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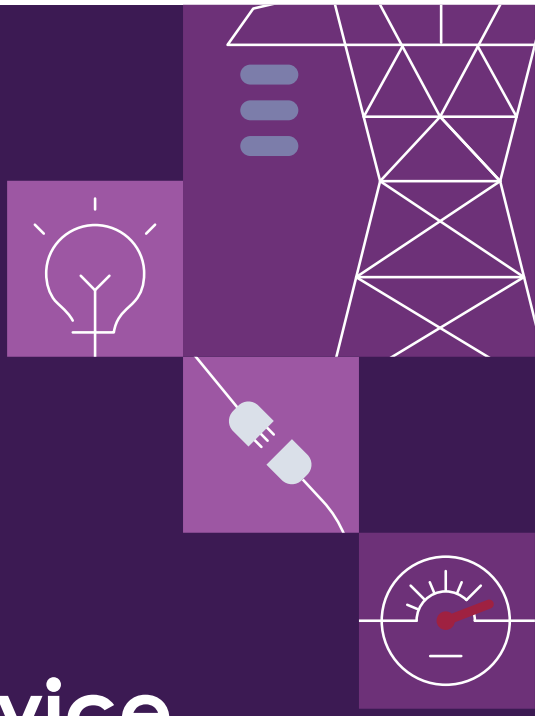

Amendment of the Market Ancillary Service Specification (MASS) – Very Fast FCAS

Final Report and Determination

Published: 7 October 2022

Executive summary

The publication of this Final Report and Determination (Final Report) concludes the consultation conducted by AEMO to amend the market ancillary service specification (MASS) under the National Electricity Rules (NER) to accommodate two new markets for very fast frequency control ancillary services (Very Fast FCAS) as required by the National Electricity Amendment (Fast frequency response market ancillary service) Rule 2021 No. 84 (Amending Rule).

AEMO commenced this consultation by publishing an Issues Paper that proposed a Very Fast FCAS specification with the following attributes:

- 1 second (s) response time.
- 6 s total timeframe.
- Raise/Lower reference frequency at ±0.5 Hertz (Hz) for the NEM mainland and ±2 Hz for Tasmania, in line with comparable Contingency FCAS.
- An assumed frequency ramp rate of 1 Hz/s.

Submissions in both stages of the consultation were largely supportive of the key aspects of the proposed specification, with the following material issues being raised in response to AEMO's Draft Report:

- The new requirement for reserving headroom and footroom. Having taken into consideration the submissions, AEMO has clarified in the Final Report that the requirement to reserve headroom and footroom for Aggregated FCAS Facilities applies at the aggregated level only.
- The new scan rate requirement for control systems. In light of the submissions, AEMO proposes to carry out further analysis and monitoring of the performance of variable controllers and will not include the scan rate requirement proposed in the Draft Report at this stage.
- Metering certification requirements. Because of the timing restrictions associated with consultations, AEMO proposes to engage with the National Measurement Institute following the conclusion of this consultation on the issues arising out of the submissions. In the meantime, AEMO will include different ways in which metering compliance can be demonstrated by FCAS providers.
- The impact on other types of contingency FCAS. AEMO does not consider that there is sufficient justification for amending the response time specifications of other contingency FCAS as a result of the introduction of the Very Fast FCAS markets.
- The removal of the multiplier effect. As demonstrated through the analysis conducted by AEMO on the impact of the multiplier effect on the frequency nadir, the amount of FCAS enabled must be more reflective of the change in active power from an FCAS Facility. Having considered the submissions that advocated for retention of these provisions, AEMO remains of the view that the FCAS markets and the power system will operate more effectively and efficiently if this effect is removed.

The impact of introducing Very Fast FCAS markets in Tasmania was considered separately and after discussions with affected parties, AEMO has decided to widen the Frequency Deviation Setting range by 0.25 Hz, and the Default Frequency Deviation Setting by 0.125 Hz for Tasmania.

AEMO's final determination is to amend the MASS in the form published with this Final Report. The substantive specifications, verification and measurement requirements for Very Fast FCAS remain unchanged from the Draft Report.

AEMO considers that the specifications for Very Fast FCAS and the other important changes and clarifications made to the MASS will result in the efficient and effective delivery of all Contingency FCAS in the long-term interests of consumers.

Consistent with the Amending Rule, the amended MASS will take effect on 9 October 2023, which is the scheduled date for commencement of the Very Fast FCAS markets.

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1. Stakeholder consultation process

As required by clause 3.11.2 of the National Electricity Rules (NER), AEMO has consulted on amendments to the Market Ancillary Service Specification (MASS) to accommodate two new markets for Very Fast FCAS in accordance with the Rules consultation procedures in NER 8.9[1].

AEMO's timeline for this consultation is outlined below.

Deliverable	Date
Notice of first stage consultation and Issues Paper published	2 May 2022
Addendum to Issues Paper published	7 June 2022
First stage submissions closed	21 June 2022
Draft Report & Notice of second stage consultation published	22 July 2022
Second stage submissions closed	19 August 2022
Final Report published	7 October 2022

The publication of this Final Report concludes the consultation.

Note that there is a glossary of terms used in this Final Report at Appendix A.

1.1. First stage consultation

On 2 May 2022 AEMO issued a Notice of First Stage Consultation and an Issues Paper that examined relevant issues and proposed a specification for Very Fast FCAS.

Following an industry forum held on 19 May 2022 and in response to a number of queries, AEMO published an Addendum to the Issues Paper on 7 June 2022 after conducting additional modelling of Very Fast FCAS options with increased FCAS volumes.

AEMO also met with Rheem & CET representatives on 17 June 2022 to address their questions on the Issues Paper.

AEMO received 13 valid submissions on the Issues Paper. A further submission was received too late for consideration in this stage of consultation, and held over to the next stage.

After considering the submissions received, the results of a study by the University of Melbourne (UoM) and metrology advice from AEMO's metering consultant, Michael Guy, AEMO published a Draft Report and Determination on 22 July 2022 (Draft Report).

1.2. Second stage consultation

AEMO held a further industry forum on 2 August 2022 to explain the proposed changes in the Draft Report.

AEMO received 13 valid written submissions and one late submission in response to the Draft Report, in addition to the submission held over from the first stage.

[1] As the consultation was commenced before the effective date of the *National Electricity Amendment (Improving consultation procedures in the rules) Rule 2022 No.6*, the applicable rules consultation procedures were those in effect prior to 11 August 2022.

On 26 August 2022, AEMO met with representatives of the following to discuss the MASS as it applies to Tasmania:

- TasNetworks
- Basslink
- Hydro Tasmania
- Firmus
- Woolnorth Wind Farm
- Greenview Strategic Consulting

On 6 and 15 September 2022, AEMO met with representatives of Shell Energy, Delta Electricity and CS Energy to discuss alternative methods of determining the appropriate reference trajectory for generation participating in the FCAS markets and providing PFR simultaneously.

1.3. Consultation documents and submissions

All AEMO consultation documents, presentations and written submissions (excluding any confidential information) have been published on AEMO's website at: https://aemo.com.au/consultations/current-and-closed-consultations/amendment-of-the-mass-very-fast-fcas.

2. Background

2.1. NER requirements

AEMO is required by NER 3.11.2(b) of the National Electricity Rules (NER) to make and publish a market ancillary service specification (MASS), which AEMO may subsequently amend at any time subject to the rules consultation procedures in NER 8.9.

2.2. Context for this consultation

In July 2021, the Australian Energy Market Commission (AEMC) published the *National Electricity Amendment (Fast frequency response market ancillary service) Rule 2021 No. 8* (Amending Rule), which introduces two new market ancillary services (FCAS) to help control power system frequency and keep the power system secure. These new services are the very fast lower service and very fast raise service (collectively, Very Fast FCAS).

The Amending Rule requires AEMO to amend and publish the MASS by 19 December 2022, with the amended MASS to take effect on 9 October 2023.

As for all existing FCAS, the MASS needs to incorporate:

- A detailed description of Very Fast FCAS in accordance with NER 3.11.2(b)(1).
- The performance parameters and requirements for a service to qualify as Very Fast FCAS, and to be met when Very Fast FCAS is delivered, each in accordance with NER 3.11.2(b)(2).

3. Summary of material issues

Appendix B summarises all issues arising from submissions to the Draft Report , together with AEMO's responses. The key material issues arising from the proposal and raised in submissions to the Draft Report are listed in the following table and discussed in section 4.

No.	Issue	Raised by
1	Key Parameters for Very Fast FCAS	AGL, Enel-X, EnergyAustralia, Hydro Tasmania, Shell Energy, SwitchDin, Tesla, VIOTAS
2	Control System Requirements	AGL, EnergyAustralia, Evergen, Rheem & CET, Shell Energy, Simply Energy, sonnen, SwitchDin, Tesla
3	Verification and Measurement Requirements	AGL, Delta Electricity, Enel X, EnergyAustralia, Evergen, Hydro Tasmania, Reposit, Rheem & CET, Simply Energy, sonnen, SwitchDin, Tesla, VIOTAS, Yurika
4	Impact on other types of contingency FCAS	Delta Electricity, Hydro Tasmania, Shell Energy, Simply Energy
5	Revision to FCAS Measurement	Delta Electricity, Enel X, EnergyAustralia, Hydro Tasmania, VIOTAS
6	Contingency Event Time	AGL, Delta Electricity, EnergyAustralia, Hydro Tasmania, Rheem & CET
7	FCAS provision in Tasmania	Hydro Tasmania

4. Discussion of material issues

4.1. Key parameters for Very Fast FCAS

4.1.1. Issue summary and submissions

In the Draft Report, AEMO proposed a specification for Very Fast FCAS with the following attributes:

- 1 second (s) timeframe to reach maximum response.
- Raise/lower reference frequency to remain at ±0.5 Hz for the NEM mainland and ±2 Hz for Tasmania.
- Fast frequency ramp rate of 1 Hz/s.
- Inertia will not be treated as Very Fast FCAS.

Submissions on the basic market design were largely supportive and comments were received on some of these parameters[2].

Response time and service timeframe

AGL

> AGL supports the amendments to the MASS put forward …; specifically, the proposed key parameters of the Very Fast FCAS markets...

Enel X

> This submission sets out our responses to the Draft Report for the MASS review to implement the Very Fast FCAS market. The key points are:
>
> - We generally support the Draft Report, specifically the Very Fast FCAS market specifications, and verification and measurement requirements.
>
> …

EnergyAustralia

> EA agrees with the rationale for most of the proposed draft settings. Many of these align with the sentiments in our earlier submission. … We, therefore, support the proposed approach for:
>
> - general settings;
> - technology types;
>
> …

Hydro Tasmania

> The proposed 1-s arrangement will likely exclude the majority of synchronous machines, which at the moment, are still the dominant form of generation in the National Electricity Market (NEM).
>
> System frequency control is not just a matter of frequency response speed, but also response coordination and overall system stability. Synchronous machines frequency response performance has been well proven over time, and in particular, the response reliability in events combined with system voltage depression and distortion. Conversely, there is currently limited operational experience and understanding of Inverter Based Resources and their capability to withstand and

[2] Note that submissions quoted in this document are in this font; a footnote in this font indicates that the footnote is copied from the submission. In the interests of saving space, AEMO has replaced some descriptions in the submissions with acronyms that are defined in the Glossary.

provide Low Voltage Fault Ride Through (LVFRT). We understand therefore that AEMO would comprehensively consider the delivery of Very Fast FCAS under different system event scenarios to ensure overall system integrity.

Shell Energy

AEMO points out that its analyses of the impact of 1 and 2-s responses from the Issues Paper and the Addendum are based on different scenarios. The Issues Paper was based on minimum observed inertia levels as per the 2022 ISP whereas the Addendum was based on the minimum threshold level of inertia requirement. In our view, both approaches fail to recognise several interconnected pieces of work. There is ongoing work underway around the delivery of essential system services, including the potential introduction of a market for inertia, as well as the fact that the current minimum level of inertia could change as AEMO's engineering framework assessment work evolves. An increase in the volume of inertia would offset the need for some volume of Very Fast FCAS response. In our view, the case for a 1-s service is far from clear cut if the total costs – which consumers pay for – are taken into account.

We also note that AEMO seems to have placed little importance on the value of largest credible risk (LCR) used in its electrical islanding requirements assessment. We consider that the LCRs in the assessment should be reflective of those expected to be required at Dispatch in order to deliver more accurate results. We also observe that for the South Australian region the expected commissioning of Project Energy Connect was not discussed in the Draft Report. A more comprehensive economic assessment including reasonable consideration of the factors set out above may demonstrate that a 1-s service truly is more efficient but at this stage, it appears that AEMO has not considered the issue in this light.

SwitchDin

In general, we support the design of the new Very Fast FCAS markets. While meeting the requirement to achieve maximum response within 1 s and monitor power and frequency at 100 ms will be a challenge for aggregators, we understand that this is necessary to deliver the level of service required…

Tesla

At large Tesla supports AEMO's position on progressing a 1 s market, and we are supportive of the approach proposed for aggregated assets – specifically the adoption of 100ms measurement resolution with a 5% discount rate applied to the bids.

…

From a first principles perspective, Tesla supports the near final market design principles that have been proposed by AEMO.

- We support the new Very Fast FCAS markets being introduced as a 1 s market.

Frequency ramp rate

VIOTAS

With regards to loads using switching controllers, a characteristic of the MASS that isn't discussed in this review is the commencement of the assessment window. For Contingency Raise FCAS this is equal to the Frequency Disturbance Time (FDT) (currently the edge of the normal operating frequency band (NOFB), ie 49.85 Hz), however Frequency Settings are assigned by AEMO at or below 49.80 Hz. This creates a ≥0.05 Hz delay between the frequency leaving the NOFB (49.85 Hz) and start time for resources using switching controllers, which in effect acts as a penalty as it reduces the measurement window. This effect is exacerbated when RoCoF is slow, or the frequency hovers between 49.85 Hz and the controller's frequency setting, further delaying the controller's start time. VIOTAS understand AEMO use engineering discretion during post event performance verification, however during registration this delay is governed by the Standard Frequency Ramp of 0.125 Hz/s for Fast, Slow and Delayed FCAS. A 0.5 Hz delta at a ramp rate of 0.125 Hz/s results in a 400 ms delay, or a fifteenth of the ramp period. See VIOTAS response to question 16 for the impact to Very Fast FCAS[3].

The UoM's latest analysis highlights this issue and adopts a rolling assessment window as a work around in order to conduct the analysis, otherwise the assessment window would be too long, although this doesn't reflect the MASS.

> "switched loads […] generally exhibit response delays associated with a combination of actual response initiation delay and the time difference between when the frequency exits the NOFB and when it reaches the trigger setting of the load (which may be different from the NOFB).

[3] See submission immediately above under the Market ancillary service offer requirements sub-heading.

> Can AEMO justify why loads are penalised in this way, that is, why FDT is equal to the edge of the NOFB and not a switching controller's frequency setting? We note that this penalty is not equally imposed on generators to account for primary frequency response (PFR), as illustrated in Figure 25 of the Issues Paper.

4.1.2. AEMO's assessment

Response time and service timeframe

AEMO notes Hydro Tasmania's comment that most synchronous generation will not be eligible for participation in the Very Fast FCAS markets if the response time is required to be within 1 s. AEMO has demonstrated that frequency response times slower than 1 s will not have the desired impact on the frequency nadir following a high RoCoF event during projected low inertia conditions.

As AEMO's first priority is to maintain power system security, the swift containment of a high RoCoF event must therefore have a higher priority in setting a response time than ensuring a majority of existing generation technologies can participate in the new markets. It is important to establish performance requirements that will serve power system needs into the future, in the long term interests of electricity consumers.

Shell commented on the appropriateness of the inertia and LCR assumptions AEMO employed in the models used to demonstrate the impact of different Very Fast FCAS timing arrangements. While all modelling assumptions should be subject to careful consideration, model outcomes are only one factor AEMO considered in determining appropriate Very Fast FCAS timing. The modelling demonstrates that there are real potential benefits to a faster service, and submissions made clear that capability to deliver such a service is readily available, even if it may be challenging for some technologies. AEMO considers that the actual future levels of inertia and LCR will be more relevant to the procurement of Very Fast FCAS than the technical requirements to be met by FCAS Facilities providing Very Fast FCAS. This is because:

- The level of inertia assumed in the studies carried out for the purposes of this consultation has no bearing on an assessment for the purposes of determining how much Very Fast FCAS would need to be procured in the future. The potential impact of an increase in the volume of inertia over time and whether this would offset the need for some Very Fast FCAS response is not something the MASS needs to address. It is an issue to be considered every time AEMO needs to determine the FCAS procurement volumes and would be based on the best known available data at that time.
- The value of LCR used in AEMO's electrical islanding assessment will alter once Project Energy Connect becomes operational and AEMO will consider its impact in due course. As Project Energy Connect is currently not expected to be operational until 2025-26, this is not a matter that can be determined at this stage.

Frequency ramp rate

The contingency FCAS markets are designed to ensure there is enough frequency response to deal with a single credible contingency event, which is typically the loss of a large generating unit or major industrial load.

As required by the frequency operating standard (FOS), for an interconnected system, power system frequency must be maintained between 49.85 Hz and 50.15 Hz. For most of the time (99% in fact) when there are no contingency or load events, power system frequency must be stabilised between 49.85 Hz and 50.15 Hz within 5 minutes following a generation or load event. The frequency disturbance time (FDT) is equal to the edge of the normal operating frequency band (NOFB) for these reasons.

VIOTAS questioned why switched loads are penalised during the FCAS assessment process due to the FCAS response being measured from the FDT rather than the controller's trigger setting. In fact, switching controllers do not respond to frequency deviations as often as generating units providing PFR. Therefore, AEMO does not agree that loads are being penalised as their switching controllers are only triggered following larger frequency excursions. FCAS Providers with switched loads may request that their trigger settings be narrower to improve their results following an FCAS assessment.

4.1.3. AEMO's conclusion

The specification for Very Fast FCAS will be as proposed in the Draft Report, namely:

- A 1-s timeframe to reach maximum response.
- A total timeframe of 6 s.
- Raise/lower reference frequency to remain at ±0.5 Hz for the mainland and ±2 Hz for Tasmania.
- Fast frequency ramp rate of 1 Hz/s.
- Inertia will not be treated as Very Fast FCAS.

4.2. Control system requirements

4.2.1. Issue summary and submissions

Requirement to reserve headroom and footroom

AEMO proposed a new control system requirement in section 6.2.2(e) in the draft MASS as follows:

> The FCAS Facility used to deliver the required contingency FCAS must have a *control system* to reserve the necessary headroom or footroom required for the delivery of frequency response whenever contingency FCAS is *enabled*.

Submissions were largely opposed to this proposal.

AGL

> While AGL supports AEMO's intent in incorporating Section 6.2.2(e) into the MASS, the explicit wording of the provision may have the unintended outcome of limiting the ability of residential virtual power plants (VPPs) and similar flexible technologies from participating in the FCAS markets.
>
> AEMO's fourth VPP Demonstration Knowledge sharing Report noted that in relation to consumer motivations for participating in VPP's that "…The consumer expectation to 'save money on energy bills' is the most prevalent factor in sign-up and retention."[5] Requiring customer assets to reserve headroom or foot-room capacity will significantly impair the ability of the CER device to deliver bill savings for its owners. It is AGL's view that this will in turn be a significant disincentive for consumers who are considering participating in VPP's and will unnecessarily impair the future capacity of FCAS market registrations delivered by VPP's.
>
> We propose that AEMO consider amending this requirement to enable the class of non-scheduled participants that do not bid into the energy market, to simply to ensure that sufficient capacity is available without restricting their ability to operate flexibly.

Evergen

> Section 6.2.2 … (e) is inappropriate as currently worded. As with measurement and metering issues previously discussed, the wording here is ambiguous as to whether AEMO is specifying requirements at the individual generating/load unit level, or at the Aggregated FCAS Facility level. Either way, the implication that a control system must be able to "reserve"

[5] AEMO NEM Virtual Power Plant Demonstrations, Knowledge Sharing Report #4, September 2021, p10. Available at https://aemo.com.au/en/initiatives/major-programs/nem-distributed-energy-resources-der-program/der-demonstrations/virtual-power-plant-vpp-demonstrations.

headroom/footroom implies a focus on utility-scale front-of-meter storage, and a neglect of the operational considerations for an Aggregated FCAS Facility comprising behind-the-meter (BTM) distributed energy resources (DER).

