



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

Mr Ben Hiron  
Australian Energy Market Commission  
PO Box A2449  
Sydney South NSW 1235

31 October 2019

**Re: Primary Frequency Response Rule Changes – Consultation Paper (ref: ERC0274)**

Dear Ben,

Tesla Motors Australia, Pty Ltd (Tesla) welcomes the opportunity to provide the Australian Energy Market Commission (AEMC) with feedback on its Consultation Paper on the Primary Frequency Response (PFR) Rule Changes (the Consultation Paper) proposed by AEMO and Dr Peter Sokolowski.

Tesla looks forward to working with the AEMC in addressing the priority objective to improve power system security in the National Energy Market (NEM).

Since 2016, we have been actively engaging on reforms to shape the Australian energy market to move towards a future of utility scale renewable energy, utility scale storage, distributed energy resources (DER) and demand side participation. Most recently, this includes contributions to the Australian Energy Market Operator (AEMO) "Integrated System Plan (ISP)"; the AEMC "Coordination of Generation and Transmission Infrastructure (COGATI)" reform; and the Energy Security Board "Post-2025 Market Design". We believe that all active rule changes currently being managed by the AEMC should be considered with this future lens.

Our feedback to the Consultation Paper, therefore, is based on how we see the set of PFR rule changes operating within the broader reform suite currently under development. Rule changes such as this cannot be considered in isolation, or we run the risk of iterative and incremental change rather than the development of long-term solutions for system security and reliability.

With this context in mind, and in reference to the issues raised in the Consultation Paper, Tesla highlights the following:

- We support the position that PFR is a necessary component for the NEM and needs to be introduced as a matter of priority. However it must be introduced in the most economically efficient manner, and avoid prejudicing longer term market design ambitions.
- We believe that further work is needed to be done by AEMO on the AEMC on the level of PFR needed to improve the current frequency position of the NEM.
- Further work is also required on the application and appropriate implementation options for asynchronous assets.
- We support a two-staged approach, and would like the AEMC to explore the following options further in the Draft Determination to be released in December:

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- **Short term (implemented prior to summer 2020/21):** explore mechanisms that can be introduced prior to next summer without mandating primary frequency response across the entire fleet of scheduled and semi-scheduled assets. The AEMC should look at 1. options for bilateral contracts – including contracts for assets with different response capabilities; and/or 2. Mandating response for a subset of the fleet commensurate with the PFR needs of the NEM – such as synchronous generation.
  - **Long term (considered in parallel for later deployment):** develop a market-based approach as a more efficient long-term solution. Creating the appropriate incentive structures for future services will be critical for the transition of the Australian energy market over the next decades - particularly as large synchronous generation plant retires.
- Maintaining a secure system in the face of any complex disturbance should be addressed through a complementary combination of PFR with existing contingency and regulation FCAS markets – services which are not mutually exclusive and should be designed to work together.
  - Geographical diversity of power system security services should be introduced immediately as a matter of principle (i.e. inertia and FCAS allocated and procured regionally).
  - The PFR dead-band should be based on that proposed by Dr Peter Sokolowski in his rule change.

Additional detail relating to each of these points is included in the response following. For more information on any of the information included in this submission please contact Dev Tayal ([atayal@tesla.com](mailto:atayal@tesla.com)) or Emma Fagan ([efagan@tesla.com](mailto:efagan@tesla.com)).

Kind regards

Mark Twidell

Kind regards



Mark Twidell

Australia Director – Energy Products

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## **Tesla supports revising the frequency control mechanisms to improve power system security in the NEM**

Tesla agrees that there are deficiencies in existing market ancillary service arrangements and notes the evidence that AEMO's AGC system is struggling to efficiently control power system frequency. We also note that the situation will only continue to worsen as the generation mix changes going forward. We strongly support the efforts of AEMO and the AEMC to reduce variability in the normal operating band of frequency, which will result in positive outcomes for the industry as a whole – flowing through to customers.

