Electricity Engineers' Association

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Submissions
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EEA Submission – Updating the Regulatory Settings for Distribution Networks

Thank you for the opportunity to provide comment on the Electricity Authority (EA) Discussion Paper - *Updating the Regulatory Settings for Distribution Networks*.

The discussion on the future structure of the regulatory arrangements for the sector is timely and will need to be ongoing as policy and technology further evolve. This submission has been prepared by the Electricity Engineers' Association of NZ Inc (EEA) having consulted with our Membership and is focused on identifying technical issues and process improvements that will better enable a safe transition to a low carbon electricity future.

While aspirational policies are important in creating a new future, it is the timely implementation of them that is a key measure of their success – and EEA believes a low carbon electricity future requires comprehensive technical/engineering input during the next two decades. The policy outcomes are challenging but achievable when supported by modern and timely technical and safety standards, and a focus on development of capability and capacity of engineering and technical people to support and enable innovation and emerging technology in a low carbon world.

The EEA welcome the opportunity to be involved 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.

EEA is keen to continue our collaboration with industry, the Electricity Authority, and other regulators to enable common technical standards and guides and tools that support Electricity Distribution Business (EDBs), customers and government to enable and support emerging technology in a low carbon world.

In this submission EEA will highlight those areas of concern and interdependencies that we believe will need to be worked through to successfully implement the proposals.

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SUMMARY

EEA makes the following recommendations:

Section 4: Information on power flows and hosting capacity

1. *The development of a transparent technical, regulatory and commercial roadmap and programme of work to agree standards for access to smart meter data*
2. *Adoption of a standard industry template for data gathering or sharing* ***of*** *network capacity information, so information is consistent and accessible to networks, flexibility services providers and other stakeholders.*
3. *EA enable and work with industry to achieve standardised access to EDB's to gain technical information to allow network optimisation.*

Section 5: Electricity supply standards

4. *Development of a process for reviewing international product Standards (e.g. IEC, AS/NZS, ISO) to ensure they are appropriate for voluntary adoption in NZ and mandating (where appropriate).*
5. *New Zealand regulators works with technology stakeholders to adopted appropriate international standards and provide a transparent and enforceable standards framework to support product safety, safe installation, and safe maintenance and operation of DER products.*
6. *That EA work with MBIE to get a timelier ESR regulations update that better enables the adoption of the latest standards into the regulations and EA, MBIE, WorkSafe and industry stakeholders undertake technical investigations of the power systems and safety impacts of any future voltage change options.*
7. *Undertake a review of part 6 with industry stakeholders.*
8. *MBIE /EA/ WorkSafe mandate minimum equipment standards where appropriate.*
9. *EA & Industry to develop a guideline for the connection of large-scale inverter-based generation.*

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BACKGROUND

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 450 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.

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 and asset management (e.g., IEC, AS/NZS, NZS Standards).
– Providing and supporting engineering and technical professional development forums, training, and competency for ESI engineers.
– 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.

Our submission will address three sections of the EA Discussion paper that relate to the work of the EEA. These include:

– Section 4: Information on power flows and hosting capacity
– Section 5: Electricity supply standards
– Section 8: Capacity and capability

The focus of the EEA submission is on technical challenges and opportunities, consideration of regulatory interventions options including areas of further research, analysis and collaboration that would enable keys stakeholders' visibility and participation in Distributed Energy Resources (DER) and decarbonisation.

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Section 4: Information on power flows and hosting capacity

Access to customer and system information will be critical in under-pinning the efficient investment by DER businesses and utilisation of network assets. Real-time data on utilisation of the Low Voltage (LV) networks will support safety and enable more efficient performance and reliability of networks. At some stage deployment of DER will result in an increase in demand for Flexible Services and will become a good investment proposition – but the timing of this change is unclear.

In the interim, as many EDBs do not have access to smart meter data on 'reasonable terms' and there is no common template for data gathering or sharing, they have relied on case studies and modelling to look at data demand on LV networks and to understand general impacts on network performance and trends.

Given the likely future ramping up of the adoption of EVs, PVs and DER use of case studies and modelling will not be enough if network real time responses are required – so for planning and operational efficiency, efficient connection and utilisation of network assets, DER management, and safety, smart meter data need to be accessible.

EEA supports a transparent technical, regulatory and commercial roadmap and programme of work to agree standards for access to smart meter data.

EEA Recommendation 1.

The development of a transparent technical, regulatory and commercial roadmap and programme of work to agree standards for access to smart meter data .

Q.2: What information do you need to make more informed investment and operation decisions?

