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SEIAPI
Sustainable Energy

Newsletter of the Sustainable Energy Industry Association of the Pacific Islands

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Correct design of Solar PV systems fairs well during Cyclone Winston

On February 20th Sever Tropical Cyclone Winston a Category 5 cyclone passed through Fiji causing an estimated US$1 billion in damage and the loss of 44 lives. Over 30,000 homes were damaged or destroyed and roughly 40% of Fiji's population were significantly impacted.

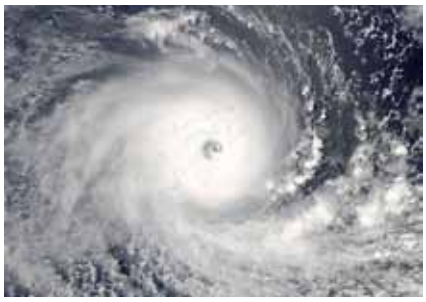
Solar PV systems are utilised throughout Fiji and particularly off-grid for the many islands not serviced by utility grids. Correct engineering design of PV array frames and associated structures (including buildings for roof mount) for cyclonic loading generally faired well in the extreme conditions.

Estimated 1 minute sustained winds in the eye area were 285 km/h (79 m/s or 154 knots) with a recorded maximum wind gust of 306 km/h (85m/s or 165 knots). TC Winston was the strongest tropical cyclone to make landfall in the South Pacific Basin in recorded history and one of the strongest ever worldwide.

Bruce Clay, Managing Director of Clay Energy, commented that with recorded gusts of up to 85m/s it would be expected that the wind speeds experienced by some PV installations close to the eye exceeded their design wind speeds by up to 20%. Despite these extreme wind speeds minimal damage was seen on correctly engineered arrays (and buildings) based on AS/NZ1170.2:2011 and the current Fiji Building Code with a regional wind speed of Vr 70m/s (3 second gust) and use of site specific exposure multiplier.

Several telecommunications sites had array damage from flying debris and structural failure associated with the extreme wind speeds above design loading including up to 20 antenna towers damaged. Being located generally on hill top these telco sites can experience wind speeds 30% higher than the coast.

The photos below show the 9kWp system



at Nasau Village on Koro Island before and after the cyclone. Koro Island experienced the peak intensity of the cyclone wth the eye passing directly over the island. Whilst the extreme wind speeds caused major structural failures the associated sea surge reported as being around 3 meters compounded the destruction in the coastal communities.

Source: Wikipedia, Clay Energy

TECHNICAL TIP

The SEIAPI/PPA technical guidelines (available from website) were written in 2011/2012 and are due to be updated this year. However all future issues of the newsletter there will be a technical tips section.

This issue we cover some key tips that are based on the AS/NZS5033-2014 a-Installation an Safety Requirements for photovoltaic Arrays and the IECT /S62548 Photovoltaic Arrays- Design Requirements.

PV Array maximum Voltage

The PV array maximum voltage is considered to be equal to open circuit voltage of the array corrected for the lowest expected operating temperature, which is usually the temperature in the early morning.

The open circuit voltage (Voc)of the array is obtained by multiplying the open circuit voltage (@STC) of a module by the number of modules in the string.

The temperature corrected voltage could be calculated using the Voc temperature co-efficient of the selected module.

Note: STC is Standard Test Conditions

There is a formula for calculating the voltage however the standards provide temperature correction factors.

The temperature correction factors that would be relevant for the Pacific are as follows:

Lowest Expected Operating Temperature °C	Correction Factor
20 to 24	1.02
15 to 19	1.04
10 to 14	1.06

Example:
Voc of selected module =38.1 V
Number of modules in a string = 20
Lowest Expected Temperature = 18 oC

The PV Array Maximum Voltage = 20 x 38.1 x 1.04 = 792.5V

Voltage Rating of Cables, Isolators and Switch Disconnectors

All cables, isolators and switch disconnectors shall be rated for the maximum array voltage.

