ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 8, Issue 6, June 2019

Modelling of High Altitude PV-Wind integrated System

A.Heymadri Narayanan

Undergraduate student, Department of Electrical and Electronics Engineering, Sri Venkateshwara College of Engineering, Sriperumbathur, Chennai, India

ABSTRACT: Among the renewable energy sources, solar and wind holds the major share. Lot of research is being done towards increasing efficiency, through changing materials and implementing new methods to extract higher energy. The proposed frameworks expect to reap higher efficiency at elevations higher than ground level by integrating solar panel systems to airborne wind turbine. This electrical energy is transferred down the tether for consumption, or to a set of batteries or the power grid. In this paper, we have simulated the simulink model of a High altitude PV-Wind hybrid airborne system and demonstrate utilization of this proposed framework, Parameters of the specific breeze plant like measure of Power age, Magnitude of prompt voltage and flows, level of vibration, Turbine speed, Humidity, irradiation and Temperature can be observed and utilized anyplace.

KEYWORDS: PV-Wind Hybrid,Airborne Wind Turbine(AWT), High altitude wind energy, High altitude solar energy, power electronics, power converters.

I. INTRODUCTION

Electric energy generation from fossil sources causes pollution and CO2 production. It also accounts to high expenses because of extensive interest and constrained assets. The only solution is to adopt elective sources that are inexhaustible, shoddy, effectively accessible, and feasible. In any case, current inexhaustible innovations have restrictions and that is why they haven't replaced fossil fuel technology completely yet. Among the renewable energy, solar and wind energy is very popular and is considered as a free and pollution less source of energy. In recent times, research in PV wind hybrid system has taken a spot light as the technology shows promises to replace the conventional thermal power plant system with effective integration to the electric grid and greater reliability[1]. In solar energy, high altitude, especially space solar power system, where solar plants set up in space generate electric power and focus the energy as light back to Earth, has been the focus of research as electric power upto 1GW can be obtained[2]. Being at high altitude provides higher wind energy as relation between wind speed and wind power is expressed by the following formula:

Wind power density = ($\rangle$ * v^3) / 2

Where $\rangle$ is the density of wind and v is the velocity of wind. As the wind velocity is higher with higher altitudes, the wind power density increases exponentially with height [2]. Also at higher altitudes, more radiations of higher frequencies can be utilized to produce greater electrical energy. Though the energy might not be comparable to that of space solar power system, the energy produced will be more than that produced at ground level for the given capacity. Also considering factors like climatic effects, clouds and dusts, being at considerable height will provide a greater reliability. Combining the High altitude airborne wind turbine and the high altitude solar space power system, we have deviced a hybrid method of generating high output electric energy. The block diagram of the described system is shown below in figure 1.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 8, Issue 6, June 2019

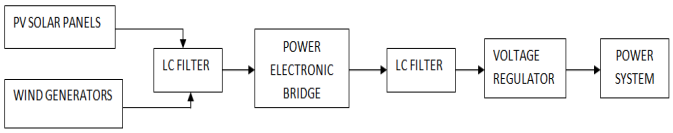

Fig.1 Block diagram of High altitude PV Wind system

II. LITERATURE REVIEW

As Airborne Wind Energy is an emerging branch of renewable energy. This branch of research in the relatively high altitude wind energy field that uses lot of aerial devices instead of conventional wind turbines to extract wind's kinetic energy, and convert this energy to electricity, the process is expensive and not many work takes place in the field. Major research in wind turbine takes place in US, Canada, Europe, China and Australia. Commercially, companies like WindLift in the US and NTS in Germany started working on air borne wind turbine which are majorly used to meet the electricity demands of military outposts. The startup company Joby Energy is founded in California, helps to create the Airborne Wind Energy Consortium (AWEC). Other firms like Makani Power, Sky Wind Power and KitGen are also exploring this region of the troposphere and Jetstream [3]. A lot of research has gone into the design of the structure of various wind turbine and the converter systems employed in them [4].

