ISSN: 2583-5637 (Online)

International Journal of Inventive Research in Science andTechnology Volume (3), Issue (2), February 2024

SOLAR/WIND HYBRID POWER SYSTEM A REVIEW

Anshu Anand[1], Dr Anula Khare[2]

[1]M.Tech Scholar, Department of Electrical and Electronics Engineering, Technocrats Institute of Technology, Bhopal, India

[2]Professor, Department .of Electrical & Electronics Engineering, Technocrats Institute of Technology ,Bhopal, India

ABSTRACT

The power electronics converters (PECs), which are the primary control component for combining a variety of resources into a micro grid, serve as a basis for the new renewable energy-based power system. This Paper presents a PV/wind system interface and uses a power converter to link a hybrid PV/wind system to grid. Based on the load's voltage and harmonic content, the integral power converter topology employs various generators and control strategies to supply the load. The analysis of the solar power and WPGS interface is the primary goal of the findings is to regain grid attributes. The grid Values and the PV/Wind hybrid system Values can both be controlled by the same controller. Consequently, the movement of real and reactive power at PCC becomes smooth.

KEYWORDS: *Alternative Energy Sources (AESs) Permanent Magnet Synchronous Generator (PMSG), Pointof Common coupling(PCC), power electronics converters (PECs), solar generation, Wind generation.*

1. INTRODUCTION

The majority of AESs are dependent on their environment, hence they have unpredictable and changing properties. However, their environmental friendliness makes them very popular for power generation in the current, severe global warming crisis. The typical low efficiency of AES as compared to traditional generating indicates another huge obstacle to its widespread adoption. In order to integrate various sources And create a hybrid system that is more dependable and sustainable, a promising technology is needed [1].

The appropriate option is the integration of several AESs with one another and with PECs in utility systems [4,5],the new fields of research that is expanding the possibilities for simple, effective, and reason able power generation and utilization of AESs is the fast growing in the technology of PECS for integrating AESs as compared to traditional power sources [2, 3].

The most potential AES as a green energy supplement are wind and solar. They are rapidly becoming the green energy sources that can meet the fast changing demand for energy and have much smaller carbon footprints than conventional energy sources. Although being in high demand, solar and wind power each have their own disadvantages. Specialized equipment is needed to tackle this intermittency because the electricity generated by AES, notably PV and wind, changes with external factors like solar irradiation and wind speed. Typically, all of the available AES generates DC power, and to improve the efficiency and optimize the power created, control mechanisms known as Maximum Power Point are used at the AES side.

ISSN: 2583-5637 (Online)

International Journal of Inventive Research in Science andTechnology Volume (3), Issue (2), February 2024

This research provides a PV/wind system interface and uses a power converter to connect a hybrid PV/wind system with the grid. Multiple generators and control strategies are used by the integrated power converter topologies to supply the load according on its voltage and harmonic content.
The assessment of the solar power and WPGS interface is the main objective to regain grid properties. The grid properties and the PV/Wind hybrid system parameter can both be controlled by the same controller. Thus, the real and reactive power flow at PCC becomes smooth.

THE PROPOSED PV/ WIND HYBRID SYSTEM

In this work, a hybrid system is designed using renewable sources of solar and wind energy. it is designed to be an integrated network that can provide a local load as well as a feed into the network. PV and WPGS developed for power generation have the conceptual architecture shown in Figure-1. The PV system is capable of generating 1 MW and the wind system is capable of generating 0.3 MW.

In this study, WPGS is designed using a permanent magnet synchronous generator (PMSG). In PMSG, the excitation field is generated using PM, synchronous is a term for the system in which the rotor and magnetic field rotate at the same speed. The PMSG produces AC output but it is not fully synchronized with the grid. Therefore, the AC output is first converted using a rectifier, then it is boosted to the required voltage, then an AC-DC converter is installed to synchronize the output. of WPGS with utility system. The PV system produces DC output that is boosted directly to the required level and integrated into the grid by connecting an AC-DC converter. The hybrid system is modeled so that both PV and WPGS systems give constant output on the AC side at all different wind speeds and solar irradiance. This is the most important task when designing PVW systems because they are discontinuous in nature and their output varies with different environmental conditions. Another aspect of the PVW system is that it must exhibit uniform and constant characteristics compared to to utility system at PCC

