PPA

A PACIFIC POWER ASSOCIATION PUBLICATION

VOLUME 26 ISSUE 2 - June 2018


SULZER

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PPA

June 2018, Volume 26 Issue 2

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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.

PACIFIC POWER magazine is published four times a year.

Advertising
Reena Suliana
Pacific Power Association, Suva, Fiji Islands

Layout & Design
Printhouse Limited

This magazine is read by audience of opinion leaders in governments, development partners, the public service, the academic community, the media, in the Pacific and members of the Pacific Power Association. Subscription to Pacific Power magazine is available at US $60 a year from the association.

Correspondence should be addressed to: The Pacific Power Association, Private Mail Bag, Suva, Fiji Islands.

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Cover Page Photograph – Tuvalu Electricity Corporation's Fogofale PowerStation

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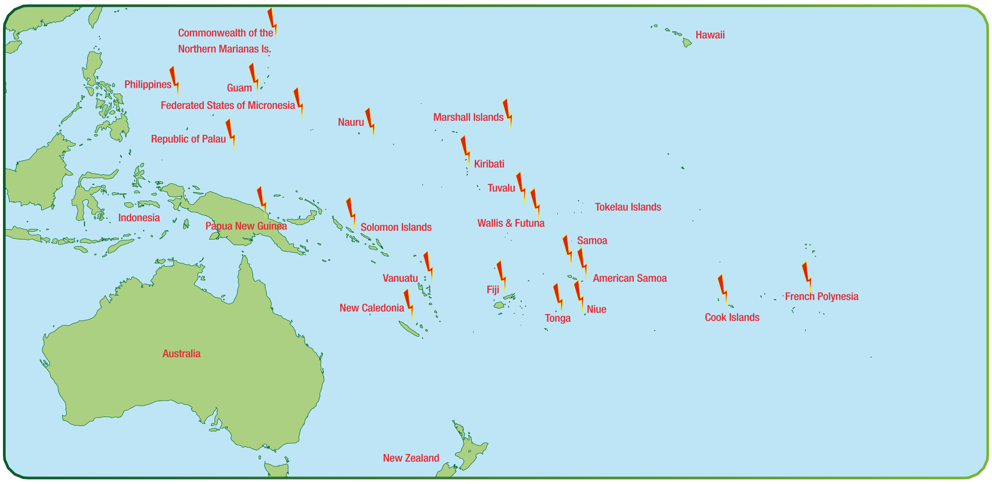

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Editor's Notes

Andrew D. Daka
Executive Director

Bula vinaka and Greetings from Suva.

We are well into the year now and I am sure everybody is into implementing their respective work programs for the year. When we pause a moment to think about it, time certainly flies and we need to be on top of activities to be able to achieve our goals for this year.

The PPA Secretariat has certainly been expeditiously implementing the World Bank funded Sustainable Energy Industry Development Project (SEIDP). The capacity building program as identified under the Training Needs Analysis complete in 2017 has begun with a seven day workshop for the Northern Utilities on PV Operation and Maintenance, Battery Storage and SCADA held in Kolonia, Pohnpei, Federated States of Micronesia from 20 – 28 June 2018. The same workshop will be conducted for the Southern Utilities in July. More workshops, in-country workshops, will follow in the third quarter of the year.

The electric utility business in one that is facing major changes in the not too distance future taking into consideration what is happening in developed markets. The major factors that will impact on what utilities look like in the future or the disruptors in the industry are decarbonization, decentralization and digitization; the 3Ds. These factors would result in more use of renewable energy, the move away from centralized power stations and digital technology playing a vital role in operating and managing the systems and networks. The impacts of these disruptors are clearly seen in the Scandinavia where over the years the number of centralized power stations have reduced whilst there has been a significant increase in the number of decentralized generation sources utilizing renewable energy.

Utility owners and operators need to note that these changes are coming and the time is now for utilities to orient themselves to face the disruptors.

Inside this issue, there is an interesting article on the work Hydro Tasmania is doing in achieving 100% renewable energy on King and Flinders islands in Tasmania, Australia. These networks have shown that if well implemented with a diversified generation mix, 100% renewable energy can be achieved with a less volatile cost with improved electricity reliability and quality.

The Solomon Islands like other Melanesian countries with the exception of Fiji has one of the lowest electricity access rates. Solomon Power is addressing this through solar/diesel hybrid systems in the outer islands to avail electricity services to the communities it services whilst reducing the fuel consumption and other operational costs.

In light of the frequent severe storms, American Samoa Power Authority (ASPA) has undertaken a project to harden its plant and network. As well, read about what is happening in other utilities working in collaboration with our Allied Members.

The 27th Annual Conference and Trade Exhibition is only weeks away. Registrations have been coming along and I urge members intending to attend that they do register so as not to be disappointed. For those who have already made travel plans to attend we look forward to seeing you in Koror, Palau

Vinaka vakalevu.

Taro, Seghe – Design, Installation and Commissioning of Hybrid Generation Systems – in Provinces

Hemant Kumar
General Manager Capital Works - Solomon Islands Electricity Authority

Solomon Power's Taro Island Solar/Diesel Hybrid Installation

Background

The Solomon Islands Electricity Authority (SIEA) trading as Solomon Power (SP) is the State Owned Enterprise (SOE) with the responsibility for providing Electricity in Solomon Island.

Two of the key challenges that SP faces at the moment are:

- The cost of electricity in the Solomon Islands is one of the highest in the South Pacific.
- Foot print of electricity in the provinces is very small, and penetration of electricity is less than 12% in the provinces.

One strategic goal that Solomon Islands Government (SIG) has set for SP is to make electricity accessible to all Solomon Islanders by year 2050.

In provinces typically people live in villages which range in population sizes from few hundred to up to few thousand. The distances between villages also range from few kilometres to several kilometres apart. Installing a large sub-transmission and distribution system in provinces to supply electricity to all the villages will be expensive and getting easements for lines will be a major challenge.

