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Comparative Study of Transient Stability by using Different Types of Facts Devices

Jaya Mishra
PG student, Department of Electrical Engineering
Azad Institute of Engineering & Technology
Lucknow, India

Vaibhav Shukla
Assistant Professor,
Department of Electrical Engineering
Seth VishambharNath Institute of Engineering & Technology
Barabanki, India

Imran Khan
Assistant Professor,
Department of Electrical Engineering
Azad Institute of Engineering & Technology
Lucknow, India

Abstract— **This paper explores the upgrade in transient stability and additionally the change in the power transfer ability in a power system. Power systems are inherently nonlinear and undergo a wide range of transient conditions, which results in under damped low frequency speed as well as power oscillations that are difficult to control. In transient stability the machine is subjected to large impact, usually a fault, which is maintained for a short time and cause a significant reduction in the machine terminal voltage and ability to transfer synchronizing power. Implementation of new equipment consisting high power electronics based technologies such as Flexible Alternating Current Transmission Systems (FACTS) and proper controller design become essential for improvement of operation and control of power systems. Flexible AC transmission systems (FACTS) devices are installed in power systems to increase the power flow transfer capability of the transmission systems, to enhance continuous control over the voltage profile and/or to damp power system oscillations. The ability to control power rapidly can increase stability margins as well as the damping of the power system, to minimize losses, to work within the thermal limits range. Every one of the recreations for the above work has been completed utilizing MATLAB (SIMULINK) programming.**

I. INTRODUCTION

Modern power systems are highly complex and are designed as such to fulfill the growing demands of power with better power quality. High technology now-a-days are being used for controlling power flow. Due to this, power quality is improved. Modern technology and new constructions of transmission line are also needed for improving power system security, profitability and reliability. Apart from these factors, restructuring of transmission line are expensive and also take considerable amount of time. Rebuilding of transmission line and expanding request on the transmission system has brought about decrease of stability edges and expanded the dangers of falling blackouts and power outage (voltage collapse) [1]. Voltage collapse happens when power systems are vigorously loaded, blamed, or have reactive power deficiencies. Voltage collapse is system instability and it happens because of numerous power system segments.

II. REACTIVE POWER COMPENSATION

Reactive power compensation is portrayed as administration of the reactive power for delaying the execution of ac power system. In the issue of reactive power compensation it can be seen from two viewpoints: voltage regulation and load compensation. The VAR compensation in the transmission system enhances stability of the system to expand greatest power which can be transmitted. It keep up generously level voltage profile levels of the power transmission builds expands transmission effectiveness, high-voltage transformation execution, controls the relentless state or makeshift voltages and maintain a strategic distance from sad power outages. Nonetheless, in later years, static VAR compensators utilizing Thyristor-exchanged capacitors and Thyristor-controlled reactors to give or take required reactive power have created. The utilization of self-commutated beat width adjustment converters with the suitable control method licenses to execution of the static compensators fit for making or taking reactive current parts reaction quicker than principal power systemcycle.

III. TYPES OF COMPENSATION:

A.Shunt Compensation

Load is an expected inductive that requirements reactive power for the correct operation and source must have supply it, expanding current from generator and through power lines. Reactive power supplied to load, line current can be diminished or minimized, lessens power losses and enhance voltage regulation at load terminals. This can be finished in three courses: 1) with capacitor; 2) with voltage source; or 3) with current source, a present source gadget is utilized to remunerate reactive part of load current.

B.Series Compensation

VAR compensation can be of arrangement sort. Series compensation systems use capacitors to decrease comparable reactance of power line at the evaluated frequency. The connection of capacitor makes the reactive power in a self-

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directed way, adjusted division of line's exchange reactance. The outcome can be enhanced functionality of power transmission system through:

- Enhanced angular stability of power Lines;
- Expanded voltage stability of Lines;
- Streamlined power sharing between the parallel circuits.

Arrangement compensation capacitors are most common methodology

C. Points of interest of compensation:

- They give slacking and driving reactive power, empowering a huge sparing in reactors. These causes diminish in possibility of resonances at the some essential conditions of operations.
- Since time response of the self-commutated converter is snappier than basic power of system cycle and reactive power can consistently be controlled.
- High regulation repeat of the self-commutated converter conclusion in low consonant substance of supply current, henceforth reducing size of the channel fragments.
- Negligible inrush current.
- The execution of component under the variety in voltage and transient can be moved forward.
- The self-commutated compensators are capable to deliver reactive power at 1 p.u. at the point when line voltages are low. This reactive power backing is better accomplished with Thyristor-controlled compensators as present in the shunt capacitors and reactors changes relatively to voltage.
- Self-commutated compensators with perfect control can act powerfully introduce in line symphonious channels, DVRs, orUPFCs.

