International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 9 Issue 7 ǁ 2021 ǁ PP. 04-08

A Recent Approach on Renewable Energy Based Modeling and Control of Three Phase Hybrid – Microgrid System

AuthorVinay Kumar Dewangan[1], Mr.AbhijeetLal[2]
*[*1]M. Tech scholar,Dept of EEE,Bhilai Institute of Technology ,Durg,Chhattisgarh ,India,*
[2]Assistant Professor,Dept of EEE, Bhilai institute of Technology,Durg, Chhattisgarh, India.

Abstract
Renewable energy-based on distributed generators (DGs) presents an imperative role in electricity production, with the increase in global warming. There are a lots of renewable energy like, biomass, solar,wind energy, hydro energy, which can be uses as Distributed generation, fuel cells and micro-turbines can be implemented to avail notable energy shortly. Distributed generator has more advantages & popular in modern day due to their flexibility expandability, and adaptability. Distributed generation provides several renewable and nonconventional small sources, well plan for configuring modern electrical grids. A micro-grid formed bygroup of loads and distributed generators that workas a single controllable system. The microgrid concept proposes the reduction of multiple reverse conversions in an individual AC or DC grid and also expedites connections to variable renewable AC and DC sources and loads to power systems. The inter-connection of DGs to the grid help to power electronic converters has risen concerned about properworking and protects the pieces of equipment. To the customer, the microgrid can be premeditated to meet their particular requirements, such as enhancement of local reliability, reduction of feeder losses, local voltages support, increased efficiency through the use of waste heat, improvement of voltage sag, or uninterruptible power supply. In the present period, the working performance of a hybrid AC-DC micro-grid system is observed in the grid-tied mode. Here photovoltaic system, wind turbine generator, and battery are used for the development of microgrid. Also, control equipmentareused for the converters to operate the AC sub-grid to DC sub-grid properly.

Keywords: *Pulse width Modulation (PWM),Hybridmicrogrid, Solar Photovoltaic***.**

Date of Submission: 29-06-2021 Date of acceptance: 13-07-2021

I. INTRODUCTION

Since the growth in technology and change in the life style of humanity, the power demand at the load center has enhanced to a greater extent. With the population growth economy boost, the requirement of energy resources is growing fast, consequence a lots of problems such as energy shortage, environmental pollution, and ecology deterioration. Making full use of renewable energy and achieving sustainable economic development has become a consensus among all countries in the world. In all sorts of renewable energy, wind power and solar energy are used most widely. Due to the instability of wind energy, it has a significant effect on the safe operation of the power grid. The micro-grid concept acts as a solution to the problem of integrating large amounts of micro generation without interrupting the operation of the utility network. The net micro-grid could even provide ancillary services such as local voltage control. In the cause of suffering on the leading system, micro-grids able to potentially disconnect and continue to operate separately.

II. LITERATURE SURVEY

In recent years, the power system has been an exciting topic and there have been many grids schemes proposed. The demand for renewable energy has risen significantly over the years due to the shortage of fossil fuels. Also, the need for pollution-free green energy has created a keen interest in renewable energy sources. Solar energy is the most natural and sufficient renewable energy source to meet the rapidly increasing energy requirements [1]. The maximum power from the solar PV array is to be tracked for its efficient implementation. Many algorithms are available in the literature for tracking maximum power from solar panels. In this paper, Perturbation and Observation, the algorithm is considered due to its simplicity. A boost converter is used to perform the maximum power point tracking algorithm [2]. The output power generated from the solar panels is periodically and transforms with the irradiance level. Hence to make the system more stable, a battery is included in the system. A bidirectional converter is also used to control the power flow from and into the battery [3]. Since the inverter is used in a PV system, a proportional-integral (PI) controller scheme is employed to preserve the output current sinusoidal and to control the power factor unity and to have a high dynamic

appearance under rapidly changing atmospheric conditions. Simulation results are providing to verify the offered control system.

III. PROPOSED METHODOLOGY

The block diagram of the suggested architecture photovoltaic in Fig. 1.With help of a boost converter three-phase inverter take the inputof the output of the solar panel. The switching pulse generated from the MPPT algorithm provides to boost converter. The power from the battery is given to the single-phase inverter through a bidirectional dc-dc converter so that power flow through either direction can be controlled. The grid voltage is sensed using a PLL, and the grid current and the reference current are compared using a comparator, and the output of the comparator is fed to the PI controller. The PWM pulses to the single-phase inverter are generated by comparing the output of the SPVWM controller with a triangular wave.

