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Fault Analysis of DFIG Wind Turbine of Grid Connected Hybrib Wind and PV system

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Abstract — Renewable Energy Resources are best today to meet the increasing demand of power. So the research towards the renewable energy are periodically increased. In wind energy conversion system two masse drive train based wind turbine with zero pitch angles drives Doubly Fed Induction Generator (DFIG) while solar potential is used to generate energy. The combined output of WIND/PV is converted into AC by using Synchronous Reference Frame Theory (d-q theory). A model of hybrid wind and photovoltaic system is developed in MATLAB simulation. Fault analysis and its protection is main thig for reliability of power supply.

Keywords- Renewable Energy, Hybrid wind/PV, DFIG

I. INTRODUCTION

Since the tenth century wind power has been in use for applications of water pumping, and grain grinding. At location, where sufficient wind energy exists, a large scale wind turbines have been installed to produce electricity. In 1930s, the Russians built a large windmill of 100 ft diameter blade, but it had very low power conversion efficiency. The solar energy and wind energy that are used as a input sources of hybrid wind and PV system. A solar system is one which utilizes solar radiation to generate electrical energy. PV cell is generally made from semiconductor material like silicon and can produce direct current from sunlight. The best silicon cell available have an efficiency of about 18%. Wind Power system is a system which converts kinetic energy of air into electrical energy. Wind power is one of the fastest growing renewable energy resources in last few years but individual energy resources either wind or solar may not be effective in terms of cost, efficiency and reliability because it is highly in irregular in nature. So hybrid wind and PV is best suitable for high reliability of power supply.

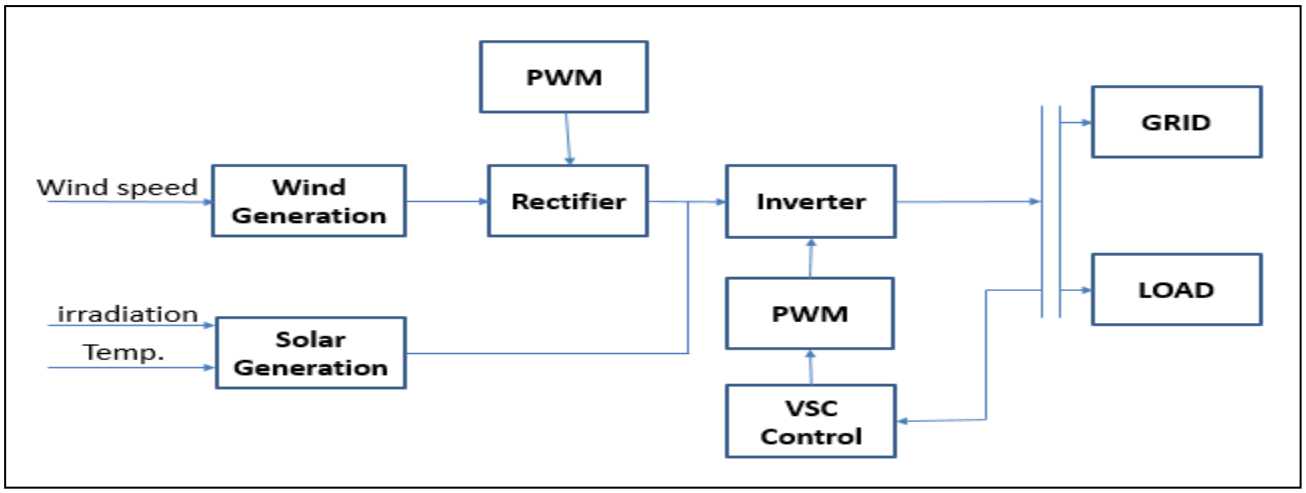


Figure 1. Basic Block Diagram of hybrid wind and PV system

Wind energy is renewable, widely distributed, completely pollution free and echo friendly. It also uses a little land as compared to conventional power plant. In 2010 wind energy production was about 2.5% of worldwide electricity usage. And its use is increasing at a rate of 25% per annum. The speed of wind varies from location to location, but the wind speed at higher altitudes is more. And the wind is also very consistent. Small wind generation systems have been installed in cities too. In this paper, the Study of hybrid power system is done on the low scale wind generation systems. The distributed generations also have some negative impact on the power system. The DGs should be properly coordinated with the power system protection. Otherwise it can lead to decrease in reliability of the power system.

