ST GEORGES CAY POWER COMPANY (SGCPC)

GLOSSARY & DEFINITIONS

PREFACE: POWER & ENERGY

POWER is like the **speedometer** of a car. It is a "**rate**".

ENERGY is like the **odometer** of the car. It is a "**quantity**".

How are they related? Energy is the use of Power over time. Just like the miles on the odometer go up as the car drives at a speed over time. **Quantity** of miles at a **rate** of speed.

The units of **power** are kilowatts "kW" or megawatts "MW". The units of **energy** are kilowatt-hours "kWh" of megawatt-hours "MWh".

Automatic Transfer Switch (ATS): A mechanical switch that is actuated automatically to connect one of two different sources of electricity to the electrical loads of the premise. Refer also to Manual Transfer Switch.

Bi-Directional Converter (BDC): A device that can convert direct-current (DC) electricity to alternating-current (AC) electricity or AC to DC. Typically, a BDC is part of an ESS. Refer also to "DC", "AC", "Rectifier", and "Inverter".

Capacity Factor: A conversion between the power capacity of a renewable-energy system (DC or AC) and its energy production on an hourly basis, expressed as a percentage of an equivalent continuous power output. Capacity Factor is more commonly used by utility companies and is calculated as the AC Yield divided by 8,760 hours in a year. For example, a PV system that produces 2,000 kWh per year per kW of AC power capacity would have a 23% Capacity Factor (2,000 / 8,760 = 23%). The Capacity Factor depends on various factors such as the geographic location, azimuth and tilt angle of the array, and electrical design characteristics. Most of the Bahamas experiences a Capacity Factor of 21% to 22% depending on the above-mentioned factors. Refer also to "Yield".

DC-AC Derate Factor: The Derate Factor is the ratio of the DC power output rating of the PV Modules added together divided by the AC power output rating of the Inverter. This ratio typically ranges from 1.2 to 1.4, meaning the DC power of the PV Modules is 1.2 to 1.4 times the AC power of the PV Inverter. For example, the PV Modules may have a total DC power rating of 10 kW-DC and the inverter AC power output may be rated at 8 kW, making the DC-AC Derate Factor = 10 kW-DC / 8 kW-AC = 1.25 Derate. This is an engineering parameter based on design conditions. The reference to power on a DC or AC basis is used in the calculation of the Yield, Capacity Factor, and the allowed power capacities in the Grid Interconnection Requirements.

Energy: Refer to Preface, page 1.

Energy Storage System (ESS): An ESS is a device or assembly capable of converting electrical energy to some other form of energy suitable for storage, typically using batteries such as lithium-ion technology for that storage. The ESS also includes the power electronics necessary to convert AC to DC current (a rectifier) and DC to AC current (an inverter). Any ESS used in the SGCPC Service Area shall be UL-9540 listed, UL-9540a tested, compliant with NFPA-855, and installed in compliance with the Canadian Electrical Code (CEC).

Feed-In Tariff (FiT): The defined financial compensation the electrical utility (in this case SGCPC) will pay the Customer-owner of a grid-tied PV System for the electrical energy the system exports to the utility grid as recorded by the bi-directional meter. This rate is published in the tariff schedule for SGCPC.

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.

Genset: Engine-alternator set, also commonly called a "generator" or "backup generator". A Customer or person with a backup genset installed on their premises in the Service Area shall not use the genset except during emergency conditions.

Grid: A network for the transmission of electricity throughout a region or service area, where the electricity is an AC voltage source produced by engine-alternator sets (generators or gensets). Typically, a service-area grid is produced and maintained by a utility company.

Grid Interconnection Application (GIA): The legal document authorizing the interconnection of a privately owned generating system to the SGCPC grid.

Grid-Tied PV System: A Grid-Tied PV System, consisting of PV Modules (or "solar panels"), PV Inverters, the racking system and module attachments, roof flashing (for roof arrays), and the associated electrical components for safety, interconnection, and monitoring. A grid-tied PV System may include an ESS, or it may operate without an ESS. Refer also to Grid-Tied PV System with ESS or Grid-Tied PV System without ESS.

Grid-Tied PV System with ESS: The combination of PV Modules and PV Inverter plus an ESS and control system. This system is "grid tied" in that there is a physical connection to the SGCPC grid. This system can make electricity "islanded" from the grid. The PV Inverters require a reference voltage which may be provided by the grid, ESS, or backup genset. A primary requirement is for the physical separation of the system from the utility grid in the event of an abnormal grid condition or a grid power outage. This can be achieved by using an automatic transfer switch (ATS). SGCPC has the right and responsibility to disconnect a PV System from the grid where the resource fails to comply with the Grid Interconnection Requirements. Refer also to Grid-Tied PV System without ESS.

Grid-Tied PV System without ESS: This system cannot make electricity without being connected to the grid or a backup genset. The PV Inverters require a reference voltage which may be provided by the grid or backup genset. The backup genset may only operate in the event of a failure of the SGCPC grid. A primary requirement for a PV System without ESS that also has a backup genset is for the physical separation of the system from the utility grid during an abnormal grid condition or power outage when the backup genset is running. This can be achieved using an automatic transfer switch (ATS). SGCPC has the right and responsibility to disconnect a PV System from the grid where the resource fails to comply with the Grid Interconnection Requirements. Refer also to Grid-Tied PV System with ESS.

