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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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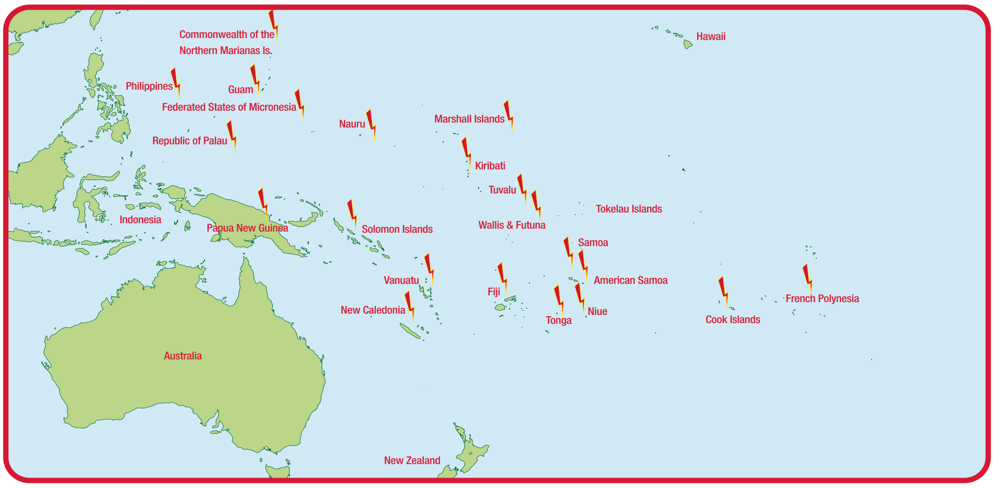

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Editor's Notes

Andrew D. Daka
Executive Director

Seasons Greetings,

Welcome to our final issue of the Pacific Power magazine for this year, 2016.

As the year draws to a close, let us take time to reflect on the year that has been for our organization and our own selves. It is a time to weigh our performance against our expectations. I hope that in doing so you find that the performance has been far better than expected despite the challenges through out the year.

As for the Pacific Power Association as an organization, that has been the case. The PPA has begun implementation of the World Bank funded Sustainable Energy Industry Development Project (SEIDP), the success of the recently convened 25th Annual Conference hosted by Tonga Power Ltd in Nuku'alofa, Tonga, and the growth in membership.

The feature articles in this edition continue with the subject of renewable energy and integration. This is becoming ever more so important given that a number of our utility members have increased significantly the capacity of variable renewable energy connected to their respective networks. The adverse impacts of not properly coordinating the integration have been noted in some of our member utilities.

Tonga Power Ltd continues to forge ahead with its renewable energy plans with the recent commissioning of two grid connected PV installations. Like other utility members, the Government of the Kingdom of Tonga sees Tonga Power Ltd as a very important entity in moving towards achieving its renewable energy target.

The next twelve months will be a busy one for the PPA Secretariat with the implementing of SEIDP and the upcoming 26th Annual Conference, which after consultation with the host utility, the Electric Power Corporation of Samoa, is scheduled for 31 July to 4 August 2017. I do hope that members plan their travel early to attend the conference.

We also welcome to the Pacific Power Association the following Allied Members who have joined the Association; Enphase Energy Australia Pty Ltd, RJE Global and Trans diesel Ltd.

On that note, may I on behalf of the Chairman, Board and the Secretariat of the Pacific Power Association wish all readers A Merry Christmas and A Happy and Prosperous New Year 2017.

Vinaka vakalevu.

Power System Stability & Efficiency Improvements through DC Techniques

Craig Harrison
Managing Director, I S Systems Pty Limited, Australia

Introduction

Improving generation efficiencies, managing the integration of intermittent RE and maintaining electrical system stability are critical utility objectives. This paper discusses potential solutions to some of the key issues confronting island electric utilities:

- Maintaining higher generator load factors,
- Reducing spinning reserve,
- Reducing cycling operation of conventional generation,
- Minimising RE spillage in the absence of storage,
- Increasing DE generation efficiency and reducing fuel consumption.

Innovative techniques to deal with these issues are discussed in this article. The specific topics include:

- Medium scale utility problems,
- A more flexible & efficient generation scheme, and
- A DC interconnector for network management and stability.

Innovative new ideas are important in problem solving. As Albert Einstein once said:

"We cannot solve our problems using the same thinking we used to create them."

A large number of studies, past & present, have been conducted for island electric utilities. These studies typically focus on determining the maximum level of intermittent RE (PV or wind) penetration permissible into an existing electrical system. A very limited number of techniques are proposed to increase the maximum level of intermittent RE generation. While the installation of a large storage system is usually the preferred solution, there are often constraints on this solution, both technical and financial. Other recommendations include the geographical distribution of the intermittent RE sources. However this is not always practical due land availability or network constraints.

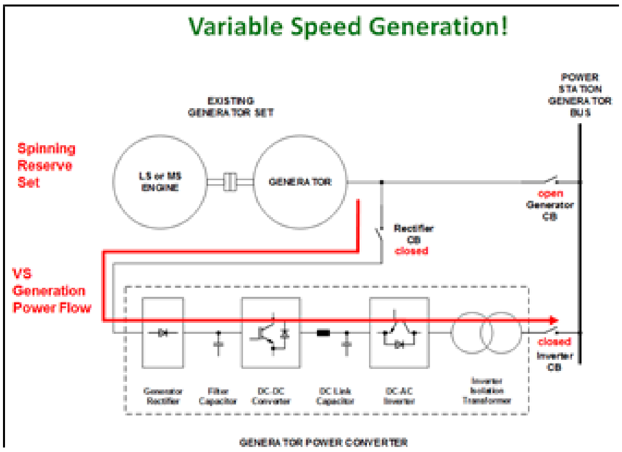
This article presents two cost effective techniques that can be applied in existing DE generation systems and distribution networks to improve generation efficiency, address the impact of intermittent RE generation, and reduce network stability problems. Both techniques utilise DC power conversion to add flexibility, control and improved dynamic behaviour.

Complementary solutions including variable speed generation and network segmentation are not discussed or considered.

Topic 1 - Flexible Generation

The concept is to convert an existing DE generator set to a flexible and more dynamic generating unit. This is achieved by allowing the engine to operate as a variable speed unit. Reducing the engine speed reduces fuel consumption. The available power is also reduced, along with the reduced frequency and voltage.

The variable speed capability is achieved by introducing an inverter between the generator and the station bus.



This combination forms a type of "Hybrid Generating" unit. The inverter rectifies the generator output to supply the inverter DC link. The DC power is inverted back to AC at the station bus, synchronised to the bus frequency at all times.

In a spinning reserve application the fuel consumption can therefore be reduced. The genset is running and able to generate power at all times. The set can quickly respond to an increase in station load as no synchronisation time is required.

