Market Ancillary Service Specification Consultation - May 2022

Submission to Issues paper template

This template has been developed to assist Consulted Persons in providing submissions on the questions posed in the Issues Paper. AEMO encourages Consulted Persons to use this template to assist AEMO when considering the views expressed on each issue.

Consulted Persons should feel free to address only those questions that are of particular interest/concern to them and delete those they are not responding to.

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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?
Response: Akaysha Energy believe AEMO should further investigate the potential registration of inverter overload capability with regards to FCAS registration amounts and acceptable testing of new units during the connection process. Many inverters are capable of sustained overload for periods of up to 5 minutes which is highly beneficial for bringing more FCAS capability to market however may not be acceptable as registered energy capability or allowed to be tested by the AEMO connections team. We also recommend further investigation on the impacts of switched FCAS controllers in a low inertia power system. Akaysha believe very high rate of change of active power from a switched controller is detrimental to power system performance and further limits should be applied to the maximum volume of switching controllers enabled for FCAS.	
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.
Response: Akaysha Energy suggest that time to full response for BESS can be lower than 0.2s, potentially 0.1s. All other technologies	

We suggest that synchronous generators should be divided by energy type (coal, OCGT, CCGT, Hydro, etc) as each technology has widely varying response capabilities. All other technologies and responses appear correct.	
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.
Response: No comment	
Question 4:	How could wind farm and solar farm operators be incentivised to participate in the Very Fast FCAS markets? What are the technical barriers impeding participation? For example, this may be a conflict of voltage disturbance controls with frequency response controls.
Response: There is no need for additional incentives to encourage wind and solar generators to participate in the VFFCAS. AEMO should provide guidance of the expected future VFFCAS volumes to the market for forecast of prices. Market prices should be the only incentive for FCAS participation to facilitate development of the lowest cost service provider.	
Question 5:	Are there any other issues relevant to the capability to provide Very Fast FCAS by different technologies that AEMO should consider?
Response: Virtual Synchronous Machine BESS with overload capability may potentially be providing system strength and inertia services in addition to FCAS services. Provision of a system strength or virtual inertia service require large amounts of inverter current causing short-term over-heating which may limit these assets ability to provide subsequent FCAS services as the inverter cools down. AEMO should consider the potential impacts of a future system strength / inertia market and how this may reduce the available FCAS capability in market. Akaysha believe markets for system strength, inertia and VFFCAS are all the optimal lowest-cost solution, however impacts of one capability on another need to be understood.	

4 Proposed design of Very Fast FCAS markets

4.2 Guidance from other FFR Markets

Question 6:	Are there any specific useful lessons to be learned from other FFR markets around the world?
Response: No Comment	

4.3 Proposed design of Very Fast FCAS markets

4.3.2 AEMO's proposed high level market design

Question 7:	Are there any issues with the concept of shifting Fast FCAS to accommodate a similar, but faster, Very Fast FCAS? Is there a better alternative that is compatible with the Amending Rule?
Response:	

Akaysha are supportive of the proposed VFFCAS integration including decisions to move from a 2 second to 1 second VFFCAS service. We also approve of the planned change to measurement of registered capability being capped at the maximum MW level achieved.

AEMO should ensure adequate resources are allocated to support the registration of new assets and re-registration of existing assets to provide these services to avoid delays in having a sufficient level of the capability available in the market.

Question 8:	Are there any other issues relevant to market design that AEMO should consider?

Response:

No Comment

4.3.3 Impact of inertia

Question 9:	Are there any other issues relevant to the impact of inertia that AEMO should consider?

Response:

Please refer to Question 5 response.

4.3.4 Primary Frequency Response

Question 10:	Are there any other issues relevant to the interaction between Very Fast FCAS and PFR that AEMO should consider?

Response:

Figure 9 appears to be incorrect as the line 1.7% droop with 0.15Hz deadband shows no PFR response.

No further comments.

