Photovoltaic System

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Abstract:

Photovoltaic systems (PV system) use solar panels to convert sunlight into electricity. A system is made up of one or more photovoltaic (PV) panels, a DC/AC power converter (also known as an inverter), a racking system that holds the solar panels, electrical interconnections, and mounting for other components. Optionally it may include a maximum power point tracker (MPPT), battery system and charger, solar tracker, energy management software, solar concentrators or other equipment. A small PV system may provide energy to a single consumer, or to an isolated device like a lamp or a weather instrument. Large grid-connected PV systems can provide the energy needed by many customers. The electricity generated can be either stored, used directly (island/standalone plant), or fed into a large electricity grid powered by central generation plants (grid-connected/grid-tied plant), or combined with one or many domestic electricity generators to feed into a small grid (hybrid plant).Systems are generally designed in order to ensure the highest energy yield for a given investment.

Keywords: DC/AC power converter, Photovoltaic systems.

I. Introduction:

The word "photovoltaic" combines two terms – "photo" means light and "voltaic" means voltage. A photovoltaic system in this discussion uses photovoltaic cells to directly convert sunlight into electricity. The primary obstacle to increased use of photovoltaic systems is their high initial cost. Continuous price reductions have been occurring. In some off-grid locations as short as one quarter mile, photovoltaic systems can be cost effective versus the costs of running power lines into the property and the subsequent continual electric charges.

Some utilities, including Austin's electric utility, have established PV centralized power stations, and many are including a "green power" option which allows customers to pay a small fee on their monthly utility bill which will be used to construct additional renewable energy installations (PV, wind, biomass, etc.) in order to add more renewable energy inputs for the City's overall energy production base. However, of greater interest to home owners is the potential of decentralized PV systems located at residences providing power to the home and to the centralized power grid when PV power exceeds the home's requirements. The grid provides power to the home when the PV's are not producing power in this case.

II. Solar cells:

Photovoltaics are best known as a method for generating electric power by using solar cells to convert energy from the sun into a flow of electrons. The photovoltaic effect refers to photons of light exciting electrons into a higher state of energy, allowing them to act as charge carriers for an electric current.
The term photovoltaic denotes the unbiased operating mode of a photodiode in which current through the device is entirely due to the transduced light energy. Virtually all photovoltaic devices are some type of photodiode.

Solar cells produce direct current electricity from sun light which can be used to power equipment or to recharge a battery. The first practical application of photovoltaics was to power orbiting satellites and other spacecraft, but today the majority of photovoltaic modules are used for grid connected power generation. In this case an inverter is required to convert the DC to AC.

Photovoltaic power generation employs solar panels composed of a number of solar cells containing a photovoltaic material. Materials presently used for photovoltaics include mono crystalline silicon, polycrystalline silicon, amorphous silicon, cadmium telluride, and copper indium gallium selenide/sulfide.[11] Copper solar cables connect modules (module cable), arrays (array cable), and sub-fields. Because of the growing demand for renewable energy sources, the manufacturing of solar cells and photovoltaic arrays has advanced considerably in recent years.

Cells require protection from the environment and are usually packaged tightly behind a glass sheet. When more power is required than a single cell can deliver, cells are electrically connected together to form photovoltaic modules, or solar panels. A single module is enough to power an emergency telephone, but for a house or a power plant the modules must be arranged in multiples as arrays.
Photovoltaic power capacity is measured as maximum power output under standardized test conditions (STC)

III. Costs and economy:

Costs of production have been reduced in recent years for more widespread use through production and technological advances. Crystal silicon solar cells have

largely been replaced by less expensive multicrystalline silicon solar cells, and thin film silicon solar cells have also been developed recently at lower costs of production. Although they are reduced in energy conversion efficiency from single crystalline "siwafers", they are also much easier to produce at comparably lower costs.

IV. Solar vehicles:

All air and space vehicles take their energy from sun. Surface vehicles generally require higher power levels than can be sustained by a practically sized solar array, so a battery is used to meet peak power demand, and the solar array recharges it. Space vehicles have successfully used solar photovoltaic systems for years of operation, eliminating the weight of fuel or primary batteries.

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