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# Effective Grid Integration of Pv And Wind Energy System With Power Quality Improvement Featuers

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**Abstract – With the prevailing power crisis due to ongoing depletion of fossil fuels, renewable energy has become an important area. The penetration of distributed and renewable generation at low and medium voltages into power system is rapidly increasing. The emerging new technologies such as wind energy, fuel cells, solar and micro hydro power sources make Distribution Generations more and more affordable and popular in this area. This paper presents some filter configurations to improve the power quality in this PV and wind system. We involve modelling and study of effective grid system built in SIMULINK MATLAB environment.**

***Index Terms— PV array, Micro grid, power quality, wind energy system, boost converter.***

## I. INTRODUCTION

As electric distribution technology steps into the next century, many trends are becoming noticeable that will change the requirements of energy delivery. These modifications are being driven from both the demand side where higher energy availability and efficiency are desired and from the supply side where the integration of distributed generation and peak shaving technologies must be accommodated.

Power systems currently undergo considerable change in operating requirements mainly as a result of deregulation and due to an increasing amount of distributed energy resources (DER). In many cases DERs include different technologies that allow generation in small scale (micro sources) and some of them take advantage of renewable energy resources (RES) such as solar, wind or hydro energy. Having micro sources close to the load has the advantage of reducing transmission losses as well as preventing network congestions. Moreover, the possibility of having a power supply interruption of end-customers connected to a low voltage (LV) distribution grid is diminished since adjacent micro sources, controllable loads and energy storage systems can operate in the islanded mode in case of severe system disturbances.

Throughout the world, electrical energy is a priority issue for governments, companies, and research institutes, and varying viewpoints are continually be presented in relation to the optimum priorities of generation technologies in both developed and developing countries. For example, developed countries are mainly concerned with the reduction of pollution emissions caused by conventional power plants using fossil fuels such as coal and oil. In the past, nuclear energy was a favourite option for some of these countries, but due to a number of global accidents (such as the tsunami disaster in Japan that caused destruction of nuclear reactors with catastrophic consequence) nuclear reactors are now being perceived as potential threats. Developing countries are seeking solutions for the mitigation of high conventional energy prices and for the political and economic limitations imposed on them in relation to building nuclear reactors.

Now a day's solar and wind power generation are the most commonly used methods nowadays, and statistics show that wind power capacity has increased at a rate of over 20% per year over the past decade in the U.S. and Europe, and the future energy share of wind-generated power will be more than 20% within the next two decades. In relation to solar energy generation, however, the special requirements involved in its production, namely, the high technology and costly fabrication methods of energy cells and the huge land areas required, are basic constraints preventing the spread of its use. In contrast with solar-generated power, wind is available throughout most of the year, and many different types of wind turbines (WTs) are offered by several companies, with different models delivering relatively low ratings and affordable prices.

India has been blessed with a huge renewable power potential of 245,880MW. Renewable sources in India has emerged as crucial area in the grid connected electricity and contribution 12.7% to the total power, it is playing an important role in reducing the gap between the energy/ peak power demand and supply benefiting millions of rural people. Distributed Generation (DG) are considered as green power which are decentralized, modular and more flexible technologies, that are located close to the load they serve. By integrating available DER's the entire systems can be operated and coordinated within and without grid. Many DGs can be installed on or close to the customers to deliver power rather than the conventional way of transmitting power from centralized power plants over transmission and distribution lines.

Usage of power electronic converters is most common method for interfacing of existing grid with renewable sources of energy, like wind, solar, fuel cell etc. This provides reliable power supply and minimizes the losses of transmission and distribution systems. In the meantime the quality of the power delivered to the end user equipment is also essential for the efficient functioning system. Amongst the renewable source of energy, the photovoltaic and wind power systems started gaining popularity with heavy demand in energy sector due to their advantageous like eco-friendly, omnipresent, cost effective maintenance and have longer life.

