EM-001: Comment to proposal P-000142 to amend AS/NZS4777.2:2020

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Preamble:

The use case of EVs exporting to the grid, commonly referred to as 'vehicle to grid' or 'V2G', is becoming a significant consideration in future energy system planning.

The AEMO step change scenario proposes approximately 7GW of V2G being available in 2050, requiring approximately 1 million EVs available for dispatch at any time. This capability is a core element of a future in which we rely on less dispatchable thermal (fossil fuel) generation.

There is reason to believe that if V2G is enabled, it will also lead to faster uptake of EVs, through the ability for consumers to engage in arbitrage to their financial benefit. If we posit that the consumer with an EV is able to export from the vehicle to the grid at 7kW between 6pm to 9pm on most days, with a FiT of 35c/kWh, and can then recharge between midnight and 6am at 10c/kWh, the annual financial benefit to the consumer is on the order of $1500-$2000. This benefit is additive to the benefits available to consumers through responding to price signals to charge their vehicle outside of peak times, which amount to $500-$1000/annum/vehicle. There is future scope for FCAS or other CER-related benefits to stack with the arbitrage opportunity.

Importantly, this arbitrage does not rely on investment in an additional stationary battery, which makes it easier to stack up commercially than a stationary-battery-based VPP.

It does require the ability for energy from the car to be exported to the grid, however – which is Where AS/NZS4777.1 and AS/NZS4777.2 comes in.

Of key importance is the relative place of Australia in the global marketplace for this technology. We are world leaders in rooftop solar uptake, currently deploying 3GW of solar each year, and therefore enjoy the ability, and have a practical need, to set the standards for equipment and connection.

In EV, we are global laggards. If we set unique local requirements through Australian Standards and/or state based regulations that apply to V2G, we should reasonably expect many global equipment manufacturers (of both Electric Vehicles and EVSE) to ignore our market with respect to the enablement of V2G capability. This will lead to reduced consumer choice, higher consumer costs, lack of access to global best-of-breed solutions, and overall slower uptake of V2G.

Use cases for electrical energy export from the vehicle:

The proposal identifies a need to clarify in clause 1.1 whether the standard applies to the EV, the EVSE, or both. We suggest that an explanatory note or table should be included in AS/NZS4777.1, AS/NZS4777.2, or both, along the lines of the below to elucidate the use cases associated with energy export from EVs, and make clear where AS/NZS4777 applies, and where it does not.

Vehicle to Load (V2L):

Vehicle to load is a use case where the inverter is in the EV, and exports AC via an electrical outlet. It is primarily intended for operating tools and other electrical appliances. AS/NZS4777.2 will not apply here, because the operation of the inverter is such that it is islanded from the grid.

Vehicle to Home, AC (V2H–AC):

An extension of the above, the AC export from the vehicle is connected to the home by way of a changeover or transfer switch. This enables energy from the vehicle to supply a building in the same way that a small petrol generator can supply a building. As with the example above, AN/NZS4777.2 will not apply. The core value to the consumer of this approach is back-up supply, in the same way that a petrol generator can provide back-up supply. It is likely to be relatively attractive in regional settings, where the use of small petrol generators in this manner is already commonplace.

Vehicle to grid, AC (V2G–AC):

In this case, in addition to exporting AC, the power electronics in the vehicle handles synchronisation with the existing network and covers off the technical requirements such as ride through. It does not appear that a majority of auto OEMS are intending to enable V2G via this method, but it may become an important use case to develop standards around in future.

Vehicle to Home, DC (V2H-DC):

In this case, the vehicle exports DC to a stationary inverter mounted in the building, which converts to AC. If the electrical installation is such that the inverter cannot connect electrically to the grid (for example by way of a changeover switch, as per V2H-AC) then it is possible that AS4777.2 would not apply. If the electrical installation is such that the inverter will has the ability to connect to the grid, then the use case is better described as V2G-DC (see below) and AS/NZS4777.2 applies.

Vehicle to Grid, DC (V2G-DC):

In this case, the vehicle exports DC to a stationary inverter mounted in the building, which converts to AC for local use and grid export. This use case is very similar to that of a solar inverter. AS/NZS4777.2 applies.

Perception of AS/NZS4777 as a barrier to V2G, as covered in the proposal:

We note from the **appendix** at I.5:

"Identified for some V2G PLLs that they can be tuned to withstand a 60° voltage phase jump while still dropping off with smaller phase jumps. (See link)."

