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AEMO Consultation on the Market Ancillary Services Specification (MASS) January 2021

To Whom it May Concern,

Delta Electricity operates the Vales Point Power Station situated at the southern end of Lake Macquarie in NSW. The power station consists of two 660MW conventional coal-fired steam turbo-generators. Since market start in 1998, Delta Electricity has participated in the support of frequency by way of installed controllers and systems subject to the market ancillary services rules and specifications. Delta Electricity appreciates the opportunity to participate in this consultation.

IMPROVE THE CONNECTIVITY BETWEEN DISPATCH SYSTEMS AND THE MASS

AEMO could improve connectivity between existing practical FCAS systems and the way that the AEMO dispatch system and individual units communicate and transfer energy dispatch targets from NEMDE to the Unit via the AEMO AGC processing and the Unit control process. In the best development of the next version of a revised market ancillary service specification, an understanding of all these mechanisms and, more particularly, the impact of inadequate total system response on the performance of each individual unit, should be included in the MASS and considered for in the objectives of the specification.

IMPROVE AND STANDARDISE IN GREATER DETAIL THE METROLOGICAL REQUIREMENTS

AEMO are encouraged to think carefully about metrological details. For the control of frequency there is little value in encouraging competition if the services obtained are not coordinated due to too great a mismatch in measurement technique, control response speed and accuracy. Coordination of controls depends initially on ensuring like-for-like data for the control signal, frequency, and the dispatch signal process confirming the correct target reaches the Unit output. Full coordination also depends on the correct engineering parameters and suitable metrology of a comparable performance and quality being demanded by the specification. Making the specification easier for some suppliers by broadening the accuracy base in value or resolution will not bring about an overall coordinated result. For example, as the specification has in recent past removed the calculations that confirm performance into a guide, it is now less certain in instructing a participant how to build a spreadsheet that evaluates the participant's performance. Perhaps this is AEMO's intention in that there are some technical advisers in the market that think the FCAS controls as currently specified and guided do not adequately provide the required reactions to coordinate frequency.

Inaccuracy for the centralised controller which can result in less coordination for frequency control has many sources including:

- Data source instrumentation differences (accuracy of device, accuracy of source transformer, settling time),
- Data conversion differences (A-D conversion resolution, time-stamping conventions, delta error interpolation of data),
- Telecommunication defects, drop-outs or inadequacy,

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- Time-base of the centralised controller and mismatched coordination between the unit controllers and the centralised controller because of transient reactions that occur within the time-frame particularly apparent on Units that have mechanical-hydraulic controllers in partnership with computer controllers that following instructions from the centralised controller to set the Unit output and
- Intermittency in the prime-moving source energy compared to predicted (wind speed, Solar irradiance, specific energy of fuel).

Whilst higher quality instrumentation can be expensive, the impact of poor-quality information, any subsequent greater mismatch and inaccuracy in the true supply and demand conditions and the overall impacts on frequency performance compounds the inaccuracy of supply/demand balance.

As the variability of frequency reflects the balance in the system between supply and demand, it is important that all instrumentation that provides information on the supply and demand quantities, and the frequency of electrical system, be measured in a consistent way to a common specification.

AEMO can reduce some of the variability in the response and performance of FCAS systems by producing in the next MASS draft an improved and more directing specification on the instrumentation signalling and quality expected.

DISTINGUISH FURTHER BETWEEN CONTROLLER AND RECORDER SPECIFICATIONS – BOTH ARE IMPORTANT AND MAY BE DIFFERENT SYSTEMS ON SOME INSTALLATIONS

AEMO are also advised to define, clarify and distinguish further between control input specifications and recorded data specification. Obviously, if the instrument that is providing the data for performance monitoring is suitable in quality and the unit complies with dispatch expectations, the performance is acceptable but, when it is not, the reasons may relate to different specifications, not included for in the MASS, having been applied to the instruments and data used by the controller and, if systems have not been constructed with suitable quality of data in the controller they will also be less likely to coordinate well with other controllers and objectives for system-wide precision and control.

Each machine's electrical response depends on and compliments the system's electrical response. As the system performance deteriorates, the response time of each unit will likely lengthen particularly if less machines are providing accurately measurable performance. Droop reactions necessarily limit a Unit's response to the relevant and fair proportion of energy required by that Unit to assist in the correction of the system frequency deviation. The level of stored energy and the output position of a Unit prior to a required response will also affect the resultant response of the unit. Knowledge of this variability in response and a performance based on the overall recovery time for the system might be worth considering in the assessment process.