## II. OVERVIEW OF SOLAR AND WIND ENERGY CONVERSION SYSTEMS

Renewable sources of energy, for example, sunlight based and wind are developing as feasible contrasting alternatives to take care of the developing energy demand of the expanding contamination reinforcing the transmission and distribution network with the combination of local producing units would help in taking care of the demand.

Every day, the sun emits light energy at free of cost. One of the effective alternative energy sources for the future has been identified as solar energy. Solar energy converted into electricity by PV plants. PV panels are comprised of semiconductor material namely; Silicon (si), Germanium (Ge), Gallium Arsenide (Ga-As), Amorphous silicon, and thin film materials etc. that allows direct conversion of sunlight into electricity and provides power for long time. PV systems are categorized and being installed from based on the needs, location, budget and sizes ranging into three types such as Autonomous, hybrid systems, and grid connected systems. Autonomous systems are called as standalone systems which consist of solar PV panel, batteries with charging unit and inverter.

A solar cell (photovoltaic cell) is a device which converts the sunlight falling on it to electrical energy by utilizing the principle of photovoltaic effect. The energy obtained during this process is commonly referred as solar energy. About 5 to 15 % of light that strikes it is converted into useful electrical current. PV cells are modular PV cell each of capacity of producing one half watt of electricity are mounted together are called modules which holds approximately about 40 PV cells are connected together to obtain required magnitude of operating parameters Solar Cell Multiple PV modules are combined to form an array. Larger the area of a module proportionate electricity will be produced. PV arrays connected in series and parallel arrangement fashion to generate any prerequisite direct current (DC).

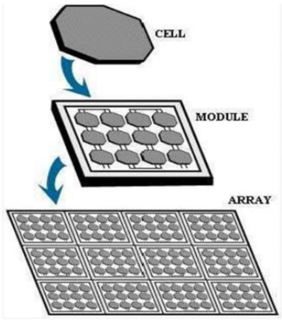


Figure 1: The PV array set up

When sunlight hits the solar panel semiconducting materials, such as silicon, germanium absorbs the photons in the sunlight. Then electrons loose from their own atoms, causing free flow of electrons through the materials which leads to the production of electricity. Due to the special arrangement and composition electrons are only allowed to flow in a unidirectional. Finally the output available from the PV array is direct current (DC).

A basic identical PV circuit model is given by an ideal current source in parallel with a real diode, a series and shunt resistance as shown in Fig. 2.4. The ideal current source develops output in accordance to the solar irradiance exposed on it. This is a feasible and most widely used model. Figure below shows the single diode model circuit.

Open-Circuit Voltage And Short-Circuit Current: The most crucial parameters for assessing electrical performance of any component are open-circuit voltage Voc and the short out current Isc. In general open circuit voltage of PV array is obtained by applying rated voltage under load terminals at open condition and similarly short circuit current is obtained by applying rated current when field terminals are shorted.

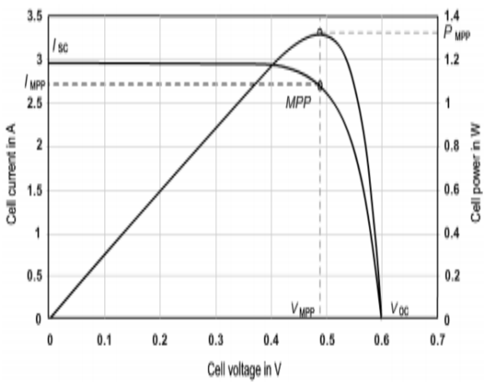

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Figure 2: Current vs voltage (I-V) and Power vs voltage characteristic of the PV module

Traditionally windmills were utilized widely as a part of medieval times to mill grain and lift water for land seepage and watering cattle. Wind energy converters are still utilized for these reasons today as a part of the world however the principle attention of consideration now lies with their utilization to produce power Basic components of wind energy conversion systems (WECS) the basic components of WECS are shown in figure 3.

