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A Review: Capability of FACTS Device for Performance Improvement of Power System

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Abstract - This paper present colorful causes of voltage problem stability and how this can be alleviate by integration of power electronics grounded Data technology. Data bias are using since 1970 and till date, because of rapid-fire and accurate corrective action for voltage stability improvement. This composition giving a review of developments of Data technolog and its operation for performance improvement of system. Pundits bandy graces and limitations of multitudinous Data and its integrations in different modes for enhancement of voltage profile at all motorcars. Authors find UPFC is a most protean Data tool because of its capability to control, all three parameters similar as voltage, impedance and phase angle. Authors demonstrate the different models and their capabilities of UPFC and its operation in different condition.

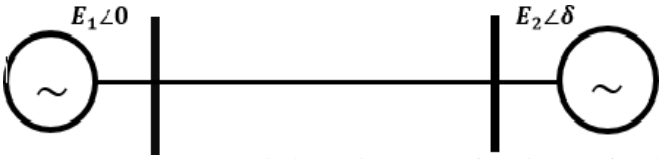
***Key Words*:** optics, photonics, light, lasers, templates, journals

1. INTRODUCTION

Now Now a days the demand on power is more in all sectors. In similar condition the power system stability is the main problem with power players. Numerous types of creators and motors, colorful types of loads, sludge circuits are used in the power sectors which leads to deranging the voltage that induces voltage insecurity in system. Enhancement of voltage stability in power sectors is a major issue for clearing the faults in transmission line.

The transmission line capacity should carrying on advanced limit to find maximum profitable returns for the possessors. Similar situation the system stability neutralize because of overall grid trustability and security.

Voltage stability in the power sector is the major problem where power transfer capability is to ameliorate. Similar cases Shunt and series compensation is used (2-4). Reactive power compensation used to control the active power demand and maintain the voltage to its normal value. Line current should be minimized so that it reduces system losses.



Power transmission is the function of the lineimpedance.However, where as it falls with advanced reactance, If the transmission line having low impedance also the advanced power can be transmitted in transmission line.

$$P = \frac{E_1 E_2}{X} \sin \delta$$

The power system development leads to riseand controlthe power transfer capability in a transmission line (1). The controlling action being performed for achieving the system healthy condition or power quality control analogous as-

1. Power transfer capability increases.
2. Enhancement in voltage control in lines.
3. Enhancement in power system stability.
4. Trust ability of the system bettered. Transmission line lading capacity increases.

The FACTS devices are used for voltage variation in steps to maintain the receiving and sending end voltages within the permissible limit. The advancement in semiconductor technology has a major role to use power electronic devices in power system (2-4).

Number of IEEE standards are written in book '5-8' relates to the modelling issues and the book '9-10' relates the voltage stability problem directly.

Main causes of voltage stability problems

1. The problems due to the improper location of FACTs devices.
2. Problem associated with multiple FACTs devices when their coordination is poor.
3. The higher reactive power consumed by loads.
4. Cases of problems happening in the future, but can't be predicted with certainty.
5. On Load Tap Changer (ONTC) operation in reverse operating event.
6. When load centres are near to voltage sources.
7. The voltage stability is adversely affected due to presents of constant power load in the power system.
8. When reactive power differs in transmission line due to heavy loads.

Taking action about Voltage Instability

1. Placing a series and shunt capacitor in proper position.
2. Proper connections of FACTs Controllers in a transmission line.
3. Proper coordination between all FACTs controllers must happen.

4. Rescheduling each generation unit in the power system.
5. Load shedding should happen for under voltage.
6. In reverse operation of transformer no tap change happening.

2. FACTS Devices

The Problem associated with insecurity in power system can remove or minimizes by the use of Flexible AC Transmission Systems (Data) bias. Similar bias are developed near history and which having stylish controlling device for power system stability in high voltage power transmission. Data regulators' also furnishing operating inflexibility for transmission line in power system. Ameliorate the power system performance for both delivering unit and entering unit.

Data are high speed semiconductor bias that increases power system quality by absorbing or delivering reactive power at light cargo and heavy cargo independently and contemporaneously it can deliver or absorb real power. Main objects of Data bias are growth of the power transfer capability of the transmission lines and provides direct control of power inflow.

