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SEIAPI Sustainable Energy

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Establishing Training Centre at USP Pacific TAFE

Article By: Geoff Stapleton (GSES)

GSES acting as the secretariat for SEIAPI have been liaising with USP Pacific TAFE to establish a Sustainable Energy Training Centre at the Statham Campus in Suva. A request for funding proposal has been developed and distributed to private foundations along with several donors. The funding requested is approximately USD800,000. This proposal includes funding for:

- Construction of a new Building
- A PV/Battery system for the budling
- Equipment for undertaking practical training
- Two Fijian based full-time trainers
- Practical training equipment to be in other countries and travel to establish the practical training in centres in other countries.

Mr. Sandip Kumar with support from other GSES trainers will train the two new full-time trainers.

The training centre will initially focus on providing the following training courses:

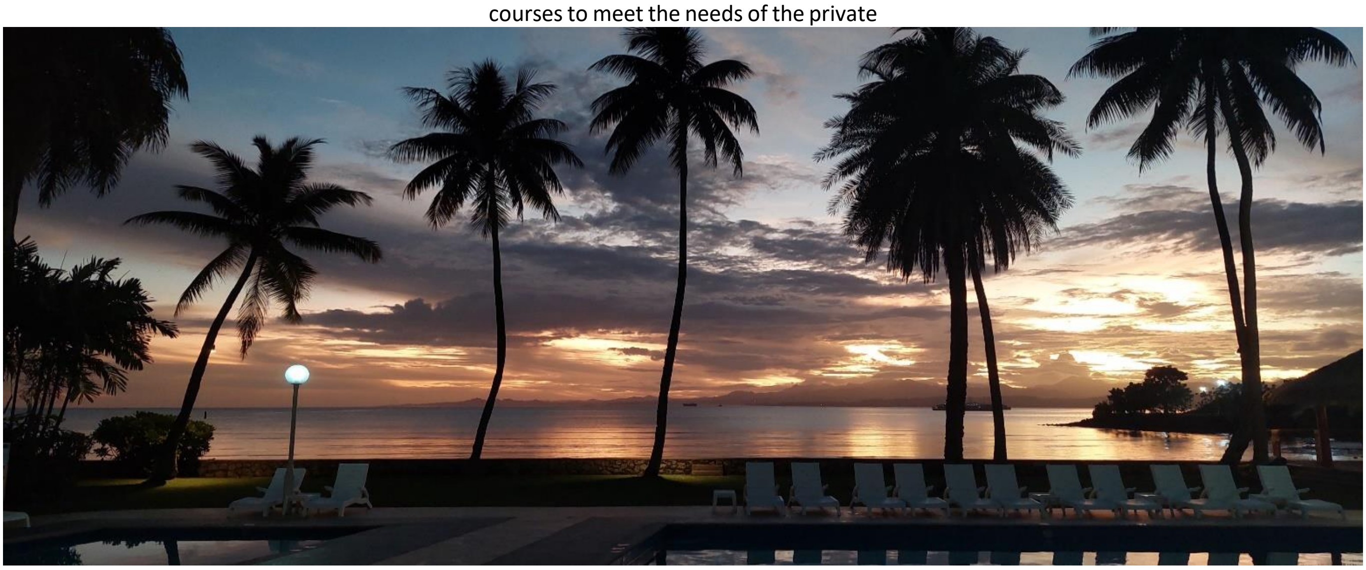
- design and installation of grid connected PV systems
- design and installation of PV based off-grid systems
- design and installation of residential/commercial battery storage systems on the grid.

Design only and install only courses for the three technology applications will also be available.

After those courses are established the training team would develop other courses to meet the needs of the private industry, the electricity utilities and interested individuals.

As an interim measure while working towards establishing the new centre, GSES/SEIAPI provided USP Pacific TAFE a proposal to establish online training courses for the above three courses in the coming months and USP Pacific TAFE has accepted it. Once THE agreement is finalized, the online training will commence. This will allow individuals within the Pacific region to undertake the theory components of the above courses while GSES/SEIAPI work towards obtaining the equipment for the practical training.

