Voltage Sag remedial output In a Doubly Fed Transmission Line Using a DVR

Mr. Gorakh Prasad[1], Mr. Deepmala[2]
[1]M.Tech. Scholar, Department of electrical Engineering, Sarvapalli Radhakrishanan University, Bhopal
[2]Assistant Professor, Department of electrical Engineering, Sarvapalli Radhakrishanan University, Bhopal

***Abstract*- Changing electric load and higher power transfer in a wide interconnected network lead stoserious, security lack in power system operations also if a sudden fault occurs there is a change in voltage profile which can lead to a sudden damage on load end. These voltage sags are compensated at generator side by various methods but at the load end there is a contingency. to avoid such sag at load side a mat lab model is proposed in which a transmission line is fed with two sources out of which one is a wind source and then is subjected to a 3 phase fault. the voltage sag which occurs is compensated in the other model at same instant when DVR Dynamic voltage restorer is programmed and is connected at the midpoint of grid. The results obtained shows that the voltage is compensated and profile is balanced, DVR uses the energy source in well-timed manner and injects nessacary AC voltage to grid.**

Index terms- DVR, matlab simulation, short transmission line, DFIG

INTRODUCTION

The economy invested in the distribution system is large enough to take into account the concept of equipment protection against various disturbances that affects the reliability of not only the distribution system but the entire power system incorporating generation & transmission too. The wide acceptance of sophisticated electronic devices at the utility end deteriorates the quality of supply & utility is suffering from its bad effects on large scale. The various power quality problems[1] encompass the voltage sags, voltage dips & voltage swells, flickers, harmonics & transients accompanied by unbalanced power, which are results of various faults with three phase fault being the most severe among all, starting of induction motor which is most often used due to its rugged construction, switching off large loads and energizing of capacitor banks.

Voltage sag is one of most important power quality issues because the increasing usage of voltage sensitivity devices has made industrial processes more susceptible to supply voltage. Custom power devices are mainly used in voltage sag mitigation, protection and control of sensitive loads, reactive power and voltage regulation and harmonic elimination applications. There are different methods which have been proposed to mitigate the voltage sags like Uninterruptible Power Supplies (UPS), network reconfiguration devices like Static Transfer Switches (STS), DSTATCOM and series compensating devices like Dynamic Voltage Restorers (DVR) The capability of DVR control schemes is demonstrated using MATLAB/SIMULINK simulations. The Simulink models have been developed for the distribution networks with linear and non-linear loads. The proposed DVR for 10kV distribution line has been assumed to be located in medium voltage distribution network level and it can mitigate three-phase sags The DVR has been designed with special importance at the control of PWM inverter i.e. fuzzy logic control. On the distribution side there is always a probability of highly sensitive load like hospitals ,communities etc and therefore on switching multiple loads the voltage profile experiences a jerk sag which can damage the load hence voltage profile needs to be maintained which is dine through fuzzy logic controlled DVR

LITERATURE SURVEY DONE

C. Sankaran [1] introduced the clear description of power quality & its associated problems in power system. He presented the examples & steps to solve

power quality problems in terms of illustrations, figures & their worst effects on power system performance leading to disruptions & substantial economic losses.

N.G.Hingorani et al. [2] introduced a technology popularly known as FACTS (flexible Ac transmission system) based on power electronics to enhance the controllability, stability & power transfer capability of ac transmission system. He revolutionized the area of power electronics by discussing in-depth the FACTS controllers

N.H. Woodley et al. The proposed DVR was installed on 12.47-kV system at an automated yarn manufacturing and weaving factory where it protected the plant from disturbances from the distribution system.

John Godsk Nielsen et al. [16] tested and controlled DVR with advanced technique at medium voltage level of 10kV.The DVR is tested for different methods to initiate voltage dips.

U. Vidhu Krishnan et al. [20] presented a control system based on dqo technique which is a scaled error between source side of the DVR and its reference for sags/swell correction. His work confirmed the effectiveness of the device in compensating voltage sags and swells with very fast response (relative to voltage sag/swell time) by MATLAB using simulation.

POWER QUALITY PROBLEMS

Power system transients- They are fast, short-duration events that produce distortions such as notching, ringing, and impulse. The mechanisms by which transient energy is propagated in power lines, transferred to other electrical circuits, and eventually dissipated are different from the factors that affect power frequency disturbances.

