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Improvement of Long Distance Transmission by Using TCSC Fact Device

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Abstract: ***The prudent point of view of Flexible AC Transmission System (FACTS) establishment and execution has been an essential issue since origin and expanding each day because of vital, specialized and showcase requirements. The advancement of these issues assumes a significant job in the achievement of any utility and at last minimal effort accessibility of intensity at the client end. This paper exhibits the ideal area of Thyristor Controlled Series Capacitor (TCSC) in control framework to limit the transmission misfortune utilizing Particle Swarm Optimization procedure. The reenactments are performed on the IEEE-14 transport framework, IEEE 30 transport framework and Indian 75 transport framework with Newton Raphson load flow calculation including TCSC.***

Keywords: FACTS, TCSC, Transmission Loss

I. INTRODUCTION

A power framework is a system of electrical parts used to supply, transmit and utilize electric power [1,2]. The interconnected power framework is known as the matrix and can be extensively partitioned into the generators that supply the power, the transmission framework that conveys the power from the producing focuses to the heap focuses and the dispersion framework that feeds the ability to close by homes and ventures. There are numerous misfortunes while transmitting the influence from age stations to load focuses. The attention is more on the event of various types of insecurity. Voltage soundness necessities and various strategies to improve the security like the fixed pay procedures and the dynamic pay systems. Certainties controllers which are the dynamic remunerating gadgets which can be g utilized for better outcomes. In this paper, arrangement pay of TCSC (thyristor control series compansation) is utilized. Shut circle control is accomplished with the utilization of microcontroller. The terminating point control of TCR is acquired with the perception of the mistake voltages. P-V curve have been drawn with and without TCSC controller. A power framework is steady on the off chance that it comes back to a relentless state or balance working condition following an unsettling influence.

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This paradigm will remain constant for all stacking conditions and age plans under ordinary working conditions; following either the loss of any power plant, or for the most serious system issues. In the arranging and activity of a power framework it is critical to think about the potential rise of an assortment of steadiness issues.

II. OBJECTIVES OF HVDC

Shunt pay is ineffectual in controlling the genuine transmitted power, which at a characterized transmission voltage, is at last dictated by the arrangement line impedance and the point between the voltages of line

• It is constantly perceived that air conditioner control transmission over long queues was principally restricted by the arrangement receptive impedance of the line.
• Series Compensators are very emotional to Improve Voltage Stability, Transient Stability, and Power Oscillation Damping and furthermore to Mitigate SSR and Power Quality Problems.
• For a similar degree of remuneration the Series Compensator size is calm little contrasted with the shunt compensator maybe the level of arrangement pay is restricted due to SSR and FR Problems.

III. CONCEPT OF HIGH VOLTAGE REACTIVE POWER

Reactive power is the power that provisions the put away vitality in receptive components. Power, as we probably am aware comprises of two parts, dynamic and receptive power. The all out aggregate of dynamic and responsive power is called as obvious power. In AC circuits, vitality is put away incidentally in inductive and capacitive components, which outcomes in the occasional inversion of the bearing of stream of vitality between the source and the heap. Clarification for responsive power says that in a rotating current framework, when the voltage and current go here and there simultaneously, just genuine power is transmitted and when there is a period move among voltage and current both dynamic and receptive power are transmitted. Be that as it may, when the normal in time is determined, the normal dynamic power exists causing a net progression of vitality starting with one point then onto the next, while normal responsive power is zero, independent of the system or condition of the framework. On account of responsive power, the measure of vitality streaming one way is equivalent to the measure of vitality streaming the other way .That implies receptive power is neither delivered nor devoured. In any case, actually we measure responsive power misfortunes,

present such a significant number of types of gear for receptive influence remuneration to lessen power utilization and cost. Capacitors are said to produce responsive power, since they store vitality as an electric field.

