

ANALYSIS AND COMPARISON OF VARIOUS FACTS DEVICES

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Abstract-*This paper provides various applications and comparison of facts devices. Facts devices are basically used in transmission lines to regulate the reactive power balance in the transmission network. Facts devices can be classified on the basis of their control strategy either as series or shunt compensators. In this paper a brief description about various facts devices is given.*

Keywords:-*Facts devices, Shunt and Series Compensation.*

I. INTRODUCTION

Due to increasing demands of power the losses in the system is also get increased and the efficiency of the whole network is getting decreased. In order to improve the transmission capability of the network various measures are being taken. One of the vast applications is of FACTS devices that are being used in the power system network to decrease the imbalance in reactive power.

Facts devices are basically defined as one of the power electronic based system and other static device that provide control for many Ac system parameters. FACTS stand for Flexible AC Transmission System that basically incorporate power electronic devices to enhance the transmission capability of the power system.

FACTS devices has provide an traditional solutions for upgrading the transmission system into advanced system which comprises of new transmission lines, substations and various equipments associated with it. Different techniques and various ways are being provided to enhance the working and performance of transmission line using FACTS devices [3].

II. CLASSIFICATION OF FACTS DEVICES

In power system basically there are only four types of FACTS Controller Devices that are mostly used. They can be classified as:-

- Series Controller
- Shunt Controller

- Combined Series-Series Controller
- Combined Series-Shunt Controller

Advanced Facts devices like hybrid facts

Controllers are also being used. In order to enhance the performance of the line the location of the controllers device [8].FACTS technologies are used for improved dynamic and transmission grid stability by limiting the loading of the transmission lines. Also it balances the active power in the system by balancing the reactive power in the system.

The FACTS devices can be further classified on the basis of power electronic device used in controlling are:-

- Variable Impedance Type
- Voltage Source Converter

The VSC based controllers have certain advantage over the Variable Impedance Type controllers. The VSC based controllers are compact in design than the variable impedance controller. The only drawback of the VSC based is that it requires a self commutating circuit which consist of various power electronics devices that requires gate pulses for its operation. The Variable Impedance Type controller comprises of:-

- Static Var Compensator (SVC)
- Thyristor Controlled Series Capacitor or Compensator (TCSC)
- Thyristor Controlled Phase Shifting Transformer (TCPST)

The Voltage Source Controllers can be classified as follows:-

- Static Synchronous Compensator (STATCOM)
- Static Synchronous Series Compensator (SSSC)

- Interline Power Flow Controller (IPFC)
 - Unified Power Flow Controller (UPFC)
- Some Special Purpose FACTS devices that are listed as below:-
- Thyristor Controlled Braking Resistor (TCBR)
 - Thyristor Controlled Voltage Limiter (TCVL)
 - Thyristor Controlled Voltage Regulator (TCVR)
 - Interphase Power Controller (IPC)

Some of the above mentioned FACTS devices can be explained briefly:-

➤ Static Var Compensator (SVC)

It is basically a first generation Facts device. It consists of variable impedance device, where the control is done by back to back connected thyristors using current control technique. SVC are basically used for the load compensation of fast changing loads. There are basically two types of SVC- Fixed Capacitor-Thyristor Controlled Reactor and Thyristor Switched Capacitor- Thyristor Controlled Reactor.

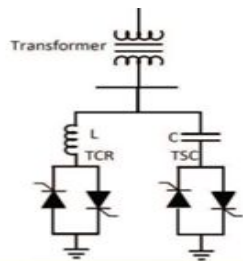


Fig.1 Static VAR Compensator

➤ Thyristor Controlled Series Capacitor (TCSC)

It basically consists of a series capacitor bank which is connected in parallel with the Thyristor Control Reactor. It can be used as an alternative of SSSC.

