Improvement in Power Quality Problems Using Unified Power Quality Controller (UPQC)

Bilal Ahmad lone[1], Kamal Kumar Sharma[2], Rajesh Choudhary[3]

[1]Student, M. Tech, ESSEAR, Ambala
[2]Professor, Dept. of ECE, E-Max group of Institutions, Ambala
[3]Assistant Professor, Dept. of EE, E-Max group of Institutions, Ambala

***ABSTRACT*-This paper deals with conceptual study of unified power quality conditioner (UPQC) during voltage sag and swell on the power network.Power quality has become an important factor in power systems, for consumer and household appliances with production of various electric and electronic equipment and computer systems. The main causes of a poor power quality are harmonic currents, poor power factor, supply voltage variations etc. The Unified Power Quality Conditioner (UPQC) is a custom power device, which diminishes voltage and current related power quality issues. It also prevents load current harmonics from entering the utility and corrects the input power factor of the load. The system performance for current harmonics, voltage harmonics, voltage sag and voltage swell will be evaluated. The MATLAB / Simulink based simulations will be provided which support the functionality of the UPQC.**

KEYWORD: UPQC, Power quality problems

I. INTRODUCTION

In today's complex electronics environment many problems can occur because of poor quality of power. Therefore, it has become necessary to provide a dynamic solution with greater degree of accuracy as well as with fast speed of response. With great advancement in all areas of engineering, particularly, in signal processing, control systems, and power electronics, the load characteristics have changed completely. In addition to this, loads are becoming very sensitive to voltage supplied to them. The power electronics based devices have been used to overcome the major power quality problems .

There are sets of conventional solutions to the power quality problems, which have existed for a long time. However these conventional solutions use passive elements and do not always respond correctly as the nature of the power system conditions change.The power electronic based power conditioning devices can be effectively utilized to improve the quality of power supplied to customers. One modern solution that deals with both load current and supply voltage imperfections is the Unified Power Quality Conditioner (UPQC) , which was first presented in 1995 by Hirofumi Akagi.

UPQC is a combination of series and shunt active filters connected in cascade via a common dc link capacitor. The series active filter inserts a voltage, which is added at the point of the common coupling (PCC) such that the load ends voltage remains unaffected by any voltage disturbance. The main objectives of the shunt active filter are: to compensate for the load reactive power demand and unbalance, to eliminate the harmonics from the supply current, and to regulate the common dc link voltage.It uses a pair of three-phase controllable bridges to produce current that is injected into a transmission line using a series transformer. The controller can control active and reactive power flows in a transmission line.

II. LITERATURE SURVEY

Sajid Ali et. al. proposed that Power quality problems become a major anxiety of industries due to enormous loss in terms of time and money. The power quality consists of a large number of disturbances such as voltage sags, swells, harmonics, notch, flicker, etc. There are the various methods to alleviate the power quality problems, but the FACTS devices are the most excellent solution to alleviate this problem. One of the most powerful FACTS devices is the DVR to alleviate the voltage sag and swell. This paper described the study and performance on DVR and various compensation method of DVR which are used to mitigate the voltage sag and swell and its impact on sophisticated loads. **[1]**

M. Sharanya et. al. proposed that the quality of power provided to the consumers can be improved by using custom power devices, (CPD). CPD uses power electronic controllers in distribution systems in order to provide reliable and good quality of power needed to power consumers. This paper gave that the use of Dynamic voltage restorer and hybrid active filters improves the quality of power by voltage profile improvement and by the mitigation of harmonics in the supply current. The DVR and hybrid filters are controlled by using PI controllers. The system is modeled by using MATLAB/SIMULINK software. **[2]**

D V N Ananth et. al. proposed that Unbalanced and distorted loads create lot of disturbances in source voltages and other neighboring loads. The loads like light or computers are sensitive, they may flicker or cause heat internally and may loses its life

earlier. For controlling unbalanced loads, custom power devices like DSTATCOM, DVR and UPQC are most widely used. In this analysis, in three phases, three different loads like resistor load, diode rectifier load and DC motor load was placed. The resistor load gives normal voltage and current, diode rectifier load voltage and current which will distort voltage waveform and DC motor load will distort both voltage and current waveforms. In the analysis, these loads are considered with different power ratings, so unbalanced voltages and currents are produced. **[3]**

