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POWER QUALITY IMPROVEMENT BY MITIGATION OF VOLTAGE SAG WITH DVR USING SVPWM TECHNIQUE

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ABSTRACT

In last decade, research has been carried out to address the problems associated with power quality improvement issues. The power quality is affected mainly due to the sensitive loads which results in voltage sag and voltage swells. It is necessary to investigate the suitable methods for mitigation of voltage sags. From the wide range of mitigation methods, the selected one has to be observed for the effect on the characteristics. Authors have carried out the study and implementation of mitigation method to address the stated problem. In this paper, authors have implemented Dynamic Voltage Restorer (DVR) based on application of Space Vector Pulse Width Modulation (SVPWM). The implemented model gives remarkable results and mitigation of voltage sag is achieved.

KEY WORDS: Voltage sag, DVR, SVPWM.

INTRODUCTION

Now days, electricity is considered as fourth basic need along with the food, clothes and shelter. Along with the continuous increase in the demand of electricity, the nature of load has also changed in last decade. Power quality problem includes voltage sag, voltage swell, noise, voltage unbalance and voltage flicker. If the quality of the voltage deteriorates, then it causes the malfunctioning of sensitive equipments. It results in the less reliability, less energy efficiency and affects on the life of the equipment [1-2].

Use of uninterruptible power supply, is most common but not one of the best solution as it is not so economical. Custom Power Devices (CPD) is proposed by Mr. N.G. Hingorani to mitigate the power quality problems.

The power quality problems occurred is to be addressed as it plays vital role in the performance of controller based devices. Power quality problem causes significant damage for a

manufacturing process and computer hardware installations. The mitigation of voltage sag as swells is achieved effectively by DVR [3-5].

DVR based on SVPWM for 3 phases VSC, This is standard method for DC-AC power conversion. The compensation of voltage sag and swells is provided by DVM which is power electronics controlled device. The distorted voltage waveform is restored due to injection of voltage by DVR. The injected voltage is depends upon the difference between the desired and actual values. The DVR consists of VSC, injection transformers, passive filters and energy storage. The control technique used in DVR is important in order to improve its performance and efficiency. As the digital instruments were implemented for the measurement of electrical quantities the response time for DVR to compensate and restore the voltage is less [6-12].

LITERATURE REVIEW

U. T. Patil ; A. R. Thorat have proposes the DVR is recognized as successful sort of custom power device for avoiding power quality problem like voltage sag and swell due to its following advantages:

1. Capacity to manage active power flow.
2. Less cost as compare to others.
3. Less maintenance and higher energy capacity.
4. DVR is more minor in size.

In this paper the hysteresis voltage control technique is used for controlling the dynamic voltage restorer and generation of switching pulses (gate pulses) for the inverter of DVR. There are various techniques for the detection of voltage sag, swell. This paper describes a better solution for power quality problems [1].

Dr. T.Ruben; Deva Prakash; G.Justin; Sunil Dhas have rightly stated that, the capabilities of DVR are limited by long duration voltage sags. This limitation is overcome by the proposed IDVR by the authors. Reduction in the size of dc-link capacitors is achieved in proposed method [2].

C. Fitzer; M. Barnes and P. Green has proposed the novel model for detection of voltage disturbance by using the neural network. This voltage detection scheme is applied to DVR. Better monitoring on the voltage is achieved by this method under transient conditions.

A. Gosh; Gerard Ledwich; have proposed the scheme for compensation of distribution voltages by using DVR. The most of the disturbances in the distribution system are occurred due to the voltage sag. In this paper the authors have implemented the system using DVR and SVPWM for three phase VSI. The authors have achieved 15% more output by implementing this system than standard sinusoidal PWM. The control strategies for DVR are proposed and implemented in this paper [4].

Anita Pakharia; Manoj Gupta; has presented the linear control scheme for DVR. The implemented scheme needs less computational efforts. This is one of the most popular schemes due to its simplicity. The basic structure of DVR, modes of operation, control schemes, compensation techniques and its control algorithm was presented by the authors in this paper.

SIMULATION WORK

In order to understand the performance of the DVR along with control, a simple distribution network as shown in figure 1 is implemented. Voltage sags are simulated using MATLAB software. As a result balanced voltage sag is created immediately after a connecting lagging load shown in Fig 2.The load voltages restoration are shown in Fig 2.through the compensation by DVR.

A prototype DVR has been built based on schematic in figure 1 in order to verify the effectiveness of the DVR operation principles. The experimental results obtained are shown in Fig 2.

