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A BRIEF REVIEW OF APPROACH THE ROLE OF FACTS DEVICES

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Abstract: The conventional method of power generation is the main source of power today. With the changes in modern electronics, the uses of alternative power generation options become more and more viable. The FACTS devices have shown performance and provide solutions for some limitations of the alternating current transmission systems.

Keywords: Static Var Compensator, power flow, system security.

1. INTRODUCTION

Due to environmental restrictions and distributed resources, some transmissions lines are very loaded and the power system becomes a power transfer-limiting factor as the modern power system networks are operating under stress conditions. FACTS devices are designed to overcome the limitations of the present mechanically controlled power systems and enhance power system stability by using reliable and high-speed electronic devices [1], [10].

FACTS devices have been developed for solving power system steady control, improving power system stability and power flow control. greenhouse gases [9].

2. FACTS INSTALLATION PURPOSE

The controllability of the electromechanical mode with different FACTS devices is in dependence with critical clearing time (as CCT is defined as the maximum *time* that is allowed to remove the disturbance without interrupting the system's performance). The literature is showing that STATCOM is performing better than SVC and TCSC is more efficient that shunt controllers for controllability of the power flow in the line [3].

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The robustness of the stabilizers to the variations of power system operation conditions it is very important factor [2]. Also, FACTS devices will provide some benefits at high levels of reliability as balancing the power flow in parallel networks over an operating condition (unwanted loop, flow, power oscillations and rising the power-transfer capacity of existing transmission ways).

3. THE CORRELATION BETWEEN FACTS CONVERTERS EVOLUTION

The main characteristic of FACTS controllers and their potential is concerning to enhance system stability. In the last twenty years, the energy engineering has developed modern algorithms for solving the optimum of power flow problem FACTS devices. Some models are used as controllable impedance for power flow studies included thyristor-controlled FACTS devices as [3], [12]:

SVC – Static Var Compensator (figure 1) can improve the dynamic stability performance of power system as to improve the transient stability of a synchronous machine.

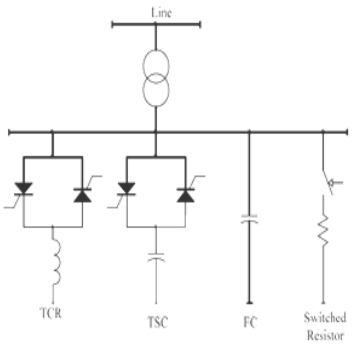

Fig.1 Simplified SVC scheme

TCSC – Thyristor Controlled Series Capacitor (figure 2) works like an impedance type series compensator and used to improve the steady state capacity and to decrease the overvoltage. It can maintain compensating voltage with decreasing line current over control range determined by the current boosting capability of the thyristor-controlled reactor [5]. TCSC cannot exchange real power with the transmission line and can only exchange reactive power.

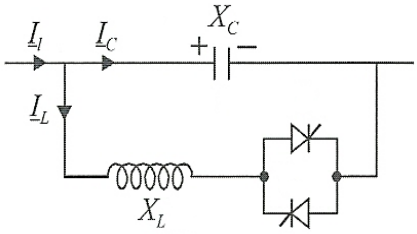

Fig.2 The simplified structure of TCSC module

TCPS – Thyristor Controlled Phase Shifter (figure 3) - A two-region interconnected power system consists of two independent power networks, each having production units and loads, connected together through a transmission line, and the TCPS controller provides efficient damping of low frequency oscillations and improves greatly the voltage profile of the system under severe disturbances.

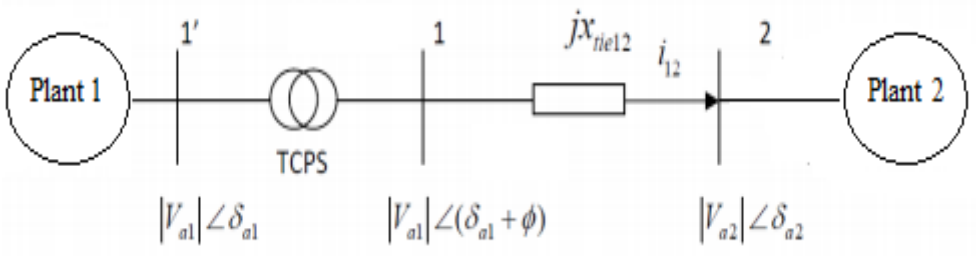

Fig.3 The simplified scheme of TCPS

Several FACTS devices are working as controllable sources as [4], [6]:
VSC – voltage sources converters (figure 4);

