Report for

Secretariat of the Pacific Community

Proposed Guidelines, Standards and Regulations for Renewable Energy Generation Systems Connecting to the Palau Central Grid

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Guidelines, Standards and Regulations

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Glossary of Acronyms

A	Amperes, unit of electrical current (Amps)
AC	Alternating Current
AWG	American Wire Gauge
°C	Celsius - temperature
CCC	Current Carrying Capacity
DC	Direct Current
Hz	Hertz – frequency cycles per second
I_{sc}	Short circuit current (amps)
$I_{sc\ array}$	Short circuit current (amps) of PV array
$I_{sc\ mod}$	Short circuit current (amps) of PV module
$I_{sc\ sub\text{-}array}$	Short circuit current (amps) of PV sub-array
I_{mp}	Maximum power point current (amps)
ICC	International Code Council
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IP	Ingress Protection
kVA	kilovolt-amperes (1 kVA = 1 kW AC at a power factor of 1.0)
kWh	kilowatt.hours (energy 1 kWh = 3.6 megajoules)
kWh/m^2	kilowatt.hours/metres squared
MEN	Multiple Earth Neutral
NEMA	National Electrical Manufacturers Association
NEC	National Electrical Code (USA)
PPUC	Palau Public Utilities Corporation
PV	Photovoltaic
PSH	Peak Sun Hours (kWh/m^2)
RE	Renewable Energy
SPC	Secretariat of the Pacific Community
UL	Underwriters Laboratory
V	Volts
V_{mp}	Maximum power point voltage (volts)
V_{oc}	Open circuit voltage (volts)
W	Watts (instantaneous power – one joule per second)
Wh	Watt.hours (energy)
W_p	Watts peak (solar PV modules are rated at 1,000W/m^2 incident light and 25°C)

1 Introduction

These Guidelines refer to the installation of renewable energy (RE) generation systems, (solar photovoltaic (PV) and wind turbines) up to 100kVA connected to the Palau Public Utilities Corporation (PPUC) central grid supplying Koror and Babeldoab.

For solar PV, wind and other RE generation systems above 100kVA, parts of these guidelines may still be relevant. However, the connection requirements to the electricity distribution grid will need to be negotiated with PPUC and may be different to that described in these guidelines.

1.1 Residential Solar Photovoltaic Systems

A typical household solar PV system is illustrated in the following figure.

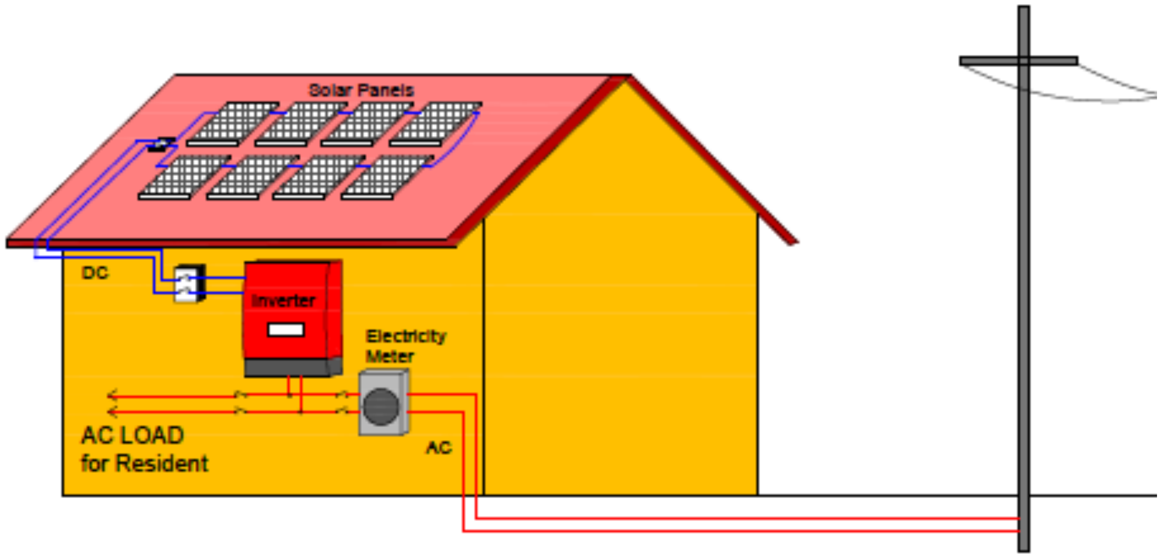

Figure 1: Typical household, grid-connected solar PV system

A PV string is a group of solar photovoltaic modules (panels) wired together in series generating direct current (DC) electricity when exposed to sunlight. A PV array can consist of one or more PV strings and is typically secured with a mounting frame.

The grid-connected inverter converts the DC electricity to alternating current (AC) electricity and ensures the Voltage matches that supplied by the electricity distribution network (the grid). If electricity from the grid is switched off or fails, the inverter will shutdown for safety reasons.

This AC electricity is used to meet all or part of the load of the house with any excess exported to the grid. A dual-element electronic meter can measure the cumulative ‘net import’ and ‘net export’ over the billing period. Alternatively, two meters can be used for measuring imports and exports separately.

A solar photovoltaic system is a powerful electricity generator. Both DC and AC electricity are potential fatal hazards and fire risks. Solar PV systems must be designed and installed by appropriately qualified people. Protection devices, including both DC and AC isolators plus circuit breakers are required for safety, emergency shutdown and to enable maintenance.

2 Standards

All RE generation systems shall be installed in accordance with:

- the USA 2011, National Electrical Code® ; and
- IEEE 1547: Standards for Interconnecting Distributed Resources with Electric Power Systems.

All RE generation systems must interconnect with the grid via an inverter.

Details of specific standards for interconnection, photovoltaic modules, wind turbines, inverters and other components are contained in Appendix A: Standards.

3 Size of renewable energy generation systems

If the RE generation system is providing single phase power only, the AC maximum nominal rating of the inverter shall be 5kVA.

If the RE generation system is providing three phase power, the generation system should be balanced across the three phases. If balancing across the three phases is not able to be done, the maximum variation between the phases shall be 5kVA.

4 Connection of inverters to the utility supply

For single phase RE generation systems, interconnection as detailed in Sections 4.1, 4.2 and 4.3 is required. The 5kVA limit should be sufficient for the size of the service supply to the building/site, however this limit will be confirmed at the time of application.

For larger three phase RE generation systems, the size of the service connection may or may not be sufficient for the size of the proposed generation system.

If the service connection is sufficient, the interconnection as detailed in Sections 4.1, 4.2 and 4.3 is required.

If the service connection is not able to be satisfied, the customer may be required to upgrade the service to the building/site. This upgrade might include increasing the size of the wiring and/or the transformer. Following this upgrade, the interconnection as detailed in sections 4.1, 4.2 and 4.3 is required.

If the service connection is not suitable for such an upgrade, the renewable system may have to be connected directly to the distribution system via a transformer of a higher voltage. This would require negotiations with PPUC.

4.1 Single family dwelling (accommodation) or multifamily accommodation

The RE generation system's AC output supplied by the inverter shall be connected to the load side of the 'grid supply's service disconnecting means' at any distribution equipment locations at the premises. This is known as the point of common coupling.

Where distribution equipment includes switchboards and/or panel boards which are fed by both the grid supply, (primary source) and one or more utility interactive inverters, the point of common coupling will be on the customer side of the utility meter. The connection point must allow the installation of switchgear, and all protection devices or separate distribution equipment (switchboards) must be mounted beside the existing equipment.

