SA Government – 2020 Inverter Standards

LAST EDITED

SA Proposed Inverter Standards – Tesla response to consultation papers

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Dear ETR

Tesla Motors Australia, Pty Ltd (Tesla) welcomes the opportunity to provide a response to the South Australian Government on the five consultation papers released by the South Australian Government on 25 June.

Tesla's mission is to accelerate the world's transition to sustainable energy and we view the work that we have been doing in South Australia as world leading in this respect. Since 2017, Tesla has worked with the South Australian Government to build the world's biggest battery, Hornsdale Power Reserve, and launch a 50,000 household virtual power plant (VPP) across South Australian homes. We have successfully delivered the first two phases of the VPP; HPR has expanded by 50% to grow to 150MW; Tesla has partnered with Infigen to deliver 25MW/ 52MWh Lake Bonney battery; and in August 2019, South Australia was the first state for Tesla to launch the Tesla Energy Plan for residential energy consumers.

South Australia is world-leading in respect of the penetration of rooftop solar. This presents unique challenges in respect of negative load, but it also presents unique opportunities for the state – particularly in respect of encouraging innovation and driving the uptake of VPPs. There are more than six VPPs that are currently operating across the state – providing competitive customer offerings and demonstrating the potential for orchestration of distributed energy resources (DER). SA Power Networks, AEMO, local SA battery manufacturers and other leading solar and storage participants have been at the forefront of establishing innovative approaches to respond to market signals, provide frequency support and demonstrate how DER can be orchestrated.

Both residential and utility scale storage is viewed as being a critical contributor to the long-term security of the South Australian energy mix. As such it will be critically important that the new inverter requirements do not inadvertently disincentivise the uptake of residential storage and VPPs. Over the last 18 months South Australia has seen a clear shift towards increased orchestration and management of DER across the state through the following initiatives:

- SA Power Networks embed an approach to enable DER integration into their 2020 – 2025 AER regulatory approval process.
- AEMO launched their VPP trial in July 2019. This currently has two participants with >8MW of capacity registered and is quickly expanding. Though the trial is available NEM wide, all participation so far has been limited to South Australia.
- SA Power Networks commenced their Advanced VPP Grid Integration work funded by ARENA, looking at the capability of smart inverters to respond to dynamic operating envelopes for flexible export.

Tesla supports the ongoing focus from the Australian Energy Market Operator (AEMO) and SA Power Networks on interoperability and increased orchestration of DER across the state. We do not support less dynamic, blunt mechanisms for integrating DER that are being either directly, or indirectly, proposed by the consultation papers. Forcing a static, interim solution as a stop-gap in a compressed timeframe will necessarily detract from the continued focus on DER innovation and the significant smart inverter work that is already underway.

Our feedback on each of the consultation papers and the process is included in the following submission, along with recommendations as to how the South Australian Government can achieve similar outcomes whilst not resulting in increased costs for consumers or disincentivising residential batteries and VPPs. For more information contact Emma Fagan (efagan@tesla.com)

Kind Regards

Emma Fagan - Head of Energy Policy and Regulation

Summary – Tesla response

Summary Position:

- The South Australian Energy Solution document presents four pillars for managing the long-term risks associated with negative load across South Australia. Increased penetration of energy storage is central to two of these options – utility scale storage and residential storage. In addition, residential battery storage will play a critical role in providing demand response which is a third key pillar considered by the SA Government. SA Power Networks and AEMO also acknowledge that batteries play a critical role in acting as a solar sponge and reducing the impact of excess daytime solar exports. As such it will be critically important that the new inverter requirements do not inadvertently disincentivise the uptake of residential storage and VPPs.
- Tesla supports all work continued on developing smart inverter capabilities, improving interoperability, and encouraging orchestration across the South Australian DER fleet.
- We support an approach that would allow for solutions to be rolled out to the existing fleet as well as new solar and smart inverter installations via firmware updates.
- We don't believe that the solutions and timeframes presented in the consultation papers will achieve this outcome.
- There is a risk that by forcing the less dynamic, blunt mechanisms for integrating DER proposed by the consultation papers, that a lot of the work on DER orchestration that has been undertaken to date will be derailed. Forcing a static solution as a stop-gap will necessarily detract from the continued focus on DER innovation and the significant smart inverter work that is already underway.
- Tesla wants to avoid a situation where the new requirements inadvertently act to disincentivise residential battery storage and/ or VPPs through additional costs or reduced system performance and efficacy.
- **This submission provides an overview of our position and concerns on each of the five consultation papers with recommendations on alternative approaches. All recommendations made consider optimal pathways for supporting continued technical evolution of DER to support the South Australian electricity network, while not creating unnecessary costs for consumers.**
- **We also suggest that South Australia continue to work on incentivising driving the uptake of residential and utility scale storage, as well as considering the role of EVs and community storage in managing excess daytime solar exports.**

