



# REQUIREMENTS FOR GRID INTERCONNECTION OF SMALL-SCALE RENEWABLE ENERGYGENERATION SYSTEMS

## 1 Purpose

This document describes the general provisions and technical requirements for connecting Small scale Renewable Generation ("SSRG") systems to BPL's power system, inclusive of transmission and distribution, ('the Grid'). These requirements ensure:

1. The compatibility of the SSRG system with the Grid
2. The safety of the SSRG system operating in parallel with the Grid
3. The safety of BPL's employees, agents, customers and the public; and
4. High standards of power quality.

This document sets out the:

- Capacity limits for SSRG systems (Section 2)
- Application and interconnection process for Residential SSRG systems (Section 3)
- General conditions for connecting an SSRG system to the Grid (Section 4)
- Grid operating conditions (Section 5)
- Technical interconnection requirements (Section 6)
- Glossary (Appendix A).

## 2 Capacity Limits

For each island of The Bahamas, there are capacity limits for individual SSRG systems and for the total installed capacity of all SSRG systems. BPL or URCA may reject applications to install grid-tied SSRG systems that would exceed either limit or the capacity of the installed service. Interconnecting an SSRG system that exceeds the limits in this section requires written approval from BPL and URCA.

Capacity limits do not apply to fully off-grid SSRG systems.

### 2.1 New Providence

1. Residential customers on New Providence may install Small-Scale Renewable Generation ("SSRG") systems with capacity less than or equal to:

$$5kW + \text{Average Customer Demand}$$

Where Average Customer Demand (ACD) is the customer's total consumption in kilowatt hours (kWh) during the preceding 12 months, divided by 8,760 (the number of hours in 1 year). The calculation for ACD will be rounded up to the nearest whole number. For example, a customer with ACD of 1.3kW would be allowed to install a system with a maximum size of 7kW. This is based on:

1.3kW ACD is rounded up to 2kW

5kW + 2kW = 7kW.

Regardless of a customer's ACD, the maximum size for any SSRG system on New Providence is 100kW. BPL may further limit the allowable system size for technical reasons subject to URCA's prior approval in writing.

2. Small Commercial customers on New Providence may install SSRG systems with capacity less than or equal to:

*50KW + ACD (to a maximum of 100KW)*

Regardless of a customer's ACD, the maximum size for any SSRG system on New Providence is 100kW. URCA may further limit the allowable system size for technical reasons, or permit system sizes above the standard limit of 50KW + ACD (subject to the limit of 100kW) where special circumstances apply.

3. This program is available on a 'first-come, first-served' basis up to a maximum total of 10,000kW of installed SSRG capacity on New Providence.

## **2.2 Abaco, Eleuthera and Exuma**

1. Residential customers on Abaco, Eleuthera, and Exuma may install SSRG systems with capacity less than or equal to:

*3kW + Average Customer Demand*

Where Average Customer Demand (ACD) is the customer's total consumption in kilowatt hours (kWh) during the preceding 12 months, divided by 8,760 (the number of hours in 1 year). The calculation for ACD will be rounded up to the nearest whole number. For example, a customer with ACD of 1.3kW would be allowed to install a system with a maximum size of 5kW. This is based on:

1.3kW ACD is rounded up to 2kW

3kW + 2kW = 5kW.

Regardless of a customer's ACD, the maximum size for any SSRG system on Abaco, Eleuthera, and Exuma is 50kW. BPL may further limit the allowable system size for technical reasons subject to URCA's prior approval in writing.

2. Small Commercial customers on Abaco, Eleuthera, and Exuma may install SSRG systems with capacity less than or equal to:

*25KW + Average Customer Demand (to a maximum of 50KW)*

Regardless of a customer's ACD, the maximum size for any SSRG system on Abaco, Eleuthera, and Exuma is 50kW. URCA may further limit the allowable system size for technical reasons, or permit system sizes above the standard limit of 25KW + ACD (subject to the limit of 50kW) where special circumstances apply.

3. This program is available on a 'first-come, first-served' basis up to a maximum total of 500kW of installed SSRG capacity on each of Abaco, Eleuthera and Exuma.

### **2.3 Long Island, Bimini, San Salvador, North Andros, Central Andros, South Andros, Inagua, Cat Island, Great Harbour Cay, Black Point and Staniel Cay (Exuma)**

1. Residential customers on Long Island, Bimini, San Salvador, North Andros, Central Andros, South Andros, Inagua, Cat Island, Great Harbour Cay, Black Point, and Staniel Cay may install SSRG systems with capacity less than or equal to:

$$2kW + \text{Average Customer Demand (to a maximum of 30kW)}$$

Where Average Customer Demand (ACD) is the customer's total consumption in kilowatt hours (kWh) during the preceding 12 months, divided by 8,760 (the number of hours in 1 year). The calculation for ACD will be rounded up to the nearest whole number. For example, a customer with ACD of 1.3kW would be allowed to install a system with a maximum size of 4kW. This is based on:

$$1.3kW \text{ ACD is rounded up to } 2kW$$

$$2kW + 2kW = 4kW.$$

Regardless of a customer's ACD, the maximum size for any SSRG system on Long Island, Bimini, San Salvador, North Andros, Central Andros, South Andros, Inagua, Cat Island, Great Harbour Cay, Black Point, and Staniel Cay is 30kW. BPL may further limit the allowable system size for technical reasons subject to URCA's prior approval in writing.