In a single dwelling there typically will only be one main switchboard to which the inverter output will be connected.

4.2 Commercial building/site

The RE generation system's AC output supplied by the inverter shall be connected to the load side of the 'grid supply's service disconnection means' at any distribution equipment locations at the premises. This is known as the point of common coupling.

Where distribution equipment includes switchboards and/or panel boards which are fed by both the grid supply (primary source) and one or more utility interactive inverters, the point of common coupling will be on the customer side of the utility meter. The connection point must allow the installation of switchgear, and all protection devices or separate distribution equipment (switchboards) must be mounted beside the existing equipment.

In a commercial building, depending on it physical size, there could be many distributions boards located throughout the site. In this case, the inverter output can be connected to the main switchboard or any of the other distribution boards.

4.3 Renewable energy generation system disconnecting means

At the point of common coupling, the output from the RE generation system's supply inverter must be a dedicated circuit breaker or fusible disconnecting means, (NEC Article 705.12).

The connection in the panel/switchboard via the inverter shall be positioned at the opposite end (the load end) from the input feeder or main circuit location.

On the distribution board to which the inverter is connected, there shall be a sign indicating that there are multiple sources supplying that distribution board and these sources should be listed.

Since the circuit breaker (or fusible disconnecting means) is also being used as a disconnector, and not just for cable protection, it shall be:

- Rated for the full current of the inverter;
- Externally operable without exposing the operator to contact with live parts;
- Simultaneously disconnect all ungrounded conductors;
- Plainly indicate whether it is open (off) or closed (on); and
- Capable of being locked in the open (off) position.

A disconnector being lockable does not mean it needs a padlock or similar function. It means that it is able to have a tag or small plastic locking device inserted to allow a person to work on the system safely. The intention is that the disconnector locking device should include the use of a tag/sign saying:

DO NOT SWITCH ON - PERSON WORKING ON SYSTEM

A permanent label shall be mounted on the distribution equipment with the following or equivalent wording:

WARNING

INVERTER OUTPUT CONNECTION

DO NOT RELOCATE THIS OVERCURRENT DEVICE

5 Inverters

Ideally the inverter shall be located in a readily accessible location. However, the NEC does allow the inverters to be located in any suitable location such as exterior areas or on roofs provided all the requirements listed in Section 5.4 of these Guidelines are met.

If the inverter enclosure is not weatherproof, ('weatherproof' equivalent of an IP 54 rating or the equivalent NEMA rating), the inverter/s should be located either inside a building or in an appropriate weatherproof enclosure. The inverter heat sink must be positioned so that it is clear of any obstacles to facilitate cooling of the inverter. The manufacturer's recommendations for these clearances must be followed.

If the inverter is designed to be installed behind the PV module (that is an AC module), consideration should be given to adequate ventilation and to the ease of component replacement in the event of an inverter failure. Note: Article 690.6 lists the requirements for the installation of AC modules.

5.1 DC disconnecting means

A suitably rated DC disconnecting means shall be mounted within sight of the inverter. This could be integral to the inverter or separate to it.

For current and voltage ratings refer to Section 8 for solar PV systems and Section 9 for wind generator systems.

5.2 AC disconnecting means

A suitably rated AC disconnecting means shall be mounted within sight of the inverter. If it is in line of sight of the inverter, this could be the RE generation system's disconnecting means as detailed in Section 4. The rating shall be based on the output rating of the inverter.

5.3 Signage

In accordance with NEC Article 705.10, a sign shall be located at the inverter. This sign shall list all the electric power sources for the site. As an example for a site having a solar PV system, a sample sign would be:

This building is supplied by utility electric power and solar electric power.

5.4 Requirements for inverters not in a readily accessible location

NEC Articles 690.14(D) and 705.70 state that inverters can be installed on a roof or exterior area provided the installation complies with the following:

a) A DC disconnecting means shall be mounted within sight or on the inverter.

b) An AC disconnecting means shall be mounted within sight or on the inverter.

c) An additional AC disconnecting means shall be installed in a readily accessible location, either on the outside of the building or structure or inside the building as close as possible to the point of entry of the system conductors.

   This disconnecting device shall be:

   - Rated for the full current of the inverter;
   - Externally operable without exposing the operator to contact with live parts;
   - Simultaneously disconnect all ungrounded conductors;
   - Plainly indicate whether it is open (off) or closed (on); and
   - Capable of being locked in the open (off) position.

d) Signage as per 5.3 shall be located at the inverter.

6 Metering

A meter shall be installed in series with the existing meter as shown in Figure 1. The purpose of this meter is to record the energy which is supplied from the RE generation system to the grid.

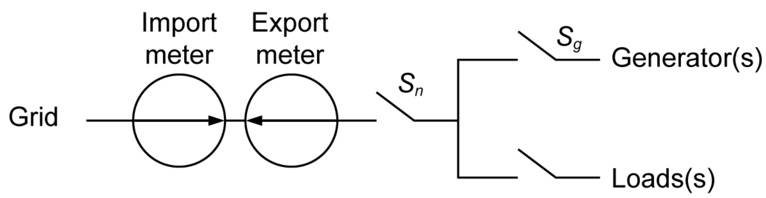

Figure 1: Schematic of separate import and export meters

The existing meter could be replaced by a dual electronic meter as depicted in Figure 2.

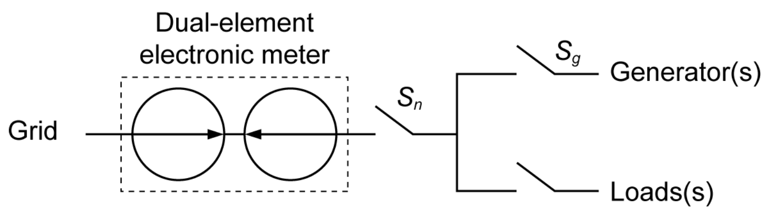

Figure 2: Dual element electronic import and export meter

The meter arrangement as described above will therefore provide information on the amount of energy that the customer uses from the grid and the amount of energy supplied to the grid. It does not provide information on the amount of RE generation directly used by the site (building or dwelling).

It is recommended that either the inverter has the facility to record the actual total amount of RE generation or that a separate meter is installed that records the total energy produced by the RE generation system.

7 Anti-islanding requirements

The customer must prevent the intentional or unintentional 'islanding' of generator installations.

Islanding is a situation where one or more inverters maintain a supply to the distribution system after the distribution system supply has been isolated. Isolation of grid supply may be unplanned (power failure) or planned (for maintenance work on the grid).

Islanding creates serious safety issues, quality of supply problems for other customers and the possibility of equipment damage.

The protection equipment associated with the RE generation system must be designed, installed and tested to ensure that islanding does not occur. The protection equipment must be part of the inverter.

7.1 Active (anti-islanding) protection

Active anti-islanding protection isolates the generation source from the distribution system in the event of a distribution system supply outage. The inverter's active component ensures that either the voltage or typically the frequency is unstable when not connected to the grid such that the passive anti-islanding described below will operate.

The inverter shall have been tested and approved in accordance with all the anti-islanding requirements of UL Standard 1741.

7.2 Passive protection

For the passive anti-islanding protection to operate, the customer's generation facilities must have the following minimum protection (part of the inverter):

a) Over/under frequency; and

b) Over/under voltage.

The inverter shall also include the following protection: over current and short circuit protection. The over/under voltage and frequency protection settings shall be in accordance with Table 1.

