Kavita Sharma, Prateek Haksar / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com
Vol. 2, Issue 1,Jan-Feb 2012, pp.812-815

Designing of Hybrid Power Generation System using Wind energy- Photovoltaic Solar energy- Solar energy with Nanoantenna

Kavita Sharma(MTech*) Prateek Haksar (MTech*)

(Department of electronics and communication, MITS, Laxmangarh (UGC-1956))
(Department of electronics and communication, MEC, Bikaner(RTU))

ABSTRACT

All the natural wastage energies are used for production of Electricity. Thus, the Electrical Power or Electricity is available with a minimum cost and pollution free to anywhere in the world at all times. This process reveals a unique step in electricity generation and availability from natural resources without hampering the ecological balance. This paper describes a new and evolving Electrical Power Generation System by integrating simultaneously photovoltaic Solar Energy, solar Energy with Nano-antenna, Wind Energy and non conventional energy sources. We can have an uninterrupted power supply irrespective of the natural condition without any sort of environmental pollution. Moreover this process yields the least production cost for electricity generation. Utilization of lightning energy for generation of electricity reveals a new step. The set-up consists of combination of photo-voltaic solar-cell array & Nano-anteena array, a mast mounted wind generator, lead-acid storage batteries, an inverter unit to convert DC power to AC power, electrical lighting loads and electrical heating loads, several fuse and junction boxes and associated wiring, and test instruments for measuring voltages, currents, power factors, and harmonic contamination data throughout the system. This hybrid solar-wind power generating system will extensively use in the Industries and also in external use like home appliance.

Keywords: - **Photo-voltaic, Solar Cell, Nano-antenna, Wind Energy, Unrenewable Energy, Renewable Energy.**

I. Introduction

The thermal power stations are causing extreme pollution to our mankind and nature. Lot of diseases and handicapped affect are the fruit of these power stations. Also natural resources like coal, oil, radio-active materials etc will come to shortage stage or an end in near future. The other power generating systems like Hydro-Electricity power generating plant cannot afford much power, although it causes less pollution. Therefore, it needs urgent invention to go for non-conventional energy resources. The most popular non-conventional power resources are solar energy power plant which converts solar energy or solar heat to electricity [1][2]. Solar power generation system has some drawback, that is, it cannot generate power in cloudy or rainy days. Therefore, people using this solar system have to remain without electricity (power) after battery gets discharged during the rainy season or the sun's shortcomings, since it is totally depended on appearance of the sun in the sky [3]. Moreover, it has very much limited capacity and we cannot take all available solar energy, because it is urgently required in all other fields' also e.g. biological body or health care, agriculture, chemical reactions, industries etc.

The aim of this work is design and implementation of a Hybrid power generation system using wind energy-photovoltaic solar energy- solar energy with nano-antenna. An Nano-antenna electromagnetic collector (NEC) has been designed, prototyped, and tested. Proof of concept has been validated [4]. The NEC devices target mid-infrared wavelengths, where conventional photovoltaic (PV) solar cells are inefficient and where there is an abundance of solar energy [5].

II. Energy Resources

Energy resources are classified into two groups: primary un-renewable and secondary-renewable resources, with respect to change in quantitative [6].

A. Unrenewable Energy Resources

Unrenewable energy resources are the ones that decay partially or vanish with the time or needs decades for reuse, such as oil, coal and coal derivatives, natural gas, wood and radioactive atoms (uranium).

B. Renewable Energy Resources

Renewable energy resources are the ones that are persistently available and renewing itself with the time. Industrialization and increasing world population has

remarked the use of renewable energy resources. Solar power, wind power, biomass, tide power, wave power, geothermal power is known ones [7].

1) Wind Power

The wind energy is a renewable source of energy. Wind turbines are used to convert the wind power into electric power. Electric generator inside the turbine converts the mechanical power into the electric power. Wind turbine systems are available ranging from 50W to 2-3 MW [8]. The energy production by wind turbines depends on the wind velocity acting on the turbine. Wind power is used to feed both energy production and consumption demand, and transmission lines in the rural areas.

