"STUDY OF MODELING AND SIMULATION FOR VOLTAGE SAGS/SWELLS MITIGATION USING DYNAMIC VOLTAGE RESTORER (DVR)"

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Abstract: *This paper describes the problem of voltage sags and swells and its severe impact on non linear loads or sensitive loads. The dynamic voltage restorer (DVR) has become popular as a cost effective solution for the protection of sensitive loads from voltage sags and swells. The control for DVR based on dqo algorithm is discussed. The proposed control scheme is simple to design. Simulation results carried out by Matlab/Simulink verify the performance of the proposed method.*

***Keywords*:** Dynamic Voltage Restorer (DVR), voltage sags, voltage swells

1. INTRODUCTION

Power Quality problems encompass a wide range of disturbances such as voltage sags/swells, flicker, harmonics distortion, impulse transient, and interruptions [1]. Voltage sags can occur at any instant of time, with amplitudes ranging from 10 – 90% and a duration lasting for half a cycle to one minute [3]. Voltage swell, on the other hand, is defined as a swell is defined as an increase in rms voltage or current at the power frequency for durations from 0.5 cycles to 1 min. typical magnitudes are between 1.1 and 1.8 up. Swell magnitude is also is also described by its remaining voltage, in this case, always greater than 1.0. [2]. Voltage swells are not as important as voltage sags because they are less common in distribution systems. Voltage sag and swell can cause sensitive equipment (such as found in semiconductor or chemical plants) to fail, or shutdown, as well as create a large current unbalance that could blow fuses or trip breakers. These effects can be very expensive for the customer, ranging from minor quality variations to production downtime and equipment damage [5]

2. LITERATURE SURVEY

N.G. Hingorani, "Introducing Custom Power in IEEE Spectrum," 32p, pp. 4l-48, 1995 in this Power Quality problems encompass a wide range of disturbances such as voltage sags/swells,(1)

The modeling and simulation of a dvr using matlab/simulink has been presented by 1rosli omar, 2nasrudin abd rahim, 3marizan sulaiman department of electrical engineering faculty of engineering, university of malaya,kuala lumpur, malaysia 3prof., faculty of electrical, utem, malacca, malaysia(2)
Voltage sags can occur at any instant of time, with amplitudes ranging from 10 – 90% and a duration lasting for half a cycle to one minute(3)

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3. DYNAMIC VOLTAGE RESTORER(DVR)

Dynamic voltage restoration (DVR) is a method of overcoming voltage sags and swells that occur in electrical power distribution.[1][2][3] These are a problem because spikes consume power and sags reduce efficiency of some devices. DVR saves energy through voltage injections that can affect the phase and wave-shape of the power being supplied.[3]Devices used for DVR include static var devices, which are series compensation devices that use voltage source converters (VSC). The basic principle of dynamic voltage restoration is to inject a voltage of the magnitude and frequency necessary to restore the load side voltage to the desired amplitude and waveform, even when the source voltage is unbalanced or distorted. Generally, devices for dynamic voltage restoration employ gate turn off thyristors, (GTO) solid state power electronic switches in a pulse-width modulated (PWM) inverter structure. The DVR can generate or absorb independently controllable real and reactive power at the load side. In other words, the DVR is a solid state DC to AC switching power converter that injects a set of three-phase AC output voltages in series and synchronicity with the distribution and transmission line voltages. The source of the injected voltage is the commutation process for reactive power demand and an energy source for the real power demand. The energy source may vary according to the design and manufacturer of the DVR, but DC capacitors and batteries drawn from the line through a rectifier are frequently used. The energy source is typically connected to the DVR through its DC input terminal.

The amplitude and phase angle of the injected voltages are variable, thereby allowing control of the real and reactive power exchange between the dynamic voltage restorer and the distribution system. As the reactive power exchange between the DVR and the distribution system is internally generated by the DVR without the AC passive reactive components.