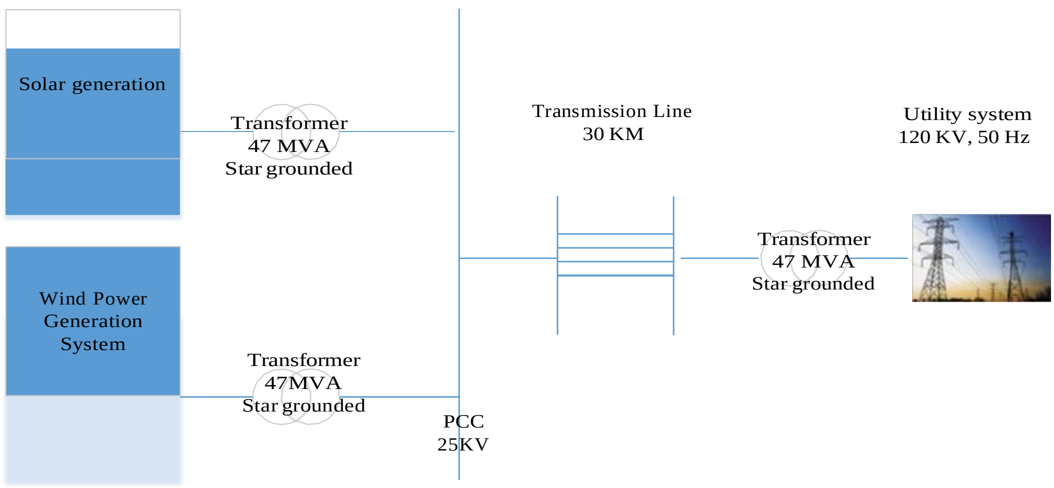

Fig. 1 Typical configuration of the proposed hybrid system.

ISSN: 2583-5637 (Online)

International Journal of Inventive Research in Science andTechnology Volume (3), Issue (2), February 2024

2. THE MODELLING OF PV SYSTEM

Photovoltaic power plants are designed using a parallel combination of photovoltaic modules. In this construction, 70 parallel and 45 series series are connected to generate 1 MW solar power output. The P-V and V-I characteristics for the varying temperature are shown in Figure 2. The variable DC output produced by the PV system is monitored using the MPPT algorithm. In this work, incremental MPPT and conductance (IC) are used to pulse the gate for the DC-DC boost converter to stabilize the solar DC output under different environmental conditions in terms of radiation. radiation and temperature, as shown in Figure 3. Figure 4. Shows the DC output of the step-up converter. The up-converter receives input from solar power generating approx. 2000 V DC and step-up converter produces approximately 3000 V DC output. The step-up converter DC output is fed to the 5-level Neutral point clamped MLI

