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Power Quality Analysis in Hybrid Energy Generation System

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Abstract: ***Application with renewable energy sources such as solar cell array, wind turbines, or fuel cells have increased significantly during the past decade. To obtain the clean energy, we are using the hybrid solar-wind power generation. Consumers prefer quality power from suppliers. The quality of power can be measured by using parameters such as voltage sag, harmonic and power factor. To obtain quality power we have different topologies. In our paper we present a new possible topology which improves power quality. This paper presents modeling analysis and design of a pulse width modulation voltage source inverter (PWM-VSI) to be connected between sources, which supplies energy from a hybrid solar wind energy system to the ac grid. The objective of this paper is to show that, with an adequate control, the converter not only can transfer the dc from hybrid solar wind energy system, but also can improve the power factor and quality power of electrical system. Whenever a disturbance occurs on load side, this disturbance can be minimized using open loop and closed loop control systems. Computer simulation results are presented to verify the s performance of the proposed PWM-VSI by using P Spice software***

Keywords: ***Power Quality, Hybrid, Harmonic, PWM-VSI, Push- Pull Inverter, Solar, Wind, Open Loop, Closed Loop Control.***

I. INTRODUCTION

Stand-alone power generation systems are utilized by many communities and remote area around the world that have no access to grid electricity Renewable energy sources are predicted to become competitive with conventional power generation systems in the near future. Unfortunately, they are not very reliable. For example, the PV source is not available during the night or during cloudy conditions. Other sources such as FCs may be more reliable but have economic issues associated with them. Because of this, two or more renewable energy sources are required to ensure a reliable and cost- effective power solution. Such a combination of different types of energy sources into a system is called a hybrid power system. With increasing concern of global warming and the depletion of fossil fuel reserves, many are looking at sustainable energy solutions to preserve the earth for the future generations. Other than hydro power, wind and photovoltaic energy holds the most potential to meet our energy demands. Alone, wind energy is capable of supplying large amounts of power but its presence is highly unpredictable.

As it can be here one moment and gone in another. Similarly, solar energy is present throughout the day but the solar irradiation levels vary due to sun intensity and unpredictable shadows cast by clouds, birds, trees, etc. The common inherent

drawback of wind and photovoltaic systems are their intermittent natures that make them unreliable. However, by combining these two intermittent sources and by PWS-VSI, the system's power transfer efficiency and reliability can be improved significantly.

Hybrid means utilization of two or more sources for the single load. So many advantages may be derived from Hybrid wind-solar generation. System is using these are:

1. Continuous power can be supplied to the consumers.
2. Environmental pollution can be reduced by using Hybrid solar- wind generation system.
3. Hybrid solar-wind can be made available to the for away consumers at economical rate from the utility saving hydraulic energy, which can be Kept in the dams during the dynamic, to be used at height. That is the dams may operate as an energy storage system.
4. The maintenance cost of hybrid solar-wind generation system is less when compared to conventional generation system. We can supply the power with low cost to the consumers.
5. In spite of a very attractive alternative with a reasonable price, the feeding of energy generated by a hybrid solar-wind generation into an existing AC grid poses some problems to the control of the converters that connect the two systems. This is especially true if the AC system cannot supply reactive power and absorb harmonic current.

II. Proposed Three Phase Inverter

The objective here is to present a modeling, analysis and design of the DC-AC converter and its controller. This system should transfer the energy from the DC link to the 3- phass AC system with controlled active and reactive power and without injecting harmonic currents and if necessary it may be designed o filter out harmonic components. Digital simulation and experimental results are presented to validate the theory. The output of hybrid solar-wind generation system is given to the push-pull inverter as input.

The push-pull inverter consists of two switches and midpoint transformer.

The ON-OFF time of the switches is very low to get high frequency at the output of the push-pull inverter. The 12v Dc supply is given to the push-pull inverter as the input. In this push-pull converter, there are two switches are present, that are S1 and S2. S1 is conducts in positive half cycle and S2 is off then the supply voltage positive terminal directly connect to the middle tapped point O of center tapped transformer The output of the inverter is 230V, 100KHZ. The output of the push-pull inverter is given as an input of the diode rectifier. The LC filter removes the higher harmonics. The DC voltage across the capacitor act as a source for VSI. The lower harmonics is removed by using PWM technique. The eight valid switch states.