During the Frequency Control Frameworks Review, AEMO advised that there was no immediate need to implement regulatory change to address the deterioration in frequency and that current regulatory tools were adequate to manage frequency performance. Given the rapid transformation occurring (and noting the 25 August separation event that highlighted the significance and immediacy of NEM-wide impacts), it seems this is no longer the case, and new regulatory arrangements to explore appropriate frequency control mechanisms must be expedited to keep pace with the system transformation that will only continue to accelerate.

## **Tesla supports further work done by AEMO and the AEMC to determine the actual PFR requirements of the NEM, and the impacts of the rule change on asynchronous assets**

Tesla supports more detail being included in the Draft Determination regarding the level of PFR actually required in the NEM and outlining what the immediacy of the problem requires. High level comparisons with comparable markets in other jurisdictions suggest procurement levels for PFR are much lower than the overall size of the market. By principle, these levels become even lower as the provision of PFR increases in quality (e.g. millisecond as opposed to 10 second response). Once the required level of PFR is determined, industry will then have a much clearer idea of the best long-term mechanism for providing PFR in the NEM.

We also believe that a better understanding the PFR requirements of the NEM will enable a short-term solution that is more economically efficient than mandating PFR across the entire fleet of scheduled and semi-scheduled assets. Finding the balance between whole-of-system solutions that can be implemented quickly, in a way that does not impact on incentives structures for new technologies and replacement capacity, will be critical.

It would be beneficial to assess how a small number of generators providing quality PFR (fast response and high accuracy) that is also geographically dispersed, compares against the proposal for broad-based provision from a generating fleet with lower quality PFR. It would also be beneficial to assess the capability and impacts for the asynchronous fleet in providing PFR.

### What are the costs associated with the proposed rule change?

It is not clear what the additional costs are for the broad-based approach. In addition, AEMO has proposed compensating any capital expenditure required for existing generators to modify their plant in order to comply with mandatory PFR.

It would be good for the AEMC to expand on the following in the Draft Determination:

- How do the capital costs associated with mandatory response compare the ability of a much smaller fleet of PFR assets providing rapid and accurate response (e.g. through a direct contracting model)?
- What are the impacts on other markets – particularly regulation and contingency frequency markets, and what impact will that have on creating the right market signals for new build capacity – in line with ISP projections?
- What are the costs of compensation expected from AEMO?
- What are the impacts of any reallocation of causer pays liabilities across different market participants?

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- If mandatory PFR settings for semi-scheduled assets are introduced in a different time-frame to the removal of disincentives rule change. What is the impact on wind and solar farm output and revenues?

If more frequency response capability is mandated than is required, there is a concern that any ancillary markets for frequency control services (whether contingency, regulation or future markets) will not serve to signal the value of the service or to appropriately incentivise investment. This would also go against broader AEMC efforts to improve price formation in wholesale markets. Without a market for PFR, the cost of frequency response would remain hidden.

To meet the short term system security needs whilst also ensuring the NEO is satisfied, it will be important to thoroughly assess whether alternative options can provide sufficient levels of PFR to maintain frequency across the NEM in the most cost-effective manner.

Tesla points to the UK's introduction of an 'Enhanced Frequency Response' service (through direct contracting), with National Grid citing significant economic benefits and operating a procurement level of only 200MW – which can be largely satisfied by fast responding inverter based technologies competing on price. The AEMC could build on this model (and avoid incentivising single-use, short-duration assets), by also allowing service stacking - with tenders for PFR requiring: high response accuracy; fast response (e.g. <500ms); and complementary service provision (e.g. availability in other FCAS markets).

### **Tesla supports a two-stage solution with a longer-term focus on introducing a market based PFR mechanism.**

As per Tesla's response to the AEMC Frequency Control Frameworks Review (FCFR) Draft Report in April 2018, Tesla supports the development of a PFR market. Creating the right incentive structures will be critical to ensuring that appropriate flexible and responsible capacity is built to replace the existing synchronous fleet as it closes over the next 10 - 15 years.