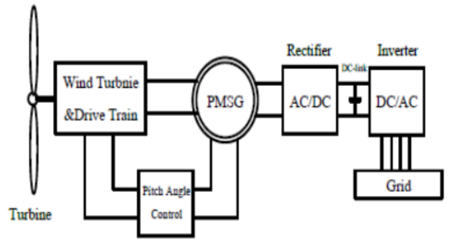


Figure 3: General Working Principle of Wind Energy System

## III. CONVERTER TOPOLOGIES

A Boost converter is a switch mode DC to DC converter in which the output voltage is greater than the input voltage. It is also called as step up converter. The name step up converter comes from the fact that analogous to step up transformer the input voltage is stepped up to a level greater than the input voltage. By law of conservation of energy the input power has to be equal to output power

The main working principle of boost converter is that the inductor in the input circuit resists sudden variations in input current. When switch is OFF the inductor stores energy in the form of magnetic energy and discharges it when switch is closed. The capacitor in the output circuit is assumed large enough that the time constant of RC circuit in the output stage is high. The large time constant compared to switching period ensures a constant output voltage $V_o(t) = V_o$(const

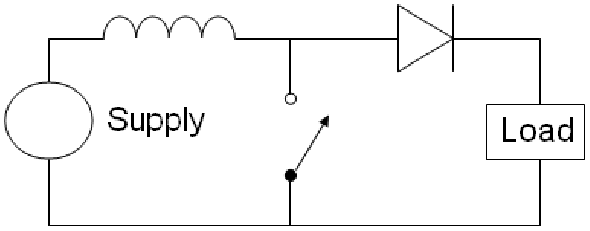


Figure 4: boost converter

Assume in the entire analysis that the current swing (maximum to minimum value) through inductor and voltage swing through capacitor is very less so that they vary in a linear fashion. This is to ease the analysis and the results we will get through this analysis are quite accurate compared to real values.

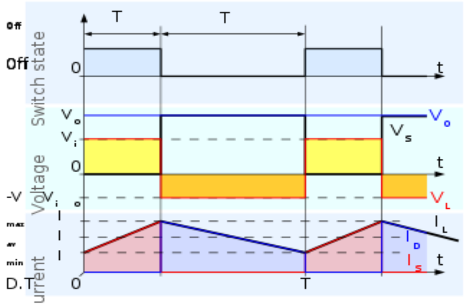


Figure 5: Waveforms of current and voltage in a boost converter operating in Continuous mode

## IV. FILTERS

Due to the grid inverter's switching operation, high frequency harmonics are produced, which could cause trouble to the power system. A line filter is needed in the inverter output in order to remove or reduce the harmonics and the ripple content in output voltage to meet the standard values. Passive line filters are normally used as L or LCL filters. The LC filter is not desired with grid-connected inverters, as the resonance frequency of the filter would be largely affected with the grid inductance. To choose between L and LCL filters. The two filters were chosen to have nearly the same attenuation below the resonance frequency.

In this paper explains the design of the filter circuit and system aiming to keep the DC injection low below the standard limit. The LCL-filter design is not an easy task as many research papers were heading towards this direction. Due to the notch around the resonance frequency, this filter may cause instability problem and it needs to be designed carefully. Numerous quantities must be considered while outlining a LCL filter design, such as filter size, current ripple and switching ripple attenuation. The capacitor interfaced with the grid may cause resonance with the variation of reactive power requirements. Passive or active damping must be including by incorporating a resistor in series with the capacitor. Passive damping solution has been embraced, but active solutions can also be used for this work

The resonant frequency is represented as to diminish oscillations and unstable conditions of the filter, the capacitor ought to be included in arrangement to associated resistor. This arrangement is called

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'passive damping'. It is simple in structure and reliable, however it increases the losses due to heating of the network and it greatly diminishes the effectiveness of the filter.