In addition to the extensive description of the performance calculations of previous versions (many now removed to the supporting guide on the FCAS Reg Tool which Delta Electricity thinks should be returned to the MASS or a MASS attachment to ensure it remains more relevant in guiding those that may wish to construct their own assessment tool), the revised MASS ought to equally describe the design and control block expectations of the controllers, the specifications for the data feeds that controllers depend on and, in this way, describe the uniformity necessary in relevant aspects of the frequency control design AEMO consider required to facilitate good frequency control.

CONSIDER CHANGING THE REGULATION DISPATCH PROCESS

The existing regulation dispatch process carries with it inherent delays due to the AEMO delivery upon the energy dispatch target. This delivery separates regulation FCAS adjustments from PFR. Ironically, the present MASS design, as applied in many controllers, means that PFR delivery is more similar to that of 6s FCAS delivery than it is to regulation control. Regulation signals delivered on the energy dispatch target become subject to necessary and less transient plant limitations as energy targets relevant to market energy changes are shaped, smoothed and delayed in response to cater for continuous operation design safety limits which are not necessarily relevant to match for transient frequency response. Regulation FCAS dispatch if separated from energy dispatch signals and sent into a unit's frequency control loop instead of its MW dispatch control loop could, in combination with the local unit's stored energy for FCAS control, be able to respond immediately to the regulation requirement and respond better during times when ramping of energy dispatch is also occurring something which, in the existing regulation FCAS dispatch design, performance is less successful.

Delta Electricity will continue to be engaged with the frequency control work program and the changes to the MASS and if AEMO wishes to discuss this submission please contact Simon Bolt on (02) 4352 6315 or simon.bolt@de.com.au.

Yours sincerely

Simon Bolt
Marketing – Technical Compliance

Attachments

1. Delta Electricity Response to AEMOs Questions in the January 2021 Issues Paper
2. 25 August 2018 response and the impacts of 1s resolution data
3. Draft MASS with Delta Electricity mark-ups for AEMO to consider

Attachment 1 – Delta Electricity Response to AEMOs Questions in the January 2021 Issues Paper

No.	AEMOs Question	Delta Electricity Viewpoint
Distributed energy resources (DER) participation in frequency control ancillary services (FCAS) markets		
1.	Which option for the ongoing measurement requirements for DER described in Section 2.3 do you want AEMO to implement and why? Should any other options be considered?	Delta Electricity recommends Option 1 for these reasons: • In a market where the accuracy of demand-supply predictions is reducing, AEMO are encouraged to seek the most accurate information possible. • The system inertia is reducing which is potentially increasing the RoCoF. 1s time sampling reduces the certainty of events between sampled data. • There are events that trigger on Delta's present 20ms high speed recorders that are not detected in the 4s sample set. 1s sampling will lose visibility of some of these. In addition, if units are only recording for triggered events and not maintaining a continuous 1s data set, the events may not be detected. • Consistency for all providers. Existing providers are meeting the existing standard. A reduced specification standard will reduce the overall standard and produce greater variability in the objective.
2.	Which option do you think is more consistent with the NEO, and why?	The NEO seeks to promote efficient investment. Investment that results in poor quality frequency control is not efficient. The NEM is focusing a lot of time and resources to improve frequency control suggesting market inefficiency already exists. To reduce the variability in the performance, common standards are recommended to be applied and expected for the specification. Allowing too much flexibility increases the likelihood of less coordination and defeats the objectives of frequency control.
3.	Should AEMO consider any principles other than those described in Section 2.4 to guide its assessment?	A fundamental principle to seek is **coordination of the overall response**. Uncoordinated responses are not good control and contribute to inefficiency. Amongst other key aspects of the specification, permitting variability of the standard of instrumentation and control performance measurements reduces the objective of a coordinated frequency response.
4.	What is the difference in implementation costs, such as updating the communication links or installing	Inaccuracy can exist in source transformers and instruments that provide for the recording. Costs of aligning source transformers to common standards is probably prohibitively expensive but good quality high-speed instruments and recorders are not.