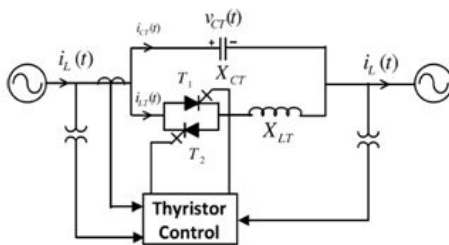


Fig.2 Thyristor Controlled Series Capacitor

➤ Thyristor Controlled Phase Shifting Transformer (TCPST)

In order to provide a rapidly changing phase angle a phase shifting transformer controlled by thyristor switches are being used. It has been used in order to increase the transient and dynamic stability of the power system.

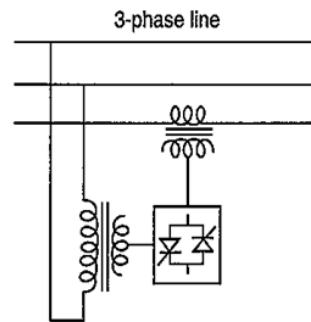


Fig.3. Thyristor Controlled Phase Shifting Transformer

➤ Static Synchronous Compensator (STATCOM)

In STATCOM Voltage Source converter is used in place of reactors and the switched capacitors. There are various advantages of STATCOM as compared with SVCs. It provides a faster response and also it requires less space.

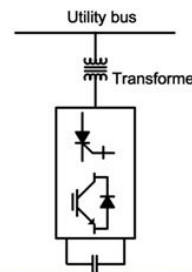


Fig.4 Static Synchronous Compensator

➤ Static Synchronous Series Compensator (SSSC)

This is basically a voltage source device. This series connected device injects a series voltage in series with the device. It consists of voltage source inverter and a coupling transformer.

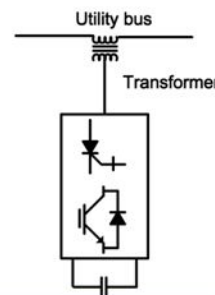


Fig5. Static Synchronous Series Compensator

➤ Unified Power Flow Controller (UPFC)

It is one of the most versatile facts device. It consists of two VSC controller one series connected and the other shunt connected. Basically it is a combination of STATCOM and SSSC. It provides series as well as shunt control in the power system.

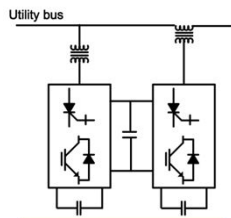


Fig 5 Unified Power Flow Controller

These above discussed Facts devices are those which are mostly used in the power system in order to enhance and for improving the voltage and current profile of the system which automatically increases the power transmission capability of the system. The comparison of various Facts devices can be explained by the table as shown below:-

S.NO	CONTROLLER	VOLTA GE CONTR OL	TRANSI ENT STABILIT Y	DAMPING POWER COMPEN SATION	REACTIVE POWER COMPENS ATION	POWER FLOW CONTR OL	SSR	POWER ANGLE CONTROL	SYSTEM IMPEDANC E CONTROL
1	BESS	✓		✓					✓
2	SMES		✓	✓					
3	SSSC	✓	✓	✓	✓	✓			✓
4	STATCOM	✓	✓	✓	✓				✓
5	SVC	✓	✓	✓	✓				✓
6	TCPST		✓	✓		✓	✓	✓	
7	TCSC	✓	✓	✓		✓			✓
8	TSBR		✓	✓			✓		
9	TSSC	✓	✓	✓		✓			
10	UPFC	✓	✓	✓	✓	✓	✓	✓	✓
11	IPFC	✓	✓	✓	✓	✓	✓		✓
12	DTSC	✓	✓	✓	✓	✓	✓		✓
13	DPFC	✓	✓	✓	✓	✓	✓	✓	✓
14	DSSC	✓	✓	✓	✓	✓	✓		✓

Table1. Comparison table of various Facts devices

III. CONCLUSION

Facts devices are used for flexible transmission of power and this could be possible by using various facts devices as per the requirement of the system. These devices provide series and shunt compensation or both which balances the reactive power in the system, hence balancing the power transmission in the system.

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