Study and Implementation of Solar Power Plant

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Abstract— World's 90-95% industry works on power. Power is very important part of today's industrial and commercial revolution. It is generated conventionally as well as some natural resources are used in order to fulfill today's power wants. The hydro power stations are the main resources of the electricity and power. Wind power station and solar power generation are some of the another source. Bio gas power station may also be there. Still as for as the usage increases, the generation cannot be increased in that proportion. Hence there is always shortage of electricity. Hence we have to planningin order to minimize the shortages. We can build the small solar power plant. This will help to minimize the dependency of the conventional power plant. Day by day the difference between the electricity consumption and demand is increases due to this, shortage of electricity is increase gradually. To minimize these shortages we want to use the non-conventional energy sources. The solar power generation is the best way to minimize this difference between demand and consumption.

Keywords: revolution, demand, consumption, generation, electricity

I. INTRODUCTION

Energy is the key input to drive and improve the life cycle. Primarily, it is the gift of the nature to the mankind in various forms. The consumption of the energy is directly proportional to the progress of the mankind with ever growing population, improvement in the living standard of the humanity, industrialization of the developing countries; the global demand for energy is expected to increase rather significantly in the near future. The primary source of energy is fossil fuel, however the finiteness of fossil fuel reserves and large scale environmental degradation caused by their widespread use, particularly global warming, urban air pollution and acid rain, strongly suggests that harnessing of non-conventional, renewable ,environment friendly, clean and green energy resources is vital for steering the global energy supplies towards a sustainable path.

India has a vast supply of renewable energy resources, and it has one of the largest programs in the world for deploying renewable energy products and systems. The Renewable Energy market in India is pegged at US$600 million, growing at 15% per annum. The Government's renewable energy target by 2030 is 200 gigawatts, estimated to require US$200 billion in capital investment. Currently, 3.5% of installed capacity is in the renewable sector, producing 3700 MW. Renewable energy is projected to produce 10,000 MW by 2012.

II. OBJECTIVE

- To promote clean and green energy, renewable energy, solar energy.
- To promote power generation by renewable energy source
- To enhance our knowledge of renewable energy sources.
- To reduce difference between electricity consumption or electricity production.
- To learn how to build a solar power plant for electricity generation.

III. PRINCIPLE OF OPERATION OF SOLAR ENERGY

Solar energy is available in abundance in most parts of the world. The amount of solar energy incident on the earth's surface is approximately1.5 x 1018 kWh/year, which is about 10,000 times the current annual energy consumption of the entire world. The density of power radiated from the sun (referred to as solar energy constant) is 1.373 kW/m2.

Solar cell is a device which converts photons in Solar rays to direct-current (DC) and voltage. The associated technology is called Solar Photovoltaic (SPV). A typical silicon PV cell is a thin wafer consisting of a very thin layer of phosphorous-doped (N-type) silicon on top of a thicker layer of boron-doped (P-type) silicon. An electrical field is created near the top surface of the cell where these two materials are in contact (the P-N junction).

When the sunlight hits the semiconductor surface, an electron springs up and is attracted towards the N-type semiconductor material. This will cause more negatives in the n-type and more positives in the P-type semiconductors, generating a higher flow of electricity. This is known as Photovoltaic effect.

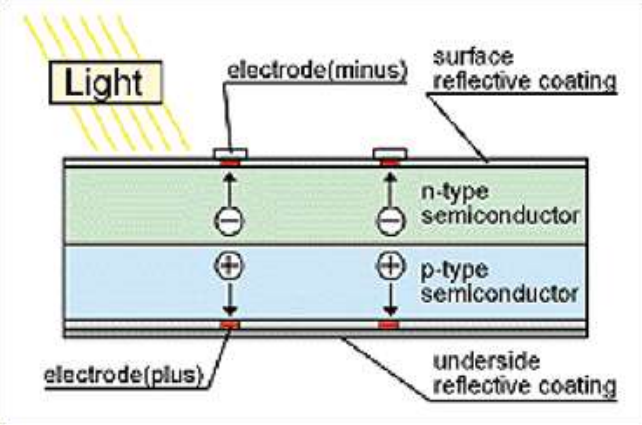

Fig.1: Silicon Solar Cell and its working mechanism
(Source: global.kyocera.com)

The amount of current generated by a PV cell depends on its efficiency, its size (surface area) and the intensity of sunlight striking the surface. For example, under peak sunlight conditions a typical commercial PV cell with a surface area of about 25 square inches will produce about 2 watts peak power.

IV. SOLAR POWER PLANTS

Power supply in most of the cities and towns is unreliable, which has forced the people to use small generators. These generators are operated with fossil fuels like kerosene, petrol or diesel cause pollution. It also leads to increase dependence on oil imports. A solar power plant is a good option for electrification in areas that are

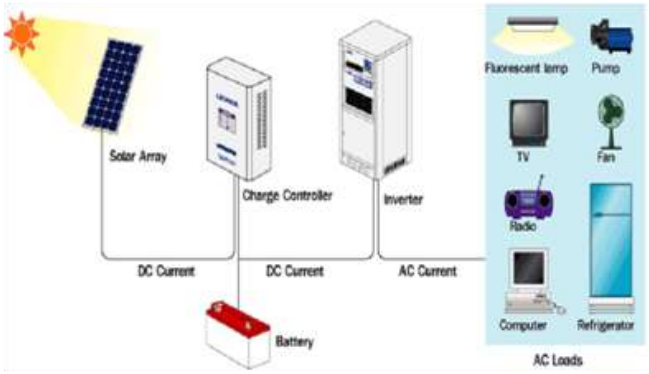

Fig.2: Schematic of Solar Home Lighting System

located away from the grid line or where other sources are neither available nor can be harnessed in a techno economically viable manner.

