INTERNATIONAL ORGANIZATION OF ENGINEERING RESEARCH & DEVELOPMENT JOURNAL (IOERD)
VOLUME3 ISSUE 4
E-ISSN :- 2455-9075

"Design Of Dynamic Voltage Restorer To Improve Power Quality"

Ms. Shital Shirpure [1], Prof.Souras Ghotekar, Dr. Sanjay S. Uttarwar
Dept. of Electrical Engineering, VIT College of Engineering,Nagpur[1]
Dept. of Electrical Engineering, VIT College of Engineering,Nagpur [2]
Principal,, VIT College of Engineering,Nagpur[3]

ABSTRACT:

Power quality is one in all major issues within the gift era. it's become vital, particularly with the introduction of subtle devices, whose performance is extremely sensitive to the standard of power provide. Power quality downside is a happening manifested as a non-standard voltage, current or frequency that ends up in a failure of finish use equipments. one in all the main issues dealt here is that the power unbalance. to unravel this downside, custom power devices square measure used. one in all those devices is that the Dynamic Voltage preserver (DVR), that is that the best and effective trendy custom power device employed in power distribution networks. Its charm includes lower price, smaller size, and its quick dynamic response to the disturbance. The role of DVR to compensate load voltage is investigated throughout the various fault conditions like voltage sag, single part to ground, and 3 phases to ground faults. This paper gift includes modeling, analysis and simulation of a Dynamic Voltage preserver (DVR) victimization MATLAB.

Keywords—Power Quality, DVR, Voltage Sag

1.Introduction

Power distribution systems, ideally, ought to give their customers with associate degree uninterrupted flow of energy at swish curved voltage at the narrowed magnitude level and frequency power grid faults, shift of huge hundreds or energization of transformers cause voltage disturbance. Such disturbances cause short term speedy modification in amplitude of voltage. A sever disturbance in voltage could cause system crash, hardware injury, touching the price of consumers and utilities. the matter quality issues like temporary voltage rise (Swell) or voltage reduction (Sag)are a lot of frequent and have severe impact on power grid. increment in offer voltage up a hundred and tenth to one hundred and eightieth in RMS voltage is outlined as swell [2]. this happens at harmonic of network and sustains for period of time of ten ms to one minute. Typical system events such energization of huge electrical condenser bank or removal of inductive load causes swells. On the opposite hand unforeseen decrease in offer voltage down ninetieth to 100 percent of nominal voltage is named as sag [3]. This drawback is for the short period and for period of time of one0ms to 1 minute. The rated voltage is recovered once short amount of your time. Voltage sag is presently the foremost severe power quality drawback encountered attributable to its adverse money impact on customers. In earth Malaysia, the primary case of voltage sag was reportable to the electrical utility of Malaysia in early 1990 within which voltage sag caused the stopping of electronic wafer fabrication method.

The power quality has serious economic implications for purchasers, utilities and electrical instrumentation makers. Modernization and automation of trade involves increasing use of computers, microprocessors and power electronic systems like adjustable speed drives .The power electronic systems conjointly contribute to power quality drawback (generated harmonics). The electronic devices square measure terribly sensitive to disturbances and diminish tolerant to power quality issues like voltage sags, swells and harmonics. because of the harmonics square measure occurring within the system it causes losses and heating of motor. The DVR could be a power quality device that has gained associate degree increasing role in protective industries against disturbances like voltage sags associated with remote defects [4][5].

The basic operation principle of the DVR is to inject associate degree acceptable voltage nonparallel with the availability through injection electrical device whenever voltage sag is detected. To mitigate voltage sag, DVR has been thought of as effective sag mitigation instrumentation and lots of analysis works are dispensed focusing within the style and management of the DVR. the most operate of DVR is to inject the specified voltage amount nonparallel with the availability with the assistance of associate degree injection electrical device whenever voltage sag is detected. Power transfer ability, transient stability and damping of power oscillation is improved by exploitation DVR in gear [6]. And it's capable of generating or engrossing real and reactive

power at its ac terminals. the fundamental principle of a DVR is easy by inserting a voltage of desired magnitude and frequency, in o rder to revive the load-side voltage balanced and curved . This study introduces numerous power quality issues and basic thought of DVR (Dynamic Voltage Restorer), this study deals with summary of a Dynamic Voltage Restore (DVR) for mitigation of voltage sags.

