Rectifying Asymmetrical Grid Faults in Wind Farms by Using FACTS Devices

A.Suganya,Dr.R.Prakash

Abstract:-In a wind farm generation is most popular reliable source in world . But the power distribution side affects severe power quality problems. Small power quality can be rectified by using capacitor bank in generation side. In larger power system capacitor bank cannot be used. Larger problem can be rectified by using FACTS controller. STATCOM can be control the voltage dip in grid side. But it performs shunt compensation only, that is reactive power compensator. But the voltage dip is severe means it cannot provide sufficient current capability to compensate voltage components. Severe problem can be control by using UPFC device. It had two VSC's connected between the capacitor bank. It operates real and reactive power compensator. Hence, the UPFC device provide higher capability for improving the system's dynamic performances. It compensates real and reactive power through the generation side to grid.

Index term:-Induction Generator, Wind Energy, Unified Power Flow Controller, Voltage Sources Converter , Power Quality, Static Var Compensator, Grid ,Voltage Dip

1. INTRODUCTION

The energy is can't be created or can't be destroyed but it can be converted from one form to another. The generation of any type energy into an electrical energy. The electrical power is generated in bulk at the generating stations which are also called power station. The generated electrical energy is demanded caused by some power quality problems. Hence the generated full electrical power is to be supplied to the consumers. Generally the power stations are located far away from the town and cities where electrical energy is demanded. Hence there exists a large network of conductors between the power stations and the consumers. In a wind farm generator directly connected to grid through induction generator. It affects power from some power quality impacts like voltage sag or swell, voltage dip harmonics [2]. Where induction generator provides some torque. It creates oscillations in generator side and it spoils the life of generator driven life.

Naturally medium power transmission have capacitor bank in generator side it can't provide proper compensation [4]. SVC control voltage at bus only and not a power flow in transmission line.

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TCSC controls power flow in transmission line not a voltage control. PQ problem can be reduced by using FACTS devices like STATCOM and UPFC. UPFC control voltage and power flow. STATCOM have only one voltage source but UPFC have two voltage source devices [9]. STATCOM can be connected to capacitor bank [13]. But UPFC had two voltage sources. It can be connected to series and shunt transformers. It gives desired output more than STATCOM device.

Section 2 An analysis of the induction generators behavior under grid faults in Section 3 is followed by the presentation of the proposed UPFC control structure in Section 4 Control Structure in Section 5. Simulation results are given in Section 6 A conclusion closes this paper.

2. AN ANALYSIS OF THE INDUCTION GENERATORS BEHAVIOR UNDER GRID FAULTS

The power system is consists of a 50-MW wind farm with squirrel cage induction generators directly connected to the grid and a 50-MVA UPFC. Model of the wind farm is used as usual here, which means that the sum of the turbines is modeled as one generator circuit [3]. The UPFC is modeled as controlled voltage sources. Both VSC's are connected to the low voltage bus and then connected to the medium voltage bus by a transformer.

The medium voltage level is connected to the high voltage level by a second transformer. Both transformers are rated for the sum of the wind farm and UPFC power and have a series impedance and shunt impedance. The grid fault is assumed at the high voltage level of the grid.

The fixed-speed induction generator (FSIG)-type directly connected to the grid. The doubly fed induction generator cannot directly connect to the grid. Because this generator type cannot provide reactive power control, it cannot fulfill the demanding grid code requirements without additional devices [9]. During voltage dips, the induction generators may consume a large amount of reactive power as their speed deviates from the synchronous speed, which can lead to a voltage collapse and further fault propagation in the network. Different methods have been investigated to enhance the fault-ride-through capability and to fulfill grid code requirements. Besides using the pitch control of the turbine the installation of a facts device has been identified to provide the best dynamic stability enhancement capabilities.

3. UPFC CONTROL STRUCTURE

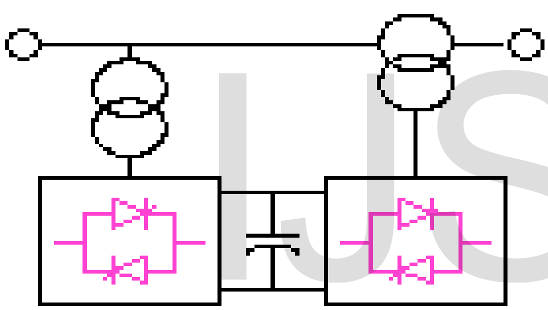

Fig.1. Model Diagram of UPFC

In existing system in order to reduce the power quality problems that arise in the grid during transmission of power from the grid power quality conditioners are generally used to reduce the power quality problems like voltage unbalances and harmonics this may be due to connecting utility grid. There are a number of good reasons to ground but primary among them is to ensure personnel safety. The following agencies and organizations all have recommendations and / or standards for grounding, to ensure that personnel safety is being protected.

