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Energy Policy WA
Department of Energy, Mines, Industry Regulation and Safety
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Via email: energymarkets@demirs.wa.gov.au.

7 August 2025

**RE: Response to the Power System Security and Reliability (PSSR) Standards Review**

Dear Mr Tim Bray,

Tesla Motors Australia, Pty Ltd (Tesla) welcomes the opportunity to provide Energy Policy WA with feedback on the Consultation Paper for the Power System Security and Reliability (PSSR) Standards Review.

Tesla's mission is to accelerate the transition to sustainable energy. A key aspect of this will be using smart, grid-forming inverters to support the increased penetration of variable renewable energy in the grid. Battery energy storage systems (BESS) are highly flexible and can value stack across a multitude of services, including energy arbitrage, Frequency Ancillary Control Services (FCAS), and Essential System Services (ESS) like inertia and system strength.

In WA, Tesla is proud to be supplying Neoen's Collie 1 (219 MW/877 MWh) and Collie 2 (341 MW/1363 MWh) BESS, and Atmos Renewables' Merredin BESS (100 MW/400 MWh), and looks forward to continuing to grow its WA pipeline. In the NEM, Tesla has a pipeline of 4.5 GW/12 GWh+ of grid-forming BESS installed or under development, and the PSSR Standards Review provides an opportunity to enable grid-forming BESS to connect and contribute to system security and reliability in the SWIS.

Tesla broadly supports many of the proposals within the PSSR Standards Review and proposes minor recommendations within 'Section 3.3 – Suitability of Technical Requirements for new technologies' to ensure that the connection standards best enable plants to appropriately provide grid-forming capabilities. These include, but are not limited to:

- **6) Withstand Short Circuit Ratio (SCR):** allow the use of alternate settings for testing.
- **7) Voltage phase angle jump:** remove as requirement will require tuning down inertia significantly.
- **8) Active and reactive current response during and after contingencies:** propose an active power level for the recovery in A12.9.2.5(b) to be 90%.
- **10) Damping of power system oscillations:** requirement (a) in A12.4.3.8 as sufficient for damping requirements.

In 'Section 3.4 – SWIS System Strength Framework', Tesla notes the contributions of grid-forming technology to support meeting system security objectives in an efficient and least-cost manner.

Tesla looks forward to continued engagement and actively participating in ongoing discussions with the PSSRWG. We welcome a workshop with Energy Policy WA to discuss any items raised below or more broadly on this topic.

Kind regards,

Tesla Energy Policy Team
[redacted]

## Responses - Power System Security and Reliability (PSSR) Standards Review

| Proposal | Proposed Changes | Tesla Response |
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| **1 – Network planning standards for PSSR** | *'The planning standard for Western Power as the Network Operator to include both customer outcome standards and deterministic standards…' (p. 10)* | No comment. |
| **2 - User categorisation framework** | *'A revised facility categorisation framework will be implemented in the ESM Rules.' (p. 11)* | No comment. |
| **3 – Application of standards to each category of users** | *'Harmonics: To be included in ESM Rules, some overlap with the existing A12.12 to be resolved in drafting.' (p. 45)* | Tesla suggests that any inclusion of harmonics in Table 10, Common Requirements, should be consulted with industry before it is designed and embedded in the ESM Rules. |
| **4 – Point of compliance with user facility standards and hybrid facilities** | *'Do stakeholders support the proposal to continue to allow compliance to be assessed at individual components behind the Connection Point if guidance is provided on when this requirement will be imposed?' (p. 47)* | Tesla supports the proposal to keep flexibility in the point of compliance for hybrid facilities. |
| **5 – Governance of the user facility standards framework** | *'ensure AEMO is consulted on the Performance Standards' (p. 13)* | Tesla notes that introducing consultation with AEMO on the Performance Standards may add more complexity to the process, as this currently is negotiated between the proponent and Western Power. |
| **6 – Withstand Short Circuit Ratio (SCR)**<br><br>*Minimum Standard* | *'A Minimum User Performance Standard for withstand SCR of 2.0 (grid-forming IBR) and 3.0 (grid-following IBR)' (p. 14)* | Tesla does not support a withstand SCR of 3.0 for GFL, as this is not reflective of actual plant output, and suggests a figure of 7.0. Also, Tesla encourages EPWA to share the guidelines that are used for the withstand SCR studies. |
| **6 – Withstand Short Circuit Ratio (SCR)**<br><br>*Automatic Standard* | *'An Automatic User Performance Standard for withstand SCR of 1.2 for grid-forming IBR. No Automatic User Performance Standard for grid-following inverters.' (p. 14)* | Tesla supports the proposal. |
| **6 – Withstand Short Circuit Ratio (SCR)**<br><br>*Grid-Forming Standard* | *'Set Minimum and Automatic User Performance Standards for grid-forming inverters as SCR of 2 and 1.2 respectively.' (p. 51)* | Tesla supports the proposal. |
| **6 – Withstand Short Circuit Ratio (SCR)**<br><br>*Alternate Settings* | *'A requirement that settings used must not be different to the setting required for compliance with other Technical Requirements unless otherwise agreed with AEMO and the Network Operator.' (p. 14)*<br><br>*'Add a provision that specifies that, for both grid-following and grid-forming inverters, the settings used must not be different to the setting required for compliance with other Technical* | Tesla does not support this requirement and encourages the same approach as the NER's S5.2.5.15 in the NEM, where alternate settings are allowed to demonstrate a withstand SCR of 1.2. |

