Energy Generation and Storage in Solar PV System

[1]Rajesh Giri, [2]Dr.Sanjiv Kumar, [3]Ajay Kumar
[1]PG Student, [2-3]Assistant Professor
Swami Vivekanand Subharti University, Meerut U.P.

Abstract **- Solar thermal energy, radiant light from the sun, has been used by humans since earliest times. The need of solar tracking system for solar PV arises to gain maximum solar energy. Using a range of ever-evolving technologies. Solar thermal energy financial statement for most of the practical. Unconventional source of energy on earth. Photovoltaic (PV) is a technique of generation of electrical power by converting solar thermal energy into direct current electricity with semiconductors that show the photovoltaic effect. The PV arrangement is modeled and its voltage-current characteristics and power-voltage characteristics are simulated and optimized. The main burden for the reach of Photovoltaic systems is their low efficiency and high investment. We plan to examine a diagram to draw out maximum available solar power from a PV module for storage and utilize in a DC application. Maximum Power Point concept for Tracking is to be implemented which results in important increase in the effectiveness of the Photovoltaic System. Different scheme of MPPT algorithms and MATLAB are used to find the different result. Incremental Conductance, Fractional Open Circuit Voltage, Fractional Short Circuit Current, Neural Network are to be Studied and implemented. The MPPT algorithm thus projected will identify the suitable duty Ratio, in which the DC/DC converter should be operated to obtain maximum power output.**

Key words - solar energy storage ,solar tracking, Photovoltaic (PV)model.

INTRODUCTION

Photovoltaic system is ready up of numerous photovoltaic solar cells. Every small PV cell is able of generate about 1 or 2 W of power around which is depends upon the type of material used. higher power modules is required for high power output, PV cells can be connected together so that, we can get maximum power. Power capacity of the module is 1 kW, even though higher capacity is possible to Manufacture, it will become bulky to handle more than 1 kW module. Energy generation and storage depend upon the available source and power plant capacity. Number of modules can be associated together to form an array.

There are many solar arrays in Solar PV systems, even though the same manufactures or same materials are same for the module but characteristics performance of module vary on whole entire system performance. Performance of system is based on the efficiency or the performance of the every components. Apart from the solar PV module ,the battery comprises with it. Inverter, charge controller, MPPT controller as well as some of the low voltage Switchgear components are also connected with it. in the market, power conditioning unit consists of charge controller, inverter and MPPT controller in PV system.

A Balance-of-System (BoS) include apparatus and equipments that change DC supply from the solar PVmodule to AC grid supply. In general, BOS of the solar PV system includes all the components of the system apart from the Solar PV modules. In calculation to inverters, this includes the cables/wires, switches, enclosures, fuses, ground error detectors, surge protectors, etc. BOS apply to all types of solar applications(i.e. residential, public facilities, agricultural, commercial and solar parks).the cost of BOS apparatus can equal or go beyond the cost of the PV modules In many systems.

While investigative the costs of PV modules, these costs do not include .the cost of BOS equipment. like battery based solar PV system the cost of the modules is 20–30 % of the total while the remaining 70 % is the balance of systems (BOS). Apart from this 50 % of the system BOS costs required more maintenance . for controlling the stability-of-system components, increase efficiency, and updated solar PVsystems can be maintained. BOS components include the majority of the pieces, which make up roughly 10–50 % of solar purchasing and installation costs, and account for the majority of maintenance requirements. Thus, suitable mixing of the BOS is fundamental for the proper functionality and the consistency of the solar PVsystem. but it is often completely unseen and poorly integrated. Costs are steadily decreasing with view to solar panels and inverters. As per the statistics, the Solar PV module world market is gradually increasing at the rate of 30 % per year. The reasons behind this increase are that the consistent.

LITERATURE REVIEW

Production of electricity with fuel consumption is easy to anywhere but we can use renewable recourses sunlight for electricity with PV system.. Also the solar PV systems using modular technology and the components of Solar PV can be configured for varying capacity, ranging from watts to megawatts. former, large variety of solar PV applications establish to be in industries but now it is being used for profitable as well as for household needs. One of the obstacle factor is the efficiency of the solar PV cell, in the profitable market a cell efficiency of up to 18.3 % is currently obtained, depending on the technology that is used. When it is related to the module efficiency, it is slightly lower than the cell efficiency. This is due to the blank spaces between the arrays of solar cells in the module. The overall system efficiency includes the efficiency and the performance of the entire components in the system and also depends on the solar installation. Here there is another numerical drop in value when compared to the module efficiency, this being due to conductance losses, e.g., in cables. In the case of inverter, it converts the

DC output from the Solar PV module to the AC grid voltage with a certain degree of efficiency. It depends upon conversion efficiency and the precision and quickness of the MPP tracking called tracking efficiency.