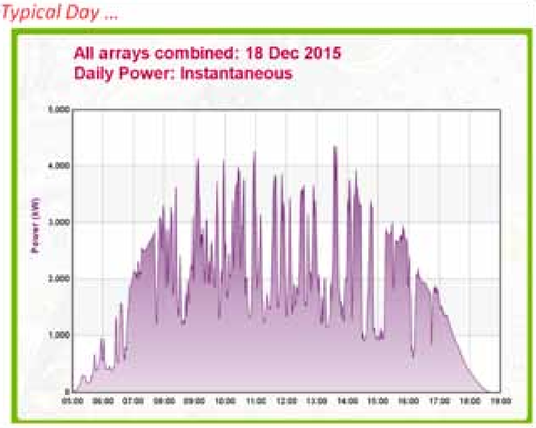
A typical operational scenario would go along the lines of:

1. The spinning reserve set is running off the station bus, say idling at 50% speed, with the power converter on-line but operating at light load, say 200kW,
2. The station load starts to rapidly increase due to say the loss of PV,
3. The inverter instantly starts ramping up its power output to compensate,
4. The engine is simultaneously accelerated to increase the available power, (less than 10 sec response time for 100% power),
5. When the excess load reduces, the engine speed is reduced accordingly.

The characteristics of PV generation are widely studied and published. The ideal day from sun rise to sun set presents the least stressful scenario for the base DE generation. A typical day is much less than ideal and it presents difficulties for the management of the DE generation.

A Nearly Perfect Day!

A More Typical Day ...



The DE generation must be very dynamic to meet the dynamics of large scale PV generation.

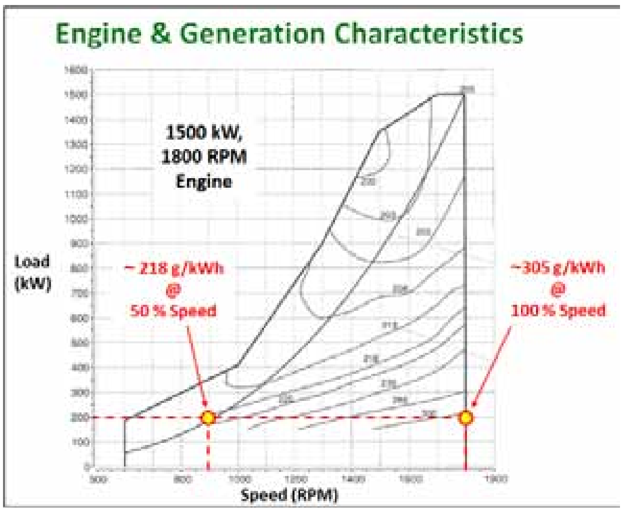
Variable speed generation offers many desirable characteristics, namely:

(a) Fast & controlled response,
(b) Spinning Reserve is online – no starting or synchronising delay,
(c) Reduced fuel consumption for the spinning reserve,
(d) Higher load factors are facilitated – security without burning more fuel,
(e) Ramp rate smoothing option with large DC link capacitors,
(f) Online inverter can function as a static VAR generator, reducing the VAR demand on the generators and thereby improving the operating load factor.

Is there an economic case for a variable speed generation solution?

In order to study this question, consider the typical fuel consumption contour curves for a 1,500kW 1,800 rpm engine and generator shown below. The graph presents 'specific fuel consumption' in g/kWh as a function of speed and power output.

When lightly loaded, say 200kW, the genset consumes 305g/kWh at rated RPM, but only 218g/kWh at 50% RPM. This equates to a fuel saving of 29%!



Clearly the net fuel savings depend upon the utilisation of the generator set in the hybrid mode. Low utilisation, say for 10hrs per day to cover PV daylight operation, generates savings of **~USD51,000** per annum (based a landed fuel price of $0.70USD per litre.At a higher utilisation rate, say 22hrs per day, savings of **~USD115,000** can be achieved.

The inverter system life expectancy is in excess of 20 years. The Cost Recovery Time for the 1,800kW set is typically between 4 to 6 years.

Running the engine at slow speed and light load must be properly managed. The effects of slow speed running are well studied and documented. The most prevalent consequences of long term underloading of a diesel engine are:

(a) *Exhaust manifold "slobber" or "wet stacking".*
(b) *Long periods of light loading can lead to deposit build up behind the piston rings or inside the cylinders.*

Variable speed operation of diesel engines is common in marine applications. The management of the engine should include scheduling to load the sets for short periods of time. The addition of cooling fan controls to ensure the engine achieves correct (or designed) operating temperature at the lower speed would be recommended.

Topic 2 - Network Stabilisation with DC Interconnector Units

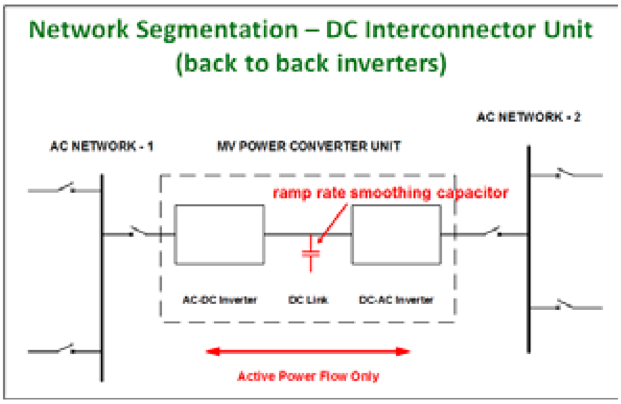
The second topic deals the option to segregate an AC network using a 'DC Interconnector'. Segregation of an AC network into separate areas facilitates the management of:

1. Reactive power & voltage levels,
2. Active power flow,
3. Frequency,
4. Fault levels.

DC transmission technology is well established. Large electrical companies including ABB and Siemens have many HVDC systems installed around the world. DC power transmission offer advantages in cost and performance for high power transmission over long distances. In our part of the world DC transmission systems are operating in Australia and New Zealand.

Segmenting the AC distribution network with a DC interconnector unit isolates the power quality issues and provides an opportunity to locally manage the performance of a weak transmission line and improve the local reactive power demand, voltage regulation and achieve higher utilisation of the generators. Stability in each AC area is also improved.

A 'DC Interconnector Unit' is comprised of two back-to-back inverters located in a single suite of cabinets – the AC system is effectively segregated into two zones with a zero length DC transmission line. The inverters are locally DC interconnected at the end of an existing AC transmission line. Only active power flows between the inverters and the active power flow can be bidirectional or unidirectional. In both cases the active power flow can be readily controlled.



The DC Interconnection Unit requires no frequency or phase synchronising between the two AC networks. The segmentation permits fault discrimination and isolation of faults to the local network.

Additionally, the DC link between the inverters can be fitted with additional capacitor storage (super or ultra-capacitors) to incorporate energy storage functionality for smoothing transient loads. Energy can be absorbed by or delivered from the storage capacitors. This provides opportunities for network stabilisation and management of transient RE energy through ramp rate control.

Static VAR compensators are often applied in networks to provide reactive power management and local voltage regulation. Static VAR compensators do not provide network segmentation or power flow control. The DC Interconnector Unit is based on two inverters- each inverter can provide static VAR compensation functionality by importing and exporting VAR's.

