

Power Quality Improvement by Using TCSC

Lukesh Kumar Sahu ¹, Ankit Dubey ², Shruti Soni ³

¹²³ Electrical and Electronics,
Disha Institute of Management and Technology
Raipur 492001, India

¹lukeshsahu@rediffmail.com

²ankit.dubey@dishamail.com

³Shrutisoni021290@gmail.com

Abstract: Power quality is one of the most important issues in power system. Voltage sag, voltage swell, flickers, and harmonics distortion causes the power quality problems. TCSC the facts device is used to compensate all these problems. The use of electronics devices increase the power quality problems ,equipment such as large industrial drive ,automatic voltage regulator generate significantly voltage and current harmonics and create excessive voltage fluctuations. The application of custom power devices gives the solution of such problems. TCSC is power electronics device used to enhance the power transfer capability near thermal limit without affecting the stability.

Keywords: Facts, Power quality, TCSC, voltage stability. Voltage swell

1. INTRODUCTION

Potential benefits of using Flexible AC Transmission system (FACTS) controllers for enhancing power system stability are well known. The use of these controllers gives grid planners and operators a greater flexibility regarding the type of control actions that can be taken at any given time. Thyristor Controlled Series Capacitors (TCSC), in particular, have been widely studied and reported in the technical literature, and have been shown and used in practice to significantly enhance system stability. In dynamic applications of TCSCs, various control techniques and designs have been proposed for damping power oscillations to improve system dynamic response , whereas for steady state control, the main interest of users and researchers has been the use of the this controller for power flow control in transmission lines, usually considering optimal scheduling strategies .

Most of the available technical literature in TCSC usually deals with steady state and, dynamic control and applications independently. However, to fully understand and properly utilize these types of controllers, a number of control tasks for both dynamic and steady state system improvement must be jointly considered. Since the time frames of the different control actions comprise a wide range of system responses, a hierarchical control scheme should be preferably considered

For the controller. In the case of a TCSC, such a scheme should consider the different control levels acting on the same control variable, which

in this paper is assumed to be the fundamental frequency equivalent impedance, as this is the control variable most commonly studied in the literature. In this kind of hierarchical control design, adverse interactions between the different control levels may be expected when not properly coordinated the main aim is to analyse the design of a hierarchical TCSC controller for stability enhancement, taking into account interactions among the different control levels.

A linear dynamic compensator with various input signals for damping power oscillations is proposed and studied based on a typical stability model of the TCSC. Since large-disturbance stability improvement is of major concern here, tuning of the control parameters is mainly carried out via simulations of severe fault conditions.

Voltage Swells

A voltage swell is an increase in the RMS voltage above the nominal voltage or a sliding reference voltage. The increase lasts from half a cycle to several seconds. Switching off large loads, capacitor banks

2. THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC)

TCSC consists of a capacitor in parallel with a Thyristor controlled reactor (TCR) as shown in Fig.1, [3]. An actual TCSC system usually comprises a cascaded combination of many TCSC modules together with a fixed-series capacitor. TCSC vary the electrical length of the transmission line which enables it to be used to

provide fast active power flow regulation. It also increases the stability margin of the system and has proved very effective in damping Sub Synchronous Resonance (SSR) and power oscillations [3]. The simpler TCSC model exploits the concept of a variable series reactance. The series reactance is adjusted automatically, within limits, to satisfy a specified amount of active power. Reactance curve of TCSC can be obtained by using following equations [4]

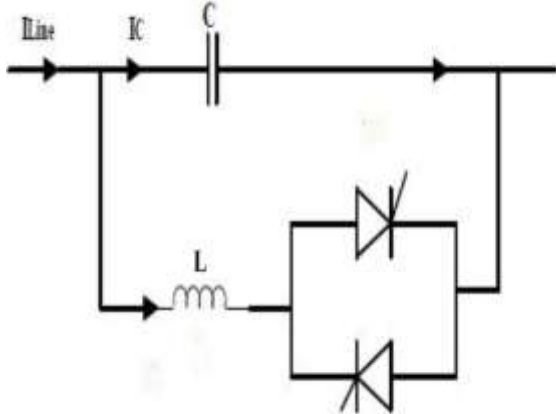


Fig 1. Thyristor Controlled Series Compensator

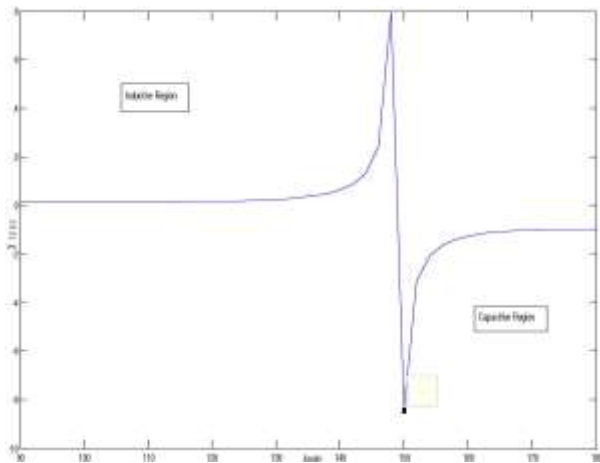


Fig 2. characteristic curve of TCSC

$$X_{TCSC} = -X_C + C_1 (2(\pi - \alpha) + \sin(2(\pi - \alpha))) - C_2 \cos^2(\pi - \alpha)(\omega \tan(\omega(\pi - \alpha)) - \tan(\pi - \alpha))$$

