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MAXIMUM POWER POINT BASED MICROGRID WITH SOLAR-WIND-BATTERY SYSTEM: A REVIEW

Tapendra Tailor[1], Vikash Kumar Yadav[2], Dr. Bharat Bhusan Jain[3], Rajkumar Kaushik[4]
[1]M.Tech Scholar, Department of Electrical Engineering, Jaipur Engineering College, Jaipur, Rajasthan
tapendratailor@gmail.com
[2]Assistant Professor, Department of Electrical Engineering,, Jaipur Engineering College,Jaipur, Rajasthan
vikashjec1990@gmail.com
[3]Professor, Department of Electrical Engineering, Jaipur Engineering College, Jaipur, Rajasthan
drbharatjec@gmail.com
[4]Assistant Professor, Department of Electrical Engineering,, Arya Institute of Engineering & Technology, Jaipur, Rajasthan
rajkaushik1812@gmail.com

***Abstract*-A Microgrid is defined as a "local grid that connects distributed energy sources with organized loads and is usually connected to the traditional central grid in a synchronous manner. Demand of electricity increased day by day so we need environment friendly generation and continuous power generation. The current trend in the developing economy has led to the expansion of renewable power. MG is best suitable option but operating cost of MG is very cheap compare to conventional grid. Due to many factors, the demand for electricity has increased significantly in the last few years. During outage in grid, low renewable power generations are preferredused than diesel generator for emergency to meet the load demands. MG can be located at consumer end whereas convention grid located far away from residential area. This article contains a detailed information about the microgrid with renewable energy penetration and various methods of maximum power point tracking for solar as well as wind power system.**

***Keywords*-Solar System, Battery Energy Storage System, Particle Swarm Optimization, State of Charge.**

I. INTRODUCTION

Renewable Energy Trends across the Globe

The current trend in the developing economy has led to the expansion of renewable power. Over the past three years, Figure 1, shows that current contributions to our global energy from different sources shows that fossil fuels account for 81% of our energy. The recent development of solar photovoltaic knowledge or reliable introductions of projects in countries/regions such as Germany and Spain have also brought significant growth in the solar photovoltaic market.

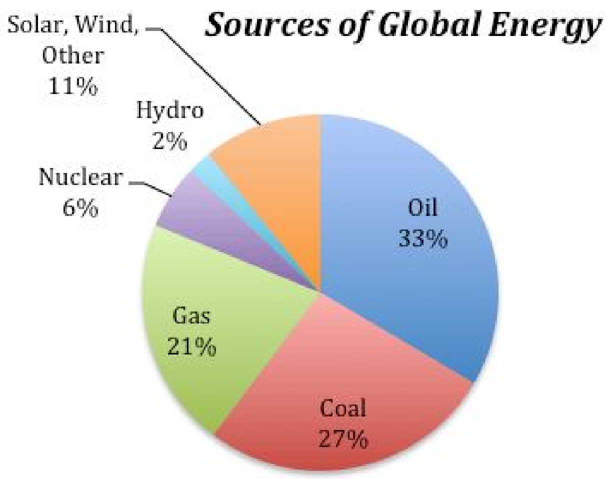

Figure 1. The current contributions to our global energy from different sources shows that fossil fuels account for 81% of our energy [2022].

The non-fossil fuel sources include nuclear, hydro (dams with electrical turbines attached to the outflow), solar (both photovoltaic and solar thermal), and a variety of other sources. These non-fossil fuel sources currently supply about 19% of the total energy.

