

Introduction to the Compensation Systems

INTRODUCTION

Nokian Capacitors Ltd. designs and manufactures 3 different types of high voltage compensation systems for industry and power utilities:

- Static Var Compensator (SVC) for industrial applications
- Series capacitor banks
- Static Var Compensator (SVC) for power utilities

COMPENSATION SYSTEMS

Nokian Capacitors is manufacturing the equipment for Series Capacitors and Static Var Compensators in its modern factory in Finland thus ensuring the reliable delivery according to the customers' specifications. The deliveries can be done on turnkey basis including studies, design, manufacturing, delivery, civil works, installation and commissioning.

Because the studies, the design and most of the manufacturing is done by Nokian Capacitors itself, it is possible to deliver large turn-key projects with short delivery times.

As the first example we can mention the delivery of eight 500 kV series capacitor banks to Vietnam with 10 months delivery time. This project included the delivery of the equipment and the supervision and installation. The second example is Nokian's delivery of five 400 kV series capacitor banks to Fingrid in 2001. This delivery was a turnkey delivery including the studies, design, civil works, delivery, installation and commissioning. All five banks were energised 11 months after the signing of the contract.

Nokian Capacitors has always been a pioneer in the design of the protection and control systems for compensation systems. For the SVC systems we have developed a modern industrial power PC based control and protection system. The system performance has been tested by Real Time Digital Simulations at an independent laboratory. The electromagnetic firing system of Thyristor Switched Capacitor valve has been developed by Nokian and it has been verified by outstanding TSC project.

For series capacitors we have been pioneers in the world delivering the fibre optic signal transmission system, fast de-ionising spark gap, completely solid state control electronics, digital control and protection, etc. Reports and detailed technical descriptions about Nokian's compensation systems are available to be consulted on request.

STATIC VAR COMPENSATOR (SVC)

The Static Var Compensator (SVC) is designed for the energy transmission lines of the power utilities and the industry. The SVC is the system used for increasing the quality of the electrical power and with that to achieve many other benefits.

The reactive power compensation, higher constant voltage level and reduced distortion level can be transferred for many advantages of the end user. With the production increase, reduced total power losses and avoided reactive power penalties, the pay back time of SVC investment is more likely counted in months than years.

Power utilities may give power quality regulations for industry in order to limit pollution of the network. The installation of a Static Var Compensator shall solve all major power quality problems.

Reactive power

The SVC system shall hold reactive power demand from public network within allowed limits thus the penalties shall be avoided.

Harmonics

The filter circuit of SVC system shall be designed in order to absorb harmonics generated by the load as well as harmonics generated by thyristor controlled reactors. Total harmonic distortion and individual harmonic voltages shall be limited below requirements. Typical requirement is 1.5% for total voltage distortion.

Voltage unbalance

The SVC is operating on single phase basis and thus it is balancing the voltage.

Voltage fluctuations

The SVC will stabilise the voltage. This is advantageous for example in the steel mills not only for the arc furnace itself but also for the control and protection system of the steel plant because modern electronics and process instruments are very sensitive to voltage fluctuations.

Flicker phenomenon

The SVC can reduce the flicker down to the value requested by the power utility.

SERIES CAPACITOR BANK

Series capacitors are used for more efficient use of the transmission lines. The diversification of generation, transmission and distribution in addition to long transmission distances and large generating power plants are resulting in increased demand for economic and reliable operation of transmission systems.

The demand for increasing power transfer means either more transmission lines or compensation of the existing lines. The series compensation is an economic method of improving power transmission capability of the lines.

Series capacitors will:

- Increase power transmission capability
- Improve system stability
- Reduce system losses

- Improve voltage profile of the lines
- Optimise power flow between parallel lines

The cost of a series capacitor bank is typically only approximately 10 % of the costs of a new transmission line. Thus the payback time for the series capacitor bank investment is only a few years.

OFFER OF A COMPENSATION SYSTEM

The offer of Nokian Capacitors Ltd. for a compensation system consists usually in all the necessary studies, the engineering, the equipment of the compensation system as specified in our technical offer, the factory tests at Nokian's factory in Finland, the supervision of the installation, the commissioning of the system and the training of customer's personnel.

The installation works for a compensation system can be done by the client under the supervision of Nokian Capacitors or they can be included in the scope of supply of Nokian Capacitors.

The size of the offered compensation system is defined and calculated based on the received information from the client and some assumptions we made based on our experience.

Anyway, we are always looking forward the opportunity to meet our clients in order to present and clarify the offered compensation systems as well as verify their ratings by on-site measurements.

REFERENCES

Nokian Capacitors Ltd. has been manufacturing capacitors, reactors and their control and protective systems for more than 45 years. During these years we have delivered large Static Var Compensator (SVC), series capacitors (SC) and filter capacitor and shunt capacitor projects for numerous power utilities and industrial companies all over the world.

Our customers have been companies like B.C. Hydro and Hydro Quebec in Canada, Bonneville Power Administration and Western Area Power Administration in USA, Swedish State Power Board, Norwegian State Power Board, Electricity Generation Authority of Thailand, Furnas (Brazil), Eletronorte (Brazil), Ende (Chile), Ministry of Energy (Vietnam), Finngrid (Finland), Outokumpu Polarit (Finland), Rautaruukki (Finland), Imatra Steel (Finland) etc. The size of these projects has been from 1 million Euros to 20 million Euros.

We have delivered our projects in two different ways depending on the requirements from the customer, either on turnkey basis or as material delivery and installation and commissioning supervision.

THE COMPANY

Nokian Capacitors' factory is located in the city of Tampere in Finland. The capacitors and reactors with their protection equipment have been manufactured for more than 45 years.

The factory has the size of 7000 square meters. Its annual production capacity of high voltage capacitors is 7000 Mvar. The manufacturing capacity of the reactors depends on the reactor size. The manufacturing capacity of small damping and filter reactors is several thousand reactors per year.

Nokian's capacitor factory is the second largest capacitor factory in Europe, and it is equipped with modern manufacturing equipment. With the testing equipment of its laboratory all type tests for the capacitor units and reactors can be carried out. For some high voltage tests the high voltage laboratory of the Helsinki University of Technology or the Tampere University of Technology can be used. The fault current tests can be carried out for instance in the high power laboratory of KEMA in the Netherlands.

Nokian Capacitors Ltd. has in 1993 obtained the quality assurance certificate on ISO 9001 for the compensation deliveries. This certificate is the highest level of ISO standard including the administration, design, manufacturing, inspection, testing, delivery and installation. At the moment, our quality system meets the requirements of the ISO 9001:2000.

In January 2000 Nokian Capacitors Ltd. obtained the environmental quality assurance certificate ISO 14001:1996.