Where $C_1 = \frac{X_C + X_{LC}}{\pi}$ $C_2 = 4 \frac{X_{LC}^2}{X_L \pi}$

$$X_{LC} = \frac{X_C X_L}{X_C - X_L} \quad \omega = \sqrt{\frac{X_C}{X_L}}$$

3. TESTED SYSTEM

A 3 phase 11 kV, 100 km long transmission system is considered as a case study for improving

the power flow. Using MAT-LAB software. Data required for developing the SIMULINK model shown in fig 3 which analysis of voltage swell and harmonic of certain time pride which are shown in fig 4 FFT analyses. In fig 4 the harmonics are presented 19.48% which are reduced using TCSC .

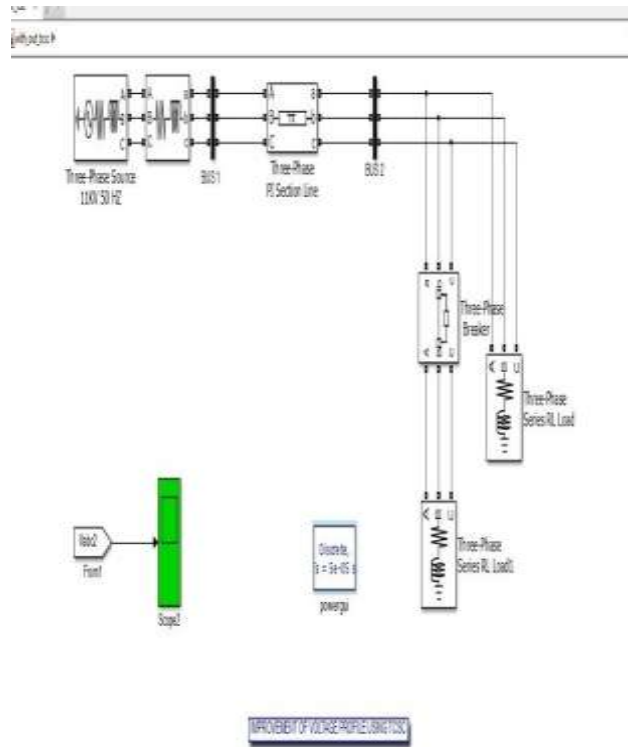


Fig 3. MAT-LAB Model of 11kV transmission system

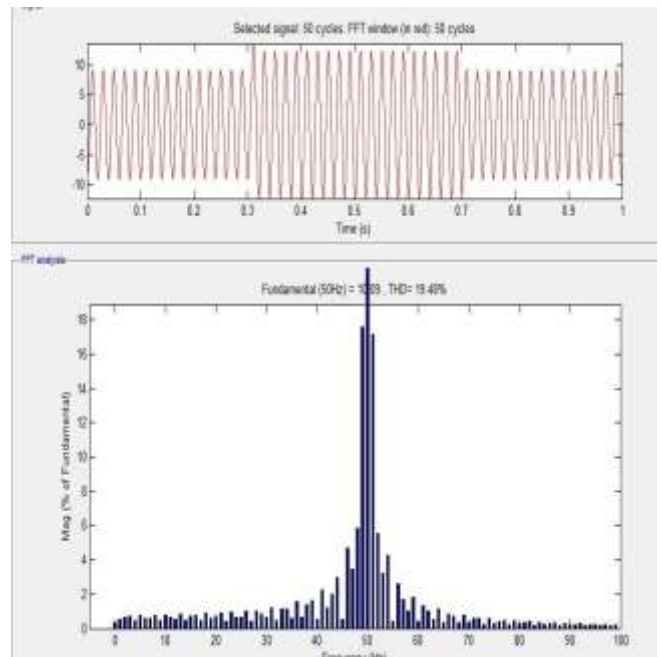


Fig 4. MAT LAB analysys of swel and harmonices

Now another modified modal which are connected TCSC system .there result and shown fig