Timeline and process concerns:

- While we acknowledge the serious potential implications of negative load on South Australian energy security, Tesla has concerns with the timelines for consultation and compliance presented in the consultation papers. These are significant changes that have been presented to the industry and with minimal supporting detail in respect of how implementation will occur, what technical solutions can achieve the required technical outcomes, and how ongoing compliance will be assessed.
- We understand that AEMO has been working on DER integration approaches from a system operations perspective, but there needs to be more time spent with industry to ensure the full impact of its nominated options are understood, as well as expanding consideration to alternatives that could provide the same operational outcome for SA, but at lower costs to customers and with better long-term outcomes for the market as a whole.
- In summary, our concerns with the process are:
  - It is unclear what the **September 2020** critical drivers are for such a drastic suite of reforms for the DER industry.
  - A two-week consultation period on critical changes does not provide industry with sufficient time to be fully consulted on the problems and consider potential alternative solutions that are less costly for consumers.
  - The compliance periods proposed are unrealistic for industry. A lead time significantly longer than 6 weeks is needed for complying with new product requirements.
  - During the period between consultation concluding and compliance commencing in September (or January in respect of export limitations), a significant amount of technical work needs to be undertaken by the OTR. As such it is difficult for industry to fully assess the likely cost implications, or compliance timeframes that may emerge on the back of these technical documents yet to be developed.

Consultation Papers - Impact for residential storage and VPPs

- Our feedback on each of the consultation papers is below, with additional detail provided at the back of this submission.
- As a general point of feedback, there seems to be overlap in the intended outcome of consultation papers 1 and 4. However, while the SA Government has considered that the proposed remote disconnection framework is technology agnostic, consultation paper 4 appears to lock in remote disconnection via new smart meter requirements. Tesla supports a technology agnostic approach with a focus on improved interoperability and continued build-out of dynamic inverter response capabilities.

Consultation Paper	Key concerns/ considerations for residential storage and VPPs
1. Proposed Remote Disconnection and Reconnection Requirements for Distributed Solar Generating Plants in South Australia	• As a general principle Tesla believe that remote disconnection of solar is already adequately managed via the freq-watt and volt-watt requirements that are mandated by AS4777.2 and by SA Power Networks. • In respect of the proposed remote disconnection approach, the use of an agent and how this would work in practice needs more technical detail to fully understand the potential impacts and or delays in timing. It is also not clear how agent responsibilities will work in practice. • Tesla supports the proposed technology agnostic approach proposed under this Consultation Paper, however systems coupled with batteries or EVs (or dual meter requirements) will face compliance challenges due to their inherent configurations (this should also be explored where compliance is likely to impact on existing and scale up of VPPs). • Ultimately we believe that the future approach for remote disconnection and reconnection should be considered under the broader interoperability work program that AEMO is leading at the moment. • Remote disconnection should be driven by a combination of autonomous settings and dynamic signals sent via API. It should be made clear how 0MW export limits can be leveraged to meet operational outcomes (rather than a hard disconnect) – as this approach is likely to hold advantages for both customers and the wider system • This work should continue to be developed with industry as per the AEMO timelines on interoperability and the SAPN work program for DER integration. There doesn't seem to be a clear driver for the condensed September timeframe. **Tesla supports a technology agnostic approach and further work progressing the interoperability framework and incorporating these remote disconnection requirements into that framework.**
2. Proposed Export Limit Requirements for Distributed Solar Generating Plants in South Australia	• As above, the potential impacts for VPPs will largely be driven by the impact of the technical requirements on the 1 January 2021 compliance period. • Tesla is a member of the SA Power Networks DER WG and understands that full integration with SAPN via API will not be an option from 1 January. As such it's unclear what will be required for solar inverters from 1 January 2021 to meet these requirements. • Tesla has been actively working with SAPN over the last 12 months in an ARENA funded project testing dynamic operating frameworks. This approach is technology agnostic, scalable, cost effective for customers and can be retrospectively deployed across the incumbent SA inverter fleet. **Tesla supports the continued work by SAPN in implementing dynamic export. This work will not be ready for a 1 January 2021 timeframe.**
3. Low Voltage Ride Through requirements	• Tesla believes that the testing protocol proposed will not fully solve for the negative load and frequency ride-through issues. Further work is required in this space. • Given the consequential impact of the new standard (never previously mandated or tested) AEMO needs to provide industry with supporting evidence justifying the need for change • The major concern for industry in respect of these new requirements is the timing for compliance. AEMO had originally proposed a November timeline for compliance with the new Disturbance Ride-Through Requirements. Our feedback to AEMO as part of this consultation is that this proposed timeframe would be challenging for industry to meet. • In general the timeframes for testing through a local JAS-ANZ facillity and listing with the Clean Energy Council (CEC) is a minimum of 6 months. This includes internal approvals, testing and work with the CEC to check off on all documentation. Tesla's response to AEMO noted the benefits of including international testing laboratories as well as JAS-ANZ faciilites. This would allow more systems to meet the November timeframes proposed by AEMO. September is unrealistic. • A hard deadline is unnecessary - committing to remote firmware updates should satisfy future security concerns – with existing hardware able to meet new standards over time **Tesla does not support a September compliance timeframe for this work. Early 2021 is a more realistic timeline for full testing and compliance and listing with the CEC.**

