16 May 2019

Mr Warwick Anderson

General Manager, Networks Finance and Reporting

Australian Energy Regulator

GPO Box 3131

Canberra ACT 2601

Dear Warwick,

Re: SA Power Networks: 2020 – 2025 Regulatory Proposal

Tesla Australia, Pty Ltd (Tesla) welcomes the opportunity to provide the Australian Energy Regulator (AER) with feedback on the South Australia Power Networks (SAPN) 2020 – 2025 Regulatory Proposal. Tesla supports the 'future network' expenditure proposed by SAPN and views it as a critical step in modernising the SAPN grid, in particular we support the proposed LV Management Business Case approach, and the introduction of **Option 2 – Dynamic export limits**.

Tesla strongly believes that SAPN is leading the way when it comes to exploring innovative approaches to better enabling distributed energy resources (DER) (particularly solar PV and battery energy storage systems (BESS)) across South Australian energy markets. The proposed approach promotes lowest cost outcomes and equity for residential customers with existing DER; customers looking to install new DER; and customers who currently do not have DER.

Conversely, the alternative approaches considered, including the SAPN "Option 1 – Static limits", or using AS4777.2 requirements as a static lever to trip assets off, limits industry innovation and provides a disincentive for virtual power plants (VPPs) to make a broader market contribution.

Without dynamic exports, customers will buy solar PV and storage systems sized to meet their exact load profile. During peak periods, these assets will not make any contribution to the wholesale energy market, frequency markets or provide any dynamic grid services. As such, these assets will have no discernible benefit to other customers on the SAPN network.

Our following submission to the AER provides an overview of the following:

- Why this is important to address now.
- Why enabling dynamic exports is the preferred approach for:
    - efficient market outcomes, and
    - customers
- Current industry capability to provide market and grid supportive services and benefits of these services.
- Interaction with other DER work programs that are currently underway.

Tesla is happy to work closely with the AER to provide more information on how DER assets are currently optimised in response to market signals; the role that we see DER playing in the Australian markets over

the next five years; and the benefits that we think DER will provide to customers. For more information on any of the content included in this submission please contact Emma Fagan (efagan@tesla.com).

Kind regards

Mark Twidell

APAC Director – Energy Products

SA Power Networks: 2020 – 2025 Regulatory Proposal – Tesla comments

Why is this important to address?

The SA Power Networks Draft Plan notes that demand for electricity from the network peaked in 2009 and since then has remained relatively flat or declined slightly, largely due to the amount of rooftop solar systems connected to the network. It is significant that solar systems have been successful in reducing the need for additional network augmentation expenditure.

The Australian Energy Market Operator (AEMO) Integrated System Plan (ISP)[1] projects that in 2025 there will be over 2GW of DER installed in South Australia including approximately 300MW of distributed storage. This will amount to 32% of the total generation capacity in South Australia, with 56% of households expected to have distributed energy.

In addition there are currently state and federal funding programs to support more than 650,000 new solar PV systems and approximately half a million new BESS systems in the NEM more broadly over the next 5 – 10 years, including the following:

- **South Australia:** SA Home Battery Subsidy scheme with VPP capability for 40,000 BESS assets. Tesla SA Housing Trust VPP for 50,000 households; AGL VPP for 1000 households; Simply Energy VPP for 1200 households.
- **NSW:** Zero interest loans for 300,000 solar battery systems.
- **Victoria:** subsidies for 650,000 new solar PV systems and 10,000 solar battery systems.
- **Federal (ALP):** subsidies for 100,000 new solar batteries. A VPP program for Australian schools.

The SAPN approach of investing in dynamic response capabilities will provide a framework that can be adopted by other jurisdictions in order to utilise these subsidised assets in a way that provides the best outcomes for the market.

Waiting until after 2025 to make these investments is not a feasible option for South Australia given the current penetrations and the rate of change that is being projected. Importantly, the rest of the country also needs a jurisdiction to take the lead in this area. Without SAPN taking the lead in this space now, the industry will lose five years of innovation.

Benefits of enabling dynamic export

During the development of the SAPN 2020 – 2025 Regulatory Proposal, SAPN undertook detailed analysis into the benefits of enabling dynamic export. This was considered against a number of alternative options including a base case of moving to zero export limits; and a further option of building out network infrastructure to support projected uptake of DER. Additional options include allowing customers inverters to self-constrain by tripping off.

