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Australian Energy Market Commission
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Re: Frequency Control Frameworks Review Issues Paper (ref: EPR0059)

Dear Claire,

Tesla Motors Australia Pty Ltd (Tesla) welcomes the opportunity to provide the Australian Energy Market Commission (AEMC) with feedback on the Frequency Control Frameworks Review – Issues Paper (the Issues Paper).

We believe that this is a great initiative by the AEMC as we introduce more renewable sources into the national electricity market (NEM) and fundamentally shift the NEM structure. The scope of this review is a good first step in addressing some of the current structural NEM issues that make it less suitable for emerging technologies such as battery storage.

From a principles perspective, Tesla believes the following:

- The current structure of the NEM was not set up to fully cater for the incorporation of non-synchronous technologies and battery energy storage.
- The current treatment of battery energy storage as both a generation asset and a customer load leads to redundancies, additional administrative burdens for battery operators, and reduces the potential of accessing the full technical capabilities of the battery energy storage system.
- Existing market and technical requirements make it difficult for brownfield retrofitting of battery energy storage to existing renewables.
- Battery energy storage, as a distributed energy resource, can provide substantial benefits to existing network infrastructure. The current network service provider (NSP) approach to connection approval should be considerate of the value and opportunities, as much as the need to mitigate potential risks.

These principles are aligned with the current issues raised in the consideration of the AEMC paper, and we are pleased to provide further supporting feedback, based on our experience in Australia to date.

Summary of Tesla position

Based on the key principles highlighted above, we believe that the current scope of review from AEMC is comprehensive and captures a number of the major issues impacting on existing and emerging frequency markets and providers.

From Tesla's perspective, the three areas to consider in this space are:

- The need to address technical and regulatory issues associated with the existing frequency markets to ensure inverter based, and fast responding technologies can participate to their full technical capability.
- The introduction of new markets to address critical services that are not currently monetized.
- The introduction of a consistent approach for NSP connection requirements and information sharing between aggregated DERs and NSPs so that appropriate value can be recognised from distributed energy resources providing grid services as well as managing network risks.

These elements are generally well considered in the current scope of work proposed by the AEMC to manage frequency issues within the existing markets.

As an additional point, we would strongly recommend that that AEMC considers whether a change to Chapter 2 or Chapter 5 of the National Electricity Rules (NER) to classify battery storage as a separate class of registered participant, or introduce specific energy storage connection requirements, would be beneficial. The current NER requirements that batteries register as both a generation asset and a load has flow-on impacts related to a number of the issues identified below. Though this solution does not specifically address the questions raised by the AEMC in the Issues Paper, it's a further consideration of some of the broader shifts needed in the transition of the NEM. A reasonably similar approach is currently being considered in the UK as Ofgem looks to modify the electricity licence conditions for energy storage assets[1].

Response to questions in the Issues Paper

Questions 2 and 3 – drivers and materiality of degradation from non-dispatchable sources?

Tesla believes that there is a clear opportunity to ensure that the market and regulatory framework are well set-up for retrofit of brownfield renewable sites with energy storage. This will work to mitigate any further impact of intermittent renewables sources on the current frequency performance of the NEM.

While the points made below aren't specific to managing frequency issues, enabling easy retrofit of brownfield renewable assets with energy storage will be important for both long-term security and reliability of the NEM.

An overview of the current principles and issues relevant to retrofitting energy storage to renewable energy assets is included below.

- The regulatory framework around retrofits should ensure that revenue generating potential of the renewable energy asset is not compromised and the risk profile is not worsened by rules associated with the addition of storage. Renewable energy resources are semi-scheduled generation assets. Brownfield retrofits of renewable energy sources with battery energy storage should not change this classification, as the addition of battery energy storage does not shift a generation asset to fully scheduled. This is important as a change to this may impact on the renewable generation asset liability.

[11] Refer, "Clarifying the regulatory framework for electricity storage: licensing" at https://www.ofgem.gov.uk/ofgem-publications/122279

- Retrofitting storage to a renewable energy asset should also have flow-through effects in minimising causer pays liability. The renewable asset should be a beneficiary of reduced causer pays factors if its output is 'firmed' by a storage unit to create an incentive to invest.

Ensuring first that the commercial and market position of a renewable energy asset is improved by the addition of battery energy storage will be vital in improving frequency as we adopt increased penetration of renewable energy into the NEM.

Question 5: Do stakeholders agree with the AEMC's proposed assessment principles?

Tesla agrees with the AEMC in that a market based approach is preferable to mandated services. A market based approach is our preference for the introduction of any new services into the NEM (such as fast frequency response (FFR)) or monetizing existing non-monetized services (such as inertia or primary frequency response). Though this is subject to the points below, and we recognise that additional guidance and jurisdictional requirements may be necessary to ensure the markets are delivering the most efficient technical outcome for the NEM.