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 voltage or current waveforms that are caused by the overlapping of the fundamental waveform with other waveforms of frequency multiples of the fundamental waveform. Harmonics generally are undesired phenomena that cause heat to build up in circuits and conductors and noise that can interrupt other electrical devices. Refer also to "Total Harmonic Distortion".

Inverter: A device that converts direct-current (DC) electricity to alternating-current (AC) electricity. Inverters shall comply with relevant portions of the most current year-versions of IEEE-1547 and UL-1741SB based on the year of the system installation. The applicable year-version shall be 2018 unless a system owner can prove through written documentation that the system was installed prior to 2018. This definition shall be known to apply to later year-versions of IEE-1547 and UL-1741SB as those standards are updated. Refer also to "Rectifier" and "Bi-Directional Converter".

Inverter Anti-Islanding: An electrical standard that requires PV Inverters to not function as an "island", meaning the system cannot produce its own voltage waveform without the presence of another voltage source. This is a critically important safety requirement to ensure that an Inverter will not export power to a distribution interconnection that is not otherwise energized by SGCPC. A PV Inverter is required to be "anti-islanding" meaning that when it is connected to the grid it will stop exporting power within two seconds of the grid voltage itself being turned off. Without anti-islanding requirements, a technician working on the grid or powerplant when the SGCPC generators are turned off could be electrocuted by the voltage and power exported by a grid-connected PV Inverter. Refer also to "Inverter Islanding".

Inverter Islanding: An operating condition where an energy-generating system can produce its own voltage waveform. This is commonly associated with backup generators and some PV Inverters that operate and create voltage and power separately and without the utility grid. These devices are also called, "voltage sources" as they can generate an operating voltage waveform on a circuit and could energize a utility grid when the utility generating equipment is not operating. This can result in a dangerous scenario that puts utility technicians and equipment at risk, and islanding is universally not allowed when connected to a utility grid. Industry safety standards (IEEE-1547 and UL-1741SB) require that PV Inverters stop exporting power when they sense a grid failure (lack of grid voltage waveform). Refer also to "Inverter Anti-Islanding".

Kilowatt (kW): A measure of electrical power. Refer also to “Energy” and “Power”.

Kilowatt-hour (kWh): A measure of electrical energy. Refer also to “Energy” and “Power”.

Levelized Cost of Energy (LCOE): A fixed cost for electric energy, represented as $ per kWh ($/kWh). It is calculated as the total cost of ownership divided by total life-cycle energy production. The cost of ownership includes the first capital cost of generation and storage assets (such as PV and ESS) plus the annual operating cost for each year of the service life (maintenance, repairs, insurance) with each years’ expenses discounted to year zero using the applicable Discount Rate.

Manual Transfer Switch (MTS): A mechanical switch that is actuated manually to connect one of two different sources of electricity to the electrical loads of the premise. Refer also to “Automatic Transfer Switch”.

Off-Grid System: An installation that has no connection to the SGCPC grid. The Off-Grid system operates independently and should be engineered such that the ESS provides as much energy as may be required during any operating conditions and at all times. An onsite backup genset shall not be used for anything other than emergency conditions. The Owner cannot use the SGCPC grid to power premise loads. Refer also to PV System, PV Microgrid, and the SGCPC Grid Interconnection Requirements.

Photovoltaic (PV) means the physical process of converting sunlight to electricity.

Photovoltaic (PV) Inverter: This is an electronic device that converts DC power to AC power. It is a current source and not a voltage source, meaning it cannot make its own sine-wave voltage output. It must be connected to another device that makes the voltage output, such as the grid, a genset, or an Energy Storage System, ESS.

Photovoltaic (PV) Module: Also called a “solar panel”, this is an integrated assembly of PV wafers, or “cells” connected electrically to deliver a specified range of DC voltage and DC amperage at a rated power. The cells are sandwiched between one or two sheet(s) of tempered glass in an engineered frame. Multiple PV Modules are connected in a series to each other like batteries in a flashlight and then connected to an Inverter.

Photovoltaic (PV) System: A defined system architecture that consists of PV modules and grid-interactive inverters to convert the energy from the sun to electrical energy. A PV system may also be coupled with an Energy Storage System (ESS) and / or Electrical Generator. PV Systems may be grid-tied or off-grid. Refer also to Off-Grid, PV Microgrid, and the SGCPC Grid Interconnection Requirements.

Power: Refer to Preface, page 1.

Point of Common Coupling (POCC): The point where the output of a PV System is physically connected to the electrical conductors of the SGCPC’s distribution system. Also referred to as the Point of Interconnection (POI).

Rectifier: A device that converts alternating-current (AC) electricity to direct-current (DC) electricity. Refer also to “Inverter” and “Bi-Directional Converter”.

Total Harmonic Distortion (THD): This is a summation of all harmonics representing the amount of distortion of a voltage or current electrical waveform. Refer also to “Harmonics”.

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.

Yield: A general conversion between the generating power capacity of a renewable-energy system and its energy production on a yearly basis. For example, a PV system with a DC power rating of 10 kW-DC would produce roughly 15,000 kWh per year. The Yield is 15,000 kWh/year divided by the 10 kW-DC power rating = 1,500 kWh/kW-DC/year. The yield depends on various factors such as the geographic location, azimuth and tilt angle of the array, and electrical design characteristics. Most of the Bahamas experiences a Yield of 1,500 to 1,650 kWh/kW/year depending on the above-mentioned factors. On an AC basis, this Yield range is approximately 1,900 to 2,100 kWh/kW-AC. Refer also to “Capacity Factor” and “DC-AC Derate”.