Impact for residential storage and VPPs (cont.)

Consultation Paper	Key concerns/ considerations for residential storage and VPPs
4. Minimum Technical Performance Standards for Smart Meters	The requirements proposed in the Minimum Technical Performance Standards for Smart Meters represent the greatest risks for the future of VPPs in South Australia in respect of increased complexity, increased cost and reduced functionality. As a summary, our concerns are: **General technical comments** • Dual element meters require separate wiring of the conductor from the PV generator breaker to the meter, this is a large change from the current practice of wiring the PV generator conductor to a "solar breaker" on the main or sub board. • Having a separate PV connection to the meter will mean that no solar can be installed without the metering provider being present (added time/cost/complexity) as the meter is not the Customer's asset and not safely accessible. • For export-limited systems or storage systems, these sites require a net load meter to be installed (that is the fundamental control signal for export limiting or battery system operation). The proposed approach creates a number of technical challenges in respect of installing the net load conductor, and it's not clear whether this can be done in compliance with AS3000. **Reduced efficacy of solar and storage systems** • For AC-coupled storage systems: a separate PV connection will completely disconnect solar in a blackout and prevent customers from having solar in a backup (reduce storage efficacy). • For DC-coupled storage systems, remote disconnect of the PV will result in the system entering backup and the backup loads circuit islanding. This will result in the loss of critical load circuits when the grid is connected and PV remotely disconnected. • Solar self-consumption will be adversely impacted as the power flow will be from the PV meter to the meter and then back to the load circuit (significantly increasing losses) as no local consumption of solar will be undertaken. • It is unclear the revenue implications of having gross solar and gross load on the meter, it should be clarified if this is moving to a gross solar FIT and gross load energy charge, which negates the benefit of solar self-consumption (and solar itself) in SA. **Tesla does not support the introduction of the proposed smart meter requirements. Work should continue on interoperability work with AEMO to determine the lowest-cost, technology agnostic approach to remote disconnection that can scale across existing solar installations as well as new.**
5. Consultation on Proposed Tariffs to Incentivise Energy Use in Low Demand Periods in South Australia	• Tesla supports ToU and prosumer tariffs in principle and the role that they play in incentivising energy consumption at the right time. We recognise the role that these dynamic tariffs will play in driving efficient customer behavior as well as supporting the uptake of enabling technologies such as home battery storage. • However, it should be made clear that the proposal only extends to retailer's standing offers. We do not support any attempts to mandate tariff structure pass through for market offers accessible to customers and underpinning existing VPP models. • VPP arrangements which orchestrate DER responses behind the meter provide a more efficient mechanism to ensure that residential storage appropriately acts as a solar sponge and grid-load control signal. VPP operators are already fully incentivised to operate systems in a manner that can optimise output and load and best support the grid. • In this instance, ToU and prosumer tariff cost structures do not need to be directly passed through to customers on VPP plans, as this will provide no additional benefits in managing excess solar / addressing operational load. Relying on customer responses to price signals is a far less efficient mechanism than simply incorporating appropriate NSP tariffs into VPP operations. **Tesla supports early implementation of SA Power Network's ToU and demand tariffs but recommends full flexibility for market offers is maintained to ensure continued innovation in VPP models. Mandating tariff structures to be directly passed through to all customers is an unnecessary step in addressing negative load issues across the state.**

Key Recommendations

1. **Consultation period needs to be extended** – with an increased focus on alternative, more dynamic options as an alternative to static solutions. During this consultation period SAG should also consider whether the solutions presented fully solve the potential implications of negative load. For instance the proposed disturbance ride-through tests do not fully solve the problem of negative load or frequency ride-through that SAG/ AEMO have flagged as a key issue.