The introduction of new markets, or monetizing existing services is an important recognition that we are shifting more to a services based market, and that these services provide great value to the operation of the NEM.

We recognize that there will still be necessary regulatory interventions as we adjust existing technical specifications to make them better suited for emerging technologies (see further points below on proposed changes to the FCAS requirements to make them more appropriate). We also understand that for generation assets of a certain size, mandating specific services may be necessary – such as the UK approach of mandating primary frequency response in their Enhanced Frequency Response Market for medium generation assets over 50MW and large generation assets over 100MW. Further, we also recognise that AEMO may need to play a role to mandate services in certain jurisdictions where there are technical constraints or specific network requirements.

We don't believe that a blanket mandate for specific services – such as fast frequency response (FFR) for all new and existing generators in the market is the best approach. This approach will likely flood the market and may result in an excess of redundant technical capability.

Q6: Are there any comments, or suggestions on the Commissions proposed assessment approach?

The current AEMC approach to amending the NER is broadly representative of the existing state of the NEM. The approach proposed by the AEMC - "1. Define the issues, 2. Determine the options available, and 3.Assess the range of options against the NEO and the guiding principles" works best for dealing with non-structural regulatory changes, or introducing new technologies that have a long project-development lead time.

In the current market we're likely to see the introduction of a more diverse mix of new technologies, providing services that are new in both the context of the Australian market, and in some cases internationally.

In addition, these new technologies entering the market – such as battery energy storage – can be rapidly deployed. As a result, the desktop analysis approach for defining new rules and services that has previously been used by the AEMC should be updated.

Tesla recommends that the AEMC consider regulatory sandbox testing of some of the new services in areas of high need.

The regulatory sandboxing approach would provide empirical evidence of how some of these new services should be entering the market, allowing AEMO to test whether a 2 second fast frequency response market is suitable for addressing network needs, or whether a 1 second market provides greater benefits in a more cost-effective way.

This regulatory sand-boxing approach will be a very important step as we effectively look to fundamentally redesign the NEM to adapt to non-synchronous generation types. This will ensure that the future design of the NEM delivers all necessary services in the most efficient way possible.

Q9: Are stakeholders aware of any other international experience in relation to primary frequency control that is relevant for this review of frequency control frameworks in the NEM?

Of the international schemes listed in the Issues Paper, the Enhanced Frequency Response Market in the UK provides a good model for Australia for primary frequency response markets – provided that the introduction of primary frequency requirements are co-optimised with the existing energy and FCAS markets.

The mandated technical requirements of the ERF are clear and do not over-reach – the requirements to provide primary frequency control apply only to generation assets passing the regulated size threshold (50MW for medium generation assets and 100MW for large generation assets). Within the NEM this approach may be adopted at the same level or with lower thresholds.

Broadly, Tesla supports learning from all existing international markets to develop an optimal Australian outcome. Specifically we support markets structures that are service focused, and support both the need for frequency support and energy reliability. Incentivising energy as well as frequency services, will ensure that new technology entering the market can provide additional necessary services – such as load shifting of renewable energy generated and renewable firming.

Q10: Mandatory primary frequency control

As we have previously noted in our submission to the AEMC on Generator Performance Standards, and as noted above, Tesla does not believe that mandating certain services for all generation assets provides the best outcome, as it's likely to result in a higher cost solution for customers with each generator being over specified relative to actual need of the market.

The approach taken by the UK in mandating primary frequency control of generators over a certain size threshold may provide a better solution.

We further believe that any mandated service should be a mandatory paid service. Mandating a service that has traditionally been provided for free by synchronous generation assets without also attaching revenue, ignores the value of the service in an evolving market. Attaching value to new, or currently un-monetized, services – either in a competitive market, or through competitive bilateral contracts, improves the competitive position of new fast-responding technologies that can provide frequency support in a market with high renewable energy penetration.

Q11: What are the advantages and disadvantages of procuring primary control through bilateral contracting as a means to improve frequency control during normal power system operation?

As noted above, Tesla prefers a competitive market based approach to ensuring adequate levels of inertia in the market. A competitive bilateral tender approach would work provided that the primary frequency response services provided, were co-optimised with both energy and existing FCAS markets.

This approach then lends itself more to bilateral contracts with AEMO, as opposed to with NSPs who cannot also access the benefits associated with energy and FCAS market participation, and as a result have no incentive to co-optimise these services.

Q12: What are the advantages and disadvantages associated with the two options presented for earlier provision of primary frequency control?

Ultimately, Tesla has no preference as to whether primary frequency control is managed through the introduction of a new market approach entirely, or through changes to the existing contingency FCAS markets.

However as it currently stands there are issues with the current status of the Market Ancillary Services Specification (MASS) that need to be addressed for existing FCAS markets, prior to it being a suitable option to base the development of a new market on.