## V. MATLAB/SIMULINK RESULTS

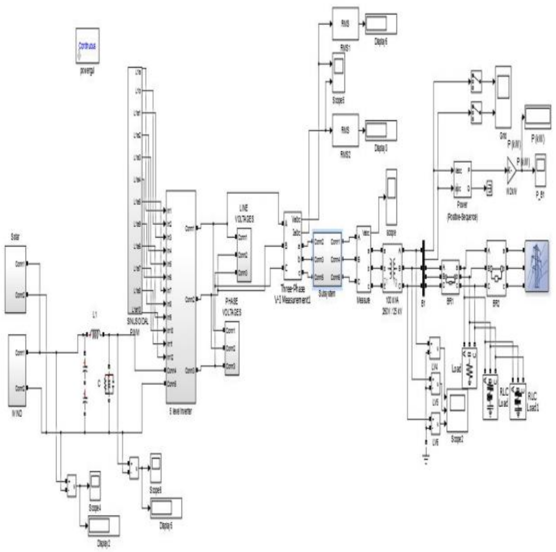

Figure 6: Proposed configuration of the grid integrated solar and wind system

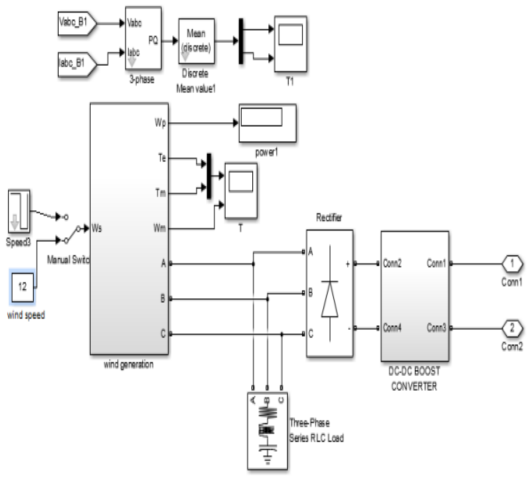


Figure 7 Wind generation system connected to boost converter.

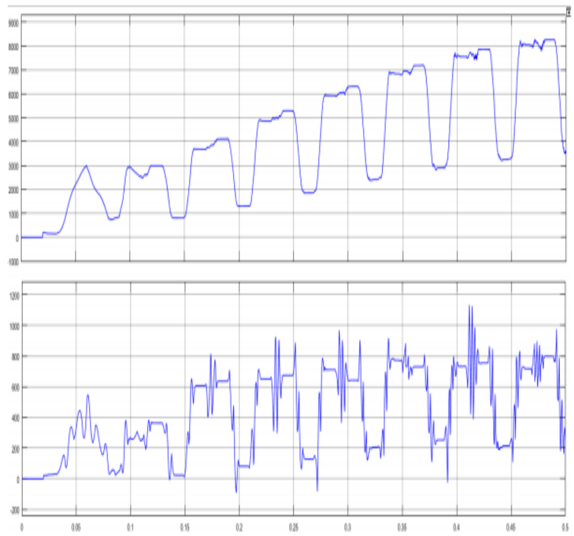

Figure 8: active and reactive power of the wind generation system

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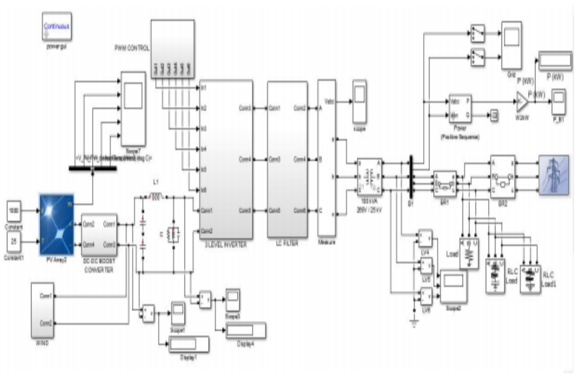

Figure 9: Simulation model of Grid integrated PV/wind system using 3 level inverter

