subject to penalties. This could be for any reason. If the power transfer does not occur across the connection point, then the clawback mechanism can be executed.

2.2.2 Magnitude of penalty

The introduction of MPFR has seen Contingency FCAS deliveries become very rare. This creates long periods of time between FCAS deliveries. This has the effect of creating very substantial and constantly growing penalties for under-delivery for all FCAS providers - including VPP providers who are being exposed to full market conditions.

Under May 2021 - July 2021 market conditions, this penalty is in the order of $47k/MW for Reposit. This penalty cost is more than enough to incentivise Reposit to make substantial investments to manage the power system security concerns raised by AEMO in the draft report.

2.2.3 Sources of risk for VPPs

AEMO has identified several power system security concerns with specific regard to DER. These can be summarised as under-delivery to a contingency event as a result of:

1. Inverter disconnection due to a voltage transient
2. Inverter control hierarchy interactions
3. Distribution network unreliability as a result of poor connection agreement formulation and/or network planning
4. Inverter power responses that result in insufficient power transfer

Reposit agrees that these are valid technical concerns. Reposit has been managing these concerns for more than five years of operation in the provision of electricity services other than FCAS. In particular, during the provision of security services to DNSPs and RERT. Reposit also has a record of successfully managing these concerns in FCAS as demonstrated by Reposit's delivery performance to date.

The table below describes in broad terms the power system security concerns raised by AEMO in the draft report, and Reposit's mitigations for them:

Risk	Mitigation
Inverter disconnection	• Rigorous and long term performance characterisation using 50ms (and faster) metering data across all deployed VPP nodes • Automated and dynamic capacity factor calculation and application across all VPP nodes
Inverter control hierarchy	• Rigorous and long term performance characterisation using 50ms (and faster) metering data across all deployed VPP nodes • Automated and dynamic capacity factor calculation and application across all VPP nodes
DNSP unreliability	• Adherence to DNSP Connection Agreements • Detection of DNSP instability with the use of 50ms (and faster) metering data • Implementation of Evolve Dynamic Operating Envelopes
Inverter power response	• Rigorous and long term performance characterisation using 50ms (and faster) metering data across all deployed VPP nodes • Automated and dynamic capacity factor calculation and application across all VPP nodes

Reposit outlined additional sources of under-delivery from a VPP in sections 3.3.3.3 and 3.3.5.3 of its submission to the MASS Consultation paper. These are of much higher likelihood than the concerns raised by AEMO as they are systematic to VPP operations. As with the concerns above, Reposit has actively managed these concerns for more than five years.

Many of these risks cannot be understood by AEMO as they are systematic to a broad range of technology at all levels in an aggregator's technology stack. This means that AEMO must present firm incentives for aggregators to manage these risks without stifling competition and innovation.

The technology required to deliver reliable responses from aggregated DER is sophisticated and cannot be considered to be homogenous across VPP providers. Reposit considers the reliable power transfer from its VPPs to be a key competitive advantage and hence invests heavily into its operation and continued development.

It cannot be overstated how influential penalty conditions on unreliable power transfer have been on past and current engineering of this technology. Appropriate penalty conditions - such as the FCAS clawback - present a powerful and pre-existing tool for AEMO to manage power system security concerns. Reposit asserts that these mechanisms are the correct means by which AEMO should be managing power system security concerns.

2.2.3.1 AS4777:2020 compliance

AEMO states that compliance with AS4777:2020 for registration of DER FCAS capacity is a potential action to alleviate the “local network fault” scenario. Reposit supports AS4777:2020 compliance for all installations made after December 2021, but does not support a requirement for all future registrations to be made totally of inverters compliant with AS4777:2020.

Reposit considers this potential action to be unnecessary. This is because Reposit is aware of thousands of inverters that do not meet AS4777:2020 and are known to be stable and reliable providers of FCAS. Excluding these inverters from FCAS provision is inefficient and thus does not promote the NEO.

