

AN OVERVIEW STANDALONE SOLAR POWER SYSTEM

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Abstract: This paper present basic information about off grid solar power system and major components of off grid solar power system. Operation of solar cell and how solar energy converted into electrical energy. The paper inculdes basic arrangement of off grid solar power system for house holds appliances and fundamental of design considerations of off grid solar power system.

Index terms: Solar panel, Components of solar power system, Arrangement and design consideration of off grid solar power system.

I. INTRODUCTION

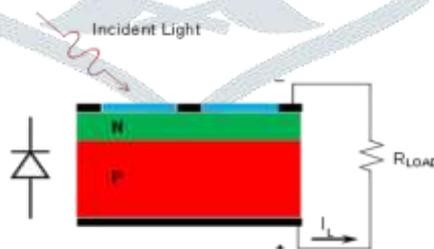
Power generated by fossil fuels cause pollution to environment. One day fossil fuel are going disappear completely so in that case we need to depend upon alternating energy source i.e. Renewable energy source . Renewable energy system is used for the future power generation. Among the several renewable energy source solar systems are used in many application like rural electrification, water pumping and remote home etc.

Standalone (off grid) solar power system means producing own power for your requirements. Stand alone system is one that does not have utility connection. Solar power system are used for rural electrification and remote house where access of grid power is not Viable. Power supply to remote house or villages where small amount of power required is more economically from solar standalone system than from main electricity.

II. SOLAR CELL

Solar cells are made up of special materials called semiconductor such as silicon. Solar cell is also called photovoltaic(PV) cell. Which as the name implies photo meaning light and voltaic meaning electricity. A solar cell is a solid state electrical device P-N junction that converts the energy of light directly into electricity (DC) using the photovoltaic effect. The process of conversion first requires a material which absorbs solar energy photon and then raises an electron to higher energy state this high energy electron flows to an external circuit.

These excess charges can flow through an external circuit to produce power.



• Figure 1: Basic structure of solar cell

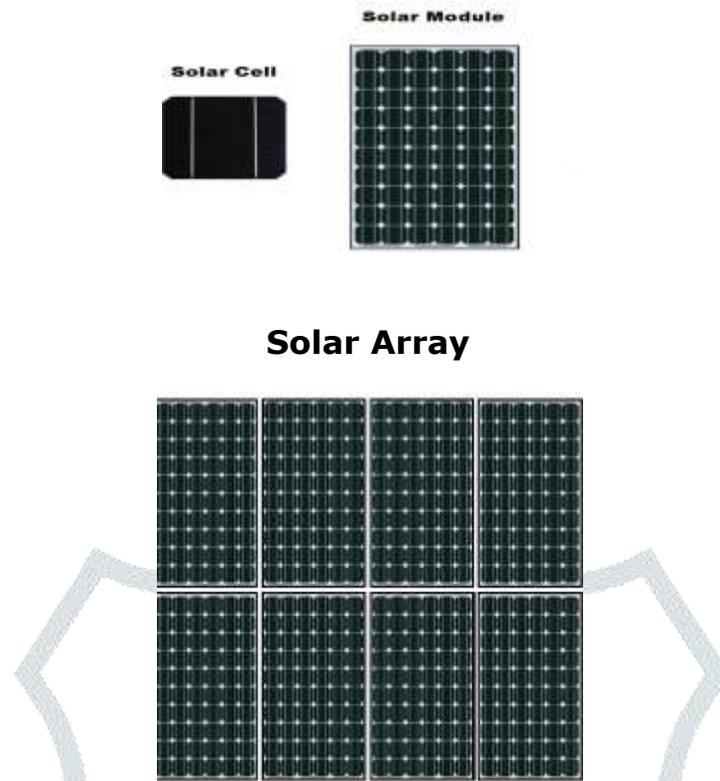


Figure 2: solar cell, solar module and solar array

Solar cell is the basic unit of solar power system. Solar cells are building blocks of solar panels. A multiple solar cells connected in series to produce a higher output is called solar module. Solar module produces a small amount of energy in order to produce large amount of energy multiple solar panels interconnected together in String. This is called PV array or Solar array.

III. MAJOR COMPONENTS OF OFF GRID SOLAR POWER PLANT

Solar power system consists of different components used to generate electricity from sunlight. Selection of solar power system components depends on climate & geographical location, site preparation needs, area available, system type and application. Solar power system components are Solar panels, solar charge controller, Battery bank and inverter.