SEIAPI will prepare a press release immediately once training is up and running at USP Pacific TAFE.



SEIAPI submits Proposal to REO Climate Grants

Article By: Geoff Stapleton (GSES)

In early May SEIAPI was made aware that the Pacific Regional Environment, Science, Technology and Health Office (REO) based at U.S. Embassy Suva had announced an open competition for climate grant awards (USD 75,000 – $100,000 or less) to support local or regional projects related to renewable energy and/or sustainable landscapes, including climate adaptation and resilience projects.

Projects were to propose activities targeted through this solicitation in the following countries: the Federated States of Micronesia; Fiji; Kiribati; Papua New Guinea; Republic of the Marshall Islands; Samoa; Solomon Islands; Tonga; Tuvalu; or Vanuatu.

The SEIAPI executive saw this as an opportunity to build on PPA's Sustainable Energy Industries Development Project (SEIDP) and work with governments, donors and power utilities for adoption of PPA/SEIAPI guidelines and technician accreditation scheme, thereby improving solar system design and installation quality.

Primary activities:

1. One day workshops in all 10 countries promoting the guidelines and high-quality technician training and accreditation. The targets are government departments, power utilities, donors, NGO's, educational bodies, industry and relevant associations such as Engineers' institutions and contractor associations.
2. Discussions with government, donors and utilities to identify their requirements for adopting/accepting guidelines and accreditation scheme.
3. Discussions with educational institutions to identify possibilities on incorporating the training resources, available under a license agreement between an Australian training centre and PPA into their curricula.

SEIAPI will inform the members on the outcome of this submission.

SEIAPI Secretary's visit to Suva, Fiji (May 2022)

Article By: Geoff Stapleton (GSES)

The SEIAPI secretary, Mr. Geoff Stapleton travelled to Suva, Fiji on Sunday 22nd May and departed on Saturday 28th May. Over twenty meetings were undertaken, and Mr. Geoff Stapleton was accompanied by Mr. Sandip Kumar (SEIAPI Secretariat) at the meetings.

(SEIAPI Executive members' meeting with FCCC)

SEIAPI Executive committee member, Mr. Peter Johnston attended the meetings with Austrade, USAID and FCCC.

(SEIAPI Executive Mr. G. Stapleton with APTC Representatives)

Meetings were undertaken with: Pacific Power Association; Pacific Community (SPC);USP Pacific TAFE; The European Union; Department of Energy; The Fiji Department of National Trade Measurement and Standards; Energy Fiji Limited; NZ Ministry of Foreign Affairs and Trade; Australian Pacific Training Coalition (APTC); Committee member of Office of the Pacific Energy Regulatory Alliance (OPERA); Australian Austrade; US State Department; Fiji Competition and Consumer Commission (FCCC); Global Green Growth Institute (GGGI); Fiji Institution of Engineers; Pacific Nationally Determined Contributions (NDC) Hub; Fiji Higher Education Commission and Centre for Appropriate Technology.

Though some meetings had a focus just on establishing the sustainable energy training centre, the general discussions at each of the meetings were to:

- Provide brief background on SEIAPI.
- Raise awareness of the following:
  - Accreditation Scheme that was launched in 2012 but has not taken off because of lack of training availability in the region since obtaining accreditation requires the

person to complete an accredited training programme.
  - 5 Technical Guidelines on RE first developed in 2012 and that these were updated and 11 more were developed so that meant 16 Technical Guidelines in total are now available.
  - 19 micro qualifications (training unit standards) were developed and accredited on PRQS—however we have found that no country we have worked with so far accepts those in the PRQS and must still get approved within the relevant country training framework.
- Advise that through SEIDP we had conducted thirty-four 4-day workshops across 13 countries and hence had built momentum and then the Covid-19 pandemic struck.
- Advise that it has been hard raising profile of SEIAPI across the Pacific because it is run by volunteers
- That SEIAPI is now working country by country to:
  - Establish what is required to have the technical guidelines endorsed within that country.
  - Establish how to have the accreditation program accepted (explaining how it works in Australia and USA) or another option would be to develop a "solar license" which SEIAPI could support. In either model, the key thing is that the individual must undertake training before getting accredited or acquire a license.
- Similarly, SEIAPI is approaching donors to have them included within any relevant project that systems must be designed and installed in accordance with the guidelines and by accredited designers/installers.

