ISSN (e): 2250 – 3005 || Volume, 07 || Issue, 11|| November – 2017 ||
International Journal of Computational Engineering Research (IJCER)

A Review on Importance of Solar Wind Hybrid Energy Systems

Mergu Chandramouly[1], Dr. A. Raghuram[1]

[1](Research scholar, Department of Electrical and Electronics Engineering, Jawaharlal Nehru Technological University Hyderabad, E-mail: cm.jntuh@gmail.com)

[1](Professor, Department of Electrical and Electronics Engineering, Jawaharlal Nehru Technological University Hyderabad, E-mail: raghuram_a@yahoo.co.in)

ABSTRACT

This paper presents the importance of Solar Wind Hybrid Energy systems (SWHES). In future energy generation depends on solar power. Solar power is the Renewable and the most abundant natural source of energy. Conventional power generation may difficult task in future, because of non availability of coal, increased cost of per unit generation in the thermal power plant. Thermal power plants effect the environment. The concept of SWHES will overcome all these difficulties. The proposed generation gives the maximum possible efficiency of combined power generations. Wind solar systems are reliable in nature and low cost compared to other renewable power generation sources. The produced power is the clean source of energy and it can transform to any source of energy with no effect on the environment. To get continuous power supply, the proposed system should operate as a battery connected power generation. The proposed combined mode of operation increases the overall efficiency of the system. SWHES are more reliable to small power application. Proposed system can also reduces the load on the conventional power generating system with no effect on the environment.

Keywords: Hybrid Energy Systems, Solar Power Applications, Wind Power Applications, SWHES, Energy storage, Combined Power Generation, SWHES

Date of Submission: 29-11-2017 Date of acceptance: 08-12-2017

NOMENCLATURE

Table1. Nomenclature used in the article

SWHES	Solar Wind Hybrid Energy Systems
WECS	Wind Energy Conversion Systems
HES	Hybrid Energy System
RES	Renewable Energy Sources
WT	Wind Turbine
PV	Photovoltaic
K.E	Kinetic Energy
P.E	Potential Energy
AC	Alternating Current
DC	Direct Current

I. INTRODUCTION

In this present modern world, everyone is habituated to use electrical power for all the applications. As the world population is increasing, electrical power demand is also increasing. The conventional sources such as coal, diesel, and gas are going to depleting. The need of renewable energy sources becomes important in this context. Many renewable energy technologies today are well developed, reliable and cost competitive with the conventional fuel generators. Cost of renewable energy is on falling trend as the demand and production increases. Renewable Power generation gives the best solution to load demand and environment issues. SWHES is proposed as Distributed generation to meet the increased load demand.

Solar-Wind Hybrid Energy Systems converts solar and wind energy to electrical energy. These systems work in small capacities. Proposed systems are installed at the load side to eliminate the transmission power loss. It is the best practice to reduce our energy bills. These systems allow integrating with any other power generating source. Combine power generation improves the overall system efficiency and reliable. "Energy conservation is the energy generation". To effective use the proposed system; it is connected with battery to store the energy. In household applications, we use single phase power from morning to evening for water heaters, cookers, fans, lights etc. This creates the more burdens on the conventional power system. This load may be diverted to the hybrid power plant. Every individual household should have SWHES to reduce the load on the conventional power system.

II. SOLAR POWER GENRATION SYSTEM

Solar energy is one of the major renewable energy resources that can be used for different applications, such as solar power generation, solar water heaters, solar chargers, and solar lamps and so on. They are various advantages of solar energy usage in electric power generation including low pollution.

A. Solar Panel's Working Principle

A solar panel is made up of solar Photovoltaic cells, and is used for converting solar energy into electrical energy. PV technologies use both direct and scattered sun light to create electricity, however, the amount of power generated by solar system at particular site depend on how much of the sun's energy reaches it. The principle is similar to PN junction diode operation. Current flow in PN junction is due to the majority carriers. N- Region is heavily doped; P-Region is lightly doped. Thus, the electrons produced in the N-type material are passed to the battery through electrode and wire. From the battery, electrons reach P-type material, where these electrons and holes are combined. Hence the solar panel connected to the battery behaves like another battery, and hence, is comparable to the two serially connected batteries. Energy from the solar panel stores in battery and it is also connected to the inverter, if we need a three phase power supply. The Fig.2.1 describes the working of solar cell.

