

# Utility Static Var Compensator (SVC)

The Static Var Compensator for utilities increases the quality of power in many respects. The benefits of stabilised voltage levels and reactive power compensation improves the system stability and increases the power transfer capability of a transmission line.

## Reduction of harmonics

Non-linear loads generate harmonic currents. The harmonic currents load the network and lead to voltage distortions. Distorted voltage may cause malfunctions in sensitive computerised devices and other process control equipment.

The filter circuit of the Utility SVC system is designed to absorb harmonics generated by charge as well as by Thyristor Controlled Reactors (TCR). The total harmonic distortion (THD) and individual harmonic voltages are limited to below specified levels.

## Power transfer capacity increases

Transmission of reactive power leads to significant voltage drops and current increases in the network, which limits the transmission

capacity of active power. Utilities can maximise their transmission line capacities by compensating reactive power. The Static Var Compensator maintains the demand of reactive power within the limits set by utilities.

## Voltage stabilisation, unbalance loads

Loaded non-transposed lines will create voltage unbalance. The unbalanced voltage causes reduced efficiency, overheating, noise, torque pulses and speed pulses to motor operations.

The Utility SVC operates in single-phase control mode, thus balancing the voltage.

## Flicker reduction

Rapidly varying reactive power causes voltage fluctuations at the point of the common coupling. The human eye perceives this frequency of voltage fluctuations as flickering lights.

The SVC will reduce the flicker.



# Solutions for better power quality by using a Utility SVC

Nowadays the quality of electricity is becoming more and more important due to the increasing usage of electricity in our everyday life. Our electrical equipment, such as computers, are becoming more sophisticated and at the same time more vulnerable to disturbances.

Less energy is produced by the use of fossil fuels and more renewable energy sources are being taken into use around the world, for example wind farm usage is increasing especially rapidly.

Disturbances in the normal operation of transmission lines and industrial distribution systems may be caused by line switching, line faults and non-linear components, such as thyristor controls, rapidly varying active or reactive loads, unbalanced phase voltages, of the network or loads.



-60...+100 Mvar, 345/15 kV, 60Hz,  
Campos, Furnas Centrais Elétricas SA, Brazil

## The problems solved with SVC:

- Harmonics
- The need for additional reactive power
- Voltage fluctuation
- Flicker phenomena
- Unbalanced loads
- Rapid changes in reactive power
- Power oscillation

Electricity makes our everyday life much easier and we want the best out of our electricity. The disadvantages mentioned above can be reduced by the use of a Utility SVC.

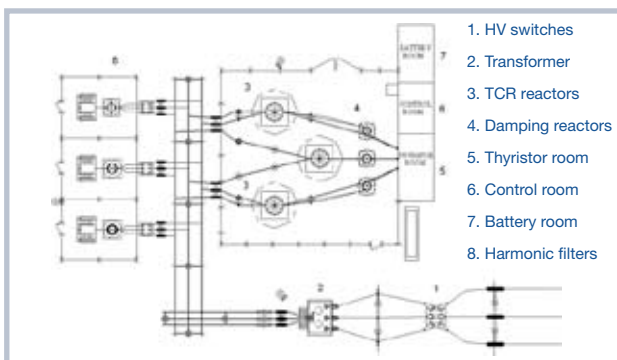
## Tailored and flexible project delivery

No two SVC installations are the same. The scope of the SVC installation depends on the technical and economic needs of each.

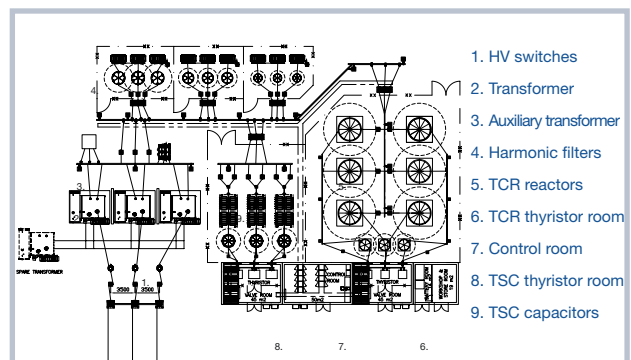
The location of the SVC, once installed, can be fixed or relocatable. While outdoor equipment is usually

built as fixed structures, indoor equipment is often located within a container that is easily relocatable. It is possible to use a modular design of the SVC. This makes transportation, installation and commissioning at the site fast and easy.

### Utility SVC layout example



### Utility SVC with Thyristor Switched Capacitors layout example



# Simulation of the network

## Real Time Digital Simulator (RTDS)<sup>®</sup>

The Real Time Digital Simulator (RTDS)<sup>®</sup> is Nokia Capacitors' tool for the design and simulation of electric networks. The simulation was made so that two SVC control systems were connected to the simulator in order to simulate the interaction between them. Nokia Capacitors has two RTDS<sup>®</sup> simulation racks, and which handle and design 100 network nodes.