Given the criticality of PFR and the need for rapid action, Tesla would like to see the AEMC further develop a two stage approach, with more information provided on both alternative short-term options, and a future market based mechanism, in the Draft Determination. Specifically we would like to see more information on the following:

1. **Short-term:** Alternative PFR mechanisms that can be delivered by next summer, specifically
  1. A bilateral contracting mechanism to procure appropriate levels of PFR; and/or
  2. Mandatory requirements for a subset of the fleet (synchronous generation) – such as synchronous assets. This solutions would both be a short term as an alternative to mandatory settings across all scheduled and semi-scheduled generators.
2. **Long-term:** Long-term transition to a market-based approach – with work done to define the market needs and structure the mechanism to support this.

From a first principles perspective, we would like to see a short-term solution implemented that can best enable the transition to a market based PFR mechanism. We need more detail included in the Draft Determination to best support this decision.

A contracting mechanism is consistent with the majority of countries that currently have a form of a primary frequency response mechanisms – whereby they pay for services (either through direct bi-lateral contracts, or through markets). This ensures efficiency of PFR provision is maintained across both pricing and quantity outcomes. Different contract specifications could also be designed to ensure an appropriate mix of fast and slow start technologies to ensure adequate PFR levels.

As an alternative, the FCFR Final Report recommended a replicating the Tasmania trial of PFR in the mainland. This solution could be further explored, with a view to mandating PFR settings for a subset of the

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NEM generation fleet (the synchronous fleet) only on a trial or longer-term basis. This would then support the transition to a functional market mechanism.

Longer term, the use of market mechanisms to procure primary frequency response will enable fair competition between all technology types that are capable of providing this service. Markets for frequency response would support resource efficiency, price formation and additional value streams for resources, and comparable treatment between new and existing resources. This aligns with AEMO's recommendations in the 25 August separation event report, which proposed that early design and assessment be submitted to the AEMC in parallel with immediate PFR changes (Q3 2019); ahead of a detailed solution and implementation process to be completed by mid-2020. Even if these initial timeframes can no longer be met, the design and implementation framework for the preferred market-based approaches should be further explored as part of this rule change process, alongside a commitment to expedite implementation timeframes.

As noted by the AEMC in the FCFR Issues Paper<sup>1</sup> released November 2017, the provision of PFR is common across a number of international jurisdictions. Mechanisms for primary frequency control trend towards market based solutions, or a combination of market based solutions and mandatory paid or unpaid solutions in all jurisdictions that were considered by the AEMC. Of the 12 jurisdictions considered, only Spain requires mandatory, unpaid PFR from market participants.

Removing disincentives and/or creating positive incentives (via causer pays avoidance) is not likely to provide adequate commercial drivers to incentivise new flexible plant to enter the market. As noted above, it may also be worth the AEMC exploring how remaining causer pays liabilities become allocated through the market should all major generation assets qualify for causer pays exemptions by providing PFR. If the understanding is that the majority of these costs will transfer to market customers, it is worth exploring the impact of these costs and efficiency of this approach should they be passed through to end-consumers.

Mandating requirements across the entire fleet of scheduled and semi-scheduled assets, even as an interim solution, risks stymieing investment and prejudicing market design decisions in the longer term – reducing the investment case for new technologies in the meantime. It would also create the unintended consequence of introducing additional barriers in moving to a market model. For example, it is not clear how the AEMC would be able to justify moving away from a mandated PFR to a market based approach without either lowering frequency stability and introducing system security risk; or introducing additional transitional costs in the market (i.e. paying for a service that has previously been required to be provided for free) – even if there is consensus that alternative mechanisms are more economically efficient.

### **Complementary frequency control measures**

Tesla supports the position that markets for fast, slow and delayed ancillary services will (at a minimum) remain to guarantee capacity reserves in the event of a contingency.

Ahead of any quantitative assessments of the NEM's PFR requirements being presented, and based on precedents set by other markets, the expectation is that only minimal amounts of PFR is required relative to the procured quantities of existing FCAS. This suggests mandating a significant portion of the NEM's generation fleet to provide PFR would over-correct and lead to unnecessary flow on impacts to existing FCAS mechanisms.