The strategy that SP is taking in achieving the required goal in increasing the footprint of electricity and keeping the electricity cost down is by installing smaller hybrid generation systems which will utilise electricity generated from solar-battery system with diesel engine as a backup when solar and battery system is not available.

This hybrid technology is relatively new and has much lower operating costs than generation by diesel engine. The solar system will produce electricity during day time and will charge the battery system. The battery system will supply electricity when the demand is low at night time. With good design in sizing of the solar and battery system, the diesel engine will only be required to supply the demand typically during days when there is no sun.

These reduced operational hours of diesel engine will provide significant savings in operational and maintenance costs as a result. The solar does not require significant maintenance and the battery system will require minor maintenance over its lifetime. The hours of operation of diesel generator potentially can be reduced by up to 90% if the system is optimised properly.

SP has identified more than 40 suitable locations to utilise the hybrid mini- grid systems in the provinces which potentially will provide access to electricity to over 21000 people.

This paper will present SP's experience from design, installation, commissioning and operation of recently commission Hybrid System at Taro in Choiseul Province and Seghe in Western Province including the following details:

1. Design concept, detail design including battery sizing/costing.
2. Commissioning /Testing of the system
3. Performance of the system in terms of energy supply from renewables sources (solar/battery verses diesel). Cost savings and other benefits.
4. Lessons learnt for future implementation.

Preparing for 100 % Renewable Energy

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Targets to vastly or totally remove fossil fuels from power supply are now common objectives of island utilities and government. If well implemented it is possible to approach 100 % renewable energy (RE) with improved and less volatile energy cost while also enhancing electricity reliability and quality. Conversely, poor implementation has considerable potential to create crippling energy problems due to the large investment sums, inherent risks of new technologies and the need for communities to embrace change. Navigating the full spectrum of options demands effective planning.

Substantial new RE generation is a cornerstone of meeting high RE targets. How and where they are deployed (including any power purchase agreement and feed-in tariff terms) has significant influence over energy cost and required investment in 'Enabler' equipment.

Enablers are critical to advance beyond low RE levels. Enablers are categorised as additional equipment necessary for grid operation with higher levels of RE but not net generators of electricity themselves. Batteries, flywheels, resistors and more sophisticated control systems are all examples of enablers.

Figure 1: Flinders Island enablers

Deploying increasing RE generators without due care or planning can create issues that require excessive investment in enablers to rectify. These large avoidable costs can slow further RE investment and, in extreme but real cases, increase energy costs so significantly that the utility is precluded from further investment to solve the problem.

Significant RE generation also changes the cost structure of the utility, replacing variable fuel costs with fixed asset costs and creating periods of generation excess that must be managed. Options then exist to modify revenue structures to appropriately assign costs while still protecting vulnerable customers. Re-assessing the 'whole of system' customer requirements, tariffs, commercial agreements, funding sources, ownership, local skills and equipment, community amenity and social equality is a valuable step because all have potential to influence the technical solution. Since many of these factors take time to influence and have outcomes that are difficult to predict it is vital that the technical solution is robust against possible consequences and these factors are considered and influence acknowledged at the outset of an RE growth plan.

What does 100 % RE look like?

Unless significant hydropower or geothermal resources are available, the most cost effective approach is a combined optimised level of RE generation and storage (typically 40 % RE to 70 % RE) and substituting diesel fuel for biofuel for the remainder to attain 100 % RE.

Biofuel life cycle emissions are an important consideration because some sources can have larger embodied emissions than diesel.

The following charts show model results for three different days of operation of a 70 % RE system (which may run biofuel to achieve 100 % RE). This example system is predominantly solar PV and batteries, with a small amount of wind.

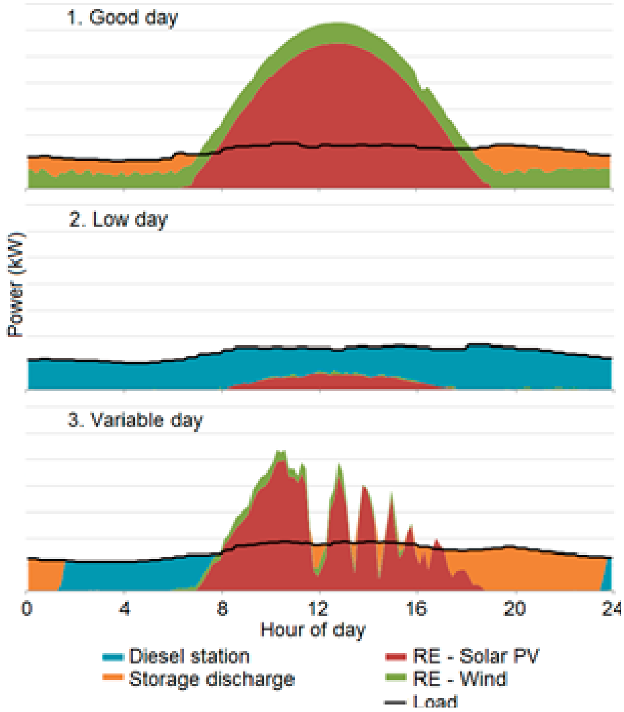


Figure 2: Daily generation

The first chart shows a good RE generation day, where 100 % RE is achieved through a surplus of energy during the day and a mixture of battery and wind during the night. The surplus must be either curtailed at the source or otherwise consumed within the power system.

The second chart shows a poor RE generation day, where very little RE is achieved. The large batteries are depleted during ongoing poor weather and diesel is relied upon of continuous supply. These periods require unfeasibly large storage to prevent diesel use and are why biofuels are an important part of 100 % RE.

The third chart shows a variable RE day. Moderate RE is achieved, relying significantly on the battery to fill RE dips during the day. These types of days are often the most difficult from a system stability perspective. Increasingly significant enablers are required to overcome RE variability, which itself is a function of the type, size, specifications, control methods and locations of the RE generators. Due to the grid size and low physical inertia these enablers must reliably balance supply and demand at millisecond levels under rapidly changing grid conditions.

