Tesla Motors Australia Pty Ltd
650 Church St
Cremorne, Victoria, 3121

Sarah-Jane Derby
Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

6 February 2018

Re: Reliability Frameworks Review Interim Report (ref: EPR0060)

Dear Sarah-Jane,

Tesla Motors Australia Pty Ltd (Tesla) welcomes the opportunity to provide the Australian Energy Market Commission (AEMC) with feedback on Reliability Frameworks Review – Interim Report (ref: EPR0060).

This Review is an important component of the broader work program that the AEMC is currently undertaking. In alignment with the Frequency Frameworks Review, we hope that recommendations emerging from the two reviews will better enable the National Electricity Market (NEM) to support renewable energy generation paired with battery energy storage capacity.

To improve reliability within the NEM, Tesla supports a twofold approach:

- Ensuring that the energy market structure adequately incentivizes flexible capacity at a utility scale, to support increased penetrations of renewable energy – for both energy and system security services.
- Ensuring that aggregated distributed energy resources (DERs) can easily participate in wholesale energy as well as ancillary services markets in addition to providing demand response services.

Our response below provides an overview of the market barriers that we believe currently exist, as well as recommendations on how these might be managed. These recommendations, in addition to the revenue streams and opportunities that are considered under the Frequency Framework Review work stream, are likely to provide additional incentives for flexible capacity.

It is important also, to note that long-term non-market mechanisms can also address NEM reliability. The current Integrated System Plan work being undertaken by the Australian Energy Market Operator (AEMO) to establish renewable energy zones will highlight the relevant infrastructure requirements necessary to ensure energy security and reliability as our generation mix changes. We believe that this work should form the basis of any non-market interventions that are taken, and may feed into final recommendations on reliability.

A full consideration of Tesla's position, as well as our feedback on current market and regulatory limitations is provided below.

1. Market based reliability – utility scale

As noted above, Tesla supports a wholesale market structure that encourages increased penetration of flexible capacity. We agree with the AEMC's comment that resources that are more flexible are more valuable in maintaining the balance of supply and demand. With due respect to the AEMC point on the limited duration that batteries can provide energy into the market for, we do not believe this is an issue. A major benefit of batteries is the scalable nature of the technology. Duration can be extended to support renewable energy sources. The points made by the AEMC on the inherent reliability limitations of both solar PV resources and battery energy storage demonstrate how renewables and batteries complement each other to provide flexible capacity.

At a small scale the 1.4MW solar PV array and the 750kW/ 6MWh Powerpack system on the island of Ta'u provides energy independence to the nearly 600 residents of Ta'u. The microgrid allows the island to store and use solar energy for all their energy needs each day, throughout the year.

Addressing energy market volatility involves addressing the following counterfactual. Energy market volatility and high price events incentivize fast responding, flexible technologies to participate in the energy markets. However, flexible capacity will increasingly be required within the NEM in order to reduce this price volatility.

As noted by Tesla in previous submissions to the AEMC, we support a co-optimised approach to energy and system security services – including co-optimisation between existing markets and any emerging markets. This position also holds for considering the best models to encourage the further integration of flexible generation capacity.

If additional optimisation is required, the AEMC may consider which services may be contracted in order to better manage price volatility. A possible solution would be to maintain the status quo of the energy market as a real-time market, but shift to greater contracting of system security services – inertia and fast frequency response (FFR), as well as existing FCAS markets. These options, as being considered under the Frequency Frameworks Review work may lower FCAS market volatility and reduce the flow on costs to consumers.

Alternatively the AEMC may consider introducing flexible capacity markets over and above the existing energy markets to further incentivize flexible capacity, and improve system stability, as well as managing price volatility.

Tesla's thoughts on reforms for the energy markets, and FCAS markets, that will better incentivize flexible capacity is outlined below. In order to fully demonstrate the behavior of flexible capacity in the energy and FCAS markets, we've included operational data from the Hornsdale Power Reserve project.

Energy markets

To an extent, Tesla agrees with the AEMC in respect of the position that "Dispatchability and flexibility can be considered to already be valued and rewarded in the existing contract, spot and ancillary services markets". Real-time energy markets provide greater incentives for flexible capacity to participate, as they are awarded for quick response times during high price events. This is likely to be realised to an even greater extent with a shift to five minute settlement.

