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A PACIFIC POWER ASSOCIATION PUBLICATION

VOLUME 28 ISSUE 3 - SEPTEMBER 2020

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Pacific Power Association, Suva, Fiji Islands. The PPA is an inter-governmental agency and member of the Council of Regional Organisations in the Pacific (CROP) established to promote the direct cooperation of the Pacific Island Power Utilities in technical training, exchange of information, sharing of senior managment and engineering expertise and other activities of benefit to the members.

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Cover Page Photograph - " Marama Nui, Hydro station, Centrale de Papenoo, Tahiti, French Polynesia".

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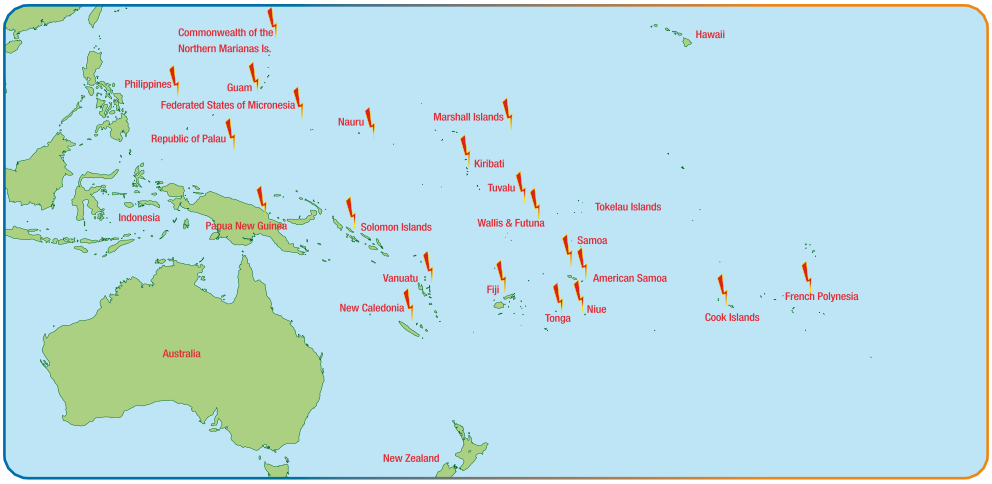

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Editor's Note

Andrew D. Daka
Executive Director

The Economic Ministers of the Pacific Islands Forum Countries (FEMM), attended a virtual Meeting on 11 and 12 August 2020, to discuss the grave concerns about the severe and disproportionate and unpredictable impacts of COVID-19 on the livelihoods of people around the world, including the small, isolated and vulnerable economies of the Blue Pacific region. It required Members to adopt innovative economic approaches in a transformative way in order to respond to the "new normal".

The FEMM recognized the three-pronged crisis currently facing the region – the impact of COVID-19, the devastating effects of climate change and natural disasters, and the fragile economic health of the region as a consequence of inherent vulnerabilities. Regional solidarity and global collective action are critical to overcoming these challenges and acknowledged the steps and measures taken by development partners, CROP agencies and other regional entities in realigning their programs, activities and resources to focus on improving data, understanding and supporting the mitigation of the pandemic's impacts on Forum Members, including thorough innovative use of online technologies. The Ministers also recognized that sound and timely data is essential, and emphasized the need to invest in data to track the needs and progress towards achievement of goals and objectives.

The meeting also recognized that the impacts on economies differ across the region with the most significant impact on countries that depend heavily on tourism which is presently at a complete standstill since the border closures in late March affecting employment and reduction in household incomes.

This editorial will most likely be my last one as the editor of the magazine as I prepare for life after 11 years at the PPA Secretariat. On that note I would like to thank the Chairman and the Board of the PPA (past and present) for their confidence in me leading the Secretariat during my 9 years as Executive Director of the Association. I would like to make special mention of a number of people who have helped me during that period; Mr. Joaquin Flores (former PPA Chairman and CEO of Guam Power Authority) for his pointers in public speaking. Kin is one of those persons that you only need to give him the topic and he will run with it. The late Utu Abe Malae for his advice on organizing and running meetings; one of which was not to have an agenda item AOB on the papers. Dr. Herbert Wade for being available to bounce ideas off him on renewable energy training in the context of the Pacific region.

I would also like to thank all the CEOs and the staff of all the utilities for the welcome and company I have received whenever I have visited their respective utilities.

Lastly but not the least a big Vinaka vaka levu to my colleague staff at the Secretariat who have ensured that the operations of the Secretariat continue regardless of the challenges. A special mention of my Deputy Executive Director, Mr. Gordon Chang for his support, advice and invaluable local knowledge in dealing with staff matters from the day of my appointment.

Wishing the Association all the best in the years ahead knowing that there are still challenges that the utilities, National Governments and the Pacific region will need to address to achieve our energy goals.

The North West Pacific Project: an Ambitious and Innovative Opportunity

Infratec Limited

What do you do when given the opportunity to save 750,000 litres of diesel fuel consumption per year in the Pacific while simultaneously improving energy reliability, access and resilience? For the team at Infratec and Sunergise – it's an opportunity you jump at.

Infratec and Sunergise did exactly that when they joined forces to deliver the North-West Pacific project, funded through the New Zealand Ministry of Foreign Affairs and Trade and co-funded by the European Union for Nauru.

This project saw five solar plants concurrently built across four Pacific countries (Fed. States of Micronesia, Palau, Marshall Islands and Nauru) with a collective capacity of 1.7MWp. A mixture of rooftop and ground mounted solar, the project took 19 months to complete with all five plants operational by March 2020 - thankfully just prior to the global Covid-19 shutdown. This was an ambitious project that of course came with its fair share of unforeseen challenges. Thankfully however, these challenges invited some pretty cool and innovative solutions.