Dealing with excess RE energy

Dynamic automated control becomes necessary at moderate RE levels to balance generation and load at all times, since any imbalance will result in grid or feeder outage/black out. This includes RE fluctuations, generator/feeder trips and preventing reverse diesel loads.

Storage is able to absorb excess power and can be used to lift RE installation limits. Generally, a 1 MW battery will provide capacity for an additional 1 MW of solar, assuming the battery is sized and controlled so it does not become full.

A more technically effective approach is to limit generation at its source when there is an oversupply. This can be through curtailment via power converter/inverter settings or, in cases where this is not possible or commercial agreements necessitate it, through use of a controllable resistor to burn unwanted energy. This wasted RE energy is called 'spill'. Significant RE levels can be achieved just by upgrading controllers to manage spill. Under this approach batteries can be deployed in a variety of ways to capture and re-use spill.

This concept is depicted in the following chart (of the earlier case) with spill and a modest battery. In this case the spill control provides grid stability even with very large PV.

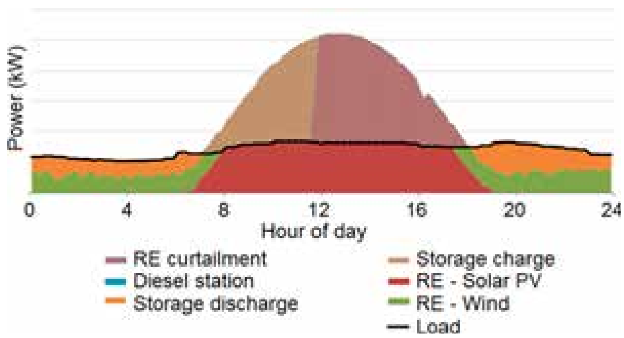


Figure 3: Managing spill

Control and SCADA

Sophisticated fully automated control is fundamental to advancing beyond low RE levels. This control scheme is termed 'Hybrid Control' due to the large number of devices that are managed.

Hybrid Control coordinates all power system equipment to maximise renewable energy without impacting power system stability and reliability and sits at the top of the control hierarchy above SCADA.

This is done by dynamically establishing generation reserve based on customer load, solar and wind generation levels and variability, renewable resource forecasts, battery capacity and status of any controllable loads. Dispatch of diesel, centralised battery and solar, distributed RE generation and smart grid aspects are then coordinated to ensure the dynamic reserve requirements are met whilst minimising the amount of diesel generation used.

SCADA (*Supervisory Control and Data Acquisition*) is a key element of reducing complexity because it allows all connected devices to communicate with each other as needed using reliable standard protocols on a single platform.

With the large quantity of connected equipment standardised user interfaces becomes important. High level HMI (*Human / Machine Interface*) for all SCADA connected devices should be accessible from the central HMI at the power station.

Further reduced complexity can be achieved by using 'unit controllers' at all interfaces between SCADA and major equipment. This ensures standardised SCADA communications and compels local functions to be handled locally.

All power station control equipment should use industry standard PLC (*Programmable Logic Controller*) equipment as often as practical, with software sufficiently open to operate the system without a high level of reliance on the supplier. Because high RE power systems are a new market and situations may change unpredictably particular care should be exercised if selecting tightly locked down controllers or controllers with limited expandability.

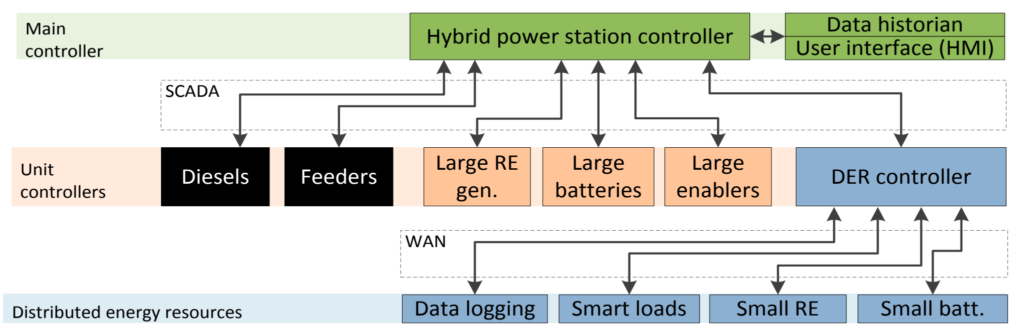


Figure 4: Hybrid Control

The figure shows example hybrid control architecture. It is broken down into a number of unit controllers (with their own HMIs) that are distributed around the power system communicating via SCADA, with the main interface located at the power station. The distributed generation unit controller then communicates to devices throughout the network via WAN (*Wide Area Network*).

Enablers

Enablers play increasingly important roles as RE levels increase. The ability to reduce the number of diesel generators operating and subsequently turn diesel generation off is an important part of achieving high RE, permitting 100 % RE generation when conditions allow. Equally important is developing the enabler solution from a whole of system approach; not just energy but reliability, stability and protection for example. There is generally not a single component solution. The final configuration is grid specific, mainly dependent on power system load and peak power, as well as distribution lengths and capacity and utilisation of other long lived infrastructure.

Switching diesel generation off in small power systems (small kW) is relatively straight forward using batteries and quality inverters. However difficulties arise in megawatt class power systems, and smaller systems covering large areas. This is because diesel generators provide considerable functionality (ancillary services) at levels necessary to achieve reliable supply, stable power quality and to operate protection schemes. This is mainly related to significant commercial loads, distribution lengths or higher reliability standards. In these circumstances diesel generation can only be turned off if a suitable suite of enablers are installed to fully match its functionality for a wide range of contingency events. Enablers must also counter RE generator shortcomings, such as rapid power and voltage variably, large number of contingency events, grid support and control capability.

The market offers an eclectic diversity of enablers with very different features intended to solve different problems. This is an area of much technical innovation and limited proven approaches.

