Electricity Engineers' Association

Professional Development Programme

Annual Power Engineering Exchange

APEX | 2017

POWERED BY DATA

CHRISTCHURCH — 18TH AUGUST

UNIVERSITY OF CANTERBURY

8.30am	**Registration — Arrival Tea & Coffee**
8.55am	**Welcome — Peter McClean, APEX Chair**
9.00am	**Hamish Janett, *Meridian Energy*** — Assessment of Pressure Relief Valve Suitability
9.25am	**Maria Fernando, *Mitton ElectroNet*** — Impeding explosion? Or just gassy? - Dissolved Gas Analysis (DGA) in Substation Transformers
9.50am	**Rebecca Harkerss, *Wellington Electricity*** — Importance of data in Network Outage Investigations carried out by Wellington Electricity to improve the management of its assets
10.15am	**Andrew McFarlane, *Marlborough Lines*** — Picton 33kV Dual Circuit Crossarm Replacement
10.40am	**Morning Tea**
11.00am	**Charles Chen, *Meridian Energy*** — Waitaki Tail Water Level Instrumentation Replacement
11.25am	**Gene Sams, *Meridian Energy*** — Aviemore Fault Displacement Device (AFDD)
11.50am	**David Stevens, *Transpower*** — Aerial Line Survey Data Developments and Applications
12.15am	**Segar Manoharan, *Beca*** — 3D Design and Modelling of High Voltage Substations
12.40pm	**Lunch**
1.15pm	**Simon Gasson, *Beca*** — Streamlining data for efficient transmission design
1.40pm	**Jarrod Wyatt, *Meridian Energy*** — Condition Assessment Criteria & the Data Required for Hydropower Generating Units
2.05pm	**Ben Dobson, *Beca*** — Modernising SCADA Today for Tomorrow's Needs
2.30pm	**Ben Snalam, *Marlborough Lines*** — Getting the right information using humans
2.55pm	**Afternoon Tea**
3.20pm	**Panel Discussion** Session facilitator: **Gareth Arnold, *Aurecon*** ***Utilisation of data in the electricity industry: Challenges and Opportunities*** Panellists: **Michael Hwang, *Meridian Energy*** **Bhaba Das, *ETEL Transformers*** **Jennifer Wen, *Orion*** **Hamish Fleming, *Orion***
4.20pm	**Presentations — Joint EEA/CIGRE Best APEX Presentation Award and People's Choice Award** **Closing Comments — Peter McClean, APEX Chair**
4.40pm	**Social Function**
6.00pm	**Close of APEX 2017 Summit**

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ABOUT THE PRESENTERS

8.30am **Registration, Arrival Tea & Coffee**

8.55am **Welcome from Peter McClean, APEX Chair**

9.00am **Hamish Janett, *Meridian Energy***

Hamish Janett is a Graduate Mechanical Engineer in Meridian Energy's Tactical Engineering Team. During his studies, Hamish completed an internship with Meridian's Wind Engineering Team and his honours research and development project on the design and construction of a four-wheel drive electric race car. Hamish graduated from the University of Canterbury in 2017 and is now based in Twizel, helping maintain Meridian's seven hydroelectric power stations.

Assessment of Pressure Relief Valve Suitability

Compressed air is a vital component of hydroelectric generation and is potentially fatally hazardous. Applications of compressed air range from direct control of governor pressure and hence generation output, to powering of workshop tools. Uncontrolled release of compressed air is a significant hazard and has been the cause of many catastrophes. To prevent such incidents occurring it is critically important that pressure vessels are able to reliably relieve excess pressure in a controlled manner. The suitability of a pressure relief valve is defined by its designed volumetric air discharge capacity in the event of excess pressure accumulation. In hydroelectric generation, where assets often have decades long service lives, regular testing and certification of pressure relief valves is important to ensuring relief valves maintain their design discharge capacity. Collection of data including valve lift, lift pressure, reseating pressure, and relieving pressure allows the integrity of pressure relief valves to be assessed with respect to their original design specifications. To collect assessment data, a pressure regulated and IANZ calibrated system has been designed and constructed. Using data obtained from relief valve testing, a new maintenance programme is being developed to ensure relief valves are regularly tested and certified.