This paper discusses the various techniques and approaches applied in our research to solve the problem. The problem taken is of performance comparison of UPFC and IPFC in a connected power system.

All simulations are done in MATLAB R2015 b on a 2.7 GHz processor based computer with 4GB RAM and 1TB hard disk. The power system is designed as below.

The two transmission lines need to be compensated using UPFC and IPFC.

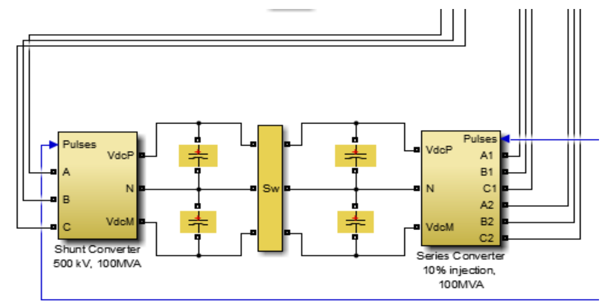

Fig-1 The two transmission lines needs to be compensated using UPFC

The controller for both the converters is designed and the complete model can be shown as below.3 phase generator is connect with line inductance and load

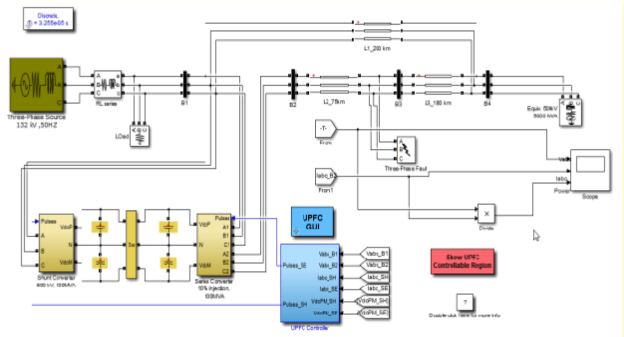

Fig-2 Complete model of two transmission lines needs to be compensated using UPFC

The series converter for the UPFC is designed as below. Series converter comprises of 3 phase transformer which act as phase shifting transformer are given 3 level bridge which act as rectifier for the reactive power. The converter needs firing pulse which is given bycontroller.

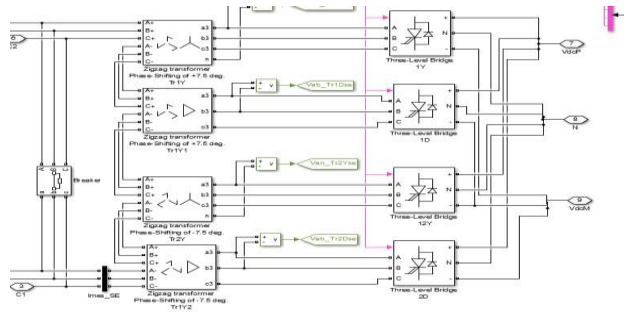

Fig-3 series converter for UPFC

The shunt converter is shown below that shunt converter consist of phase shifting transformer. which provides appositive phase shift compare to the series converter two transformer zigzag-star while other to are zigzag-delta output provide to 3 level bridge which are control firing angle from UPFC controller