A DC Interconnector Unit can be retrofitted to an existing network substation as shown. In this configuration the interconnector unit may be in serv0ce of may be switched out as required.

Integration Assessment Study of a 2 MW Photovoltaic Power Plant to the Solomon Power Network

Kerim Mekki, Group Manager Transmission & Distribution, Jacobs Group (Australia) Pty Ltd
Pradip Verma, Chief Executive Officer, Solomon Power

Abstract: In accordance with its strategic objective of a planned and sustainable development, Solomon Power (SP) considers the integration of solar photovoltaic (PV) generation to its power system in Honiara. Jacobs performed a power system study to assess the impacts of the solar plant's integration to the existing generator operations and to the SP electrical network.
The study considers various PV plant capacities up to 2 MW, and assesses the impact on network stability for an islanded system that ranges from 7 MW to 24 MW peak load with power generation exclusively by diesel plants.

A PV plant will typically provide less network stability than a diesel plant of identical power rating, due to the nature of the PV technology that is unlike a rotating generator: The PV plant does not have spinning inertia or a controllable fuel source, and is therefore not capable of increasing rapidly the MW output in the event of a frequency drop.
The study results indicate that the integration of one PV plant rated up to 2 MW in SP's Honiara power network is feasible.
However, the situation could be different with the addition of multiple and large renewable energy plants, with an impact on energy quality (flicker and harmonics), on the frequency stability and on the generation dispatch.

Keywords: Solomon Power (SP), solar photovoltaic (PV), renewable energy (RE), power system study, network stability, diesel plant, Dynamic Grid Support (DGS)

I. INTRODUCTION

Currently, many utility companies are planning to increase the renewable energy (RE) penetration. The major objective of adopting renewable energy for Island nations is to reduce reliance on imported fossil fuels and to reduce carbon emissions. The most common and widely used RE sources are now wind and solar. While solar and wind are readily available, one of the major drawbacks of these sources is the variability of power supply. While power systems have been designed to handle the variable nature of loads, the variability and uncertainty associated with RE generation pose new challenges for the network stability and reliability.

In accordance with the Strategic Objectives, SP has planned the integration of photovoltaic generation plants to the Honiara system. This paper discusses the integration assessment of a solar plant in the SP network, and presents the study findings.

II. THE SOLOMON POWER (SP) SYSTEM

The Solomon Power (SP), previously trading as Solomon Islands Electricity Authority (SIEA), is a vertically integrated state owned enterprise that owns, maintains and operates the national electricity grid in the Solomon Islands. SP generates, transmits and distributes electricity in SP.
SP Strategic Objectives for 2015 – 2020 include the following:

- Strategic. Planned and sustainable development consistent with government objective,
- Operations. Reliable, affordable and safe generation and distribution,
- People and Safety. Right people in the right job, safety for staff and public,
- Commercial. Profitable, efficient and sustainable business.

A significant program of capital investment in generation, network and distribution infrastructure is planned over the short to medium term to improve power system economics, reliability and security of supply. One of the key strategies of SP is to double it numbers of customers within next 5 years from 15,000 to 30,000 customers.

The majority of the SP assets are located in Honiara on the island of Guadalcanal, the capital of the Solomon Islands. SP's electricity networks are largely concentrated in ten town centers serving the main urban/industrial areas on each of the seven major provinces. They include Guadalcanal Province (Honiara), Western Province (Noro, Munda and Gizo), Malaita Province (Auki and Malu'u), Central Province (Tulagi), Makira Province (Kirakira), Temotu Province (Lata) and Isabel Province (Buala).

The largest electricity network in the Solomon Islands, both in terms of coverage and in electricity sales, is in Honiara with a maximum demand of approximately 15.5 MW. For this study, we considered Honiara maximum demand ranging from about 7 MW (week-ends in 2016) to 24 MW (planned weekdays for 2020).

The main generation plant for Honiara is located at Lungga, about 10 km from the Honiara CBD. The Honiara network consists of the following:

- Diesel power stations at Lungga and Honiara (34.2 MW installed capacity),
- Five 33 kV feeders interconnecting the power stations and substations,
- 33/11 kV substations at Lungga, Honiara, Ranadi, Honiara East and White River,
- Thirteen 11 kV distribution feeders.

III. SOLAR PLANTS CHARACTERISTICS

The study considers various PV plant capacities in the range from 0.5 MW to 2.0 MW. Two locations are considered for the PV plant connection to the SP network:

- The Lungga power station through one 11 kV cable 250 m in length, and one transformer,
- The White River substation through one 11 kV cable 250 m in length, and one transformer.

The basis for the studies for the new PV plants is the following:

- Crystalline PV fixed panels, with a panel tilt of 12 degrees,
- 250 kW central inverters, with a power factor range of ±0.9,
- Under normal conditions, the PV plant operates in power factor control, with a 0.9 constant power factor,
- Under transient events, the inverter reactive power limits is ±100 kVAr per inverter,
- Typical maximum fault contribution is the double of inverters rated currents, which is 900 A per inverter.
- The dynamic behaviour of the PV plant is defined as constant P and Q while the voltage is above a predefined threshold. If the voltage falls below the predefined threshold, then there are two options:
  - o 1. The Dynamic Grid Support (DGS) mode is available and enabled, which provides a behaviour similar to a reactive compensation device (D-VAR® for example). As a result, under a fault condition, the PV plant is modelled as a shunt capacitor rated 100 kVAr for each inverter, with a virtual capacitor switched in 60 ms after the first predefined voltage threshold of 0.85 pu is reached. The grid support mode is disabled, and the PV plant returns to normal operation, 60 ms after the voltage reaches the second predefined threshold of 0.95 pu.
  - o 2. The Dynamic Grid Support (DGS) mode is not activated, or not available, and the PV plant stops generating under a fault condition. When the DGS mode is not activated or not available, the PV plant stops generating 60 ms after the first predefined voltage threshold is reached. The PV plant is switched back online 60 ms after the voltage reaches the second predefined threshold.
- The central inverters have Dynamic Grid Support (DGS) mode, and that this mode is enabled during normal operations and under outage conditions. The first predefined threshold is 0.85 pu. The second predefined threshold level is 0.95 pu.

IV. SCOPE OF THE ASSESSMENT AND TOOLS

A PV plant will typically provide less network stability than a diesel plant of identical power rating, due to the nature of the PV technology that is unlike a rotating generator: The PV plant does not have spinning inertia or a controllable fuel source, and is therefore not capable of increasing rapidly the MW output in the event of a frequency drop.

The study assesses the impact on the network performance of a PV plant connection to the Honiara islanded network, for various PV plant capacities. The study considers a range of maximum demand from 7 MW to 24 MW for the Honiara system. The *SP Electrical Design Standards for Power Systems* [1] are the reference document to assess the system conditions compliance. The power generation is exclusively provided by diesel plants before the PV plant connection.

