May-June 2020
ISSN: 0193-4120 Page No. 10628 - 10631

Design and Implementation of E-House with Photovoltaic-Wind Hybrid System for Smart Microgrid

Dr.G.Karthikeyan, Dr.D.Prasad, P.Kirubakaran
*Dr.G.Karthikeyan, Associate Professor. Department of EEE, Sona College of Technology, Salem 636005.
Dr.D.Prasad, Assistant Professor, Department of EEE, Sona College of Technology, Salem 636005.
*P.Kirubakaran, PG Scholar, Department of EEE, Sona College of Technology, Salem 636005.

Article Info
Volume 83
Page Number: 10628 - 10631
Publication Issue:
May - June 2020

Article History
Article Received*: 19 November 2019*
Revised*: 27 January 2020*
Accepted*: 24 February 2020*
Publication*: 18 May 2020*

Abstract:
A hybrid Renewable Energy sources (HRES) based on solar and wind energy system is designed in this work. The solar t model is formulated using 170 W PV panels which are connected in series. The wind plant is designed using PMSG motor and AC/DC conversion is carried out using an uncontrolled full-bridge rectifier. The output obtained from these plants are connected to a full bridge VSI. This inverter is controlled using SPWM topology. From the analysis, it is concluded that this proposed system produces a constant output voltage with reduced fluctuations.

Keywords*: REP, PV, Wind, SPWM*

INTRODUCTION

The usage of conventional fossil fuels like coal/natural gas results in increased production cost due to their declination and it also affects the cleanliness of the environment. Hence, to overcome this, the RES are now days utilized in power generation. Hence, more number of researches has been carried out so far in the utilization of RES for power generation. However, the RES are utilized in power generation, governments also issued energy policies over the utilization of RES [1,2].

Similarly, when compared to other electrical power generation system like thermal nuclear, the RES based system exhibits non-linear characteristics but they are pollution free generation. Keeping this view, all the countries in the world are moving towards RES. Among these various kinds of RES, PV and wind are generally used for power generation[17-19].

Ackermann et al said that distribution generator is the power source which can be directly connected to the consumer network [3]. Wind energy is utilized as an alternative source to PV. It can be utilized in high power requirement and it can be also operated in both islanded/grid connected mode.

PV plays a vital role in power generation, due its continuous availability and simplicity. All the RES are weather dependent. Hence, the power generated by the RES will vary according to the environmental condition [9,10]. Hence, by integrating the two or more RES together, the problem which occurs due to environmental conditional can be eliminated. Hence, the formulation of hybrid RES is an excellent work in distributed energy generation[11-15].

Thus, the combination of 3 PV configurations [4] is carried out. They are of rated power 15 KWs. The conversion system is done by the buck converter with P&O algorithm. From the result, it is found that the stability of the system is assured by the converter.

The Simulink model of hybrid wind and solar system was modeled. In this study, a novel topology is implemented to control both the systems and reduces the environmental effects [16].

May-June 2020
ISSN: 0193-4120 Page No. 10628 - 10631

The fuel cell and ultra-capacitor model has been introduced to supply energy to the loads during the absence of wind/ solar system [5] and to store the excess energy produced by this system.

A hybrid wind/solar system in islanded mode is formulated. In this system, so as to ensure the flow continuity to the consumers, a battery band along with a diesel generator is added. But when a dump load is connected, the battery should be full charged. This is the major drawback. Thus the dump load indirectly controls the charging of battery. This increases the life time of battery [6].

A hybrid system formulated using fuel-cell and wind turbine can also be controlled using controller. A fuzzy PI controller formulated in this work controls the harmonics produced in the system. From the results, it is proven that this proposed controller reduces the THD to about 5% according to international standard [7].

