Market Ancillary Service Specification Consultation - May 2022

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1 Background

1.4 Industry advice

Question 1:	Are there any further issues for investigation by the Consultative Forum that are relevant to the specification of Very Fast FCAS?

Consideration and specification of an eligibility and discounting regime based on the number of DER within a DUID for the VFFCAS market, similar in approach to the current arrangements for the fast market.

3 Capability of different technologies to deliver Very Fast FCAS

Question 2:	Do you agree with the capabilities expressed in Table 3? If not, please advise which of these you do not agree with and provide evidence to support alternative capabilities.

Table 3 suggests battery storage requires 0.2-1second for time to full response. Evergen has limited data to speak to this point on a residential level since our telemetry is 1-second maximum granularity. However, we note from high-sample rate frequency injection testing for the VPP demonstration program that at least some residential battery vendors have small-scale BESS capable of reaching maximum response within 1-second. At least one VPP demonstration program hardware vendor required closer to 3 seconds to reach maximum power, however Evergen notes that this is for older/initial technology for the demonstration program and this vendor is working on improvements for new models.

Question 3:	Are there any technologies not mentioned in Table 3 that could potentially provide Very Fast FCAS? If so, what characteristics (including response time) could be expected of them? Please provide evidence to support their capabilities.

- Fuel cells (e.g., https://www.sciencedirect.com/science/article/pii/S0378775318300995)
- Hydrogen Electrolysers (e.g., Ghazavi, Mehdi & Mancarella, Pierluigi. (2022). Fast Frequency Response Capabilities of Utility-scale Hydrogen Electrolyser: Benefits and Challenges in the Context of Australian NEM Grid with High Share of Renewable Generation.)

4 Proposed design of Very Fast FCAS markets

4.4 Existing capability to deliver Very Fast FCAS

Question 12:	Is there anything else AEMO should consider in maximising the pool of potential Very Fast FCAS?

There are a multitude of residential DER battery vendors, many of whom will be able to achieve fast response times in response to detected frequency excursions. However, at present, granularity of telemetry may be a limitation. Evergen is aware of only 2 battery/inverter vendors that can deliver 200ms telemetry *via API* for FCAS verification without additional hardware at this point in time, although more have indicated they are targeting this level of capability in 2022. If telemetry granularity required for VFFCAS assessment were 100ms

or less, this may exclude control-via-API residential battery-based aggregators from participating in this market, at least in the short term.

3rd party hardware based solutions for control and monitoring of DER may be able to deliver higher granularity telemetry in the short term, though the requirement of additional hardware will mute the capability and growth of residential DER to participate, especially if the incremental value for an end user to purchase this hardware is only for eligibility in the VFFCAS market.

Evergen supports the participation of small-scale battery-based aggregators participating in the VFFCAS market at 200ms, through a discounting process. This discounting process could be based on the existing discounting process that aggregators can use to participate in the fast markets, using the number of devices under the DUID as a factor when determining eligibility for the VFFCAS market, and how FCAS contribution should be discounted.

5 Specification of Very Fast FCAS and associated changes to the MASS

5.2 Proposed key parameters for Very Fast FCAS

5.2.1 Response time, timeframe and initiation delay

Question 13:	Will some technology types be locked out of the Very Fast FCAS markets if the maximum response time is specified as 0.5 seconds rather than 1 second?

A 6 second market with 200ms granularity telemetry reporting for verification and application of discounts is already a challenging benchmark that the residential battery sector is working towards meeting.
While Evergen is optimistic about the possibility of residential, battery-based aggregators participating in a 1 second market with 200ms granularity and discounting, Evergen expects a 0.5second market (with likely higher granularity telemetry requirements than 200ms) to be sufficiently challenging to render most residential VPPs unable to participate in the VFFCAS market in the short term. Whether residential battery/inverter vendors decide to improve their offering to meet the requirements of a 0.5s market would depend on the incremental financial returns available for entering the VFFCAS market over and above the other contingency markets.

5.4 Verification and measurement requirements

5.4.3 Frequency measurements

Question 26:	Are measurement rates of <100ms feasible for your technology? What is the nature and extent of changes that would need to be made to support rates of <100ms?

Evergen is able to accommodate high sample rate (e.g., 100ms or less) data on our platform. However, our approach to VPP orchestration for small-scale DER is to reduce costs and achieve monitoring and control via a cloud-to-cloud API-based integration with hardware vendors. This means FCAS capability via Evergen is based on the capabilities of our hardware partners.

Evergen does not currently have any **residential** hardware partners who can deliver 100ms or finer resolution measurements to the Evergen platform via API, and only two as of June 2022 are able to deliver FCAS capability with 200ms sample rate.

Question 27:	Are there any other issues relevant to the proposed verification and measurement requirements that AEMO should consider?