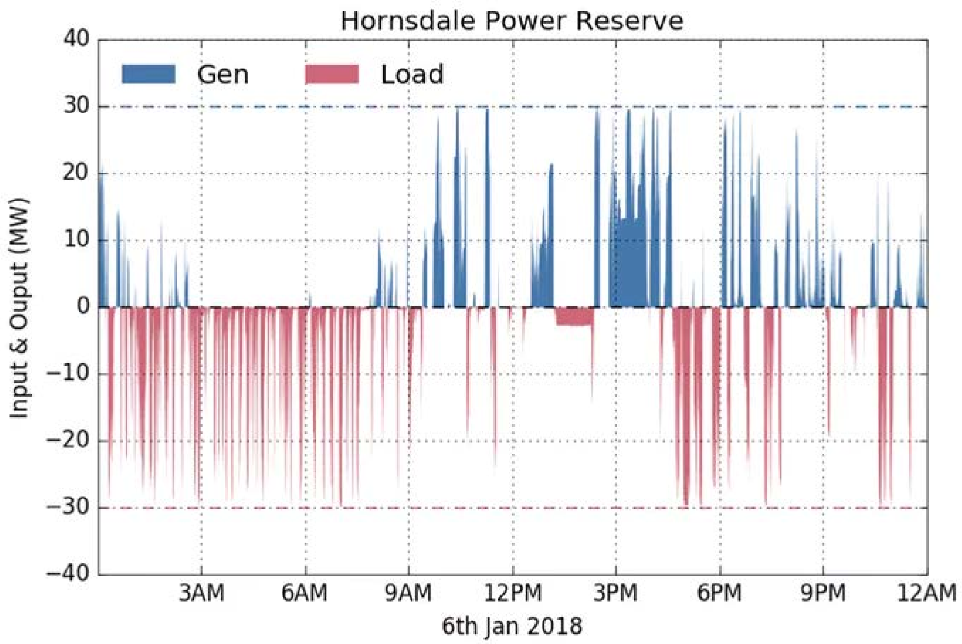
Tesla also agrees with the position of the AEMC that the existing contract markets are designed to manage some of this volatility, and wholesale market price exposure, and do a relatively good job of doing so. The contract market structures will need to evolve over time to account for changing markets – such as a shift to five minute settlement, but they are unlikely to lose their effectiveness.

The primary issue currently relates to how different flexible inverter-based technologies are treated within existing market participant categorisation.

Currently, a battery energy storage system (BESS) asset currently has to register as both a generator and market load to provide both charging and discharging services. As a result a more conservative approach to bidding is required as the BESS operator or market participant is required to estimate whether a charge or discharge service is likely to be more valuable to the market within a given dispatch period. This approach avoids dual clearance risks but does not deliver the most efficient market outcome.

In an optimal market the BESS system would be able to submit a single dispatch bid for both generation and load services, and the market would determine whether charging or discharging provides the greatest market value for a given dispatch period.

The following figures, developed by Dylan McConnell of the Australian-German Climate & Energy College provide insight into the speed and flexibility of the response times of the Hornsdale Power Reserves. Figure 1 above provides a demonstrable overview of the speed at which a utility scale battery energy storage system can move from charging to discharging.



Generation and consumption of the Hornsdale Power Reserve on the 6th of Jan 2018. Author provided [data from AEMO]

Figure 1: Hornsdale Power Reserve charge and discharge

Tesla recommends the following energy market changes should be considered to better incentivize flexible responding technologies:

- A distinct market participant classification for BESS assets that will allow for single dispatch bids for both generation and load services, and provide optimal market results.
- The consideration of alternative mechanisms for incentivizing utility scale capacity outside of changes to the existing energy market:
  - Require that a portion of all generation is flexible, which may be managed under the NEG reliability obligations
  - Establish a capacity market for flexible generation. The UK model provides an overview of energy markets operating in conjunction with capacity markets. This approach could incentivize increased penetration of flexible generation, capable of providing fast responding services; which would start to manage some price volatility in the energy market.

