Advanced Research in Electrical and Electronic Engineering
Print ISSN: 2349-5804; Online ISSN: 2349-5812 Volume 2, Number 6 April-June (2015) pp. 12-14

http://www.krishisanskriti.org/areee.html

Performance Analysis of Grid Connected Hybrid Wind/Photovoltaic System

Anjali Rana[1], Mohammad Ilyas[2] and Ankur Kumar[3]

[1,2]AFSET, Dhauj Faridabad
[3]Shri Ram group of college, Muzaffarnagar
E-mail: [1]en2010.anjali@gmail.com, [2]mohdilyas33@yahoo.com, [3]ankurdhiman07@gmail.com

Abstract—*Due to the critical condition of industrial fuels which comprise oil, gas and others, and emission of harmful pollutants the growth of renewable energy sources is incessantly improving to meet the day by day growing electricity demand. Among different renewable sources solar and wind energy are the world's fastest growing energy resources usually are more reliable and incur lower costs than photovoltaic (PV) or wind systems. Main concerns for designing hybrid solar-wind power generation systems are power system reliability under different changing weather conditions and the corresponding cost. This paper shows the simulation and modelling of hybrid energy system consisting of Wind and Photovoltaic with battery storage. A model of hybrid energy system comprises of wind and photovoltaic system is developed in MATLAB/SIMULINK software. The simulation studies indicate the hybrid system is a best solution with higher system performance than photovoltaic or wind alone.*

1. INTRODUCTION

The Rapid depletion of fossil fuel resources, global environmental concerns and the yet increasing need for energy are some of the reasons to impose an urgent search for alternative energy resources to supply the day by day increasing energy demand. The steady progress in renewable energy technologies draws attention towards the utilization of renewable energy resources. Alternative energy resources such as wind and solar are widely used resources to generate power on a large scale. . A solar system is one which utilizes solar energy to generate electricity. Basic component of solar system is PV cell which is an electronic device that utilizes the semiconductor technology and can produce direct current from sunlight. The best silicon modules available have an efficiency of about 18%. Wind Power system is a system which extract kinetic energy form air and converts it into electrical energy. Wind power is one of the fastest growing renewable energy resources in last few years but individual energy resources either wind or solar may not be effective in terms of cost, efficiency and reliability. An alternative solution of this problem is a combination of these alternative energy resources to form a hybrid system. A Hybrid system is a combination of more than one energy resources that provide energy in a more economic, reliable and efficient manner. In this paper a model of hybrid system comprise of wind and solar system is developed in MATLAB/SIMULINK software.

2. SOLAR (PV) SYSTEM

Solar panels are used to convert solar power into the electrical power. Solar cell modules or panels can convert the energy directly or heat the water with the induced energy. PV cell is the basic building block of the PV system made up of semiconductor material such as silicon and germanium. When photon strikes the surface of solar cell, the electrons and holes are produced by breaking the covalent bond inside the atom of semiconductor material and as a result electric field is generated by creating positive and negative terminals. When these terminals are linked by a conductor an electric current begin flowing. This electricity is used to enerzies a load. Fig. 1. Shows the basic structure of PV cell

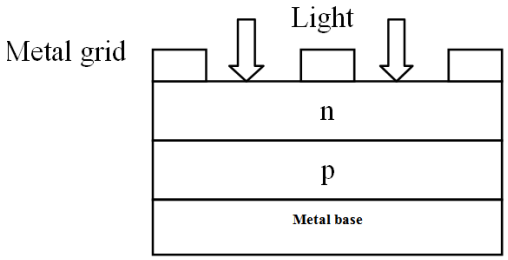

Fig. 1: Structure of PV cell

Solar cells are combined into modules that consist of about 40 cells; a number of these modules are mounted in PV arrays. These PV arrays can be mounted at a fixed angle facing south, or they can be mounted on a tracking device that follows the sun allowing them to confine the maximum sunlight. A number of connected PV arrays can make available enough power for a household; for large electric utility or industrial applications. Basic block diagram of a solar (PV) system is shown in Fig. 2.

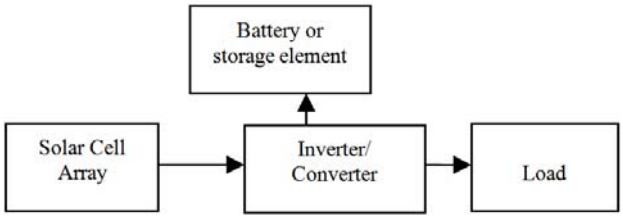

Fig. 2: Block diagram of basic solar (PV) system

Fig. 2 shows the solar cell array or panel consists of a number of solar cell modules linked in series or parallel to provide the required current and voltage. Storage batteries give the backup power during insufficient sun light by storing the surplus power or some portion of power from the solar arrays.

