SYNOPSIS

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Modern industrial power electronic based equipments offer higher efficiency, compact size and better controllability. But on the flip side, due to switching actions, these systems behave as non-linear loads. This creates power quality problems such as voltages Sag/Swell, flickers, harmonics, interruption, impulse transient, asymmetric of voltage have become increasingly serious. At the same time, modern industrial equipments are more sensitive to these power quality problems. Failures due to such disturbances create high impact on production cost [1]. So nowadays high quality electrical power has become basic needs of highly automated industries.

Until now, to filter these harmonics and to compensate reactive power at factory level, only capacitor and passive filters were used. Many new PWM converters for motor control are used but still there is scope and need of improvement. This is one of the

reasons that the research is being done in the area of Active Power Filter (APF) [2]. Active power filters are offering unprecedented ability to clean the network from harmonics. They eliminate harmonics in a controlled way and can compensate load unbalances and power factor at the same time. Present devices can eliminate up to the 50th harmonic, with a programmable filtering strategy and free choice of harmonics

Modern concept of FACT devices is an effective solution for power quality problems. One of the fact device is static compensator (STATCOM) used for reactive power compensation in power transmission systems. Shunt active power filters compensate load current harmonics by injecting equal but opposite harmonic compensating current [3][4]. In this case the shunt active power filter operates as a current source injecting the harmonic components generated by the load but phase shifted by 180°. Same way for series compensation FACT device used is Dynamic Voltage Restore (DVR). DVR inject an appropriate voltage magnitude with an appropriate phase angle dynamically [5].DVR effectively mitigates voltage sag/swell. Dynamic compensating signals are determine based on the difference between desired and actual values[6].

The present technique used for power quality solution is useful either for current issue or voltage power quality issue. At the Same time it is very complex and very costly. The control technique used decides the response of STATCOM and DVR[7].

Three phase combination of shunt and series FACT devises is very rarely and lately introduce. It is combination of shunt and series devices. It is known as Unified Power conditioner (UPQC). UPQC is a combination of fact devices. The design of UPQC is made up with STACOM and DVR [8][9] with innovative technique. This unique combination device able to reduce current and voltage related power quality issue effectively

The motivation behind the work presented in this thesis are :

1. Simulate the fast response STATCOM to eliminate the current harmonics
2. Using innovative technique design a DVR to mitigate voltage sags and swells

3. Main task is to combine both devices and to use an appropriate fast response control technique to filter out current and voltage harmonics.
4. Explore different control technique for UPQC to get optimum response
5. Simulate different types of loads like R- L and DC machine
6. To study the effectiveness of optimal adjustment of control circuit

A brief description of the research work reported in the thesis is given below:

Chapter 1: In this chapter the background of power quality issues, power quality problems and the available solutions are discussed briefly. Also certain active power filters topologies have been briefly discussed. Moreover, this chapter includes the brief details of references which have been referred for this thesis work.

Chapter 2: In this chapter the shunt active power filter is discussed in detail. In this the basic compensation principle of shunt active power filter, power flow, estimation of reference source current, control scheme, design of dc link capacitor, selection of reference capacitor voltage, selection of filter inductor, PI controller and hysteresis controller have been discussed. Also the operation of simulation model has been discussed briefly. The Voltage Source Inverter (VSI) based The Static Synchronous Compensator (STATCOM) is used for eliminating current harmonics and compensating reactive power. This VSI draw or supply a compensating current from the utility such that it cancels current harmonics on the AC side.

Chapter 3: In this chapter the series active power filter has been discussed in detail. In this the basic compensation principle of series active power filter, estimation of reference voltage and control scheme and brief operation of simulation model has been discussed. The DVR restores constant load voltage and voltage wave form by injecting an appropriate voltage. Present novel structure improves power quality by compensating voltage sag and voltage swells.

Chapter 4: In this chapter the unified power conditioner (UPQC) has been discussed in detail. In this the Mathematical Modeling, Operating Principle and Control scheme of the UPQC have been discussed in detail. Using innovative control technique combine series and shunt combination

Chapter 5: In this chapter the simulation blocks and their respective results of shunt and series active power filters and unified power quality conditioner have been shown. A very simple hysteresis current controller based control technique with help of unit vector template is proposed for STATCOM. DVR is simulated with abc to dq0 base new control algorithm to generate the pulse Phase Locked Loop (PLL) is used to generate unit sinusoidal wave in phase with main voltage. The combination of shunt and series Fact devices test on the RL load and DC machine

Chapter 6: This chapter gives the main outcomes of the thesis and scope of the future works

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