Hydro Tasmania achieved prolonged diesel off operation and 65 % long term RE contribution on the King Island multi-megawatt system in 2014. This has been followed by completion of other Hydro Tasmania projects at Flinders Island, Rottnest Island and Coober Pedy, achieving various RE goals up to 70 % long term RE contribution and the current record at Flinders Island of 92 hours of continuous diesel off operation. They are still the only systems of their class achieving this level of performance worldwide, whilst also significantly improving reliability, power quality and protection scheme performance.

King Island is also converted and tested with pure biodiesel, making it 100 % RE ready and creating demand for local biodiesel production.

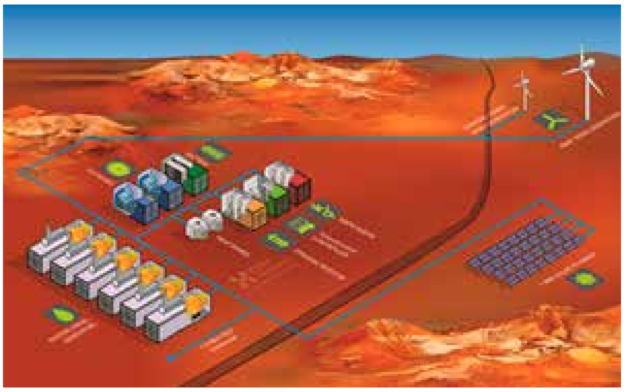


Figure 5: Coober Pedy power system

Figure 6: King Island biodiesel upgrade

The most valuable lesson Hydro Tasmania has learned from these projects is that at first enablers rarely operate exactly as anticipated, either because of an unpredictable complex element of the project or design shortcomings. By adopting HAZOP (*Hazard and operability studies*) into design processes utilities can identify these risks at project planning and design the system robustly. Hydro Tasmania has frequently re-visited the concept of using only battery enablers to allow diesel off operation. At present HAZOP and detailed design still concludes there are unmet technical challenges and significant risks that have not yet been adequately addressed for megawatt class grids.

Figure 7: King Island vanadium redox flow (decommissioned) and advanced lead acid batteries

Issues are mainly related to fault currents for protection schemes; reliability; end of life performance; and vendor ability to properly implement required functions. These all have dire consequences because poor performance can render the battery functionally useless in diesel off applications.

This situation can be dramatically improved by selecting enablers to perform functions not well suited to batteries at this scale or offer short term redundancy if battery fails. The following enablers working in conjunction with battery systems are favoured:

Synchronous condenser. This is basically a generator whose shaft is not connected to anything so spins freely. When sized correctly it can be used to perform many diesel generator functions like controlling voltage and supplying fault current to the protection scheme.

Flywheel. When attached to a synchronous condenser a flywheel adds large mechanical inertia that stabilises power quality and provides time for corrective actions.

Diesel UPS. When a diesel is attached to a synchronous condenser and flywheel, the flywheel mechanical inertia can be used to bring a diesel from 'off' to 'generating' very quickly. This is a reliable approach to prevent grid/feeder outage from infrequent events.

Figure 8: Coober Pedy diesel UPS

Low load diesel. This is a standard diesel generator designed to operate at near 0 kW output for long periods. It uses some fuel in doing this, so is not technically 'diesel off' but can achieve very significant fuel savings.

Dump load resistor. Useful in removing spill or as reserve if spill control fails, thus adding to system security and reliability.

Dynamic resistor. Manages frequency by rapidly altering its load. Useful if batteries are not feasible or they are too small to provide this functionality. Also allows batteries to fully charge rather than maintain regulation headroom, doubling their useable range in some cases.

Smart grid. Actively monitor and control distributed RE generation and schedulable loads. Electric cars will add an entirely new dimension.

The path to 100% RE

Achieve high RE levels in one step is difficult for many grids. Normally a number of smaller steps are employed to progressively increasing RE levels or pre-emptively install enablers to enable private investment. This path is unique to every system and has many pitfalls. The following should be considered:

Community engagement. High RE levels often require RE generation to be distributed throughout a community, often with multiple owners. There may also be new energy cost and tariffs. It is crucial that planning take into consideration the wider community and key stakeholders at the outset and be continuously managed. While it is tempting to focus only on the technical solution, an absence of community and stakeholder engagement may lead to poor community acceptance and a wide range of adverse outcomes.

Figure 9: Rottnest Island and King Island apps

Complexity. High RE systems are inherently more complex than diesel based systems. Complexity should be minimised as much as possible because it can introduce significant design and O&M burdens in remote areas and so any solution must be supported by suppliers before, during and after a project.

Reliability and security. If a project is not planned with this in mind from the outset then it will become less reliable and secure. This is often solved after the event by very conservative operation that increases diesel use and overall energy cost.

Protection scheme. Distributing generators throughout the grid dynamically changes voltage profiles, which can challenge traditional protection schemes with multiple generation points and bi directional power flows for example

Revenue structures. New revenue structures may be necessary and, depending on the size of system and customer base, this can appear daunting and complex at the outset. However assessing new structures in consultation with community and key stakeholders and staging large implementation projects can help traverse this transition.

Changing circumstances. Material changes to forecasts (such as diesel price or load) may demand a change in approach.