Data regulators are working collectively in the power system or with links to another one to control the series impedance, shunt impedance, current, voltage, phase angle, oscillation damping. Data bias maintain the transmission system to be operated hard to its thermal limit without dwindling the system 's thickness. Data regulators also ameliorate the safety and inflexibility in power system. There are two type of technologies available in literature first related to Thyristor-Switched Capacitors and Reactors with Tap Changing Mills and the alternate group is about Gate Turn Off (GTO), Thyristor- Switched Transformers act like Voltage Source Transformers (VSCs). The first fashion is called as Stationary Var Compensator (SVC), Thyristor-Controlled Series Capacitor (TCSC) and Thyristor – Controlled Phase Shifter (TCPS). Secondly, it related to Static Synchronous Compensator (STATCOM), Static Synchronous Series Compensator (SSSC), Unified Power Flow Controller (UPFC) and interline power inflow regulator (IPFC).

Connection ofFACTs bias are vary either in series or in shunt differently combination of both. The SVC and STATCOM are always placed in shunt connection and the TCSC and SSSC are placed in series connection. UPFC is cold-blooded Data device which comprises both connections (series and shunt). These are classified as like

2.1 Series controllers

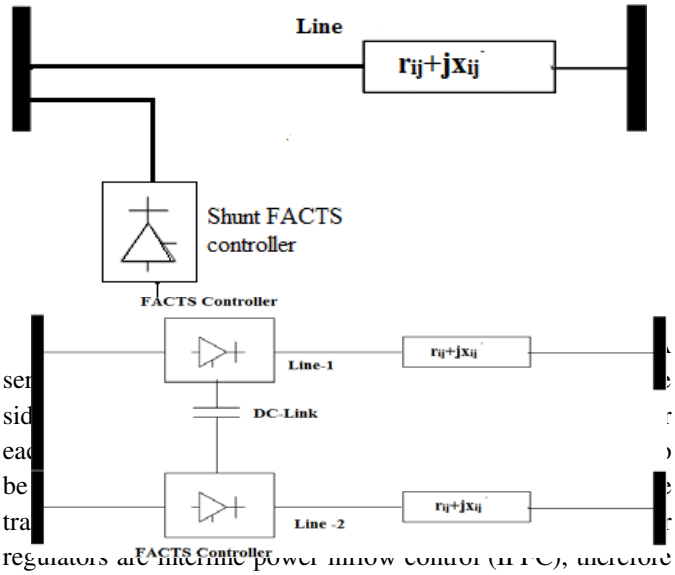
The damping oscillation present in power system are controlled by using series regulator having variable inductive and capacitive impedance. This process is achieving the asked result by installing a suitable voltage phasor in series with the line. The series regulator absorbs or produce the reactive power when line voltage is in quadrature to line current. In other condition the regulator can absorb or produce both real and reactive power. Some of the regulator

Which are used in similar situation are Stationary Synchronous Series Compensator (SSSC), Thyristor- Switched Series Capacitor (TSSC), and Thyristor-Controlled Series Reactor (TCSR).

2.2 Shunt controllers

The functions deviate regulators and series regulators are analogous, but with a difference is that shunt regulator can fit the reactive power into the power system at its location. However, also variation of power injection is doable, If the fitted current and line voltage are in phase quadrature. In other case real power adaptation is carried out. This is possible with the help of similar Data bias, which are as Static Synchronous Generator (SSG), STATCOM (Static Synchronous Compensator), Stationary Var Compensators (SVC)

2.3 Combined Series-Series controllers



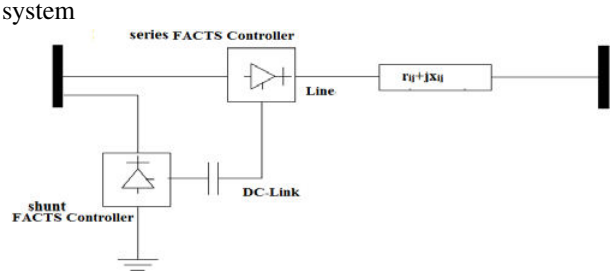
regulators are interline power inflow control (IPFC), therefore real and reactive power flows in the lines contemporaneously.

