A Review Paper to study Performance Analysis of IUPFC using Matlab Simulation

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ABSTRACT

UPFC and IPFC are FACTS devices that can control active and reactive power flow in transmission line by means of injection controllable series voltage to the transmission line. This paper proposes a new connection for a Unified Power Flow Controller (UPFC) to improve the power flow control of one transmission line in a power system and it regulates bus voltage in another transmission line. It is connected between two different transmission lines, this connection of the UPFC will be called an interline UPFC (IUPFC). It is one of the newest devices within the FACTS technology. The structure and capability of the IUPFC is discussed and its control scheme is based on the d-q orthogonal coordinates. The obtained simulation results from Matlab/Simulink confirm the effective features.

Keywords: UPFC, IPFC,FACTS

I INTRODUCTION

The most interesting for utilities is that the technology flexible A.C. transmission system (FACTS) opens up new opportunities for controlling the certain important aspects of power quality viz., Voltage sag, swell, THD, transient oscillations apart from controlling power and enhancing the usable capacity of the present transmission system closer to its thermal rating.The UPFC is a robust device among the family of FACTS controllers as it has the capability to control all the transmission parameters viz., voltage, impedance and phase angle (Schaulder et al 1998) unlike its other family members. While "Power Quality" is a convenient term for many, it is the quality of the voltagerather than power or electric current - that is actually described by the term. Power is simply the flow of energy and the current is a demand by the load. For the mitigation of problems in the voltage supplied by the utilities, this Thesis focuses on new schemes of UPFC which exhibits better performance on the aspects of power quality. The five level inverters employed as voltage source converters (VSC) in UPFC have an edge over UPFC of two level inverters with regard to reduction in THD. The closed loop UPFC system reduces the period of voltage sag to a great extent when compared to open loop systems.

II LITERATURE REVIEW

A.V NARESH BABUet.al in the year 2017published a paper on journal of IEEE statesthat the advanced and versatile member of flexible AC transmission systems (FACTS) controller is interline power flow controller (IPFC). In general, IPFC is used in

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multiple transmission lines of a power system network. This paper presents a power injection model of IPFC. The power injection model is incorporated in Newton-Raphson (NR) power flow solution method to study the effects of IPFC parameters in power flow studies. A program in MATLAB has been written in order to extend conventional NR algorithm based on this model. Numerical results are carried out on IEEE 14-bus system to demonstrate the performance of the IPFC model. It is shown that there is a possibility of regulating bus voltages, active power flow, reactive power flow and minimizing the power losses simultaneously with proper IPFC parmeters.[1]

J.NAVEEN et.al in the year 2017, published a paperon International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering states that, in modern power systems, power demand is continuously increasing. To meet the increased power demand, the power flow on the transmission lines are to be effectively controlled. For such purpose, power flow controllable devices are required. Unified Power Flow Controller (UPFC) is a FACTS device which controls the power flow on the single transmission line and Interline Power Flow Controller (IPFC) controls the power flow in the parallel transmission lines or on the multi-lines. The Interline Unified Power FlowController (IUPFC) is the newest device, which is the modified version of IPFC and UPFC.[2]

AMIR GHORBANI et.al in the year 2016,published a paper onJournal of Electrical Systems and Information Technology states that Generalizedinterline power-flow controller (GIPFC) is one of the voltage-source controller (VSC)-based flexible AC transmission system (FACTS) controllers that can independently regulate the power-flow over each transmission line of a multiline system. This paper presents the modelling and performance analysis of GIPFC based on 48-pulsed voltage-source converters. This paper deals with a cascaded multilevel converter model, which is a 48-pulse (three levels) voltage source converter. The voltage source converter described in this paper is a harmonic neutralized, 48-pulse GTO converter. The GIPFC controller is based on d-q orthogonal coordinates. The algorithm is verified using simulations in MATLAB/Simulink environment. Comparisons between unified power flow controller (UPFC) and GIPFC are also included.[3]

