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FUNCTIONS OF FACTS DEVICES WITH INNOVATION TECHNOLOGY IN THE ELECTRICAL ENERGY SYSTEM

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АННОТАЦИЯ

В управлении электроэнергетической системой целесообразно использовать гибкую систему передачи переменного тока (FACTS-Flexible Alternative Current Transmission System).Задача технологии FACTS важна для улучшения управления потоками мощности в сетях высокого напряжения. системы электроснабжения.

Ключевые слова

FACTS, электроэнергетическая система, переток мощности, SSSC, TCSC, SVC, STATCOM, UPFC, IPFC.

ABSTRACT

It is advisable to use the flexible alternative current transmission system (FACTS-Flexible Alternative Current Transmission System) in the management of the electric power system. The task of FACTS technology is important for improving the control of power flows in the high voltage networks of the electric power system.

Keywords

FACTS, electric power system, power flow, SSSC, TCSC, SVC, STATCOM, UPFC, IPFC.

Achievements in the management of electric power systems are evaluated according to the use of flexible (controlled) power transmission systems with innovative technology (***FACTS - Flexible Alternative Current Transmission Systems***). Because FACTS technology is a promising means of ensuring the reliability and efficiency of electric power systems (EET).

FACTS technology is a family of devices, each of which can be used individually or in combination with other devices to control the interrelated parameters of the electric power system. The purpose of FACTS technology is to improve the stable control of power flows in electric power systems. One of the main elements of FACTS is the RQM-reactive power source (Fig. 1), capable of both generating and consuming reactive power depending on the required mode and the specified characteristics of the EET.

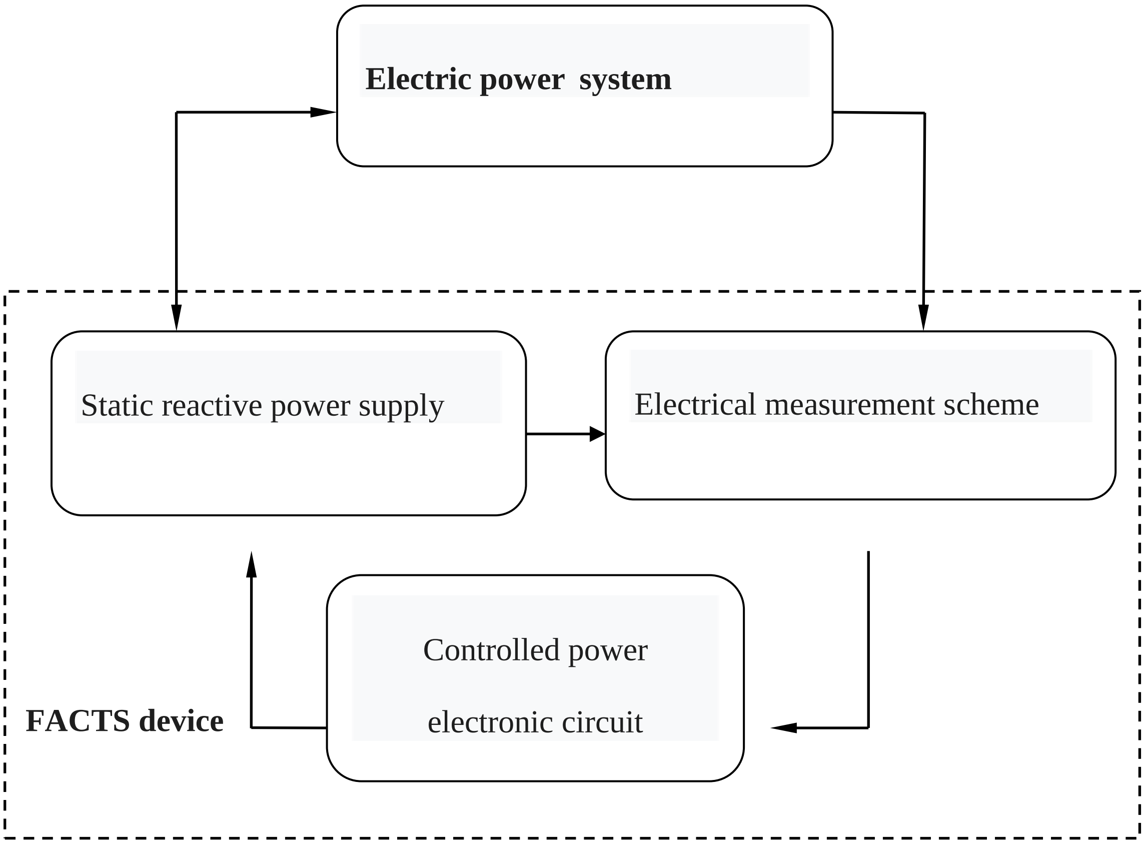

Figure 1. General scheme of FACTS device

To implement the above possibilities, FACTS devices can be connected to the network in series, parallel and combined mode.

In general, FACTS technology allows taking various corrective actions depending on the conditions of a specific control task and is divided into types.

There are following types of FACTS devices:

SSSC (Static Synchronous Series Compensator)- Longitudinal static synchronous compensator;

TCSC (Thyristor Controlled Series Capacitor) - thyristor controlled longitudinal capacitor;

SVC(Static Var Compensator)- Static reactive power compensator;

STATCOM(Static Synchronous Compensator)- Static synchronous compensator;

UPFC (Unified Power Flow Controller)- Unified power flow controller;

IPFC (Interline Power Flow Controller)- Interline power flow controller.