No.	AEMOs Question	Delta Electricity Viewpoint
	additional equipment, for capturing data at a resolution of either 50ms or 1 second for every NMI for different VPP facility types?	AEMO should include specifications for the controller reactions, the controller's frequency input data and sampling rate separately from specifications of the recorded data. If the Unit controller is responding to a frequency value only sampled at 1s will it provide the necessary response required? If the controller is rapidly detecting and reacting to frequency fast enough, the recorded data can probably be taken at a slower sample rate but it is better that control and monitoring data are comparable.
	Do you consider the cost difference to be prohibitive for participating in the Contingency FCAS markets? Please provide examples or analysis if possible.	No. Accurate MW and MVAr transmitters with fast settling times recently purchased were difficult to locate from international suppliers but at around $2-3k per instrument are reasonably priced. High speed recorders that can maintain a 2-week continuous record of data sampled at 20ms are only $50-100k.
5.	Do you think that either of the options presented will result in more or less competition in the Contingency FCAS markets?	Competition will be more effective when there is greater clarity of purpose in the design specification, consistency in data metrology, effectiveness in performance monitoring of like-for-like information improving the confidence of the Operator that more/less supply of specific services improves frequency control objectives.
6.	Are there any technical risks that you envisage if the Option 2 measurement requirements are allowed? How material do you consider those risks and how could they be efficiently mitigated?	Electrical response during large contingency events happens in cycle-time and 1s scans will miss important activity particularly where it is monitoring delivery from new technologies capable of acting much faster than 1 second. Reducing the scan times is going in the opposite direction to what is required, presently, and certainly in the future as and when system inertia reduces. Lack of coordination and separation of performance between participants with faster recordings and, of more relevance to frequency control objectives, faster controllers, from those with controllers relying on 1s sampled information whose units may be varying in uncertain ways between each sample point, unknown to the participant's controller and to AEMO, could affect the overall steadiness and response of frequency and, due the nature of the accepted low resolution data, not be identifiable as **the** cause of unsteadiness in both transient and steady state conditions.
7.	Does the sampling rate of one second rather than 50ms for Fast Contingency FCAS under Option 2 and the	It won't impact on the market itself unless AEMO finds reasons with the lower resolution information to reduce services when, if better information was collected, the opposite may be obvious as being required.

<table>
<tr><th>No.</th><th>AEMOs Question</th><th>Delta Electricity Viewpoint</th></tr>
<tr><td></td><td>determination of the FCAS delivery at the inverter/controllable device level create market distortion or negatively impact the FCAS markets?</td><td>However, the market purpose to control frequency may be reduced in reliability if overall frequency control continues to be considered by the operator as being inadequate and frequency quality, continued to be considered a threat to system security. If power system security due to frequency quality remains a concern, particularly in events that can occur rapidly and interrupt interconnectors and disconnect customers, greater detail in the information is required, not less, to ensure the operator can adequately identify all causation.</td></tr>
<tr><td>8.</td><td>If Option 2 was adopted, should the changes to the measurement requirements of the MASS be limited to small-scale DER (under 1 MW per NMI), or should a different threshold apply, such as 5 MW? For example, what do you see as the risks and benefits of expanding these measurement requirements to other FCAS providers and in what circumstances might that be appropriate?</td><td>Delta Electricity does not recommend the adoption of Option 2 even for small-scale DER which should be encouraged to aggregate capability and install appropriate recording for the whole aggregation to improve efficient outcomes that do not overburden low cost suppliers but also do not undermine frequency control objectives.