Reposit reiterates that AEMO’s power system security concerns are best addressed by the FCAS clawback mechanism provided that AEMO is able to accurately measure Fast FCAS responses. This requires that FCAS metering:

1. Complies with MASS v6 accuracy standards
2. Is 50ms or better
3. Is made at the connection point

This will allow AEMO to reliably detect under-delivery where it occurs and apply the clawback mechanism as appropriate. This will provide VPP operators with sufficient incentive to not register inverters unable to deliver a reliable FCAS response. This obviates AEMO’s need to police inverters on a unit by unit, or model by model basis.

2.3 DNSP provision of reliable power transfer

Reposit acknowledges the primary importance of distribution network reliability in the provision of any electricity services from DER. Electricity services cannot be delivered by DER to the NEM in any meaningful way without a reliable distribution network.

Reposit considers the exploration of Distribution Network Service Provider (DNSP) reliability performance well beyond the scope of this MASS Consultation. However, AEMO has referenced this key topic in its draft report and has followed it up with a DNSP forum[3] within the scope of the MASS consultation. Reposit assumes this topic to now be within scope and will briefly address it accordingly. Reposit has spent several years considering this issue and is enthusiastic to contribute to a conversation at this time.

2.3.1 Network role under the National Electricity Rules

The role of a network provider in the NEM is to connect Participants to the market. This is made very clear early in Chapter 5[4]:

> **5.1A.2 Principles**
>
> This Part B is based on the following principles relating to *connection* to the *national grid*:
>
> (a) all *Registered Participants* should have the opportunity to form a *connection* to a *network* and have access to the *network services* provided by the *networks* forming part of the *national grid*;
>
> (b) the terms and conditions on which *connection* to a *network* and provision of *network service* is to be granted are to be set out in commercial agreements on reasonable terms entered into between a *Network Service Provider* and other *Registered Participants*;
>
> (c) the technical terms and conditions of *connection agreements* regarding standards of performance must be established at levels at or above the *minimum access standards* set out in schedules 5.1, 5.2, 5.3 and 5.3a, with the objective of ensuring that the *power system* operates securely and reliably and in accordance with the *system standards* set out in schedule 5.1a;

Key to this is a commercial agreement that describes the terms and conditions under which this connection is made. This is referred to in the NER as a Connection Agreement.

The NER says that the objective of connection agreements is to ensure that "the power system operates securely and reliably". This objective was written to be technology agnostic (as is the entire NER) and undoubtedly will be referred to by Reposit and others many times in the near future.

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[3] https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2021/mass/second-stage/dnsp-forum-minutes.pdf

[4] National Electricity Rules - 5.1A.22

2.3.2 Connection Agreements

Network Connection Agreements are central to how the NER operates. They define the power transfer interface between a Participant and the wider system. As such they are fundamental to AEMO's understanding of the NEM at a given point in time. Simplistically[5] AEMO should assume that the instantaneous aggregate power transfer capability of all NEM Connection Agreements is possible at a given point in time. This is because the Connection Agreement is the NEM's model for electrical coupling. Because of this, Connection Agreements are fundamental to the management and operation of the NEM.

The key input into a Connection Agreement then is the network provider's assessment of the continuous power transfer capability available in a particular location. This is discoverable via a person's submission of a connection enquiry to a network service provider.

The timings and content of a response to a connection enquiry are governed by the NER[6]. The purpose of this is to allow a Participant to know what amount of continuous power transfer is available. This amount gets written into the Connection Agreement. The NER is then very clear that network provider is then obligated to provide that continuous power transfer[7]:

> (e1) A *Network Service Provider* must, except in so far as its *market network services* and parts of its *network* which are used solely for the provision of *market network services* are concerned, arrange for:
>
> (1) management, maintenance and operation of its part of the *national grid* such that, in the *satisfactory operating state*, electricity may be transferred continuously at a *connection point* on or with its *network* up to the *agreed capability*;

Network providers cannot renege on their Connection Point agreements due to the introduction of new electricity services being provided over their network. Any failure of a network to provide continuous power transfer within the limits of a Connection Agreement is a failure of the network provider.

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[5] Realistically the power transfer across a connection point is often modulated by regulatory processes including central dispatch, wholesale energy prices, AGC, network tariffs and others.
[6] National Electricity Rules - 5.3.2
[7] National Electricity Rules - 5.2.3(e1)(1)

It is not the fault of DER, or an Aggregator, or a Consumer. All network service providers, DNSPs included, are obligated under the NER to meet the commitments they make in their Connection Agreements.

