

SVC for voltage stability in the Saudi Arabian 380 kV power transmission grid

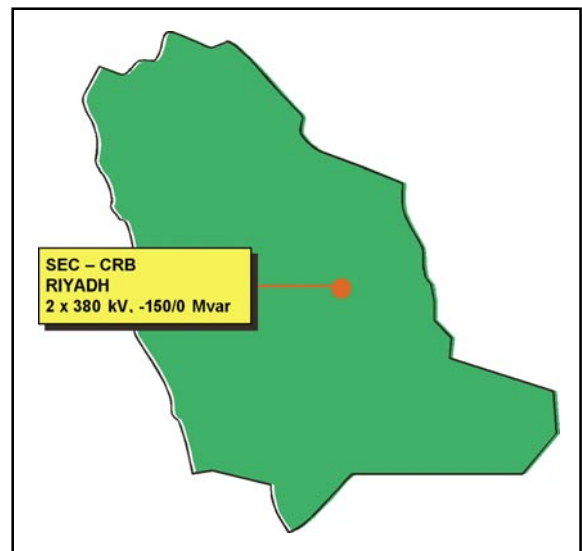


Two Static Var Compensators (SVC), each rated at 380 kV, -150/0 Mvar and supplied by ABB, are in operation in the SEC-CRB power transmission grid in the Riyadh area. The SVCs were commissioned in 2000.

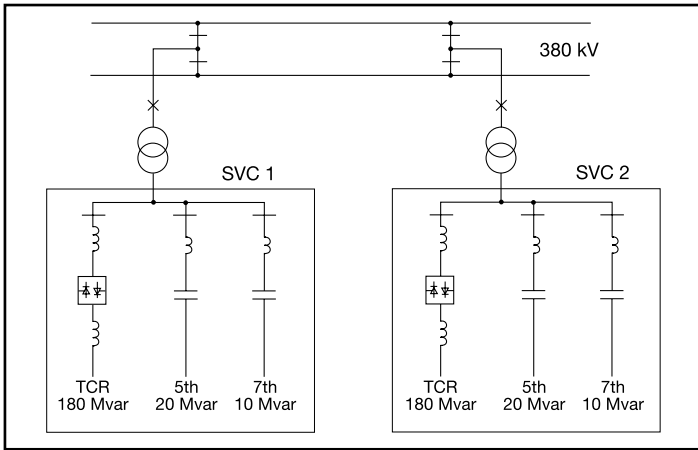
The purpose of the SVCs is to provide the AC transmission system with very fast and accurate reactive power compensation. This will improve the transient as well as steady state voltage control in the system. It will release the generators from absorbing excessive reactive power for certain load conditions, and thus increase the stability limit of the generators.

By operation of Thyristor-Controlled Reactors (TCR), the reactive power can be controlled in a linear manner from 0 Mvar to 150 Mvar inductive at the 380 kV system level.

During normal network conditions the SVC will/can give a minimum reactive power output to have a maximum dynamic range of the SVC available in case of disturbances and major contingencies in the network. To achieve the correct reactive power compensation for any event, the SVC will automatically control the TCR.



Single-line diagram



Main system design

Each SVC consists of the following main parts:

One Thyristor-Controlled Reactor (TCR) rated at 180 Mvar;

One 5th Harmonic Filter rated at 20 Mvar;

One 7th Harmonic Filter rated at 10 Mvar.

The SVCs each has a total dynamic range of 150 Mvar inductive to 0 Mvar. The variable Mvar output from the TCR is achieved by phase angle control of the thyristor valve. By changing the firing angle, the magnitude of the current through the reactor can be continuously controlled, and thereby, the reactive power consumption can be determined.

The Harmonic Filters have the purpose to suppress the harmonics generated in the TCR, and prevent these harmonics from entering the network that the SVCs are connected to.

Control system

The SVC control system is built up by microprocessor based computer functions that constantly monitor the status of the SVC reactive output and the status of switching devices.

A voltage regulator basically monitors the 380 kV bus voltage and automatically adjusts the reactive power output to maintain the bus voltage at the pre-set value selected by the operator. To achieve this voltage control, a closed-loop three-phase symmetrical voltage control is utilized. If changes in the 380 kV voltage are detected, the control system will generate trigger pulses to the TCR valve. If there is a demand to reduce the bus voltage, the control will adjust the inductive output of the TCR to meet the reference value.

