Analysis of Voltage Regulation in SEPIC Converter Based Hybrid Solar and Wind Energy System

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***Abstract*- Confined sustainable power source frameworks that depend completely on inexhaustible assets yet are simultaneously solid are fundamental for satisfying the power needs of remote spots where utility network isn't accessible and for which half breed wind-solar assume a vital job. In this paper, a simplified control scheme has been presented for a standalone hybrid photovoltaic (PV) array-excited wind-driven permanent magnet synchronous generator (PMSG), considering a three-phase variable load with or without unbalance. The main use of solar PV and wind generation is compared to the hybrid case. The proposed system abuses the roughness and savvy PMSG as a suitable option for a costly lasting magnet synchronous generator, which is perpetually utilized in independent PV and wind turbines.**

***Index terms*- Renewable energy system, Solar, Wind forms.**

I.INTRODUCTION

This paper presents a hybrid solar PV and wind energy system for voltage regulation in an station. Demand response is participating to minimize the total energy using, to maintain network security and integrity, and enhancement to the voltage. Investigation is carried out on an autonomous MG bus feeder to validate the effectiveness of the proposed system. Test outcomes did on the MG bus feeder, are introduced and analyzed. Wind energy is one of the most important and developed renewable energy resources. Among different types of generators, Permanent Magnet Synchronous Generator (PMSG) is a perfect choice for using in Wind Energy Conversion Systems (WECSs). It has notable advantages such as high power density, high efficiency, low maintenance, high reliability and elimination of slip rings. PMSGs with large number of poles are available and are suitable for direct drive systems. In order to connect the PMSG to the load or the power grid, a power electronic interface, consisted of two stages of rectification and inversion is needed. For the rectification stage, there are mainly two configurations used in PMSG-based WCESs.

II. PROPOSED SYSTEM

Wind energy is one of the most promising and developed renewable energy resources. A power electronic interface is needed in order to connect a Wind Energy Conversion System (WECS) to the load or the utility grid. Control of this interface is very significant and troublesome. The main purpose of controlling the generator-side converter is implementing Maximum Power Point Tracking (MPPT). In this paper, the conventional Hill Climbing Search (HCS) MPPT technique is altered FUZZY logic technique such that its presentation has been upgraded as far as precision and speed. This modified method enables the system to continuously extract the maximum energy. A non-linear control system based on Sliding Mode Control (SMC) is utilized in this work for efficient speed control, which has main advantages over linear controllers. The rectifier is used as the generator-side converter due to main advantages in WECSs. Control of this interface, which comprises of generator-and grid side converters, is a significant and requesting task.

The increased infiltration of DG units in a electrical grid systems, the renewable energy sources (RESs) including photovoltaic (PV) systems and wind energy systems have been generally used in the distributed power systems in the past methods. The distributive generation units play a main role in voltage regulation, decreasing power transmission losses and improving local utilization of RESs, which becomes a strong support for the large-scale power grid. When a number of distributive generation units are helpful, it form a micro grid (MG) that problems solving caused by high infiltration of DG units' success fully and makes the large-scale application of DG systems possible.

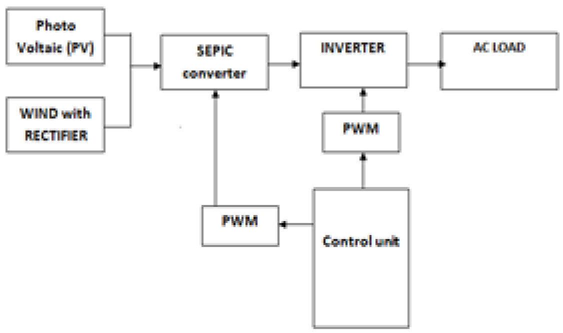

Fig -1: Proposed block diagram

III.BLOCK DIAGRAM CONFIGURATIONS

A. SEPIC Converter

The single ended primary inductor converter (SEPIC) is a converter type used to electrical potential or voltage at its output limits will be greater than, less than, or equal to that at its input level. The controlled by the duty cycle of the control switch S1 from the output of SEPIC.A SEPIC is necessarily a boost converter followed by buck-boost converter, because it is combination to a traditional buck-boost converter, but the output is non inverted.

