

A REVIEW ON SOLAR PHOTOVOLTAIC POWERPLANT

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Abstract — The limited supply of traditional energy sources, resulting in high prices of the traditional energy sources like coal, oil, natural gas etc. They have resulted in rapid development of alternative energy sources, in particular solar energy. Various types of alternative energy such as solar energy, hydroelectric energy, wind energy etc are used in day to day life which exhibits more consumption of energy sources at a very cheap rate. This also results in environment eco-friendly and resulted in less pollution. Photo-voltaic systems are very useful to create a good economic society as well as environment eco-friendly. Photovoltaic Solar Power plant price will play a vital role in the larger development of solar power generation. In this paper we deals with photo-voltaic solar power plant components as well as steps taken to design a photovoltaic system and what are the pros and cons of the systems.

Keyword :- Photo-voltaic, Solar power, Power-plant Design, Dc-Dc converter, Battery

I. INTRODUCTION

With increasing awareness of sustainability and the increasing demand for renewable energy sources, the solar industry plays an essential role in providing such a solution. Infact solar energy presents the opportunity to generate clean electricity, which can lead to a sustainable life style. Solar radiation arriving on earth surface is the most fundamental renewable energy source. In recent years, solar energy utilization in various applications has increased significantly [1]. Solar radiation is variable in different parts of the world and in the Earth Sun Belt has the highest value. India's policy for the solar sector – Jawaharlal Nehru National Solar Mission (JNNSM) – a target of 20 GW of solar installations by 2022 has been set. India is endowed with vast solar energy potential. About 5,000 trillion kWh per year energy is incident over India's land area with most parts receiving 4-7 kWh per sq. m per day [2]. Testing of Photovoltaic devices and reference cells using pyranometers is described in IEC 60904, IEC 61215 and IEC 61646 standards.

II.GROWTH OF SOLAR ENERGY IN INDIA

The geographical location of India is also quite favourable for solar energy implementation The nature of Indian electricity market is quite unique, and cannot be compared directly with other countries. Unlike USA or Japan, India has numerous villages and islands unconnected from the main grid, spatial and seasonal variation in agricultural demand, and cottage- to large-scale industrial sectors. Our country, therefore, requires solar energy development at different scales such as, small wattage to megawatts, grid-connected, supplemented with some energy-storage to no-storage capabilities. By end of year 2008, India had power generation capacity of about 152GW. Even with such an installed base, about 17% of the villages in India are non-electrified, which would translate to about 450 million. With a growing economy, the demand for power is growing at about 6% every year and the peak load demand is expected to reach 174 GW by 2014. Figure 1 represents the growth of photovoltaic system by the years.