MPP (Maximum power point) tracking which is having an efficiency of 98–99 % is existing in the market, each and every MPPT is based on a exacting tracking algorithm. Present investigate states that all resources have physical limits on the electricity that they can produce. For example, the maximum efficiency of crystalline silicon is only 28 %. But cycle cells provide vast scope for growth in coming years. Efficiency of accessible laboratory cells has already achieved efficiency values of over 25 %. PV Modules with BOS components known as an entire PV system. This system is usually sufficient to meet a particular energy demand, such as powering a water pump, the appliances and lights in a home, and electrical requirements of a community. In the cost of PV systems and in consumer acceptance, reliability of PV arrays is a crucial factor. With the help of fault-tolerant circuit design, consistency can be better using various redundant features in the circuit to control the effect of incomplete failure on overall module yield and array power degradation. Degradation can be limited by dividing the modules into a number of parallel solar cell networks. This type of design can also improve module losses caused by broken cells. The hot-spots in the Solar PV module can be avoided by having diodes across each cell and that is called as bypass diodes. virtually a solar PV module consists of one bypass diode for 18 cells to moderate the effects of local cell hot-spots.

Photovoltaic Systems Types of PV Systems

The PV industry is drawing attention because of worldwide environmental concerns and of it immense energy production potential due to the widely available free solar resource. Based on the electric energy production, PV modules can be arranged into arrays to increase electric output. Solar PV systems are usually classify based on their efficient and operational requirements, their part configurations. It can be classify into grid-connected and stand-alone systems

Grid-Connected Solar PV System

The primary part of grid-connected PV systems is power conditioning unit (PCU). The PCU converts the DC power produced by the PV array into AC power as per the voltage and power value supplies of the utility grid. A bi-directional line is made between the PV system AC output circuits and the electric value network, typically at an on-site supply panel or service entrance. This allows the AC power formed by the PV system to either supply on-site electrical loads or to back-feed the grid when the PV system output is superior than the on-site load demand. This safety characteristic is required in all grid-connected

Stand-Alone Solar PV System

Stand-alone PV systems or direct coupled PV systems are designed and sized to supply DC and/or AC electrical loads. It is called direct coupled systems because, the DC output of a PV module or array is directly connected to a DC load. There is no electrical power storage (batteries) in direct-coupled systems as because of that, the load only operate throughout sunlight hours. The maximum power point tracker

PV-Hybrid Systems

Hybrid systems normally refers to the mixture of any two input sources, here solar PV can be integrated with Diesel Generator, Wind Turbines, Bio-mass or any other renewable on non-renewable energy sources. Solar PV systems will normally use battery bank to store energy output from the panels to accommodate a pre-defined period of lacking sunshine, there may still be exceptional periods of poor weather when an alternative source is required to agreement power production. PV-hybrid systems combine a PV module with another power sources -typically a diesel generator, but occasionally another renewable supply such as a wing turbine. The PV generator would typically be sized to meet the base load demand, with the alternate supply being called into action only when essential. This arrangement offers all the benefits of PV in respect of low process and maintenance costs, but additionally ensure a secure supply. Hybrid systems can also be rational approach in situations where irregular demand peaks are significantly superior than the base load demand. It makes little sense to size a system to be able to meet demand entirely with PV if, for example, the normal load is only 10 % of the peak demand. By the same token, a diesel generator-set sized to meet the peak demand would be operating at ineffective part-load for most of the time. In such a situation a PV-diesel hybrid would be a good cooperation.