4.4 Existing capability to deliver Very Fast FCAS

Question 11:	Does a 1-second response time specification automatically exclude certain technologies from being able to participate in the Very Fast FCAS markets? Which ones and why?

Response:

Akaysha agrees with AEMO's comments that many synchronous technologies will be excluded from providing a 1-second FCAS response due to technical limits. Our experience with synchronous generators suggests that active power ramping sub-1-second for many of these assets is unachievable due to mechanical plant limits such as control valve movement, actuator movement and with additional cycling would be detrimental to plant condition and future availability. This should not however prevent the market from having sufficient 1-second FCAS capability in the next couple of years as a number of large BESS projects come online.

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

Response:

AEMO should consider more aggressive droop curves from large BESS assets where these are located in stronger network areas and commissioning tests verify their response is well controlled. Limiting the amount of power a BESS can provide to the FCAS market reduces available supply to the market and subsequently increases prices.

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?

Response:

Akaysha believes that most technologies able to provide a 1-second FCAS response will also be able to provide a 0.5-second response. The limitation will be the methods by which their FCAS controller is implemented. FCAS controllers in the Power Plant Controllers take longer to response to frequency disturbances as they must transmit new dispatch target signals to individual inverters. Some assets may need to implement control system changes to move their FCAS controllers to be within the inverter controls or provide a different control system architecture.

Question 14:	Are there benefits to setting the response time for Very Fast FCAS faster than 1 second that AEMO should consider?

Response:

AEMO's modelling showing the decreased amount of system inertia required with a 0.5-second FCAS service as opposed to 1-second service is the primary benefit. A faster service would also require less VFFCAS to manage the same contingency event for a given level of system inertia. We suspect that moving forward the service may need to become faster as the NEM moves toward becoming a lower inertia power system.

Question 15:	Are there any other issues relevant to the proposed response time and timeframe that AEMO should consider?

Response:

Analysis on the size of the VFFCAS market volume for varying levels of system inertia would be beneficial for developers to consider market sizes going forward. However ultimately if delivered from an inverter as inertia or a fast FCAS service, assets can only do one or the other service at any instant in time. Fundamentally by control system theory if you do things early and fast e.g. inertia, the smaller the action required to manage RoCoF, hence inertia response is more valuable.

5.2.2 Market ancillary service offer requirements

Question 16:	Are there any other issues relevant to the proposed market ancillary service offer requirements that AEMO should consider?

Response:

How do AEMO plan to subtract any inertial response from the calculation of the registered VFFCAS level? This is most relevant for VSM BESS which may provide virtual inertia in addition to a large amount of VFFCAS. The inertia response would come in first and then followed by a more considered response through VFFCAS meaning you can offer both at the same time.

5.2.3 Reference frequency levels

Question 17:	Are there any other issues or concerns relevant to AEMO's proposal to apply the current definitions of 'Raise Reference Frequency' and 'Lower Reference Frequency' to Very Fast FCAS?

Response:

No comment

5.2.4 Frequency Ramp Rate

Question 18:	Are there any other issues relevant to RoCoF that AEMO should consider?

Response:

No comment

5.3 Control system requirements

Question 19:	Is AEMO's proposal to permit the use of a 'combination' controller, namely, a hybrid of proportional and switched controls for Very Fast FCAS appropriate? Please provide reasons for your response.

Response:

Akaysha believe any switched controller (hybrid or standalone) is non-ideal for management of power system frequency, particularly for low inertia systems. Control should be droop or PID based to ensure no large step-changes in generator output. If a hybrid controller is proposed, why would this be better than a droop controller with slope more aggressive than 1.7%?

Switched controllers could be included as a Non-Market Ancillary Service for extreme conditions of very high or very low frequency.

Question 20:	Are there any other issues relevant to the proposed control system requirements for a combined FCAS controller that AEMO should consider?

Response:

No comment

Question 21:	Are there other FCAS delivery methods that AEMO should consider allowing for Very Fast FCAS?