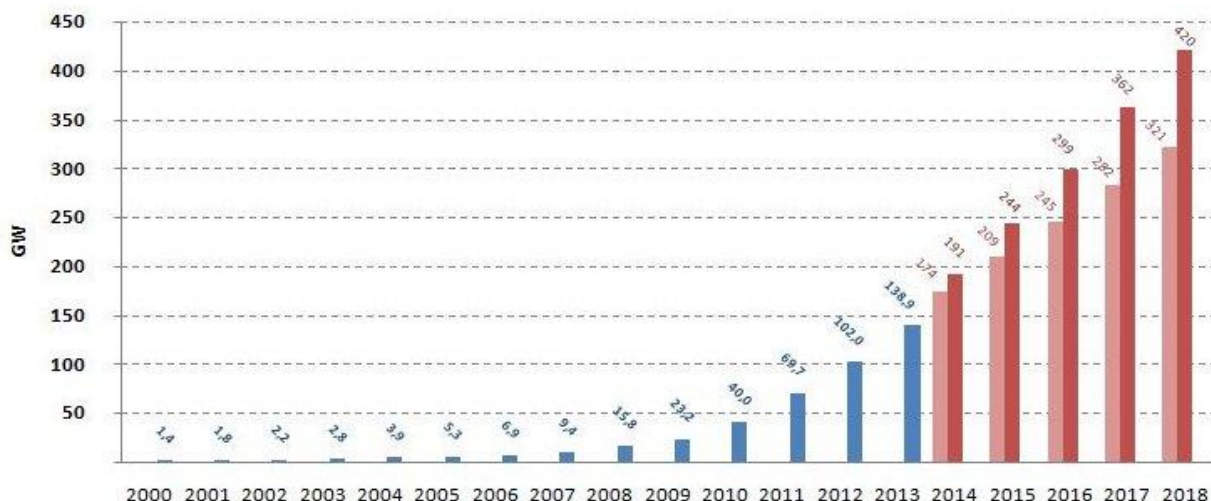


Fig 1. Growth in india pv production

III. Photovoltaic system

Photovoltaic (PV) is the field of technology and research related to the application of solar cells for energy by converting sun energy (sunlight, including sun ultra violet radiation) directly into electricity. A Photovoltaic cell is a smallest basic solar electric device which generates electricity when exposed to sunlight. PV panels are specified under Standard Test Conditions (STC). These conditions are 1000 W/m² of solar radiation, 25 °C, Air Mass 1.5 and no wind. Because these conditions are far from the real world, additional measurements are required to show the PV panel's typical performance. Both pyranometers and reference PV cells are used to measure the radiation. Because pyranometers have standard characteristics they can be used to independently compare all types of PV cells. Solar PV system is very reliable and clean source of electricity that can suit a wide range of applications such as residence, industry, agriculture, livestock, etc. Photovoltaic production has been doubling every 2 years, increasing by an average of 48% each year since 2002, making it the world's fastest-growing energy technology. At the end of 2008, the cumulative global PV installations reached 15,200 Megawatts.

IV. COMPONENTS

4.1 PV Module

It is an assembly of photovoltaic (PV) cells, also known as solar cells. To achieve a required voltage and current, a group of PV modules (also called PV panels) are wired into large array that called PV array. PV modules can be wired together in series and/or in parallel to deliver voltage and current in a particular system.