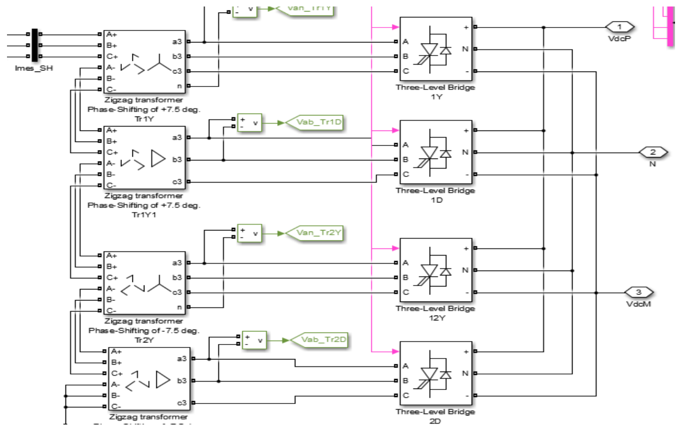

Fig-4 Shunt converter for UPFC

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The controller is designed for the converter and is shown as below that consist of two module first is STATCOM control which provide firing pulse to the shunt converter and the other module consist of series controller namely SSSC and provide the firing angle for the series converter of the UPFC device. Two type controllers have been utilized for regulating the current and voltage of UPFC device. In first type PID control has utilized while the second type PI control has utilized the result of both these result compare and analysis.

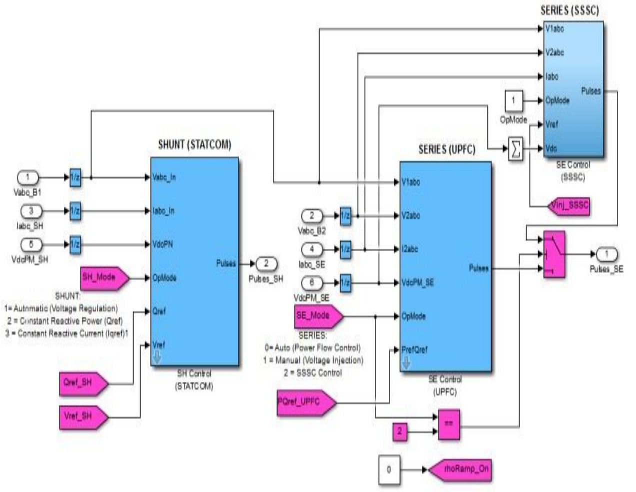

Fig-5 Controller for Converters

The same line is compensated using an IPFC also and the complete model of the IPFC is shown below. IPFC Model has implement with IPFC control unit compensate the two line are parallel and regulate power flow as inter line power flow devices consist of two type converter both series which are connected by dclink.

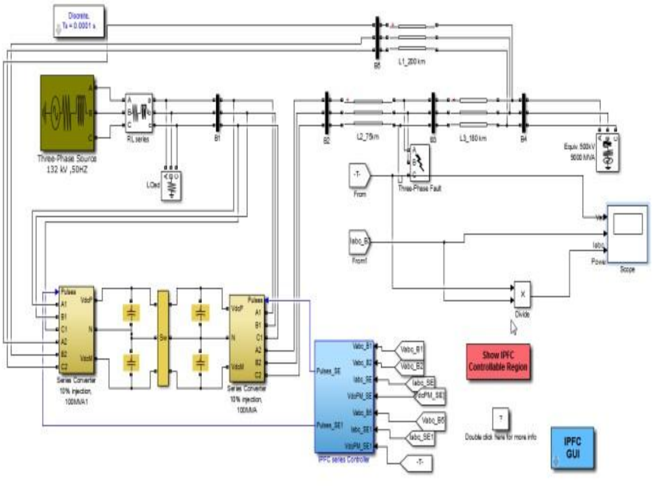

Fig-6 Line compensation using IPFC

The controller for IPFC has to be designed separately as it is a series-series control. IPFC controller takes input as the voltage across they lines in which they connect in series. SSSC control is utilized separately for both controller and provides firingpulse to the series device ofIPFC.

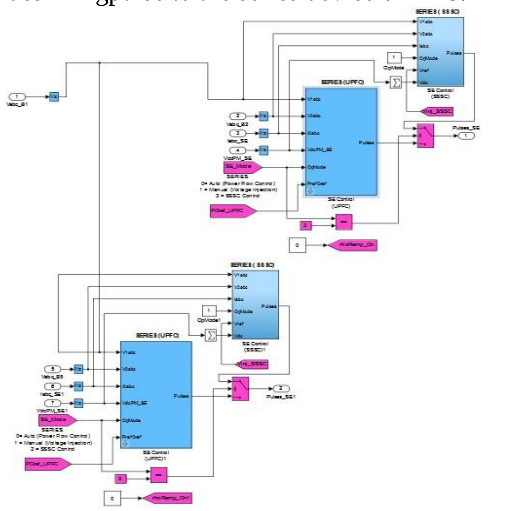

Fig-7 Controller for IPFC

IV. ANALYSIS of UPFC WITH PI CONTROLLER

The UPFC model is designed and applied and the voltage for the above mentioned system is shown below.

