Role of UPFC in Power Transmission Line

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Abstract. In this work, the optimal placement and parameters of UPFC in Electrical Power transmission Systems is calculated. The FACTS are combination of controlled devices to increase reliability & stability of power networks. The flexible transmission devices are located in more places the working of parameters like impedance, voltage, and phase angle can improved. FACTS devices gives transmission system flexibility improvement through better new utilization of facilities like more system reliability, improved dynamic and transient stability and also power supply quality increased. Flexible transmission systems can be connected shunt or series with power line and also like shunt –series combination. To compensate voltage drops and controlling of voltage the series compensation and for current control the shunt compensation is provided in power transmission. Further, to minimize the losses and enhancement of load ability and voltage stability, the UPFC is used in power system and it is an advanced device of FACTS group. The presented system is simulated by MATLAB/Simulink for the verification of the performance of the technique.

Keywords: FACTS, UPFC, shunt compensation, series compensation, stability and power quality

1. Introduction:

FACTS gives new solutions as effective changes to modern transmission line. The FACTS devices are used now gives the uses of HVDC opportunities and challenges [4]. Hence it become the very key role alternatives to overcome the power networks inflexible condition and the gives growing power demand as construction of new high voltage dc transmission lines the Static Compensator which is shunt connected line with the series connected line SSSC via their common dc Link & shows in the UPFC, which will gives the advantages of both components and hence get a more result.
The FACTS family, The UPFC has many control [1] parameters as similar with the other FACTS devices, it can modify a lot of system parameters during its working, make more flexible the system, hence it is high valued. The optimal placement gives a use of UPFC in the dynamics charging of its simulation of DC link capacitor then simulated on a power network with dynamic model of UPFC, and the results of simulation checked that the unified power floe controller device can modify transient stability [2] of power system in good manner This optimal placement shows a exact analysis of a power system using UPFC.

The implementation of flexible transmission systems is show in Fig. 1 gives a functional control of an AC power networks between interconnection .The two power networks transmit the real power between the end points is shown by expression ,the net reactance of the transmission (x), and also it as difference between phase angle of both systems. Power flow relation shown in Fig.1 shows that the power transmission is given by following parameters: impedance offered, potential, and difference of phase angle. FACTS devices can gives one or more of these parameters, and there by load flow influence. Upfc is familiar with for control power flow, improved reliability and control of voltage in power systems .

![Figure 1: Power flow control in ac power system](image)

2. Unified Power Flow Controller:
The UPFC as of two VSCS that are in dc capacitor back-to-back connection [Fig.2] It injects an series AC voltage into the line and gives the injected voltage of power flow by the amplitude and phase is controlled. To control the inter pole a set of synchronous voltages series inverter is used. The real and reactive power exchange with the line is given by series inverter .i.e The reactive power is gives the series inverter, and the true power is transmitted to the terminals of dc . The shunt inverter is functioned as to serve dc power from the line, gives the voltage to dc bus hence absorbed total real power from the transmission line and their transformers .The other capacity is gives reactive current exchange of line by shunt inverter.
The shunt inverter is functioned as to gives a current control from the line automatically. One component of this current found by the necessity to equate the series inverter true power. The other component of current is reactive and can be given desired inductive or capacitive reference level within inverter capability. The reactive compensation necessity modes of the shunt inverter are same to those used on modern static VAR compensators.

3. **Configuration of Upfc in transmission line**:

Assume the line is transferring power to an infinite bus from a large generating station and connected center with series capacitor and a shunt device at other point as shown in figure. The value $k$ is gives the percentage of length of line placing of upfc device [5]. The devices like STATCOM or UPFC and are generally connected to line via low voltage transformer. The transmission line is divided into 2 parts, and part 2 is again sectioned in sub modules $[(0.5-k)$ of length & half-line length as given in figure 3. It as rating of the shunt fact device is necessity to give sufficient reactive power to keep a magnitude of stationary voltage $m$ th bus and real power is not absorbed or given by the device.
The sufficient placing of the shunt FACTS device is not permanent for uncompensated lines [4] because it changes with the change in position of series compensation. The change in the placing of the shunt fact device from the middle point of line depends upon the series compensation position, more linear from the middle point of the line into the alternator side series compensation position of (%S) more. If by placing the shunt facts device power transmission handling capacity and good system operation can be changed much more at the another place of mid-point of the line optimal location.

4. Simulation results:
Calculation of sufficient location of flexible upfc devices in power line in Simulation is given by Figure.3 The operation of this circuit shown in figure

![Simulation Circuit](image)

**Figure 4**: Transmission line with UPFC connected in series & shunt to the line

When varying the capacitance value which we represent as %S which is connected in the mid point of the circuit shown in figure.4 for variation of maximum power at the receiving end.

![Power Deviation](image)

**Figure 4.1**: Deviation in receiving end power for different parameters of %S.
5. Conclusion:
This workout gives the necessary parameters placed and upfc in area of power system networks. The upfc is important fact devices to control quantities of system. As flexible devices like shunt as advantages for measuring voltage of transmission, load flow, decreasing losses, and system oscillations for more energy dispatch levels. Optimal placement of shunt FACTS device of series compensation gives highest possible benefit is implemented. The output shows the location of FACTS devices gives the variation in the position of series compensation. This literature survey gives that the upfc devices are much important for finding the power system problem.

6. Future Scope:
FACTS devices are very costly and idea regarding their application gives to include these costs. The taken model gives results for only single operative condition and does not include such analysis and for one point in time. Hence different difficult methods can be taken for an extension work.
7. References

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