

# **CASE STUDY ON MITIGATION OF VOLTAGE SAG/SWELL USING DYNAMIC VOLTAGE RESTORER**

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## **ABSTRACT**

*This paper is about voltage sag and swell, introduction about dynamic voltage restorer. Also it is about compensation of voltage sag and swell. In the 21<sup>st</sup> century, the increasing demand of power has lead to increase in complexity of load. This raises the issue of power quality. Power quality is actually the quality of the voltage. There are certain problems associated with power quality such voltage sag, swell, notch, spike, transients, etc. So, it is necessary that power supplied to load is stable and sinusoidal. Dynamic Voltage Restorer is such a device which is used to control voltage waveform and provide stable voltage output.*

**Keywords: Power Quality, Voltage sag, Voltage Swell, Dynamic Voltage Restorer(DVR)**

Some related terms :

## **I. POWER QUALITY**

It is often defined as the grid's ability to supply a clean and stable power supply. Ideal power quality creates a perfect power supply that is always available, has a pure noise-free sinusoidal wave shape and is always within voltage and frequency tolerances.

## **II. VOLTAGE SAG/DIP**

It's a short duration reduction in r.m.s. voltage which can be caused by a short circuit, overload or electric motors. It happens when the r.m.s. voltage decreases between (10-90)% of nominal voltage value for one-half to one minute.

### **III. VOLTAGE SWELL**

It's the opposite of voltage sag. It's a momentary increase in voltage. It happens when a heavy load turns off in a power system. It is the increase in the r.m.s. voltage level to (110-180)% of nominal voltage value.

### **IV. VOLTAGE NOTCH**

It's a recurring power quality disturbance due to the normal operation of power electronic devices, when current is commutated from one phase to another.

### **V. VOLTAGE SPIKE**

Voltage spikes are fast, short duration electrical transients in voltage, current or transferred energy in an electrical circuit.

### **VI. HARMONICS**

These are the distortion of the normal electrical current waveform , generally transmitted by non-linear loads.

#### **1.1 Causes of Voltage Sag**

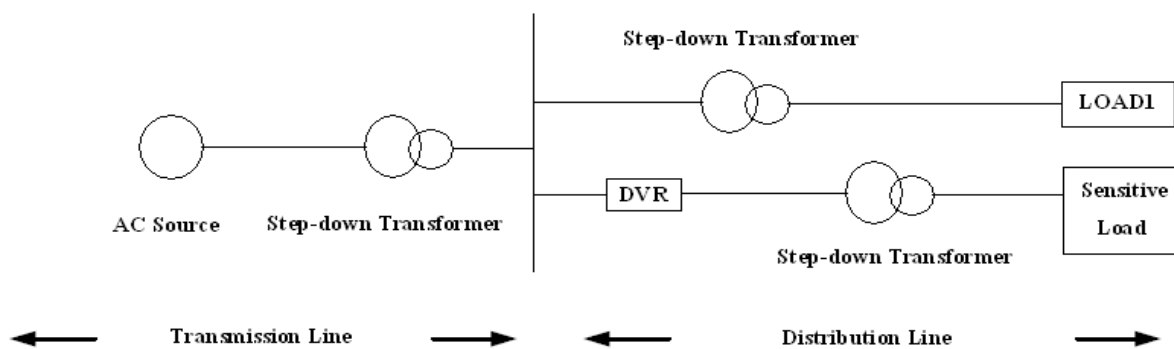
- Starting an electrical motor.
- During a line-to-ground fault.
- Sudden load changed
- Transformer energizing.

#### **1.2 Causes of Voltage Swell**

- In ungrounded or floating delta system, where sudden change in ground reference result in voltage rise.
- Due to de-energizing of a very large load.
- Energization of a large capacitor bank.

**VII .INTRODUCTION TO DYNAMIC VOLTAGE RESTORER**

DVR is an apparatus used to sustain ,or restore an operational electric load during voltage sag,swell,etc. It’s a static var device that has seen applications in a variety of transmission and distribution systems. A series compensating device ,which protects sensitive electric load from from power quality problems. It is used to inject 3 phase voltage in series and works in synchronism with the distribution feeder for compensating voltage sag.



**Location of DVR**

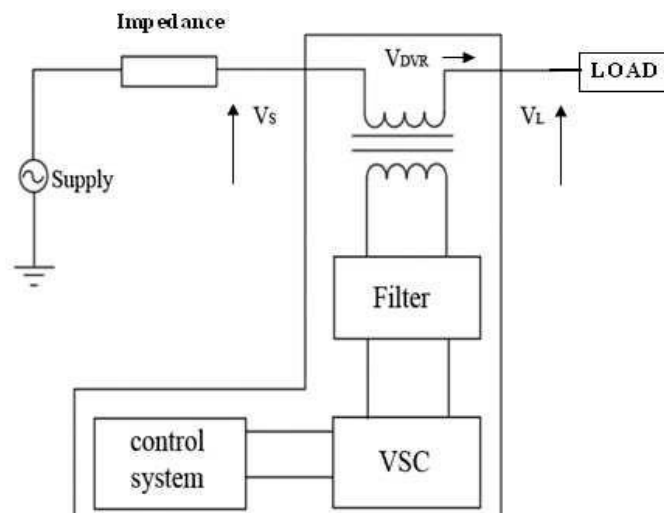
**2.1 Operation of DVR**

It operates in stand-by-mode during normal conditions. It mainly monitors the load voltage waveform constantly by injecting missing voltage during voltage during sag/swell. It is basically a VOLTAGE SOURCE CONVERTER. During disturbance, normal system voltage is compared to the voltage variation for injecting the required voltage. It is normally installed in a distribution system between the supply and the critical load feeder at the Point of Common Coupling(PCC).

## 2.2 Components of the DVR

These are:

- An injection transformer
- A HARMONIC FILTER
- Storage Devices
- A voltage source converter
- DC charging circuit
- Control system
- Protection system



**Schematic Representation of DVR**

## VIII. VOLTAGE SAG/SWELL COMPENSATION METHODS

There are 4 different methods. These are :

- Pre-sag compensation method
- In-Phase compensation method
- In-Phase advanced compensation method
- Voltage tolerance method

## IX. CONCLUSION

In this paper review, starting with power quality till voltage compensation methods have been taken. Overview of power quality and DVR is studied. At the end, voltage compensation methods have been stated.

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