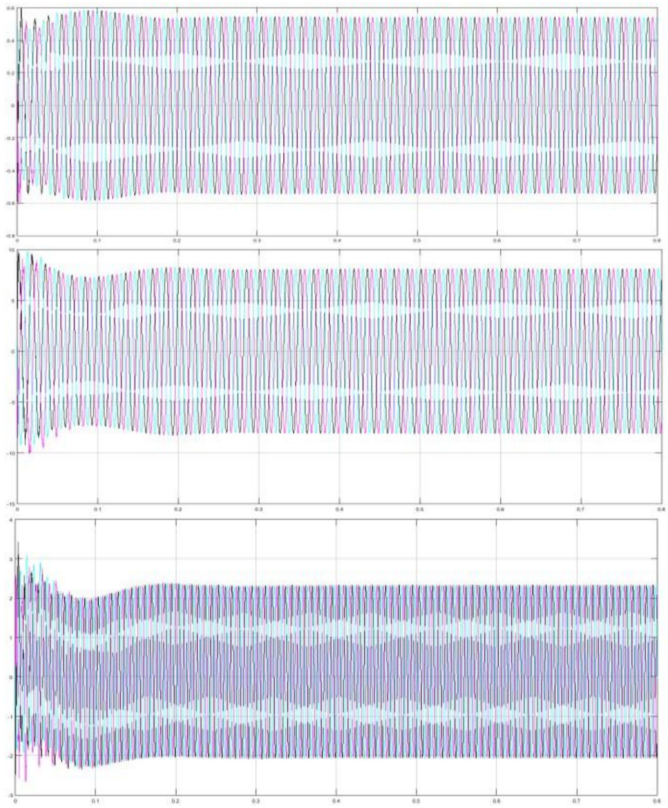

Fig-8 System Output Voltage, current, power PI with UPFC of bus B2

Above fig.0 to 0.1 time period at faulty condition after some time they normal condition

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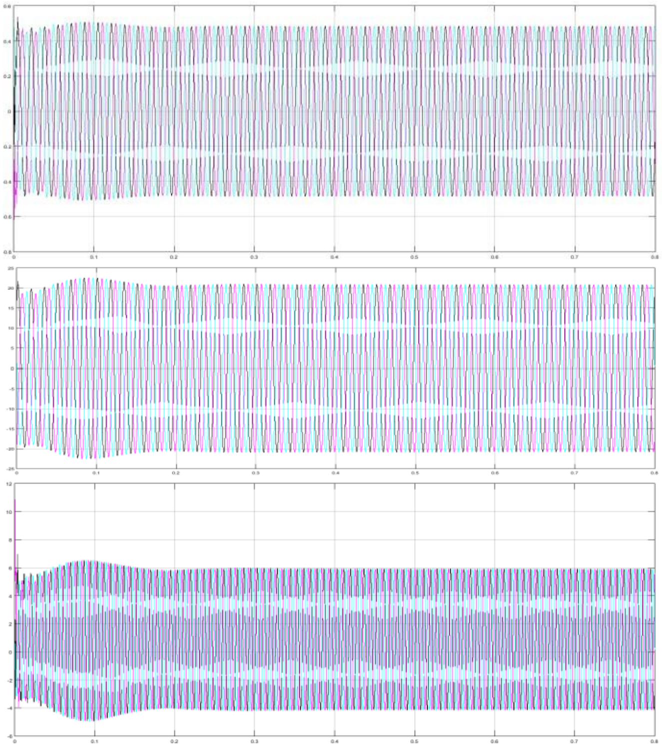


Fig-9 System Output Voltage, Current, Power PI with UPFC of Bus B1

Above the fig output voltage at 0 to .1 time period at B1 bus fault condition after some time at in normal condition. Same as current follow same time interval faulty condition after some time period at 0.2 they are normal condition. Same as power at 0 to.1 time interval at faulty condition after some time its normal condition

All these simulations were done for PI control. The total harmonic distortion obtained in case of UPFC is shown in figure.