"Consider options to ensure that inverters are capable of meeting an array of conditions. Incorporate feedback from manufacturers/local suppliers of V2G infrastructure to ensure 4777.2 does not continue to be perceived as an unjustified barrier to this technology."

We note from the **project proposal**:

"Further review of testing procedures may need to be considered, as there is recent reported evidence of inverters that are able to withstand a 60° voltage phase jump while still tripping with smaller phase jumps. The testing procedures may either need to be clarified or adjusted to ensure the relevant scenarios are captured to ensure inverters perform as required"

The position from the appendix around addressing the perception that AS4777 is an unjustified barrier to V2G is most welcome. The position in the proposal itself, however, appears to lean towards augmenting existing testing and compliance requirements, on products that are already passing the established test requirements (which we understand to be ride through at 15° and 30°). Other elements of Appendix A appear designed to capture more extreme behaviour in testing, presumably with the goal of enabling a determination to be made of non-compliance. This appears to be taking the standard and testing requirements, which are already unique, in the direction of increased stringency.

We suggest that close consideration should be given to creating a compliance pathway for V2G inverters in Australia based on compliance with international standards, with a preference for IEC standards. This could potentially be in the form of an appendix specifically related to V2G inverters, enabling a V2G inverter to demonstrate compliance to 4777.2 via ***either*** the existing 4777.2 requirements applied to solar inverters, or by demonstrating compliance to the relevant IEC standards applicable to V2G inverters. This should be done in close consultation with existing multinational hardware manufacturers building for the European markets, to determine which IEC standards it is appropriate to reference. This could reasonably be done with a view to allowing more straightforward compliance option for equipment manufacturers and suppliers for a period of five years, by which time we'd expect to see a review of the standards in this fast moving space both at the local level and at the IEC level.

We note that this would constitute a departure from the existing technical requirements in 4777.2, specifically for this new use case. The requirements in 4777.2 have evolved over time with a view to ensuring appropriate grid security outcomes in the face of rapidly rising levels of roof-top solar, and are world leading – they need to be, because we are world leaders in rooftop solar, and it is Australian jurisdictions that are dealing with the consequences of high levels of rooftop solar uptake.

While V2G may in time become large, it is starting from zero in Australia, in a context where we are among the slowest in the developed world to take up the core underpinning technology, that being the actual electric vehicles. The AEMO step change scenario predicts 7GW of dispatchable V2G in 2050, which will typically be utilised during the traditional evening peak. Rooftop solar is already at 30GW and is adding 3GW each year. Rooftop solar is much, much bigger, and will remain so for decades to come. For the avoidance of doubt, we are explicitly not suggesting the application of IEC standards to solar inverters in this submission. In that domain, the more appropriate outcome is for

the technical experts on 4777.2 to provide input into the IEC standards – the rest of the world would benefit from following Australia's lead in that respect.

If there is concern with respect to the application of European technical standards in V2G resulting in the inverters causing system-level issues in the near term, it is worth considering the likely scale of V2G over five years as a back-of-the-envelope exercise. Assuming rapid implementation of ambitious fuel efficiency standards at the federal level in the near term, we may have up to 1 million EVs on Australian roads by 2028 – we're unlikely to see significantly more than this number on our roads in a 5 year time frame. Perhaps one in ten consumers will install a V2G charger if one is available over this time frame, which will mean V2G chargers may exist in 100,000 Australian homes. Perhaps 20% of these will be exporting concurrently, at 7kW each. This would yield about 140MW of generation, spread across the NEM and WEM, during the evening peak – meaning, ~0.5%-1% percent of total generation at that time. This is entirely unlike solar, where unbounded rooftop generation is hitting 100% of demand at state level on some days and requires constraint to ensure system security. A large amount of solar generation simultaneously switching off through a failure to ride through a wide scale fault could credibly be a direct causative factor in a system black event, but the same cannot reasonably be said of V2G in the near term.

The position here is that there is comparatively little system risk associated with allowing a simpler pathway to V2G compliance, aligned with European standards, especially in the near term while numbers are small. The provision of a runway to enable V2G to establish itself as a technology, will provide a footing for a nascent, and important, element of the transition of our energy system. If we instead lean towards the application of unique Australian-only standards, we could reasonably expect significantly less in the way of consumer options for V2G over the next 5 years, which will translate to significantly delayed uptake of the technology – meaning other elements of the energy transition will need to do more of the heavy lifting. It will also mean that Australian consumers will have less access to global best-of-breed technology in this space, which may impact the overall rate of EV uptake, since the value of V2G has the potential to make a material difference to a consumer choosing between a petrol car and an EV.