There are two key benefits to enabling dynamic export that need to be reiterated:

- It promotes more efficient market outcomes than static regulatory requirements in respect of both wholesale energy markets and frequency markets; as well as setting the appropriate framework approach for new network services markets.
- It provides a better customer outcome – both for customers with DER and customers without.

[1] AEMO, ISP – "HighDER scenario"

Supporting efficient market outcomes

Tesla believes that encouraging DER to provide dynamic, market based support to address grid and frequency issues will ultimately provide the best market outcomes. Enabling dynamic exports will ensure that VPPs and other aggregated DER assets are actively responding to market signals in a way that causes the least stress on the SAPN network.

Tesla recently provided the following advice to the Australian Energy Market Operator (AEMO) in response to their "Technical Integration of Distributed Energy Resources – Consultation Paper".

> *Regulated or mandated product requirements can provide a static approach to managing a particular issue, however encouraging greater participation from DER assets in market conditions, will result in greater dynamic market and network services being provided.*
>
> *We feel that in the longer term the best outcomes for the market and network services providers (NSPs) will be for services to be delivered via a mix of market based services, regulated requirements and bi-lateral contracts with individual NSPs, where there is no commonality of issues across jurisdictions, and a market based mechanism isn't appropriate.*
>
> *There is a major risk that if mandatory regulated requirements for inverters go too far, they will undermine similar market mechanisms that are being developed to encourage DER to more actively participate in current and emerging markets. The Technical Integration of DER work program will need to work closely with the NEM VPP Demonstrations Program and the Open Energy Networks work to make sure that this does not occur.*

This position is equally relevant here.

An alternative suggested is to simply rely on inverter settings to mitigate network risks. Per Table 13 of AS/NZS 4777.2:2015 the set points for inverters tripping due to under-frequency or over-frequency events are 47Hz and 52Hz respectively. In contrast, where DER assets and VPPs are actively registered to provide contingency FCAS, these assets will start providing a frequency response when grid frequency falls outside of the normal operating frequency band (NOFB) at 50.15Hz or 49.85Hz. As a result, grid frequency is actively supported and far less likely to reach the set-point value for tripping outlined in AS/NZS 4777.2:2015. This provides a financial benefit to DER customers providing this service, and means that other DER customers are unlikely to see their systems trip off.

Similarly relying on inverter standards to respond when grid frequency or voltage levels reach a static set-point will cap generation at that point in time. This limits the ability of DER to support the grid during these periods. BESS assets, in particular, can make an active market contribution. During high frequency events, BESS assets can charge to lower grid frequency. During low frequency events BESS assets can discharge to raise grid frequency.

Encouraging greater uptake of smart, integrated DER on the network can also improve the visibility of localised voltage issues. For instance, Tesla has undertaken our own internal review of voltage issues on the SAPN network, using our Powerwall fleet. Our findings in respect of voltage issues on the LV network are consistent with the risks and issues presented by SAPN. Most importantly BESS assets can provide reactive power and voltage support during these high voltage periods to improve grid voltage levels.

Proper orchestration of DER on the SAPN network will provide far greater market outcomes than purely relying on mandated inverter standard settings.

Customer experience

Moving to a dynamic export approach also improves the customer experience for all SAPN customers looking to connect DER, and those without.

For DER customers this approach has the following benefits:

- It promotes transparency and consistency for SAPN customers looking to connect DER. All DER customers will be aware of the fact that they'll be able to export on a dynamic basis. Under the alternative scenario proposed by SAPN, customers will gradually see a decline in the level of export permitted. This creates an inequity situation where one person may install solar PV with the ability to export 5kW, while their neighbour who subsequently installs solar PV, is given a 0kW export limit.
- Without dynamic export, the ability of customers with DER to participate in markets and access market value is significantly undermined. In addition to resulting in inefficient market outcomes (as outlined above) this also leaves value on the table for customers, where their assets are being under-utilised.

Importantly, Tesla believes that enabling dynamic export has the greatest benefit for all customers on the SAPN network including those without DER. All SAPN customers benefit from the most efficient network investment from SAPN and from lower power prices, and by better utilising all dispatchable generation on the SAPN network. More generation leads to lower power prices and more dispatchable generation – DER or otherwise – leads to energy use during peak periods.