Operating problem	Corrective action	FACTs controllers
Voltage limits:		
Low voltage during large demand	Delivering reactive power	STATCOM, SVC,
High voltage during low demand	Consume reactive power	STATCOM, SVC, TCR

High voltage due to an outage	Consume reactive power; avoid overload	STATCOM, SVC, TCR
Low voltage due to sudden load	Delivering reactive power; avoid overload	STATCOM, SVC
Thermal limits:		
Transmission circuit overload	Reduce overload	TCSC, SSSC, UPFC, IPC, PS
Tripping of parallel circuits	Limit circuit loading	TCSC, SSSC, UPFC, IPC, PS
Loop flows:		
Parallel line load sharing	Adjust series reactance	IPC, SSSC, UPFC, TCSC, PS
Post fault power flow sharing	Network rearrangement or uses thermal limit actions	IPC, TCSC, SSSC, UPFC, PS
Power flows direction reversal	Phase angle Adjustment	IPC, SSSC, UPFC, PS

2.4 Combined Series-Shunt controllers

A concerted series-shunt regulator are also of two arrangements like former combined series-series regulator. The shunt and series regulators operate in a coordinated manner. The shunt element injects current into the system and series element fit the voltage. The real power can be changed between these shunt and series element of regulators via the power line. Similar regulators are in the order of Unified Power Flow Controller (UPFC) and Thyristor- Controlled Phase- Shifting Motor (TCPST). The series-shunt regulators are more effective and can fit voltage and current without affecting power or current inflow and line voltage control in the system



The use of FACTs (Flexible Alternating Current Transmission Systems) controllers in power system operation

3. INTEREST ON FACTS IN AC TRANSMISSION LINE

The check of the Data bias carried on and complied by two important databases similar as IEEE/ IEE electronic library and wisdom direct electronic databases. The database has been collected after nonstop check for last 19 times from time 1991 to 2009. This time period can be categorised into three sub ages similar as 1991-1998, 1999-2004 and 2005-2009. Each publication bandy different power system including record of each step and its result. Similar recorded information are relatively clear about the operation of Data bias for different power system studies.

The capability of Data bias is to enhance the power system stability as bandied by Noorozian and Anderson in book 22. The analysis of damping of power system, electromechanical oscillation analysis grounded upon Data bias is written by Wang and Swift in book 29. It describes about the damping necklace related to Data bias. Colorful points of studies and exploration are taken about FACTS bias with the use of simulation and results are collected.

4. APPLICATION OF FACTS DEVICES

By By the time 1970 thyristor was well developed and used for operation of high voltage operation. Ultramodern Stationary Var Compensators (SVCs) were developed using thyristor. In addition thyristor controlled/ switched series capacitors (TCSCs/ TSSCs) and thyristor controlled phase shifter controllers (TCPSs) were also developed the principle of thyristor grounded switching regulators are unresistant factors used for enhance its geste where compensation demand is levelling sluggishly. Different number of reports are published for analysis of the Data bias effect on power systems similar as SVC, TCSC and TCPS.

A Phillips Heffron model is developed by Wang and nippy for the enhancement of SVC/ TCSC/ TCPS in power system. In this model the damping necklace measure is used. The effect of damping with different lading condition in Data bias is analysed by Abido and Abdel-Magid. This model is enhancing the power stability by the effectiveness of PSS and FACTS bias. The Eigen grounded ideal function is used in this model for development of system damping. The model optimum stability parameter finds out from GA hunt system. The scientistE.W. Kimbark refocused out that shunt capacitor should be used at the midpoint of transmission line for voltage compensation and midpoint is an optimum point for a transmission line. In this condition doubly of the normal power can be transmitted through the compensation line. Numerous types of controlling bias are used in transmission line similar as Thyristor-Controlled Series Capacitor (TCSC) and Thyristor – Controlled Phase Shifter (TCPS). Secondly, related to Static Synchronous Compensator (STATCOM), Static Synchronous

.Series Compensator (SSSC), Unified Power Flow Controller (UPFC) and interline power inflow regulator (IPFC). We can use this in PWM asynchronous DC line Thyristor-Controlled Series Capacitor (TCSC) are used for control action (23-28).

