Typical Installation of an SVC

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.

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.

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.

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TYPICAL INSTALLATION

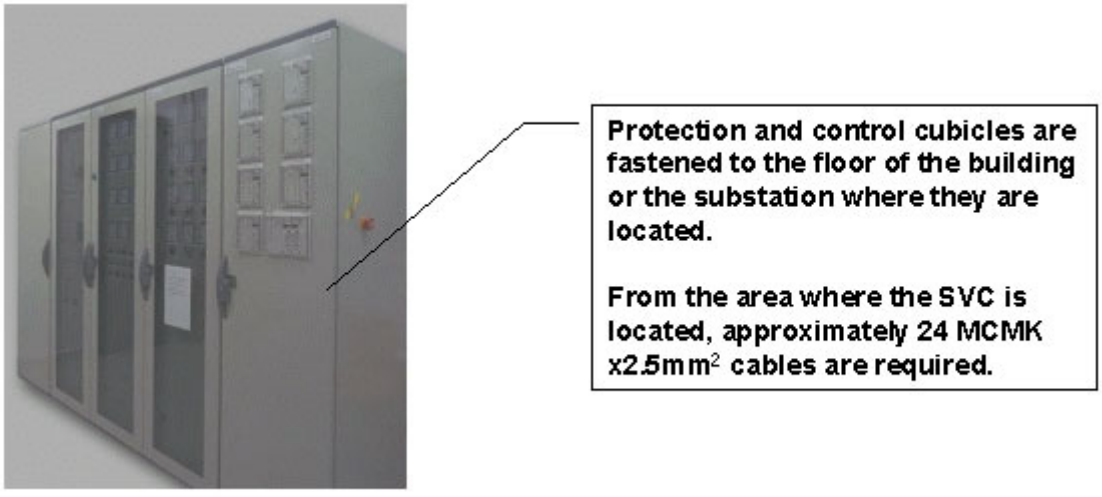
The SVC for industrial applications and the SVC for power utilities are systems with similar configurations. Here briefly will be explained the general installation guidelines for the installation of both systems. Also it will be explained what are the normal scopes of supply of the supply and installation of the systems and components for Nokian Capacitors and for the client.

Control and protection system

The task of control system is to find out by measuring of load the correct firing angle of the thyristor valves to compensate the reactive power. All the logical decisions of the SVC are concentrated in the control system. The PLC in the control system collects information from the control system itself, protection system, valve base system and cooling system and operates the control system, cooling system and circuit breakers according to the predefined logic. The control system is designed and manufactured by Nokian Capacitors.

The protection system is the solid part of control system. This protection system can be understood to protect the outdoor equipment. The protection system utilises commercially available electronic components. The status information of the relays is delivered to the control system.

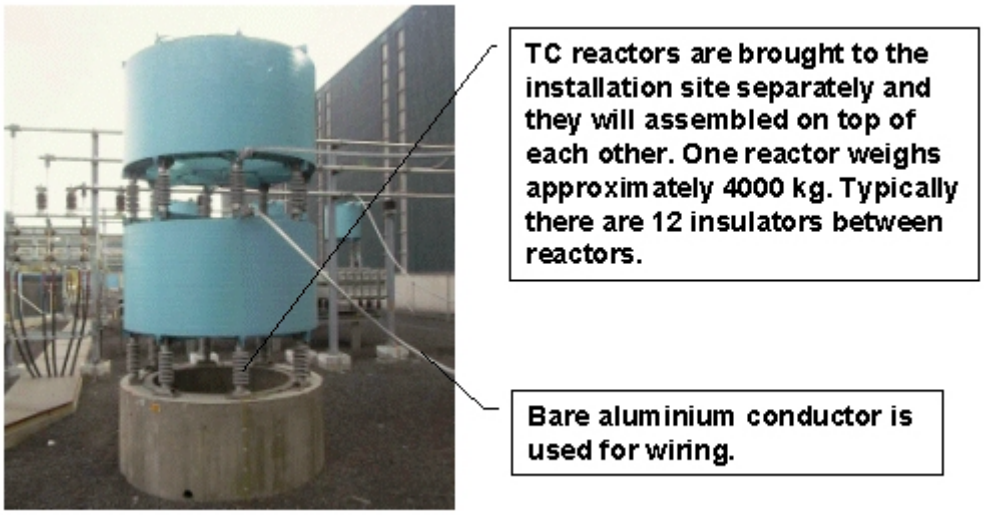
The control and protection system is installed in two adjacent cubicles, bolted permanently together. The Control Cubicle NCC includes the electronic measuring and control circuits, programmable logic of the control system and signal interfaces for digital / analog signals from different SVC equipment.



