Regulation Of Power in a Photovoltaic Battery Based Microgrid

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***Abstract*—The Increasing requirement for electrical energy and the various interruptions to the supply of power has given the attention for the realization of energy generation based on renewable sources. This project work is concentrated on control and management of power of a micro grid system that comprises of Photovoltaic (PV) array, battery, and AC load, connected to the utility grid. This work mainly focuses on the compensation of photovoltaic (solar) power reduction due to partial shading using power electronics converters with battery storage. In This system the demand of a local load is fulfilled through PV production and then, the power is managed among the battery and grid. The PV array along with the battery, load and grid is simulated for various conditions such as PV supplying to the load and charging the battery, PV-Battery both supplying the load and grid, grid is supplying the load, The output parameters like PV power, battery power, load power, grid power graphs are plotted and analysed for each condition The entire paper is simulated on Mat lab-Simulink environment.**

I. INTRODUCTION

Utilization of naturally available energy i.e. Renewable energy is considered as one of the most important topics now a days and many more research work has been going on in this particular field. As on now large quantity of electrical power is generated mainly by utilising non-renewable energy sources, and hence the use of solar energy is the most important motivation for the reformation of conventional grid system.

The power which is generated from the solar panel is quite unstable and it is mostly depends on the weather conditions of a particular region which varies for each season in addition to this the consumption of power is not only depends on the weather condition of a region but also depends on the inhabitant activity. Therefore, it is very important to manage the supply of power from the PV panel and its consumption for various activities because it is very difficult to predict the generation and consumption of power.

There are two types of solar Photovoltaic system (PV) in which one is Standalone Photovoltaic system and another is Grid-connected Photovoltaic system. In Standalone Photovoltaic system, the supply power is greatly influenced by the condition of climate. To avoid this problem devices which are used to store electrical power are proposed. But in system in which the grid is connected, the supply of power will be managed by both the grid and the solar Photovoltaic system (PV). Here the grid output power is increased to maintain the load when there is a reduction or completely shortage of Photovoltaic output power. A Photovoltaic system model with the power management scheme is presented in order to increase the potential of solar PV system.

The power storage device (battery) remains idle when the output power generated from PV panel is enough to full fill the considered load. Immediately the battery Acts as a primary source of power supply when the output power generated from Photovoltaic system is not sufficient to handle the load, and if needed power is also taken from the grid.

II. LITERATURE SURVEY

1. Umashankar S, Akhil Mathur and Kolhe "Control and power management of photovoltaic battery based micro grid" This paper tells about how a solar PV power production can be used to meet the need of a local load, with the management of power within in

the battery (which is used as a storage device) and a grid which is connected to the load. It also focuses on how a battery and bidirectional converter can be utilised for PV power compensation owing to the effect of partial shading.

2. Sonal Gaurav, Chirag Birlaa, Aman Lambaa, S. Umashankara, Swaminathan Ganesan"Energy Management of PV - Battery based Micro grid System" In this paper the authors utilized a PV system which is having a storage battery as a backup electrical power supply. And also a technique of Maximum power point tracking is facilitating in this system. It mainly concentrated on the supply source as solar photo Voltaic for generation of power.

3. C.Wangh,R.Waai, W.Linn, "High-performance standalone photovoltaic generation system" In this paper, a high-performance standalone Grid connected PV system is proposed with converter, inverter and with PWM technique. Here the battery is not used as a backup electrical power supply source which is the main drawback of this proposed system is that. And the method MPPT has done only for the mechanical frame work of the system, for electrical system we can't haven electrical power tracking technique here.

4. Johnnson Juliano, Roger Gulaees, and Helio Leams "A power system, with the parallel connection for Photo Voltaic applications" In this paper, focuses on tracking of MPPT enabled converter capable of boosting which is connected with the main power circuit in parallel condition. Page 6 The main disadvantage of this proposed system is that it needs very high PV based voltage. battery which is connected as a backup is also maintain high voltage to the load connected to this system, and Also loss is caused by the traditional converter used in given system.

III. BACKGROUND THEORY

PV MODULE TECHNOLOGY As we know Solar Cells are the basic working components of solar PV panels and also solar panels are the building blocks of the solar Photovoltaic module. Power generates from single solar cell or single module is not enough to satisfy the huge loads demand, and hence these Solar cells are connected in series and parallel and that constitutes a solar PV panel. in this way many numbers of solar PV panels are arranged and connected in series and in parallel arrangement to satisfy the power rating which is required to fulfil the load By combining many numbers of Photovoltaic modules a PV array is formed.

