POWER FLOW WITH FLEXIBLE ALTERNATING CURRENT TRANSMISSION SYSTEMS (FACTS) CONTROLLER

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ABSTRACT

FACTS controllers are used to improve power system performance. These controllers be able to reduce electrical disturbances, modified the flow of power and absorb or provide reactive power support. It increases every types of stability of the system. FACTS controllers provide quick and consistent control over the three main transmission parameters, i.e. magnitude of voltage, angle of phase and impedance of line.

Keywords: *Facts controller, power flow.*

1.Introduction

It gives nodal voltages phase angle that power injection at all buses and interconnected power lines. Power flow solution is essential for designing, planning and restructuring of a new power system according to the load demand. It requires calculation of load flow under normal, abnormal conditions and transient behavior of the system during operation.

The buses are classified as load bus, generator bus and slack or swing bus. At load bus real and reactive powers are specified where as voltage magnitude and phase angle through the load solution determined. At generator bus, voltage magnitude and real power of generations are specified where as reactive power generation and phase angle of bus voltage has to required. In slack bus voltage magnitude and phase angle are specified whereas real and reactive power are obtained through the power flow solutions. The power flow problem give relationship between voltages, powers and reactive volt amperes that will be mathematically formulated and flow of power will be found out at all lines of network. The power flow equations are nonlinear and solved by iterative methods. The Newton-Raphson power flow solution is favored compared to other as it has more efficient, solve the practical problem, less computation time and convergence characteristics are very fast.

FACTS controllers help to taper the gap between the no controlled and the controlled power system mode of operation, by providing voltages at best locations of the network and degrees of liberty to control flows of power (Hingorani and Gyugyi, 2000).

It is necessary to power engineers to promote majority of the analysis tools on rely to plan and to operate their systems (IEEE/CIGRE, 1995).

Solutions of power flow are most likely the large amount accepted type of computer-based calculations approved by planning and process engineers. The proficient and logical way to learn models and methods for the demonstration of FACTS controllers in power flow studies. The algorithm for power flow studies are as follows.

1. Initial values of bus voltage and phase angle. $|V_x|$ and δ_x for i=2,3….n
2. Calculate active and reactive power at each load bus

$$P_x = \sum_{k=1}^{n}(VxVk\,Yxk\,Cos(\delta x - \delta k - \theta xk)$$

$$Q_y = \sum_{k=1}^{n}(VxVk\,Yxk\,Sin(\delta x - \delta k - \theta xk)$$

Calculate schedule errors

$$\Delta P^{(r)}_x = P_{xsp} - P^{(r)}_{x(cal)} \qquad i = 2,3,\ldots.n$$

$$\Delta Q^{(r)}_y = Q_{xsp} - Q^{(r)}_{y(cal)}$$

Obtain δ and Δ|V| by Jacobian matrix

$$\begin{bmatrix} \Delta Px \\ \Delta Q \end{bmatrix} = \begin{bmatrix} H & N \\ M & L \end{bmatrix} \begin{bmatrix} \Delta\delta \\ \frac{\Delta V}{V} \end{bmatrix}$$

