International Journal of Electrical and Electronics Engineers
Volume 14, Issue No. 01, Jan-June 2022
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

STANDARDIZATION OF RENEWABLE ENERGY SOURCES FOR A MICROGRID

Geeta K M[1], Geeta Yadav[2], Hareeni Raj K[3], Murari Pallavi[4], Tooba Afreen[5]

[1]*Assistant professor, Department of Electrical & Electronics Engineering*

[2,3,4,5]*UG students in Electrical & Electronics Engineering,*

Navodaya Institute of Technology, Raichur, Karnataka, India

ABSTRACT:

With the rise in stipulation of electrical energy, there is a requirement of eco-friendly favorable generation, here we are using renewable energy sources in a microgrid. The pile-up penetration of renewable energy resources and distributed generation has grown up significantly in power quality issues. The flexibility of power system can be amplified during contingency circumstances by the utilization of microgrids due to potential to supply local loads. Although, accurate prediction of disturbance events are complex, rather the occurrence probability can be demonstrated as high, medium or low etc. Therefore, a fuzzy logic based Battery Energy Storage System(BESS) operation controller is presented here. BESS is connected to the AC side of the grid converter. Inverter is connected in between the converter and loads. Driver board gives signals to the inverter. MPPT of the PV system based on ANFIS algorithm maintains the voltage and frequency of the system. MATLAB or SIMULINK software is adapted to simulate an AC microgrid using incompatible control strategies.

Key words: *Microgrid, Stability, AC-DC Converter, BESS, MPPT (Maximum power point tracking), ANFIS (Adaptive Neuro fuzzy inference system).*

1. INTRODUCTION:

Microgrids are composed of different (DERs), including different renewable or non-renewable energy controllable loads. In order to have highly efficient power systems and to develop clean energy, microgrids have been proved very advantageous. The different modes in which a microgrid can operate are the grid connected mode, islanded mode and the transition between these two modes. For controlling the stability of the system various power system stabilizers have been used.

In addition to the harmonic performance, the voltage profile plays an important role in the penetration level of DG systems . Using passive, active and hybrid harmonic filters to attain improvements in power quality incurs increased cost and losses. However, prevention of harmonics at its source is better than curing it by introducing filters . The current source inverter (CSI) lends itself as a natural candidate in photovoltaic and fuel cell power conversion systems owing to its voltage boosting capability and smooth DC-link current .

Real-time optimization is therefore feasible in microgrids, through frequent adjustments of generator outputs to minimize costs or meet other targets . Optimization may include power flow to the public network: energy for storage can be bought when prices are low, and then used when the grid connection is unavailable. Energy Management Systems (EMS) have been proposed to coordinate such functions

International Journal of Electrical and Electronics Engineers
Volume 14, Issue No. 01, Jan-June 2022
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

An important consideration when implementing optimal generator outputs is system stability. When the microgrid is operated in stand-alone mode, its dynamics are strongly dependent on the connected sources and on the power regulation control of the converter interfaces . This is similar to a conventional grid where the system stability is largely influenced by the synchronous generators. For droop-controlled microgrids, which offer advantages in terms of autonomous operation, analysis has shown that the parameters that determine generator power sharing have a significant effect on stability in stand-alone operation . A deeper understanding of this effect is required, to allow an EMS to apply real-time optimization.

Renewable energy resources such as solar, wind, geothermal, hydropower and tidal energy are reliable, plentiful and will potentially be very cheap once technology and infrastructure improve . A flexible experimental platform for comprehensive studies of MG has built-in intelligent MG lab in Aalborg University, Denmark with the primary control loops are developed in MATLAB/Simulink and compiled to dSPACEs for local control purposes as well as a LabVIEWbased MG central controller [4]. the proposed fuzzy logic controller was only concentrated on Rotor Side Converter (RSC) of wind generator and two GSCs of inverters.

To improve the controllability of the fuzzy controller that depends on the programmer's experience, an AdaptiveNetwork-based Fuzzy Inference System (ANFIS) algorithm that combined fuzzy logic and artificial neural network was introduced in [. Due to its simplification and ease of designing, ANFIS is used replacing for controllers that are not obvious or cannot be calculated by definite equivalence. This paper is organized as the following sections: In Section II, the studied MG system configuration is represented. The designed ANFIS controller for inverters of MG is proposed in Section III. Simulation results and conclusions are illustrated and discussed, respectively.