Hybrid system with wind, PV and FC along with diesel generator and battery is modeled. Due to band variation in wind speed and variation in irradiation in solar. there will be fluctuations in the output power. Hence, UC is implemented as an alternative storage element. Then, PI controller is instigated to improve the deviations raised due to frequency conditions [8]. From the analysis, it is seen that the frequency deviations are alleviated using the proposed controller. Hence, in this work, to improvise the performance of the hybrid RES system, it formulates a hybrid PV and wind system.

In this work, a distributed generation system is designed by modelling a solar energy plant and a wind turbine model in Simulink. The designed model is comprises three main subsections

- Solar energy plant,
- Wind energy conversion system
- DC/AC conversion Unit.

This proposed HRES is analysed in terms of design and analysis and are discussed in the following section.

II. HRES design

The proposed HRES consists three parts;

(i) WECS with PMSG wind turbine generator and uncontrolled full bridge rectifier.
(ii) PV system containing PV panels, MPPT with Boost converter
(iii) SPWM controlled VSI.
Thus the structure of the proposed HRES is shown in Fig. 1.

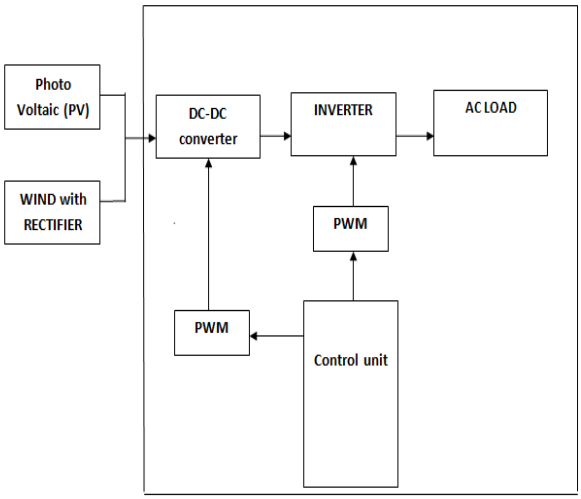

Figure 1. Topology of proposed HRES.

PV panels

PV cells are made from semiconductor materials and it has the ability to convert sunlight directly into electrical energy. Thus the electrical circuit model of PV comprises a current source, diode and resistors as shown in Figure. 2. It elucidates the state of the simplified equivalent circuit of PV.

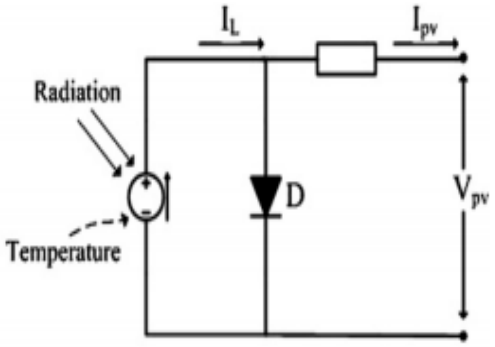

Fig. 2. PV cell- simplified circuit.

Wind energy conversion system

A WECS transforms the wind power into electricity through an electromechanical energy

May-June 2020
ISSN: 0193-4120 Page No. 10628 - 10631

conversion. Whenever the load impedance matches with generator, the PMSG generates maximum power at constant rpm. The AC voltage generated by the PMSG is rectified into DC using an uncontrolled diode rectifier. In the study, a 2 kW PMSG model is designed for WECS.

Full Bridge Inverter (VSI)

The major part of this conversion unit is the DC/AC VSI. This proposed work utilizes 3 phase VSI controlled using SPWM topology for AC conversion.

III. SIMULATION RESULTS

The efficiency of the proposed HRES is analysed using a simulation carried in MATLAB. Thus the AC output of wind turbine is converted to DC using an uncontrolled full bridge rectifier. The DC output obtained from the rectifier is shown in Fig. 3a.