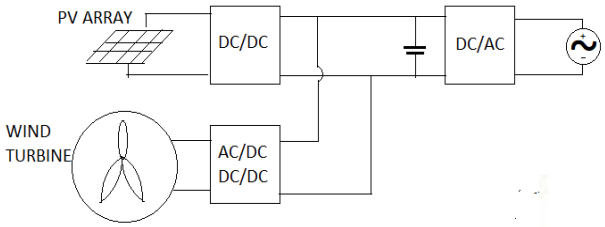

Figure 1: Hybrid grid basic structure

Here is a hybrid solar PV and wind system with the battery bank that is connected to an AC Micro-grid. The system able tooperates in both the mode grid-connected or stand-alone method. The DC outputs' voltages from single solar PV and wind stream, through individual DC/AC and AC/DC-DC/AC units, are incorporated and combined in parallel on the AC side to produce the power to the grid/loads even with only one basis available. Therefore, in the grid-connected mode of operation, the renewable energy sources act as current sources and inject power directly into the AC bus. The battery system interfaced with a bi-directional converter and can be charged or discharged depending on the condition of the generation, load, and state of charge. However, in the stand-alone mode, the renewable energy sources act as current sources feeding the loads directly, and the battery bank works as a voltage source controlling the AC bus voltage by charging or discharging. The battery converter regulates the magnitude and frequency of the load voltage. The particular RES units can be operated for MPPT systems to have the determined power from the solar PV and wind systems in the grid-connected mode. The corresponding thing can be implemented in the stand-alone mode in a condition that the battery bank stand for as a voltage source to control the AC bus voltage by indicting or discharging.

A PV energy system is mainly powered by solar energy. The configuration of the PV system is manifested in the figure.

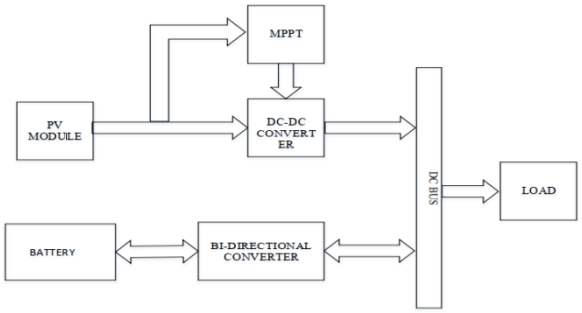

Figure 2: Overall block diagram of PV energy system

It contains PV modules or arrays, which transform solar energy into the usage of solar irradiation into electrical energy. The dc-dc converter alternate the level of the voltage to harmonize it with the electrical apparatuses that are supplied by this system. This DC-DC converter may be each buck or boost or buck-boost contingent on the essential and available voltage levels. The MPPT system coerces the maximum energy from the PV modules. A bi-directional converter that can supply the current in both directions is used to charge the battery when there is a power surplus, and the energy stored by the battery is discharged into the load when there is a power deficit.

This system comprises of a wind turbine which transforms wind's kinetic power into rotating movement, a gearbox to agree with the turbine speed to generator speed, a generator which converts mechanical

energy into electrical energy, a rectifier which converts ac voltage to dc, a controllable dc-dc converter to trace the maximum power point, a battery is charged and discharged through bi-directional converter.

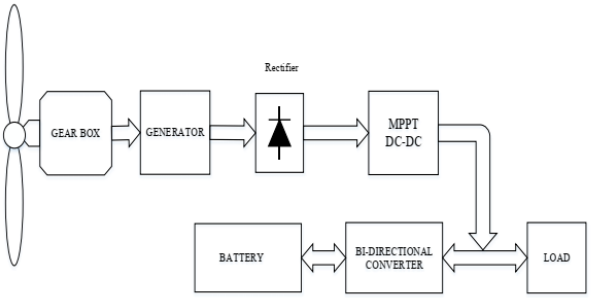

Figure 3: Wind turbine basic structure

A wind turbine transforms the kinetic energy of air into production power, such as rotating motion of the turbine that can be used directly to run the various machine or generator to produce electricity. Power gained by wind turbine blade is a concurrent of a pitch angle, blade shape, rotation speed, the radius of the rotor.

IV. DISTRIBUTION SMART SOLAR

Distributed Smart Solar(DSS) technology combines an advanced panel-level inverter with the smart grid sensors and communication technologies (Figure 1). A typical configuration is to provide each solar panel with a Smart Energy Module (SEM) connected to the low voltage utility network.All the SEMs form a secure meshed communication network that uploads their information to a data center via communication aggregators. Command and control centers and distribution management systems (DMS) access the data center to manage the solar portfolio as a virtual power plantand also to implement several smart grid functions.

This technology enables each solar panel to become a node

in a smart grid and thus facilitates the implementation of many utility applications such as demand response, conservation voltage reduction(CVR) [6], Volt/VAR loss minimization, predictive maintenance, outage notification, theft detection,and street lighting controls. The financial benefits of this technology go beyond those of solar energy generation to The Economic Opportunity of Distributed Smart Solar Systems Hisham A. Othman, Ruba A. Amarin those of the smart grid, and thus allow the utility to optimize

thegeneration,theload,and the distribution assets in between.