BTM DER participating in FCAS are not simply participating in the wider energy market. First and foremost, they are appliances servicing the immediate needs of end-user consumers. For example, a residential battery typically has the primary function of maximising the end-user's self consumption of rooftop PV generation, and minimising grid imports. It is entirely possible - even likely - that a majority of end-users' preferred FCAS participation strategy is to continue using their own battery as they normally would without constraint, and only contribute to an Aggregated FCAS Facility frequency response at those times when they just happened to have sufficient headroom or footroom. For an end-user to reserve headroom/footroom within their own battery reduces the capacity of that battery for preferred or more valuable purposes such as load shifting and time-of-use tariff arbitrage. Residential end-users with small-capacity batteries (e.g., 5kWh or less) would find that actively reserving capacity for FCAS may deprive them use of the majority of their battery.

Offering capability only when it happens to be available omits the need for a reserve control mechanism to deliver adequate frequency response.

Of course, an Aggregated FCAS Facility operator will need an appropriate mechanism to constantly assess and forecast aggregate capacity. This is crucial for ensuring the Aggregated FCAS Facility is only bid into the FCAS market when aggregate capacity is forecast to be available. Aggregated FCAS Facilities may still make compliant bids even when some of the DER in the Aggregated FCAS Facility lack headroom or footroom to individually respond, provided the Aggregated Facility as a whole can still deliver against its enablement commitment. Assessing capability and ensuring compliant bidding is a fleet-level consideration, not an individual DER consideration.

Again though, compliance at the Aggregated FCAS Facility level does not amount to a mechanism to "reserve" headroom or footroom, since enablement of the Aggregated FCAS facility can be targeted to periods where the facility happens to be capable based on the aggregation of individual behaviours. This can occur, without ever reserving headroom or footroom at the aggregated facility level.

Headroom and footroom considerations seem more relevant to front-of-meter facilities with no BTM loads, where the only considerations are the tradeoff between trading energy vs FCAS enablement. The inclusion of this requirement and its wording again implies a narrow focus on utility-scale front-of-meter plant, without proper consideration of the unique and still relatively novel circumstances of Aggregated FCAS Facilities comprising BTM DER.

Recommendation: AEMO should omit Section 6.2.2 (e) from the draft MASS.

Simply Energy

Simply Energy would appreciate if AEMO could provide clarification of the purpose of its proposal to require FCAS Providers to have a control system to reserve headroom and footroom for contingency FCAS. AEMO does not provide explanation of this proposal in the Draft Report, and it is not clear what issue this proposal is seeking to resolve and how compliance would be verified. Simply Energy considers it is challenging to provide informed feedback on this proposal in its current state and would appreciate more information on the intended purpose of this reform and the benefits it would provide over current compliance requirements. For example, Simply Energy is already required to provide accurate forecasts of availability for contingency FCAS.

From our perspective, this proposal appears to create significant challenges for VPP operators and would deteriorate the value proposition we could offer our customers. Simply Energy's key concern is that complying with the requirement as drafted would require us to implement reservation at the asset level and potentially lock customers out of the use of their battery assets (to some degree).

This would be an unacceptable outcome for consumers and would be detrimental to the future development of the emerging VPP market.

sonnen

sonnen strongly object to the proposed requirement for Ancillary Service Load FCAS Facilities to 'reserve' or 'set aside' headroom or footroom.

The proposed requirement is more restrictive than the NER 3.8.7A requirement of 'capability' to respond, and 'blocking actions' cannot be practically implemented for large aggregations of domestic loads.

As currently drafted, to 'reserve' headroom or footroom, the 'autonomous' or 'self-consumption' behaviour of domestic batteries would need to be blocked and replaced with fixed power settings whenever FCAS is enabled. A similar approach to 'freeze' the behaviour of other loads would be required for other distributed energy resources (DER) technologies.

A 'reserve' is unnecessary for large aggregations where the cluster behaviour ('capability') over a 5-minute trading cycle is well understood and FCAS delivery is disciplined by a closed loop control system to adjust any deviations from the required frequency droop characteristic.

Highly distributed resources naturally provide 'portfolio diversity'.

Furthermore, short term uncertainty in the 'capability' of DER is less likely to result in a material under-delivery compared to the failure or protection actions of a single large generator. sonnen notes generation plant protection systems that deploy 'runback' schemes potentially erode the reserve of heatroom or footroom necessary for the delivery of an FCAS response.

Recommendation

If AEMO is concerned that FCAS Providers' plant/facility control and market systems maybe issuing commands to FCAS Facilities that 'conflict' with the 'capability' to deliver a FCAS response, then sonnen recommend this provision be redrafted to address 'conflicts' with the enabled contingency FCAS.

This approach would be technology agnostic and readily applied to standalone and DER.

SwitchDin

Additional clarity is required within the MASS on how the requirement to reserve headroom and footroom for contingency FCAS should be implemented by aggregators. As a contingency service it is critical that FCAS Providers ensure that there is necessary headroom and footroom to deliver contingency FCAS into the relevant markets when enabled. However the way in which large assets can implement this is significantly different to how an aggregator can.

As an example, a large battery can easily reserve a portion of its capacity (MW and MWh) for use in contingency FCAS with the remainder available for arbitrage or any other service. In contrast, VPPs are a collection of hundreds to thousands of consumer owned BTM assets (currently batteries), and the "spare" capacity (kW and kWh) is aggregated to form contingency FCAS bids and responses. On a 24/7 basis these batteries are used locally to minimise grid consumption, which may include minimising cost by optimising against the retail tariff.

In forming contingency FCAS bids an aggregator needs to forecast availability taking into account factors such as likely state of charge and aggregated power, including the impact of charging and discharging in response to local generation/consumption on the available power response. This is not a straightforward task as at certain times in the day significantly less than the registered VPP capacity may be available to provide contingency FCAS leading to times where either Raise or Lower capacity is not available in sufficient quantity to form the minimum 1MW bid.

Currently VPP operators may participate in contingency FCAS markets (subject to registration) and may also choose to use the fleet to provide energy arbitrage. At a VPP level, using a control system or manual process to ensure that the same available capacity is not concurrently bid into contingency FCAS and used for energy arbitrage is possible. However, if the MASS requires a control system to physically reserve headroom and footroom (MW and MWh) then this becomes problematic for aggregators. Physical reservation of headroom and footroom is not possible at a VPP level and would need to be implemented at the asset level, through constraints on the power and energy able to be used locally by the asset owner. Not only would this negate the efficiencies of aggregation, it would result in a completely different customer experience, require alternative contractual arrangements and result in significant loss in value.

Tesla

… on the face of it, this new clause appears to be designed to provide additional context to prospective FCAS Providers that headroom and footroom needs to be maintained to deliver compliant bids.

This is unnecessary. The requirement for maintaining headroom and footroom is baked into an FCAS Provider's compliance obligations. If this is not maintained, then it will be difficult for them to deliver compliant bids. The additional requirement to maintain headroom and footroom is ambiguous. It is unclear how AEMO are going to be enforcing this (i.e., for aggregated assets by requiring additional sites above nameplate capacity), and given the ambiguity, there is a real risk of conflicting compliance requests.

There is also a risk that if this is interpreted at face value as requiring capacity to be reserved for FCAS market participation, then this will limit the ability of both BTM DER and utility scale battery energy storage systems (BESS) assets from participating. These assets are designed to be fully flexible and optimised for market conditions at the point in time. VPP and utility BESS operators will bid available capacity into the market with the highest need during each bidding interval. For aggregated DER, having reserve capacity at all times will limit this flexibility, and limit the customers utility of the asset and reduce the viability of VPPs from being able to participate in markets.

Tesla suggests that this additional clause is unnecessary to efficient market operation. If it is retained, we ask AEMO to provide additional clarity on what the expectations are, and how this requirement will be verified by AEMO.

Scan rate requirement

It was brought to AEMO's attention during the first stage of this consultation that some organisations involved in designing and building the control equipment for VPPs were assuming that the measurement sampling rate specified in the MASS refers to both measurement for control and metering. This is not the case. The analysis of different metering arrangements conducted during last year's consultation that, ultimately, facilitated the introduction of a lower sampling rate for Fast FCAS delivered by DER, looked solely at FCAS measurement, not FCAS control. This seemed to expose some confusion, so AEMO proposed a new requirement in the draft MASS called a 'scan rate' for FCAS facility control systems.

This proposal received a mixed response and, unfortunately, some of these still conflate the issue of control system scan rates with metering installation sampling rates.

EnergyAustralia

> EA agrees with the rationale for most of the proposed draft settings. Many of these align with the sentiments in our earlier submission. … We, therefore, support the proposed approach for:
>
> - …
> - clarification of control and metering sampling rates…; and
> - …

Evergen

> Evergen supports the inclusion of section 6.2.2(d) on scan rate requirements. We noted the concern expressed by one respondent to the first stage issues paper over whether there was any confusion between recording sampling periods and scan rates to drive response. In discussing FCAS response with our hardware partners we have not held nor observed any great uncertainty over this distinction, and believe that the possibility of confusion is somewhat overstated. Nevertheless, it is sensible to be explicit in specifying scan rate requirements within the MASS.

Rheem & CET

> We support the addition of a separate specification for the Controller and would suggest that the specification be more extensive.
>
> Recommendations:
>
> - Uncertainty requirements for controller frequency measurements should be specified (or the equivalent for analog, mechanical or other systems).
> - Control system performance should be specified across a range of network (e.g. very fast RoCoF, very slow RoCoF, harmonics, etc.) and environmental conditions (e.g. a range of temperatures possibly in line with IEC 61557-12 requirements).

Shell Energy

> The main issue for Shell Energy is the proposal to require all contingency FCAS Providers to be able to scan for changes in Local Frequency at a rate of less than 50ms for the provision of all contingency FCAS, not just to meet the requirement for supplying the new Very Fast FCAS.[7] This proposal comes as a surprise given that this issue was not raised in the Issues Paper. The likely effect of this new scan rate requirement is that many systems already in the market will need to be retrofitted in order to comply. This will add costs to FCAS Providers as well as creating a barrier to entry for new FCAS Providers. For small sites, such as those participating in FCAS markets through VPP arrangements, the new requirements and associated costs may be enough to prevent their participation. This is likely to mean that there will be reduced participation in Fast FCAS markets, and therefore reduced competition. Reduced competition is likely to result in increases to overall FCAS costs to end users. Shell Energy fails to see how AEMO's proposed scan rate requirements

[7] Draft Market Ancillary Services Specification, section 6.2.2(d).

meet the national electricity objective (NEO) when assessing the reliability, security and safety of the NEM alongside costs to consumers.

Indeed, we note that in discussing the sampling rate of Very Fast FCAS Providers AEMO states:

> "Allowing FCAS Providers with a slower sampling rate to register in the Very Fast FCAS markets, with appropriate safeguards through the discount mechanism, is expected to increase competition, which AEMO considers to be in the best interest of consumers."[8]

We strongly agree with AEMO that increased competition is in the best interests of consumers. However, AEMO's overall approach in requiring 50ms scan rates for all FCAS Providers is likely to lessen competition by acting as an inefficient barrier to entry. We recognise that scan rates of 50ms may be necessary for single sites to participate in the Very Fast FCAS and Fast FCAS markets, but we do not see why a 50ms scan rate is also necessary for aggregated FCAS Providers such as VPPs which typically have a different economic profile, or for participation in the Slow FCAS and Delayed FCAS markets.

We understand that a 100ms scan rate requirement would be consistent with approaches internationally, and would also allow for lower cost implementation and therefore increased competition in Fast FCAS markets. Should AEMO still consider that a 50ms scan rate requirement is necessary, then we believe it should come with two caveats. Firstly, existing Fast FCAS Providers should be allowed to continue to use their existing settings and services. This is akin to the approach taken with market non-scheduled generation that operated prior to the formation of the NEM. Secondly, if there is a genuine system security concern about having significant volumes of FCAS provided by FCAS Facilities using 100ms scan rates, then a cap could be placed on the total volume of FCAS provided by non-50ms FCAS Providers. Shell Energy believes a cap of around 30 MW could be reasonable given this aligns with the threshold for registration as a scheduled generator.

AEMO's proposed scan rate requirements seem to advantage one or two FCAS Providers capable of meeting the requirements, with their existing set of equipment. We see parallels with AEMO's previous consultation on the MASS in 2021 when AEMO proposed a reduction in the sampling rate to 50ms with only a limited transition period. We call on AEMO to reassess the 50ms scan rate requirement in light of the detrimental effect it could have on participation in the contingency FCAS markets, particularly with respect to VPP FCAS Providers.

Simply Energy

Simply Energy is concerned that AEMO's proposal to include scan rate requirements for FCAS controls could potentially unwind AEMO's previous decisions made around 50 ms and 200 ms meter sampling rates for contingency FCAS in its 2021 'Amendment of the Market Ancillary Service Specification – DER consultation' (2021 review). AEMO's decision at the conclusion of the 2021 review recognised that Aggregated FCAS Facilities would likely be uneconomical under a requirement to provide high speed data samples of 50 ms to participate in Fast FCAS markets.

Simply Energy considers that the introduction of a requirement to scan and respond to Local Frequency at 50 ms sampling rates may result in the same issues we raised in our submissions to the 2021 review. As the proposed amendment does not specify the service it applies to, it appears that AEMO intends that the requirement for 50 ms scanning frequency would apply to all FCAS markets.

The challenge that VPP operators face with 50 ms measurement requirements relate to the need to obtain prohibitively expensive high-speed metering solutions to meet this required rate at the specified accuracy. In our confidential submission of 6 August 2021 to the 2021 review, we provided AEMO with the results of our investigation into the estimated costs of high-speed metering alternatives if we were to retrofit our VPP fleet. As demonstrated in that submission, high-speed metering alternatives are not currently commercially viable, and we do not expect these alternatives to be viable for some time. The introduction of a frequency scan rate within a control system will likely be difficult to verify without metering to the same speed, i.e. 50 ms, so we would question whether it is actually feasible to validate the scan rate.

Simply Energy urges AEMO to clarify the problem it is attempting to solve and the intention of its proposal to introduce a scanning frequency of 50 ms. We also ask AEMO to clarify whether this proposal is intended to apply to contingency FCAS Providers.

sonnen

We are disappointed by the late introduction into the consultation of frequency response coordination concerns for FCAS Facilities providing existing Fast, Slow and Delaying contingency FCAS responses, and an apparent lack of critical review

[8] AEMO, Market Ancillary Services Draft Determination, p 45.

of the topic. sonnen would like to stress the importance of ensuring the MASS is focused on providing a framework to deliver technology agnostic and efficient market outcomes.

VPPs providing FCAS act as a 'stepping off point' for further integration into the NEM for consumers, original equipment manufacturers (OEMs) and aggregators. As VPP technology and commercial models mature the industry is building the necessary experience and infrastructure to participate more actively in a two-sided market as envisaged in AEMO's Scheduling-Lite work stream. AEMO has put this pathway in jeopardy by abandoning sound, functional and technology agnostic objectives (i.e. what outcome is required) in preference of specific technical control system design parameters (i.e. how to deliver).

VPPs do not behave like traditional large standalone FCAS Facilities, and due to the large number of individual resources in a cluster present significant opportunity for innovation in control algorithms, communications infrastructure, and metrology. When AEMO develop requirements that 'speak to directly specifying' how VPPs should go about controlling their resources the opportunity to innovate is lost and the requirement is no longer technology agnostic.

Technology agnostic specifications must be clearly expressed in functional terms that describe ('abstract') the desired behaviours or responses, rather than the specifying the pathway to delivering a desired outcome. This is also sound 'systems engineering' and is critical to avoiding perverse outcomes where good/robust systems are eliminated in favour of worse performing but otherwise 'compliant' systems.

AEMO has abandoned the technology agnostic systems engineering approach by specifying that FCAS Facilities (some of those only providing 5-minute responses) must 'scan' and initiate responses to power system frequency at a rate less than or equal to 50 ms. Fast detection and initiation will not turn a lagging or poorly disciplined (open loop) active power response into a well-coordinated frequency versus active power response.

AEMO has access to a 'technical working group' that would have happily leveraged their significant industry experience to assist AEMO to develop functional requirements targeting the delivery of a well-coordinated frequency versus power response at least cost. AEMO has unnecessarily 'run the clock down' by proposing control system changes to FCAS Facilities offering Fast, Slow and Delayed FCAS without accessing all available resources.

sonnen recommend focusing on the work to deploy the Very Fast FCAS market and abandon changes to control system specifications for Fast, Slow and Delayed FCAS to a future MASS update where AEMO can establish using an evidence-based approach:

- if there is a realistic risk of an uncoordinated active power frequency responses that materially degrade power system security
- what type of FCAS Facility responses (if any) present the greatest risk
- what desirable FCAS Facility response characteristics cost effectively address emerging and material risks to power system security
- how can these desirable characteristics be described and codified into the MASS in a technology agnostic manner

…

For the provision of Fast, Slow and Delayed FCAS sonnen strongly reject the proposed requirement to scan for Local Frequency and initiate a control response at a rate ≤50ms.

Based on the current MASS requirements AEMO have not presented evidence of material 'uncoordinated frequency responses' or demonstrated that the proposed requirement would cost effectively deliver material improvements to power system security.

The proposed approach does little to guarantee a 'coordinated' frequency vs active power response because it fails to functionally describe the 'whole of system' performance of a FCAS Facility.

Fast detection and initiation will not turn a lagging or poorly disciplined (open loop) power response into a well-coordinated frequency versus active power response.

Fast detection and initiation will not eliminate competing control actions from other FCAS Facility control elements such as setpoint controllers.

AEMO's proposed changes risk stranding otherwise very effective and well controlled FCAS resources that utilise a slower scan rate.

SwitchDin

The current MASS does not provide any requirement to monitor and respond to Local Frequency at a particular rate. In 2021 the Amendment of the Market Ancillary Service Specification - DER and General Consultation resulted in the introduction of lower resolution measurement requirements of frequency and power for verification of Fast FCAS delivery in recognition of the significant cost and technical barriers that measurement at 50 ms presented for participation of DER in the FCAS markets. Despite this, meeting the 200ms measurement requirement in a cost effective manner remains a significant challenge for aggregators of DER seeking to register for Fast FCAS, and will be a future challenge for registration for Very Fast FCAS (100 ms measurement).

Introducing a new requirement to scan and respond to Local Frequency at 50 ms effectively negates the benefits gained in the 2021 consultation. While not clearly specified within the draft MASS, it is assumed that the same accuracy requirements would apply for scanning frequency as for measuring frequency. The challenge in meeting the 50 ms measurement requirements is not in the storage of measurement data, but in measuring at the required rate and specified accuracy without the need for using expensive, power quality grade meters at every household. Not only would introducing a scanning frequency of 50ms make registration for Fast FCAS much more challenging for DER, the scanning requirement appears to apply to all FCAS markets (Very Fast, Fast, Slow and Delayed) impacting the ability of DER to participate in any of the contingency FCAS markets. This is in direct contradiction to the purpose and outcome of the 2021 MASS consultation which was "to determine whether and how to amend the MASS to facilitate the ongoing participation for DER in the FCAS markets".

Should a scanning rate for frequency be introduced, the separate measurement requirements for power and frequency may encourage separate metering devices to be used to record power flow and frequency. The device used to scan for frequency at 50ms would also likely record frequency at this point for verification purposes rather than measuring at two separate points. Guidance would therefore need to be provided on how measurements from separate devices should be time synchronised.

Tesla

Tesla understands that this is being introduced as an additional piece of guidance for potential FCAS Providers to ensure that there is no confusion regarding sampling rates used for measurement verification (i.e., 200ms for aggregated DER for Fast FCAS market participation, and the proposed 100ms for aggregated DER for Very Fast FCAS markets).

Tesla has no problem with AEMO making this clarification, but we do have a question on how this will be verified. As noted by AEMO the time series for frequency scan rates and measurement verification sampling are different and should be different. As such, it will not be possible to provide live data to demonstrate compliance with this obligation. Is AEMO considering that this will form part of the registration checklist, and demonstrated with the freq-watt test data that is required for all new FCAS Providers? If this is going to evolve into additional compliance obligations, it would be good for AEMO to provide more detail and properly consult on these requirements.

4.2.2. AEMO's assessment

Requirement to reserve headroom and footroom

The requirement to reserve headroom and footroom is a distinguishing feature of the FCAS markets and is, in effect, what the FCAS Providers are being paid for. This requirement has been in existence since the commencement of the FCAS markets. As recently as 2019, when seeking a new rule to make the provision of PFR mandatory for certain types of generation, AEMO described the FCAS markets as frequency reserve markets[9].