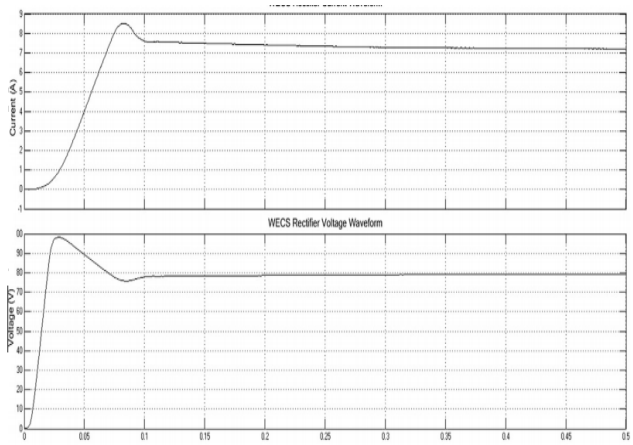

Fig 3. WECS rectifier current and voltage.

From the figure, it is found that the proposed system stabilises the current and voltage of WECS.

The current and voltage output of the PV panel is depicted in Fig. 4. From this, it is observed that the stabilised output waveforms represent the efficiency of the proposed topology.

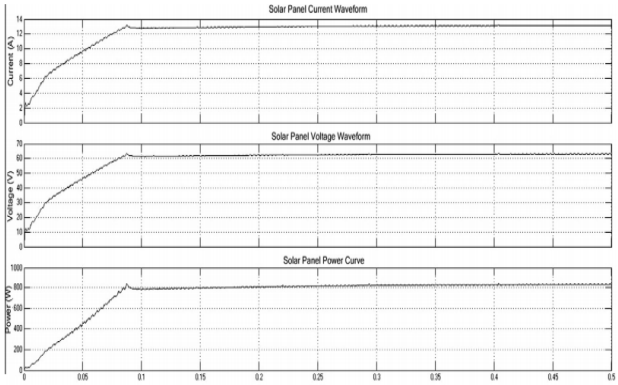

Fig 4. solar plant current, voltage, and power

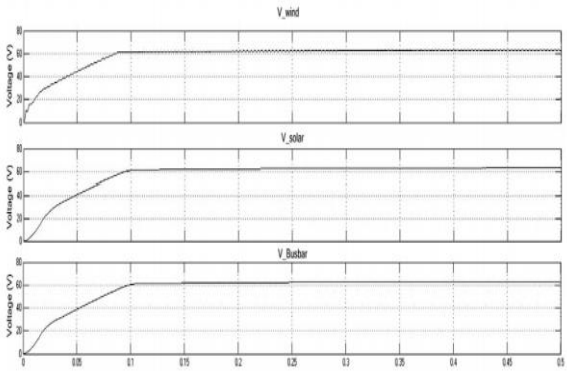

Fig. 5. Output voltages of wind, solar and bus-bar voltage

The stabilised DC voltage levels of wind turbine, solar panel and bus-bar are shown inn Fig. 5. The total DC voltage obtained from bus bar is applied as an input to the VSI.

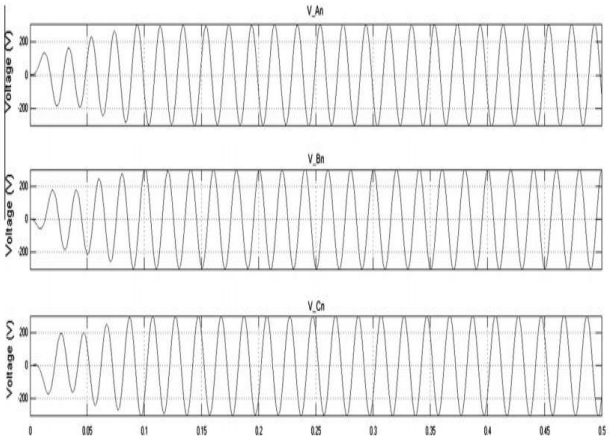

Fig 6. The phase voltages of HRES

The output phase voltage of VSI is depicted in Fig. 6. From the figure, it is concluded that the proposed system produces the balanced output voltage to the load. Hence, from all these analysis, it is concluded that the proposed system exhibits a

May-June 2020
ISSN: 0193-4120 Page No. 10628 - 10631

stable output by ignoring the change in environmental conditions.

