

## ***An Examination of the Prevention of Power Quality Events***

***Devendra Gupta<sup>1</sup>, Akansha Sharma<sup>2</sup>***

*Student<sup>1</sup>, Associate Professor<sup>2</sup>*

*Department of Electrical Engineering*

*Dronacharya College of Engineering, Haryana*

***Corresponding Author's Email id: priya.ee25@ietbhaddal.edu.in<sup>2\*</sup>***

### ***Abstract***

*The quality of electrical power is an essential contributor to any country's growth. Because of the widespread use of power electronic or microprocessor-based regulated loads in recent decades, power quality has gotten a lot of attention. It is essential to overcome power quality problems and have dependable power performance in order to prevent unexpected interruptions and damage in the power system. Power quality event mitigation aids the power system in overcoming power quality problems to a large degree. It is preferable to mitigate power quality events in order to improve power quality and minimise problems associated with it. Power quality event mitigation not only gives you control over your power issues, but it also keeps them under control. We'll go through some of the power quality events that create problems, as well as how to locate the right device to assist solve the problems.*

***Keywords:*** *Electrical Power, Power Quality, Power System, Harmonics*

### **INTRODUCTION**

Because of its negative effect on energy providers, manufacturers, and consumers, power quality is now recognised as one of the most significant problems in electric power transmission and distribution. In a power system, power quality is defined as

the deviation of voltage, current, and frequency from their standard values. Voltage sags, swells, harmonics, unbalances, and flickers are all examples of voltage disturbances. These disturbances may cause voltage-sensitive loads in factories, buildings, and hospitals

to fail, as well as severe process interruptions that result in significant financial and/or data losses. When it comes to industrial equipment, voltage sags or dips are considered the most serious disruptions. Some industrial loads are so sensitive that they can't tolerate even the tiniest voltage variation. In certain loads, voltage sags may be devastating. Voltage sag is a brief drop in rms ac voltage (10%–90% of normal voltage) with a power frequency of 0.5 cycles to a few seconds. A voltage swell is described as a short-term rise in rms supply with a voltage increase of 1.1 to 1.8 p.u. of nominal supply. Switching big capacitors or removing high loads are the two most common causes of voltage swells. Now, voltage support at the load end is critical, and this may be accomplished by injecting reactive power at the common coupling load point.

The use of mechanically switched capacitors linked in shunt is one of the most helpful traditional methods. The reactive power may be introduced into the system by mechanically switching the capacitors according to the system's needs. However, due of the restricted time period of mechanical switching, certain high-speed transients and voltage sags cannot be corrected by this technique. Also,

transformer tap change may be done, although doing so while the transformer is in operation is extremely difficult and expensive. Power electronics technology has played an important role in power flow control and electrical energy utilisation; additionally, for the electrical power system, FACTS devices are more frequently used due to their exceptional performance and ability to mitigate power quality problems such as voltage sag, swell, harmonics, and so on. For example, the phrase bespoke power in the FACTS for transmission systems refers to the employment of power electronics controllers, particularly in distribution systems, to minimise different power quality issues. FACTS devices may enhance power transfer capacities and stability, and bespoke power guarantees that clients get pre-specified power quality and power supply dependability. Minimal phase imbalance, low flicker at load point, no power interruptions, low overall harmonic distortions, overvoltage and under voltage within defined ranges, and so on are examples of pre-set power quality criteria.

Custom Power devices come in a variety of shapes and sizes. Active Power Filters (APF), Battery Energy Storage Systems (BESS), Distribution static synchronous

compensators (DSTATCOM), Distribution Series Capacitors (DSC), Dynamic Voltage Restorer (DVR), Surge Arresters (SA), Super conducting Magnetic Energy Storage (SMES), Static Electronic Tap Changers (SETC), Solid-State Transfer Switches (SSTS), Solid State Fault Current Limiter (SSFCL), Static Electronic Tap Changers (SETC), Static Electronic Tap.

## **LITERATURE SURVEY**

### **A Novel Configuration for a Cascade Inverter-Based Dynamic Voltage Restorer with Reduced Energy Storage Requirements**

The basic cascade converter is augmented with a shunt thyristor-switched inductor in this work, resulting in a novel configuration for a cascade (H-bridge) converter-based dynamic voltage regulator. The suggested architecture is shown to be capable of mitigating severe and long-term voltage sag while using considerably less energy from the cascade converter.

### **Mitigation of Voltage disturbances Using Dynamic Voltage Restorer Based on Direct Converters**

Two novel topologies for three-phase dynamic voltage restorers are presented in this article (DVRs). Direct converters are used in these topologies. There are no dc-link energy storage components required

in the suggested topologies. As a consequence, they are smaller in size, weight, and price. Long-term voltage sags and swells may also be compensated using them. The suggested DVRs can adjust for voltage sags, swells, unbalances, harmonics, and flickers, among other disturbances.

### **An Overview of Various Control Techniques of DVR**

In this article, an overview of DVR is given, as well as several control methods. To keep the load voltage constant at its nominal value, the DVR may inject three phase control voltage.

### **An Enhanced Voltage Sag Compensation Scheme for Dynamic Voltage Restorer**

To prolong the DVR compensation period, the work described in this article offers an improved sag compensation technique. It improves the dc link voltage gradient (by controlling the amount of active power injected by DVR). The controller in the proposed approach recovers both phase and amplitude of the load voltage to the presag value before transitioning to minimal active power (MAP) mode. The next subsections go through the general operation sequence and implementation of the suggested compensation technique.

### **Mitigation of voltage sags and voltage swells by dynamic voltage restorer**

This article examines the modelling and simulation of a Dynamic Voltage Restore (DVR) for voltage sag and swell reduction. The d-q-O method is used to regulate the compensation voltages in a DVR.