The smallest of the five sites was situated in Palau, a small island named Kayangel. A small community of 32 people live there and the solar + battery micro-grid (65kWp solar PV and 165kWh) was the first of its kind in Palau. In fact, the children in Kayangel had never even seen a solar plant before this installation, so we ran educational workshops to teach them how solar plants convert energy from the sun, and how we can all do our bit to save energy and look after the planet. This system was established to reduce the community's reliance on diesel generators and it saves them approximately 85 litres per day. It will also save them around $62,000 a year which is a significant per capita saving.

The challenge with the Kayangel site, and similarly another site built in Majuro, Marshall Islands, was how close it was situated to the ocean. The ocean's proximity caused concern as the high salinity would not meet the manufacturer's warranty for typical Mono-crystalline panels. This led to bi-facial panels being used on both sites. Bi-facial panels are frameless which eliminated the corrosion concerns. Another handy upside of bi-facial panels is you are able to generate electricity from both sides of the panel, which assisted in maximising energy output of these two smaller plants.

At the other end of the spectrum, the largest of the five sites was the 1.15MWp solar array established in Nauru. This plant alone will reduce diesel fuel usage by approximately 600,000 litres per year as well as provide 6.6% of Nauru's annual energy consumption. It's a significant milestone for Nauru and their renewable energy targets.

One of the challenges in Nauru was because of the land quality. Nauru's phosphate rich land and economic reliance on this substance has meant that extensive mining has occurred there for a long time. The site area had been re-established and its poor quality had originally led to the conclusion that concrete mass foundations were the only way forward. The high cost of this method was certainly a road block. However, a solution was developed in collaboration with Gayk Australia which involved a unique predrill method and drive foundation system. This method proved to be more efficient and cost effective than concrete mass foundations and is a solution that will no doubt assist future builds of this nature throughout the Pacific.

Another challenge in Nauru, is the scarcity of fresh water, needed for cleaning the PV panels. To address this, the PV array was constructed with a pilot water catchment system. The water is used for module cleaning but also serves as an emergency source of water for the island as the water is clean and drinkable. This pilot system was extremely successful and has led to further plans to expand this water collection system into future PV projects on the island.

The ambitious size and unique innovations made this project an exciting venture to be a part of. There was also a lot of positive community interactions throughout the project, which

helped make evident the impact of this work on individual's lives.

Therefore when SEANZ awarded Infratec and Sunergise the Best Grid Connected Implementation Award for the work specifically done in Nauru, it really was just icing on the cake.

This project strengthened and improved grid utility, significantly reduced carbon emissions, and alleviated reliance on diesel fuels across the Pacific; so it certainly was an opportunity not to be missed.

138kWp rooftop solar array on Majuro Electric Company warehouse in Majuro, Republic of Marshall Islands

Kayangel educational workshop, Jan 2020

Project Manager, Paul du Plessis with completed 1.1MWp solar farm, Nauru

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Electratherm – The Future of Energy Efficiency Next Generation Engine Cooling System

David Knight
Business Development Analyst - ElectraTherm Inc

ElectraTherm, as a technology driven renewable energy company continues the journey to develop efficient heat to power generation solutions using their successful Organic Rankine Cycle (ORC) technology.

Recent advancements, incorporated into the ElectraTherm Power+Generator, have included improved efficiency with higher temperature heat input, enhanced control systems enabling 1:10 turndown with an operating envelope of 5 – 125 kWe and full combined heat and power (CHP) capability. Accompanying these product improvements, internal company systems and capabilities have also been strengthened with increased engineering, manufacturing and product support further enhancing our ability to meet current and future market requirements.

As part of the worldwide BITZER Family our clients through ElectraTherm have access to world class products manufactured and supported by the BITZER Group. The twin-screw expander, the generating heart of the Power+Generator, is designed and manufactured by BITZER.

Manufacture of sub-assemblies, final assembly and factory acceptance/ simulation testing of the Power+Generator is undertaken at our facilities in Flowery Branch Georgia USA which ensures full compliance with exacting technology and quality assurance standards.

Next Generation Energy Efficiency Application

ElectraTherm have embarked on the design and manufacture of the next generation of products to bring energy efficiency improvements to engine-based power generation. It is recognised that heating and cooling are one of the largest components of energy usage and energy requirements for the cooling of internal combustion engines are no exception.

All engines create heat during operation, transforming energy from a liquid/gas fuel to mechanical energy. It is necessary to remove this heat to enable the continued safe operation of the engine with traditional engine cooling systems based on power consuming air-cooled radiators or water based evaporative coolers.

Traditional cooling systems are designed to directly reject engine heat to the atmosphere without any consideration of the direct costs incurred in both the generation and rejection of that heat. These direct costs are ongoing and never stop whilst engine cooling is required and have a direct impact on the profitability of the generating asset.

Until now engine cooling systems have not considered the potential to utilise the heat contained within the jacket water systems as a resource. ElectraTherm have recognised this omission and have developed the Active Cooler, that uses the available heat to generate electricity to power the cooling system for optimum engine operating efficiency and under typical conditions generate excess electricity for an additional income stream.

The ElectraTherm Active Cooler incorporates a re-engineered version of the successful ORC technology used in the Power+Generator and have coupled this with latest technology air-cooled radiators to provide energy free, emission free engine cooling.

The design brief for the ElectraTherm engineering team was to develop a compact ORC with simplified control system for the primary purpose of engine cooling with the ability to generate excess power a secondary consideration.

The process of engine cooling remains the same as traditional radiator/cooling tower systems with the heated jacket water being cooled by a radiator but with the addition of the compact ORC to harvest heat for power generation.