II. RELATED RESEARCH

Meiqin Mao et al. (2018) Stability studies are the most important activity in the operation of the AC microgrid. For a single bus microgrid (SBMG) that contains voltage or current control inverters, offered impedance investigation method divides the microgrid into two, and judges whether it is consistent with the accuracy of the vehicle. Nyquist position of the impedance analysis method. However, this will be very difficult for SBMG communication systems. This paper suggest a method of analyzing the stability of a microgrid AC island based on a single bus. The main idea starts with a stability analysis in each SBMG, and then according to the topology of the power and load distribution between the buses, the node values are obtained for stability analysis in the entire system. [1]

Bhuvnesh Rathor et al. (2018) investigated and analyzed the effect of symmetric fault on grid-connected AC microgrid and improved the stability of the first control of the same section generators. In this AC microgrid there are four distributed power generators and three renewable energy sources, namely a photovoltaic power plant, a wind power plant and a power plant. [2]

Abdelsalam A. Eajal et al. (2019) future intelligent networks consist of ac-dc clusters called ac-dc microgrids. For safe and secure purposes, each Microgrid has its own comparison-based and converter-based data sources. However, especially for hair straighteners, due to the limitations of their hair system, their ability to move is limited, which can lead to problems with instability when hosting microgrid islands. The AC-DC microgrid also has a controllable load and load control. Most modern AC and DC loads have an electronic power supply, which can control power at both ends to exhibit unique electrical properties. [3]

Moudud Ahmed et al. (2019) The stability of a microgrid depends on many factors, such as the feed of the microgrid, the level of energy / reactive distribution, or load dynamics. This paper focuses on pressure of feed characteristics on stability of AC / DC hybrid microgrids. The resistance parameters of the line (R), inductance (L) or capacitance (C) depend largely on the voltage of the supply. Therefore, these parameters will involve dynamic or dynamic power distribution of related power source converter (VSC). This paper examines stability of an AC / DC hybrid microgrid with a low-voltage (LV) and medium-voltage (MV) filter. [4]

Cao Wenchao et al. (2020) For the design of an AC island type microgrid system based on a three-phase inverter, the problem of low instability often caused by the connection of the inverter droop processor is a major problem. When the internal control profile of a commercially purchased inverter is not known, a fixed standard of impedance can help to predict the resonance at high and low intervals. , but they often assume that the frequency range of the grid does not vary, so that the bottom cannot be analyzed. The rotation of the frequency of the frequency in the microgrid island. To solve this problem, this paper recommend two steadiness examination process based on individuality of the inverter and the passive network terminal, including the frequency characteristics, in order to examine the low-precision stability. [5]

Moudud Ahmed et al. (2020) autonomous regions in power systems, called “microgrids”, incorporate small renewable energy sources (RES) and improve energy efficiency and efficiency. According to the electrical properties and structure of the microgrid structure, the microgrid can be separated into three categories. 1) AC microgrid, 2) DC microgrid or 3) AC / DC hybrid microgrid. This article provides a complete overview of the stabilization, control, power management, or fault flow (FRT) strategies of AC, DC, and AC / DC hybrid micrograms. This article also organize microgrids according to their use and summarizes chuck set forth in the standard (e.g., IEEE Std. 1547-2018). The control strategy of each microgrid structure is considered according to its concept and performance. [6]

Yuxi Men et al. (2020) This paper sets out a small signal model of a microgrid AC hybrid DC and DC, including the AC circuit, the DC component, and the inverter for the interface between the AC and DC buses. Based on a small complete signal model available, a region-based stability examination method will be proposed or residential. Meanwhile, in order to obtain a constant working point for region - based stability studies, practical and efficient power calculations are performed with low -controlled AC and DC microgrids. Instead of following the method of evaluating the stability degree at each point, the stability area achieved in this work is obtained from cross-domain parameters selected from the control system or large power circle. [7]

Oluleke Babayomi et al. (2020) as the popularity of renewable energy in power systems continues to grow, the need for synthetic resilience based on converters has become more important. In this article, the second teaching principle of frequency and power is applied to a model converter (MPC) source converter (VSC) in an AC microgrid (MG). First, a low-resolution analysis of VSG-based inverters based on a parallel relationship with MG is examined. Next, a second control of the power and frequency control of the AC MG section was performed (with the same VSC inertia simulation). In addition, for the load change applied in this study, the results show that the proposed control strategy can effectively reduce the ROCOF caused by the load change to 'of 89%, and has a fast and rapid active response, which can quickly cure disorders. Stability MG. [8]