Normally, single lithium ion battery typically discharges voltage from 4.2 volts to 3 volts. Then compare with other components required 3.3 volts, so the SEPIC would be effective. The schematic diagram for SEPIC is shown in Figure2. Specifically DC-to-DC converters, the SEPIC convert energy between the inductors and capacitors in order to convert from one voltage level to another voltage level. MOSFETs produce higher input impedance and lower voltage drop than bipolar junction transistors (BJTs), and do not require biasing resistors as MOSFET switching is controlled by differences in voltage rare than a current, as with BJTs. The voltage drop diode D1 is critical to a SEPIC's efficiency and reliability. The diode's switching time to be very fast in order to not generate high voltage limits across the inductors, so mainly affected or caused damage to components. Because, necessary Fast conventional diodes or Schottky diodes may be used.

B. Combination of Hybrid Solar PV and Wind Turbine

The hybrid system is supposed to have a unity power factor. Therefore, the power injections of the PV and wind turbine are connected as illustrated system, whereas the details of the connection follow the block diagram shown in Fig. 1.

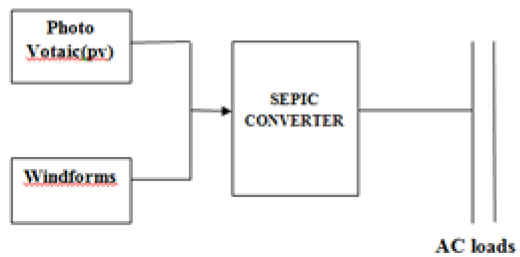

Fig -2: Hybrid Solar PV and Wind Turbine using SEPIC Converter

The method is tested on an autonomous MG bus feeder of an actual 115 kV/4.16 kV 50-Hz distribution circuit. The distributed among commercial and residential energy consumers using a total load is 3.866 MW. This system consists of a three-phase overhead or underground primary feeders and double-phase and single-phase line sections near the end of the feeder laterals. The method is taken from the IEEE 13 feeder test system. Loads are different types including constant current, constant impedance and constant power is modeled at the system buses.

It is clear that both PV and wind could not maintain the voltage at 1.0 pu, albeit still within the acceptable voltage bounds of 0.95 pu to 1.05 pu. The voltage regulation of the solar panel appears to be more fluctuating as long as the hourly voltage profile at bus 14 is concerned; in comparison with the one resulting from the wind generator. The wind appears to exhibit more bounded excursions duration of the day. The power delivered by each of the VRG is presented in this diagram. This highlights the unstable characteristics of the VRG system; whatever solar or wind systems. Nonetheless, Fig. 4 suggests that the variability of wind generation is somewhat less than that of the solar PV one; albeit dropping to almost zero at 6:00 pm. While short term fluctuations are smaller in case of wind; therefore the total voltages and losses are is better than the solar PV.

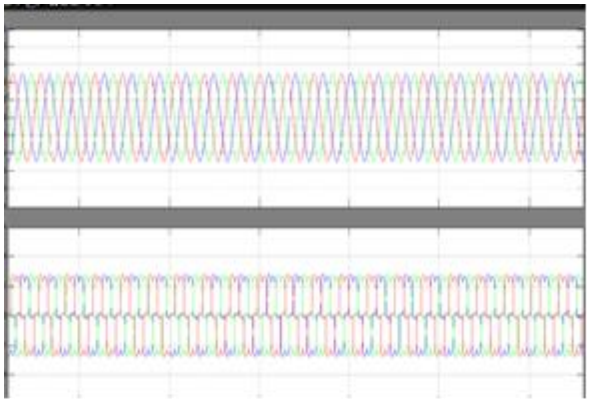

Chart -1: Wind voltage and current

The red- colored line, for the PV, shows a maximum voltage magnitude of 0.9982 pu and a minimum voltage magnitude of 0.9870 pu with corresponding losses of 118.6 kW.