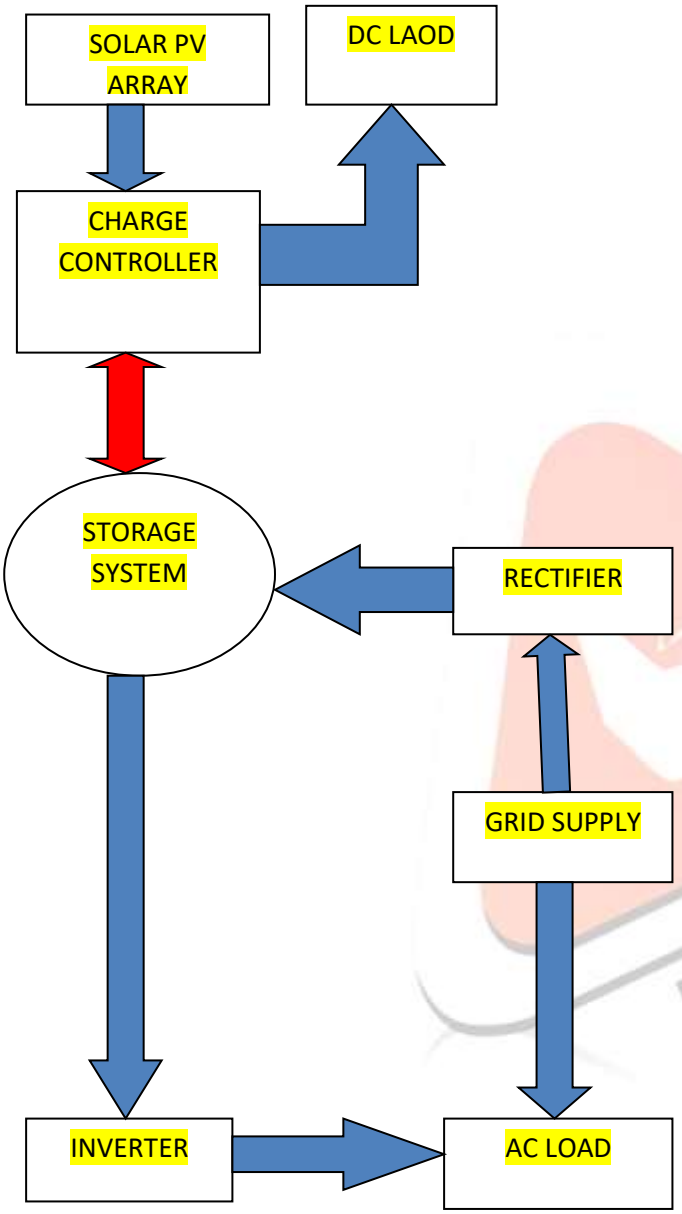
Stand-Alone Hybrid AC Solar Power System with Generator and Battery Backup

A stand-alone hybrid solar PV design is essentially identical to the DC solar power system. In this alternating current inverters are used to convert DC into AC. The output of inverter is square waves, which are clean and created into sinusoidal AC waveforms. Any waveform, when analyzed, basically consists of the superimposition of many sinusoidal waveforms known as harmonics. The first harmonic represents a pure sinusoidal waveform. Additional waveforms with superior frequencies, when superimposed on the base waveform, add or subtract
from the amplitude of the base sinusoidal waveform.

The mixture of base waveform and higher harmonics produce a unclear wave shape that resembles a distorted sinusoidal wave. Converted DC output, derived from the solar power, is considered to be a numerous superimposition of odd and even numbers of harmonics. To obtain a relatively clean sinusoidal
output, most inverters employ electronic circuitry to filter a large number of harmonics. Filter circuits consist of specially designed inductive and capacitor
circuits to block certain unwanted harmonics. In general, DC-to-AC inverters are complex electronic power exchange equipment designed to convert direct current to a single or three-phase current that replicates the regular electrical services provided by utilities. Most inverters, in addition to PV module input power, accept secondary input power to form a reserve generator, used to provide power when battery voltage is dropped to a minimum level. A special type of inverter, referred to as the grid-connected

type, incorporate synchronization circuitry that allows the production of sinusoidal waveforms in harmony with the electrical service grid. When the inverter is connected to the electrical service grid, it can effectively act as an AC power generation source. Grid-type inverters used in grid-connected solar power systems are strictly regulated by efficacy agencies that provide net metering. Some inverters incorporate an internal AC transfer switch that is capable of accepting an output from an AC-type standby producer. In such designs, the inverters include special electronics that transfer power from the generator to the load.

BLOCK DIAGRAM AND METHODOLOGY



The power output from the Solar PV systems is usually stored in a battery or in a battery bank deepening upon the necessities of the system. Mostly batteries or used in the stand-alone system and in the case of grid coupled system, batteries are used as a support system.

Primary Batteries

Primary batteries are non rechargeable but they can store up and distribute electrical energy. Typical carbon-zinc and lithium batteries usually used primary batteries. Primary batteries are not used in PV systems because they cannot be re-energized.

Secondary Batteries

Secondary batteries are rechargeable and they can store up and distribute electrical energy. Common lead-acid batteries used in automobile and PV systems are secondary batteries**.**

Charge Controller Types

There are two basic charge controller (i) Shunt Controller and (ii) Series Controller.