Response:

No comment

5.4 Verification and measurement requirements

5.4.3 Frequency measurements

Question 22:	What is the error margin and resolution for frequency measurements by high-speed metering installed by Fast FCAS Providers that could be retrofitted to existing Ancillary Service Facilities for participation in Very Fast FCAS markets?

Response:

No comment

Question 23:	What is the error margin and resolution for frequency measurements by high-speed metering that is not currently in use in the NEM, but is available for use in the Very Fast FCAS markets?

Response:

No comment

Question 24:	What is the cost of high-speed metering that captures frequency measurements with a margin of error lower than <0.1 Hz?

<table>
<tr><td colspan="2">Response:

No comment</td></tr>
<tr><td>Question 25:</td><td>Can metering providers submit the specifications of their high-speed metering currently available, or in use by Fast FCAS providers?</td></tr>
<tr><td colspan="2">Response:

No comment</td></tr>
<tr><td>Question 26:</td><td>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?</td></tr>
<tr><td colspan="2">Response:

No comment</td></tr>
<tr><td>Question 27:</td><td>Are there any other issues relevant to the proposed verification and measurement requirements that AEMO should consider?</td></tr>
<tr><td colspan="2">Response:

No comment</td></tr>
<tr><td colspan="2">5.5 Overload capacity</td></tr>
<tr><td>Question 28:</td><td>How long can overload capacity be sustained?</td></tr>
<tr><td colspan="2">Response:

Akaysha are working with an inverter supplier with a product capable of P/Q of 2.0pu for 2 seconds, 1.7pu for 30 seconds and 1.2pu for 5 minutes. Very few products in the market are capable of providing such overload capability and unfortunately despite this having a high potential for support of the power system, the MASS currently does not enable use of this capacity in FCAS markets.

Overload capability is also extremely valuable for a VSM BESS to provide system strength and virtual inertia to enable the connection of additional renewables. Any FCAS market opportunity to support the business case of an overload capable BESS must be explored by AEMO to support the use of these assets in the NEM and reduce the costs by providing multiple services at the same time from the same generator e.g. VSM.

Many other inverters can provide sustained overloads of 1.1 to 1.2pu however Akaysha believe it is more economic to install a single set of inverters with 2pu overload capability than two sets of 1pu inverters that are output limited to be able to provide a more beneficial overload capability.

Akaysha would be happy to work with AEMO on how this overload capability can be best utilised for all stakeholders in the NEM.</td></tr>
<tr><td>Question 29:</td><td>What percentage of a generating unit’s nameplate rating is equivalent to the overload capacity?</td></tr>
<tr><td colspan="2">Response:

Refer to Question 28.</td></tr>
<tr><td>Question 30:</td><td>How often can overload capacity be triggered in a 5-minute trading interval?</td></tr>
<tr><td colspan="2">Response:</td></tr>
</table>

This depends on the magnitude of overload capability delivered. The capability is based around the amount of heating the additional current creates within the silicone and copper of the inverter. For partial overloads, multiple triggers can occur in a 5-minute interval.

Question 31:	Can overload capacity be delivered proportionally to the frequency deviation, or can it only be delivered by a step change in active power?

Response:

This is likely control system dependent. The inverter Akaysha Energy are working with can deliver overload either proportional to frequency deviation or as a step change.

Question 32:	Is there an energy payback after overload capacity is delivered?

Response:

Inverter overload should be separated into reactive power overload versus active power overload. Reactive power overload is mainly used to provide system strength where active power overload relates to inertia and VFFCAS. Reactive power overload does not require additional battery capacity whereas real power overload will require a larger battery or one with a boosting capability.

Battery cell types each have different discharge and charge rate limit. Most cells used in utility storage applications are 0.25c, 0.5c or 1c. 0.25c means the cell takes 4 hours to discharge at its nominal output. For a 100MW BESS to have overload capability up to 150MW, it needs to have at least 150MWh of 1C cells, or 300MWh of 0.5C cells. This means for any real power overload capability an inverter has, this must be matched by sufficient DC power in the cells, often making project economics more challenging.