   - To ensure industry is fully engaged in the process and establishing the most cost-effective and technology forward solutions, Tesla would recommend establishing an AEMO, SA Government inverter manufacturer working group with key industry players and SA Power Networks. A fast-tracked solution is possible, and engaging industry will ensure that the optimal solution is presented for the current and future SA electricity grid problems.

2. **Extend compliance time-frames.** Linked to the above, Tesla also believes that the compliance timeframes also need to be reconsidered. Tesla believes the following compliance timeframes are more appropriate:

   - Disturbance ride-through tests: Start 2021 for full testing and updated CEC listing
   - Dynamic exports: linked to SAPN capability to deploy a broad API integration approach.
   - Remote disconnection: linked to continued interoperability work and API response integration.

3. **Don't mandate dual element meters.** Keep working on interoperability with industry, exploring dynamic response signals. Continued work on these innovative approaches will be:

   - Less expensive for customers, so unlikely to detract from installations of new battery systems.
   - Able to be retrospectively deployed to incumbent solar systems
   - Dynamic rather than static.

4. **Incentives** – Linked to the above, the SA Government should consider an API credit incentive mechanism to encourage customers to network connect and register their inverters to receive both export and disconnection signals. This will support roll-out of these new requirements to the existing fleet as well as to new installations.

5. **Tariffs.** Tesla supports the early adoption of SA Power Network's TOU and demand tariffs via new retail standing offers. However, it should be made clear that network tariff pass through to customers should not be mandated for market offers and where customers are on a VPP offer (or any other new energy models that actively orchestrates DER behind the meter). Manually relying on customers behaviour response based on market signals is much less efficient than what can be achieved through automated orchestration and optimisation of assets under VPPs.

6. **Community storage and EVs** – the South Australian Government should also consider the role that community storage and electric vehicles can play in managing excess solar exports in the middle of the day.

Part 1 – Cost and technical implications

Direct cost implications of new requirements

Smart Meter requirements – direct costs

- It is important for AEMO and SA Government to recognise the significant cost impost that will be associated with moving to a dual element meter (in direct conflict with aims to lower costs for consumers, support integration of storage technologies, and scale up of VPPs to enable the state's high renewables future).
- Tesla provides estimates for 3 discrete cost elements that will be increased by the proposed approach:
  1. Additional meter costs: ~$60 per meter just for hardware
  2. Additional wiring costs associated with contactors: ~$400 (inclusive of costs for 63A contactor, enclosure, circuit protection & installation)
     - Sites with existing switched load likely to require this (17%).
     - If separate (3rd) element required – as the consultation paper implies may be the case for sites with controlled loads - another additional meter may be required. This is creates further cost, requires more meter panel space; and the complete upgrade of panel enclosures will be likely if inadequate room is available based on the existing configuration.
  3. Additional installation costs:
     - ~$450 per site (for a typical site with solar at main switch board / metering panel).
     - However, it is also possible a Neurio meter will be required for each site if site CT(s) must move to the line side of Utility Meter
     - This would also create additional compliance work to allow for installation of (CT's) line side of Utility Meter. It may also result in significant tariff and operational issues under self-consumption charging with solar export on element 2 and PW import on element 1.
     - There could be further major install costs for 'atypical' sites where solar PV is installed on sub boards without segregation, requiring dual conductor runs which are costly and, in some cases, won't be practicable (e.g. for large houses with distributed boards)

Minimum Total additional cost = ~$1,000 per site (conservative estimate and assuming 'typical' PV and metering set-up; not including third extra meter, additional wiring & conductor charges)

- Looking at the implications of this for DER across South Australia – this would result in a **minimum cost impost of $50 million for a 50,000 site VPP** applying proposed requirements for the VPP at scale
- Under the AEMO Integrated System Plan High DER scenario (~2.5GW of rooftop PV by 2030; or approx. 500,000 systems @5kW each) the cost impost would be **over $500 million in additional costs**
- **These costs also compare unfavourably with the SAPN 2020-2025 DER integration expenditure which the AER approved at $30.3 million for strategic LV management to build new operational capabilities to manage reverse power flows in the LV network across South Australia.**

Other consultation papers

- There would also be additional costs of testing for ride-through requirements, including process time, resources and coordination with global test labs
- It is difficult to estimate costs of compliance with the other consultation papers at this stage as the technical detail has not yet been considered.