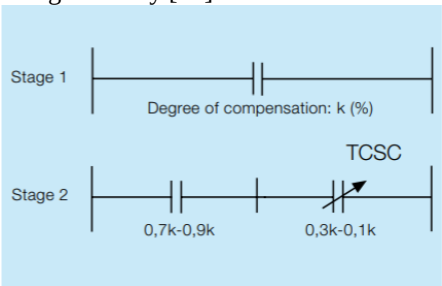
IV. LONG DISTANCE TRANSMISSION THYRISTOR-CONTROLLED SERIES CAPACITORS (TCSC)

Arrangement Flexible AC Transmission Systems (FACTS) gadgets, for example, Thyristor Controlled Series Compensation (TCSC) can significantly affect operational adaptability and controllability of the power framework. They can progressively change the all out reactance of transmission lines and control the power course through lines in a manner to expand the transient strength edges and make the framework increasingly secure. Power stream in Electrical Power System can be improved by modifying reactance parameter of the transmission line. It can likewise be upgraded by including another transmission line in parallel with the current one [3]. Thyristor Controlled Series Capacitor (TCSC) is one such gadget, which offers smooth and adaptable control of the line impedance with a lot quicker reaction contrasted with the customary control gadgets. While there have been various investigations concerning the use of these gadgets, up until this point, the greater part of the exploration has concentrated on issues, for example, transient strength improvement, sub-synchronous reverberation (SSR) moderation, damping of intensity swings, staying away from voltage breakdown and controlling force streams, and so forth [4],[5]. Actualities gadgets, for example, controllable arrangement capacitors TCSC can lessen the transmission blockage, bringing about an expanded loadability, low framework misfortune, improved solidness of the system, diminished expense of creation and satisfied legally binding necessity [6]. There have been a few of these FACTS gadgets applied to genuine power frameworks in the United States and different spots [7]. A TCSC was introduced at Kayenta substation in Arizona to repay its 300km, 230kV transmission line. This TCSC was utilized to assess transmission line limit upgrade, control stream control, and damping of sub-synchronous reverberation [8]. Comparable framework has been introduced in Slatt substation in Oregon [9]. In China, a TCSC is applied at Fengtun station for the 500kV Yimin - Fengtun line [10]. The TCSCs are still under assessment for control framework adjustment to demonstrate it powerful for capital speculation decrease [11].FACTS can improve both dynamic and static execution of the framework. Ideal area of FACTS has been examined in numerous investigates. Static files, for example, framework cost, framework loadability and voltage deviation have been upgraded in numerous papers.In [12] the ideal area, type and qualities are resolved to improve loadability of the system.[13] enhances the area of FACTs to limit the general framework cost, which bargains of age cost and speculation cost. [14] utilizes a multi target of all out fuel cost, control misfortunes and framework loadability. In this exploration ideal area of FACTS gadgets are resolved to improve just static criteria. Apportioning FACTS to improve dynamic records haven‟t been completely considered, yet.

TCSC designs involve controll reactor parallel with segments of a capacitive bank. Then mix permits smoothing control of major recurrence capacitive reactance over broad range. The capacitive bank of each stage is mounted on a stage to empower full protection to ground. The thyristor valve contains a series of arrangement associated high power thyristors. The inductor is of air-center structure. A metaloxidevaristor (MOV) is associated over the capacitor to anticipate overvoltage. TCSC present various significant advantages in the use of arrangement remuneration:

– Clearance of subsynchronous resonance dangers
– Damping of dynamic power motions
– Post-possibility steadiness progress
– Dynamic power stream control.

Relevant in new just as existing systems.The advantages of thyristor-controlled arrangement capacitors are in no way, shape or form achievable just for establishments beginning without any preparation. It is completely conceivable and practicable likewise to update existing arrangement capacitors by making all or part of them thyristor-controlled, in this way expanding their effect and convenience in the matrix most significantly [15].



Fig(4.1) Upgrading of series capacitor into TCSC (typical values).

V. LONG DISTANCE TRANSMISSION HIGHER VOLTAGE DAMPING OF POWER OSCILLATIONS

Motions of dynamic power in control transmission frameworks may emerge in hallways between producing territories because of poor damping of the interconnection, especially during overwhelming force move. Such motions can be energized by various reasons, for example, line shortcomings, exchanging of lines or an unexpected difference in generator yield. The nearness of dynamic power motions acts to confine the power transmission limit of interconnections between regions or transmission locales. It is regularly conceivable to discover cure by building extra lines or updating existing lines, yet this costs a great deal of cash and takes a ton of time, if not rendered incomprehensible through and through by absence of the fundamental grants. Now and again, it might likewise be conceivable to present Power System Stabilizers (PSS) on generators, however this won't generally work, especially not for between region control motions which will in general be of a low recurrence (ordinarily 0,2 Hz to 0,7 Hz). In either case, TCSC will be an alluring choice to consider. It offers a savvy, vigorous power wavering damper, inhumane toward its area in the framework and noninteracting with neighborhood swaying modes. In various cases, it will end up being the best practicable arrangement. ABB has created and licensed a sharp control methodology that improves the TCSC damping execution contrasted with traditional innovation. We call it Phasor Estimation Technique.