2. Small Commercial customers on Long Island, Bimini, San Salvador, North Andros, Central Andros, South Andros, Inagua, Cat Island, Great Harbour Cay, Black Point and Staniel Cay may install SSRG systems with capacity less than or equal to:

$$15KW + \text{Average Customer Demand (to a maximum of 30KW)}$$

Regardless of a customer's ACD, the maximum size for any SSRG system on Long Island, Bimini, San Salvador, North Andros, Central Andros, South Andros, Inagua, Cat Island, Great Harbour Cay, Black Point and Staniel Cay is 30kW. URCA may further limit the allowable system size for technical reasons, or permit system sizes above the standard limit of 15KW + ACD (subject to the limit of 30kW) where special circumstances apply.

3. This program is available on a 'first-come, first-served' basis up to a maximum total of 250kW of installed SSRG capacity on each of Long Island, Bimini, San Salvador, North Andros, Central Andros, South Andros, Inagua, Cat Island, Great Harbour Cay, Black Point and Staniel Cay.

### **2.4 All other Family Islands**

1. Residential customers on all other Family Islands may install SSRG systems with capacity less than or equal to:

$$1kW + \text{Average Customer Demand}$$

Where Average Customer Demand (ACD) is the customer's total consumption in kilowatt hours (kWh) during the preceding 12 months, divided by 8,760 (the number of hours in 1 year). The calculation for ACD will be rounded up to the nearest whole number. For example, a customer with ACD of 1.3kW would be allowed to install a system with a maximum size of 3kW. This is based on:

$$1.3kW \text{ ACD is rounded up to } 2kW$$

$$1kW + 2kW = 3kW.$$

Regardless of a customer's ACD, the maximum size for any SSRG system on all other Family Islands is 10kW. BPL may further limit the allowable system size for technical reasons subject to URCA's prior approval in writing.

2. Small Commercial customers on all other Family Islands may install SSRG systems with capacity less than or equal to:

*5KW + Average Customer Demand (to a maximum of 10kW)*

Regardless of a customer's ACD, the maximum size for any SSRG system on all other Family Islands is 10kW. URCA may further limit the allowable system size for technical reasons, or permit system sizes above the standard limit of 5KW + ACD (subject to the limit of 10kW) where special circumstances apply.

3. This program is available on a 'first-come, first-served' basis up to a maximum total of 25kW of installed SSRG capacity on each other Family Island.

## 2.5 Summary Table

The following table summarizes the capacity limits for Residential and Small Commercial SSRG systems, as well as the overarching limit that applies to all types of SSRG systems.

	Residential Maximum System Size	Commercial Maximum System Size	No system may exceed this size regardless of ACD
New Providence & Paradise Island	5kW + ACD	50kW + ACD	100kW
Abaco, Eleuthera and Exuma	3kW + ACD	25kW + ACD	50 kW
Long Island, Bimini, San Salvador, [North/Central/South] Andros, Inagua, Cat Island, Great Harbour Cay, Black Point and Staniel Cay (Exuma)	2kW + ACD	15kW+ACD	30kW
All other Family Islands	1kW + ACD	5kW+ACD	10kW

## 3 Application and Interconnection Process for Residential SSRG Systems

This section describes the application and interconnection processes for Residential customers.

**Commercial and Off Grid Residential customers should apply to URCA in accordance with URCA's application process for SSRG systems, which will be available from URCA's website at [www.urbabahamas.bs](http://www.urbabahamas.bs) from 8 May 2017.**

Residential customers seeking to interconnect the SSRG system must apply for a Small-Scale Renewable Generation Permit from BPL. Customers should contact BPL to obtain information on interconnection requirements **BEFORE acquiring the SSRG system**. BPL is not obligated to approve or allow the connection to the Grid of any installation that is non-compliant, unsafe, or unfit for purpose.

Residential customers may obtain all relevant information on SSRG requirements, including the SSRG Application Form and the SSRG Interconnection Agreement, from BPL's offices or on BPL's website: [www.bplco.com](http://www.bplco.com).

To apply for Small-Scale Renewable Generation Permit, Residential customers must complete and submit the following to BPL:

1. The SSRG Application Form
2. An Electrical One-Line diagram (see Appendix 1 for sample) specifying all the components of the SSRG system
3. Copies of the operation and installation manuals for all system components
4. A non-refundable application fee of \$50.

Customers with existing SSRG systems who wish to connect to the grid must also apply for an SSRG Permit and submit the documents listed above to BPL.

BPL will review the application and provide its response, either approving or denying the application, within 21 days of receipt of a completed application.