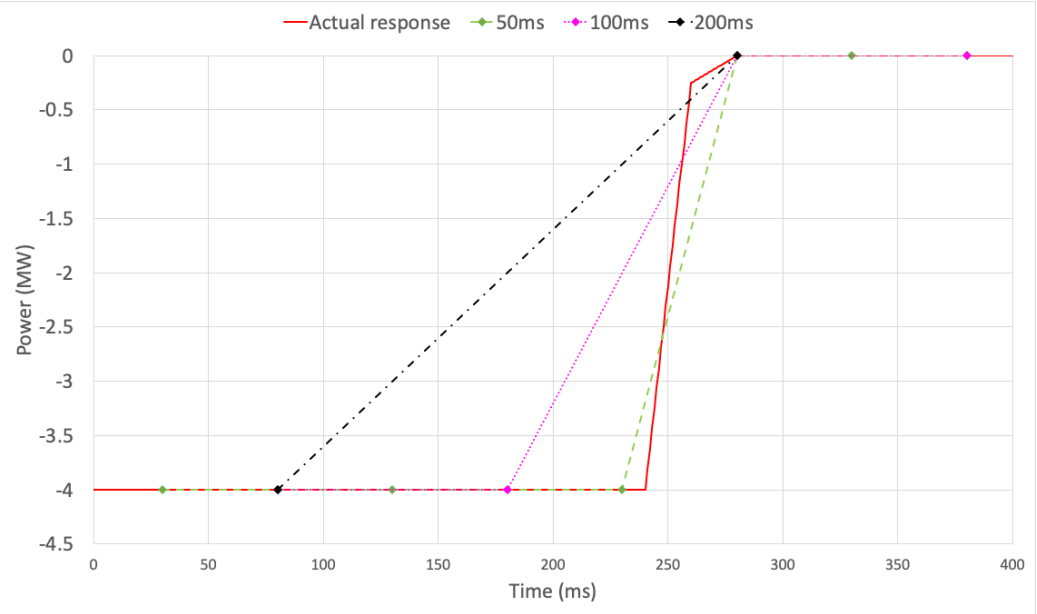
University of Melbourne study, reasons for bias towards underestimation for switched response profiles
The University of Melbourne (UoM) study indicated a bias towards underestimation (almost all errors were negative values) when assessing VFFCAS for switched response facilities (see Figs. 3.1-3.4 from the 1-second study, and Figs 4.1-4.3 from the 0.5s study).

Evergen is concerned by this, as it suggests that this error may be mitigated with different analysis assumptions, perhaps resulting in smaller absolute errors if the average/median were closer to zero with positive and negative errors occurring across the family of generated profiles.

By considering Figs. 3.9 and 3.10, it appears that this bias towards underestimation is only evident in the 0ms delay case. Evergen wonders if this bias towards underestimation is an artifact of the way UoM determined a reference assessment window for the switched control cases (given the reality was that the delay in the real responses was so long their assessable VFFCAS would have been zero, requiring an artificial method to determine the assessment window).

In practice, the locally measured FDT will be dependent on the sampling rate, and therefore the assessment window will also depend on sampling rate. By choosing the start of the 1s assessment window (for the no-delay case) as a point of maximum change in the response, and this point being **universal** across all profiles at all sample rates, perhaps this may have biased errors towards underestimations. We are interested in hearing from UoM as to why errors are biased in this way for the 0ms delay switched response profiles. Can UoM identify whether this is a result of their methodology for creating and assessing response windows for switched response loads, the FCAS verification approach in general, or the real-data profiles that formed the basis of the analysis?

Fig. 3.5 from the UoM study depicts how worst-case underestimation errors might occur based on the timing of samples. Evergen includes here a different sampling timing to indicate how close to worst-case **over**-estimation might occur for low sample rates:



It seems intuitive that a large over-estimation might occur in the worst case similar to the under-estimation worst case, especially for the 200ms sampling rate case. And yet the bias towards underestimation is apparent in UoM's results.

Evergen believes that the issues discussed here are especially relevant for consideration of facilities comprising many DERs (such as a VPP of many residential BESSs). If verification error is unbiased with a fairly equal distribution of over- and under-estimation errors, then there is less risk in allowing VPPs of many small-scale DER to participate in the VFFCAS market even with a coarser sampling rate, provided there are a sufficient number of DER in the facility, perhaps with a discount based on the number of DER.

This is the approach AEMO determined for discounting of fast-market response over the 2021 MASS Review, and Evergen supports a similar approach being adopted to facilitate participation of small-scale DER in the VFFCAS market.

Using samples outside the assessment window to improve coverage for low sampling rates

At the end of Section 4.1, UoM says:
“These larger errors stem from the way samples are selected for the assessment. In the case of 200ms sampling rate, the 0.5s assessment window only enables capturing three samples, potentially leaving a fifth of the response unaccounted for. This uncaptured area naturally introduces another approximation in the area calculated as the Very Fast FCAS contribution, thereby increasing the assessment errors for 200ms sampling rate. Sampling rates of 50ms and 100ms are divisors of 500ms, which create samples that, in principle, can cover the full window of 0.5s. This issue was not experienced in the 1s assessment window, as all the sampling rates considered (50ms, 100ms and 200ms) are divisors of 1000ms “

Evergen does not understand why lower sampling rates would leave some of the response “unaccounted for”, or why it should matter whether the sampling rate is a divisor of the assessment window duration. It seems mathematically principled and straightforward to use sample points on either side of the assessment window to determine additional trapezoidal areas, and then pro-rata a portion of these edge trapezoids when calculating area.

For example, if the assessment window is from 0-500ms, and 200ms samples occur at -120ms, 80ms, 280ms, 480ms and 680ms, then it seems principled and mathematically uncomplicated to calculate the verification area as consisting not just of the two trapeziums between 80-280 and between 280-480, but also include 40% of the trapezium between -120 and 80 and 10% the trapezium between 480 and 680ms.
Doing this would reduce the verification error arising from lower sampling rates, and Evergen believes there is some justification that this would be appropriate. This issue may not have been considered previously by AEMO, given that it only becomes extremely acute when considering lower sample rates and very short (0.5second) assessment timeframes.

6 Issues not under consideration

6.4 Geographic diversity

Question 43:	Are there any other issues relevant to geographic diversity that AEMO should consider?

Evergen notes that aggregators of small-scale DER are well-positioned to deliver FCAS capability that is highly geographically diverse. To the extent that locational concentrations of VFFCAS are to be avoided, this does not present a limitation for aggregator-based FCAS delivery.