### **Mitigation of Voltage Sag and Swell Using Dynamic Voltage Restorer**

The value of integrating DVR in a distribution system for voltage sag and swell reduction is discussed in this article. The dynamic voltage restorer (DVR) is a series-connected power electronic device that can rapidly reduce voltage sags in the system and restore the load voltage to pre-fault levels. The DVR described here is based on the dqo transformation idea.

### **Transformerless Dynamic Voltage Restorer for Voltage Sag Mitigation**

A transformerless dynamic voltage restorer based on three-single phase Voltage Source Inverters is discussed in this article (VSI). The DVR has a lower loss, cheaper cost, and is less bulky since it does not have an injection transformer. Synchronous Reference Frame (SRF) theory is used to provide DVR control.

### **Voltage Swell and Overvoltage Compensation with Unidirectional Power Flow Controlled Dynamic Voltage Restorer**

During unbalanced circumstances, the minimal energy injection method fails to address voltage swell and overvoltage compensation issues in a diode-bridge rectifier supported transformerless-coupled dynamic voltage restorer (DVR). As a result, this article presents a new unidirectional power flow management method that takes into account the DVR maximum compensation limit and can effectively suppress issues with continuous increasing dc-link voltage. To avoid compensated load voltage distortion or discontinuity, the progressive phase rotating technique is used.

### **Design and Experimentation of a Dynamic Voltage Restorer Capable of Significantly Reducing an Energy-Storage Element**

A dynamic voltage restorer (DVR), also known as a voltage-sag compensator, is a device that comprises of series and shunt converters linked in series, three series transformers, and a dc capacitor placed on the common dc connection. Installing a series converter on the source side and a shunt converter on the load side distinguishes the DVR. The use of a very

tiny dc capacitor for smoothing the common dc-link voltage is possible with this system design. This article describes how to build a dc capacitor in a voltage-sag situation and offers a series converter control technique that may lower the voltage ratings of both the series converter and the series transformers.

### **Power Quality: Overview and Monitoring, Second International Conference on Industrial and Information Systems**

PQ events may vary from tens of nanoseconds to steady-state voltage/current disruptions. PQs have distinct properties and qualities that are often recognised and utilised for PQ monitoring. PQ monitoring devices range from a basic true r.m.s. metre to sophisticated artificial intelligence methods such as ANNs, Fuzzy Logic, Genetic algorithms, and so on. The features, consequences, and causes of PQ events are discussed in this article, as well as current developments in PQ monitoring.

### **Voltage Sag Detection Technique for a Dynamic Voltage Restorer**

This article describes and validates a new voltage sag detection method for use with a DVR's primary control system. The DVR control system must not only detect

the start and end of a voltage sag, but also identify the sag depth and any related phase shift in all instances.

### **PROPOSED SCHEME**

DVR (dynamic voltage restoration) is a technique for overcoming voltage sags in electrical power distribution systems. These are an issue since spikes waste energy and sags decrease device efficiency. DVR saves energy by injecting voltage into the power supply, which may change the phase and wave form. Static var devices, which are series compensation devices that utilise voltage source converters, are used for DVR (VSC). The first such system in North America, a 1247 kV system in Anderson, South Carolina, was installed in 1996. Even when the source voltage is imbalanced or distorted, the fundamental concept of dynamic voltage restoration is to inject a voltage of the magnitude and frequency required to restore the load side voltage to the appropriate amplitude and waveform. In a pulse-width modulated (PWM) inverter construction, devices for dynamic voltage restoration typically use gate turn off thyristors (GTO), solid state power electronic switches. At the load side, the DVR may produce or absorb independently controlled real and reactive power. 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 into the distribution and transmission lines in series and synchronisation.

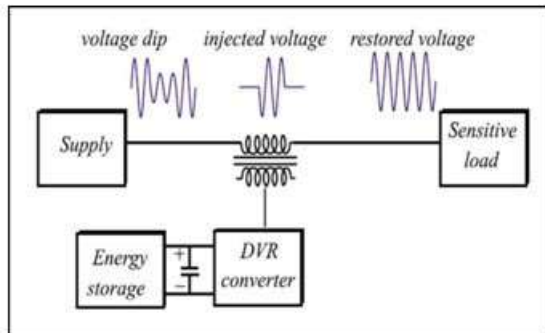


**Fig. 1 Schematic diagram of dynamic voltage restorer**

## MERITS OF DVR OVER OTHER CUSTOM POWER DEVICES

- Although the SVC predates the DVR, it is nevertheless preferred because the SVC lacks the capacity to regulate active power flow.
- When compared to DSTATCOM and other specialised power devices, the DVR is tiny and inexpensive.
- When compared to the UPS and SMES, the DVR has a higher energy capacity. DVR offers a number of benefits over UPS, including lower costs, greater capacity, lower losses, the ability to inject just the missing portion of the supply voltage, and lower maintenance.

- Economic comparisons of SSTs and DVR have been conducted, and it has been discovered that if a secondary undisturbed or independent feeder is available, SSTs offers a superior solution in terms of anticipated savings, cost of solution per KVA, yearly running cost, and a greater benefit/cost ratio. Because SSTs does not control voltage or generate/absorb reactive energy, DVR is considered the most cost-effective option. Its only function is to disable a defective feeder and replace it with a healthy one.

## CONCLUSION

As a result of reviewing all of the aforementioned sources, we can conclude that although there are many methods to reduce power quality events, Dynamic Voltage Restorers have been recognised as a cost-effective option for shielding sensitive loads from voltage-related power quality problems. There are also a variety of control methods that may be used to address power quality issues with this power conditioning equipment.

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