II.POWER QYALITY PROBLEMS, CAUSES & EFFECTS

A.Various power quality problems

- **Transients**- A transient is a temporary occurrence of a fault which is of a very short duration in a system caused by the sudden change of state
- **Voltage sags**- A voltage sag or voltage dip is a short duration reduction in RMS voltage which can be caused by a short circuit, overload or starting of electric motors .A voltage sag happens when the RMS voltage decreases between 10 and 90 percent of nominal voltage for one-half cycle to one minute.
- **Voltage swells**- Voltage swell, which is a momentary increase in voltage, happens when a heavy load turns off in a power system.
- **Voltage interruption**- Interruptions are classified as short-duration or long-duration variation. The term interruption is often used to refer to short-duration interruption, while the latter is preceded by the word sustained to indicate a long-duration. They are measured and described by their duration since the voltage magnitude is always less than 10% of nominal.
- **Harmonics**- Harmonics is the integral multiple of frequencies voltages and currents in an electric power system due to non linear loads. Harmonic frequencies in the power grid are a frequent cause of power quality problems.

B.Causes of Power Quality Problems:

- **Transient** – Due to Lightning, turning major equipment on or off, back to back capacitor energization.
- **Voltage Sags**– Due to starting of large motors, energization of heavy loads, incorrect VAR compensation.
- **Voltage Swells** – Energizing a large capacitor bank, Switching off a large load, incorrect VAR Compensation
- **Interruption** – Faults (Short circuit), Equipment failures, Control malfunctions (attempting to isolate electrical problem).
- **Harmonics** – IT equipment, Variable frequency drives, Electro Magnetic Interference from appliances, fluorescent lighting, Arc Furnace (Any non linear load).

C.Effects of Power Quality Problems:

- **Transient** – Tripping, Processing error, Data loss, hardware reboot required, Component failure.
- **Voltage Sags** – Dim lights, Equipment shutdown,
  Data error, shrinking display screens, Memory loss.
- **Voltage Swells** –Bright lights, Data error, shrinking display screens, Memory loss.
- **Interruption** – Faults, Equipment failures, Control malfunctions
- Harmonics – Line current increases, Losses increase, transformer and neutral conductor heating leading to reduced equipment life span.[7]

III.BASIC CONFIGURATION OF DVR

harmonic etc, voltage sag is that the most severe disturbances within the distribution system. to beat these issues the construct of custom power devices is introduced recently. one among those devices is that the Dynamic Voltage trained worker (DVR), that is that the most effective and effective fashionable custom power device employed in power distribution networks. DVR may be a recently projected series connected solid state device that injects voltage into the system so as to control the load facet voltage. it's typically put in during a distribution system between the availability and therefore the essential load feeder at the purpose of common coupling (PCC). aside from voltage sags and swells compensation, DVR may another different options like line voltage harmonics compensation, reduction of transients in voltage and fault current limitations.

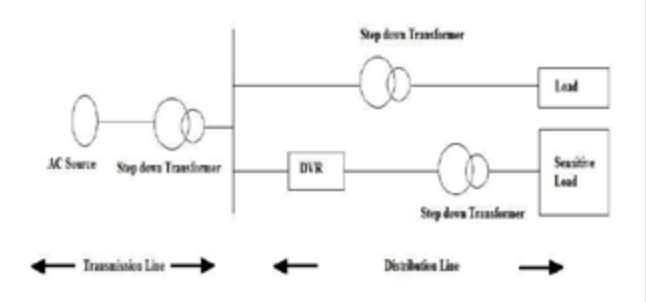

Figure 1. Location of DVR

A.Operation of DVR:

A DVR may be a solid state power physics change device consisting of either GTO or IGBT, a condenser bank as associate degree energy device and injection transformers. it's connected nonparallel between a

distribution system and a load that shown in Figure three.2. the essential plan of the DVR is employed to inject a controlled voltage generated by a forced commuted convertor in a|during a|in associate degree exceedingly|in a very series to the bus voltage by means that of an injecting electrical device. A DC to AC electrical converter regulates this voltage by curving PWM technique. for the duration of traditional operative condition, the DVR injects solely atiny low voltage to catch up on the free fall of the injection electrical device and device losses. However, once voltage sag happens within the distribution system, the DVR system calculates and synthesizes the voltage needed to preserve output voltage to the load by injecting a controlled voltage with a particular magnitude and point into the distribution system to the essential load [8].