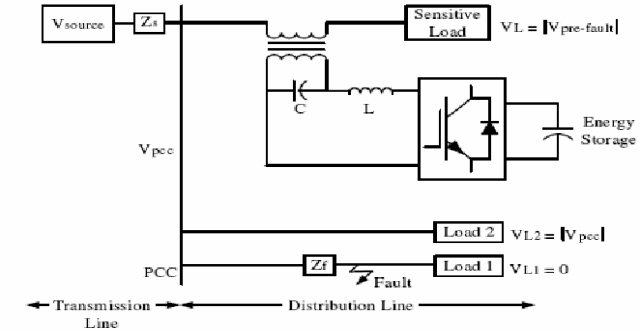


Figure 1: DVR

4. TOPOLOGY OF DVR

Economic design, quick response to the PQ problems and modularity are the main factors considered while proposing new topologies. The number of end users is a significant factor deciding the location of the DVR. The location of the DVR is suggested either at the MV distribution level or at the LV level.

The MV three wire DVR systems centralize the custom power conditioning for multiple critical customers in a single grid and thereby reduce the cost per MVA [45]. The decentralised compensation by LV DVR targets mainly voltage dip sensitive loads. The LV four wire DVR systems compensate for positive, negative and zero sequence voltages wherein the MV DVR injects only positive and negative voltages [17]. Figure 5 shows the MV and LV DVRs, respectively.

The size and weight of the DVR decides platform/ground mounting of the system. The platform mounted DVR reported in [10] is having a compact mechanical design. The on-board energy storage acts as a stringent limitation to the platform mounting of DVRs [10]. Modular inverters and energy storage systems are the requirements for the overhead mounting of the DVR.

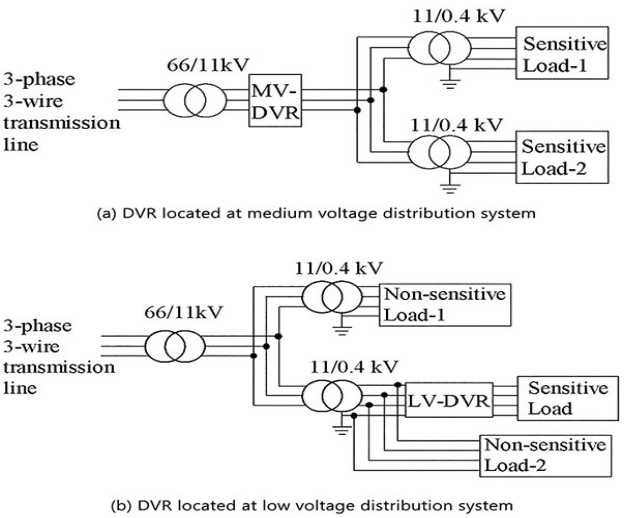


Figure 2*: DVR topologies based on distribution line vo**ltage levels*

4. ADVANTAGE OF DVR

- DVR performance is satisfactory in mitigating voltage sags/swells
- DVR compensates the sags/swells quickly and provides excellent voltage regulation
- The DVR handles both balanced and unbalanced situations without any difficulties
- Injects the appropriate voltage component to correct rapidly any anomaly in the supply voltage to keep the load voltage balanced and constant at the nominal value

5. PROPOSED WORK

The proposed work can be divided into the following modules,

1. Study and analysis of voltage sag/swell
2. Study and analysis of DVR topologies
3. Study of control algorithm of DVR.
4. To simulate "DYNAMIC VOLTAGE RESTORER CONFIGURATION " in MATLAB environment
5. Design and development of DVR for the proposed system.