Thyristor controlled reactors (TCR)

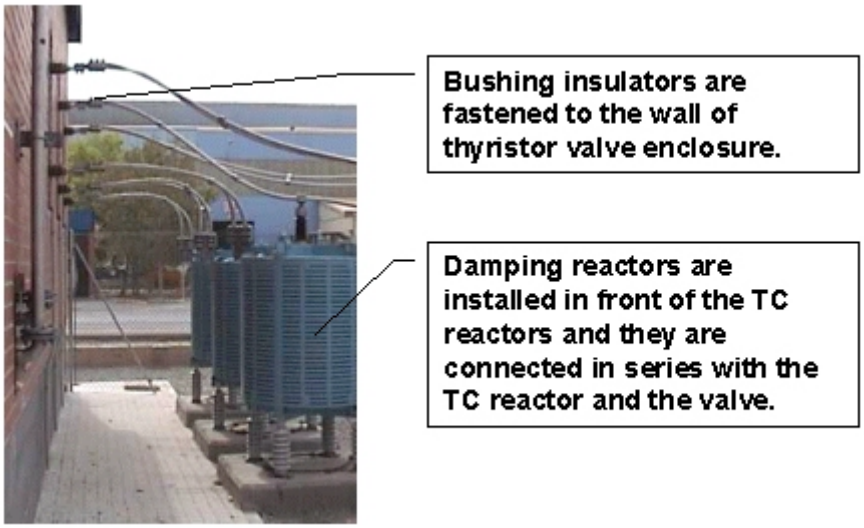
Thyristor controlled reactors (TCR) are providing inductive power in relation of the thyristor current.

Thyristor controlled reactors are delta connected and split into two series connected reactors (coils) between two phases. The one complete TCR consists of six reactors. The thyristor valve has been connected between the reactor series connection. The thyristor valves are protected by the reactor inductance in case of short circuit.



Current limiting reactors

The damping reactors are connected in series with TCR's for decreasing total stray capacitance of the circuit. The low stray capacitance is needed for limiting rate of rise of current and energy injected into thyristor during turn-on stage.



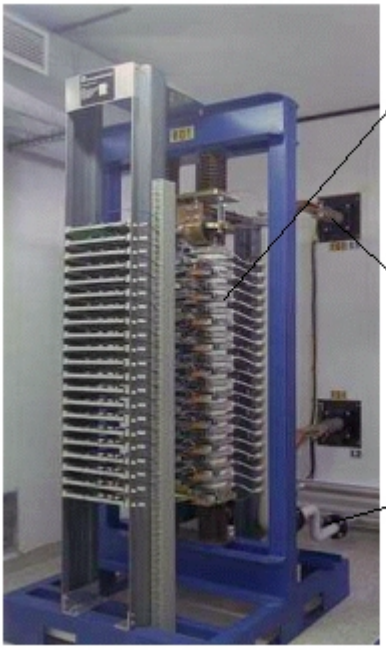
Thyristor valves

The thyristor valve is designed and made by Nokian Capacitors using the thyristor disks of Dynex, EUPEC (or equivalent). The thyristor valve is completely assembled and tested at our factory. At site, the installation work consists of connection of busbars, signal cables and cooling pipes.

The thyristors have been installed inside a ridged steel frame and compressed together with conical spring washer system to give the thyristors correct compression force for sufficient electrical and thermal conductivity.

The thyristor valves are designed to meet the requirements of the relevant IEC publications. Any failed thyristor can be changed without opening or disturbing the water cooling circuit.

The thyristor valve consist of three single phase valves and a control unit (Valve Base Electronics) common to all three phases.



Cooling system

Cooling of the thyristor valves consist of valve cooling unit and valve room air conditioning or ventilation systems that are completely independent of each other.

The cooling system is a single closed system with water/water coolers located indoors. The outside minimum temperature is according to the customer specification. Because the cooling system is closed, the water “level” is monitored by pressure and it is not necessary to increase coolant medium.

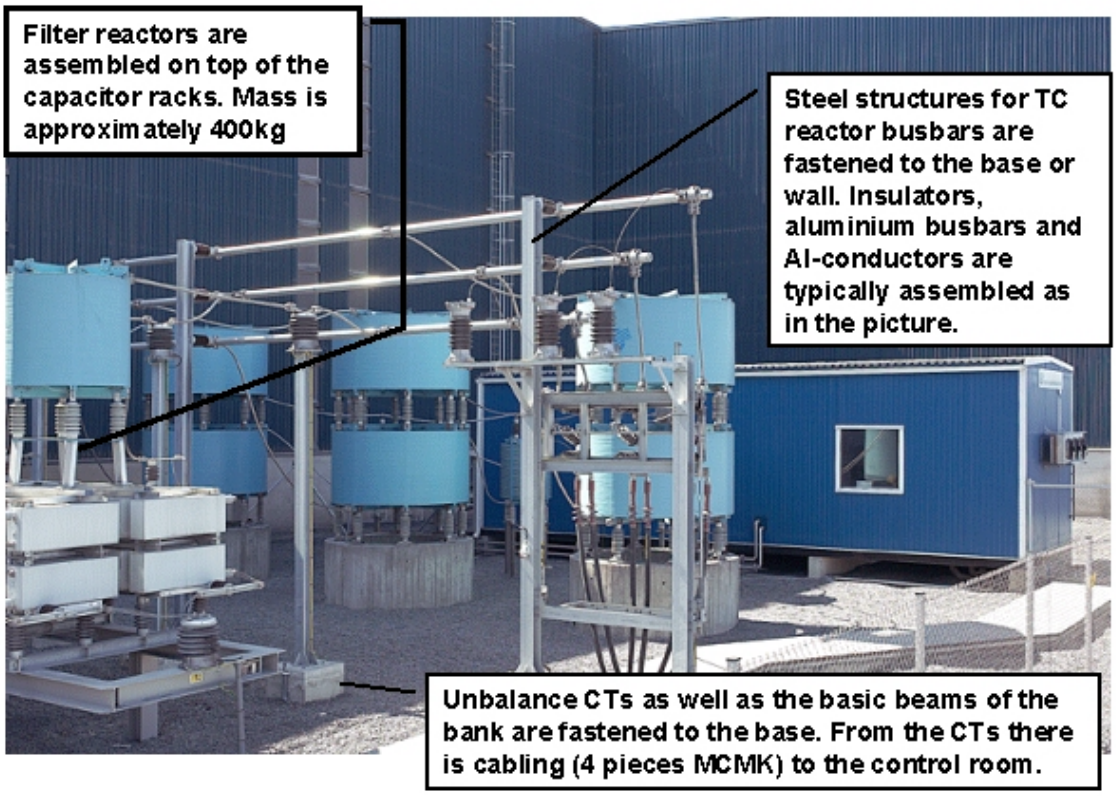
There is one cooling unit for three single-phase thyristor valves. In case of water/water cooling, the cooling unit and the heat exchanger are designed for indoor installation. In case of water/air cooling the heat exchanger will be installed outdoors.