Establishing the right solar energy policies and regulations in a country is crucial to the proper expansion of the various forms of solar energy technologies. In this respect, it is essential to understand who, along the electricity value chain, benefits from the solar energy investments in order to allocate the costs to these beneficiaries in a proper fashion.The beneficiaries of a solar energy investment depend on the market structure and subsidy system in a country.

V. WIND POWER INTEGRATION

speed, and they can generate electricity at both day and night. While the power output of photovoltaic cells is determined by the light intensity and they can generate electricity only at day. The differences of power output feature between wind power units and photovoltaic cells related with time decide that the influences of both on the power grid are different. The wind power units generate more electricity usually at night. Thus the suitable wind power capacity can be calculated by renewable energy consumption at night in order to make full use of wind energy. While photovoltaic cells can generate electricity only at day and it will make the actual power generation capacities of the power grid at day and night are different. This point should be considered when deciding photovoltaic accommodation capacity. The paper takes the result that the renewable energy consumption of power grid at day minus the consumption at night as the ability to consume the photovoltaic power output and decides photovoltaie capacity according to the result.

VI. ENERGY STORAGE MANAGEMENT

Battery energy storage systems are comprised of batteries, power electronics for conversion between alternating and direct current, and the control system. The batteries transform the electrical energy into chemical energy for storage. Different types of battery chemistries have various advantages and trade offs in terms of power and energy capabilities, size, weight and cost. In large grid-tied applications, the most common batteries are typically Sodium-sulfur, Lead-Acid, or Lithium-Ion chemistries. Various other chemistries have been used in pilot projects and laboratory tests.

discussing different electrochemistry is found in [2] Batteries are charged and discharged using DC power, whichmust be converted by a bi-directional power electronic interface.

The power electronic interface is generally known as a power conversion system (PCS). The PCS regulates the flow of power between batteries and the power grid and can respond to a changing power command on sub-cycle time scales, far faster than typical peaking thermal plants. The power electronics are capable of taking independent control signals for real and reactive power on the AC side of the PCS,which enables the BESS to provide power factor and voltage support functions. This function is referred to as a four-quadrant operation and can eliminate the need for such system components as capacitor banks at the point of interconnection of the wind plant and the grid.

VII.DISCUSSION AND CONCLUSION

This paper explores the relationship between DC bus voltage and system efficiency in a hybrid photovoltaic-grid power system. An optimal efficiency bus voltage value can be found by loss analysis within a specific voltage range. A latest method of improve the efficiency of the hybrid PV-grid power system by changing the dc bus voltage is discussed. It provides an idea to improve the effectiveness of the hybrid photovoltaic-grid Power system. The optimal efficiency point of the system is different under different power states. So this paper proposes a new method to optimize the efficiency in a hybrid photovoltaic-grid power system by changing dc bus voltage.

VIII. EXPECTED OUTCOMES

In this paper, the proposed hybrid wind-solar system will be modeled and simulated in MATLAB. Grid interconnection of Renewable System is done using DC-DC converter and grid interfacing inverter. An inverter is controlled in such a way that it acts as a grid interfacing unit as well as an active shunt filter. Nonlinear loads are appended at the spot of universal coupling. Various Renewable Energy generation conditions with unbalanced and distorted grid conditions are simulated and found that the system works well for different conditions. Thus grid interfacing inverter with the additional functionality of shunt active power filter can be utilized in distribution systems for cost-effective distributed generation with power quality improvement features.

Hybrid generation systems that use more exceeding than a single power source can significantly improve the certainty of load demands all the time. Even higher generating capacities can be obtained by the hybrid system. In the stand-alone mode, we can able to provide independent fluctuation output to the load irrespective of climates condition. To perceive the energy output of the PV system converted to save energy, and consistent power performed by the wind turbine, an efficient energy storage device is challenged, which can be achieved by the battery bank.

ACKNOWLEDGMENT

Expression of giving thanks is just a part of those feelings which are too large for words but shall remain as memories of beautiful people with whom I have got the pleasure of working during the completion of this work. I am grateful to Assistant Professor Mr.ABHIJEET LAL sir Bhilai Institute of Technology Durg (C.G) , which helped me to complete my work by giving an encouraging environment. I want to express my deep and sincere gratitude to HOD Dr. ANUP MISHRA Bhilai Institute of Technology Durg (C.G). His comprehensive knowledge and his logical way of thinking have been of great value to me. His understanding, encouragement, and personal guidance have provided a sound basis for the present work.

REFERENCES

[1]. B. Singh, N. Mittal, K. S. Verma, "Multi-Level Inverter: ALiterature Survey On Topologies And Control Strategies,"International Journal of Reviews in Computing, Vol. 10, July2012, pp. 1 -16.

