A Review Paper on Inrush Current Mitigation Technique of Load Transformer for Series Voltage Sag Compensator

Mr. Gholap Mayur Radhakisan  
M.Tech. Student  
Department of Electrical Engineering  
Central India Institute of Technology Indore  
Indore, India  
mayurgholap11@gmail.com

Prof. Sunil Kumar Bhatt  
Asst. Professor  
Department of Electrical Engineering  
Central India Institute of Technology Indore  
Indore, India  
Sunilbhatt54@gmail.com

Abstract— In many countries, high-tech manufacturers concentrate in industry parks. Survey results suggest that 92% of interruption at industrial facilities is voltage sag related. In recent era boost in computer technology and electronics devices flooded the system with the devices prone to quality of power, as the system consist of electronics load, critical loads, electronics processors which are very sensitive to quality of power. Through survey we found that voltage sag is generally present in power system. Many techniques are available for voltage sag compensation. To maintain the system voltage profile the voltage sag compensator is in need to be installed at various levels in the power system.

Keywords: Voltage sag, compensator, power quality, voltage sag compensator

I. INTRODUCTION

In modern power system reliability and stability are considered to be very important issues. Stability of the system can be achieved by enhancing the power quality. Power quality deals with several issues and problems, maintaining the power quality can be beneficial for both customer and utility. As the system is increasing and is a vast network power quality is main issue to be considered for increasing efficiency, stability and reliability. Power quality may be affected by voltage sag, voltage swell, harmonics, transients, voltage fluctuation, dc offset, interruptions, noise etc.

II. LITERATURE SURVEYS


In this paper study and performance of DVR for mitigating the voltage sag/swell in distribution power system is presented. The various technique shows that the DVR is suitable for compensation of voltage sag and swell with the help of different controlling techniques DVR easily handles both balanced unbalanced situations without any difficulties and injects the appropriate voltage

2.“Compensation of Sag and Swell Voltage using Dynamic Voltage Restorer (DVR) during Single line to Ground and Three phase faults”. S.F.Torabi ,D.Nazarpour, Y.Shayestehfar Faculty of Engineering ,University of Urmia , Urmia , Iran. ISSN 2077-3528 IJTPE Journal,September 2012

This paper deals with modelling and simulation technique of a Dynamic Voltage Restore (DVR). The DVR is a dynamic solution to protect sensitive loads against voltage sag and swells. The DVR can be implemented to protect a group of medium voltage or low voltage consumers. The new configuration of DVR has been proposed using improved d-q-o controller technique. The study present compensation of sags and swells voltage during single line to ground (SLG) fault and three phase fault.


This paper shows the power quality problem to the industrial customers. In which voltage sag can cause miss operation to several sensitive electronic equipments. That problem can be mitigating with voltage injection method using custom power device, Dynamic Voltage Restorer (DVR). This paper present modeling and analysis of a DVR with pulse modulation (PWM) based controller using Matlab/Simulink. The performance of the DVR depends on the efficiency of the control technique involved in switching the inverter.

4. “Modeling and Simulation of Dynamic Voltage Restorer (DVR) Based on Hysteresis Voltage Control” Fawzi AL Jawder, Member,IEEE, Electrical and Electronics Engineering Department, University of Bahrain,Kingdom of Bahrain.

In this paper, a DVR based on hysteresis voltage control is proposed. The DVR is modeled using Simulink’ Sim Power System Tool box. Discrete Fourier Transform (DFT) is used to detect the magnitude and the phase jump of the voltage sag and swell. The influence of the band of the
hysteresis voltage controller on the quality of load voltage and DVR voltage is studied.

III. AIM AND OBJECTIVES

To enhance the stability of electrical power system by minimizing the power quality issues. To strengthen the power network by mitigating the power quality problems.

1. Balancing the active and reactive power in power system.
2. To maintain voltage profile across power system.
3. Reduces the harmonics disturbances from the system.