It is used to run a windmill which in turn drives a wind generator or wind turbine to produce electricity. Practically it is observed that the flexible three blades propeller about 35 m in diameter, in a 60 Km/hr wind pressure with a rotation speed of 47 rpm produce maximum power 12 MW. For small wind power generation system, multiple blade type (3 to 5 number blades) or Darrieus type (Curved Blade 3 to 5 numbers) is highly suitable. The main drawback of this system is that as the wind speed or velocity is not constant with respect to time i.e. fluctuating, hence the electric power thus obtained is also not having predetermined value i.e. varying nature. Thus, it is better to feed the wind electricity to the battery or any power storage device i.e. accumulator circuit which supply the load accordingly, rather directly supply to the load as shown in Fig. 1.

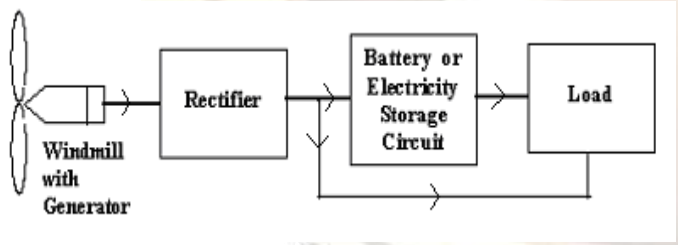

Fig.1. Block Diagram of Windmill Power System

In wind power system, the power generation increases in proportion to the cube of the wind speed. Thus it is highly affected in rainy and stormy period when the wind speed is formidable to produce electricity. This power generation system is pollution free pure ecologically balanced one.

2.2.2. Photovoltaic Solar Power

Solar panels are the medium to convert solar power into the electrical power. Solar panels can convert the energy directly or heat the water with the induced energy. PV (Photo-voltaic) cells are made up from semiconductor structures as in the computer technologies. Sun beam is absorbed with this material and electrons are emitted from the atoms that they are bounded. This release activates a current. Photovoltaic is known as the process between beam absorbed and the electricity induced. With a common principle and individual components, solar power is converted into the electric power.

The Solar Power Generation System is planned accordingly Fig. 1. The solar cell array or panel consists of an appropriate number of solar cell modules connected in series or parallel to provide the required current and voltage.

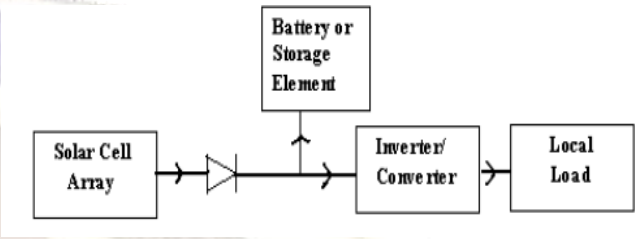

Fig.2. Basic Solar (Photovoltaic) System

Storage batteries as shown in Fig. 2 provide the backup power during no sun shine period by storing the excess power or some portion of power from the solar arrays. This solar power generating system is used for private power consumption, meteorological stations, radio or TV relay stations, entertainment places like cinema, hotel, restaurant etc, villages and islands.

Traditional p-n junction solar cells are the most mature of the solar energy harvesting technologies. The basic physics of energy absorption and carrier generation are a function of the materials characteristics and corresponding electrical properties (i.e. band gap). A photon need only have greater energy than 2eV that of the band gap in order to excite an electron from the valence band into the conduction band. However, the solar frequency spectrum approximates a black body spectrum at ~6000 K, and as such, much of the solar radiation reaching the Earth is composed of photons with energies greater than the band gap of silicon [9] [10]. These higher energy photons will be absorbed by the solar cell, but the difference in energy between these photons and the silicon band gap is converted into heat (via lattice vibrations — called phonons) rather than into usable electrical energy. For a single-junction cell this sets an upper efficiency of ~20%. The current research path of implementing complex, multi-junction PV designs to overcome efficiency limitations does not appear to be a cost-effective solution. Even the optimized PV materials are only operational during daylight hours and require direct (perpendicular to the surface) sunlight for optimum efficiency.

Economical Alternative to PV

We have an alternative energy harvesting approach based on Nano-antennas that absorb the incident solar radiation .The Nano-antennas target mid-infrared rays, which the Earth continuously radiates as heat after absorbing energy from the sun during the day. In contrast, traditional solar cells can only use visible light, rendering them idle after dark. Infrared radiation is an especially rich energy source because it also is generated by industrial processes such as coal-fired plants.

