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ABSTRACT

Power Quality has been a major is focus area in power systems since the last four decades. Use of power electronics based flexible ac transmission systems (FACTS) devices for solving power quality problems was introduced by EPRI in late 1970's [1]. These devices are basically of two types – thyristor based and voltage sourced converter (VSC) based. The performance of the VSC based FACTS devices is known to be superior than that of thyristor based devices [1].

Static Synchronous Compensator (STATCOM) is one of the most popular VSC based FACTS device. It is a shunt connected device which is used to maintain the voltage the voltage profile of the system by absorbing or delivering the required amount of reactive power. STATCOM can also be used for harmonic suppression by delivering the harmonic current required by the load and making the source current harmonic free.

FACTS devices are mainly used in transmission system. Gradually, a new set of Custom Power Devices were introduced in the mid 1990's specifically for distribution systems. These devices take care of problems like voltage swell, voltage sag, harmonic distortion, flicker etc. which occur in distribution systems. Shunt connected custom power devices are used mainly for voltage related problems while the series connected devices are preferred for current related problems.

Similar to a STATCOM, Distribution Static Synchronous Compensator (DSTATCOM) was introduced for maintaining the voltage profile in case of sudden switching of linear or non-linear loads in distribution systems. DSTATCOM has the capability to make the source power factor unity even though the load is lagging/leading in nature. This is helpful as the source supplies only active power in the system. In this work a DSTATCOM is considered for maintaining the voltage profile of the system at Point of Common Coupling (PCC) and system power factor to unity under different load conditions.

DSTATCOM is modeled using Simulink and SimPower System in MATLAB environment. The results are presented for a test system with/without DSTATCOM for a wide variety of system disturbances. The modeled DSTATCOM is also tested for load compensation of linear and non-linear loads in both steady state and dynamic conditions. Battery Energy Storage System (BESS) is also modeled and tested for compensation of load. The results are found to be satisfactory under different tested conditions.

LIST OF ABBREVIATIONS

AC	Alternating Current
BESS	Battery Energy Storage System
CP	Custom Power
DSTATCOM	Distribution Static Synchronous Compensator
DVR	Dynamic Voltage Restorer
FACTS	Flexible Alternating Current Transmission Systems
IRPT	Instantaneous Reactive Power Theory
PCC	Point of Common Coupling
PI	Proportional Integral
PLL	Phase-Locked Loop
PQ	Power Quality
PU	Per Unit
PWM	Pulse Width Modulation
RMS	Root Mean Square
SRF	Synchronous Reference Frame
STATCOM	Static Synchronous Compensator
SVC	Static VAR Compensator
UPQC	Unified Power Quality Conditioner
VAR	Volt Ampere Reactive
VSC	Voltage Source Converter
VSI	Voltage Source Inverter
THD	Total Harmonic Distortion
V	Voltage

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