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To:	Electricity Authority (the Authority) FSR@ea.govt.nz
From:	Electricity Engineers' Association of NZ
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Subject:	EEA Submission – Consultation Paper – The future operation of New Zealand's power system

OVERVIEW

The Electricity Engineers Association (EEA) of NZ welcomes the opportunity to provide feedback on The Electricity Authority's (the Authority) consultation paper on *"The future operation of New Zealand's Power System".*

The EEA represents over 70 Corporate Members (companies) and 600 Individual Members across Aotearoa New Zealand from all engineering disciplines and sectors of the electricity supply industry (see Appendix A).

Collectively, we are the power industry's largest collaborative forum in Aotearoa New Zealand, provide clarity on complex engineering and technical issues, practical support and solutions, and market intelligence to support our members and other industry stakeholders to deliver good practice and policy outcomes.

The EEA supports the Authority's endeavours to identify and establish a work programme to manage the challenges and opportunities concerning the future operation of New Zealand's power system. This undertaking holds paramount importance, as it will profoundly impact the electricity sector's capacity to navigate and facilitate the energy transition. As more variable and intermittent generation and load resources connect to the power grid, and electricity flow becomes increasingly bi-directional, the coordination of New Zealand's power system will grow increasingly complex.

As such, EEA consider that it is a priority for the Authority to continue to collaborate with the electricity sector to recognize and address challenges and opportunities. Only with a collaborative effort will it ensure the electricity industry maintains its high level of reliability and security and facilitate efficient operations crucial for shaping New Zealand's energy future.

EEA is keen to continue our collaboration with the Authority, industry, and other stakeholders regarding the review of the system operation requirements for New Zealand.

Introduction

Q1 (page 24): Do you consider section 3 to be an accurate summary of the existing arrangements for power system operation in New Zealand? Please give reasons if you do not agree.

EEA agrees that the Authority's description of the existing arrangements outlined in Section 3 of the consultation document may be accurate from a transmission perspective. However, for distribution system owners and operators, some improvements could be made. The following comments provide more details. They largely relate to the operational impact of the Electricity (Safety) Regulations and the roles that distributors play to maintain quality of supply to consumers.

For consideration:

- *Table 1: Distributor asset owner operations* - A large part of day-to-day distribution network operations involves switching/operations for maintenance and capital work.
- *3.48: The core objective is to provide reliable levels of network capacity to consumers* - One possible objective could be ensuring consistent distribution network capacity for consumers, even though there is no explicit mandate for capacity provision in current legislation. Instead, the primary legislative goals are focused on achieving specific safety or quality outcomes and ensuring transparency. Under the Commerce Act, the Commerce Commission has the authority to enforce Price-Quality regulation on certain distributors, and all distributors are required to disclose information, including capacity, in Annual Monitoring Plans (AMPs). Additionally, the Electricity (Safety) Regulations (2010) dictate electricity supply quality standards for consumers, encompassing aspects such as the MEN system of supply, voltage levels, Quality of Service (QoS), customer isolation, and protection systems. Moreover, the The Civil Defence and Emergency Management Act 2004 (CDEMA) emphasizes resilience through maximizing service provision to the fullest extent feasible, or similar language to that effect.
- *3.48b: Distribution network operators operate … by* - Consider adding
    - Remotely monitoring and controlling network voltage by controlling transformer and regulator tap settings.
    - Carrying out power quality monitoring after receiving a power quality complaint and arbitrating between consumers to enforce power quality standards.
- *3.48b: Distribution network operators operate one or more (usually one) distribution networks* - There appear to be various definitions of what a distribution network entails. Some refer to whether a network footprint is contiguous, others refer to whether-or-not a distribution network can be interconnected, others define it by ownership.

- *3.49: The Authority, Commerce Commission and WorkSafe NZ have statutory …* - CDEMA also applies, requiring service provision to the fullest possible extent following a major civil defence event.
- *3.69: These regulations have a relatively small influence on power system operation* – This statement is incorrect. The ESRs regulate the voltage levels to which consumers are supplied, the MEN system of supply; limits to fault levels in installations; requirements for protection systems into consumer installations; and the requirement for consumers to have means for their isolation cite the wrong standards for Power Quality. For distributors, these are critical operational requirements that need to be include in the Authority's consideration.

Q2. (page 36) Do you agree that we have captured the key drivers of change in New Zealand's power system operation in section 4? Please give reasons if you do not agree.