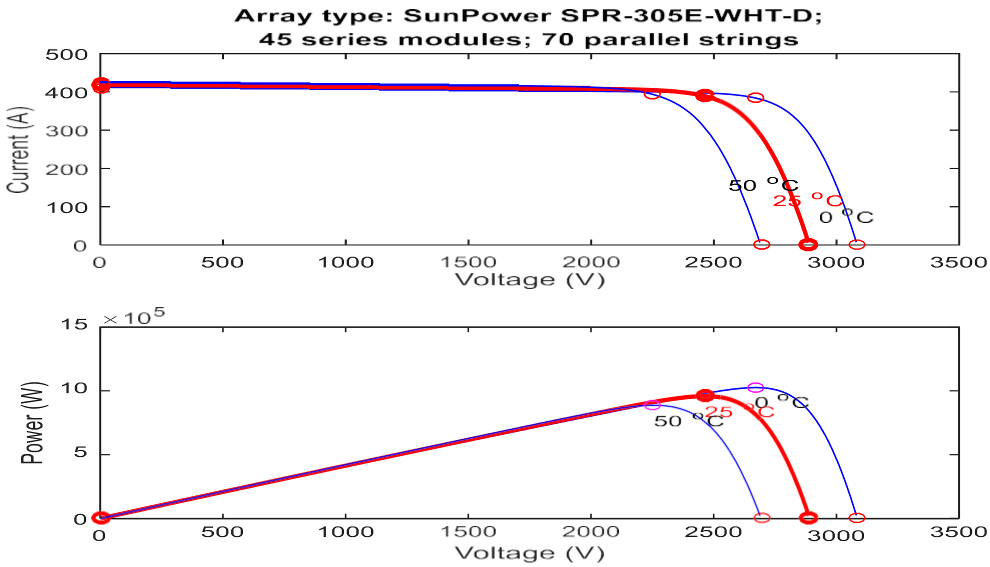

Fig. 2 V-I and P-V characteristics curve of the PV system

ISSN: 2583-5637 (Online)

International Journal of Inventive Research in Science andTechnology Volume (3), Issue (2), February 2024

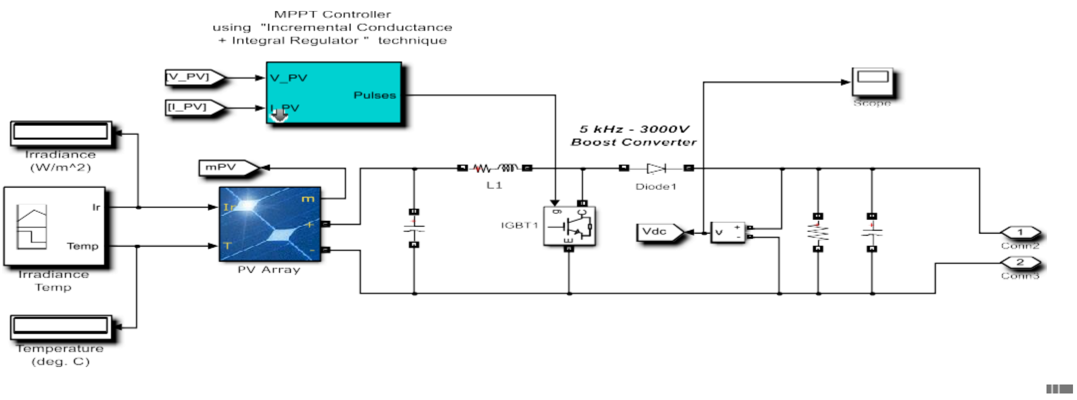

Fig.3 Simulation model of the PV system

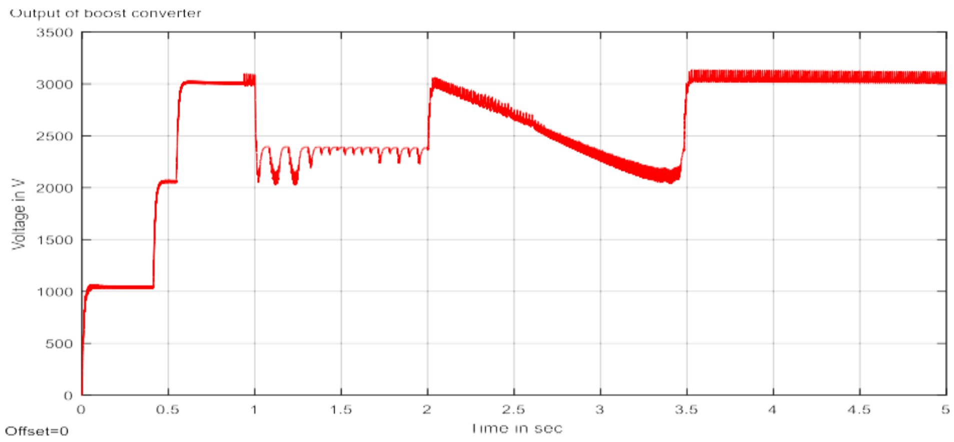

Fig. 4 DC output of boost converter

ISSN: 2583-5637 (Online)