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The main capabilities of FACTS technology are: voltage control (rectification), load balancing, increase of dynamic stability limit, limitation of temporary overvoltages, compensation of reactive power, increase of EUL transferability, etc.

Below is a look at some of the capabilities of FACTS technology:

Adjusting the voltage. As can be seen from Figure 2, with an increase in load, the voltage at the node can be significantly reduced to the point of avalanche. In this case, the installation of FACTS technology on the load bus prevents the voltage on the load bus from falling below the permissible value.

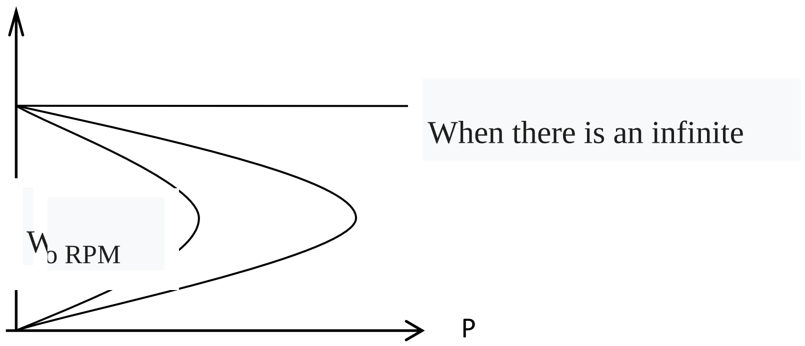

Figure 2. Voltage adjustment at the end of ETL (RPM-reactive power supply)

Increasing the limit of dynamic stability. If the compensator for the production power is chosen such that the reactive power output is zero, then the necessary compensation is provided over the entire operating range of the FACTS device to maintain the voltage and increase the dynamic stability margin.

Damping of fluctuations in EET. With the longitudinal compensation of the inductive resistance of the transmission line, subsynchronous resonance can occur due to the resonance of the capacitance of the capacitor batteries and the equivalent resistance of the transmission line and the generator at frequencies lower than the fundamental frequency. As a result, the amplitude of the oscillations increases until the generators go out of synchronism. FACTS devices allow effective damping of subsynchronous resonance at this time.

Limiting overvoltages. The use of reactors equipped with circuit breakers in several 1000 km long transmission lines does not give the desired result in compensating charge capacities. The use of a FACTS device prepared in the form of a switching reactor allows limiting overvoltage at the end of the power transmission line.

Load balancing. Unsymmetrical loading in electrical networks causes voltage imbalance, overloading of elements and additional losses in electric machines. Use of cross-reactive power compensator balances the load in EET and increases cosph. Load balancing with cosph or voltage control can only be done with FACTS devices capable of phase reactive power control. This is confirmed in the circuit in Figure 3.

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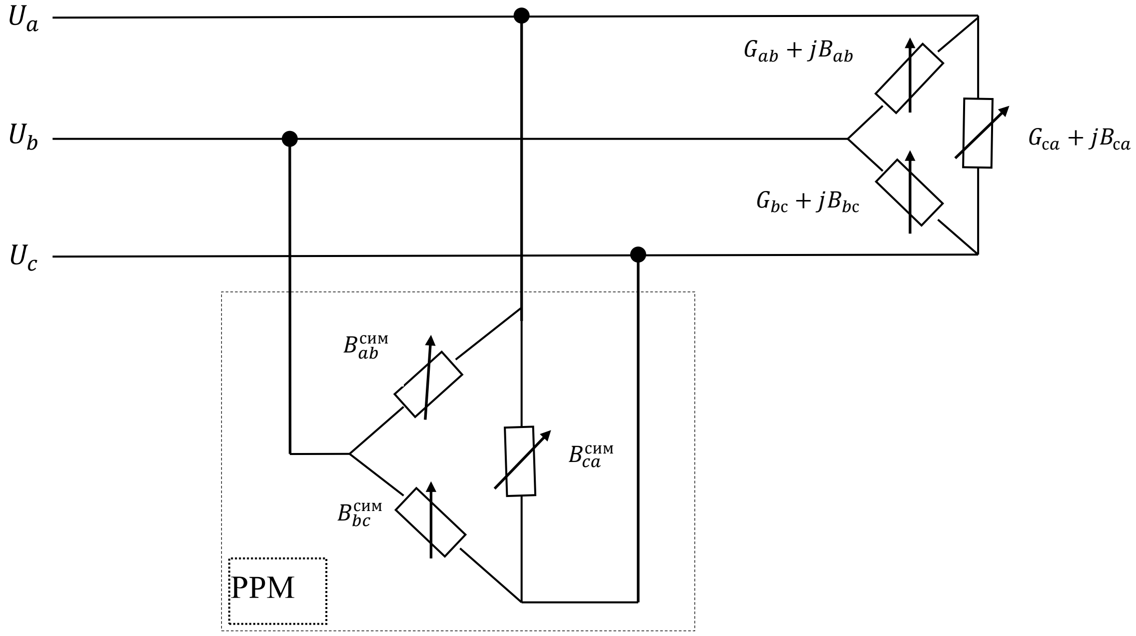

Figure 3. Load balancing through FACTS devices.

Reactive power compensation. FACTS devices located in the substation have the ability to adjust the voltage in the AC network by compensating the reactive power consumed by the transformers or caused by switching filters.

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