eea Electricity Engineers' Association **Professional Development**

Annual Power Engineering Exchange

APEX | 2020

22ND AND 23RD SEPTEMBER 2020

TIMING FOR EACH DAY: 9.30AM TO 12.30PM

AGENDA AND ABOUT THE PRESENTERS

About the EEA

The Electricity Engineers' Association (EEA) is a key industry coordination organisation providing a voice for the electricity supply industry and ensuring the industry is engaged, informed and active in engineering, technical and health and safety issues affecting companies, individual engineers and other stakeholders. **Being a part of the EEA is about being linked in to the wider electricity supply industry.**

Our Members

For over 85 years, the EEA has been committed to providing the New Zealand electricity supply industry with expertise, advice and information on technical, engineering and safety issues.

To do this we work with and represent over 50 Corporate Member organisations and more than 400 individual professional members. These include chief executives, senior engineering/technical managers, engineering and field staff, health and safety managers working in network, generation and electricity retail companies, contractors, consultants and equipment suppliers.

EEA Scholarships

The EEA has supported over seventy students into engineering careers by awarding annual scholarships to undergraduates specialising in electricity generation, power systems or electricity utilisation at Auckland and Canterbury Universities and, from 2013, Auckland University of Technology.

EEA Awards

The Best Conference Paper Award—Student Category recognises the excellence of student engineers who have demonstrated a high level of technical competence and communication skills.

Young Engineers can apply for further awards as they develop in their role, such as the Young Engineer of the Year Award or the Professional Development Award.

Annual Power Engineering Exchange (APEX) Summit

APEX is a conference for graduate engineers, of any discipline, in the electricity supply industry and a great opportunity to share experiences while learning from the presentations of others. Networking at events such as the APEX Summit is an excellent way to start relationships and gain exposure to the industry.

APEX is also a must-attend for students willing to meet graduates working in the industry, and to hear about some real world projects they are involved in.

Joining The EEA

Are you a full-time student undertaking an engineering qualification relevant to the New Zealand power industry? If so, as an **EEA STUDENT MEMBER**, your benefits would include:

- Free student membership
- Free attendance to the APEX Summit
- Free attendance at student events and guest lectures organised by EEA
- Notification about scholarships, awards and networking events
- Access to EEA guides and safety rules (free or discounted)
- Online access to EEA Electricity Industry Update and Safety Rules Newsletters

If you have recently graduated with a tertiary engineering qualification relevant to the New Zealand electricity supply industry in the preceding 12 months, you are eligible for an EEA Graduate membership.

As an **EEA GRADUATE MEMBER**, your benefits would include:

- Free graduate membership for two financial years (1 April – 31 March)
- Use of the post-nominal 'GradM.EEANZ'
- One free attendance to the EEA Annual Conference
- Free attendance to the APEX Forum
- Discounted registrations for attending professional development events and courses
- Access to EEA guides and safety rules (free or discounted)
- Subscription to EEA mail alerts (awards, networking events, accident and incident reports)
- Online access and mail subscription to EEA Electricity Industry Update and Safety Rules Newsletters

Online Membership Application

Membership provides an excellent opportunity to be informed, actively engaged and influencing change in our industry. Visit us on the web: **www.eea.co.nz—About Joining the EEA—**to complete the online application form.

ABOUT THE PRESENTERS

9.00am **Welcome from Thahirah Jalal Mitton Etel Transformers: APEX Chair**

9.05am **Guest speaker — Michael Dalzell, Transpower**

HVDC & Power Electronics Manager: 2019 EEA Young Engineer

9.35am **Laura Harding, Beca**

Power team. Laura graduated in 2019 from UC with a Bachelor of Engineering with Honours (Electrical & Electronic Engineering) with a minor in power engineering. Outside of work she participates in a range of sports including sailing, road cycling and most recently karate.

