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Behavior of TCSC in transmission line using MATLAB/Simulation

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Abstract: The growth of interconnected power system continuous process as the demand of power is increasing day by day. As per power demand is increasing, power generation is also increase, and hence need of reactive power compensation; oscillation damping improves more, and improved the voltage control. This research paper is present behavior of TCSC on the transmission line. Here for different value of firing angle the influential characteristic of TCSC is simulated.

Keyword: FACTS, MATLAB/ Simulink, Vernier, TCSC.

I. INTRODUCTION

Today the power system has become complex as the demand of power is increasing rapidly day by day. Due to environmental factors the location of generation is shifted a distance from load centers. The Power destruction of the system has increased system operation uncertainties. The Stability margin of the power system is changing by short circuit, faults, outage, back out.

AC lines have less provision for power flow control. Protective devices like circuit breaker, relay are intend for clearance of faults. These problems can be solved by the introduction of electronic controller to regulate the power flow in AC transmission line. The technology to control power flow with the aid electronic device like Diodes, IGBT, Thyristors, and MOSFET etc. is called Flexible Alternating current transmission system.

II. FACTS

FACTS is define as :A system which control AC transmission parameters by the help of electronic device is called FACTS.

FACTS are of two types-

1. Variable impedance type
2. voltage source converter

FACTS Controller classification –

1. Shunt Connected Controller
2. Series Connected Controller
3. Combined Series-Series Connected Controller
4. Combined Shunt-Series Connected Controller

III. THYRISTOR CONTROLLER SERIES CAPACITOR

Thyristors Controlled series capacitor (TCSC) is variable impedance series connected controller. It can be is a series compensator which can damp power oscillation, mitigate SSR. TCSC connections have series compensating capacitor shunted by thyristor controlled reactor. Its cost is and power loss have reduce due to low frequency switching [3].

TCSC can be more understood with the following diagram figure

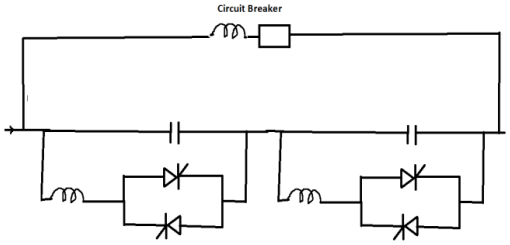

Fig. 1 TCSC single line diagram

The above diagram represents two group of TCSC which are series connected. The group can be increased as per requirements.

Behavior of TCSC:-

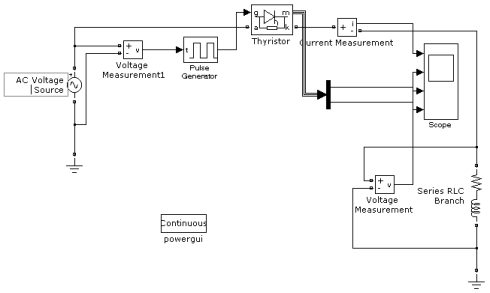

Fig. 2 simulink diagram of TCSC

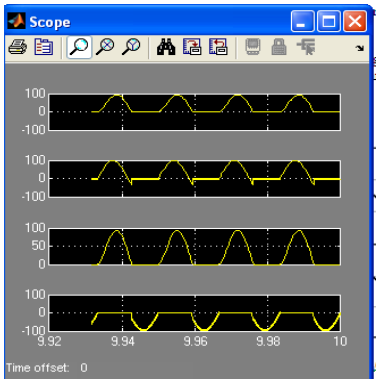

Fig. 3 Waveforms representing behavior of TCSC

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Every group operate in three operating mode. Here, the thyristor is ideal and current i_s is sinusoidal and taken as reference waveform [4].

A. Mode I- Thyristor switched reactor mode :-

The thyristor is gated for 180°. The susceptance of the reactor is greater than capacitor. Most of the line current passes through reactor and thyristor valves. For protection of capacitor against overvoltage, this mode is used.

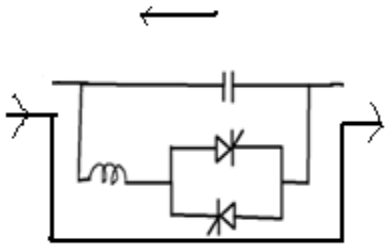

Fig. 4 Bypassed

B. Mode II- Waiting Mode:-

No current pass through valves and gate pulses are blocked. The reactance of TCSC and fixed capacitor is similar. That's why this mode is awaited mostly.

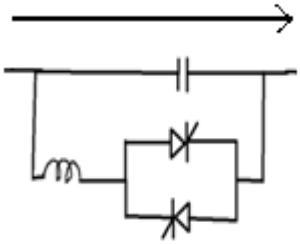

Fig. 5 Thyristor blocked

C. Mode III-

Here the thyristor valves are operated by two gate pulses in the two region i.e. capacitive vernier region ($\alpha_{min} < \alpha <$ 90°) and inductive vernier region α is reduce to 180°.

