PCS-9580

Static Var Compensator (SVC)

SVC is a set of electrical devices for adjusting reactive power fast and effectively in high-voltage power grid, which can regulate voltage and power factor, keeping voltage stable and improving power quality. It is widely used in power transmission, HVDC converter station, industrial field and wind farm, and so on.

Operating Principle

The SVC can be seen as a dynamic reactive power source. It can supply capacitive reactive power to the grid or consume the spare inductive reactive power from the grid. Normally, the system can absorb the reactive power from a capacitor bank, and the spare part can be consumed by an air-core shunt reactor.

Typically, there is one or more banks of fixed or switched shunt capacitors or reactors in one SVC system, of which at least one bank is switched by thyristors. The widely applied elements in SVCs include: thyristor controlled reactor (TCR), thyristor switched reactor (TSR),thyristor switched capacitor (TSC), breaker switched capacitor/ filter capacitor (BSC/FC).

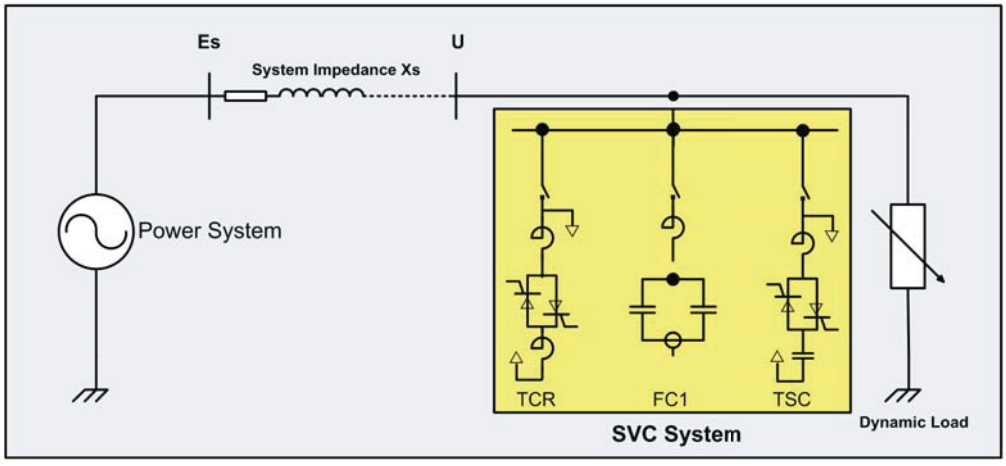

Figure 1 SVC Operating Principle

Functions

- Power Transmission
  - Regulating system voltage.
  - Increasing static stability and transient stability of power system.
  - Increasing line transmission capacity.
  - Restraining power oscillation and sub-synchronous resonance.
  - Restraining transient overvoltage.
  - Balancing three-phase voltage.
  - Controlling the voltage in DC converter station and providing reactive power.
- Industrial Consumers
  - Reducing power fluctuation and voltage flicker.
  - Balancing three-phase load.
  - Reducing harmonic current and harmonic voltage.
  - Improving power factor.
- Electrified Railways
  - Balancing three-phase voltage.
  - Improving power factor.
  - Eliminating harmonics.
  - Suppressing voltage fluctuation and stabilizing grid voltage.

System Configuration

The PCS-9580 SVC system mainly consists of the following components:

- Step-down Transformer
  The static var compensator is normally installed at low voltage side of main transformer, otherwise a step-down transformer is needed to reduce the voltage.
- Medium Voltage Switchgear
  The medium voltage switchgear typically includes isolating switches, grounding switches and transformers. It can be installed indoors or outdoors.
- Linear (Air-core) Reactor
  The air-core reactor in static var compensator has high stability and high linearity. It is used to absorb reactive power under the control of thyristors. Usually the air-core reactor is connected in series to the thyristor valve in delta-connection, and then connected to the power grid.

