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Harmonics Distortion, Improvement of Active Power And Voltage Sag Mitigation In Distribution System With DVR

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Abstract - *The successfully utilization of electrical energy from the distribution system is deals with the power quality. Various factors like interruption in power system, over voltage, under voltage, unbalance voltage or current, flickering voltage, voltage sag etc. results in poor quality. Various custom power devices are help to solve the power quality related problems, the most several problem occurs on the power system is voltage sag based on current power distribution consideration, and the effect of this voltage sag is very rigorous on the sensitive load. The range of impact from load distributions to financial losses, in spite of the technical advances in electronics, there are some type of electronics equipment they are very responsive to the voltage sag, so that there are many varies methods to mitigate voltage sag, but a custom power supply device is to consider most efficient method. So that this dissertation report studies about a custom power device called a dynamic voltage restorer (DVR), which is a most a most efficient and effective device to protect sensitive equipment against voltage sag, and the DVR has also a low cost, smaller size and it has dynamic response to the disturbance.*

Key Words: (Size 10 & Bold) Key word1, Key word2, Key word3, etc (Minimum 5 to 8 key words)…

1. INTRODUCTION

Power system should provide good quality of power supply that is current and voltage waveform should be sinusoidal and balance and the voltage levels on the system be within practical limits, generally limits is within ±5% of the rated value. If level of voltage is less or more than the specified value, the equipment performance has to be sacrificed. Power quality may define as the improvement of bus voltage usually a load bus voltage, this improvement is require to maintain bus voltage to be sinusoidal at rated frequency and voltage, the power quality in terms of consumer is that the consumer should use electrical energy effectively from the distribution system without any interruption or disturbance[1].A broad meaning of power quality is dielectric selection on equipment and conductors, continuing outages, voltage unbalance in three-phase systems, power electronics and their crossing point with the electric power supply and many other area [2].

1.1 Factors Responsible For Poor Power Quality

1.2 Unbalanced Voltage:-

Three phase voltage is said to be balanced when magnitude of three phases are same and phase displacement is having 120°, otherwise it is unbalanced. In balance three phase systems there only positive sequence component negative and zero sequence component are absence [3]. The major cause of unbalance voltage is due to unsymmetrical transformer winding, transmission impedance, large single phase load. Due to presence of negative sequence impedance, large unbalance motor current flow; in the application of the induction motor the large unbalance current flow is most affected to such as vibration of motor heat problem, increase of losses, shorting of the life, acoustic noise, decreasing of the rotating torque.

1.3 Harmonic Distortion

The electronics devices are used for different operation but they introduce harmonics in system, and it is a frequency which is an integral multiple of fundamental power line frequency. The harmonics are frequently occurs when there is large numbers of drives (AC and DC), uninterruptable power supply or any electronics solid state device used for power switching are used. Harmonics are important and hence they need to be studied into the larger context of power quality. In modern technology, sensitive components present new challenges for plant operation. When sinusoidal voltage is applied across a load then current of sinusoidal manner is produced and it is called as a linear load. Nonlinear load occurs when the resistance is variable and change during each sign wave of applied voltage waveform and hence there is series of positive and negative pulses. Battery chargers, variable frequency drives, non-linear loads, are the example of the non-linear loads. The voltage distortion is introduced in the system when non-linear current flow.

1.4 Voltage Sag

The voltage sags are the most commonly occurring power quality problem. The voltage sags occur because of reduction of the magnitude of voltage for certain period of time. The most commonly occurring power quality issue is voltage sags. Voltage sag is occurred due to reduction in voltage magnitude for certain time period. Voltage sag is define as the value of root mean square voltage between

0.1pu to 0.9pu and having duration of 0.5 cycles to 1 minute[8].The preliminary attention toward the voltage sags is very important because of the undesirable effect of voltage sag on the sensitive electrical apparatus such as adjustable speed drives, programmable logic controllers, computers etc. When the voltage dropped to 30% of the specified voltage limit then less sensitive equipment's are failed. Most of sensitive component are failed when the voltage is dropped to 80-86% of rated value.

Magnitude, duration and phase angle are the fundamental properties of voltage sags. These three parameters affect the performance of the customer's equipment. Initially the consequence of voltage sag considered only the momentary drop in voltage magnitude for short duration of time. Magnitude simply indicates the severity of voltage sag which is subjected to the type of fault occurring in the system Duration indicates the measurement of time of the sag. This factor is dependent on the effectiveness of the protection scheme employed by the utility.