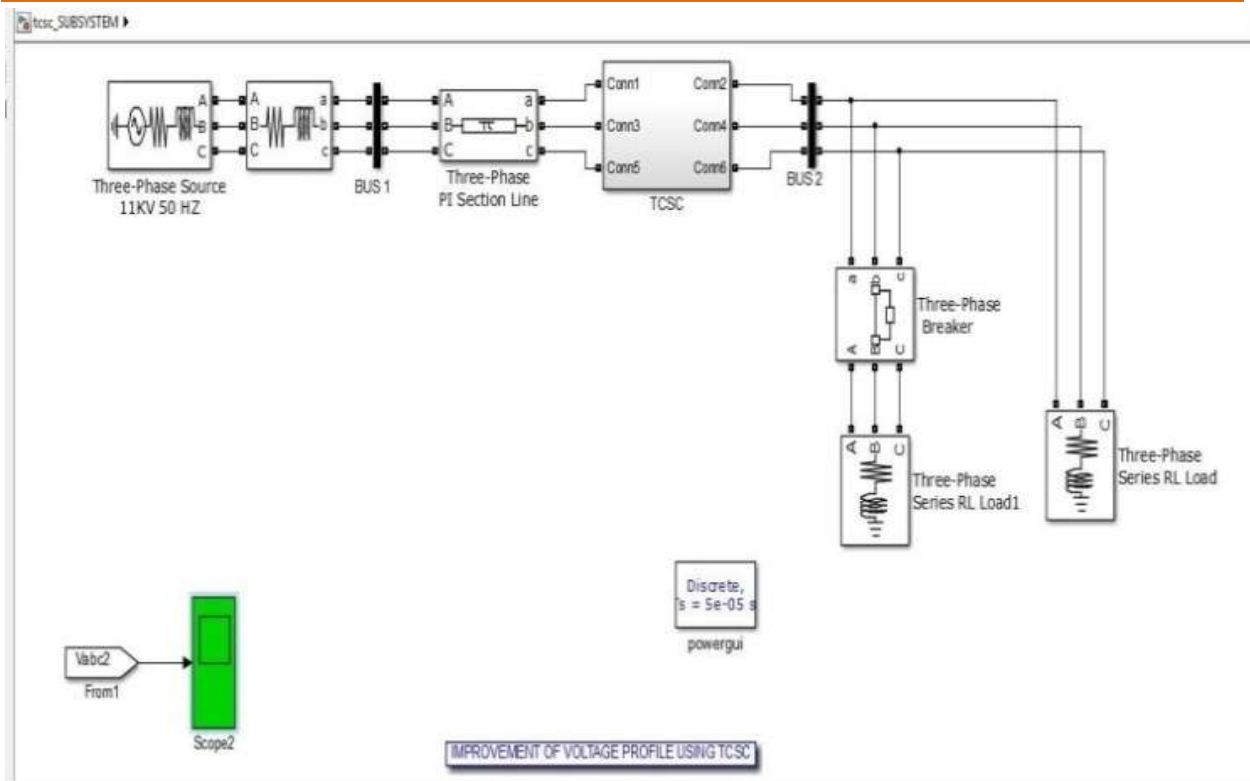


Fig 4. MAT-LAB Model of 11kV transmission system with TCSC system

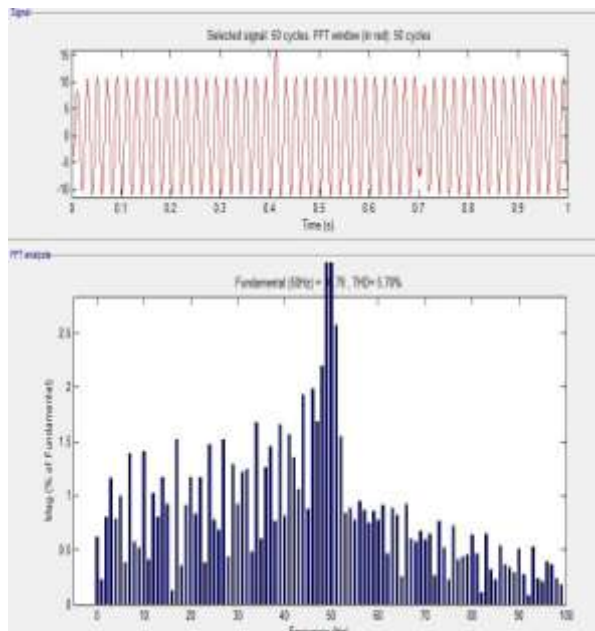


Fig 5. MAT LAB analysis of swel and harmonics

4. CONCLUSION

System is modeled in MATLAB/Simulink software in order to reduce the system voltage drop in the line and to improve the power flow. A TCSC are implemented on considered test system for variable loads. The constant power control circuit is developed to tune the TCSC for power flow improvement. The transmission system transfers the required power demanded by the load by implementing TCSC compensator.

Though control circuit is not designed for transient stability and power oscillation damping, some transients and oscillations are observed. Further work may carry out to suppress the oscillations and transients in the system. For all varying loads, load voltage is maintained within the limit by reducing the net voltage drop in the transmission system.

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