After receiving written approval from BPL to acquire the specified system, the customer must apply to the Ministry of Works for the required electrical and building permits. In the application to the Ministry of Works, the customer must include a copy of its Small-Scale Renewable Generation Permit from BPL.

After receiving any required electrical and building permits from the Ministry of Works, the customer may install the approved SSRG system. The SSRG system must be installed according to the technical specifications in the customer's application to BPL and the Ministry of Works.

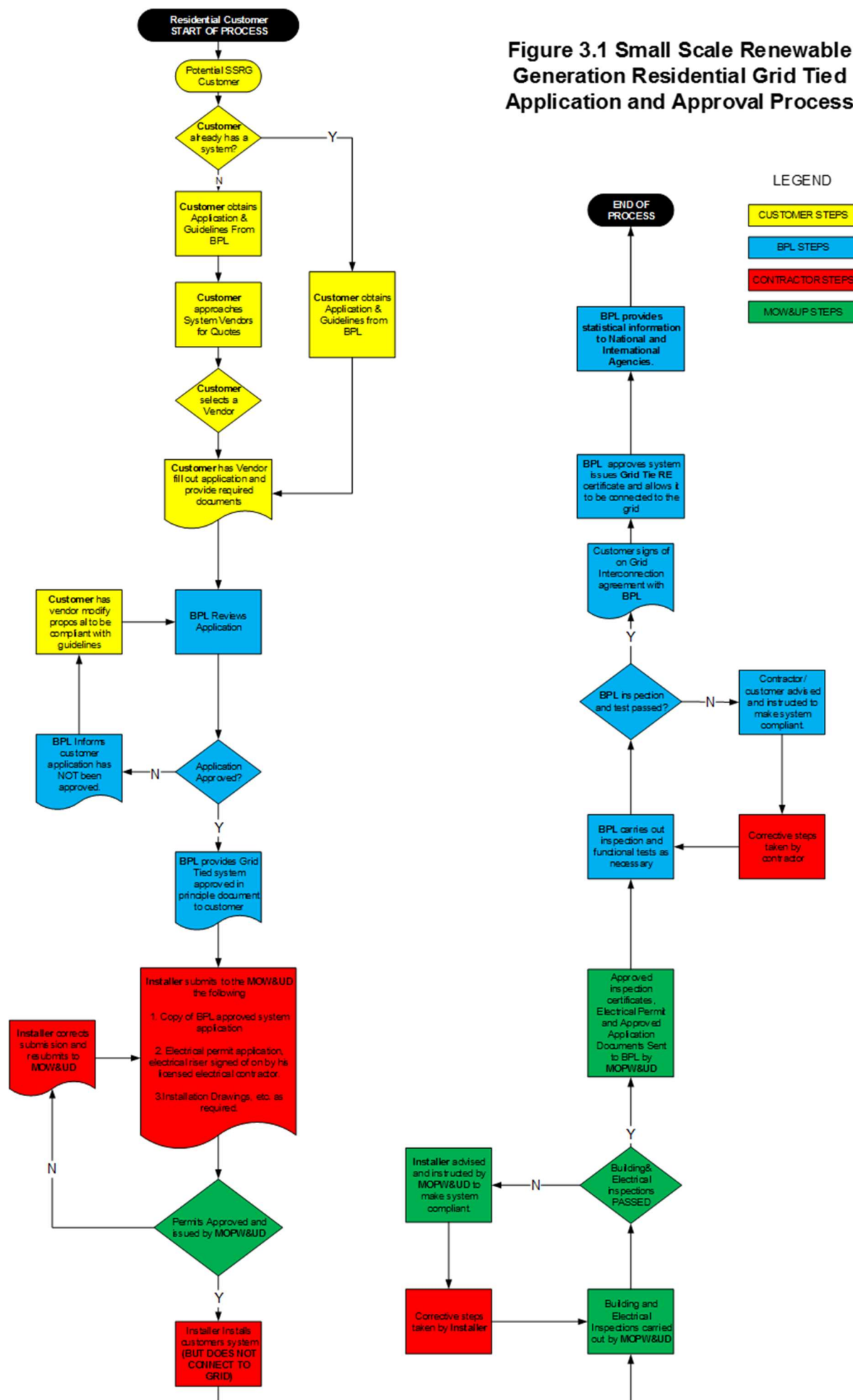
Once all approvals have been obtained and inspections passed, BPL may perform inspection and functionality tests to ensure the safety of the system. The tests must be performed no later than 21 calendar days after BPL receives written notice from the customer that the Ministry of Works has approved all relevant electrical and building permits. In the written notice, the customer must include approved copies of the relevant permits.

BPL will carry out inspections and tests in accordance with Section 6 of this document, and will advise the applicant in writing whether the SSRG system qualifies for interconnection to the Grid. BPL may, if deemed necessary, apply additional labelling and markers to identify the site as an approved SSRG system.