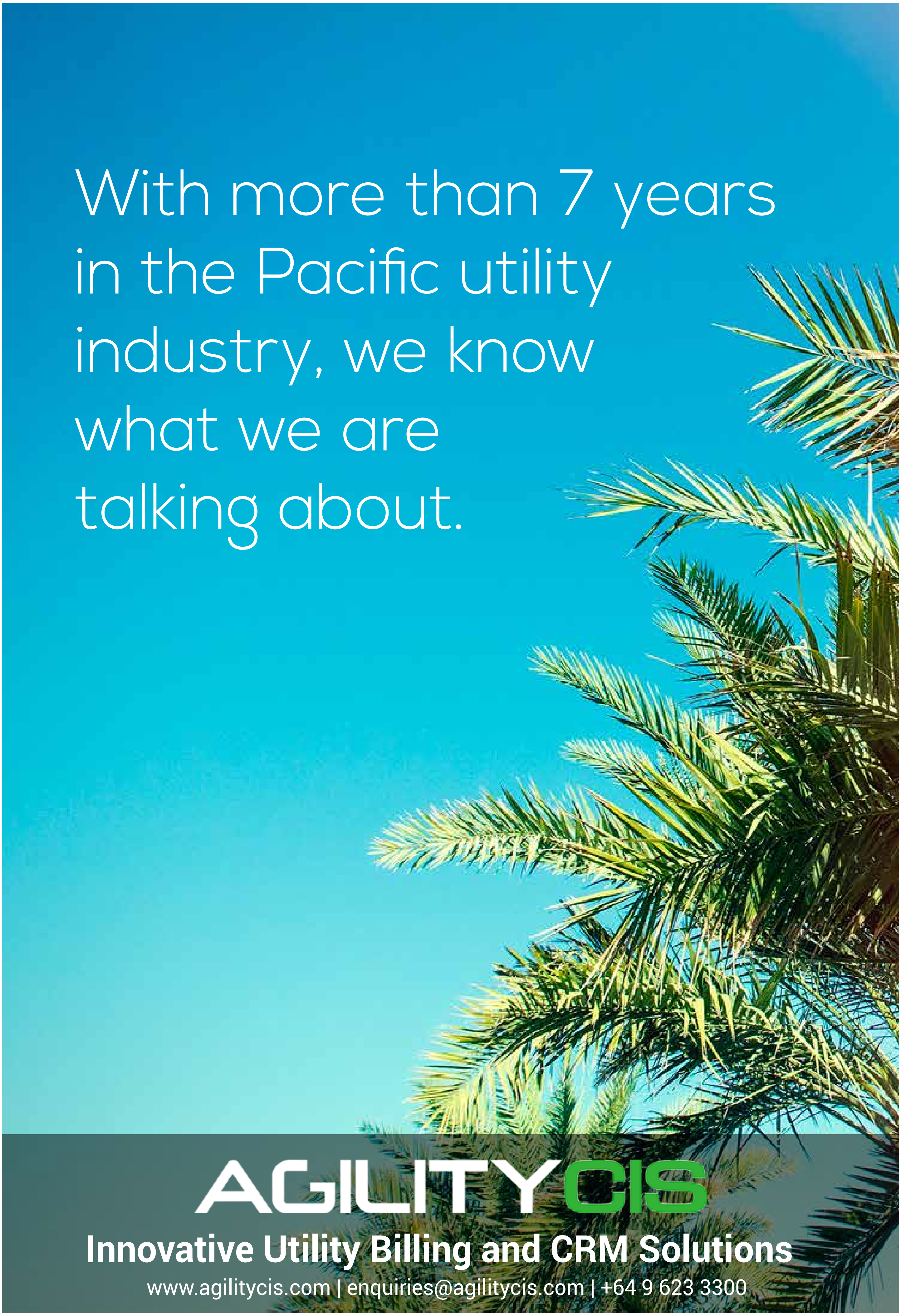
Grant funding. Some projects may require grant funding. This can be difficult to plan for and can bring a raft of new challenges.

Contract interfaces. Procuring design and/or equipment from multiple sources requires interfaces to be very well defined. This is particularly important for work at the power station where there are many considerations, or in more innovative aspects were interfaces may not be clear initially or suppliers misunderstand the capabilities of their offering.

Off grid uptake. Customers that choose to go off grid may reduce revenue and reduce the utilisation of grid infrastructure that was installed to service them. Both retailer and customer need to be aware of the compromises and be open to alterative mutually beneficial options. Distributed off grid systems in the community may place obtrusive plant (such as diesel or petrol generators) in sensitive locations without net community benefit. Proper planning, regulation and monitoring processes should deter projects that challenge social, amenity, industry or environmental values.

Many remote grids have been progressing towards high renewable energy operation for a number of years. Depending on implementation detail and commercial arrangements this existing infrastructure can either support or hinder additional renewable energy growth. It is worth noting that even investments in traditional infrastructure, such as new diesel generators, can reduce the renewable energy levels that can be achieved cost effectively when not planned effectively.

The technology improvements that have allowed high renewable energy contributions on island systems, mainly cheap solar and new 'enabler' approaches, are still rapidly moving. It is important that all power system investments look forward and remain flexible to new proven innovations.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Solomon Power Improves Services to Customers with Itron's Meter Testing Equipment

Ravi Khire
Manager - Delstar NZ Ltd (Itron Agent)

Solomon Islands Electricity Authority trading as, Solomon Power, the fourth largest electricity utility in the region, recently invested in a state-of-the-art Itron Elektra P1000 test bench. This fully automated ten position test bench is used for the calibration and verification of conventional (single and three phase), prepaid, CT, smart and VAR meters.

As electricity metering technology evolves and energy efficiency becomes vital, the need to monitor and test meters prior to installation is becoming increasingly important. Solomon Power faced high, non-technical losses and had no reliable means of testing and verifying meters. To address these problems and fulfill its revenue protection strategy, Solomon Power decided to equip its custom Meter Test Bench Room in the head office in Ranadi to improve efficiency and better serve its customers.

Solomon Power commissioned an Itron Elektra P1000 test bench to address its needs. Itron has leveraged its vast experience and expertise in the field of calibration and verification of electricity, gas and water meters to develop a complete range of equipment that assures maximum measurement efficiency. The Elektra P1000 offers a typical accuracy greater than 0.02% and is fully automatic. Designed to perform either multiple sequential or individual tests, the solution enables selection by an operator from the control and data management software CalwinElec. In addition, the continued development in key metrology components like the electronically compensated ICTs, CI4000 error calculators, auto adjusted optical scanning heads SCH30A and others give customers high accuracy, reliability and results on quality assurance, predictive maintenance and smart bypass.

