Electricity Engineers' Association

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To: Electricity Authority (the Authority)
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From: Electricity Engineers' Association of NZ

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Subject: EEA Submission – Issues Paper – Future Security and Resilience - Review of common quality requirements in Part 8 of the Code

OVERVIEW

The Electricity Engineers Association (EEA) of NZ welcomes the opportunity to provide feedback on The Electricity Authorities (the Authority) issues paper on *Future Security and Resilience - Review of common quality requirements in Part 8 of the Code.*

The EEA welcomes the opportunity to be involved in this review as we provide the power industry's largest collaborative forum in New Zealand, focused on delivering clarity on complex engineering/technical issues, practical support and solutions, and market intelligence to support our members and other industry stakeholders to deliver safe and reliable electricity supply within a low carbon policy framework. The EEA represents over 70 Corporate Members (companies) and 600 Individual Members across New Zealand from all engineering disciplines and sectors of the electricity supply industry (see Appendix A).

EEA supports efforts by the Authority to review the common quality requirements in Part 8 of the Code, and we consider that the changes required to the Code will be significant and fundamental to the electricity sector's ability to efficiently allow for decarbonisation of New Zealand's economy and the delivery of electrification. As such, EEA consider that it is a priority for the Authority to work with the electricity sector, in consultation with all other key stakeholders, to deliver 'fit for purpose' common quality requirements that will allow the electricity industry to; promote competition in, provide reliable supply, and deliver the efficient operation that will enable New Zealand's energy future.

EEA is keen to continue our collaboration with the Authority, industry, and other stakeholders regarding this ongoing review of the technical requirements for distributed energy resources (DER) for New Zealand.

Response to Questions

Q1 (page 20): Do you agree with the description of the first common quality issue and that addressing it should be a high priority? If you disagree, please provide your reasons.

EEA agrees with the Authority's description of the first common quality issue regarding inverter-based variable and intermittent resources causing more frequency fluctuations, which are likely to be exacerbated over time by decreasing system inertia.

Issues that EEA think could be added for consideration regarding frequency include:

- EEA assumes that the normal frequency band of +/- 0.2 Hz is the desired performance level that will be required. If yes, we agree that it will be necessary for the Authority to consider how frequency controlling services can achieve that band.
- EEA also note that power system function does not need a time error correction, so EA should consider if it is still a necessary requirement.

However, while we agree that this is an issue that needs to be reviewed and updated, we consider that it is a lower priority issue compared with some of the other issues outlined within the paper. Our reasoning for this prioritisation is based on the premise identified in the Phase 1 Report which indicates that inertia within the system should be sufficient until an IBR penetration of 50% is reached. The current IBR penetration level is approximately 10% as identified in the consultation paper.

Also, the Authority should note that this issue is a priority in Australia where increased connection of inverter-based resources (IBR) are already posing additional challenges in maintaining grid stability, voltage and frequency control. As a result, the Australian Energy Market Operator (AEMO) now undertakes a power system frequency risk review (PSFRR) for the National Electricity Market (NEM) in consultation with transmission network service providers (TNSPs) and publishes a PSFRR report under the National Electricity Rules (NER). Recommendations from this report are then used to guide whether new measures need to be instigated for the NEM. The Authority should consider if a similar power system frequency risk review (on a periodic basis) could be instigated for NZ, with the findings utilised to inform the Authority of any changes that may be required for the code.

Q2, Q3 and Q4 (page 34): Do you agree with the description of the second, third and fourth common quality issues (i.e., first, second and third voltage-related issues) and that addressing it should be a high priority? If you disagree, please provide your reasons.

EEA agrees with the Authority's description of the common quality issues related to voltage that are expected to arise as more inverter-based variable and intermittent resources connect to the power system and that addressing it should be a high priority of the Authority. Whilst not critical yet for New

Zealand, as has been found in other jurisdictions around the world, the regulation of voltage management New Zealand will become increasingly important as DER penetration increases across the country and will become a limiting factor influencing the capability of the system to host large amounts of DER. In addition, overvoltage issues if not managed correctly will therefore lead to increased risk of DER curtailment, can impact appliances and can waste energy thus increasing customers' electricity bills.

The EEA would recommend that the Authority consider the development of a regulatory framework for voltage management.