Indirect costs and reduced efficacy of systems

Smart Meter requirements – indirect costs and impact on consumers

- Even if the direct costs are deemed acceptable or can somehow be addressed, they do not include the indirect costs that will be created through restricting operations and interactions between solar PV generation and on-site storage technologies. There are three aspects to major indirect costs:

  a. **Removes self-consumption benefits:** Our overarching concern is that battery systems will not be able to capture solar PV output during self-consumption, crippling operation and viability of all installs (e.g. significantly extending the payback period for both new solar and storage installs, and storage retrofits)
  b. **Eliminates back-up protection:** new requirements remove the ability to provide solar PV backup. This further reduces customer benefits from residential solar and storage – where grid 'independence', reliability and self-sufficiency are major selling points. This restriction also damages VPP revenues, another limiting factor to the commercial model of VPPs in addition to direct costs
  c. **Future compliance risks:** If rules are extended to Battery IES, Tesla's residential battery product (Powerwall 2) cannot be installed.

Market implications

- Any reduced efficacy of systems will disincentivise the uptake of residential storage and VPPs and also have a flow-through impact on state wholesale electricity and frequency market prices.
  - The AEMO VPP Knowledge Sharing report (available at - https://aemo.com.au/-/media/files/electricity/nem/der/2019/vpp-demonstrations/aemo-knowledge-sharing-stage-1-report.pdf?la=en&hash=50B02E668A57A9B5257951537F431134) noted the role that VPPs can play in reducing wholesale electricity prices.
  - It also noted the high-quality frequency control ancillary services (FCAS) that can be provided by VPPs – see Figure 1. Higher penetrations of VPPs providing these high-quality services will benefit the state.
  - The SA Power Networks 2020 – 2025 AER expenditure approval included a detailed cost-benefit analysis on the market benefits of increasing DER output, particularly in an orchestrated manner. Tesla recommends that the consideration is given to the impact on this cost benefit analysis in light of these new standards.

- Finally it is also unclear as to the broader industry costs of pausing installations for a period of time as inverter manufacturers struggle to comply with the proposed compliance timelines.

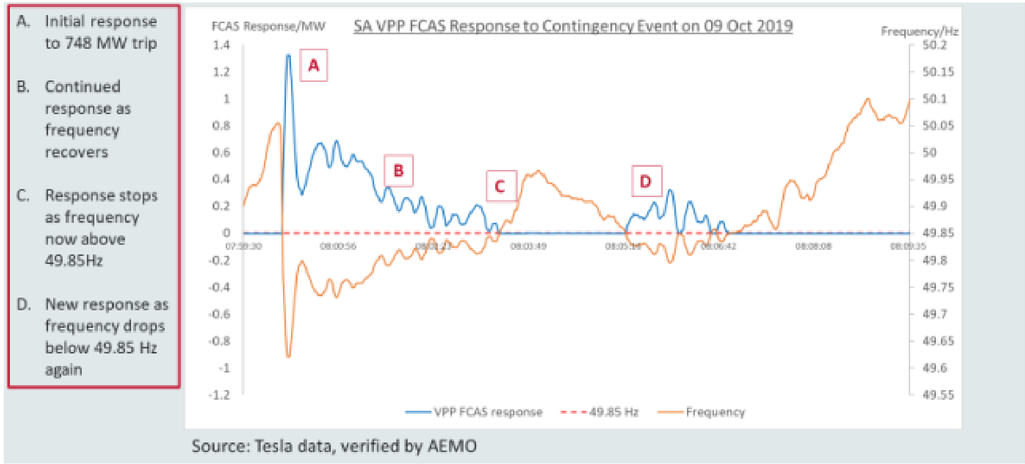

Figure 1: SAVPP FCAS response to Kogan Creek contingency event

[source: AEMO, https://aemo.com.au/-/media/files/electricity/nem/der/2019/vpp-demonstrations/aemo-knowledge-sharing-stage-1-report.pdf?la=en&hash=50B02E668A57A9B5257951537F431134]