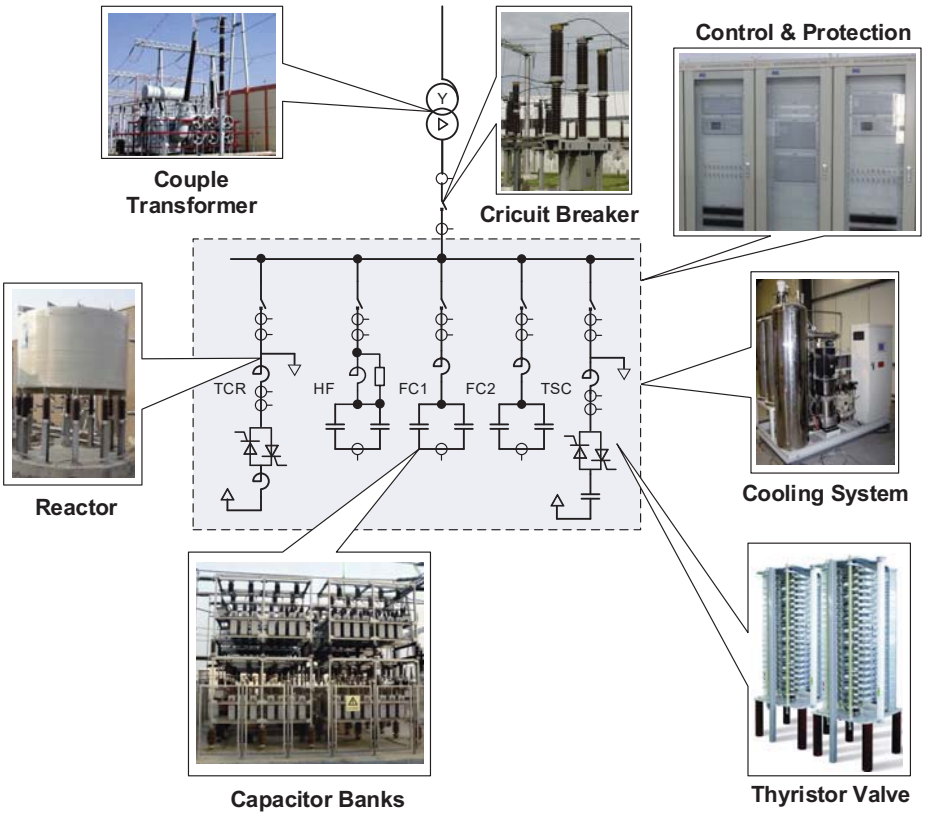

Figure 2 SVC System Configuration

Figure 3 Thyristor Valve

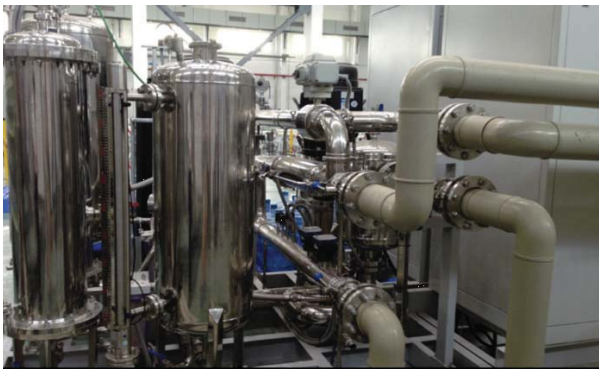

Figure 4 Cooling System

- Thyristor Valve
  The thyristor valve is the main control part in a SVC system. It is composed of several series/paralleled connected thyristors and its auxiliary components. The thyristors are triggered by photoelectric triggering system and it adopts water cooling as the main cooling method.

- Capacitor/Filter Bank
  The capacitor/filter banks can supply sufficient capacitive reactive power to power grid and filter the harmful harmonics. The filter is composed of capacitors, reactors and resistors, providing capacitive reactive power to the entire system.

  In practical, the capacitor/filter banks are divided into several sub-banks which can be switched by mechanical breakers or other electrical switches according to the actual situation.

- Cooling System
  The heat produced by thyristor valve will be harmful to thyristors if the heat is not dissipated in time. The water cooling system is sufficient for the thyristor valves which have a high operating voltage. The cooling system uses the de-ionized pure water for internal cooling and airwind for outdoor cooling.

- SVC Control and Protection System
  The key functions of SVC control and protection system are:
  - Generating the control pulses to the valve at suitable time to fire the thyristors
  - Monitoring the SVC system to provide operation condition, fault record or self checking information
  - Switching the FCs in order
  - Protecting each component to ensure the safe operation of SVC
  - Friendly Human-Machine Interface

Features

- Fast system response time (the measured open-loop response time is below than 10ms) .
- High-precision control angle (0.01 °), wide control range (102 ° -165 °).
- Vertical and free-floating press-stack structure for the valve. A valve block features: small size, convenient layout, low costs of infrastructure, simple valve block structure, high reliability and simple installation and maintenance.
- Advanced electro-optical trigger mode employs a high-voltage fiber-optic one-to-one trigger. This technology provides strong anti-interference performance, reliable operation and fast trigger speed.
- Patented water-cooling technology with high reliability and high thermal efficiency. This cooling method has been widely used for the locomotive and aerospace industries. It has also been used in one million kilowatts generating units, and high-pressure and UHVDC transmission.
- High-performance control and protection system. NR Electric SVC system adopts a high-performance decentralized and distributed structure to facilitate functional expansion and remote maintenance.