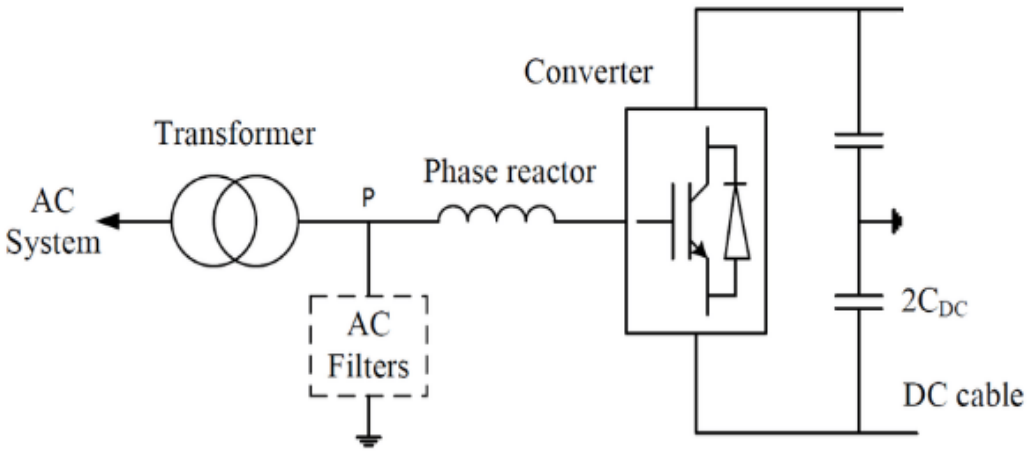

Fig.4 Scheme of VSC converter

SSSC – Static Synchronous Series Compensator (figure5) is a voltage source inverter type series compensator and is capable of internally generating a controllable compensating voltage over identical inductive and capacitive range independently of the magnitude of the line current; applied to different power system has the role to improve the system stability performance and to control the line flow, as well as for the injection of reactive power for the scope of keeping the efficient ratio X/R high independency of the degree of series compensation.

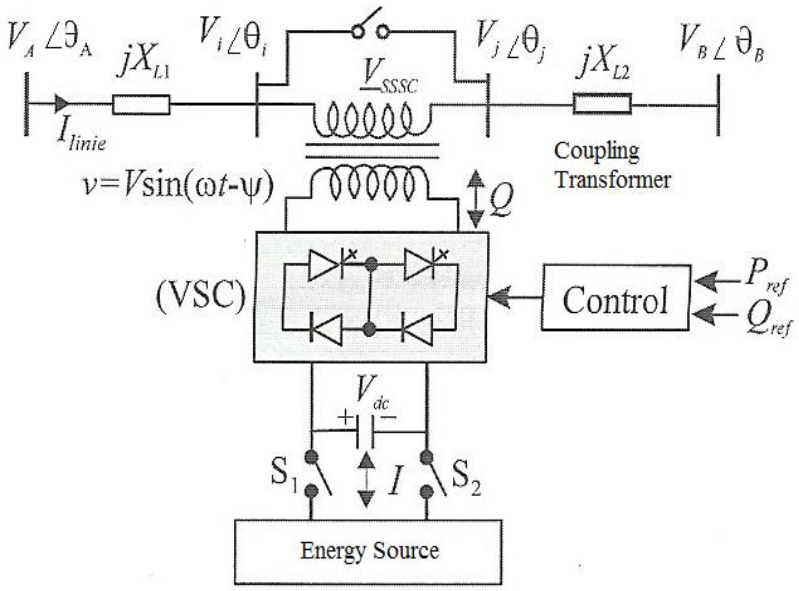

Fig.5 SSSC scheme

Maintaining the synchronous operation of parallel generators represent the problem of stability. This problem is represented by rotor angle of stability. Voltage instability appears in the form of progressive deteriorate in voltage magnitude at some busses. Voltage collapse is the process where the sequence of events is leading to a blackout or anomaly low voltages in a part of power system of the same time with voltage instability [11].

UPFC- Unified Power Flow Controller (figure 6) is the most improving device between FACTS devices due to the capability to control the three parameters as the bus voltage, transmission line reactance and phase angle between two busses simultaneously.

