NOKIAN CAPACITORS

Industrial Static Var Compensator (SVC)

Nowadays, the quality of the electricity supply is becoming more important due to the use of sophisticated computer controlled systems. This has been recognised by the electrical utilities, which penalise user for disturbances.

The Static Var Compensator (SVC) is designed to decrease disturbances caused by changes in reactive power and voltage fluctuations in the normal operation of transmission lines and industry distribution systems. Disturbances may be caused by line switching, line faults, non-linear components such as thyristor controls and rapidly varying active or reactive loads. A typical source for these kind of disturbances are electric arc furnaces and rolling mills.

These disturbances result in harmonics that load the supply network and cause voltage fluctuations. Varying loads can also create disturbances in the form of phase unbalance and voltage flicker phenomenon as well as create a need for additional reactive power.

The benefits of an SVC can be seen within a steel plant as a stable power factor in spite of varying loads at the plant, and externally when the disturbances do not effect the supplying grid. In short, the Static Var Compensator effects the following:

- Flicker reduction
- Voltage stabilisation
- Reactive power compensation; improved power factor
- Increased voltage on the load bus
- Reduction of harmonics

Nokian Capacitors ensures the high quality of the Static Var equipment by manufacturing the main components such as capacitors, reactors, thyristor valves and the digital control and protection system, in-house.

Functional benefits of the Static Var Compensator

The benefits of reactive power compensation, more constant voltage levels and reduced distortion levels are transferred to the end user as production increases, total power losses are reduced and reactive power penalties are avoided. Static Var Compensators increases the quality of power in many respects.

Flicker reduction

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

Voltage stabilisation

Electrical Arc Furnace (EAF) operations can be intensely unbalanced especially in the beginning of the melting process. The three-phase induction motors suffer due to the unbalanced voltage supply. The unbalanced voltage causes reduced efficiency, overheating, noise, torque pulses and speed pulses to motor operations.
The SVC operates in single-phase control mode, thus balancing the voltage.

Reactive power compensation

Transmission of reactive power leads to significant voltage drops and current increases in the networks, which limits the transmission capacity of active power. Public utilities maximise their transmission line capacities by advising their customers to utilise local reactive power compensation.
The Static Var Compensator maintains the demand of reactive power within the limits set by utilities, thus avoiding penalties.

Reduction of harmonics

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

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

The pay back time of the SVC investment ranges typically between one to two years.

Economical benefits

Energy savings

Compensation and improving the quality of power increases the capacity of active power transmission and reduces energy consumption. Thus, the unnecessary overload of the power network can be avoided. Both your company and the environment benefit from the more efficient use of electricity and saving in the consumption of energy.

Increase in productivity

The SVC system can keep a steel plant bus voltage practically at a constant level. This decreases the steel processing time and thus increases productivity. The SVC system also reduces production breaks and expensive restart procedures.

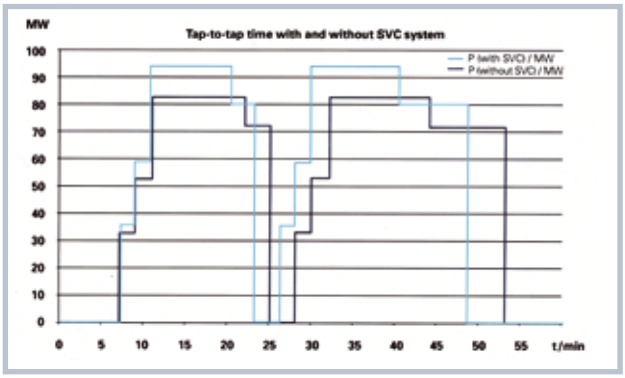
The arc furnace, stabilised by the SVC, also has a considerable positive effect on the consumption of electrodes, heat losses and the lifetime of the furnace‘s inside lining.

As the improved quality of power from the network reduces the stress on equipment, its lifespan increases, thus lowering the maintenance and replacement costs.

Benefits of the SVC:

- Increase in productivity
- Energy savings
- Reduction in consumption of electrodes
- Reduction of heat losses
- Increase lifetime of furnace inside lining

Tap-to-tap time with and without SVC system



This figure shows the influence of the shortened tap-to-tap time as increased steel production. The melting time of the changes decreased from 53 minutes to 48 minutes once the SVC was installed. This is a 9.4% reduction of one heat time - the total increase of the productivity can be transferred to the steel tons via saved time for each heat.

