International Journal of Advance Research, IJOAR .org
Volume 2, Issue 2, February 2014, Online: ISSN 2320-9186

POWER QUALITY IMPROVEMENT BY USING TCSC

Lukesh Kumar Sahu1
M-Tech 1
lukeshsahu@rediffmail.com

Ankit Dubey2
Professor 2
ankit.dubey@dishamail.com

Disha Institute Of Management And Technology Raipur (India),12

Abstract—

Power quality is one of the most important issues in power system. Voltage sage, 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.

I. Introduction

Thyristor Controlled Series Capacitor (TCSC) is a series FACTS device which allows rapid and continuous changes of the transmission line impedance. It has great application potential in accurately regulating the power flow on a transmission line, damping inter-area power oscillations, mitigating sub synchronous resonance (SSR) and improving transient stability. [2]

Voltage sags and interruptions are related power quality problems. Both are usually the result of faults in the power system and switching actions to isolate the faulted sections. They are characterized by rms voltage variations outside the normal operating range of voltages. Voltage *sag* is a short-duration (typically 0.5 to 30 cycles) reduction in rms voltage caused by faults on the power system and the starting of large loads, such as motors. Momentary interruptions (typically no more than 2 to 5 s) cause a complete loss of voltage and are a common result of the actions taken by utilities to clear transient faults on their systems [1].

An *overvoltage* is an increase in the rms ac voltage greater than 110 percent at the power frequency for duration longer than 1 min. Overvoltages are usually the result of load switching (e.g., switching off a large load or energizing a capacitor bank). The over-voltages result because either the system is too weak for the desired voltage regulation or voltage controls are inadequate. Incorrect tap settings on transformers can also result in system over voltages.

II. Thyristor Controlled Series Capacitor

Thyristor controlled series compensation provides fast control and variation of the impedance of the series capacitor bank. TCSC is part of the Flexible AC Transmission System (FACTS), which is an application of power electronics for control of the AC system to improve the power flow, operation, and control of the AC system. TCSC improves the system performance for subsynchronous resonance damping, power swing damping, transient stability, and power flow control.

Series compensation is commonly used in high-voltage AC transmission systems. They were first installed in that late 1940s. Series compensation increases power transmission capability, both steady state and transient, of a transmission line. Since there is increasing opposition from the public to construction of EHV transmission lines, series capacitors are attractive for increasing the capabilities of transmission lines. Power transmitted through the transmission system is given by:

$$P = \frac{V_1 . V_2 . \sin\delta}{X_L} \quad .... (1)$$

Where P = Power transmitted through the transmission system
V_1 = Voltage at sending end of the line
V_2 = Voltage at receiving end of transmission line
X_L = Reactance of the transmission line
δ = Phase angle between V_1 and V_2

Equation (1) shows that if the total reactance of a transmission system is reduced by installing capacitance in series with the line, the power transmitted through the line can be increased.

With a TCSC installed in the line, Eq. (1) can be written as

$$P = \frac{V_1 . V_2 . \sin\delta}{X_L - X_C} \quad .... (2)$$

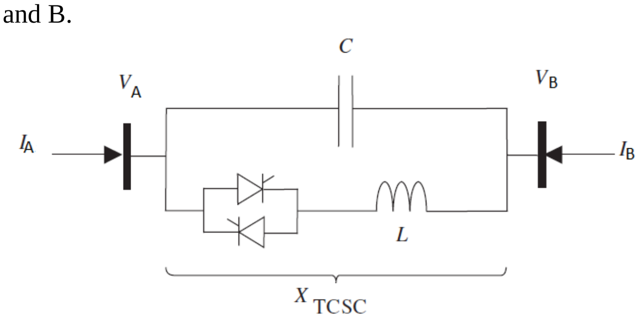
$$P = \frac{V_1 . V_2 . \sin\delta}{1 - k} \quad .... (3)$$

Where $K = \frac{X_L}{X_C}$ is degree of the compensation, usually expressed in percent.

A. *Control concept of TCSC*

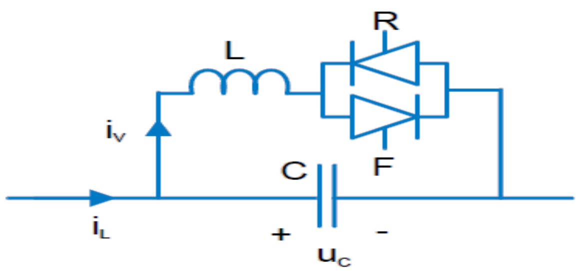
B. *Title and Author Details*

Single-phase thyristor-controlled series capacitor (TCSC) comprising an equivalent capacitor and a thyristor-controlled reactor (TCR) in parallel is shown below where it is assumed that the TCSC is connected between buses A and B.