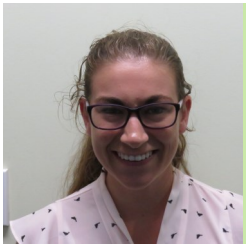
9.25am **Maria Fernando, *Mitton ElectroNet***

Maria Fernando is an Assistant Engineer within the Distribution Team at Mitton ElectroNet. Maria has two years' experience in the power industry and has been involved in a diverse range of projects. After completion of her engineering degree at the University of Canterbury in 2014, she worked for EA Networks managing small to medium sized technical projects, developing SCADA systems, protection relays and managing assets. She also has a valuable field work experience after working with technicians in the field and supporting control staff after-hours. Maria is currently gaining experience in assisting senior members of the distribution team with primary and secondary system design.

Impending explosion? Or just gassy? - Dissolved Gas Analysis (DGA) in Substation Transformers

The analysis of dissolved gases in oil is a useful method which can prevent major faults by diagnosing internal faults of power transformers and intervening by replacing or refurbishing the transformer. Several methods are available for the interpretation of dissolved gas analysis (DGA) results in oil-filled electrical equipment. These methods are based on the ratios of the five dissolved hydrocarbon gases formed in power transformers, namely hydrogen (H_2), methane (CH_4), ethane (C_2H_6), ethylene (C_2H_4), and acetylene (C_2H_2). In practice, depending on which method is utilized, the interpretation of these results can lead to differing conclusions as to what the problem is. A holistic view to all methods is needed when interpreting results to take into consideration all gases present, including carbon monoxide (CO) and carbon dioxide (CO_2). This presentation will compare the methodology of dissolved gas analysis and discuss the best practice in using these methods to complement one another.

9.50am **Rebecca Harkerss, *Wellington Electricity***



Rebecca Harkerss graduated with a Bachelor of Applied Science majoring in telecommunications and minoring in economics from the Otago University in 2012. She then graduated from the University of Canterbury with a Bachelor of Electrical Engineering (Hons) in 2016. After graduating in 2016 she started work at Wellington Electricity and currently holds the title of Graduate Engineer. This is giving her experience in a range of different electrical engineering areas from network planning to asset engineering. Her current work focusses on conducting outage investigations.

Importance of data in Network Outage Investigations carried out by Wellington Electricity to improve the management of its assets

This presentation will cover the reasons for, and importance of, doing effective investigations of outages on Wellington Electricity's electrical distribution network. It will include the process behind doing an outage investigation for both an Outage Report and an Asset Failure Report. This includes the importance of gathering the correct data and how to analyse it. It will also cover the benefits they have to the company and how the Asset and Planning team use the results as feedback to manage the assets on Wellington Electricity's network. It will reference the importance of investigations in the context of international best practices and continual improvement. It will conclude with two examples of Outage Investigations compiled during Rebecca's graduate training in the Asset Engineering team at Wellington Electricity.

10.15am **Andrew McFarlane, *Marlborough Lines***

Andrew McFarlane graduated from the University of Canterbury after completing his studies in Electrical Engineering in 2010. From 2011, Andrew has worked in engineering with Marlborough Lines Ltd, with involvement across a wide range of areas including project design and management, SCADA implementation across the network, network protection and maintenance. In 2013, Andrew took a year off to further his education, completing a Master of Engineering Management degree from the University of Canterbury.

Picton 33kV Dual Circuit Crossarm Replacement

One of the challenges that all electricity distribution businesses face is how to maintain the distribution infrastructure while keeping the lights on.

Marlborough Lines Ltd owns and operates the 33kV, 11kV and 400V distribution network in the Marlborough region, supplying electricity to the people of Blenheim, Picton, Havelock and many rural remote areas of the Marlborough Sounds and Awatere Plains.

In April 2017, Marlborough Lines undertook a project to replace the aged timber crossarms on the 33kV dual sub-transmission circuit that supplies the township of Picton and its surrounds. This had to be performed in a timely, cost effective and safe manner, while maintaining a supply of electricity to all of the 3325 consumers normally supplied by this circuit. This added a further level of complexity to the project given that there exists no permanent alternate supply to Picton.

This presentation discusses the implementation of a remote 7.5MVA diesel generation system embedded within the Picton 11kV distribution network, to supply electricity consumers throughout the duration of the sub transmission outages demanded for the cross arm replacements. It also looks into the challenges of utilising diesel generating sets as a viable solution including ensuring correct operation of system protection, generator synchronising schemes, analysis of data for load forecasting and outage management.