The study includes the assessment of the PV plant integration, considering the following:

1. Impact on the generation dispatch plan,

2. Steady state conditions with load flow analysis, voltage levels estimation under different scenarios, reactive power flow calculation, and protection coordination concept design,

3. Transient stability of the system including fault ride through, and recovery from transient events such as a power generation unit trip.

DigSILENT PowerFactory software was used to model the Honiara network, including the generators' regulators (AVRs and governors), and to assess the network responses under a range of conditions.

V. RESULTS

1. The generation dispatch plan needs was reviewed for the integration of a solar plant, to take into account the variability of supply from solar plant, and its operation confined to day time. A generation dispatch solution can rely on an increase of the spinning reserve during day time equal to the PV plant ratings.

2. The load flow assessment shows that the implementation of a PV plant in the investigated range is not precluded. All equipment loadings are within the equipment's ratings and the system voltages are within the SP's Network Standard limits. The protection system integration of a PV plant within the existing SP protection system is not precluded.

3. The power system transient studies consider the sudden outage of a solar plant, and a phase to ground fault on the transmission system.

The results for a solar plant outage are illustrated by Figures 1a & 1b on next pages, for a 7 MW load. The figures compare frequency and voltage excursions for the following scenarios:

- 2 MW PV plant trip,

- 2 MW diesel unit trip, with a 2 MW PV plant online,

- 2 MW diesel unit trip, without a PV plant online (reference).

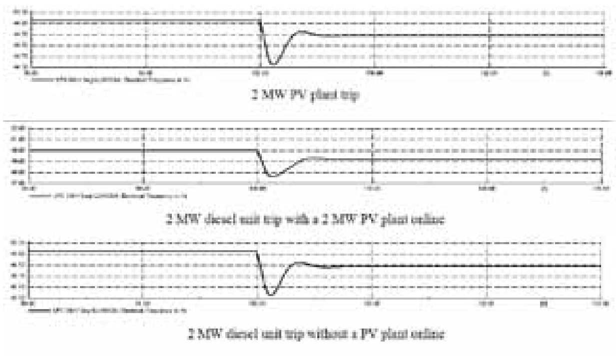


Fig 1a. Frequency excursions following the sudden outage of a power plant, for a 7 MW load

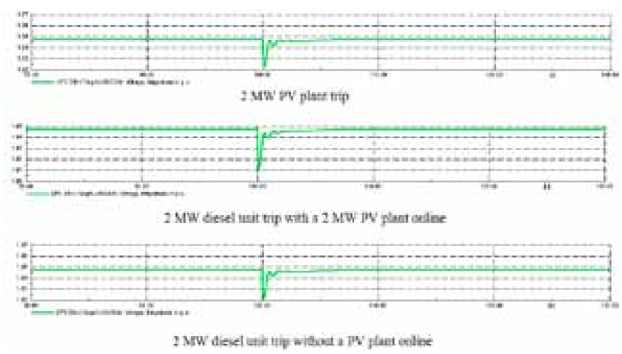


Fig 1b. Voltages excursions following the sudden outage of a power plant, for a 7 MW load

The results for a phase to ground fault are illustrated by Figure 2a & 2b on next pages, for a 7 MW load. The outage is a 0.5 s long phase to ground fault, on the Lungga to Honiara 33 kV overhead line at 1.4 km from the Lungga 33 kV substation, with a resistive fault impedance of 10 Ω. The figures compare frequency and voltage excursions for the following scenarios:

- 2 MW PV, Dynamic Grid Support (DGS) enabled,
- 2 MW PV plant, without DGS,
- Without a solar plant installed (reference).

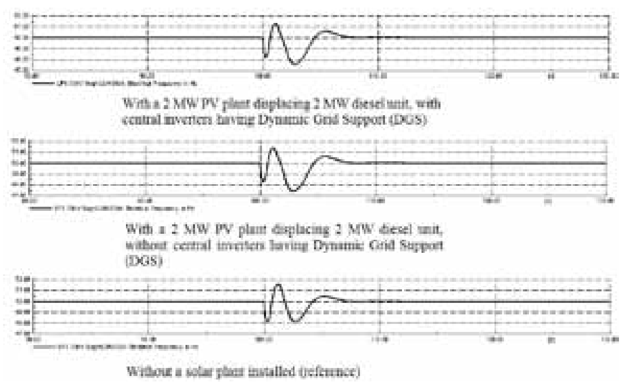


Fig 2a. Frequency excursions following a phase to ground fault on the Lungga to Honiara 33 kV overhead line, for a 7 MW load

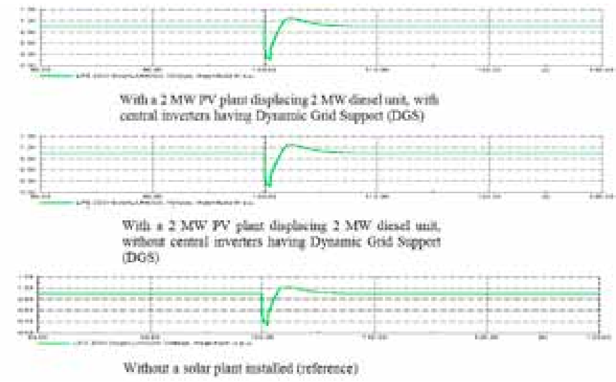


Fig 2a. Voltage excursions following a phase to ground fault on the Lungga to Honiara 33 kV overhead line, for a 7 MW load

The substitution of an existing diesel generator with a PV plant of identical power rating results, as expected, in lower stability. However the studies show that the integration of a PV plant of up to 2 MW does not significantly impact the Honiara network stability performance.

The lowest load condition is the worst case scenario for the islanded network stability and the PV plant integration: There is less online 'spinning' generation compared to the peak load condition, resulting in less stability following an outage.

While the PV plant results in a system stability slightly decreased and in a different generation dispatch likely requiring more spinning reserve, the PV plan can offer additional benefits including the provision of continuous network voltage control through reactive power generation.

The study outcome could be different with the addition of multiple and large renewable energy plants, with an impact on energy quality (flicker and harmonics), on the frequency stability and on the generation dispatch.

VI. CONCLUSIONS

The substitution of an existing diesel generator with a PV plant of identical power rating results as expected in lower stability. However the studies show that the integration of a PV plant of up to 2 MW does not significantly impact the Honiara network stability performance.

REFERENCES

[1] *The Electrical Design Standards for SIEA Power Systems*, revision C, dated 10/12/13

Foresight - A Faster, More Accurate Way To Improve Network Reliability

Goran Stojadinovic
Northpower Limited

Any business that operates its own electricity network knows that ongoing inspection and maintenance is essential to avoid expensive outages or downtime for repairs. Traditional inspection services - including visual assessments (from the air and from the ground); Thermographic; Corona camera; RFI and old-style Ultrasound detectors – all have their limitations. Generally they are slow to use and not particularly reliable at defect detection.

Northpower Limited now offers Foresight - a major step forward in inspection speed and accuracy for overhead networks. This powerful new service uses a directional ultrasonic detector which precisely analyses an acoustic signal from each network asset in turn. Any defects or potential problems cause a variance in the 'normal' response. This feedback can be analysed together with high quality photographs of the equipment to determine when a repair or replacement should be carried out.