Table 1: Over/Under Protection Setting Limits

	Minimum	Maximum
Frequency	58Hz	62Hz
Voltage (120V Utility Supply)	105.6V	132V

Table 2 details the maximum trip time for the various voltages.

Table 2: Voltage Trip Settings

Voltage at Connection Point	Maximum Trip Time
V< 60 (V < 50%)	6 cycles
60 ≤V ≤ 105.6 (50% ≤V≤88%)	120 cycles
105.8 ≤V ≤ 132 (88% ≤V≤110%)	Normal Operation
132 <V < 165 (110% < V < 137%)	120 cycles
165 ≤V (137% ≤ V)	2 cycles

Source IEE929-2000

Table 3 details the system response times to abnormal frequencies as detailed in IEE1547-2003.

The logic of these settings at the time of writing was so that the renewable power generating system is removed from the distribution system if the frequency drifted outside a very tight frequency band. The main objective was to use these settings to disconnect from the grid quickly, in particular when the distribution power had failed.

However field experience has since shown that, in particular on diesel powered grids where the frequency can vary, such a tight frequency band is too restrictive resulting in regular 'tripping off' occurrences and high penetrations actually causing power fluctuations on the distribution system. There is now provision for a wider range of frequency windows and the maximum time allowed (usually cycles) for a distribution system with frequencies outside any limited range, so that these fluctuations in the grid do not cause the inverter to 'nuisance' trip.

Therefore Table 1 recommends a window of 58 to 62 Hz with the times shown in Table 4.

Table 3: Interconnection System Responses to Abnormal Frequencies

Renewable Generator size	Frequency range (Hz)	Clearing Time (s)
≤ 30 kW	> 60.5	0.16
	< 59.3	0.16
> 30 kW	> 60.5	0.16
	< 59.8 to 57.0 (adjustable)	Adjustable 0.16 to 300
	< 57	0.16

Source: IEEE1547-2003

Table 4: Recommended Clearing Times for Frequency Variation

Frequency (Hz)	Clearing time
> 62	0.16
58 ≤ f ≤ 62	Normal Operation
< 58	0.16

8 Solar photovoltaic systems

Palau is located at latitude 7 degrees North and the following Section refers to solar PV systems connected to the central grid in Palau.

8.1 Solar PV array frames

Solar PV arrays consist of a number of solar PV modules wired together. In grid connected systems, the solar PV array is generally mounted:

- fixed on a frame 'flat' to the roof, meaning parallel to the roof area slope; or
- fixed on a frame that is tilted to fix the array at a preferred angle above horizontal, used for flat roofs, ground mounts and carpark shading arrays; or
- integrated into a new building.

8.1.1 Solar PV arrays orientation and tilt

Taking into account the sun's path throughout the year, the theoretical, optimal year-round performance for a fixed PV array in Palau, would be achieved by mounting facing true south at an inclination above horizontal equal to the latitude angle (7°). However, this does not take into account seasonal cloud patterns, local shading and other environmental factors such as dust, local vegetation and bird droppings.

A minimum inclination above horizontal (tilt angle) of 10° is recommended to enhance self-cleaning during rain periods.

In addition, as the period March to May experiences the most sunshine hours and the period June to August experiences the most rain, a tilt angle of 15 to 20 degrees above horizontal is recommended.

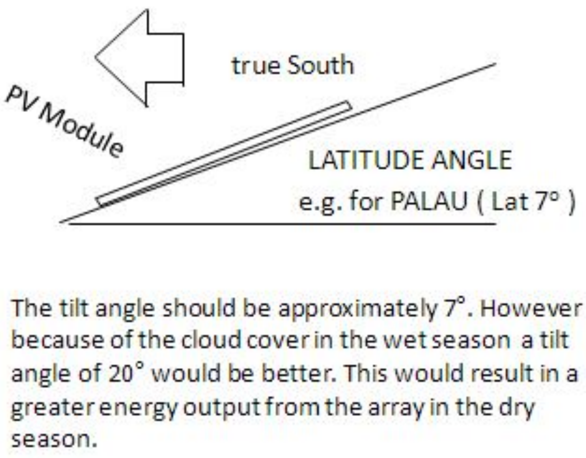

Figure 3: Tilt Angle of Modules for Palau,

Note: the 'dry season' refers to the period February to April.

It should also be noted that for optimal performance PV modules that are electrically wired together in the same string must all be at the same orientation and tilt.

8.1.2 Roof mounting

- It is preferable to allow sufficient space below the PV array (> 2 inches) for ventilation cooling, particularly for crystalline PV modules but also for thin-film PV modules.
- It is important to allow sufficient clearance behind the PV array to facilitate self-cleaning of the roof and to prevent the build-up of leaves and other debris.
- If fauna are a problem in the vicinity of the installation, consideration should be given to prevent any animals gaining access to the underneath of the array.
- All supports, brackets, screws and other metal parts should be of a similar material or stainless steel to minimise corrosion. If dissimilar metals (based on their galvanic rating) are used, the two surfaces of the metals should be separated by using rubber washes or similar. Palau has a marine environment with high humidity, so materials must be selected to be suitable in this environment.
- Where timber is used, it must be suitable for long-term external use and fixed so that trapped moisture cannot cause corrosion of the roof and/or rotting of the timber. The expected replacement time for these materials should be stated in the system documentation.
- Any roof penetrations must be suitably sealed and waterproof for the expected life of the system. If this is not possible, this item must be detailed in the Maintenance Schedule.
- All fixings must ensure structural security when subject to the highest wind speeds for the region and local terrain. This may require specific tests of the fixing/substrate combination for that roof.
- The installer shall ensure that the PV array frame that they install has applicable engineering certificates to verify that the array frame meets wind loadings for that particular location.
- The installer must follow the array frame supplier/manufacturer's recommendations when mounting the array to the roof support structure to ensure that the array structure still meets wind loading certification.
- The solar PV array modules must be rated for the static wind load of that region.

8.1.3 Free standing PV arrays

All components must be wind rated to meet the wind loading for the region. This includes footings and/or piles, mounting structures, frames and the solar PV panels.

8.2 Disconnecting means and protection

8.2.1 Solar PV array DC disconnecting means

According to the National Electrical Code, Article 690.15, PV arrays must have a disconnecting means to isolate the inverter from the PV power source. Utility grid-tie inverters that utilize PV arrays with voltages above 250V DC require a disconnection device rated for 600V DC to perform this function.

The DC disconnecting means is used to safely interrupt the flow of electricity from the PV array. This is an essential component when system maintenance or troubleshooting is required. The disconnection enclosure houses an electrical switch rated for use in DC circuits. It also may integrate either circuit breakers or fuses, if needed. In many off-the-shelf residential and small commercial inverters, DC disconnects are integrated into the inverter.

The disconnecting device shall be rated at 1.25 x the total short circuit current of the PV output that is connected to the device.

8.2.2 Solar PV array AC disconnecting means at the inverter

If the inverter is not in a readily accessible location, an AC disconnecting means located at the inverter as described in Section 5.4 shall be installed.

It is recommended that, even if the inverter is mounted in a readily accessible location, an AC disconnecting means is installed unless the inverter is line of sight of the renewable generator supply disconnecting means detailed in Section 4.3. This is to allow isolation of the AC supply while a person is undertaking any servicing of the inverter.

The current rating of the disconnecting means shall be based on the inverter continuous output current rating.

8.2.3 Disconnecting all conductors in a building

Article 690.14(C) 1 states that:

> "The photovoltaic disconnecting means shall be installed at a readily accessible location either on the outside of a building or structure or inside nearest the point of entrance of the system conductors".

