Comparative Study In Between STATCOM and SSSC Subjected to Wind Energy System

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Abstract: **In energy transmission systems, effective equipments on power control are generally known as Flexible AC Transmission System (FACTS). In addition, the power electronics-based equipment, which are called power conditioners are use to solve power quality problems. Since the topologies of these equipments are similar to those used in FACTS equipment, power conditioners are also called Distribution FACTS (DFACTS). The principal operating modes and applications whichever one of equipment in transmission and distribution system (such as UPFC, and UPQC) will be discussed and compared. In this work FACTS based equipment are implemented and the comparative study has been done to underline the special features of each. The nonlinear load and complexity of control system in industrial processes have triggered the power quality problems in the distribution network. The major aim of power quality enhancing techniques is to maintain a specified voltage magnitude at a desired frequency for sensitive loads irrespective of the fault or conditions in the power distribution network. This is possible only by ensuring an uninterrupted flow of power at proper voltage and frequency levels. As a result of this, the need of custom power devices is felt.**

INTRODUCTION

Power quality problem is occurring as a non-standard voltage, current and frequency. The power quality has serious economic implications for customers, utilities and electrical equipment manufacturers. Modernization and automation of industry involves increasing use of computers, microprocessors and power electronic systems such as adjustable speed drives. Integration of non-conventional generation technologies such as fuel cells, wind turbines and photovoltaic with utility grids often requires power electronic inter-faces. The power electronic systems also contribute to power quality problem (generated harmonics). The electronic devices are very sensitive to disturbances and become less tolerant to power quality problems such as voltage sags, swells and harmonics. Voltage dips are considered to be one of the most severe disturbances to the industrial equipments. Voltage support at a load can be achieved by reactive power injection at the load point of common coupling. Due to the harmonics are occurring in the system it causes losses and heating of motor. This work focuses on the key issues in the power quality problems, in the proposed system Voltage sag/Voltage swell occurs due to the three phase fault/ground fault/phase to ground fault in the transmission line and harmonics occurs due to the connection of controlled six pulse converter (rectifier) to the main drive load(non linear load). All these factors affect the sensitive load which is connected in parallel to the main drive load. So the proposed system protects the sensitive load by mitigating the harmonics using dynamic voltage restorer technique.

M. Vasudevan et. al. [33] presented a detailed comparison between adaptive intelligent torque control strategies of induction motor, emphasizing advantages and disadvantages. Induction motors are characterized by complex, highly non-linear, time varying dynamics and hence can be considered as a challenging engineering problem.

T.Devaraju et. al. [12] proposed that power quality problem is an occurrence manifested as a non standard voltage, current or frequency that results in a failure of equipments. Utility distribution networks, sensitive industrial loads, and critical commercial operations all suffer from various types of outages and service interruptions which can cost significant financial loss per incident based on process down-time, lost production, idle work forces, and other factors. In this electromagnetic transient studies are presented for the following two custom power controllers: the distribution static compensator (DSTATCOM), and the dynamic voltage restorer (STATCOM).

Afshin Lashkar Ara *et. al.* [10] Described the power electronic devices and technical review in various power engineering levels. In addition, the power electronics-based equipment, which are called power conditioners are use to solve power quality problems. Power conditioners are also called Distribution FACTS (DFACTS)

devices. [1] presents the comparison of the operating modes and applications of FACTS devices (such as STATCOM, SSSC, SSSC , DSTATCOM, STATCOM and UPQC) in transmission and distribution systems.

Juan W. Dixon et. al. [11] presented a series active power filter working as a sinusoidal current source, which is in phase with the mains voltage. The amplitude of the fundamental current in the series filter is controlled with the help of error signal generated between the load voltage and a pre established reference. The control provides the effective correction of power factor, harmonic distortion, and load voltage regulation.

Power quality is a comprehensive term that squeezes all features related with amplitude, phase and frequency of the voltage and current waveforms existing in a power circuit. Poor power quality may result from transient conditions accumulate in the power circuit or from the non-linear loads. Power distribution systems ought to deliver their customers with an associate degree uninterrupted flow of energy with smooth sinusoidal voltage at the contracted magnitude level and frequency, but the distribution systems, have several nonlinear loads, which significantly affect the quality of power supplies [1-4].