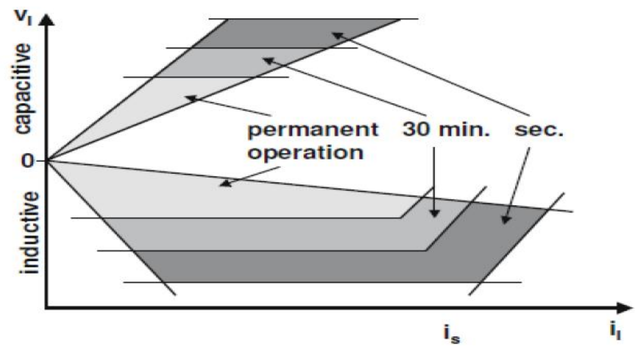


The transfer admittance matrix relates the nodal currents injections, I_A and I_B, to the nodal voltages, V_A and V_B, via the variable TCSC reactance is given by equation (4).

$$\begin{bmatrix} I_A \\ I_B \end{bmatrix} = \begin{bmatrix} -\frac{1}{jX_{TCSC}} & \frac{1}{jX_{TCSC}} \\ \frac{1}{jX_{TCSC}} & -\frac{1}{jX_{TCSC}} \end{bmatrix} \begin{bmatrix} V_A \\ V_B \end{bmatrix} \quad \text{........ (4)}$$

