Integrating hosting capacity into Part 6 of the Code on low voltage networks

Submission on the Electricity Authority consultation paper dated 4 September 2018

Submitter	Northpower	Submission dated 12 November 2018

Question	Response
Q1. Have we adequately outlined the issues with increasing levels of SSDG, particularly inverter-connected solar PV systems?	No, it has not dealt with the impact on AUFLS (now called "Extended Reserves"). Small scale inverter connected generation will trip out due to the under-frequency trip settings in the inverter adding more load onto the grid while the system is tripping load to correct a serious under-frequency event. The impact of harmonics has not been fully covered. Harmonics can cause overheating of the distribution transformers as well as interference with other electrical equipment. The reference to NZECP 36 does not adequately address harmonics because NZECP 36 out-of-date and was not primarily written for small scale inverters. The discussion in items 3.7, 3.8 & 3.9 on page 5 is flawed. (1) Statement made in Item 3.7 is not correct. Measurement results from high levels of SSDG clearly show high flicker levels (P_{st}) and hence is an issue (which can be addressed). By the way, voltage does NOT flicker. It is voltage fluctuations that result in light flicker. (2) NZECP 36:1993 is inadequate in many areas as it does not give harmonic current allowances and hence cannot be used for compliance of an installation or equipment. This is why EEA Power Quality Guidelines were developed. NZECP 36 should be retired. (3) Article 31 of the Electricity (Safety) Regulations 2010 deals with "Requirements relating to quality of supply". There are shortcomings. Firstly, the wrong device standards are referenced. Should be AS/NZS not IEC, and there are subtle differences made for our environment. Also the mixing of a harmonic voltage requirement from ECP 36 and device standards from IEC (or AS/NZS) is not correct because the philosophy of the requirements in the latter are based on the harmonic voltage requirements in IEC 61000-2-2 (or AS/NZS 61000.2.2). (4) The IEC standards assume diversity. Even when equipment complies with device standards, the harmonic voltages and currents can be unacceptable. This has been

	clearly shown in a number of cases. One avenue of research is diversity of equipment. We assume 3.9 is incorrectly worded because it is not an issue of electronic components themselves which are incorporated into inverters not complying with standards. The implication of 3.8 (page 5) is that harmonic issues only occur in equipment that does not comply with standards - this is not true, and there are plenty of examples to show this. Further reading: [1] J.D. Watson and N.R. Watson, Impact of Residential PV on Harmonic Levels in New Zealand, The 7th IEEE International Conference on Innovative Smart Grid Technologies (ISGT Europe 2017), Torino (Italy), 26-29 September 2017
Q2. What other factors are relevant to these technical network considerations?	Control interaction is an issue and this has been demonstrated in a number of studies with regard to ripple signals. This is an issue regardless of the presence of Volt-VAr and Volt-Watt modes. With more power electronic equipment entering the electrical power system, there is a need to ensure the equipment is robust and not going to cause unwanted interactions.
Q3. Do you agree these options broadly represent the range of actions we could consider at this time? Are there other broad conceptual options we should consider that are not covered by these three approaches?	Yes, but in reference to 4.11, it is about reducing carbon emissions. As far as reducing carbon emissions with PVs, New Zealand seems to be focussing on SSDG at residential premises. From our perspective, the emphasis should be on commercial roofs, such as shopping centres, where the electrical hosting capacity is far greater and the commercial loads are a better match for PV generation. We could host at least 10 times the installed PV in these situations.
Q4. Do you think the Authority should pursue the types of measures that Option B would require? If not, please outline your alternative preferred approach, including if possible the costs and benefits. If you consider there is a valid Option C-style alternative, please provide details, including your view on how your alternative would meet the Authority's statutory objective.	Yes, definitely pursue Option B. The sooner Volt-VAr and Volt-Watt modes are used the better for our system.
Q5. Do you have any comments on the draft EEA guide's stated objectives?	The EEA objectives are good and we would like to see the Code amended so that this EEA guide can be fully issued
Q6. What advanced power quality capabilities do inverters sold into the New Zealand market possess?	Volt-VAr and Volt-Watt compensation would allow more PVs to be hosted on LV network which are voltage constrained in regard to hosting DGs. Many inverters on the market already have the capability.