The heated jacket water is connected to the inlet flange on the Active Cooler. The jacket water passes through the ORC Evaporator, where initial cooling takes place with the heat used to vaporise the ORC working fluid. Further cooling, as maybe required to meet engine manufacturer's specification, is undertaken via a heat transfer module which is part of the air-cooled radiator before return to the engine.

Power is generated by the vaporised working fluid passing across a twin-screw expander which drives the integrated induction generator. The power generated is principally used to operate the active cooler with excess power available to be added to the main generator output.

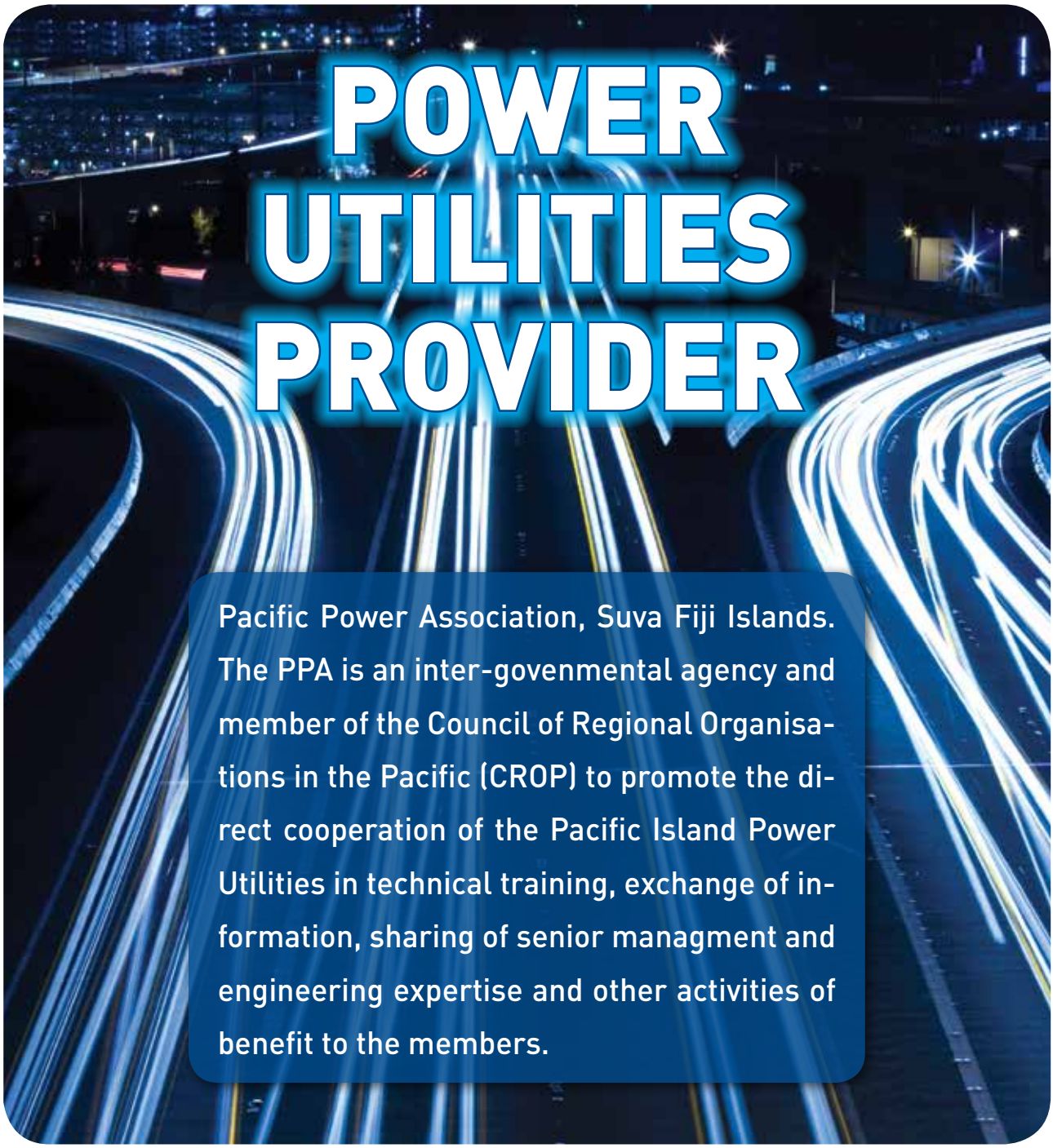
A safety backup system is provided to ensure that engine cooling will continue should the ORC module be offline for any reason. In this operating mode external power will be required to operate the radiator.

The sizing of an engine cooling system is determined through a combination of the engine heat to be rejected and the operating conditions such as ambient temperatures which can vary widely between winter and summer seasons. During summer the radiator is fully utilised but in winter the additional capacity is underutilised. As a result, the actual sizing of the cooler is often a compromise between cooling requirements and capital/operating costs.

The ElectraTherm Active Cooler removes the need for compromise with the ability to meet all operating costs during the summer, ensuring engine operating efficiency, whilst during the remaining seasons making use of the underutilised capacity to generate extra power and income.

In summary the ElectraTherm Active Cooler is the next generation solution for Energy Efficient Engine Cooling Systems, providing the opportunity for savings in operating costs, opportunity to earn extra income though generation of excess power and improved engine efficiency through right sizing of the cooling system.

The ElectraTherm Active Cooler has been released to the market with the AC800 available 1st Qtr 2021 delivery and a larger unit AC1800 to follow.