10.40am **Morning Tea**

11.00am **Charles Chen, *Meridian Energy***

Charles Chen is currently working for Meridian Energy as a graduate electrical engineer based in the Engineering Strategy Team in Christchurch. He graduated from the University of Auckland with a BE(Hons) in Electrical and Electronic Engineering last year, with a focus on power systems and power electronics. Charles has been working on the automation replacement projects at Ohau A Power Station, Benmore Power Station and some water level site upgrades across Meridian's assets.

Waitaki Tail Water Level Instrumentation Replacement

The tail water level (TWL) of a hydroelectric power station plays a vital role in the operation of the turbine governing systems as well as safe plant operation during the flood and seismic events. Multiple factors can contribute to an inaccurate TWL measurement including the geographical location of the water level instrument, the design and maintainability of the stilling well and instrument, and the method of capturing, sampling, and processing the level data. A project was initiated to install a new TWL instrument, controller, stilling well, and communication equipment to provide accurate and reliable TWL data for Waitaki Power Station. This presentation will discuss the key technical design considerations and challenges that were encountered. There will be a focus on Safety in Design (SiD) and health and safety from the initial concept design through to the completion of the project including important learning outcomes and observations from the perspective of project management.

11.25am **Gene Sams, *Meridian Energy***

Gene Sams is a new Electrical Engineering Graduate from the University of Canterbury. In his third year at UC he was given the opportunity to work for Meridian Energy as an Automation Intern. He enjoyed his work there, and upon completion of his degree, he joined Meridian's Graduate program.

Aviemore Fault Displacement Device (AFDD)

The AFDD informs Meridian of a major fault displacement (1.2-1.5m) of the Waitangi fault which passes directly under the Aviemore earth dam. Should such an event occur, the device sends out alarms to the Meridian Control Centre which escalates this to a Dam Safety Emergency Response.

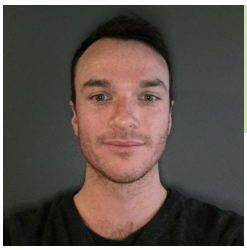
This fault displacement device previously relayed these critical alarms through satellite communications to the responsible parties, however the issue now faced by Meridian is the decommissioning of this satellite. Without this link the device cannot fulfil its design intent.

Remote seismic monitoring of the Aviemore Dam is not possible without reliable satellite communications. This project aims to have the AFDD working again with new equipment to relay the appropriate alarms to the responsible Meridian personnel.

The new parts include a new Micrologix 1400 PLC, batteries, a wall mount rectifier as well as a new satellite communication (SATCOM) device. Furthermore a seismically isolated tray will also need to be designed and manufactured.

The design, procurement and installation of these parts along with the necessary PLC code / alarm modifications will allow for the AFDD to once again send this critical information to the responsible parties and reliably work for years to come.

11.50am **David Stevens, *Transpower***



David Stevens studied mechanical engineering at the University of Canterbury, graduating in 2013. Since graduating, he secured a role on Transpower's Graduate Programme followed by a position on the Grid Engineering Lines team.

Aerial Line Survey Data Developments and Applications

The introduction of Transpower's Aerial Survey programme in 2001 has provided a data set that has become invaluable to enable Transpower to deliver its business model. An Aerial Survey is a method of collecting geomatics or imagery using aeroplane, helicopters, UAV's or other aerial methods. LiDAR, or 'Light Imaging, Detection and Ranging', by Helicopter is Transpower's present preferred data collection method.

The way in which the data is used varies widely, and benefits many parts of Transpower's business and external parties. The data supports line design, compliance, substation design, easement negotiations, among many others.

Transpower has developed the Aerial Survey method over time, though there are still some limitations. There are many emerging technologies which Transpower is also looking at bringing in to strengthen this data set further and fill in some of these gaps. The main limitations for discussion include the cost of survey and the impact of ageing of data.

12.15am **Segar Manoharan, *Beca***

Segar Manoharan has worked as a design consultant at Beca for the last 18 months and has been involved in a number large scale substation projects in both New Zealand and Australia. He has worked with a number of 3D modelling software and has a keen interest in the emerging technologies market.