1.5 There are numerous reasons why DVR is preferred over other devices

i. The static voltage controller predominates the DVR but still the DVR is preferred over SVC because the SVC has no ability to control active power flow.
ii. As compare to UPS the cost of the DVR is less.
iii. UPS has also a high level maintenance because it has problem of batter y leak and have to be replace as often five years.
iv. As compare to super magnetic energy storage device the energy capacity is high and the cost is less.
v. DVR is smaller in size and cost is less as compare to DSTATCOM
vi. The DVR is power efficient device as compare to that of UPS.

1.6 The benefits due to custom power devices are listed below

i. The power flow in critical lines can be improved as the operating margins can be used as a fast controllability.
ii. By increasing current carrying capacity of the conductors, the power carrying capacity of lines can be increased to values up to the thermal limits.
iii. The dynamic security of the system reducing the incidence of blackouts and improve the transient stability limits.
iv. The custom power devices contribute to best possible system operation by improving voltage profile and reducing stability limits.

2. CONSTRUCTION AND WORKING OF DVR

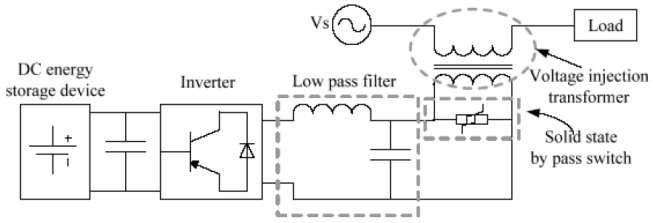

Fig. 1. Power Circuit of DVR

The basic construction structure of the DVR is consisting of the five essential components which are as follows [5].

i) Storage devices
ii) A voltage source inverter(VSI)
iii) Passive filters
iv) By-pass switch
v) Voltage injected transformer

During the disturbance in the distribution system, DVR needs real power for compensation purposes, so that the energy storage device is need to supply this energy during the disturbance hence the battery unit is used as an energy storage device in DVR. To convert the DC voltage supplied by the energy storage device into an AC voltage is the main function of the inverter circuit used in DVR. The voltage source inverter (VSI) of high current and low voltage in conjunction with the step up injection transformer is used for the compensation techniques. The inverted PWM waveform of voltage source inverter in converted into the sinusoidal waveform with the help of filters used in the DVR circuit. The sinusoidal waveform can achieve by removing unwanted harmonic component generated by the VSI operation. In order to maintain the acceptable total harmonics Distortion (THD) level, the unnecessary switching The DVR inverter circuit is very much affected due to the faulty current flowing through it so that to avoid the faulty current through inverter circuit of DVR, a protected device called by-pass switch is used which by pass the inverter circuit during the disturbance occur. Harmonics generated by the VSI must be removed. The secondary circuit of the current transformer is connected to the DVR power circuit and the primary is connected in series with the DVR power circuit. Due to problems like saturation, overheating, cost and performance related to the transformer, the design of the transformer is to be very critical. If the injected transformer is not properly design its result is in saturation of the transformer and improper operation of the DVR. The voltage injected may be of fundamental, desire harmonics and DC voltage component [6-7].

2.1 Modelling of DVR in Matlab

To validate the implementation of DVR, a MATLAB simulation is carried out. Fig 2 shows a block diagram which

represents three phase, 11kv, 50 Hz source voltage having Phase-to-phase RMS voltage of 11000 V, source resistance of 0.8 Ω, source inductance of 16.5e-3 H, with distribution line R,L parameters as R=0.8929 ohm and L=16.58e-4 H. Three phases to ground fault has been created on distribution line. Fault timing can directly be defined from the dialog box or by applying an external logical signal. Firstly the simulation was done without DVR and a three phase fault is applied to the system at point with fault resistance of 4 ohm and for time duration of 0.2 sec to 0.7 sec. Fig.3 shows both volatge and current waveforms on occurrence of L-L-L-G fault in the system. The second simulation model has been developed for the same system as discussed above but now a DVR is introduced at the load side to compensate the voltage sag occurred due to the three phase to ground fault. Fig. 4 below shows that the voltage profile has been compensated during the fault time by using the proposed DVR model.