EEA considers that the Authority has adequately captured current drivers of change in New Zealand's power system operation. However, we have identified some key risks associated with those drivers that have not been fully captured and will need to be further addressed. These include:

- The training and capability of the people installing small scale energy systems within consumer installations brings risks relating to phase balancing and inverter modes of operation.
  - AS/NZS4777 gives options for small inverter systems of Volt/Var or Volt/kW control. The stability of inverter control systems is dependent on the DG capacity and the loop impedance of the grid connection. However, it appears that this knowledge is currently not widely known amongst installers.
  - Small scale inverter installers have been known to connect inverters to an unloaded phase, which increases neutral currents and worsens voltage performance.
- Distributors have limited information about the types, maintenance regimes and testing requirements of inverters that the consumers use in their installations. Distributors are assured that the inverters comply with relevant regulations when they are connected but receive no ongoing assurance of the continued compliance with regulatory requirements. There is currently no mandatory future testing or maintenance regime in place for small scale inverters, or oversight of settings applied. Matters we believe need to be addressed include:
  - This limited visibility of (behind meter) inverter capability, raises significant operational risks when sections of network are shut down for maintenance.
  - In distribution networks which are characterised by significant adoption of small-scale Distributed Generation (DG), there exists a potential operational challenge stemming from the delay in 'cold load' pick-up. When a feeder or a cluster of feeders experiences a brief loss of supply, it triggers the disconnection of small-scale inverters. These

inverters stay disconnected for a short duration following the restoration of supply, during which leave the feeders to carry the entire consumer load.

  - The existence of small-scale inverters also has the potential to worsen Automatic Under Frequency Load Shedding (AUFLS) if not managed correctly. When AUFLS triggers feeder tripping, it disconnects both the generation and the load on those feeders. The generation lost during this event could have been valuable for stabilizing the power system frequency.

- *4.26 and 4.45:* Consideration needs to be given to how quickly flexibility in the power system can adjust demand (up or down), and the notice time required for these adjustments to be made. Additionally, there is a need to evaluate the reliability and resilience of internet-dependent flexibility systems during major events such as storms or earthquakes or third party actions. In contrast, ripple control systems offer secure, reliable, and rapid operation, with adjustments possible within six seconds.
- *4.45*: Key Driver 5, places emphasis on weather and storm events. It is noteworthy that following significant occurrences such as the Canterbury earthquake, Kaikōura earthquake, and Cyclone Gabrielle floods, the government is re-evaluating the resilience of the power system. The Sendai framework underscores the importance of concentrating efforts on Risk Reduction (4R). The Authority paper needs to take into account strategies for reducing resilience risk in alignment with the principles outlined in the Sendai framework?

Q3. (page 36) Do you have any feedback on our description of each key driver in section 4?

The descriptions of the key drivers are well articulated., However there are additional factors as outlined above, that the Authority should consider from a distributor's viewpoint.

Q4. (page 39) What do you consider will be most helpful to increase coordination in system operation? Please provide reasons for your answer.

Other issues that EEA recommend the Authority should consider that are not fully addressed in the consultation paper include:

- *5.9. Distribution system operators and DOE* - When encountering multiple Inverter-based generation units connected at similar points within a distribution network, distributors currently rely solely on connection contracts to enforce static operational envelopes. This becomes complicated when the operational limits of the initial party need adjustment to accommodate the connection of a second party and will only be rectified by upgrading the system so that it can be managed using dynamic operating envelopes.

- *5.9. Distribution system operators and DOE* - Fulfilling the requirements of Clause 31 of the ESRs places the distributor with dual roles of arbitrator and enforcer and the standards cited in the clause are not the right ones. Furthermore, ECP36 (1993) relies on outdated material dating back 40 years, primarily aimed at mitigating interference on copper wire telephone lines. Industry, through EEA, have provided more up to date guidance but from a compliance situation are 'hamstrung' by an outdated regulation/ECP. Withdrawal of ECP 36 and a review of the ESRs should be a priority piece of work being done in conjunction with the Authority's review otherwise the market and regulations will continue to misalign and impact on the effectiveness of the future energy transition.
- *5.14: Agreements between distributors, retailers and flexibility traders* - EDBs have frequently voiced concerns regarding the challenges of acquiring smart meter data (such as voltages, currents, and power factor) at a reasonable cost and within a timely manner. Access to data is critical to making informed investment decisions and without it will, hamper visibility of DER and therefore efficient management of the network.

Q5. (page 39) Looking at overseas jurisdictions, what developments in future system operation are relevant and useful for New Zealand? Please provide reasons for your answer

The EEA believes that several significant advancements in overseas jurisdictions in future system operations that are relevant and useful for New Zealand stakeholders to consider. These developments span the areas of flexibility, whole of system planning, resilience, congestion management, workforce development, the integration of Distributed Energy Resources (DER) and black start capabilities amidst high DER penetration. We urge the Authority to focus attention on Australia and the UK, as they are well advanced in these domains as well as being the most closely aligned with New Zealand's system.

One area of particular focus for the Authority should be the establishment of flexibility. Power system flexibility relates to the power system's capacity to effectively navigate and adapt to changes. As such, demand flexibility will be an important tool in electrifying and managing the power system to the greatest extent possible while maximising the use of renewable energy resources.