Key issues that need to be considered within that voltage framework are the waveform shape and amplitude. This includes:

- System strength – Modern wind and solar PV generation as well as battery energy storage systems connect to the grid using power electronics inverter-based technology and require adequate system strength for the inverters to work reliably. This is because synchronous machines are electro-magnetically coupled to the power system's voltage waveform, whereas an inverter is decoupled from the grid by the inverter and, at present, inverters do not create a voltage waveform like a synchronous machine. Therefore, managing stability in low system strength conditions often requires a combination of minimum support from the network in conjunction with coordinated tuning of power electronic control systems of existing and new equipment. Therefore, the importance of smart inverters that can respond to signals in real-time will become increasingly significant as more DER connects to the system.

  It should also be noted that smart inverter-based resources can provide fast and accurate voltage regulation at their point of connection and operate when there is zero fault level. The Authority should therefore investigate how IBR such as solar or wind could provide voltage regulation when not producing active power (i.e., overnight, or in no wind situations).

- Distortion of waveform - waveform shape is degraded by harmonics, and by flicker (normally caused by short duration loads like welders or arc furnaces) and voltage magnitude step changes caused by switching events (most noticeably for capacitor banks but also for lines, transformers, loads etc).
- Fault ride-through – This issue was identified by members as a high priority. A single fault may risk disconnecting multiple small generating stations which can lead to attendant impacts to frequency and supply.

The Authority should also consider reviewing the voltage standard. This could include considering the use of AZ/NZS 4777.2:2020 and/or another modern equivalent (i.e., from other jurisdictions such as the

European voltage standard IEC 60038) or newer equipment surpassing the requirements of these standards. The management of increasing levels of DER on distribution networks will be simpler and cheaper if New Zealand adopts a standard that aligns with other jurisdictions.

Q5 (page 40): Do you agree with the description of the fifth common quality issue and that addressing it should be a high priority? If you disagree, please provide your reasons.

EEA agrees that there is ambiguity around the applicability of harmonics standards in New Zealand. This issue is deemed a high priority given its impacts on voltage waveform and equipment operation.

EEA believes that the Authority should undertake a review of harmonic standards and regulations to identify the best solution moving forward for New Zealand. It should be noted that harmonic standards can be either on an installation basis or on a device basis, with each having its place. It should also be noted that some harmonic standards are absolute and others statistical which can cause issues in interpretation and practice. For example, absolute limits for a system, as is outlined in NZECP36, should not be mixed with statistical limits such as are found in IEC and AS/NZS documents, yet this is currently done. If after review we agree that absolute limits for a system are to be used, as in NZECP36, then appropriate installation and device level limits and allocation methods need to be developed that are consistent with this methodology. This has not currently been done.

It should also be noted that many of the existing standards that are currently applied are outdated (for example, NZECP36 is from 1993 with an implicit assumption that generators do not produce harmonics). Therefore, any review of harmonic standards needs to start with either a complete review and update of existing standards and/or identify appropriate international standards that could be applied in New Zealand. As such, EEA has engaged with our members on this issue, who identified numerous issues in this area, and they consider that this review should be undertaken as a matter of high priority.

Q6 (page 43): If you are a distributor, what is your experience of asset owners sharing information with you for network operation purposes?

As EEA is not a distributor, we cannot provide any personal experience. However, as EDBs are members, we have received anecdotal evidence that there currently are issues with asset owners sharing information. EEA therefore recommends that the distributors' visibility of the location, size and functionality of DER should be improved. Under higher penetration of IBR on distribution networks the EDBs and grid owner/operator will need more visibility of those asset capabilities. The level of penetration of embedded generation should be available for both for real-time system operation needs and for grid planning and system analysis.

Whilst this is an issue for EDBs, it will also become an issue for Transpower as the grid owner as aggregated small scale IBRs present a contingent event risk. The implementation under RTP4 for demand flexibility and DER to be more visible in the wholesale market will cumulatively create effects at grid level. EEA consider that as DER penetration increases, real-time data processes would need to show aggregate DER of 1MW or greater, at a network supply point level, although not immediately. The grid operator will need access to unencrypted equipment and control system models to obtain understanding on how plant will interact with the grid and how it will perform during grid events.

EEA recommends that the Authority should consider the option of establishing a central DER Register (like the one established by the Australian Energy Market Operator (AEMO) for Australia), based on information provided by distribution businesses, but which relies on standardised reporting processes including mandated input by installers during the connection process. The DER Register should have electric vehicle (EV) chargers included.

Q7 (page 47): Do you agree with the description of the sixth common quality issue and that addressing it should be a high priority? If you disagree, please provide your reasons.

EEA agrees with the description of the sixth common quality issue regarding network operators having insufficient information on assets wanting to connect, or which are connected, to the power system (see recommendation above).