3. WIND SYSTEM

Wind is a natural occurrence associated to the movement of air masses caused by the differential solar heating of the earth's surface. Seasonal variations in the energy received from the sun decide the strength and direction of the wind. The wind turbine extracts winds kinetic energy with the help of rotor having two or more blades mechanically coupled to an electrical generator. The turbine is placed on a tall tower to increase the energy capture. Commercially existing wind turbine uses a horizontal-axis configuration with two or three blades, a drive train consisting a gearbox, a generator and a tower as a supporting structure for rotor. Typical sizes for a wind turbine are in the range of 200-750 KW, with electricity produce within a specific range of wind speed. Fig. 3 shows a block diagram of windmill power system.

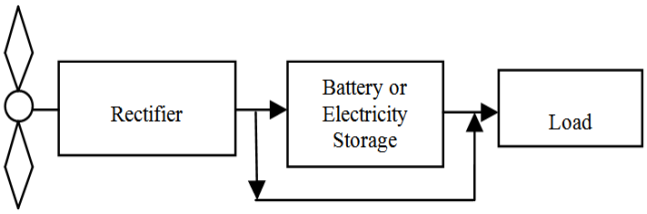

Fig. 3: Block diagram of windmill power system

4. HYBRID WIND AND SOLAR POWER SYSTEM

Wind-Solar hybrid Power system is the collective power generating system by wind mill and solar energy panel.

This system includes a battery which is used to store the energy generated from both the sources. In this system power is generated by windmill when wind source is available and from PV module when light radiation is available. In case when both units are available both sources can generate power. Fig. 4. Shows the basic block diagram of hybrid system

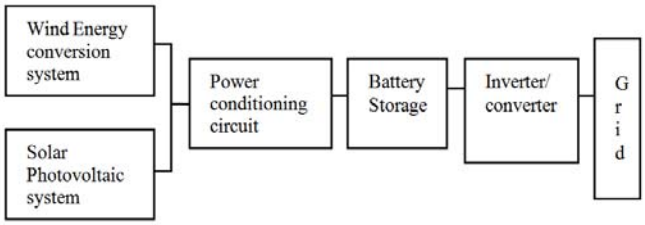

Fig. 4: Block diagram of hybrid Wind/PVsystem

5. SIMULATION & RESULT

A hybrid model comprises of PV system and wind power system is developed in Matlab/Simulink software. It consists of a wind turbine, a photovoltaic system and converters. Fig. 5 shows a model of hybrid system of wind and photovoltaic system.

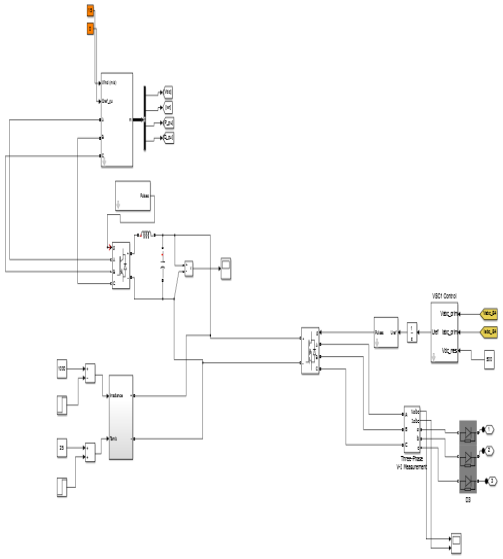

Fig. 5: Model of Wind and Photovoltaic Hybrid system

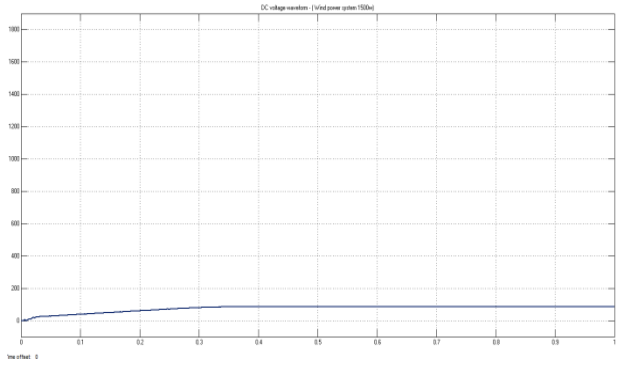

Fig. 6: Output of wind turbine

A wind turbine generates an ac output. This ac output voltage is converted into dc with the help of an inverter. PV system generates dc voltage at its output. Fig. 7 shows the combined irregular output of hybrid system.

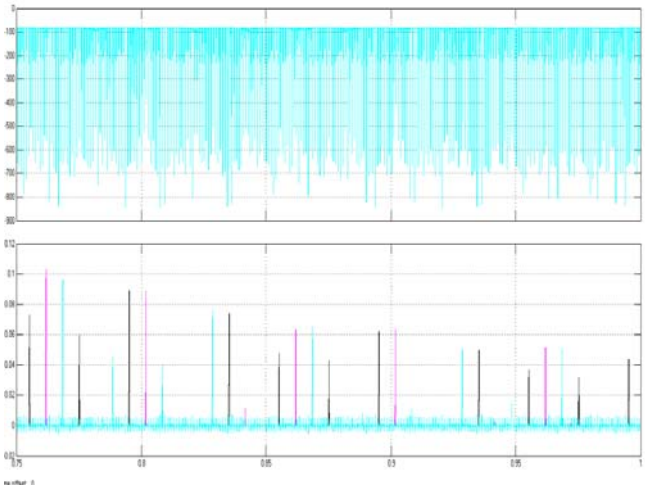

Fig. 7: Irregular Output of wind and hybrid system

6. MODEL OF GRID CONNECTED HYBRID SYSTEM

A model of grid connected hybrid system is developed in Matlab/Simulink software. Hybrid model connected to grid is shown in Fig. 8