MOSFET's S1,S2,S6 are on and S4,S5 and S3 are off then vab is Vs and Vbc=0 and Vca is –vs. in state1 s3,s6 and s7 are On,s4,s5 and s8 are off .in state2 s6,s4 and s3 are on , s7,s8 and s5 are off .in state 3 s4,s8 and s6 are on and s3,s7 and s5 are off and similarly remaining states until the state8 continuous The PWM technique is advantageous over other method, because we can vary the output voltage, removing the harmonics and improve the power factor simultaneously.

III. Digital Simulation

Considering there is no disturbance in load side and source side, then the output voltage of DC-AC is constant and its output has less harmonic distortion by using PWM-VSI Simulation of open loop configuration without disturbance

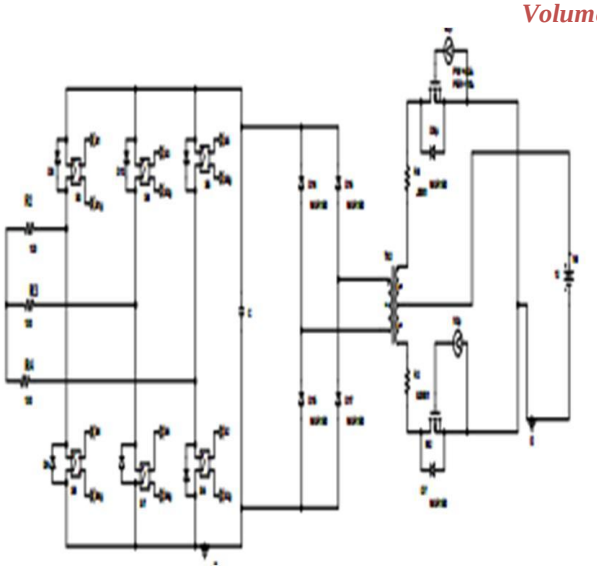
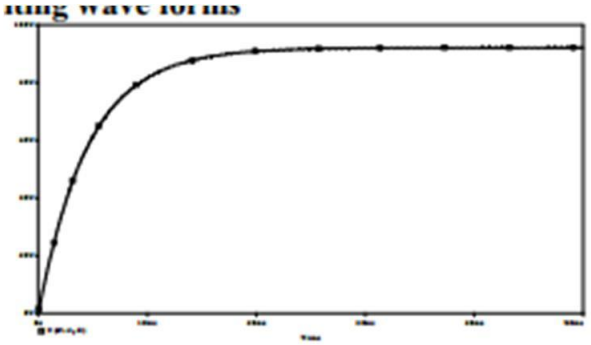