Sequence control functions are integrated in the control system and monitor the SVC circuit breaker in the 380 kV switchyard and the SVC disconnecting switches. The system also checks that all conditions are met for allowing start and stop sequences of the SVC in a controlled manner.

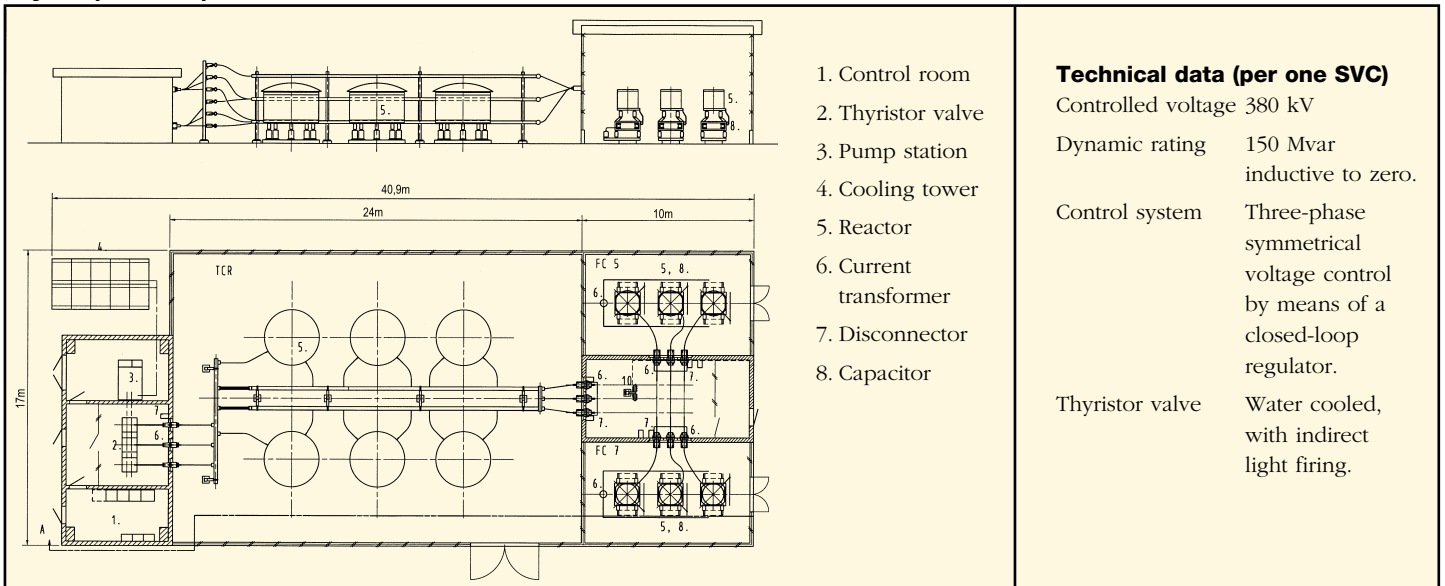
The two SVCs are normally operated together in joint control. In this mode of operation the voltage reference settings of both SVCs are in unison. The SVCs can also be operated individually in case they are not electrically connected on the 380 kV side.

The SVCs can be controlled from three different control localities:

- SVC control room;
- Main substation control building;
- Energy control center.

In case of large reductions of fault level in the power grid, a Gain Supervisor will automatically reduce the regulator gain in order to maintain the SVC control stability. After restoring of the fault level, the regulator gain can be reset to normal values.

Layout (one SVC)



1. Control room
2. Thyristor valve
3. Pump station
4. Cooling tower
5. Reactor
6. Current transformer
7. Disconnecter
8. Capacitor

Technical data (per one SVC)

Controlled voltage	380 kV
Dynamic rating	150 Mvar inductive to zero.
Control system	Three-phase symmetrical voltage control by means of a closed-loop regulator.
Thyristor valve	Water cooled, with indirect light firing.



ABB Power Technologies AB

FACTS

SE-721 64 Västerås

Sweden

Tel: +46 21 32 40 00

Fax: +46 21 18 31 43

E-mail: info.sepow@se.abb.com

www.abb.com/powersystems