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| | *Requirements unless otherwise agreed with AEMO and the Network Operator.' (p. 51)* | As such, the site-specific settings are not chosen to withstand an SCR of 1.2, but to provide optimal performance at the actual project's fault level.<br><br>By not allowing the use of alternative settings to demonstrate performance at a withstand SCR of 1.2, the plant will have sub-optimal performances for the grid due to lower frequency support and inertia. This is to avoid active power transfer limit in SCR 1.2 SMIB system conditions, which does not represent the actual low system strength conditions. The system would be tuned for a situation that is not representative of how it is deployed, as a withstand SCR of 1.2 is considerably lower than the actual fault level on site in WA.<br><br>Tesla proposes two alternative approaches for the use of alternate settings.<br><br>Firstly, to create a withstand SCR threshold, where if it is a higher, and thus stronger value, alternate settings are allowed to meet technical requirements. Contrarily, if there is a weaker withstand SCR value at site, then the actual plant settings could be required to demonstrate capability.<br><br>Secondly, an approach could include demonstrating the inverter's ride through capabilities in islanded operation, which would have an SCR of 0. |
| **6 – Withstand Short Circuit Ratio (SCR)**<br><br>*Alternate Settings* | *'Flexibility should be provided for AEMO and the Network Operator to consider accepting the use of different settings if there are sizeable differences between the minimum anticipated SCR and the withstand SCR.' (p. 51)* | Tesla supports this proposal, although as above, suggests there should be a clearly defined threshold value on what is considered a sizeable difference between the minimum anticipated SCR and the withstand SCR. |
| **6 – Withstand Short Circuit Ratio (SCR)**<br><br>*Alternate Settings* | *'At the same time, it is understood that in some connections there may be large differences between the minimum anticipated SCR at the Connection Point, e.g. SCR of 10, and the withstand SCR, which might mean that control system tuning will be done sub-optimally for conditions that may not likely arise if flexibility is now allowed for.' (p. 51)* | Tesla supports this statement, noting that a vast majority of projects will face this challenge. Operating the grid on a long-term basis with a high SCR, with plant settings tuned to support a very low SCR can disadvantage the running of the grid. |
| **7 – Voltage phase angle jump**<br><br>*Response Time* | *'A Minimum User Performance Standard for grid-forming inverters to withstand an angle jump of less than 60 degrees and supress the phase angle jump with a response time of 20ms or lower.' (p. 15, p. 53)* | Tesla does not support this proposal, and suggests that it is removed, given it will limit the plant's ability to provide inertia. 20ms is a very stringent requirement for plant capability. |

