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Study of Interline Power Flow Controller by using Practical Prototype and Software

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Abstract - This paper presents comparative study of effect of transmission line with IPFC and without IPFC considering three cases i.e. 1) base load condition 2) with the increase in10% load and 3) with the fault created in one line by using MATLAB simulink model. As IPFC is one of the latest generation flexible AC transmission system controller using converter as a control scheme shows a new approach for the effective improvement in real and reactive power utilization.

Keywords **- FACTS, VSC, IPFC.**

1. Introduction

To achieve operational reliability and financial profitability more efficient utilization and control of the existing transmission system infrastructure is required. Mechanical switch based traditional approaches cannot realize full utilization of transmission system due to the needed large stability margin and therefore minimizing the gap between the stability and the thermal levels. Basic principal of IPFC to realize power balance in a transmission system hence IPFC at a substation can function as regulator based on converter.

The Interline Power Flow controller (IPFC), proposed by Gyugyi with sen and Schauder in 1998, addresses the problem of compensating a number of transmission lines at a given substation. Due to increase in power demand, power system networks are being operated stressed conditions. This is resulted into the difficulty in meeting real and reactive power requirements.

This capability makes it possible to: equalize both real and reactive power flow between the lines; reduce the burden of overloaded lines by real power transfer; compensate against resistive line voltage drops and the corresponding reactive power demand; and increase the effectiveness of the overall compensating system for dynamic disturbances. In other words, the IPFC can potentially provide a highly effective scheme for power transmission management at a multiline substation.

2. Basic Operating Principles

In its general form the Interline Power Flow Controller employs a number of dc-to-ac converters each providing series compensation for a different line. In other words, the IPFC comprises a number of Static Synchronous Series Compensators. However, within the general concept of the IPFC, the compensating converters are linked together at their dc terminals, as illustrated in Fig 1. With this scheme, in addition to providing series reactive compensation, any converter can be controlled to supply real power to the common dc link from its own transmission line. Thus, an overall surplus power can be made available from the underutilized lines which then can be used by other lines for real power compensation. In this way, some of the converters, compensating overloaded lines or lines with a heavy burden of reactive power flow, can be equipped with full two-dimensional, reactive and real power control capability, similar to that offered by the UPFC. Evidently, this arrangement mandates the rigorous maintenance of the overall power balance at the common dc terminal by appropriate control action, using the general principle that the under loaded lines are to provide help, in the form of appropriate real power transfer, for the overloaded lines.Fig2.

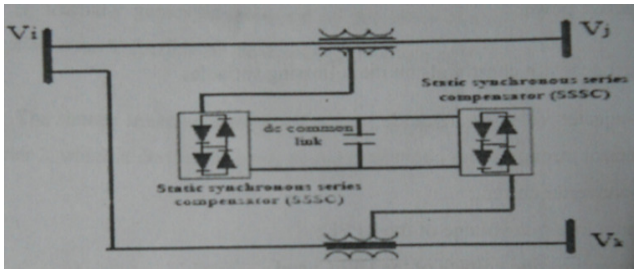

Fig1 IPFC scheme with dc link between lines

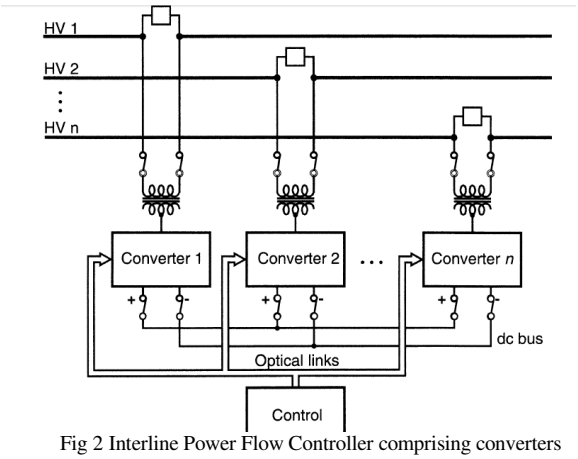

Fig 2 Interline Power Flow Controller comprising converters

2.1 Control Scheme of IPFC

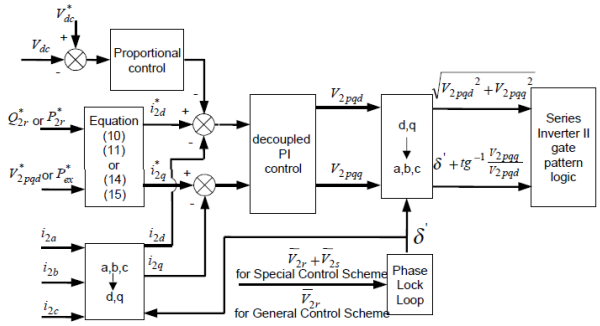

Fig3 Basic control sheme

In paper [9] the regulation model of an Interline Power Flow Controller and its control strategies at rated Capacity was discussed. Thus the overall surplus power can be made to utilize from the lightly loaded line to overloaded line. For analysis purpose let as consider the IPFC consist of two Voltage source converters among which converter 1 will act as the master which control the power flow on the line one independent of the line 2. Converter 2 on the line 2 is meant for maintaining the DC link voltage irrespective of variation in supply.