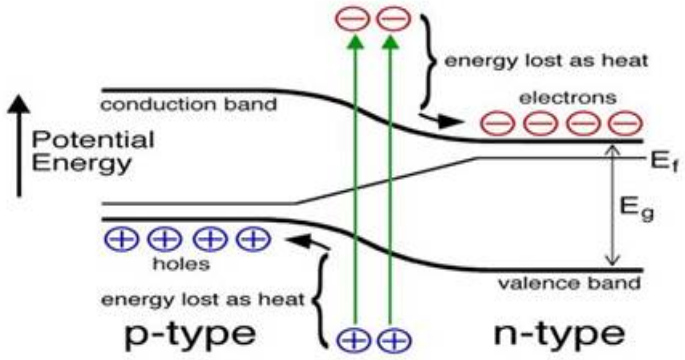

Fig 2.1 Electron flow from N-Type to P-Type

Photovoltaic cell converts sunlight into electricity, which is the physical process know as photoelectric effect. Light falls on a PV cell, may be reflected, absorbed or passed through; however, only absorbed light generates electricity. Solar radiation energy is in the form of photon, transferred to electrons in the atoms of the PV cell. The excited electron with their new found energy to become part of the electrical current flow in the circuit. A special electrical property of the PV cell, Called "built - in electric field" provides the force or voltage required to drive the current through an external load.

B. Solar power System

PV systems can be designed to meet any electrical requirement, no matter how large or how small. You can connect them to an electric distribution system. PV power generating systems may be of standalone (off-grid) or Grid connected. A small solar electric or Photo voltaic (PV) system can be a reliable, as it is used for Street lighting purpose also. Small PV systems can provide a cost-effective power supply in locations where it is expensive or impossible to send electricity through conventional power lines. PV systems connected to the grid will provide the continuous power supply to the load.

III. WIND POWER

Solar radiation falls on the Earth surface, which creates the pressure difference to flow wind. The wind is basically flows from high pressure to low pressure. Wind possesses energy by virtue of its motion. The wind mill works on the principle of converting kinetic energy of the wind to mechanical energy. Wind power systems convert the kinetic energy of the wind into electrical energy. Although wind energy conversion is relatively simple in concept, turbine design can be quite complex. Most commercially available wind turbines use a horizontal-axis configuration with two or three blades, a drive train including a gearbox and a generator, and a tower to support the rotor.

➢ **Wind Energy Conversion principle**

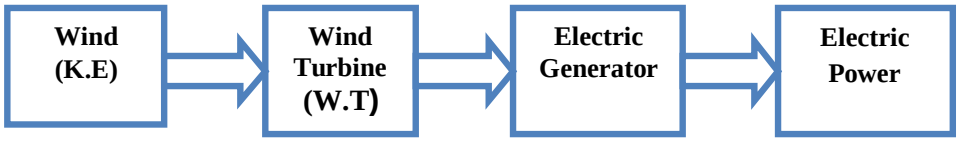

Fig.3.1 Block Diagram of Wind Energy Conversion

From the above Fig.3.1 kinetic energy converted to electrical energy. Wind Turbine and Electrical Generator are mechanically coupled. Kinetic energy of wind rotates the blades of the turbine, which causes to generate electrical power form the Generator. The power in wind can be computed by kinetics which relates to objects in motion. The energy available is the kinetic energy of the wind. The kinetic energy of any particle is equal to one half of its mass times the square of velocity.

Mathematically,

Kinetic energy $K_E = \frac{1}{2}mv^2$ (1)

where, m: mass of particle (kg),

v : velocity of the particle (m/s), and

m= ρAd

We can write the Kinetic energy as below

Kinetic Energy $K_E = \frac{1}{2}\rho A d v^2$

Power (P_w) = Energy per unit time.