Some submissions focused on the application of this requirement to Aggregated FCAS Facilities, which have been addressed below.

Subsequent to the introduction of PFR, the requirement for headroom and footroom has been referred to in the MASS since version 6.0 in the context of distinguishing regulation FCAS from PFR. The same distinction applies to contingency FCAS and, in hindsight, should have also been referred to in relation to contingency FCAS.

The proposed requirement in section 6.2.2(e) of the draft MASS states:

[9] AEMO, Electricity Rule Change Proposal: Removal of Disincentives to the Provision of Primary Frequency Response under Normal Operating Conditions, 1 July 2019. Available at https://www.aemc.gov.au/rule-changes/primary-frequency-response-incentive-arrangements.

> The FCAS Facility used to deliver the required contingency FCAS must have a *control system* to reserve the necessary headroom or footroom required for the delivery of frequency response whenever contingency FCAS is enabled.

This requirement merely operationalises the obligation of FCAS Providers in NER 3.8.7A(k), which states:

> (k) an *Ancillary Service Provider* that submits a *market ancillary service offer* must ensure that the *ancillary service generating unit* or *ancillary service load*, as the case may be, is at all times capable of responding in the manner contemplated by the *market ancillary service specification*;

AEMO acknowledges that compliance with this new requirement by an Aggregated FCAS Facility, such as a VPP, needs to be restated as being applicable at the aggregated level.

Evergen puts it well:

> Of course, an Aggregated FCAS Facility operator will need an appropriate mechanism to constantly assess and forecast aggregate capacity. This is crucial for ensuring the Aggregated FCAS Facility is only bid into the FCAS market when aggregate capacity is forecast to be available. Aggregated FCAS Facilities may still make compliant bids even when some of the DER in the Aggregated FCAS Facility lack headroom or footroom to individually respond, provided the Aggregated Facility as a whole can still deliver against its enablement commitment. Assessing capability and ensuring compliant bidding is a fleet-level consideration, not an individual DER consideration.

AEMO confirms that Aggregated FCAS Facilities do not need to physically reserve headroom or footroom at the asset level when the FCAS Provider submits offers to provide FCAS. Moreover, the requirement does not prevent FCAS Providers with Aggregated FCAS Facilities from being used for energy arbitrage.

Given the different interpretations of the requirement to reserve headroom or footroom demonstrated in the submissions, AEMO proposes to remove the specification that this be achieved through an FCAS Facility's control system. The requirement itself will be applicable to all types of FCAS.

Scan rate requirement

AEMO's key objective in proposing a control system scan rate was to ensure a sufficiently fast response of FCAS Facilities to Local Frequency changes. What is a suitable sampling rate for a metering installation might not be a suitable scan rate for an FCAS Facility's control system, especially in the Very Fast and Fast FCAS markets.

The control system scan rate requirement is to ensure that an FCAS Facility can detect and respond to changes in Local Frequency in a timely, appropriate, and co-ordinated manner so as to maintain power system security. The sampling rate requirement for FCAS metering is to ensure that an FCAS Facility's response to changes in Local Frequency is measured accurately enough to identify whether a Facility is delivering the correct amount of FCAS within the applicable timeframes. They serve quite different purposes and, hence, different requirements for each should not be unexpected.

After further consideration, AEMO has identified that:

- This is not an issue for FCAS Facilities that use switching controllers because of the way they operate; they are designed to detect changes in Local Frequency before triggering and delivering a single stepped active power response. A scan rate of 200 ms for a switching controller should not affect the ability of the associated FCAS Facility to deliver the required response.
- FCAS Facilities with variable controllers are liable to alter the response of the FCAS Facility after the initial detection of a Local Frequency change, especially where they are part of an Aggregated FCAS Facility. AEMO's expectation is that they are not programmed, or built, to respond slower as a result of the active power being measured at intervals of 200 ms. AEMO is concerned that inappropriate control scan rates could trigger inappropriate responses and lead to an under-delivery

of FCAS or even cause oscillation if Variable FCAS controllers are not keeping up with more rapid changes in Local Frequency.

Noting the limited number of variable controller types which are part of an Aggregated FCAS Facility and considering that it is the FCAS Providers' responsibility to ensure that they can meet their FCAS requirements, AEMO has concluded that further analysis and monitoring of the performance of variable controllers is warranted. Therefore, AEMO will exclude the scan rate requirement that was proposed in the draft MASS.

FCAS Providers are reminded that AEMO can take action if a non-conformance with a dispatch target is detected[11]. If evidence emerges of FCAS Facilities contributing to power system security issues, oscillations, or power quality issues, AEMO will reconsider the need for a scan rate requirement for variable controllers as part of a future MASS review.

4.2.3. AEMO's conclusion

AEMO has amended the draft MASS to:

- Clarify that the requirement to reserve headroom and footroom for Aggregated FCAS Facilities applies at the aggregated level only, and remove the specification that this be met through facility control systems.
- Remove the scan rate requirement on a provisional basis subject to further review and monitoring, which may lead to a reformulated proposal in a future MASS consultation.

4.3. Verification and measurement requirements

4.3.1. Issue summary and submissions

Sampling rate and discounting

AEMO noted in the Draft Report that it is important to consider the delay before an FCAS response is initiated and concluded that a 200 ms sampling rate is inadequate to assess the delivery of Very Fast FCAS. Therefore, AEMO proposed to amend the MASS by:

- Specifying the measurement sampling rate for Very Fast FCAS Providers as follows:
  - ≤100 ms for Aggregated FCAS Facilities comprised of ≥25 FCAS Facilities with no Inertial Response and with an initiation delay of ≤500 ms.
  - ≤50 ms for all other FCAS Facilities.
- Specifying the applicable discount on the quantity of Very Fast FCAS delivered by an Aggregated FCAS Facility with a sampling rate >50 ms but ≤100 ms as follows:
  - 5% to the combined quantity of Very Fast FCAS measured at or close to the *connection points* of the Aggregated FCAS Facility if the control system is a variable controller; or
  - 10% if the control system is a switching controller or a discrete combination of both.

Submissions were generally supportive of these measures.

[11] See section 7.3 of the MASS and section 3.1.1 of the Dispatch Procedure, which is available at https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/system-operations/dispatch-information.

AGL

AGL supports the amendments to the MASS put forward in the second Very Fast FCAS consultation; specifically, … sampling rate, discounting....

EnergyAustralia

EA agrees with the rationale for most of the proposed draft settings. Many of these align with the sentiments in our earlier submission. … We, therefore, support the proposed approach for:

- …
- clarification of control and metering sampling rates…; and
- …

One other clarification that may be useful concerns initiation delay. This is not currently defined, and it may help with the noted confusion around sampling rate and scanning rate issues. We also highlight that many residential and mass market OEMs are still catching up with the requirements for Fast FCAS. Greater clarity would help with understanding whether the new specifications can be met with current product offerings and, if not, with decisions around investment and timing in metering solutions that do. Combined with the above settings, we consider this will help to:

- ensure secure system outcomes at the lowest cost to customers,
- avoid placing an undue burden on FCAS Providers, and
- minimise any delays in VPP FCAS Providers entering the two new markets.

Hydro Tasmania

At the conclusion of the 2021 consultation, AEMO adopted a tiered measurement regime for Fast FCAS. The MASS applies a discount factor to Fast FCAS delivered by Aggregated FCAS Facilities made up of DER that meet certain criteria. In the Issues Paper, AEMO considered that the same approach could be applied to Very Fast FCAS. It also mentioned that the proposed Very Fast FCAS must respond six times faster than Fast FCAS, which means that measurement times with a resolution of 200 ms or 100 ms might not be adequate for measurement of its provision. Very Fast FCAS Providers would have the option of capturing data at a higher resolution to avoid the application of the discount, or use their Fast FCAS metering installation knowing that a discount will apply to their delivered quantities.

A discounting regime is necessary to avoid the need to procure additional Very Fast FCAS to offset the potential verification errors arising from data captured at a lower measurement time resolution. AEMO acknowledged that the applicable discount must be reasonable.

In addition to the measurement sampling rate, the allowable error and accuracy must be sufficient for AEMO to assess whether Very Fast FCAS has been delivered in accordance with the MASS. In the Issues Paper, AEMO proposed to specify:

- For power measurements, an allowable margin of error at 2% and resolution of 0.2%, which means that all types of contingency FCAS would have the same requirements in this area.
- For frequency measurements, AEMO considered that a balance needs to be reached between sufficient accuracy and the relative cost of compliance.

Regarding the proposed ≤100ms metering requirement for Aggregated FCAS Facilities comprised of ≥25 FCAS Facilities, Hydro Tasmania is concerned that this requirement may create an undesired barrier to business VPP which are likely to have fewer FCAS Facilities (i.e. >25), compared to other VPP operators who may target residential customers.

In a hypothetical situation where 26 identical FCAS Facilities with variable controllers, totalling 3 MW in capacity are aggregated into one DUID, this portfolio can bid capacity into Very Fast FCAS without the requirement to install expensive high speed metering equipment. If split over two identical DUIDs of 1.5 MW each (13 FCAS Facilities each), these assets would not be able to be bid into Very Fast FCAS unless expensive metering equipment is installed. This is despite these assets having an identical response and therefore no impact on system security if they were all bid in to Very Fast FCAS as part of 1 DUID or as part of 2 DUIDs. The more costly metering requirements for portfolios of < 25 FCAS Facilities is therefore less desirable in this situation (and similar situations), and will make it harder for aggregators to 'onboard' and bid new assets and provide Very Fast FCAS response at a lower cost.

Reposit

Reposit maintains its position that the Tesla/UoM's statistical treatment of sampling error does not accurately calculate measurement uncertainty from an aggregated fleet. As discussed in multiple submissions already, this approach assumes a Gaussian distribution of error. This is valid for the measurement of physical processes, but the control system of a VPP node is not a physical process and is subject to correlations caused by software, state-of-charge, grid voltage and ambient temperature, among others.

Reposit maintains that National Measurement Institute scrutiny of AEMO's approach to the calculation of measurement uncertainty is required.

Tesla

At large Tesla supports AEMO's position on progressing a 1 s market, and we are supportive of the approach proposed for aggregated assets – specifically the adoption of 100ms measurement resolution with a 5% discount rate applied to the bids.

…

- We support 100 ms measurement resolution and the approach taken to discounting bids. Tesla believes that the 5% discount that has been suggested for aggregated assets appears to be reasonable.

…

In particular Tesla is supportive of the approach that AEMO has taken and the thought that has gone into the inclusion of aggregated DER. It is great to see AEMO recognizing that aggregating a number of different assets leads to an overall lower error rate, and that AEMO is not automatically excluding assets for having a less-granular measurement resolution. The discounted bidding approach is a good example for all international jurisdictions for encouraging all different asset types into the market.

VIOTAS

20ms power and frequency samples are currently possible. Only software changes are required to unlock this sampling rate.

Impact on VPP/DER

Evergen

AEMO's approach of creating specific considerations (e.g., a lower sampling rate requirement for eligible Aggregated FCAS Facilities), in recognition of the verification advantages arising from multiple data streams is justified and welcome.

Evergen is mostly supportive of AEMO's proposed design for Very Fast FCAS market specification, however, our view remains that the verification advantages for Aggregated FCAS Facilities arising from having many data streams may as yet be insufficiently recognised. We firmly believe discussion over verification accuracy and data requirements for Aggregated FCAS Facilities should continue. We understand and accept AEMO's conservative approach to these issues in the establishment of this new, more challenging market.

In this submission, we wish to highlight:

- …
- Observations that speak to principles for the ongoing evolution of the MASS, and specifically DER participation in FCAS, throughout the energy transition taking place across the NEM.

1. BTM DER and the MASS

BTM DER such as residential batteries are able to respond quickly to Frequency Disturbances with both raise and lower capability. Therefore they can play a useful role in the Fast FCAS and Very Fast FCAS markets.

Evergen is supportive of the DER-enabling changes made to the MASS last year, and also proposed in the Draft Report, specifically:

- Alternative verification measurement sampling period requirements for Aggregated FCAS Facilities; and
- A discounting approach based on the number of facilities in the Aggregated FCAS Facility to ensure a satisfactory level of verification accuracy given the existing verification methodology.

Evergen's view is that the above are appropriate incremental changes to accommodate DER into the contingency FCAS markets within the narrow scope of these MASS consultations. They recognise the verification advantages arising from providing many data streams for Aggregated FCAS Facilities, while remaining mindful of the principle that robust verification is essential.

However, in a sense, these changes have the appearance of being exceptions to the core specification. It is perhaps unsurprising such changes have then generated at times heated debate. Exceptions to the rule are by nature controversial, because they impact consensus on what the key principles guiding development of the MASS are meant to be. These principles obviously focus on adherence to the NEO, but can also include notions of technological neutrality, avoiding market distortion, favouring a conservative approach to specification changes, or a recognition that regulation should move quickly to guide the transition currently taking place across the NEM.

Without clear and agreed principles, the possibility remains of further amendments to the MASS continuing to entrench intrinsic biases or create polarisation. Below we will suggest that some changes proposed in the draft MASS are exemplary of this.

2. Meter certification requirements and interaction with power flow measurement requirements

The Draft Report proposes to adopt certification of compliance with IEC-61157-12 type tests as a requirement under the MASS. The proposed certification process would be based on the measurement requirements set out in Table 5 of the draft MASS.

For the *Measurement Range of Power Flow Measurements* specification in Table 5, the wording includes "As appropriate to the FCAS Facility…".

However, Table 1 of the draft MASS defines an FCAS Facility as "An ancillary service generating unit or ancillary service load used to deliver FCAS, and includes an Aggregated FCAS Facility unless the context otherwise requires". The definition of an FCAS Facility seems to class an Aggregated FCAS Facility as an FCAS Facility.

This wording creates ambiguity as to whether the "...Intrinsic Uncertainty of ≤2%, and resolution of ≤0.2%" are meant to apply only to the aggregated power flow measurements at the DUID level for an Aggregated FCAS Facility, or whether these requirements are intended to apply to measurements for each and every ancillary service generating/load unit comprising an Aggregated FCAS Facility.

Evergen suggests that this ambiguity in the draft MASS is not a trivial definitional fix, there are challenges to either interpretation.

Intrinsic uncertainty decreases as the number of measurements increases. For context, the number of power measurements over a 1-s assessment window for:

- a single-plant 50MW FCAS facility with a sampling period of 50ms: 20
- a 10,000x5kW DER 50MW Aggregated FCAS Facility, sampled at 100ms: 100,000

If the power flow measurement standard applies to individual DER units

- The overall power flow measurement requirement for an Aggregated FCAS Facility will be higher than for a comparable single-plant FCAS Facility, since intrinsic uncertainty reduces when aggregating across many measurements; and
- The difference in requirement would be substantial when comparing a single-unit FCAS Facility to an Aggregated FCAS Facility comprising many thousands of units.

If specifying power flow measurement standards to the aggregated power flow across an entire Aggregated FCAS Facility

- The measurement requirements for individual DER become uncertain; and
- Certifying individual DER metering against a standard such as IEC-61157-12 given this interpretation would be fraught, given the uncertainty requirements for individual DER would vary as fleet size varies.
- It is not clear that the intrinsic uncertainty in individual measurements, and how this interacts with sampling rate and number of units being aggregated to contribute to overall error, was considered.

…

Active participation and coordinated DER are central to the future of the NEM

AEMO's Integrated System Plan 2022 (ISP) Step Change scenario was regarded by stakeholders as the most likely scenario of those considered. It projects that by 2050, most domestic PV will include an energy storage system, and that approximately half of all dispatchable capacity in the NEM by 2050 will be delivered by co-ordinated DER. In the ISP, AEMO stated:

> *The emergence of VPPs across the NEM is expected to assist in maintaining grid reliability and provide further benefits for consumers. However, full integration requires a step change in engagement to ensure consumers, retailers, networks and other market participants increase the orchestration of new technologies and resources, to increase benefits to consumers and enable the grid to maintain security and reliability at lower cost.*

If, as an industry, we are serious about fostering two-way markets with active participation from consumers, and if the projected key role of coordinated DER storage in providing dispatchable capacity and grid services is to be realised, the visionary plan laid out in the ISP step change scenario needs to be backed up with commitment and careful implementation. Evolution of the MASS should be no exception, and incremental changes to the MASS may not be able to achieve this.

Recommendation: AEMO and industry to adopt a key principle that VPPs comprising coordinated, BTM DER are not an afterthought in the fundamental architecture of the MASS and FCAS Verification Tool.

Recommendation: AEMO to consider a more in-depth overhaul of the MASS and FCAS Verification Tool to ensure that BTM DER Aggregated FCAS Facilities are a first class citizen on the same level as traditional utility-scale FCAS Facilities.

Certification requirements for FCAS metering

During the first stage of the consultation, AEMO sought advice from an independent metering expert, Michael Guy, to determine adequate testing requirements for FCAS meters. AEMO accepted his recommendation that the equipment measuring FCAS responses should be type-tested and certified to the IEC61557-12 standard to ensure that the metering used by FCAS Providers were capturing FCAS responses adequately.

While most submissions did not express a concern with the concept of certification of FCAS metering, they generally opposed the reference standard proposed by AEMO[13].

AGL

AGL does not object, in principle, that equipment measuring FCAS response should be type tested and certified to agreed standards particularly where this supports AEMO's confidence in operational data. However, metering standards certification has not previously been raised as part of this consultation. On this basis, AGL queries whether the late introduction of these additional requirements is in the spirit of the Rules Consultation Procedure provisions in NER 8.9 and whether AEMO has had the opportunity to holistically consider the impact that constricting the number of available systems will have on FCAS Providers, particularly new entrants.

The introduction of new technical standards from foreign jurisdictions can have a disruptive effect on local market participation if not appropriately considered, and AGL would query whether the full scope of impact on existing and prospective FCAS Providers who would be affected by this requirement has been appropriately considered by AEMO. As no alternative metering standards were put forward in the Draft Report, no other independent experts appear to have been consulted, and no industry views were sought by AEMO prior to incorporating the IEC61557-12 requirements into the amended MASS, AGL proposes that it may be more appropriate that type testing requirements are considered as part of a separate consultation where respondents are able to consider the market disruption created through application of a new standard alongside the benefit to AEMO's operations.

Delta Electricity

The advice provided to AEMO that supported the application of IEC 61557-12 seems to have formed the viewpoint that existing systems have no requirement for traceability of the measurements to ensure the measurement itself is of a known accuracy. Whilst it is agreed the MASS has been lacking in this area, it is suggested that for some FCAS Providers, the

[13] Note that submissions quoted in this document are in this font; a footnote in this font indicates that the footnote is copied from the submission. In the interests of saving space, AEMO has replaced descriptions in the submissions with acronyms that are defined in the Glossary.

existing equipment is also incorporated into the power station performance standard compliance programme, meaning equipment accuracy checks are being made to high standards. At such stations, it is considered the additional check under application of IEC 61557-12 will be an impost possibly carrying some expense to achieve but it is also acknowledged that ensuring all FCAS Providers provide a consistent quality of recorded signal is important to overall frequency control and performance in the NEM.

As was discussed on this point in the recent forum, a future revision to the MASS could also consider time-stamping protocols and conventions. Without consistency in this area, comparison of the recorded data from one FCAS Provider to another will be less successful. However, it is also probably useful to note that system frequency is generally expected to be consistently measurable and comparable over great distances in an enmeshed AC system so it ought to also be possible and straight-forward to time shift less synchronised data in comparison to nearby data carrying more accurate time-stamps such as may be obtainable from Transmission Network Service Providers and/or existing FCAS Providers with suitable equipment synchronised to relevant national time conventions.

Implementation periods

Some of the changes proposed, particularly if installed equipment requires removal and off-site testing to meet the proposed certification to IEC 61557-12 or new devices are needed to be acquired to bring controllers up to full compliance with the revised MASS, may not be easily implemented particularly on Units that do not undergo outages more frequently that once per year. AEMO are requested to consider providing a grace period of two years from commencement of the Very Fast FCAS in October 2023 to allow enough time for existing systems to fully adopt such changes as might impact on installed equipment.

Enel X

This submission sets out our responses to the Draft Report to implement the Very Fast FCAS market. The key points are:

- We generally support AEMO's Draft Report, specifically the Very Fast FCAS market specifications, and verification and measurement requirements.