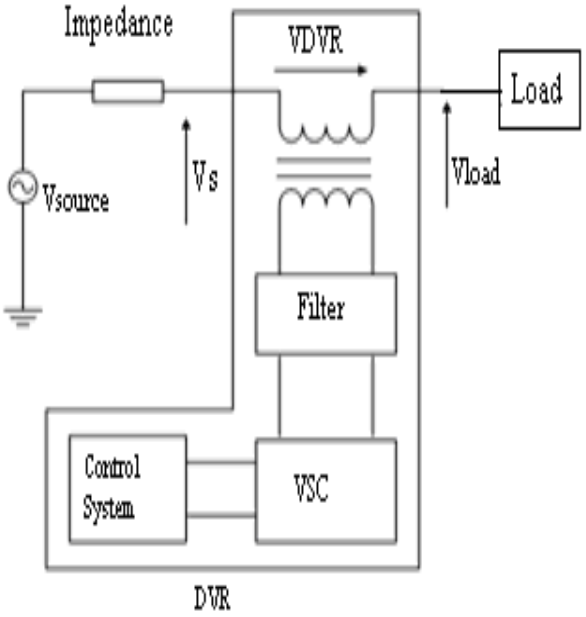
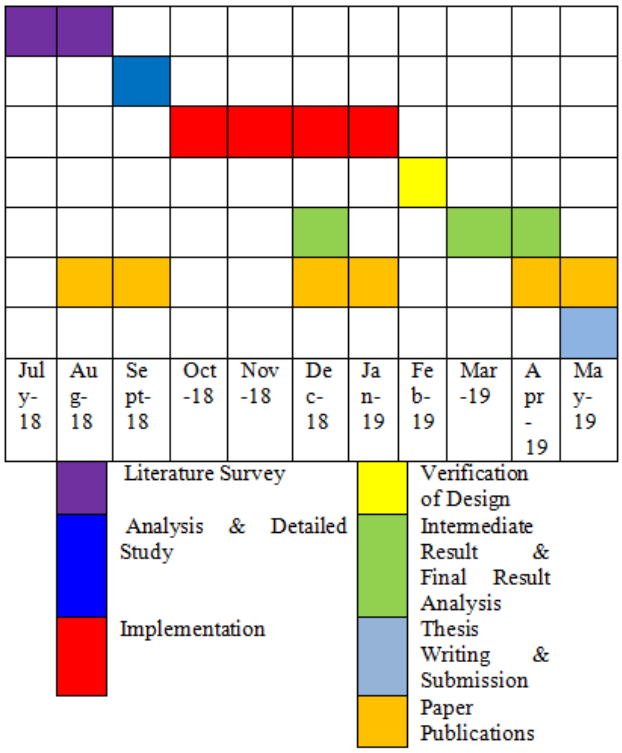


Figure 3: Block Diagram of Proposed Work

6. PLAN OF RESEARCH WORK



7. REFERENCES

[1] N.G. Hingorani, "Introducing Custom Power in IEEE Spectrum," 32p, pp. 4l-48, 1995.

[2] 1ROSLI OMAR, 2NASRUDIN ABD RAHIM, 3MARIZAN SULAIMAN Department Of Electrical Engineering Faculty Of Engineering, University Of Malaya,Kuala Lumpur, Malaysia 3Prof., Faculty Of Electrical, UTeM, Malacca, Malaysia

[3] IEEE Std. 1159 – 1995, "Recommended Practice for Monitoring Electric Power Quality".

[4] P. Boonchiam and N. Mithulananthan, "Understanding of Dynamic Voltage Restorers through MATLAB Simulation," Thammasat Int. J. Sc. Tech., Vol. 11, No. 3, July-Sept 2006.

[5] J. G. Nielsen, M. Newman, H. Nielsen, and F. Blaabjerg, "Control and testing of a dynamic voltage restorer (DVR) at medium voltage level," IEEE Trans. Power Electron., vol. 19, no. 3,p.806, May 2004.

[6] A Ghosh and G. Ledwich, "Power Quality Enhancement Using Custom Power Devices," Kluwer Academic Publishers, 2002.

[7] S. Chen, G. Joos, L. Lopes, and W. Guo, "A nonlinear control method of dynamic voltage restorers," in 2002 IEEE 33rd Annual Power Electronics Specialists Conference, 2002, pp. 88- 93.

[8] 08) 2008, Johor Baharu, Malasia.