

APOLLO SOLAR - GLOSSARY OF TERMS RELAVANT TO TELECOM ENERGY SYSTEMS

As the relatively new Solar Power industry meets the well established Telecommunications market, there is likely to be confusion with terms. This Glossary provides definitions to allow professional from both disciplines to work from the same understanding. This is not intended to be exhaustive or even complete for either trade, but to address the overlap where Solar is providing energy to power the cell phone towers.

3S5P	Short hand to express how a group of PV Modules or Battery Cells are wired. 3P means 3 in Series followed by 5 in Parallel.
AIR	Abnormal Incident Report. One tool used to minimize Down-Time by tracking all failures and incidents to determine the Root Cause so corrections can be made.
Absorb Charge	The second stage in charging a battery which brings them up the last 15% or 20% up to 100% full. This is done at a constant voltage which is set in the charging device. The efficiency is lower than the Bulk Charge stage.
AGM	Absorbed Glass Mat - A spill proof and maintenance free lead acid battery. The electrolyte is a damp, putty consistency held in place by porous plates. In the family of VRLA (Valve Regulated Lead Acid), they are not actually sealed, but have a valve to release pressure in the case of an overcharge.
ALR	Array to Load Ratio. A shorthand method to estimate the amount of PV that is required for a specific load. Typically 8:1 to 12:1 depending on the amount of Irradiance at the specific location. If the Load is 1kW, the PV Array should be 8kW to 12kW.
ATS	Automatic Transfer Switch. When a site has 2 sources of AC power such as a Generator and the Utility Grid, the ATS selects the lower cost Grid power, but switch to the Generator when the Grid fails.
Autonomy	The number of Hours or Days that a Battery Based Site will provide full power even when no energy has been available to charge the Batteries. Typical Pure Solar sites are designed for 3 to 5 days of Autonomy to survive monsoon type weather. Note that 3 days of autonomy requires the battery to be exactly 3 times larger and 3x the cost of the 1 day battery. This factor is the major cost driver in Pure Solar systems.
Backhaul	The radio gear that connects each tower back to a Central Office.
Battery Based	An accurate name for the Remote Energy Systems we are focused on for Telecom Towers.
Battery String	A battery is made up of a series connected group of Cells often called a String. Multiple Strings can be connected in parallel to increase the total storage capacity.
BLR	A new shorthand expression of the Battery Size in kWh related to the Load in kW. This is not as accurate or commonly used as ALR. The ratio is typically 100 to 140.
BMS	Battery Management System. An essential part of any Lithium Ion battery string. Li-Ion cells must be prevented from over-charge and over-discharge. The BMS monitors every cell and disconnects the entire battery if any cell hits either limit. - Note: BMS may also be used to mean Battery Monitoring System which measures the voltage and temperature of each battery cell, but does not take any action.
BTS	Base Transceiver Station. This is the radio equipment that receives and transmits to the subscriber mobile phones. A typical BTS requires about 750watts of power.
BTS (2)	Build-to-Suit. For some reason the tower companies sometimes uses BTS to refer to a tower system which is custom built to meet just the carrier's specific requirements.
Bulk Charge	The first stage of Battery Charging. A regulated Current stage at the end of which the battery is up to 80% or 85% of full charge. The Bulk Charge stage is terminated when the battery hits the preset Absorb Voltage Setpoint. This is typically 56 to 57 volts for telecom systems.
Carrier	The Telecommunications company who owns or rents the Tower and the BTS to send and receive phone traffic between their subscribers and their central office.