Cables used within an array

All PV arrays with a PV Array maximum array voltage greater than 120V DC shall comprise single core double insulated multistranded solar cables as shown in Figure 1.. These cables will have solar DC and their voltage rating marked on them and comply with one of the following three cable standards:

- PV1-F requirements
- UL4703 or
- VDE-AR-E 2283-4

PV1-F cable requirements are found in the documents TUV 2PfG 1169/08.2007

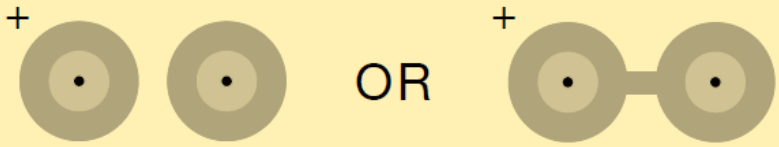


Fig 1. Multistranded, Single Conductor Cable bot Insulated and Sheathed.

Introducing lithium-ion batteries

IT Power (ITP) has been using battery energy storage to optimise the design of remote photovoltaic (PV) diesel hybrid mini grids around the world for 35 years. Batteries are used for a range of purposes. For example, in small installations they can be used for maintaining power quality while larger battery installations are used for peak-shaving and bulk energy storage.

For decades lead-acid technologies have been the industry standard. Flooded lead-acid batteries are used, for example, in the four megawatt hour battery system which Powersmart Solar and ITP installed (together with 1 megawatt of PV) on Tokelau in 2012.

Competing energy storage technologies are appearing on the market, however, especially lithium-ion batteries.

Lithium-ion battery manufacturers claim their technology has a number of benefits compared to lead-acid batteries. These include

- higher efficiency - a typical lead-acid battery will deliver 75-80% of the energy that was input during charging, compared to around 95% for a lithium-ion battery
- that they can be discharged further; lead-acid batteries should not be regularly discharged more than 30%, compared to 80% for lithium-ion batteries
- longer lifetimes (measured in charge / discharge cycles)
- greater tolerance to high temperature environments than lead-acid batteries
- lower risk of gas explosions, since no hydrogen is produced
- lighter and more compact for the same energy capacity (a feature that is highly relevant for remote installations).

While lithium-ion batteries currently have a higher upfront capital cost than lead-acid technology, our analysis indicates that the claims of longer battery lifetime and better performance in hot conditions could result in lower overall project costs, and therefore a lower system levelised cost of energy. It is also notable that the capital cost of lithium-ion technology is likely to decrease as production volume increases. Lead-acid battery technology by contrast is a mature technology with relatively stable prices.

A significant barrier, however, is that energy system designers and end-users are reluctant to transition to new technologies, especially for remote applications, where reliability is critical. In part this reticence is due to uncertainty over manufacturers' claims, which often rely on lab-based tests and lack independent verification.

It is also notable that the capital cost of lithium-ion technology is likely to decrease as production volume increases.

To reduce this uncertainty ITP are developing a three-year lithium-ion battery performance test. The testing will take place at the Institute of Technology in Canberra, Australia, and is supported by a $450,000 grant from the Australian Renewable Energy Agency.

The project aims to provide investor information and confidence by independently assessing the performance of six major lithium-ion battery brands, an 'advanced' lead-acid battery and a conventional lead-acid battery side by side in hot daytime and cool overnight temperatures similar to what they would be expected to face in real-world conditions.

Each battery will be cycled (charged and discharged) several times per day, albeit within the manufacturers' specifications, and testing will measure the batteries' decrease in storage capacity over time.

If the battery trial successfully demonstrates that lithium-ion and or advanced lead-acid technology is both more reliable and or cost-effective compared to traditional lead-acid batteries, then we would expect an increase in the use the new technologies both in remote off-grid systems as well as in on-grid applications. This would have the effect of facilitating an increase in the proportion of electricity derived from renewable sources.

RESPONSE TO SEIAPI SURVEY MARCH 2016

How can SEIAPI Improve?

Create and publicize an on line library of downloadable documents relating to renewable energy in the islands. There are lots of reports and training materials in the public domain that could be included and would be useful to people wanting to learn more about how to do renewables both in government and in the private sector though they would need to be vetted to be sure they are appropriate for the islands environments. I would be glad to contribute materials from my collection if such a library were to be created and possibly could help in preparing summaries of each paper for the library's index.

Work the talk.