In their documents to the AER, SAPN have presented compelling economic arguments as to why enabling dynamic export provides greater market benefits than setting zero export limits or building out new network infrastructure. SAPN expects a positive NPV of $39m to be achieved when this option is compared with the alternative options presented.

Separately, Frontier Economics undertook independent economic modelling on the benefits of the Tesla VPP in South Australia. This modelling showed that VPPs can reduce the wholesale energy costs for all South Australian energy consumers by $3/MWh with each additional 50MW of capacity installed. Frontier Economics noted that the "Tesla proposal could reduce the wholesale price by around $8/MWh, or about $90m p.a. across all South Australian customers if just the SA Housing Trust customers participated in the arrangement. The savings would be approximately double this if the project its full scale of production of 250 MW."[2]

Impact of mandating zero export limits or relying on inverter standards

While the benefits of enabling dynamic export are clear, for both customers with and without DER, the alternative approaches considered will have equally negative outcomes. These include, but are not limited to:

- **Lower customer use of system** – customers will lose the value associated with their DER investment where assets are tripping off more frequently based on inverter standard settings.
- **No broader market benefits** - relying purely on inverter standards or enabling zero export, limits the incentives for VPPs to operate in South Australia, this will mean that assets that would otherwise be able to provide frequency services, are prevented from doing so.
- **Less competition** – encouraging VPPs in South Australia improves competition both in generation and market services, and in new customer retailer offers. Under a zero export approach, or through relying on trip settings, no such competition is encouraged.
- **Reduced innovation** - there will be less incentive for companies to focus their innovation efforts in South Australia.

These impacts contrast strongly with the benefits associated with enabling dynamic export outlined above.

[2] Frontier Economics, "South Australia's Virtual Power Plant", available at https://www.frontier-economics.com.au/documents/2018/02/south-australian-virtual-power-plant-summary-note.pdf/

Current industry capability

It is important for the AER to recognise that distributed generation has moved on significantly from passive, uncontrollable devices to dynamic, controllable assets, capable of making a real contribution to Australian energy markets. As such, enabling dynamic export will mean that DER assets are able to provide a number of complementary services immediately.

Distributed assets are already capable of providing the same services as utility scale assets in respect of system security and reliability. This includes the following:

- Frequency control ancillary services (FCAS)
- Energy arbitrage to contribute to peak demand periods
- Dynamic voltage and reactive power support
- Inertia

To support the work undertaken in Phase 1 of the Tesla South Australian VPP, Tesla undertook tests of Tesla Powerwalls to respond to simulated contingency and regulation frequency events, to prove out the capability of DER assets to provide critical system security services.

Figure 1 below provides the outcome of a test to demonstrate the capability of aggregated DER assets to follow a simulated AGC signal (simulated regulation FCAS response). The AGC test was performed by sending a single active power signal every 4 seconds to a test group of 10 South Australia VPP Powerwalls, 9 active and 1 inactive system. As shown, the aggregated test group responds to a high degree of accuracy to meet the 4s active power set points.