…

EnergyAustralia

EA agrees with the rationale for most of the proposed draft settings. Many of these align with the sentiments in our earlier submission. … We, therefore, support the proposed approach for:

- …
- … the introduction of the new testing requirement standard; and
- …

Evergen

In this submission, we wish to highlight:

- Specific concerns with the draft MASS, driven by the inclusion of new specifications that are not exclusively related to the establishment of Very Fast FCAS requirements; and

…

Evergen also notes that inclusion of a certification process in the draft MASS would apply to all FCAS Providers regardless of the markets for which they are registered. This change is beyond the original scope of the 2022 MASS consultation and its focus on introduction of Very Fast FCAS markets. Affected DER OEMs in particular may not have initially engaged with or monitored the MASS consultation this year as a result (e.g., if they regarded Very Fast FCAS participation as beyond their short-term capability). Such OEMs are now confronted with certification requirements that could impact their eligibility and costs even in existing slower contingency FCAS markets, with less than 4 weeks to become aware and develop a considered response.

Being conservative is a worthy principle for AEMO to apply when making decisions, but it is not the only principle. For example, given the expectations and identified need for a big increase in coordinated DER storage in the NEM over the coming years, enabling active participation of co-ordinated DER might arguably also be a principle guiding development of the MASS.

To relate these concerns to our earlier comments regarding principles, we note that in the Draft Report, AEMO suggests a preference to be conservative as justification for applying a discount, regardless of the number of ancillary generation/load units in an Aggregated FCAS Facility in the Very Fast FCAS market. This is in contrast to the threshold of 500 units in the Fast FCAS market, a threshold above which discounts no longer apply. If being conservative is a guiding principle for administration of the MASS, then the swift inclusion of metering standard compliance measures within the MASS, introduced part-way through a consultation focused on Very Fast FCAS, but with implications for all contingency FCAS markets, seems counter to this principle.

Evergen generally supports the idea of explicitly defining a certification process for FCAS metering. However, to handle the obvious challenges presented above requires more thought and consultation than appears to have been undertaken for the inclusion of a certification methodology in this draft MASS. Completing appropriate consultation on this may jeopardise the timeframes for delivery of a specification for Very Fast FCAS.

Recommendation: Section 5.7. Certification of FCAS metering equipment type should be omitted from the draft MASS. Inclusion of metering certification requirements should be subject to further consultation and a separate MASS amendment round.

Reposit

Type testing of FCAS metering

Reposit supports the type testing of FCAS metering for all FCAS and agrees that traceable accuracy testing is important if a level playing field is to be provided for Australian and international FCAS Providers and technology vendors.

Selection of the appropriate standard for Australian markets

Reposit suggests that the nomination of IEC61557-12 requires additional consideration. And that there are more appropriate standards that can referenced for power and frequency measurement certification under Australian circumstances.

AEMO is right to limit the application of the standard to the power and frequency measurement tests so as to "ensure that the type test does not add a significant cost burden to the participant"[14]. In effect, AEMO are not interested in the entire standard, but only in the testing procedures, influence factors and disturbances listed in the standard that are applicable to power and frequency measurement.

AEMO define the accuracy and precision requirements of MASS metering in Table 4 of the MASS and so these values do not dictate the choice of standard. The choice of standard then should be made based on practical implementation concerns.

Appropriate standards already widely used in the NEM

The "NMI M 6"[15] standard is used throughout the NEM on millions of Type 1-6 revenue meters. It is published and maintained by the National Measurement Institute. The test procedures in NMI M 6 actively consider voltage, current and frequency accuracy. The tolerances are different to Table 4 of the MASS, but as described above, AEMO is free to specify accuracy and precision requirements.

Section 4.7 of the NMI M 6 standard describes permissible error (accuracy/precision) and the influence factors and disturbances when testing for that error.

Table 1. Percentage error limits for single phase and polyphase direct-connected meters with balanced loads

Range for test current	Power factor	Percentage error limits for meters of class[1]	
		1	1.5
$0.05\ I_b \le I < 0.1\ I_b$	1	±1.5	±1.5
$0.1\ I_b \le I \le I_{max}$	1	±1.0	±1.5
$0.1\ I_b \le I < 0.2\ I_b$	0.5 inductive	±1.5	±1.5
	0.8 capacitive	±1.5	—
$0.2\ I_b \le I \le I_{max}$	0.5 inductive	±1.0	±1.5
	0.8 capacitive	±1.0	—

[14] https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nemconsultations/2022/amendment-of-the-mass/second-stage/review-of-fcas-metering-test-andcertification-requirements-for-aemo.pdf

[15] https://www.industry.gov.au/sites/default/files/2019-05/nmi_m_6-1.pdf

Table 4. Influence factors (I) and disturbances (D)

Influence factors and disturbances	Test clause or reference	I/D	Range for test current (balanced load)	Power factor	Limits of variation in percentage error for meters of class			
					0.2	0.5	1	1.5
Voltage variation[1]	A.2.12	I [1]	$0.05\ I_b \le I \le I_{max}$	1	—	—	0.7	1.0
			$0.1\ I_b \le I \le I_{max}$	0.5 ind.	—	—	1.0	1.0
			$0.02\ I_n \le I \le I_{max}$	1	—	—	0.7	—
			$0.05\ I_n \le I \le I_{max}$	0.5 ind.	—	—	1.0	—
			$0.05\ I_n \le I \le I_{max}$	1	0.1	0.2	—	—
			$0.1\ I_n \le I \le I_{max}$	0.5 ind.	0.2	0.4	—	—
Frequency variation	A.2.13	I	$0.05\ I_b \le I \le I_{max}$	1	—	—	0.5	1.0
			$0.1\ I_b \le I \le I_{max}$	0.5 ind.	—	—	0.7	1.0
			$0.02\ I_n \le I \le I_{max}$	1	—	—	0.5	—
			$0.05\ I_n \le I \le I_{max}$	0.5 ind.	—	—	0.7	—
			$0.05\ I_n \le I \le I_{max}$	1	0.1	0.2	—	—
			$0.1\ I_n \le I \le I_{max}$	0.5 ind.	0.1	0.2	—	—

Should AEMO find the M 6 standard insufficient for some reason, the National Measurement Institute also publish the more modern NMI R 46[16] and NMI M 13[17] standards.

Reposit suggests that AEMO engage with the National Measurement Institute when considering the selection of appropriate testing procedures and other key metrology values for the FCAS.

Lab testing capability and capacity

Reposit's FCAS metering is embedded in its controller. This metering is not certified to the power and frequency measurement requirements of IEC61557-12.

Reposit was unable to identify any Australian certification laboratories that were able to certify power and frequency metering to IEC61557-12. This means that any metering that is not already certified to this standard's power and frequency measurements currently requires testing in international laboratories. This seems grossly inefficient given that FCAS markets do not span international borders.

The lack of local certification labs for IEC61557-12 unfairly penalises Australian designers and OEMs of clean energy technology and favors large, international manufacturers and their customers.

The selection of an "NMI"-based standard means that at least nine local certification labs are immediately available[18], all of which are appointed by the National Measurement Institute:

Title	Address	Expiry date	Services offered	State/territory
Itron Australasia Pty Limited (PDF 392.62 KB)	8 Rosberg Road, WINGFIELD SA 5013	29 June 2024	Electricity meters	SA
Metlogic Pty Ltd (PDF 369.1 KB)	33 John Radley Avenue Dural NSW 2158	20 August 2023	Electricity meters	NSW
Energy Queensland Limited (PDF 368.94 KB)	524 Bilsen Road, Geebung QLD 4012	14 September 2023	Electricity meters	QLD
Landis & Gyr Pty Ltd (PDF 391.2 KB)	50 Cyanamid Street Laverton North VIC 3026	16 November 2023	Electricity meters	VIC
PLUS ES (PDF 392.4 KB)	48-50 Holker Street Silverwater NSW 2128	15 February 2024	Electricity meters	NSW
Utility Meter Verification Services (PDF 391.21 KB)	Unit 3, 21 Enterprise Street Cleveland QLD 4163	31 March 2024	Electricity meters	QLD
Secure Meters (Australia) Pty Ltd (PDF 392.3 KB)	39-41 Fennell Street Port Melbourne, VIC 3207	29 November 2023	Electricity meters	VIC
AusNet Transmission Group Pty Ltd (PDF 391.49 KB)	308 Hyde Street YARRAVILLE VIC 3013	18 October 2024	Electricity meters	VIC
EDMI Pty Ltd (PDF 391.92 KB)	162 South Pine Road Brendale QLD 4500	21 March 2025	Electricity meters	QLD

[16] https://www.industry.gov.au/sites/default/files/2022-06/nmi-r-46-1-2-v1-0.pdf

[17] https://www.industry.gov.au/sites/default/files/2022-06/nmi-m-13-1-v1-0.pdf

[18] https://www.industry.gov.au/regulations-and-standards/australias-measurement-system/utilitymeter-verifiers?field_nmi_services_offered_tid%5B%5D=1937&field_nmi_state_territory_tid=All

Independence of standard

The National Measurement Institute is part of Australia's federal government and is the body that implements the Commonwealth's constitutional role as head of power and weights. Standards that are published by the National Measurement Institute have legislative force and are as independent as Australia's democratically elected leaders.

The IEC61557-12 standard is promoted by large[19] European[20] switchgear[21] manufacturers[22]. Reposit questions the independence of this standard relative to the independence of National Measurement Institute published standards.

Cost of standard and impact on this consultation

The nomination of a standard to support FCAS measurement and verification is a key part of this MASS consultation. The nomination of IEC61557-12 by AEMO means a Consulted Person must be able to consider the relevant parts of this standard.

This requires a Consulted Person to make an expenditure of $1224.94 for the purchase of the standard from the Standards Australia Store[23]. Reposit considers this expenditure requirement to strongly discourage Consulted Persons to critically evaluate and provide feedback on AEMO's nomination of IEC61557-12.

Reposit notes that National Measurement Institute standards are freely available to all parties.

Retroactive additional requirements

It is inevitable that applying a certification requirement to in-market FCAS metering will be problematic to any party that is using meters not already certified to the selected standard. Reducing the application of the standard to power and frequency measurements does reduce the difficulty, but it does not remove it. This is because active power and frequency are both derived quantities from the measurement of voltage and current waveforms. The measurement of voltage and current waveforms is subject to Influence Factors[24] and Disturbances[25].

Influence Factors affect meter accuracy and are always tested for under certification regimes. They determine what the allowable accuracy degradation is under changing environmental and electrical conditions that are within the rated operating conditions of the meter. Some typical Influences are:

- Radiated, RF and electromagnetic fields
- Self-heating
- Solar radiation
- Load balance
- Tilt
- Magnetic induction
- Frequency variation

Disturbances are extreme quantities of an Influence that are outside of the rated operating condition of the meter. They are also tested for under certification regimes.

[19] https://blog.se.com/power-management-metering-monitoring-powerquality/2016/10/18/understanding-iec-standard-makes-meter-comparisons-easier

[20] https://it-resource.schneider-electric.com/electrical-infrastructure-power/understanding-theiec-61557-12-standard-that-makes-meter-comparisons-easier-part-2

[21] https://download.schneider-electric.com/files?p_enDocType=White+Paper&p_File_Name=998-19721656_GMA-US.pdf&p_Doc_Ref=998-19721656_GMA-US – See Conclusions and Summary (p. 14)

[22] https://www.linkedin.com/pulse/before-yesterday-today-measurement-solutions-iec-liammccafferty/

[23] https://store.standards.org.au/product/iec-61557-12-2018-amd1-2021-csv - date: 19/8/22

[24] https://www.industry.gov.au/sites/default/files/2019-05/nmi_m_6-1.pdf - 2.16

[25] https://www.industry.gov.au/sites/default/files/2019-05/nmi_m_6-1.pdf - 2.10

Reposit assumes that Influence factors and quantities from IEC61557-12 will be applied to active power and frequency certification. These factors and quantities are new requirements for existing metering. It does not matter what they are specified to be, they were not specified in any MASS since FCAS market start. Whether a given in-market meter type is able to meet the required accuracy under the Influence factors and quantities specified in the selected standard is simply a matter of luck. This is true regardless of the standard chosen.

As a result Reposit considers the retroactive application of any certification requirement to in-market metering to be unworkable where AEMO is committed to the provision of a level playing field for all FCAS Providers.

Reposit suggests that all in-market metering should not be subject to retroactive certification. Additionally, AEMO must provide ample time for FCAS Providers in the Fast, Slow and Delayed markets to re-engineer and certify metering without impeding FCAS registrations. This should occur for an appropriate period before the selected standard comes into effect. To do otherwise risks energy system security as new FCAS capacity registration will be paused and will be unable to replace retiring fossil fuel generator FCAS capacity.

Reposit notes that this issue does not exist for the Very Fast FCAS as there are no existing providers of Very Fast FCAS.

Rheem & CET

In summary we support the proposed Draft Report, subject to inclusions for clarity of further metrology specifications as detailed in our attached comments and recommendations.

Please find attached our comments and recommendations which have been made with a view to enhance the integrity of the MASS for Very Fast FCAS by removing any confusion in respect to metering related specifications that we believe are not addressed by the IEC 61557-12, as they are specific to the MASS. Further we believe that any current interpretation is unclear and could lead to the use of power metering equipment of a lesser specification than was intended by the MASS for Very Fast FCAS.

…

Whilst we applaud the use of the independent expert in drafting the proposed amendments to the MASS for Very Fast FCAS, we would suggest that AEMO give due consideration to a metrology review of our metering specification recommendations, conducted by an independent metrology organisation with experience developing standards and regulations.

We would suggest the involvement of the National Measurement Institute as the logical choice given its role in certification of revenue meters for use in the NEM. Such as review should be conducted to help identify and correct any remaining issues, or omissions in our observations and recommendations.

…

Specification of IEC 61557-12 for active power and frequency metering.

Having reviewed the Draft Report, in general we agree with the proposal to require certification of FCAS metering equipment to IEC 61557-12.

However, we believe that the change creates a greater possibility of confusion when selecting off-the-shelf power metering and monitoring devices (PMDs). Specifically, we are concerned that a PMD's IEC 61557-12 certifications and datasheet specifications may give a false impression that the PMD is compliant with the MASS.

For example, some PMDs that claim fast update rates require long (often many multiples of the update rate) measurement windows to achieve their stated accuracy. This is allowed by IEC 61557-12, but is frequently omitted from PMD specification sheets. Such a PMD might not actually comply with the MASS due to its excessively long measurement window, but could appear to do so, based on the published specifications and some reasonable assumptions.

While this is not an issue unique to the requirement for IEC 61557-12 certification and solved by type-testing requirements, the combination of an established standard (and associated range of notionally or expectedly compliant PMDs) with MASS-specific requirements (e.g. a measurement window that would make it difficult to determine compliance from published specifications) will mean that choice of a MASS compliant off-the-shelf PMD is open to interpretation.

We are also concerned that the MASS is underspecified, or could be clearer, with respect to PMD specifications. Specifically, both the IEC 6155-12 accuracy classes as well as the allowed minimum and maximum measurement windows should be explicitly stated.

Recommendations:

- The MASS should be amended to emphasise that IEC 61557-12 certification does not necessarily satisfy the MASS requirements, and we recommend that the PMD should be type tested in line with the MASS requirements.
- The required IEC 61557-12 accuracy classes should be explicitly stated (e.g. in Table 5).
- The minimum and maximum allowed measurement windows should be explicitly stated (e.g. in Table 5 / Table 6).

Other Metering Specifications

As raised by multiple parties in the MASS Public Forum on 2 August 2022, the MASS appears to be underspecified with regards to timing/synchronisation requirements, particularly where active power and frequency metering are performed by separate PMDs. We expect that other similar omissions with regards to the metering specification are likely.

Recommendations:

- The timing requirements for split active power and frequency metering should be determined and specified in the MASS. We suggest the involvement of an independent metrology organisation and the National Measurement Institute would be a logical choice given its role in certification of revenue meters for use in the NEM.
- A review of the MASS metering specifications should be conducted to help identify and correct any remaining issues or omissions. This review should be conducted by an independent metrology organisation, ideally one with experience developing standards and regulations such as the National Measurement Institute.

Simply Energy

While the certification of equipment in accordance with a standard is a reasonable proposal, it is not clear why AEMO considers that IEC 61577-12 standard is the correct standard to apply in the case of distributed/customer energy resources. At this point in time, Simply Energy is not aware of any easily obtainable metering that has been manufactured to the IEC 61557-12 standard.

It is also not clear from the Draft Report whether AEMO intends to apply this standard retrospectively to current equipment or whether it would solely apply to new applications. This would clearly be a significant issue if AEMO is seeking to apply this new requirement to markets beyond Very Fast FCAS.

Simply Energy urges AEMO to provide further clarification on the reasoning behind this proposal, and AEMO's assessment of whether the costs and benefits of applying IEC 61577-12 favour the introduction of this standard over other potentially more cost-effective standards.

…

In closing, Simply Energy is concerned that there appears to be an element of scope creep from the original intention of this MASS review. In our view, the scope of this MASS review should be limited to the accommodation of two new markets for Very Fast FCAS. The introduction of elements such as the IEC 61557-12 type testing requirements mid-way through a MASS review will likely mean that stakeholders will not have had adequate time be consulted and provide meaningful responses.

sonnen

sonnen has yet to fully evaluate the potential compliance of our existing products with the proposed application of IEC 61557-12. It is plausible that existing installed batteries may not meet some of the proposed requirements.

SwitchDin

The issues raised in this submission are focussed on a number of new requirements included in the draft MASS that are not directly related to the introduction of the Very Fast FCAS markets and would have a significant impact on the ability of aggregators to participate in any of the contingency FCAS markets.

…

While we agree that certification of measurement equipment is a reasonable proposal, it is unclear what the cost impact of requiring compliance to the relevant sections of IEC 61557-12 would be. We have reached out to two testing labs to get an indication of certification cost and input on the practicalities of testing equipment such as inverters to this standard but have not yet received a response. In taking a type-testing approach, guidance from AEMO is required on what would constitute a new "type" of device that would trigger the need for separate certification, for example whether testing a

family of devices is sufficient or whether each separate model number requires certification as this will significantly alter the cost impact.

Individual laboratories can have different accreditations and the manner in which they test and report the results of the tests can vary. AEMO needs to clearly specify the requirements and acceptance criteria that apply to laboratories and test reports as well as who is responsible for governing this to ensure uniformity of compliance across the measurement devices.

Tesla

Tesla does, however, have concerns with some of the new suggestions that have been made by AEMO in this second round of consultation.

In particular, are concerned that AEMO is now using this consultation to change the operational requirements for existing market access to **all** FCAS markets – particularly for VPPs – when this is clearly out of the scope of the consultation. Tesla is also concerned that some of the newly introduced requirements included in the MASS Review 2022 Redline could be read as ambiguous. Our comments below are focused on the following areas:

- The introduction of new type-testing requirements as a measurement asset requirement for all market access, not just for participating in the new Very Fast FCAS markets.
- …

As noted in our previous submission to AEMO, aggregated DER and VPPs are going to make up a significant proportion of the total storage capacity needed across the NEM for the lowest cost energy mix – more than 50% of the installed GW capacity is estimated to be orchestrated DER by 2050[26] (see following figure).

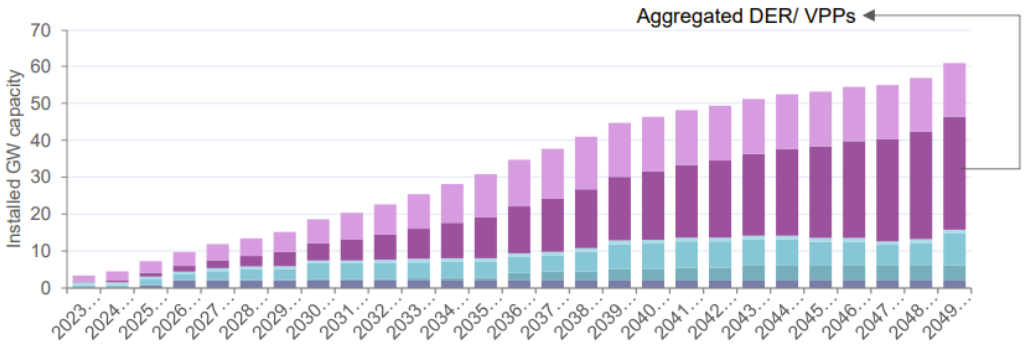


Figure 1: AEMO 2022 ISP Storage Projections

It will be critically important that AEMO creates the right market settings to continue to incentivise more controllable DER in the market, and that the costs of market participation do not outweigh the benefits. Where this is the case, we will continue to see passive DER make up the market share.