With these tools, Solomon Power has the ability to correctly verify the accuracy and reliability of meters and investigate issues on energy meters if disputed by customers. It can also envisage pattern approval and decide strategical improvements in the network for the future.

Moreover, the certification of Itron's complete test bench process ensures peace of mind for Solomon Power. The entire metrological chain is certified from the wiring and contactors to the error calculators, acquisition system and the reference meter.

Utilizing Itron's meter testing equipment, Solomon Power is empowered to protect revenue, measure efficiency and better communicate with customers.

For further information, please contact Ravi Khire @ ravi.khire@delstar.co.nz

NAN Electrical Supports PUB - Kiribati Power Refurbishment Project to the Damaged main Kiribati causeway

Heavy seas late 2015 resulted in Kiribati's main causeway linking the two most populated parts of Tarawa atoll to close due to the damage caused by the very high seas and strong winds making the causeway no longer safe for the public.

The Dai Nippon Causeway, which links the main two towns Betio and Bairiki, has been damaged by very strong winds and resultant high seas.

Due to the damage, student's, employees and the public were told to return home early as the road and causeway were closed for repairs.

Only trucks and construction workers were allowed access to repair the road link. The causeway was built nearly 28 years ago by Japan's Dai Nippon Construction.

The project is a joint funded project by the Government of Japan & the Government of Kiribati, where Japan will refurbish the causeway that was built in 1970 and as part of the project, there will be a designated causeway design, with the utilities channel and this will also provide services for water, electricity and a communication link.

PUB Staff -Wayne Brearley -CEO and Tenikoria Katauea -Power Engineering Manager made direct contact with NAN Electrical -International Marketing Manager -David McNamara following a meeting at the 2017 Apia PPA Conference.

NAN Electrical engineering/design team provided various HV cables solutions to support PUB in upgrading the Kiribati Power Refurbishment Project for the benefit of the public on South Tarawa.

Participation and being active members in the PPA resulted in both organizations working together to achieve a positive outcome and overall benefit to their country's needs.

Dai Nippon causeway linking Bairiki with Betio

ASPA's Tafuna Power Station Hardening and Generator Replacement Projects

American Samoa Power Authority

The American Samoa Power Authority is constructing two projects concurrently at its Tafuna Power Plant. The first project involves the replacement of two 4.75MW Deutz diesel units with three new 3.0 MW (prime) C3500 D6e Cummins gen-sets. The second project is to rehabilitate and harden the Tafuna power plant building to meet wind loads up to 170 mph. (up from 130mph).

The new gen-sets are expected to arrive in the territory around June 30, 2018; these new diesels will:

- Replace lost capacity resulting from the decommissioning of two 4.75MW Deutz generator sets in 2016.
- Improve the security of supply to the western half of Tutuila by providing redundancy or backup to the 10MW / 34.5 KV single tie-line circuit between the two power plants on the main island of Tutuila.

Generator Selection

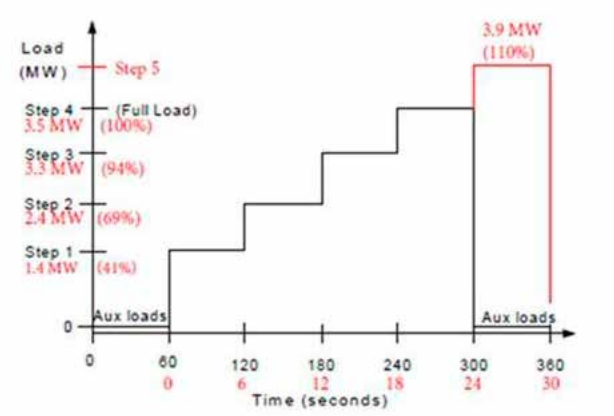
Cummins C3500 D6e gen-set in test cell in Minneapolis, Minnesota.

Frequency regulation is a constant second by second adjustment of power- to maintain grid frequency at 60 hertz. It is achieved by the ramping up or down of generation assets.

The speed response time for medium speed diesels are inherently slow and it is no different with seven GE 16V250, 3.5MW gen-sets recently installed at ASPA's Satala plant.
Longer than expected frequency excursions are experienced and dips become more pronounced during large changes in Solar PV output and when large diesel units trip out.
ASPA is also planning for the installation of an additional 10MW of Solar PV with battery storage on Tutuila. As more PV generation is added to the ASPA grid - supply quality problems will become a major issue, unless addressed sooner.
One solution to this problem is to use battery storage for the first few seconds and long enough for the new diesels to change load and control the frequency.

The Cummins C3500 D6e gen-sets were selected over medium speed engines because of their exceptional ramps rates and very competitive pricing.

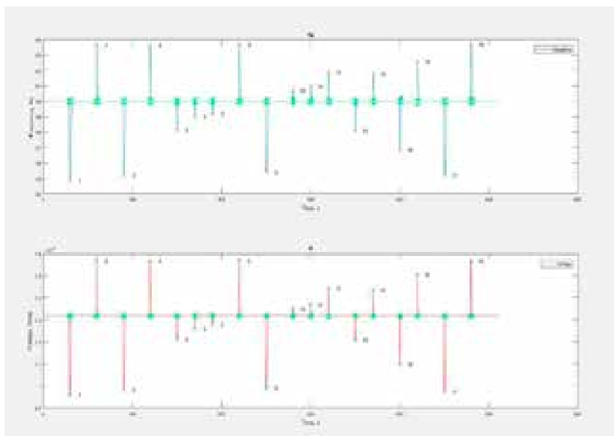
A comparison of the Cummins C3500 D6e and the GE 16V250 gen-set is shown below.



GE 16V 250 Permissible Load Step and Ramp Rates

Any sudden increase in load above the permissible load step will result in slowing down of the engine and a severe speed drop that may cause under-frequency relays to operate.
A 1.0 MW load step would require a recovery or correction time of 5 to 6 seconds. The GE engines will not be damaged if their allowable ramp rates are exceeded, but their slow response raises supply quality issues.