For improving the power quality of feed-in grid current in a grid-connected MG that can be influenced by a distorted utility grid, a feed-in grid current resonant controller-based harmonic compensation loop is integrated to the original autonomous current sharing controller that can effectively reduce the system equivalent output admittance at selected harmonic frequencies. Thus, the total harmonic distortion of the feed-in grid current can be significantly decreased .

2. BLOCK DIAGRAM:

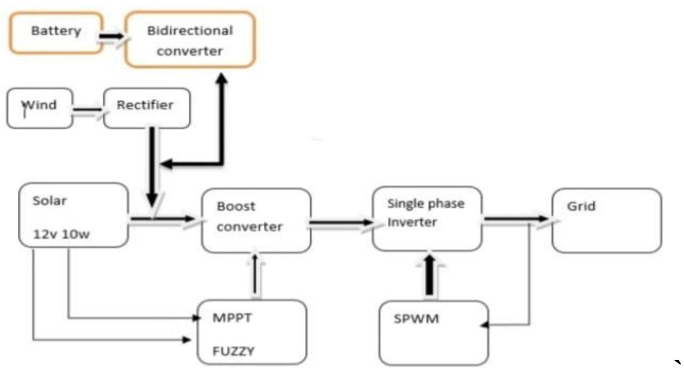


Fig.1 Studied Block Diagram of MG System

International Journal of Electrical and Electronics Engineers
Volume 14, Issue No. 01, Jan-June 2022
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

3. Working principal :

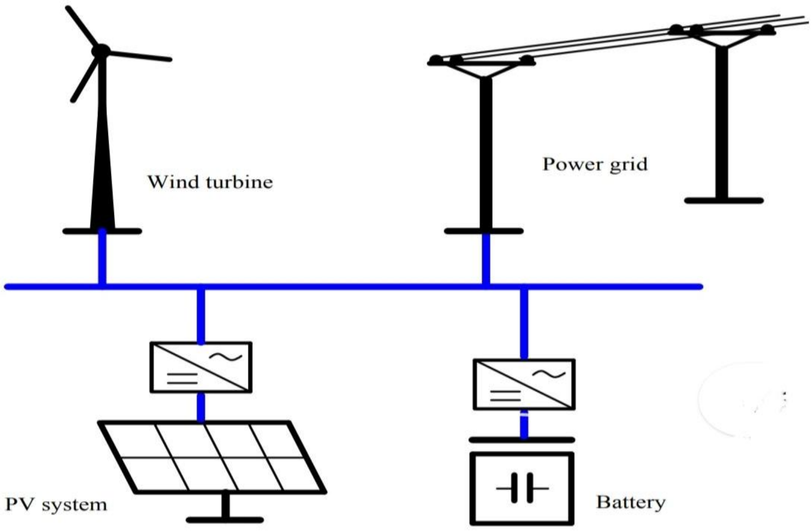


Fig 2: The studied MG system

In this considered MG system, the PV panel model SunPower SPR-305-WHT is used for PV array with its I-V curve is depicted in Fig. 2 while the PMSG based wind turbine energy system is selected to implement in the system.

The MPPT for PV and wind systems are not considered in this studied system. The characteristic of the PV system is shown as the following current and voltage equations

$$I_{PV} = I_{sat}\left(e^{V_d/V_T} - 1\right) \qquad (1)$$

$$V_T = \frac{kT}{qQ_d N_{cell} N_{ser}} \qquad (2)$$

where:

I_{PV} = PV current (A)
V_T = temperature voltage
V_d = diode voltage (V)
I_{sat} = diode saturation current (A)
T = cell temperature (K),
k = Boltzman constant = 1.3806e-23 J.K^-1
q = electron charge = 1.6022e-19 C
Q_d = diode quality factor
N_{cell}= number of series-connected cells per module
N_{ser} = number of series-connected modules per string

International Journal of Electrical and Electronics Engineers
Volume 14, Issue No. 01, Jan-June 2022
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

The grid-connected operational strategy of MG is mainly used to coordinate the output power of MG to satisfy the requirements thus the operational control strategy of MG is mainly used to achieve the power balance control to ensure the safe and stable operation. When the demand from the load is greater than power generation, if the energy storage system can satisfy the requirements, the net load power is provided by the BESS. If the State Of Charge (SOC) of the BESS does not satisfy the requirements, it will be discharged in maximum state and the rest will be provided by the power grid. CoThe PV system and wind power generation system are the generating unit and supply power to load. In the practical, PV system and wind power system will work in different modes according to the power requirements of the load.