Q7. Is it reasonable to assume that the advanced power quality modes outlined are currently available in the marketplace at no additional cost? If not, what are the likely incremental costs involved to obtain these modes?	We understand that most inverters have this feature and have been tested at the University of Canterbury, so the advanced power modes could probably be implemented at little or no extra cost. It would also stop New Zealand being a “dumping ground” for inverters which do not have these advanced features. Otherwise, the cost of increasing the LV distribution network to ensure that voltage is maintained within the regulatory limits will potentially be significant and, since the cost of network upgrades tend to be spread across all consumers, this would be unfair to those consumers who do not have PVs.
Q8. Would a default requirement to provide volt-var and volt-watt modes for all future inverter installations that use the Part 1A connection process have any unintended adverse consequences (for example, leaving a stock of unsold inverters that are otherwise compliant with the superseded AS4777:2005 standard suite)? Are these adverse consequences surmountable?	Possibly, but one suggestion would be to allow SSDG without Volt–VAr and Volt–Watt modes to be processed through Part 1 but leave it to the EDB to determine whether they accept inverters without these modes. For example, an inverter connected to DG at an installation supplied on a dedicated transformer, is probably not going to be an issue. The other option would be to have a sunset clause, probably after a 1 to 2 year period, but the application should go the Part 1 path and not Part 1A because, as more SSDGs go into the LV network, more detailed technical consideration needs to be conducted. We understand that it is already a requirement in Australia. Moving to the current version of AS/NZ 4777 would create commonality with Australia.
Q9. What comments do you have about the hosting capacity assessment process described in detail in the draft EEA guide?	We support this because it is derived from the collective work across the industry and represents best practice in the New Zealand environment.
Q10. Do you support the Code amendment request discussed in the draft EEA guide? If not, please explain why and, if possible, suggest an alternative approach.	Yes.
Q11. Do you think there is a problem or conflict with the ‘10 kW total’ versus ‘5 kW per phase’ thresholds respectively adopted in the Code and AS/NZS 4777.2:2015? If so, would you support aligning the Code threshold with the inverter standard?	Yes & No. AS/NZS 4777 is a technical standard. The Code should not try to replicate a technical standard but should focus on the rules around the connection process and allocation of capacity for DG. The Code’s 10 kW limit for SSDG for processing the application is less than effective. Firstly, it should be based on the power level injected into the distribution network, not the output of the generation. For example, a 20 kW PV DG system on a commercial installation where the load is never below 20 kW, is effectively the same as a load reduction. Secondly it should be about

	the electrical capacity at the "point of common coupling". For example, a 240 kW PV DG on shopping complex supplied from a dedicated 800 kVA transformer is technically far simpler to model than most residential SSDGs. It is not a matter of merely aligning the Code with AS/4777.2:2015 as the 10 kW total from the Code comes from the "Electricity Industry Participation Code 2010 Part 6 Connection of distributed generation". The Electricity Industry Participation Code has different sections for "Applications for distributed generation 10 kW or less in total" and "Applications for distributed generation above 10 kW in total". There is no real conflict in that the 5 kW per phase (stated as 21.7 A per phase in AS/NZS4777.2) is used to define the Inverter current balance across multiple phases (section 8.2 and 8.4, page 34) and reference network impedance for testing purposes (A5, page 43). These can still hold regardless of the threshold for assessment procedure. In addition, a three-phase inverter delivering 5kW per phase to an LV network is likely to have less adverse effect on the network voltage than a single-phase inverter delivering 10kW to only one phase on the LV network.
Q12. Do you think there are emerging problems with capacity or power quality from in-home electric vehicle chargers, or is it too early to tell? We are keen to hear industry views and experiences and from parties that supply electric vehicle charging equipment.	There are diverging opinions. New EVs have higher capacity batteries and more powerful chargers; however that doesn't mean they will necessarily travel further per day and consume more energy. EVs with higher capacity batteries will not need to charge as often. There needs to be consideration of diversity instead of assuming all EVs will be charged at home daily and at the same time. The Government is considering making it compulsory for landlords to install heating in every bedroom of their rental properties, which will potentially put more demand on networks than EV charging, because home charging of EVs will generally be off-peak, whereas spacing heating in homes is likely to be at peak times. There have seen engineering studies on another network and they have found the hosting capacity for EV charging is much higher than Vector is reporting. If there was a requirement for consumers to lodge applications to connect home EV chargers then you need to consider at what level. Mode 3 EVSE are generally set 16 Amp or 32 Amps although other settings between 6 and 32 Amps are possible. We suggest allowing single-phase EV charging up to 16 Amps (say 4 kW) without requiring an application. However some EVs have multi-phase on-board chargers e.g. Renault Zoe and Tesla (3 phase) and the VW e-Golf (2 phase). Many homes in Northpower's network are multi-phase; under your suggestion a

	Renault Zoe charging at 6 Amps per phase would need the distributor's permission. Whether there is a future problem or not depends on what is allowed. • For home charging, most EVs will draw 1.6 to 2.3 kW and this is adequate for over-night charging. Because of usage patterns and diversity, not every EV will be charging overnight. • On-route charging must be the fastest possible. These chargers can be placed near substations where there is the capacity to cope. Alternatively, Tesla's approach on "autobahn stops" in Europe could be used (trickle charge stationary batteries and then dump the energy into the car). • Destination charging can be slower because the vehicle is likely to be there for a few hours. If a person uses the charge they have put in overnight, during the day, they can go to the nearest fast-charger to top up in the same way someone goes to a petrol station when low of fuel. • Studies by a number of people have shown that the distribution systems in New Zealand can easily accommodate EV charging provided home charging is limited in power level (as it effectively is now with the supplied 10A in-line charging lead). Further reading: [1] VongYee Mei and Shaneel Singh, Ashburton – EV Ready, GREEN Grid & EV Seminar, Christchurch, 13 April 2018, [2] J.D. Watson and N.R. Watson, Impact of Electric Vehicle Chargers on Harmonic Levels in New Zealand, The 7th Innovative Smart Grid Technologies (ISGT Asia 2017), Auckland (New Zealand), 4-7 December 2017 The long term issue is the future of natural gas and people switching to electricity. If there is a move to require significant loads to go through an application process similar to Part 6 of the Code, then it should be for all significant load increases, not just for EV charging.