Cummins C3500 D6e Actual Transient Tests



Cummins C3500 D6e Transient Test Results

Load (KW)	Event Number	Voltage 13,200 Resp. Time -sec-	Voltage 13,200 % Dip / Rise	Frequency 60 Resp. Time -sec-	Frequency 60 % Dip / Rise
0 – 3000	1	2.17	24.94	2.91	7.67 dip
3000 – 0	2	2.02	18.71	2.68	6.02 rise
0 – 3000	3	2.12	24.81	2.88	7.67 dip
3000 – 0	4	1.97	19.17	2.64	6.02 rise
0 – 1500	5	1.76	8.09	1.54	3.11 dip

For each MW load step, the medium speed GE units require 5 to 6 seconds to recover. The Cummins units on the other hand require 2.8 to 2.9 seconds to recover from a one step 3.0MW or 100% load change.

Tafuna Power Plant Building Rehabilitation Project

This hazard mitigation project will address three major issues with the existing building as follows:

- Structural improvements
- Noise reduction
- Ventilation and lighting

Tafuna power plant building rehabilitation drawing

The existing Tafuna power station is a pre-fabricated steel building installed in 1972. It has weathered major cyclones in the past including cyclone Ofa in February 1990, cyclone Val in December 1991 and cyclone Heta in January 2004, but structural deterioration due to corrosion has significantly weaken the building.

When constructed in 1972, the areas outside the plant boundary lines were no more than empty undeveloped lots. The power plant is now surrounded on all sides by commercial and residential buildings and a major highway.

To protect the surrounding residences and the public from high noise levels generated by the diesel plant, noise reduction and ventilation improvements were included in the hardening project.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Unpredictable Photovoltaic is a thing of the past with ComAp

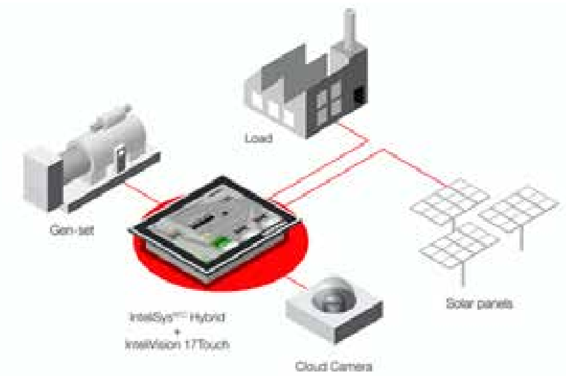
ComAP Limited

Harnessing the limitless energy of the sun has been a goal for the power generation industry for many years, but the unpredictability of the weather has always been the main issue the industry has faced in widespread adoption of the use of solar power. Cloud cover significantly reduces the amount of solar radiation that hits the photovoltaic panels, reducing the amount of energy produced, and thus reducing their efficiency. Another source of electricity is therefore needed to supplement the solar power when it is not available - in areas without the grid electricity infrastructure it is usually a diesel generator (this is commonly called a PV/Diesel hybrid system). Having a diesel generator run on stand-by, just in case the cloud cover changes, and the solar output drops, is very inefficient, uses a lot of diesel fuel, wears the generator out, and has negative impact on the operational costs reduction and the environment.

Under normal circumstances, to ensure the reliability of the power supply, hybrid applications require a high dynamic spinning reserve (i.e. keeping the gen-sets running even when the PV system generates energy), so that they can immediately replace a potential drop in electricity production caused by cloud cover. The diesel gen-sets are thus operated at a low load level, which reduces production efficiency, negatively impacts the possible fuel savings and extends the return on investment for high PV penetration systems. Apart from this, running generators at a low load also has a negative effect on the generator itself as carbon black and other impurities settle because of the suboptimal combustion process.

Optimization by tracking cloud movement

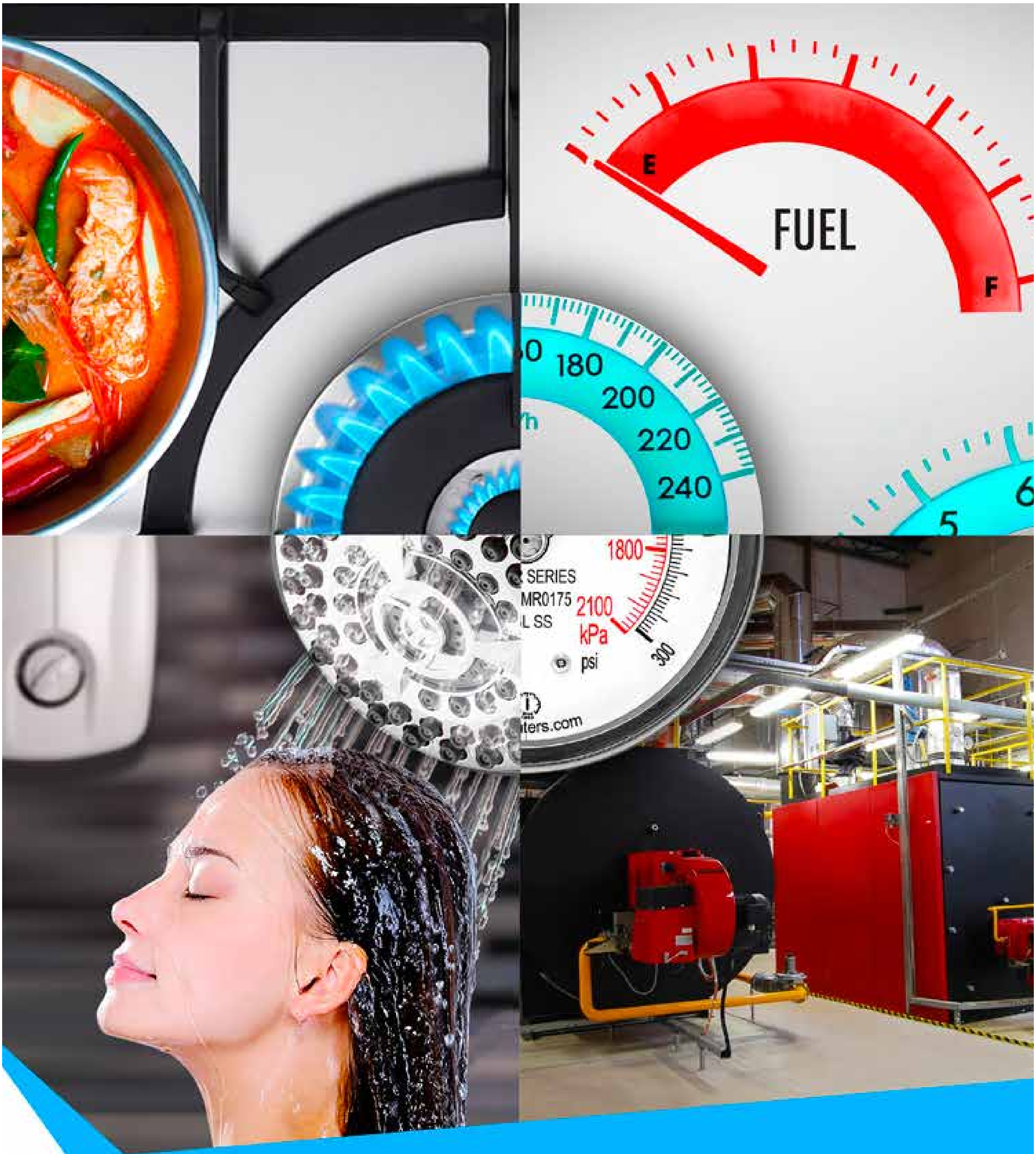
How can the operation of these hybrid systems be optimized? ComAp is currently preparing pilot project to test a new solution with its Cloud Forecasting System; a system for tracking cloud movement and forecasting electricity generation from a photovoltaic power plant and is particularly suited to hybrid applications with a high proportion of PV power.