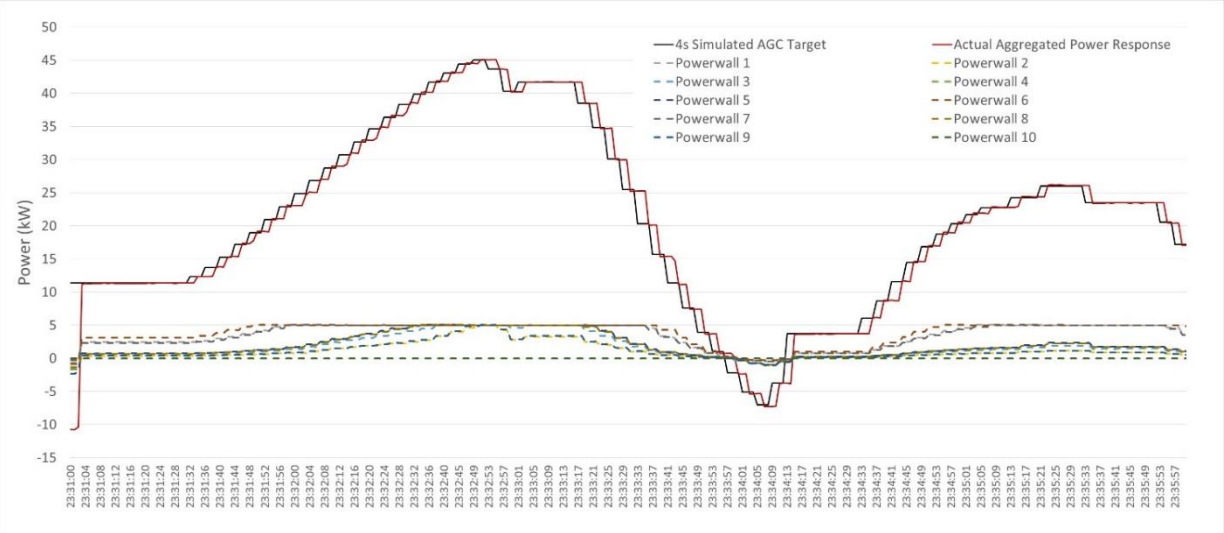

Figure 1: 4 Second AGC target and system response for a 5 minute dispatch period

The response from an aggregated DER asset base provided above is comparable to that provided by Hornsdale Power Reserve, and surpasses traditional synchronous assets both in terms of timing and accuracy in following an AGC signal. Figure 2 below shows the speed and accuracy of a large steam turbine following an AGC signal (as shown in AEMO's report on the initial operation of the Hornsdale Power Reserve).

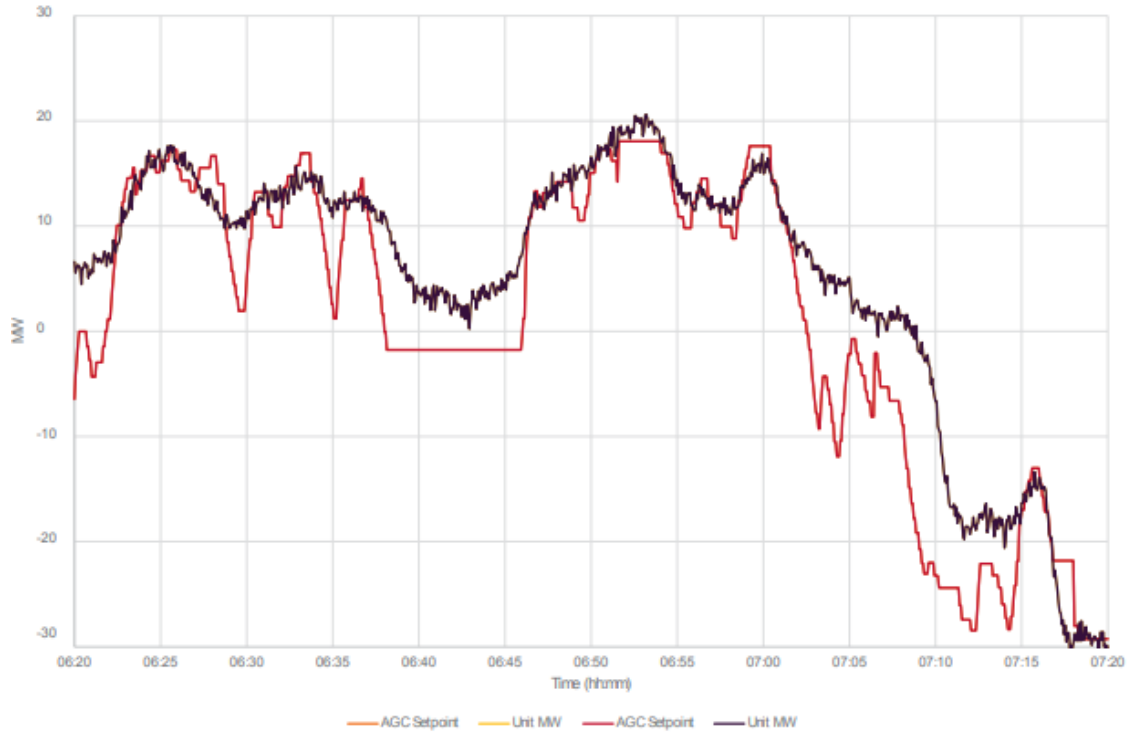

Figure 2: Accuracy and speed of regulation FCAS response – large conventional steam turbine[3]

A secondary test was also used to test how DER assets respond to frequency drops below 49.85Hz by autonomously injecting active power based on pre-applied frequency-watt droop curve settings. This provides the same services as contingency FCAS, with frequency benefits delivered in the same way that they are delivered by the utility scale Hornsdale Power Reserve.

