STATIC VAR COMPENSATOR
Static Var Compensator (SVC)

By providing dynamic reactive power, SVC can be used for the purpose of regulating the system voltage, compensating the voltage at a reasonable level, improving the power flow capacity of the transmission line, enhancing the damping of the low frequency oscillation as well as inhibiting the sub-synchronous oscillation. Furthermore, SVC is also capable of inhibiting the variation of busbar voltage caused by the fluctuating load, which is favorable for the recovery of transient voltage and the improvement of stabilizing the system voltage. For industrial users, it can effectively control the reactive power, improve the power factor, reduce the voltage influence and harmonic interference caused by the nonlinear load, balance the three-phase load, improve the power quality, improve the productive efficiency, improve the product quality and reduce the energy consumption. It is widely used in industry of machine, electric power, metallurgy, electrified railway, wind power generation and mine, etc.

SVC Function

Benefits of SVC to regular applications
- Stabilization of voltage
- Reduction of harmonics
- Minimum flicker disturbances on own and neighboring facilities
- Minimum malfunction of protective devices
- Balanced load

Benefits of SVC to EAF
- Improving Power factor, no power factor penalties
- Reducing Harmonic distortion
- Stabilize voltage, increasing melting power
- Restrain Flicker level
- Shorter melting times, higher productivity
- Electrode savings
- Reducing energy losses
- Reducing wear of furnace lining due to more stable arcs

SVC Technical Features

- Adopting full digital control system based on the DSP. Response time of controller is no more than 10ms. Control accuracy of controller is no more than 1%.
- The control system provides with local and remote operator workstation to supervise all equipments in real time.
- Adopting dual redundant digital protection. The control system is the fast flexible main protection and the microcomputer protection is safe, reliable back-up protection, to ensure safe and reliable operation of the SVC by the greatest extent.
- The thyristor valve adopts the valve components manufactured by well-known foreign companies, photoelectric triggering mode, high voltage energy storage with high potential board, thyristor BOD protection and compact structure, which can ensure the SVC safe and reliable operation, efficient and convenient maintenance.
- Adopting the closed-loop pure water-cooling system, or high efficient
Adopting photoelectric triggering mode, which can ensure powerful anti-jamming ability.

Providing several control modes, such as synchronous three-phase control, split control, three-phase equilibrium, reactive power control, voltage control and unified control of reactive power and voltage.

Adopting a variety of communication protocol to facilitate communication with the substation automation system, which can truly realize the unattended operation or centralized control.

Device Component

SVC system of thyristor controlled reactor (TCR) type is mainly composed of filter (capacitor) branch and TCR branch, including thyristor valves, control and protection system, cooling system, TCR reactor and other equipments.

Overall Performance Indicators

- SVC dynamic capacity: 0 ~ 400MVar
- Control-target bus rated voltage: 6 ~ 500kV
- SVC rated voltage: 6 ~ 66kV
- Total dynamic response time (reactive power output): <15ms
- SVC availability: >99%
- SVC biggest loss: <0.8%

1. Control and Protection System

- Layered and distributed control system can simplify the system design and strengthen the reliability and expansibility of the SVC.
- Digital signal parallel processing based on the DSP can realize the calculation of the real time control signal, and the response time of controller is no more than 10ms.
- The control system provides with local and remote operator workstation to supervise all equipments in real time and the favorable human-machine interface (HMI).
- Adopting dual redundant digital protection. The control system is the fast, flexible main protection and the microcomputer protection is safe, reliable back-up protection, to ensure safe and reliable operation of the SVC by the greatest extent.
- Providing several control modes, such as synchronous three-phase control, split control, three-phase equilibrium, reactive power control, voltage control and unified control of reactive power and voltage.
- Adopting a variety of communication protocol to facilitate communication with the substation automation system, which meets the requirement of the high-speed data transfer, fast control (direct I/O) and remote communication (RS485), and truly realizes the unattended operation or centralized control.
- Open loop/closed loop feedback control mode not only guarantees the system voltage fluctuating and flicker accord with national standard (GB), but also ensures the stabilize the power factor of the system.
- High anti-jamming capability from EMC test.
2. Thyristor Valves