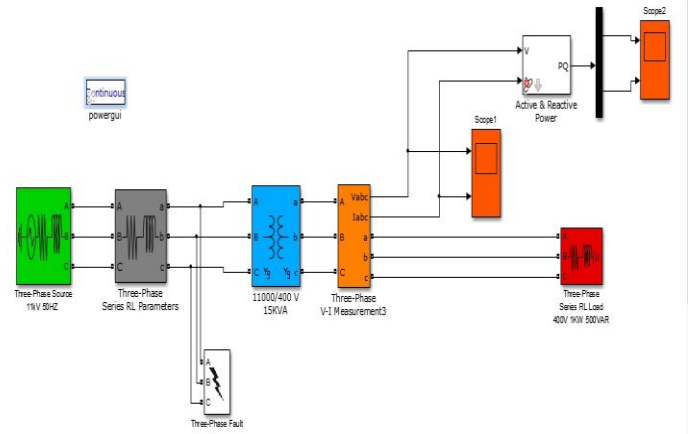

Fig.2 Overall System implemented in Simulink without DVR

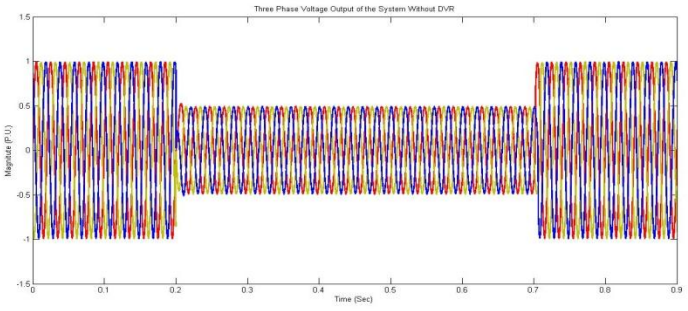

Fig.3 Voltage Output of the System without DVR

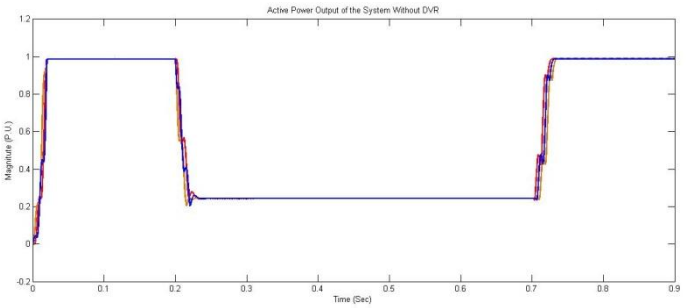

Fig.4 Active Power Output of the System without DVR

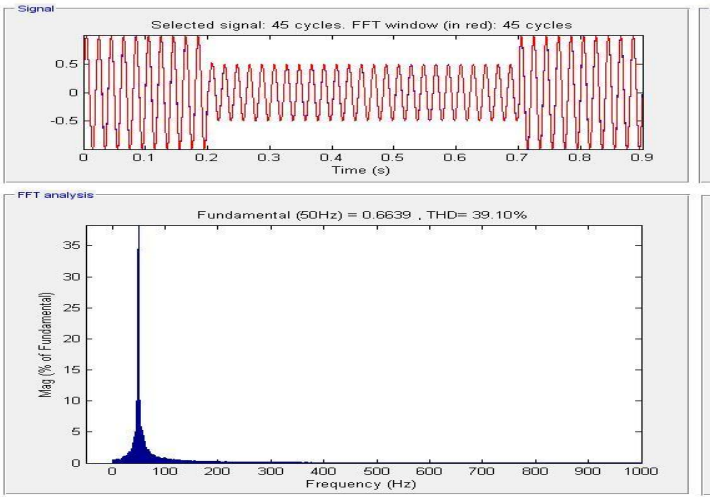

Fig.5 FFT Analysis of the System without DVR

2.2 Simulation with Installation of DVR system

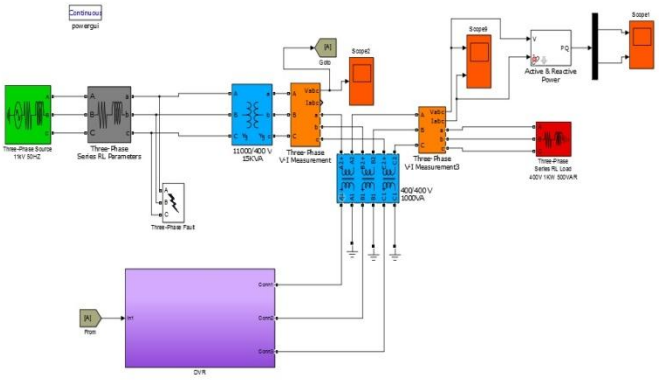

Fig.6 Overall System implemented in Simulink with installation of DVR

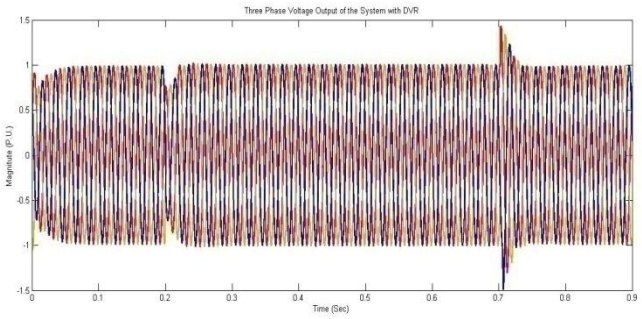

Fig. 7 Voltage Output of the System with DVR

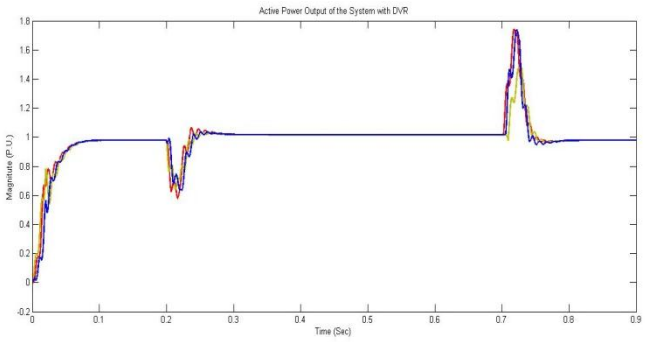

Fig. 8 Active Power Output of the System with DVR

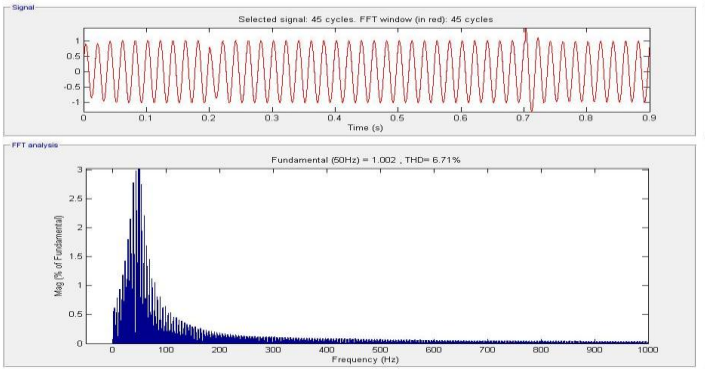

Fig.9 FFT Analysis of the System with DVR

3. CONCLUSION

In proposed work, mitigation of voltage sag due to a fault in a distribution line has been done by DVR using Simulink in MATLAB. During the fault between 0.25 to 0.75 seconds, voltage has been dropped from value of 1 pu to 0.5 pu Also, it has been seen that the active power is reduced during the fault condition. THD in the system is calculated as 39.10%. Now, on implementation of suitable DVR in the test system it has been observed that the voltage profile has been improved during fault condition which has been occurred between 0.25 to 0.75 second and the active power in the system is also improved. The value