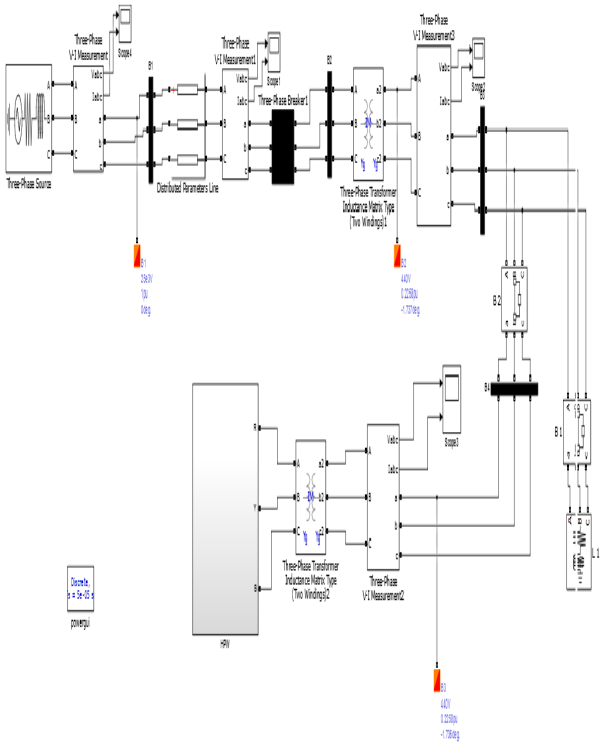

Fig. 8: Complete model of grid connected hybrid system

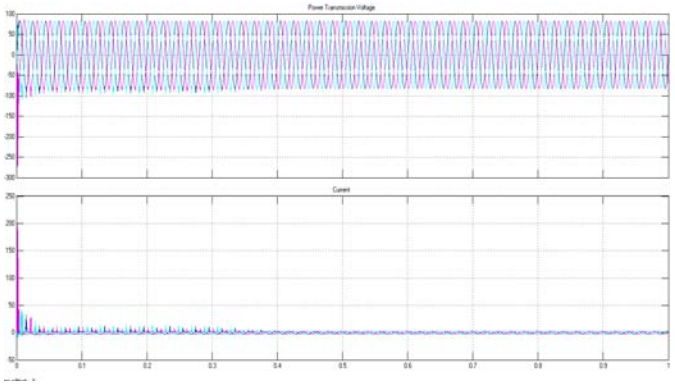

Fig. 9: Complete model output showing a regulated voltage and current supplied to the grid

7. CONCLUSION

In this paper a hybrid model of wind and solar photovoltaic system is developed in Matlab/Simulink environment. It has been shown that we obtained a continuous regulated power supplied to the grid as an alternative source of energy in a more reliable manner.

REFERENCES

[1] Karim Mousa, Hamzah AlZu'bi, Ali Diabat., " Design of a Hybrid Solar-Wind Power Plant Using Optimization", *IEEE Transactions on Software Engineering*, 25, 1, January 1999, pp. 91-121.

[2] Dihrab, S.S. And Sopian, K. "Electricity generation of hybrid PV/wind systems in Iraq", *Renewable Energy*, Vol. 35, pp. 1303-1307, 2010.

[3] Alejandro Rolan1, Alvaro Luna, Gerardo Vazquez, Daniel Aguilar and Gustavo Azevedo. 2009. Modeling of a Variable Speed Wind Turbine with a Permanent Magnet Synchronous Generator. IEEE International Symposium on Industrial Electronics. pp. 734- 39

[4] T. Salmi, M. Bouzguenda, A. Gagtli, "MATLAB/Simulink based modeling of solar photovoltaic cell," International journal of renewable energy research, vol.2, no.2, 2012

[5] Nabil A. Ahmed, Masafumi Miyatake, "A stand-alone hybrid generation system combining solar photovoltaic and wind turbine with simple maximum power point tracking control," IPEMC 2006, IEEE, 2006.

[6] M. G. Villalva, J. R. Gazoli, "Modeling and circuit based simulation of photovoltaic arrays," Brazilian power electronics conference (COBEP), 2009

[7] Marcelo Gradella Villalva, Jonas Rafel Gazoli, "Comprehensive approach to modeling and simulation of photovoltaic arrays," IEEE transaction on power electronics, vol.24, no.5, May 2009.

[8] Hiren Patel and Vivek Agarwal, "Matlab based modeling to study the effect of partial shading on PV array characteristics," IEEE transaction on energy conversion, vol.23, no.1, March 2008

[9] Eftichios Koutroulis, Kostas Kalaitzakis, "Design of a maximum power tracking system for wind-energy conversion application," IEEE Transaction on industrial electronics, vol. 53, no.2, April 2006