Power (P_w) $= \frac{1}{2}\frac{\rho A v^2}{t}$

Power (P_w) $= \frac{1}{2}\rho A v^2 \left(\frac{d}{t}\right)$

Power (P_w) $= \frac{1}{2}\rho A v^3$ (2)

Where,

Velocity (v) = $\frac{\text{Distance (d)}}{\text{Time (t)}}$

ρ = air density,

A = rotor swept area,

d = distance,

m = mass of air =air density * volume

m= ρ*A*d, and

v = distance/time.

With the theoretical power available in wind established by (1) and (2). It can be observed that the wind power is proportional to the cube of the wind speed. This means for higher speeds of the wind, there is much more

energy is available at the turbine to extract. Also, since the power is proportional to the rotor swept area, and thus to the square of the diameter, doubling the rotor diameter will quadruple the available power. Air density also plays a role in the amount of available mechanical power of the turbine.

IV. SOLAR WIND HYBRID ENERGY SYSTEM

The solar wind hybrid energy system is used where the load is relatively small in rural areas. It can be used in schools especially in residential apartments. Also this usage is extended to commercial and industrial sectors. Below Fig 4.1 describes the block diagram of Solar Wind Hybrid Energy System.

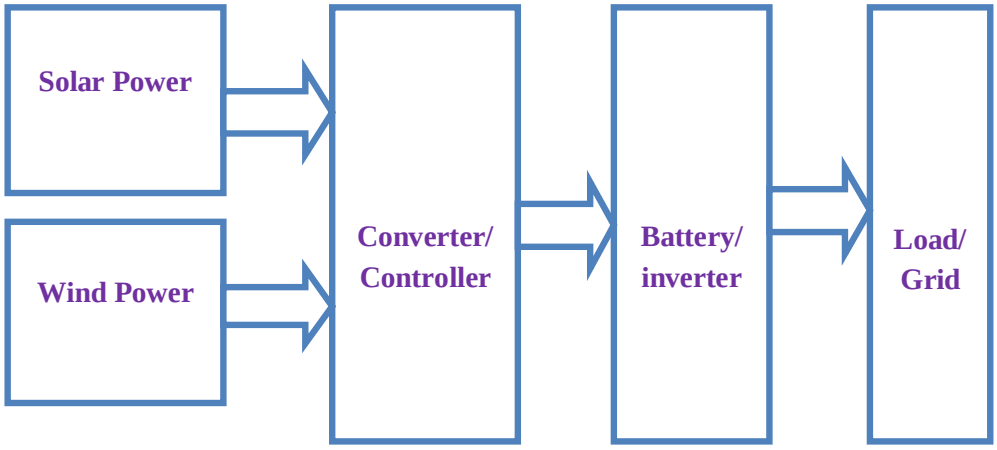

Fig.4.1 Block diagram of Solar Wind Hybrid Energy System

A combination of solar arrays & wind turbines generate electricity (operated through respective controllers) and charge a large tubular battery bank which in turn supplies AC power through a large capacity industrial grade grid sine wave inverter. The proposed system uses two energy sources acting depending on the load requirement. The control algorithms operate the energy sources on their maximum power point operation. Electric Generator may be of synchronous or asynchronous generator. Wind is variable in nature; it is more for some time and less for some other time. Due this variable speed generator is suitable in this area.

Daytime, solar power generation source is active, it gives the energy for only daytime. Wind operates entire day and nighttime. AC power from wind generation system converts to dc to store in the battery. This stored energy can feed the Direct current loads. The proposed systems may connect to the Grid to operate in an efficient manner. In these types of systems generating sources face the integrating issues. This will be done by suitable algorithm based controllers [1]. Proposed system has the concept of load sharing, depends on the amount of load requirement sources will come in to operation. These are more suitable for distributed and remote power applications.