If BPL does not carry out these tests within 21 calendar days of receiving the approvals from the Ministry of Works, the SSRG system is considered approved, and the customer may interconnect the system to the Grid. BPL maintains the right to perform additional inspection and functionality testing for interconnected SSRG systems at any time, after providing the Customer-generator with at least 48 hours' notice.

BPL may reject the request to connect an SSRG system to the Grid, or may disconnect an interconnected SSRG system, if the system is found to be unsafe during the inspection or the verification test results. The customer should take corrective measures to ensure its system complies with the requirements. BPL will perform a second inspection and functionality test to ensure the safety of the system no later than 21 calendar days after the customer requests a second inspection.

When BPL approves an SSRG system, the customer is required to execute an SSRG Interconnection Agreement with BPL to authorize the connection with the Grid and provide for the export of energy to the Grid under the terms defined in the SSRG Interconnection Agreement.



## **4 General Conditions**

This section sets out the general conditions that apply to all customers with grid-tied SSRG systems.

### **4.1 Customers Must Be in Good Standing**

Persons seeking to acquire and connect SSRG systems to the Grid must be BPL customers in good standing. The SSRG system must be located at the customer's owned or rented property.

For rented properties, the applicant must obtain and provide to BPL written approval from the property owner authorizing the SSRG installation and fully indemnifying BPL with respect to damages from the installation, maintenance, operation, or removal of the SSRG installation.

Grid-tied SSRG systems must be capable of operating in parallel with the Grid (in accordance with the stipulated technical requirements) with the intent to offset some or all of the customer's own electricity usage.

### **4.2 Types of Grid-tied SSRG Systems Allowed**

Unless otherwise approved by BPL, to be eligible to connect and operate in parallel with the Grid, grid-tied SSRG systems must be wind and/or solar powered. Section 2 of this document describes the limits of the nameplate capacity of grid-tied SSRG systems.

The SSRG system may be single-phase or three-phase. In either case, its rated size is limited to 80 percent of the size of the main breaker servicing the system or the capacity of the service originally approved at the location, whichever is the lesser. Additionally, the phasing of the SSRG system must match that of the electrical service that is in place.

### **4.3 SSRG Interconnection Agreement**

Where the SSRG system has been approved, and passes all required inspections, the customer is required to execute a SSRG Interconnection Agreement with BPL prior to beginning operations. The SSRG Interconnection Agreement contains the terms and conditions for operating a grid-tied SSRG system, including the rate that BPL will pay for electricity sold to the Grid.

