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SOLAR ENERGY CONVERSION AND ITS UTILIZATION

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Abstract - *Solar energy is a clean renewable resource with zero emission, has got tremendous potential of energy which can be harnessed using a variety of devices. With recent developments, solar energy systems are easily available for industrial and domestic use with the added advantage of minimum maintenance. The electricity requirements of the world including India are increasing at alarming rate and the power demand has been running ahead of supply. It is also now widely recognized that fossil fuels (i.e., coal, petroleum and natural gas) and other conventional resources, presently being used for generation of electrical energy, may not either sufficient or suitable to keep pace with ever increasing demand of electrical energy of the world. Also generation of electrical power by cold based steam power plant or nuclear power plant causes pollution. Solar energy is clean and itcannot cause pollution and by using solar energy we can convert large amount of electricity by using inverter.*

Key Words: Concentrating solar power, Photovoltaic, Renewable energy sources, solar energy.

1. INTRODUCTION

One of the most incredible things about photovoltaic power is its simplicity. It is almost completely solid state, from the photovoltaic cell to the electricity delivered to the consumer. Whether the application is a solar calculator with a PV array of less than 1 W or a 100 MW grid-connected PV power generation plant, all that is required between the solar array and the load are electronic and electrical components. Compared to other sources of energy

Human kind has harnessed to make electricity; PV is the most scalable and modular. Larger PV systems require more electrical bussing, fusing and wiring, but the most complex component between the solar array and the load is the electronic component that converts and processes the electricity: the inverter. In the case of grid-tied PV, the inverter is the only piece of electronics needed between the array and the grid. Off-grid PV applications use an additional

DC to DC converter between the array and batteries and an inverter with a built-in charger.

Solar photovoltaic (SPV) systems convert sunlight directly into electricity. A small power system enables homeowners to generate some or all of their daily electrical energy demand on their own roof top, exchanging daytime excess power for its energy needs in nights using SPV generation, if it is supported by the battery back-up. A SPV power system can be used to generate electric energy as a way of distributed generation (DG) for rural areas. Several approaches have been proposed to improve efficiency of SPV system and to provide the proper ac voltage required by residential customers. For this purpose, DC-DC converters have been explored extensively to meet the required electric energy demands by these systems using a battery back-up. Standalone Solar Power Systems are completely independent from any electric utility grid. They are most often used in remote areas where electricity is not available or where the connection fees of the grid are higher than the cost of an alternative energy system. Standalone solar systems also known as autonomous, or off grid systems are used to collect and store solar energy to be used by household appliances.

These systems typically generate 500 Watts for small systems. During the day, the electricity generated is used to power the home and charge the batteries. At night, and during rainy days, all necessary power is provided by the battery.

2. OFF GRID SOLAR INVERTER

Off Grid Solar Inverter Consist of Following Blocks:

i) Solar panel
ii) Solar charge controller
iii) Inverter
iv) Battery
v) Loads

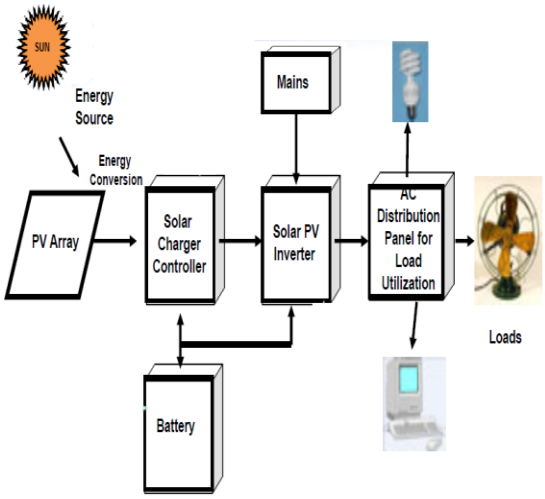

Fig. 2.1: Block Diagram of Off Grid Solar Inverter

i) SOLAR PANEL

Fig. 2.2: Solar panel

A solar panel is a set of solar photovoltaic modules electrically connected and mounted on a supporting structure. A photovoltaic module is a packaged, connected assembly of solar cells. The solar module can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions (STC), and typically ranges from 100 to 320 watts. The efficiency of a module determines the area of a module given the same rated output - an 8% efficient 230 watt module will have twice the area of a 16% efficient 230 watt module. Because a single solar module can produce only a limited amount of power, most installations contain multiple modules.