…

Type Testing to IEC 61557-12

Tesla has concerns with the introduction of the proposal to introduce new product type-testing requirements for several reasons.

1. It is being introduced as a metering requirement for all market access, even though the scope of the consultation is limited to the introduction of new Very Fast FCAS markets. It has also been introduced as a new requirement mid-way through an open consultation process;
2. The specific standard recommended, IEC 61557-12 has been based on the recommendation of a single person with no proper market sounding or due diligence conducted on alternatives; and
3. There is a best practice approach to considering and adopting new product standards in Australia.

[26] AEMO 2022 ISP.

These areas are considered in more detail below –

Scope of the current MASS review

AEMO has been very clear on the scope of the current MASS consultation throughout both the Issues Paper released in May, and the Draft Report that the scope of the consultation is to "accommodate two new markets for Very Fast FCAS". AEMO also notes that the consultation is undertaken in accordance with NER 3.11.2, 11.140.2 and 8.9, and specifically NER 8.9.2 which notes that the initial consultation must set out the particulars of the proposal and the provision of the NER under which the consulting party is making the proposal, which in this case is NER 11.140.2, introduced through the Amending Rule.

NER 11.140.2 is particularly clear in outlining the scope of AEMO's obligations for this consultation:

CLAUSE

11.140.2 Amendments to market ancillary service specification

(a) By 19 December 2022, *AEMO* must review and, where necessary, amend and *publish* the *market ancillary service specification* to take into account the Amending Rule, including amendments to incorporate:

(1) a detailed description of the *very fast raise service* and the *very fast lower service* in accordance with clause 3.11.2(b)(1); and

(2) the performance parameters and requirements which must be satisfied in order for a service to qualify as *very fast raise service* or a *very fast lower service* and also when a *Market Participant* provides those services, each in accordance with clause 3.11.2(b)(2).

(b) Amendments made to the *market ancillary service specification* under paragraph (a) must apply from the commencement date.

As per 11.140.2 the consideration of performance parameters and requirements is specific to the requirements to quality as a Very Fast FCAS.

AEMO's current drafting of the IEC 61557-12 type testing requirement, as a requirement for all FCAS market access then raises a number of governance concerns. This is clearly out of scope of the existing consultation process, and does not align with NER 11.140.2, which raises a number of probity and governance concerns:

- It appears to constitute a consultation scope change mid-way through the process – even though AEMO have already ruled out a number of other considerations that are out of scope.
- There are a number of FCAS Providers – existing or new – that may not be considering Very Fast FCAS market access and as such will not have been engaging in this consultation process. Those FCAS Providers will be impacted by this MASS change, without proper engagement. It is unreasonable for AEMO to assume that all FCAS Providers will be following potential scope changes in consultations specific to new market development on the chance that changes may also be introduced for existing market access.
- There are a range of grandfathering considerations that will need to be considered if a new product type-testing standard is introduced, and AEMO will need to consider the market implications on different asset types. I.e. VPPs will be disproportionately affected where grandfathering is introduced, as they are the assets most likely to update their registered capacity and as such be captured by new requirements.

Related to the above, the fact that this has been introduced mid-way through a consultation process as a new topic also creates governance issues and makes it difficult to properly consult on it.

Measurement standard due diligence

Tesla understands that the introduction of IEC 61557-12 was based on independent advice received by AEMO and appears to be the only standard recommended. We note that at least one product in market at the moment (the Schneider PowerLogic PM8000 meter) is compliant with this standard, however there are a number of other measurement standards used by different high-speed meters in the market.

- Elspec meters (using G4430 as an example) are certified to the following measurement standards - EN50160, IEEE1159, IEEE519, IEC61000-4-15,IEC61000-4-7, IEC61000-4-30 Class A,IEC62053-22/23 Class 0.2[27].

[27] https://www.elspec-ltd.com/elspec-shop/power-quality-analyzer/permanently-installed-power-quality-analyzers/g4430-fixed-blackbox-powerquality-analyzer/

- Acuvim meters[28] list the following measurement standards IEC 62053-22; ANSI C12.20. Note that they consider IEC61557-12 to be a safety standard, rather than an appropriate measurement standard.
- The Schneider PowerLogic PM8000 series, noted in the MASS Draft Report and Determination as being compliant with IEC61557-12. It also notes that PQ compliance reporting and analysis is undertaken in compliance with IEC 61000-4-30 class S, IEC 62586, and EN 50160.
- Separately IEEE1547 includes several frequency response and power measurement requirements that could also form the basis of measurement requirements.

Related to the above points, AEMO also needs to explore, in collaboration with industry, if IEC61557-12 is the most appropriate measurement standard. As flagged, it is designed as a safety standard for power metering and monitoring devices.

Best practice approach to introducing new product requirements

While we appreciate AEMO's interest in introducing new metering requirements to ensure consistent market performance, product certification is a high-cost exercise and should be done with considerable due diligence. Rather than accepting the recommendation from a single external source, Tesla recommends that AEMO run a separate MASS review process specific to the measurement verification requirements for all market access.

The best practice approach to adopting new product standards in Australia includes:

- Technical assessment by a range of different independent and industry bodies – not a single adviser;
- Cost/ benefits of introducing new type-testing and product requirements above and beyond the existing frequency and power tests that are included in the MASS currently for compliance purposes;
- Consideration of all existing international standards that currently exist and could be fit for purpose to achieve AEMO's desired outcomes;
- Related to the above, consideration as to whether type testing to a single standard is required, or if there are several standards that could be introduced to provide additional market flexibility and reduce cost; and
- A 12-month development lead time to enable products to comply – something that will not be possible with the current MASS review timeframes. **This is a particular issue for existing market access, as the new MASS will take effect immediately (or shortly thereafter) release. This would provide industry looking to participate in existing FCAS markets with no compliance lead-time. This would be unprecedented from a product compliance perspective**.

Tesla recommends that AEMO run this as a separate process to ensure that there are no probity or governance concerns that are raised by the AEMO process, which AEMO has the authority to do under NER 3.11.2. This should include a full consideration on all measurement and product standards that currently exist in market; targeted engagement with all impacted market participation (not just FCAS Providers interested in participating in the new Very Fast FCAS markets); grandfathering arrangements for existing FCAS Providers – including when sites may need to upgrade measurement equipment; and AEMO should consider any undue impacts on different types of FCAS Providers.

As per the MASS review undertaken last year, a key focus of AEMO is to avoid a situation where high-speed meters are required to be installed at every site at significant costs to consumers. A similar assessment should be undertaken in respect of type-testing, with a focus on ensuring that the standards are appropriate for residential assets as well as market high-speed meters.

An additional benefit of running this a separate process with appropriate due diligence, it provides the opportunity for international alignment. ERCOT, for instance, are looking at introducing type-testing arrangements for measurement equipment to support their newly announced VPP Demonstration. A separate AEMO led process can support international consistency in frequency measurement requirements.

Yurika

Yurika suggests that the instantaneous power and frequency definitions need to be refined to ensure measurements between power and frequency samples are taken over the same time period to ensure correlation of measurements. It is also recommended that the definitions include the number of cycles to be used to average the measurement samples. For example, whether the definition of 50 ms considered the last single cycle measurement or the average of the last 'x' number of previous cycles. Yurika considers that single cycle measurements should be avoided, as they may be problematic with associated false triggering from switching spikes, waveform distortions and harmonics. Yurika recommends measurements should be aligned with a frequency cycle, not part of a cycle.

[28] https://www.accuenergy.com/wp-content/uploads/Acuvim-II-Advanced-Power-and-Energy-Meter-Datasheet.pdf

The standard referred to, i.e. IEC61557-12, has the frequency accuracy at ±2%, with a 3 s settling period for a measurement. The requirements specified in Table 5 of the MASS require a resolution of 0.0025 Hz, which is far in excess of the accuracy requirements defined in EC61557-12. Yurika recommends re-consideration of the use of this standard to define the accuracy requirements.

Further, from a metering perspective, there is very little capability in the typical market meters currently deployed to meet the new requirements of Very Fast FCAS (50 ms). Yurika recommends further consideration of the ability to leverage the capabilities of the existing metrology investments.

With regard to validation of metering, Yurika agrees there should be a component of traceability of measurements performed as part of the assessment process to comply with Table 4 of the MASS. Different instrument classes for each FCAS market segment (from Delayed FCAS to Very Fast FCAS) could also be considered.

4.3.2. AEMO's assessment

Sampling rate and discounting

AEMO notes that submissions were generally supportive of the proposed sampling rate and discounting regime.

AEMO recognises that there is a need to define the term "initiation delay" as it is used to specify the sampling rate requirement. It is the time difference between Local Frequency exceeding an FCAS Facility controller's frequency deadband or deviation setting and the start of the Raise Response or Lower Response.

In response to Hydro Tasmania's comments concerning the size of Aggregated FCAS Facilities of <25 FCAS Facilities comprised of larger business customers, AEMO notes that the studies completed by UoM for the purposes of last year's consultation demonstrated the verification error associated with slower sampling rates decreases as the number of sites within a VPP increases. If an FCAS Provider were to aggregate <25 sites, the applicable discount would need to be adjusted to reflect the associated error. AEMO determined that the discount would be maintained at 5% but this would only be possible if the number of sites ≥25. As summarised in Table 5 of the Final Determination and Report[29], the applicable discount for an aggregation of <25 sites would have been unreasonable as the maximum verification error for an aggregation of 25 sites was around 7.5% while the error was over 100% for an aggregation of 10 sites.

On the verification error, AEMO agrees that the results of the UoM study could be improved if more examples capturing the impact of electrical and environmental conditions were considered. To address this, AEMO took a conservative approach on measurement and considers that the applicable discount significantly negates the verification error associated with a slower sampling rate.

Finally, as mentioned below, AEMO has commenced engagement with the National Measurement Institute and intends to discuss the metrology requirements of the MASS further.

Impact on VPP/DER

One of the design principles adopted by AEMO in designing the Very Fast FCAS markets is, if practicable, the design should be technology neutral.

Evergen's detailed submission on the status of BTM DER Aggregated FCAS Facilities is valuable but does not recognise that they only represent a very small proportion of FCAS Facilities by volume. The MASS is an evolving document that has changed significantly over the last two years and will continue

to change as more experience with BTM DER as Aggregated FCAS Facilities enables AEMO to refine the requirements in the MASS with more confidence.

The issue is not whether BTM DER Aggregated FCAS Facilities are treated in the MASS as a first-class citizen on the same level as traditional utility-scale FCAS Facilities but whether the FCAS delivered by each type of FCAS Facility is entirely fungible.

Hence, until AEMO gains sufficient confidence that this is the case, a more in-depth overhaul of the MASS and FCAS Verification Tool is not practicable.

Evergen's submission has highlighted that some requirements need to be expressed more clearly in the MASS to ensure that they apply to the Aggregated FCAS Facility, and not each FCAS Facility within the aggregation. These include:

- Intrinsic uncertainty and resolution of power measurements.
- Reservation of headroom and footroom[30].

AEMO agrees that the intrinsic uncertainty will reduce as the number of sites increases, which is why a slower sampling rate is allowed for aggregations exceeding 25 sites. Certification to the IEC 61557-12 standard is to ensure traceability across the measurements. In comparison, the requirements under Table 5 of the MASS are specified to enable AEMO to verify whether the FCAS response is in line with the FCAS capacity enabled. There is no reason for the accuracy and resolution requirements of the MASS to align with the IEC 61557-12 standard.

AEMO also agrees that the references to FCAS Facility vs Aggregated FCAS Facility is not a trivial definitional fix, and until a more sophisticated solution is identified and stress-tested, this is the most economical means of drafting the document. The matters raised by Evergen will be considered further in consultation with the National Measurement Institute.

Furthermore, AEMO considers that it is the aggregator's responsibility to consider the intrinsic uncertainty of the measurements and determine the number of sites needed to meet their FCAS requirements during every trading interval that they are participating in the FCAS markets.

AEMO also agrees with Evergen that the opening words in the Measurement Range of Power Flow Measurements row in Table 5 of the draft MASS were superfluous.

Certification requirements for FCAS metering

Several submissions questioned whether the introduction of the certification requirements was out-of-scope, or not consistent with the rules consultation procedures in NER 8.9.

The focus of this consultation is the creation of new markets for FCAS, as required by the Amending Rule. In doing so, AEMO has encountered issues that require review and amendment because existing concerns will be accentuated following the creation of these new markets. The revision to FCAS measurement to address the multiplier effect[31] is one amendment necessitated by the creation of the Very Fast FCAS markets and the removal of Contingency Event Time (CET) from the verification methodology[32] is another.

The proposed Very Fast FCAS requirements were generally supported, but their introduction gives rise to issues that AEMO also needs to address during this consultation. It is neither correct nor feasible for

[30] See section 4.2.

[31] See section 4.5.

[32] See section 4.6

this consultation to ignore issues affecting other types of FCAS that are caused or contributed to by the creation of Very Fast FCAS markets.

When AEMO encountered these measurement issues, AEMO was cognizant of the guiding principles expressed in the Issues Paper. Several of these are relevant to the issue of measurement:

- Power system security considerations are paramount.
- Very Fast FCAS should be utilised to fulfil a need that Fast FCAS cannot.
- If possible, the markets should be simple.
- If possible, the markets should maintain consistency with the existing contingency FCAS markets.
- Unless there is a clear power system need to adjust the requirements for registration, the registration of existing Fast FCAS Providers should remain unaffected.
- If possible, existing FCAS Providers who wish to provide Very Fast FCAS should be able to integrate their provision of Very Fast FCAS with the provision of other types of contingency FCAS and use the same measurement equipment.
- If practicable, the design should be technology neutral.

In the context of measurement, the first, fourth, fifth and sixth of these principles are particularly relevant.

First, AEMO cannot ignore anything that could feasibly jeopardise power system security, such as knowing how much FCAS is being delivered at any time. FCAS is one of the most important tools AEMO uses to manage power system security and the accuracy of the measurement requirements for FCAS ensures that AEMO can rely on the data provided by FCAS Providers to verify their performance. Having identified a material issue related to measurement, some measures need to be established immediately to address it, but AEMO recognises that further work is required to determine other appropriate ways to ensure traceability of the FCAS measurements. Leaving the issue to be wholly addressed in a future consultation will fail to address potentially immediate risks to power system security if the measurements are inaccurate.

The fourth, fifth and sixth principles relate to the need to keep the requirements consistent between each type of contingency FCAS as much as possible. AEMO does not intend to specify different metering requirements for Very Fast FCAS unless there is a compelling case to do so, given the associated cost, registration and ongoing compliance implications for existing FCAS Providers seeking to enter the Very Fast FCAS markets.

Furthermore, in response to the probity issues around the selection of the independent metering expert, AEMO did not pursue the suggestion that the National Measurement Institute be approached during this consultation because of timing issues. It was highly unlikely that AEMO would be in a position to receive recommendations in time to meet the deadline for this consultation on 19 December 2022.

Nonetheless, having reviewed the submissions, AEMO agrees that more work is required to determine if there are other appropriate options to ensure the traceability of the measurements captured by FCAS meters. AEMO has commenced engagement with the National Measurement Institute to assist with these matters and following further work, will determine the next course of action after consultation with industry groups, such as the Ancillary Services Technical Advisory Group (ASTAG).

In the meantime, AEMO considers that the most equitable outcome is to recognise existing high-quality meters used to meet the measurement arrangements in the MASS and to not restrict certification to only one standard.

On the question of time-stamping, AEMO is not proposing this. Measurements of power and frequency on a common time scale are required for an FCAS assessment. The sampling rate needs to be specified in the FCAS Verification Tool but the time-stamp is not required. As pointed out by Delta Electricity, the frequency in an interconnected system ought to be consistent, and AEMO does not consider that a time-stamping protocol is required to compare the response from one FCAS Provider to another. If the measurements of frequency and power are captured by different metering equipment, the FCAS Provider would be required to demonstrate how they comply with section 5.3.1 of the MASS, which has been amended to clarify that sufficient information should be provided to compare Local Frequency and power flow data on a common time scale. Version 6 of the MASS specified this, but it was omitted from version 7, inadvertently.

On the issue of PMD specifications, there is no need to refer to the accuracy classes in IEC61557-12. The MASS has its own intrinsic uncertainty and resolution requirements. The MASS specifies that the measurements of power and frequency must be captured on a common time scale. It is up to the FCAS Provider to demonstrate that they can meet it if separate PMDs are used. FCAS Providers must provide data to AEMO that demonstrate compliance with the MASS measurement requirements during registration for the purposes of participating in an FCAS market. Finally, AEMO agrees that the measurement window is an important consideration when stating the accuracy of a meter and will take this point into account when consulting the National Measurement Institute.

Reposit questioned the independence of the IEC61557-12 standard relative to the National Measurement Institute's standards. While AEMO understands that Reposit is correct in suggesting that the IEC61557-12 standard is promoted by large "European switchgear manufacturers", the NMI M 6 standards are derived from the same international source subject to local harmonisation by Standards Australia.

On the appropriateness of the National Measurement Institute standards versus IEC 61557-12, AEMO understands that:

- The NMI M 6 standard is based on the Australian standards for energy measurement, which are modified versions of the IEC standards. Accuracy requirements and test methods for power and frequency are not covered in the NMI M 6 standard.
- The requirements for pattern approval under NMI R 46 and NMI M 13 are also limited to energy.
- Australian laboratories do not provide type-testing services to IEC61557-12, NMI M 6, M 13 or R 46, or the standards they are derived from.
- NMI pattern approval requires a sample to be type-tested against NMI M 6 or M 13 or R 46, however, type tests called up in the pattern approval document and conducted by a laboratory recognized by International Organization of Legal Metrology (OIMIL), traceable to International Laboratory Accreditation Cooperation (ILAC), are acceptable.

AEMO will be considering these issues further in its discussions with the National Measurement Institute.

In response to SwitchDin's comments around type-testing, the FCAS Provider or OEM will be required to confirm with AEMO whether the same type of FCAS metering equipment is being used for a family of devices within the one Aggregated FCAS Facility. If different metering equipment types are being used, the FCAS Provider will need to demonstrate compliance in accordance with section 6.5 (formerly section 5.7) of the MASS.

Unless AEMO has reason to believe that the intrinsic uncertainty and resolution requirements of the MASS are not being met by an FCAS Provider's metering equipment, AEMO will not require FCAS

Providers who have been participating in the FCAS markets to demonstrate compliance with section 6.5 of the MASS. Demonstration of this requirement will only be required as a matter of course during assessment for the registration of new FCAS Providers.

4.3.3. AEMO's conclusion

Although there will be no changes to the sampling rate and discounting regime, for clarity, AEMO has included a definition of the term 'initiation delay' and has deleted the opening words in the Measurement Range of Power Flow Measurements row in Table 5 of the draft MASS.

AEMO will retain the general requirements for demonstrating compliance with the metering requirements of the MASS, however, until AEMO has conducted a more comprehensive review of the measurement and verification requirements in the MASS, section 6.5 will provide alternative ways of demonstrating compliance with the metering requirements. If the FCAS metering equipment's datasheet does not clearly specify the intrinsic uncertainty and resolution for measurements of active power and frequency, the metering requirements can be met as follows:

- through certification against the sections of the IEC 61557-12 specified in the draft MASS;
- through certification against other relevant standards; or
- provision of test results or other evidence of compliance.

Sections 5.4, 5.5 and 5.7 of the draft MASS have been relocated to section 6, which governs the requirements that are specific to contingency FCAS, as the requirements in these sections only apply to those types of FCAS.

Section 5.3.1 of the draft MASS has been amended to require sufficient information to compare Local Frequency and power flow data on a common time scale.

4.4. Impact on other types of contingency FCAS

4.4.1. Issue summary and submissions

AEMO noted in the Draft Report how fully 'overlapping' the timing of Fast FCAS and Very Fast FCAS would result in a sub-optimal outcome and proposed not to vary the response times of other types of contingency FCAS. However, five submissions did not support the proposal to maintain the status quo insofar as other contingency FCAS response times were concerned.