If the inverter (or inverters) are located inside the building, then it will be the solar PV array DC cables that will be entering the building which will require the disconnecting means in a readily accessible location. If the PV array is on the roof, then it is typical that the PV array cabling enters the building on the roof—not a readily accessible location. Article 690.31(E) does allow DC PV cables to run inside a building to the first readily accessible disconnecting means as long as the cables are contained in metal raceways or enclosures.

Assuming the inverters are located in a readily accessible location, the required disconnecting means could therefore be located near the inverters.

The disconnecting device shall be rated at 600V and 1.25 x the total short circuit current of the modules that are connected to the device.

If the inverters are located external to the building then the disconnecting means referred to in Article 690.14(C)(1) will be an AC device and is that referred to in (c) in Section 5.4. This device can be at the point of common coupling if it is sufficiently close.

The disconnecting device shall be rated for the sum of the continuous ratings of all the inverters that are connected in parallel to the device.

Multiple disconnecting devices should be grouped together per NEC Section 690.14(C)(5). NEC690.14(C)(4) states that the PV "system disconnecting means shall consist of not more than six switches or circuit breakers mounted in a single enclosure, in a group of separate enclosures, or in or on a switchboard." The disconnecting device must operate without exposing anyone to any live parts and must plainly indicate the open and closed positions.

8.2.4 Point of common coupling

Section 4.3 details where the inverter (or inverters) from the PV system connects to the distribution network.

8.2.5 String protection

Series string fuses are used to protect PV modules from overcurrent under fault conditions. PV modules are rated by the manufacturer to withstand a certain number of amps. This rating is known as the 'maximum series fuse rating' or 'reverse current rating' and is typically listed on the module specification sheet. An excess of current flowing through the module (for example current back-fed from paralleled modules or paralleled strings of modules) could damage the PV module if the module/string is not protected by an appropriately rated overcurrent device. Back-feeding from other strings is most likely to exist if one series string of PV modules stops producing power due to shading or a damaged circuit.

Because PV modules are current-limited sources, there are some cases where series fusing may not be needed. When there is only one string, there is nothing that is able to back-feed current, and no series string fuse is needed. In the case of two series strings, if one string stops producing power and the other string back-feeds current through it, no fuse is needed because each module is designed to handle the current from one string. Some PV systems allow for three strings or more with no series fuses. This is allowable by NEC Article 690.9 (exception b).

Each solar PV module has a maximum reverse current rating provided by the manufacturer. If the array consists of parallel strings such that the reverse current flow into a string with a fault is greater than the maximum reverse current for the modules in that string, protection shall be provided in each string. The protection can either be DC rated fuses or non-polarised DC rated circuit breakers.

Series string protection is required when the number of parallel strings is such that:

(Number of parallel strings -1) x Short circuit current of module > Module's maximum reverse current

Example: The reverse current rating for a module is 15A while the short circuit current is 5.4A. If the PV array consists of 3 parallel strings and a fault occurs in one string, the potential fault current will come from the other 2 strings in parallel, which equal 10.8A combined (2 x 5.4A). This figure of 10.8A is less than the reverse current rating of 15A, so no protection is required.

However if the array consists of 4 parallel strings, the fault current could come from the other 3 parallel strings of the array. The current from these 3 strings is 16.2A (3 x 5.4A) and is now greater than the reverse current rating of the module (15A). Protection is now required in each parallel string.

The fuses or DC circuit breakers shall have the following current rating:

$$1.25 \times I_{sc\ mod} < \text{Fuse Rating} < 2.0 \times I_{sc\ mod}$$

If the array consists of sub-arrays, then each sub array shall be protected by a fuse or circuit breaker with the following rating:

$$1.25 \times I_{sc\ sub\text{-}array} < \text{Fuse Rating} < 2.0 \times I_{sc\ sub\text{-}array}$$

8.2.6 External mounted disconnection and junction boxes

The NEC, Article 690.14(C) does not require a disconnecting means at the PV array. However if string overcurrent devices (fuses) are required, disconnecting means might be required (Article 690.16) if the fuse holders cannot be isolated from energised circuits so that they can be worked on. Therefore these could be externally mounted (e.g. on roof) disconnection and/or junction boxes.

Where external mounted isolators (disconnection devices) and/or array junction boxes are mounted on the roof (or in any external location), the installer must ensure that the integrity of the IP (or NEMA) rating is maintained and that no moisture can enter the isolator or junctions boxes.

The external isolator should be mounted vertically, that is, the switch is in a vertical position (see Figure 4). The conduit entry points should be on the bottom face of the isolator.

It is recommended that Junction boxes are mounted so that the access to the junction box is vertical not horizontal. The conduit entry points should be on the bottom face of the isolator.

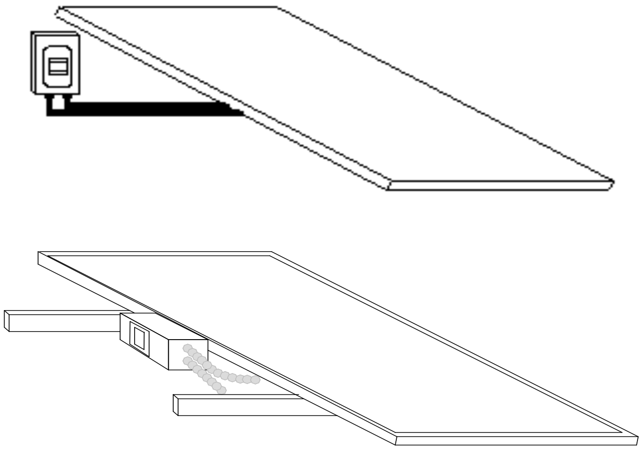

Figure 4: Position of Roof isolators and/or junction boxes

Note: Ensure that the switch does not shade the array.

8.3 Cabling

All cables shall be installed in a neat and tidy manner and in accordance with the National Electrical Code and any specific rules required by PPUC.

Correctly sized cables in an installation will produce the following outcomes:

1. There is no excessive voltage drop (which will equate to an equivalent power loss) in the cables.
2. The current in the cables will not exceed the safe current handling capability of the selected cables known as current carrying capacity (CCC) or ampacity.

8.3.1 Selection PV string cables

If a fault current protection device is located in the string, the string must be rated to carry at least that current. For example, if the fault current protection device is rated at 8A, the string cable will need to be rated at a minimum of 8A.

If no fault current protection is provided, then the string cable will be rated as:

$$CCC \geq 1.25 \times I_{sc\ mod} \times (Number\ of\ Strings - 1)$$

8.3.2 Selection of PV array cables

The PV array cable should be rated according to:

$$CCC \geq 1.25 \times I_{sc\ array}$$

8.3.3 Voltage drop

Losses in the cabling between the PV array and the inverter should be kept to a minimum, consistent with cable size and cost decisions, and to maximise system output it is recommended that the voltage drop is a maximum of 3%.

It is recommended that the voltage drop between the inverter and the point of connection of AC supply should be kept to a minimum (recommended < 1%) so as to minimise voltage rise within the installation and to limit inverter disconnection in areas where the grid voltage may be high in order to decrease incidents of overvoltage trips for inverters.