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New Renewable Energy Analytics Platform to Enable Energy Transition Aspirations

Institute of Environmental Analytics

The Institute for Environmental Analytics (IEA), a UK-based world leading centre for data analytics focused on environmental challenges, has been working collaboratively with a group of Small Island Developing States (including Tonga, Palau and Vanuatu) for the past four years to develop an online energy analytics platform.

The proof of concept version of the platform is already supporting 170 registered users with renewable energy generation planning at pre-feasibility but will shortly be released in an operational version. The new version will provide substantially more sophistication for exploring the optimal renewable energy generation mix with potential for transforming energy transition efforts and moves towards low carbon futures for Pacific Islands.

The project is receiving financial support from the UK Space Agency, as part of the International Partnership Programme.

At the core of the platform is renewable energy scenario planning. An attractive and intuitive interface allows planners to place combinations of renewable installations (utility solar, rooftop solar, onshore wind, offshore wind or wave) within their island context and model the potential generation. Locating installations is informed by renewable resource maps and the ability to integrate existing or new geospatial layers (grid topologies, road networks, administrative boundaries, land ownership layers, environmental zones etc).

Scenario outputs provide a comprehensive range of metrics to inform generation planning:

- Energy generation metrics:
  - Annual gross renewable energy generation
  - Equivalent emissions avoided
  - Equivalent fuel volume displaced and equivalent fuel savings
  - Scenario renewable energy penetration
- Levelised cost of renewable generation
- Power generation metrics by installation type and location
- Renewable generation versus demand metrics:
  - Curtailed generation
  - Residual generation requirement (net of renewables)
  - Min/max demand by date and time
  - Max demand ramp up/down by date and time, and many more.

Small Island Developing States (SIDS) are typically data poor in terms of in situ meteorological observations. To mitigate this the platform metrics are based on highly sophisticated multi-year simulations of a range of weather variables. The process starts with the best available global weather simulations. IEA modellers then develop customised regional models using satellite data, numerical weather models and any available local observations. These are down-scaled using proprietary techniques to produce weather data at 1km spatial resolution and a 10-minute timestep. The resulting weather simulations are validated against any available observations from weather stations or existing renewable energy installations.

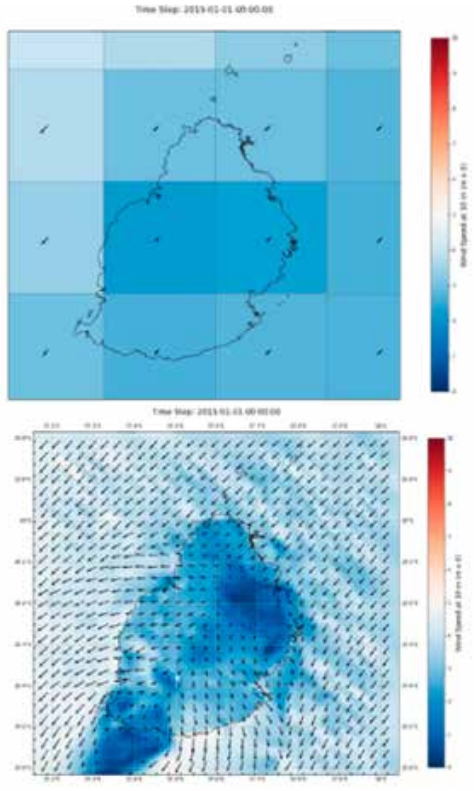

Figure 1: Best available global wind modelling over Mauritius (Top), enhanced high-resolution wind modelling used in the platform (Bottom)

The customised weather modelling provides previously data poor island stakeholders with high resolution, high frequency, locally tailored weather simulations. These preserve realistic correlations between relevant parameters such as wind speed, irradiance and temperature. The multi-year modelling is also able to quantify the inter-annual variability in the intermittent resource.

The weather simulations enable the platform to provide more reliable power and generation metrics from intermittent renewables. Probabilistic weather modelling techniques are used to allow uncertainty to be quantified in the scenario reporting. For most metrics, presentation can be tailored according to exceedance probability. Choose P10, P25, P50, P75 or P90 depending on the intended audience, with metrics updated on-the-fly. Overall, the platform provides a range of capabilities which are all designed to improve the bankability of projects and drive forward national plans for energy independence.

Policymakers and planners will typically develop scenarios for key milestones on their energy roadmaps. A scenario developed for the first milestone can then be copied and further amended for future key checkpoints. Platform users can collaborate by sharing their scenarios with other stakeholders for further development or evaluation. Scenarios and their associated data can be provided as inputs into further feasibility or grid integration studies.

Weather data products are being produced for Tonga, Palau and Vanuatu. Platform configuration and setup for these islands will be completed in time for the launch of the operational version (expected end 2020). Potential for transfer to other Pacific Islands is very high and those interested are encouraged to contact the Institute via the website (https://www.the-iea.org/contact/).

Megger Portable Oil Dielectric Breakdown Test Set

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Megger's automatic portable oil test sets perform accurate breakdown voltage tests on mineral, ester and silicon insulating liquids. Moulded test vessels give repeatable results in the field and laboratory with lock in precision electrode gap setting adjustment wheels. The transparent, shielded lid is a key feature enabling users to see what is happening within the test chamber.

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The Value of a Real End-to-End Lateral-Protection Strategy

Andrew Jones
S & C Electric Company

Challenges in the Pacific Islands

The islands in the Pacific Ocean, collectively called the Pacific Islands, are spread across a diverse and unique area making up 15% of the Earth's surface. The Pacific Islands are particularly vulnerable to extreme weather events and the short-term and long-term impacts that they incur. These extreme weather events include rising temperatures, heavy rainfall and tropical cyclones, causing damage and loss of assets to infrastructure and overgrown vegetation, which impact the health and safety of local communities.