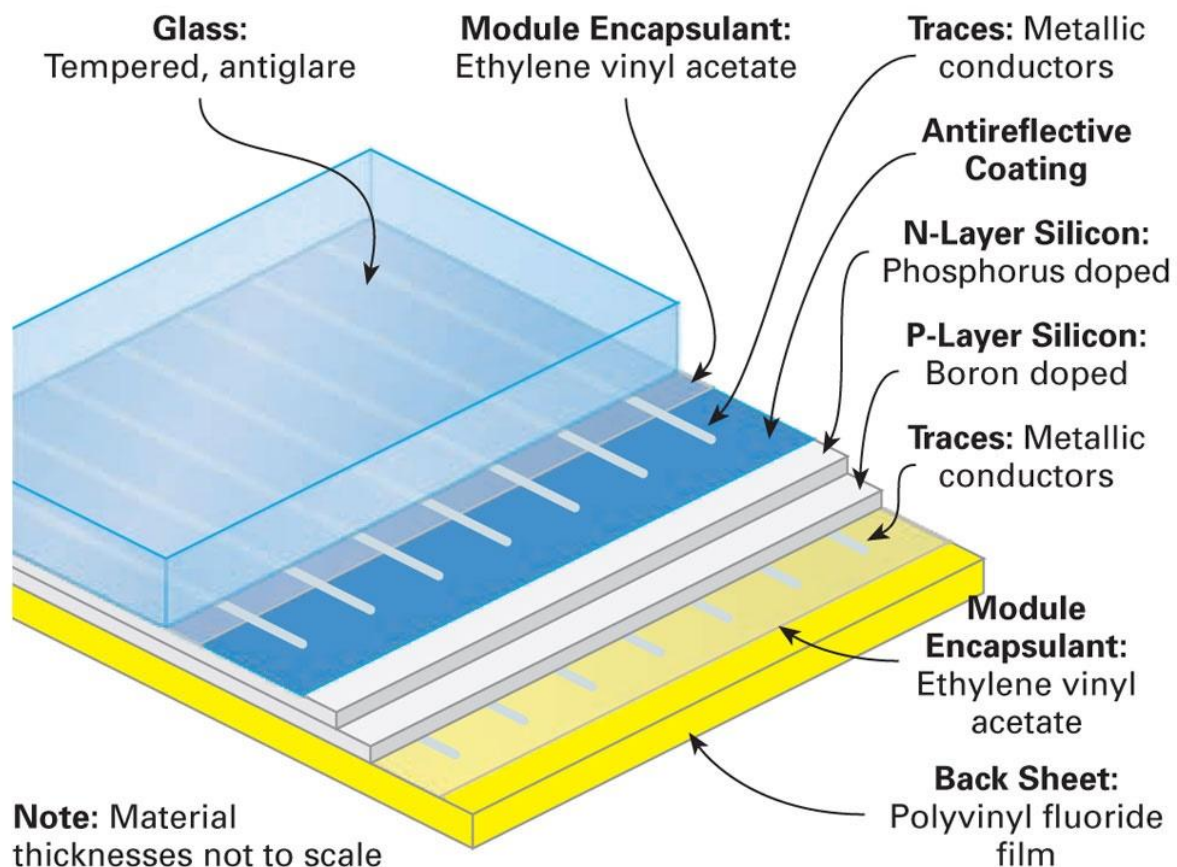


Fig 2. PV module anatomy

4.2 Solar charge controller

Charge controller is used in the solar application and solar battery charger. Its function is to regulate the voltage and current from the solar arrays to the battery in order to prevent overcharging and over discharging. There are many technologies which have been included into solar charge controller.

4.3 Inverter

Inverter converts DC output of PV panels, wind turbine into a clean AC current for AC appliances, or fed back into grid line. Inverter is a critical component used in any PV system where alternative current (AC) power output is needed. It converts direct current (DC) power output from the solar arrays or wind turbine into clean AC electricity for AC appliances. Inverter can used in many applications. In PV or solar applications, inverter also is called solar inverter. To improve the quality of inverter's power output, many topologies are incorporated in its design such as PWM (Pulse-width modulation) inverter.

4.4 Battery

The PV array not always can be used when it is produced because the demand for electric energy does not always coincide with its production. Therefore, electrical storage batteries are commonly used in PV system. The primary functions of a storage battery in a PV system are: -

1. Energy Storage Capacity and Autonomy: to store electrical energy when it is produced by the PV array and to supply energy to electrical loads when needed or on demand.
2. Voltage and Current Stabilization: to supply power to electrical loads at stable voltages and currents, by suppressing or smoothing out transients that may occur in PV system.
3. Supply surge currents or high peak operating currents to electrical loads or appliances.

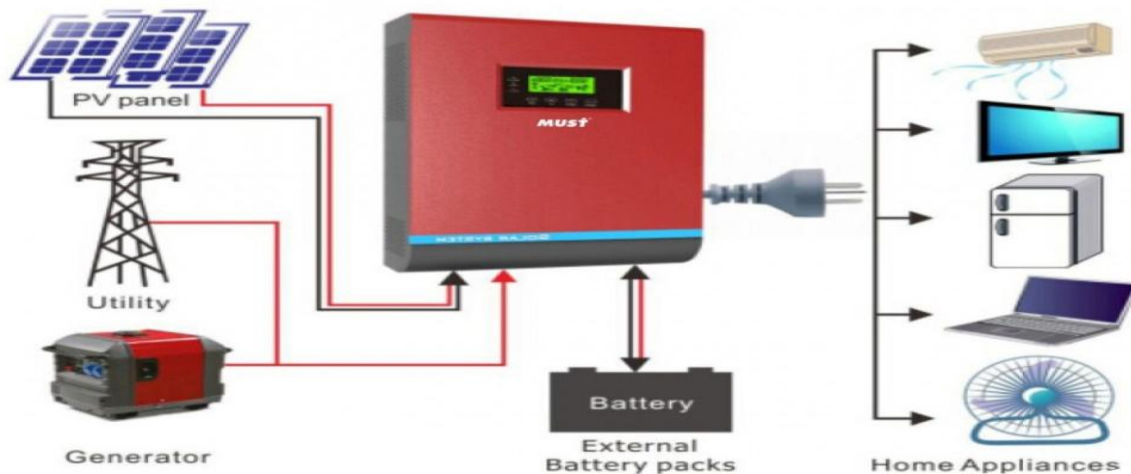


Fig 3. Distribution of components of pv powerplants

Blocks	Suggested Voltage Rating	Required Power Rating
Charge controller	600 VDC	50 Kw
Battery	300 VDC	NA
Inverter	440 VAC	50 Kva
Utility Transformers	440V/ 11V	50 KVA

