[Prajapati, 4(4): April 2017]
DOI- 10.5281/zenodo.570073

ISSN 2348 – 8034
Impact Factor- 4.022

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

MATLAB SIMULATION OF DVR SYSTEM FOR VOLTAGE SAG MITIGATION

Sandhya Prajapati[*1] & A Pachori[2]
[*1]PG Scholar JEC Jabalpur
[2]Associate prof. JEC Jabalpur

ABSTRACT

The dynamic voltage restorer (DVR) is one of the modern devices used in distribution systems to protect consumers against sudden changes in voltage amplitude. In this paper, emergency control in distribution systems is analyzed by using the proposed multifunctional DVR control strategy. Also, the multiloop controller using the posicast and P+Resonant controllers is proposed in order to improve the transient response and eliminate the steady-state error in DVR response, respectively. The proposed algorithm is applied to some disturbances in load voltage caused by induction motors starting, and a three-phase short circuit fault. Also, the capability of the proposed DVR has been tested to limit the downstream fault current. The idea here is that the DVR acts as virtual impedance with the main aim of protecting the PCC voltage during downstream fault without any problem in real power injection into the DVR. Simulation results obtained using MATLAB software show the capability of the DVR to control the emergency conditions of the distribution systems. The simulation results coincide with the hardware results.

Keywords- *DVR, Power System, PCC, Resonant controllers, Closed loop control.*

I. INTRODUCTION

Modern power systems are complex networks, where hundreds of generating stations and thousands of load centers are interconnected through long power transmission and distribution networks [1]. However in practice, power systems, especially the distribution systems have numerous nonlinear loads, which significantly affect the quality of power supply [2,3]. As a result of the nonlinear loads, the purity of the waveform of supply is lost. This ends up producing many power quality problems. Apart from nonlinear loads some system events; both capacitor switching, motor starting and unusual faults could also inflict power quality problems [4]. A power quality problem is defined as any manifested problem in voltage/current leading to frequency deviations that result in failure or mis-operation ofcustomer equipment. Depending on the electrical distance related to impedance, the type of grounding and connection of transformers between the faulted/ load location and the node, there can be a temporary loss of voltage or temporary voltage reduction (sag) or voltage rise(swell) at different nodes of the system [5]. Among the several novel custom power devices,the DVR is the most technically advanced and economical device for voltage sag mitigation in distribution systems. The DVR functions by injecting AC voltages in series with the incoming three phase network, the purpose of which is to improve the voltage quality by an adjustment in the voltage magnitude, wave shape and phase shift. The voltage sag compensation involves the injection of real and reactive power in to the distribution system. The reactive power requirement can be generated electronically within the voltage source inverter of the DVR.

II. PERFORMANCE OF DVR SYSTEM

A Schematic diagram of a conventional DVR incorporated into a distribution network is shown in Fig. 1.

ISSN 2348 – 8034
Impact Factor- 4.022

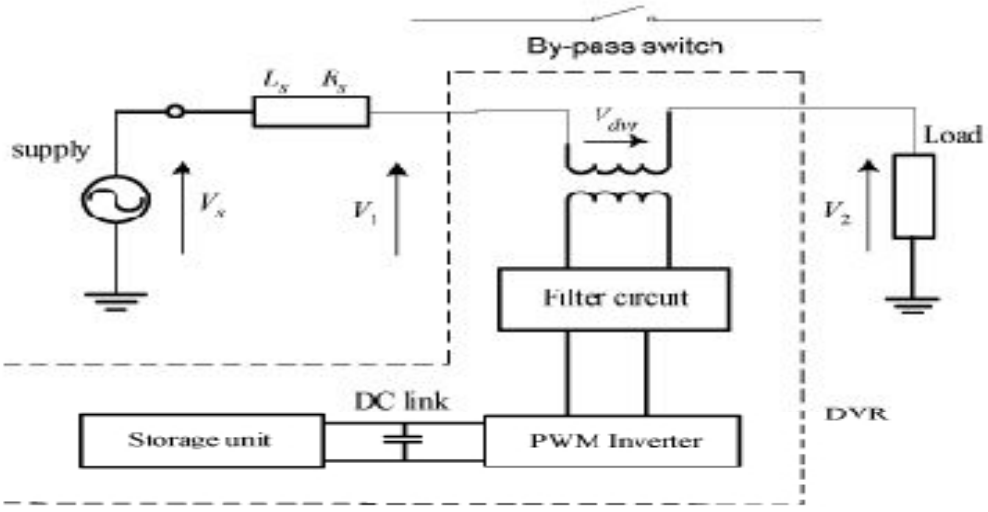

Fig.1. Representation of DVR system Injection/ booster transformer.