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| | | Additionally, Tesla seeks clarification on how response time is defined. For comparison, in NESO, response time is defined as the time for the initiation of the response.[1] |
| **7 – Voltage phase angle jump**<br><br>*Angle Magnitude* | *'A requirement to withstand a phase angle jump of less than 60 degrees at the connection point is proposed for grid-forming inverters, consistent with the National Grid ESO Grid Code, as well as a requirement to supress the phase angle jump with a response time of no greater than 20ms. This is in recognition that the ability to supress a voltage phase angle jump constitutes a core definition of grid-forming inverter capability.' (p. 53)* | Tesla notes that the magnitude of the angle jump will lead to challenges to plant performance, requiring it to tune down its inertial response to essentially 0. Consequently, the outcomes of the requirement will be counterintuitive to its objective of supporting grid-forming capability.<br><br>Similarly, Tesla notes that synchronous generators or condensers would not be able to ride through such a phase jump, but are still a recognised provider of system strength, indicating that this is not a suitable benchmark to impose on grid-forming inverters. |
| **8 – Active and reactive current response during and after contingencies**<br><br>*Injection Ratio* | *'Revise Minimum User Performance Standard for IBR from 2% to 0%.' (p. 16)*<br><br>*'Amend A12.9.3.5(a) to reduce the current Minimum User Performance Standard for IBR from 2% reactive current injection per 1% voltage drop to 0 % per 1 % reduction of positive sequence voltage.' (p. 56)* | Tesla supports this proposal. |
| **8 – Active and reactive current response during and after contingencies**<br><br>*Negative Sequence Current Control* | *'Remove sub-clause A12.9.1.6(c) and add new criteria to the Minimum and Automatic User Performance Standards requiring grid-following and grid-forming IBR to inject negative sequence current during unbalanced faults leading the negative sequence voltage by at least 90° and specify prioritisation between positive and negative sequence currents during faults.' (p. 16)* | Tesla challenges the request to specify prioritisation between positive and negative sequence currents during faults, as this is an inherent response within the grid-forming control mechanism, with no prescriptive hierarchy between positive and negative sequence current.<br><br>Tesla further suggests a small language tweak to replace '*inject negative sequence current during unbalanced faults*' with *'inject negative sequence current to reduce overvoltage in unfaulted phases'*. This is due to the original phrasing not fully capturing the actual physical mechanism at play, as negative sequence current does not "oppose" unbalanced voltages but rather reduces overvoltage in the unfaulted phases.<br><br>Tesla also opposes requirements for negative sequence control mechanism, since grid-forming technology inherently manages this aspect without needing refinements to control methodologies, as it is built into the plant design. Instead, |

[1] NESO Guidance Notes for Grid Forming Plant EU Code Users, September 2023

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| | | Tesla recommends that requirements emphasise overall plant performance outcomes. |
| **8 – Active and reactive current response during and after contingencies**<br><br>*Frequency of Current Injection* | *'Amend clause A12.9.1.6 to add a new requirement under the Minimum and Automatic Performance Standards requiring that, during the fault, injection of active and reactive current from the Generating System and each of its Asynchronous Generating Units must have a fundamental frequency component same as the fundamental frequency of the terminal voltage.' (p. 16)* | Tesla does not support this proposal, as any plant frequency of current injection will be synchronised with the grid, noting that the grid can slightly deviate from its fundamental frequency. Current injection frequency will be the same as rotor frequency to enable synchronisation, as is the plant behaviour for synchronous machines. |
| **8 – Active and reactive current response during and after contingencies**<br><br>*Oppose Fast Changes in Voltage Magnitude* | *'Amend clause A12.9.2.5(a) for grid-forming IBR to add a requirement for equipment covered in that clause to be capable of reducing the sensitivity of voltage magnitude to a given change in current within 20ms after the disturbance, as compared to when the facility was not connected.' (p. 17, p. 61)* | Tesla seeks clarification on how this requirement will be assessed, given the challenge in demonstrating the insensitivity of voltage magnitude to current change. |
| **8 – Active and reactive current response during and after contingencies**<br><br>*Behaviour at Current Limitation* | *'Comply with all withstand requirements set out in other Technical Requirements including steady-state voltage and frequency deviations, voltage and frequency rate of change, phase angle change and SCR.' (p. 57)* | Tesla supports the proposal and suggests a small wording tweak to replace current 'limitation' with 'limiter'. |
| **8 – Active and reactive current response during and after contingencies**<br><br>*Long Duration Faults* | *'The duration within which the reactive current response must be sustained following a contingency.' (p. 59)* | Tesla supports the proposal. |
| **8 – Active and reactive current response during and after contingencies**<br><br>*Active Power Recovery* | *What is an appropriate level of active power to specify in A12.9.2.5(b) for grid forming inverters? (p. 61)* | Tesla proposes an active power level for the recovery in A12.9.2.5(b) to be 90%, or alternatively to extend the recovery time duration from 100ms to 300ms, as this is comparable to synchronous machines, which have a similar range of 250ms to 500ms. |
| **9 – Disturbance ride through for multiple disturbances** | *Do stakeholders agree with the above proposed provisions/standards? (p. 63)* | Tesla proposes that demonstrations proving a plant's disturbance ride-through capability for multiple disturbances can be assessed through model simulations, alongside a single hardware capability demonstration per technology type.<br><br>This approach addresses the constraints of limited compliance lab facilities, which would require testing every project in the lab, leading to potential delays—even though models can effectively showcase identical performance. |
| **10 – Damping of power system oscillations** | *'A12.4.3.8. With respect to grid-forming inverters, the Generating System must have Equipment capabilities and Control Systems, including, if necessary, a power system stabiliser, sufficient to ensure that:* | Tesla supports (a) in A12.4.3.8, and notes that for point (b), it is sufficient to state: '*The operation of the Generating System does not cause instability that would adversely impact the SWIS power system or other equipment* |