The SEIAPI secretariat believed it was a successful week and they are now working on many action items that resulted from the meetings.

Mr. Stapleton is planning a visit to Vanuatu in July and to more countries as the borders reopen.

Akuo commissions the South Pacific's largest storage project

(Article extracted from Akuo's Press Release)

Battery Energy Storage System in Tonga

Akuo, an independent global renewable energy power producer and developer, and Tonga Power Limited, the Tonga Islands' public grid operator, announce that they commissioned Tonga 1 & 2, the South Pacific's largest battery energy storage system with a total capacity of 29.2 MWh / 16.5 MW.

A stationary battery services

The two battery storage facilities use Storage GEM®, the innovative modular energy storage container technology developed by the Akuo Group. A total of 8 such containers have thus been deployed on Tongatapu, the Tonga archipelago's main island: three Storage GEM® for Tonga 1 and five for Tonga 2. Because of the global public health crisis, the deployment of these two projects on behalf of Tonga Power Limited, signed in July and November 2019 respectively, was in large part steered remotely, helped by the substantial adaptability of the methods used and the site's organization. The containerized technology, entirely checked on test benches in the factory, easily lent itself to remote deployment.

A resilient set-up that has already proven itself during the volcanic eruption of January 2022

These two facilities have already had an opportunity to prove their resilience. Indeed, the volcanic eruption of January 15th, which resulted in a tsunami that devastated the archipelago's coastline and cut the country off from the rest of the world, did not affect their ability to function correctly, enabling these facilities to continue operating and help stabilize the grid in the days following the catastrophe.

Better penetration of renewable energies in the archipelago's energy mix

Previously, the Kingdom of Tonga's renewable energy capacity (3 solar farms and 1 wind farm) totaled 5.6 MW, an electricity mix penetration rate of just 10%. These two facilities provide direct support to the grid and provide Tonga Power Limited with facilitated steering thanks to the customized EMS (Energy Management System) developed by Akuo. The Tonga 1 facility, with a capacity of 5.3 MWh / 9.3 MW, is designed to improve the grid's stability, while Tonga 2, which has a greater capacity of 23.9 MWh / 7.2 MW, is designed for load-shifting. Together, they meet Tonga's need to strengthen its storage capacity in order to support the increase in the percentage of renewable energy in its electricity mix and are contributing to the islands' goal of increasing the share of renewables to 70% by 2030. They have already allowed Tonga to double its renewable energy capacity, with the connection of 6 MW of solar supported by a private partner. The installation of these facilities was made possible by the "Tonga Renewable Energy Project" program, financed by the Green Climate Fund (56%), the Asian Development Bank (23%), the Tongan government (10%), Tonga Power Limited (6%) and the Australian government (5%).

Sealing Conduits for Resilient Electrical & Telecom Systems

(Article extracted from PPA Magazine Volume 30 Issue 2)

Natural disasters such as hurricanes, cyclones, tsunamis, floods, tornados, and bushfires are examples of extreme weather that wreak havoc on people's lives, homes, and businesses and impose serious consequences on society. Consumers are typically unaware of behind-the-scenes work required to provide reliable power and digital access, but outages bring instant and unwanted focus.

Severe weather events are increasing the need to seal out water. Power and communication outages are costly not only due to the loss of the essential utility services during the disaster, which are considered mission critical, but require resources and time to make post disaster repairs. System reliability during floods to support critical infrastructures such as hospitals, police, fire and emergency and agencies is important to public safety. The investment in systems that reduce risk and exposure and increase the resiliency of the system will be beneficial in both minimising direct cost and indirect cost of floods and storms on utility networks.