Specifically, the current approach to assessing ramp and range of technologies has been set up for synchronous generation assets, and is not equally suited for inverter-based, fast responding technologies. Tesla has raised the following issues with the AEMC in our previous submission on Generator Performance Standards.

- The max enablement (MW) registration limitation for FCAS 6s, 60s, and 5 minute second contingency services are based on a theoretical frequency ramp that is not representative of the current power system; and
- The limitation due to the frequency ramp and range (i.e., 0.125Hz/s and 49.85Hz to 49.5Hz for mainland registration) for which these services are registered, as presented in the MASS and accompanying FCAS verification tool. This underestimates the capability of energy storage frequency response capability that can operate over much more aggressive ramps and ranges to benefit the power system. Furthermore the system will be providing its full capability but will only generate revenue to what is registrable.
- The parameters required under the current FCAS registration process are not representative of the technical capabilities of fast-responding technologies. Current standards compensate batteries for their capacity based on fossil generator response rates, despite the ability to provide a faster ramp time.

This makes it difficult for the full value of fast responding technologies to be recognized in the current contingency FCAS markets. Regardless of whether primary frequency control is adopted as a new contingency FCAS market, or introduced as a separate market entirely – AEMO and the AEMC need to ensure that technical specifications are written for the technical capabilities of these new technologies.

Q15: What are your views on AEMO's advice on how and when FFR might emerge in the NEM?

Tesla agrees with the point on FFR being technically feasible at present. The Tesla Powerpack for instance, has a response time of <200ms – which falls within the range of FFR technical specifications that are being explored.

Further, the ability of emerging technologies to provide primary frequency response is also technically and commercially feasible at present. The major differences between primary frequency response (or synthetic inertia) as mentioned above, and FFR is that Inertial Response of a resource is based on the Rate of Change of Frequency (RoCoF), whereas the FFR is based on the changes in grid frequency. Tesla battery energy storage systems utilize two separate control schemes to provide both FFR and Inertial Response by reacting to the grid frequency changes and its RoCoF, respectively.

We disagree with AEMOs assertion that “Simulated inertia and grid-forming technologies are not yet commercially demonstrated”. There are a large number of demonstrated microgrid projects in the market with inverters operating in grid forming mode that maintain a simulated grid voltage and frequency. These provide a practical example of how simulated inertia can provide the requisite grid services needed for maintaining stability. There are a number of lessons that AEMO can take from these projects when considering grid-connected options for simulated inertia.

Q16: Potential options for making changes to FCAS frameworks?

What are your views on the above indicative approaches to varying the design of FCAS services, and on other potential changes?

The current technical difficulties of fast responding technologies participating in the existing FCAS markets are noted above in response to question 12. The introduction of a new 2 second market should be designed with fast responding technologies in mind to ensure these issues aren’t carried into any new markets.

Q17: Technical characteristics of emerging sources of FCAS? What should the commission be aware of?

The potential for batteries to provide contingency and regulation FCAS services are already well known, and the MASS has been updated to reflect the inclusion of new technologies such as battery energy storage.

The major points of consideration (however) are around the technical parameters, and redefining what is included in the MASS, and the other technical requirements needed for proper technical consideration of batteries.

There is also sufficient international evidence of the ability of wind-farms to provide FCAS and synthetic inertia services. Montréal-based Hydro-Québec TransÉnergie, was an early grid operator to mandate this capability from wind farms at an international level. During a December 2015 transformer failure that took more than 1,600-MW of power generation offline, synthetic inertia kicked in 126 MW of extra power to arrest the resulting frequency drop[2]. In Australia, Neoen’s Hornsdale Wind Farm is undertaking a trial as the first Australian wind farm to provide FCAS services to the NEM[3].

Notwithstanding the comments above regarding the technical changes necessary to allow inverter-based technologies to participate in FCAS markets to their full technical capabilities, the AEMC should be aware that renewables and battery energy storage are already commercially providing FCAS and primary frequency services, with capability and commercial appetite only likely to grow with appropriate market set-up.

Q20: Co-optimisation with other markets: Are there other system services, such as inertia, system strength or system stability, that should be co-optimised with FCAS markets?

We believe that it is important to co-optimise energy, FCAS and any emerging frequency markets as we shift more towards a services based energy market.

[2] Refer "Can Synthetic Inertia from Wind Power Stabilize Grids?”, at https://spectrum.ieee.org/energywise/energy/renewables/can-synthetic-inertia-stabilize-power-grids

[3] Refer, “Frequency Regulation Capabilities in wind power plant”, at http://www.sciencedirect.com/science/article/pii/S2213138817303892

Co-optimisation of markets will encourage the uptake of technologies that can provide a range of different services, necessary for the efficient operation of the NEM. This includes regulation and contingency FCAS, primary frequency control, and time-shifting of renewable energy loads to improve energy reliability. These services may also be co-optimised with broader network support services to manage network constraints and delay investment in new or additional transmission and distribution infrastructure.