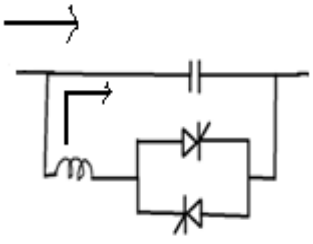

Fig. 6 Vernier operation

The natural characteristic of the series capacitor of compensated line cannot change by bypassing the series capacitor and high degree of compensation can cause sub synchronouse oscillations [2].

IV. ANALYSIS OF TCSC FOR VERNIER CONTROL

let us assumed line current is view as current source

$$C \frac{dV_c}{dt} = i_s(t) - i_T \quad \text{----- (1)}$$

$$L\frac{di_T}{dt} = V_c\mu \quad \text{- (2)}$$

$$i_s(t) = I_m Cos(wt) \quad \text{------(3)}$$

For μ= 1; Switch S is closed

μ= 0; Switch S is open

When μ = 0, current in thyristor switch and the rector (i_T) is zero and if initial current i_T=0 remains zero until μ becomes equal to 1 i.e switch is closed. α is measured line current crossing zero; α ranges from 0° to 90° when conduction angle (υ) ranges from 180° to 0°, and angle of deviation (β) is

β= 90° - α

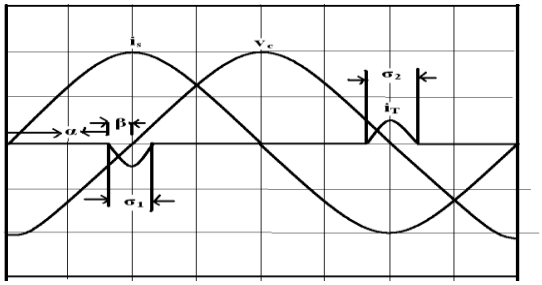

Fig. 7 wave form $i_s(t)$, $i_T(t)$, $v_c(t)$

V. BENEFITES OF TCSC

a) Power flow control dynamically
b) Power oscillation damping
c) Load sharing is improved
d) System losses are minizing [5].

VI. PROPOSED METHODOLOGY

The Behavior of TCSC is studied with simple block diagram made by usiing MATLAB/Simulation.

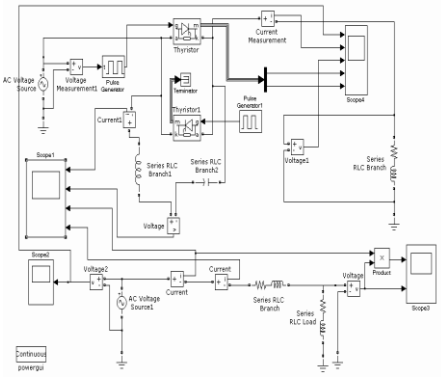

Fig. 8 Simulation model of TCSC device

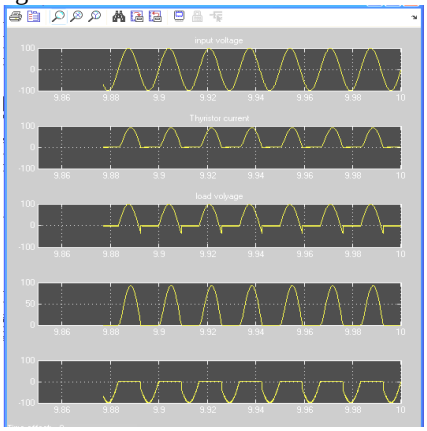

Fig. 9 working waveform of TCSC

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VII. CONCLUSION

This research paper focused on behavior of TCSC in transmission line. Simulink model of TCSC with transmission line is presented and associated waveforms are analyzed. An open loop MATLAB/simulation model of TCSC device on transmission line also analyzed with waveform.

FUTURE WORK

The analysis of TCSC with the help of simulink / simpower system has been studied in this paper. The behavior TCSC, in which a series connected variable impedance type FACTS is focused here. Further analyzes of TSCS along with SSSC (static synchronous series compensator) can be investigated in transmission line.

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REFERENCES

[1]. N. G. Hingorani and L.Gyugi, The understanding FACTS, IEEE press.
[2]. K. R. padiyar, FACTS controllers in Power transmission and distribution, New AGE international publisher.
[3]. M. Nayeripour and M. Mahdi Masouri, Analysis of real switching angle limits in TCSC on capacitor and inductor values and their selection factors
[4]. Ali H. Abdul-Jabbar, Mohammed K. Edan, Dr. Jamal A. Mohammed, Design and simulation of control circuit for TCSC based MATLAB/ simulink.
[5]. Martin German- Sobek, Lubomir Bena, Roman Cimbala, Using of Thyristor controlled series capacitor in electrical power system.