A solar power plant of the size 10–100 kW (kilowatt), depending on the load demand, is preferable particularly with a liberal subsidy and low-interest soft loan from financial institutions. The idea is to raise the quality of life of the people subjected to poverty in these areas. This coupled with low-gestation remote areas of many states that need electrification. Typical Stand alone solar power plant for the power generation comprises of Solar PV module array, Module mounting structures, Charge controller, Battery bank, Inverter and Load circuitry. A typical stand alone Solar PV power plant is shown in the Figure 20. The control panel (inset of photograph) withall the peripheral components is housed as shown below.

Typical specification of a solar power plant for village electrification is as follows:

- A clean, silent and eco-friendly source of power
- Power in the range of 1 kWp to 10 kWp capacity
- Module Rating
- 75 Wp or more, 24 V
- Battery

V. SYSTEM DESIGN OF SOLAR PV SYSTEMS

A. Load analysis

1) Accurate sizing

Accurate sizing of the load involves analyzing the various components in the load list in terms of energy requirements. It includes the current drawn by each component, Operating voltage range of that component and its expected duty cycle.

2) Peak current loads

For equipment loads that are variable or pulsating, identify "peak" current levels unless definite patterns or duty cycles are determinable.

3) Worst case scenarios

Assessment of worst case scenario is extremely important because any small increment in load apart from already assessed load can lead to system unbalance or a cycling down of battery capacity. So, assessing worst case load scenario is important. Worst case load scenario could be consequent to any load variations due to seasonal conditions.

4) Plan for the future

The system must be designed focusing on the future needs. The system must be scalable to cater to the needs of expansion.

5) Compatibility issues

The system must be compatible with existing systems to meet the load requirements. All the loads must be cross checked to ensure their compatibility of operation throughout the upper and lower voltage ranges of the solar system.

Determine design margins Additional design margins to be considered and kept at minimum level to make the system more cost effective because of the early consideration of worst case load scenario and possible system expansions.

B. Solar array design

Solar array is one of the major subsystems of any solar power generating system. Solar array is formed by connecting solar "modules" in series and/or parallel arrangement. This array produces direct current with respect to the incident solar radiation. The following are the factors that need to be considered in designing solar array for power generation.

1) Collector size

The required solar collector area depends on the solar isolation level of a particular region. A region with poor isolation level will need a larger collector area than one with high isolation levels. Once isolation level of a region is known, the required collector size and energy output can be computed with some precision.

2) Selection of most appropriate module

Solar modules are often rated on the basis of peak watts, and their electrical characteristics are described on a current-voltage curve popularly known as I-V curve. However, the most important factor is the module's behavior under expected operating conditions. One very important concern is module's charging voltage generation under expected high temperature. It must be adequate to charge the battery after providing for system losses.

3) Dirt and Other contaminating effects

Dirt and other contaminants (e.g. bird-droppings) on the face of the solar array can reduce the power output. Site conditions should be assessed to gauge the problems associated with contaminants. The mitigating solutions like special mounting considerations, more frequent cleaning could be recommend. If the tilt angle of the array is less than 30°, buildup of dirt and other contaminants can be expected.

4) Orientation and Tilt issues

The specific orientation and tilt of the solar array should be adopted to optimize system power during the worst-case periods of the year and when the average solar isolation is lowest and load requirements are highest. It may be desirable in certain locations to increase the array tilt to aid the clearing of snow and ice.

5) Design of Balance of Systems (BOS)

Design of Balance of Systems is a very important factor in system design. Balance of systems includes the Charge

controller, Battery, Cables etc. Balance of systems must be designed in such a way that it is neither too small nor too large.

C. Battery design

Battery selection and sizing is critical to overall system performance and reliability. The battery serves as an energy buffer, storing excess energy produced by the solar array during the day and releasing that energy as required during night and periods of inclement weather, when the array is unable to support the load. The following are some important factors that need to be considered in designing a battery bank.

1) Physical and Performance Requirements

The battery should be capable of handling both the physical and electrical rigors of the application, while providing the desired life expectancy and reliability. Key areas to be considered include:

- Cycle life
- Capacity to withstand extended undercharged condition
- Capability to withstand extended overcharging when array output is not regulated
- Charge efficiency and degree of self-discharge
- Performance and life effects of temperature extremes
- Tolerance of abuse

2) Temperature and Ageing duration

Battery performance is not static but will vary with age and environmental conditions. Battery performance should be derated to compensate for loss of capacity due to ageing and the reduction in available capacity due to low temperature. These factors will vary with type of battery. An additional consideration for certain applications will be the life-shortening effects of sustained high-temperature environments.

3) Regulation and Charge control

A system regulator or Charge controller may be necessary to prevent excessive overcharge during peak periods of solar radiation, which could damage some batteries, particularly flat plate lead acid batteries and sealed maintenance-free batteries. A regulator or controller may also be desirable to reduce battery water consumption and extend required maintenance intervals.

VI. CONCLUSION

- This report is meant only as an overview in hopes that it will encourage even more rapid and extensive development of the solar energy resources.
- We take knowledge of developing of clean and efficient electrical energy in college premises.
- After working on this project we came to know that by implementing SPP, we can reduce our electricity bills and we learned the process of implementation of solar power plant.
- India and other developing countries have ambitious and difficult task regarding electrical power sector.
- In this report all the information is written in such way that it can understand to anyone. And this information is given with suitable diagram and easy language
- Energy can be conserve by implementing the solar energy power plant.

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