Connecting Solar Farms to Rural Networks

Solar energy, from photovoltaic panels, is one of the technologies being implemented to transition the New Zealand electricity network to carbon zero by 2035. Space and visual constraints in urban environments mean it may be easier to obtain consent for larger-scale photovoltaics in a rural situation. However rural electrical networks tend to be sparse, long and weaker than urban networks. How do you continue to ensure the quality of the power supply to the surrounding possibly weak network, particularly if the solar is of similar capacity to the surrounding load?

Beca explored this issue in 2019 during a connection study for Kea Energy's Wairau Valley Solar Farm. The proposed 2MW scheme had to meet voltage stability, dynamic stability and total harmonic distortion requirements of the local distribution company, Marlborough Lines.

This presentation outlines how the team established that a generation range up to 1.85 MW was able to maintain stable voltages. It expands on the process of using load flow studies with combinations of load and generation levels to determine this range. Additionally, the studies analysed the impact of a voltage-dependent constraint of the selected inverter in limiting the solar farm from achieving the required VAr response necessary to operate at full rated power output. Time-based RMS stability simulations demonstrated the ability to maintain dynamic stability with up to 1.85 MW of output power from the solar farm. The simulations included island peak/high load conditions and major trip events.

10.05am **Table talk session**

10.15am **Craig Oliveria, company**

Craig is a first year graduate engineer from Massey University who joined the Beca Central Power team as a Transmission Line Engineer. In his role, he is responsible for detailed design of high voltage power poles, towers and lines, gaining valuable experience while working on a range of projects throughout New Zealand and Australia. Craig is passionate about sustainable design and manufacturing innovations leading the world towards a Carbon Zero future.

Sustainable Transmission Line designs in to reduce Concrete consumption

While it may seem that transmission lines have little impact on carbon emissions, there are small changes that can have a large impact on sustainability. In addition, these changes can result in significant economic benefits. Reducing concrete use, upgrading existing lines, and recycling materials can all make a difference.

Approximately one kilogram of carbon dioxide is released into the atmosphere for each kilogram of cement. Therefore, innovations in transmission line design to reduce concrete consumption have the potential for significant reductions in CO^2 emission.

In 2017, Beca Ltd (Beca) was commissioned to investigate the economic benefits of using cathodic protection instead of concrete over grillage to extend the life of the tower foundations. Cathodic protection consists of sacrificial anodes to extend the life of steel grillage foundations on transmission towers.

The client's existing strategy was to refurbish foundations at approximately 250 towers each year by installing concrete over the corroding grillage foundations.

Installing concrete over grillage foundations comes at a considerable cost and uses a significant amount of concrete.

The results of the investigation found that cathodic protection, tailored to New Zealand's varied soil conditions, has the potential for significant savings of capital expenditure over the life of the asset along with significant reduction of the use of environmentally harmful concrete.

10.45am **Maria Langdale, Meridian**

Maria Langdale studied mechatronics engineering at the University of Canterbury in 2019. For the last eight months, she has been working as an automation engineer for Meridian Energy in Twizel. This has allowed her to apply a range of skills learnt in her degree to work to improve safety and monitoring of systems on Meridian Energy plant equipment.

So, how's the weather?

Meridian Energy has a variety of sites, some located in remote places around the country. These places can have extreme weather conditions; for example there is up to 8000mm of yearly rainfall in Fiordland. How are we able to define the effect this extreme weather has on our sites and its extent?

Installing weather stations at Meridian sites has given us the tools and ability to take measurements of the surrounding environment where our sites are located. This data can then be collected and stored in Meridian's plant information database, used to aid analysis and research for current and future projects.

The monitoring of weather conditions at our sites in conjunction with Meridian's reliability systems has two major bonuses: insight in to how weather events can affect plant operation, and the ability to monitor how climate change affects our generation output. Through using data analysis systems such as PI and BI Server, the information extracted from the weather stations can be managed against the plant operation. This information collected by the weather station can then be used to help us predict how future weather patterns may impact the future generation at our power stations.

11.15am **Edward Popham, Transpower**

Edward studied mechanical engineering at the University of Canterbury and joined the Transpower graduate program in March this year. Since March, he has contributed to lines projects in Transpower's southern network and experienced first-hand the work involved on re-wiring a section of line in the Rangitata area.

