Scientific Journal Impact Factor (SJIF): 1.711

e-ISSN: 2349-9745
p-ISSN: 2393-8161

International Journal of Modern Trends in Engineering and Research
www.ijmter.com

SALIENT FEATURES OF GRID-CONNECTED PHOTOVOLTAIC SYSTEM AND ITS IMPACT ON POWER SUPPLY

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Abstract— Solar energy is available to the world for free of cost from millions of years and it is a basic energy source to the mankind. It is also one of largest energy source to the mankind. PV systems are a relative new technology. The operational experience with PV systems itself is at an acceptable high level and today's installed PV systems are of a good quality and are able to operate without any problems for many years. The price level of the PV modules and the Balance of System costs (inverter included) have decreased significantly. This energy is available all around the world in large quantity. When this energy is collected by the solar PV cells it is in the small power with the D.C. supply, which is not compatible with the existing grid in the world. There is an inverter and the converter stage comes before this energy can used. Grid interactive PV systems can vary substantially in size.

Keywords— PV System, PV Cell, PV Array, PV Module, PV Inverter, PV Harmonics, Grid-Connected System.

I. INTRODUCTION

A grid-connected photovoltaic power system or grid-connected PV system is an electricity generating solar PV system that is connected to the utility grid. A grid-connected PV system consists of solar panels, one or several inverters, a power conditioning unit and grid connection equipment. Before connecting a PV system to the power network, the DC voltage of the solar modules PV systems are installed on roof tops, facades of buildings, special construction like sound Barriers on motor ways. PV-system have, by definition, a large exposure to the open sky and are therefore subjected to atmospheric influences. A lightning strike is one of the most severe atmospheric influences. To protect a PV-system for a direct lightning stroke is very difficult due to the very high energy content of the lightning stroke. However, a PV system must and can be designed to withstand the effects of indirect lightning strike [1].

Because as day by day the demand of electricity is increased and that much demand cannot be meeting up by the conventional power plants. And also these plants create pollution. So if we go for the renewable energy it will be better but throughout the year the generation of all renewable energy power plants. Grid tied PV system is more reliable than other PV system. No use of battery reduces its capital cost so we go for the grid connected topology. If generated solar energy is integrated to the conventional grid, it can supply the demand from morning to afternoon. Grid connected systems have demonstrated an advantage in natural disasters by providing emergency power capabilities when utility power is interrupted. Although PV power is generally more expensive than utility provided power, the use of grid connected system is increasing [2].

II. PV SYSTEM

Photovoltaic systems are comprised of photovoltaic cell, devices that convert light energy directly into electricity. Because the source of light is usually the sun, they are often called solar cells. The word photovoltaic comes from "photo" meaning light and "voltaic" which refers to producing electricity. Therefore, Photovoltaic process is "producing electricity directly from sunlight. Photovoltaic are often referred to PV [2,3].

PV systems are frequently connected to other sources of power or energy storage such as batteries, standby generators, hydro-generators and the utility grid. The grounding of the PV system must be consistent with the grounding used on the connected power system. Including a battery storage system in a PV application adds additional battery-related considerations including corrosion of connections, leakage paths caused by condensed acidic gasses, spillage of electrolyte and conduction along normally insulated surfaces, and very high dc fault currents from the batteries when the fault is low resistance.

2.1 PV Cell

Photovoltaic (PV) is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect. The basic PV cell model is presented in Figure 1 [4].

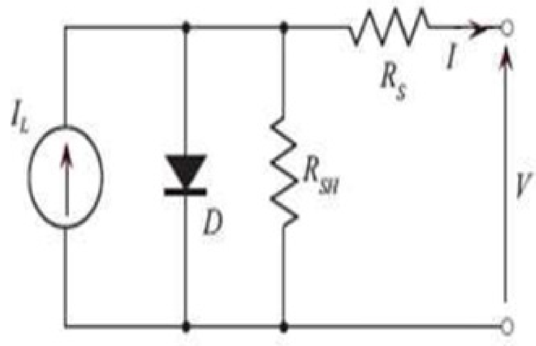

Figure 1: Basic PV Cell Model

2.2 PV Module

PV modules can develop leakage currents as they age, especially in wet conditions. It exhibits a variable current source behavior due to variation of irradiance.

2.3 PV Array

The system grounding ensures a solid or known PV array ground through properly sized conductors. PV systems are nonlinear power sources whose output power is greatly under effect of two radiation and environment temperature elements. One of the disadvantages of these systems is their low efficiency, because solar cells rarely operate at their maximum power point. So in order to increase the efficiency, as much power as possible should be extracted from the array.