International Journal of Inventive Research in Science and Technology Volume (3), Issue (2), February 2024

3. SIMULATION MODEL OF WIND SYSTEM

In the proposed PV/W hybrid system, wind power generation system & # 40; WPGS & # 41; designed using a permanent magnet synchronous generator as shown in Figure 5. To generate synchronous output for grid connection, an AC-DC-AC converter is used on the WPGS. In WPGS, ICMPPT is also used to activate the IGBT connected in the boost converter. The DC output obtained from the boost converter is synchronized to the grid using a PLL and PI based AC converter

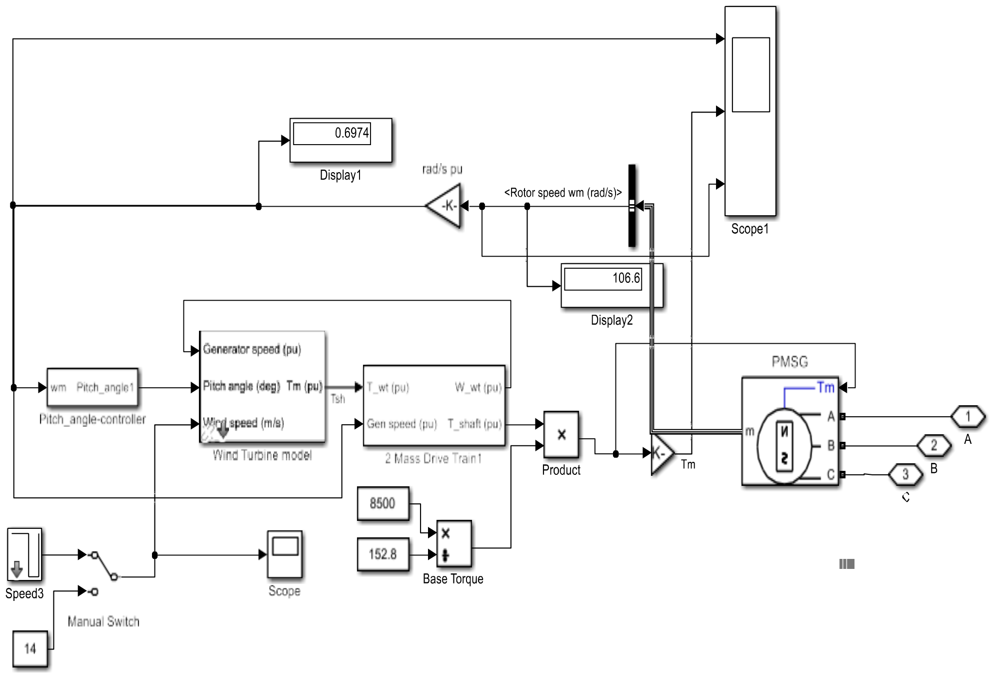

Fig. 5 Simulation Model of Wind system

ISSN: 2583-5637 (Online)

International Journal of Inventive Research in Science and Technology Volume (3), Issue (2), February 2024

4. PV/WIND HYBRID SYSTEM

Generator identification, integrated system topology, and control computing are practical issues when using these sustainable energy sources. Researchers are developing a variety of technologies to integrate many types of sustainable sources and perceive their operation in grid-tied and off-grid modes. Efficient controller design is imperative for hybrid systems for an efficient interface of power conversion and controller circuit strategies to meet the load demands and maintain high power quality of the distribution system. distribute. The complete simulation model of the system design is shown in Figure 6. The output voltage and current configuration of the proposed NPC-5 level PWM shows that the system is synchronized at the PCC to the grid. , Figures 7 and 8 show the output voltage and current to the PCC when the PV/W hybrid system is grid integrated. From the data, it is observed that the system designed to be fully synchronized with the network has also been verified by THD analysis at PCC as shown in Figures 9 and 10. The system was analyzed for solar irradiance changes and wind speed to test the effect. of the proposed controller. THD analysis of voltage and current at PCC is also presented in the proposed work. The design parameters of the simulation system are presented in Table 1.