III. MICROGRID WITH SOLAR WIND ENERGY SYSTEM

The U.S. Department of Energy defines a microgrid as a group of consistent loads or energy sources distributed within clearly distinct electrical limits. They are carried by a single controllable wire connected to a wire. The microgrid system has been identified as a key component of future "grid connections". They offer several advantages as follows;

1. The ability to integrate different types of DER management systems and storage devices in a board.
2. Ensure greater crisis capabilities than physical and cyber-attacks.
3. Ability to repair oneself with the intervention of an electrical system.
4. It may act as a "black boot" during a power outage to speed up the recovery process.
5. Achieving the quality requirements of power transmission under heavy and critical loads.
6. Support high-capacity power systems by providing additional services (such as demand transfer, investment in closed infrastructure and frequent adjustments).

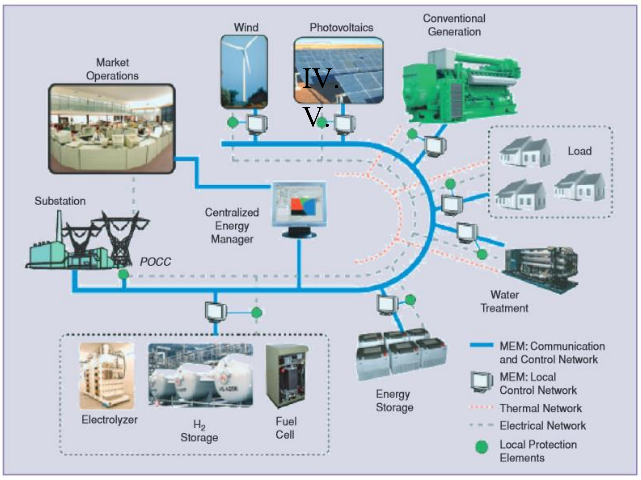

Figure 2. Microgrid Structure

During the power outage, many critical loads suffered enormous losses. In 2003, the power outage in the Northeast was one of the largest power outages in the history of the United States, affecting 45 million people in 8 states in the United States [13]. The establishment of a micro-grid is one of the objective methods of reducing the severity of power outages, which can ensure continuous power supply to critical loads by generating electricity in power distribution facilities. When power requirements are high, the Microgrid provides benefits to utilities by distributing power to reduce peak load [14]. Therefore, it helps to retain stability of organization when electricity production cannot meet the demand. When the micro-grid meets the load demand, especially when the electricity price is high, it can reduce the end user's electricity bill [15]. Micrograms help reduce transmission losses by generating electricity in local facilities. In addition, any upgrade required by the transmission system to increase its capacity may be delayed. Many energy sources used in microgrid, such as solar panels, wind farms and rechargeable batteries, are environmentally friendly and therefore have lower carbon emissions.

IV. MAXIMUM POWER POINT TRACKING TECHNIQUES

Maximum Power Point Tracking for Solar System

MPP is defined as a point where the solar module provides maximum power. The current and the voltage corresponding to this point (Impp and Vmpp) are called maximum current and maximum voltage respectively. The solar panel does not deliver its maximum power during normal operation. To achieve maximum conversion efficiency, it is desirable to apply a smart algorithm. In addition, it is also important to connect the module to the load so that maximum load power is available. The block diagram of the MPPT method is presented in figure 1.

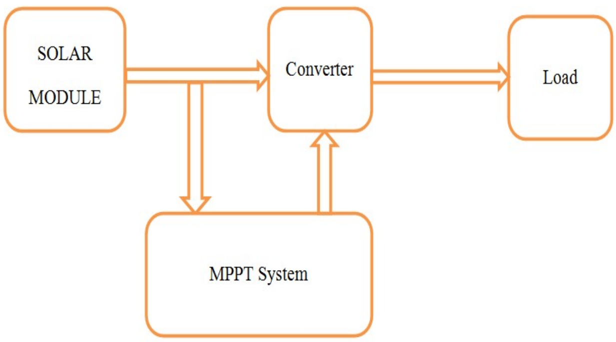

Figure 3. Block Diagram of MPP Tracking for Solar System

P & O MPPT Technique for SPV System

The P&O algorithm is also called "climbing," but both names refer to the same algorithm depending on its application. The correction includes disruption of the power cycle of the power converter and P&O and disruption of the working power of the DC link between the photovoltaic array and the power converter. On the upside, interrupting the power converter's circuit breaker means changing the DC link between the PV array and the power converter so that one technology refers to the same technology. In this method, the final turbulence and the increase in the final turbulence signal are used. To determine the expected subsequent turbulence.