The introduction of PFR needs to be part of a broader suite of rule changes as contemplated in the FCFR and in this Consultation Paper, specifically:

- Jurisdictional contingency FCAS procurement
- Fast frequency response (FFR)
- Performance based regulation FCAS payments

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<sup>1</sup> [https://www.aemc.gov.au/sites/default/files/2018-03/Issues%20paper\\_0.pdf](https://www.aemc.gov.au/sites/default/files/2018-03/Issues%20paper_0.pdf)

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There is broad consensus that fast response frequency control can be valuable, particularly following a large disturbance, or when the power system is operating with low inertia.

The viability of a 'deviation pricing mechanism' could be explored to efficiently value the provision of regulation frequency services under normal operation, progressively ramping up the \$/MWh price offered as the level of deviation increases. This could also operate as an extension to existing causer pays processes - i.e. ensure positive contribution factors become recognised, rewarded and paid from charges levied on participants that negatively impact system frequency.

A related primary regulating response could be facilitated through the creation of a new market (so as not to compete with services offered under existing regulation FCAS) and similarly introduce positive factors or incentive payments for quality performance. Ultimately this performance-based pricing mechanism should be extended to all services – frequency, inertia, FFR etc. This will mean that generators able and willing to provide a frequency response at a lower cost will set their dead bands at a narrower range and will therefore be the first to respond to any deviations in frequency.

Similarly, managing poor performance could be explored through the introduction of performance standards. For example, requiring resources to meet minimum accuracy factors in order to maintain full payments and ultimately prevent the most in-accurate responders from being eligible for service provision.

Enhanced granularity in the procurement of frequency services would also highlight the true value of frequency response and avoid a situation where out of market actions to ensure system reliability further obscure the costs of service. This aligns with findings from AEMO's 25 August separation report that recommended investigating whether a minimum regional FCAS requirement may be justified, as also highlighted in the Consultation Paper (pg 35): "*Considering the regional allocation of contingency FCAS to ensure geographical diversity of market procured PFR*" and in AEMO's rule change request.

A precedent for regionally based procurement has already been set by inertia requirements – where the 'Managing the rate of change of frequency' rule change published in September 2017 introduced the requirement for AEMO to maintain minimum levels of inertia throughout different regions of the NEM. Upon AEMO declaring an inertia shortfall in a NEM region, TNSPs must procure inertia network services through the construction and operation of synchronous condensers or entering into service agreements with synchronous plant.

### **Benefits of fast responding technologies**

Dr Undrill's recommendation that "*deadbands and droop settings should be as uniform as possible across the fleet in the interest of equitable contribution to PFR*" fails to recognise the spectrum of service provision that can be obtained across different technology types, such as the 'premium' service provided by HPR:

- "*HPR's Fast Frequency Response provides a premium Contingency FCAS service on the NEM with the speed and accuracy of its response. Modelling demonstrates its potential to provide significant support to arrest falling frequency due to contingency events which, in some cases will avoid or reduce the activation of load shedding*"<sup>2</sup>
- HPR currently provides Fast Frequency Response while participating in all six of the existing Contingency FCAS markets. It provides a premium service in this market through its fast response time of approximately 100ms, as compared to the minimum required 6 second response under existing Contingency FCAS markets. This premium service supports a reduced Rate of Change of Frequency and total deviation in frequency during contingency events. However, HPR's high response capability is not recognised or rewarded differently to the slower services provided by conventional generation.

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<sup>2</sup> Aurecon - Hornsdale Power Reserve, Year 1 Technical and Market Impact Case Study – Available at: <https://www.aurecongroup.com/markets/energy/hornsdale-power-reserve-impact-study>

- Similar to its 'premium' contingency response, HPR has consistently demonstrated its ability to provide both rapid and precise regulation FCAS, particularly when compared to the service typically provided by a conventional synchronous generation unit. Whilst this response has been demonstrated by HPR throughout its almost 2 years of operation, regulation FCAS arrangements in the NEM do not recognise differences in the 'quality' of service delivery. Further consideration could be given to recommendations made in AEMC's FCFR, which concludes: "*the best approach to the procurement of frequency services in the longer-term will need to be performance-based, dynamic and transparent*".
- With future increases in asynchronous generation and declining real inertia, there is increasing potential for batteries to provide a 'Simulated' Inertia service. As the inverter's inertial response is purely created by the inverter controls, not the physics of a rotating mass, the response is tunable and can be modified based on the grid's needs (unlike traditional generators that have a fixed inertial constant based on their physical characteristics).