When the BESS, PV system and wind power system cannot satisfy the total load demand, it must remove the secondary load to make the MG system operate normally. III. DESIGN ANFIS CONTROLLER FOR GSC OF MG The GSC manages the power of the whole MG system. It stores the surplus active power in BESS during light load conditions and feeds power during power deficit. Moreover, GSC also compensates the required amount of reactive

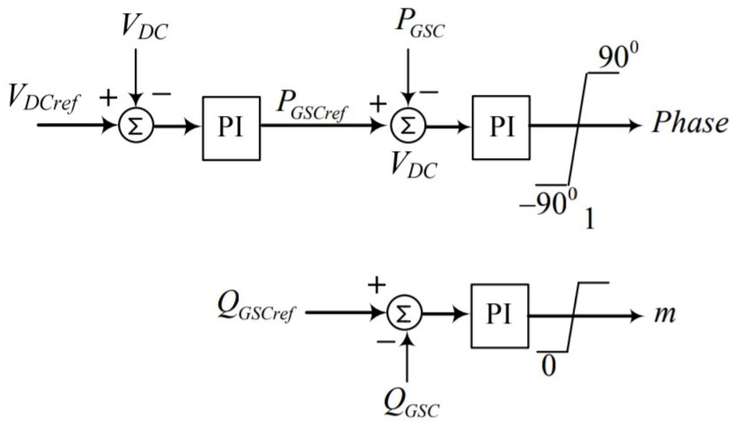


Fig 3.Control Scheme Of GS

power to keep the system voltage constant during load fluctuation. In state of the art systems, cascaded voltage control is often implemented in order to control the GSC of MGs. , the currents of the converter are controlled directly by means of the inner control loops. The outer control loops control the active power, or DC link voltage and reactive powernversely, the The basic principle of the current controlled of GSC is to control the instantaneous active and reactive grid currents independently and hence provide unity power factor.

Besides independent control of active power (P) and reactive power (Q), this kind of converter can mitigate the power fluctuation by absorbing/releasing the unbalanced energy at AC/DC side . However, with this method, the considerable number of feedback signals required (two ac line currents, two ac line voltage signals and a DC bus voltage signal) are associated with the extra cost of sensing devices and slow dynamics of the outer DC regulation loop is other backward of this method. In this paper, the proposed ANFIS controllers are used to replace PI controllers in GSC of PV system. An ANFIS controller that is a class of adaptive multi-layer feedforward networks it combines the self-learning ability of neural network with the linguistic expression function of fuzzy inference is designed. Fig. 4 shows the structure of the ANFIS controller.

As shown in Fig. 4, the ANFIS' structure is similar to a neural network, which maps inputs through

International Journal of Electrical and Electronics Engineers
Volume 14, Issue No. 01, Jan-June 2022
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

dependent functions to corresponding parameters, and then through BESS works in the SOC.

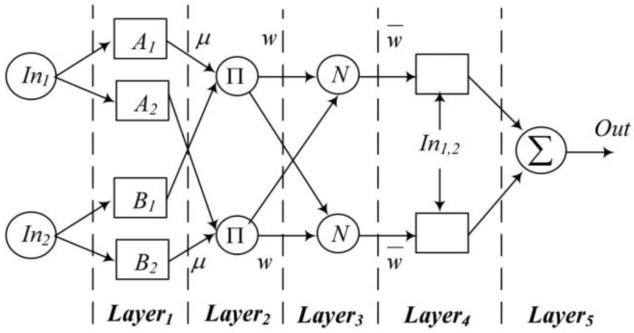
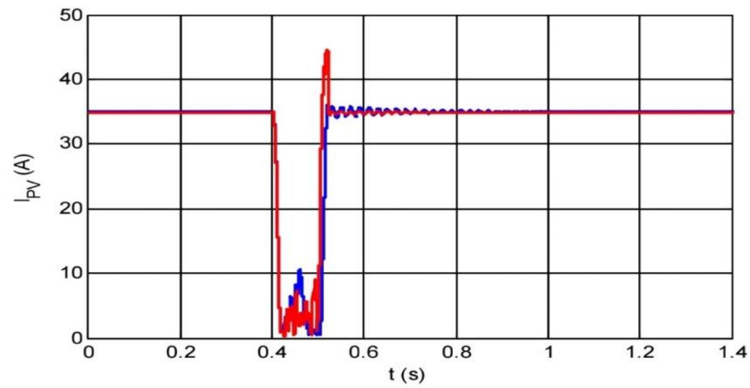