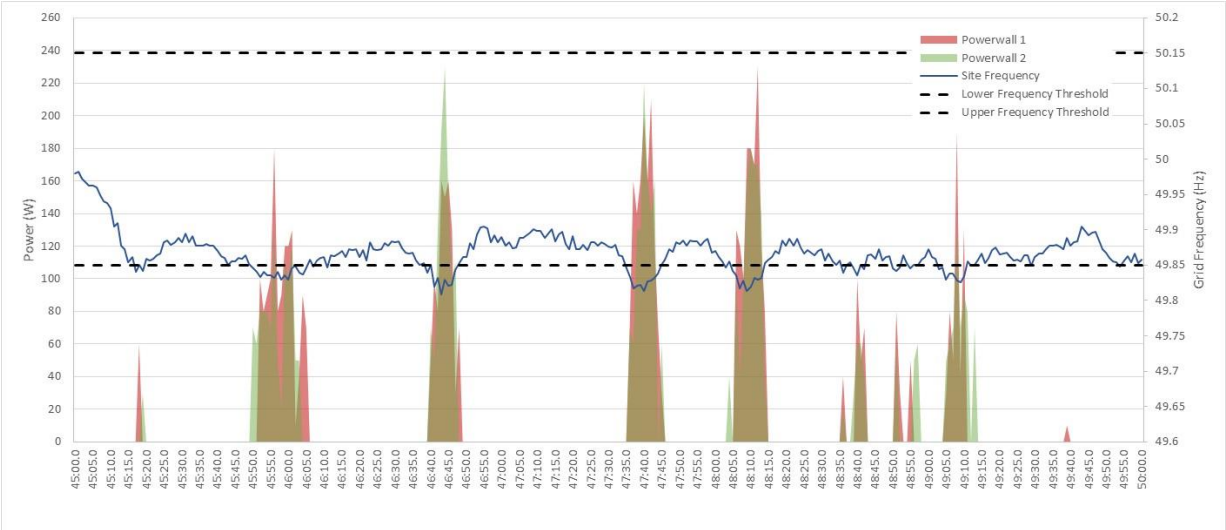

Figure 3: Frequency-watt response from two individual customer Powerwalls for a 5 minute period

In addition, distributed assets can respond to localised network signals

[3] AEMO, "Initial Operation of the Hornsdale Power Reserve Battery Energy Storage System", April 2018

Broader DER work programs

It is also important to note that the SAPN regulatory strategy proposal has not been made in isolation. Dynamic exports is indicative of where the DER market is heading, and operates in support of a number of other work-streams that are currently underway. These include, but are not limited to:

- AEMO/ Energy Networks Australia (ENA) – Open Energy Networks work, which supports the development of a dynamic market for grid services.
- AEMO – NEM VPP Demonstrations work, which will improve the current market settings for VPPs in providing frequency services.
- More than $12.5m in ARENA funding for DER projects to improve the integration of DER into Australian networks. These include:
    - Funding to Greensync to further deploy of the dEX platform.
    - Funding to AEMO to support the NEM VPP trial outlined above.
    - Five additional DER pilot projects from Jemena, SAPN and Tesla, Solar Analytics, Evolve Energy and Zeppelin Bend, and RACV.

The Tesla and SAPN project will introduce an interface (API) to exchange real-time and locational data on distribution network constraints between SA Power Networks and the Tesla South Australian VPP, enabling the VPP to optimise its output to make use of available network capacity. This concept will be tested in a field trial over 12-months. This directly supports the SAPN regulatory strategy proposed. Tesla is fully committed to supporting this work program over the 12 months and beyond.

The DER industry in Australia has dedicated time, effort and development expenditure to support these projects with a view to the Australian market evolving to world-leading position in respect of VPPs and integrated DER.

We are currently in a world leading position in respect of our levels of DER penetration, and now have the choice about whether the industry continues to innovate to best use the systems already installed, or we move to limit functionality and reduce the long-term uptake of DER. Tesla supports the former, and believes that SAPN's regulatory proposal outlines the best way that this should be undertaken.