V. APPLICATIONS

- Solar Wind Hybrid Energy Systems are using in almost all field applications. Some of the applications of SWHES are given below.
- **Grid connected and Stand alone**
- **Grid connected:** SWHES can be connected to the grid, no matter how much power generating from this source.
- **Stand alone:** Almost all SWHES are the examples of stand – alone systems.
- **Street lighting:** The best running application of SWHES is the solar street lighting. It reduces the load from conventional power plants.
- **Household:** SWHES are integrated with the buildings, equipped with the house for good appearance also.
- **Remote Applications:** like military services where it is impossible to provide conventional power supply these SWHES are useful.
- **Power Pump:** SWHES can also help to pump the water to any building. DC power operated pump can circulate the water through your home.
- **Village Power:** The proposed system is very useful in villages which are in valley and on hills, where it is not possible to send electricity.
- **Commercial:** In hotels, tourist places SWHES give the required electric power.

VI. CONCLUSION

The proposed systems help in lowering a building's utility bills. These systems not only pay for themselves over a period of time, they help to reduce air pollution caused by conventional systems. Solar Wind Hybrid energy Systems become reliable for small power applications. To improve the solar Photovoltaic power generation efficiency, wind energy is integrated to form as hybrid energy system. The proposed systems help to reduce the burden on conventional power system.

By installing SWHES to every house, the burden on the conventional power generating system reduces. The grid connected systems will give continuous supply to the loads; in case of no power generation takes place by this proposed system. Almost in all field of electric power usage, the SWHES are being used. It provides the power to inaccessible places, where convention power transfer is difficult. The Proposed Systems are more reliable and efficient energy generating system with less effect on the environment.

REFERENCES

[1]. Joanne Hui, Alireza Bakhshai, and Praveen K. Jain, "A Hybrid Wind-Solar Energy System: A New Rectifier Stage Topology," IEEE Conference, February 2010.

[2]. S. Jain, and V. Agarwal, "An Integrated Hybrid Power Supply for Distributed Generation Applications Fed by Nonconventional Energy Sources," IEEE Transactions on Energy Conversion, vol. 23, June 2008.

[3]. Subho Upadhyay, M.P. Sharma "A review on configurations, control and sizing methodologies of hybrid energy systems ," Renew Sustain Energy Rev, 38 (2014), pp. 47-63

[4]. Bahadur Singh Pali , Shelly Vadhera "Renewable Energy Systems for Generating Electric Power: A Review," 1st IEEE International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES-2016)

[5]. Belfkira R, Hajji 0, Nichita C and Barakat G, "Optimal sizing of standalone hybrid wind/PV system with battery storage," European Conference on Power Electronics and Applications, pp.l-lO, Sept, 2007.

[6]. www.electricaltechnology.org/2015/06/how-to-make-a-solar-cell-photovoltaic cell.html

[7]. Y. S. Mohammed , M. W. Mustafa , and N. Bashir , " Hybrid renewable energy systems for off-grid electric power: Review of substantial issues," Renewable Sustainable Energy Rev. 35, 527 (2014).

[8]. M. K. Deshmukh and S. S. Deshmukh , " Modeling of hybrid renewable energy systems," Renewable Sustainable Energy Rev. 12(1), 235 (2008).

[9]. V. K. Gajbhiye, Prof. A. A. Kanaskar, Prof. S. S. Jawre, "Solar Wind Hybrid System- A Review" International Journal of Research in Advent Technology, Vol.5, No.5, May 2017 E-ISSN: 2321-9637.

[10]. Prashant Kumar, Subir Biswas, Shipra Kumari "Building Integrated Photovoltaic Generation System" Proceedings of 2014 1st International Conference on Non Conventional Energy (ICONCE 2014).

International Journal of Computational Engineering Research (IJCER) is UGC approved Journal with Sl. No. 4627, Journal no. 47631.

Mergu Chandramouly "A Review on Importance of Solar Wind Hybrid Energy Systems." International Journal of Computational Engineering Research (IJCER), vol. 7, no. 11, 2017, pp. 54-58.