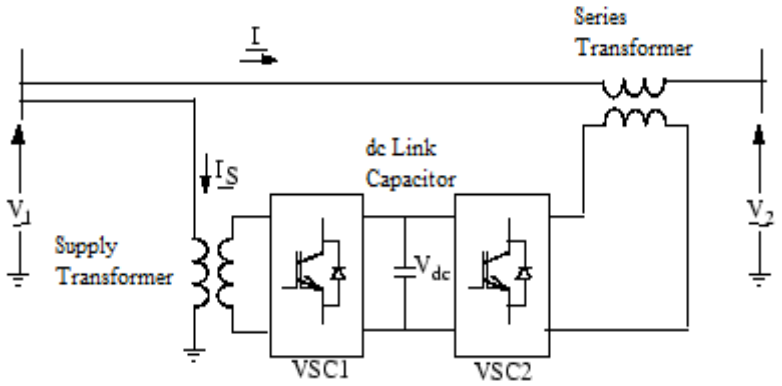

Fig.6 Common Scheme of UPFC

IPFC – Interline Power Flow Controller (figure 7) is a powerful device which can provide the power flow control of multiple transmission lines.

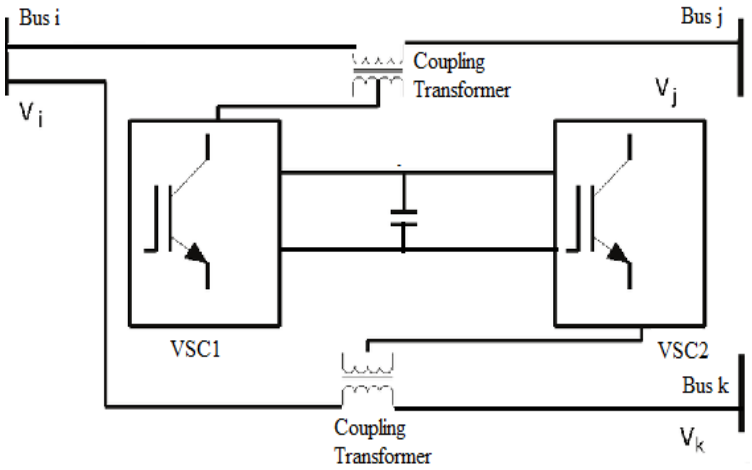

Fig.7 Scheme of IPFC

STATCOM – Static Synchronous Compensator (figure 8), has developed technology for competitive the conventional Static VAR Compensator. Going from the control of power system voltage and the stability of power system dynamic, the STATCOM presents better damping characteristics than SVC due to the capacity to exchange active power with the system [7],[8].

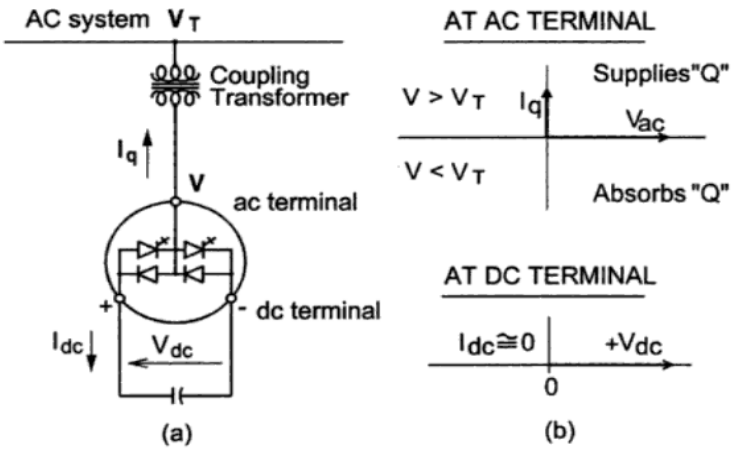

Fig.8 a) synchronous voltage source operate as STATCOM
b) steady state power exchange diagram

These groups of controllers are performing different.

4. CONCLUSIONS

The paper is showing the performance comparison of different FACTS devices due to the electricity demand is increasing nowadays in the same time with enhancing power transmission networks. It is created the environment for forces of competition and bargaining due to open market of electricity and deregulation. For maintaining the system security and serving more loads through their networks, the electricity companies are being to use FACTS devices as an alternative to reduce the flows in heavily loaded lines, resulting in raised loading, decreased system loss, enhanced stability of the grid, reduced cost of production and fulfilled of the grid, reduced cost of production and fulfilled some requirements to control the power flow network.

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