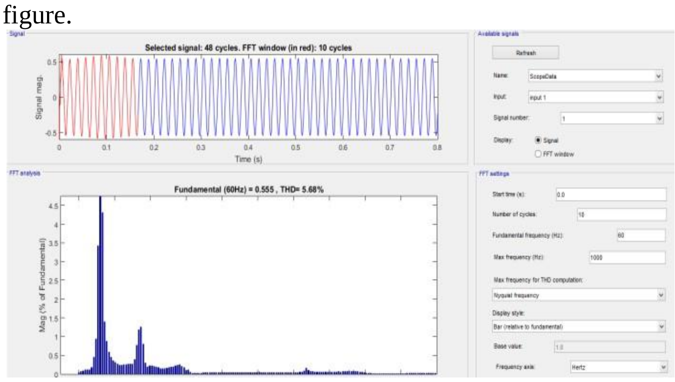


Fig-10 THD with PI Controller in UPFC

V. ANALYSIS OF UPFC WITH PID CONTROLLER

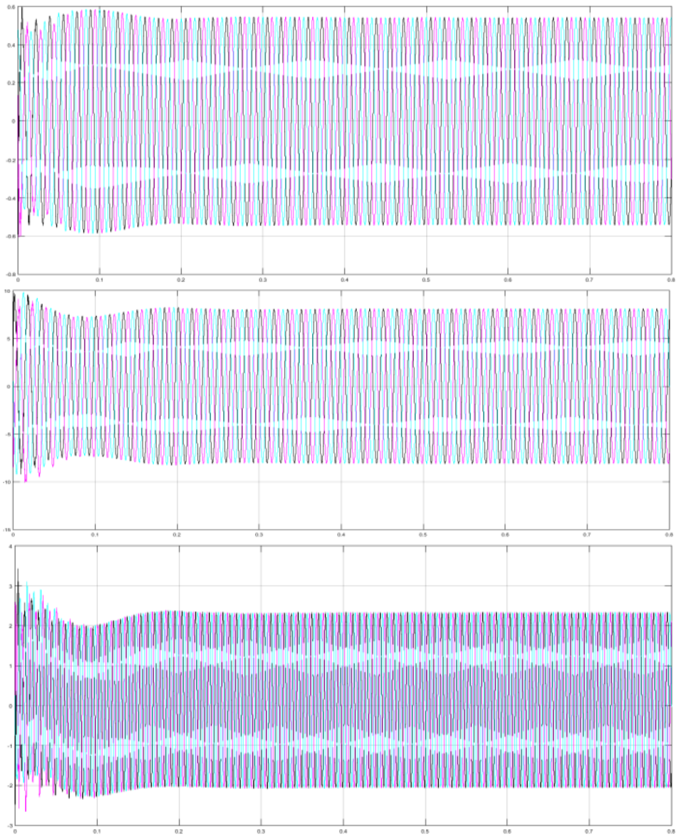
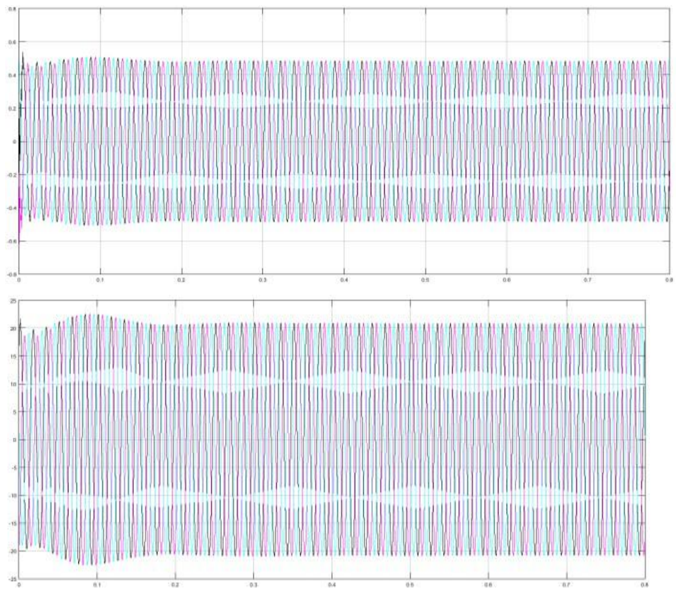


Fig-11 system output voltage, current power PID with UPFC at bus B2

In above fig show that the system fault at time interval 0 to 0.1 fault occur after at time 0.2 clear the fault.