The measured data or simulated model is run on the RTDS<sup>®</sup>. The simulation model and control system parameters are altered to give maximum performance. Simulations may be used to optimise installation cards, losses and performance. In some cases the SVC power is reduced to minimise losses and at the same time increasing the performance. RTDS<sup>®</sup> is also a powerful tool in line fault situations.



The above picture, design tool for electric networks, shows an RTDS simulated network in which Nokia Capacitors delivered two Utility SVCs to the same network.

## Mechanical Switched Reactive Elements logic

The MSRE-switching system is part of the larger utility control system called SVS (Static Var System) which consists of the -60...+100 MVar SVC and 16 mechanically switched external elements. Basically the SVC controls the voltage at dynamic basis and the MSRE elements provide reactive power support at steady state condition.

### The operation range of the SVC was divided in three areas:

- Transient condition: reactive elements shall be switched as fast as possible.
- Intermediate condition: the reactive elements are switched according to inverse time curve with faster behaviour as the instantaneous operation point of SVC is far from 0 MVar.
- Normal condition: reactive elements are switched in long term to a pre-defined operation condition.

The reactive elements are divided in three groups according to its power (MVar) and voltage level (345, 138 and 13.8kV).

The purpose of the MSRE Logic is to measure the SVC' susceptance and identify what element should be switched on or off according to the operation areas and size of available MSRE element. Other aspects as discharge time of capacitors, operation rotation of MSRE elements inside one group, maintenance of one MSRE element, breaker operation cycle, logic's freezing during short circuit in power system are considered as well.

The MSRE Logic was extensively tested in RTDS environment together with Furnas Operation Team in order to verify the power system behaviour and set all parameters of the logic aiming the best performance according to Campos area operation practice.

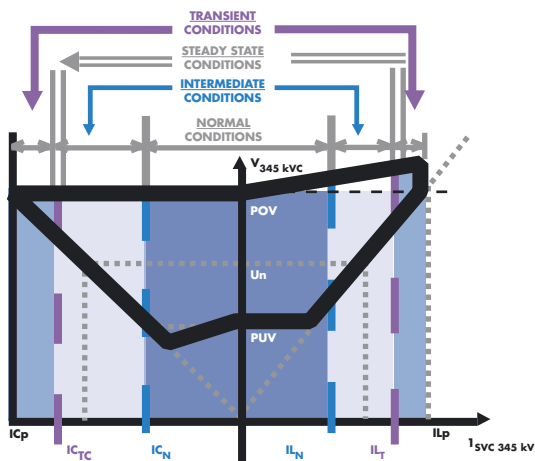


Figure 1: SVC Operation Ranges

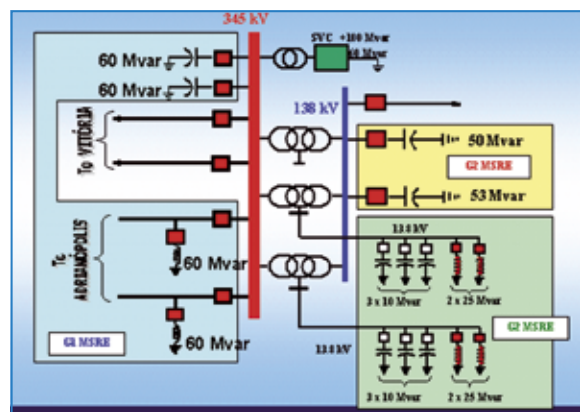


Figure 2: Campos MSRE elements

## Quality System

Nokian Capacitors' Quality System fulfils the requirements of the ISO 9001:2000 standard.

The ISO 9001 certificate was received in 1993 and updated to ISO 9001:2000.

Environmental aspects have always been taken into account during the design, manufacturing and delivery of Nokian Capacitors' products. In 2000 Nokian Capacitors received the certificate conforming to the environmental standard, ISO 14001. In 2004, Nokian Capacitors received the IQNet 2004 certificate and in 2005 the OHSAS 18001 certificate.

**We participate  
in IEC, CIGRE  
and IEEE actions.**



## Highlights of the NC Service Concept

- Telephone support, online knowledge management, remote equipment monitoring services
- Annual maintenance & support contracts
- Modernisations & Upgrading
- Spare parts
- Training
- Evaluations & net analysing service



## Other products

**In addition to Utility SVCs,  
Nokian Capacitors is also a manufacturer of:**

- Series Capacitors
- Static Var Compensators (SVC) for industry
- SVC MaxSine
- MaxSine active filters
- Railway series capacitors
- Air core reactors
- Shunt capacitor banks
- Filter capacitor banks
- High voltage capacitor units
- Low voltage capacitor units
- Control and Protection System for capacitor banks
- Power factor controllers
- Unbalance relays
- Capacitance meters (clamp type)
- Enclosed Medium Voltage (MV) banks



In line with our policy of ongoing product development we reserve the right to alter specifications.



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