Review of Control of Power Flow by UPFC in Transmission System Having Wind and Hydro Generator

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Abstract: **As the most powerful FACTS (flexible alternative current transmission systems) device, UPFC (unified power flow controller) could be considered as a multi-function controller which is capable of providing the performance of one or two FACTS device. this paper is the review of how UPFC is useful in controlling of power flow. For this we have used Matlab/Simulink model of the system having UPFC with wind and hydro generators which are seperated by double circuited transmission line.**

Keywords- **FACTS, UPFC, MATLAB, Compensators, oscillations, stabilizer, transient stability, voltage regulator**

I. INTRODUCTION

The power stations, the transmission lines, and the distribution substations compose the power system, which produce and transport electric energy into every family and business. The rapid growth in electric energy demand and the demand for low-cost energy has historically led to remotely located generation plants. The situation has made it necessary to use transmission lines to transport electric energy to the end consumers. To increase the system reliability, redundant lines exists in power transmission system. Inherent in the electric energy demand is the demand variation and non-storability. The demand characteristics require that the power flow on a particular transmission line to be controllable in a multi-path transmission network.

The Flexible Alternating Current Transmission Systems (FACTS) are a group of power electronics devices specially designed to address the need to enhance the use and performance of the electric utility grid. A FACTS device is described by IEEE as "a power electronic based system and other static equipment that provide control of one or more AC transmission system parameters to enhance controllability and increase power transfer capability." [5]

FACTS devices have several purposes:

1) To increase the capacity of the existing power transmission system.
2) To control the power flow in desired transmission route.
3) To provide dynamic stabilization enhancement for the transmission system.
4) To provide system optimization control, when a large number of FACTS devices are installed on the power system.

FACTS devices in power transmission systems

Inspired by the way the traditional electro-mechanical system control the power transmission, researchers and engineers came up with the power-electronics based FACTS controllers. Compared with the traditional electro-mechanical system control, FACTS devices have the following advantages [13]:

- The main advantage of FACTS over simple mechanical devices is their near-instantaneous response to changes in the system voltage.
- Lower maintenance requirements without rotary parts.
- Lower losses compared with mechanical/rotary compensators.
- High reliability.
- Possibility of individual phase control.

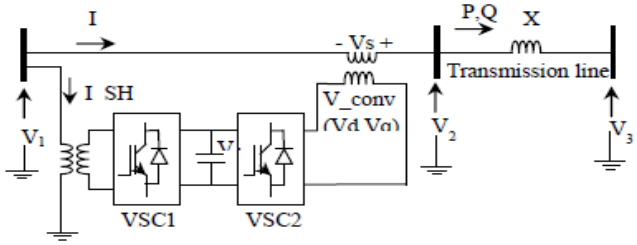
The FACTS devices form a large group of power electronic based converters designated to enhance controllability and increase power transfer capacity. These devices can be classified into two groups: thyristor based FACTS devices and converter based FACTS devices.

II. UPFC

Unified Power Flow Controller (or UPFC) is an electrical device for providing fast-acting reactive power compensation on high-voltage electricity transmission networks. It uses a pair of three-phase controllable bridges to produce current that is injected into a transmission line using a series transformer. The controller can control active and reactive power flows in a transmission line. The UPFC uses solid state devices, which provide functional flexibility, generally not attainable by conventional thyristor controlled systems.

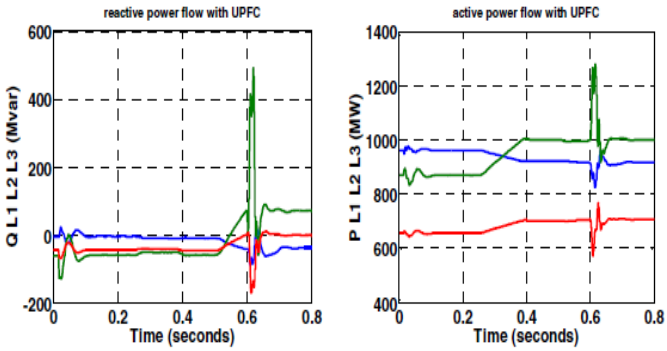
The UPFC is a combination of a static synchronous compensator (STATCOM) and a static synchronous series

compensator (SSSC) coupled via a common DC voltage link. The UPFC concept was described in 1995 by L. Gyugyi of Westinghouse. The UPFC allows a secondary but important function such as stability control to suppress power system oscillations improving the transient stability of power system [4, 8, 10].

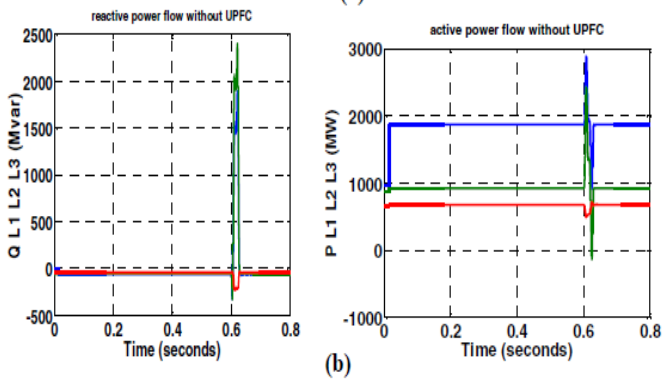


III. POWER FLOW CONTROL

Form figure below, we can observe that when the fault is applied (short-circuit) so this fault will cause the oscillation on active and reactive power flow of the lines, we can see clearly that the system oscillation is more important and dangerous without UPFC as shown in Fig (a) (it can reach 3000 MW and 2500 MVar), while the oscillation with the UPFC is less important (it can reach 1300 MW and 500 MVar), the system power can restore stability after some sec running when the fault removed, active and reactive power of the system still shocking seriously in a long time after the fault removed when UPFC does not work, so the UPFC damp the oscillations of the power system and provides improved dynamic performance.



(a)



(b)

IV. CONCLUSION

In this study, the Matlab/Simulink environment is used to simulate a simple grid with UPFC, the test system was analyzed with and without incorporating UPFC under fault to examine the performance dynamic of UPFC in transmission line. According to what mentioned in the simulation results obtained, given an indication that UPFC have the capability to improve the voltage profile, as well as regulating the active and reactive power of the buses and the lines even during the fault conditions without losing balance and improve the stability of power system.

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