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Unit Template Based Control Design for Alleviation and Analysis of SSR in Power System Using STATCOM

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CONTENTS

Abstract——Subsynchronous resonance (SSR) is an undesirable phenomenon in series compensated power system which tries to menace the stability of both electrical and mechanical system. This paper researches the effect of static synchronous compensator (STATCOM) for mitigation of SSR in a single machine infinite bus system. The mathematical modeling is presented in the form of linearized equations, which can be used for eigenvalue analysis of SSR. A novel control technique based on unit template algorithm is incorporated in STATCOM for alleviation of SSR and it proves to be ingenious in damping out all the oscillations. Furthermore, frequency scan and fast Fourier transform (FFT) analysis are presented, that provide resonant frequencies at different levels of compensation and dominant modes of oscillations respectively. To examine and authenticate the efficacy of the proposed controller, the IEEE second benchmark model on SSR is simulated in MATLAB/Simulink environment and the results are analyzed to illustrate the potency of the proposed control strategy.

Keywords: subsynchronous resonance, STATCOM, torsional oscillations, frequency scan, FFT analysis, FACTS, series compensation

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1. INTRODUCTION

Electrical utilities throughout the world are striving hard to achieve a higher level of power quality and reliability predominantly for industrial and commercial electrical customers. However, this requires a smooth and flexible operation of power system free from any disturbances. The power transfer capability of the transmission system and the stability is mainly enhanced by series compensation and with the trend of moving toward the renewable energy sources, series compensation is unavoidable. However, series compensation is the main cause of subsynchronous resonance (SSR) in the power system. Due to ineffective cost, it is not possible to replace the already existing fixed capacitor lines with new transmission lines [1, 2].

As seen right from its first recorded incident in Mohave, in 1971, SSR is of great concern and also a dynamic as well as drastic phenomenon [3]. It is responsible for shaft failures and can cause damage to both electrical and