Blocking water by choosing a reliable sealing technology

Flooding causes more economic damage than all other types of weather events. Sealing underground networks from flooding is an effective means of protecting valuable electrical and communication assets. High winds, heavy rainfall, and storm surges generated by hurricanes and cyclones combine to produce large volumes of floodwater that degrade the operational capacity of a system. This is especially true in urban areas where underground networks are susceptible to flooding. Protecting these valuable networks from water penetration is a top priority.

Sealing technology protects infrastructure from flooding and comes in many forms. There are advantages and disadvantages among sealant choices, which we explain below:

• Low-cost, mastic putty is an age-old sealant with limited sealing performance. It does not hold water or air pressure.

It is susceptible to sagging at higher temperatures and deforms when cables are moved.

• Cement/mortar, grout, and Plaster of Paris are also historical sealants. The lack of available water for onsite mixing makes them inconvenient. Their extended reaction or setting times can further complicate installation.

• Pre-engineered mechanical seals perform well. They resist high water head and gas pressure, are easily removed, and help support cables; but they can be challenging in complex cable or high-conduit-fill configurations.

• Two-part, closed cell expanding foam is an excellent choice. High-performance foams readily adapt to varied configurations, remove easily for future access, and offer robust chemical resistance. Foam selection is key, as the chemistry varies.

• Epoxy mortar can be used as a sealant or coating, particularly for cracks and small imperfections. It has strong water and chemical resistance. Epoxies are typically high in viscosity and require trowel application.

Tuvalu 100% Renewable Energy Target

Article By: Mafalu Lotolua

General Manager, Tuvalu Electricity Corporation (TEC)

Aerial Photograph of the 77kWp Solar PV Systems at Nukufetau Island

Introduction

Tuvalu is one of the countries that is 100 percent depended on diesel fuel for its power generation. In 2008 during the World Financial Crisis, the Tuvalu Government set a target of 100 percent renewable energy for its electricity power generation.

In achieving the target of the government of Tuvalu the 10-Year Master Plan was born in 2012. The Plan has two stated goals; (i) to generate electricity with 100% renewable energy by 2020; and (ii) to increase energy efficiency on Funafuti by 30%

The 100% target is guided by the REEE Master Plan, which is directly linked to the Tuvalu National Sustainable Development Plan (Te Kakeega III) and so now called the “Te Kete”, the Climate Change Policy (Te Kaniva), and the Tuvalu National Energy Policy 2009.

The Master Plan has identified the most proven and mature technologies for Tuvalu to meet its target and the Implementation Strategies are as follows:

- 60-95% - Solar
- 0-40% - Wind
- 5% - Biodiesel
- 30% - Energy Efficiency

Solar

In 2015 a major transition took place in the power generation of the seven outer islands of Tuvalu from diesel-based power generation to hybrid power system which includes solar PV/battery storage/generator systems were commissioned with total capacity of 1,212kW of solar PV with storage capacity total to 244,020Ah, which provide the communities with 24/7 power supply. A total capacity of 756kW grid-connected solar PV was installed in Funafuti, of which 436kW is controlled with SMA Fuel Saver and 320kW uncontrolled – feeding directly into the grid. The European Union (EU) funded the installations in three of the islands and New Zealand Ministry of Foreign Affairs and Trade (NZMFAT) funded the other four.

The percentage of the overall share of renewable was at 29% at that time and in recent times the percentage share of renewable energy has been decreased significantly because from the significant increase of demand and the ageing of the equipment.

On walking the road toward the 100% mark, Tuvalu is not doing it alone, it is doing it with the assistance of the donor community. The World Bank would install 700kWp ground mounted solar PV and 1MW/2MWh and 500kW roof-top solar PV and 1MW/3MWhr by ADB. The ADB also fund additional 224kW solar PV in three of the outer islands. It is anticipated that when the World Bank project is commissioned the share of renewable will increase to 37% and further increase to 49% once the ADB project is commissioned.