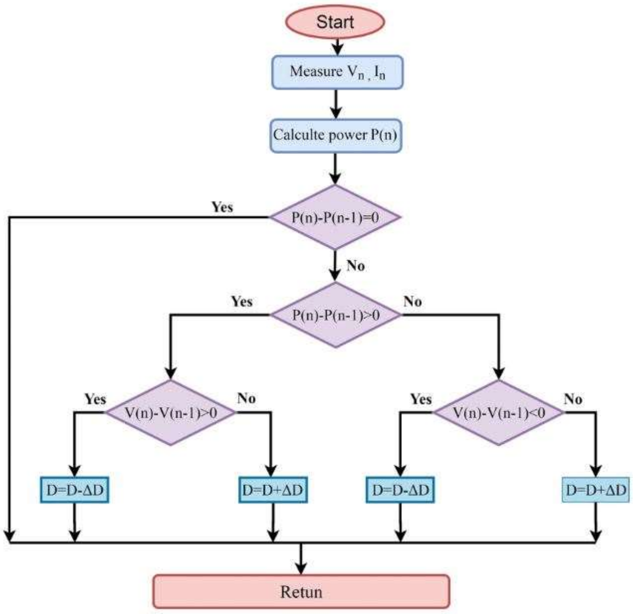

Figure 4. The Flowchart of the P&O Algorithm

Reference Torque Control MPPT Technique for Wind System

The following shows the wind turbine generation system with the DTC technique along with the rotor flux amplitude reference generation strategy to control the DFIG during the unbalanced condition, i.e., during a voltage dip. During the voltage dip, if DFIG is maintained with constant electromagnetic torque and rotor flux amplitude, that means if no control strategy is been adopted then it leads to non-sinusoidal grid currents making the grid to be in unstabilized condition. The proposed control strategy eliminates the perturbations in electromagnetic torque, makes it to be within the stabilized limits, reduce the stator and rotor over currents produced leading to elimination of the crowbar protection during low voltage dips and generate sinusoidal grid currents without the necessity to change the hardware requirement and also the prevalent control philosophy adopted.

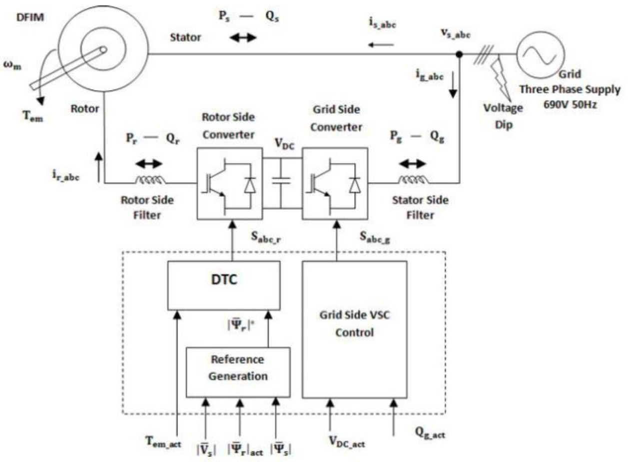

Figure 5. Circuit Diagram of Reference Torque Control Method

V. DISCUSSION &CONCLUSION

This article contains a brief knowledge about the renewable energy source, design of microgrid, integration of microgrid with renewable energy and different techniques of maximum power point tracking. After a detailed study about the MPPT technique, we have concluded that Perturb & Observe MPPT method is best fit for solar system and reference torque control method is best for wind energy system.

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