Reposit understands that some DNSPs in particular may be unfamiliar with their network being used to deliver electricity services. It is however inevitable under the NEO as the economics of DER make it the most efficient source of electricity services in the NEM.

To these ends Reposit has been collaborating with DNSPs for more than five years to characterise and operate electricity services provided by DER. Likewise Reposit has been active in the development of Connection Point management technology to ensure that DER provided electricity services are able to be securely implemented at broad scale in the NEM.

2.4 Implementation of Dynamic Operating Envelopes (DOEs)

For some years Reposit has advocated for the use of Dynamic Operating Envelopes to regulate DNSP Connection Points. This was initially motivated by work done by Energex/Ergon to statically constrain a residential connection point[8].

Reposit considers it inefficient for a DNSP to provide static and somewhat arbitrary connection point ratings for DER. The promotion of a concept associated with dynamic limits was adopted as policy by Reposit at this time.

The concept is relatively simple. DOE DNSP Connection Agreements are formulated with an obligation being made by a DNSP to make the maximum import and/or export power transfer available when it is available, in return for the Participant (or their customer) to adhere to limits being imposed by the DNSP when maximum power transfer is not available.

2.4.1 DOE function in relation to FCAS delivery

A Reposit-controlled battery will not commit capacity that violates a connection point constraint to FCAS real time bidding. This is the current operating procedure. It is done so as to not commit Raise or Lower capacity to FCAS markets that cannot be supported by the network. These limits are provided by the Connection

[8] https://www.ergon.com.au/__data/assets/pdf_file/0005/211199/Thinking-about-solar-PV.pdf

Agreement that mediate the DER to the system. As a result they are decided during the battery connection process and are unchanging over time.

Reposit devices that are subject to DOEs will likewise not commit capacity to FCAS real time bidding that violates a connection point constraint. Where a DOE is active, the network limits are communicated to the Reposit controller as they change. The same machinery used to optimise solar and battery behaviour, and calculate bids volumes using static limits is employed where DOEs are active.

This results in modulated connection point-level FCAS bid volumes such that an FCAS bid is not made where a related FCAS delivery would violate the Connection Agreement. FCAS under-delivery as a result of network limits will not occur provided that a DNSP is correctly calculating and communicating the capacity limits of their network. Likewise, AEMO the clawback mechanism will not be executed. Reposit's multi-year investment in DOEs was prompted in no small part by the FCAS clawback mechanism.

2.4.2 Evolve project

Reposit is a part of the Evolve[9] project. This project seeks to build the infrastructure required to facilitate distributed orchestration of DER. It has been active since 2019 and is near completion. The project describes itself as:

Collecting: Operational data from the electricity system.

Analysing: The data to understand network capacity for all parts of the network

Publishing: Details about the congestion within the network will be securely published to customer devices in areas where congestion is currently, or likely, to occur during the day.

Orchestrating: Customers, and their aggregators will be able to more intelligently determine how to operate their batteries, electric vehicles and smart loads in their houses, businesses and industry in real time, working autonomously and invisibly according to the customer's preferences for their energy usage patterns.

2.4.3 Initial implementation

Reposit operates Evolve DOEs on selected systems in Essential Energy's network. These systems receive operating envelopes from Essential Energy and modify their behaviour accordingly.

[9] https://bsgip.com/research/evolve/

It is important to note that this implementation has been operational for several months and is continuous. The Reposit software operating these systems is considered to be Production grade.

Reposit looks forward to the application of Evolve DOEs to other Evolve partnering DNSPs (Ausgrid, Energex, Energy Queensland, Ergon Energy).

3 Increased uncertainty in proposed MASS

Reposit flags the amendments of Sections 2.2, 6.1.1 and 6.1.2 in the Proposed MASS as having no stated rationale. While Reposit generally supports the restructuring of the MASS document to improve readability, it does not support the inclusion of multiple consequential amendments which remain unjustified. Changes such as these introduce significant investment uncertainty and without due consideration will have material consequences for the integrity of the standardised FCAS markets.