The solar power generated by a particular module is often sufficient for an application, as a result PV modules are connected to create array to send power to the required load. The output of PV arrays is depending on the radiation and temperature of the given area. The negative aspect of PV technology is the less efficiency of the system, whereas PV cells frequently network at maximum power point. Therefore, to increase the efficiency peak power must be observed by an array.

SOLAR PHOTOVOLTAIC CELL Solar Photovoltaic cells are the major parts of the Photovoltaic array. To manufacture Solar PV cells Semiconductor material such as silicon and some other materials are used, the device used to convert solar energy of the sun to electrical energy is known as Photovoltaic cell.

As we identify demand for electricity is growing day by day and due the declining of nonrenewable energy resources like fossil fuels Photovoltaic cells are the basic source of renewable energy for extracting the electricity from the sun. Number of photovoltaic cells is combined to form solar Photovoltaic modules. These Solar photovoltaic cells are manufactured in various shapes according to the requirement like Square, Rectangular and Circular etc. Solar cells are manufactured from Silicon which is the main element; solar photovoltaic cells are the components which convert light energy of sun into electrical energy, and works on the principle of photo electric effect. Solar photovoltaic cells are manufactured from semiconductor.

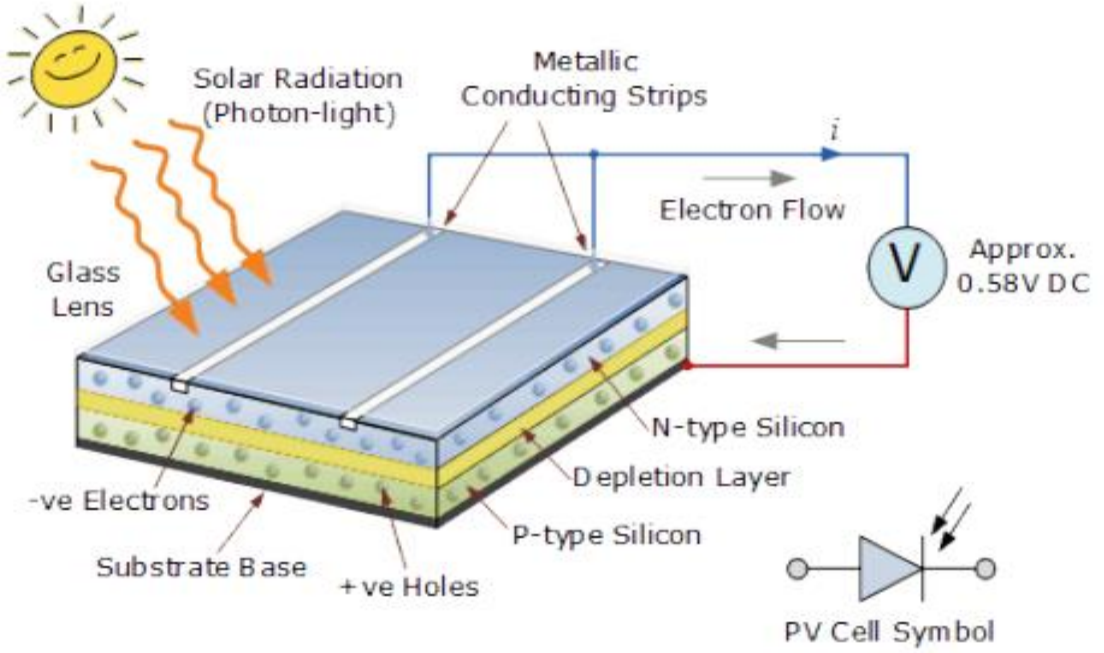

Fig 1. Working of a solar Photovoltaic cell

When light from the sun falls on the solar cell, it is absorbed by the semiconductor material particularly from the outer electrons which are present at outer most orbits. By absorbing the energy from the sun, the valence electrons energy is boosted up. These valence electrons will gain energy to an extent that it should attain the threshold frequency.

As soon as threshold level of the valence electrons reached, they start to move. The current start to flow due to the movement of electrons and finally the potential in the semiconductor material is established which is known as Voltage. Here the amount of electrical energy generated is directly proportional to the amount of irradiation falling on solar photovoltaic cell.