Sumit Mazumder et. alproposed a unified power quality compensator (UPQC) to alleviate the voltage quality excess power circulation problems. Single phase distributed energy resources (DERs) can cause voltage rise along distribution feeder and power imbalance among the phases. Usually transformer tap setting are used to mitigate voltage drop along feeders. However this can aggravate the voltage rise problem when DERs are connected. **. [4]**

R. Nittala et. al. proposed Interline Dynamic Voltage Restorer (IDVR) to mitigate voltage sag, while its DC link energy is restored by phase shifting transformers. The Dynamic Voltage Restorer (DVR) was proposed as a solution to Voltage Sag compensation involving considerable amount of real power injection into the system which entirely depends on the energy storage capacity of DVR thus limiting its capabilities. The extension of the Dynamic Voltage Restorer leads to the concept of IDVR which consists of two DVRs sharing a common DC link**[5]**

III. OBJECTIVES

The objective of this dissertation is

- To design a unified power quality controller (UPQC) to improve power quality problems.
- To overcome main power quality problems voltage sag, voltage swell, harmonics & interruption.
- The other objective is to handle the value of THD which should be less than 5%.

IV. SYSTEM ARCHITECTURE

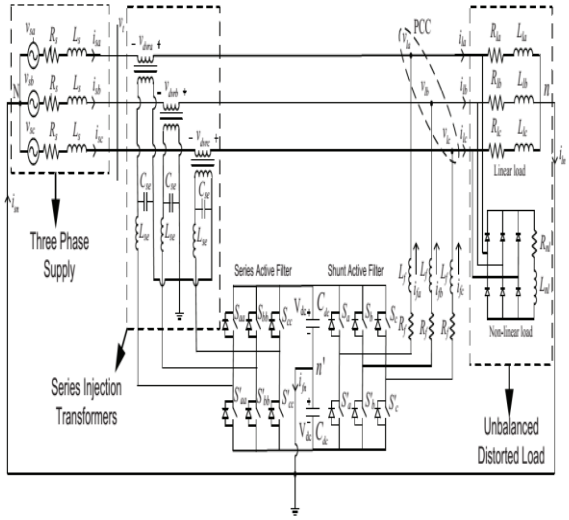

Figure: Equivalent circuit of VSI topology based UPQC.

V. POWER QUALITY PROBLEMS

Transients

Transients' results in deflection of original wave form from its wave shape. These are of two types (a) impulsive transients (b) oscillatory transients. Impulsive transients are the one in which wave deforms only on the upper side (unidirectional). Lightning strikes, switching of inductive load are the main causes of them. Oscillatory transients are the bidirectional variations of the wave.

Interruption

When voltage level drops below its 10% value of its original value, then it is termed as black out or interruption. They are the worst type of error and also most little likely to occur. They are of three types (a) Momentary interruption (last for 30 seconds), (b) Temporary interruption (last for 1min), and (c) Sustained interruption (for more than one min).

Voltage Sag

Voltage Sag is the most severe problem in the power quality. Voltage sag is the decreasing in voltage between 10% and 90% of nominal voltage for half cycle to one minute. The external causes of sag are from the utility transmission and distribution network. The sags generated on the transmission or distribution system can travel hundreds of miles thereby affecting thousands of customers during a single event.

Voltage Swell

Voltage swell is opposite to voltage sag. It is the 10% increase in the value of applied voltage for half a cycle to one min. It is often caused due to switching off of loads and switching on of capacitor bank.

Harmonics

Harmonics are the periodic sinusoidal distortion of the supply voltages or load current due to non-linear loads. Harmonics are measured in integer multiple of fundamental frequency.

VI. SOFTWARE USED

The designing & simulation of proposed System will be done by using MATLAB & SIMULINK Software.

VII. REFERENCES

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