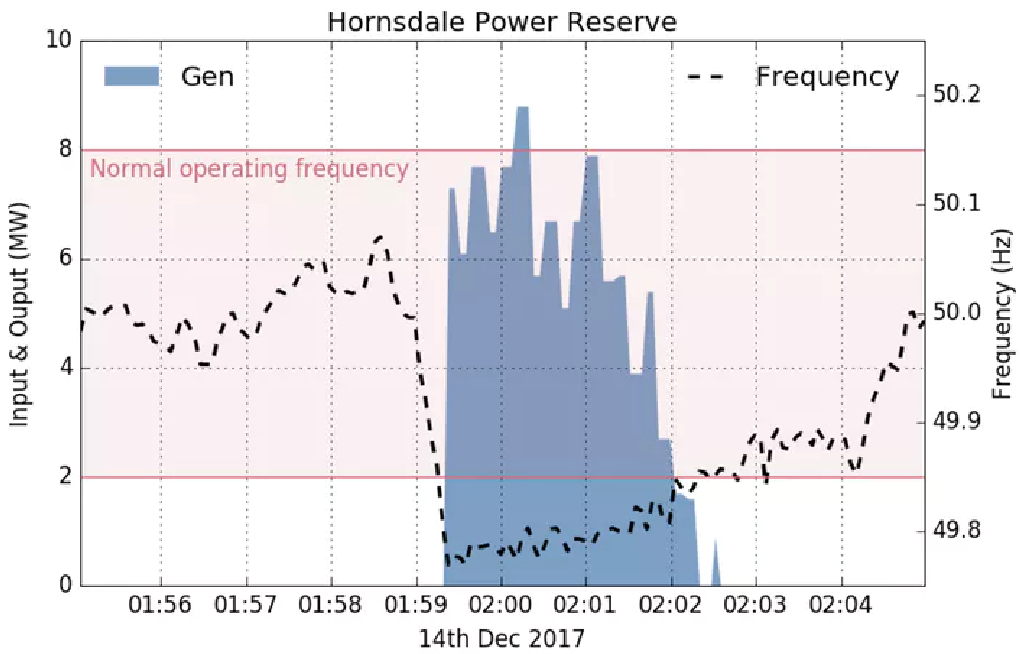
FCAS markets

As Tesla noted in previous submissions to the AEMC, the technical parameters for FCAS participation were not established with battery energy storage in mind.

A full overview of these inherent technical limitations are included in detail, in Tesla's responses to the Generator Technical Performance Standards rule change (ref: ERC0222) and the Frequency Control Frameworks Review Issues Paper submission (ref: EPR0059).

The experience of the Hornsdale Power Reserve has demonstrated both the value of battery energy storage in FCAS market participation – as well as the current limitations associated with registering a BESS asset to provide such services, both technical and market. For the purposes of this submission, we only consider the market issues.

Figure 2 below demonstrates the speed at which the Hornsdale Power Reserve is able to respond to a contingency FCAS – specifically to an incident when a Loy Yang unit tripped on December 14.



The Hornsdale Power Reserve responding to a drop in system frequency. Author provide [data from AEMO'

Figure 2: Hornsdale Power Reserve - response to contingency FCAS event

As demonstrated in the charts above – the Hornsdale Power Reserve can respond rapidly within existing market parameters. However the true value of this rapid response is not fully recognised. The fastest FCAS contingency FCAS market is six seconds, while the Tesla Powerpack response time is <200ms.

Tesla understands that the consideration of a new fast frequency response (FFR) market as a stand-alone market or an update to the existing FCAS settings is a matter for the Frequency Frameworks Review. However the two processes are very interrelated. Ultimately ensuring the appropriate mix of reliability and security in the market should be based on appropriately compensating flexible capacity that can provide both energy and system security services.

The Hornsdale Power Reserve project has also been effectively responding to AEMO AGC signals and providing regulation frequency support since it commenced operation[1].

[1] Dylan McConnell, "A month in, Tesla's SA battery is surpassing expectations", https://theconversation.com/a-month-in-teslas-sa-battery-is-surpassing-expectations-89770

Tesla has made the following recommendations in our previous submissions to the AEMC, but it's also important to account for these when considering the optimal market settings for security and reliability:

- Addressing technical constraints that prevent fast responding technologies from accessing their full technical value in existing FCAS markets.
- The need for monetization of critical services required for ongoing system security – such as the provision of inertia or FFR, needs to be appropriately compensated.

As noted above, improved system security settings will further incentivize flexible capacity to enter the market, and enhance optimal market settings for reliability and security.

Day-ahead markets

Day ahead energy markets have been demonstrated to hedge the risks of large industrial players and energy consumers in the US. However, the existing derivatives market should provide the same service to the NEM.

Day ahead markets are predominantly used internationally to provide market signals and certainty to large energy users. To an extent the NEM manages this issue through pre-dispatch data released by AEMO, which covers 30 minute forecast data by region to the end of the next market day.