"The system is made up of a fish-eye camera and an industrial computer. The camera continuously monitors the sky, monitoring both the size and movement of the clouds and the intensity of the sun's radiation. The computer then processes the data obtained to predict cloud cover and the expected irradiation and thus the output of the PV plant in that area. The data from the local computer is then processed in the ComAp control system (InteliSys NTC Hybrid), where it serves to calculate the above-mentioned dynamic spinning reserve. It is this that the entire system's efficiency depends on. The lower the spinning reserve on the gen-sets, the greater the fuel savings, the reduction in emissions and the reduction in operating costs," explains Petra Píclová, head of the Renewable Energy Division at ComAp. "A forecast that is faster and more accurate than satellite data, is provided for the next five minutes, which is more than enough time to start diesel gen-sets in the event of an expected drop in the output from a photovoltaic power plant," she adds.

The continuous updating of the predicted values improves the forecast's accuracy and reliability, which allows the control system to optimize the operation of the hybrid microgrid and increase its efficiency. The history from the measured data on cloud movement allows the prediction algorithm to be continuously improved and the subsequent refinement of the predictions provided. The system is suitable for commercial and industrial use, one camera is sufficient for a 1-2 MW photovoltaic power plant.

With growing prediction accuracy, it is possible to imagine a camera system replacing expensive battery storage in the role of an uninterruptible power source (UPS). The price of a camera system is negligible compared to the price of a UPS for large installations generating several tens of MW.


FUEL
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SERIES
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kPa
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300

Solar Operation Maintenance, Battery Storage Systems and SCADA Workshop, 20 – 28 June, Pohnpei, Federated States of Micronesia (FSM).

Pacific Power Association

The PPA held a 7 day training workshop on Solar Operation & Maintenance, Battery Storage and SCADA in Kolonia, Pohnpei, FSM, from 20 to 28 June, 2018, hosted by PUC. The workshop is the first arising from the Training Needs Analysis conducted in 2017 with funding from the Sustainable Energy Industry Development Project (SEIDP).

Figure 1: Workshop Participants

The workshop was attended by 20 participants representing 8 utilities from the Northern Pacific; PPUC (Palau), YSPSC Yap State FSM, CUC (Northern Marianas, CPUC (Chuuk State FSM), the host utility PUC (Pohnpei State FSM), KUA (Kosrae State FSM), KAJUR (Marshall Islands) and MEC (Marshall Islands). The workshop was officially opened by the CEO of PUC, Mr. Nixon Anson. Also present at the opening was Mr. Romeo Alfred, CEO of KAJUR, who was also in Pohnpei at that time on business.

Figure 2: Field Visit to Pohnlangas Solar Farm

There were 3 main sections in the workshop program with Days 1 – 4 spent covering PV Operation maintenance, Days 4 - 5 on Battery Storage Systems and Days 6 – 7 on SCADA design. The workshop sessions allowed for practical sessions as well as a site visit to PUC's 600kW Solar Farm at Pohnlangas.

PPA Secretariat Welcomes New Staff

Penelope Verebasaga

The Secretariat recently welcomed Miss Penelope Verebasaga who joined the Secretariat as an Accounts Clerk under the SEIDP. Ms. Verebasaga will be assisting the Accountant in the daily financial operations of the SEIDP.

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Welcome! *New Allied Members*

Four (4) new companies who have joined PPA as Allied Members since our last PPA Magazine. The new members are:

FUELCHIEF TRUSTEE LIMITED: Fuelchief Trustee Limited is based in Christchurch, New Zealand. Their primary activity is manufacturing.

MONJE EXPORTS: Monje Exports is based in Oregon, United States of America. Their primary activity is equipment category.

CANADIAN SOLAR: Canadian Solar is based in California, United States of America. Their primary activity is PV module manufacture and their secondary activities are Unity Scale PV development and construction.

VERGNET SA: Vergnet SA is based in Ormes, France. Their primary activities are Wind turbines manufacturers, Turnkey EPC and O & M services and their secondary activities are project financing and project development.