All Fast FCAS providers should be asked to invest in both accurate instrumentation with fast settling times for use in both the controller AND a suitable fast capturing recorder, assuming the controller and the recorder do not use the same data feed which is possibly the case in some existing systems.
<table>
<tr><td>Risks</td><td>Benefits</td></tr>
<tr><td>Unfair standards if lesser quality standards are not equally permitted to be installed by all participants.</td><td>Cheaper system development costs</td></tr>
<tr><td>Greater inaccuracy and subsequently lower coordination in control</td><td>More options in development</td></tr>
<tr><td>Expansion of lesser quality of controlling and monitoring and retarded control delivery impacting on overall coordination requiring overuse of mandated control systems or emergency response systems</td><td></td></tr>
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General MASS improvements		
9.	Does the proposed reformat of the MASS (see Attachment 1) make for improved readability and understanding? What other improvements in the form and drafting of the MASS could be beneficial? If you consider the reformatted MASS may have materially changed the substantive meaning of the MASS v6.0, please also bring this to our attention.	The draft is heading in the right direction in its structure but not in its detail. AEMO are encouraged re-incorporate all details, including re-incorporation back into the MASS the FCAS RegTool guidelines to develop the document into being a more complete specification covering all aspects of importance to designers. A document can contain an abundance of information but still be straightforward to comprehend. Understanding should become easier for the appropriately qualified engineers and designers. AEMO are cautioned against making amendments designed to make the specification simpler to understand but, in doing so, remove necessary details without which participants need to assume if not specified. The draft MASS does not have the correct purpose and scope for the Rule it is addressing. • The purpose and scope distract from the MASS also being meant to be a specification for the frequency controller and focus a reader on monitoring and recording. In the coordination of overall frequency control, recording equipment is possibly less important than control equipment. Accurate data provided by instruments specified separately for both the controller and the recorder will improve the overall objective. AEMO should seek audience with industry specialist control design consultants to obtain suggested additional frequency controller details to include in the draft. • The Rule requires that the MASS include “the performance parameters and requirements” which must be satisfied by the service providers. This should be applied separately to both the controllers and the recorders. • The Rule also refers to the use of undefined standards which should be included in or referred to by the specification and which could enhance the expectations for quality of control. If the standards don’t exist, AEMO should also draft them and deliver them with the next draft of the MASS. If the FCAS REG Tool is a standard it should be named as such rather than being sidelined to being a guide which weakens its purpose. • The word “specification” included in the Rule defines what the MASS is meant to be. An English definition is “**<u>an act of identifying something precisely or of stating a precise requirement.</u>**” Precision requires the

No.	AEMOs Question	Delta Electricity Viewpoint
		right amount of detail. A reduced and simpler specification may not be possible without undermining the actual purpose and therefore should not necessarily be the target for a revision of the MASS. A revision that more precisely and completely defines the requirements for control and for monitoring is recommended. The draft has made amendments in the direction of separating out specifications applicable to controllers from those applicable to the monitoring but could go much further. The structure of the whole document should focus up front on the Controller Specifications and follow later in the document with Data Recorder Specifications specifying each of these with consistent rigour and referencing required standards of instrumentation. Sections 7,8 and 9 are really aspects relating to data recorders for Contingency services.
10.	**Clarification of FOS references** – please provide any feedback on the proposal to clarify that FOS terms relate to Table A.1 of the FOS, and any other terms that have ambiguous values.	Whilst the FOS defines several different NOFBs, it is generally understood that NOFB when used without reference to islanded conditions and other operating states, means the 49.85 to 50.15Hz band. However, the MASS is a specification that ought to provide concise descriptions of the expectations for the services. Therefore, it is **essential** to make as many clarifications as necessary to avoid misinterpretations.
11.	**Frequency responsiveness of FCAS:**	
a.	What would be involved in ensuring that non-frequency responsive facilities:	
i.	Respond only when enabled in the relevant FCAS market(s)?	The SCADA system can deliver enablements to Units and automatically select the relevant controllers for service. Processes relying on human observation and manual arming or disarming of controllers are unlikely to be successful in supporting this objective.
ii.	Do not deliver significantly more than market enablement (for example, >50%)? Do any alternative options exist to manage over-delivery?	A switched controller could be assigned the required MW value by automated dispatch. SCADA and Unit controller modifications would be required for this which can be expensive and which require coordinated projects between AEMO, TNSPs, participants and technical resources. Without the above, the separation between FCAS bidding, dispatch and controls means that controllers will deploy a maximum value including times when the enabled quantity is less suggesting over-delivery will be common.
b.	Please provide feedback on the proposed revised trigger ranges for	Delta Electricity considers Delayed controls should be set wider than any faster services. The trigger ranges proposed in the Draft that narrow Delayed FCAS activation to tighter values of 49.85 and 50.15 are not recommended. Generally,