of the total harmonics distortion (THD) falls from 39.10% to 6.71% after installing the DVR in the system. Hence, implementation of DVR is an efficient solution for voltage mitigation in distribution system due to its relatively low cost, small size and dynamic response to mitigate the voltage sag.

REFERENCES

[1] C. Sankaran, "Power Quality", CRC Press , 2002.

[2] M.A. Golkar, "Electric power quality types and measurements", *IEEE International conference on electrical utility deregulation restructuring and power technologies proceedings,*2004.

[3] Ghosh, Himari, Pradip*et al.*, "Performance comparison between DVR and DSTATCOM used for load voltage control in distribution side", *international conference on advances in power conversion and energy technologies (APCET),*2012.

[4] Math H. J. Bollen, Understanding Power Quality Problems, Voltage Sags and Interruptions, New Jersey, USA, IEEE Press, 1999.

[5] KasuniPerera, Arualpalam Atputharajah, SanathAlahakoon, Daniel Salomonsson, "Automated Control Technique for a Single Phase Dynamic Voltage Restorer", *Colombo, Sri-Lanka,* December 15-17, 2006

[6] www.1.eere.energy.gov/ba/pba/pdfs append_overview.Pdf

[7] T.I. El-Shennawy, A.M. Moussa, M.A. El-Gammal, A.Y. Abou-Ghazala, "A Dynamic Voltage Restorer for Voltage Sag Mitigation in a Refinery with Induction Motors Loads,"American J. of Engineering and

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