POWER QUALITY IMPROVEMENT WITH DYNAMIC VOLTAGE RESTORER (DVR)

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ABSTRACT: Users of power electronics devices employ technology to make their daily life easier and more efficient. In terms of affordability and effectiveness, the Dynamic Voltage Restorer is the greatest homemade power device for reducing voltage sag and swelling. The four major components of the DVR are the voltage source inverter (VSI), input transformers, filter, and DC energy source. They use the DVR principle of adding voltage in series with the main voltages to alleviate voltage disturbances. The Dynamic Voltage Restorer uses a variety of control mechanisms. This study introduces the discrete pulse width modulation (PWM) approach. PI controllers, mixed voltage and current controllers, and Fourier transforms are utilized to detect voltage sags and generate switching pulses for the dynamic voltage restorer's inverter. The recommended system was created using MATLAB, a computer program that controls itself via voltage reference signals. The findings indicate that a dynamic voltage restorer can improve voltage sag and rise in distribution networks.

Key Words: Static Series Compensator (SSC), Dynamic Voltage Restorer(DVR).

1. INTRODUCTION

The number of nonlinear loads in the power distribution system has increased dramatically as technology has advanced. This reduces the quality of the power supply. This nonlinear load distorts the given voltage waveform. This incident has a negative impact on power quality [1].Many organizations rely on programmable logic controllers (PLCs) and electronic drives. These can result in flicker, harmonics, voltage transients, sags, and swells. Here are some ways to characterize issues with power quality.

Voltage sags:

Voltage sag occurs when the root mean square voltage lowers temporarily. It can be triggered by excessive load, a sudden electrical link, or the initiation of electric motors.

Voltage swells:

A voltage rise is a half-cycle decline in root mean square voltage that lasts only a short time. Which can be caused by turning off a large load or charging a bank of capacitors.

2. DYNAMIC VOLTAGE

Voltage variations are the most common cause of power quality issues. This can be accomplished at the connecting location using reactive power. Issues can be remedied by integrating a mechanically switched shunt capacitor into the distribution transformer. Short-term increases in pace are not compensatory. Certain deformations or development patterns show insufficient dispersion. An alternative technique, albeit more expensive, is to use transformer connections.

As a result, specialized power devices are used as a solution. The power system network includes the Dynamic Voltage Restorer, the most efficient and cost-effective custom power device. The DVR connections are connected in sequence at the point of intersection. A specialized power supply that adjusts the system's voltage to keep it stable on the output side. At this point, the DVR is linked in series with the power supply and the critical load feeder (PCC).Figure 1 depicts the positioning of the DVR. DVRs can do more than just correct voltage spikes and declines. They can, for example, limit fault currents, rectify line voltage harmonics, and minimize transient voltage variations [2].

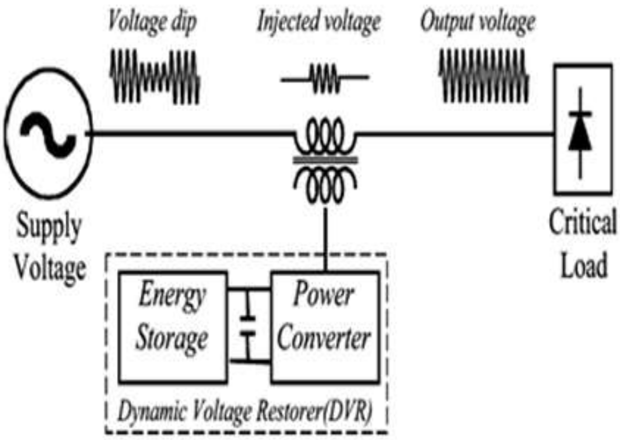

Fig.1: Location of DVR

Basic Configuration of DVR:

The general configuration of the DVR consists of:

- In Injection transformer
- A Voltage Source Converter (VSC)
- Storage Devices
- A Control and Protection system

Protection mode:

If there is a high inrush current or a short circuit on the load side, the DVR will not allow excessive current to flow through it. When you turn on the bypass switches (S2 and S3) and create an additional conduit for electricity to flow (S1 will be closed), the DVR is effectively disconnected from the other systems.

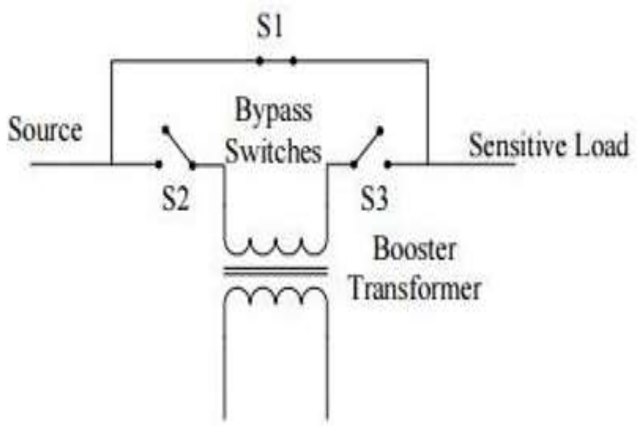

Fig.2: Protection Mode

Solutions for power quality problems:

Power quality concerns can be resolved by installing a system on either the utility or the customer side. Consumer-side devices are employed when tools can withstand power outages more effectively. A gadget on the utility side can likewise reduce or eliminate disruptions. Utility-side alternatives play an essential role in improving power. Here are some practical and cost-effective steps:

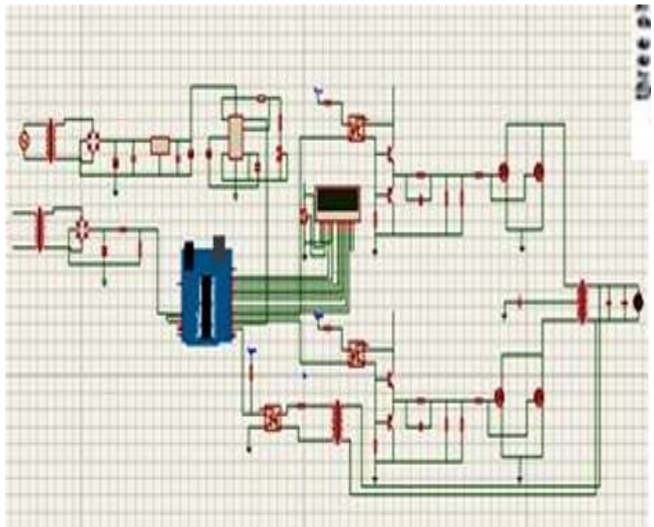

Fig.3: Circuit Diagram Constant DC-link voltage

Energy storage devices are required, as demonstrated in Figure 3.5, which depicts a DVR with a stable DC-link. A second converter will manage and stabilize the DC-link voltage while also transferring energy from the main storage to a smaller DC-link. It stabilizes the direct current (DC) voltage on the link and does not increase the amount of electricity drawn from the power source. The Sag is in charge of determining how much electricity is cut off from the grid.

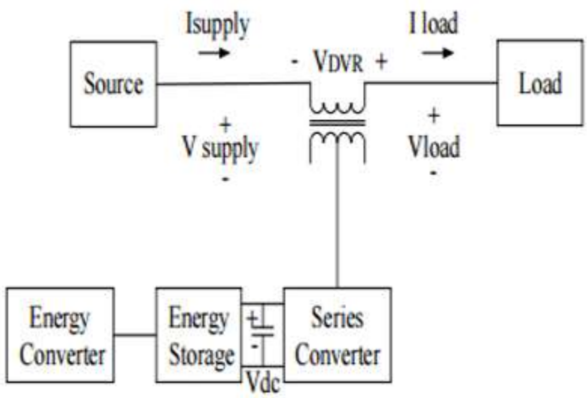

Fig.4: DVR topology with constant DC-link voltage

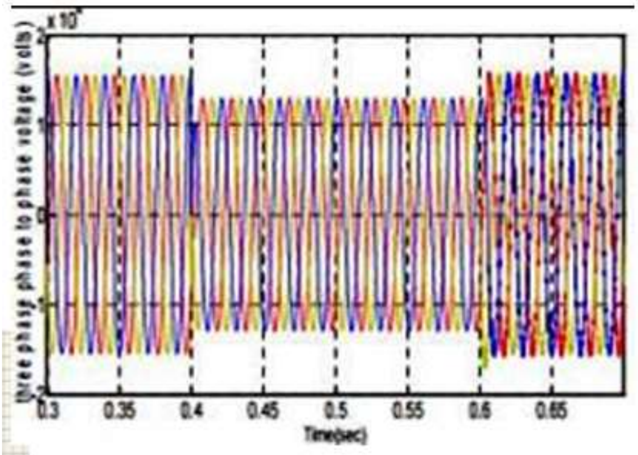

Fig.5: Output Waveform

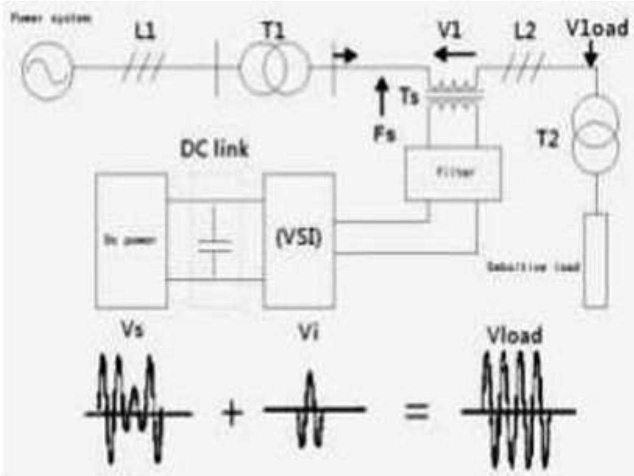

Fig.6: Restore Voltage

3. CONCLUSIONS

This issue is caused by insufficient voltage on the bus. Changes from ideal circumstances can result in harmonics, sags, gaps, over voltages, and under voltages. Voltage sag, defined as short intervals of reduced voltage lasting up to a few hundred milliseconds, has a significant impact on many manufacturers in the sector each year, while appearing to be a minor issue. The purpose of this project is to teach future electrical engineers about dynamic voltage restorers, which are cutting-edge specialized power devices designed to improve power quality. It explains everything you need to know about this cutting-edge technology.

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