3.1 Priority in delivery of different FCAS Types

> Draft MASS Section 2.2:
>
> ~~Contingency Services~~ Unless specifically advised to do so by AEMO[4], there are no circumstances under which an Ancillary Service Facility should ignore ~~and not respond to AGC instructions while~~

Section 2.2 of the recently reformatted MASS includes this amended statement that gives AEMO the ability to waive participants from obligations to deliver enabled FCAS services. The need for this carveout has not been stated, but Reposit asserts that having a Participant be paid for Regulation FCAS, but not deliver it on instruction from AEMO is inefficient. Reposit suggests that AEMO does not require this carveout in the MASS and can rely on the well-defined NER Chapter 4 mechanisms already governing AEMO directions and instructions.

If a facility were to be enabled for FCAS delivery and AEMO provided advice to ignore AGC instructions, this advice must be in accordance with NER clause 4.8.9 for the facility to receive payment for any delivered services during this time. Reposit would also like to highlight that the MASS section 2.5 requires delivery of enabled services and that any payment for non-delivery should adhere to AEMO's current claw-back procedures.

- NER 2.3.5 (i) '*A Market Customer is not entitled to receive payment from AEMO for market ancillary services except where those market ancillary services are produced using an ancillary service load in accordance with Chapter 3 or pursuant to a direction or clause 4.8.9 instruction.*'

- NER 2.2.6 (i) '*A Market Generator is not entitled to receive payment from AEMO for market ancillary services except where those market ancillary services are produced using an ancillary service generating unit in*

accordance with Chapter 3 or pursuant to a direction or clause 4.8.9 instruction.'

3.2 Frequency Settings for Switching Controllers

Draft MASS Section 6.1.1:

> Until an Ancillary Service Facility that uses a Switching Controller to deliver Contingency FCAS is allocated one or more~~a~~ Frequency Deviation Setting~~s~~ under section 6.1.2, the FCAS Provider must apply the default Frequency Deviation Setting shown in Table 5 if the Ancillary Service Facility is on the Mainland or Table 6 if the Ancillary Service Facility is in Tasmania.

Draft MASS Section 6.1.2:

> AEMO encourages FCAS Providers with Ancillary Service Facilities using Switched Controllers to configure them so that different Frequency Settings can be assigned to different parts of their Ancillary Service Facilities.

The effectiveness of existing frequency setting allocation mechanisms should be explored fully before introducing additional complexity and uncertainty created by encouraging pseudo-proportional control of switched facilities. The existing Frequency Setting allocation already provides a mechanism for AEMO to avoid any undesired system behaviour by allocating different settings to each switching controlled facility.

AEMO has not provided quantitative technical justification for switching-controlled facilities to accommodate multiple Frequency Settings. Sections 6.1.1 and 6.1.2 both introduce a pathway to implement multiple Frequency Deviation Settings for a single switching Ancillary Service Facility. These changes in the MASS would introduce significant investment uncertainty for this type of control. Additionally, Reposit asserts that many of the conclusions in AEMO's Renewable Integration Study (RIS) on the limitations of switching controllers are controversial and require additional scrutiny. The RIS input to this MASS review appears to be one of the key motivations for introducing these amendments. As such, Reposit has provided commentary on the key issues with the RIS input below.

3.3 Switching Controller Issues

Reposit supports AEMO's draft determination to not progress general limits on the proportion of switching-controlled FCAS and blanket requirements to limit over-delivery of switching FCAS facilities.

We maintain that limitations should be driven by quantifiable requirements for minimum amounts of synchronous, frequency responsive capacity as is the case for TAS1.

We suggest that AEMO investigate the future adjustment or even allocation of Frequency Recovery Settings for managing over-delivery of switched FCAS rather than pursuing seemingly arbitrary limits such as the suggested 150%.

Reposit would also like to flag the distinction between the terms 'switching control' and 'non-frequency responsive' which seem to have become conflated in this recent MASS review.

'Switching control' is specific to the control regime specified in the MASS for responding to contingency disturbances, this control actually follows a simple but dynamic profile where the response must be modulated with respect to the duration of the frequency disturbance and the boundaries of the Fast, Slow and Delayed services.