II. SRF (d-q) MEHODE FOR CONTROL OF INVERTER

The d-q theory is based on a synchronous rotating frame derived from the mains voltages with the use of a Phase Locked Loop (PLL). In this theory, active filter currents are obtained from the instantaneous reactive and active current components (iLd and iLq) of the nonlinear load in a two-step. The load current in the a-b-c reference frame is transformed to the reference frame, in first step and in the second step, these stationary reference frame quantities are then transformed into synchronous reference frame quantities based on the Park's Transformation.

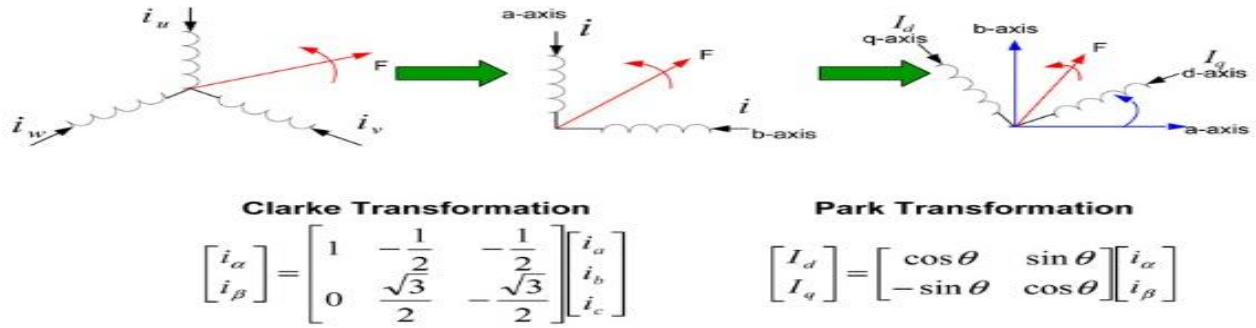


Figure 2. Basic of d-q Theory

The block diagram of this theory is given in Figure .In then online ear load case, the instantaneous active and reactive load currents can also be decomposed into oscillatory and average terms. Since the d and q axes rotate at an angular frequency 'w' (=2*pi*f) in the w plane and the first harmonic positive sequence current is transformed to a dc quantity and other current components constitute the oscillatory parts.