SOLAR PANEL

Solar panel is the important component of solar power system. Solar panel is also known as solar Module. Solar panel absorbs solar energy from the sun and converts it to DC power. Solar module in string can be connected in series or parallel. In series connection the voltage will be added up and in parallel the voltage will remain the same.

SOLAR CHARGE CONTROLLER

The most important component in a standalone solar power system is the solar charge controller. It is the brain of the system, responsible for performance, durability, and reliability.

Solar charge controller, also known as a solar regulator, coordinates the main components of any standalone system.

Off-grid solar power systems for household applications require a battery bank when sunlight is not available; the energy stored in the battery supplies the loads. The battery-based system should have a charge controller. The main function of a charge controller is to regulate the voltage and current coming from the solar module and going to the battery. A solar charge controller selected correctly, with specification of battery rating, prevents battery overcharging and thereby improves battery life. MPPT (Maximum Power Point Tracking) solar charge controllers are useful for off-grid solar power systems. MPPT-type charge controllers extract the maximum available power from the solar module by making them operate at the most efficient voltage.

The MPPT charge controller takes the voltage output of the solar panels and compares it to the battery voltage. It figures out what is the best voltage to get maximum current into the battery. MPPT charge controllers are most efficient in all weather conditions.

low temperature condition PV module works better at cold temperatures and MPPT utilized to extract the maximum power available from the module. When battery deeply charge, MPPT can extract more current and charge the battery if the state of charge in battery is lower.

BATTERY BANK

A Group of batteries wired together is known as a string of batteries. IT is a key component in standalone solar power system. Batteries store energy collect form solar power system and supplies to electric appliances where there is demand and not availability of sun energy. The battery should be large enough to store sufficient energy to operate the appliances at night time, cloudy days and if needed in winter. There are two basic types of batteries that are available for use in a standard solar energy production system. They are sealed batteries and flooded lead acid batteries. The battery suits for standalone solar power system have deep cycle battery.

A cycle in solar battery occur when it is discharged and recharged back to its full level, how much a solar battery is discharged is called depth of discharge.

INVERTER

Inverter converts Dc power from solar panels into Ac power. This power is used for the AC loads. An Inverter used in the system where 230V, AC power output is needed. For standalone systems the inverter must be large enough to handle the total amount of watts that household appliances will using at one time.

IV. BASIC ARRANGEMENT OF OFF GRID SOLAR POWER SYSTEM

The amount of produced will depends on how large the PV system. The greater area of PV panels the more Electricity is generated. The basic arrangement of off Grid solar power system is show in the fig.

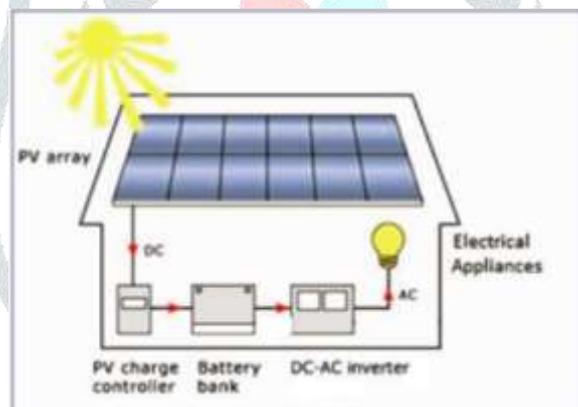


Figure 3: Off grid solar power system

Once solar power system is installed and it is operating the power produced is free and there is little maintenance required. Solar energy is a clean source of power. A well designed and installed solar power system will provide electricity for more than 20 years.

Disadvantage: Initials cost is high to install the solar power system. Solar electricity is not available at night and is less available in cloudy weather so storage system battery bank is required.

V. OFF GRID SOLAR POWER SYSTEM DESIGN CONSIDERATIONS

The first step in designing a solar PV system is to find out the total power and energy consumption of all loads that need to be supplied by solar PV system.

Different size of solar modules will produces different amount of power. To find out the sizing of solar module the total peak watt produced needs. The peak watt produced depends on size of solar module and climate of site location. The selection of inverter should never be lower than the total watt of appliances. The input rating of inverter should be same as solar array rating of inverter should be safe and efficient operation. The battery should be large enough to store sufficient energy to operate the appliances at night and cloudy days. Selection of the solar charge controller to match the voltage of solar array and batteries which solar charge controller has enough capacity to handle the current from solar array.

CONCLUSION

This paper describes importance of off grid solar power. Solar system fast growing energy source because of the increase in energy demand. The major components used in off grid system and energy conversion process in which sunlight energy is converted to electrical energy.

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