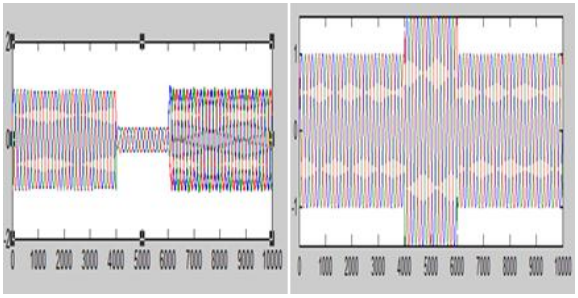
Voltage sag: It is a short duration disturbance. During voltage sag, r. m. s. voltage falls to a very low level for short period of time.

Voltage swell: It is a short duration disturbance. During voltage sag, r. m. s. voltage increases to a very high level for short period of time.

Flicker: It is visual effect and undesirable frequency variation of voltage in a system.

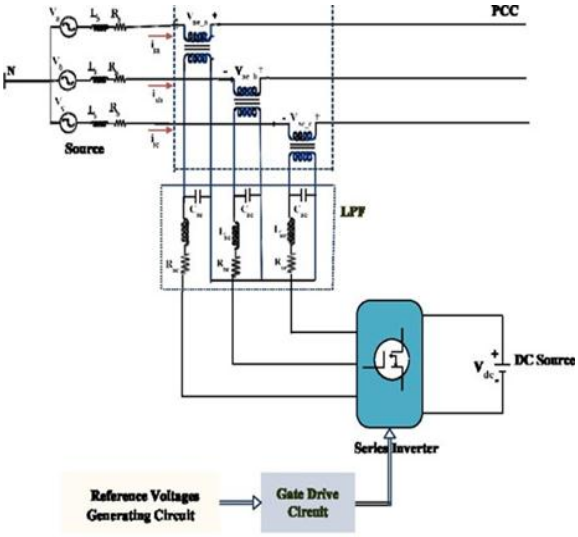
Ringing waves: Oscillatory disturbances of decaying magnitude for short period of time is known as ringing wave. It may be called a special type transient.

Outage: It is special type of interruption where power cut has occurred for not more than 60 s due to fault or mal-tripping of switchgear/system.



POWER QUALITY SOLUTION

DVR



The first DVR was installed in North America in 1996 - a 12.47 kV system located in Anderson, South Carolina [13]. Practically, the capability of injection voltage by DVR system is 50% of nominal voltage. This allows DVRs to successfully provide protection against sags to 50% for durations of up to 0.1 seconds. Furthermore, most voltage sags rarely reach less than 50%. The dynamic voltage restorer is also used to mitigate the damaging effects of voltage swells, voltage unbalance and other waveform distortions. DVRs of capacities up to 50 MVA have seen applications to critical loads in food processing, semiconductor and utility supply. Cost and installation constraints limit these to where there is clear need for constant voltage supply

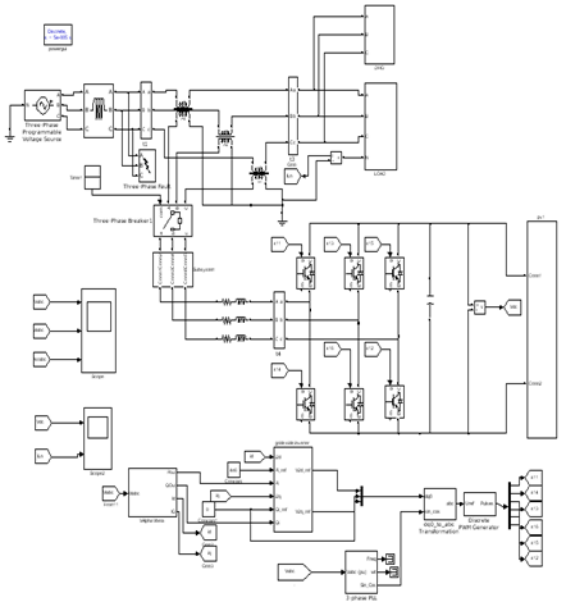
MODELLING OF DFIG

DFIG is essentially a WRIG which has a stator and rotor circuit. Stator circuit of the DFIG comprise of stator edge, covered stator center having stator openings implanted in it and an adjusted 3 stage windings set 120 degree electrically separated from each other. The twisting appropriated in nature, are protected and are housed in the stator openings. Stator windings might be associated in delta or star way.