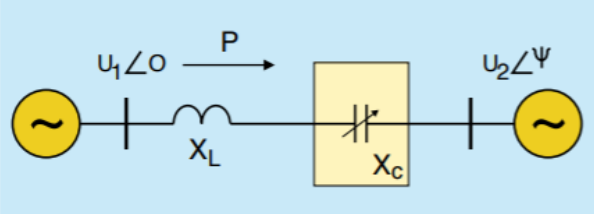


Fig (4.2) Power transmission P over a series compensated line is governed by the expression:

$$P(t)=\frac{U_1 U_2 \sin\Psi}{X_L - X_C(t)}$$

Fig(4.3) Power oscillation

A. Proposed Method OF TCSC Compensator

The variable arrangement remuneration is profoundly successful in both controlling force stream in the line and in improving solidness. With arrangement remuneration the general successful arrangement transmission impedance from the sending end to the less than desirable end can be discretionarily diminished in this way affecting the power stream,

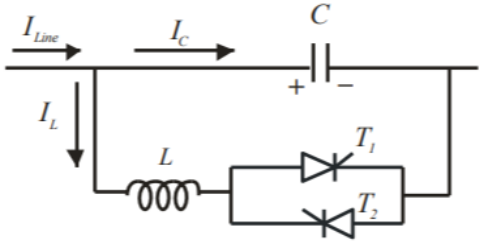
$$P=U^2/X\sin\sigma$$

Thyristor Controlled Series Capacitor (TCSC) is a significant FACTS segment which makes it conceivable to shift the obvious impedance of a particular transmission line [15]. A .Steady-state model The IEEE characterizes the TCSC as a capacitive reactance compensator which comprises of three principle segments, capacitor bank C, sidestep inductor L and bidirectional thyristors SCR1 and SCR2. Arrangement capacitive remuneration has been utilized to expand line power move just as to upgrade framework soundness. TCSC have a wide range of structure, one of this fundamental detailing is appeared in figure.1, demonstrated that fastened capacitor and parallel associated of TCR., A parameter to portray the TCSC principle circuit is which is the remainder of the thunderous recurrence and the system recurrence coming about in

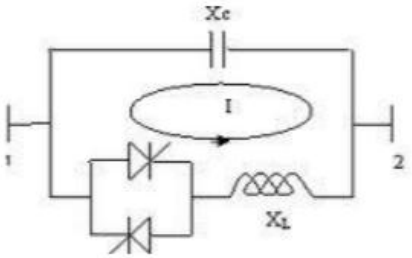
$$\lambda=\sqrt{\frac{-X_C}{X_L}}$$

where,

$$X_C=-\frac{1}{W_C} \quad \text{and} \quad X_L=W_L$$



TCSC is a device connected in series with a transmission line. It can change the line reactance Xline and therefore is able to control the active power flowing over the line [16].



Consider the Line reactance of the transmission line in per unit system For fifty percent remuneration, the estimation of the capacitor in the TCSC will be fifty percent of the line reactance. Presently for capacitive remuneration, the estimation of inductive reactance must be more prominent than capacitive reactance, that

is, Xl >Xc

Xtcsc = (Xl * Xc) / (Xl – Xc)

Total reactance of the line with TCSC is

X = Xl – Xtcsc

Qtcsc = (Ic * Ic * Xc) – (Itcr * Itcr *Xl).

VI. OPERATION OF TCSC

TCSC is an arrangement control capacitive reactance can give ceaseless controlled of intensity on the air conditioner line over a wide range. From the framework perspective, the guideline of variable-arrangement remuneration is basically to expand the essential recurrence voltage over a fixed capacitor (FC) in an arrangement repaid line through proper variety of the terminating edge, α. A basic comprehension of TCSC working can be gotten by breaking down the conduct of a variable inductor associated in parallel with a FC. The impedance, Zeq, of this LC blend is communicated as The impedance of the FC alone, in any case, is given by - j(l/ωC).

If ωC - (l/ωL) > 0 or, in other words, ωL> (1/ωC), the reactance of the FC is not as much as that of the parallelconnected variable reactor and that this mix.