The information needed is network capacity information to enable operational decisions and flexibility services. The suggested minimum data needed includes :

- kWh (30/5min intervals)
- kVa (30/5min intervals)
- Voltage (30/5 min intervals, max, min, average)
- Power Factor (30/5 min intervals)
- Energisation status (5 min intervals)
- Real-time 'operational' information (e.g. last gasp, first breath, energisation status).

Also, there should be visibility of customer information on the type and scale of DER installed capacity behind the meter - including output of larger scale PVs and batteries. This would provide more clarity and visibility of a 'baseline' for an LV network prior to the future deployment of new technologies.

Having a 'baseline' information enables better understanding of capacity and a more effective response in network planning, safety, upgrading and the possible use of non-network alternatives.

EEA Recommendation 2.

Adoption of a standard industry template for data gathering or sharing ***of*** *network capacity information, so information is consistent and accessible to networks, flexibility services providers and other stakeholders.*

Q.3: What options do you think should be considered to help improve access to information?

Network and customer data is critical to achieving open access, improved risk management and investment decisions, and safety. Access to data will enable networks and investors to have visibility over opportunities for DER and market interventions by understanding the capacity and capability of the infrastructure.

EA should enable access to smart meter data in a consistent standardised reporting framework (see Q.2 above) that enables analysis across networks and within networks to encourage informed access for DER.

Both the United Kingdom (UK) and Australia have examples of how such a framework could be established and what lessons have been learnt around data gathering and access.

Network and customer data is of significant importance for workplace safety, safety of the public and safety of the network. An open grid without rules and visibility of key data sets has the potential to operate unsafely & potentially harm workers or the public, technically perform below optimum, and cause issues with physical connections and electricity flowing back into the grid when there is a conductor down or line crews working on the network.

Low Voltage (LV) 230/400V networks connect customers installations to the EDB LV /HV grid via local distribution transformer. They are complex with many interconnected and interrelated assets in the power flow path including conductors, connectors, cables, cable joints, terminations and fuses. To add to the complication, the ownership of these component can be unclear (from the local electricity distribution business to multiple private landowners) and this can vary the design, operations and maintenance practices that are applied.

Variations to the impedance of the LV system between transformer and network customer can dramatically affect customer/network power quality - specifically the voltage and harmonics. From a safety perspective it is variations in impedance on the neutral network that pose the highest risks. With a high impedance neutral connection, whether on the Distributors or private network, the customer's installation becomes almost entirely reliant on the customer's own local earthing pin.

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In these situations not only may the customer see hazardous supply voltages (with the possibility of associated appliance damage), but more critically it could in certain situations (typically linked to network loading at the time), see a rise in voltage on the neutral / earth conductors within their property. If this happens it is possible that exposed metal work such as plumbing, taps, and the outer casing of metallic appliances (e.g., toasters or washing machines) could be livened, therefore presenting a risk to the public if touched.

Counties Energy who was awarded the 2021 EEA Public Safety Award, have a good example of addressing public and customer safety through unfettered access to smart meters across their network. Smart meter data was used to report voltage deviations multiple times per day to identify voltage disturbances at customer premises, this information is then used to send out work crews to identify and repair the issue making it safer for the customer and public.

Public and network safety be a priority for visibility of network data. Counties Energy is a clear demonstration of how real time access to metering data improves the safety outcomes for consumers.

Learning from Australian trials noted that "*the installation equipment on customers' sites that enable the collection of real-time meter data to monitor customer DR performance requires access to utility meter pulses. Connection to this functionality can only be provided by the Meter Provider (MP) for that NMI and the timeliness with which different MPs responded to requests for this service varied significantly" (ARENA, Demand Response RERT Trail Year 1 Report, March 2019)*

Learning from the Australian trials also indicate there are significant technical issues that need to be considered with urgency in New Zealand and EEA is including this information into our industry work programme.

EEA Recommendation 3.

EA enable and work with industry to achieve standardised access to EDB's to gain technical information to allow network optimisation.

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Section 5: Electricity supply standards

This section of the EA paper focuses on **what** electricity supply standards are needed. Such standards may be mandated or voluntary and can be recognised in Regulation or Standards (international/national), guidelines or technical support notes or Publicly Available Specification (PAS).

The codification of key product/ technical performance and safety information for stakeholders, and a transparent review process, will provide clarity and enable a more dynamic and sustainable move to DER.

The framework around the standards will require careful consideration – what needs to be regulated and what can be based in 'voluntary' standards?