The concept of custom power was introduced by N.G.Hingorani [6]. The term custom power means the utilization of power electronic controllers for distribution systems. The custom power devices will increases the quality and reliability of the power that is delivered to the customers. Customers are increasingly demanding more exigent quality in the power supplied by the electrical company.

Comprehensive review of compensating type custom power devices, issues of power quality, survey of power quality issues, standards and indices proposed by different agencies and different approaches to boost power quality from time to time [6-9].

Power quality can be classified into three categories that is, voltage stability, continuity of supplying power, and voltage. Based on this classification, several examples of power quality level definitions were presented by **Toshifiimi Ise** *et. al.* [5]

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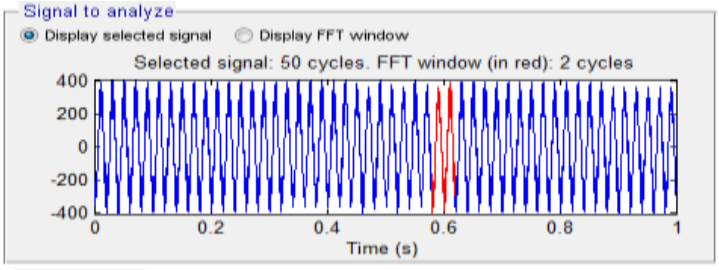
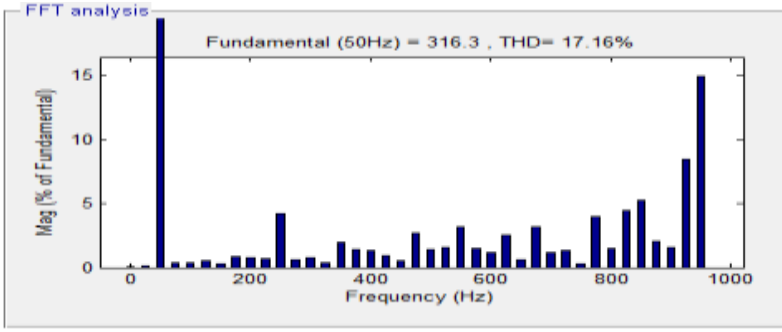
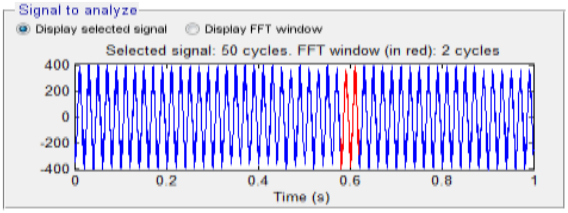
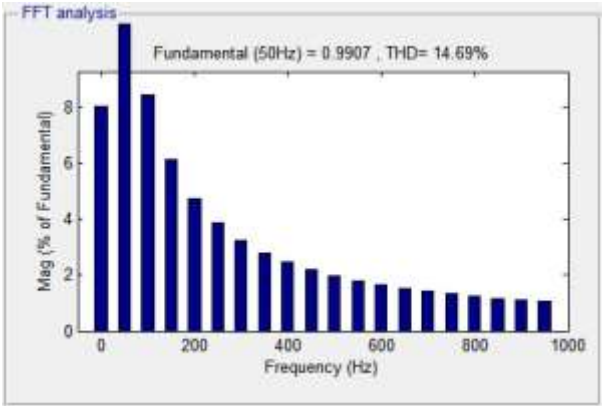
Result and Discussion

In simulink model figure (STATCOM) shows the harmonics is generated in the system using six pulse converters connected to the main drive non linear load which is parallel to the sensitive load. The percentage of Total harmonic distortion in the sensitive load side is, in phase1 17.16%, in phase2 14.99%, in phase3 12.77%. In this work MATLAB simulation is carried out **with compensation technique**.