DFIG CONTROL SCHEMES

Control of DFIG can be achieved by controlling the rotor side power flow. Hence controlling the power converter of rotor side (i.e RSC and GSC) we can control the DFIG completely. To achieve a smooth operation generally vector control method is adopted on both sides. In vector control scheme first the 3 phase quantities are transformed into 2 mutually orthogonal frames of reference and then by controlling this 2 components independently, decoupled control is achieved.

MATLAB SIMULATION & RESULTS USING DVR IN LINE



SIMULATIONS AND RESULTS

(i) The system runs at 50 Hz frequency and total simulation time is chosen to be 0.35 seconds in each case. The scope connected to the V-I measurements at supply side as shown in fig 7.5.1

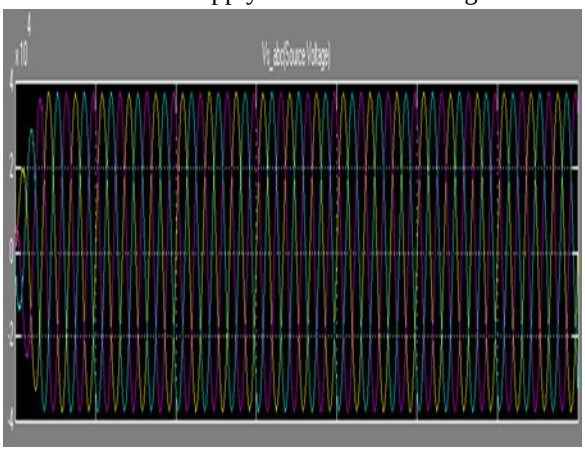
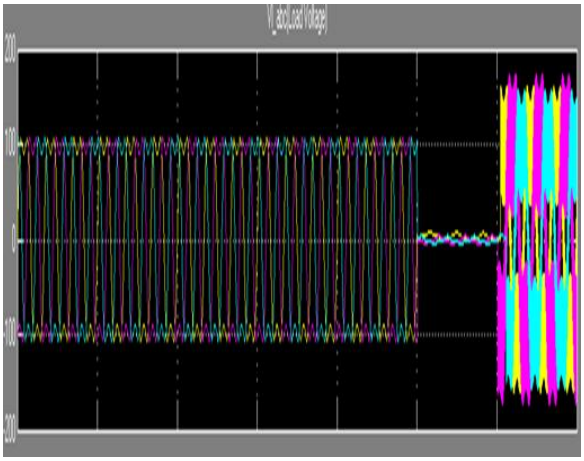


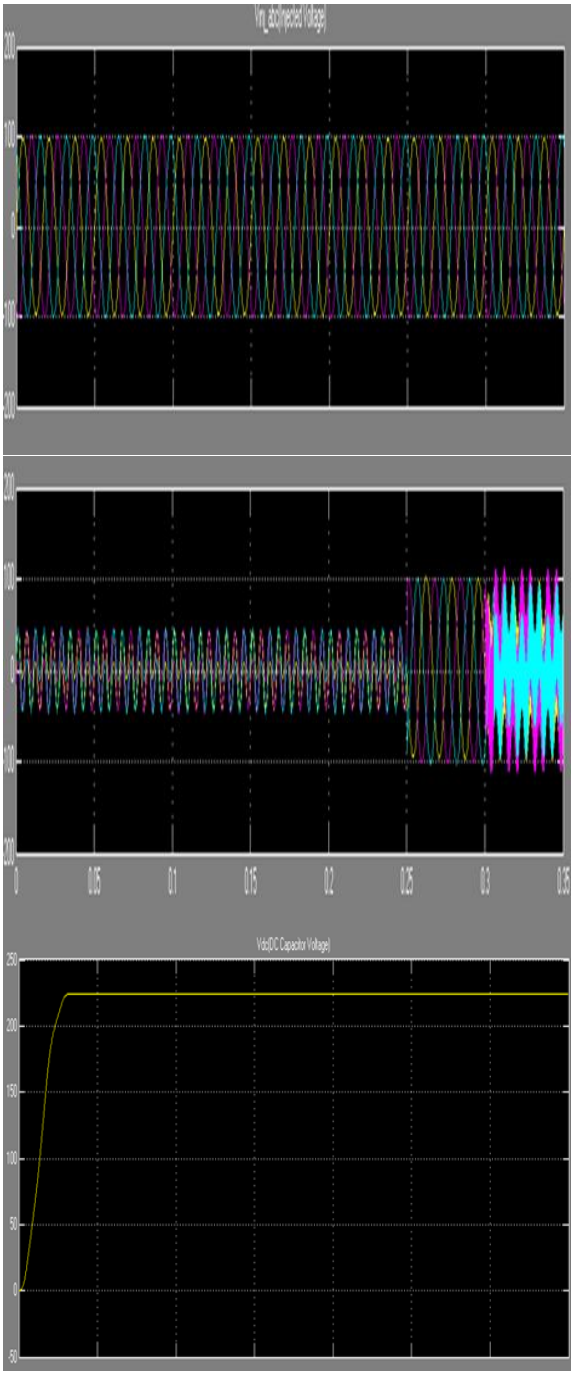
Fig 6.5 Voltage Sag due to DFIG/disturbances