VAISHALI et.al in the year 2016, published a paperon International Research Journal of Engineering and Technology (IRJET) states that, In the power system, the price of the transmission lines is an important factor in the network company. An interline power flow controller (IPFC) is a grouping of series and series converter based FACTS controller which has the ability of controlling power flow among multiple lines in the same network of the transmission line. This paper is based on the performance of multi-

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machine system and system is studied with & without interline power flow controller (IPFC) under different environments. The IPFC is designed to limit the power transferring across lines and minimize the oscillations during disturb condition. Series FACTS devices are mainly used to limit the flow of power minimize the disturbances and improving transient stability of the system. Simulation is done by using MATLAB software.[4]

A MURUGAN et.alin the year 2015 published a paper on IEEEstates that The interline power flow controller (IPFC & UPFC) is one of the latest generation flexible AC transmission systems (FACTS) controller used to control power flows of multiple transmission lines. The main objective of this paper is detailed study about a new real and reactive power coordination controller for a interline power flow controller (IPFC & UPFC). The basic control for the IPFC is such that the series converter of the UPFC controls the transmission line real/reactive power flow and the shunt converter of the (IPFC & UPFC) controls the bus voltage/shunt reactive power and the DC link capacitor voltage. Because of the common link, any inverter within the (IPFC & UPFC) is able to transfer real power to any other and thereby facilitate real power transfer among the lines of the transmission system. Since each inverter is able to provide reactive compensation, the (IPFC & UPFC) is able to carry out an overall real and reactive power compensation of the total transmission system. This capability makes it possible to equalize both real and reactive power flow between the lines, transfer power from overloaded to under loaded lines, compensate against reactive voltage drops and corresponding reactive line power and to increase the effectiveness of the compensating system against dynamic disturbances. A simulation in MATLAB has been done in order to extend conventional algorithm based on this model.[5]

Y.N.VIJAYAKUMAR et.al in the year 2014,published a paper oninternational journal of innovative research in electrical, electronics, instrumentation and control engineering states that the interline power flow controller (IPFC) is one of the latest generation flexible AC transmission systems (FACTS) controller used to control power flows of multiple transmission lines. In recent years, power demand has increased substantially while the expansion of power generation and transmission. It has been severely limited due to limited resources and environmental limitations. Flexible AC Transmission Systems (FACTS) controllers have been mainly used for solving various power system steady state control problems. Interline Power Flow Controller is a versatile device can be used to control power flows of a multi-line system or sub-networks An Interline Power Flow Controller (IPFC) is a converter based FACTS controller for series compensation with capability of controlling power flow among multi-lines within the

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same corridor of the transmission line. It consists of two or more Voltage Source Converters (VSCs) with a common dc-link. Real power can be transferred via the Common dc-link between the VSCs and each VSC is capable of exchanging reactive power with its own transmission system. In this paper, a control scheme of an IPFC system with two VSCs to compensate the impedances of two similarly dimensioned parallel transmission lines is presented. A Mathematical model of the IPFC is presented and the model is used to investigate the flexibility of power flow control, in the presence of operating constraints of the IPFC. In this paper, the application of Interline Power Flow Controller (IPFC) in damping of low frequency oscillations is investigated. The potential of various IPFC control signals upon the power system oscillation stability is investigated under various loading conditions.[6]

III PROPOSED METHODOLOGY

In modern power systems, there is a increase in power demand continuously. To meet the change in power demand the power flow on the transmission lines are actively controlled. Power flow controlling devices are required for such purpose. Among all Power flow control devices;the UPFC and IPFC are used. The Unified Power Flow Controller (UPFC) is used to control the power flow on the single transmission line and Interline power flow controller (IPFC) is used to control the power flow in the parallel transmission lines or on the multi-lines. Interline unified power flow controller (IUPFC) is a new device, which is the modified version UPFC and IPFC.