Grounding is not only for the safety of personnel but to provide for the protection of plants, equipment, etc. A good ground system will improve the reliability of equipment and reduce damage as a result of lightning or fault currents. The control objectives are undeniably different from those of UPFC listed below .

1) Controlling its shunt converter in current mode, so as to shape the grid current as balanced sinusoid (unbalanced and harmonic load current compensation);
2) Controlling its series converter in voltage mode, so as to balance the load terminal voltage (unbalanced and harmonic grid voltage compensation);
3) Controlling its series converter in voltage mode, so as to improve the downstream load voltage quality during upstream utility voltage sag (series voltage injection).

4. Controller diagram

The Combination of the Controllers like P, PI, or PD controller. It has been estimated that of all controllers in the world 95 % are PI controllers. PI(proportional integral) control is one of the earlier control strategies. Its early implementation was in pneumatic devices, followed by vacuum and solid state Analog electronics, before arriving at today's digital implementation of microprocessors. It has a simple control structure which was understood by plant operators and which they found relatively easy to tune. Since many control systems using PI control have proved Satisfactory, it still has a wide range of applications in industrial control.

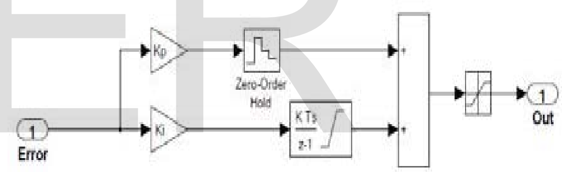

Fig.2. Model of PI controller

According to a Survey for process control systems conducted in 1989, more than 90 of the control loops were Of the PI type. PI control has been an active research topic for many years. Since many process plants controlled by PI controllers have similar dynamics it has been found possible to set satisfactory controller parameters from less plant information than a comitial model.

These techniques came about because of the desire to adjust controller parameters in situ with a minimum of effort, and also because of the possible difficulty and poor cost benefit of obtaining mathematical models. The most popular PI techniques were the step reaction curve experiment, and a closed-loop "cycling" experiment under proportional control around the nominal operating point.

5. SIMULATION AND RESULTS

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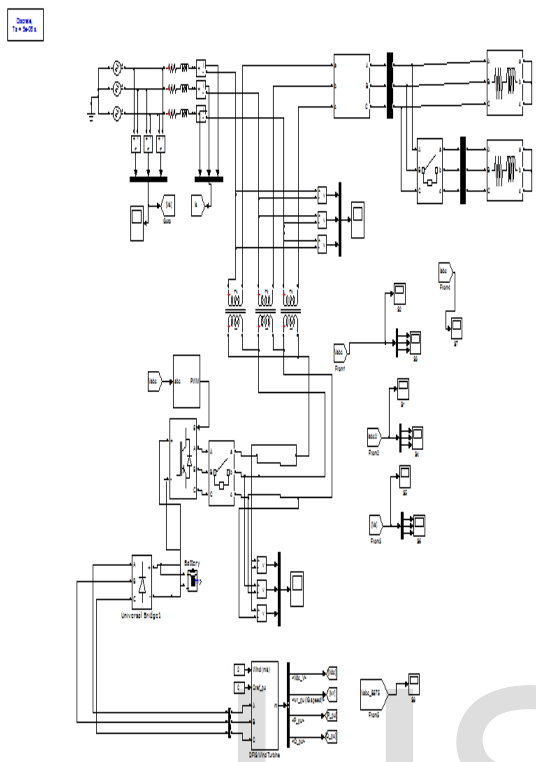