(ii) Load side gives the simulations of supply voltage having sag and the voltage across load. We have taken DFIG and three phase programmable sources. The disadvantage of DFIG as a source is that it creates voltage misbalance in the system due to which sag is produced. In Fig 7.5.2 it is observed that initially there is no voltage injection and power flow from DVR to the system. As no voltage sag is sensed. As soon as the load becomes unbalanced the voltage sag occurs.

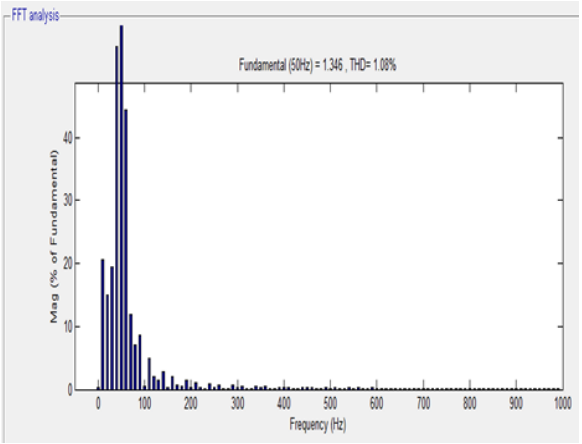


After the occurrence of Voltage Sag DVR comes into action and injects voltage which somewhat lessen the sag. Thus the system becomes more stable.as shown in fig 7.5.3 and 7.5.4.the sensing of DFIG disturbances by the DVR results in a rectified output voltage profile in which the voltage sag is compensated. the proposed methodology proves very unique that rectified the critical load changes disturbance problem.

(iii) The primary task of DVR is providing the high quality voltage to the critical loads. DVR enable the proposed system for providing a good power and voltage quality to the critical load. The controller output signals stabilize when all the phase voltages of the load attain the desired value. DVR gives high performance in injecting the more in-phase voltage with proper polarity and phase angle.



(iv) The Fig 6.5 Illustrates how quickly the DVR responds for sudden changes to keep the sensitive load voltages at reference value. The calculated injection voltages exactly compensate the sag because the controller exactly calculates the missing voltage. Also the exponential rising curve of energy storage device above depicts that the sensing done by DVR for voltage sag and response given by capacitor storage resolves the problem, the single-phase PWM inverters managed by the control system generate the three distinct series inverter output voltages to compensate the source voltages at different sag level. In the last figure the total harmonic distortion are under control below 4 percent as shown



CONCLUSIONS

In this work, cost effective & reliable custom power concept, dynamic voltage restorer is used to mitigate the voltage sags in the distribution system, thereby improving the performance of the system. The various control strategies are employed & tested for 11kV distribution system. The PI controller based DVR, fuzzy controller based DVR and PI-fuzzy controller based DVRs are connected step by step in the compensated feeder to compare their performances. The effectiveness of different control techniques based DVRs for static linear

FUTURE SCOPE OF WORK

With the increase use in number of sophisticated electronic devices by the industrial customers to increase their efficiency & productivity, it is important to ensure reliable power supply even under the system disturbances. To meet the varying system parameters & conditions, various other non-linear controllers can be used.

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