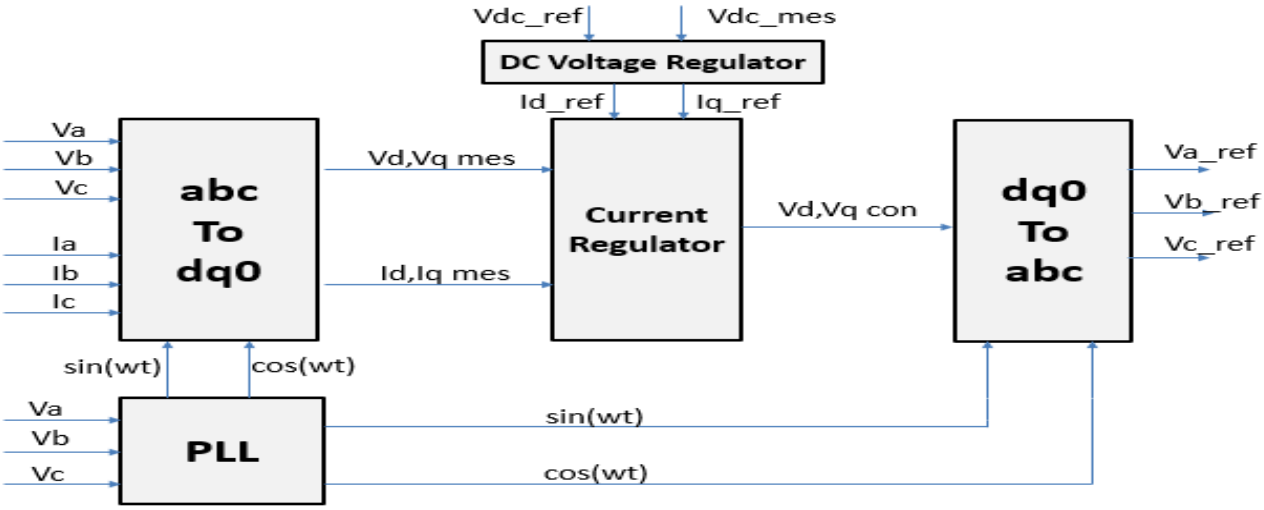


Figure 3. Basic Block Diagram of VSC Controller

The controller design problem of a grid-tie inverter bypassing DQ trans-formation. First, we show that the cascade connection of DQ transformation, a transfer function, and the inverse transformation is equivalent to a linear time-invariant system having a certain structure. Furthermore, the result is extended to the situation where the angle velocity is not constant. Second, we analyze the effect of positive phase and negative phase signals by the transfer function.

3-phase bridge type VSI with square wave pole voltages has been considered and the output from this inverter is to be fed to a 3-phase balanced load. This circuit may be identified as three single-phase half-bridge inverter circuits put across the same dc bus. The individual pole voltages of the 3-phase bridge circuit are identical to the square pole voltages output by single phase half bridge or full bridge circuits. To enable the vector representation a rotating coordinate system can be defined to become a constant without any time variations. Thus, a d-q coordinate system has been defined such that the 'd' and 'q' axes rotate at an angular frequency. A balanced three-phase vector representation in this rotating d-q coordinate system will now be constant over all times and the angle is a uniformly increasing function of time.

