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Hybrid Solar PV and Wind to Grid Connection through VSG

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ABSTRACT: The virtual synchronous generator (VSG) control technique is proposed to destroy the various stability issues in distributed power generation systems. This paper presents an in-depth literature review on VSG, along with a discussion on many modified and improved control techniques for VSG. In this paper, a grid-supporting PV system, which can provide inertia and participate in frequency regulation through virtual synchronous generator (VSG) technology and an energy storage unit. The function of supporting the grid is implemented in a practical PV system through using the topology. The proposed PV system can moderate autonomously the power imbalance between generation and consumption. VSG can be controlled in real time to improve the fast response of the virtual machine in tracking the steady-state frequency. The genetic algorithm is used to optimize the values of checking and inertia of the VSG. The performance of the proposed system is validated in MATLAB.

KEYWORDS: VSG, PV System, MATLAB, Virtual Machine

I. INTRODUCTION

The most challenging issue with the inverter-based units is to synchronize the inverter with the grid and then to keep it in step with the grid. The solution can be found in the control scheme of inverter-based DGs. VSG control generates amplitude, frequency, and phase angle for its terminal voltage based on its power command. The structure of the VSG system and the bang-bang control algorithm of Alternating Inertia control. The main objective of this paper is therefore to equip PV systems with the function of supporting the grid through emulating SG characteristics. This paper presents a novel grid-supporting PV system. The VSG is developed to simulator the dynamic characteristics of the synchronous generator. However, there are certain limitations of VSG functionalities. The parameters of VSG can be adjusted in real-time, therefore providing major flexibility in comparison to the synchronous generator. The control algorithm of VSG can be divided into two parts, such as active power frequency and reactive power-voltage. The VSG is developed to participate and improve the stability of renewable energy sources-based power systems. But simple VSG could not provide stability to the renewable energy sources based power system. The VSG inertia and its damping are designed by considering and calculating the capacity ratio of SG and VSG units. , the line inverter of the grid-supporting PV system simulators not only the inertia and frequency damping of SGs, but also the synchronization mechanism of SGs.

II. RELATED WORK

The proposed grid-supporting PV system is superior to the conventional PV system, the conventional PV system cannot moderate the deficits and surplus of power in the grid. The core of VSG technology is to present the various energy sources interfaced to the grid through power electronic converters as SGs. VSG research focus towards developing novel control strategies, and improving the performance of these strategies from the point-of-view of enhanced dynamics. The proposed grid-supporting PV system is superior to the conventional PV system. A simple VSG can somewhat overcome and suppress the small-signal disturbance. The main purpose of VSG is the dynamic performance of the synchronous generator. A simple VSG consists of an energy storage system, electronic inverter, and special control mechanism. VSG control has an advantage in that its swing equation parameters can be adopted in real time to obtain a faster and more stable operation. The damping effect is investigated by the transient energy analysis and its stabilizing performance on the nearby machines in the power system is investigated by simulations.

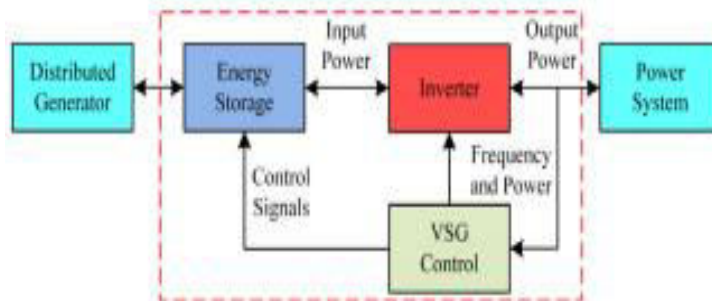


Fig 2.1: Block diagram of VSG control

III. METHODOLOGY

This chapter will cover the details explanation of methodology that is being used to make this project complete and working well. MATLAB/Simulink software is used to achieve the objectives of the project that will complete. The grid-supporting PV system, presenting as SGs from the point-of-view of the grid by representing SG characteristics with VSG control, can support the grid through mitigating the power imbalance between generation and consumption, and slowing down frequency dynamics with virtual inertia. The VSG is developed to integrate and improve the stability of renewable energy sources-based power systems. The VSG-based system experience huge frequency oscillations when connected to the grid due to mechanical supply via frequency power controller. The parameters of VSG can be adjusted in real-time, therefore providing significant flexibility in comparison to the synchronous generator. The VSG is integrated into grid-connected mode and islanded mode. During disturbance in the power system or micro grid, the VSG suffers different stability problems that depend upon the nature of the disturbance.

IV. EXPERIMENTAL RESULTS

A detailed nonlinear time-domain simulation model for the CSC-PV system is built under MATLAB/Simulink environment to evaluate the preceding theoretical analysis. This paper discusses the active power frequency control and reactive voltage control in detail. Additionally, various improved control techniques are discussed, along with their results.

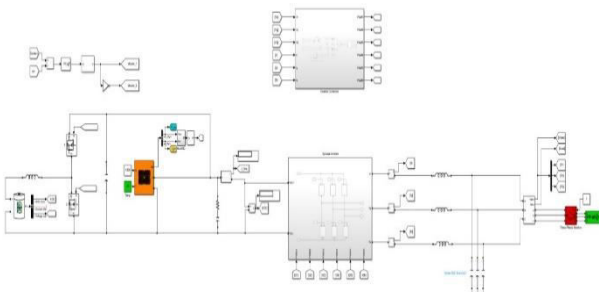


Fig 4.1: Proposed simulation diagram

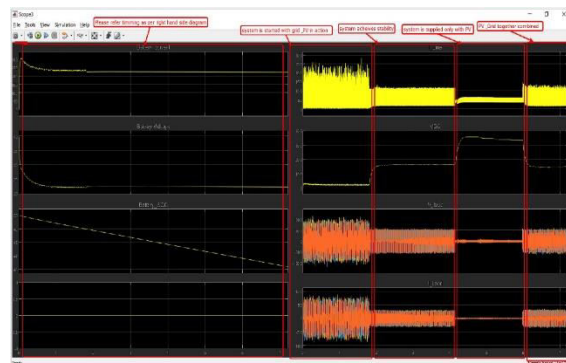


Fig 4.2: Output



V. CONCLUSION

The developments in power generation from renewable energy sources have been growing significantly in recent years. VSG development gives an easy and reliable solution to integrate renewable energy resources into the conventional power system. The VSG control and the ES unit capacitate the interface inverter of the proposed inverter to mimic SG characteristics. The VSG control and the ES unit capacitate the interface inverter of the proposed inverter to simulator SG characteristics, slowing down frequency response with inertia, and moderating the power imbalance between generation and consumption. The proposed scheme was realized on the experimental system, and the results affirmed the outstanding stabilizing effect of Alternating Inertia.

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