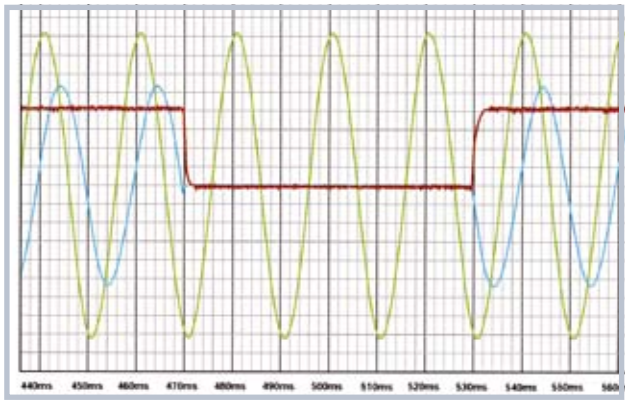
Experts at your service

The services of Nokian Capacitors range from analysis and design, delivery of the SVC to after-sales services. We also carry out tests and reactive power / distortion measurements to ensure that the perfomance levels of the SVC are met as determined in the beginning of the project. Our global sales network contributes to projects with knowledge of the local enviroment and customs.

Digital control & protection at the heart of perfomance

The digital control system measures changes in the reactive power consumption and initiates corrections to either generate or consume reactive power. The software and hardware of the control system are designed by Nokian Capacitors, which are based on commercial circuit boards. The control system communicates easily with the other systems operated by the steel plant.

The SVC control system is based on three Motorola CPU powered PC boards in a virtual machine environment (VME) rack. The units are the master board, which calculates the output of the SVC, the slave board, that takes care of Programme Logic Control (PLC) operations and the communication interface, which transfers data between the VME rack and the Human Machine Interface (HMI) computer. The operations of the SVC are controlled through a user interface screen.



Step responses of the control systems.
The figure shows the measured step response of the control system. The green curve is the phase voltage. To the left of the curve, the 60 degree lagging current (red curve) is stepwise interrupted. To the right there is a stepwise switching on the load current. The blue curve is the measured reactive power signal used to control the thyristor valves. The thyristor valve causes an additional delay depending on the point of wave switching requirement. This may be between 0 to 10 ms.

System parameters determine the design of the SVC

Each plant has its own quality requirements for the supply of power, thus the SVC must always be tailor-made. The design of the SVC depends on the fault level and load parameters. In case of a high fault level, the main parameter of the SVC design might be reactive power compensation while flicker and harmonic reduction are major concerns for a low fault level.

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.

Tailored and flexible project delivery

A successful delivery begins with an accurate assessment of the requirements for an SVC. Nokian Capacitors can provide consultative help already when determining the scope of supply.

As a competent team of experts will be on incharge of the project, on site, for as long as needed. In the beginning of a project, Nokian Capacitors analyses the network, its load and the physical space in which the SVC is to be installed. Changes in the reactive and active power are measured as a function of time, as well as distortions caused by harmonic currents. The fault level of the network is also checked, in case it is not already known. Based on these measurements, the size of the SVC is calculated, the parameters for the filters and flicker reduction are assessed.

Since Nokian Capacitors manufactures the main components of the SVC, it has full control of its delivery times. In fact, Nokian Capacitors is recognized for having exceptionally fast delivery times, without compromising the flexibility and individual service provided to its customers. Specific needs are also taken into consideration by Nokian Capacitors´ international sales network team. The team provides high quality documentation (such as installation, operation and maintenance manuals) and operation training in the customer´s language according to their requirements.

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.

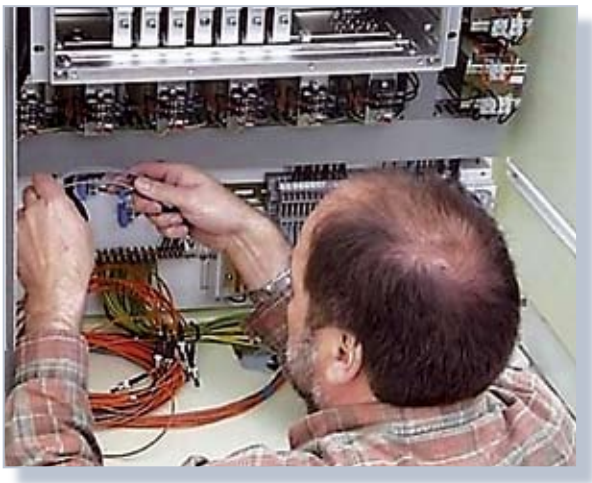
Environmental aspects have always been taken into account during the design, manufacturing and delivery of Nokian Capacitors´ products. In 2000 Nokian Capacitors received the certificate conforming to the environmental standard, ISO 14001. In 2004, Nokian Capacitors received the IQNet 2004 certificate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

We participate in IEC, CIGRE and IEEE actions.


CERTIFICATE

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 Industrial SVCs Nokian Capacitors also manufactures:

- Series Capacitors
- Utility Static Var Compensators (SVC)
- 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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