Delta Electricity

> The changes to the MASS that AEMO proposes to include for the new Very Fast FCAS seem generally reasonable and it is understood that AEMO wishes to keep the new design as simple a change from the existing system as possible. However, the concern AEMO has about how other adjustments to timing of existing FCAS may overcomplicate the process, causing additional registration revisions and need for retesting of the existing FCAS, is not shared by Delta Electricity. On the contrary, Delta Electricity considers it likely many FCAS Providers, when registering for Very Fast FCAS, will take the opportunity to reconsider and re-register the capability of the existing FCAS, in which case other options for the timing of each service could be considered by AEMO.
>
> It is also noted that AEMO expects the proposed active power cap on service delivery may only generate a need for re-registration not warranting retesting. However, as the test of service delivery for many FCAS Providers really amounts to evidence provided from actual events, the additional testing to accommodate any changes in the timing of other services, should AEMO reconsider changing these, is not considered an overbearing difficulty.
>
> Delta Electricity continues to consider there is merit in maintaining a focus on the faster forms of FCAS and would prefer AEMO extending the proposed ramp up period of the Fast FCAS by a second to have it applied over 1 to 7 s and retire over 7 to 61 s instead of AEMOs proposed 1 to 6 s retiring over 6 to 60 s. Rather than such a suggestion being considered to have an economic or market basis, Delta Electricity considers it to be technical with impacts on the capacity on the

existing Fast FCAS. Most proportional controllers are not limited by the time frames involved but the longer specification time allows for the equitable amount of overall time in the assessment to that which exists for Fast FCAS now. Examining typical responses of steam generators to typical events suggests that shortening the rising period from 0 to 6 to 1 to 6, particularly taking the proposed cap on delivery into account, will remove capacity from Fast FCAS delivered by steam generators. After 6 s into typical frequency events with smaller deviations, service delivery of proportional controllers appears to be still increasing. Maintaining the Fast FCAS with a 6 s rise time over 1 to 7 s can maintain the present capacity of existing services as opposed to shortening it by a second, coupled with active power "capping", which is expected to reduce it. It is the speed of response, the fact that Fast FCAS from steam plants will usually continue to increase from 6 to 7 s for most assessable deviations, and the method of application by AEMO of the proposed new cap that will be deciding factors. The shortening of the rising portion of Fast FCAS will have more impact on Fast FCAS capability than would a shortening of the longer rise period of Slow FCAS. A 1 s removal from the ramp up time of Slow FCAS, being only 1 s removed from a 54 s ramp up, would have much less impact compared to the removal of the 1 s ramp up time from existing 6 s of Fast FCAS, which removes a much larger percentage of the overall assessable service period. However, Delta Electricity considers that Slow FCAS and delayed period timing could also be shifted with minimal impact on all FCAS.

Hydro Tasmania

The unnecessary imposition of obligations on existing FCAS Providers (such as re-registration or increased metering requirements) would prove highly burdensome and disruptive, and should be avoided to the extent possible. On this basis, we strongly support AEMO's general market design principle that "Unless there is a clear power system need to adjust the requirements for registration, the registration of existing Fast FCAS Providers should remain unaffected". Mitigating unnecessary burden on existing FCAS Providers where possible will facilitate a more seamless implementation of the Very Fast FCAS market. The appendix[34] notes several items that have been identified that may impact existing FCAS provision.

…

Hydro Tasmania agrees with AEMO's assessment that introducing the new Very Fast FCAS provision is unlikely to impact on the other FCAS categories, as long as the existing evaluation procedures, assumptions and response configurations remain the same.

Shell Energy

Shell Energy has previously argued that in conjunction with a shift to a Very Fast FCAS market, the current 6-s Fast FCAS markets could move to an 8 or 10-s service. AEMO has rejected this, arguing that the adjusted timing may not meet the technical requirements of the NEM, and that facilities would need to be substantially re-tested. We agree that we have not put forward evidence to indicate that an 8 or 10-s Fast FCAS would meet the technical requirements of the NEM. We believe AEMO is best placed to assess whether an extended timeframe for Fast FCAS can meet the technical requirements of the NEM. We also agree with AEMO that our argument for an extension to the Fast FACS timeframe is based on economic grounds. The NEO is "to promote efficient investment in, and efficient operation and use of, electricity services for the long-term interests of consumers of electricity with respect to: price, quality, safety and reliability and security of supply of electricity…" In our view this clearly shows the NEO allows for an economic lens to be used when it comes to changes to a range of services affecting electricity supply, including the MASS. We encourage AEMO to consider the potential for an extended timeframe for Fast FCAS to meet the technical requirements for the NEM at a lower cost to consumers.

On the second point AEMO makes regarding the need to re-test FCAS Facilities, our understanding is that FCAS Facilities shouldn't need to be re-tested. If an FCAS Facility can already deliver the required FCAS within 6 s, then by definition it could still deliver the response within 8 or even 10 s.

We therefore encourage AEMO to consider an extended Fast FCAS timeframe on a long-term basis and investigate whether it could meet the FOS at a lower cost to consumers through increased competition.

Simply Energy

Simply Energy is concerned that several proposals in the Draft Report have implications that reach beyond the intended scope of Very Fast FCAS. While we are comfortable with AEMO making minor drafting improvements as part of this review, any significant changes that impact other FCAS markets should be deferred until a further MASS review. This approach would ensure that all stakeholders have the opportunity to participate in the review and provide informed feedback to AEMO's proposals.

…

[34] See Hydro Tasmania's submission in section 4.7.1.

> In closing, Simply Energy is concerned that there appears to be an element of scope creep from the original intention of this MASS review. In our view, the scope of this MASS review should be limited to the accommodation of two new markets for Very Fast FCAS. …
>
> It is our view that any significant proposed changes to the MASS that affect other contingency FCAS markets should be carried out separately to this current review. AEMO should give industry sufficient notice of any proposed change and adequate time to adapt if those changes are adopted.

4.4.2. AEMO's assessment

It was inevitable that the creation of Very Fast FCAS markets would have implications for other types of FCAS. Identifying and addressing those impacts was always within the scope of this consultation, as discussed in the Issues Paper. Having discounted the need to consider regulation FCAS any further, the focus was on contingency FCAS.

Accordingly, AEMO does not agree with the characterisation of this aspect of the consultation as out-of-scope. At the other end of the spectrum of submissions, AEMO does not consider there to be sufficient justification to revise the current specifications for the response times of other Contingency FCAS as a result of the introduction of the Very Fast FCAS markets.

4.4.3. AEMO's conclusion

AEMO will not make any further changes to the draft MASS as a result of the issues discussed in section 4.4.1.

4.5. Multiplier effect

4.5.1. Issue summary and submissions

AEMO explained in the Draft Report its rationale for requiring a cap on the maximum registered ancillary service capacity for all FCAS markets and how it was necessary for this apply to all existing and new FCAS Providers. Of the five submissions on this issue, four did not support the proposal[35].

Delta Electricity

> The application of "caps" to the service needs to also ensure that the measured maximum determined from recorded data is compensated in the arithmetic to make sense of the purpose of the arithmetic that compares the reaction that may have occurred for a 0.5Hz deviation as represented in enablement quantities. As most deviations are much smaller than 0.5Hz, the real peak MWs experienced in a proportional reaction to any one event will be relative to the experienced deviation and will not necessarily match the quantity of contingency FCAS procured. For a steam plant, the maximum possible delivery in faster time frames, particularly of relevance to the new service, is larger than existing maximum service capacities registered for the Fast FCAS. e.g. a 660MW steam turbine with a mechanical-hydraulic governor has capability to rapidly deliver a 165MW retardation to a 0.5Hz rise in frequency and, when operated with suitable additional pressure (often in the order of 10% additional to that required for the energy dispatch), will react to try to initially deliver upwards of 66MW increase in output in response to a 0.5Hz fall. A mechanical-hydraulic governor reaction to the initial speed change will be followed by other responding actions both local and system-based. It is the coordination of all of these actions and reactions that determines the overall result. For these reasons, most steam generator FCAS Providers have conservatively registered capacity at less than half of the comparable peak MWs that may be delivered and the proposed capping of active power therefore makes it necessary to reconsider Fast and Slow FCAS capability.

Enel X

> This submission sets out our responses to the Draft Report to implement the Very Fast FCAS market. The key points are:

[35] Note that submissions quoted in this document are in this font; a footnote in this font indicates that the footnote is copied from the submission. In the interests of saving space, AEMO has replaced descriptions in the submissions with acronyms that are defined in the Glossary.

…

- While we understand AEMO's rationale for the removal of the multiplier effect, we note further consideration of unintended consequences of its removal without replacement of similar incentive faster response times is required.

Multiplier effect

Enel X acknowledges AEMO's security concerns of the current approach using the multiplier effect. However, its removal without replacement may similarly have perverse security outcomes. The multiplier effect's ultimate objective is to incentive FCAS Providers to react as quickly as possible and we consider this is still important in the MASS today. As such, we urge AEMO to reconsider its position that "AEMO must consider the needs of the power system over the incentives provided by the multiplier effect to FCAS Providers."[36]

Instead, we consider that AEMO can do both – consider the needs of the power system and the incentives provided by the multiplier effect to FCAS Providers [for fast provision of the service]. This is because the multiplier effect provided for competition within the market, i.e. faster responders were renumerated greater than those that responded slower. This encourages a stratified response from providers by paying providers who could provide a faster response. These disincentives FCAS Providers from potentially waiting until the last minute and acting right at the halfway point (the last chance to respond and gain full payment). In order to avoid the possibility of getting all responses at the halfway mark of the ramp window, we consider a modified multiplier effect – for example, one that is limited to 1.2 times total active power capacity – or another incentive mechanism should be considered. We recommend that AEMO implement a limit to the multiplier effect while it considers a new mechanism that can be implemented in later MASS reviews.

EnergyAustralia

As with FDT, EA appreciates the extra AEMO analysis on the impact of the multiplier effect on frequency nadir. We agree that new examples better illustrate the potential magnitude and severity of the issue than those used in the Issues Paper. The new examples add further weight to our earlier stated position that FCAS Providers should not be paid for services not actually delivered. As expressed in our earlier submission, doing so will keep customer costs as low and as transparent as possible.

Despite this support, we reiterate our earlier position that existing FCAS Providers should not bear any financial impost from this change. Forced re-registration of existing plant that has already demonstrated market compliance seems to be introducing additional regulatory burden and costs for no benefit. In particular, if they have no intent in participating in the new Very Fast FCAS market which is the genesis of the proposed changes. If re-registration is deemed to be required for existing plant, we strongly encourage AEMO to handle this automatically at no cost to FCAS Providers.

Hydro Tasmania

Hydro Tasmania understands the 'multiplier effect' raised by AEMO and acknowledges the challenge of the current FCAS measurement methodology, which basically uses a time average of energy to reflect the FCAS demand and contribution in a market environment. However, from the system 'power balance' perspective, this approach as AEMO illustrated, could be impacted by the facility frequency response power trajectory, hence experiencing a discrepancy between the anticipated and actual FCAS delivery. Hydro Tasmania understands that the multiplier has been introduced since the establishment of the FCAS markets and has been applied to all six contingency FCAS.

The concern is that along with the uncertainty this creates, there is the potential of significant expense and effort with the rework involved in re-evaluation, and re-registration as well as altering operational systems to facilitate these proposed changes. This is of particular concern to Hydro Tasmania with approximately 40 generating units registered for FCAS. In light of this, Hydro Tasmania proposes the potential revision of the 'multiplier' be treated as a structural change of the MASS, and therefore would highly recommend AEMO to de-couple this matter from this consultation.

VIOTAS

VIOTAS believes the proposed approach is sufficient, subject to an appropriate financial incentive (to reward faster responding resources) and omitting the new requirement in s5.6.4 of the Issues Paper, which requires response to initiate no later than half way through the ramp period – see response to question 16[37].

AEMO has not justified the need for introducing the initiation requirement. The market multiplier already incentivises FCAS Providers to respond as quickly as possible.

[36] AEMO, Amendment of the Market Ancillary Service Specification (MASS) – Very Fast FCAS, Draft Report and Determination, p. 10.

[37] See the discussion on market ancillary offer requirements in section 4.1.1

…

VIOTAS understands that the multiplier effect leads to AEMO procuring FCAS volumes that do not reflect the underlying active power requirement to maintain power system security. VIOTAS stresses the importance of the speed of response during a Frequency Disturbance and specifically, faster responding resources are technically better at arresting RoCoF than slower responding resources, which is exacerbated as inertia decreases.

VIOTAS speculates that the resources benefiting most from the market multiplier are those which can respond fastest, likely in less than 1s, which will naturally participate in Very Fast FCAS, likely reducing the multiplier effect across the NEM portfolio. Resources currently registered in Fast FCAS but unable to participate in Very Fast FCAS likely have a linear ramp rate or at best can respond in 2-3s, thus experiencing a relatively minor multiplier effect.

Deploying both the active power cap (removing an incentive to respond quickly) and introducing Very Fast FCAS simultaneously without experience of either appears to be a hasty decision that may materially impact the combined response of Fast FCAS resources.

It is important to note the success of performance based pricing in other markets. For example, in Ireland where "scalars" are applied to DS3 ancillary services payments to appropriately reward response speed. The Irish market rewards FFR response within 150 ms threefold versus that within the 2 second minimum requirement.

With lower levels of inertia, the loss of the same LCR will result in faster system frequency nadirs. Response times fast enough to meet the minimum frequency nadir time allow safe operation across all inertia levels. Fast FCAS act to address the frequency nadir quickly and also reduce the RoCoF experienced by other devices on the grid. Within the same service, not all response is equal and that which can respond faster provides greater benefit, which should be appropriately rewarded and encouraged.

VIOTAS believes it is important for FCAS minimum requirements to be as broad as possible (enabling the widest possible range of FCAS Providers) but for these to be complemented by strong price signals to incentivise the characteristics of highest value to the system. One method to achieve this is scalars / differential pricing.

Currently the MASS implicitly includes a form of differential pricing, despite pricing being out of scope, as it uses response speed to determine the maximum volume a resource can provide. The intention of the multiplier is correct – reward faster resources – however perhaps price multipliers would be more appropriate than volume multipliers.

4.5.2. AEMO's assessment

In response to Delta Electricity's submission, AEMO will consider, when updating the FCAS Verification Tool, how the cap to the peak active power change for a variable controller should be compensated in line with the frequency deviation. The FCAS delivered, as calculated by the tool, could then still be compared to the FCAS capacity enabled. This is essentially an extension of the 'proportional compensation' arithmetic that already exists in the FCAS Verification Tool.

EnergyAustralia and Hydro Tasmania were concerned about the expense associated with FCAS Providers having to be re-evaluated. AEMO notes that no fees are payable when updating the registered FCAS capacity of their FCAS Facilities as it forms part of their bid and offer validation data. NER 3.13.3(h) requires this data to be updated 6 weeks prior to the implementation of planned changes[38].

While VIOTAS submits that the removal of the multiplier effect and the introduction of the Very Fast FCAS markets simultaneously is a hasty decision that could materially impact Fast FCAS Providers, AEMO considers that this will have an overall lesser impact on FCAS Providers than removing the multiplier effect in isolation for the following reasons:

- If the Very Fast FCAS markets commence without removing the multiplier effect and the change in active power within one second of an FDT is significantly less than the generation or load capacity

[38] Bid and offer validation data must be updated annually in accordance with NER 3.13.3(b) and the Spot Market Operations Timetable (Available at https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/dispatch-information). As long as there is no change to the NMIs associated with the relevant FCAS Facility, this change is not required as a change in registration.

lost during low inertia conditions, there will be a negative impact on the frequency nadir, thus increasing the risk of breaching the containment band specified in the FOS for a generation or load event.

- If the multiplier effect were removed before the Very Fast FCAS markets commence, a substantial number of FCAS Providers would have to decrease their maximum registered Fast FCAS capacity to align with the peak active power change and the accelerated response from their FCAS Facilities would not be valued elsewhere.

AEMO also notes VIOTAS' comments on the success of performance-based pricing in other markets. In the NEM, there are six existing contingency FCAS markets and the Very Fast FCAS markets have been specifically designed to facilitate and value the delivery of a service faster than Fast FCAS. Their purpose, by design, is to recognise the accelerated response of FCAS Facilities that are capable of delivering a faster FCAS. The FFR pricing mechanism in other markets is probably not comparable to, or compatible with, the NEM's FCAS markets. What VIOTAS is proposing would require a change to the NEM's dispatch engine as FCAS is co-optimised with energy. Hence, the change proposed by VIOTAS would materially impact FCAS Providers.

4.5.3. AEMO's conclusion

AEMO will not make any further changes to the draft MASS as a result of the issues discussed in section 4.5.

4.6. Contingency event time

4.6.1. Issue summary and submissions

AEMO proposed to revert the measurement of FCAS by basing it on the FDT, rather than CET, noting that the provision of PFR would continue to be recognised as contingency FCAS in appropriate circumstances.

Most submissions on this issue supported the proposal.

AGL

> AGL supports the amendments to the MASS put forward in the second Very Fast FCAS consultation; specifically, … the change from Contingency Event Time to FDT.

Delta Electricity

> The change proposed to the Contingency Event time and the proposal to apply a narrow deadband adjustment to correct the base level MWs is not supported. The proposed change is simply not considered to be a reliable adjustment because it:
>
> (a) will adjust the baseload of some Units that may actually not have provided any response,
>
> (b) may not make sensible outcomes with the regular 50-75mHz variations over 25-30 s period occurring in normal conditions impacting on the accuracy of the adjustment as determined from the measured average frequency, and
>
> (c) the proposed change will overestimate the adjustments for most FCAS Providers in events where the total change in frequency has occurred over a long timeframe and where the relevant deviation, for the actual triggered data record and subsequent calculations, is only a portion of the overall deviation, particularly when considering adjustments made, during the same long timeframe of the event, by AEMO energy and regulation FCAS dispatch which can also affect the result should an event extend across several dispatch intervals.
>
> Delta Electricity favours the use of adjustments by comparing actual MWs at the precise moment in time the event leaves the NOFB, to that predicted by the linear trajectory from the last actual of the preceding dispatch interval to the next assigned dispatch target. A more complex but fairer trajectory might also include commencing the trajectory timing from the determined time of the initial receipt of the AGC target at the Unit. Such a calculation may also need extrapolation of

the trajectory line across a dispatch interval up until the time of commencement of receipt of the next dispatch target from AEMO. This would be particularly necessary when a frequency event occurs late in a dispatch interval or just inside the next prior to commencement of receipt of the target for the next dispatch interval from AEMO. Such times sometimes extend well into the first minute of the dispatch interval and, where the AEMO target itself has been interrupted for whatever reason, which has also been regularly experienced in recent times, can occur even later in the interval.

Delta Electricity also supports no adjustment being made if the Unit is found to be off target unfavorably compared to the change in frequency direction caused by a contingency event.

Type of event	Difference to trajectory at time of leaving the NOFB	Adjustment
Low Frequency	positive	Subtract the absolute MW difference between actual MWs above the estimated trajectory MWs, from the base levels calculated for Very Fast FCAS, Fast FCAS and Slow FCAS
Low Frequency	negative	No adjustment
High Frequency	positive	No adjustment
High Frequency	negative	Add the absolute MW difference between the estimated trajectory level MWs above the actual MWs, to the base levels calculated for Very Fast FCAS, Fast FCAS and Slow FCAS

Requiring FCAS Providers to need a Contingency Event Time determined by AEMO in order to undertake an assessment has made self-assessment less achievable and so any change that overcomes any impediment to self-assessment capability is considered a good idea. Other alternatives would be for AEMO to publish the contingency event time for every event.

Finally, however, Delta Electricity also has concerns that the permitted continuation of 50-75mHz variations in normal frequency conditions will also hamper accuracy in MASS arithmetic including adjustments for PFR, particularly when it is remembered that mechanical-hydraulic governors for many steam turbines react proportionally to any detected speed change and are therefore sensitive to the larger up and down transitions. The variation maybe hampering the effectiveness of the calculations for the services. The existing MASS, guide and the FCAS Verification Tool may benefit from a reconsideration of this point and AEMO are encouraged to consider smoothing the frequency record more extensively than is presently the case in the assessment arithmetic.

EnergyAustralia

FDT Changes And Primary Frequency Response Clarifications Are Most Welcome

We thank AEMO for addressing stakeholder concerns on the proposal to move back to FDT as the starting point for FCAS measurement. In particular, Matthew Holmes, who provided further key detail and insight on the intent of the proposed change. The earlier Issues Paper was somewhat ambiguous and led to several proponents questioning how this would work in practice. In particular, given the interaction with, and recognition of, PFR.

The Draft Report makes many changes to address these concerns. These include:

- new examples,
- extended and improved explanation,
- a new deadband adjustment mechanism,
- setting the baseline frequency over a period of time instead of using a point estimate, and
- a commitment to enshrine recognition of PFR provided within the NOFB as counting toward contingency FCAS obligations.

