International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 05 Issue: 08 | Aug - 2021 ISSN: 2582-3930

A Review paper on modelling of hybrid power system using solar power and fuel cell

Sudha Bala Gupta

Electrical Department ShriRam institute of technology, Jabalpur

---

Abstract - Electrical power demand is increasing throughout the world. Power generation from the conventional sources will not be an option in future because of fast consumption of fossil fuels. It is needed to shift the complete dependence from conventional to non-conventional source of energy like solar, wind, tidal, etc. Hybrid power system provides a provision to supply the power from two more different type of sources. This paper focuses on the view of modelling of hybrid solar power system comprises of a solar power and a fuel cell power. This model uses the solar panel as the main source of energy and in case of insufficient power generation, the power will be taken from the other power source such as fuel cell. The results obtained from the simulation are found satisfactory.

Key Words: hybrid power system, simulations, solar, fuel cell

1.INTRODUCTION *(Size 11, Times New roman)*

Power from the alternative source of energy will be the back bone of the power supply to various system because of the limited fuel resources and the effect of that on the environment [1]- [2]. The main advantage of the alternative source of energy is that they are pollution free, easily available and present in a very large amount with zero slope of consumption. An alternative source is a source that does not depends on the fossil fuel [3][4] or the nuclear actions [5].

Solar system depends on the sun rays to generate electricity. Solar power generation has seen a great improvement in the recent years. Three type of solar panel are used currently, mono-crystalline, poly-crystalline and amorphous thin film. The efficiency of Mono-crystalline solar panel is the highest [6]. It has been observed that the cost per watt peak of mono-crystalline is high as compare to amorphous and polycrystalline panels [6]. As the temperatures increases above 450 the efficiency of all the three types of panel becomes almost equal. In the region of higher temperature, amorphous solar panel is the best choice as it gives the same power with less cost per watt peak [6].

It has been estimated that by the year 2050, solar will provide the 45% of the total power requirement [7]. A fuel cell is a cell that converts a chemical energy to the electrical energy [8]. With the rapid advancement of the fuel cell, hydrogen based energy production is becoming more practical [9]. The combination of these two power source provides a sustainable power generation.

2. System Design

Hybrid power system is the best option to cater the global energy demand [10]. In the Hybrid power system, the power is taken from two or more than two different type of energy sources. Solar and Fuel cell together is a good option to form a hybrid power system. Different Mathematical model of hybrid power system has been developed using the MATLAB. Solar panel is used to be a main source of energy in such hybrid power system while the fuel cell is used as a secondary source of power. When the climatic condition change, solar panel may not provide the sufficient power to the load, under such condition, the power is taken from the backup source, which is a fuel cell [11]

The block diagram of the hybrid power system is shown below

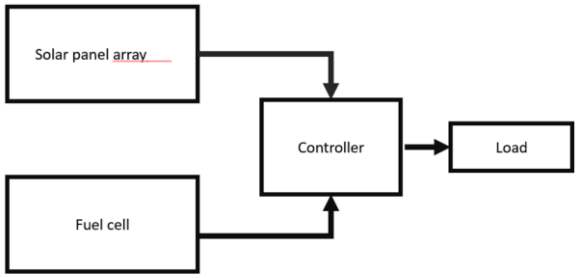


Figure 1 Block diagram of model

As shown in the block diagram, there are two sources of energy in the left side. Primary source of energy is the solar panel array and the secondary source of energy also known as a backup source of energy is the fuel cell. Controller control the power from the source to load.

When the climatic condition is favorable for the solar panel, controller connects the load to the solar panel. When the power coming from the solar panel is not sufficient, controller connects the load to the backup source.

The flow diagram of the controlling process is shown below

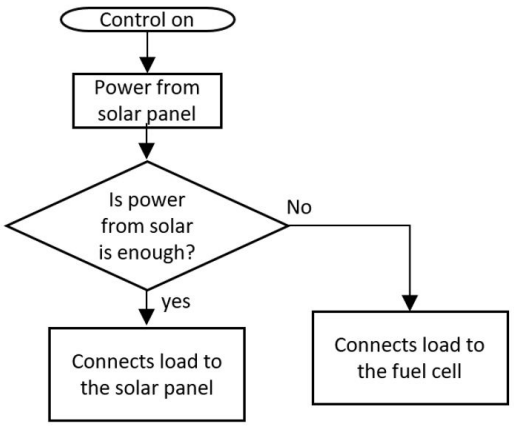


Figure 2 Flow chart of control action of controller

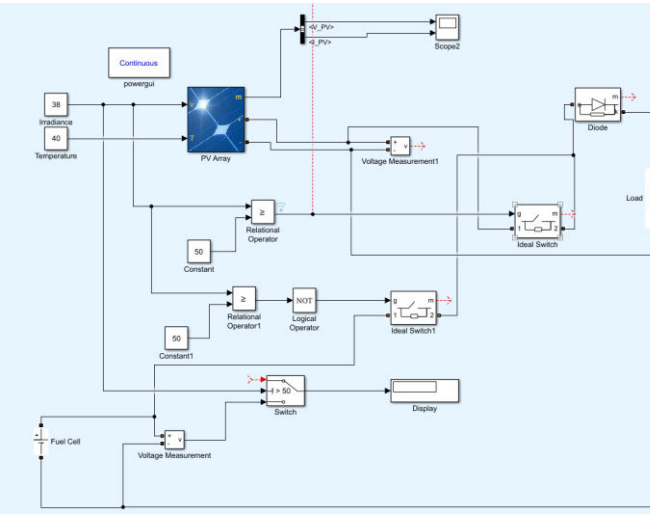
As shown in the diagram, as the control action starts, the controller compares the power of solar power to its set vale. If the generated power from solar is enough, the controller

connects the load to the solar panel. If the generated power from the solar panel is not enough, the controller disconnects the load from the solar panel and then connects the load to the fuel cel. Later on when the solar power becomes sufficient, the controller then disconnects the load to from the fuel cell and connects the solar panel to load. Controller switches back and forth, depending on the power generation from the solar panel.

