Coordinated Control of SVS and CSC for Damping Power System Oscillations

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Abstract: In this paper the effectiveness of Static Var System (SVS) auxiliary controller in coordination with controlled series compensation has been demonstrated for damping power oscillations for wide range of operating conditions. A new SVS auxiliary controller, known as the combined derivative of reactive power and derivative of computed internal voltage (CDRPDCIV) auxiliary controller has been developed and incorporated in the SVS control system located at the middle of a series compensated long transmission line to get most effective damping effect. The first IEEE benchmark model for analysis of torsional modes has been adopted. Eigen value analysis study is conducted for various levels of power transfer and series compensation. The results of eigen value analysis are validated by carrying out time domain analysis study based on non linear model. The proposed SVS auxiliary controller in coordination with CSC with its bang – bang form of control is very effective in damping power system oscillations over a wide operating range under large disturbance conditions thus enhancing the Transient performance of the power system.
Keywords: Static Var System, Series compensation, Auxiliary controller, Torsional oscillations, Controlled series compensation

1. Introduction

Damping of power oscillations associated with the generator rotor swings is an important and challenging task in the power industry. These low frequency oscillations arise due to the dynamics of inter area power transfer and exhibit poor damping at high power transfer levels. Oscillations associated with single generator (Local Modes) have frequencies in the range of 0.8-1.8 Hz. The inter area modes have the frequency of oscillations in the range 0.2-0.5 Hz and involve large group of generators swinging against each other. The stability of these low frequency oscillations is a pre requisite for secure operation of system after critical contingencies.

With the advent of fast acting, power electronic based FACTS controllers like SVS, TCSC, SSSC, STATCOM, TCPAR and UPFC, it is feasible to enhance the damping of power system oscillations effectively at low cost [4, 5, 7, 11]. In recent years SVS has been employed to an increasing extent in modern power systems [1, 4, 10] due to its capability to work as Var generation and absorption systems. Besides, voltage control and improvement of transmission capability SVS in coordination with auxiliary controllers [3, 4, 6, 10] can be used for damping of power system oscillations. Damping of power system oscillations plays an important role not only in increasing the transmission capability but also for stabilization of power system conditions after critical faults, particularly in weakly coupled networks.

The controlled series compensation is one of the novel technique under FACTS philosophy for damping of power system oscillations [5]. D. Povh and Mihalic proposed the application of CSC and SVC for transient stability enhancement of an ac transmission system. Noroozian, M et. al. [6] proposed a robust control strategy for thyristor controlled series capacitor and static VAr systems to damp electromechanical oscillations. Larsen et al [2] have presented the design