Technical concerns

AEMO DER integration work-program

- Tesla has been working closely with AEMO and SA Power Networks for a number of years on all aspects of distributed energy resources (DER) including both the market integration of DER and the review of associated technical standards.
- Our understanding of the broad timelines that are influencing all of the elements currently being considered is:
  - **2015:** Updated AS4777.2.2015 released including new inverter requirements.
  - **2016:** Compliance with AS4777.2.2015 inverter requirements expected
  - **December 2017:** SAPN TS129 updated mandating volt-var and volt-watt settings for all new inverters installed in SA.
  - **April 2019:** AEMO releases “Technical Integration of DER – Report and Consultation Paper” highlighting the AEMO DER standards work program for DER across the NEM.
  - **2019:** AS4777.2 review process commenced by AEMO/ Standards Australia to enable a number of new inverter protection features to be included in the Standard.
  - **June 2020:** AEMO releases “Short Duration Undervoltage Disturbance Ride-Through Requirements – Inverter test procedure for South Australia” with a testing and compliance timeframe of November 2020.
  - **June 2020:** SAG releases five consultation papers for new solar and smart inverter requirements in South Australia due for response 10 July 2020
  - **8 July 2020**: Consultation draft of AS4777.2 is released for industry comment
- These documents all provide a detailed roadmap for the future of DER integration, however it is unclear what the particular problem is that needs to be addressed by September this year.
- The original AEMO “Technical Integration of DER approach” envisaged a three-year time-frame for developing the processes needed to transition to a more integrated framework for DER.
- The focus of the proposed AEMO work program was also focused on improved interoperability as well as managing disturbance ride-through requirements.
- All remote signaling and disconnection work would appear to tie into this broader interoperability work program underway, so there is need for considerably more consultation on the most cost-effective, technology agnostic approach to manage this.
- Our key priority is that work on smart inverter functions, and dynamic interaction with AEMO and SAPN continues. Forcing compliance through new metering requirements will be neither the most cost-effective solution, nor encourage continued innovation in the industry.

Technology problem statement

The data analysis undertaken to date and system results, are not fully representative of the recommendations made to solve the problems presented by negative load. In addition, without continued work on interoperability and remotely, deployable solutions, they will not address identified issues with the current fleet of inverters already installed.

- Tesla has undertaken further independent analysis based on its own system data available, and this data does not provide a clear or unifying issue as purported by the AEMO report (see next page)
- From the analysis, it can be seen that the majority of inverters already provide a correct ‘smart inverter’ response (volt-watt / volt-var as per AS4777.2), and so any future requirements being considered for low-voltage ride through should be made through the regular AS4777.2 consultation process
- **Tesla are not convinced rushing through LVRT requirements will solve the problem AEMO have originally identified as the cause of PV generation reduction. Tesla analysis concludes that the primary cause of PV production reduction is due to over-frequency response not low voltage disconnections.**
- **We also believe that the new disturbance management requirements (including frequency ride-through) proposed in the newly released consultation draft of AS4777.2 should resolve many of the issues that the SA Government is concerned about.**

Tesla data analysis

- AEMO have highlighted that the primary concern with PV is the sudden reduction in PV generation of in the Adelaide metropolitan area.
- Tesla have reviewed internal data from 887 sites actively participating in the AEMO VPP FCAS demonstrations program on the 31st of January 2020 South Australia NEM separation event and have plotted the expected AS/NZS 4777 freq/watt response. Tesla expects that the additional variation between real and theoretical response is due to Volt-Watt response as required under SAPN's TS129
- As demonstrated the sudden loss of generation from PV systems is mostly in line with the expected reduction in PV generation as required by the default AS/NZS 4777.2:2015 frequency response for over-frequency conditions
- The sudden loss of PV generation is in line with the operation required to arrest the sudden jump in frequency caused by the NEM separation
- **Tesla are not convinced rushing through LVRT requirements will solve the problem AEMO have originally identified as the cause of PV generation reduction. Tesla analysis concludes that the primary cause of PV production reduction is due to over-frequency response not low voltage disconnections as highlighted in the 3rd Match 2017 analysis using Solar Analytics data.**

Part 2 - feedback on individual consultation papers

Consultation Paper #1 - Remote Disconnection and Reconnection Requirements for Distributed Solar Generating Plants

Consultation Paper	Overview of concerns	Options to address
#1 - Remote Disconnection and Reconnection Requirements for Distributed Solar Generating Plants	• Tesla supports the technology agnostic approach proposed in the consultation paper, however at this stage there is very little information as to how the process will be managed. • The consultation paper notes an agent listed with the OTR who will be responsible for remote disconnection of systems. • It is unclear how an agent will be expected to remotely disconnect systems and the type of systems that might be used. • Tesla supports an approach that would allow for remote disconnection via API signals. • However the work on interoperability is still under development and it us unclear how API integration would occur by September 2020 (i.e. would the integration be with SAPN or AEMO? Which data protocol would be used?) • We strongly disagree with a hard, physical control being introduced on site as an interim stop-gap. In reality there is no off-the shelf approach for this approach either and there would still be a development/ integration timeline beyond September 2020. • This development work would occur in parallel to the interoperability work and take critical time and resources for a solution that will be redundant in <12 months.	**Governance of existing requirements** • The volt-var/ volt-watt requirements mandated by SAPN in their 2017 update of TS129 supports autonomous disconnection of systems in the event of a major over or under voltage event. • The critical issue in this respect is the lack of governance that exists to appropriately monitor the performance of systems in the field. This is supported by the AEMO/ UNSW bench-testing work, though we support a release and review of this data using alternative sources to test how widespread this issue is. • As a first step Tesla supports improving the governance settings against AS4777.2. • The costs for complying with the requirements proposed will equal more than **$500m over the next 10 years** (based on the AEMO High DER scenario). This cost will be born predominantly by consumers. SA Government should consider redirecting some of this cost to improved governance protocols. **Continued work on interoperability** • For additional control overlays sitting above the volt-var/ volt-watt automated responses, Tesla supports a continued focus on interoperability and API integration. • This approach is the basis of the bulk of domestic work underway (see the SAPN Advanced VPP Grid Integration work and the AEMO VPP Demonstrations Trial); as well as international work programs (California Rule 21) and international product standards (IEEE1547). • Continued development of a remote, API approach to remote disconnection has the added benefit of being able to be retrospectively rolled-out via firmware updates to the entirety of the installed DER asset base, rather than just to new installs. • This approach can also be tested in the near term through trials that are already underway. As noted above, integration via API is the basis of the AEMO VPP trial. Disconnection signals could be tested through existing participants with a view to including a base of solar inverters for additional testing. • Similarly SAPN has undertaken a significant API build-out to provide DER signals through their VPP Integration Work. Expanding this to solar inverters and the broader DER fleet should be the critical focus of industry.