If ωC - (1/ωL) = 0, a resonance builds up that outcomes in an endless capacitive impedance-a clearly unsatisfactory condition.

If, be that as it may, ωC – (1/ωL) < 0, the LC blend gives inductance over the estimation of the fixed inductor. This circumstance compares to the inductive method of the TCSC activity.

In the variable-capacitance method of the TCSC, as the inductive reactance of the variable inductor is expanded, the comparable capacitive reactance is slowly diminished. The base equal capacitive reactance is gotten for very enormous inductive reactance or when the variable inductor is open-circuited, in which the worth is equivalent to the reactance of the FC itself [17].

A. ADVANTAGE OF TCSC

Utilization of TCSC conceivably offers the accompanying points of interest:

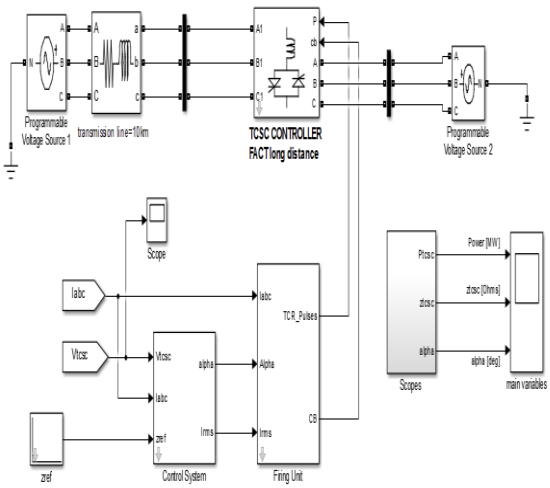
• Fast, reliable control the transmission line reactance.

• Dynamic control of force stream in picked transmission lines inside the framework to engage perfect power-stream conditions

• Damping the power swings from close by and between district movements.

• Suppression of sub synchronous movements, the TCSC presents a typically resistive-inductive reactance. The sub synchronous movements can't be proceeded in this condition and therefore get damped.

VII. RESULT AND SIMULATION



Fig(7.1) Proposed Modelling Long Distance transmission

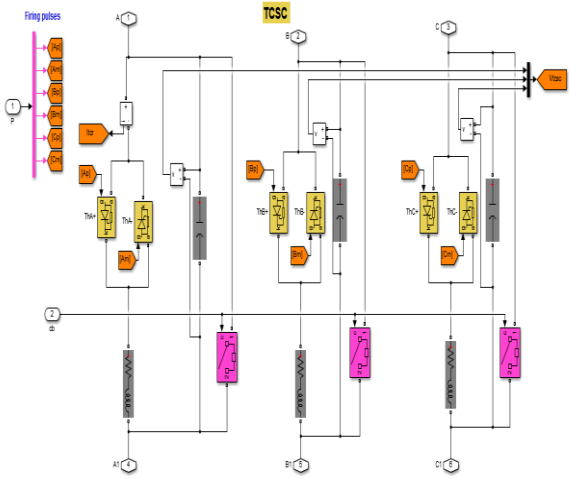


Fig (7.2) Proposed TCSC

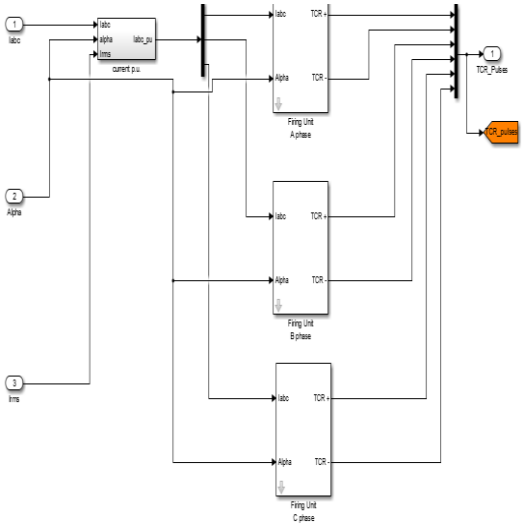


Fig (7.3) Firing Unit.