Edward is new to the power industry and excited about contributing towards New Zealand's electrification and carbon zero goals.

Water beats towers. Are poles more in our future?

On the 7th of December 2019 the Rangitata River, which passes 29kms south-west of Ashburton, was flowing at around 2265 cubic metres a second and approaching the highest flood levels in 20 years. Transpower own three 220kV tower lines that cross the Rangitata River around state highway 1. During the flood Transpower had 7 towers damaged or completely wiped out! A flood response project involved commissioning a temporary pole line to provide Christchurch with a secure winter power supply before building a permanent tower line due for commissioning end of August.

The unique part of this project was the temporary pole line and the foundations used. Poles are commonly used for electricity transmission, but this is the first time concrete poles that are normally used on 110kV lines were used on a 220kV line. Small stretches of steel poles are used on 220kV lines already at Otahuhu Auckland and South Dunedin where a pole comes in handy with its smaller footprint. It would be interesting to see if this pole design would be suitable for a 220kV permanent replacement or if they would phase out tower replacements in the future.

11.45 **Table talk session**

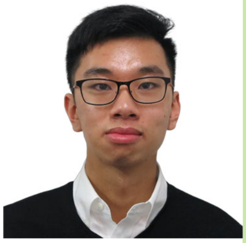
11.55 **Guest speaker — Brad Henderson : Mitton Consulting**

12.20pm **Close out day one**

DAY 2 — 23rd September

9.00am **Welcome from Rebecca Marx, Mitton ElectroNet: APEX Chair**

9.05am **Matthew Ting, PowerNet**



Matthew Ting obtained his Bachelor of Engineering (Hons) degree in Electrical and Electronics from the University of Canterbury in 2019. From there, he began his career in the industry as a Graduate Electrical Engineer at PowerNet. PowerNet, build, maintain and manage electricity assets in the Southern region of New Zealand.

Matthew's work in the Asset Management team allows him to have an all-round exposure to a variety of engineering projects and assets management. Lately, he gained the opportunity to work on the Open Country Dairy project. His work involved power system analysis, distribution loss factor calculation, transformer assembly and commissioning testing.

The challenge and opportunity for distribution companies in process heat electrification. (Case Study: Open Country Dairy 13MW Electrode Boiler

Electrification of industrial process heat plays an important role in the drive towards a low carbon economy. This is going to create a lot of challenges and opportunities for the electrical industry. In 2019, Open Country Dairy (OCD) decided to expand its Southland plant at Awaura which included installing a 13MW electrode boiler to increase the plant production capacity.

This presentation will focus on how PowerNet Ltd, the electricity network management company overcame the challenges in upgrading the supply capacity for OCD to meet the electrode boiler and plant expansion. Despite the short time frame, network capacity and COVID-19, PowerNet was able to deliver the project on time and meet the deadline for commissioning the electrode boiler.

This electrification of processing heat project was an excellent learning opportunity for graduate engineer in both project management and network planning. The wave of electrification is coming; working closely with the stakeholder is vital to increase network utilisation. Also, ensure there is sufficient capacity and reliability of electricity on the network to manage the demand for the new load.

9.35am **Nisheel Hirani, The Line Company**

I am passionate about using my engineering skills to solve real life problems. The completion of my degree has allowed me to realize the theoretical aspects of engineering and that supplements the practical experience I have gained to date. In my current role at The Lines Company a distribution company serving the central north island community I am responsible for;

- Engineering Approval for New/increase load connection to the network
- Subdivision electrical reticulation designing
- Carrying out system planning activities i.e. load flow analysis and proposing solutions for better system reliability and network security
- Network modelling and setting up relays on simulation program making sure protection condition is functioning as per the company STDs.
- Carrying out load flow and risk based analyses for planned feeder outages; making sure the back feeds are capable of picking more load with less system overloads

Network requirements for accommodating EV chargers at a park and ride facility.