2. Modelling of Hybrid power system

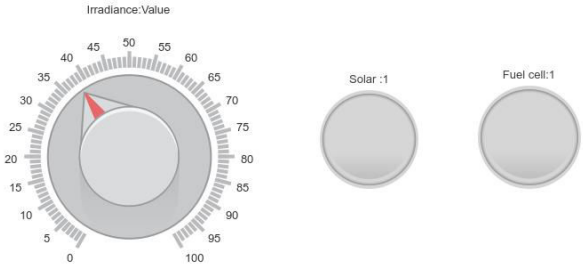
The hybrid power system model has been made in the MATLAB Simulink. Simulink is a tool in the MATLAB that has a large number of libraries in it. Each library has a function block that can be connected together to form an overall system [12].

The Simulink model of the developed hybrid system is shown below



As shown in the model, the PV (Photo-voltaic) array accepts the two parameter as the input Simulink signal.

One of the signal corresponds to the intensity of sun radiation and the other is the Temperature at which the PV array is operating. The Irradiance value for the PV array is mapped to a knob in Simulink model. Whether the load is connected to solar or the fuel cell, this status in mapped to two lamps in the Simulink model. The mapped knob and lamps are shown below.



4. Simulation Results

The voltage across the load have been given to the oscilloscope to view the switching from the solar power to fuel cell power. The output voltage from the solar panel have been set as 300V and the output voltage from the fuel cell have been set to the 100V to view the switching correctly. These values are editable in the model and the same model can be validated for different values of source voltages. The oscilloscope output is shown below.

As shown in the oscilloscope output, the switching is smooth. Before switching action took place, the load was accepting power from the PV array. As soon as the irradiance value is decreased by knob, the switching action took place and load starts accepting power from the fuel cell.

5. Conclusion

In this paper, hybrid power system based on the Solar power and the fuel cell is being reviewed. The modelling of the hybrid power system is done using the MATLAB. To simulate the condition of the varying sunlight intensity, the irradiance value has been mapped to the knob to visualize the real time effect on the load voltage. The simulation results obtained from the model are found to be satisfactory.

In the future, the tests can be conducted for different voltages values of the solar power and fuel cell power.

REFERENCES

[1] Carrasco, J. M., Franquelo, L. G., Bialasiewicz, J. T., Galván, E., PortilloGuisado, R. C., Prats, M. M.,& Moreno-Alfonso, N. (2006). Power-electronic systems for the grid integration of renewable energy sources: A survey. IEEE Transactions on industrial electronics, 53(4),1002-1016.

[2] Ganechari, S. M., & Kate, S. (2005). Alternative energy sources. Alternative Energy Sources, 5

[3] Crutzen, P. J., Mosier, A. R., Smith, K. A., & Winiwarter, W. (2016). N 2 O release from agro-biofuel production negates global warming reduction by replacing fossil fuels. In Paul J. Crutzen: A pioneer on atmospheric chemistry and climate change in the anthropocene (pp. 227-238). Springer, Cham

[4] Crutzen, P. J., Mosier, A. R., Smith, K. A., & Winiwarter, W. (2007). N 2 O release from agro-biofuel production negates global warming reduction by replacing fossil fuels. Atmospheric Chemistry and Physics Discussions, 7(4), 11191-11205

[5] Tsang, M. B., Friedman, W. A., Gelbke, C. K., Lynch, W. G., Verde, G., & Xu, H. S. (2001). Isotopic scaling in nuclear reactions. Physical Review Letters, 86(22), 5023

[6] A. A. Hossam El-din and C. F. Gabra, A Comparative Analysis Between the Performances of Monocrystalline,Polycrystalline and Amorphous Thin Film in Different Temperatures at Different Locations in Egypt-Conference paper 2014, ResearchGate

[7] Mekhilef, S., Saidur, R., & Safari, A. (2011). A review on solar energy use in industries. Renewable and Sustainable Energy Reviews, 15(4), 1777–1790. doi:10.1016/j.rser.2010.12.018

[8] A Mohapatra and S Tripathy 2018 IOP Conf. Ser.: Mater. Sci. Eng. 377 012135, A Critical Review of the use of Fuel Cells Towards Sustainable Management of Resources

[9] Midilli, A.; Ay, M.; Dincer, I.; Rosen, M.A. On hydrogen and hydrogen energy strategies. I: Current status and needs. J. Renew. Sustain. Energy Rev. 2005, 9, 255–271.

[10] Aditi and Dr. Ashok Kumar Pandey, A Review Paper on Hybrid Power System with Different Controllers and Tracking Methods, nternational Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 IJERTV5IS010022 www.ijert.org, Vol. 5 Issue 01, January-2016.

[11] Md. Habibur Rahman, Kamanashis Barua, Simulation of a Solar Power System with Fuel Cell backup Source for Hybrid Power System Application, 978-1-7281-1126-1/19/$31.00 ©2019 IEEE

[12] Modelling in MATLAB. https://www.mathworks.com/help/simulink/gs/create-a-simple-model.html