Consultation Paper #2 – Export limit requirements for distributed solar

Consultation Paper	Overview of concerns	Options to address
#2 - Export limit requirements for distributed solar	• The potential impacts for VPPs will largely be driven by the impact of the technical requirements on the 1 January 2021 compliance period. • Tesla is a member of the SA Power Networks DER WG and understands that full integration with SAPN via API will not be an option from the beginning of 2021. As such it's unclear what will be required for solar inverters from 1 January 2021 to meet these requirements. • As per our comments on the previous slide, Tesla does not support a physical stop-gap solution. We believe this approach will add additional costs to consumers, and will become technically redundant within a short period of time.	• As per our comments on the previous slide, Tesla supports a continued focus on interoperability and developing a technology forward approach for integration with new and existing DER. • Support the existing dynamic exports work being undertaken by SAPN, which will include capability to deploy a broad API integration approach. Note this will not be ready to deploy from January 2021. • Tesla has been actively working with SAPN over the last 12 months in an ARENA funded project testing dynamic operating frameworks. This approach is technology agnostic, scalable, cost effective for customers and can be retrospectively deployed across the incumbent SA inverter fleet.

Consultation Paper #3 – Disturbance ride-through requirements

Consultation Paper	Overview of concerns	Options to address
#3 - Disturbance ride-through requirements	• Our major concern relates to the timing proposed by the SA Government and the impacts that it will have on the industry. • Specifically the vast majority of inverters will not be tested prior to September 2020. • This will effectively pause the DER industry in SA for a period of time, leaving businesses out of work for a period of months, resulting in an under-subscription of the Home Battery Subsidy Scheme (which will also result in fewer batteries being available to manage the impacts of excess solar from existing installations), and will result in a number of SA businesses holding stock that cannot be sold. • AEMO had originally proposed a November timeline for compliance with the new Disturbance Ride-Through Requirements. Our feedback to AEMO as part of this consultation is that this proposed timeframe would be challenging for industry to meet. • It should be noted there is likely to be a rush of applications to connect inverters prior to the new requirements taking effect . This may result in a disproportionate amount of non-compliant products being installed on the network and will also create delays in processing applications, increase in ombudsman escalations, and further impact reputation. • Finally, we have concerns the test conditions are not prescriptive enough to guarantee all inverters will perform as intended . There is a risk, as discovered in previous versions of AS4777, the complete response of inverters is not captured by the test cases proposed which results in unintended or inconsistent behaviour. • This opens up the door to later, reactive measures that increase costs for consumers and apply stop-gap solutions to managing an issue.	**Compliance timelines review** • It is critical that these timelines are revisited. • Tesla proposes the start 2021 or the point at which 50% of inverters sold in South Australia are tested. This will minimize the impact on industry in South Australia and minimize the amount of stock sitting in warehouses that cannot be sold. • In general the timeframes for testing through a local JAS-ANZ facility and listing with the Clean Energy Council (CEC) is a minimum of 6 months. This includes internal approvals, testing and work with the CEC to check off on all documentation. Tesla's response to AEMO noted the benefits of including international testing laboratories as well as JAS-ANZ facilities. This would allow more systems to meet the November timeframes proposed by AEMO – which were already challenging. September is unrealistic. • To achieve streamlined, safe and efficient implementation, this capability must be built into inverter settings upfront – which avoids unnecessary manual configuration by each individual installer. **Review of test protocol** • Tesla believes that the testing protocol proposed will not fully solve for the negative load and frequency ride-through issues. Further work is required in this space to ensure that it aligns with the test protocol that will be introduced in an updated AS4777.2 and fully solves for the issues present. • Suggest that SA Government and AEMO set up a dedicated inverter manufacturer working group that considers data from a range of different systems to consider the best approach for managing the issues identified. • Solutions can be rapidly identified and introduced, but it is critical to properly include industry in this process as that will result in the most cost effective and technology forward solution. This work cannot be properly done in a two-week consultation period.