IV. METHODOLOGY

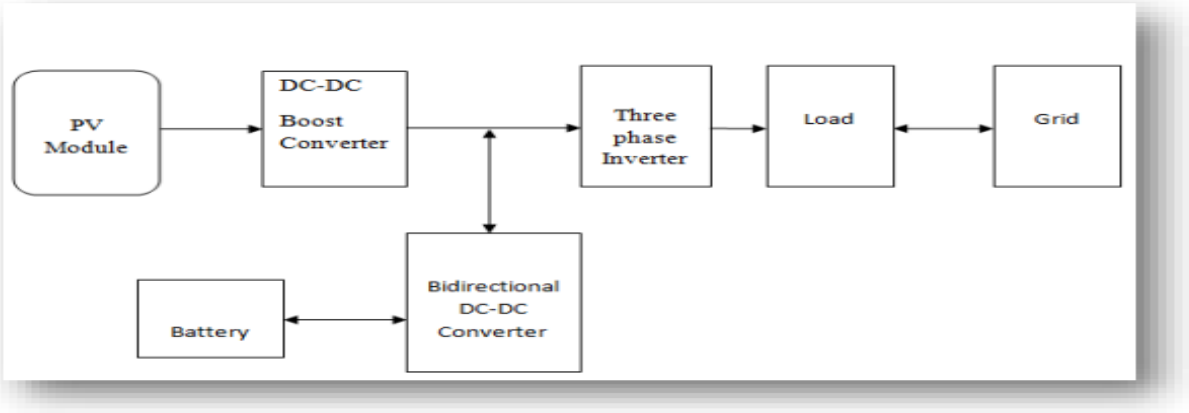

Fig 2. Proposed block diagram

The Figure shows the working of the proposed system. Here solar panels are used to generate electrical power which acts as a main power generating source, solar power generated from the solar panel would be supplied to the dc-dc converter.

The voltage given to the boost converter is boosted i.e. increased to the required voltage level by the boost converter as soon. Then the voltage from the DC-to-DC boost converter is supplied to the DC bus, and then this voltage is made available at the DC bus. In this system DC bus acts as an important part which is used to transfer power to the load area from the side of generation. Finally, three phase inverter is used to convert DC electrical power to AC power and then the power is supplied to the load which is connected to the grid.

If the power generated from the solar panel is exceed the amount of power required by the load i.e. the power generated is higher than the power required by the load the excess power is used to charge the battery and also supplied to the grid. A Bidirectional DC-DC converter is used to charge and dish charge the battery which is also called as buck-boost converter, the battery is used as a backup source which supplies power to the load when there is less or no power from the solar panel In this system for providing uninterrupted power to the load a backup supply is maintained by means of a battery. For this purpose, a lead acid Battery with the ratings of 1000Ah and 250V is being used.

To take in a control on the battery working process, we are using SOC technique. During the charging process of battery, converter operates in buck mode to converts required voltage. The load handling capacity of the system is analyzed by the SOC block. When the problems such as reduction in power generation from PV panel and overloading are occur the SOC block will immediately send the duty cycle pulse to the bi-directional converter in order to maintain the desired voltage level there by handing the loads without any interruption in power supply.

When the power generated from the solar panel is low and the power available from battery is less, and hence it is not possible to meet the load requirement in this case the extra power is taken by the grid in order full fill the demand of the load. In certain condition when the load is increased, power generated from solar panel and from the battery is not sufficient to fulfill the load requirement in this case the power is supplied from the grid.

V. CONCLUSION & FUTURE SCOPE

In this project the different type of energy management approaches with the controlled flow of power for a hybrid grid is done. Here three different constraints/conditions are taken into picture. First one is how the entire system works at constant irradiation and Loading conditions which is considered as normal working condition. In the Second condition we take effect of Partial shading on Solar PV panel and finally in third condition the system is suddenly overloaded. Here In all these 3 different working conditions how the given system react to keep whole system in stable condition is described and successfully simulated in a MATLAB/SIMULINK environment. The advantage of this framework is that, higher quality of service without interruption of power supply can be obtained by using MPPT and High converter performance. And also a very less Harmonic Distortion is attained. The method which is proposed in this project can be improved for higher power rating operation by using various other renewable energy sources such as fuel cell, wind turbine etc., without varying the control technology

In this project, solar photovoltaic energy is for the purpose of applying the proposed methodology. The control strategy used here can be implemented/expanded with many other different resources such as fuel cell, wind source etc. And in addition, with improved efficiency and voltage regulation this conception can be put into the future world, which include higher power rating operation. High level inverters can be included and analysed by using MATLAB, for further improvement in reduction of harmonics.

In India most of the population live in rural areas, there is much scope for solar energy in these areas. Use of solar energy can directly reduce the use of firewood and cow dung cakes by rural household families.

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