As New Zealand moves towards a fully decarbonised economy, solutions providing advances in flexibility will be of the utmost importance in the investment, planning and operation of the future power system. Flexibility in the energy system can significantly contribute to resolving the key challenges of scaling the intermittent renewable energy system and driving decarbonisation in at least three ways:

- Avoiding the deployment of peak capacity – which is typically provided by natural gas plants – for example, managing demand side response.

- Deferring grid and network infrastructure investment by improving utilisation.
- Avoiding the curtailment of renewables such as EV charging, battery storage charging or green hydrogen production at times of high supply.

In this area, developments in Australia, the UK, Europe, and the US are of interest although for differing reasons. The flexibility ‘use cases’ that each jurisdiction is currently focused on are:

- *Australia:* Due to the high level of DER connected into the distribution networks in Australia (i.e. Household PV and batteries etc..), they are particularly focused on standardisation that enables flexibility & interoperability; network visibility and establishing dynamic operating envelopes (DOE) and inverter control.
- *UK:* The UK is currently focused on DER dispatch system interoperability.
- *Europe:* The focus in Europe is DER integration and the development of a single flexibility platform.
- *USA:* In the US the key focus at present is situational awareness and the establishment of distribution services using DERMS. However, the key focus of the DERMS projects is to monitor, control and coordinate DERs and not on the development of the competitive flexibility services market. So, while this could be useful from a technical integration point of view may not be as suitable for New Zealand use cases currently.

Q6. (page 41) Do you consider existing power system operation obligations are compatible with the uptake of DER and IBR generation? Please provide reasons for your answer.

EEA considers that while some existing obligations align well, there are other issues requiring attention. Notably, the EIPC lacks any reference to power quality: the definition of a "satisfactory state" that solely revolves around system stability (synchronism); and meeting voltage criteria in Part 8 as there's a conspicuous absence of consideration for voltage fluctuations within the Part 8 parameters that could prove unacceptable to consumers. Other matters to consider include:

- *5.31: Benefits of conjoint network planning* - • Certain segments of the grid, like the Waikato 110kV network, serve multiple distributors and are beginning to show strain from being overloaded. Network planning for these types of networks necessitates collaboration between transmission and distribution planners. Upgrades to the grid need to fulfil the grid investment test but the thresholds for investment are high and outages would need to have long duration and be regular for augmentation to be agreeable.
- It should also be noted that some IRB proponents use reactive power for managing voltage at the point on which they connect. Yet the transmission grid may not be able to export or import the reactive power at the GXP.

Q7. Do you consider we need an increased level of coordination of network planning, investment and operations across the New Zealand power system? Please provide reasons for your answer.

The EEA considers that there is a growing willingness towards coordinating network planning among distributors and between distributors and Transpower and this is already happening to some degree in certain grid regions of the country. However, there is a pressing need for consensus on planning criteria. For example, while there's a suggestion to utilize ECP36 for establishing harmonic levels, it's evident that ECP36 falls short in this regard. Currently there is also a problem with IRB Control system stability. Individual control systems can be stable but when another control system operates nearby, they both could become unstable. Other matters to consider include:

- *5.52: Behavioural status quo bias* - A status quo bias could prove beneficial during resilience events, as investing in additional feeders can enhance network security and streamline operations.
- 5.54: Capital versus operational expenditure biases - The business objectives of network owners shape the potential biases between capital and operational expenditures, which may lean in either direction. Similarly, biases can arise between short-term efficiency and long-term efficiency, often tipping in favour of short-term gains.

Q8. (page 47) Do you think there are significant conflicts of interest for industry participants with concurrent roles in network ownership, network operation and network planning? Please provide reasons for your answer.

The EEA acknowledges that there may be conflicts of interest among industry participants who hold simultaneous roles in network ownership, operation, and planning, as discussed in our previous responses. These conflicts can differ based on ownership structures and business motivations. Consideration may need to be given to the scale and impacts of any conflicts of interest on overall market function and customer ability to interact with the market.

Q9. (page 47) Do you have any further views on whether this is a good time for the Authority to assess future system operation in New Zealand, and whether there are other challenges or opportunities that we have not covered adequately in this paper? Please provide reasons for your answer

The EEA has identified that a number of facets of current legislation have lagged behind as the industry has evolved, and need to be urgently addressed to future system operational needs are met. For example, the Electricity (Safety) Regulations still cite a dated version of AS/NZS4777, which is two revisions behind. In addition, it references ECP36, a standard that is four decades old and holds greater legal weight than more current IEC standards.

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.

The EEA is currently a partner with EECA and industry in the delivery of the FlexTalk programme which aims to maximise participation in flexibility services through the adoption of a common communication protocol. It also has membership on the Electricity Authorities Common Quality Technical Group (CQTG) and has observer status on the Authorities Network Connection Technical Group (NCTG).