IV. PROBLEM FORMULATION

The Electrical Power System is a very large network in which number of power quality issues may occur such as voltage sag/swell, harmonics, interruptions, transients, voltage fluctuation, noise, notching. In a power system different types of loads are connected across load side as well as source side of system. In survey it is found that most of the interruption at industrial facilities is voltage sag related. Voltage sag is a most notorious problem as it goes on affecting a large network.

As the power network consist of large numbers of transformers which are affected by inrush current drawn due to sudden loading. Hence inrush current across the transformer also create the voltage sag which is not addressed in any voltage sag compensator. A system to mitigate the inrush current is required to minimize the voltage sag in the network.

V. ROLE OF FACTS DEVICES

A flexible alternating current transmission system (FACTS) is composed of static equipment used for AC transmission of electrical energy. It is generally electronics based system. These devices are capable to mitigate multiple power quality. Which is accepted to distribution system to provide power quality mitigation.

- Static synchronous compensator (STATCOM)
- Static var compensator (SVC)
- Dynamic voltage restorer (DVR)
- Static synchronous series compensator (SSSC)
- Unified power flow controller (UPFC)

A. Preferred Methodology: Inrush mitigation technique

Survey results suggest that 92% of interruption at industrial facilities is voltage sag related. The voltage sag compensator, based on a transformer-coupled series connected voltage source inverter, is among the most cost effective solution against voltage sags. Transformers are often installed in front of critical loads for electrical isolation purposes. When voltage sags happen, the transformers are exposed to the disfigured voltages and a DC offset will occur in its flux linkage. When the compensator restores the load voltage, the flux linkage will be driven to the level of magnetic saturation and severe inrush current occurs. The compensator is likely to be interrupted because of its own over-current protection, and eventually the compensation fails, and the critical loads are interrupted by the voltage sag. In an inrush current mitigation technique together with a state feedback controller for the voltage sag compensator.

B. System Configuration of the Proposed Compensator

The series compensator is consisted by a three phase voltage source inverter. The leakage inductor of coupling transformer $L_f$ and capacitor $C_f$ is recognized as the low-pass filter to suppress PWM ripples of inverter output voltage $v_{m}$. Fig 2 shows the equivalent circuit of series voltage sag compensator and its dynamic equation can be expressed as below.

VI. SIMULATION AND RESULTS

A system with nonlinear load having load transformer with inrush mitigation technique is modelled in MATLAB. Voltage sag effects and mitigation is studied with simulation.

Fig.1. A simplified one line diagram of the off-line series voltage sag compensator

Fig.2. Per-phase equivalent circuit of the series voltage sag compensator

Fig 3. simulation model with mitigation technique
An inrush current mitigation technique incorporating with the full sate feedback controller to prevent the inrush current during the voltage compensation process. The controller includes a voltage control, a current control and a flux linkage control. The proposed control method is based on the synchronous reference frame which enables voltage sag compensator to achieve fast voltage injection and prevent the inrush current. When voltage sag occurs, the controller can track the transient flux linkage and calculate a required compensation voltage in real-time for fast compensation and elimination of flux linkage DC offset caused by voltage sags. The effectiveness of the proposed the flux link age compensation mechanism is validated by laboratory test results. The proposed method can be easily integrated with the existing voltage sag compensation control system without using any extra-sensors.

**VII. FUTURE WORK**

1. Analysis of mitigation technique in different load condition and ratings
2. Comparison with different voltage sag compensator
3. Inrush mitigation in case of fault on system

**ACKNOWLEDGMENT**

I would like to take this opportunity to express our gratitude towards all those who helped me in completing this project work. I am very thankful to my guide Prof. Sunil Kumar Bhatt for his continuous guidance. I would like to express my deepest gratitude towards him. I am also grateful to all staff members of “Central India Institute of Technology Indore, India” works for their constant support in my work. I am also thankful to my friends for their help.

**REFERENCES**