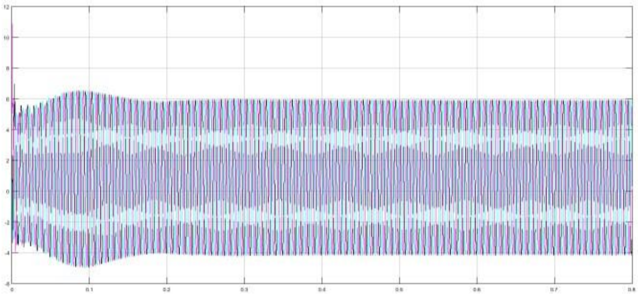


Fig-12 System output voltage, current power PID with UPFC at bus B1

In above fig show that bus1 voltage, current and power at time
0 to 0.1fault occur after some time 0.2 clear the fault they operate normally. Then PID control is also implemented for the same system and the results shown are below

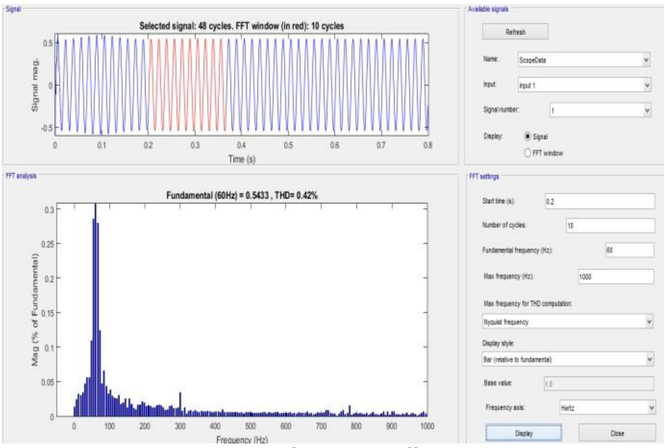
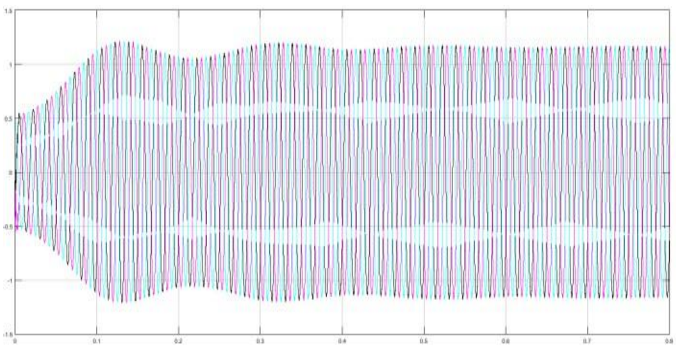


Fig-13 THD With PID Controller In UPFC

As seen above the THD of PI control is more than that of PID control. This represents that PID control performs better in case of UPFC.PID control THD (.42%) and PI control THD (5.68%).

VI. ANALYSIS OF IPFC WITH PICONTROLLER

The same model is also implemented by using IPFC. Theresults of IPFC are shownbelow
The voltage, current and power at bus B2 is shown below for PI control



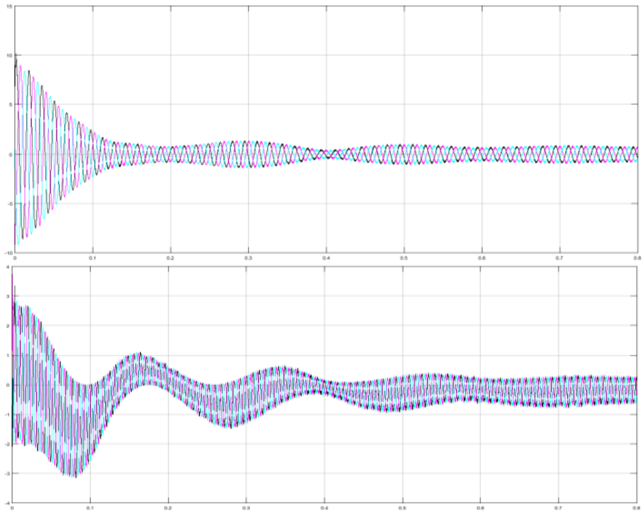


Fig-14 System output voltage, current and power at Bus B2 for PI Control With IPFC