IV. CONCLUSION

This work described a HRES with solar and wind energy sources. They are modelled together to build a distributed generation system. The DC bus bar connection improves the stability of the energy conversion. This can be extended by adding FC, UC, diesel generator in future works.

REFERENCES

1. Figueiredo J, Martins J. "Energy production system management – renewable energy power supply integration with building automation system". Energy Convers Manage 2010;51(6):1120–6.
2. Ozgener O. "A small wind turbine system (SWTS) application and its performance analysis". Energy Convers Manage 2006;47(11–12):1326–37.
3. Ackermann T, Andersson G, Soder L. "Electricity market regulations and their impact on distributed generation. In: Proc int conf on electric utility deregulation and restructuring and power technologies". London (UK); 2000.
4. Çolak I, Kabalcı E, Bal G. "Parallel DC–AC conversion system based on separate solar farms with MPPT control". In: Proc IEEE 8th int conf on power electronics. Jeju (Korea); 2011.
5. Chen H, Qiu J, Liu C. "Dynamic modeling and simulation of renewable energy based hybrid power systems". In: Proc DRPT. Nanjing (China); 2008.
6. Hirose T, Matsuo H. "Standalone hybrid wind-solar power generation system applying dump power control without dump load". IEEE Trans Indust Electron 2011;59(2):988–97.
7. Guo Z, Lee KY. "A self-adaptive fuzzy PI controller of power conditioning system for hybrid fuel-cell/turbine power plant". In: Proc North American Power Symposium (NAPS).
8. Ray PK, Mohanty SR, Kishor N. "Proportional–integral controller based smallsignal analysis of hybrid distributed generation systems". Energy Convers Manage 2011;52(4):1943–54.
9. Vlad C, Munteanu I, Bratcu AI, Ceanga E. "Output power maximization of lowpower wind energy conversion systems revisited: possible control solutions". Energy Convers Manage 2010;51(2):305–10.
10. Ambia MN, Islam K, Shoeb A, Maruf NI, Mohsin ASM. "An analysis and design on micro generation of a domestic solar-wind hybrid energy for rural and remote areas – perspective Bangladesh". In: Proc 2nd int conf on mechanical and electronics engineering. Kyoto (Japan); 2010.
11. Ruisheng L, Bingxin W, Fengquan Z, Yanbin L. "Design of wind-solar and pumped-storage hybrid power supply system". In: Proc 3rd int conf on computer science and information technology. Chengdu (China); 2010.
12. Sharp NE-170UC1 multipurpose module. Sharp: USA; 2008. [04.06.12].
13. Serban I, Marinescu C. "A sensorless controller method for variable-speed small wind turbines". Renew Energy 2012;43:256–66.
14. Tankari MA, Camara MB, Dakyo B, Nichita C. "Ultracapacitors and batteries integration for power fluctuations mitigation in wind-PV-diesel hybrid system". Int J Renew Energy Res 2011;1(2):86–95.
15. Muyeen SM, Al-Durra A, Tamura J. "Variable speed wind turbine generator system with current controlled voltage source inverter". Energy Convers Manage 2011;52(7):2688–94.
16. Wood D. Small wind turbines, analysis, design and application. London: Springer; 2011.
17. Patel MR. Wind and solar power systems: design, analysis, and operation. 2nd ed. USA: CRC Press; 1999.
18. Colak I, Kabalcı E. "Practical implementation of a DSP controlled multilevel inverter with low THD for motor drive applications". J Power Sources 2011;196(18):7585–93.
19. IEEE Standard 519-1992. Recommended practices and requirements for harmonic control in electrical power systems. USA: The Institute of Electrical and Electronics Engineers; 199