The Injection / Booster transformer is a specially designed transformer that attempts to limit the coupling of noise and transient energy from the primary side to the secondary side. Its mainly connects the DVR to the distribution network via the HV-windings and transforms and couples the injected compensating voltages generated by the voltage source converters to the incoming supply voltage. In addition, the Injection / Booster transformer serves the purpose of isolating the load from the system (VSC and control mechanism).The PWM produces the pulses and it is amplified by the driver circuit. This voltage is then injected by the transformer to the transmission line.. When the load is connected and disconnected there occurs a sag and swell in the system.

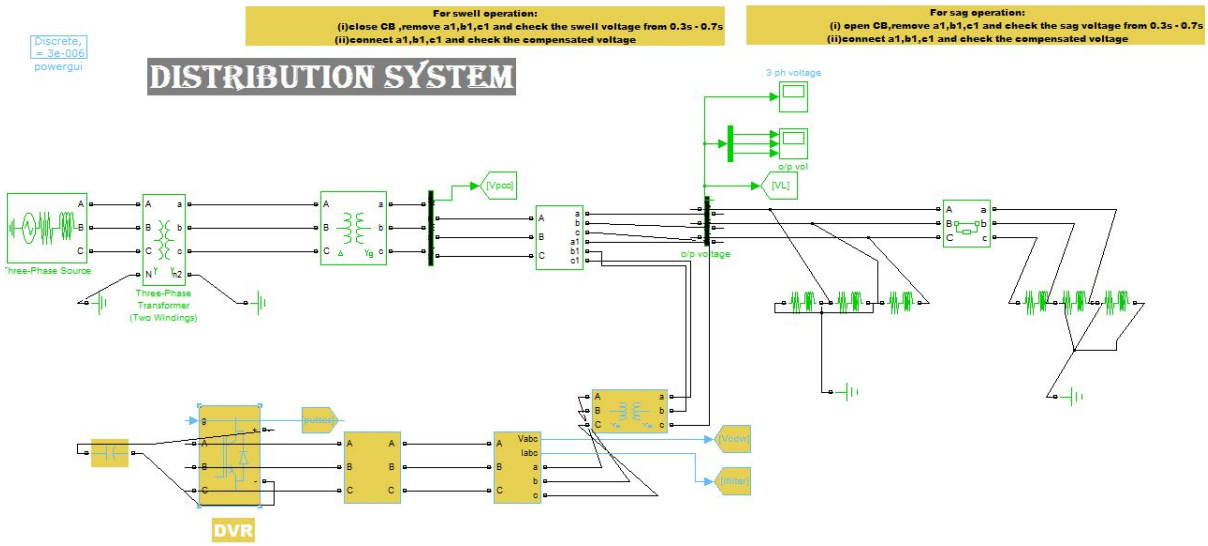

Fig.2. Simulation with feedback

The second load when connected from time 0.3s to 0.7s there occurs a sag in the voltage which is when the DVR comes into action. The DVR injects voltage into the system and the voltage sag gets compensated. During normal operation of the system the DVR gets charged and the charge is stored in the battery which is then used under

ISSN 2348 – 8034
Impact Factor- 4.022

voltage sag conditions. The real and reactive power of the system can be compensated with the help of this system. The control circuit of DVR system is as shown in fig 3.