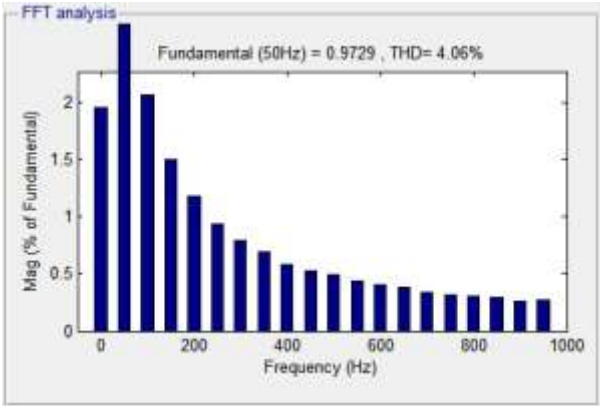




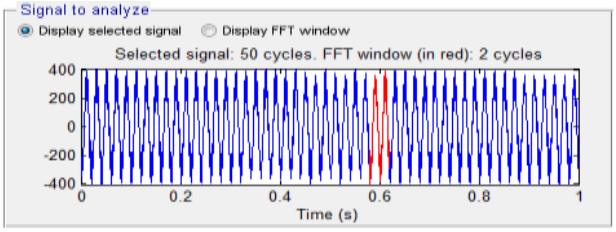


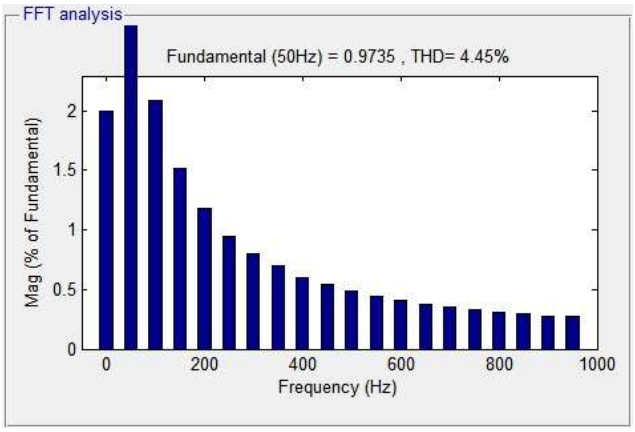


Spectrum Analysis of Source Voltage, Load Voltage of STATCOM

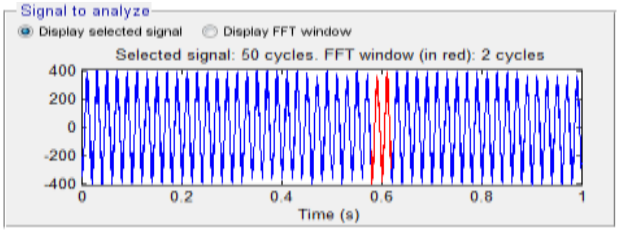


Spectrum Analysis of Source Voltage, Load Voltage of SSSC





Spectrum Analysis of Source Voltage, Load Voltage of UPFC



CONCLUSIONS

This work has presented the power quality problems such as voltage dips, swells, distortions and harmonics. Comparative analysis of compensation techniques of custom power electronic devices like STATCOM and SSSC are presented and compared for same parameters. The design and applications of STATCOM and SSSC for voltage sags and comprehensive results were presented. The results show that SSSC have higher capacity to provide better filtration then the STATCOM.

STATCOM is proved to compensate voltage levels under faulty conditions. Voltage harmonics has been reduced considerably. Harmonics generated at source side has THD of 17 % which has been compensated to 14.06% at load end. Even the voltage sag during fault duration has also been compensated to a desired level.

SSSC is proved to compensate current and voltage levels under faulty conditions. Voltage and current harmonics has been reduced considerably. Current harmonics generated at load side has THD of 4.45% which has been compensated to 4.06% at PCC. Voltage Harmonics generated at source side has THD of 4.45% which has been compensated to 4.06% at load end. Even the current and voltage level during fault duration has also been compensated to a desired level.

Limitations

In this thesis work, it has been identified that the simulation results heavily dependent on the time step considered in the simulation software. By reducing the time step (for a run time of 1s) the oscillatory and the stepped nature of the output waveform can be changed. Due to the limitations in the MATLAB simulation software and also the limitations in the processing speed of the computer the time step could not be reduced as desired.

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