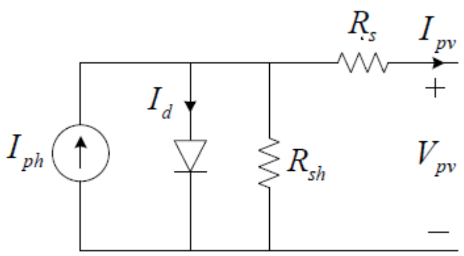

Figure 2: Equivalent Circuit of PV Array

In connection of the PV array to grid, a DC/DC converter is applied and is used to adapt the variable voltage of PV with the voltage of grid and extract the maximum power from the array [3,4].

2.4 PV Inverter

PV Inverter that convert dc signal into an ac signal which is being injected into the power grid. The ac output power from the inverter depends on the radiation variation which in turn results in dc power changes.

Due to the PV inverter power conversion efficiency characteristics, the power injected by the PV inverter into the electric grid is maximized. power switches of the PV inverter under consideration are controlled according to the Sinusoidal Pulse Width Modulation (SPWM) principle, the PV inverter switching frequency, s f (Hz) is constrained to be an integer multiple of the grid frequency, f (Hz) [2,5].

2.5 PV Harmonics

- **Transients:** Voltage disturbances shorter than sags or swells are classified as transients and are caused by the sudden changes in the power system. In electronic equipment, power supply component failures can result from a single transient of relatively modest magnitude.
- **Noise:** Noise is unwanted distortion of the electrical power signals with high frequency waveform superimposed on the fundamental. Noise is unwanted electrical signals with broadband spectral content typically lower than 200 kHz superimposed upon the power system voltage or current in the phase conductors or unwanted electrical signals found on neutral conductors or signal lines.
- **Flicker:** Impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time.
- **Waveform Distortion:** A steady-state deviation from an ideal sine wave of power frequency principally characterized by the spectral content of the deviation [6].

3. GRID CONNECTED PV SYSTEM

PV grid-connected system is one of the most commonly found distributed generations on a distribution system. Such a system typically consists of a PV array and a grid-connected inverter. Most commercially available inverters are current source inverters because the function of the inverter is not to regulate the voltage but to inject current. The PV system is connected to the utility grid using high quality inverter which converts DC power from the solar array into AC power that confirms to the grid's electrical requirements. During the day, solar electricity generated by the system is either used immediately or sold off to electricity supply companies. In the evening, when the system is unable to supply immediate power, electricity can be bought back from the network [7].

The propose system can compensate the voltage sag and swell as well as voltage interruption, harmonics and reactive power in interconnected and islanding modes. The proposed system is able to inject the active power to grid in addition to its ability in improvement of power quality in point of three common coupling. The general structure of grid connected PV systems is shown in Figure 3.

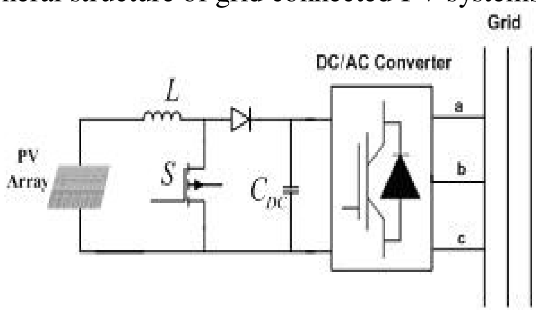

Figure 3: General Structure of Grid Connected PV Systems

Grid-connected PV system feed electricity directly to the electrical network, operating parallel to the conventional electric source. System performance depends on local climate, the orientation and inclination of the PV array and inverter performance. The traditional grid-connected photovoltaic systems contain voltage source inverter and the current source inverter. They are either a boost or a buck converter but not a buck–boost converter. Their obtainable output voltage range is also limited. The common problem of this topology is that the two switches of any phase leg can never be turned on at the same time otherwise a short circuit (shoot through) will occur and it may damage the inverter [8,9].

4. FEATURES

- A grid-connected photovoltaic power system will reduce the power bill as it is possible to sell surplus electricity produced to the local electricity supplier.
- Grid interconnection of photovoltaic (PV) power generation systems has the advantage of effective utilization of generated power because there are no storage losses involved.
- A photovoltaic power system is carbon negative over its lifespan, as any energy produced over and above that to build the panel initially offsets the need for burning fossil fuels. Even though the sun doesn't always shine, any installation gives a reasonably predictable average reduction in carbon consumption [9].

5. CONCLUSION

For some topics PV does put special constraints on the solution that are normally used by the utilities. Hence, international work is required on utility aspects of grid connected PV systems. Electricity generated by a grid connected photovoltaic power system will reduce your power bill and you may be able to sell surplus electricity produced to your local electricity supplier.

Grid-connected PV systems are easily installed and do not need a battery system as your existing mains supply is still available. Once installed, these systems are essentially maintenance free, generate no pollution and are as silent as the sun. Increasing evidence suggests installing a PV system adds value to your property.

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