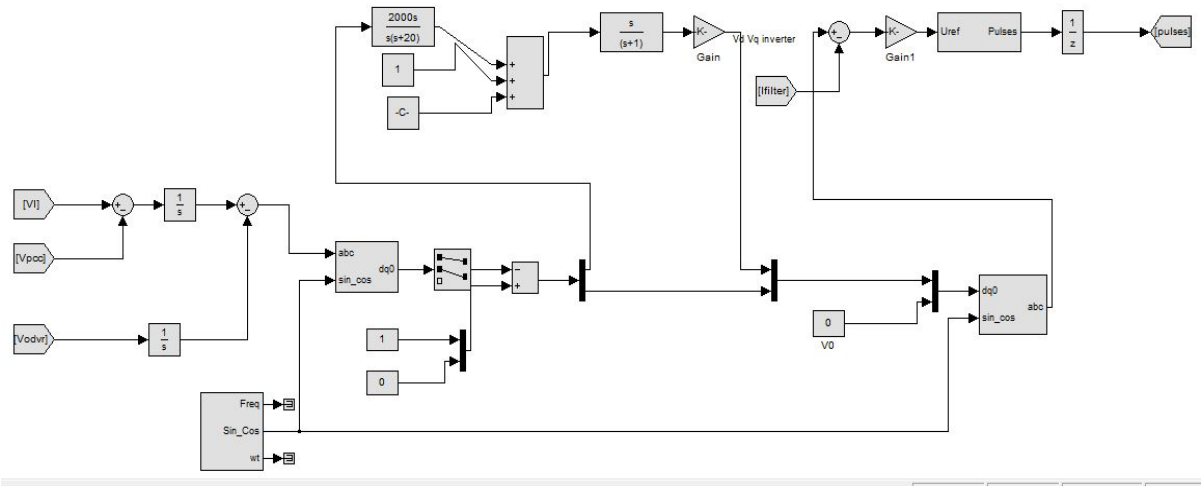

Fig.3. Control circuit of DVR system

III. SIMULATION RESULTS

The Vl and Vpcc voltages are compared and the error voltage is integrated using an integral controller to reduce the settling time of the system. Vdvr voltage is also integrated and then this is compared with the error voltage obtained. This isin three phase as abc which is then converted into a voltage in the d-q axis. This is done because small variations cannot be found in abc plane.The output of this posicast controller is multiplied with gain. The output of this posicast controller is then multiplexed with the dq axis output. This output is then converted into a three phase signal in the abc plane. The output of this block is then compared with the filter output and then after multiplying with a gain is given to the discrete PWM generator.The simulation results of sag and swell is as fig.4

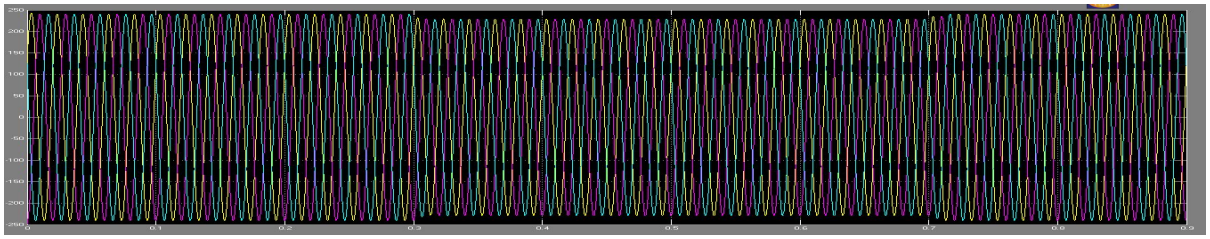

Fig.4.Simulation showing the swell in closed loop system

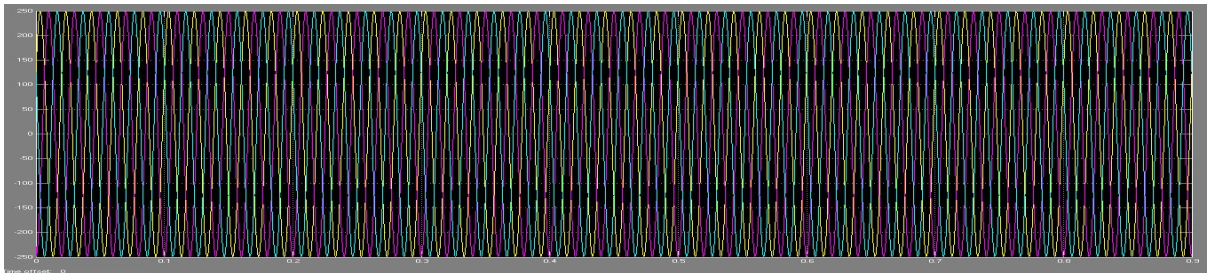

Fig.5.Simulation showing the output after DVR is connected

To mitigate the sag and swell the DVR is then connected to the system. The compensated voltage is shown in fig.5.

[Prajapati, 4(4): April 2017]
DOI- 10.5281/zenodo.570073
ISSN 2348 – 8034
Impact Factor- 4.022

IV. CONCLUSION

The main purpose of using DVR in industries is to maximize efficiency in production. Our paper has proposed an improved progressive phase changing scheme of post fault voltage. The sag transients can be easily mitigated and pre fault voltage can be established. For real time applications, this may necessitate the application of the microcontroller/processor with fast speed. In this proto type model the hardware results coincide with the simulation results.The analysis done in this paper is detection and compensation of the voltage sag with DVR active power.

REFERENCES

1. *S. S. Choi, B. H. Li, and D. M. Vilathgamuwa, "Dynamic voltage restoration with minimum energy injection," IEEE Trans. Power Syst., vol. 15, no. 1, pp. 51–57, Feb. 2011*
2. *C. Benachaiba and B. Ferdi, "Voltage quality improvement using DVR," Electt. Power Qual. Utilisation, Journal, vol. XIV, no. 1, 2010.*
3. *D. M. Vilathgamuwa, H. M. Wijekoon, and S. S. Choi, "A novel technique to compensate voltage sags in multiline distribution system-the interline dynamic voltage restorer," IEEE Trans. Ind. Electron., vol. 53, no. 5, pp. 1603–1611, Oct. 2012.*
4. *M. I. Marei, E. F. El-Saadany, and M. M. A. Salama, "A new approach to control DVR based on symmetrical components estimation," IEEETrans. Power Del., vol. 22, no. 4, pp. 2017–2024, Oct. 2012.*