Extreme weather such as high winds and heavy rainfall make the Pacific Islands particularly prone to long lasting outages, and unaddressed vegetation can cause customers to experience momentary and permanent outages caused by foliage brushing against lines. Notwithstanding such weather conditions impacting this region, there is rising demand and expectations from customers for more reliable power.

With a significant increase in demand for reliable power at the grid's edge, making lateral-protection strategies is more important than ever. There's no better time for utilities to adapt to changing environments and customer lifestyles by prioritizing lateral protection today.

Placing an increased focus on modernizing the last mile of the grid can bolster reliability and drive significant O&M savings—all while increasing customer satisfaction. Conventional lateral-protection strategies are typically composed of a variety of devices that aren't "smart." This mix of unrelated protective devices can result in lengthy, avoidable outages for customers and unnecessary truck rolls that can put line crews at risk while servicing the grid.

The better way to support the last mile of the grid is with a suite of advanced protection devices designed to work together and protect lateral lines from end to end.

Protecting All Types of Lateral Lines

S&C's TripSaver® II Cutout-Mounted Reclosers are designed to provide advanced protection throughout the lateral system. The device is available in a variety of ratings, ranging from 40-200 amperes, making it the only advanced lateral protection solution designed to support all lateral line locations, from closest to generation all the way to the grid's edge.

Regardless of where a device is placed on the grid, its rating capability must closely match the expected load of the line it's protecting. Compared to conventional alternatives that support fewer, specific locations throughout the grid, TripSaver II reclosers simplify the need for crews to learn and manage several devices, allowing them to use variations of the same device throughout their laterals.

Many systems around the world are also being designed to include three-phase lateral lines, which can create additional delivery and protection challenges for utilities. If a fault is detected on one phase and the other two phases remain energized, this poses a significant safety risk for line crews responding to the fault. When configured for group operation, TripSaver II reclosers can collectively operate to effectively respond to faults on three-phase laterals. When one device detects a persistent fault and trips open, the other two devices will follow suit, limiting the risk of phase-to-phase faults and providing a safer environment for line crews responding to the outage.

The TripSaver II recloser is not only versatile in where it can support lateral lines, but it also has more than 190 operation curves available, making it possible to configure in series with any protective device already on the system. The wide range of curves available for this device makes it the smartest choice when integrating into new or legacy systems.

These reclosers are also designed to adjust to your changing system. Whether a utility is

experiencing expected increased loads or adding new devices to its lateral lines, the utility may will want to update operational curves for existing devices. Cutout-mounted reclosers allow for easy adjustments by accommodating updates made in the field through a simple laptop connection, without needing to remove the device from operation.

Lateral Segmentation

Having cutout-mounted reclosers available at a variety of ratings means utilities can place multiple devices on the same line to better segment the grid and limit the number of customers affected by any outage. Increased lateral segmentation works best when all the devices on the line coordinate with each other to avoid unnecessary operations and momentary outages.

The TripSaver II Cutout-Mounted Recloser is enabled with a sequence-coordination feature, which equips devices further upstream from the fault with the ability to detect whether a downstream device has completed its operating sequence before operating itself. Without sequence coordination, automatic protection devices upstream from a fault typically react before a downstream device can identify, clear, or isolate the fault, creating unnecessary momentary outages for more customers.

O&M Savings

The biggest benefit from using smart devices on laterals is the operation and maintenance (O&M) savings. With 80% of overhead faults being temporary in nature, TripSaver II reclosers keep these faults from becoming permanent outages—and utilities from needing to send crews to restore power.

When a fault is permanent, the reclosers physically swing open to provide a clear visual indicator for line crews to identify the location of the fault. By simply inserting the TripSaver II recloser back into the cutout, this speeds up the process of crews finding and fixing the fault.

Over time, these O&M costs remain low, too. The TripSaver II reclosers are maintenance-free—there's no need to change oil or replace a battery. To ensure constant operation and data-logging, the cutout-mounted recloser harvests energy from power lines, eliminating the need for a battery backup system. With various ratings of the TripSaver II recloser needing as little as 1 amp to run, the recloser is more reliable than its battery-powered counterparts. This energy-harvesting capability ensures utilities never have to worry about sending a crew to recharge the device or replace a battery after a prolonged outage.

The benefits cutout-mounted reclosers bring to a utility's O&M costs are also reflected in improved customer satisfaction. As an industry, we know customers won't accept outages of any length because any outage can cause costly disruptions to businesses and households.