On the other hand, 'non-frequency responsive reserve' is described in AEMO's RIS as achieved by "Removing frequency responsiveness from output completely, [and] forcing a generator to track a static profile"[10]. We believe that maintaining this distinction is important as we work to facilitate the increasing participation and rising value of switching control in the Contingency FCAS markets.

3.4 Switched FCAS Misconceptions

Reposit challenges the set of assumptions and conclusions made by AEMO's Renewable Integration Study (Stage 1 Appendix B: Frequency Control) on the operation and functionality of switching controlled FCAS.

This study appears to underpin the decisions to introduce multiple frequency settings for a single switched facility in the draft MASS and to inform general discussions of switching control in this review. Reposit believes that there are some key misconceptions in the switched FCAS limitations outlined in B4.8.5 of the RIS which we have addressed individually below.

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[10] https://aemo.com.au/-/media/files/major-publications/ris/2020/ris-stage-1-appendix-b.pdf

3.4.1 Continuous control

Switching control requires the continuous measurement of frequency coupled with continuous control instructions.

Any switching control implementation needs to be responsive to both trigger and recovery settings so that delivery can be initiated and concluded as per the MASS.

It is incorrect to assert that the switched controller is not 'continuously sensitive to frequency and does not act to control it'. If an underlying asset is not capable of continuous control, Reposit would question the feasibility of adhering to the MASS in delivering a response that can then be effectively recovered once frequency has been restored.

Switching FCAS facilities are not limited to a discrete delivery size. In Reposit's case, assets are continuously and variably controlled to deliver the enabled capacity for the period under the switching specification.

The controllability and continuity of an asset's frequency response is not limited by the specific MASS control regime (variable/switched) but rather the underlying asset and architecture of the facility.

3.4.2 Repeatability

Switching controlled FCAS is a continuous frequency-responsive effort to stabilise grid frequency. As addressed in the sections above, it is a misconception that switching control follows a static response profile once triggered and requiring 'some minutes' to 're-arm' demonstrates a technology prejudice.

If multiple complete frequency disturbances do happen in quick succession, a switching controlled FCAS facility will have no more trouble than a variable controlled facility in attempting to respond to the subsequent disturbances.

Reposit notes that it is incorrect for AEMO to assume the source of power modulation simply because that power modulation is switching-controlled. Reposit suggests that this type of assumption has influenced AEMO's consideration of switching control throughout the RIS.

A material issue could arise if multiple disturbances occur within the same dispatch interval as there would be insufficient time to re-bid FCAS capacity. This

however is unlikely and affects all FCAS participants. Should AEMO consider this eventuality to be more probable in the future, Reposit suggests that the MASS should clarify the requirements for any FCAS provider responding to multiple frequency excursions within a single 5 min interval.

3.4.3 Over-provision

When managed correctly, over-delivery of Contingency FCAS actually increases system stability and security by providing reserve capacity for 'free'. Reposit suggests that over-delivery can be managed effectively with appropriate frequency recovery and deadband settings, these settings limit the system security consequences of over-delivery.

The RIS refers to the "discrete sized MW" response of a switched FCAS as the potential cause of over-delivery but this is not an inherent issue specific to switching control. The discreteness of a facility's response is determined by the limitations of the underlying modulation of the asset's output and the facilities control architecture.

All providers must also navigate the integer MW bidding limitation of the NEM, this is another discrete enablement problem that affects small facilities most. To ensure delivery of enablements, small providers must underbid by a significant proportion of their available capacity when adhering to the MW bidding constraint. This market structure effect could create significant over-delivery if all FCAS was procured from small facilities who are all having to underbid a sizable proportion of their capacity to remain compliant.

3.4.4 Over-response to smaller events

Over-recovery of system frequency due to an unmanaged switching FCAS response to small disturbances can be mitigated by enforcing stringent frequency recovery settings.

> Draft MASS Section 3.1:
>
> Ancillary Service Facilities ~~need not provide~~ may cease to provide Contingency FCAS once Local Frequency ~~has recovered~~once Frequency Recovery has occured. For example:

Reposit notes that Section 3.1 of the current draft MASS, AEMO only requires delivery of a response up until Frequency Recovery after which a facility "may cease to provide" a response. Reposit suggests amending this section to *require*

facilities to stop responding after frequency recovery if AEMO is concerned about over-response to smaller events.