We note and agree with the commentary on page 62 that no single methodology will work ideally in every conceivable circumstance. However, we consider the proposed refinements constitute a clear and cohesive approach to fairly and accurately measuring FCAS performance. Moreover, that it should be robust in the vast majority of cases. We, therefore, support these changes to facilitate the move back to FDT as the starting point for FCAS measurement.

Hydro Tasmania

Hydro Tasmania agrees with AEMO that the FDT is more preferable to use than the Contingency Event Time. This is because it is difficult for FCAS Providers to easily determine the Contingency Event Time independently of AEMO.

Similar to the 'multiplier effect', Hydro Tasmania suggests that the proposed 'adjustment to the pre-disturbance baseline' requires further consideration, and should be de-coupled from this consultation, noting the rapidly approach 30 September 2022 due date for this final MASS amendment. With the proposal of capturing the machine PFR impact in the FCAS response by introducing an 'adjusted MW' value, there are a few issues that Hydro Tasmania suggests require clarity:

1. Whether or not the t0 adjustment from Contingency Event Time to FDT could potentially cause the machine FCAS trapeziums to be less conservative and more likely exposed to a non-compliance. Based on our experience, the FCAS trapeziums have been created based on FDT, the area 'A1' illustrated in the AEMO presentation effectively provides a safety margin. If the t0 is adjusted to FDT as the same as the trapeziums, this margin would be diminished.

2. Whether or not the averaged frequency measurement between FDT-20 and FDT-8 is a meaningful technical definition, to reflect the machine general PFR droop response prior to the event. Unfortunately, at the moment we don't have any study or reference with regards to this 'averaged frequency' concept.

3. If the frequency excursion pre and post the event is opposite, it is unclear whether or not the 'adjusted value' could negatively offset the FCAS delivery and expose the machine FCAS response to non-compliance. Note, as a standard process, the FCAS trapezium development is created based on a constant pre event output, i.e. the pre event PFR impact is effectively ignored.

In summary, Hydro Tasmania supports a clear, practical and simplified (wherever possible) evaluation approach. We expect this approach should incorporate both FCAS evaluation and FCAS trapezium development and ensure the overall outcome is technically conservative from both system security as well as FCAS provider delivery compliance perspectives.

Rheem & CET

Changes from the Contingency Event Time to FDT and Baseline Adjustment.

Recommendations:

- The MASS should be amended to clarify whether there are any additional verification requirements for the proposed baseline adjustment.

4.6.2. AEMO's assessment

Following receipt of submissions on the narrow deadband adjustment and the proposed removal of the CET, AEMO met with representatives of FCAS Providers[40] with synchronous generation who are currently providing PFR. Submissions from these parties had suggested alternatives to the 'narrow deadband adjustment' proposal in the Draft Determination.

Matters covered during that discussion were:

- The narrow deadband adjustment is based on the droop and deadband settings of the FCAS Facility, and this method assumes that the PFR contribution can be calculated based on the FCAS Facility's droop curve. For comparatively slower ramping FCAS responses, however, the PFR contribution from some synchronous generators might not be estimated accurately using this method.
- The narrow deadband adjustment will overestimate the PFR response of generating units if they are off-target and contributing negatively to a frequency deviation.
- The Reference Trajectory is the expected generation or electricity consumption, from or to, an FCAS Facility if a Frequency Disturbance had not occurred. The difference between the active power measurements following a Frequency Disturbance and the Reference Trajectory constitutes the FCAS response, referred to as the 'basic response' in section 6.6 of the MASS. The discussion was

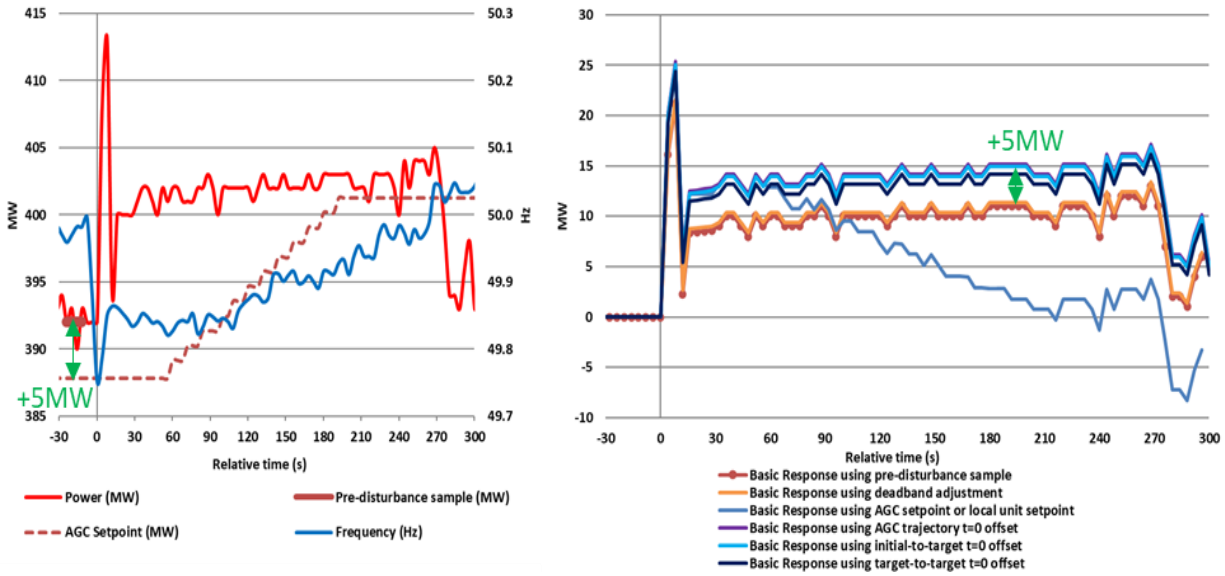
[40] See section 1.2 for more detail.

focused on how the PFR contribution of FCAS Facilities could be recognised more accurately by either:

- Using the local setpoint of a generating unit or the AGC setpoint as the Reference Trajectory.
- Calculating the difference between the measured active power before a Frequency Disturbance and the initial-to-target trajectory, target-to-target trajectory or the AGC setpoint, and adjusting the Reference Trajectory by an equivalent amount. This adjustment would then be observed in the 'basic response'.

Example outcomes of using the existing 'pre-disturbance sample' method and each of the alternative methods to determine the Reference Trajectory are depicted in Figure 1. In this example, which features a relatively long frequency disturbance, and a ramping AGC target, there is a quite a range of outcomes produced by the different calculations.

Figure 1 Power and frequency traces (L), and various methods for assessing frequency response (R)



- It is clear to AEMO that alternative methods need to be considered further, and this could be done with the aid of the ASTAG or other suitable industry collaboration mechanism.
- At this point in time, AEMO is not contemplating a replacement for the existing 'pre-disturbance' method, but rather allowing the option of working with FCAS Providers to agree a more representative Reference Trajectory for a given facility.
- AEMO noted that the exact equations for establishing the Reference Trajectory are covered by the MASS FCAS Verification Tool and User Guide, rather than the MASS, and that these can be updated independently of the current formal consultation.

4.6.3. AEMO's conclusion

AEMO will discontinue further investigation of the narrow deadband adjustment methodology and will investigate more promising options via separate industry collaboration, ideally facilitated through ASTAG. As noted in section 4.6.2, this method could result in erroneous estimates of the PFR contribution of an FCAS Facility in various plausible circumstances.

The following changes to the MASS have been made:

- As proposed in the Draft Report, the CET has been removed and an FCAS assessment will start from the FDT.
- The definition of Reference Trajectory has been amended to allow FCAS Providers with an FCAS Facility providing PFR to request the use of a Reference Trajectory other than the linear trajectory between two consecutive energy market dispatch targets.
- The changes to section 3.1.1 of the draft MASS will be retained, to explicitly state that PFR will be counted towards Contingency FCAS obligations.

4.7. FCAS provision in Tasmania

4.7.1. Issue summary and submissions

While AEMO did not separately consider the situation in Tasmania in the Draft Report, AEMO recognises that it requires special consideration. A submission was received from Hydro Tasmania about the issues that are specific to Tasmania.

Hydro Tasmania

As noted in the Issues Paper, the implementation of Very Fast FCAS may be different on a regional basis. Whilst we note and agree with the principle that any market structure for FCAS should be the same across the NEM, we note that the practical impact and implementation of Very Fast FCAS in the Tasmanian context has a number of technical characteristics that must be considered. For instance:

- **The suite of current constraints in Tasmania may deal with many of the issues that the Very Fast FCAS market may be required for in other regions**. As there is not the anticipated reduction in synchronous generation in Tasmania, the requirement for Very Fast FCAS response may be minimal.
- **The Tasmanian power system currently has FCAS switching settings to allow for the frequency variations experienced during interconnector power flow reversals**. This unique characteristic of the frequency management framework in Tasmania may create challenges in the implementation of a Very Fast FCAS in the region.
- **Careful consideration must be given to the interactions of FCAS and power transfers between Tasmania and the Mainland**. As a principle, Hydro Tasmania would support that interconnector transfer capability be maximised for both power and FCAS.
- **Hydro Tasmania utilises a number of switched Fast FCAS facilities that may deliver Very Fast FCAS in a 1-second timeframe**. We are currently assessing the capability of these services to provide Very Fast FCAS and will continue to engage with AEMO as our work in this space progresses.

…

Capability of different Technologies to deliver Very Fast FCAS (Section 4.3)

Hydro Tasmania appreciates AEMO's consideration of whether there are any barriers that could impact operators of certain technologies in participating in the Very Fast FCAS markets.

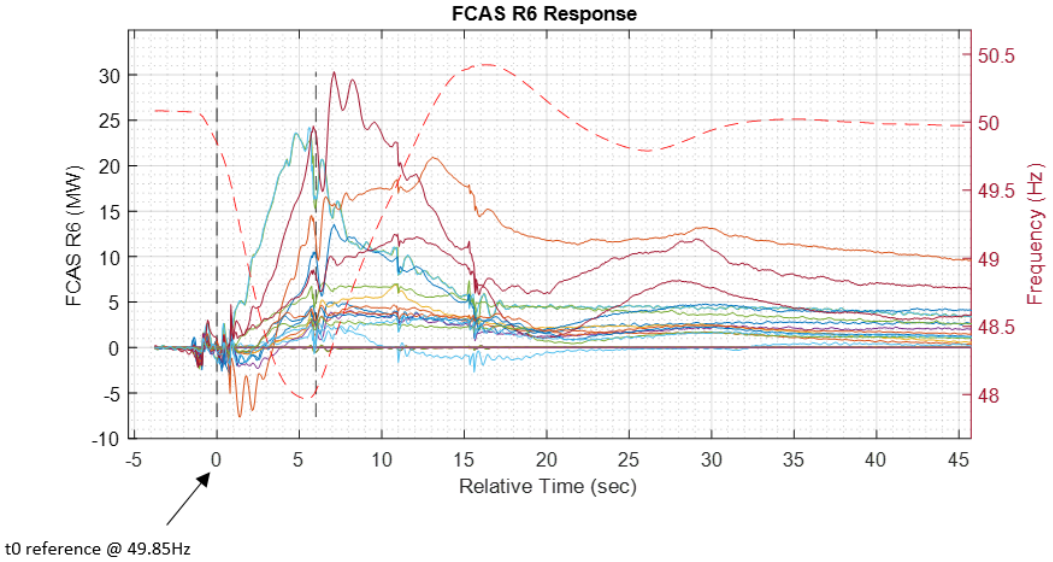
The response timeframes expressed in Table 3 of the Issues Paper is one of the key references for AEMO to evaluate and determine the Very Fast FCAS capability for different technologies. We agree with the majority of the information provided in this table, however, as identified by previous respondents, the frequency response timeframe of synchronous generators will vary according to the technology.

For hydro generators, based on Hydro Tasmania's experience, the hydro machine water column acceleration time constant is typically around 1 to 2.5 s. On this basis, we believe that it will be challenging for hydropower units to achieve full output within a 2-s timeframe.

Table 3 Summary of potential FFR capabilities of various technologies

Technology	Time to full response	Sustained response
Synchronous Generation (including pumped hydro and compressed air storage)	2 seconds	Yes
Load	0.25 – 0.5 second	Yes
Wind Turbine	0.5 – 1 second[16]	Few seconds with recovery. Ineffective at low wind speed.
Solar PV	0.5 – 1 second	Yes, depending on the sun.
Battery Storage	0.2 – 1 second	Yes, depending on state of charge.
Supercapacitor	<0.2 second	Only a few seconds. Depends on size.
Flywheel	<0.01 second	<15 minutes
HVDC Voltage Source Converter	0.2 – 1 second	No. Depends on available energy.

To best illustrate the hydro machine Very Fast FCAS response capability, Hydro Tasmania has reviewed our unit responses to a significant actual system frequency event. Based on 50ms high speed data recorded, the hydro machine governor responses are illustrated in the following plot. Note, the dashed red line represents the system frequency, the other lines represent the hydro machine MW responses at the time.



Note: hydro machine response to a generator event only. Response to a load event not included.

From this event, we note that:

- In this case, the high-speed data suggests that limited Very Fast FCAS injection can be observed within 1s after t0.
- The hydro machine frequency response time constant is typically located between 1s and 2.5s,
- The statement in table 3 that 'synchronous generation' (including hydro) could achieve full output within 2 seconds after the event may be too optimistic.

As outlined by this example and noting the fundamental hydro machine frequency response characteristics (e.g. inherent governor response and water column acceleration time constant), Hydro Tasmania believes that many hydro units will find it challenging to provide 1-s Very Fast FCAS response via governor action. As noted in the cover letter, Hydro Tasmania is assessing the potential provision of Very Fast FCAS response via switching controllers currently operational in the Tasmanian power system.

…

Another issue to consider, particularly in the Tasmanian context, is the interconnector transfer capability and the interrelation with a new 1-s Very Fast FCAS market including issues such as the allocation of local or global FCAS. As a principle, Hydro Tasmania would strongly support that the interconnector transfer capability be maximised.

…

> Noting that AEMO is proposing not to restrict switching controllers in the Very Fast FCAS window, Hydro Tasmania suggests that consideration be given to the following points in implementation:
>
> Switching response is typically considered in the latter stage of an event where there is a challenge to arrest system frequency within the FOS band specified. Introducing switching response immediately after a system frequency event could complicate system frequency coordination and control.
>
> In the Tasmanian case, the frequency switching response is typically restricted due to the Frequency Disturbance introduced by an interconnector power reversal.

4.7.2. AEMO's assessment

Following the detailed submission by Hydro Tasmania, AEMO met with representatives of parties with significant electricity market operations in Tasmania[42].

Matters covered during that discussion were:

- Appropriate frequency trigger ranges in Tasmania for switching controllers - A proposal to widen the settings for switching controllers to avoid shedding loads as a result of Basslink flow reversals, which are routine events, was accepted.
- Appropriate assumed fast frequency ramp in Tasmania – A 1 Hz/s ramp was considered and accepted.
- Issues relating to Basslink and the transfer of Very Fast FCAS – No issues identified that could impact the transfer of Very Fast FCAS.

4.7.3. AEMO's conclusion

The only changes required to the draft MASS as it applies to Tasmania are to the Frequency Settings in Table 7 of the MASS. The Frequency Deviation Setting range has been widened by 0.25 Hz, and the Default Frequency Deviation Setting by 0.125 Hz.

5. Final determination

Having considered the matters raised in submissions, AEMO's final determination is to amend the Market Ancillary Service Specification (MASS) in the form published with this document, in accordance with NER 3.11.2.

The final MASS amendments are largely consistent with the draft published with the Draft Report, with the following material differences:

- The narrow deadband adjustment has been removed. Instead, the definition of Reference Trajectory has been amended as noted in section 4.6.3.
- The scan rate requirement has been removed for the reasons mentioned in section 4.2.2.
- The compliance of FCAS meters to the measurement requirements of the MASS can be demonstrated through means other than certification to the IEC61557-12 standard. As noted in section 4.3.2, further work is already being considered on this matter.

In addition, AEMO has made a number of minor drafting amendments between the draft and final MASS. A marked-up version has also been published for reference.

Consistent with the Amending Rule, the amended MASS will take effect on 9 October 2023.

[42] See section 1.2 for more detail.

Appendix A. Glossary

Term or acronym	Meaning
[number] ms	millisecond
[number] s	second
Addendum	The Addendum to the Issues Paper – June 2022. Available at https://aemo.com.au/consultations/current-and-closed-consultations/amendment-of-the-mass-very-fast-fcas.
AEMC	Australian Energy Market Commission
AGC	Automatic generation control system
Aggregated FCAS Facility	As defined in the MASS.
Amending Rule	National Electricity Amendment (Fast frequency response market ancillary service) Rule 2021 No. 8. Available at https://www.aemc.gov.au/our-work/changing-energy-rules/rule-changes.
BESS	Battery energy storage system
BTM	Behind the meter
Contingency Event Time	As defined in version 6.0 of the MASS.
Contingency FCAS	Any of the following: • fast raise service; • fast lower service; • slow raise service; • slow lower service; • delayed raise service; and • delayed lower service
Delayed FCAS	Delayed raise service (also known as R5) and delayed lower service (also known as L5)
DER	Distributed energy resources
Draft Report	AEMO's draft report and determination published in July 2022 and available at https://aemo.com.au/consultations/current-and-closed-consultations/amendment-of-the-mass-very-fast-fcas
DUID	Dispatchable unit identifier
Fast FCAS	Fast raise service (also known as R6) and fast lower service (also known as L6)
FCAS	Frequency control ancillary services, referred to as market ancillary services in the NER – effectively, contingency FCAS and Regulation FCAS
FCAS Facility	As defined in the MASS
FCAS Provider	A Market Participant in one or more FCAS markets
FCAS Verification Tool	An Excel spreadsheet published by AEMO to assist FCAS Providers to calculate FCAS delivered by their plant
FFR	Fast frequency response
FOS	Frequency operating standard
Frequency Disturbance	An occasion when the power system frequency moves outside the NOFB
FDT	Frequency Disturbance Time. As defined in the MASS
Frequency Settings	As defined in the MASS

Term or acronym	Meaning
Hz	Hertz
Issues Paper	AEMO's Issues Paper titled: Market Ancillary Service Specification Consultation – May 2022 Available at https://aemo.com.au/consultations/current-and-closed-consultations/amendment-of-the-mass-very-fast-fcas.
LCR	Largest credible risk.
Local Frequency	As defined in the MASS.
Lower FCAS	Any of the following (terms defined in the NER): • fast lower service; • slow lower service; and • delayed lower service.
Mainland	As defined in the MASS.
MASS	Market ancillary service specification
ms	millisecond
MW	megawatt
NEM	National Electricity Market
NEO	The objective specified in section 7 of the National Electricity Law, which is to: … promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to— (a) price, quality, safety, reliability and security of supply of electricity; and (b) the reliability, safety and security of the national electricity system.
NER	National Electricity Rules. NER followed by a number indicates the corresponding rule or clause of the NER.
NOFB	Normal operating frequency band
OEM	Original equipment manufacturer
PFR	Primary frequency response
Raise FCAS	Any of the following: • fast raise service; • slow raise service; and • delayed raise service
Regulation FCAS	Any of the following: • regulating raise service; and • regulating lower service
RoCoF	Rate of change of frequency
s	second
Slow FCAS	Slow raise service (also known as R60) and slow lower service (also known as L60)
Switching controller	As defined in the MASS
UoM	University of Melbourne
Variable controller	As defined in the MASS
Very Fast FCAS	Very fast raise service (also known as R1) and very fast lower service (also known as L1)
VPP	Virtual power plant

Appendix B.Summary of submissions and AEMO responses

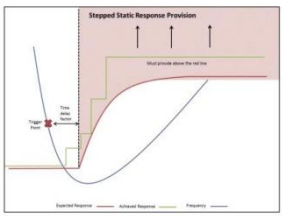
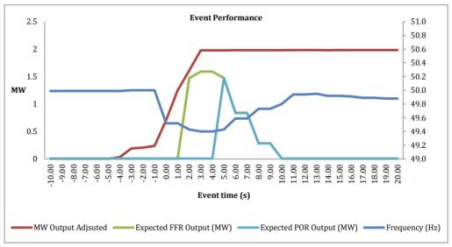
No.	Consulted person	Issue	AEMO response
1		Key Parameters for Very Fast FCAS See section 4.1.1.	See section 4.3.2 and 4.1.3.
2		Control System Requirements See section 4.2.1.	See section 4.2.2 and 4.2.3.
3		Verification and Measurement Requirements See section 4.3.1.	See section 4.3.2 and 4.3.3.
4		Impact on other FCAS See section 4.4.1.	See section 4.4.2 and 4.4.3.
5		Revision to FCAS Measurement See section 4.5.1.	See section 4.5.2 and 4.5.3.
6		Contingency Event Time See section 4.6.1.	See section 4.6.2 and 4.6.3.
7	Enel X	We support AEMO gaining more operational experience before making decisions on limiting switching controllers in Very Fast FCAS. Enel X welcomes proactive engagement with AEMO on this topic.	Noted.
8	EnergyAustralia	EA agrees with the rationale for most of the proposed draft settings. Many of these align with the sentiments in our earlier submission. … We, therefore, support the proposed approach for: • further investigation into switching controllers, overload capacity and geographic procurement.	Noted.
	VIOTAS	**Market ancillary service offer requirements** Section 5.6.4 dot point 2 [of the Issues Paper] proposes a revision to the measurement process for registration and assessment stating: "A new requirement that the relevant contingency FCAS must be initiated no later than half-way through the relevant ramp-up period. For example, this would be by 3 seconds after FDT for Fast FCAS" However, this requirement is not specified in section 5.2.2. Can AEMO clarify if this new requirement will in fact be included in the upcoming MASS and why this is required given the multiplier effect already incentives resources to respond as quickly as possible? For switched controller FCAS Providers, Very Fast FCAS would translate to a maximum 'initiation' window (delta between FDT and the latest time a load could commence a measurable response) of 450ms (FDT +50ms to FDT+500ms), assuming a ramp rate of 1Hz/s and a frequency setting of 49.80 Hz. This window will decrease for loads with a frequency setting below 49.80 Hz by 50ms per 0.05 Hz. Assuming FCAS Provider's control and monitoring hardware has a latency of ~100ms, this reduces a load's portion of the activation lead time to 350ms. It is unlikely many loads' communication, control systems (eg SCADA) and physical load response will be able to commence responding in 350ms. To meet this requirement loads would typically	As AEMO is no longer proposing this, no further comment is required.