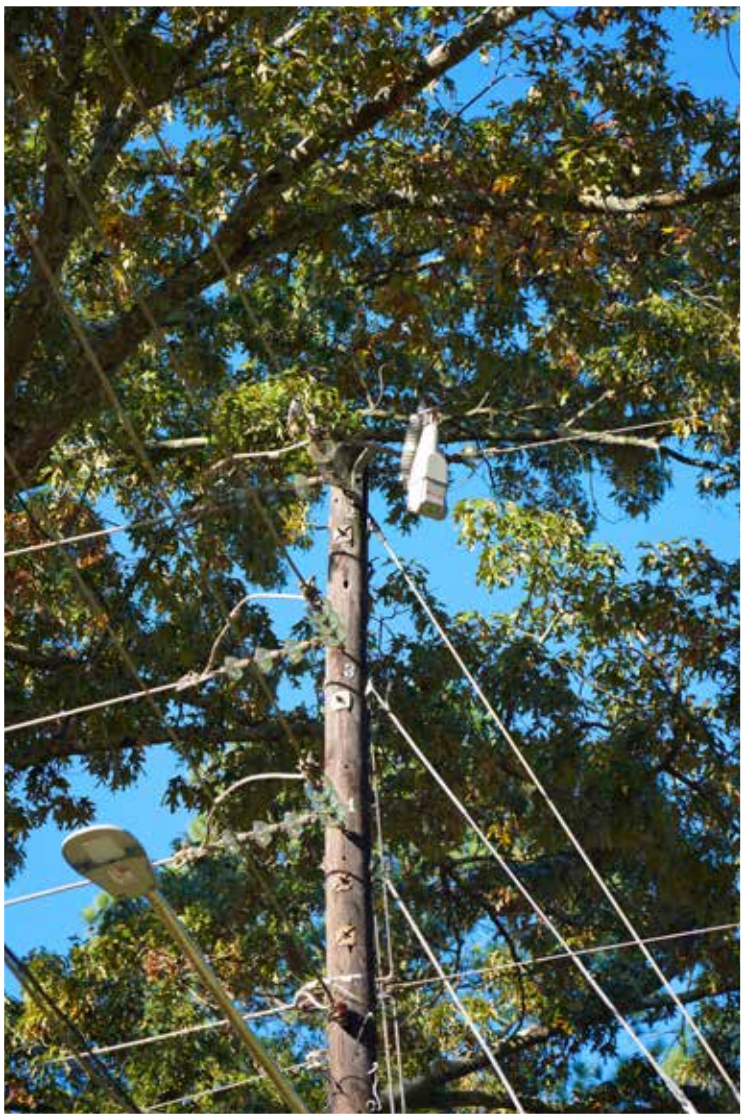
Bringing Advanced Protection to the Grid Edge

End-to-end lateral protection should truly mean end to end, protecting everything from the head of the lateral to overhead distribution transformers. S&C is the first innovator to take advanced lateral protection to the very edge of the grid with the VacuFuse® Self-Resetting Interrupter—the first device to replace fuses at this location and bring intelligence to the grid edge. Specifically designed to respond to faults at overhead distribution transformers, these devices help restore service to homes after experiencing a transient fault, eliminating up to 70% of O&M costs at this grid location.

Often, these locations experience repeat outages, so the VacuFuse interrupters provide a solution to the difficult-to-solve problem areas of the grid. Especially for the customers who are subject to repeat outages, VacuFuse interrupters improve customer satisfaction in these troublesome locations.

Improving reliability in the Pacific Islands

Adaption is vital to enhance the resilience of the Pacific Islands. Utilities across the Pacific Islands have been searching for effective management strategies and technologies to ensure their network is more durable and resilient to withstand these major weather events, to improve reliability and reduce the number of permanent outages from the head of the feeder to the edge of the grid.



Top - S&C's TripSaver® II Cutout-Mounted Recloser in three-phase, group operations configuration

Left - S&C's TripSaver® II Cutout-Mounted Recloser

PROUDLY CONNECTING OUR PACIFIC COMMUNITIES

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Insulating Oil Dielectric Breakdown Testing

AVO New Zealand Limited

Oils that combine a high flashpoint with high dielectric strength have long been used as an insulating medium in transformers, switchgear and other electrical apparatus. To ensure that the dielectric strength of the oil does not deteriorate however, proper maintenance is essential, and the basis of proper maintenance is testing.

The dielectric breakdown voltage test is a relatively quick and easy way of determining the amount of contamination in insulating oil. Usually the contaminant is water, but it can also be conductive particles, dirt, debris, insulating particles and the by-products of oxidation and aging of the oil.

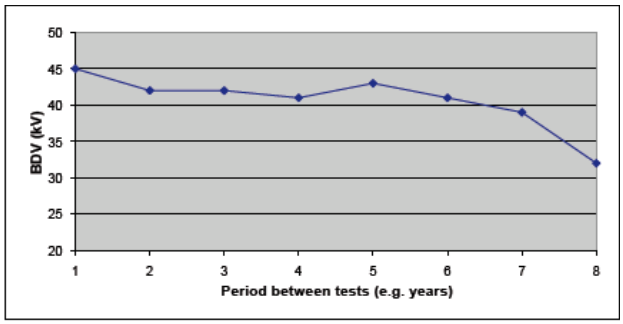
For in-service equipment, the dielectric breakdown voltage test offers a useful and convenient way to detect moisture and other contamination in the oil before it leads to a catastrophic failure. The information gained from the test can also be used as an aid to:

- Predicting the remaining life of a transformer
- Enhancing operational safety
- Preventing equipment fires
- Maintaining reliability

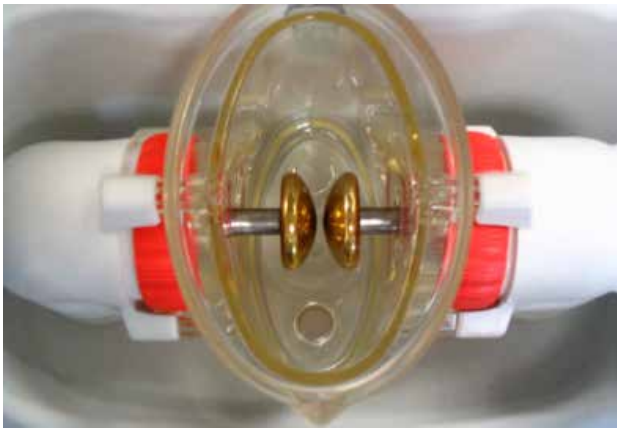
Dielectric breakdown voltage testing is also carried out on new oil before it is used to fill equipment, and as part of the acceptance testing for deliveries of new and reprocessed oil.

How Often?