EEA has significant concern at the ability of the regulatory framework to respond in a timely way to new and evolving technology, market changes, and government policy so as much as possible would like to see the use of 'voluntary' standards which are supported by regulators.

Fundamental safety requirements to protect people and property must remain in Regulation (e.g. Electricity (Safety) Regulations) and any changes required as a result of DER technologies needs to be researched and consulted. For example – eg DER technology will impact upon voltage, power quality and grid performance, so any changes in Electricity Safety Regulations (ESRs) (e.g ESR 28) must be based on achieving no less levels of safety/technical performance than what currently exists. New technology is generally more sensitive to these technical performance variations and if not dealt with will be exacerbated as more of the technology has access to the networks/grids.

Consideration should be given to a process for considering, supporting and mandating (where appropriate) international product standards (e.g. IEC, AS/NZS) to ensure NZ does not become a 'dumping ground' for outdated product that no longer meets modern standards, has outdated technology which will not deliver the opportunity for DER flexible services, and is not able to be sold in other jurisdictions who have similar DER policy aims as NZ. Standards adopted for use in NZ should provide information and confidence to consumers/DER investors, and to network operators that safety and system quality are not compromised.

A significant limitation such a framework is that the regulatory process in both MBIE or EA will need to be able to respond quickly to consider and adopt new standards.

EEA Recommendation 4.

Development of a process for reviewing international product Standards (e.g. IEC, AS/NZS, ISO) to ensure they are appropriate for voluntary adoption in NZ and mandating (where appropriate).

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Q.4 (section 5, pg 40) Have networks experienced issues from the connection or operation of DER?

Based upon some initial NZ research and information from overseas jurisdictions there are several technical issues that will likely occur as a result of increased DER , on either a single installation or as the number of DER installations increases on a network in the same area .

Issues include the impacts of thermal ratings of network components/assets; voltage stability and regulation (over/under voltage issues); short circuit levels; and power quality considerations. Also additional constraints may create issues from islanding considerations and the possibility for reversal of power flows.

APPENDIX 1 - *DER on-Distribution Networks: Technical Considerations* provides more details on the issues that EDB's will experience.

The identification, research and management of these issues requires access to data, customer complaints, and incidents report analysis .

Our research has also brought to our attention the risk of photovoltaic and battery failures - including fires in installations and equipment. A recent report from Australia has stated "DC systems, are responsible for two solar related fire each week" (*Enphase Energy, ww4.enphase.com/en-au,*)

While these occurrences may be relatively few, the consequences are significant. So, the lack of a transparent and enforceable standards framework to support product safety, safe installation, and safe maintenance and operation to support customer decision processes and confidence around new technology and its safe integration into existing network should be considered going forward.

EEA Recommendation 5.

New Zealand regulators works with technology stakeholders to adopted appropriate international standards and provide a transparent and enforceable standards framework to support product safety, safe installation, and safe maintenance and operation of DER products.

Q.5 (section 5, pg 40) *Do the Electricity (Safety) Regulations 2010 (ESR) require review? If so, what changes do you think are needed (a) in the near term and (b) in the longer term?*

The EEA has already submitted to MBIE regarding amendment to the *Electricity (Safety) Regulations.* Our concerns relate to the regulations addressing in a timely manner the impacts of the rapid change in technology. The slowness of the ESR update process has been a long standing concern for EEA and industry.

Of particular concern is the delays in updating Standards set out in schedules of the ESRs and the need for adoption of more international Standards (e.g. IEC, AS/NZS and ISO). Currently the ESR cite several significantly outdated Standards.

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In the near term the ESR need to be updated to cite the latest safety and product standards that will support and enable DER - such as AS/NZS 4777.2. This standard set the limits for new inverters to be installed and will enable flexible services using 'smart technology'.

The EA will likely receive feedback from some industry stakeholders to adjust the voltage allowance limit in the ESR, 28 -Voltage supply to installations. Voltage is critical to safety, capacity and quality issues so any changes in ESR should only be considered after technical investigations of the power systems and safety impacts.

Getting more generation back into the grid should not compromise safety or increase risk of damage to electrical appliances, and cost to consumers.

Regulation 28 (3) of the ESR states a person who supplies electricity commits an offence if in breach. A homeowner or company that is generating into the network above the voltage is in breach of this regulation. As a first step better education and information should be provided to the DER industry to ensure the equipment is supplying electricity within the parameters and ensure that the network and appliances remain safe.

EEA Recommendation 6.