The Facilitation of the Achievement of Sustainable National Energy Target of Tuvalu (FASNETT), a GEF Funded Project in Tuvalu provides financial assistance for the installation of a 100kWp grid-connected Floating Solar PV (FSPV) demonstration project in Funafuti. The project is under progress and lesson learnt from this demonstration will improve future development of FSPV projects.
With the limited land space Tuvalu is facing, it will not be able to achieve its target. So, the TEC is now moving towards in exploring the use of building rooftops and also floating PV in the lagoon. At present, solar PVs have been installed in few rooftops in Funafuti and all are working perfectly.

Wind

Tuvalu was a participant of the Pacific Power Association Sustainable Energy Industry Development Project (P152652) funded by the World Bank. The project is to install the solar and wind measurement stations. The stations were installed in Tuvalu early in February 2020. The wind station was removed in June 2021 and the solar station was removed in March 2022. These stations were removed to move to another country. The data for the monitoring is under analysis and it will soon be published.

Energy Efficiency

Energy Efficiency is also important to avoid additional renewable energy generation. The Energy Efficiency Act has been endorsed by Parliament in April 2016 and this will restrict the importation of five non-efficient appliances into the country, this includes refrigerators and chest freezers, air-conditioning unit, lights and washing machine. There are activities under the energy efficiency portfolio that covers by various donors and are all contributing to the achievement of the 30% as stated in the Master Plan.

The Development Bank of Tuvalu has received additional financing from the FASNETT project for the community to access the funding for the procurement of more energy efficient appliance.

Conclusion

As power generation become convenient and reliable, it increases the need to use more household electrical appliances. The transition to renewable energy in 2015 TEC saved around 80% of its diesel consumption in the outer islands. As time passes, the demand increases and the equipment ages, and the diesel consumption increased.

Walking the road to the 100% mark is not an easy task and there are challenges along the way like, technically by using storage or limit the maximum output of solar/wind generation so the maximum limit is not exceeded under brief periods when there are wind gusts or the shine fully. Also, the high level of RE penetration, there are challenges associated with that will raises the potential interconnection and challenges associated with system safety, reliability and imbalance and demand, just to name a few.

The 100 percent renewable energy target was set to be achieved by 2020 and then was extended to 2025. Because of the COVID-19, the delivery of the two large Utility Scale Project that were funded by the World Bank and the Asian Development Bank were delayed thus affect the contribution of increasing the share of renewable energy to the achievement of the 100 percent target. The Government is now working on setting the new date for the achievement of the RE 100 percent target for Tuvalu.

In conclusion, achieving the 100 percent target would be possible if Tuvalu walk together with the donor community. As the saying goes; "If you want to Walk Fast, Walk Alone and if you want to Walk Further, walk Together".

Battery Storage at Outer Islands of Nanumea.

SEIAPI Plans for Monthly Online Workshops

The SEIAPI Secretariat had been brainstorming on organizing professional development initiatives and knowledge sharing sessions for its members where the designers, installers and technicians could participate to further improve their knowledge on their day-to-day work and also engage in forums where issues commonly affecting the members could be further deliberated upon. It is envisioned that the 1st knowledge sharing session will commence in July and will be delivered by Mr. Bruce Clay and it will be followed by other reputable and experienced speakers.

The SEIAPI industry members, engineers and tradesman are requested to participate in these sessions and raise constructive issues through the medium available. At this point in time, it is planned to be conducted online on ZOOM. An invitation will be sent to SEIAPI members where interested persons will be required to register for these events and a ZOOM link will be sent to all those who register.

These sessions will be about half an hour to one hour long.

A tentative layout has been prepared as shown in the table below.

Interested people will be informed of the updated schedule once confirmed.

Table 1: Tentative Webinar schedule

Month	Topic	Presenter	Webinar/Knowledge sharing
22nd July	Software in PV Design	Bruce Clay (Clay Energy)	Knowledge sharing
26th August	Cable management ideas	PCS	Knowledge sharing
16th September	TBC	TBC	Webinar
14th October	Oversizing arrays in off grid PV System	Geoff Stapleton (GSES)	Webinar
11th November	Safety Aspects & Servicing of the Solar Projects	Pawan Bajpai (Narhari Electrical)	Knowledge sharing
9th December	SEIAPI Accreditation Scheme – How do I get accredited?	Sandip Kumar (GSES)	Webinar

Note: The above is a tentative schedule and is subject to change based on the preference/availability of the presenters.