No.	AEMOs Question	Delta Electricity Viewpoint
	switching controllers set out in Table 1 and Table 2 of section 3.3.	switched control ought to be considered a secondary back-up to frequency responsive controls. In typical installations, the switched controllers have been applied in the Delayed service only, which by existing MASS design are set outside the operational levels of Fast and slow services and are only be required where 6 and 60s responses have been inadequate. The Delayed switched control follows in more stepped correction to hopefully prevent further deterioration of conditions and avoid the deployment of more disruptive protective measures such as load shedding.
c.	Please provide feedback on the proposal in section 3.3 to require proportional controllers to set deadbands no wider than ±0.1 Hz.	Clarifying that the controller must continue to operate until recovery is appropriate if that is what is required for good frequency control relative to the FOS. However, for many existing designs it also determines the activation value and the frequency deviation point that determines the effective proportional droop reaction in MWs. The specification needs to be clearer about this (e.g. wording of 6.2.3 in the draft still implies where the control should commence). AEMO should consider the impact from controller designs that choose to include hysteresis in activation between an initiation point at 49.85Hz, for example, and a recovery point to 49.9Hz. If both are configured with a droop response applicable to the relevant frequency value, the response will be different depending on whether frequency is deteriorating or recovering. Such complexity could contribute to oscillatory reactions and is probably best avoided in fast and slow frequency responsive controllers as it adds to the complexity of coordination. It would be better if the FOS NOFB meant what it has meant previously as being the point where frequency controllers are meant to operate but the simpler compromise to cater for possible detection delays in controllers is to have the controller set at the frequency recovery band initially but permit its variation out to the NOFB as long as the recorded MW response quantities remain compliant with MASS expectations. Additionally, if participants are using the same controller to deliver Mandatory PFR, the practical deadband for these FCAS services will be much tighter. Does the MASS permit this in all places particularly when proportional response at

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		±0.15Hz deviation will be much larger from a large machine with a ±0.015Hz deadband vs a one with a ±0.1Hz deadband?
12.	**Co-ordination of different FCAS and PFR:**	
a.	Referencing the list of co-ordination matters in section 3.4, are there other co-ordination matters AEMO should seek to address in the MASS?	A couple of suggestions: • AGC control time-base of 4s vs mechanical hydraulic governor response time (1-2s) and complimentary PFR or retarding Unit controller response times (5-20s) – What the AGC should do is match the DCS expectations not the mechanical governor reactions which are faster than the control time of the AGC. • Coordination differences between the fast and slow services of units with separated fast and slow controllers and those with a combined controller providing both services. • Coordination between frequency responsive and switched controllers – Should the MWs assigned by the switched controller be assigned only on top of the energy dispatch value or on top of energy dispatch value plus any proportional frequency control still active?
b.	Does the list of clarifications on co-ordination of Contingency FCAS/PFR controls with AGC controls in Section 3.4 provide a reasonable balance between guidance and flexibility for plant control design?	The specification should seek precision and clarity. The balance of guidance and flexibility is less important than the precision, standardisation and clarity of technical parameters, without which, the interpretative measures adopted by designers to fill in gaps in aspects of the specification will reduce overall coordination of frequency control. AEMO is encouraged to seek advice from technical design specialists as to what this specification requires. If that advice has already been obtained AEMO is encouraged to include it with the consultation papers. Inclusion of a reference to a document that details how the AEMO AGC interacts with Unit dispatch participates in frequency control should be considered. AEMO are advised to think in more detail about what the specification implies by clause 2.2 regarding priority. Many controllers provide FCAS support and PFR added/subtracted to/from the AEMO delivered energy target which also includes any regulation amount AEMO is dispatching to the Unit. The implications of the clause suggest the MASS requires specific decoupling from the energy target of some frequency reactions including contingency services, when triggered, to essentially freeze the energy target at the pre-event level until frequency