The thyristor valve adopts the compact structure with multilayer form, and the frame adopts the special metallic material. The thyristor valve is built up of thyristors which are from the foreign semiconductor company and can withstand the system maximum overcurrent/overvoltage and higher $dv/dt, di/dt$. Cooperated with the reactor, the thyristor valve can achieve the nice dynamic response, high potential taken from the high potential panel, triggering and BOD protection function. It adopts photoelectric triggering mode with anti-jamming ability, which can ensure the SVC safe and reliable operation, efficient and convenient maintenance.

- Rated Voltage: 6 ~ 66kV.
- Rated Current: 4000A (phase current).
- Trigger method: photoelectric trigger.
- Cooling method: closed-loop pure water-cooling, or high efficient air-cooling.
- Special ability of preventing or withstanding false firing.
- Normal firing system and forced-firing system.
- Safe overvoltage protection.
- Perfect dynamic voltage sharing damping circuit and static voltage sharing circuit.

3. Cooling System

► Closed-loop Pure Water-cooling

- Precision design of the regulation and control system, multiple early warning and protection function make sure the cooler running under safe temperature.
- Many parameters are displayed in real time, such as cooling water pressure, cooling water flux, cooling water temperature, cooling water resistivity, valve hall temperature, the water level in the vessel.
- All core components choose foreign high quality products, and among them the main cycle pump, pipe filter, ion exchanger, precision filter, buffer container adopt the stainless material to avoid water leaking.
- Having the function of water leakage detection. the water-cooling control system will send alarm signal to the SVC control system, when the leakage is higher than setting value.
- Having the function of controlling the occurrence of dew. When the water temperature is below the dew point temperature, the water may be heated to prevent the occurrence of dew.
- Having the unique function of the anti-freeze, which can guarantee the circulating cooling water not to freeze in the cold regions.
- Remote communication function.
- Annual availability is not less than 99.5%.
4. Filter Banks
Filter banks are made up of several filter branches. On the one hand, they provide capacitive reactive power. On the other hand, they are needed for the filtering of harmonics generated by the load and the TCR.

5. TCR Reactor
- Dry, air-core, epoxy resin curing.
- Each phase reactor may be divided into two reactors.
- Manufacturing error: ±3% (each phase) ±2% (three phases).
- Adopting a structure of multiple conductors wound in parallel and multiple enclosures, and adopting small round section aluminum wires as coil conductor, which can ensure low eddy current and stray current, low interturn capacitance, and equal voltage distributing along height of coils.
- Adopting lots of effective precautions to avoid tree discharge.
- Simple convenient installation and maintenance, no tinder, and running safely and reliably.
- Natural cooling.

6. Other Equipments
Circuit breakers, isolating switches, surge arresters, current transformers etc. are manufactured by well-known companies at home and abroad to ensure the overall performance of SVC.
### Technical Data

- **Rated furnace power**: 40MVA
- **Rated voltage**: 110kV/35kV
- **Dynamic rating of SVC**: 0~40 Mvar
- **Power factor after compensated**: >0.95
- **Production increase**: 5%
- **Specific electrode consumption decrease**: 0.3 kg/ton
- **Specific energy consumption decrease**: 10kWh/ton

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**Without SVC (35kV Bus):**

- **Active power**
- **Reactive power**
- **Voltage RMS**
- **Voltage total harmonic distortion**

**With SVC (35kV Bus):**

- **Active power**
- **Reactive power**
- **Voltage RMS**
- **Voltage total harmonic distortion**
Rolling Mill SVC Project

Technical Data
Rated power: 3 * 5500kW + 3000kW
Rated bus voltage: 35kV
Dynamic rating of SVC: 0 ~ 35 Mvar

Without SVC (35kV Bus):

- Active power
- Reactive power
- Voltage RMS
- Voltage total harmonic distortion

With SVC (35kV Bus):

- Active power
- Reactive power
- Voltage RMS
- Voltage total harmonic distortion

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