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A Variable Structured TCSC Controller for Power System Stability Enhancement

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Abstract

In present era, the main contact of the power segment engineers is to expand the ability and immovability of the current power segment for attractive system presentation and dependable process. This directs to the growth of FACTS technology. FACTS controllers raise power convey ability and constancy. This article represents representing and simulation of single machine infinite bus (SMIB) system with TCSC controller. Thyristor Controlled Series Capacitor (TCSC) controller is exercised to improve transient constancy of the SMIB system. In this article propose of TCSC controller is projected. The form of SMIB with TCSC and PID controllers are expanded in MATLAB for simulation. Three phase symmetrical faults are initiated to learn its characteristics. The simulation effects confirm that the constancy of the power system is being developed by TCSC controller and it efficiently damp out the power system oscillations.

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1. Introduction

At present, power systems are expanding in apply and difficulty, are precised by long distance huge power transmissions and large region similarity. To gratify reliability, load demand and stability criteria in a compound present interrelated power system, either it is wanted to operate the presented transmission lines more powerfully, or recently created lines should be connected to the system. When the raise of electrical power require, the power stations are slightly situated in detached areas. As a result, it has become unavoidable to create innovative long transmission lines and by latest technologies. Alternatively, this idea is very exclusive and ecological matters should be believed. One of the resolutions to this trouble is the operation of the accessible transmission lines further

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efficiently and with a higher loading capacity. To recognize a elegant and fault liberal grid a new technology Flexible AC transmission system (FACTS) was suggested. FACTS devices are mainly solid state converters having the capability of scheming different electrical parameters in transmission circuits line. The instruments of FACTS family i.e. Thyristor Controlled Series Compensator (TCSC), Static VAR Compensator (SVC), Static Synchronous Series Compensator (SSSC), Static Compensator (STATCOM), Unified Power Flow Controller (UPFC),Thyristor Controlled Phase Angle Regulator (TCPST) etc.

At present the stability of power system has become a chief anxiety in structure process. Numerous disorders absorb a large digression of generator rotor angles, bus voltages, power flows and other system variables. In present days significant labors have been made to progress or improve the power system stability. To convene the load demand in a complex intersected power system and gratify the stability and reliability criteria in current power systems with EHV, operation of the accessible transmission lines more effectively and have higher loading capacity is the best solution. So to diminish power oscillations through a disorder and to develop power system stability FACT devices can be applied in transmission line. In this learn TCSC controller with various managed configuration is proposed individually to progress the presentation of power system issued to a disorder.

2. Basic Module of TCSC

TCSC is one of the mainly significant and greatest identified series FACTS controllers. It has been in exercise for many years to raise line power reassign in addition to develop system stability. Mostly a TCSC abides of three mechanisms; capacitor banks \( C \), bypass inductor \( L \) and bidirectional thyristors. The firing angles of the thyristors are managed to regulate the TCSC reactance in agreement with a system control algorithm, usually in reply to some system parameter deviations. According to the deviation of the thyristor firing angle (\( \alpha \)) or conduction angle (\( \sigma \)), this practice can be formed as a quick change between equivalent reactance presented to the power system. Assuming that the total current exceeding during the TCSC is sinusoidal; the corresponding reactance at the fundamental frequency can be presented as a variable reactance \( X_{TCSC} \). There survives a steady-state relationship between \( \alpha \) and the reactance \( X_{TCSC} \). While the relationship between \( \alpha \) and the corresponding fundamental frequency reactance proposed by TCSC, \( X_{TCSC}(\alpha) \) is an exclusive-significance function; the TCSC is copied here as variable capacitive reactance within the effective section distinct by the restrictions forced by \( \alpha \). Thus \( X_{TCSCmin} \leq X_{TCSC} \leq X_{TCSCmax} \), with \( X_{TCSCmax} = X_{TCSC}(\alpha_{min}) \) and \( X_{TCSCmin} = X_{TCSC}(180^\circ) = X_C \). This paper depicts the controller is supposed to control only in the capacitive area, i.e., \( \alpha_{min} > \alpha_r \) where \( \alpha_r \) communicates to the significant point, as the inductive section connected with \( 90^\circ < \alpha < \alpha_r \) encourages high harmonics that cannot be correctly formed in stability exercises.

3. SMIB Power System with TCSC

The SMIB power system with TCSC (viewed in Fig. 2), is judged in this learn. The generator has a limited load of admittance \( Y = G + jB \) and impedance of the transmission line is \( Z = R + jX \). \( V_T \) and \( V_B \) are the generator terminal and infinite bus voltage correspondingly. The generator is presented by the third-order form involving of the generator internal voltage equation and electromechanical swing equation. The state equations may be written as:

\[
\omega = \left[ P_m - P_e - D(\omega - 1) \right] M \tag{1}
\]

\[
\delta = \omega_0 (\omega - 1) \tag{2}
\]

\[
V_T = v_d + jv_q \tag{3}
\]

\[
I = i_d + j i_q \tag{4}
\]

where, \( P_m \) and \( P_e \) are the input and output powers of the generator correspondingly; \( M \) and \( D \) are the inertia constant
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