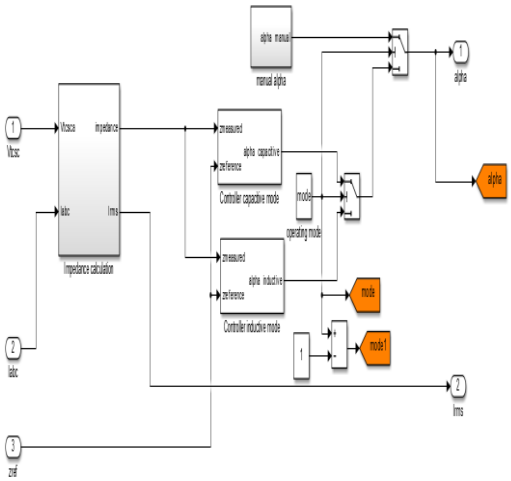


Fig (7.4) Control Unit.

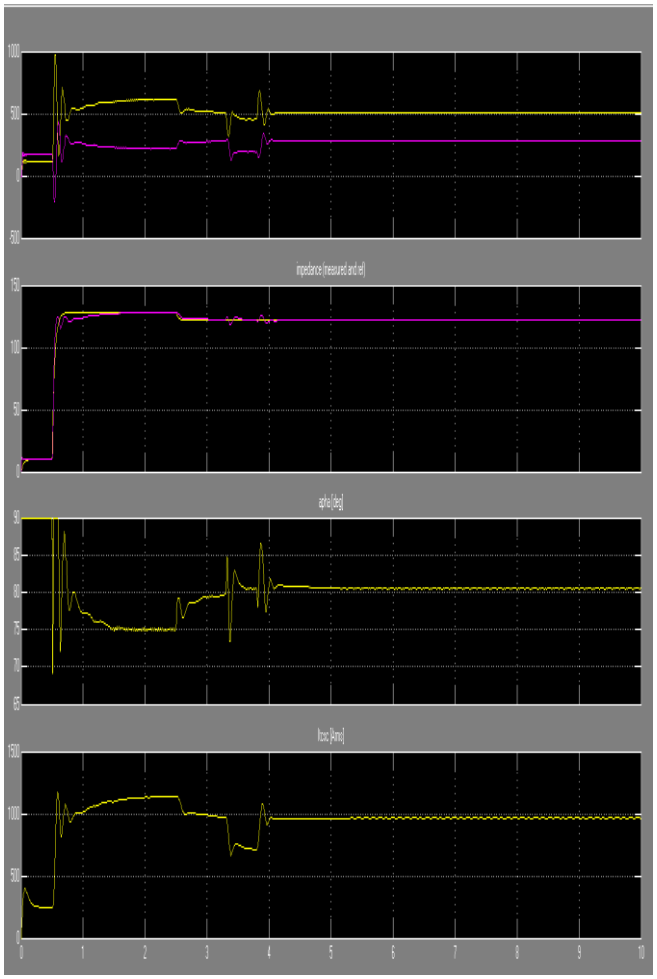


Fig (7.5) TCSC Outputs

Comparison between base paper and our proposed technique

S.N	PARAMETERS	OUR RESULT(S)	TIME (BASE PAPER)
1	Xe (Impedance)	4	10
2	Power(MW)	5	10

VIII. CONCLUSION

The outcomes shows that there is improvement in the both synchronous and voltage soundness edges, when TCSC is associated in the test framework. Arrangement capacitive pay is in this manner used to lessen the arrangement responsive impedance to limit getting end voltage variety and the probability of voltage breakdown and it can improve power stream ability of the line. It is likewise seen that the pay by utilizing this procedure i.e TCSC is more successful than other remunerating methods, for example, mechanical exchanging capacitors and synchronous condensers.Under light burden condition, a level voltage profile is accomplished by inductive shunt pay. Under substantial burden condition, a level voltage can be accomplished by including shunt capacitive pay. Arrangement capacitive pay may hypothetically be utilized rather than shunt pay to give a level voltage profile, under overwhelming stacking. As for all intents and purposes, lumped arrangement capacitors are not reasonable for getting a smooth voltage profile along the line. Therefore, clearly we get stage an adjustment in voltage happens at focuses where the arrangement capacitors are applied. Be that as it may, with utilization of arrangement capacitors improved voltage guideline anytime can be gotten

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It is optional. The preferred spelling of the word “acknowledgment” in American English is without an “e” after the “g.” Use the singular heading even if you have many acknowledgments. Avoid expressions such as “One of us (S.B.A.) would like to thank ... .” Instead, write “F. A. Author thanks ” Sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page.

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