Fig 1: Three phase inverter fed push pull Dc to-Dc converter



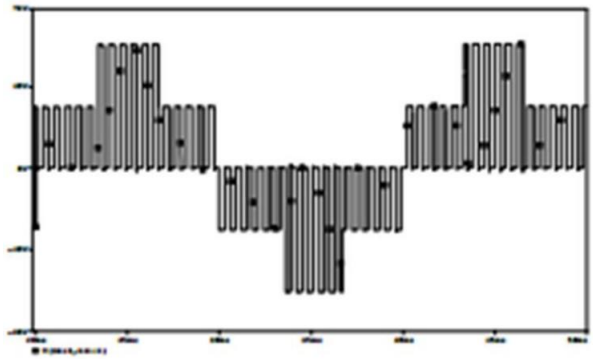


Fig 2 :Inverter R-phase voltage

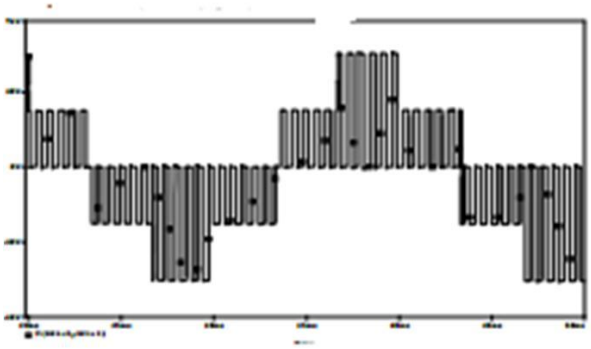


Fig 3: Inverter Y-phase voltage

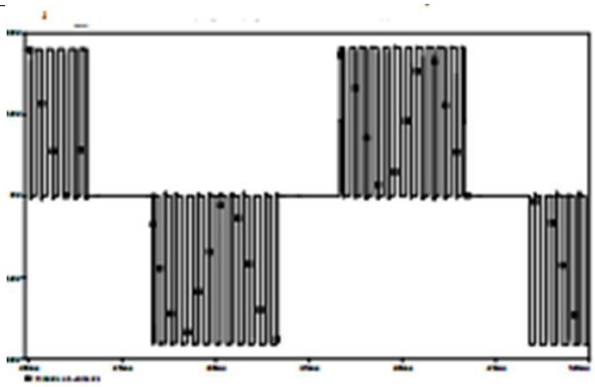


Fig 4: Inverter B-phase voltage

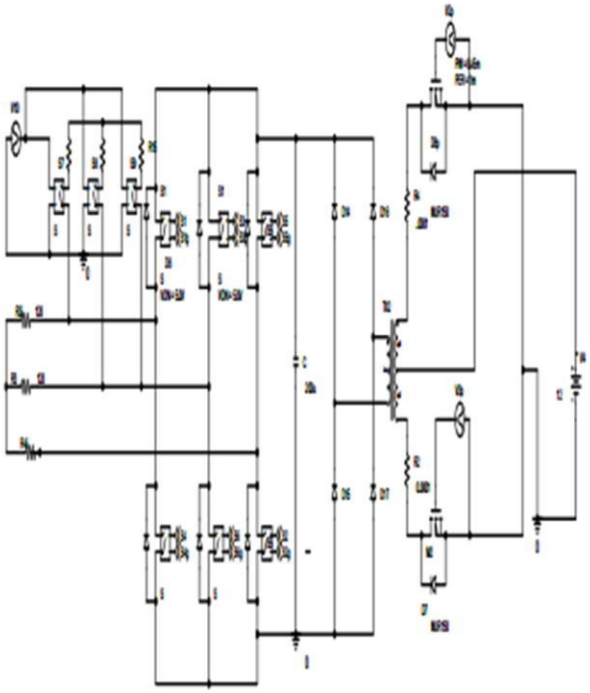


Fig 5: Circuit Diagram of Open Loop Control with load side disturbance

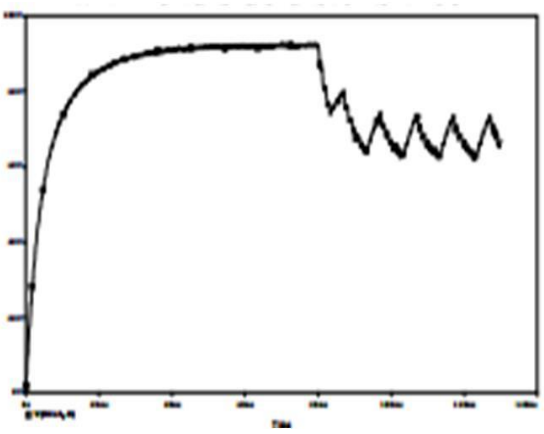


Fig 6: Inverter Input Voltage With Load Side Disturbance

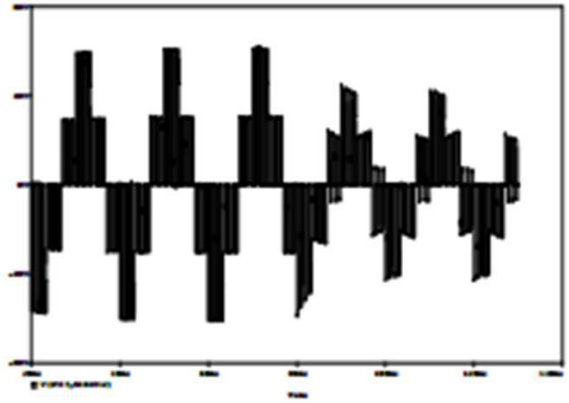
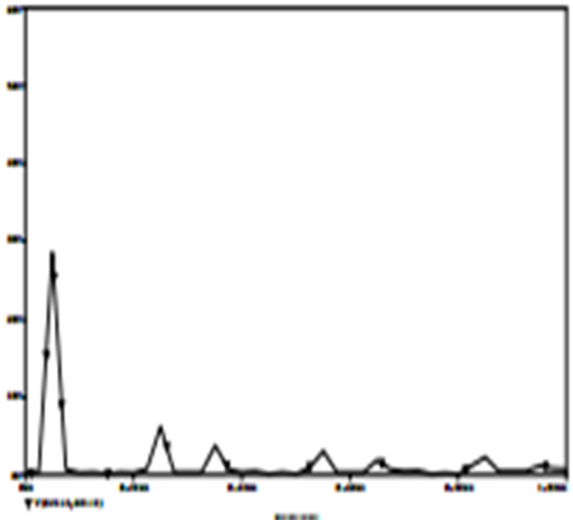


Fig 7: Inverter Output R-phase voltage with Load side disturbance



Frequency spectrum for phase (R) 5. Simulation Of Open Loop Configuration With Load Side Disturbance

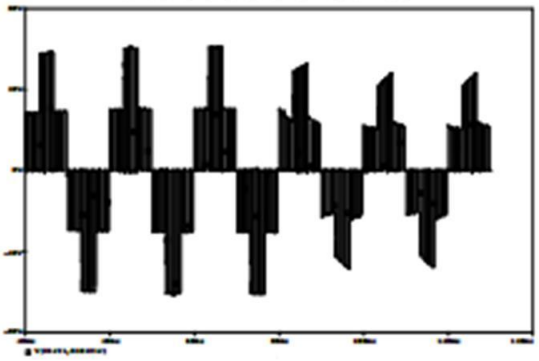


Fig 8: Inverter Output Y-phase voltage with Load side disturbance

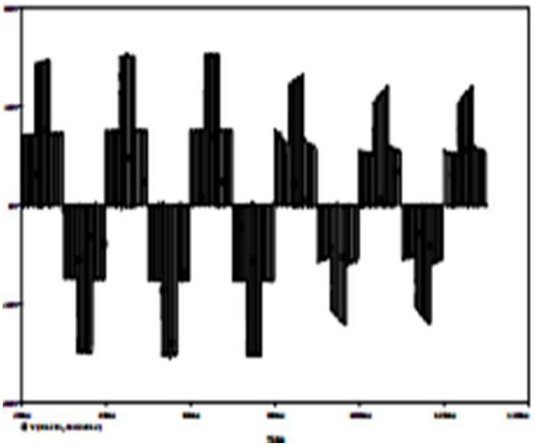


Fig 9: Inverter Output B-phase voltage with load Side disturbance

IV. CONCLUSION

Wind and solar power are safe, and do not send emissions or residues to the environment. The production of clean energy, which is harmless and does not aggravate the greenhouse effect, must be promoted. The use of electricity generated from renewable non-pollutant energy sources (green electricity), and all technologies involved must increase the scientific community is also contributing with technological innovations. Nowadays, the development of Power Electronics enables economical solutions for the production of renewable energy based on small power plants. Portugal presents good conditions for the implementation of a large number of these systems, based on wind power and photovoltaic energy. This paper proposes the development of a low-cost high efficiency hybrid system (wind and solar) with an interface to the electrical grid that ensures the power quality of the produced energy. The proposed solution may be a contribution to a better, cleaner and safer environment and to a decrease in energy dependence.

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