INVERTER

Inverters are second-hand to convert DC current into AC currents in PV systems. Different types of inverters create a different "quality" of electricity. So, the user must match the power superiority required by your loads with the power quality produced by the inverter. Major discrepancy exist between power generation with PV modules and the necessities of the public grid. The job of the inverter is to connect the systems with each other and to feed the solar power into the grid with the highest probable efficiency. Types of Inverter are below.

1-Centralized Inverters
2-String Inverters
3-Multi-string Inverters
4-Module Integrated Inverter/Micro-inverters

APPLICATION

MATLAB and Power electronics application ranges from power materials to robotic controls, industrial automation, automotive, industrial drives, power quality, and renewable energy systems. In particular, before the fitting of power plant, MATLAB finds applications in selecting the system based on the supplies and to choose particular components for the Solar PV application.

This paper is to explore the role and possibility of MATLAB along with its tool boxes in Solar PV Systems to endorse Modeling, and Simulation with importance on Analysis, and Design. In renewable energy systems applications, MATLAB helps for selecting the matrix manipulations in the converters to grid inverter, plotting of functions and data, implementation of MPPT algorithms, creation of user interfaces for monitoring the Solar PV modules and for interfacing with inverters and converters, wherein which control algorithms would be written in other languages. As a result of the MATLAB simulation of the components of the solar PV system one can benefit from this model as a photovoltaic generator in the framework of the MATLAB/ SIMULINK toolbox in the field of solar PV power translation systems. In addition, MATLAB and Power electronics application ranges from power supplies to robotic controls, industrial mechanization, automotive, industrial drives, power quality, and renewable energy systems. In particular, before the installation of power plant, MATLAB finds applications in selecting the system based on the requirements and to choose exacting components for the Solar PV application.

This chapter is to explore the role and possibility of MATLAB along with its tool boxes in Solar PV Systems to promote Modeling, and Simulation with emphasis on Analysis, and Design. In renewable energy systems applications, MATLAB helps for selecting the matrix manipulations in the converters to grid inverter, plotting of functions and data, implementation of MPPT algorithms, creation of user interfaces for monitoring the Solar PV modules and for interfacing with inverters and converters, wherein which control algorithms would be written in other languages. As a result of the MATLAB simulation of the components of the solar PV system one can benefit from this model as a photovoltaic generator in the framework of the MATLAB/ SIMULINK toolbox in the field of solar PV power conversion systems

CONCLUSION

Solar PV is used primarily for grid-connected electricity to operate residential appliances, profitable gear, lighting and air conditioning for all types of buildings. Through stand-alone systems and the use of batteries, it is also well suited for remote regions where there is no electricity source. Solar PV panels can be ground mounted, installed on building rooftops or calculated into building materials at the point of developed. This chapter discussed the solar PV array, batteries, charge controllers, inverters, power conditioning unit and MPPT techniques along with their MATLAB/SIMULINK modules. The future will see everyday matter such as clothing, the rooftops of cars and even roads themselves curved into power-generating solar collectors.

FUTURE SCOPE

India has a broad scope of generating solar energy. The geographical location of India is its benefit for solar power generation. With more than 1 billion people, India is facing a huge energy demand and therefore, solar power is a growing industry in India. Generation of solar energy has tremendous scope in India. The geographical location of the country stands to its benefit for generating solar energy. The reason being India is a tropical country and it receives solar radiation almost throughout the year, which amounts to 3,000 hours of sunshine.

Active solar technologies increase the supply of energy and are considered supply side technologies, while passive solar technologies reduce the need for alternate resources and are generally considered demand side technologies. Sunlight can be directly converted.

REFERENCES

1-Koutroulis E et al (2001) Development of a microcontroller-based photovoltaic maximum power tracking control system. IEEE Trans Power Electron 16(1):46–54.
2- Liang TJ, Kuo YC, Chen JF (2001) Single-stage photovoltaic energy conversion system. Proc Inst Elect Eng 148(4):339–344.
3-Xue Y, Chang L, Kjaer S, Bordonau J, Shiminizu T (2004) Topologies of single-phase inverters for small distributed power generators: an overview. IEEE Trans Power Electron 19(5):1305– 1314
4- Ahmed MM, Sulaiman M (2003) Design and proper sizing of solar energy schemes for electricity production in Malaysia. National Power and Energy Conference 2003, pp 268–271.
5-Atlas H, Sharaf AM (2007) A photovoltaic array simulation model for matlab-simulink GUI environment. In: Proceeedings of IEEE international conference on clean electrical power, ICCEP 2007, Capri.