Japan Aerospace Exploration Agency (JAXA) has been conducting studies on space solar power systems (SSPS) using microwave and laser beams for years. JAXA is proposing a roadmap that consists of a stepwise approach to achieve commercial SSPS in 20-30 years[5].

III. PROPOSED SYSTEM

The proposed system namely consists of 2 systems, namely the power electronic system for airborne wind turbine and power electronic system for solar panel system. The irradiation falling on the solar cells provide electrical energy directly. The electrical energy is given to the LC filter of the power electronic system. The kinetic energy from the wind provides energy to wind turbine. The turbine, coupled with the generator produces electric energy. The electric energy is passed through rectifier of power electronic system.The main technical challenge tackled in this paper is the design of an efficient power converter system. The power converter design for low weight system and to provide a proper 3 phase sinusoidal output power that can be put to consumers use. The power from the generator is first passed through the rectifier to obtain a DC output. The ripples and harmonics *from both wind and solar system* are eliminated using an LC circuit. For conversion MOSFET based universal bridge is used. MOSFET is being utilized for switching of the fact that they're just utilized in "on" or "off" states, which has brought about their being the most generally utilized low-voltage switch. When contrasted with the IGBT, a power MOSFET has the upsides of higher commutation speed and greater efficiency during operation at low voltages *[6]*. For operation of universal MOSFET bridge, PWM technique pulse modulation is used. This is mainly used Duty cycle is expressed in percent, 100% being fully on. The main advantage of PWM is that power loss in the switching devices is very low *[7]*. The power supply is again passed through an LC filter to reduce harmonics. The electric energy is passed through a voltage regulator. The voltage regulator is designed for automatic voltage control of the electric power to maintain stability in the system despite of any oscillations. The voltage regulator is based on proportional controller as it will have the impact of decreasing the ascent time and will diminish, however never dispose of. When an integrator is added, the control signal is proportional to the integral of error and the integral gain Ki. The supply is given to a three phase RLC load *[8]*. The system has been modelled and simulated using simulink as seen in figure 2. The simulation output have been generated for a high altitude PV Wind power system.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 8, Issue 6, June 2019