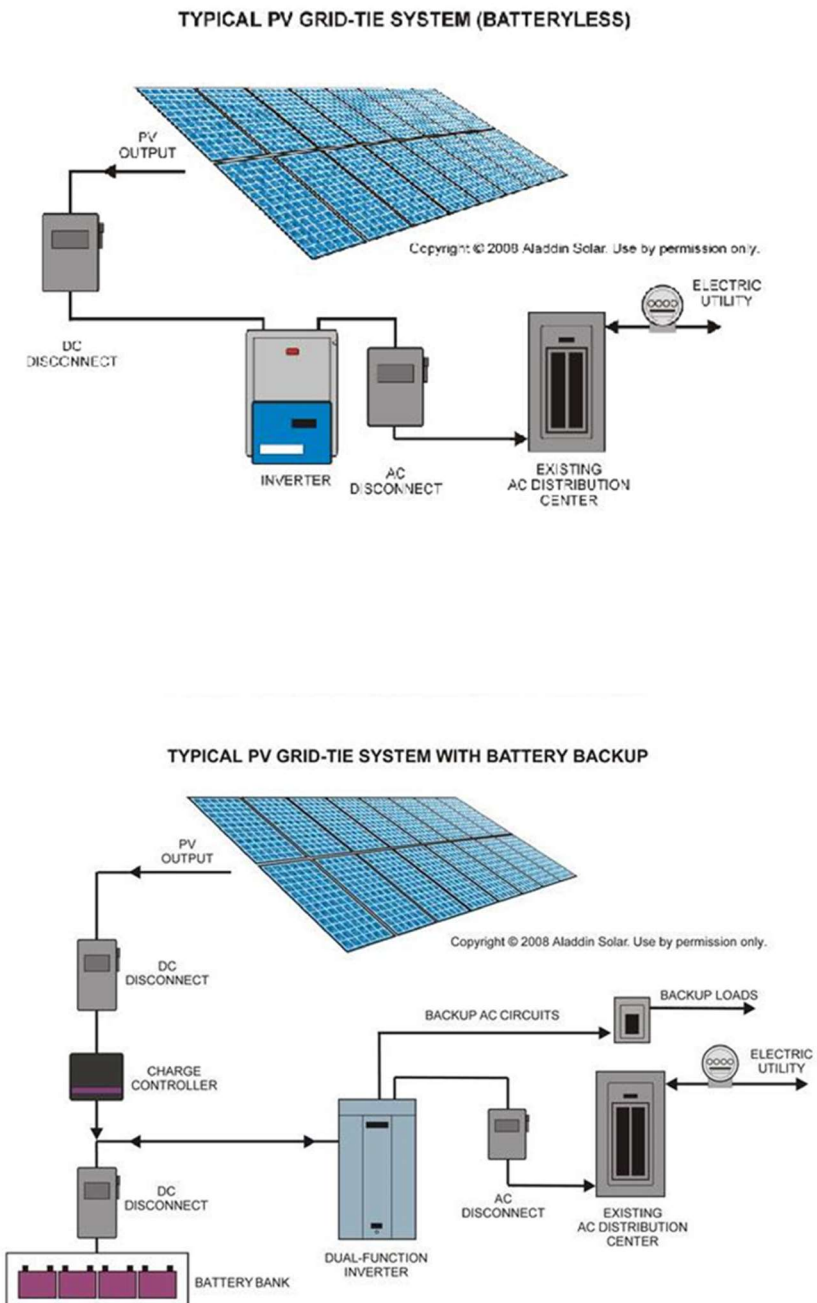
### **4.4 Unauthorized Connections**

BPL or URCA must grant approval in writing, and the customer must have executed a SSRG Interconnection Agreement with BPL, before any SSRG system is connected to the Grid. For the purposes of public and utility personal safety, BPL reserves the right to disconnect any customer who connects or has connected a SSRG system to the Grid without written authorization from BPL. If BPL decides to disconnect a SSRG system from the Grid, it shall notify URCA within two (2) days of doing so, giving reasons for the disconnection. A customer whose system has been disconnected pursuant to this power may have the matter reviewed by URCA by making a written complaint to URCA.

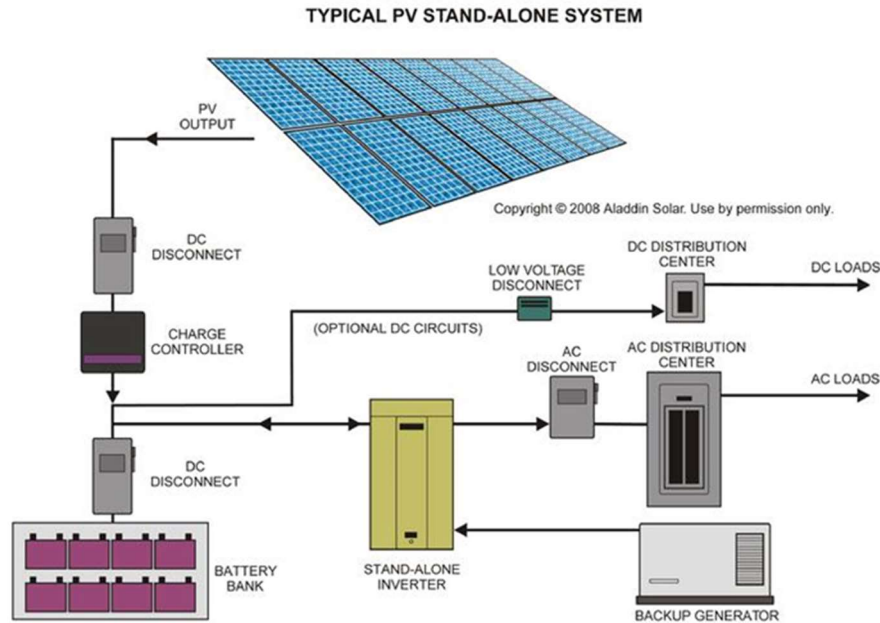
### **4.5 Metering**

BPL will furnish metering to measure the energy supplied from the Grid to the customer and the energy supplied to the Grid by the owner of a SSRG system. A sample diagram showing a metering configurations are provided in Figure 4.1.

Figure 4.1: Sample Metering Configuration







Images courtesy of Aladdin Solar

#### 4.6 Labelling

Buildings and structures with a grid-tied SSRG system must, where practicable, have the disconnecting means grouped (in accordance with BPL's Grid Code). Where such an arrangement is not practicable, there must be a permanent plaque posted on or near each disconnecting means, indicating the location of all other service boxes supplying power to the building.

Grid-tied SSRG systems that store electrical energy shall be labelled in a conspicuous, legible, and permanent manner with a suitable warning sign at the location of the service disconnecting means of the premises.

#### 4.7 Insurance

The owner of a SSRG system must maintain general liability insurance in amounts not less than:

- \$50,000 for SSRG systems with capacity less than or equal to 5kW
- \$100,000 for SSRG systems with capacity greater than 5kW, but less than or equal to 10kW
- \$500,000 for SSRG systems with capacity greater than 10kW, but less than or equal to 100kW.

An endorsement on a homeowner's policy providing the required amount of coverage is acceptable to meet this insurance requirement. Failure to maintain the insurance coverage will render the SSRG Interconnection Agreement invalid. BLP does not accept responsibility for the failure of the customer to renew its insurance policy.