The electrification of transportation has been developed to support energy efficiency and CO2 reduction. As a result, electric vehicles have become more popular in the current transport system. TLC in conjunction with local council came up with an innovative idea on how to wisely make use of a park and ride facility at National park. The park and ride site was an ideal location to install 14 (7kw) slow (EV) chargers. People can leave their (EV) with the charging port and in return they can drive off the facility with a fully charged battery.

As a local distribution company we had to make sure the existing infrastructure is capable of handling additional EV load. Load calculations carried out to accommodate 14 (EV) chargers plus a proposed 400kW bus charger to size a new transformer. Network modeling; load flow analysis carried out to make sure the feeder voltages did not sag at full EV load, also carried out protection study making sure the HV Fuse blow before any inline CBs. Short circuit analysis was also carried out to make sure the maximum fault current at each EV pillar will trigger the RCDs. A smart data logger has been installed on the LV Cubical that captures LV data and will continuously sync with the cloud system.

9.50am **Martino Adisuwono, Beca**

Martino started his career as an intern with Beca in early 2019 and now he is a first-year graduate power systems engineer at Beca. He earned his Bachelor of Engineering degree in electrical engineering from Universitas Indonesia and Master of Engineering degree in electrical engineering from University of New South Wales. Martino is passionate about the development and the implementation of renewable energy generations. He was part of Universitas Indonesia's Tropical Renewable Energy Center research group where he did research about solar panel performance and its effect on grid stability under tropical area conditions.

For his master's degree thesis research, he focused on fuel cells technology and how to effectively and safely harness its electricity. In his current role with Beca, he is responsible for the design of primary and secondary systems of various substations across Australia and New Zealand, excited to contribute towards carbon zero future in Australia and New Zealand.

An introduction to interleaved converter topology

Fuel cell is regarded as one of the most promising renewable energy sources in the future. It offers high efficiency (up to 70%) and it is not weather dependent - making it suitable for base load generator alternative. Fuel cells utilize electrochemical reaction between Hydrogen (fuel) and Oxygen (oxidant) to generate electricity. Since the electrochemical reaction always produces DC voltage, fuel cells need power converter to step-up the DC voltage and/or to convert the DC voltage into an AC voltage. However, manipulating DC voltage always involves some switching actions within the power converter, which results in current ripple at the fuel cell output terminals.

This current ripple is affecting the electrochemical reaction within the fuel cells directly as the electrochemical reaction must follow the constant changing of the current at the terminal. This could lead to all sorts of problems such as oxygen starvation, overheating, increased fuel consumption, and ultimately reduced lifespan. By applying Kirchhoff's Current Law principle, the current ripple seen at the output of the fuel cell can be reduced by paralleling several identical power converters which are phase-shifted in their operation. That way, the ripples can cancel out each other. Not only does it reduce the current ripple at the fuel cell terminal, it also reduces the rating and the size of the power converter required since the current is now split between all paralleled converters. This method is commonly known as interleaved converter topology.

10.20am **Table talk session**

10.30am **Georgina Price, Beca**

Georgina graduated with first class honours in electrical and electronics engineering from the University of Auckland in 2018. After graduating, Georgina joined Beca as a power systems engineer and now has over one and half years' experience in the industry. She has been working on a diverse range of projects involving wind farms, transformer replacements and cable design.

Georgina's main passion and reason for pursuing engineering is to help bring New Zealand closer towards its 100% renewable energy goal. She is always happy for a chat about sustainability!

Powering a Sustainable Future

The power industry is at a turning point. Presently, rapid climate change and environmental disasters are some of the most serious issues.

Beyond ethical responsibilities as professional engineers, there are many other reasons to push for sustainability excellence. It is time to think about the carbon emissions that are being created to satisfy the growing thirst for electricity.

At Beca, a balanced approach is taken to drive sustainability initiatives to 'Carbon Zero'. With the introduction of the Climate Change Response Amendment Act 2019 , Beca have started to make things happen. Sustainability and Carbon tools are just the beginning. The following presentation explores the journey of a business to 'carbon zero' and the value in positioning a business to significantly contribute to community, and planet, sustainability.