With better knowledge and visibility of DER, the grid operator and EDBs can better manage the grid and ensure that consumer-led energy investments can deliver their expected value to consumers and the energy system. Whilst not yet critical in New Zealand, it is anticipated that increasing levels of DER and new technologies, such as batteries and electric vehicles, will be connecting to the grid as New Zealand moves towards decarbonisation. As these levels increase their combined effect will change the way that the Authority needs to plan and operate the energy system. Getting this right for everyone requires better visibility of DER devices installed across the system.

Knowing the locations and specifications of all the DER connected to the electricity grid will become increasingly critical for sustaining a secure and reliable electricity supply for all New Zealanders. With the help of energy sector participants, the Authority should consider developing and deploying an online DER Register to record and hold this data so that the Networks, in conjunction with the Authority, can map out where all the DER devices are across Aotearoa.

A DER Register could also provide for the safe integration of all DER devices into the electricity grid and market, which will enable the establishment of innovative new markets for customers to participate in with their DER devices.

Q8 (page 51): Do you agree with the description of the seventh common quality issue and that addressing it should be a high priority? If you disagree, please provide your reasons.

EEA agrees that the Code contains terms that were included to reflect the technological environment of 20 years ago but are no longer fit for purpose and could hinder the enablement of new technologies. We note that this recommendation is consistent with the FSR Roadmap and should be addressed by the Authority as a high priority.

Q9 (page 51): Do you consider there to be other high priority common quality issues not identified in this paper that are occurring or that you expect to occur because of:

EEA has identified several other issues that could be considered by the Authority as part of their review of common quality across grid and distribution networks:

1. Expanding the *"common quality"* definition to distribution networks. Currently the System Operator does not have the tools to control for voltage and frequency on distribution networks. Should this be considered in the design and establishment of a framework for Distribution System Operators (DSO)?
2. Develop an interoperability policy and regulatory framework. There is currently a work program by Australia's Energy Security Board (ESB) to make interoperability a mandatory requirement for all new inverters being installed. This will mandate that all new connections to the distribution network will be required to demonstrate that the inverter is interoperable with the distribution networks utility server and is capable of dynamic export limitation. The Authority should consider the development of interoperability capability by distribution networks for New Zealand to allow for the same functionality.
3. Ability to restart/re-energise GXPs may be impacted with embedded generation. The stable islanding of grid forming inverter generation with load is a possibility that may become much more common and should be considered by the Authority.
4. Interactions between generators. Has the Authority considered how new generators may potentially impact commercially on other generators and / or grid operation? This has become an issue in other jurisdictions (i.e., the UK and Australia).
5. Testing generator capability. Has the Authority considered how to test the generator fault ride-through on a live system? Overseas evidence is showing that IBR modelled behaviour for fault ride-through is not the same as for real events.
6. Protection setting and auto reclose. Higher penetration of inverter-based generation resources is driving protection manufacturers to amend protection algorithms to improve discriminative protection, however IBRs can also improve control settings.

7. **Connection code dependency with Part 8**. Part 8 of the Code ties to the Connection Code under Part 12 and common quality considerations include harmonics (as identified); power factor (a lot of leading power factor (capacitive) is coming into the grid); and flicker due to electrification of load. The Authority needs to consider ensuring any changes made to Part 8 are aligned in Part 12.

Contact

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Appendix A

Introducing EEA

Founded in 1927 the EEA is the national organisation for engineering, technical and health and safety matters within the New Zealand Electricity Supply Industry (ESI).

Our members include over 70 Corporate Members (companies) and 600 Individual Members from all engineering disciplines and sectors of the electricity supply industry including generation, electricity networks (transmission and distribution), contractors (operation/maintenance), engineering consultancies and equipment suppliers.

The EEA works collaboratively with industry, government, and other stakeholders to provide expertise, advice, and holds or contributes to significant bodies of knowledge on engineering/ technical and safety issues relating to the electricity supply industry in New Zealand. All EEA guides and publications are publicly available.

A key focus of our work is enabling engineering and technology understanding and solutions to support decarbonisation and ensure the safe, reliable, and secure delivery of electricity to our communities.

Our functions include:

- Production and ongoing stewardship of 'bodies of knowledge' including engineering, technical, asset management and safety publications (e.g., guides, Standards, industry reports, and links to relevant legislation and international information).
- Representing the New Zealand electricity supply industry in national and international Standard development and facilitation of benchmarking in safety, technology, and asset management (e.g., IEC, AS/NZS, NZS Standards).
- Providing and supporting engineering and technical professional development and competency for our engineers/technical staff.
- Providing a web-based knowledge hub on safety, engineering, asset management, emerging technology and professional development including information services, notifications, newsletters, guidelines and support documents, events, and infrastructure engineering careers information.