No.	AEMOs Question	Delta Electricity Viewpoint
		recovers. To the knowledge of Delta Electricity, no systems are presently built this way and if AEMO now requires them to be modified it needs to be more definite in this pursuit and seek modifications on all controllers, acknowledging also, the time it might take to achieve this alteration across the NEM. Following from other comments, the design specification would benefit from better diagrams to describe better how dispatch targets should be managed during contingency event responses. In addition, as many frequency controllers are the same controller that delivers PFR, decoupling the reaction from the dispatch signal on such controls would mean the dispatch target will be continuously stalled unless further modifications ensure the reaction to the PFCB in droop fashion differs from the reaction to NOFB breaches that now requires suspension of the dispatch target until frequency recovers. Finally, as the delayed service is seeking recovery to 50Hz, the designs are become very complicated for words to adequately describe.
13.	**Regulation FCAS requirements:**	
a.	Are the requirements and proposed settings listed in section 3.5 adequate and achievable? In particular, can PFR (separate to other plant targets) be determined readily and communicated to AEMO?	Control system and SCADA modifications would be required for this which can be expensive, use resources with limited availability, require considerable testing periods post implementation and require coordinated projects between AEMO, TNSPs, participants and technical resources. The MW adjustment (some of the PFR) deployed by a computerised proportional frequency controller, can be accurately sent to AEMO. PFR delivered by mechanical-hydraulic controllers can be calculated and provided but in AEMOs 4s AGC the data would not be useful. By the time the AGC has considered and adjusted, the PFR from the mechanical-hydraulic governor will have changed significantly. The time-frame of the response of the AGC should target only that part of a controller it can reasonably expect to react to which for many machines will only be the computerised portion of the control, of which the actual amount can be communicated to AEMO in the SCADA data set. The currently designed Regulation FCAS dispatch is particularly difficult to deliver during energy ramping because of AEMO's delivery of the dispatched quantity on the energy dispatch signal. Some of the proposed requirements are difficult to meet because of this design. AEMO could separate the FCAS

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		regulation target and send it to each Unit separately where it could be delivered with more assurance by Frequency controls instead of via MW setpoint controls. Ramp rate limitations often occur due to ambient temperature and fuel constraints. It is better that the FCAS regulation dispatch observe the applied Unit ramp rate and restrict the maximum possible regulation FCAS dispatch to suit the ramp rate rather than the specification trying to enforce that a Unit should maintain enough ramp rate to deliver any amount up to the maximum registered Regulation FCAS in 3 minutes.
b.	Would a 1-year phase-in period for existing Regulation FCAS providers be satisfactory?	Outages, budgets and planning will be required and for many participants this extends the period of time it may take to consider the revised specification, obtain estimates for the cost of modifications, consider the economic viability of the project and modify and test revised controllers. 2-years is recommended as a minimum. The implementing resources are often resource constrained which can also extend the delivery time.
c.	Do Consulted Persons believe that a 2-year Regulation FCAS testing cycle strike the right balance of stringency and reasonableness?	Testing could be at wider periods. e.g. AVRs are not tested at this frequency. But participants may also observe defective performance in shorter time frames and, if so, ought to be required to report and correct. AEMO may also be able to perform the tests without notice in which case AEMO could do that at whatever cycle it chooses but are encouraged to approach such testing in coordinated fashion with the participant to seek improvement in performance if required.
	Clarification of requirements for Delayed FCAS – please consider the implications from your perspective of clarifying that Delayed FCAS controls may be of a switched type only (rather than also proportional), and, whether other factors in addition to those outlined in section 3.6 need to be considered.	Switched controllers are preferred for the delayed services but in a slow recovering system, frequency responsive proportional controls may still be active and the total response will need to be coordinated. Some switched controllers may be ramping the provision in from a zero amount to an assigned MW value (control value not market enabled) over a five-minute period and then ramping down over the next five minutes. Is this acceptable or should the switch be an abrupt 'On' and 'Off' of switched MWs when required?
14.	**Regarding issues associated with the pending FFR rule change canvassed in section 3.7 and any other rule changes of concern**, AEMO wishes to hear from Consulted Persons on the following issues, which would be used to help scope future changes to the MASS:	