Ideal of installing SVC is to increase operation effectiveness, ameliorate service quality and insure a certain security position. The SVC is planned to an optimisation problem where two stage optimization system is used for similar system and simulated annealing (SA) is used to break placement position, in large power system (30-31). Var compensation is used for system planning and the attention is concentrated upon the losses voltage divagation and expenditure.

The simplest styles used for Svc planning on model analysis is to define operating point should define in power system. The Eigenvalue analysis with a system Jacobean matrix can be used for the identification of motorcars where voltage collapse do.

The SVC shunt compensation element is designed for voltage compensation in power system. Similar bias are TCSC. Flash stability and damping performance in the power system can be bettered for the below case (32-33). STATCOM/ STATCON and ASVC/ ASVG are used for reactive power compensation in numerous rotating machines. A STATCOM with an energy storing device can control both active and reactive power to gain flexible power system operation. This composition deals with the position of a shunt Data device to ameliorate flash stability in long transmission line and to determine power inflow.

Two types of reactive power compensator are used in power system similar as SVC and STATCOM. The performance of STATCOM is better than SVC in view of nonstop controllability and response time (34). Real time and off line simulation tool and three simulation system available in PSB for effective fashion used for analysis of complex control system in Data bias.

Dynamic performance Enhancement in power system by using a UPFC is mentioned in the composition (35-40). The effect of Data bias with series compensation is essential to ameliorate the dynamic performance of the power system. This can be achieved by connecting UPFC with different modes of operation as like impedance control mode, vertical Vertical voltage control with series motor is most simple and practical mode of operation of a UPFC. Small disturbances in power system can be bettered by damping and large disturbances bang- bang control is demanded.

5. IMPLEMENTATION OF FACTS TECHNOLOLGY

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The check of the Data bias carried on and complied by two important databases similar as IEEE/ IEE electronic library and wisdom direct electronic databases. The database has been collected after nonstop check for last 19 times from time 1991 to 2009. This time period can be distributed into three sub ages similar as 1991-1998, 1999-2004 and 2005-2009. Each publication bandy different power system including record of each step and its result. Similar recorded information are relatively clear about the operation of Data bias for different power system studies.

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6. UPFC MODELLING

UPFC is most complex and protean Data bias which is a combination of STATCOM and SSSC (1). These outfit are control the introductory power station variables similar as transmission voltage, impedance and phase angle. UPFC contains two voltage source inverter connected with a DC link and the coupled motor is connected to the power system.

The series motor coupled with the ac system through a motor provides the main action. The control of real or reactive power inflow in the transmission line by fitting AC voltage with proper magnitude and phase angle control. Alternate shunt motor motor can induce or absorb reactive power and deliver shunt reactive compensation to control machine voltage at a specified value. DC link is used to change the active power between the two transformers (51-52).

7. OPERATING MODES OF UPFC

1. Shunt inverter

It's operated to draw a controlled current from the line. One element of current balance the real power of the series inverter automatically and the other reactive element of power is set the asked position of inverter capability.

- Var control mode

To control reactive power a reference input is made which is inductive and capacitive as per VAR demand. The shunt motor control interprets the reference input signal into a shunt current request and adjusts the motor to maintain the current limit in the circuit. The unrestricted circle arrangement uses a current feedback signal to achieve the affair current of the shunt motor. Power Data IS known by mode of operation where feedback dc signal is present to guard it.

- Automatic voltage control mode

The shunt motor reactive current automatically controls the transmission line voltage to a asked value at the point of connection with respect to droop characteristics. Droop FACTS defines the per unit voltage errorw.r.t. per unit reactive Motor current at its being state. The positive sequence element of machine voltage is generally used for voltage feedback signal for automatic voltage control.

2. Series inverter

Series inverter controls the magnitude and angle of the voltage of the transmission line. The inflow of power on the line is directly commensurable to the voltage injection.