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| | *(a) operation of the Generating System does not degrade the damping of power system oscillations; and*<br><br>*(b) operation of the Generating System does not cause instability or poorly damped oscillations that would adversely impact the SWIS power system or other Equipment connected to the SWIS.*<br><br>*AEMO and the Network Operator must specify a frequency range of oscillations consistent with the bandwidth of control systems for which the above requirements will apply. An upper frequency limit of 300 Hz will be applied unless sufficient evidence is provided to AEMO and the Network Operator regarding the actual bandwidth of the converter control.' (p. 100)* | *connected to the SWIS.'* This is due to 'poorly damped' as hard to define and vague terminology.<br><br>Tesla does not support the proposal for specifying a frequency range of oscillations and suggests that paragraph is removed. Similar to the considerations in NER clause S5.2.5.13, it is not practical to specify a fixed frequency range of oscillations that aligns with the bandwidth of control systems. For grid-forming inverters, the main control loops relevant to generator performance assessments are typically outer-loop RMS-based controllers, with bandwidths generally limited to within 10 Hz. Due to variations in control methodologies among different OEMs, defining a universal RMS controller bandwidth for all GFM inverters is not feasible.<br><br>Typically, GFM inverters are capable of providing active damping for oscillations within this ~10 Hz range. At higher frequencies—particularly above 100 Hz—GFM inverters generally only contribute passive damping.<br><br>For very high frequency oscillations, the inverter does not respond via control loops at these frequencies. Damping is instead provided through physical or virtual impedance characteristics (e.g. filters, LCL networks, virtual admittance) that inherently absorb or dissipate high-frequency energy. |
| **11 – Partial load rejection** | *'Adopt changes to the definition of continuous uninterrupted operation and clause A12.6.1.5 to recognise potential beneficial responses, such as active power response opposing phase angle jumps and primary frequency response, including inertial response opposing frequency changes.'* | No comment. |
| **12 – Revised system strength definition** | *Do stakeholders agree with the proposed definition? (p. 69)* | Yes, Tesla supports this definition. |
| **13 – A future fleet outlook for use in fault level assessments** | *'This forecast should take into account the likely fleet given: the investment likely to meet minimum fault levels for network protection.' (p. 69).*<br><br>*'The future fleet outlook can also have a broader use, for example in analysing the impact of network congestion on market outcomes.' (p. 69)* | Tesla notes that while the main application for fault current is to distinguish between a fault and normal operation in protection relays, almost all transmission networks already use differential relays for primary and distance for backup rather than legacy overcurrent relays for their protection schemes.[2] For the distribution network that still uses overcurrent protection relays, a deep fault in distribution is a |