The overall message and purpose of the following is clear, how to power a sustainable future. There is a massive opportunity in the power industry and it's an important time to change.

11.10am **Luke Reisima, Meridian**

Luke graduated in 2018 from Canterbury University as an electrical engineer, which makes 2020 his third year working in industry. He's worked at Meridian as both an intern, and a graduate, and now more recently as a full-time employee in Twizel. He works as a maintenance project engineer on small to mid-size projects which span the spectrum of electrical specialisations.

Working for Meridian has him well cemented in the Hydro world, with favourite activities including dam watching and annoying the Electric Kiwi CEO. Like any engineer he enjoys hypothetical what-ifs, with a specific interest in trying to apply real world engineering to fictional scenarios.

Pushing automation to the limit, hands of control of the NZ electrical grid

This paper poses a thought experiment of how long the New Zealand grid could operate with zero human interaction, relying only on automated systems. Control algorithms for the grid tend to rely on a predictable demand curve and a 'hands on the wheel' approach even if operators aren't 'steering'. But how would the national grid deal with a worst-case scenario; what would happen if we took our hands off the wheel?

Three points of view are examined for their interaction; transmission, generation and consumers. Transmission benefits in the short-term by dispatching pre-programmed demand curves, however fractures when demand departs from modelled expectations. Generating plant utilises hard wired frequency control such as governor droop alongside automatic re-synchronisation to ride through significant faults. Consumers have the most volatile response, with the possibility of cascade failure due to the inherently reactionary response of the grid.

As automation becomes increasingly ubiquitous so does its ability to replace human controllers. However, due to algorithms being intrinsically limited to the parameters within which they were designed for, what happens when real-world conditions depart idealised models.

11.35am **Guest speaker — Nikki Newham:** Regional Services Manager at Transpower

12.00pm **Close of APEX 2020 Summit**

EEA: Graduate Membership

If you have recently graduated with a tertiary engineering qualification relevant to the New Zealand electricity supply industry in the preceding 12 months, reside in New Zealand, you are eligible for up to two financial years of free EEA Graduate membership.

As an EEA graduate member, your benefits would include:

- Free graduate membership for two financial years, or part thereof (1 April - 31 March)
- Use of the post-nominal 'GradM.EEANZ'
- 1 free attendance to the EEA Annual Conference during Graduate membership period

SPONSORSHIP

Thank you to our sponsors for their support.

- Priority attendance to the Annual Power Engineering Exchange (APEX) Summit, held annually, and notification about APEX papers
- Discounted registrations for attending professional development events
- Access to EEA guides and safety rules (free or discounted)
- Subscription to EEA mail alerts (awards, networking events, accident and incident reports and statistics)
- Online access and mail subscription to EEA Electricity Industry Update and Safety Rules Newsletters

Apply online to become a graduate member of the EEA: www.eea.co.nz/Site/join/why-join.aspx

Thomas Patrick — EPECentre 2014 field trip to Meridian Energy's West Wind Farm, Makara

Luke Schwartfeger - 2015 Best Student Paper Award winner

POWER YOUR CAREER

JOIN THE EEA

EEA SCHOLARSHIPS

The Electricity Engineers' Association (EEA) is proud to support every year a number of students into engineering careers, help them raise their profile and **recognise the young talents that will contribute to the future of our electricity supply industry**.

We award five undergraduate scholarships annually, in partnership with the University of Canterbury (x2), the University of Auckland (x2) and the Auckland University of Technology (x1). The scholarships are tenable for a period of one year, for a value of NZ$4,500 each.

This initiative is part of the EEA's commitment to the future development of engineers and engineering education in New Zealand and to the ongoing professional development of its members in all sectors of the industry

STUDENT & GRADUATE

PROFESSIONAL DEVELOPMENT
FUTURE ENGINEERS AND LEADERS

Engineering Excellence—Electricity Engineers' Association | EEA

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