The integration of Distributed Energy Resources (DER) with traditional network asset increases the need to monitor network health. Foresight's rapid and cost-effective inspection and condition monitoring methodology delivers early detection of pre-fault conditions providing forensic analysis to support defect prioritisation, ensuring the useful life of existing assets is maximised, reducing unnecessary expenditure.

Developed by EIS Global in Korea, Ultrasonic Inspection technology has been successfully used by KEPCO in Korea for over five years, where close to 95% of the national network is surveyed annually. 10 million data points have been collected on KEPCO's network and pre-emptive rectification of the defects found has improved KEPCO's SAIDI by 42% over this time.

Proof of Foresight's superior detection ability comes from its deployment on 150,000 poles, wires and other equipment in networks in Australia, New Zealand and the Pacific Islands. Foresight found over 2,000 electrical defects in these networks previously undetected through traditional inspection methods. Most of those 2,000+ defects had the potential to adversely impact a network performance, reliability, security or safety.

Not only is it more reliable, Foresight is also more accurate, finding the location of each problem precisely. It runs at 10 times the speed of traditional methods, checking up to 300 distribution poles/structures per day. And because it can detect potential problems up to 18 months before they actually become an issue, Foresight enables companies to optimise their maintenance and replacement schedules.

Northpower has the exclusive rights to Foresight within Australia, New Zealand and the Pacific Islands.

Website: www.foresightdiagnostics.com

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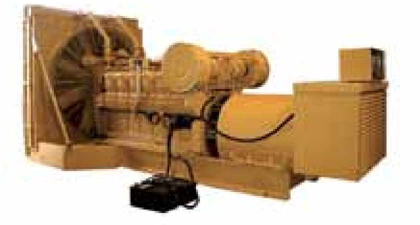

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Pacific Islands Forum Diesel Maintenance Programme

Pacific Power Association

INTRODUCTION AND BACKGROUND

This article provides a summary of the 2016 Pacific Islands Forum Diesel Maintenance Programme convened at Sagamihara 17-21 October 2016.

The 2016 Pacific Islands Forum Diesel Maintenance Programme was hosted by Overseas Reprocessing Committee (ORC).

Mitsubishi Heavy Industries Ltd delivered the training in the classroom and practical sessions. The general arrangements, management, training skills and hospitality were excellent and contributed to the success of the programme, particularly the transfer of knowledge and skills on the operation and maintenance of diesel engines.

OBJECTIVES

The Pacific Islands Forum Diesel Maintenance Programme consists of the following primary objectives:

- introduce participants to diesel engine and trouble shooting procedures, and operation; and
- highlight on the importance of safety in the work environment

PROGRAMME OUTLINE AND CONTENT

The programme was carried out at the Mitsubishi Heavy Industries Ltd training center in Sagamihara prefecture.

The training schedules were presented in lectures and hands-on practical sessions. In general, the programme content was on the basics of diesel engines, maintenance and trouble shooting, safety, and the current developments in the respective technologies.

PARTICIPANTS VIEWPOINT

Four countries participated in the 2016 programme. The participants consist of a mechanics, and operators. The following provides a summary of the participants' views raised during the round table meeting at the conclusion of the training programme.

List in order of priority what were the most impressive and useful sessions in the program for you	• Engine specification, repair and maintenance • Generator construction, trouble shooting and maintenance • Panel principal, trouble shooting and maintenance • Diesel generator Load Test • Generator Construction
Do you have any suggestions or proposals that you feel should be considered for inclusions in future program	• More practical and hands on work • Turbocharger overhauling • Electronic Governor •
Was there any program that was not useful to you?	Everyone found the programmes useful.
How about the degree of difficulty?	Moderate
Others (would you please frankly let us know anything you have perceived for the whole program?)	• The generator component of the programme should just provide an overview of its operation, as many of the participants were mechanical engineers (or mechanics). • A very helpful programme for the Pacific islands

CONCLUSION AND RECOMMENDATIONS

The excellent arrangements, training skills and hospitality provided by the hosts and the enthusiasm and performance of the participants contributed to the overall success of the 2016 Pacific Islands Diesel Maintenance Programme.

The participants' views expressed during the round table meeting at the end of the training programme are noteworthy as they highlight some of the areas of interest by participants. However, these may not be immediately incorporated into the 2017 training programme or future programmes due to factors such as budget constraints, its relevance to the region, etc.

Since the beginning of the Pacific Islands Forum Diesel Maintenance Programme in 2000, its focus has been on basic maintenance of diesel engines. Major work on diesel engines and generators in the respective power utilities are usually referred to the suppliers of the equipment due to limited manpower, knowledge, skills and availability of appropriate tools in the Pacific islands.

It is therefore suggested that future diesel maintenance programmes consider the following:

- continue to focus on the basic maintenance procedures, safety and troubleshooting with diesel engines and if there will be any changes to the programme then consideration to change to advance course in diesel maintenance should be considered.;
- extend the time duration for practical sessions with diesel engines;
- Reduce the workshop days to 4 days duration of the programme and the site visit for the Friday if possible

Training Program for PIF Diesel Maintenance, October 17-21, 2016, Japan

<u>Sun., October 16</u>

19:20	Assemble at Keio Tama Center Station (When you get off the limousine bus at Keio Tama Center Station, a JTB staff will meet you.)
19:30	Leave for Hashimoto Park Hotel
20:00	Arrive at Hashimoto Park Hotel
	Stay at Hashimoto Park Hotel 3-4-4 Hashimoto, Midori-ku, Sagamihara City, Kanagawa Pref. 252-0143, Japan TEL: +81-42-774-6112, FAX: +81-42-774-6119

<u>Mon., October 17</u>

08:20	Assemble at lobby
08:30	Leave Hashimoto Park Hotel for Mitsubishi Heavy Industries, Ltd. (MHI) Sagamihara Works Training Center
09:00-11:30	Opening ceremony and Factory tour
	at MHI Sagamihara Works Training Center 3000 Tana, Chuo-ku, Sagamihara City, Kanagawa Pref. 229-1193, Japan TEL: +81-42-763-0032
11:30-13:00	Lunch break
13:00-16:30	Engine construction & function of diesel engine (Lecture) Basic knowledge of engine (Test)
17:00	Arrive at Hashimoto Park Hotel
18:00	Welcome Reception (The venue is to be determined)
	Stay at Hashimoto Park Hotel

Tue., October 18

08:20	Assemble at lobby
08:30	Leave Hotel for MHI Sagamihara Works Training Center
09:00-11:30	Training on Engine disassembling (Practice)
11:30-13:00	Lunch break
13:00-16:30	Engine disassembling (Practice) & Part measurement (Piston, Cylinder liner)
17:00	Arrive at Hashimoto Park Hotel
	Stay at Hashimoto Park Hotel