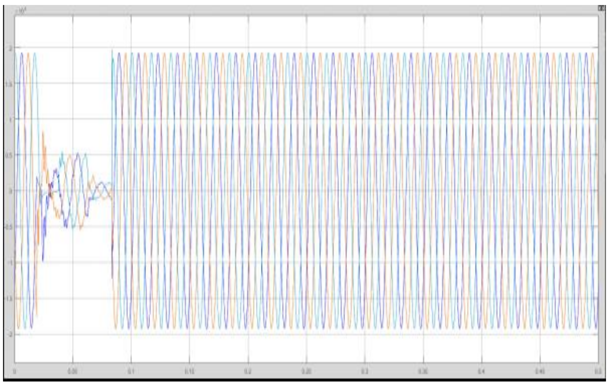

Figure 10: Phase voltage waveforms at bus B1

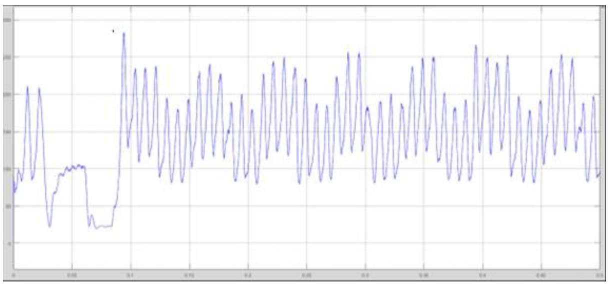

Figure 11: Waveform of DC voltage given to the 3 level inverter.

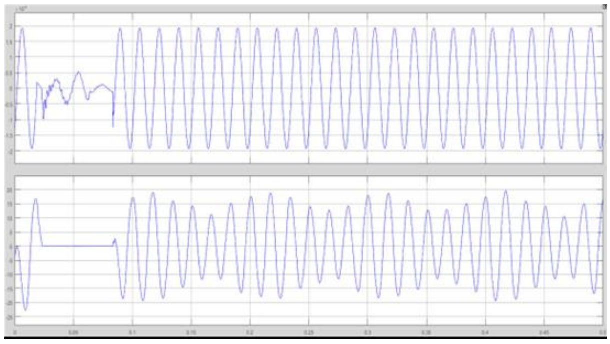

Figure 12 Waveforms of grid voltage and current

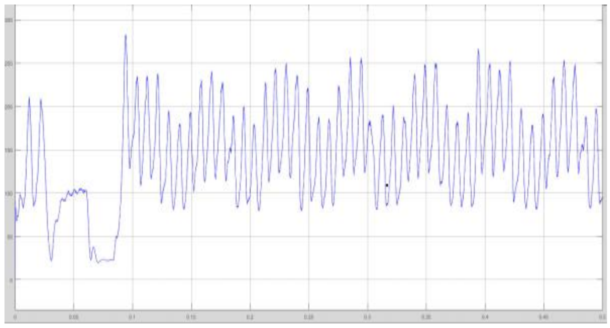

Figure 13: Waveform of the active power at the bus_B1

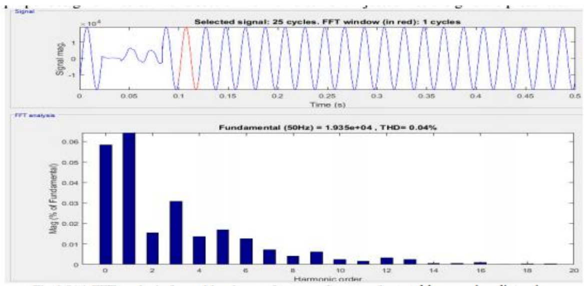


Figure 14: FFT analysis for grid voltage of proposed system for total harmonics distortion % VTHD