Proof of coverage must be provided prior to an installation being authorized for connection to the grid. This coverage is to provide, at a minimum, protection in the event of electrical or mechanical failure or malfunction of the installation that causes loss, damage injury or death to persons or property. BPL may from time to time require the home owner to verify the existence of valid insurance coverage.

#### **4.8 Indemnification**

The owner of a grid-tied SSRG system must indemnify BPL, its agents, and third parties for losses and damages resulting from the operation of the SSRG system, except when the loss or damage occurs due to the negligent actions of BPL, its agents, or third parties. BPL and its agents will indemnify the customer for all loss to third parties resulting from the operation of the Grid except where BPL and its agents have used reasonable care in the exercise of their functions or when the loss occurs due to the negligent actions of the customer.

#### **4.9 Future Modifications and Expansion**

The customer must obtain written approval from BPL and the Ministry of Works Electrical Inspection Department, prior to modifying, expanding, or altering the approved SSRG system. The customer must present an approved Electrical Inspection Certificate to BPL, and must obtain written approval from BPL, before interconnecting the modified SSRG system to the Grid. The customer may be required to execute a new SSRG Interconnection Agreement.

#### **4.10 Customer-owned Equipment Protection**

The protection of the facility loads and generation equipment owned by the customer and ensuring compliance with all standards, codes and requirements of local authorities is solely the responsibility of the customer.

#### **4.11 Additional Fees**

Customers may be required to pay BPL additional fees for services related to the installation of the SSRG system. URCA must approve any fees before BPL may charge them to customers.

### **5 Grid Operating Conditions**

This section describes the typical distribution operating and power quality conditions within which the SSRG system should operate. These are representative values that BPL attempts to maintain and includes some abnormal conditions that the SSRG system should be designed to withstand. It is the customer's responsibility to ensure that all equipment operates correctly in this environment.

#### **5.1 System Frequency**

The Grid operates at 60Hz. Frequency typically ranges from 58.5 to 61.5 Hz for small contingencies resulting in modest disturbance where the SSRG system is expected to remain connected to the Grid. For larger contingencies, broader frequency variations may occur such as when major generation or transmission is lost and load shedding occurs. The SSRG system protective systems are expected to operate as outlined in the Technical Interconnection Requirements section below.

#### **5.2 System Voltage**

The LV distribution Grid typically operates at voltages of 120/240V single phase and 120/208V or 277/480V three phase. Voltage typically ranges from 112.8V to 127.2V (L-N on 120V base, 6%) for small contingencies resulting in modest disturbance where the SSRG system is expected to remain connected to the Grid. For larger contingencies, broader voltage variations may occur such as when major generation or transmission is lost and load shedding occurs. The SSRG system's protective systems are expected to operate as outlined in the Technical Interconnection Requirements section below.

## 6 Technical Interconnection Requirements

This section provides the technical requirements to be met by the SSRG system to qualify for interconnection to the Grid and lists typical conditions and response to abnormal conditions that the system is required to meet. Except as modified herein, the SSRG System must confirm to IEEE Standard 1547 "Standard for Interconnecting Distributed Resources with Electric Power Systems". Internal wiring must conform with national standards, as set by the ministry responsible for Building Regulation under Buildings Regulations (Chapter 200).

All components, inclusive of but not limited to inverters, panels, charge controllers and batteries, must be accompanied by the manufacturers' specifications sheets, installation/operation manuals, and other details relevant to the inverters function. These documents must be available at the time of application, initial installation inspection, and all subsequent inspections/reviews. Voltage, current and power limits, and operating points are key parameter sets must also be available for review. To maintain system safety and compliance, Underwriters Laboratories (UL) listing is required for all electrical components UL 1741 is required for all inverters, converters, controllers and Interconnection System Equipment and all Solar Modules are required to be listed under UL 1703

All small wind turbine systems must meet UL 6142 requirements as well as any applicable local code requirements.

### 6.1 Over Current Protection

The SSRG system must detect and promptly cease to energize for over-current fault conditions within its system.

### 6.2 AC Disconnect

Ensure a visible and lockable AC disconnect is in an accessible location at or near BPL's meter and required signage and notices are posted.

### 6.3 Anti-Islanding

For an unintentional island condition, where the SSRG system energizes a portion of the Grid, the SSRG system shall detect the island condition and cease to energize the Grid within a maximum of two seconds after the formation of the island.

### 6.4 Voltage Flicker

Voltage flicker is an increase or decrease in voltage over a short period of time and is normally associated with fluctuating loads or motor starting. A flicker problem is site-specific and depends on the characteristics of the changes in load. A flicker is considered objectionable when it either causes a modulation of lighting levels sufficient to be irritating to humans or it causes equipment to malfunction. The SSRG system shall not cause objectionable flicker for other customers on the Grid.

### 6.5 Harmonic Distortion

SSRG systems are to employ pure sine wave inverters and are expected to comply with IEEE Standard 519 current distortion limits with regard to harmonic current injection into the Grid. The harmonic current injection arising from the SSRG system shall not exceed the values listed in the table below – (excluding any harmonic currents associated with harmonic voltage distortion present on the Grid without the SSRG system connected). Total current harmonic distortion shall not exceed 5% of rated current.