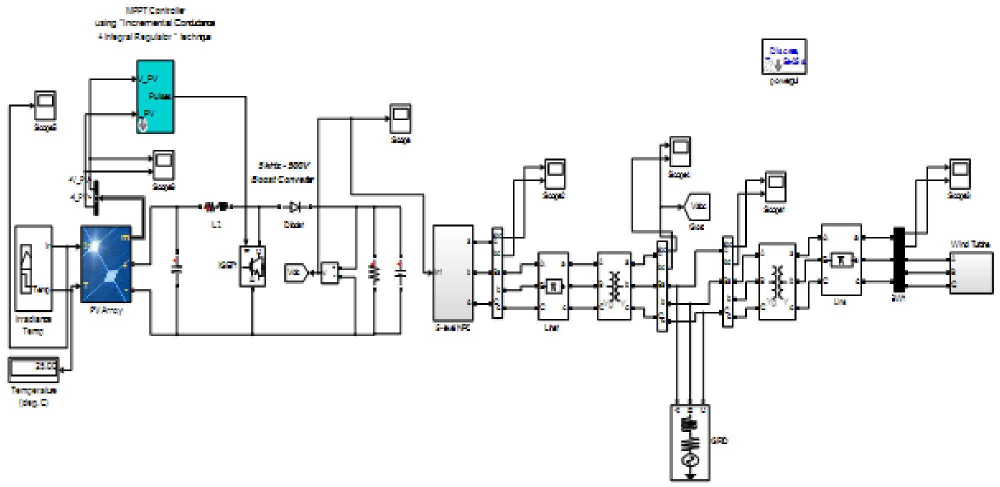

Fig.6 Simulation model of the grid connected PV/W hybrid system

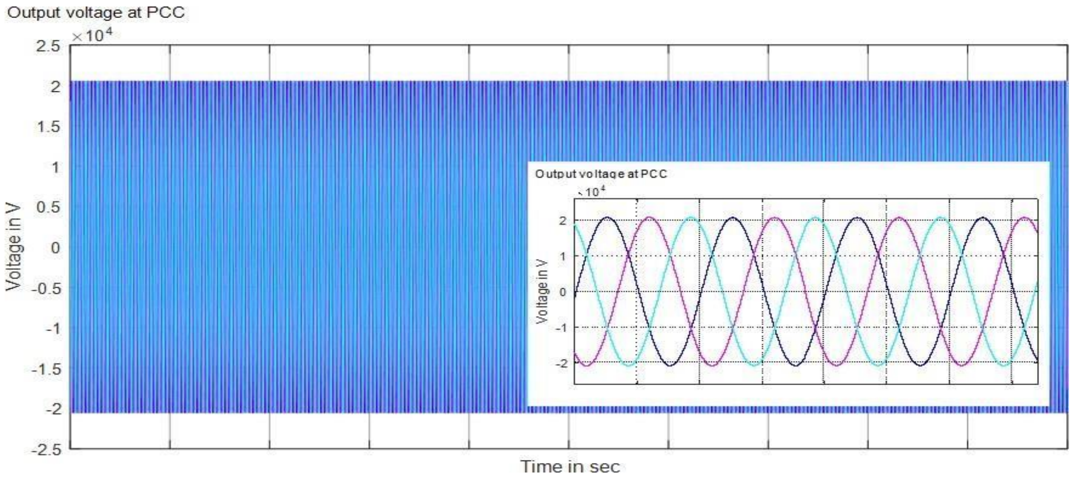

Fig.7 Grid voltage at PCC

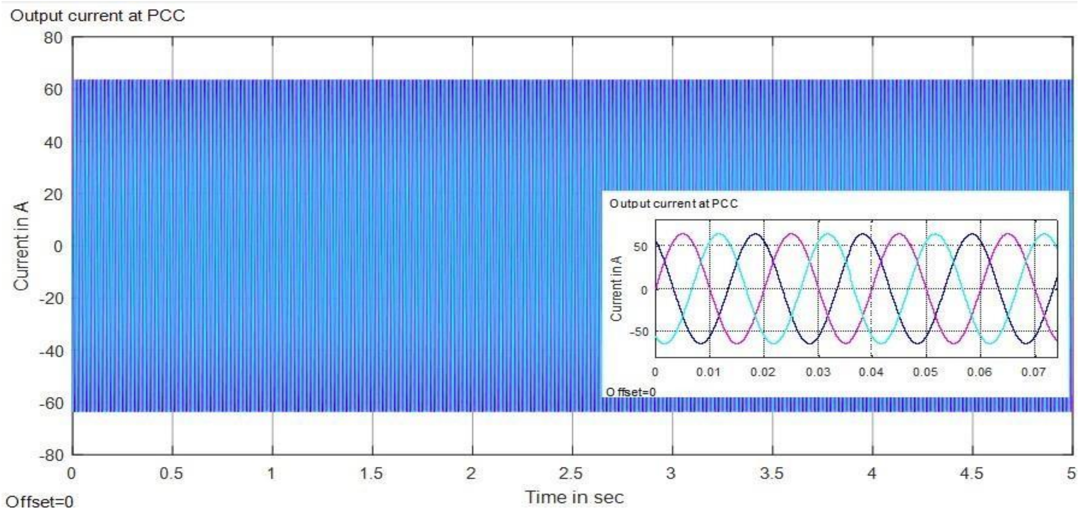

Fig.8 Grid current at PCC

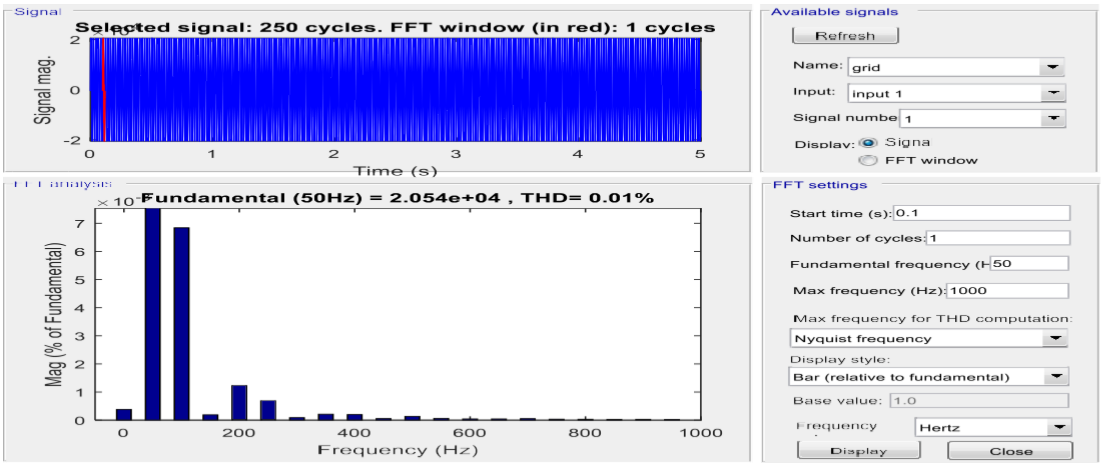

Fig.9 THD analysis of the voltage at PCC

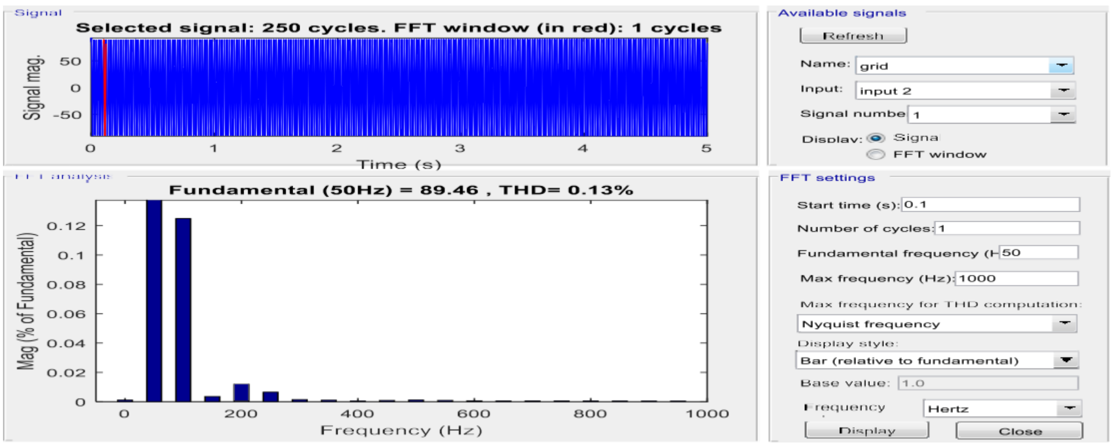

Fig. 10 THD analysis of the current at PCC

Table 1. Design parameters

Parameter	Value
PV rating	1 MW
DC voltage output	3000 V
switching frequency	5kHz
Boost converter inductor	150mH
Boost converter capacitor	100µF
Filter inductance	100mH
Filter resistance	0.01 ohm
Filter capacitance	1000 µF
Output voltage of DC/AC inverter	25KV
Output current of DC/AC inverter	60A
DC voltage of WPGS	9 KV
AC voltage of WPGS	200V
Rating of WPGS	0.8 MW
Voltage at PCC	25KV

5. CONCLUSION

In the discussed system, both PV and WPGS give constant output on both the DC side and the AC side at any variable wind speed and solar irradiance. THD at PCC for voltages is 0.01% and 0.13%, as per with the grid code regulations. Furthermore, the discussed topology provides a constant output for the PV system