

# **A Wide Area Monitoring System Base Load Restoration Method**

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**ABSTRACT:** The paper discusses the dynamic behavior of two different flexible ac transmission system devices; the interline power-flow controller (IPFC) at benchmark. The small-signal model of the interline power-flow controller is developed and validated using detailed electromagnetic transients simulation. Using this validated model, the damping capabilities of the IPFC a small-signal dynamics point of view, it is shown that the series branches of these devices essentially segment the network creating a new structure. This structure change may be used to effectively improve system damping without requiring the design of a tuned feedback controller. The IPFCs two series branches in contrast to the UPFC's single series branch permit more opportunities for network segmentation. Hence, the IPFC has greater potential for improving the system's dynamic performance.

**KEYWORDS :** IPFC,UPFC,dynamics,transient

## **1. INTRODUCTION**

The technology of power system utilities around the world has rapidly evolved with considerable changes in the technology along with improvements in power system structures and operation. The ongoing expansions and growth in the technology, demand a more optimal and profitable operation of a power system with respect to generation, transmission and distribution systems. In the present scenario, most of the power systems in the developing countries with large interconnected networks share the generation reserves to increase the reliability of the power system. However, the increasing complexities of large interconnected networks had fluctuations in reliability of power supply, which resulted in system instability, difficult to control the power flow and security problems that resulted large number blackouts in different parts of the world. The reasons behind the above fault sequences may be due to the systematical errors in planning and operation, weak interconnection of the power system, lack of maintenance or due to overload of the network. In order to overcome these consequences and to provide the desired power flow along with system stability and reliability, installations of new transmission lines are required. However, installation of new transmission lines with the large interconnected power system are limited to some of the factors like economic cost, environment related issues. These complexities in installing new transmission lines in a power system challenges the power engineers to research on the ways to increase the power flow with the existing transmission line without reduction in system stability and security. In this research process, in the late 1980's the Electric Power Research Institute (EPRI) introduced a concept of technology to improve the power flow, improve the system stability and reliability with the existing power systems. This technology of power electronic devices is termed as Flexible Alternating Current Transmission Systems (FACTS) technology. It provides the ability to increase the controllability and to improve the transmission system operation in terms of power flow, stability limits with advanced control technologies in the existing power systems.

## **II. NEEDS OF FACTS TECHNOLOGY**

FACTS technology is not a single power electronic device but a collection of controllers that are applied individually or in coordination with other devices to control one or more interrelated power system parameters such as series impedance, shunt impedance, current, voltage and damping of oscillations. These controllers were designed

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based on the concept of FACTS technology known as FACTS Controllers. FACTS controllers are advanced in relation to mechanical control switched systems that are controlled with ease. They have the ability to control the power flow and improve the performance of the power system without changing the topology. Since 1980s, a number of different FACTS controllers with advanced control techniques proposed as per the demand of the power systems. Unified Power Flow Controller (UPFC) is one among the different FACTS controllers introduced to improve the power flow control with stability and reliability. It is the most versatile device introduced in early 1990s designed based on the concept of combined series-shunt FACTS Controller. It has the ability to simultaneously control all the transmission parameters affecting the power flow of a transmission line i.e. voltage, line impedance and phase angle. Restoring a large-scale power system has always been a complicated and important issue. A lot of research work has been done on different aspects of the whole power system restoration procedure. However, more time will be required to complete the power system restoration process in an actual situation if accurate and real-time system data cannot be obtained. With the development of the wide area monitoring system (WAMS), power system operators are capable of accessing to more accurate data in the restoration stage after a major outage. The ultimate goal of the system restoration is to restore as much load as possible while in the shortest period of time after a blackout, and the restorable load can be estimated by employing WAMS. Moreover, discrete restorable loads are employed considering the limited number of circuit breaker operations and the practical topology of distribution systems. In this work, a restorable load estimation method is proposed employing WAMS data after the network frame has been reenergized, and WAMS is also employed to monitor the system parameters in case the newly recovered system becomes unstable again.

### III. NEED FOR POWER RESTORATION

Power system restoration after a major outage has always been an important issue to be addressed. Continuous growth of electric load and generation capacity has increased the complexity of power system operations and maintenances significantly. Although in different system restoration stages there are different objectives and constraints, the ultimate goal in common is to minimize the outage time while resupplying the maximum level of outage load.

