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IMPACT OF FACTS AND HVDC ON TRANSIENT AND SMALL SIGNAL STABILITY IN A MULTI-MACHINE POWER SYSTEM

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Abstract:
Flexible alternative current transmission systems (FACTS) and high-voltage direct current (HVDC) systems are considered as one of the enablers of the future smart grids. They facilitate smoother integration of variable renewable energy based power plants into the existing networks by providing reactive power support, power flow enhancement and power oscillation damping. In order to analyse the impact of FACTS and HVDC systems on the transient and small signal stability of a power system, a fully detailed three-phase model of power system components is not a requirement. This paper analyses the impact of two FACTS devices and HVDC system on the power flow, transient stability and the electro-mechanical oscillation damping of the power system. The FACTS devices considered include static synchronous compensator (STATCOM) and unified power flow controller (UPFC). The respective dynamic models of the FACTS devices along with corresponding control strategy are developed and simulations are executed using a user friendly software. Firstly power system without controllable components is analysed by applying different small and large disturbances in the system. Next, observability and controllability of different FACTS devices (STATCOM, UPFC and HVDC system) are calculated. Two types of input signal to power oscillation damper (POD) are used. These include rotor speed of the corresponding single machine equivalent system of the multi-machine system (wSIME-eq) and active power signal. Lead lag filters are tuned using the residue method for STATCOM. In addition, two types of control Lyapunov function (CLF) based control signals are used and analysed. Finally, results are compared and plotted for different FACTS device and conclusions are drawn. The analysis approach presented in this paper liberates researchers from complex and time-consuming detailed modelling in other commercial software to perform these analyses where linearization of the power system model itself is challenging.

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