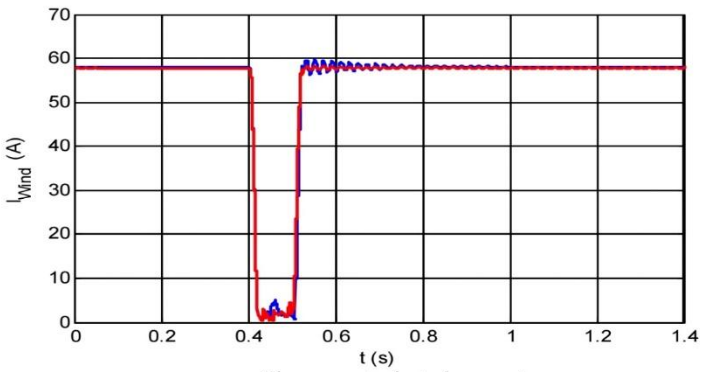
Fig. 4 Structure of the ANFIS

4. SIMULATION RESULTS

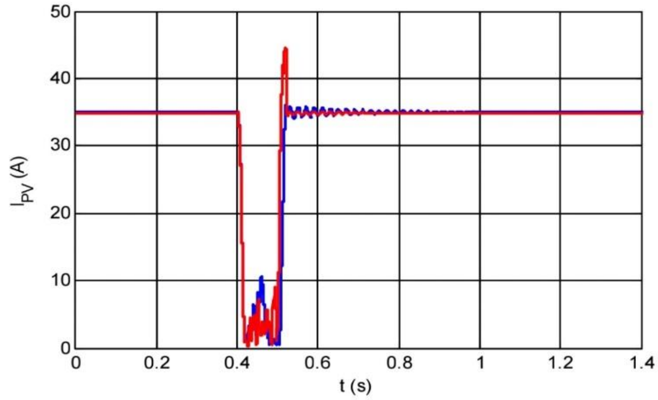
The simulation results based on the proposed MG system and with ANFIS controller are performed in MATLAB/Simulink platform. The results showed in Fig. 6 simulated three-phase short circuit fault happened at the connected bus of MG to the power grid with blue lines are the responses of the system with PI controller for GSC and the red lines are represented the designed ANFIS controllers for GSC. In this figure, the current of wind generator, the current of the PV system, the active power of BESS and the voltage at grid are shown