### IV. . EXISTING AND PROPOSED SYSTEM IN POWER FLOW

In this method a novel emergency damping control(EDC) to suppress inter-area oscillations occurred as anticipated low-probability cases in power system operations. The main functionality of the project is provided by shunt converter by injecting an ac voltage considered as a synchronous ac voltage source with controllable phase angle and magnitude in series with the line. The transmission line current flowing through this voltage source results in real and reactive power exchange between it and the AC transmission system. The inverter converts the real power exchanged at ac terminals into dc power which appears at the dc link as positive or negative real power demand

### V. COMPARISON BETWEEN THE UPFC AND THE IPFC IN OPTIMAL POWER FLOW CONTROL AND POWER FLOW REGULATION

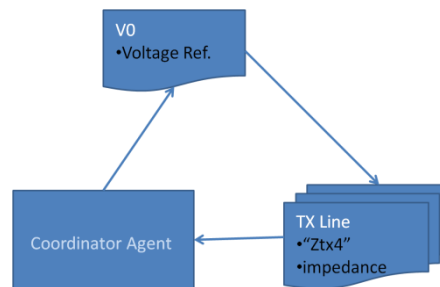
This paper presents a comparison study between the applications of the unified optimal power flow controller (UPFC) and the interline power flow controller (IPFC) in optimal power flow (OPF) control. The power injection models of the flexible AC transmission systems (FACTS) devices are reviewed and incorporated in the OPF problem without active power generation re dispatching, which minimizes the overall generating cost. The FACTS devices are planned for power flow regulation and their additional degrees of freedom act as additional potential in optimizing the power system. The performance of the UPFC and the IPFC is compared from the viewpoint of the total active power losses and their necessary capacities through numerical examples. The feasibility of a gradient-based algorithm, namely sequential quadratic programming (SQP), is tested, and the importance and some techniques of proper selection of the initial optimization conditions are also presented.

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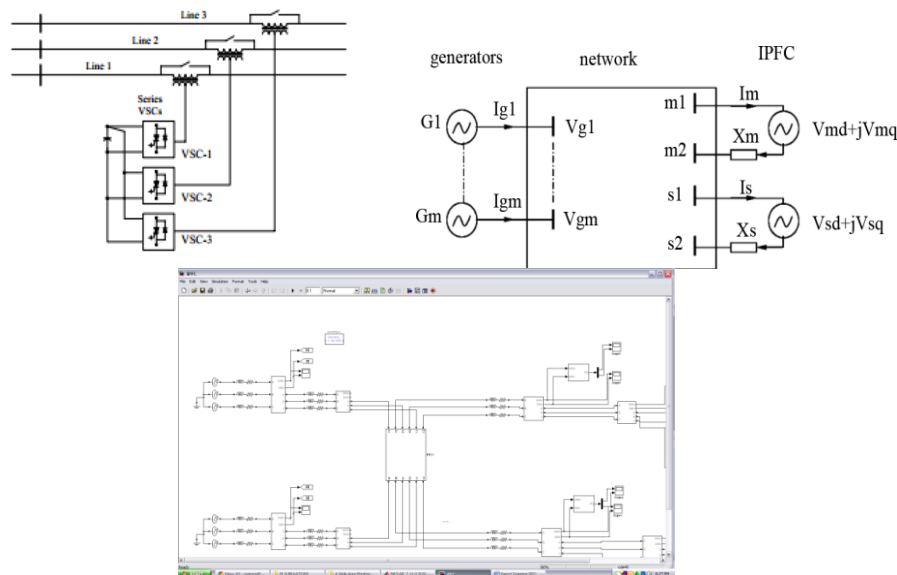
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## VI. MULTI AGENT SYSTEMS



The interline power flow controller (IPFC) proposed is a new concept for the compensation and effective power flow management of multi-line transmission systems. In its general form, the IPFC employs a number of inverters with a common DC link, each to provide series compensation for a selected line of the transmission system. Because of the common DC link, any inverter within the IPFC is able to transfer real power to any other and thereby facilitate real power transfer among the lines of the transmission system. This paper presents a mathematical model of IPFC, termed as power Injection model (PIM). A program in MATLAB has been written in order to extend conventional Algorithm based on this model. The results without and with IPFC are compared in terms of voltages, active and reactive power flows to Demonstrate the performance of the IPFC model.



Since many process plants controlled by PID controllers have similar dynamics it has been found possible to set satisfactory controller parameters from less plant information than a complete mathematical model. These techniques came about because of the desire to adjust controller parameters in situ with a minimum of effort, and also because of the possible difficulty and poor cost benefit of obtaining mathematical models. The most popular PID techniques were the step reaction curve experiment, and a closed-loop “cycling” experiment under proportional control around the nominal operating point.

## VII. CONCLUSION

The damping performance of the IPFC is evaluated by using the validated IPFC small-signal model. The damping performance is also compared with that of a UPFC. The following results are obtained:

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- 1) The effect of installing an IPFC or UPFC in constant power control mode for the series branch is similar to that of disconnecting the transmission line that contains the series branch; this resulting change in network structure introduces significant changes in the corresponding mode frequencies as well as mode damping.
- 2) With proper selection of the location of the series branch, the resulting network can be made to exhibit improved damping behavior
- 3) The improved dynamic performance is essentially caused by a virtual change of the network structure rather than by the tuning of controller parameters as is the case with most traditional approaches such as the PSS, hence, the feedback damping controller design can usually be avoided.
- 4) It is theoretically possible that poorly damped modes still exist in the changed network; if so; a suitable damping controller can be introduced that modulates the power references of the FACTS device;

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