Note that the DVR capable of generating or riveting reactive power however the active power injection of the device should be provided by associate degree external energy supply or energy storage system. The interval of DVR is incredibly short and is proscribed by the facility physics devices and therefore the voltage sag detection time. The inevitable interval is regarding twenty five milliseconds, and that is way but a number of the normal strategies of voltage correction like tap- dynamic transformers [9].

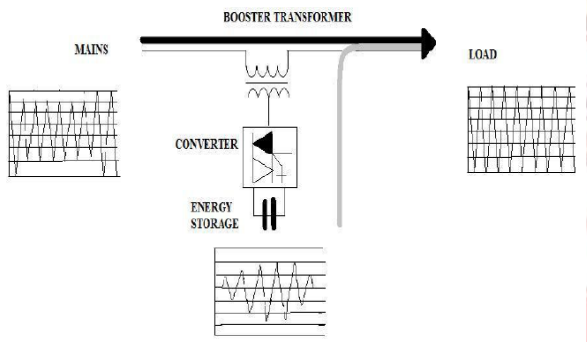

Figure 2: Basic Principle of DVR

IV. CONTROL TECHNIQUES OF DVR

The unit vector templates are very simple control strategy. The distorted supply is used to generate the unit vector templates. The schematic diagram of unit vector templates (uvt) generation is shown in figure 4.1. These templates nothing but pure sinusoidal signal with amplitude unity (p.u.) will be equal to pure sinusoidal signal with the unit (p.u) amplitude. The sinusoidal template can be extracted by multiplying a gain equal to 1/Vm (peak amplitude of the input fundamental voltage). with input supply voltage Vs.

IV.CONTROL TECHNIQUES OF DVR

The unit vector templates are very simple control strategy. The distorted supply is used to generate the unit vector templates. The schematic diagram of unit vector templates (uvt) generation is shown in figure 4.1. These templates nothing but pure sinusoidal signal with amplitude unity (p.u.) will be equal to pure sinusoidal signal with the unit (p.u) amplitude. The sinusoidal template can be extracted by multiplying a gain equal to 1/Vm (peak amplitude of the input fundamental voltage). with input supply voltage Vs.

Figure 3. Control Technique of DVR based on unit vector

The phase locked loop input is unit voltage vectors. A unit vector template can be determined by adjusting appropriate phase delay.

Va = sin wt

Vb = sin (wt-120)

VC = sin (wt +120)

K=1/Vm

Vm is multiplied with template of the unit vector to give the load reference voltage signal

V * Labc = Vm. Vabc

The purpose of load voltage compared to the reference signal voltage load. For generating the required gate signals for inverter. The error is process through hysteresis controller.

Hysteresis Voltage Control

This control technique is used for determine switching signals for inverters gates. It is also used for improve the load side voltage. The control signal is produced by the error signal i.e. generating between a reference voltage of DVR (Vref) and an injection voltage (Vinj). The above and lower bands for reference voltage are called Hysteresis Band (HB). If the difference between the inverter voltages and reference voltage reaches to the upper limit, the voltage is forced to decrease and vice versa.

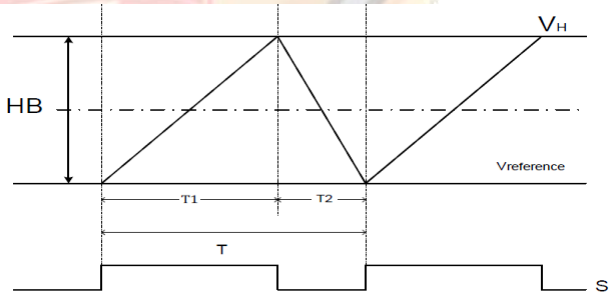

Figure 4: Hysteresis Band Voltage Control

Tc =1/fc = T1 + T2

Where HB is called Hysteresis Band, fc is called switching frequency and T1 and T2 are the turn-on and turn-off time respectively. The relation between switching frequency and Hysteresis Band (HB) has

inversely proportional. The Hysteresis Band (HB) is defined as (HB=VH-VL).

SIMULATION RESULTS

To validate the proposed algorithm, the series injection device (dynamic voltage restorer) simulated using Power System Block set in MATLAB/SIMULINK. The system parameters are shown in Table 1.