8.3.4 Cabling/Conduit installation

Article 690.31 details all the wiring methods allowable. The following points represent a summary of this Article and include best practice techniques:

- All DC PV source or output cables that run inside a building shall be contained in metal raceways or metal enclosures until the first readily accessible disconnecting means.
- Wiring shall not be installed within 10 inches of the roof decking or sheathing, except where directly below the roof surface covered by the PV modules, NEC690.31(E)(1).
- All cables used in the installation should be securely fixed in place to minimise any movement of the cable.
- Where the cables could be damaged, there should be suitable mechanical protection of the cables. Please refer to Article 690.31(E)(2).
- Where the presence of fauna is expected to constitute a hazard, either the wiring system shall be selected accordingly, or special protective measures shall be adopted.
- All conduits and cables exposed to sunlight must be suitably UV resistant and moisture resistant. Not all corrugated conduits are UV rated, so if using corrugated conduit ensure that it is UV resistant.
- Plastic cable ties are not suitable for cables in exposed situations. They can also chafe the cables.
- All cables , enclosures and raceways shall be labelled in accordance with NEC690.31(C) Paragraphs (3) and (4)
- All PV source and output cables are to be identified at all points of termination, connection and splicing.

Cables connected to the inverter must be mechanically secured in such a manner that they cannot be inadvertently unplugged from the inverter. This mechanical securing can be achieved by:

1. Having the inverter housed in an enclosure (with cables suitably supported); or
2. The use of an inverter which has the cable connection area of inverter covered by a removable enclosure/cover which protects the supported cables so that there are no exposed, unsupported cable loops; or
3. The use of conduit and secure wall fittings.

8.3.5 AC and DC in enclosures and raceways

PV DC cables are not to be located in the same raceway, cable tray etc, with other non-PV system cables unless the conductors from the different systems are separated by a partition, NEC690.4 Paragraph (A). Connection of AC and DC components in the same enclosure should be segregated.

AC and DC cables from the same PV system can occupy the same junction box or raceway. However, if there is more than one PV system, the AC and DC conductors of each system shall be grouped separately.

8.3.6 Wiring PV arrays

To prevent the possibility of an installer coming in contact with live wires, it is a recommended practice that one of the interconnecting cables in the middle of each string is left disconnected until all the wiring has been completed between the array and the inverter. Once all the isolators and other hard wired connections are completed, the interconnections in the middle of the array can be connected.

The installer shall ensure that all connectors used are waterproof and connected securely to avoid the possibility of a loose connection. The connectors shall be of the latching or locking type. Only connectors of the same type from the same manufacturer are allowed to be mated at a connection point.

Solar PV module interconnecting cables must be supported clear of the roof surface to prevent debris build up or damage to insulation.

In accordance with NEC690.33 paragraph (E):

The connectors shall be either (1) or (2):

(1) Be rated for interrupting current without hazard to the operator:

(2) Be a type that requires the use of a tool to open and marked: “Do not disconnect under load” or “Not for current interrupting”.

8.3.7 Wiring from PV arrays to DC disconnecting means near inverter

The PV array cable shall be clearly identified as 'DC solar cable' to ensure that it cannot be mistaken for AC cable.

To avoid confusion, it is recommended that, between the PV array and the inverter, single core double insulated solar cable is used. This cable is similar to that used for interconnecting the solar modules in the array.

It is recommended that the cable is sized so that the maximum voltage drop between the array and the inverter is less than 3%.

8.4 Grounding

Please refer to:

- NEC Article 690.5 for a full explanation of the requirements for ground fault protection and, in particular, the exceptions in grounded PV systems.
- NEC Article 690.35 for ungrounded PV systems.
- NEC Article 690.41 for grounding of PV systems.
- NEC Article 250 for the installation of grounding systems.

For safety, it is recommended that all the grounding connection is completed once the wiring of the array has been completed.

8.4.1 Grounding of equipment

All exposed non-current-carrying metal parts of PV modules, frames and all associated equipment shall be grounded with an equipment grounding conductor between the PV array and the equipment and shall be installed in the same raceway as the PV output cables when leaving the array. The sizing of the conductors is specified in Article 690.45. In summary, the conductors shall be sized in accordance with Table 250.122.

Equipment grounding conductors shall be no smaller that 14AWG but if smaller than 6AWG they shall comply with 250.120(C) which states that the cable must be mechanically protected from physical damage e.g. in a suitable raceway.

8.4.2 Grounded PV arrays

Except where the PV system meets all the requirements of Article 690.35 (see 8.4.3), one conductor of a 2 wire PV system (unless system voltage is less than 50V) shall be solidly grounded. Note: Article 690.35 basically refers to systems using transformerless inverters.

There shall only be one DC grounding point on the PV output circuit.

Grounded PV arrays shall be provided with ground fault protection as detailed in Article 690.5. In summary, the ground fault protection device shall be capable of: detecting a ground fault current; interrupting the flow of current; and providing an indication of the fault.

8.4.3 Ungrounded PV arrays

Ungrounded PV arrays ate permitted when all the paragraphs (A) through to (G) in Article 690.35 are met.

The PV source and output circuits shall be provided with a ground fault protection device/system that:

(1) Detects a ground fault.

(2) Indicates that a ground fault has occurred.

(3) Automatically disconnects all conductors or causes the inverter to automatically cease supplying power to the output circuits.

Typically the inverter turns off and disconnects from the PV array.

8.5 Shutdown procedure

A shutdown procedure shall be installed near the inverter or main distribution board to ensure safe de-energization of the system.

The procedure should be:

- Turn off the AC disconnecting means at the distribution equipment where the point of common coupling has occurred and then the AC disconnecting means at the inverter
- Then turn off the DC disconnecting means at the inverter.

When undertaking any work on the array cabling between the array and inverter, good practice is to disconnect a plug in the middle of each string so that the array is then de-energised.

8.6 Signage

The NEC lists the requirements for signage of PV systems.

a) NEC 200.6(A)(2)

A single-conductor, sunlight-resistant, outdoor-rated cable used as a grounded conductor in photovoltaic power systems shall be identified at the time of installation by distinctive white marking at all terminations."

b) NEC690.4(B) (1) to (4)

All photovoltaic conductors shall be identified and grouped. The means of identification can be separate color coding, marking tape, tagging or other approved means.

c) NEC690.5(C)

Grounded DC photovoltaic arrays shall have a warning label on the inverter or near the ground fault indicator at a visible location, stating:

WARNING

ELECTRIC SHOCK HAZARD

IF A GROUND FAULT IS INDICATED,

NORMALLY GROUNDED CONDUCTORS MAY BE UNGROUNDED AND ENERGIZED

d) NEC690.14(C)(2)

Each PV system disconnecting means shall be permanently marked to identify it as a PV system disconnect.

e) NEC690.14(D)(4) and NEC705.10

Inverters shall have a plaque installed in accordance with 705.10, denoting all electric power sources on or in the premises, shall be installed at each service equipment location and at locations of all electric power production sources capable of being interconnected.

f) NEC690.16(B)

Non load-breaking disconnecting means shall be marked 'Do Not Open Under Load' (e.g. plug and socket connectors).

g) NEC690.17

Where all terminals of a disconnecting means may be energized in the open position, a warning sign shall be mounted on or adjacent to the disconnecting means. The sign shall be clearly legible and have the following words or equivalent:

WARNING

ELECTRIC SHOCK HAZARD

DO NOT TOUCH TERMINALS.