Wed., October 19

08:20	Assemble at lobby
08:30	Leave Hashimoto Park Hotel for MHI Sagamihara Works Training Center
09:00-11:30	Training on Engine reassembling (Practice)
11:30-13:00	Lunch break
13:00-16:30	Engine reassembling & adjustment (Practice) Major component parts (Lecture & Practice) - Turbocharger
17:00	Arrive at Hashimoto Park Hotel
	Stay at Hashimoto Park Hotel

Thu., October 20

08:20	Assemble at lobby
08:30	Leave Hashimoto Park Hotel for MHI Sagamihara Works Training Center
09:00-11:30	Training on Diesel generator operation procedure (Lecture) Practice in diesel generator load test
11:30-13:00	Lunch break
13:00-16:30	Training on Practice in diesel generator load test - Performance test, Calculation of test data
17:00	Arrive at Hashimoto Park Hotel
	Stay at Hashimoto Park Hotel

Fri., October 21

08:20	Assemble at lobby
08:30	Leave Hashimoto Park Hotel for MHI Sagamihara Works Training Center
09:00-11:30	Small engine troubleshooting – S3L engine
11:30-13:00	Lunch break
13:00-16:30	Small engine troubleshooting Answer & explanation of the test, Q&A Closing
17:00	Arrive at Hashimoto Park Hotel
	Stay at Hashimoto Park Hotel

Sat., October 22 Technical visit to Isogo Thermal Power Plant
(Detailed schedule is to be determined)

Stay at Hashimoto Park Hotel

PARTICIPANTS LIST

Country	*Participant*	*Utility / Institute*	*Designation*
Samoa	Mr. Ie'u M. Milosi	Electric Power Corporation	Senior Mechanic
Niue	Mr. Harris Ikitule	Niue Power Corporation	Mechanical Tradesman
Tonga	Mr. Finau Angitau	Tonga Power Ltd	Mechanic/Operator
Cook Islands	Mr. Ngatokorua Tiaiti	Te Aponga Uira	Apprentice Mechanic
Fiji PPA Secretariat	Mr. Gordon Chang	Pacific Power Association	Deputy Executive Director

ACKNOWLEDGEMENTS
The following are gratefully acknowledged for their assistance in the organisation and during the course of the training programme:

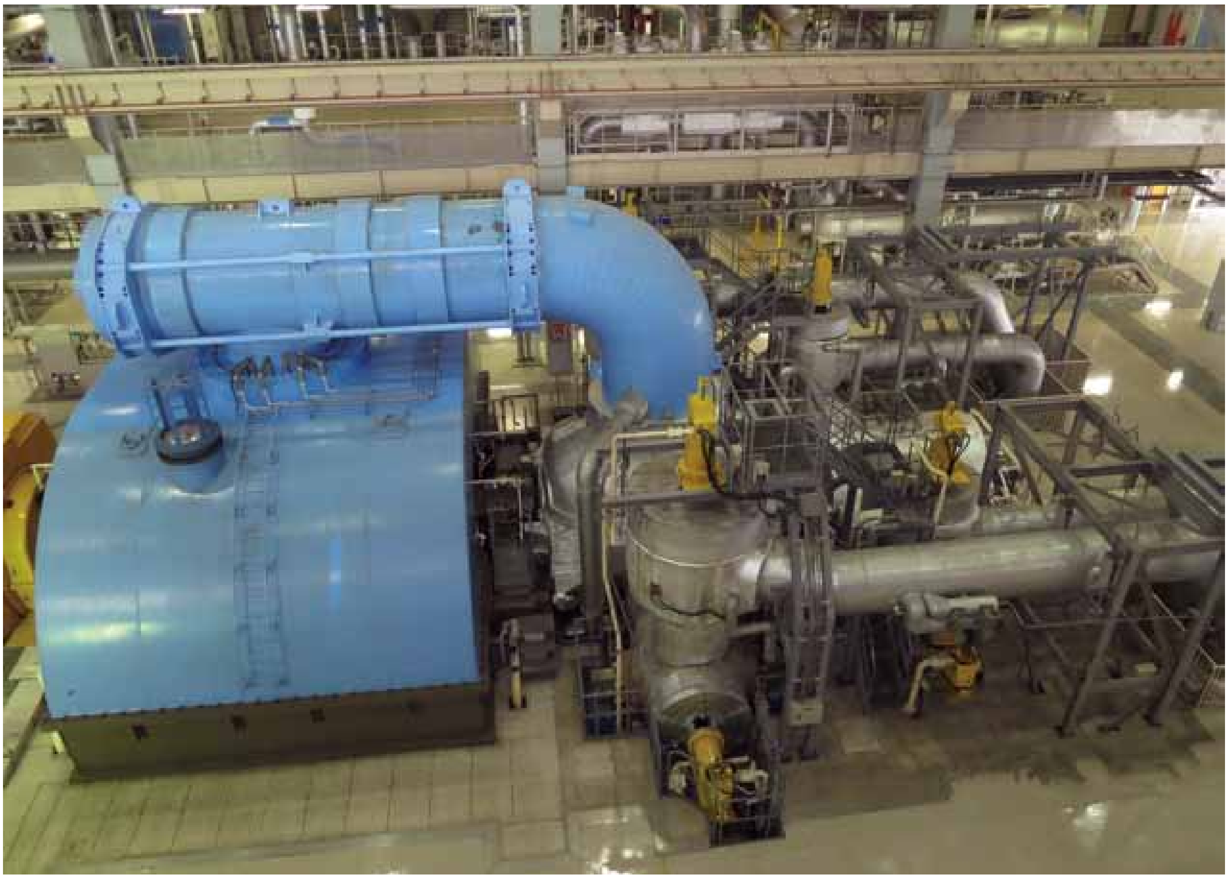
- The Government of Japan
- Overseas Reprocessing Committee (ORC)
- Mitsubishi Heavy Industries Ltd (MHI)
- Mr Shigeru Hiki (JTB)
- Mr. Seiichi Sugai, Deputy General Manager, ORC
- Mr. Atushi Maeda, Manager, ORC
- Mr. Kiyoshi Araki, Adviser, The Federation of Electric Power Companies
- Mr. Akihiko Hara, General Secretary, ORC
- Mr. Ko Sugiura, General Manager, ORC

It is also noteworthy to acknowledge the participants for their enthusiasm and performance during the course of the training programme.

PIF Training Participants and MHI Trainers

PIF Training Participants discussing diesel engine operations

PIF Participants Training on Engine Disassembling



Site visit to a Coal Fired Power Station in Japan

PIF Participants Training on Engine Reassembling

Ha'apai Solar Farm To Come On Grid In November

Tonga Power Ltd

Australia's Minister for International Development and the Pacific, Hon. Concetta Fierravanti-Wales, H.E. Andrew Ford and delegates at the Ha'apai Solar Farm. 22 September 2016.

Australian Minister, Senator Concetta Fierravanti-Wells together with the Australian High Commissioner to Tonga, H.E. Ambassador Andrew Ford and delegates of Australian Department of Foreign Affairs yesterday visited the Ha'apai solar farm project. The on-grid project will become the first utility scale solar energy generation facility in Ha'apai.