Communication could be improved – both internal and external. Members engagement – our impression is that member do not interact much at this stage, having access to other members would be good when memberships have been updated.

It will serve the industry better when we get more support for admin and its less reliant upon people with full time jobs and other commitments. I think the World Bank/PPA grants that are in the pipeline will be really beneficial.

Raise its profile within the various countries and in particular with government departments and related industries. Better communication with the members by the committee and also between the members. Have staff so that more can be done.

Use the associations mission and objectives to provide focus for SEIAPI. Raising awareness of the regional SE industries capabilities and looking at how to develop an enabling environment for developing SE business. Communications and providing information and developing relationships with stakeholders in the region are important.

List 2 or 3 priorities SEIAPI should focus during next 12 months?

Prepare an online or face-to-face training program to help persons interested in doing business in the islands that covers non-technical issues (bookkeeping, taxes, management, organization, etc.) since most businesses I know of that have failed have failed not so much because of a lack of technical knowledge (though that can be a definite issue) but rather because they did not know how to manage their resources as a business. There are lots of materials available online that could be brought together to make such a training. Again, I would be glad to help if such a program were to be created. In particular I foresee a need for local businesses to engage in maintenance of mini-grids in rural areas. So far, utilities have been the only ones that have successfully kept rural mini-grids going but in many countries the utility is not willing or functionally able to take on that responsibility (e.g. Kiribati, Vanuatu, Solomons, etc.). How to structure such a business would be a good thing to develop.

Office manned, provide training and Certification in PIC, set network supply for one stop shop for PIC – (standard and labeling).

Get stronger financially. Start preparing transformation plan on how to move SEIAPI from initial stage (voluntary based organization) to more mature organization.

Becoming accepted across all energy ministries and utilities in the Pacific as the body for installation and design standards as well as the certifying body for technicians working on grid and off grid PV.

Increasing membersship numbers within the Pacific (Industry) and also the associate membership. Workshops within countries which serve the members but also raises the profile.

Raising the visibility of the association and its work through newsletters and taking advantage of any opportunities that are financially viable to promote the association such as trade shows, etc. Promotion and roll out of the accreditation scheme in conjunction with regional training projects underway by others. Provide more technical and business information for members which may also include training components.

What activities do you want SEIAPI to do for you?

Develop fairly detailed 'standard' designs for modular SHS and modular mini-grids and make those designs available for use in the islands by anyone that wants to develop SHS or mini-grids for rural areas. NZ has such a design for mini-grids that is being used in the Cook Islands and Tuvalu to convert outer island diesel grids to solar and the Palau development bank has a basic design for a multi-level SHS that can start at 200W at12V for minimal services and be developed using mostly the same components to a multiple kW 48V home AC system. I can provide some details of those approaches if there is interest.

Organize In country (PIC) training for SIEAPI members.

More opportunities to network between members.

I would like SEIAPI to grandfather people with equivalent/suitable expertise into their scheme. That being said, I have not done enough for SEIAPI on many fronts due to being busy, so I don't want to be critical and understand that progress is volunteer driven, and is relative to the time that people can put in.

Provide training workshops particularly for technical/trade staff.

What issues is your business facing in your country/region which you want SEIAPI support and help?

Continue to work with PPA and others to provide training in renewable energy implementation. Funding needs to be sought through development of good quality project proposals.

Organized Specialized product training (SMA Inverters).

We are covered here in NZ, but in general you can't have enough training, especially for new installers, both with general solar and specific product training.

Education of customers about the pitfalls of poor quality equipment, targeted at batteries. It would be good to do an educational push behind the merits of different battery technologies and telling customers how to choose the battery that is right for them.

Assistance in lobbying on the removal of duty on batteries reintroduced last budget to protect the local battery manufacturer.

Do you want SEIAPI to help in discussions with Government Departments or Utilities in your country/region?

Include energy efficiency in SEIAPI programs since it should always be closely integrated into renewable energy projects.

Yes but on approved products to reduced fake or sub standard supplied in PIC.

We are also covered at this stage by other organisations in NZ at this stage.

This would be good, but hasn't affected my business to date.

Continue to work with PPA and others to provide training in renewable energy implementation. Funding needs to be sought through development of good quality project proposals.

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