III. FAULT ANALYSIS

A. Simulation

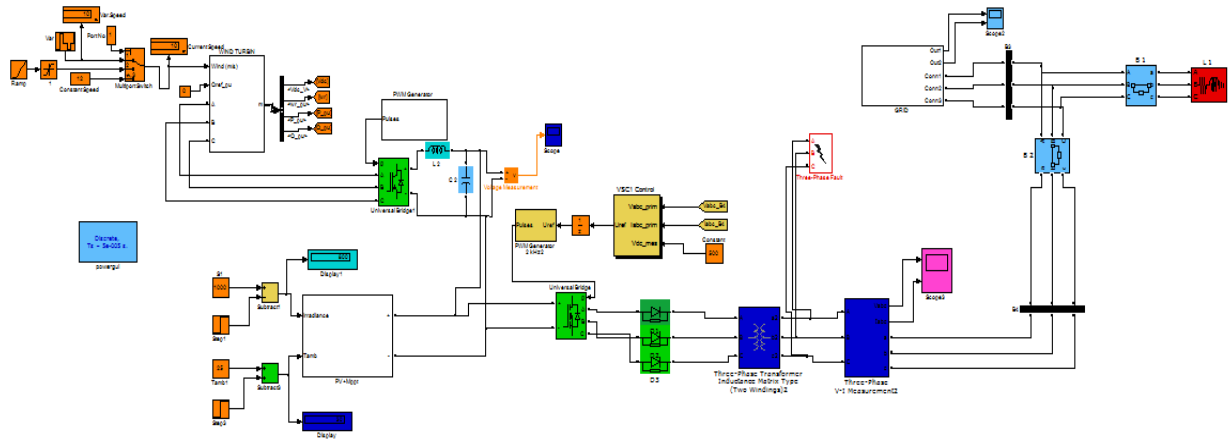


Figure. 4. Simulation of grid side fault on hybrid wind and PV system

B. 3-phase to ground fault

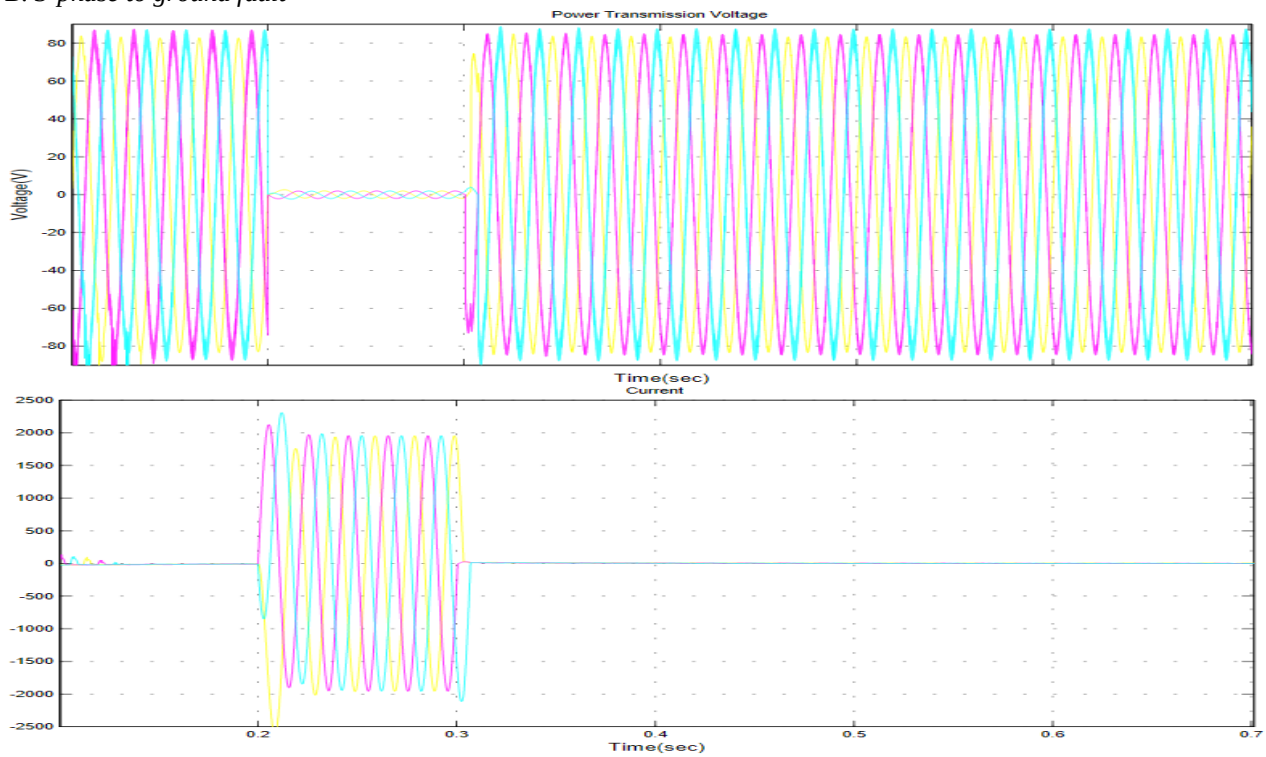
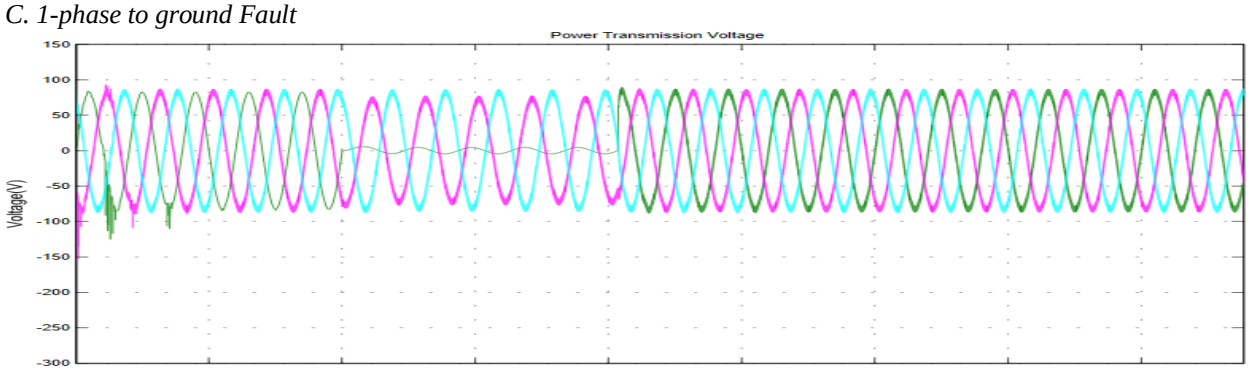