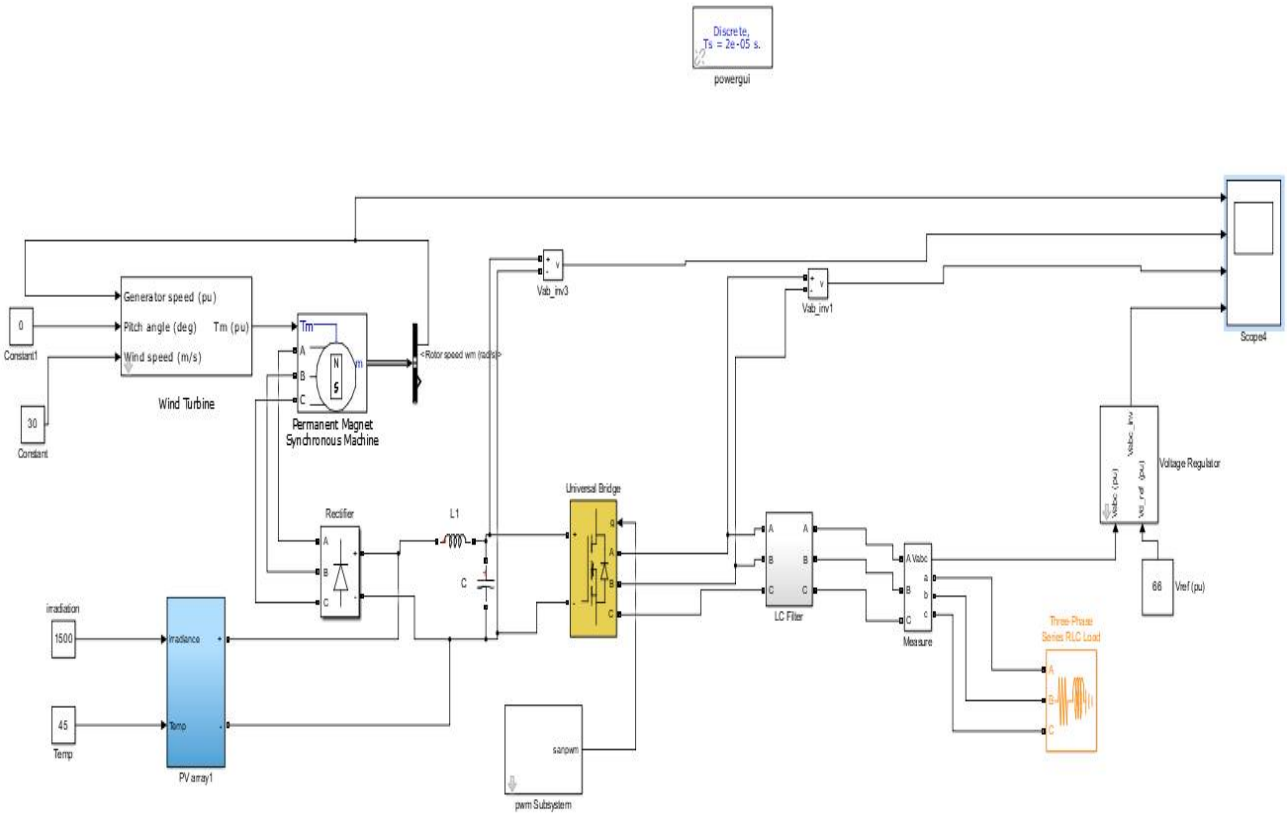

Fig 2. Simulation of conventional based Wind turbine

IV. RESULT

The proposed system has been simulated using Simulink. The image 3 represents the output waveform of the simulink architecture. Based on the MATLAB circuit design for the proposed system and simulation output, it is seen that the proposed power electronic system architecture provides stable power output by integrating both PV and wind energy. This hybrid system is capable of providing high energy output combining the advantages of both high altitude wind energy and high altitude solar energy system. Thus, the proposed MOSFET based converter, the PWM modulation technique and the PI based voltage controller helps in achieving a 3 phase sinusoidal output, with negligible ripples, which can used for commercial usage.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 8, Issue 6, June 2019