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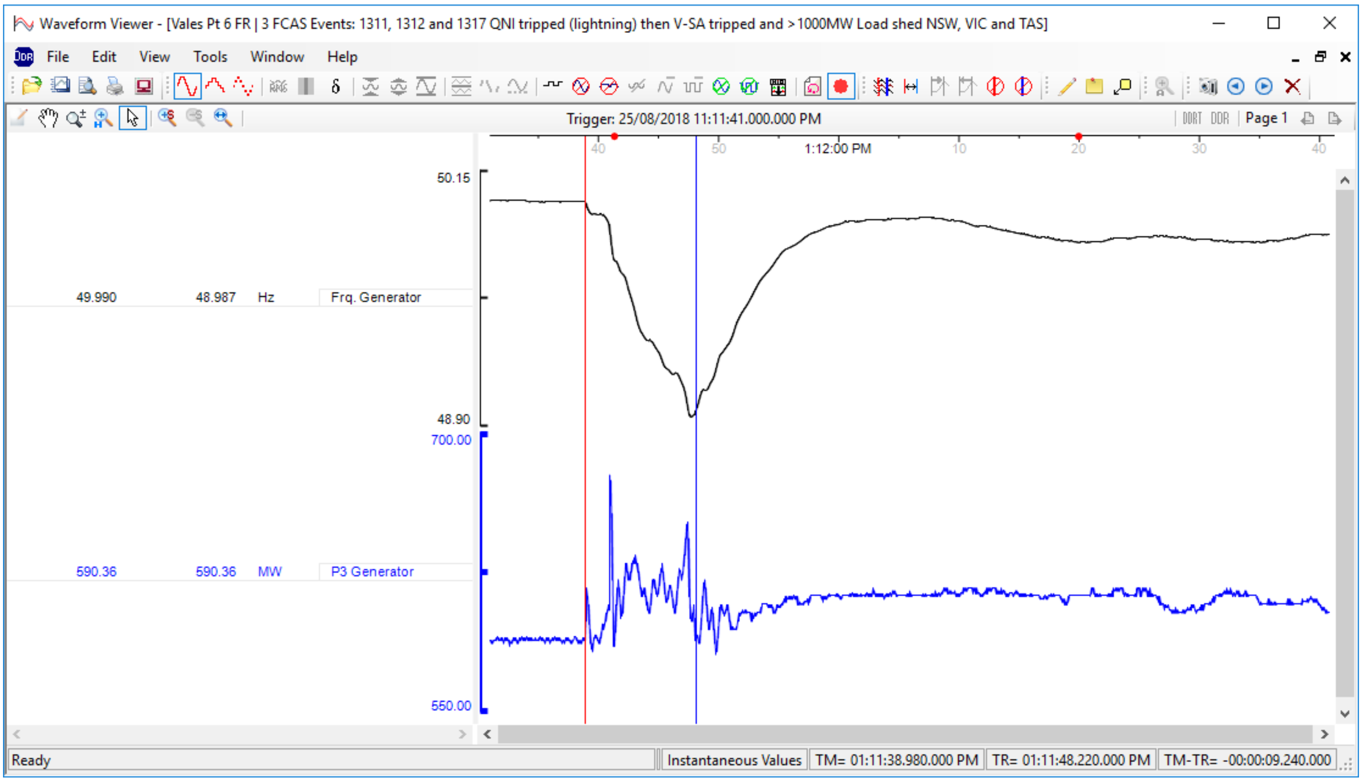
a.	What MASS issues they consider should be addressed in subsequent reviews, including if possible, provide reasoning as to why these issues are important.	FFR services may need to include for control and monitoring data at a rate faster than 1s sampling.
b.	How any other desirable changes to the MASS could be managed in the context of ongoing rule changes.	The combination of services and the incorporation of PFR into the MASS in combination with or separated from Regulation FCAS. These two are a theoretical combination because each is continuously operating during dispatch. However, many contingency FCAS systems utilise the same controller as does the mandatory PFR which means there is a technical challenge and contradiction between the objectives of continuous PFR and that of the more sparsely employed contingency services making the occasional delivery of the latter likely to be affected by the constant delivery of the former. Redesigning the MASS to employ the present frequency responsive controllers as PFR instead of 6s and 60s FCAS is one solution. A redesign of Regulation FCAS could also see a faster and more reactive delivery using the same frequency controller as present PFR and many frequency responsive 6/60s Contingency FCAS systems. This redesign would need AEMO to separate Regulation FCAS delivery signals from the energy dispatch signal and send it separately to each unit where it can be channeled into frequency controls instead of MW setpoint controls

Attachment 2 – 25 August 2018 response and the impacts of 1s resolution data

The permission for participants to use 1s data will limit the capability of AEMO or any other organisation to analyse large contingency events that contain great variability.

The chart below is seventy seconds of frequency and power traces during 25 August 2018 separation of NSW and Victoria systems from Queensland and South Australia. This data was captured in NSW at a 20ms sampling rate.



Observations:

- The red and blue cursors are 9.24s apart
- The frequency decline is non-linear but in 1s sampling, this detail would be lost
- The MW variations and rises and falls are regular and as large as 100MW in 0.3s. Such variations may not be captured by 1s data sampling particularly when examining fast responding frequency services
- Controllers that only assess the frequency every second are also probably less responsive to all variations in frequency (but actually for computerised controllers this might be common and perhaps is preferred to smooth the overall response)