Cell (Battery)	The smallest division of any battery. Any Battery is a group of Cells. Each Cell in a Lead-Acid battery is a 2 volt rechargeable device that varies from about 1.9 volts to 2.5 volts from full discharge to full charge. Other cell chemistries have different voltages. Lithium Ion is 2.9 to 3.55 volts per cell. Multiple cells are often packaged in a series stack.
Combiner	The PV Combiner Box is connected directly to the Solar PV Array of Modules. Several series strings of modules are joined together in Parallel inside the Combiner using Circuit Breakers to prevent backfeeding of current in adverse circumstances. The Combiner Box is a good place to connect a Surge Protection Device to the combined output from PV Array. The combined output is a single pair of wires (called the home run) going directly to the Charge Controller in the electronics cabinet.
Contact	A high power relay. Typically Contactors have only Normally Open contacts and a large coil to close them. A second, lower power coil may be added to hold the contacts closed.
Cycle Life	Every Rechargeable Battery has a limited number of Charge-Discharge Cycles. The deeper the discharge, the fewer number of cycles. The preservation of Cycle Life is the major concern in the design of all battery charging systems.
Deep Discharge	Batteries will be damaged by discharging them beyond a certain level. Using more than the top 25% to 35% of a Lead Acid Battery is considered a Deep Discharge. Li-Ion Batteries can be used down to 80% or 90% of their total capacity. The battery based system must be designed to avoid deep discharges.
DG	Abbreviation for Diesel Generator.
DoD	Depth of Discharge. See Deep Discharge. The Maximum DoD of a system is a critical specification that affects the battery life and determines the size of the battery required.
Down Time	Telecom Carriers do not allow their towers to have more than about 0.01% to 0.05% of the time without power. The penalties are very costly for the Tower owner and/or the Energy Company. See SLA.
Energy	The Power used over a period of time. For example kilo-watt-hours or kWh is number of kilowatts used per hour.
Essential Load	The Loads on the Tower can be divided into priorities in the case they must be shed in order to prevent the Battery from becoming deeply discharged. The Essential Loads are usually the Backhaul equipment since it will be carrying traffic from many towers back to the central office. The Non-Essential Loads are usually the individual BTS for the local subscribers near that tower.
Float Charge	The last stage of Battery Charging. After Bulk and Absorb have fully charged the battery to 100%, a lower voltage and lower current stage is used to simply keep the battery maintained against self-discharge. Note, Li-on Batteries do not use a Float stage.
Flooded	One of the types of Lead-Acid Batteries. The plates sit in a jar and are "flooded" with water based electrolyte. Flooded batteries lose the water when charging which must be replaced periodically. The opposite of Flooded is VRLA Valve Regulated Lead Acid.
GELL	One type of VRLA (Valve Regulated Lead Acid) battery. The electrolyte is gelled to avoid spilling and evaporation. They are not actually Sealed although they sometimes get that name.
Grid	The Utility AC electric transmission and distribution network. Grid power may or may not be reliable or consistent in developing Nations. If reliable, Grid Power is lower cost than power from Diesel Generators. Solar Power is always the lowest cost because both the energy and the delivery of the energy to the site are totally free.
Hot Swap	Rectifier Power Modules which can be removed from service and replaced without turning the power off. This has value since it avoids Down Time.
Hybrid	An over-used term which has a different meaning for every field. We refer to a Hybrid Energy System that uses input from multiple sources, typically Solar and Diesel.
Insolation	The amount of Energy which is available from the Sun at a specific location. It is expressed in kWh/m ² /day. Tables can be used to look up these important values for each site.

IP66	Ingress Protection is expressed with 2 numbers for Dust and Water. A wine bottle is IP67 and a submarine is IP68. We use cabinets which are built to meet IP66 which keeps almost everything out which might concern us.
Irradiance	See Insolation.
kWh/m²/day	See Insolation.
LiFePO4	Lithium Iron Phosphate battery. This is the best type of Lithium Ion battery available today for stationary energy systems.
Li-Ion	Short for Lithium Ion. A family of several variations with other elements added to enhance certain parameters.
Lithium Ion	See Li-Ion.
Load	The equipment to be powered. In most cases this will mean the BTS at the specific site. The load power is expressed in watts or kW. The exact Load is the first and most important parameter to be established when designing the energy system for that site.
Microwave	One of the transmission technologies (capable of 4Mbit/s to 400Mbit/s) of connecting the individual BTS systems on each tower back to the Central Office. The backhaul Microwave equipment is the highest priority for power since a single outage will disable the communications to the Central Office from many BTS towers.
Modem	A common concatenation for Modular / Demodulator. A device to encoding serial data in a form for radio transmission. We use GSM modems to send data over the cellular network.
MPPT	Maximum Power Point Tracking. An essential feature for harvesting energy from PV modules. The MPPT Charge Controller finds and locks onto the optimum voltage and current point of the PV Modules. This peak point changes drastically during day with changes in temperature and irradiance.
n+1 Redundant	Using multiple identical modules in parallel in equipment such as Rectifiers provides greatly improved system reliability. In a system that requires 5 Power Modules, a 6th unit can be installed. If any one of the power modules should fail, the remaining 5 redundant modules automatically close ranks and provide 100% of the power required.
Non-Essential Load	Typically the BTS equipment on a tower. See Essential Load and Microwave.
Off-Grid	Same general meaning as Battery Based or Remote. Any location which is not served by the Utility Power connection or Grid.
OPzS	Literally Ortsfest Panzerplatte Flussig - German for stationary tubular plate flooded battery. The long positive plates are tubular. Commonly called Tubular Flooded.
OPzV	Literally Ortsfest Panzerplatte Verschlussen - German for stationary tubular plate closed battery. Popular in telecom service, this package of VRLA battery is claimed to offer good deep discharge and long life. The long positive plates are made of tubular sleeves which hold the active gel electrolyte. Commonly called Tubular Gel.
Positive Ground	Telecom equipment runs on 48 volts DC. The positive wire is connected to Earth Ground.
Power	Defined as Volts x Amps and expressed in watts or kW. Instantaneous by nature.
Pure Solar	Solar is the only source of energy at the site. There is no diesel generator or grid input. The track record has proven that Pure Solar systems are the most reliable and lowest cost over time. They are free of the costs of diesel fuel, fuel delivery and fuel theft as well as the maintenance of the generators.
PV	Photo-Voltaic. Varieties include Monocrystallian, Polycrystallian and Thin Film referring to the PV cells. The cells are assembled into Panels and packaged with a frame called Modules. Typical PV Modules are made up of either 60 or 72 cells today. The power rating of a PV Module is typically 250 watts to 350 watts today. A popular term is "solar panel", but that can be confused with the water heating unit.
PV Array	Multiple PV Modules mounted using a common frame. The Modules are wired in Series Strings and multiple strings are connected in Parallel inside the Combiner Box. For Apollo Solar equipment, each PV Array is typically wired as 3 modules in each series string with 5 such strings connected in Parallel. For remote telecom, they are Ground Mounted.