Total Harmonic Distortion Limit		5.0%
Maximum Distortion		
Harmonic Numbers	Even Harmonics	Odd Harmonics
$h < 11$	1.0%	4.0%

10 < h < 17	0.5%	2.0%
18 < h < 23	0.4%	1.5%
24 < h < 35	0.2%	0.6%
H > 35	0.1%	0.3%

## 6.6 Inverter Response to Abnormal Voltages and Frequencies

The SSRG inverter must be able to meet the disconnection criteria set out below:

Voltage Condition (% of Nominal Voltage)	Maximum Time to Disconnect
V < 50%	0.16 sec – (10 cycles)
50% < V < 88%	2secs – (120 cycles)
110% < V < 120%	1 sec – (60 cycles)
V > 120%	0.16 sec – (10 cycles)

Frequency	Maximum Time to Disconnect
F < 59.4	0.16 sec – (10 cycles)
F > 60.6	0.16 sec – (10 cycles)

## 6.7 Voltage Imbalance

Only three-phase SSRG systems may be grid-tied to incoming three-phase services. In these cases, approximately equal amounts of generation capacity should be applied to each phase of the three-phase circuit.

## 6.8 DC Injection

The SSRG system shall not inject a DC current greater than 0.5% of the unit's rated output current at the Point of Delivery after a period of 6 cycles following connection to the Grid.

## 6.9 Synchronization

SSRG systems that can generate an AC Voltage Waveform independent of the Grid shall be connected in parallel only in combination with its synchronizing capabilities. The SSRG system shall synchronize to the Grid while meeting the Flicker requirements previously indicated and causing no greater than a 5% voltage variation at the Point of Delivery. Synchronization may occur once the Grid has stabilized following an outage or another disturbance event.

## 6.10 Interconnection Protection Function Requirements

The system shall incorporate the following protective functions:

- AC disconnecting;
- Anti-Islanding;
- Automatic synchronizing (inverters with stand-alone capability);
- Under-voltage trip (on each phase for 3-phase equipment);
- Over-voltage trip (on each phase for 3-phase equipment);
- Instantaneous over-current trip (on each phase for 3-phase equipment);
- Timed over-current trip (on each phase for 3-phase equipment);
- Under-frequency trip;
- Over-frequency trip.

## Appendix A: Glossary

**Alternating Current (AC):** An electric current that reverses its direction at regularly occurring intervals, known as the frequency which, in the case of The Bahamas, is 60 times per second.

**Automatic Reclosing:** This refers to the automatic restoration of power by devices following a fault. It may involve a sequence of short interruptions before permanent restoration or cessation of power.

**Capacity (gross):** The full-load continuous rating of the Renewable Generation System, under specified conditions, as designated by the manufacturer. It is usually indicated on the nameplate attached to the equipment.

**Customer-Generator:** The person or entity accepting responsibility for the electricity account associated with the Small-Scale Renewable Generation (SSRG) system.

**Delta ( $\Delta$ ) connection:** A method for connecting three phase supply where each phase is connected in series with the next, separated by a phase rotation of 120 degrees. Compare with Wye (Y) (star) connection.

**Direct Current (DC):** An electric current that flows in a constant direction. The magnitude of the current does not vary or has a very slight variation.

**Distribution System:** The local poles, wires, transformers, substations, and other equipment used to deliver electricity to consumers. (See Grid also)

**Flicker:** Flicker (voltage) is an unsteady visual sensation associated with changing lighting luminance caused by sudden and repetitive increases or decreases in voltage over a short period of time. It is normally associated with fluctuating loads or motor starting.

**Frequency Protection (over/under):** Use of relays or other devices to protect lines or equipment by causing circuits to open based on the degree by which the measured frequency varies from a set value.

**Generation (Electricity):** The process of producing electrical energy from other forms of energy; also, the amount of electrical energy produced, is expressed in Watt hours (Wh) for small amounts or kilowatt hours (kWh) for larger amounts.

**Grid:** A network for the transmission of electricity throughout a region. The term is also used to refer to the layout of an electric distribution system.

**Grounding:** An electrical connection to the earth or a body that extends from an earth connection for the purposes of safety and voltage reference.

**Harmonics:** Distortions in the sinusoidal voltage and current waveforms caused by the overlapping of the fundamental waveform at 60 Hz with other waveforms of integral multiple frequencies of the fundamental waveform. Total harmonic distortion (THD) is summation of all the distortions at the various harmonic frequencies.

**Hybrid System:** A self-generation system that combines multiple power sources (such as solar and wind) and is located behind a single electric utility service meter. Energy storage systems such as batteries do not constitute a power source for the purpose of this definition.

**SSRG Interconnection Agreement:** The legal document authorizing the flow of electricity between the facilities of BPL and a Customer-Generator. SSRG systems must be permanently interconnected and operating in parallel to the electrical distribution grid of the utility serving the customer's electrical load.