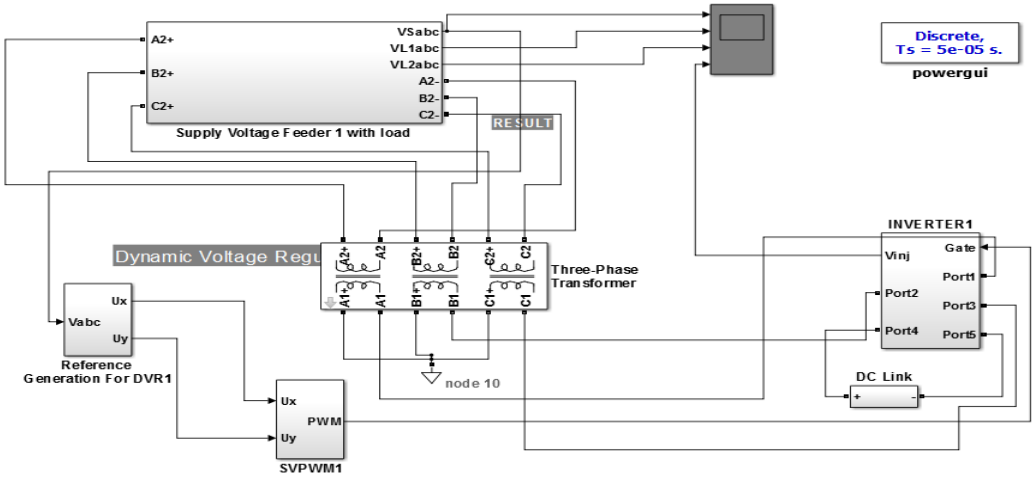

Fig 1.1: Simulation for DVR system

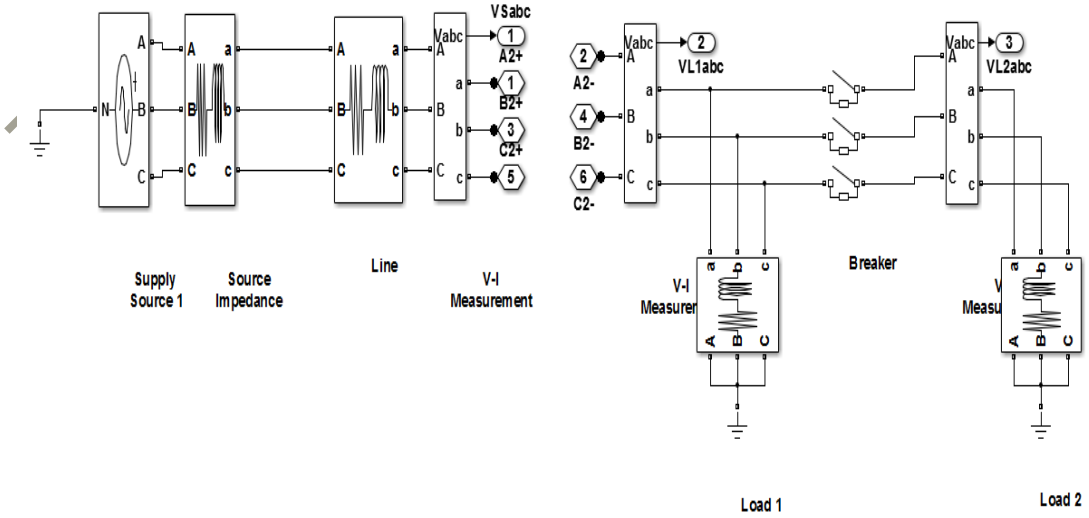

Fig 1.2: Simulation for source to load

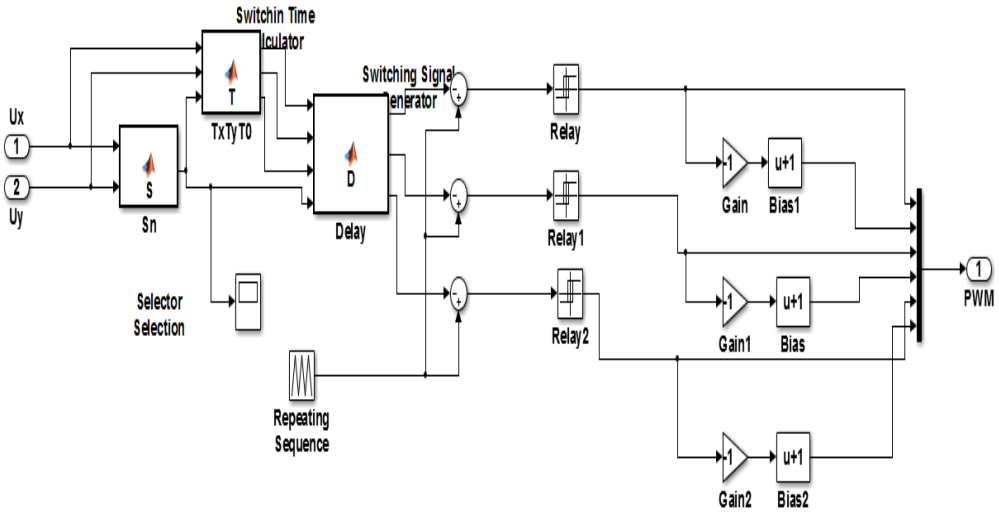

Fig 1.3: Simulation for SVPWM

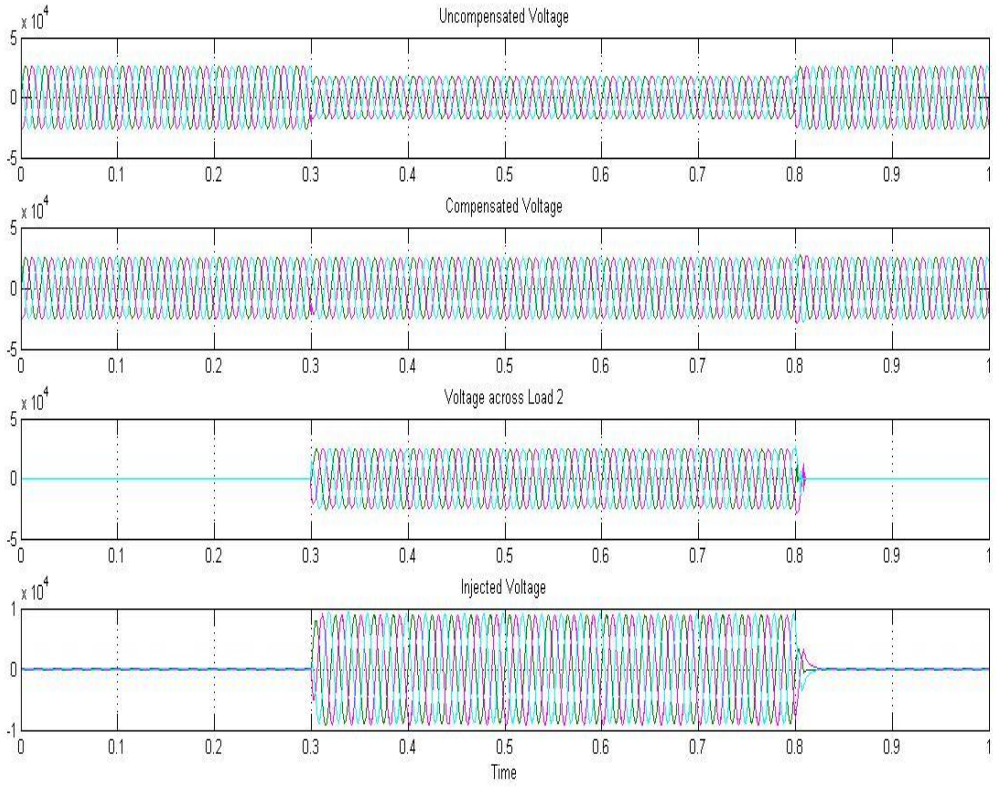

Fig. 2: Simulation results shows the load 1, load 2, and injected voltage

RESULT

System has following parameters.

Table: 1 System Parameter

Main supply voltage rms-ph-ph	33kv
Line Impedance	4 Ω
DC Bus Voltage	35000
Filter Inductance and capacitance	2 Ω ; 1 mH ; 0.0177 u F
Load resistance and inductance	500 Ω ; 0.8 H
Supply frequency	50 Hz
Series transformer turns ratio	1:1

The parameters of the implemented system are listed in table 1 above. System has experienced the voltage sag in between 0.3 to 0.8 period of time. Fig 8.Shows the supply voltage, injected and load voltages when voltage sag is created. The appropriate voltages are injected to maintain the load voltage and compensate the voltage sag.

CONCLUSION

From the simulation results authors have stated that the sags are mitigated with implementation of the proposed system. Authors have addressed the most critical problems of voltage sag with the MATLAB environment. The DVR is proven to be the effective power quality improvement device. From the implemented model and the results achieved, it is also demonstrated that the proposed control strategy based on Space Vector Pulse Width Modulation (SVPWM) technique to generate the pulses for mitigating voltage sags. IDVR can also be the solution to overcome the limitations in overcoming the long duration voltage sags. Renewable systems like PV can be used instead of DC bus system.

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