UNIFIED POWER FLOW CONTROLLER (UPFC):

The UPFC is a device, which can control simultaneously all the three parameters of line `power flow which are line impedance, voltage and phase angle [1-2]. It improves terminal voltage regulation, series capacitor compensation and transmission angle regulation [3]. The UPFC is made out of two voltage-source converters (VSCs) i.e. static compensator (SATACOM) and a static synchronous series compensator (SSSC) with semiconductor devices having turn-off capability, sharing a common DC capacitor and connected to a power system through coupling transformers as shown in figure 4.1.The shunt converter is primarily used to provide the real power demand of the series converter at the common DC link terminal from the AC power system. It can also generate or absorb reactive power at its AC terminal, which is independent of the active power transfer to (or from) the DC terminal [5-6].

The series converter is used to generate a voltage at the fundamental frequency with variable amplitude and phase angle, which is added to the AC transmission line by the series connected boosting transformer. The inverter output voltage injected in series with the line can be used for direct voltage control, series compensation, phase shifting, and their combinations. This voltage source can internally generate or absorb all the reactive power required by the different type of controls applied and transfers active power at its DC terminal as depicted in fig 4.1

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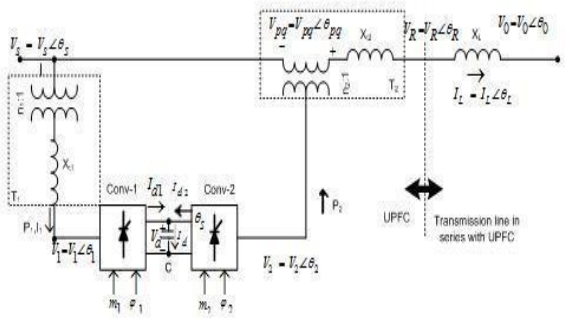

Figure 4.1: Implementation of UPFC in transmission line

INTERLINE UNIFIED POWER FLOW CONTROLLER (IUPFC)

IUPFC as the novel topology is proposed; Interline unified power flow controller (IUPFC) using 48 pulse voltage source converter to provide the quality power supply. Shunt and series converters are combined together. It improves the power flow on one transmission line in a power system and it regulates bus voltage in another transmission line. The simplified single line diagram of the system with IUPFC is shown in Figure 4.2, It consists of two voltage source converters with separate controllers but sharing a common DC link therefore IUPFC composes STATCOM and SSSC in two separate transmission lines, STATCOM provides the energy of DC-link from the secondary transmission line, it regulates the voltage of DC-link and maintains the bus voltage at constant level in secondary line and it also operates as active filter. The provided voltage of DC- link by means of STATCOM, feeds SSSC till inject a voltage of adjustable magnitude and phase angle in form of series with transmission line via series transformer and it has ability of power flow controlling in wide range. Therefore comparing SSSC and STATCOM it has increased the application abilities, flexible and controlling confine. The performance of the IUPFC has been modelled and simulated using Matlab/Simulink.

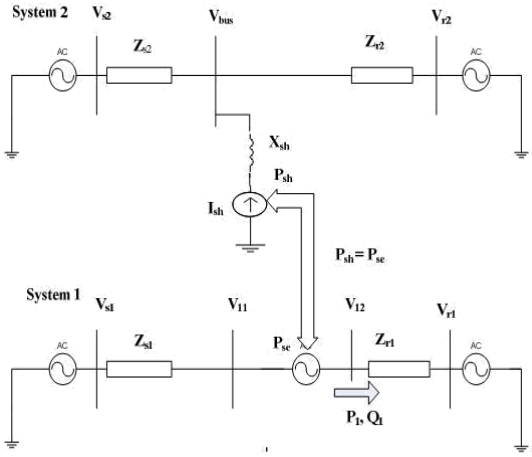

Figure 4.2. Complete structure of a three phase IUPFC

IV EXPECTED OUTCOME

This work deals with the control of real and reactive power in power system using MATLAB/SIMULINK. Unified Power Flow Controller (UPFC) is a shunt-series type converter used for improving power quality. The UPFC controls the real and reactive powers by varying firing angle of the rectifier and inverter. The circuit

model for UPFC is developed using MATLAB/SIMULINK.

In the future work MATLAB simulation will operate in following modes for analyses theIUPFC:

1. Power control in UPFC mode

2. Var control in STATCOM mode

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3. Series voltage injection in SSSC mode

The propose system is modeled and analyzed using Matlab/Simulink

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