Dielectric breakdown voltage testing is an important element in the maintenance programme of any item of oil insulated electrical equipment. However, to get the maximum benefit from this type of testing, Megger strongly recommends that the oil is tested at least once a year and preferably twice a year. The results should be recorded, as trending the data will make it easier to identify sudden or unexpected changes. If a sudden change in the results is found, the transformer can be inspected for leaks, the oil level can be checked and the water content of the oil evaluated. If contamination is confirmed, it will often be possible to dry and filter the oil, thereby reconditioning it rather than having to replace it with expensive new oil.



Dielectric breakdown test is performed by using a test vessel that has two electrodes mounted in it, with a gap between them. A sample of the oil to be tested is put into the vessel and an ac voltage is applied to the electrodes. This voltage is increased until the oil breaks down that is, until a spark passes between the electrodes. The test voltage is then immediately turned off. The voltage at which breakdown occurred is the test result, and is typically evaluated by comparing it with guidelines set out in various standards, or in the oil manufacturer's specifications



The exact method of performing the test is determined by the standard that is being used. The standard typically defines parameters such as the size and shape of the electrodes, the gap between them, the rate at which the test voltage is increased, how many times the test is repeated

and whether or not the oil is stirred during the test.

What are the test standards?

There are many test standards for insulating liquids, but they are derivatives of three main standards. Two of these are from ASTM International (USA) and the other is from the IEC (Europe). These main standards are:

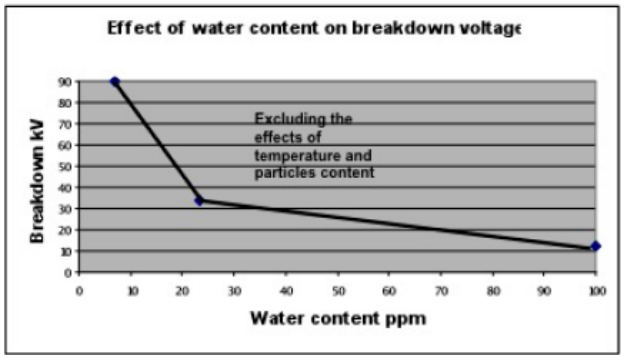
- ASTM D877 – Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
- ASTM D1816 – Standard Test Method for Dielectric Breakdown Voltage of Insulating Oils of Petroleum Origin Using VDE Electrodes.
- IEC 60156 Insulating Liquids – Determination of the breakdown voltage at power frequencies – Test method.

Can new oil fail the breakdown test?

The simple answer is yes, new oil can fail a breakdown test. Sometimes users suspect that their test set is faulty because it is failing new oil. When the test set is checked however, almost invariably no fault is found. The true situation is that the oil being tested really does have a low breakdown value, so the test results are actually correct, even if they are hard to accept.

The problem usually relates to the way the oil has been stored. Often oil is delivered in drums that are stacked on site in readiness for filling a transformer or other equipment. In hot climates (like the pacific islands), pressure rises in the drums when they are exposed to the heat of the sun, but falls at night when the ambient temperature drops. Sometimes this pressure cycling damages the seals on the drums, and they start to allow the penetration of moisture. It only takes a very small amount of moisture to degrade the properties of the oil to the extent that it fails the test.

To give an idea how quickly oil can deteriorate, after a drum of new oil is opened it is often less than three weeks before it fails a breakdown test.



Oil Sampling Tips:

For a sample to be truly useful, it must be representative of the oil in the equipment. This means that cleanliness is extremely important.

- Samples are normally drawn from a drain valve or sampling cock. This must be cleaned both inside and out before the sample is taken to ensure that dirt does not fall into the sampling container.
- The drain valve is at the bottom of the equipment, where all of the sludge, water and contaminant particles collect. It is important therefore, to flush the system thoroughly to ensure that the sample is drawn from the main bulk of the oil. This may involve removing two litres of oil, and even more if the equipment has been out of service for some time.
- Do not be tempted to use old engine oil bottles, even for a few p.p.m.of engine oil will cause the sample to fail a breakdown test.
- Do let the oil flow down the side of the sample bottle, or use a clean tube run to the bottom of the bottle; it will prevent air being mixed with the oil.
- Do store the oil samples in glass or clear plastic bottles in the dark, mineral oil will deteriorate if exposed to UV light.

Safety

Before taking samples, ensure that you have all of the required permissions and permits

- Have everything you need to lock out/tag out to hand
- Make sure that the PCB (polychlorinated biphenyl) content of the oil, if any, is known and that the equipment is labelled. PCB is very hazardous and requires special handling
- Use all of the correct personal protective

equipment (PPE) and correctly rated tools
- Check the area for electrical and tripping hazards
- Check for wildlife – snakes, bees, etc like transformers!
- Check that the transformer is under positive pressure – are the pressure gauges reliable? Could they be blocked or broken? NEVER try to take a sample from a transformer under negative pressure. Air could be drawn into the transformer and cause it to fail.

Sampling equipment

- Take extra sample bottles and syringes – they're often needed
- Ensure that the sample bottle seals are airtight
- Use only ground glass syringes
- If rubber hose is used, discard after each sample is taken

Flushing the system

When flushing the system, a spare sample bottle is usually repeatedly filled and emptied into the waste. It is good practice to measure the oil temperature using the last bottle that will be discarded, as this avoids having to put the thermometer into the actual sample.

Taking the sample

Wherever possible, try to take samples during times of relatively steady loads and temperature – in other words, when the equipment is at equilibrium. (This is particularly important with transformers, as if the sample happens to be taken after the transformer has cooled following a long period of running at full load, the breakdown voltage of the oil will be much lower than normal. This is because moisture in the paper insulation will have migrated to the oil during the period of full load, and will not yet have had time to migrate back. This is usually considered to be a normal phenomenon, but it is possible that it may also be a factor in so-called 'sudden death' transformer incidents where, for no apparent reason, a seemingly healthy transformer suddenly fails. This is another good reason for recording as much information about the transformer as possible and for trending results to look for unexplained changes).