For any queries, comments and suggestions, email us on secretariat@seiapi.com or info@seiapi.com or admin@seiapi.com

Technical Article

PV overcurrent protection changes from AS/NZS 5033:2014 to 5033:2021

(Credit: GSES Australia)

The requirements for DC overcurrent protection seem to have changed a lot in the AS/NZS 5033:2021 update upon first glance. But most of these changes are just rearrangement and new notation. This article will explain the new requirements.

AS/NZS 5033:2021 requirements

The requirements for overcurrent protection are still covered in Clause 3.3.3 in AS/NZS 5033:2021, but cross-referencing between different sub-clauses becomes important.

Clause 3.3.3.1 explains how to calculate the maximum expected string current, which is used in Clause 3.3.3.2 to calculate the potential string fault current, Clause 3.3.3.3 to calculate the potential sub-array fault current, and in Table 3.1 to calculate the various overcurrent protection ratings.

The calculation of potential string fault current in Clause 3.3.3.2 is then used in Clause 3.3.4.1 to determine if string overcurrent protection is required. There are no explicit requirements to test whether sub-array and array overcurrent protection is required.

Clause 3.3.5 and Table 3.1 gives the sizing requirements for string, sub-array and array overcurrent protection, using values calculated from the previous clauses.

One of the reasons for the rearrangement of clauses in AS/NZS 5033:2021 is accommodating the introduction of DCUs (DC conditioning units) into the calculations. Clause 3.3.3.1 offers three different methods for calculating the maximum string current $I_{STRING\ MAX}$, depending on the presence of DCUs within the string.

Maximum string current where there are no DCUs (3.3.3.1a):

$I_{STRING\ MAX} = 1.25 \times K_I \times I_{SC\ MOD}$

This is analogous to the AS/NZS 5033:2014 formulas.

Maximum string current where all PV modules have DCUs attached (3.3.3.1c):

$I_{STRING\ MAX} = I_{DCU\ string\ max}$

Maximum string current where only some PV modules have DCUs attached (3.3.3.1b):

Whichever of the previous two formulas gives the larger result.

The sizing requirements in Table 3.1 for all three types of overcurrent protection are then based on the calculated $I_{STRING\ MAX}$.

String overcurrent protection sizing I_n must comply with:

Where there are no DCUs:

$1.2 \times I_{STRING\ MAX} < I_n \leq I_{MOD\ MAX\ OCPR}$

Where all PV modules have DCUs attached:

$I_{STRING\ MAX} < I_n \leq I_{DCU\ OCPR}$

Where only some PV modules have DCUs attached:

Comply with both of the previous two formulas.

Sub-array overcurrent protection sizing I_n must comply with:

$I_n \geq S_{SA} \times I_{STRING\ MAX}$

Array overcurrent protection sizing I_n must comply with:

$I_n \geq S_A \times I_{STRING\ MAX}$

To work out whether string overcurrent protection is required, an additional calculation of potential string fault current is required, as per Clause 3.3.3.2.

Potential string fault current:

$I_{F\ STRING} = (S_A - 1) \times I_{STRING\ MAX}$

If there is only one string, $I_{F\ STRING} = I_{STRING\ MAX}$.

Whether string overcurrent protection is required, as per Clause 3.3.4.1, is then based on $I_{F\ STRING}$.

String overcurrent protection required if:

$I_{F\ STRING} + I_{BF\ TOTAL} > I_{MOD\ MAX\ OCPR}$

Clauses 3.3.4.2 and 3.3.4.3 don't specify situations in which sub-array and array overcurrent protection would be required, just that if they are not used, the cable size will need to be larger as per Clause 4.4.2. Inclusion of sub-array and array overcurrent protection therefore becomes an economic decision, balancing the cost of protection against potentially larger cables. For more information refer to the GSES full technical article available at https://www.gses.com.au/5033-overcurrent-protection/