Comments to other elements of the proposal:

Emergency backstop curtailment of solar

The proposal identifies that in regions without mandatory emergency backstop curtailment provisions, AEMO may need to recommend that state governments and NSPs cease permitting the installation of new solar, until compliance with the new proposed standard can be ensured.

We would observe that logically AEMO could, as an alternative, recommend the adoption of mandatory emergency backstop provisions.

As the rollout of solar generation continues, we will reach a point where curtailment of solar generation will become routine, because without curtailment solar generation will regularly exceed demand. The core issue today may be ride-through, system security, and power quality, but the elephant approaching the room is minimum demand.

Fuel and technology neutrality

The proposal identifies that AEMO remains fuel and technology neutral. We would observe that the ISP planning that AEMO does clearly and specifically pick technologies and performs analysis to determine how much of which technology will be in play over time. This is a core responsibility of the market operator.

The AEMO step change scenario identifies 30GW of co-ordinated DER storage in 2050, comprising 23GW of stationary batteries, and 7GW of V2G. If we are serious about having 7GW of V2G in play in 2050, we need to start removing the roadblocks today.

Impact on public health and safety

We would agree that inverter systems enabling solar export have the potential to cause breaches to system technical limits, leading to bad outcomes. This is a function of scale. On the order of 30GW of solar generation is already installed in Australia, and an additional 3GW is being installed every year. The nature of solar export is that it occurs in a temporally co-incident manner, which will increasingly lead to system minimum demand issues.

We would contend that V2G is unlike solar in this respect. It is not at a comparable scale, and will not be at comparable scale for years to come. Neither is it likely to be exporting co-incident with solar – V2G will be principally be exporting into the grid during the evening peak, co-incident with many other generation assets, and making up a very small fraction of supply at that time.

This will change over the long term as V2G becomes a more significant factor, and the standards will adjust to keep pace. We do not need the 2050 standards in place in 2023.

Impact of this standard

If V2G is not adequately considered in this standard, V2G uptake and its attendant benefits to consumers and the energy system will be delayed.

If V2G is considered, and the technical compliance and testing requirements remain uniquely Australian, V2G uptake and its attendant benefits to consumers and the energy system will be delayed.

Recommendations on parties to consult:

We note that Fronius, a solar inverter manufacturer, has been consulted in this process. With this as precedent, we would suggest that consultation should include car makers with either a current or declared future interest in V2G, and inverter manufacturers with a focus on V2G.

Specifically, we suggest consultation should include at minimum:

- ABB
- Delta Electronics
- Wallbox
- Jetcharge
- Rectifier Technologies
- Hyundai
- Volkswagen
- Mitsubishi
- Nissan

In addition, consultation should include the team responsible for the REVS project from ANU, whose report was referenced in the project proposal.

Additional notes / further work:

<u>CEC approved inverter framework</u>

Once the AS/NZS4777 standard is revised to support V2G, the CEC inverter category flowchart will need review to incorporate inverters intended to deliver V2G outcomes as a separate category. Lumping V2G in with other types of multiple mode inverter is

This is not a responsibility of EL-042 but should be borne in mind by the committee in the drafting of the standard, as it is a necessary part of the enablement of the market that the standard supports.

<u>Earthing of batteries and AS/NZS5139</u>

AS/NZS5139 is called up by clause 2.4.2 of AS/NZS4777.2 and creates a requirement for earthing and earth fault alarm monitoring of the battery system. This is not usefully applicable in the case of V2G, as the battery is within a vehicle that is insulated from the ground by the tyres. AS/NZS5139 should be updated to make it very clear that it is not intended to apply to V2G use cases, and clause 2.4.2 in AS4777.2 should be re-written to make it clear that it does not apply to V2G.

<u>Testing of V2G inverters</u>

In addition to technical requirements for V2G inverters being aligned with international standards, test procedures for V2G inverters should be aligned with international standards. The risk here is that if technical requirements are set in accordance with international requirements, but test procedures are not, we may end up with hardware that is tested to an acceptable compliance level in overseas jurisdictions, but fails the more stringent local testing requirements, and therefore cannot be used.