The issues that are addressed with day ahead markets in international electricity markets, either do not exist in the NEM or are already being addressed with the existing mechanisms. A cheaper, faster and less complex approach to increase reliability instead of introducing a day ahead market, would be to consider the effectiveness of how the pre-dispatch data is currently been used.

Tesla agrees with the point made by the AEMC that the problems that a day-ahead market would seek to address have not been fully demonstrated. In light of the forthcoming shift to five minute settlement, and subject to the comments above, the benefits of moving to day ahead markets are yet to be fully articulated.

2. DER participation and demand response

As noted above, a key component for the ongoing reliability considerations within the NEM will be ensuring that distributed energy resources can add additional capacity into both the wholesale and retail markets, as well as provide contingency and regulation FCAS services, provided they can meet the technical requirements.

We would like to see a framework that allows for a broader range of market participants to provide both demand response and aggregated energy or FCAS services. The existing settings of the NER provide some challenges in this area.

As noted by the AEMC, there are three ways that wholesale demand can currently be provided in the NEM:

1. Retailer procurement of demand response
2. Spot price pass through arrangements with a retail contract
3. Registering as a market customer and purchasing electricity directly from the wholesale market.

The first two options are reliant on retailer involvement and do not allow for alternative types of aggregated DER assets to access demand response revenue streams.

The third option – registering as a market customer – is open only to large energy users willing to hedge their price risks. Again, this isn't an option for aggregated DER assets.

Market changes to support DER participation

Tesla supports a market change that will open up new opportunities for aggregated DER asset bases to participate in the wholesale energy, and FCAS markets, as well as providing demand response services.

Bloomberg New Energy Finance (BNEF) projects over 3GW of cumulative installed residential BESS capacity by 2030[2]. As with utility scale BESS assets, this represents an asset base of fully controllable generation and customer load that can provide critical reliability in a changing market.

The existing market framework is not, however, well set up to extract energy, FCAS or demand response services from these assets, without the involvement of a retailer.

Excluding retail requirements, existing market participation classifications are written with large scheduled or semi-scheduled generating assets in mind. The Small Generator Aggregator (SGA) market classification has specific revenue grade metering requirements, beyond standard residential meters. Further SGA market participants are still limited in the services that can be provided, most notably SGA market participants cannot provide FCAS services.

An ideal model would allow an aggregated asset base to participate in wholesale energy and FCAS markets. These new models should also take into account the rapidly expanding technological advances that may provide alternative means to meet the measurement and monitoring requirements associated with energy and FCAS market participation.

This approach provides a larger asset base for improved energy reliability and enables greater participation. In addition, we would like to see a model that also enables DER assets to provide additional relevant services such as:

- Behind the meter wholesale market demand response.
- Network support services.

To properly allow for this, we recommend that the AEMC considers the following principles:

- **Current market participant categorisations** - there is no single market participant category that sufficiently allows for aggregated DER assets to participate in wholesale energy and FCAS markets, as well as providing demand response services. As new models are considered and adopted, we support a streamlined approach for allowing aggregated DER assets to provide all relevant services.
- **Existing barriers** – the market participation categories that are suitable for DER resources currently have significant barriers. Most significantly are the costs associated with integrating traditional revenue metering requirements – designed for much larger generation assets – onto much smaller generation units.
- **Technology benefits** – a key component of integrating a broader aggregated base of DER units is recognising the unique technological features that they bring to the market. We support trials that demonstrate both the technical capabilities of aggregated asset bases, as well as more efficient options for providing all of the required measurement and performance monitoring requirements under the NER.

Tesla suggests that setting up an appropriate regulatory sandboxing approach would be the best option for establishing how an aggregated DER base could be set up to best provide all relevant energy, FCAS and demand response services, without disrupting existing AEMO processes. Testing of appropriate models should inform the best approach for establishing a new class of market participant, to improve access for this new class of energy provider, and increase market competition.

[2] Bloomberg New Energy Finance, “Energy Storage Forecast, 2017-30”, November 2017

Conclusion

Tesla is happy to further support the AEMC in testing any of the suggestions outlined above. As greater penetrations of utility scale battery energy storage and aggregated DER assets are rolled out, the benefits to the broader markets should become clear. We look forward to continuing our engagement with the AEMC during this transition.

Kind regards

Mark Twidell

APAC Director – Energy Products