Consultation Paper #4 – Smart Meter Technical Standards

Consultation Paper	Overview of concerns	Options to address
#4 – Smart Meter Technical Standards	• Dual element meters require separate wiring of the conductor from the PV generator breaker to the meter, this is a large change from the current practice of wiring the PV generator conductor to a “solar breaker” on the main or sub board. • Having a separate PV connection to the meter will mean that no solar can be installed without the metering provider being present (added time/cost/complexity) as the meter is not the Customer’s asset and not safely accessible. This is estimated to increase costs by around $1000 per install (not including the meter). This will be a significant discouragement for retrofit of storage to existing PV, as well as new PV or PV + storage. • For export-limited systems or storage systems, these sites require a net load meter to be installed (that is the fundamental control signal for export limiting or battery system operation). There is no longer a net load conductor to the meter, it is unclear how it would be possible to install the CTs over two independent conductors (load + solar), as this work would be upstream of the boards and not able to be safely conducted under AS3000. • For AC-coupled storage systems: a separate PV connection will completely disconnect solar in a blackout and prevent customers from having solar in a backup (reduce the efficacy of storage). • For DC-coupled storage systems, remote disconnect of the PV will result in the system entering backup and the backup loads circuit islanding. This will result in the loss of critical load circuits when the grid is connected and PV remotely disconnected. • It would not be possible to install PV on sub boards without segregation and costly dual conductor runs which are costly and in some cases won’t be practicable (large houses with distributed boards) • Solar self -consumption will be adversely impacted as the power flow will be from the PV meter to the meter and then back to the load circuit (significantly increasing losses) as no local consumption of solar will be undertaken. • It is unclear the revenue implications of having gross solar and gross load on the meter, it should be clarified if this is moving to a gross solar FIT and gross load energy charge, which negates the benefit of solar self-consumption (and solar itself) in SA. • **Tesla does not support the inotriduction of dual element meters. It is a blunt instrument that adds additional costs to consumers and detracts from system efficacy thus disincentivising storage and VPPs.**	• As per our response to Consultation Paper 1 and 2, Tesla supports a technology agnostic approach to managing remote disconnection and dynamic export. • This continued focus on interoperability should continue and the SA Government should **not** pursue the dual-element meters as an option.

Consultation Paper #5 – Tariffs to incentivise energy use in low demand periods

Consultation Paper	Overview of concerns	Options to address
#5 – Tariffs to incentivise energy use in low demand periods	• Tesla provides in principle support for the accelerated move to dynamic pricing structures in 2020 as originally proposed by SA Power Networks. • However, clarifying implementation details would be helpful given the tight timeframes being proposed. For example, we recommend clarifying that mandated requirements for standing offers do not concurrently impose unnecessary restrictions on market offers. • Need to ensure the proposal maintains efficient market-led arrangements to maximise benefits for consumers. • This will also drive better outcomes for the integration of flexible, controllable assets behind the meter (e.g. home battery storage) as well as at the local distribution level (e.g. community-scale storage). • Allowing full flexibility for market offers (i.e. by not enforcing full network tariff pass through to customers) will also ensure continued innovation in VPP commercial models – ensuring the efficacy and underpinning continued scale-up of VPPs in the state. • Restrictions placed on the broader suite of retail offers will severely impact operating flexibility and could undercut the commercial models of existing VPPs - affecting their financial viability relative to arrangements that were based on retail market rules at the time of design and investment • Linking to the other consultations being proposed, it would be helpful to outline the broader transition pathway and how this tariff reform will integrate with the complementary work being undertaken – e.g. by SAPN on dynamic export controls, as well as NEM-wide market reforms progressing such as development of ‘2-sided markets’, and ongoing consideration for use of system charges to be applied to generation at the distribution level.	• Clarify requirements on retailer’s standard vs market offers: • Allow retail market innovations to provide alternative structures that offer customers overall lower bill costs (even if individual components of the structure may appear higher than individual elements of the TOU or prosumer standing offer tariff structures) • Exclude requirements to pass through network cost structures to customers for all market offers, and in particular exclude customer systems that are part of a VPP.