with variable irradiance and for the WPGS system with variable wind speed. In addition, when these systems are integrated, they also produce a constant output for both voltage and current to the PCC. System has been analyzed for a constant static three phase loading.

REFERENCES

[1] Puneet Raj ,Kirti Patel " Stand Alone PV system for with Battery Backup for Domestic Purposes" Wesleyan Journal of Research vol 14, 2022

[2] H Sabry,Wan Juha,Wan Hasan "Stand-alone backup power system for electrical appliances with solar PV and grid options" in Indonesian Journal of Electrical Engineering and Computer Science,February 2021

[3] Ayas Shaqor,Hooman Faraneh"Power control and simulation of a building integrated stand-alone hybrid PV-wind-battery system" Elsevier Energy Reports Volume 6, February 2020.

[4]Noureldeen, Omar, and Ahmed MA Ibrahim. (2018, February). Modeling, implementation and performance analysis of a grid-connected photovoltaic/wind hybrid power system. In 2018 International Conference on Innovative Trends in Computer Engineering (ITCE) (pp. 296-304). IEEE.

[5]H. Laabidi and A. Mami, (2018). Grid connected Wind-Photovoltaic hybrid system. 2015 5th International Youth Conference on Energy (IYCE), pp. 1-8.

[6] A.Moualdia, MO. Mahoudi, L.Nezli, O. Bouchhida, oualdiaAbdelhafidh, “Modelling and Control of a Wind Power ConversionSystem Based on the Double-Fed Asynchronous Generator”, Vol.2, No.2, 2016, International Journal of Renewable Energy Research.

[7] R. Benadli and A. Sellami, (2014). Sliding mode control of a photovoltaic-wind hybrid system. 2014 International Conference on Electrical Sciences and Technologies in Maghreb (CISTEM), pp. 1-8.

[8]A. Parida and D. Chatterjee, (2016). Cogeneration topology for wind energy conversion system using doubly-fed induction generator. IET Power Electronics, vol. 9, pp. 1406-1415.

[9] Caroline de Oliveira Costa Souza Rosa, Kelly Alonso Costa, Eliane da Silva Christo and Pâmela Braga Bertahone, “Complementarity of Hydro, Photovoltaic, and WindPower in Rio de Janeiro State”, journal ofsustainability, 29 June 2017.

[10] Martinez, J. A., Dinavahi, V., Nehrir, M. H., &Guillaud, X. (2011). Tools for analysis and design of distributed resources—Part IV: Future trends. IEEE Transactions on Power Delivery, 26(3), 1671-1680