That EA work with MBIE to get a more timely ESR regulations update that better enables the adoption of the latest standards into the regulations and; EA, MBIE, WorkSafe and industry stakeholders undertake technical investigations of the power systems and safety impacts of any future voltage change options.

Q.6: (section 5, pg 40) Does Part 6 remain fit for purpose? If not, what changes do you think are needed (a) in the near term and (b) in the longer term?

Part 6 offers an alternative regulated framework to support standardisation across the industry.

Near term, Part 6 of the Code needs to reference the latest AS/NZS 4777.2 for safety and creating a consistent connection to the networks.

Long term, Part 6 should be reviewed to consider the following areas and ensure that safety is paramount in all new connections.

(a) Include an additional size category.
   - Larger size applications create network capacity issues and require more systems studies thus creating greater expense and resources for EDB's and applicants.

(b) Approach to network upgrades where there are constraints.

(c) Battery systems integration.

(d) Differentiate the responsibilities between network owner and DSO.

- Network owners have accountability for safety of the network and have the ability under the code to disconnect if there is a risk to public safety the option to disconnect need to be maintained.

Long term, Part 6 also needs to be reviewed for technical alignment between part 8 and part 12. Large inverter-based generation connecting to Distributors networks will raise the issues identified in Appendix 1, these issues will flow into the Transmission grid and impact safety for the public and consumers.

EEA Recommendation 7.

Undertake a review of part 6 with industry stakeholders.

Q.7 (section 5, pg 40) Is there a case to be made for minimum mandatory equipment standards for DER equipment, specifically inverter connected DER?

- New Zealand regulators need to consider mandating international standards for equipment that is connected to the network. To not mandate could allow any supplier to provide substandard equipment that will hinder DER, flexible services and potentially increase the safety risk to consumers and the public.
- Under the current Electricity Participation Code, schedule 6.2, 15, Permanent Disconnections, a Distributor may permanently disconnect a generator where there is an ongoing risk to person or property. Through not mandating the equipment there is a high likelihood of disputes caused when Distributors disconnect Generators due to substandard equipment.

EEA Recommendation 8.

MBIE /EA/ WorkSafe mandate minimum equipment standards where appropriate.

Q.8 (section 5, pg 43) What standards should be considered to help address reliability and connectivity issues?

EEA supports a four-step approach to DER management.

1. Sensible autonomous behaviour of DER
2. Connectivity and visibility of DER
3. Remote control or DER
4. Flexible markets

EEA consider achieving the first step Standards for equipment suppliers is necessary to ensure the safety of people and autonomous management. Standards such as AS/NZS 4777.2, AS/NZS 61000.3 series on electromagnetic compatibility must be mandated or there will be significant safety implications.

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Step 2, relates to visibility, knowing where DER has been installed is important, near real-time visibility is state of art and allows Distributors to manage networks safety and ensure public and consumer safety. Due to the rapid changing environment and use of equipment, industry should develop guidelines and protocols to allow for visibility to occur and encourage innovation.

Additionally, the EA should consider and work with stakeholders on the development of a standard / guideline for the connection of large-scale inverter based generation onto Distributor's network and the linkage to Part 12 of the code.,

EEA Recommendation 9.

EA & Industry to develop a guideline for the connection of large-scale inverter-based generation.

Q.9 (section 5, pg 43) *Is there a case to look at connection and operation standards under Part 6 with a view to mandating aspects of these standards?*

The processes of Part 6 are fundamentally working (but are complex and slow) and EDBs are aligned with the EEA Guide on connecting small scale generation/inverters. However, there is case to develop a set of guidelines for generators and distributors on larger scale connections. As EDB's have more applications and connections the risk of technical impacts increases and will either cease connections or cause disparity for the connection that has the connection that causes the network upgrades. *See recommendation 9 above.*

Section 8: Capacity and capability

Q.18: What are distributors doing to ensure their network can efficiently and effectively manage the transformation of networks?

It is difficult to predict the future for emerging technology, so EEA focuses on ensuring the engineering/technical/ safety side of the industry has access to the latest knowledge and learnings – particularly around emerging technology and its impacts. Within EEA's strategic goal, our role is to nurture common standards and grow our industry capability through collaboration and engagement.

This is done in several ways using the collective engineering knowledge of the industry to work with regulators and others to address safety and engineering/technical and asset management standardisation; and through voluntary guidance to support industry continual performance improvement. This work has included supporting emerging technology and transformation of networks.

Our focus is also on supporting the growth of capability within the industry through developing the future engineers, technical staff, system operators & maintainers, safety professionals, innovators, influencers, and change-makers. The EEA Workforce capability survey in 2019 showed current and future skill shortage areas and highlighted future skill capabilities needed buy industry to support future power system transformation.

