



A NOVEL CONCEPT OF POWER QUALITY IMPROVEMENT IN DISTRIBUTION SYSTEM USING D-STATCOM

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ABSTRACT

STATCOM (static synchronous compensator) as a shunt-link flexible AC transmission system (FACTS) controller has shown extensive feasibility in terms of cost-effectiveness in a wide range of problem solving abilities from transmission to distribution levels. Advances in power electronic technologies such as Voltage Source Converter (VSC) improves the reliability and functionality of power electronic based controllers hence resulting in increased applications of STATCOM. In this paper, design and implementation of a Distribution type, Voltage Source Converter (VSC) based static synchronous compensator (D- STATCOM) has been carried out. It presents the enhancement of power quality problems, such as voltage sag and swell using Distribution Static Compensator (D-STATCOM) in distribution system. The model is based on Sinusoidal Pulse Width Modulation (SPWM) technique. The control of the Voltage Source Converter (VSC) is done with the help of SPWM.

The main focus of this paper is to compensate voltage sag and swell in a distribution system. To solve this problem custom power devices are used such as Fixed Compensators (FC, FR), Synchronous Condenser, SVC, SSSC, STATCOM etc. Among these devices Distribution STATCOM (D-STATCOM) is the most efficient and effective modern custom power device used in power distribution networks. D- STATCOM injects a current into the system to mitigate the voltage sag and swell. The work had been carried out in MATLAB environment using Simulink and SIM power system tool boxes. The proposed D-STATCOM model is very effective to enhance the power quality of an isolated distribution system feeding power to crucial equipment in remote areas. The simulations were performed and results were found to be satisfactory using MATLAB/SIMULINK.

Keywords - Statcom, Facts Controllers, D-Statcom, Voltage Source Converter, Total Harmonic Distortions

1. INTRODUCTION

An increasing demand for high quality, reliable electrical power and increasing number of distorting loads may leads to an increased awareness of power quality both by customers and utilities. The most common power quality problems today are voltage sags, harmonic distortion and low power factor.

Voltage sags is a short time (10 ms to 1 minute) event during which a reduction in rms voltage magnitude occurs. It is often set only by two parameters, depth/ magnitude and duration. The voltage sags magnitude is ranged from 10% to 90% of nominal voltage and with duration from half a cycle to 1 min.

Voltage sags is caused by a fault in the utility system, a fault within the customer's facility or a large increase of the load current, like starting a motor or transformer energizing. Voltage sags are one of the most occurring power quality problems. For an industry voltage sags occur more often and cause severe problems and economical losses. Utilities often focus on disturbances from end-user equipment as the main power quality problems.

Harmonic currents in distribution system can cause harmonic distortion, low power factor and additional losses as well as heating in the electrical equipment. It also can cause vibration and noise in machines and malfunction of the sensitive equipment. The development of power electronics devices such as Flexible AC Transmission System (FACTS) and custom power devices have introduced and emerging branch of technology providing the power system with versatile new control capabilities.

There are different ways to enhance power quality problems in transmission and distribution systems. Among these, the D-STATCOM is one of the most effective devices. A new PWM-based control scheme has been implemented to control the electronic valves in the DSTATCOM. The D-STATCOM has additional capability to sustain reactive current at low voltage, and can be developed as a voltage and frequency support by replacing capacitors with batteries as energy storage.