- **Do not** take samples when it is raining or snowing, or when the relative humidity is above 50%, as there is a high probability that samples taken in these conditions will be contaminated.
- **Do not** take samples when it is windy, as dust blown by the wind may contaminate the sample.
- Try not to take samples when the ambient temperature is high, as perspiration is a common source of contamination problems.

For more information oil breakdown testing see - The Megger guide to insulating oil dielectric breakdown testing

Or ask AVO New Zealand how we can assist with training or application support for your transformer testing requirements.

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Update on the Pacific Power Utilities Benchmarking Activities

Krishnan Nair
PPA Consulting Electrical Engineer – The World Bank

Since year 2000 PPA Secretariat has been providing power utility benchmarking services to its members. This ongoing process has allowed the Secretariat to compile a history of utilities performance based on the adaption of a set of internationally recognised performance indicators. Since October 2016 the World Bank through the SEIPD project funded services of an electrical engineer to provide assistance in vetting of the data and liaising with utility benchmarking officers on data and put together terms of reference for an online benchmarking platform.

The purpose of this developing benchmarking activity is to bring improvement in the PPA's capacity. The project aims to support the PPA in building its capacity to support its members by providing guidance and technical support to improve building efficiency in business performance through use of professional benchmarking tool. One of the primary functions of the power utility benchmarking activity is to provide utilities with an additional strategic planning tool and help improve decision making capabilities within business.

All power sector utilities participating in PPA's annual benchmarking activity has benefited from evaluating their businesses performance and have been able to identify performance gaps. This activity has allowed utility benchmarking liaison officers to use the 46 key performance indicators to rank their performance with similar size power utilities in the region.

Due to Covid-19 pandemic only 15 utilities participated in the 2020 benchmarking survey. In June 2020, PPA hosted a series of virtual training using Zoom meeting platform for utility benchmarking liaison officers. The purpose of training was to provide a refresher training on the use of Online Benchmarking Platform. The training was conducted over three day period between 16th and 18th of June. Fourteen utility staffs took benefit of this three day training and more similar type of benchmarking trainings are planned for future.

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Federated States of Micronesia Increases Energy Efficiency with ElectraTherm

ElectraTherm

ElectraTherm, in association with integration partner B:Power, has been awarded a contract by Pohnpei Utilities Corporation (PUC) for the design, supply, installation and commissioning of an Organic Rankine Cycle (ORC) waste heat to power generation system at the Nanpohnmal Power Plant, Pohnpei Micronesia.

The contract provides for the design and installation of a complete waste heat recovery and power generation system incorporating exhaust gass heat exchanger installed on existing diesel generators, three 6500B+ containerized heat to power ORC generators complete with high efficiency coolers along with a control system integrated with the Nanpohnmal Power Plant.

A key component of the contract is the requirement for the waste heat to power generation system to be both scalable and mobile allowing it to take advantage of the additional waste heat from new diesel generators to be installed as part of the Nanpohnmal Power Plant upgrade.

For this small island state, efficient energy is crucial for long term viability. When commissioned, the efficiency of the PUC's power generation assets will be one of the best in the Pacific – reducing CO2 emissions along with producing an additional 1,700,000 kWh, or 1,700 MWh, of clean energy annually.

The 6500B+ ORC's to be installed are the latest generation units incorporating the BITZER Semi Hermetic Twin-Screw Expander. The combined advantage of ElectraTherm's engineering design along with the value of being backed by the BITZER Group allows us to proudly deliver world-class ORC solutions.

About Pohnpei Utilities Corporation
Pohnpei Utilities Corporation is dedicated to providing efficient, reliable, accessible, and cost-effective utility services in order to improve and sustain the quality of life in Pohnpei.

About B:Power, a. s.
B:Power is a leading European based engineering company specializing in the full turnkey design and installation of ORC based power generation plants. The system design along with the installation and commissioning of this project will be undertaken by B:Power.

About ElectraTherm
ElectraTherm by BITZER Group, is a global leader in small scale waste heat recovery headquartered in Flowery Branch, Georgia. ElectraTherm's commercially proven Power+ Generator produces fuel-free, emission-free power from low temperature waste heat using the Organic Rankine Cycle (ORC). ElectraTherm's offerings are modular, robust and offer several advantages over turbine systems such as higher turndown ratios and transient operations. For more information on the Organic Rankine Cycle and the strides ElectraTherm is taking in the industry, please visit www.electratherm.com. For additional information please contact:
info@electratherm.com

Pacific Power Association's Executive Director, meets with the United States of America's Ambassador in Fiji

Pacific Power Association

The Executive Director and Deputy Executive Director of the PPA met with the US Ambassador to Fiji, Nauru, Tonga, Kiribati and Tuvalu, His Excellency Joseph Cella, on 23 September 2020 to discuss and explore opportunities for greater involvement in the PICT energy/electricity sector by US Aid and US companies based in Fiji and the region.

The discussions also touched on opportunities for US based investors to invest in renewable energy projects as well as potentially liqudified natural gas (LNG).Both parties agreed that there needs to be a get together of all utilities and potentially energy sector participants to discuss how the different stakeholders can tap into these available resources.

Welcome!

New Allied Member

One new Company has joined PPA as Allied Members since our last PPA Magazine. The new member is:

RICARDO ENERGY & ENVIRONMENT: Ricardo Energy & Environment is based in Guilford, United Kingdom. Their primary activity is consulting. Their secondary activity is Energy/Power Sector Services.

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