As a principle, the PFR rule change should look to encourage a mix of technologies – including fast-responding, inverter based technologies. The market will benefit from a mix of both fast and slow responding technologies. Designing for a uniform response may reduce the quality of service, and also fails to consider our future market, where thermal plant will be replaced with renewable energy generation integrated with flexible, fast response assets such as battery energy storage. It is not clear that a mandatory requirement based on the NEM's existing fleet will lead to an efficient outcome for the NEM's future generation mix – and may in fact introduce unnecessary risk if investment in battery energy storage is dis-incentivised.

The AEMC references AEMO's report which highlights how each generation type responded to frequency deviations on 25 August, with large-scale battery storage identified as the asset type that responded well to events. As such, a more efficient outcome would be designing frequency markets to encourage more batteries, rather than just focusing on improving the settings of an aging asset base. This aligns with the beneficial outcomes seen in markets where a pay for performance approach can simultaneously reduce ancillary service costs whilst providing a much greater quality and flexibility of service (e.g. PJM's previous 'mileage payments' model; or the UK's 'Enhanced Response' supporting storage).

### **Alignment with parallel and complementary market reforms**

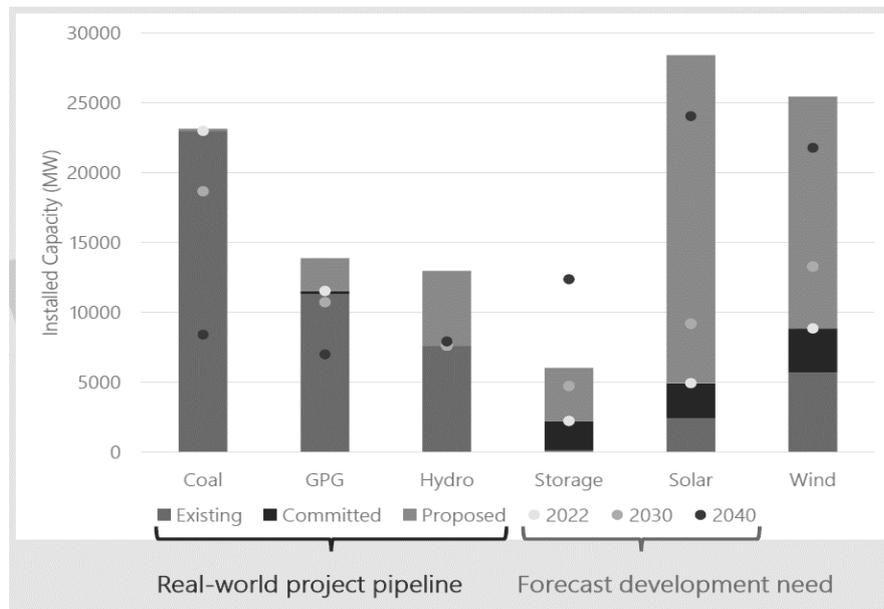
Alignment with AEMO's Integrated System Plan (ISP) will be critical. As per the 2018 ISP (fast scenario), AEMO highlights the importance of integrating ~40GW of renewable energy, ~10GW of energy storage and significant transmission network upgrades, all by 2030.

As recognised by both AEMC and AEMO in several recent consultations – integrating fast response technology will be critical to underpin this future (highly renewable) grid. We need to be assessing the pathway to our future grid in parallel and collectively encourage technologies that support system security, reliability and dispatchability, rather than targeting market risks in a piece-meal approach, which will only perpetuate market inefficiencies in the long-term.

In a post-RET policy landscape, it is becoming less clear what investment signals will be utilised to drive sufficient levels of investment. This is particularly crucial as additional uncertainties and complexities are being considered (e.g. COGATI's dynamic pricing and transmission hedge proposal for generators to fund new transmission; or ongoing MLF risks and changes).