[2] Powerlink Protection Design – Standard Version 11.0, December 2024

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| | | shallow fault in transmission – therefore there is not a significant overload contribution required. Furthermore, as we see an increase in generators, the base MVa will increase with more plants contributing to fault current, reducing the need for significant overcurrent capability.<br><br>Similarly, Tesla seeks further clarification on the link between fault level and network congestion. |
| **13 – A future fleet outlook for use in fault level assessments** | *'The framework must capture the availability of resources that provide system strength into the future (i.e. account for outages and maintenance of the facilities that provide system strength).' (p. 69)* | Tesla notes the risks to reliability with sourcing system strength through synchronous condensers and encourages greater consideration for grid-forming batteries to provide this service.<br><br>This is due to synchronous condensers relying on mechanical components and can experience a total loss if taken offline for maintenance due to even minor faults. The modular architecture of batteries allow them to continue operating even when individual units fail, maintaining inertia provision without disruption. AEMO outlines in a report: "Inadvertent trips of synchronous condensers could present an increasing risk as progressively more SCs are installed across the NEM to manage system strength requirements."[3]<br><br>More broadly, synchronous condenser asset life is likely shorter than expected due to equipment obsolescence and limited vendor maintenance support, and requiring periodic major refurbishments to maintain functionality and impacting ability to meet annual availability targets closer to end of life. [4] |
| **13 – A future fleet outlook for use in fault level assessments** | *'Currently only Facilities with synchronous inertia can provide RoCoF Control Service, and therefore this market acts as a safety net to manage system strength (noting that this may not account for locational needs). In the future there may be provisions that allow for synthetic inertia to provide RoCoF, and System Strength may become the binding system need which requires synchronous generation to be operating.' (p. 69)* | Tesla strongly supports facilities with synthetic inertia to participate in WA's RoCoF Control Service and also notes that grid-forming inverters can contribute to both minimum and efficient levels of system strength.<br><br>Regarding the capability of synthetic inertia, Tesla points to AEMO Inertia methodology finalised in December 2024, that outlines the approach to quantify synthetic inertia and remove restrictions for procurement.[5], and also its response to the AEMC Efficient Provision of Inertia consultation.[6] |

[3] AEMO Multiple Events Involving the Trip of Buronga Synchronous Condensers between 11 November 2020 and 30 March 2022, November 2022
[4] GHD Advisory Economic Life for ElectraNet Synchronous Condensers, June 2019
[5] AEMO Inertia Requirements Methodology, December 2024
[6] Tesla Submission into the AEMC Efficient Provision of Inertia Consultation, February 2025

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| **14 – Maintaining minimum fault levels required for network protection** | *'The Network Operator will be required to: develop and publish a methodology for calculating minimum fault level requirements at each transmission node; compare the minimum fault level requirements with the expected fault level at each node as part of the TSP each year, using the fleet outlook and the demand forecast, as part of the System Strength calculation; and resolve any forecast shortfalls through network reinforcement or non-network solutions (e.g. competitive NCESS procurement), as necessary.' (p. 21)* | See response to 13 – A future fleet outlook for use in fault level assessments (1). |
| **15 – A centralised planning/investment function for system strength to facilitate new connections** | *'The Network Operator will be required to forecast shortfalls in system strength required to host the expected portfolio of inverter-based resources on the system, and to take steps to procure services that can address these shortfalls through competitive mechanisms (using the NCESS framework).' (p. 21)* | Tesla supports EPWA's consideration of centralised framework to provide planning certainty for both the Network Operator and proponents seeking connection, as well as to enable efficient levels of investment.<br><br>Tesla notes WA has a real opportunity to be a nationwide leader in this space and utilise the opportunity to design the system strength framework to support efficient procurement, by reflecting on the challenges with the RIT-T framework in the NEM. The RIT-T process often does not align with the investment timelines of new assets[7], and the regulatory design favours higher-cost synchronous condensers due to the 'total economic cost framework', outlined in previous submissions by Tesla.[8,9] |
| **15 – A centralised planning/investment function for system strength to facilitate new connections** | *'OEM updates may make inverters capable of providing system strength or inertia, however the process for modifying a registered GPS is onerous. It would be useful to have a more streamlined process to update facilities' systems to provide these services without going through a full re-registration.' (p. 71)* | Tesla strongly supports EPWA's consideration to enable a streamlined process to update systems, for instance, for a BESS to go from grid-following to grid-forming, given the benefits to system security, and the relatively lower costs than installing new capacity. |

[7] NEM Review Draft Report, August 2025
[8] Tesla Submission into AEMC Consultation Paper on Improving Cost Recovery Arrangements for Non-Network Options, September 2024
[9] Tesla Submission into Transgrid Meeting System Strength Requirements in NSW PADR, August 2024