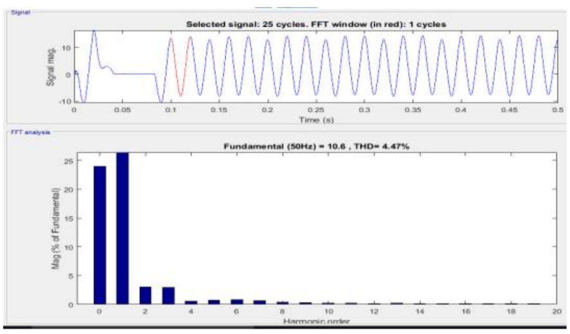

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Figure 15: FFT analysis for grid current of proposed system for total harmonics distortion % ITHD

## VII. CONCLUSION

The aim of this work is to improve the efficiency and enhance the performance of the proposed grid integrated PV/ wind hybrid system by using 3-level inverter. Performance improvements of the detailed research work and contributions have been highlighted within this paper. The proposed system architecture provides an elegant integration of the two renewable energy systems to extract optimum energy. Both wind PMS generator output is transformed to DC by using a uncontrolled rectifier and PV panel outputs are integrated and given to the inverter The present work mainly focuses on the grid tied mode of operation of integrated PV/wind grid. Cascaded H bridge inverter model is being developed to ensure system stability under diversified loads and also the control mechanism are presented. Excellent performance of the inverter with negligible fluctuation of the DC bus voltage is obtained. The simulated models were exact and are utilized to decide the voltage and current characteristics

The dynamic PV performances were examined under different operating conditions. The results demonstrated here shows that the DC voltage extracted from the PV array delivers an AC sinusoidal current at the output of the Voltage source inverter which are integrated to the PMSG. The efficiency relies on the minimization losses occurred during conversion and minimization of ripples existed in output waveform. The hybrid grid can ensure efficient, high a reliable and quality power to end loads. The simulation of grid systems has improved the voltage profile and the adequate performance of Hybrid PV/wind system is being analyzed. The harmonic analysis of the grid voltage and current performed and the THD is obtained which comes out to be 0.04% and 4.47 %.

## REFERENCES

[1] Mukhtiar singh, vinod khadkikar,"grid interconnection of renewable energy sources at the distribution level with power quality improvement features" IEEE transection on power delivery vol .26, 1, january 2011.

[2] J.P.Pinto,R.pregitzer,L.S.C Monteiro,and J.L. Afonso, "3-phase 4-wire shunt active power filter with renewable energy interface,"presented at the conf.IEEE Renewable energy and power quality,seville,spin,2007.

[3] J.M.Carrasco,L.G.Franquelo.J.I.Leon, and N.M.Alionso. "power electronic systems for the grid integration of renewable energy sources: Asurvey," IEEE Trans.Ind.Electron.,vol.53,no.4,pp.1002-1016.Aug.2006

[4] F.Blaajerg,R.Teodorescu,M.Liserre,and A.V.Timbus. "Overview of control and grid [3synchronization for distributed power generation systems."IEEE Trans.Ind.Electron., vol.53,no.5,pp.1398-1409,oct.2006

[5] Stefano Barsali, Massimo Ceraolo, Paolo Pelacchi, Davide Poli, "Control techniques of Dispersed Generators to improve the continuity of electricity supply" , IEEE, 2002.

[6] F. D. Kanellos, A. I. Tsouchnikas, N. D. Hatziargyriou, "Micro-Grid Simulation during Grid-Connected and Islanded Modes of Operation", International Conference on Power Systems Transients, pp. 05 – 113, June 19-23, 2005.

[7] Ankita Papriwal, Dr. Amita mahor. "Mitigation of harmonics in inverter", IOSR Journal of Engineering, Volume 2, Issue 9, Sept 2012.

[8] P.V. Abdelaziz fri, Rachid el Bachtiri. "Cascaded h-bridge three-phase multilevel inverters controlled by multi-carrier spwm" Journal of Theoretical and Applied Information Technology, Vol: 58, No.2, 20th Dec, 2013.