Table 1. Parameters of Simulation

Supply Voltage, Vs	415 V
Supply frequency	50 Hz
DC Bus voltage,Vdc	120 V
FILTER	R=0.8,C=430 uF
DC side capacitor, C	5000 uF
Load	R-L Load (30 ohm and 5mH connected in series)
Series filter transformer	10 kVA

Wave forms of source voltage, load voltage, unit vectors templates, error voltage and load voltage are shown from Figure 5 & 6

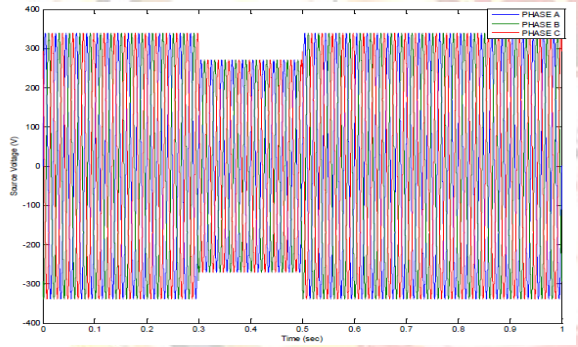

Figure 5: Source Voltages during sag from 0.3sec to 0.5 sec

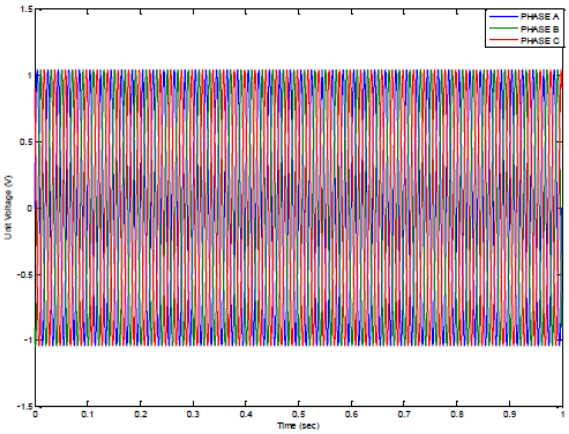

Figure 6: Unit Vector Template

CONCLUSION

Since the power quality problems are boom in this era this paper gives description about various power quality issues, causes and effects. Further this paper also proposes a fast and cost effective Dynamic Voltage Restorer (DVR) with various techniques for mitigating the problem of voltage sag or dip. The design is made in such a manner that the maximum voltage is injected in the system in order to mitigate the power quality problem which is voltage sag. It is clear from the results that the power quality of the system is maintained.

REFERENCE

[1] Ali O Al-Mathnani, Azah Mohamed,"Photovoltaic Based Dynamic Voltage Restorer For Voltage Sag Mitigation", The 5th Student Conference on Research and Development –SCOReD 2007, 11-12 December 2007, Malaysia

[2] Reza Sedaghati1, Mehdi Ghasemi2 and Mahdi Hayatdavudi "Performance Study of Dynamic Voltage Restorer (DVR) in order to Power Quality Improvement" ArticleCode : pqa_3266

[3] Shailesh M. Deshmukh, Bharti Dewani, " Overview of Dynamic Voltage Restorer (DVR) for Power Quality Improvement" Applications (IJERA) ISSN: 2248-9622 Vol. 2, Issue6, November- December 2012, pp.1372-1377

[4] Mayank Paliwal, Rohit Chandra Verma and Shaurya Rastogi," Voltage Sag Compensation Using Dynamic Voltage Restorer"

[5] Advance in Electronic and Electric Engineering. ISSN 2231-1297, Volume 4, Number 6 (2014), pp. 645-654

[6] Ankit Pandey, Rajlakshmi," Dynamic Voltage Restorer and Its application at LV & MV Level International Journal of Scientific & Engineering Research, Volume 4, Issue 6, June-2013 668 ISSN 2229-5518

[7] IEEE Standard 1159-1995 "IEEE Recommended Practice for Monitoring Electric Power Quality. Published 1995.

[8]P. T. Nguyen *and* Tapan. K. Saha, *Senior Member, EEE,"* Dynamic Voltage Restorer Against Balanced and Unbalanced Voltage Sags:

[9]D. Daniel Sabin, Senior Member, IEEE, and Ambra Sannino, IEEE "A Summary of the Draft IEEE P1409 Custom Power Application Guide" Transmission and Distribution Conference and Exposition, IEEE PES, vol. 3, pp. 931-936, 2003.