3.4.5 Limiting provision from switched controllers

Reposit believes that minimum requirements for levels of synchronous or virtual-synchronous reserve should be modelled from specific constraints in low-stability NEM regions.

While it is true that maximum limits on the amount of switching control exist in other jurisdictions, Reposit believes that there is little evidence of the detrimental impact of switching reserve in the NEM. Reposit suggests that no limits should be introduced until any such negative impacts of switching control can be quantitatively modelled and characterised.

Initial limits applied to the procurement of switched reserves in other jurisdictions have been incorrect. As described in the RIS, the value of switching reserve was clearly underestimated in ERCOT and initial precautionary limits had to be significantly relaxed over the following decade[11]. Reposit suggests that this experience resulted in inefficient investment in, and operation of electricity services in ERCOT.

[11]https://aemo.com.au/-/media/files/major-publications/ris/2020/ris-stage-1-appendix-b.pdf - p.34

4 Trials of new technologies

Reposit flagged changes to AEMO's "Trials of New Technologies" in section 6.3 of its first stage submission to AEMO's MASS Consultation paper.

Repost reasserts that the formulation of trials under the MASS has a significant impact on future investments in market ancillary service providing technology.

Reposit recommends that Chapter 8 NER Regulatory Sandbox Processes are implemented for all market ancillary services trials to make them consistent with other NEM electricity services innovation processes.

4.1 Redefinition in proposed MASS

The Proposed MASS changes to the "Trials of New Technologies" section removes all constraints on AEMO when executing a trial under the MASS. In MASS v6 this section reads:

7.3. Trials of new technologies

AEMO, at its absolute discretion, may allow an Ancillary Service Facility to participate in a trial to test the performance of new technologies.

It is envisaged that any trial will:

- Be for a limited period,
- Be for a limited measurable quantity of the service, and
- Be subject to the conditions that the party conducting the trial:
  - Withdraw from the market if directed by *AEMO*.
  - Use best endeavours to meet the full requirements of the MASS.
  - Meet any other requirements AEMO, at its discretion, requests.

In the Proposed MASS, this section reads:

11. TRIALS OF NEW TECHNOLOGIES

11.1. AEMO's Requirements

From time to time, a trial to demonstrate the capability of new technologies in the delivery of FCAS may be authorised. Where this occurs, AEMO may specify the capabilities, measurements, verification and other requirements and conditions of the trial in its absolute discretion.

11.2. Report to AEMO

AEMO may specify the contents of a report and supporting data that trial participants must submit to AEMO upon the conclusion of a trial to enable AEMO to assess the efficacy of reviewing the MASS to address any issues that the trial has raised as to the performance of the new technologies in the delivery of FCAS or the operation of the *spot markets* for FCAS.

While MASS v6 only "envisaged" that an AEMO trial formulator would apply constraints on time period, measurable quantity and conditions, the Proposed MASS applies no constraints whatsoever. This is clearly a lessening of structure and regulation applicable to trials of new Market Ancillary Services - albeit from a low base.

Reposit considers this inappropriate given the very clear market distortion and resulting inefficiencies created by the VPP Demonstrations Project executed under the "tighter" trial conditions in MASS v6.

Reposit asserts that the market can learn from the outcomes of the VPP Demonstrations Project to make the trialling of market ancillary services innovations more efficient.

Reposit flagged the changes to AEMO. AEMO's response to Reposit was as follows[12]:

AEMO does not consider the suggested changes to be appropriate. The reason for the changes is to permit AEMO to set restrictions on any trials in an ad hoc manner otherwise it would be necessary for AEMO to commence a consultation if a trial required different conditions to those specified in the MASS and this is not an efficient way to carry out this work.

AEMO agrees with Reposit Power that a trial is not a backdoor into any of the markets AEMO administers, however, there is a need for flexibility in specifying the scope and conditions for participation in any trial. Any trial that has the potential to result in changes to a market that is in the longer term interests of consumers is consistent with the NEO and AEMO does not wish to stifle efforts to learn from innovations by putting up artificial barriers to the commencement of trials.