Remote Monitoring	See SCADA.
SCADA	Supervisory Control And Data Acquisition. Software application for process control which gathers data in real time from remote locations in order to control equipment and conditions. The Apollo Solar Remote Monitoring is an example of a good SCADA system.
Self Discharge	Batteries will drain their own power internally. This is stated in percentage per month. Lead Acid batteries can be over 5% per month. Li-Ion batteries Self Discharge rate is about 2% to 3% per month. The self discharge rate doubles for every 10°C over 25°C.
Shelter	The small building at the base of the tower that houses the BTS and Backhaul radio gear along with the energy system equipment. Generators are outside.
SLA	Service Level Agreement which is a Guaranteed Level of Energy Availability. Usually the Telecom Carrier, who is the end customer, will require a Service Level Agreement from the Tower Company and the Energy Service Company. For the Energy provider, this contract imposes a for 99.95% to 99.99% up- time required from the Energy System. These compute to 53 minutes to 4.38 hours PER YEAR of allowed down time. A stiff monetary penalty is imposed for any more down time than that. Unplanned Down-Time is very costly and must be avoided. The Energy System is vulnerable if not designed, installed and maintained properly. Apollo Solar equipment is designed to meet this challenge.
SoC	State of Charge of the Battery. It is critical to know the amount of energy in the battery and all times. The Apollo Solar T80HV includes a special coulomb counter which keeps a running total of all energy into and out of the battery. The readout is always available. A popular method used to estimate the SoC is to simply measure the voltage. However the voltage is full of inaccuracies caused by charging, discharging and age of the battery.
SPD	Surge Protection Device. This is a category of products used to limit the amount of energy imposed by near-by lightning strikes from getting into the electronic equipment. Large transient voltage spikes caused by fast current impulses must be shunted to ground before they enter the electronic cabinet. Several different devices of appropriate voltage levels may be required in tandem. Apollo Solar offers enhanced surge protection on all the wires from the PV Array.
Storage	A general term referring the Battery used to store energy in our case.
Sun Hours	A shorthand term meaning the average number of hours of full insolation per day. In the case where a site may enjoy sunshine for 10 to 12 hours a day, the nature of the sine curve traced by the sun means that full sun (1000watts /m ²) is only at solar noon. The total sun hours for the day may be 5.5 kWh/m ² /day. See also Insolation, Irradiance.
Tenant	Telecom carriers rent space on towers. Towers can have multiple tenants.
Tower Company	Tower Companies own the tower, maintain it, and rent space on it to telecom carriers. The Tower Company may also own the energy system and provide the energy.
Tubular Battery	Properly called Tubular Anode Battery. This is a popular configuration for both Flooded and VRLA batteries which started in Europe. The OPzV and OPzS are the most popular versions.
Turnkey	Purchasing the Energy System as a complete package.
Up Time	See Down-Time and SLA.
VRLA	Valve Regulated Lead Acid battery. This is a spill proof and maintenance free battery, but it is not actually sealed as they are sometimes called.
Vmp	The PV Maximum Power Point Voltage. This is the usable voltage from the PV modules. It decreases with high temperatures, so the system may not have enough voltage to run properly at high temperatures.
Voc	The PV Open Circuit Voltage. This is the highest voltage from the PV module. It increases as the temperature drops, so one must be careful of wiring too many PV modules in series and causing damage to the electronics at low temperatures due to high voltage.