Tonga Power staff and Governor Mo'ale Finau were pleased to welcome the Honorable Minister at Ha'apai during her visit to the solar facility which is located at the power station in Pangai. The senator is in Tonga on an official visit to strengthen Australia's bilateral relationships with its Pacific partner countries.

Honorable Concetta Fierravanti-Wells said, "The Government of Australia is proud to be supporting Tonga to reach its renewable energy goals and climate change targets through the Outer Islands Renewable Energy Project (OIREP).

Australia has contributed $5.7 million AUD towards the project in co-financing with the Asian Development Bank and the European Union.

TPL Major Projects Manager, Simon Wilson said, "We are very thankful for the financial support that Development Partners have provided for this benchmark project. This project will bring Ha'apai up to approximately 50% renewable electricity supply which will be a first for Tonga".

He adds, "This is an important stepping stone towards the Government of Tonga's goal of 50% renewable electricity generation for Tonga by 2020".

The OIREP project includes the construction of the 550 kWh solar plant in Ha'apai which also contains a 660 kW battery storage system. The Ha'apai solar farm is expected to be complete in November 2016. In addition, a 200 kWh solar farm in being constructed in 'Eua and is expected to be complete in October 2016. The overall cost for the solar facilities for both islands is approximately $3 million USD dollars.

Fiji based company CBS is the lead contractor on the project, which is an alliance between Tonga Power Ltd and the Government of Tonga.

The OIREP project also includes the electricity network rehabilitation in ‘Eua and Vava’u funded by the Asian Development Bank, European Union, Second Danish Cooperation Fund and the Australian Government at a cost of $5 million USD. TPL is responsible for the construction and refurbishment of the electricity network in ‘Eua up to 80 percent and up to 20 percent in Vava’u.

The OIREP project has been well underway since July in ‘Eua and around 30% of the work has already been completed. Construction of the electrical network in Vava’u is expected to commence in May 2017.

Tonga Power Limited CEO said, “The OIREP project is yet another example of Tonga Power’s ability to work in close collaboration with Government, the industry and our Development Partners to deliver safe, reliable and more affordable electricity to the outer Islands.

Tonga Power also provides equal employment opportunity for both women and men in the workforce and has successfully trained and employed four female staff in Ha’apai and three in ‘Eua to join the OIREP network rehabilitation workforce in support of the Gender Action Plan.

Tonga Power’s CEO, Robert Matthews said, “TPL remains committed to a balanced approach to gender equality as we continue to engage the very best people for the job regardless of their gender”.

Mr. Matthew adds, “I sincerely thank all our Development Partners including Senator Concetta Fierravanti-Wells, H.E. Ambassador Andrew Ford and the people of Australia for their continued support”.

Tonga Police Solar Goes Live

Tonga Power Ltd

Representative from the Embassy of People's Republic of China, Sophie Tempy, Sarah Walsh, Hon. Siaosi Sovaleni, Hon. Pohiva, Tu'i'onetoa, Stephen Caldwell, Robert Matthews. 28 September 2016.

The Tonga Police solar was officially commissioned by the Deputy Prime Minister of Tonga, Hon. Siaosi Sovaleni at a ceremony held at the national police headquarters in Longolongo.

More than 30 delegates attended the celebration, including the New Zealand High Commissioner Her Excellency Mrs. Sarah Walsh and the Australian Acting High Commissioner Sophie Tempy, Minister of Police Hon. Dr. Pohiva Tu'i'onetoa and distinguished guests.

The event marked the completion of the construction phase of the 225 kWh solar facility. The project was made possible by a funding grant from the New Zealand Aid Programme and the Government of Australia and the solar expertise of Reid Technology.

Tonga Power Ltd's CEO Robert Matthews said that the pilot program hoped to set a benchmark for future expansion of a national solar photo-voltaic distributive energy program that aims to feed energy harvested from the sun into the power grid.

"This program will see a dual tariff in place with Tonga Police to encourage exporting of electricity from the 180kWh of battery storage onto the Tonga Power grid during peak demand."

"The program was designed in mind that it had to provide a sufficient solar energy to offset the energy needs to Tonga Police stations and that the facility was selectively oversized to provide excess capacity with battery storage, among other thing".

He adds, "This is an exciting project and I believe sets an excellent example and a significant leap towards the development of renewable energy forms of electricity generation in Tonga, which will hopefully encourage others to consider a similar approach to develop renewable energy projects in the future."

In his remarks to the gathering the Deputy Prime Minister of Tonga, Hon. Sovaleni explained that the Government of Tonga intended to lessen carbon emissions by increasing electricity generation from renewable energy.

Hon. Sovaleni said, "To help fight climate change, Tonga intends to reduce carbon emissions, as outlined in our National Determined Contribution, and we are committed to increasing our electricity generation from renewable energy to 50% by 2020 and 75% by 2030."

"The solar project will enhance the operational capacity of Tonga Police through access to a reliable source of electricity, reduce operational costs, and contribute to Government's efforts to reach 50% renewable generation by 2020", he adds.

Stephen Caldwell, Tonga Police Commissioner said the 225kWh system will not only enhance the operational capacity of Tonga Police through access to reliable source of electricity 24-hrs daily, seven-days a week but more importantly perhaps, it will also aid the Tongan Government's priority to reduce reliance on imported fossil fuel through the use of renewable energy.

Under the same fund, solar projects have also been developed and implemented at police stations in Mu'a, Vaini, Nukunuku.

Improved Reliability At Emergency Water Well Generators

Guam Power Authority

The availability and reliability of over 200 standby generators has increased to 95% percent. These generators service Guam Waterworks Authority (GWA) water wells, booster pumps & waste water facilities. It was through Consolidated Commission on Utilities (CCU) Resolution No.: 2015-64 authorizing GPA to operate & maintain all GWA standby generators that the Water Systems Diesel (WSD) Section of the Generations Division and GWA employees initiated efforts to increase the operational effectiveness of these critical infrastructure assets.

"In January, the availability status of these emergency backup generators were 64% operational," stated GPA General Manager John M. Benavente, P.E., "With investments into new generators, fuel tanks and miscellaneous equipment, the WSD Section reports that standby generator availability is at 95% - this is a significant improvement over the past 10 months."

"This effort came after a brief period of evaluation and coordination with GWA whose commitment to this endeavor included $500k for generator upgrades and repairs – much of this work, which include new generators, automatic transfer switches and larger fuel tanks, will be installed over the next few months and at that time will bring availability up to about 100%," remarked Benavente, The synergy between GWA and GPA and their excellent working relationship is the main reason of their success.; this is important to provide continuity of operations during storms or typhoons."

GPWA Standby Generator Availability

9-Nov-16

The following includes all Water and Wastewater Facilities:

Sector	Total Facilities	Gensets Available	Gensets Down	% Available
Northern	93	91	2	97.8%
Central	64	61	3	95.3%
Southern	46	40	6	87.0%
All Sectors	**203**	**192**	**11**	**94.6%**

PUC Approves New LED Streetlight Tariff

Guam Power Authority

The Guam Power Authority received approval from the Public Utilities Commission (PUC) of its petition to reduce the existing HPS streetlight tariff to the new LED streetlight tariff an average of 22 percent.