TERMINALS ON BOTH THE LINE AND LOAD SIDES MAY

BE ENERGIZED IN THE OPEN POSITION.

h) NEC690.31(E)(3)

The following wiring methods and enclosures that contain PV power source conductors shall be marked with the wording ‘Photovoltaic Power Source’ by means of permanently affixed labels or other approved permanent marking:

i. Exposed raceways, cable trays and other wiring methods
ii. Covers or enclosures of pull boxes and junction boxes
iii. Conduit bodies in which any of the available conduit openings are unused.

i) NEC690.31(E)(4)

Photovoltaic power circuit labels shall appear on every section of the wiring system that is separated by enclosures, walls, partitions, ceilings or floors. Spacing between labels and markings shall not be more than 10ft/3m.

j) NEC690.35(F)

If a photovoltaic power system is ungrounded, then it shall be labelled with the following warning at each junction box, combiner box, disconnect, and device where energized, ungrounded circuits may be exposed during service:

WARNING

ELECTRIC SHOCK HAZARD

THE DC CONDUCTORS OF THIS PHOTOVOLTAIC SYSTEM

ARE UNGROUNDED AND MAY BE ENERGIZED

k) NEC690.51

Modules shall be marked with identifications of terminals with regards to polarity, maximum overcurrent device rating for module protection and:

- V_{oc}
- Operating voltage
- Maximum permissible system voltage
- Operating current
- I_{sc}
- Maximum power.

l) NEC690.53

A permanent label shall be provided at the disconnecting means with:

- Rated I_{mp}
- Rated V_{mp}
- Maximum system voltage
- I_{sc}

m) NEC690.56(B)

Buildings with both utility service and a photovoltaic system shall have a permanent plaque or directory providing the location of the service disconnecting means and the photovoltaic system disconnecting means if not at the same location.

n) NEC 702.8

A sign shall be placed at the service-entrance equipment to indicate the type and location of on-site optional standby power sources

o) NEC 705.10

A permanent plaque or directory, denoting all electric power sources on or in the premises, shall be installed at each service equipment location and at locations of all electric power production sources capable of being interconnected.

p) NEC 705.12(D)(7)

A permanent label shall be mounted on the distribution equipment with the following or equivalent wording:

WARNING

INVERTER OUTPUT CONNECTION

DO NOT RELOCATE THIS OVERCURRENT DEVICE

9 Small wind generators

9.1 Introduction

Small wind turbines (generators) are typically installed on towers and the installation recommendations of the particular tower provider and/or wind turbine supplier should always be followed when installing a wind generator. The following sections provide some basic guidance on the siting and installation of wind turbines. This is then followed by the requirements as specified in NEC Article 694: Small Wind Electric Systems.

9.2 Siting wind generators

To optimise the output from the wind turbine, it should be installed at twice the height of obstacles. As a rule of thumb, a wind generator should be installed no closer than at least ten times the height of that obstacle, on the down-wind side. Twenty times the obstacle height is preferred, see Figure 5.

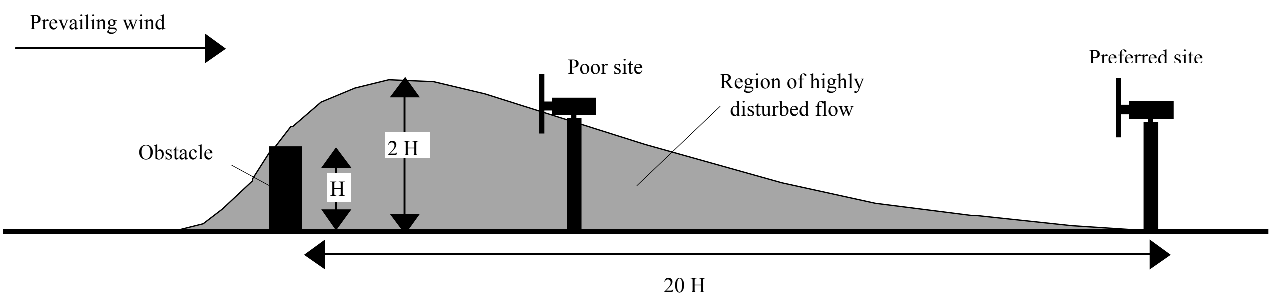

Figure 5: Disturbed Flow Region Caused by Obstacle of Height H

Be aware that vegetation grows and that a suitable site now may not be suitable in 2 years' time.

Slopes in the land may cause increases in the wind speed just in the vicinity of that slope, so take advantage of these. In general, gentle slopes enhance the wind speed but abrupt slopes cause turbulence, see Figure 6.

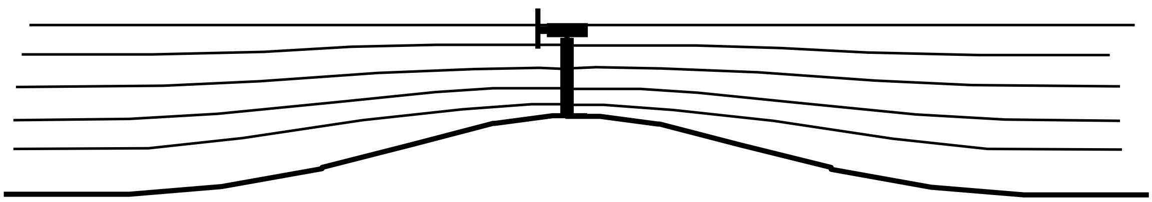

Figure 6: Increased Wind Speed on a Gently Sloping Hill

To determine whether a site is suitable for a wind generator, the amount of wind available over a long period must be known. To test the site using wind measuring devices, at the proposed turbine hub height, over several years is optimal.

Where measured wind data is not available for the proposed site, use local knowledge as much as possible. The wind speed data from the nearest weather station may be of assistance. Other possible sources for local wind data might be a local airport or the Bureau of Meteorology. Once you have some site specific data for the intended installation site available, you can then use the site referenced data from other sites as a reference to extrapolate longer term wind data for your actual site.

Take note of vegetation, landscape features and any buildings which are planned for the vicinity of the selected site as they will all be possible sources of obstruction and turbulence.

9.3 Turbulence

As much as the average wind speed is important in determining the site for a wind generator, the quality of the wind is very important. If the wind is turbulent, it may be as unsuitable as having no wind at all. Wind turbines should be placed at such a height so that turbulence is not present. As a way of determining whether turbulence is present, fly a kite with crepe paper tied to the string at various heights. If the crepe paper lies almost straight out from the string there probably is no turbulence present. This will help to determine how high to place the turbine.

9.4 Tower height

Another factor in determining the position of the wind generator is the height of the tower. Because of possible cost considerations, the height of the tower may be kept to a minimum, however the wind speed increases with height above the ground which will relate to the power output performance of the wind turbine.

After choosing and siting the wind turbine, the tower height is the single most important item in the success of a wind energy system. As shown in Figure 7, at a height of 12 metres there is 350% more energy than at 1.5 metres, even though the wind speed is only 50% greater. This extra energy may not be of any use if your turbine is operating above the cut out speed. The advantage of a taller tower is in the number of hours per year that the rated wind speed will be obtained compared to a short tower. A tall tower will be more difficult to install, be more expensive and require a larger clearance area around it for guy wires and to raise and lower the tower to service the generator. Examine the cost/benefit before selecting your tower.