Reposit disagrees that the more liberal phrasing of the Proposed MASS's trial section makes it more restrictive. Reposit suggests that it gives AEMO more discretion and market ancillary services investors, Participants and Consumers even less certainty on the conduct and governance of any future trial.

Reposit does agree that requiring a MASS Consultation to vary trial conditions is inefficient. A middle ground is required. This middle ground should balance the risks of running in-market trials against the benefits of in-market evaluation of new technologies. NEM market bodies have been working on exactly this sort of

[12] AMENDMENT OF THE MARKET ANCILLARY SERVICE SPECIFICATION – DER AND GENERAL CONSULTATION DRAFT REPORT AND DETERMINATION - 14 June 2021 - p. 182

middle ground. The Regulatory Sandboxes rule change specifically addresses in-market trialling of innovations in the NEM.

4.2 MASS application of Regulatory Sandbox processes

The Regulatory Sandboxes rule change process has been running since November 2019. Its objective is to implement[13]:

a framework within which participants can test innovative concepts in the market under relaxed regulatory requirements at a smaller scale, on a time-limited basis and with appropriate safeguards in place.

It was recommended by the Finkel review which resulted in the the COAG Energy Council requesting advice on "how to best facilitate coordination of proof-of-concept trials and the need for formal regulatory sandbox arrangements"[14].

The sandbox works to modulate the NER, NERR and NGR such that innovative concepts can be tested in the market. It's development has been contributed to by at least eighteen parties - including AEMO.

Its formulation is complete and will result in a section J being added to Chapter 8 of the NER, various changes being made to the NERR, and some small changes being made to energy laws.

It provides the mechanism for the efficient operation of innovation trials, ensures that existing consumer protections are maintained, and facilitates the gathering of information required to support innovation accommodating changes to regulations.

Reposit asserts that the Regulatory Sandbox mechanism is absolutely applicable to market ancillary services and should be adopted by AEMO for trials of new technologies in the MASS.

Reposit suggests that there is no reason why market ancillary services innovation is different to wholesale energy, network or metering services innovation - all of which will be enabled by the Regulatory Sandbox mechanism. Reposit suggests that doing otherwise may be counter to the achievement of the NEO.

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[13] https://www.aemc.gov.au/market-reviews-advice/regulatory-sandboxes
[14] FINAL REPORT - REGULATORY SANDBOXES - ADVICE TO COAG ENERGY COUNCIL ON RULE DRAFTING - 26 MARCH 2020 - Section 1.2

As a result, Reposit suggests that Section 11 of the Proposed MASS should formally adopt the Regulatory Sandbox mechanism for trials of new technologies in market ancillary services.

4.3 VPP Demonstrations extension

Reposit does not support the extension of the VPP Demonstrations. AEMO has not articulated a NEO-based reason for the extension of this trial.

Reposit points out that this extension will see the VPP Demonstrations trial run for a total of *five years*. This equates to half of the operating life of the assets included in this trial. Reposit asserts that the VPP Demonstrations cannot be considered a trial any longer.

It is Reposit's opinion that the VPP Demonstrations has delivered any learnings it is likely to deliver and that to maintain its operation creates unnecessary costs that will be ultimately borne by consumers. AEMO has not articulated what additional learnings AEMO is looking to gain with the extension of the VPP Demonstration.

Reposit recognises the limitations on Trial Participants in Section 11.3 of the Proposed MASS as an attempt to recognise and compensate for the degraded service being provided by Trial Participants.

Reposit also notes that clawback provisions should be applied to Trial Participants if the VPP Demonstrations is to continue. The clawback mechanism must be equitably applied if Trial Participants are to be subject to the same incentive mechanisms as full market Participants.

Reposit is of the opinion that AEMO should be seeking a Regulatory Sandbox Trial Waiver should it wish to continue the VPP Demonstrations. Section 11.3 should not be in the MASS, but included in the Trial Waiver given that it is only applicable to Trial Participants.

Also, Reposit does not consider the extension of the VPP Demonstrations to be an issue that should be dealt with in a MASS Consultation. Reposit continues to consider the confluence of the MASS Consultation and the VPP Demonstrations evaluation processes to be inefficient and highly unusual.