AEMO should work to enable BESS to provide overload capability in VF and existing FCAS markets to enable better utilisation of these assets. This would allow to use for instance two different type of batteries with a single inverter grid connection (DC coupled) to provide an energy power service and a high-power service.

Question 33:	What technologies other than BESS have overload capacity that be sustained for at least 6 seconds?

Response:

We believe possibly flywheels and Supercapacitors, possibly also solar PV with high DC/AC overbuild. However, Akaysha's position is that these technologies will not be economic or have sufficient availability to provide these services at the times they are needed.

Question 34:	Are there any other issues relevant to the potential use of overload capacity for Very Fast FCAS that AEMO should consider?

Response:

AEMO's FCAS team must work with the connections team to determine how overload capacity will be functionally tested during commissioning noting that connection will typically only allow a generator to run at its 5-minute maximum rating. Akaysha sees large project risks that AEMO FCAS team may allow the use of overload capability that we would consider in our financial models, however AEMO Connections may now allow the utilisation of this capability.

5.6 Changes to other FCAS

5.6.1 Interaction between Very Fast FCAS and Fast FCAS

Question 35:	Can Consulted Persons identify any case where a decrease in Fast FCAS capability could be observed?

Response:

No.	
Question 36:	Are there any other issues relevant to the interaction between Very Fast FCAS and Fast FCAS that AEMO should consider?
Response: AEMO have mentioned in Figure 8 that R1 and L1 may increase above R6/L6 and other Contingency FCAS services depending on inertia levels in the power system. Logically it is ideal to procure more R1/L1 to enable operation at lower levels of inertia, but how is this implemented functionally? Any generator with capability to provide VFFCAS or any other Contingency FCAS will likely do so via a single droop controller, meaning if enabled for more MW in R1/L1, it will also provide more MW in R6/L6. Would this then mean that generators provide more than they have been enabled for without renumeration? We feel that based on the new proposed measurement methodology capping the time weighted average to the peak value, a BESS will provide the same level of Contingency FCAS across all services (excluding energy availability limits). How then would AEMO procure additional VFFCAS without then making all BESS provide additional 6s, 60s, 5min FCAS? BESS owners may consider implementing controllers to limit the droop output after VFFCAS which is probably non-ideal from a power system perspective.	
5.6.2 Interaction between Very Fast FCAS and Slow FCAS and Delayed FCAS	
Question 37:	Are there any issues relevant to the interaction between Very Fast FCAS and Slow FCAS and Delayed FCAS that AEMO should consider?
Response: Nothing further from Question 36.	
5.6.3 Interaction between Very Fast FCAS and Regulation FCAS	
Question 38:	Are there any issues relevant to the interaction between Regulation FCAS and Very Fast FCAS that AEMO should consider?
Response: None that we are aware of.	
5.6.4 Revision to FCAS measurement	
Question 39:	Are there alternatives to capping the registered Very Fast FCAS capacity to the actual peak active power change to minimise the discrepancy between the amount of FCAS enabled and the actual contingency size?
Response: Akaysha are supportive of the proposed measurement cap to peak MW value. Consideration should be made to the comments in Question 36.	
Question 40:	Are there any other issues relevant to the proposed market ancillary service offer requirements that AEMO should consider?
Response: No comment.	
5.7 Proposed handling of Contingency Event Time	
Question 41:	Are there any other issues relevant to the proposed removal of Contingency Event Time that AEMO should consider?

Response: None that we are aware of.	
Question 42:	In there a better alternative to the baseline compensation approach than the one proposed by AEMO? Please provide reasons for your response.
Response: Not that we can think of.	
6 Issues not under consideration	
6.4 Geographic diversity	
Question 43:	Are there any other issues relevant to geographic diversity that AEMO should consider?
Response: Akaysha believe that within a few years geographic diversity of VFFCAS capable BESS will not be an issue due to the large number of projects under development. Geographic diversity is logical from a system security perspective as distribution of the services helps protect against non-credible contingency events such as regional separation.	