While we support further markets being co-optimised with the existing energy and FCAS markets, it's important that AEMO considers their current approach to dispatch and internal co-optimisation of generation assets. Battery storage assets have significantly faster ramp rates than traditional synchronous generators. During volatile price events, AEMO's current market approach of co-optimizing generation assets, can work to push out battery storage assets during high price events. This may result in perverse market outcomes, as batteries should be able to deliver the services more efficiently.

Q21: To what extent is it important that the NER arrangements for the provision of system security services are consistent between providers of such services, e.g. large, transmission-connected generators and distributed energy resources?

The NER arrangements do not need to be consistent for connections under Chapter 5 (registered participants) and Chapter 5A (DERs). The connection approval processes and metering arrangements should be different and appropriate for the size of the installation being connected. This is important to maintain appropriate technical and administrative requirements for DERs. For example, AEMO currently requires industrial-grade meters for demand-side participation that is cost-prohibitive for residential systems. Metering requirements for residential demand-side participation should be limited to reasonable residential accuracy levels for cost-effectiveness.

However, we believe that consistency in arrangements for DERs connecting to various distribution networks would be beneficial from a technology deployment perspective (see also response to Q22 below).

Q22: Frameworks for the connection and operation of distributed energy resources

Tesla supports a focus on adopting a transparent, appropriate and consistent frameworks for DER sources to manage the long-term market participation of aggregated energy sources and virtual power plants (VPPs). Tesla believes that increased consistency across existing DNSP technical specifications will be an extremely valuable step in improving the ability of distributed energy resources (DERs) to provide network support. There are significant network benefits to be accessed by NSPs from DER sources – and this should be the basis for any framework developed.

a) Tesla believes that the existing connection frameworks do inhibit the participation of DER sources in the broader energy markets. There are significant barriers around the inconsistent interpretation of AS4777.2 by DNSPs and the limitation requirements put on inverter based technologies by DNSPs. The current DER connection requirements call for some or all of the above:

- DNSP total inverter size limits (e.g. 10kVA per phase)
- DNSP export limits (e.g. 5kVA per phase), and
- DNSP phase imbalance requirements
- Power ramp rate limitations

We recognise that networks understand their requirements and seek to limit major grid issues associated with DERs. We propose that the identified issues could be alleviated through improved information sharing and communication between distribution network management systems and aggregated DER systems. We would support the focus on a consistent framework that still manages specific network requirements.

A focus on developing consistent principles across the DNSPs would alleviate many of the issues associated with inconsistent interpretation of AS4777.2 requirements (some of which are outlined in response to part C below). In addition to minimising impacts on the grid from DER sources, we also believe that a consistent framework and principle based approach for DER connections, will increased opportunity for DNSPs to access some of the network support benefits associated with DER sources.

We're supportive of the AEMC's focus on creative partnerships between the networks, technology providers and others – through data sharing and dynamic DNSP network management systems.

b) We believe that the provision of system security services should be incentivised through aggregated platforms that can interact with AEMO/DNSPs/etc. signalling. These capabilities do not need to be mandatory requirements, i.e. basic connections could have export limits applied if not interactive with the utility management system.

c) It is administratively burdensome and costly for technical studies to be undertaken to assess connection requests for systems not meeting basic criteria. This can also impact on connection approval of systems in certain places. Again the information sharing aspects between network service providers and DER aggregators can alleviate the need for these detailed studies.

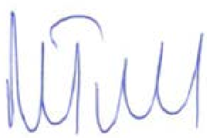
The lack of consistency in the current interpretation of AS4777.2 and Chapter 5A of the NER also results in inconsistent opportunities for DERs in network jurisdictions. For instance in network jurisdictions with 5kVA export limitation only, small business' may be able to install upwards of 20kW in battery storage for self-consumption with little to no administrative issues. In jurisdictions with firm 10kVA total inverter limitations – this process would be far more difficult and may result in reasonably substantial additional costs for the consumer. This would also prevent the NSP from accessing the full benefits of grid services from these resources.

With the appropriate management of these issues noted above, and a consistent framework across the board – there is significant potential for DER sources to take a more active role in participating in the energy market.

Conclusion

Tesla appreciates that this is the first step in addressing some of the emerging challenges in the NEM, but we appreciate the efforts of the AEMC in addressing these issues. We look forward to seeing technical specifications adapt to emerging technologies; new markets introduced to recognise necessary services; and existing regulatory frameworks adjust to appreciate the services of new technologies. We're grateful for the opportunity to comment and would be welcome the opportunity to provide the AEMC with further learnings on our experience in Australia or internationally.

Kind regards



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