We have designed Nano-antenna elements that capture electromagnetic energy from naturally occurring solar radiation and thermal earth radiation. The size of the antenna is relative to the wavelength of light we intend to harvest. The basic theory of operation is as follows: The incident electromagnetic radiation (flux) produces a standing-wave electrical current in the finite antenna array structure. Absorption of the incoming EM radiation energy occurs at the designed resonant frequency of the antenna [11].

Since objects give off heat as infrared rays, the nanoantennas could collect those rays and re-emit the energy at harmless wavelengths. Such a system could cool down buildings and computers without the external power source required by air-conditioners and fans. It also provides designers another mechanism to increase the efficiency of antenna arrays through the expansion of the radial field. Antennas by themselves do not provide a means of converting the collected energy. This will need to be accomplished by associated circuitry such as rectifiers.

The Nano-antennas are tiny gold squares set in a specially treated form of polyethylene, a material used in plastic bags. A Nano-antenna array capable of collecting power from infrared energy that could be harvested in any weather (or even at night) [12]. The cell production process is even supposed to be ridiculously cheap compared to making standard silicon photovoltaic cells, but, as always, there's a rub. The grid collects its oscillating IR energy at ten thousand billion times per second, which is proving to be a challenge to the nerds behind the tech, who are working on a way to convert that to the 50-60Hz power that the world uses [13] [14].

Nano-antennas, on the other hand, can be tweaked to pick up specific wavelengths depending on their shape and size. This flexibility would make it possible to create double-sided nanoantenna sheets that harvest energy from different parts of the sun's spectrum [15] [16].

2.2.3 Structure of Solar cell with Nano- antenna

The structure of purposed design consist array of Nano antennas at the middle part of structure and boundary covered by Photovoltaic cells shown in figure in 3. It also consist controlling circuit at the back side of panels [17].

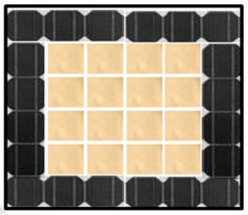

Fig. 3. Structure of new purpose Solar panel

Vi. Integrating power generation system by using wind energy- photovoltaic solar energy- solar energy with nano-antenna

To eliminate the above drawbacks of individual renewable power generation system like Solar and Wind, we design a new electricity or power generating system by integrating the wind energy sources, Photovoltaic solar energy and Solar energy with Nano-antenna simultaneously, so that power supply remains continuous without any sort of interruptions or load shedding.

The aim of this work is design and implementation of a Hybrid power generation system using wind energy- photovoltaic solar energy- solar energy with Nano-antenna for continuous (24*7) power generation.

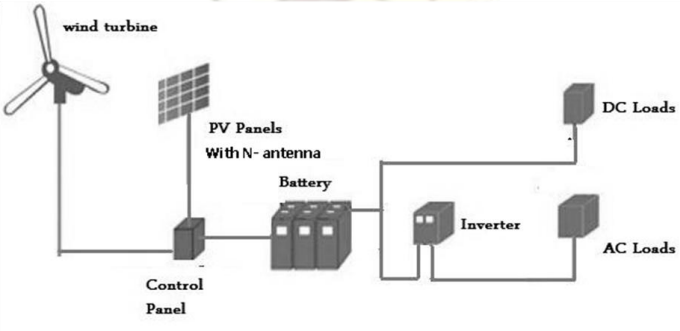

Figure 4. Integrated Electricity Generating System

The Solar-Wind with Nano-antenna Power Generation System is designed as shown in Fig. 4 It has some special equipment to charge the battery or the power storage (accumulator) circuit. Control circuit ad-joint with electric power generating system provides necessary control functions such as adding or summing up electric power derived from more than one sources at a time i.e. solar and wind power simultaneously, solar with Nanoantenna and wind power simultaneously, over voltage protection, amount of electric power directed to the load and the battery etc. Thus by implementing Solar with Nano-antenna Wind-Lightning Integrating Power Generation System in a compact package, we have an uninterrupted power supply at the minimum cost

to all places at all times. Moreover, we can avoid the accidental risk and causes by lightning to human and nature both. This method ensures a highly practical oriented pollution free and accident free inventory for electric power generation system. The electric power afforded by this system is completely pure and secured form without any sort of environmental pollution. Also it does not produce any greenhouse effect or acid rain or emit any kind of poisonous gases or radiation etc.