No.	Consulted person	Issue	AEMO response
		need to be controlled directly by protection equipment, such as circuit breakers, which have a response time of ~50ms for medium voltage applications, which is not the industry norm in Australia. This may limit the pool of load participants looking to participate in Very Fast FCAS, particularly during the first months of operation when the value of the market is uncertain. VIOTAS suspects most FCAS Providers will require several months to develop, deploy, and test the service once AEMO has released the final specification. Aggregators who also need to sell the service will potentially 'wait and see' to assess the value of participating.	
9	Enel X	**Limit on Switched Controllers** Enel X welcomes AEMO not proposing to specify a limit on the percentage of enabled Very Fast FCAS from FCAS Facilities using switching controllers. We welcome continued engagement with AEMO operational and policy teams on the issues AEMO raised in this process, among other MASS reviews regarding switching controllers. Proactively discussions on issues to work through potential outcomes will result in the best understanding for all parties.	Noted.
10	Delta Electricity	**A "Specification" and Participant Self-Assessment** From experience with performing assessments since 2004, Delta Electricity considers that the MASS remains difficult to translate into custom built spreadsheets that can perform full assessment. Previous amendments that relocated relevant and necessary assessment calculations out of the specification into the supporting guide have actually made the task more difficult in our opinion. Even if FCAS Providers successfully interpret the NER, understand the relevant system operating procedures and the MASS and follow the FCAS Verification Tool User Guide, to build an assessment calculator, they have less confidence that the calculations are NER compliant because they are no longer an integral section of the specification. Of course, FCAS Providers can opt to use the FCAS Verification Tool (provided by AEMO) instead and this tool appears effective in most cases even though it contains caveats that even it may not be strictly representing the expectations of the NER. Delta Electricity reiterates comments from previous submissions on MASS changes, that the word "specification" has its own sensible English definition that should be remembered. In its present form, Delta Electricity considers any description of arithmetic that adequately performs an assessment really belongs in the specification else relegating both the FCAS Verification Tool and any other calculation of performance into possible contradiction with the NER and the default purpose of normal specifications. The NER dictate that the MASS be a "specification" therefore, to avoid disagreements with FCAS Providers and NER arbitrators about the need for the MASS to completely define the FCAS specification, it is recommended that AEMO return the calculations to the MASS as a schedule. An alternative to the above is to remove almost all technical details completely and rewrite the specification to describe a process by which FCAS	Noted, however, the word 'specification' is not given its plain English meaning in NER 3.11.2. The contents of the MASS are specified in NER 3.11.2(b) and this is what AEMO has set out to achieve in publishing the MASS. AEMO is also conscious that, while Delta Electricity has significant experience with the FCAS markets, an increasing proportion of FCAS Providers do not. If the MASS were to exclude almost all technical details and describe a process by which FCAS Providers can demonstrate compliance, AEMO is concerned that some providers may find it difficult to determine what the technical requirements are. The MASS sets out the technical requirements and measurement arrangements for each type of FCAS market and the FCAS Verification Tool reflects the verification requirements associated with the MASS. FCAS Providers should not design their controls based on the calculations only. Therefore, AEMO will leave the calculations in the FCAS Verification Tool and Guide.

No.	Consulted person	Issue	AEMO response
		Providers must develop a compliant FCAS system in consultation. Those proposing to provide a new service can be instructed by the specification of the need to make a request to AEMO for design requirements. Design requirements could then be uniquely provided by AEMO for each proposed project or selected from an evolving library set of design requirements allowing flexibility to AEMO to advance FCAS system designs. Following design requirements provided by AEMO, each new proposing FCAS Provider would then design the system. Typical design requirement examples could be included in the specification for reference but the specification would indicate that each design, including modelling to demonstrate the expected performance, must be individually approved by AEMO, and then tested (or assessed from real event conditions) to confirm the predictions of the design. Such a process would provide full latitude to AEMO and flexibility to FCAS Providers to provide a variety of service designs to achieve the design expectations of AEMO, would be relevant to the time of the proposed project, and be ultimately determined by both design reports and commissioning testing in a similar way to processes that develop automatic voltage regulators. Such a specification would lead to a wider variety of systems, reduce the dependency on specific calculations and develop specific plant testing procedures from commissioning activities. However, such a process would make frequency control less transparently understood by NEM participants which may not be favourable.	
11	Shell Energy	Shell Energy has actively engaged with AEMO on changes to the MASS as part of the DER focussed amendments in 2021 and the Issues Paper. By and large, our arguments can be categorised as placing a high degree of importance on competition within FCAS markets to ensure that consumers benefit. Again, in responding to the Draft Report we consider that AEMO may not have adequately assessed the full benefits competition for FCAS may deliver. While the technical requirements of FCAS are critical to ensuring frequency can be maintained within the FOS, services that can deliver an acceptable response could meet AEMO's requirements at a far lower cost than services that meet a gold-standard approach. In considering the required technical requirements we consider it is critical that AEMO procure services to meet the FOS and does not seek a level of service requirements to achieve outcomes well in excess of what the FOS requires.	While the FOS does not specify a RoCoF limit, this may change in the foreseeable future. NER S5.2.5.3 specifies the ride-through capability for a generating system and each of its generating units. The minimum access standard in NER S5.2.5.3(c) specifies that they must be able to operate continuously unless RoCoF is outside the range of -2 Hz/s to 2 Hz/s > 0.25 s, or -1 Hz/s to 1 Hz/s > 1 s, or such other range as determined by the Reliability Panel. In section B3.4 of the Renewable Integration Study - Stage 1 Appendix B report[43], AEMO noted that RoCoF should be maintained within the range outside of which significant generation tripping is expected, with some margin. During this consultation, AEMO published study results demonstrating that a 1-s service would be more effective at containing RoCoF to 1 Hz/s and the frequency nadir within the containment bands specified in the FOS for a generation event or load event in an interconnected system or in an island system. Considering that more Very Fast FCAS capacity would need to be enabled if the response time was slower and its efficacy to contain RoCoF and the frequency nadir would be less, it is speculative to suggest

[43] Available at: https://aemo.com.au/-/media/files/major-publications/ris/2020/ris-stage-1-appendix-b.pdf?la=en.

No.	Consulted person	Issue	AEMO response
			that more Very Fast FCAS Providers with slower response times will come at a lower cost to the market (because of increased competition). This needs to be weighed against the cost of increasing the risk of power system disruption caused by the slower responses.
12	VIOTAS	VIOTAS understands that AEMO's proposed combination controller solution is to encourage fast responding droop based resources, primarily BESS technologies, to partially register as proportional controllers in place of entirely registering as switching controllers. This would enable BESS resources to register their full capacity and provide the smoother response of proportional control. VIOTAS noted during the MASS workshop that at least one BESS vendor said registering a BESS as switching controller was purely a commercial decision and VIOTAS has heard similar comments from other BESS vendors. Assuming this is true, it is clear then that the combination controller solution **must have greater commercial benefit** than registering as a switching controller to incentivise BESS FCAS Providers. VIOTAS' experience supports AEMO's comments that "variable controllers are preferred [over switching controllers] from a power system security perspective where feasible, as this control design is more versatile". VIOTAS currently operates a hybrid switching controller technology in the Irish FFR market (150ms ramp window) which mimics dynamic like behaviour to provide the grid operator greater flexibility of switching controller response. This technology is called Stepped Static and is illustrated in the figures below. Providers are assigned a maximum and minimum trigger response point and required to give a proportional response over this range. We understand AEMO currently distribute Frequency Settings of switching controllers on a FCAS Provider portfolio basis with the intention of approximating an overall dynamic response, but we question the effectiveness of this approach in comparison to Stepped Static. We encourage AEMO to consider how a similar hybrid controller design to Stepped Static could be included in the MASS to better utilise switching controllers.	The MASS does not preclude an aggregator from delivering a combined proportional response to frequency by dynamically adjusting the stepped response from multiple sites. VIOTAS is encouraged to discuss this approach further with AEMO. The initiation delay, scan rate, frequency deadbands are all important factors to consider should VIOTAS participate in the FCAS markets with this type of response.

No.	Consulted person	Issue	AEMO response
		 *Ideal Stepped Static Response in DS3 System Services in Ireland*  *Actual Stepped Static Response in DS3 System Services in Ireland*	
13	VIOTAS	**Interaction between Very Fast FCAS and Fast FCAS** AEMO has assumed FCAS Providers would not change their control configuration if the Fast FCAS timeframes were changed. VIOTAS questions this assumption in the scenario where loads are too slow to participate in Very Fast FCAS. VIOTAS would likely change relay control settings to reflect any changes in Fast FCAS timeframes to mitigate the risk of tripping loads when not required to respond – ie Frequency Recovery is achieved between 0-1s, as per section 3.7.1(a)(i) of the MASS. This would reduce the ramp period to 5s, thus potentially reducing Fast FCAS capacity. VIOTAS suggests AEMO validate this assumption through FCAS Provider feedback. Can AEMO explain how frequency is arrested between 0-1s when Very Fast FCAS has not been procured, due to sufficient system inertia and interconnectedness?	AEMO noted in section 5.6 of the Issues Paper that it would be highly unlikely for Fast FCAS Providers to re-register their maximum R6/L6 capacity if the Fast FCAS timeframe is 1 s to 6 s rather than 0 s to 6 s. This holds true if the FCAS response remains unchanged. Should any FCAS Provider introduce an initiation delay of 1 s, an assessment of the Fast FCAS capacity would be required. In response to the question on the procurement of Very Fast FCAS, AEMO noted in the Issues Paper that the calculation of the procurement quantity is not a matter for the MASS and will be considered outside this consultation. Further information on the matter will be communicated with the industry in due course.
14	Hydro Tasmania	**Overload Capacity** Hydro Tasmania agrees with AEMO's conclusion that further consideration is required to assess whether the overload capacity of an FCAS facility should be counted as Very Fast FCAS. We support AEMO's decision to consider this as part of a future review, and we would like to make the following observations. The overload capacity typically refers to generating units overload thermal withstand capacity. Based on our understanding, for semiconductor based IBRs (e.g. BESS), the overload capacity is typically specified between 1.2 p.u. to 2 p.u. with the sustainable interval typically between sub seconds to seconds (could be longer with special designs). In contrast, a synchronous machine normally has a much higher overload capacity due to its thermal structure as well as its need to deal with fault conditions, e.g. withstanding the sub-transient fault current which could be up to 3-8 times of the rated current. For a synchronous machine, the overload capacity sustainable interval varies from a few to tens of seconds. Hydro Tasmania understands the overload capacity only reflects the generating units thermal	Noted.

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		withstand capacity, and doesn't necessarily mean additional power injection for the purpose of frequency correction. Effective overload delivery capacity can be vastly different based on different technologies. It is worthwhile to point out that from the system security perspective, in a case where the system frequency event is combined with voltage depression, the attempt to utilise the generating units overload capacity for the purpose of Very Fast FCAS response could restrict the system reactive power reserve and adversely impact on the system resilience. This is particularly true for a grid operating with high non-synchronous penetration, where reactive support and voltage restoration has to be prioritised after an event to facilitate the IBRs achieving successful commutation. Given this, Hydro Tasmania would encourage a conservative approach to utilising the overload capacity for Very Fast FCAS purposes. Hydro Tasmania acknowledges the complexity of this topic, especially with respect to the primary source and injection mechanism, and as noted is supportive of AEMO deferring this topic for a future review.	
15	Delta Electricity	The removal of the definition "trigger rate" may benefit from some further considerations by AEMO of its purpose as defined and utilised in past versions of the MASS. Previous versions of the MASS excluded the need for FCAS Providers to capture data if the trigger rate was less than 0.05Hz/s. The version 7.0 published in February 2022 appears to have omitted the reference to trigger rate in the last row of Table 4 on page 17, perhaps by mistake. Regardless of this possible typographical error in version 7.0, previous AEMO engineers must have considered assessment unnecessary when frequency changed at less than this rate. Such slow changes may have been considered outside the correction FCAS can reasonably provide for and which are more in the sphere of energy demand/supply dispatch adjustments and/or other controls that AEMO centrally maintains. If this was the case previously, without details as to why it is no longer the case, it is unclear why a possible error should now be consolidated, and further, the definition deleted entirely.	The trigger rate is no longer required. Since the introduction of mandatory PFR, it is true that significant frequency events are rarer and thus there are fewer opportunities to assess the performance. In light of the improvement in frequency performance under normal conditions, AEMO may want to analyse events where there was a frequency deviation, but RoCoF was relatively slow. For example, AEMO requested high-speed data from enabled FCAS Providers following the frequency excursion on 17 June 2022 and is reviewing the response from their FCAS Facilities. AEMO also took into account that in the last few years, no new FCAS Providers have requested AEMO to capture data based on RoCoF measurements. If there is a need to specify a trigger rate, e.g., if frequency excursions outside the NOFB without a contingency or load event occur frequently, AEMO will consider whether the trigger rate is necessary and will include the issue in the next consultation on the MASS.
16	sonnen	**Reporting requirements** NER 3.11.2 (h) and (i) currently establish an obligation on FCAS Providers to report on responses to frequency events, and compliance with standard test procedures. It is unclear what part of the NER establishes a broader obligation on FCAS Providers for ongoing reporting on matters not related to responses to frequency events or standard test procedures. sonnen would appreciate a response from AEMO that demonstrates the proposed reporting framework is consistent with the NER. sonnen notes there is no limitation on the reasonableness or the frequency of the additional reporting requirements. Reporting on large pools	The FCAS framework is not limited to NER 3.11.2. NER 3.2.2 states: *AEMO* must do all things necessary to operate and administer a *spot market* for the sale and purchase of electricity and *market ancillary services* in accordance with this Chapter including: … (h) the collection and dissemination of information necessary to enable the *market* to operate efficiently. AEMO considers that section 5.8 is consistent with its powers under NER 3.11.2.

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		of aggregated assets can involve significant data retrieval and processing effort. sonnen recommend replacing "demonstrating compliance with any aspect of the MASS" with "demonstrating compliance with any relevant aspect of the MASS".	The requested amendment does not improve the efficacy of the provision, and could have the opposite effect by creating scope for unproductive arguments about relevance.
17	Tesla	Tesla also notes additional reporting obligations that have been introduced by AEMO in a new section 5.8 of the Draft MASS. As above, these new requirements are ambiguous and could lead to AEMO making constant data requests or information requests on any topic. We suggest that this section should be limited to times where there is a real or perceived risk of non-compliance.	Certainly, it would not be in AEMO's or consumers' interests to make constant data or information requests and there is no intention to do so. Using the example referred in section 5.8.1 of the MASS, AEMO must be able to verify that FCAS Providers using Aggregated FCAS Facilities are maintaining adequate headroom and footroom to meet this requirement. AEMO accepts the suggestion that a request should be predicated on a concern that there might be a non-compliance and has amended section 5.8.1 accordingly.
18	sonnen	**Drafting Comments** 3. Description of each type of FCAS Minor amendment for clarity For the avoidance of doubt regarding the applicability of batteries for the provision of contingency FCAS. Recommendation sonnen recommend adding "Rapid change in charging or discharging from batteries." consistent with the Fast Raise FCAS definition to the description of all other contingency FCAS.	AEMO accepts this recommendation and has amended the description of all other contingency FCAS accordingly.
19	sonnen	**Data retention** For the avoidance of doubt clearly establish the 'classes' and 'applicability' of data to be retained. Recommendation - Modify provision to restrict data retention to "only data and other measurements required to demonstrate compliance with the NER and MASS".	Section 5.6 of the MASS requires FCAS Providers to retain recordings of data and other measurements for at least 12 months from an FDT and provide them to AEMO on request. Objectively, this is not an onerous obligation, considering NER 1.9, which states: > Unless otherwise specified in the *Rules*, all records and documents prepared for or in connection with the *Rules* must be retained for a period of at least 7 years. The provision in the MASS is limited both in terms of the class of data required to be retained and as to the period for which it is to be retained for the purposes of the MASS. Given the discrepancy between the MASS and the NER, AEMO considers that the best way to resolve the two might be to align section 5.6 with NER 1.9, but this is best left for a broader MASS consultation.
20	VIOTAS	**Capability of different technologies to deliver Very Fast FCAS** The time to full response by loads will vary by more than 0.25 - 0.5 s. In the Irish electricity market VIOTAS operates loads which can fully respond in less than 150 ms (including communication and control latency). VIOTAS currently sees fast responding sites reaching full	Noted.

No.	Consulted person	Issue	AEMO response
		response between 150ms to 2s, including all control and communication system latency.	
21	VIOTAS	**Re-registration process** Can AEMO please provide details of the re-registration process it is considering for Ancillary Service Loads that wish to participate in Very Fast FCAS and those not wishing to participate in Very Fast FCAS.? For aggregation based FCAS Providers such as VIOTAS this will potentially have a material resource and cost impact if further testing, registration application work and AEMO fees are required.	This is a matter that is currently being worked out by AEMO's Registration team.
22	VIOTAS	**Impact of inertia** Can AEMO provide an indication to the number annual hours Very Fast FCAS will be required and the demand volume?	This is not an issue for the MASS.
23	VIOTAS	**Existing capability to deliver Very Fast FCAS** As highlighted in question 18[44] a 1s response time for a switching controller load with a ramp rate of 1Hz/s, FDT equalling 49.85 Hz and a standard frequency setting of 49.80 Hz, equates to 950 ms of usable response time and a proposed initiation time of 450ms. It's unlikely many load FCAS Providers that currently prefer to parse tripping control signals via onsite communications systems (eg SCADA) will be able to meet the proposed specification for go-live.	AEMO is no longer proposing that the FCAS response is initiated no later than half-way through the relevant ramp-up period. Regarding the useable response time, AEMO notes that switching controllers do not respond to smaller frequency excursions, which has contributed towards longer frequency recovery times on occasion. The useable response time is as a result of the trigger setting being outside the NOFB.
24	VIOTAS	**High-speed meters for use in Very Fast FCAS markets** This equipment is currently in operation and exceeds the proposed metering requirements.	Noted.
25	Yurika	**Possible error in Table 5 - Measurement requirements** Yurika suggests a possible error in Table 5 of the MASS, which lists items that show the relationship of the market to the response times. Yurika seeks confirmation as to whether the first response time should be noted as 50 and the second as 100, where potentially the greater than/less than signs may be incorrectly allocated in the definitions in the number of FCAS Facilities.	AEMO confirms there are no errors in Table 5 of the MASS. If the initiation delay exceeds 500 ms, a faster sampling rate is required to meet the measurement requirements for Very Fast FCAS.

[44] See Frequency Ramp Rate.