MODELING AND SIMULATION OF UPFC FOR DYNAMIC VOLTAGE CONTROL IN POWER SYSTEM USING PSCAD/EMTDC SOFTWARE

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ABSTRACT

This paper discussed the effect of Unified Power Flow Controller (UPFC) controllers for enhancement of power system voltage regulation and power flows in the transmission system. The model of UPFC are studied and validated in power system computer aided design & electromagnetic transient direct current (PSCAD/EMTDC) environment. The basic operations are explained, as well as the control strategies and circuit configurations of the controller. PI controller is used for control scheme. In this proposed work, the 4 bus test system is used to verify the proposed model. The steady-state analysis is done to show the capability of the controller in improving voltage regulation in the transmission system.

Keywords – unified power flow controller, proportional integral (PI), PSCAD/EMTDC

INTRODUCTION

Nowadays, the power system becomes more complicated to operate with huge power flows. In transmission system, the power transmitted need to follow several basic requirements. The power transmission should be low risk of power system failure, economical and high power transfer capability, with no reduction of system stability.

There are several controllers that are used for controlling the power system stability. A second generation FACTS device is the Unified Power Flow Controller (UPFC) which enables independent control of the power flow and improving the voltage regulation in transmission line [1]. UPFC is combination of two FACTs device which are STATCOM (Static Synchronous Compensator) and SSSC (Static Series Synchronous Compensator) [2]. UPFC controller used in control the real and reactive power flow in the transmission system. A unified power flow controller (UPFC) performs this through the control of the in-phase voltage, quadrature voltage, and shunt compensation. It can control the three control parameters either individually or in convenient combinations with its series-connected output while maintaining reactive power support with its shunt-connected input [3].

The operating principle of UPFC is combination of the STATCOM and the SSSC into a single device with a common control system [4]. UPFC consists of a shunt transformer and a series transformer, power electronic switching devices and a DC link. It is independently control real and reactive power by injects UPFC device through the series transformer. Figure 1 shows the basic circuit configuration of UPFC. The schematic diagram of UPFC is depicted in Figure 2.

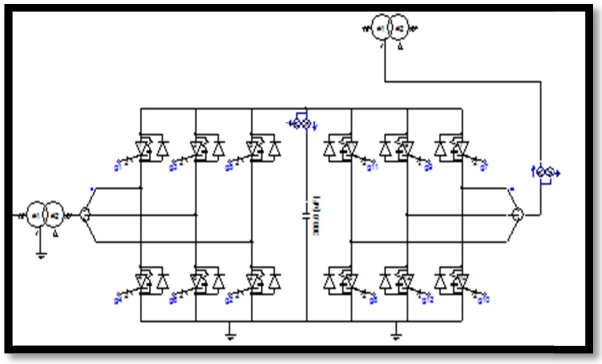

Figure-1 Single line diagram of UPFC Model [4]

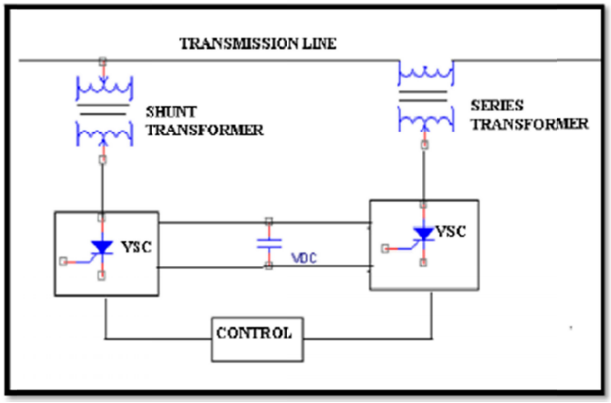

Figure-2 Schematic diagram of the UPFC [6]

METHODOLOGY

This paper is about to study the effect of Unified Power Flow Controller (UPFC) controllers for enhancement of power system voltage regulation and power flows in the transmission system. The proposed technique is developed using PSCAD/EMTDC software to model and verify the UPFC system. The active power and reactive power performance will be improved through injecting the UPFC device. The model of UPFC controller is tested in 4 bus power system network to verify the effectiveness of UPFC's application in power system. To verify the simulation in PSCAD/EMTDC environment, the steady-state analysis of the test system is acquired using MATLAB software.

Model of UPFC

A proportional-integral (PI) controller was applied to regulate the AC voltage or alternatively, power flow absorbed or generated by the UPFC controller. The output of PI controller is the angle order; it represents the required shift between system voltage and voltage generated by UPFC controller. The shift determines the direction and amount of real power flow. The values parameters of PI