- Direct voltage injection mode

The series motor generates the voltage vector (VS). Where its magnitude and phase angle are calculated grounded on input. Special functional operations are used in this case. The magnitude control is grounded upon the fitted voltage vector (VS) which is in phase of system voltage or in quadrature with it.

- Line impedance emulation mode

The magnitude of the fitted voltage vector, VS is maintained in agreement with the magnitude of the line current. The impedance is taken as reference input and generally is a complex amounts as combination of resistance and reactance. Special case of impedance compensation is resorted when the fitted voltage is quadrature with the line current. This operating mode elect the mode of matched series capacitive line compensation.

- Automatic power flow control mode

The input power plays major part to maintain the value of P and Q in transmission line although the system changes. The magnitude and phase angle of fitted vector VS is controlled and it forces the line current vector that to maintain real and reactive power inflow in the line. The series fitted voltage induce automatically and closed circle control system action takes place. It'll manage the suitable P and Q despite power system changes. In this situation the UPFC is used with transmission line as a high impedance power source or Gomorrah.

- Stand-alone mode

The UPFC offers shunt and series transformers singly which can operate by decoupling their common DC line and unyoking the capacitor bank. In this case the shunt motor operates as like STATCOM and series motor as like SSSC. The reactive power sphere is doable when the two transformers are standalone mode. In this case none of motor is able to absorb or induce real power also reactive power sphere is only possible. The fitted voltage controls reactive voltage compensation in power system for power inflow control.

8. UPFC MODEL:

The basic electrical model of UPFC is as shown in figure:

Fig.3.2 Electrical model of UPFC

The below fig. represents a lossless UPFC- bedded transmission line. The line connects knot m and k as shown over. The affair of the series voltage source Vs and θs are controllable magnitude and angle between the limits Vsmin ≤ Vs ≤ Vsmaxand 0 ≤ θs ≤ 2π independently and the shunt branch is original to an ideal current sourceIsh. The variable I sh of shunt current source also is controllable within Ish ≤ IshN, IshN is current capacity limit of shunt motor. Ish is perished into two factors It and Iq, which are independently the real and imaginary controllable factors of ideal shunt current source. It, in- phase factors with respect to Vm, is determined by active power of shunt motor swapping with the system and the loss of UPFC. Command is in quadrature factors with respect toVm, which provides independent shunt reactive compensation to maintain machine voltage position where the UPFC is installed (21, 22). Assuming lossless motor values, the active power absorbed from the system by shunt motor is equal to that fitted into transmission lines by series motor supplied to the shunt motor

$$V_m I_T = \mathrm{Re}[\bar{V}_S \bar{I} * r_k] \qquad (1)$$

This constraint equation shows that the overall active power exchange between the UPFC and the AC system come zero. So the active power Prk is equal to the Pmk on the transmission line. Still, the steady- state model of UPFC are classified into two main orders severed model and coupled model.

9. CONCLUSIONS

The The Research work is going on the Data regulators' implicit to ameliorate the system stability. Considering rapid-fire electric power demand. The FACTS regulator are used in power systems for its trustability and advanced technology. It improves the functional inflexibility and controllability in power system with considering colorful power system limits. It gives most effective result. The Data also used for better application of being transmission coffers. After review of exploration literatures about the Data bias, it can be said that these are most accessible device for working the voltage stability problem in the power system. Author's check papers of supereminent experimenters for analysis of Data bias in present and once. The decision of the voltage enhancement by Data regulators in complex power system networks are technically suitable and feasible.

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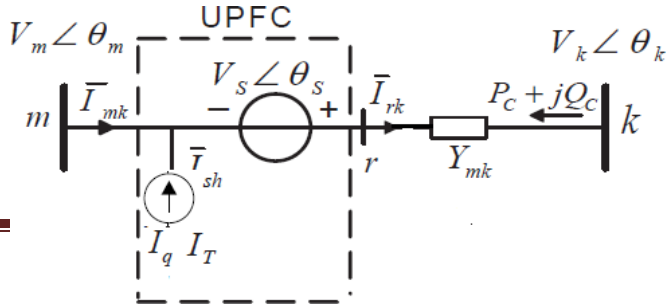

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