Figure.5. Voltage and Current waveform for 3-phase to ground Fault

C. 1-phase to ground Fault



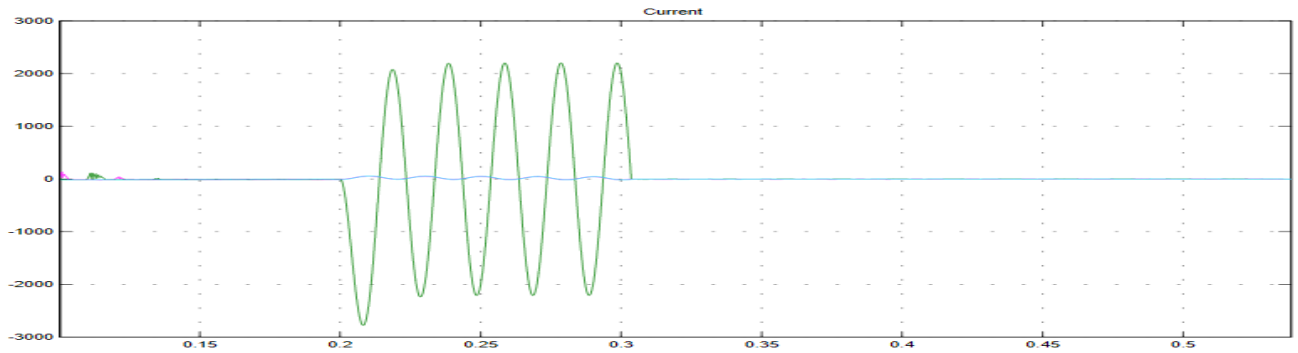


Figure.6 .Voltage and Current waveform for 1-phase to ground Fault

The hybrid system operates in transient condition from time 0.2 to 0.3seconds.lt Shows the variation of currents during transition from the grid connected to the isolated mode and in subsequent operation. It is to be noted that the current deviation is such that the generator will trip because of the system protection. However, this deviation is presented to show extreme conditions and to check the exact current deviation during the transition from 0.2 to 0.3 seconds. The load power is reduced by a small amount after grid isolation because of the reduction in the system voltages caused by the lack of sufficient reactive power in the isolated micro grid system.

IV. FAULT CONTRIBUTION OF DFIG TURBINE

A. DFIG under fault condition

When a fault occurs on a transmission line, over-currents flow in the system so the role of the protection system of the wind generator has to limit the short circuit current. The converter is disconnected from the circuit and connected to a load resistor or dump resistor. The diagram of the fault and protection is depicted in Figure.

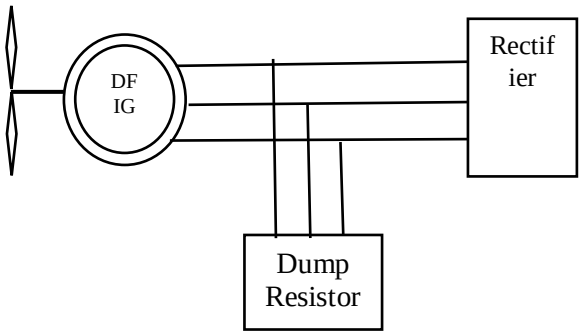


Figure.7. DFIG Under faulty condition

When a short circuit occurs and the current rises, the voltage drops at constant power. Based on this, capacitors in the circuit may be neglected. The rotor is no longer supplied from the voltage source inverter. Instead, it is connected to the dump resistor through a commutator.

