Paper from Proceeding of the National Conference "Science in Media 2012" Organized by YMCA University of Science and Technology, Faridabad, Haryana (India) December 3rd -4th 2012 Published by IJMRS's International Journal of Engineering Sciences, ISSN (Online): 2277-9698
www.ijmrs.com

Combined heat and power applications of solar energy

Siddhartha, YMCA University of Sc. And Tech, Faridabad, India

I. Introduction

Solar radiation can be converted to more useful forms of energy principally heat , mechanical or electrical power . Solar heat is being carried out by means of a variety of solar thermal collectors. Solar heat after getting converted into light is being used for variety of end uses including water pumping ,lighting and refrigeration. Solar energy technology conversion can be achieved by solar thermodynamic and solar photovoltaic routes.

When radiant energy strikes the surface of an object , a proportion depending upon the angle of incidence and the nature of the surface is reflected , a part is absorbed and some of it is transmitted through the object. Assemblies of photovoltaic cells are used to make solar modules which generate electrical power from sunlight . Multiple cells , in an integrated group all oriented in one plane , constitute a solar photovoltaic panel or module . A group of connected solar modules is called an array. Solar cells can be made from several different semiconductor materials , and these materials are available in a variety of physical states – single crystal, polycrystalline or amorphous. High power concentrating photovoltaic (HCPV) multijunction Ga As cell battery , with a broad absorption spectrum ,high efficiency , good temperature characteristics , low power manufacturing process etc. , so that it can focus on high fewer high temperature environment remains under a high photoelectric conversion efficiency. HCPV products include the extension of multijunction solar cell materials , photovoltaic conversion chip , optical receiver components , condenser , PV modules , dual – axis tracker and so on. Battery chip multi junction technology a substantial increase in photoelectric conversion efficiency compared with silicon based materials , based on III-V semiconductor multijunction solar cell has the highest photoelectric conversion efficiency of silicon solar cells. The cost of a PV device is determined by several factors which include the kind of materials used ,the amount of materials required, the choice of substrates, the device design and the fabrication processes. The choice between higher efficiency and lower fabrication cost often boils down to a choice between crystalline and thin film materials. Crystalline devices are generally more efficient , but thin film devices cost less.

The goal of PV technology is to generate large amounts of power in conjunction with the existing utility grid, there by displacing fossil fuel use. Voltage support systems are defined as centralized PV systems , between 250 and 1000KWp in size are deployed with the existing utility transmission grid to support the electrical service quality (voltage , power factor etc.) during periods of peak demand. Stand alone micro utility shares many of the characteristics of the voltage support systems. apart from optimization and associated incremental improvements in cell efficiency , the areas which needs attention are – reducing the quantity of silicon used through thinner wafers and more efficient ingot sawing , developing new high volume , energy efficient routes for purifying silicon to provide low cost solar grade silicon and optimizing cell processing to achieve production efficiencies approaching 20% for standard crystalline silicon cells and upto 16% for cells made from low purity upgraded metallurgical grade silicon.

II. Literautre Review

Solar thermal : Solar power point use the Sun's rays to heat a fluid from which heat transfer systems may be used to generate steam that in turn is used to drive a turbo generator or the fluid may be used to operate an engine directly. Fuel is direct heat energy rather than stored energy in the form of fossil fuels , from which the heat energy needs to be released by combustion.

The land requirement of solar thermal plants is worth consideration. The current calculated cost for electricity production at solar electric generating stations plants varies between various plants due to the difference in quoted capital costs. Economies of Scale in manufacture should result in further lowering of costs.

Solar photovoltaics: Converting light energy directly to electrical energy using photovoltaic devices. Photovoltaic modules are made from a number of materials and fabricated in a variety of different designs. The wavelength of the sunlight absorbed depends on the band gap of the material. The materials are designed so that the electrons can not return to these sites easily except by flowing through an external circuit thus generating a current. A typical solar cell consists of a layer of semiconductor material sandwiched between conducting top and bottom layers. Modules can be further interconnected to form arrays. Nontracking arrays that remain in a fixed position and tracking arrays that follow the Sun's movement across the sky.

III. ADVANTAGES AND DISADVANTAGES COMPARISON FOR PHOTOVOLTAICS

ADVANTAGES	DISADVANTAGES
Fuel source is vast.	Fuel source is diffuse.
No emissions, no combustion or radioactive fuel for disposal.	High installation costs.
Low operating costs.	Poorer reliability of auxiliary elements including storage.
No moving parts.	Lack of economical efficient energy storage.
Ambient temperature operation.	
High reliability in modules.	
Safe	

First Generation Photovoltaics : Silicon wafer based photovoltaic is the dominant technology for terrestrial applications. Single crystalline and multi crystalline wafers , allow power conversion efficiencies upto 25%.

Second Generation Photovoltaics : Based on the use of thin film deposits of semiconductors , such as amorphous silicon, cadmium telluride , copper indium gallium diselenide or copper indium sulfide. The efficiencies of thin film solar cells tend to be lower compared to conventional solar cells , around 6% to 10% , but manufacturing costs are also lower , so that a price in terms of $/watt of electrical output can be reduced.

Third Generation Photovoltaics: dye sensitized nano crystalline or Gratzel solar cells , organic polymer based photovoltaics , tandem solar cells , hot carrier solar cells , multiband and thermo photovoltaic solar cells.

Photovoltaic cells can be defined as photodiodes , which are operated under forward bias. They are designed to capture photons from the solar spectrum by exciting electrons across the band gap of a semiconductor , which creates electron hole pairs that are then charge separated typically by p-n junction introduced by doping. The space charge at the p-n junction interface drives electrons and holes in opposite directions , creating at the external electrodes a potential difference equal to band gap. A semiconductor can only convert photons with the energy of the band gap with good efficiency. Photons with lower energy are not absorbed and those with higher energy are reduced to gap energy by thermalisation of the photogenerated carriers.

In addition to PV modules we must purchase balance of system (BOS) equipment. This includes Battery charge controllers , batteries, Inverters , wires, conduit, grounding circuit , fuses , safety disconnects , outlets , metal structures for supporting the modules and any additional components that are part of the

PV system. A PV system may have to be sized to store a sufficient amount of power in the batteries to meet power demand during several days of cloudy weather. BOS Cost = Business Processes Cost + Structural system + Electrical system.

Estimate of the sizing of PV array and batteries can be calculated using the following design rules: (1) Determine the total load current and operational time.(2) Add system losses.(3)Determine the solar irradiation in daily equivalent sun hours.(4) Determine total solar array current requirements. (5) Determine optimum module arrangement for solar array.(6) Determine battery size for recommended reserve time.

Blocking diodes are installed in solar arrays to prevent reverse current flows into the modules , which may damage the modules and cause energy losses. By – pass diodes are incorporated into modules to prevent damage of arrays when same cells or modules became shaded.

IV. CONCLUSION

Increase in PV market will also play an important part in cost reduction because of economies of scale and incentives for innovation in manufacturing. The incentive to PV manufacturers decrease costs substantially , which will occur only if the market increases are large enough to enable the industry to recoup its investment in PV research and development. Other future issues of importance in PV industry are the supply of raw materials as the crystalline silicon PV market expands beyond the waste silicon available from the semiconductor industry. Emphasis has been on photovoltaic modules , when the balance of System components form 40 % to 60% of the total cost. Economies of scale and extensions in component lifetimes are expected to be the 2 main factors in reducing these costs. Batteries are an expensive component with short lifetime and needs replacement.