The 2019 preliminary findings recently shared by AEMO highlight the most significant challenge in reaching the forecast generation requirements (relative to the real-world project pipeline) will be for storage assets:<sup>3</sup>

<sup>3</sup> AEMO Integrated System Plan – Preliminary modelling outcomes workshop – 10 October 2019



Source: AEMO, 2019

If mandated PFR requirements negatively impact market signals for new storage projects, this gap will only increase – and committed projects may also seek to unwind, putting even near term capacity requirements at risk.

The UK and NZ markets have specifically recognised this in their consideration of PFR mechanisms, providing additional investor certainty that policy settings being applied today, recognise the changing dynamic of the market going forward.

#### What are the NEM's long-term investment signals?

It remains an open question to market bodies - what investment signals are expected to drive the uptake of new fast-responding, flexible energy assets, and replacement capacity for the closing synchronous fleet? If it is the promise of new markets in the longer-term, greater definition and clarity on what these markets may look like is needed now to adequately incentivise project developers over the next 5 years. In the absence of any federal energy policy, appropriate market signals become even more critical.

A key consideration will be the interaction across all existing and proposed market types, noting that new technologies are increasingly reliant on multiple sources of revenue ('value stacking') to meet required rates of return and drive new investment, so any new mandated requirements that remove the value potential of these markets must be taken in this context. A requirement that all generators have frequency response capability would hide the true value of the frequency response service and make it impossible for those resources that can most economically provide the service to be fairly compensated.

#### What are the expected impacts on existing FCAS markets?

AEMC has already acknowledged that "*Generators may also experience a potential decrease in generator revenue from contingency FCAS markets due to increased supply pushing down FCAS prices*" even if procurement volumes remain unchanged.

It would be good for the AEMC to provide more clarity in Draft Determination on what the impacts for regulation FCAS markets are likely to be. This could be particularly acute in the short term, ahead of a general expectation of the longer-term trend for regulation FCAS requirements to increase as the proportion of renewable generation increases in the NEM.

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Lower (regulation & contingency) FCAS costs are positive from the perspective of measuring short-term direct market costs – but indirect costs should not be forgotten, including (a) upgrading existing fleet to be modified to provide PFR; and (b) limiting a key incentive to encourage new fast-response technologies from entering the market that will need to be supplanted by other market mechanisms (or other forms of intervention) - in order to achieve any of the ISP scenarios envisaged by AEMO and close the gap to generation capacity requirements. These indirect costs are not expected to be insignificant and could also lead to highly disruptive price events – also not in the long-term interests of consumers and clearly misaligned with the NEO.

These impacts will only increase the need for wholesale changes to market design (as contemplated by the ESB's post 2025 issues paper), whether through direct contracting, capacity-tied mechanisms, or other means to underpin the economics of future generation entering the NEM.

**Any broad changes to power system security requirements should also consider the potential role and benefits of DER and virtual power plants (VPPs) in supporting the grid**

Tesla also notes that the future NEM, under any credible future scenario, will see a significant contribution from distributed energy resources (DER), a fleet of technologies that when aggregated can participate in wholesale energy markets as well as provide a suite of system security services such as PFR much more efficiently - at a localised level.

Many of these capabilities are already being demonstrated as part of AEMO's Virtual Power Plant trials. The accelerating uptake of DER (and other demand-side response technologies) is rapidly changing the role of traditional generators. As such, the AEMC needs to be cognisant of flow-on impacts from any decisions that mandate requirements on generators today that may significantly affect the ability of DER to participate in tomorrow's energy markets.

**Conclusion**

Tesla looks forward to working with the AEMC in addressing the priority objective to improve power system security in the National Energy Market, ideally through a market based approach that can ensure the NEO remains central to reform. Ultimately, innovation will flourish when design principles focus on achieving outcomes, rather than mandating specific short-term requirements.

Tesla will continue to engage closely with the AEMC and AEMO on ensuring the NEM continues to work on the Frequency Control work plan, to deliver optimal market and system services.