**Interrupting Device Rating:** The highest current that a device is intended to interrupt safely at rated voltage.

**Inverter:** A device that converts direct current (dc) electricity into alternating current (ac) electricity. Some types are used for stand-alone systems (not connected to the grid, or 'off-grid') and others are designed as utility-interactive (grid-tied) systems to operate in parallel with the utility to supply common loads and may deliver power to the utility.

**Islanding:** Islanding is a condition which occurs when an interconnected Renewable Generation System continues to energize the facility (and the Grid) after a utility power interruption. Industry practice requires that the Renewable Generation System be disconnected promptly according to applicable standards to avoid equipment damage and safety hazards to personnel.

**Overcurrent Protection:** Use of a device or relay to protect the system by tripping it offline based on the degree by which the measured current varies from a set value. The trip may be instantaneous or after a pre-set time.

**Kilowatt (kW):** A measure of instantaneous power equal to one thousand Watts of electricity (See Watt).

**Kilowatt hour (kWh):** A quantity of electricity usage equal to one thousand Watthours.

**Manual Disconnect switch:** A manual switch required for interconnection to disconnect the renewable generation source from the utility line.

**Net Metering:** An arrangement that permits a facility to offset its electrical consumption against energy delivered by the Grid at the retail value and sell power more than its local consumption.

**Net billing:** Arrangement that permits the utility (using two meters or one meter that separately measures inflows and outflows of electricity) to sell power delivered to the customer at the prevailing tariff, and buy excess power from the customer's SSRG at a rate contracted by the utility. The utility issues a net bill for each billing period.

**Peak Watt:** A manufacturer's unit indicating the amount of power a photovoltaic cell or module will produce at standard test conditions (normally 1,000 watts per square meter and 25 degrees Celsius).

**Photovoltaic (PV) Cell:** An electronic device capable of converting incident light directly into electricity (direct current).

**Photovoltaic (PV) Module:** An integrated assembly of interconnected photovoltaic cells designed to deliver a selected level of working voltage and current at its output terminals, packaged for protection against environment degradation, and suited for incorporation in photovoltaic power systems.

**Point of Common Coupling:** The point where the electrical conductors of the utility's distribution system are connected to the customer's conductors and where any transfer of electric power between the customer and the distribution system takes place.

**Point of Delivery:** The point where the Renewable Generation System is electrically connected to the electric utility for metering purposes.

**Point of Disconnection:** The point at an accessible location where the disconnect switch used to isolate the Renewable Generation System from the utility is located.

**SSRG System:** Small-Scale Renewable Generation system. These are systems with the ability to generate their own energy from acceptable renewable acceptable sources using approved technologies.

**Renewable Energy:** Energy flows that occur naturally and repeatedly in the environment (such as solar, wind, biomass) and can be harnessed for human benefit.

**Residential:** Electrical Service category of dwellings single or multi-unit, low rise, not being operated as a resort, townhouse, hotel or condominium with each unit having its own metered supply.

**Root Mean Square (RMS):** Used for AC voltage and current, this quantity equals the square root of the average of the squares of all the instantaneous values occurring during one cycle. It is considered as the effective value of AC because, for a fixed resistive load, the AC RMS voltage will produce the same heating effect as a DC voltage of equivalent value.

**Small Commercial:** A commercial business customer, which has a peak demand less or equal to 50kW.

**Solar Energy:** The radiant energy of the sun, which can be converted into other forms of energy, such as heat or electricity. Sunlight can be converted to electricity directly, as in the case of photovoltaic (PV) applications or indirectly as in the case of solar thermal applications.

**Synchronization:** The process of connecting two previously separated ac sources such as the customer's private generation system and the Grid, to allow them to operate in parallel (after matching frequency, voltage, phase angles etc.).

**Total Harmonic Distortion (voltage and current):** This is a single number representation of the amount of distortion of a voltage or current electrical waveform from a true sine wave.

**Voltage protection (over/under):** Use of relays or other devices to protect lines or equipment by causing circuits to open based on the degree by which the measured voltage varies from a set value.

**Voltage (current) Waveform:** The variation of voltage (current) over one cycle indicated by the pattern which results when the instantaneous value of voltage (current) is plotted with respect to time over a cycle. Ideally, AC waveforms are represented by sinusoids and DC waveforms are constant over time.

**Watt (Electric):** The electrical unit of power represented by the rate of energy transfer of 1 Ampere of electric current flowing under a pressure of 1 Volt at unity Power Factor.

**Watt-hour (Wh):** The electrical unit of energy represented by 1 Watt of power supplied to, or taken from, an electric circuit steadily for 1 hour.

**Wind energy:** Energy present in wind motion that can be converted to mechanical energy for driving pumps, mills, and electric power generators.

**Wye (Y, star) Connection:** A method for connecting three phase supply where each individual conductor is connected to a common point, which may be grounded or ungrounded. Compare with delta ( $\Delta$ ) connection.