This survey has led to EEA establishing a *Professional Development Group* provide an industry wide focal point on engineering and technical capability. EEA also, in partnership with the new Infrastructure Workforce Development Council and Connexis, instigating a longer-term study of workforce capability to address COVID impacts, emerging technology, and barriers for learners wanting to join our sector. These results are due to be published in October 2021.

EEA has a significant focus on sharing and improving knowledge around emerging technology and provides forums and conferences to look at issues, sharing information and growing knowledge on international application/practices for emerging technology and integration into the grid. An example of this was the focus of the EEA's 2021 conference technical papers, keynote, panel sessions and technical workshops on *"Engineering, Technology and Innovation - In a Low Carbon Environment"*.

The event also included a comprehensive Trade Exhibition – to enable businesses from around the world and NZ to showcase technology and services, people, and products, and for attendees to get 'hands-on' with the technology solutions they need.

The EEA also produces technical and safety guides that support ongoing continual improvement. These guides are widely used across the industry, guide users are supported, and the documents are regularly reviewed. As highlighted earlier EEA are working on several new industry guides and engaging with industry and other stakeholders. Some examples of industry led good practice that support the innovation are:

Connection of Small Scale Inverter based Distributed Generation (Interim Guide) (2018) ;

Resilience Guide (2020) ;

Asset Criticality Guide (2019) ;

Asset Health Indicator Guide- Networks (2019);

Asset Health Indicator Guide- Generators (2013);

Asset Management Maturity Assessment Tool (2014);

Safety in Design (2016) ;

Security of Supply in NZ Electricity Networks (2013);

Standards NZ/EECA EV Publicly Available Specifications (PAS) for EVs;

EPECentre/ University of Canterbury - Green Grid Project (2015-20190; and

Liaison and joint activities with international Standards Groups (including IEC, ISO, AS/NZS) and technical bodies (including IET (UK), IEEE(PES) (USA); CIGRE (Europe) ; ENA (Australia))

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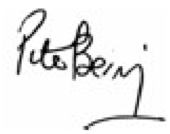
CONCLUSION

EEA are happy to provide further details and to work with EA, industry, and other stakeholders to ensure the Electricity Supply Industry has a regulatory, standards and guidance framework that is response to the changes in emerging technology and industry structure that will occur from decarbonization and electrification of the NZ economy to ensure the safe secure and reliable supply of electricity to consumers.

If you require further information on our submission, please contact the undersigned.

Yours sincerely



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APPENDIX 1: DER Impacts on Distribution Networks - Technical Considerations

Technical issues that occur with hosting DER on distribution networks are briefly discussed below, the effects will increase where a network is congested.

Thermal ratings

Each element of the distribution network (lines, transformers etc.), is characterized by a maximum current-carrying capacity (thermal rating). Connection of DER has the effect of changing current flows in the network, which may lead to violation of the loading levels of network elements, especially under maximum generation and minimum load conditions.

Voltage regulation

Voltage regulation is primarily achieved through on-load tap changers (OLTC) controlled by automatic voltage control (AVC) schemes at the HV/MV substations, as well as by step voltage regulators (VR) installed along MV feeders, while switchable capacitor banks may also contribute to this task. Although DER may have a positive effect, compensating voltage drops, high DER penetrations complicate voltage control and may lead to overvoltage situations. Another concern is the excessive tapping of OLTC and VR, which increases wear of the equipment and increases maintenance costs along with the risk of catastrophic failure and safety risk to public.

Fault level

Distribution networks are characterized by a design short circuit capacity, which corresponds to the maximum fault current that can be interrupted by the switchgear used and does not exceed the thermal and mechanical withstand capability of the equipment and standardized network constructions. Since DER contribute to the fault current, their interconnection may lead to exceeding the short circuit capacity of the network, thus creating a public safety risk.

Power quality

DER installations may induce power quality disturbances, which mainly include fast voltage variations due to switching operations, emission of harmonics and flicker. Disturbances depend very much on the type and technology of DER equipment, as well as on the characteristics of the network and may impose limits to the hosting capacity of specific networks.

Other technical constraints

Reversal of power flows in the network may have a negative effect on certain types of tap changers and on the operation of voltage control schemes. Islanding is a serious consideration in distribution network, which often leads to conservative approaches for the acceptable capacity of DER. Additional technical requirements are also imposed concerning the effect on mains signalling systems, protection etc.