Fig5 shows the block diagram for the slave system. Fig4 shows the overall control structure of the master IPFC system. This block diagram is similar to the block diagram of the slave IPFC system and has many of the same blocks except for two major differences: (a) the dc voltage controller and (b) Impedance controller. Since the dclink Voltage is controlled by the slave system, the dc voltage Controller no longer needed.

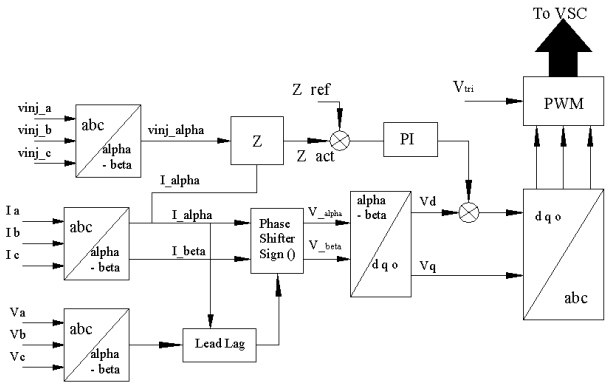

Fig4 master control scheme of IPFC

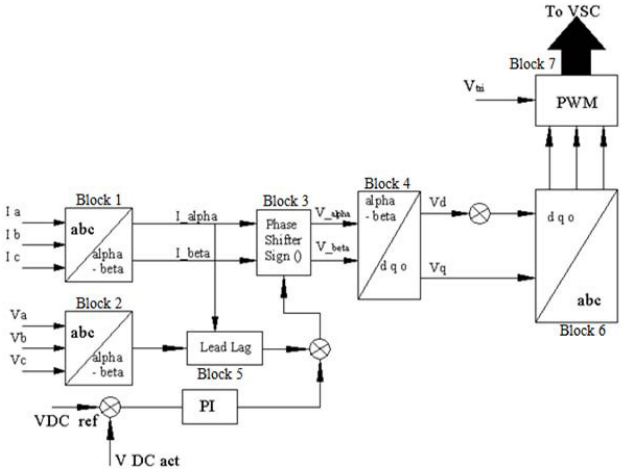

Fig5 slave control scheme of IPFC

2.1 Study of line without IPFC

Simulink model of transmission line is as given in fig 6 whereas simulink model with IPFC consist of both control scheme in between parallel transmission line operating at a substation in the same corridor.

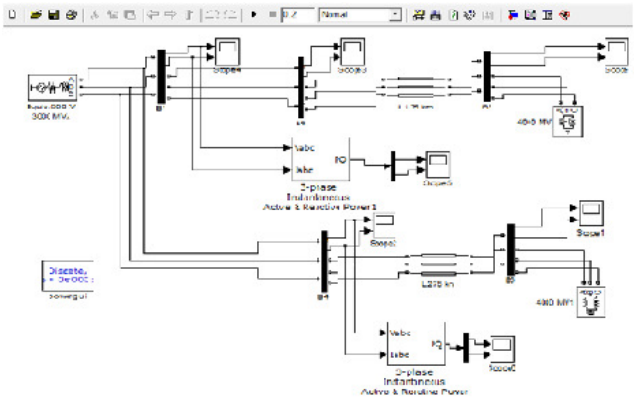

Fig.6 with base load condition without IPFC.

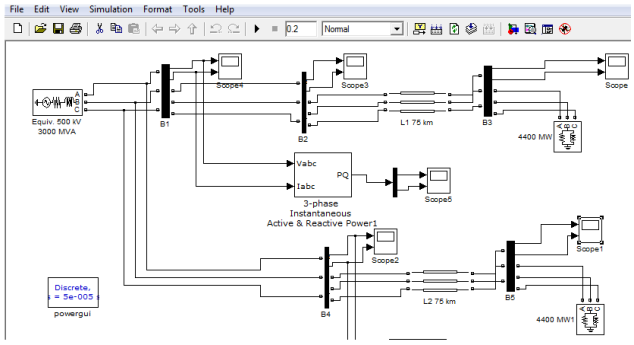

Fig7 with the increase in 10% load without IPFC

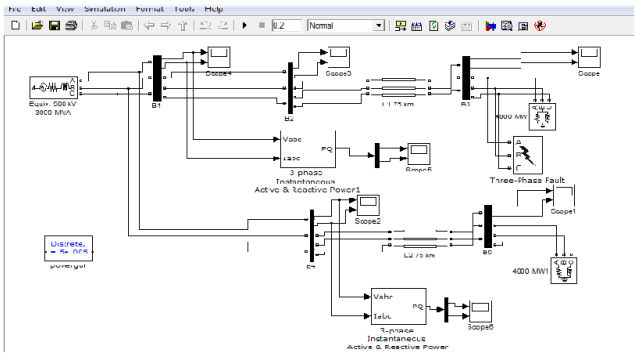

Fig8 with fault condition without IPFC

3. Conclusions

Comparative study considering three conditions can be summaries in the table form are as follows.

Table1

	WithoutIPFC	10%Increase in load	Fault condition
Bus no.	B1 b2	B1 b2	B3 b5=b4
Vb	77.781 77.781	84.852 84.852	0 35.355
P	18.35 18.35	18.6 18.6	17 17
Q	25.85 25.85	24.99 24.99	26 26

Where vb is in KV, P is in MW.Q is in MVar

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