3D Design and Modelling of High Voltage Substations

Computational technology has grown at an exponential rate in the past decade, fuelled by the abundance of data that can now be collected and stored. 3D visualising and scanning technology has grown significantly in this time and this growth has given engineers access to a wide array of tools such as point clouds and virtual reality engines. Point clouds are sets of data points used to represent external surfaces of objects and are generated through a 3D scanner. This process allows engineers to collect and store a tremendous amount of precise measurements that can be referred to during the design process. Point clouds also significantly mitigate the upfront cost required when modelling existing sites and equipment. Virtual reality engines provide a means to effectively present designs and showcase scenarios by allowing users to spatially navigate their way through a model. This enables users to identify errors within a design early on and help reduce costs over the lifecycle of a project. Adoption of these tools and other 3D virtualisation technologies in the engineering industry is becoming increasingly common. The numerous benefits that these tools provide allow engineers to come up with innovative solutions. This paper will present thoughts on the future of 3D visualising technology and will refer to examples of these tools being used throughout the design lifecycle of a major project.

12.40pm **Lunch**

1.15pm **Simon Gasson, *Beca***

Simon Gasson is a transmission line engineer with one year of experience. After completing a Bachelor of Engineering (Hons) degree in mechanical engineering at the University of Auckland, Simon joined Beca in their Power Team. Here he picked up experience working with PLS CADD, PLS-Pole and PLS-Tower. He has worked on pole replacement projects, tower modelling, catenary support systems, standard structure drawing sets, and clearance assessments. Outside of work Simon has a passion for outdoor sports, in particular trail running and skiing.

Streamlining data for efficient transmission design

BC Hydro is a Canadian electric utility and the main electric distributor in the province of British Columbia. Their HV network primarily consists of wooden pole transmission structures. In order to maintain the grid, BC Hydro has a project to assess, design and replace selected transmission structures. With a network of over 18,000km of transmission lines, this requires a large amount of data.

Each individual line requires a model which can consist of millions of 3D data points. From all of this data, it is required to determine what is critical and what can be eliminated as noise or excessive data?

Each individual structure requires field survey to understand the structure, its surroundings and what complications will arise during design. With thousands of structures on the network, this creates a large amount of data to be collected, processed and stored, which poses a number of questions:

- How is this being done?
- Is there a more efficient way this could be done?
- How is the data presented?
- What is the best way to deal with and use this data?

This presentation will discuss how excess survey data is filtered, leaving only what is relevant and crucial; how processes were streamlined for efficiencies so that engineers can focus on design; and what can be done in the future to ensure that data is managed and controlled.

1.40pm **Jarrod Wyatt, *Meridian Energy***

Jarrod Wyatt is a graduate from the University of Canterbury and now works as a Graduate Mechanical Engineer for Meridian Energy. He has spent time in the tactical engineering team based in Twizel working a number of different projects around Meridian's hydro sites. He is now involved in the strategic engineering team where he is working on a number of projects including condition assessment of main generating units.

Condition Assessment Criteria & the Data Required for Hydropower Generating Units

The aging and deterioration of plant is an unavoidable phenomenon and having in depth information as to the current condition of assets is critical for any asset owner to be able to make informed decisions regarding the management of the asset lifecycle, including end of life replacement.

Every hydropower generating unit has a large number of components that all contribute to the overall health of the unit. From cracks and cavitation to the condition of the pads of guide and thrust bearings, to the performance of coolers, every part of the unit has a set of data that is required to be collected and analysed. The data is then used to make decisions about operating parameters, maintenance and refurbishment or replacement of the components.

This presentation covers the project being undertaken by Meridian to streamline the collection, analysis and storage of condition data to make better decisions around the future operation, maintenance and life extension/ replacement of the 36 main generating units throughout its fleet. It will also discuss the difficulty in obtaining and storing consistent condition evaluation information and the current difficulty in accessing the relevant data.

2.05pm **Ben Dobson, *Beca***

Ben Dobson is a Power Systems Engineer with three and a half years' experience. After graduating from the University of Canterbury in 2014, Ben joined Beca in Christchurch and has since been primarily involved in SCADA design and upgrade projects for Transpower sites.
Additionally, Ben was seconded to Transpower's Hamilton-based System Modelling team in 2015 and worked alongside the System Operator team to migrate the existing SCADA system to the new DNP3 communications protocol.
Recent work includes designing and staging RTU upgrades within Substations and Power Stations for Transpower NZ Ltd to support modern digital SCADA systems.