Table 1. Ratings of different electronics components per string

V. DC-DC CONVERTER

DC-DC converters are power electronic circuits that convert a dc voltage to a different dc voltage level, often providing a regulated output. The key ingredient of MPPT hardware is a switch-mode DC-DC converter. It is widely used in DC power supplies and DC motor drives for the purpose of converting unregulated DC input into a controlled DC output at a desired voltage level. MPPT uses the same converter for a different purpose, regulating the input voltage at the PV MPP and providing load matching for the maximum power transfer. There are a number of different topologies for DCDC converters. In this thesis we are using BUK, BOOST, BUKBOOST dc-dc converter as it is obtained by using the duality principle on the circuit of a buck boost converter.

VI. PHOTOVOLTAIC SYSTEM DESIGN

To design a Grid connected distributed Photovoltaic system for the considered areas, the following steps are required to be taken.

1. Determine power consumption demands.
2. Size the PV modules
3. Inverter sizing
4. Battery Sizing
5. Solar charge controller sizing
6. Estimating the cost of PV system.

6.1. BATTERY SIZING

The battery type recommended for using in solar PV system is deep cycle battery. Deep cycle battery is specifically designed for to be discharged to low energy level and rapid recharged or cycle charged and discharged day after day for years. The battery should be large enough to store sufficient energy to operate the appliances at night and cloudy days. To find out the size of battery, calculate as follows:-

1. Calculate total Watt-hours per day used by appliances.
 2. Divide the total Watt-hours per day used by 0.85 for battery loss.
 3. Divide the answer obtained in item 4.2 by 0.6 for depth of discharge.
 4. Divide the answer obtained in item 4.3 by the nominal battery voltage.
 5. Multiply the answer obtained in item 4.4 with days of autonomy (the number of days that you need the system to operate when there is no power produced by PV panels) to get the required. Ampere-hour capacity of deepcycle battery.
- **Battery Capacity (Ah)** = Total Watt-hours per day used by appliances x Days of Autonomy $(0.85 \times 0.6 \times \text{nominal battery voltage})$

VII. ADVANTAGES

1. Generation of environmentally clean energy.
2. A major advantage of solar power is that a solar power plant is self-sufficient, running completely off of the power of the sun.
3. The semi-conductive materials used in storing and converting solar energy have yet to be made as economically as the equipment used in electricity.
4. Reduction in diesel consumption wherever DG backup is provided.

VIII. DISADVANTAGES

1. Solar power plants is the extremely high cost of building
2. Solar power plants require a large area of land to efficiently absorb solar energy.
3. High maintenance cost is required.
4. These plants are only as effective as the amount of solar energy they can absorb. This means that certain locations where there is less sun are workable for a solar power plant.

IX. CONCLUSION

Solar PV is a technology that offers a solution for a number of problems associated with fossil fuels. It is clean decentralized, indigenous and does not need continuous import of a resource. On top of that, India has among the highest solar irradiance in the world which makes Solar PV the more attractive for India. The photovoltaic systems are considered as the most promising energy sources for these sites, due to their high reliability and safety. New and Renewable Energy dept. has been making serious efforts in promoting renewable in various sectors including corporate houses. The main factor that the photovoltaic system is non-polluting and not harmful to the environment. As the cost of the per unit is also increasing day by day, the payback period of the photovoltaic system is less and it is economical for long term. Regardless , of using traditional energy sources we use alternative energy ,in particular solar energy ,this will results in environment eco-friendly and non-polluting.

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