"We pleased with this latest order from the PUC," stated John M. Benavente, P.E., GPA General Manager, "Existing High Pressure Sodium (HPS) streetlight system were the most efficient type of its time, but new LED streetlights today are much more efficient which provides GPA the opportunity to invest in a new system which reduces cost . . . there are approximately 10,360 HPS lights remaining to be changed over to the more efficient Light Emitting Diode (LED) technology out of a total of 16,000 streetlights installed islandwide."

As of September 2016, a total of 5,675 LED replacements or change-outs have been completed. GPA estimates approximately $5 million to change out the remaining public and private streetlights from HPS to LED with the program's expected completion to be within one to two years.

"The decrease in fixture prices is effective 1 November 2016 for public & private streetlights while providing an opportunity to fund the program internally. Original estimate was around $15M, however, funding required today is about $5M," remarked Benavente, "The planned source of funding is the line extension and internal CIP with annual maintenance costs to drop by about 80% saving nearly $400K per year. The reduced tariff provides the Department of Public Works the opportunity to add additional streetlights in the villages by working alongside each village Mayor."

ACKNOWLEDGEMENT

Cummins®

The Association would like to acknowledge Cummins South Pacific for sponsoring the 25th Annual Conference Polo Shirts.

PPA Secretariat welcomes new staff

Reena Mata Fiu-Suliana

Reena Suliana joins the PPA Secretariat in October 2016 as the new Administration Officer. She hails from the beautiful Island of Rotuma, Fiji, and she brings with her a vast experience in administration skills. Reena spent 8 years with a local NGO which deals with bio-diversity conservation overseeing all administration and operational work of the Organization.

Krishnan Nair
(MSc (UK), MEngSc (Aus), BE (NZ), IET (UK))

Position: Electrical Engineer (Consultant to the World Bank Project)

Part of PPA project team to provide technical support on the implementation and delivery of World Bank funded Sustainable Energy Industry Development Project (SEIDP). Project activities and responsibilities include providing consultancy service with procurement and use of power system modelling software. Work with PPA and World Bank team to implement renewable energy integration studies as well as assist in developing a new online benchmarking platform.

Previously work history includes appointment as the Wind Operations Engineer responsible for wind farm operation and maintenance. Later appointed as the Distribution Engineer responsible for efficient and reliable operation of distribution network system.

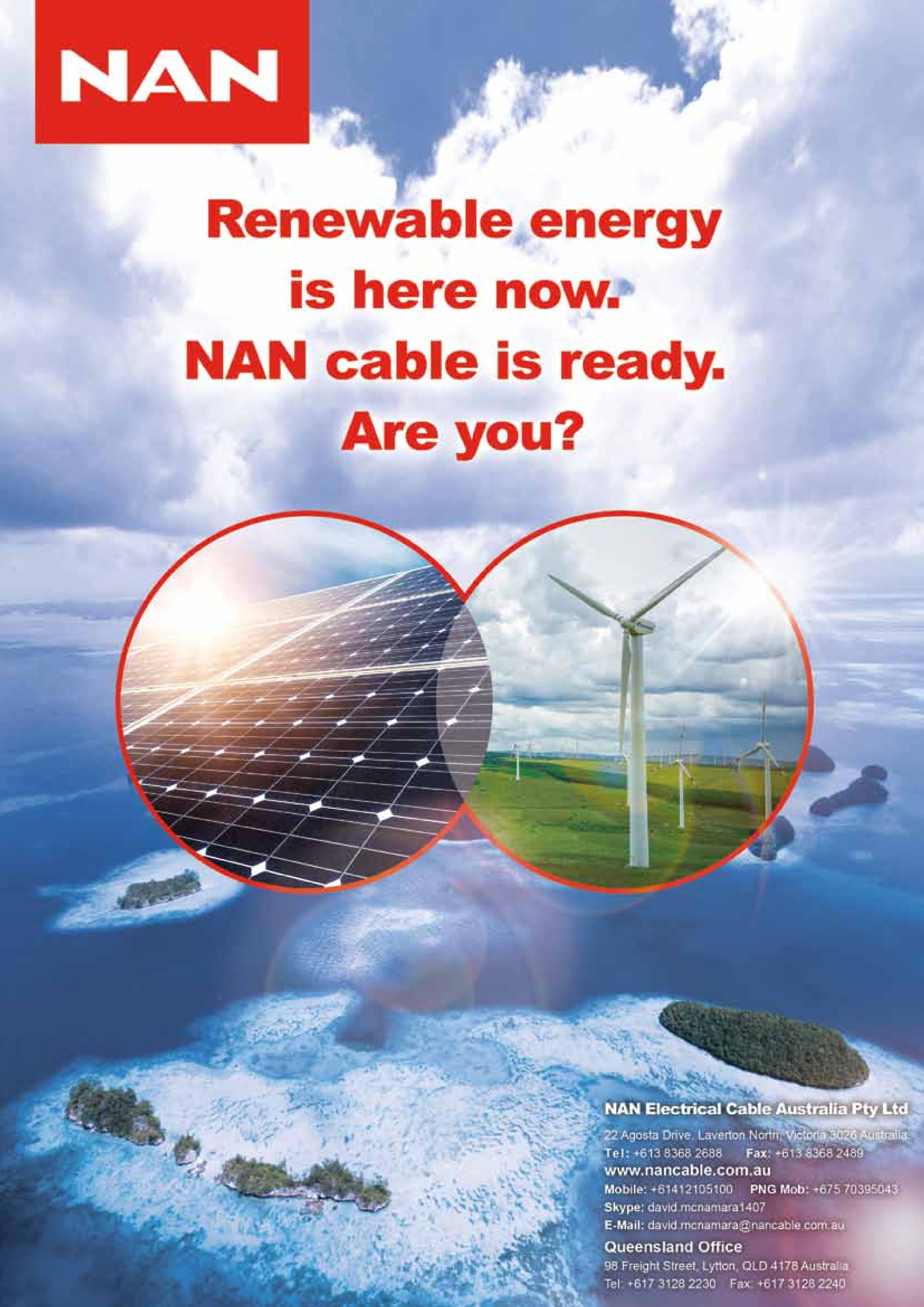
Welcome! *To New Allied Members*

Three (3) new companies have joined PPA as Allied Members since our last PPA Magazine. The new members are:

ENPHASE ENERGY AUSTRALIA PTY LTD: Enphase Energy Ltd is based in Sydney, Australia. Their primary activity is manufacturing of power electronics hardware and software.

RJE GLOBAL: RJE Global is based in Morphett Ville, Australia. Their secondary activity is Pre Contracts Manager.

TRANSDIESEL LTD: TransDiesel Ltd is based in Auckland, New Zealand. Their primary activities are supply of Volvo and Yanmar construction equipment, Perkins engines and Kohler products (generators, engines). Their secondary activities are supply of filtration equipment, ENI oil and spare parts.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