B. Simulation

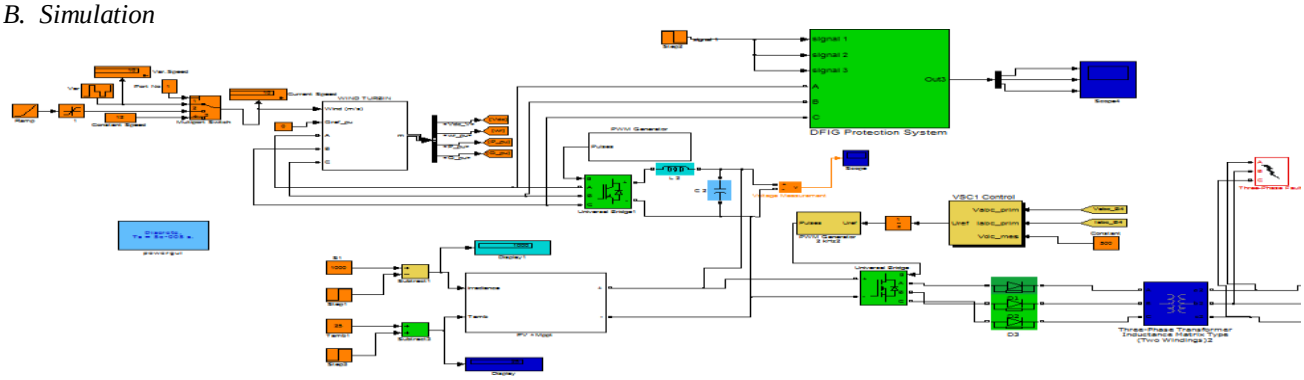


Figure.8. Simulation of DFIG Fault Protection

C. Subsystem of DFIG fault Protection system

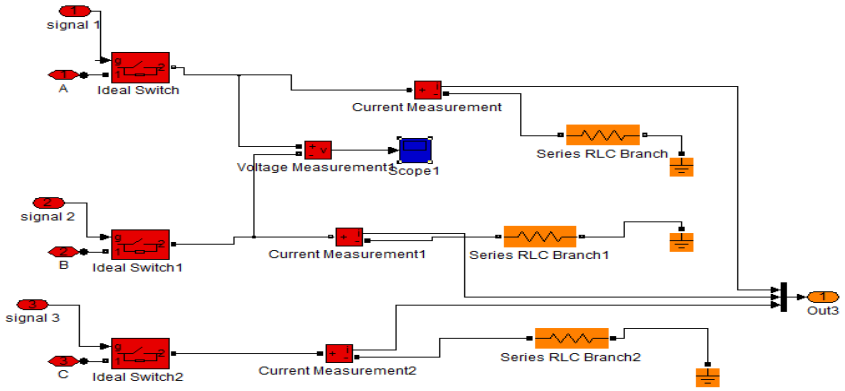


Figure.9. Subsystem of DFIG fault Protection system

D. Results

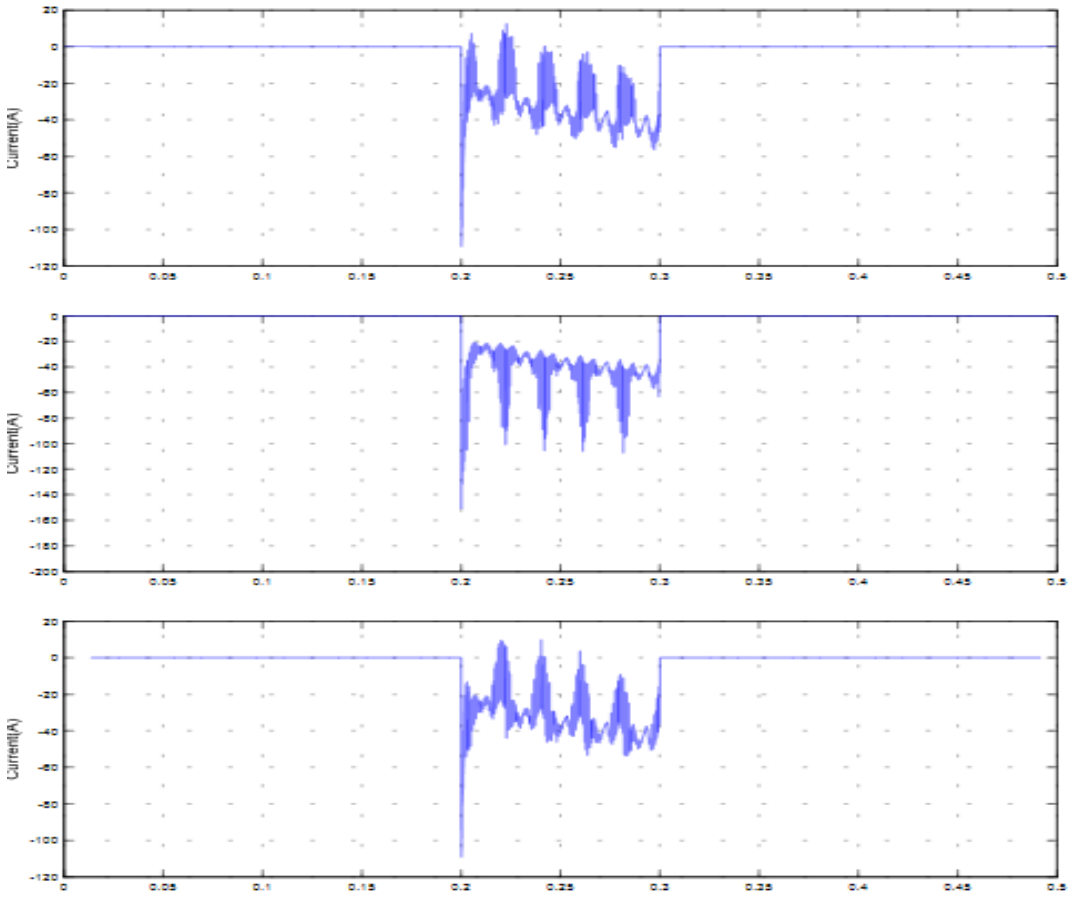


Figure. 10 Current Waveform followin through DUMP Resistor

V. CONCLUSION

This paper presented the modeling, simulation and Control of a grid connected PV and Wind Hybrid Power System. The system is simulated in Matlab/Simulink environment. It is observed that in Wind Energy Conversion system is done using DFIG based wind turbine. The wind output and PV output after converting to AC by the help of PWM,VSC controller and Universal bridge is given to the inverter and then the combination of PV and Wind is given to the grid. The assumption is that the mechanical system cannot respond during the short time of a three phased short circuit. Here equivalent circuits are built to model the fault response of DFIG.

REFERENCES

[1] "Simulation of DFIG and FSIG wind farms in MATLAB SimPowerSystems": Division of Industrial Electric al Engineering and Automation Lund University

[2] Balasubramaniam Babypriya "Modelling, Simulation And Analysis Of Doubly Fed Induction Generator For Wind Turbines": Rajapalan Anita, Journal of Electrical Engineering, Vol. 60, No. 2, 2009, 79–85

[3] G.Walker, "Evaluating MPPT converter topologies using a MATLAB PV model," Journal of Electrical & Electronics Engineering, Australia,IEAust, vol.21, No. 1, 2001, pp.49-56.

[4] Ajay Kushwaha, Inderpreet Singh "Literature review paper on doubly fed induction generator wind turbine technology" 2013IJERSTE.

[5] S.Saib, A.Gherbi "Simulation and Control of hybrid renewable energy system connected to the grid" 2015 IEEE

[6] Z. Chen, Senior Member, IEEE "Issues of Connecting Wind Farms into Power Systems" 2010 IEEE

[7] George Weiss and Qing-Chang Zhong "Some problems with connecting renewable energy sources to the grid" Proceedings of the 19th International Symposium on Mathematical Theory of Networks and Systems.