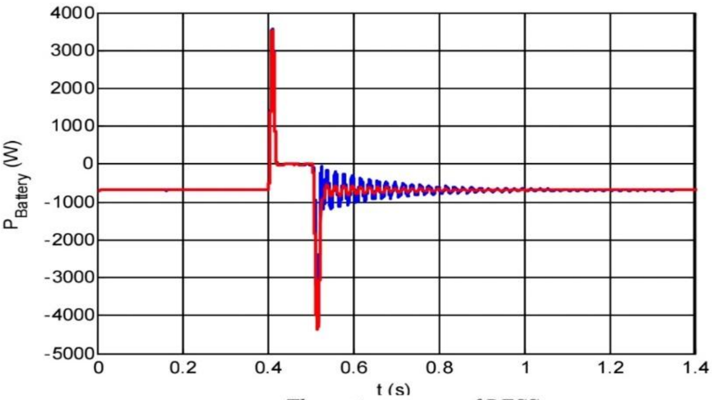
b. The current of the PV system



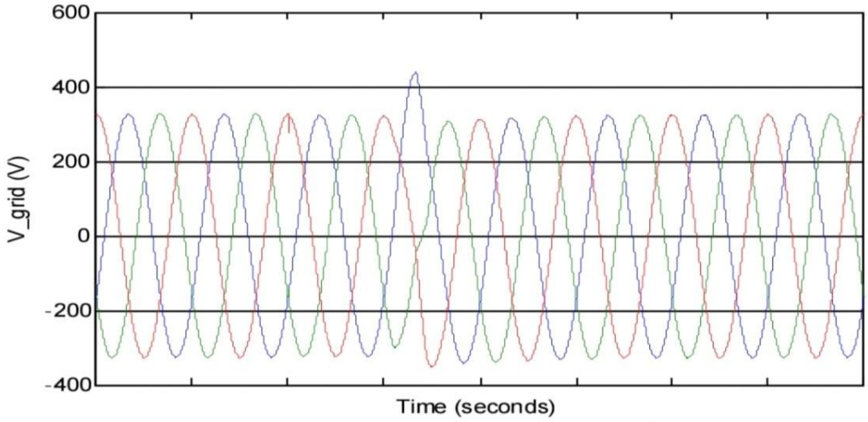
a. The current of wind generator



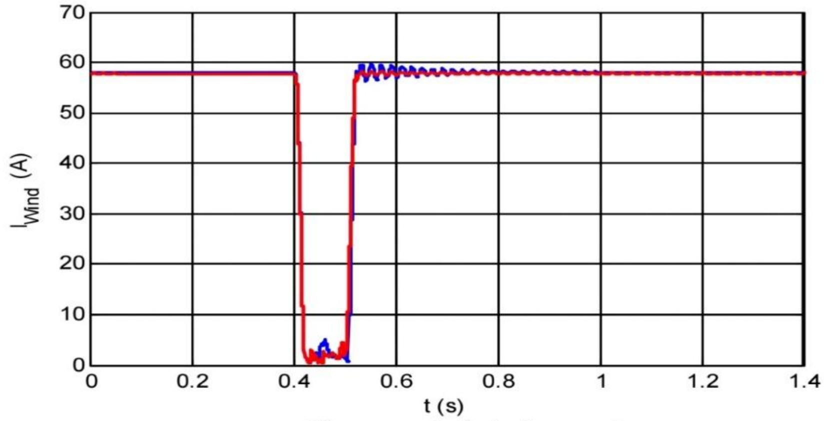
b. The current of the PV system



c. The active power of BESS



d. The active power of BESS



a. The current of wind generator

5.CONCLUSION:

In this paper, the two most rapidly growing renewable sources include solar PV and wind generator in MG are studied. The main objectives of this paper are to improve the stability of the grid-connected MG system. The ANFIS controllers for the GSC of MG has the potential to significantly increase energy surety. The BESS is also suggested to deal with the constant unavailability of solar and wind energy problem in the case of integration. As the time-domain simulation results shown in this paper, it can be concluded that the designed ANFIS controllers can be used improve the power stability and reduce the oscillation of the system after a severe three-phase short circuit happened in the system.

AKNOWLEDGEMENT:

The authors would like to thank the Navodaya Institute of Technology Raichur for providing the technical support.

REFERENCE:

[1] F. Nejabatkhah and Y. W. Li, "Overview of Power Management Strategies of Hybrid AC/DC Microgrid," in IEEE Transactions on Power Electronics, vol. 30, no. 12, pp. 7072-7089, Dec. 2015.

[2] J. Hofer, B. Svetozarevic and A. Schlueter, "Hybrid AC/DC building microgrid for solar PV and battery storage integration," 2017 IEEE Second International Conference on DC Microgrids (ICDCM), Nuremberg, 2017, pp. 188-191.

[3]Available at https://homeguides.sfgate.com/importance-renewableresources-energy-79690.html (last accessed on 14th April, 2019).

[4] L. Meng, M. Savaghebi, F. Andrade, J. C. Vasquez, J. M. Guerrero and M. Graells, "Microgrid central controller development and hierarchical control implementation in the intelligent microgrid lab of Aalborg University," 2015 IEEE Applied Power Electronics Conference and Exposition (APEC), Charlotte, NC, 2015, pp. 2585- 2592.

[5] Y. Guan, W. Feng, J. Lu, J. M. Guerrero and J. C. Vasquez, "A Novel Grid-Connected Harmonic Current Suppression Control for Autonomous Current Sharing Controller-Based AC Microgrids," 2018 IEEE Energy Conversion Congress and Exposition (ECCE), Portland, OR, 2018, pp. 5899-5904.