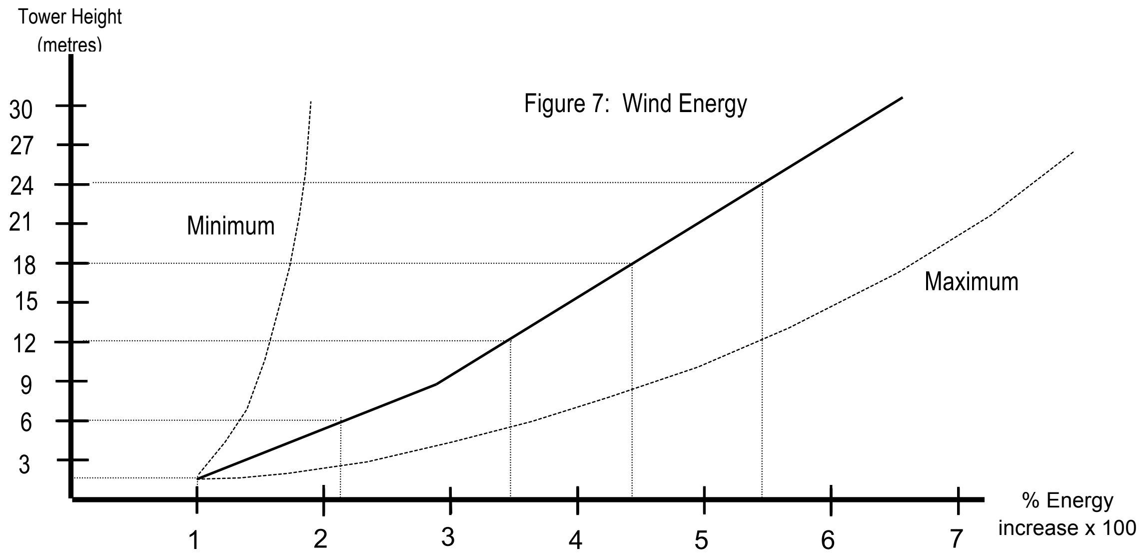

Figure 7: Wind Energy

9.5 Wind turbine installation

Wind turbine generators connected to residential households shall not have an output voltage exceeding 600V. All conductors over 150V to ground shall not be accessible while energised, except to qualified persons. All conductors over 30V shall be installed in metal raceways.

9.6 Equipment

Inverters used on wind generator systems shall be listed as appropriate for that application.

A surge protection device (SPD) shall be installed between a wind generator and any loads.

Systems utilising a diversion load controller shall also contain an additional means of over-speed operation. The utility grid shall not be used as the supplementary diversion load.

9.7 Disconnecting means and protection

Article NEC694.20 refers to disconnecting means.

9.7.1 Wind generator DC disconnecting means

According to the National Electric Code, Article 694.24, wind generators must have a disconnecting means to isolate the inverter from the wind power source.

The disconnecting device shall be rated at 1.25 x the maximum current of the wind turbine operating at maximum output power.

Overcurrent protection is not required if the cables are sized at 1.25 x the maximum current.

9.7.2 AC disconnecting means at the inverter

If the inverter is not in readily accessible location then an AC disconnecting means located at the inverter as described in Section 5.4 shall be installed.

It is recommended that even if the inverter is mounted inside in a readily accessible location then an AC disconnecting means is installed unless the inverter is line of site of the renewable generator supply disconnecting means detailed in section 4.3. This is to allow isolation of the AC supply while a person is undertaking any servicing of the inverter.

The current rating of the disconnecting means shall be based on the inverter's continuous output current rating.

9.7.3 Disconnecting the system

Disconnecting means shall be provided to disconnect all current-carrying conductors of small wind power systems from all others in a building. Grounding conductors must not be able to be disconnected if it leaves the marked grounded conductor in an un-grounded and energised state.

Turbines that self-regulate turbine speed based on output shall not require a disconnecting means prior to the inverter.

All disconnecting devices shall be manually operable and shall be readily accessible, operable without exposing the operator to live parts and shall plainly indicate whether they are in the open or closed position.

Disconnecting means shall be located on or adjacent to the turbine tower and either outside or inside the point of cable entry to the building or structure containing the point of common coupling.

If the inverter/s is located inside the building, it will be the wind turbine DC cables that will be entering the building, and they will require disconnecting means in a readily accessible location at the tower and at the point of cable entry to the building. Article 694.30(C) does allow DC wind cables to run inside a building to the first readily accessible disconnecting means as long as the cables are contained in metal raceways or enclosures.

Assuming the inverters are located in a readily accessible location, the required disconnecting means (at the building) could therefore be located near the inverter/s.

If the inverter/s are located externally to the building, the disconnecting means referred to in Article 694.22 paragraph (C)(1) relating to entry to the building will be an AC device. If the inverter/s are not readily accessible then the AC disconnecting means at the building are those that are referred to in Section 5.4. There will still be a requirement for a disconnecting device beside the tower.

The AC disconnecting device at the building shall be rated for the sum of the continuous ratings of all the inverters that are connected in parallel to the device.

Multiple disconnection devices should be grouped together per NEC Article 694.22(C)(4) and system disconnecting means shall consist of not more than six switches or circuit breakers mounted in a single enclosure, in a group of separate enclosures, or in or on a switchboard. The disconnecting devices must operate without exposing anyone to any live parts and must plainly indicate the open and closed positions.

9.7.4 Point of common coupling

Section 4.3 details where the inverter (or inverters) from the wind system connects to the distribution network.

9.7.5 Disabling the wind turbine

NEC Article 694.28 states that "open circuiting, short circuiting, or mechanical brakes shall be used to disable a turbine for installation and service".

9.8 Grounding of wind generators

NEC Article 694.40 states that "exposed non-current carrying metal parts of towers, turbine nacelles, and other equipment are connected to an equipment grounding conductor." This shall be connected to the premises grounding system. Guy wires do not require grounding nor do the blades.

9.9 Lightning protection

Auxiliary electrodes must meet all applicable requirements. Separate tower lightning protection devices, if used, shall be bonded to the generator grounding electrode. Guy wires, if used as lightning protection, are not required to be bonded to the generator grounding conductor.

9.10 Signage

All isolation means shall be permanently marked to identify its purpose as a wind generator disconnecting means. In buildings with both a wind generator and grid supply, the sign will denote the disconnection point of both supplies.

Instructions for isolating the wind generator will be installed on or near the generator.

The NEC lists the requirements for signage of wind systems.

NEC694.22

a) Where all terminals of a disconnecting means may be energized in the open position, a warning sign shall be mounted on or adjacent to the disconnecting means. The sign shall be clearly legible and have the following words or equivalent:

WARNING

ELECTRIC SHOCK HAZARD

DO NOT TOUCH TERMINALS.

TERMINALS ON BOTH THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION.

b) Each wind turbine system disconnecting means shall be permanently marked to identify it as a small wind electric system disconnect.

NEC694.50

All interactive system points of interconnection with other sources shall be marked at an accessible location at the disconnecting means and with rated AC output current and the nominal operating AC voltage.

NEC694.54(B)

A permanent plaque or directory shall provide location of service disconnecting means and the small wind electric system disconnecting means.

NEC694.56

A permanent plaque placed on or adjacent to turbine providing information for disabling the turbine.

NEC705.10

Inverters shall have a plaque installed in accordance with 705.10. NEC705.10 states that a permanent plaque or directory, denoting all electric power sources on or in the premises, shall be installed at each service equipment location and at locations of all electric power production sources capable of being interconnected.

NEC 705.12(D)(7)

A permanent label shall be mounted on the distribution equipment with the following or equivalent wording:

WARNING

INVERTER OUTPUT CONNECTION

DO NOT RELOCATE THIS OVERCURRENT DEVICE

10 Commissioning renewable energy generation systems

The installer shall undertake commissioning of the system at the completion of the RE generation system installation. The installer should prepare standard commissioning sheets. A copy shall be provided to the customer in the system documentation and a copy retained by the installer.