Modify δ and $\Delta|V_x|$

$$|V_x^{(r+1)}| = |V_x^{(r)}| + \Delta|V_x^{(r)}|$$

$$|\delta_x^{(r+1)}| = \delta_x^{(r)} + \Delta\,\delta_x^{(r)}$$

3. Continue until schedule errors for all load buses are within a tolerance ΔP and ΔQ < ε.
4. Calculate the power flows.

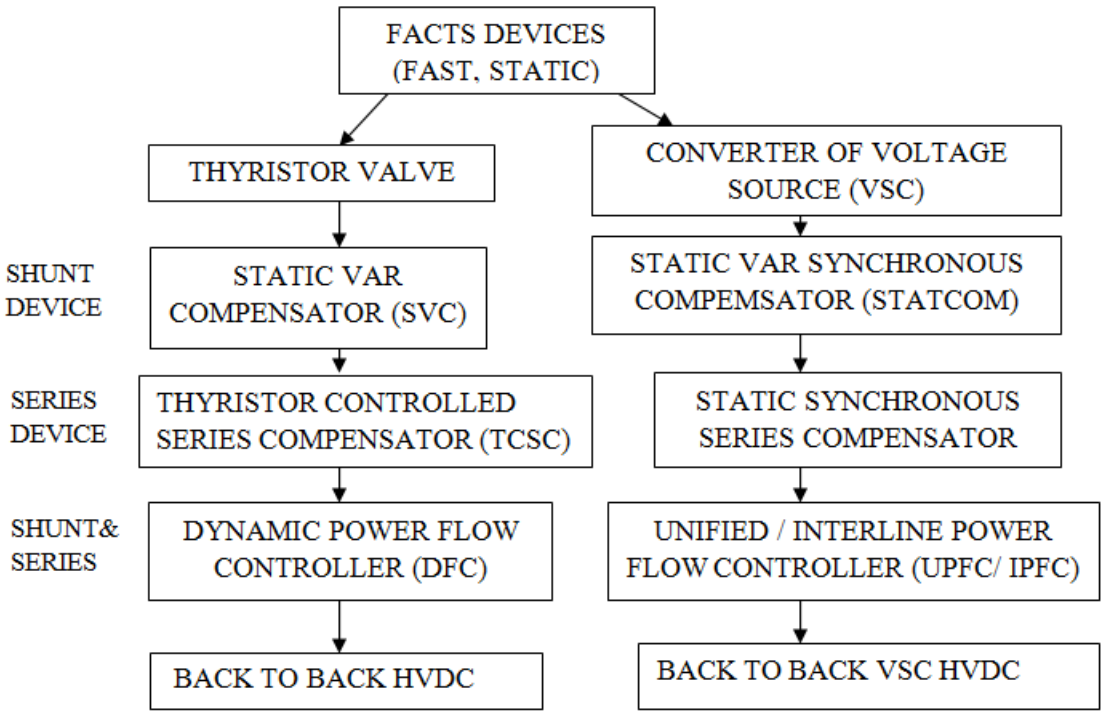

Figure 1: Overview of major FACTS devices

The overview of major FACTS devices are as shown in fig.1. The static var compensator (SVC) and static synchronous compensator (STATCOM) are shunt connected device while Thyristor Controlled Series Compensators (TCSC) is a series connected FACTS controller.

All FACTS controller are speed switching capability provides a mechanism for controlling line power flow, which permits better loading of existing transmission lines, and allows for rapid readjustment of line power flow in response to various contingencies.

In purpose of using FCATS controller in power flow studies is to minimize power losses, and to improve the voltage magnitude profile. The SVC is placed at various load buses at favorable location to satisfy the objective.

2.Simulation & Results

In this paper two cases are taken. In first case run power flow algorithm without FACTS devices and in second case run power flow data with FACTS devices. These two cases are considered for any IEEE bus system such as 14, 30 or 57 bus system.

The simulation results of voltage profile without FACTS devices is shown in figure 2.0 below**.**