Fig.3. Simulation diagram of FSIG affects grid fault with UPFC

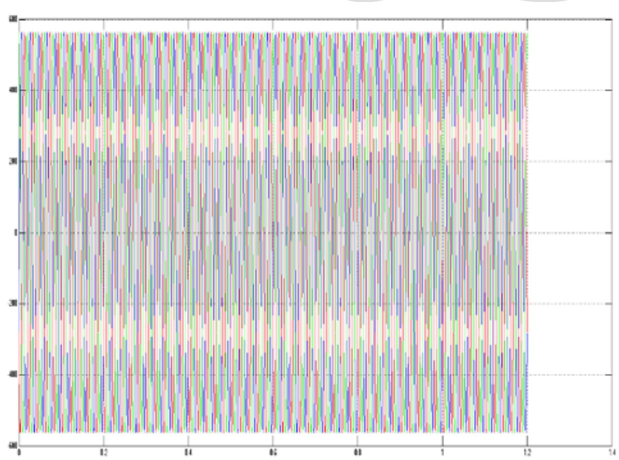

Fig3.1. Source voltage

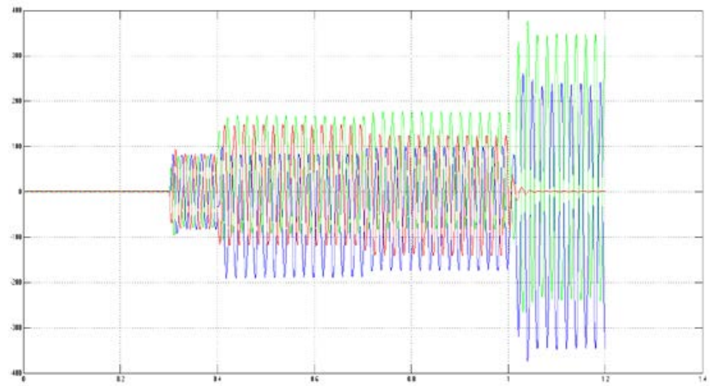

Fig3.2. Voltage during fault

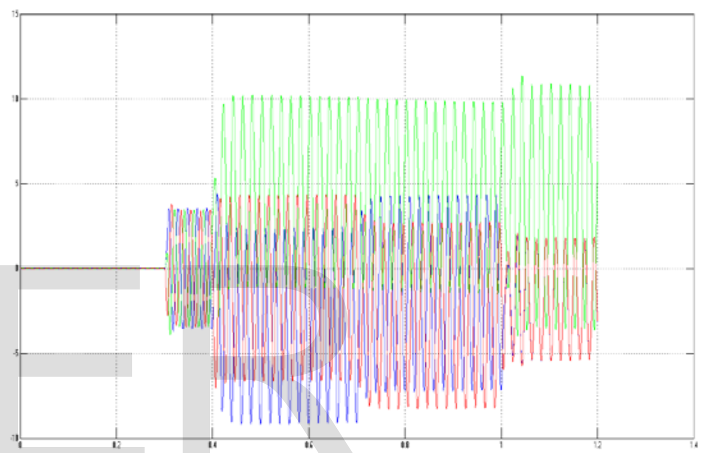

Fig3.3. Current during fault

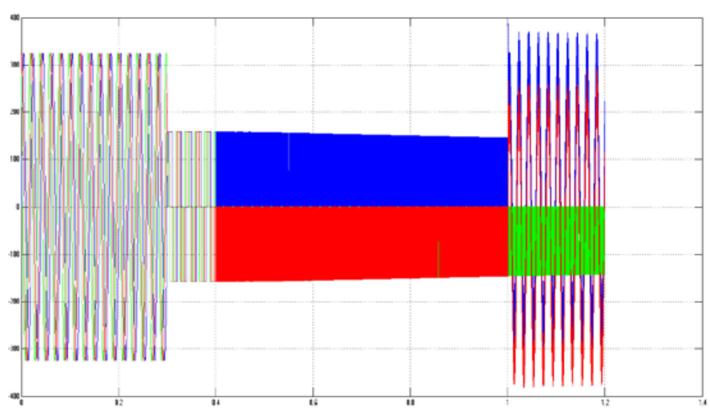

Fig3.4. Fault with UPFC device

Fig.3 Shows the basic voltage of the source .Fig3.1Explains voltage during fault.Fig3.2Explains Current during fault .Fig3.4Fault rectification UPFC device.

6. CONCLUSION

The Unified Power Flow Controller UPFC on the stability of the system during different fault locations and different fault duration times are studied. By studying the effect of fault location, in the cases of single line to ground fault and double line to ground fault the wind farm has the ability to stay connected under fault condition with or without UPFC connection either when the fault occurs at points a time instant value. The Simulation is built and evaluated with MATLAB. Results were Studied.

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