Mounting of Solar Panel

a) GROUND MOUNTED

Ground mounted solar power systems consist of solar modules held in place by racks or frames that are attached to ground based mounting supports.

b) ROOF MOUNTING

Roof-mounted solar power systems consist of solar modules held in place by racks or frames attached to roof-based mounting supports.

c) INVERTER

Electrical power is usually transmitted and used in the form of alternating current. However, some kinds of electrical generation and storage devices produce direct current, examples being PV modules and batteries. An inverter is a power electronic apparatus which converts DC to AC, allowing the DC power from these generators to be used with ordinary AC appliances, and/or mixed with the existing electrical grid.

3. WORKING OF OFF GRID INVERTER

PV array of 120W absorbs the solar energy and convert the solar energy into electrical energy by photovoltaic effect. This electrical energy transferred to the solar charge controller. The main function of solar charge controller is to protect the battery from over discharge and over charging. Also it prevents current flowing back to the solar panel during night. The solar charge controller transfer electrical energy to charge the battery of 12V , 45A. When power energy to it cut off, battery supplies the energy to the inverter circuit. An inverter circuit is power electronic apparatus which converts DC to AC. This AC 12V fed to the autotransformer. Then autotransformer step up 12V, 90A to 230V, 5A. The AC distribution panel distributes the voltage to the load which is connected to the solar inverter. Load having fan of 60W, PC of 250W and tube light of 40W.

4. PHOTOVOLTAICS

Photovoltaic (PV) is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect. Photovoltaic power generation employs solar panels composed of a number of solar

cells containing a photovoltaic material. Materials presently used for photovoltaic include mono crystalline silicon, polycrystalline silicon, amorphous silicon, cadmium telluride, and copper indium gallium selenide/sulfide. Due to the increased demand for renewable energy sources, the manufacturing of solar cells and photovoltaic arrays has advanced considerably in recent years.

5. PHOTOVOLTAIC SYSTEM

A Photovoltaic system is an arrangement of components designed to supply usable electric power for a variety of purposes, using the Sun as the power source.

PV systems may be built in various configurations:

- Off-grid without battery (Array-direct)
- Off-grid with battery storage for DC-only appliances
- Off-grid with battery storage for AC & DC appliances
- Grid-tie without battery
- Grid-tie with battery storage

6. SOLAR CELL

A solar cell is also called a photovoltaic cell. It is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect. It is a form of photoelectric cell in that its electrical characteristics e.g. current, voltage, or resistance vary when light is incident upon it which, when exposed to light, can generate and support an electric current without being attached to any external voltage source.

The operation of a photovoltaic (PV) cell requires 3 basic attributes:

- The absorption of light, generating either electron-hole pairs or excitons.
- The separation of charge carriers of opposite types.
- The separate extraction of those carriers to an external circuit.

7. CONCLUSION

Since this paper report is based on the non-conventional resources of energy i.e. we charge the battery with the help of solar panel by capturing the sunlight and give the charged battery to the load as a result of which the load on the grid is somewhat reduced and plays a vital role in protecting the damage cause to the distribution transformer. The proper designing of the solar panel along with the battery change over helped us to overcome this problem. This system generates power up to 500 W and it is used for home appliances like fans, tube light, computer. As solar energy is renewable source of energy so it will not generate any kind of pollution. This system is useful in areas where if this system is in large scale then we can connect to the grid and can provide extra generated power to the grid.

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