Modernising SCADA Today for Tomorrow's Needs

We live in an age where information is all around us. But to make the most of this information and use it to improve our business operations we need to verify, analyse and interpret it. SCADA (Supervisory Control and Data Acquisition) is the power industry's core platform for collecting, sorting, and controlling the vast amounts of data that keeps the National Grid in operation. It is also the backbone that will enable implementation of future Smart Grids.

Access to data is key to providing all stakeholders with the information they require to operate in today's world. In the past, focus has been geared towards the benefits for the end users. But what does this increased data and control mean for the National Grid and its customers - the generators, distributors and the system operator?

To keep up with the increasing volumes of data and renewal of their asset base Transpower Ltd is well underway with upgrading each of their substations to support modern digital SCADA systems. Beca Ltd has carried out many such designs for Transpower including Benmore power station, providing vital information links between generator, HVDC, and the Grid. This paper provides an overview of the unique challenges that had to be overcome in implementing the new SCADA backbone at this complex site.

2.30pm **Ben Snalam, *Marlborough Lines***

Ben Snalam finished up his engineering degree from the University of Canterbury in 2012. Since then he has completed four years in the electrical industry working as an electrical engineer for Marlborough Lines.
Ben describes himself as a generalist, so far his work has included substation design and project management for power transformer installations, management of a fleet of mobile generators, earthing system reviews, operations planning, architecting asset structure for an asset management system, drafting maintenance standards and supporting MLL's integrated engineering analysis and outage management system. Occasionally, he is utilised as a control room operator.
Ben is also has a keen interest in training and education. He is a Futureintech Ambassador and has been in instructor and training management roles within the New Zealand Cadet Forces for the last 10 years.
Currently, Ben is leading a Field Mobility project, getting tablets into the hands of field workers to help them see more information about their surroundings and collect better field data.

Getting the right information using humans

Good information is vitally important to the effective management of Assets. Data comes in many shapes and forms, e.g. current, voltage, power, harmonics levels from CTs and VTs, DGA readings from transformers, and SCADA data on CB operations. On its own, data is just a series of numbers, to make it into information and useful it needs analysis and consideration. One of the most versatile and often overlooked tools in our arsenal is the field services worker. Observant and well trained people can often identify issues before the numbers reveal them.

As young engineers, we are often positioned on the interface between the field staff and the rest of the organisation. It is not uncommon for field staff to feel remote from management. This can result in missed opportunities and poor data collection. We have an opportunity to facilitate effective communication and build up rapport, thereby both improving data collection, teamwork, individual moral and organisation performance.

The primary goals of this paper: Firstly, give you a few good reasons why strong work force engagement is useful to you, the people you work with and your company. As well, this paper will suggest a few ways to break down the barriers that can exist to building good relationships.

2.55pm **Afternoon Tea — Cast your vote for the Best Presentation - People's Choice Award**

3.20pm **Panel Discussion — Based on an idea by Michael Hwang, *Meridian Energy***

Utilisation of data in the electricity industry: Challenges and Opportunities

Panellists: **Michael Hwang, *Meridian Energy*** **Bhaba Das, *ETEL Transformers***

Jennifer Wen, *Orion* **Hamish Fleming, *Orion***

Panel facilitator: **Gareth Arnold, *Aurecon***

Engineers in the electricity industry rely heavily on data collection and utilisation for the safe, reliable and efficient operation and management of assets. While advances in data science create new opportunities and tools for engineers, they do not come without challenges: for example, the lack or inaccuracy of data, the quality of the information that can be collected, or simply economic and logistical challenges in implementing the most efficient data analysis tools available. Knowing how to tackle these challenges and make the most of emerging analytical techniques may provide some critical new information to help engineers make decisions.

At this year's panel session, four different speakers will reflect on how data is being utilised in the generation, network, and manufacturing sectors of the electricity supply industry. They will discuss the impact of data on:

- moving from preventive to predictive maintenance,
- managing assets more efficiently,
- preparing for future industry developments (e.g. EVs, PVs),
- skills that engineers need for efficient data utilisation now and in the future.

4.20pm **Awards Results — Joint EEA / CIGRE Best APEX Presentation Award and People's Choice Award**

4.40pm **Social Function**

6.00pm **Close of APEX 2017**

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