[2]. G. Cerlia, V. Grau, C. Sanchez, F. Ibanez, J. Walter, A. Millan,M.IGimenez, "A New Multilevel Inverter Topology," in FifthIEEE International Caracas Conference on Devices, Circuits,and Systems, Dominican Republic, November 2004, pp. 212-218.

[3]. G. Cerlia, V. Guzman, C. Sanchez, F. Ibanez, J. Walter, M.I.Gimenez, "A New Simplified Multilevel Inverter for DC-ACConversion," IEEE Transactions on Power Electronics, Vol. 21,No. 5, September 2005, pp. 1311 -1319.

[4]. N.A. Rahim, J. Selvaraj, "Multilevel Inverter for Grid-Connected PV-System Employing Digital PI Controller", IEEETransactions on Industrial Electronics, Vol. 56, No. 1, Jan 2009,pp. 149-158.

[5]. Singh, P. A, S., & Kumar, P.(2015, Jan-June). BATTERY (NiCd) CHARGING ANALYSIS OF STAND-ALONE 300WSOLAR PHOTOVOLTAIC SYSTEM AT CONSTANTSOLAR INSOLATION. International Journal of Electrical andElectronics Engineers, 7(1), 310-317.

[6]. Magzari, Ali. Online Photovoltaic Monitoring System.Diss.WORCESTER POLYTECHNIC INSTITUTE, 2015.

[7]. Fleming, Eric M., and Ian A. Hoskins. "Dynamics of amicrogrid supplied by solid oxide fuel cells." Bulk PowerSystem Dynamics and Control-VII. Revitalizing OperationalReliability, 2007 iREP Symposium. IEEE, 2007.

[8]. S.J. Park, F.S. Kang, M.H. Lee, C.U. Kim, "A New SinglePhaseFiveLevel PWM Inverter Employing a Deadbeat ControlScheme," IEEE Transactions on Power electronic, Vol. 18, No.3, May 2003, pp. 831 -843.

[9]. A. K. Panda, Y. Suresh, "Research on Cascade MultilevelInverter with Single DC Source by using Three-phaseTransformers", Electrical Power and Energy System, Vol 40,March 2012, pp. 9-20.

[10]. B. Singh, N. Mittal, K. B. Singh, N. Mittal, K. S. Verma, "Multi-Level Inverter: ALiterature Survey On Topologies And Control Strategies",International Journal of Reviews in Computing, Vol. 10, July2012, pp. 1 -16.

[11]. [G. Cerlia, V. Grau, C. Sanchez, F. Ibanez, J. Walter, A. Millan,M.IGimenez, "A New Multilevel Inverter Topology", in FifthIEEE International Caracas Conference on Devices, Circuitsand Systems, Dominican Republic, November 2004, pp. 212-218.

[12]. Yang, C.N. "Visual cryptography: An introduction to visual secret sharing schemes", Department of Computer Science and Information Engineering National Dong Hwa University Shoufeng, Hualien 974, TAIWAN, Last accessed on July 04, 2010.

[13]. Ibrahim Nasir., Ying Weng., &Jianmin Jiang. (2008). Novel Multiple Spatial Watermarking Technique in Color Images, IEEE Fifth InternationalConference on Information Technology: New Generations, 777 - 782.

[14]. YuanchengLi.,&Xiaolei Wang. (2009), "A Novel Multiple Watermarking Algorithm Based on Bandelet Transform", IEEE, Global Congress onIntelligent Systems.

[15]. Surekha, B., Swamy, G. N., &SrinivasaRao, K., "A Multiple Watermarking Technique for Images based on Visual Cryptography", International Journal of Computer Applications, 1 (11), 66-71, 2010.

[16]. VijendraRai., JaishreeRai., &ManojRana, "Effective Multiple Image Watermarking based on Dither Quantization" , Proceedings of the 5thNational Conference (INDIACom) Computing for Nation Development, 2011.

[17]. Sergey Anfinogenov., Valery Korzhik., & Guillermo Morales-Luna., "A Multiple Robust Digital Watermarking System for Still Images",International Journal of Computer Science and Applications, 9 (3), 37 - 46, 2012.

[18]. Jaiswal. R. J., &Patil, N. N., "Multiple watermarking for text documents: a review", World Journal of Science and Technology, 2(3), 176-179, 2012.

[19]. G. Cerlia, V. Guzman, C. Sanchez, F. Ibanez, J. Walter, M.I.Gimenez, "A New Simplified Multilevel Inverter for DC-ACConversion", IEEE Transactions on Power Electronics, Vol. 21,No. 5, September 2005, pp. 1311 -1319.

[20]. N.A. Rahim, J. Selvaraj, "Multilevel Inverter for GridConnected PV System Employing Digital PI Controller", IEEETransactions on Industrial Electronics, Vol. 56, No. 1, Jan 2009,pp. 149-158.