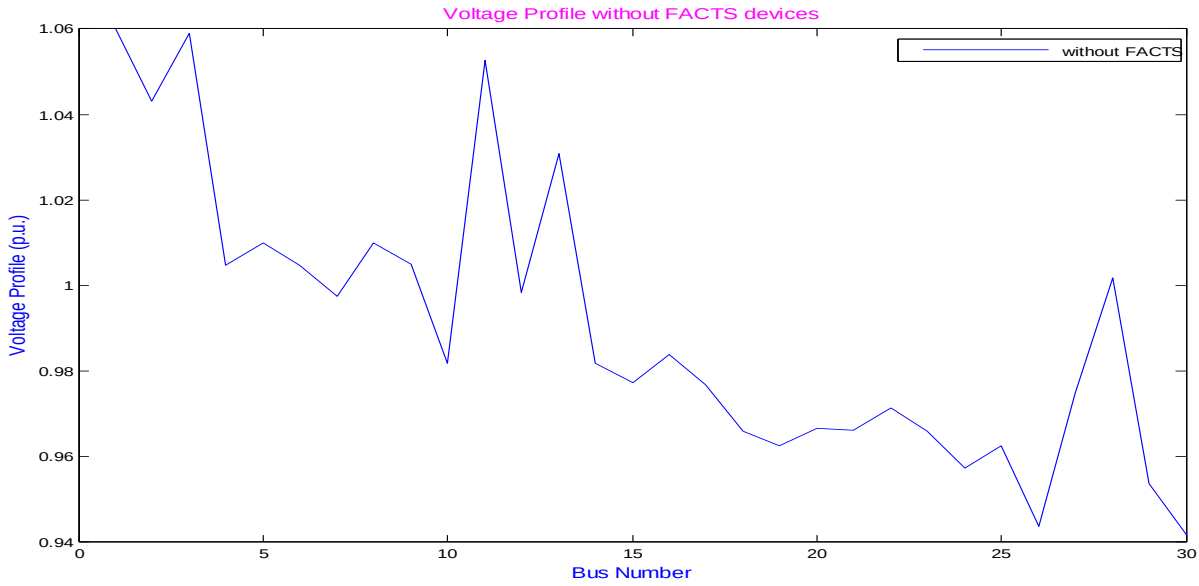

Figure 2.0 Voltage profile without FACTS devices in power flow solutions

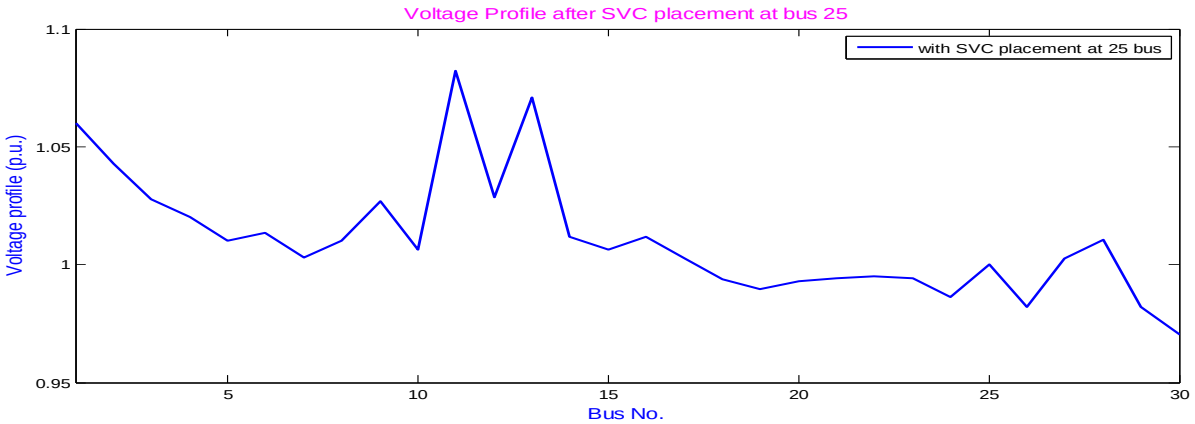

Figure 2.1: Voltage profile after SVC placement in IEEE bus system

The Voltage profile after SVC placement in power flow with IEEE bus system is shown in Fig. 2.1 above.

The Voltage profile after STATCOM placement at IEEE bus system is shown in Fig.2.2 and the comparison of real power loss savings is shown in Fig.2.3.

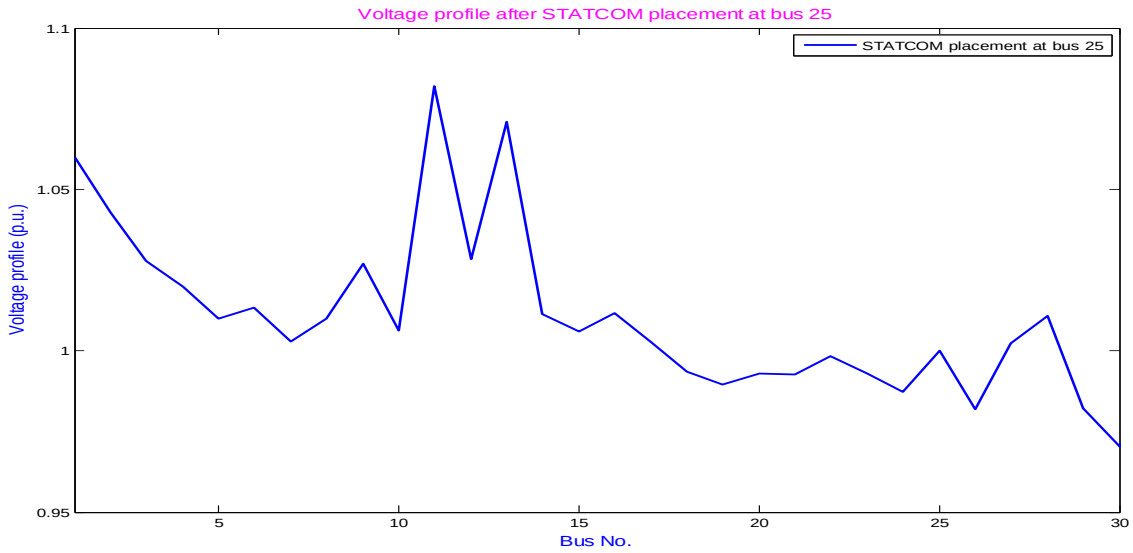

Figure 2.2: Voltage profile after STATCOM placement in IEEE bus system

On comparison of result obtained in power flow between Fig.2 (without FACTS controller) and then power flow with FACTS controller in Fig 2.2 and in Fig 2.3. It can be observed form Fig 2.2 and 2.3 that when FACTS controller are employ in power flow its performance are improved and it provides better voltage magnitude and hence we can say that losses are considerably reduced in transmission line with the help of FACTS controller.

3.Conclusion

Power flow solution with FACTS controller is important technique for designing, scheduling and reformation of a new power system according to the load demand. Its studies provide a reasonable mathematical move toward for the purpose of a variety of bus voltagesower flows through different branches under stable state condition. The usefulness of the FACTS devices for dropping the power losses in power system is invented. Iin the direction of the achievement of the proposed methods, standard test system IEEE bus system is used for simulation study work.

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