The base case power flow without any VRG, gives a voltage magnitude of 0.9861 pu at bus14. The output voltage of the solar/wind system at different hours of the day, due to the integration of solar PV is shown in Fig.1.

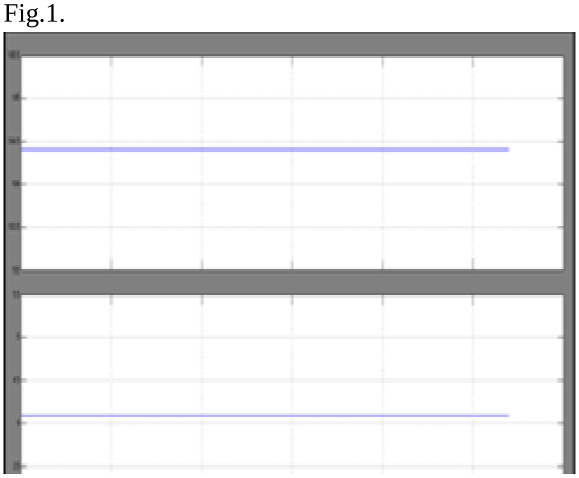

Chart-2: Solar voltage and current

The increase in system losses due to hybrid solar and wind turbine is a result of a minor increase in its size. The losses on distribution system reduce to a minimum as the DG increases in size up to an optimal level. However, the losses start to increase if the size of the DG is further increased. It may even overshoot the base case losses. There is appreciable voltage increase in the hybrid solar and wind compared to the individual use of solar PV and wind.

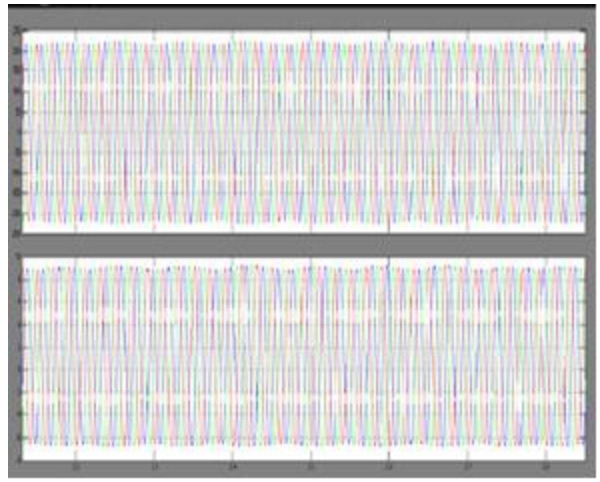

Chart-3. AC output voltage and current

Meanwhile, the output voltage and current with the wind turbine connected independently to the microgrid is shown in Fig.6. Its maximum voltage is 0.9972 pu and the minimum is 0.9933 pu and the losses of 116.2kW.

IV.CONCULSION

Accelerated installation of variable renewable generation coupled with the introduction of the smart grid, have created an increased interest in microgrids. This paper has demonstrated the voltage regulation in a microgrid system comprising hybrid solar PV/wind turbine in the autonomous operation mode. Solar PV and wind turbine size and locations in the microgrid were preselected. Simulation studies were carried out on a microgrid system to test the impact of various individual and variable renewable energy (solar/wind) combination. The hybrid solar PV/wind generation provided more effective voltage regulation to the microgrid system as compared with each of the solar PV/wind turbine acting alone. Furthermore, when the voltage variation fell beyond the capabilities of the hybrid system, the combination of demand response (DR), a feature of the smart microgrid, with the hybrid PV/wind system were apt to bring the voltage back within statutory limits. Voltage drop across the distribution feeders reduce in the case of load curtailment due to DR, causing an increase in the voltage at the far end of the MG's feeder system.

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