4. Experimental Results

Both modeling and experimental measurements demonstrate that the individual nanoantennas can absorb close to 90 percent of the available in-band energy. Optimization techniques, such as, increasing the radial field size could potentially increase this efficiency to even higher percentages. The current and voltage values from the wind turbine, solar panels, battery group, and load are measured in the implemented system. Production and consumption of power for each module can be calculated. In order to allow separate chassis, a laptop computer which is disconnected from the power line is used to record the measurement data of the operating system.

VII. Conclusion And Future Work

This Integration of renewal Energy source will be highly effective in all places, especially in commercial areas where need of electricity is more. It causes no effect on nature i.e. pollution free, at the same time not proneness any kind of accident due to lightning. It is also useful to minimize power supply load i.e. cut short power charge. By using this system, we can save electricity charge because very less maintenance charge to this equipment is required. The designing of this equipment is done in such a way that it is very compact and acts as user friendly. When it is manufactured in a large scale, cost of this integrated natural resources power generation system is affordable. Moreover there is no power failure or load shedding situation at any times. Therefore, it is the most reliable renewable power or electricity resources with less expenditure.

This research is at an intermediate stage and may take years to bring to fruition and into the market. The advances made by our research team have shown that some of the early barriers of this alternative PV concept have been crossed and this concept has the potential to be a disruptive and enabling technology. We encourage the scientific community to consider this technology along with others when contemplating efforts and resources for solar energy.

References

[1] Bill Williams, 2002, Solar and Other Renewable Energy Technologies
[2] Energy Information and Administration, (01.05.2009), http://www.eia.doe.gov
[3] Enslin, J. H. R., "Maximum Power Point Tracking: A ost Saving Necessity In Solar Energy Systems", *16th IEEE Annual Industrial Electronics Society Conference*, Pacific Grove, USA, 1990, pp.1073-1077.
[4] Guy J. Consolmagno and Martha W. Schaefer, World's Apart: A Textbook in Planetary Sciences (1994) Englewood Cliffs, NJ: Prentice Hall.
[3] http://www.kurasc.kyoto-u.ac.jp/plasma-group/sps/history2-e.html
[5] Subramanian Krishnan, Shekhar Bhansali, Kenneth Buckle,and Elias Stefanakos, "Fabrication and Characterization of Thin-film Metal-Insulator-Metal Diode for use in Rectenna as Infrared Detector", Mater. Res. Soc. Symp.Proc. Vol 935.
[6] F. C. Treble, 1991, Generating Electricity from the Sun, Pergamon Press, Oxford, England.
[7] M. R. Patel, 1999, Wind and Solar Power Systems, CRC Press, Florida.
[8] Burton T., Sharpe D., Jenkins N., Bossanyi E., *"Wind Energy Handbook"*, John Wiley & Sons Ltd., England, 2001, pp. 41-170.
[9] H. P. Garg, J. Prakash, 2002, Solar Energy Fundamentals and Applications, 1st Edition,Tata McGraw-Hill Publishing Company Ltd, New Delhi.
[10] G. Willeke, 1987, G. Grassi, Photovoltaic Power Generation, D. Reidel Publishing Co, Holland.
[11] K. S. V. Santhanam, 1988, M. Sharon, Photoelctrochemical Solar Cells, Elsevier Science, Amsterdam.
.[12] Alda, J. Rico-García, J. López-Alonso,and G. Boreman, "Optical antennas for nano-photonic applications," Nanotechnology, vol. 16, pp. S230-4, 2005
[13] Efficiency of Nano-antenna comparison with solar panel http://www.ecogeek.org/content/view/1329/
[14] http://www.physorg.com/nanotech-news/
[15] http://www.nature.com/ncomms/journal/v2/n5/full/ncomms1334.html
[16] Optical forces near a nanoantenna http://www.standrews.ac.uk/microphotonics/Assets/Publications/Ploschner_OpticalForcesNearANanoantenna_Feb10.pdf
[17] http://www.zdnet.com/blog/emergingtech/solar-nanoantenna-energy-collectors/1007