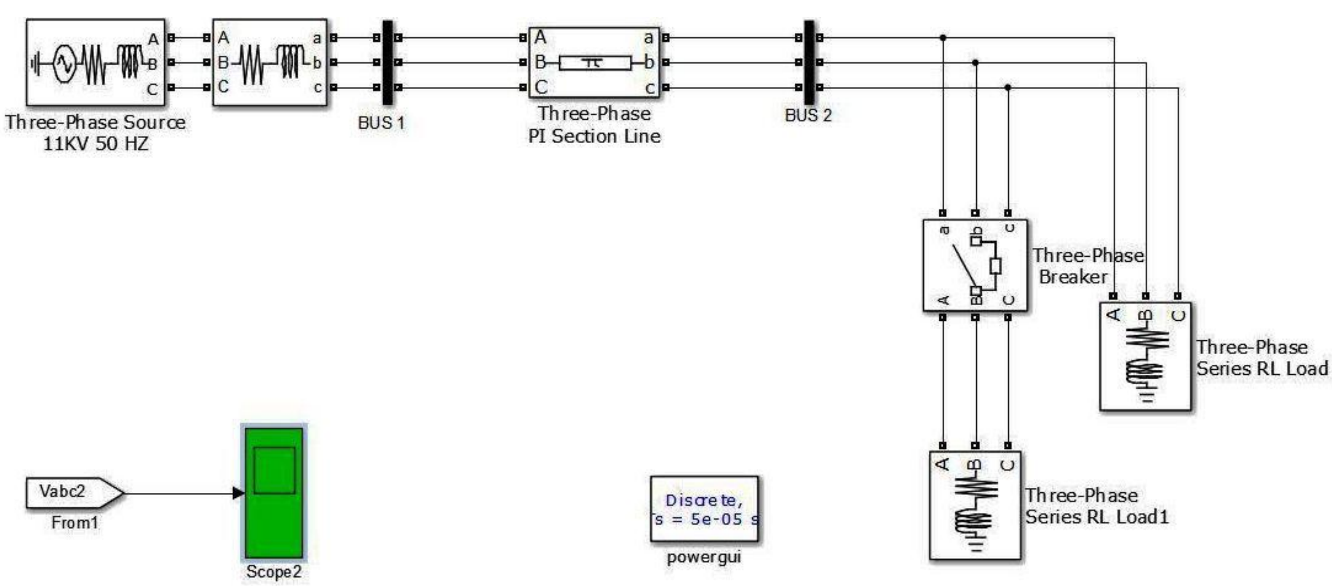


C. Section Headings

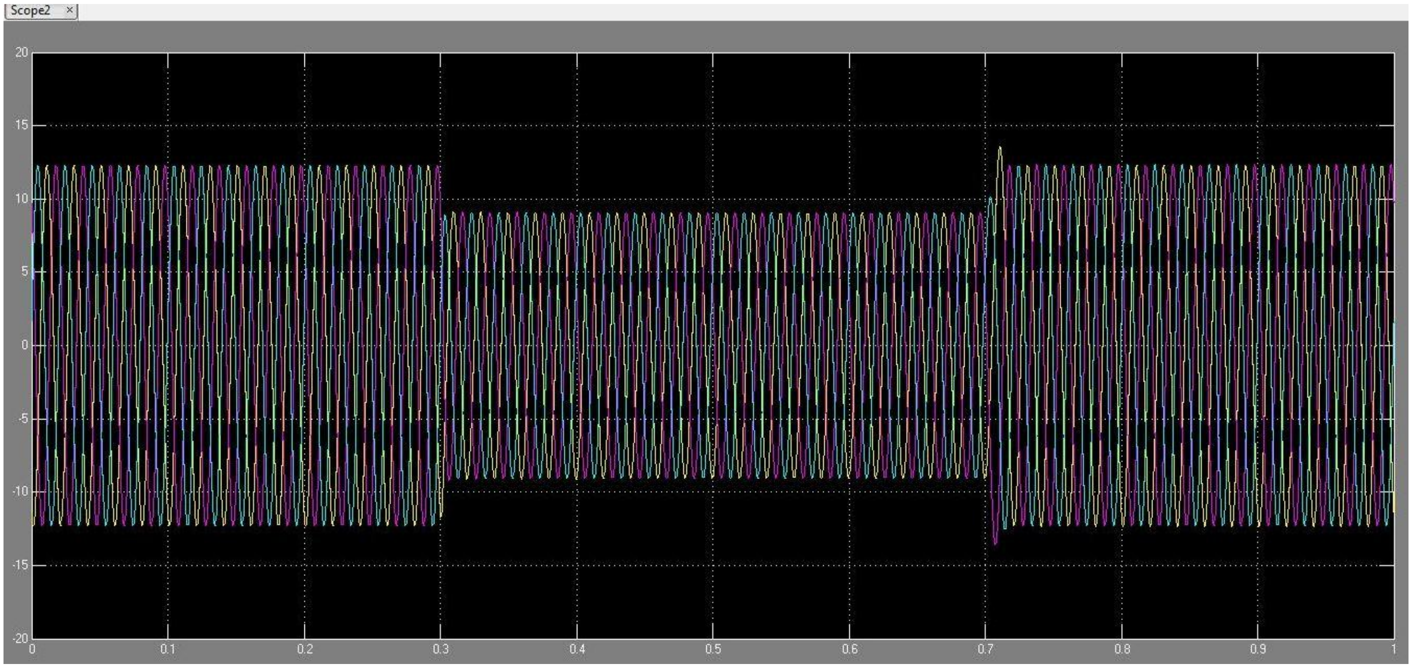


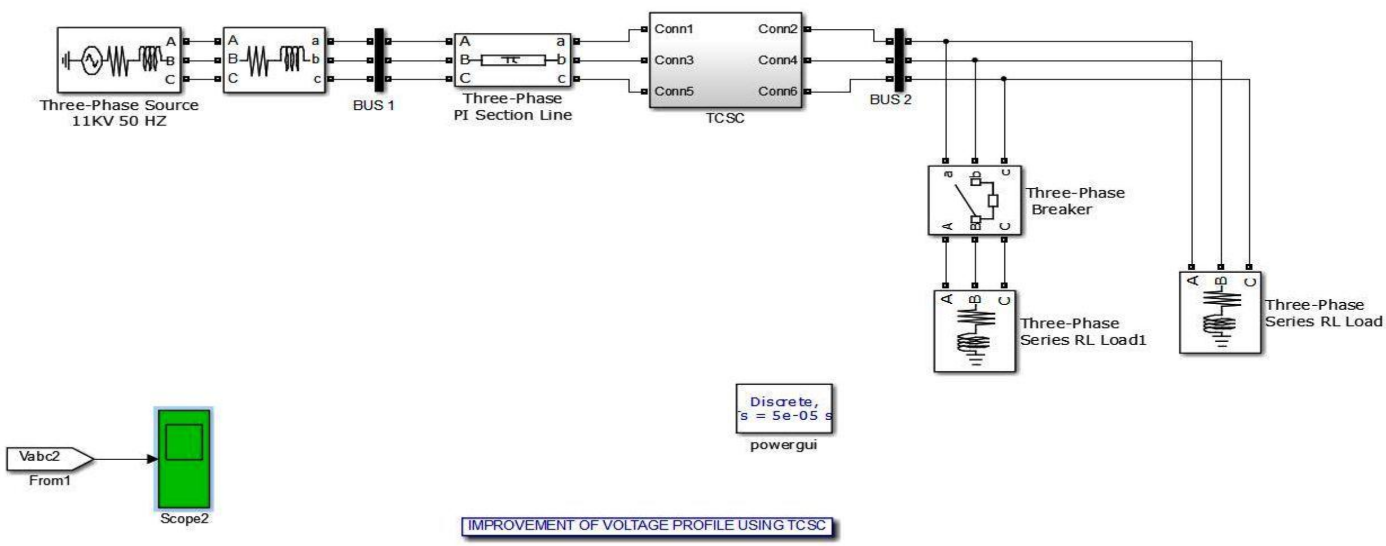
Operational characteristics of TCSC

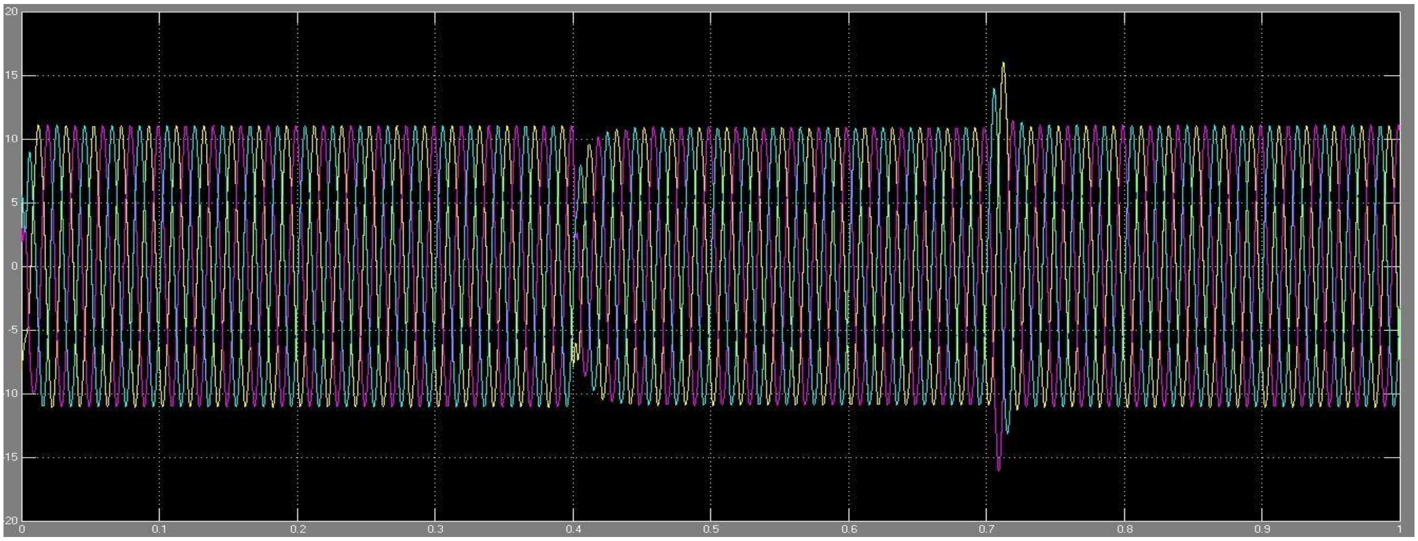
TABLE I
FONT SIZES FOR PAPERS



IMPROVEMENT OF VOLTAGE PROFILE USING TCSC


Scope2
20
15
10
5
0
-5
-10
-15
-20
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Three-Phase Source
11KV 50 HZ
BUS 1
Three-Phase
PI Section Line
Conn1
Conn3
Conn5
Conn2
Conn4
Conn6
TCSC
BUS 2
Three-Phase
Breaker
Three-Phase
Series RL Load1
Three-Phase
Series RL Load
Discrete,
Ts = 5e-05 s
powergui
Vabc2
From1
Scope2
IMPROVEMENT OF VOLTAGE PROFILE USING TCSC



References

[1] "Electrical Power Systems Quality" by R.C.dugan, McGraw-Hill Companies.

[2] D.Jovcic, G.N.Pillai "Analytical Modelling of TCSC Dynamics" IEEE® Transactions on Power Delivery, vol 20, Issue 2, April 2005, pp. 1097-1104.

[3] C.R.Fuerte-Esquivel, E. Acha, and H. Ambriz-Pe´rez, 'A Thyristor Controlled Series Compensator Model for the Power Flow Solution of Practical Power Networks', IEEE Trans. Power Systems2000.