In above figure show that voltage,(0 to .1) fault occurs after .2 they will in normal condition. Now in current (0 to .4) fault occurs after .5 time periods normal condition same as power (0 to .6) occurs fault after .6 it is normally stable condition

The voltage, current and power at bus B3 is shown below for PI control with IPFC

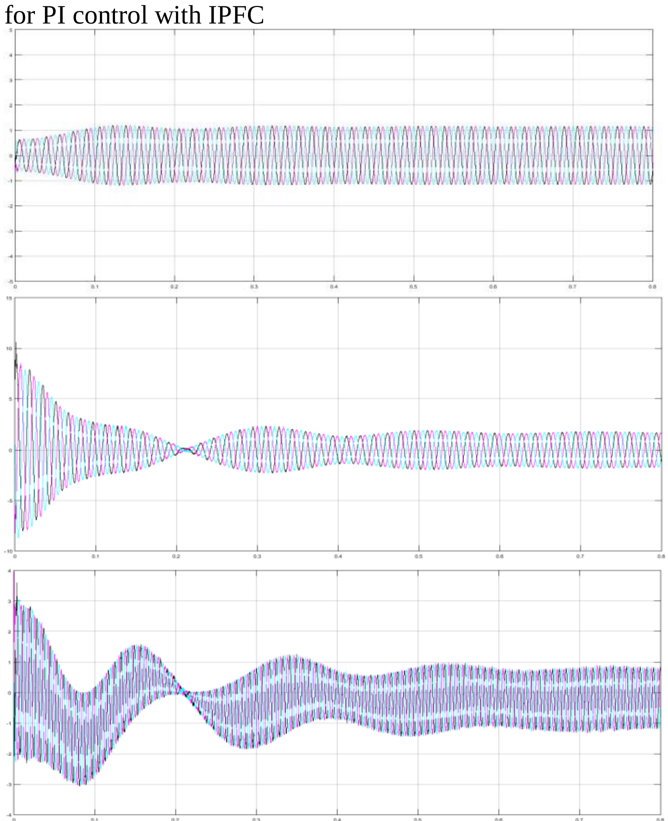


Fig-15 voltage, Current and power at Bus B3 for PI Controller With IPFC

In above figure show that voltage,(0 to .1) fault occurs after .2 they will in normal condition. Now in current (0 to .4) fault

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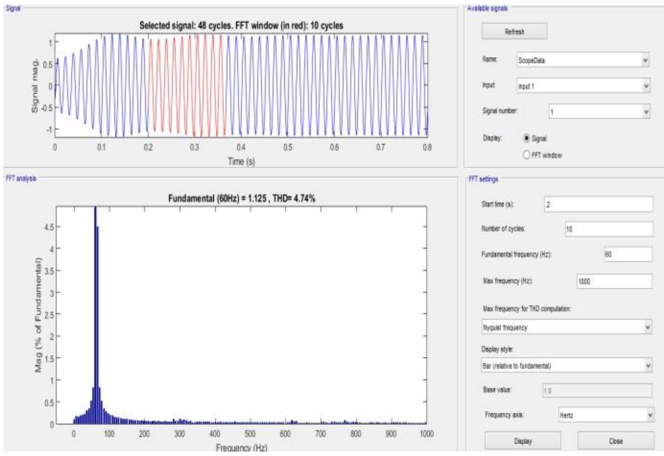
Fig-19 THD With PID Control In IPFC

As observed the THD (3.20%) in case of PI control is more in case of PID control. But overall in case of UPFC versus IPFC, UPFC performs better with PID control. PID IPFC (4.74%) and PID UPFC (.42%). PI control UPFC (5.68%) and PI control IPFC (8.54%) and PID control UPFC (.42%) and PID IPFC (4.74%). For PID control, IPFC shows lower THD and hence improved performance.

VIII. CONCLUSION

Basically the transients are two types one is the lighting transient and other is switching transient. In this thesis, the transient stability of the system is compared by using different compensating devices and also making the comparison of different controller performance with these compensators. The thesis attempts to implement a novel control strategy for UPFC and IPFC and the performance of both these were compared. The transmission line was designed and both the techniques were applied along with their control. The performances were compared and it was found that UPFC performs better than IPFC in overall THD while UPFC's performance degrades when we are using PI controller. Differ also in both UPFC and IPFC the performance of PID controller is better than that of PI controller.

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