11 Documentation

All complex systems require a user manual for the customer. Grid-connected renewable energy generating systems are no different. The documentation for system installation that must be provided is:

- List of equipment supplied.
- Shutdown and isolation procedure for emergency and maintenance.
- Maintenance procedure and timetable.
- Commissioning sheet and installation checklist.
- Warranty information.
- System connection diagram.
- System performance estimate.
- Equipment manufacturers documentation.
- Handbooks for all equipment supplied.

12 Approval procedures

1. Customers who want to install a renewable energy generating system must complete an application form and submit it to the Palau Public Utilities Commission.

2. The information that will be required will include:
   a. Type of system (solar PV or wind turbine).
   b. Proposed equipment - number and ratings of PV modules and or wind turbine; number and rating of inverter.
   c. Diagram which shows where the equipment will be positioned on the site/building.
   d. Electrical drawings showing the interconnection of the proposed system with the existing service and all the required disconnecting means and protection devices include current and voltage ratings.

3. The PPUC will provide written consent for the installation of the system and the customer and the system supplier are not to start installation until this consent is provided.

4. PPUC will inspect the system prior to it being turned on and connected to the PPUC distribution system.

5. PPUC will provide an explanation if permission for interconnecting the system is not granted.

Appendix A: Standards

The inverter shall meet either:

a) Underwriters Laboratories (UL) Standard 1741: Standard for Inverter, Converters, Controllers and Interconnection System Equipment for use with Distributed Energy Resources (Suitable for PV Systems and Wind Systems) and Institute of Electrical and Electronic Engineer (IEEE) Standard 1547-2003: IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems.

or

For PV systems only:

b) IEC 62109: Safety of Power Converters for use in Photovoltaic Power Systems

Part 1: General Requirements

Part 2: Particular Requirements for Inverters

In particular, solar PV systems shall meet Article 690: Solar Photovoltaic Systems and *NFPA 70* (NEC®) Uniform Solar Energy Code. Note: NFPA70 is now included with the 2011 version of the National Electrical Code.

The solar PV modules shall meet either:

a) Underwriters Laboratories (UL) Standard 1701: Flat Plat Photovoltaic Modules and Panels.

or both b and c:

b) IEC 61730-1: Photovoltaic (PV) Module Safety Qualification Part 1: Requirements for Construction and IEC 61730-2 Photovoltaic (PV) Module Safety Qualification Part R: Requirements for Construction (or EN 61730-1 and EN 61730-2).

and

c) Crystalline silicon PV modules shall comply with IEC 61215: Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval; while Thin film PV modules shall comply with IEC 61646: Thin Film terrestrial photovoltaic (PV) modules - Design qualification and type approval.

The interconnection of a Wind Generator Systems shall be in accordance with National Electrical Code 694 - Small Wind Electric Systems.

The interconnection to the utility supply shall be in accordance with National Electrical Code 705 - Interconnected Electric Power Production Sources.

Appendix B: Regulations

B1 Introduction

1.1 These regulations relate to the installation of a private renewable energy generation system at a customer's premises that are connected to the distribution system for Koror and Babeldoab (central grid) via an inverter. The renewable energy generation system is most commonly solar photovoltaic (PV) arrays, but these regulations also apply to wind generators.

1.2 These regulations apply to:

a) single phase generators rated at a maximum of 5kVA; and

b) three phase generators rated at a maximum of 100kVA, (total).

Larger renewable energy generation systems will require special review and approval from the Palau Public Utilities Corporation (PPUC).

1.3 Customers proposing renewable energy generation systems that comply with the Standards, Regulations and Guidelines can submit an Application for Connection to PPUC. If approved, a Connection Agreement can be signed and the installation proceed. After the installed renewable energy generation system is inspected and written approval from PPUC received, it can be connected to the grid.

1.4 Connecting a renewable energy generation system to the grid allows the customer to offset part or all of their electricity consumption and export any excess energy to the grid.

B2 Responsibilities

2.1 The customer is responsible for the design, installation and maintenance of private renewable energy generation systems. The installation must comply with all relevant Standards.

2.2 Customers must not connect renewable energy generation systems until PPUC gives approval in writing. PPUC will advise its requirements upon receipt of the Application for Connection and all supporting documentation.

2.3 The necessary Application for Connection must include full details of the power source's rating and the inverter rating.

2.4 The customer is responsible for any upgrade required on the distribution line to meet the output power of the proposed power source generator. This could include but is not limited to:

i) increasing the size of distribution cables to the customer's dwelling;

ii) increasing the size of the distribution transformer; and

iii) changing the necessary protection and switchgear.

B3 Standards

The components and installation of all renewable energy generating systems shall be in accordance with the National Electrical Code and all relevant Standards, (see Appendix A).

B4 Quality of supply

The customer is responsible that the system installed does not affect the quality of supply via the following methods:

- AC Voltage of inverter raising the supply voltage higher than that specified within the PPUC guidelines.
- Injection of DC currents onto AC supply.
- Allowing the inverter to remain connected when the frequency and voltage is outside the limits specified in the PPUC guidelines.

B5 Islanding prevention

The customer must prevent the intentional or unintentional 'islanding' of renewable energy generation system installations. Islanding is a situation where one or more inverters maintain a supply to the distribution system after the distribution system supply has been isolated. Isolation of grid supply may be unplanned (blackout) or planned (for work on the grid).

The customer shall ensure that the anti-islanding of their system is in accordance with the PPUC guidelines.

The PPUC shall undertake appropriate tests of the renewable energy generation system's anti-islanding before allowing the system to be connected to the grid.

B6 Connection point for renewable energy power source generating system

6.1 For single family dwelling (accommodation) or multifamily accommodation, the renewable energy generation system's output shall be connected to the load side of the 'grid supply's service disconnecting means' at any distribution equipment locations at the accommodation. This is known as the point of common coupling. The point of common coupling will be on the customer side of the utility meter.

6.2 For commercial buildings/sites, the renewable energy generation system's output shall be connected to the load side of the 'grid supply's service disconnecting means' at any distribution equipment locations at the commercial site. This is known as the point of common coupling. The point of common coupling will be on the customer side of the utility meter.

6.3 If the renewable energy generation system's peak power output is greater than the rating of the service connection, the point of common coupling will need to be negotiated with PPUC and, if approved, may require connection directly to the distribution system via a transformer of a higher voltage.

6.4 All signs as specified in the PPUC guidelines shall be installed with the system.

6.5 All switching and protection equipment as specified in the PPUC guidelines shall be installed with the system.

B7 Balancing of phases

7.1 If the renewable energy generation system is providing single phase power only then the AC maximum nominal rating of the inverter shall be 5kVA.

7.2 If the renewable energy generation system is providing three phase power, the system should be balanced across the three phases. If balancing across the three phases is not able to be done, the maximum variation between the phases shall be 5kVA.

B8 Buy back tariff

The customer will be advised by PPUC of the applicable buy back rate (tariff) for any excess energy sent to the grid by the renewable energy generation system.

B9 Metering requirements

PPUC will advise the metering requirements for the renewable energy generation system installation at the time the application is lodged with the PPUC.

B10 Approval process

10.1 A customer shall apply to the PPUC for approval to install a private renewable energy generation system.

10.2 The application shall be on the appropriate forms as provided by the PPUC. All the forms must be completed in full before PPUC commences the procedure to approve the installation of the system.

10.3 The customer shall not install the renewable energy generation system until such approval has been granted by the PPUC.

10.4 The PPUC will not be held responsible for costs incurred if the customer has commenced the installation of a system prior to receiving notification from the PPUC that approval is not granted.

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