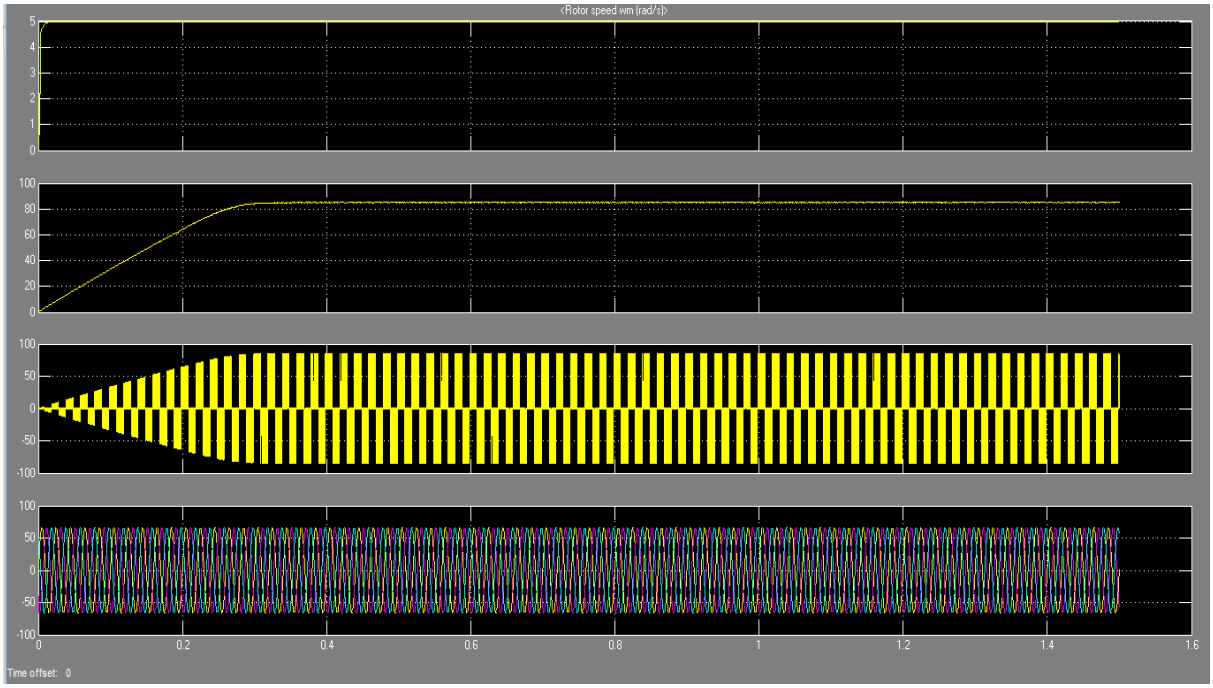

Fig 3. Output for Airborne Wind Turbine

V. CONCLUSION

Thus the proposed system of High altitude PV Wind system will be able to provide large energy output with minimum disturbance and large output. The proposed power electronic converter system will provide 3 phase sinusoidal output with negligible harmonics, which can be commercially used. The energy produced will be more than that produced at ground level for the given capacity. Also considering factors like climatic effects, clouds and dusts, being at considerable height will provide a greater reliability.

VI. FUTURE SCOPE

- Airborne wind turbines can used for telecommunication set-ups for effective signal transmission
- Automatic retractable system, effective MPPT tracking and effective monitoring will increase the output and bee helpful during need of maintenance and during harsh weathers.
- With development of solar cells that can produce energy based on high energy radiations like the UV radiation, the solar energy system will be able to generate higher output.

REFERENCES

[1] Al Badwawi, Rashid & Abusara, Mohammad & Mallick, Tapas. (2015). A Review of Hybrid Solar PV and Wind Energy System. smart science. 3. 127-138. 10.6493/SmartSci.2015.324.
[2] M. Oda, "Building a space solar power system," *Proceedings of 2nd International Conference on Recent Advances in Space Technologies, 2005. RAST 2005.*, Istanbul, Turkey, 2005, pp. 24-27.
[3] [2] Prathap, Vishnoo & K, RAJAN. (2016). Design And Analysis Of Airborne Renewable Energy System.
[4] Schmehl, Roland & Ahrens, Uwe & Diehl, Moritz. (2013). Airborne Wind Energy. 10.1007/978-3-642-39965-7.
[5] M. Mori and Y. Saito, "Summary of studies on space solar power systems of Japan Aerospace Exploration Agency," *2004 Asia-Pacific Radio Science Conference, 2004. Proceedings.*, Qingdao, China, 2004, pp. 608-.
[6] S. Jang, H. Ryoo, G. Goussev and G. H. Rim, "Comparative Study of MOSFET and IGBT for High Repetitive Pulsed Power Modulators," in *IEEE Transactions on Plasma Science*, vol. 40, no. 10, pp. 2561-2568, Oct. 2012
[7] Patel, Mahesh & Patel, Ankit & Vyas, Dhaval & M Patel, Ketul. (2009). Use of PWM Techniques for Power Quality Improvement. POSTER PAPER International Journal of Recent Trends in Engineering. 1. 99-102.
[8] Vivek Kumar Bhatt, Dr. Sandeep Bhongade" Design Of PID Controller In Automatic Voltage Regulator (AVR) System Using PSO Technique"
ISSN: 2248-9622, International Journal of Engineering Research and Applications, Vol. 3, Issue 4, Jul-Aug 2013, pp.1480-1485