Filter banks

The task of the filter capacitor banks is to provide the needed amount of the capacitive power and to absorb harmonic currents generated by the load and TCR. Some of the existing filters have been chosen to be wide band filters in order to damp side band of harmonics generated by the loads.

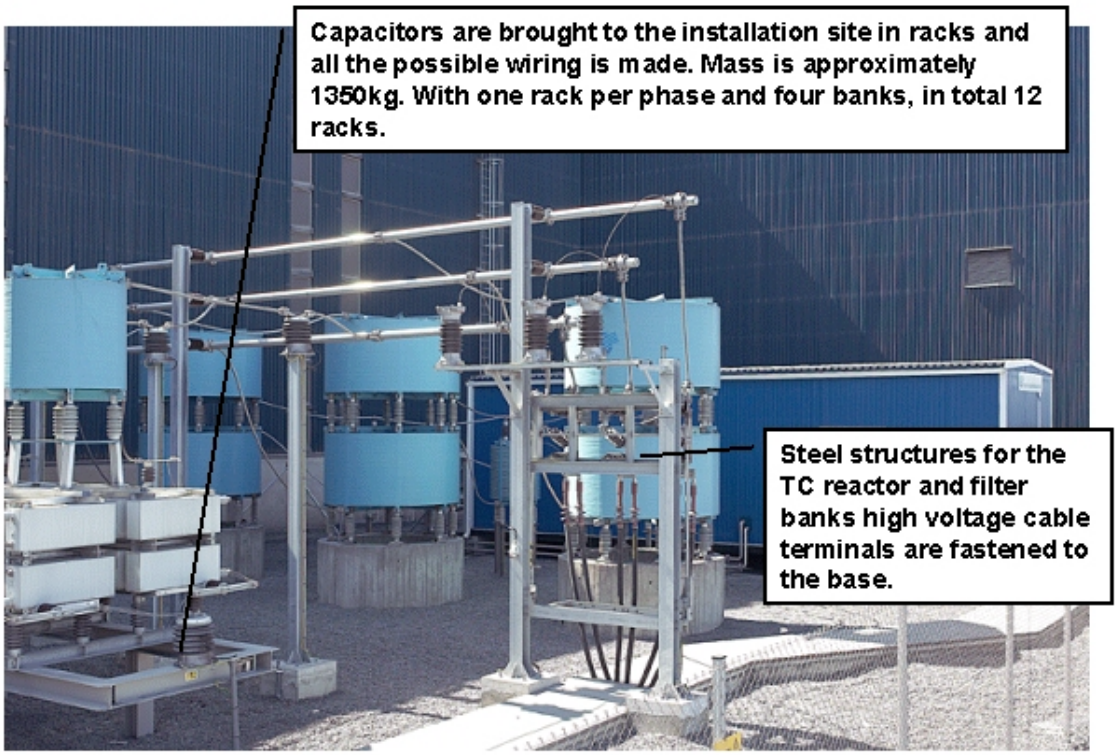
The filter capacitor banks are designed for outdoor installation. They consist of capacitor bank and series connected air core reactor. Air core reactors have been chosen because of their reliability and because they are maintenance free. Because they have no iron they have fixed accurate inductance.

In our usual arrangement the banks have double star connection and unbalance protection using the CT between the star points.



The capacitor banks have capacitor units installed in racks in our factory. Also the internal wiring inside the racks has been made in our factory. The banks have been arranged to star-star connection for unbalance protection. In series with the banks there are the CTs for short circuit and overload protection.

The steel structures, buswork, internal connection material, insulators and wall bushings for the SVC in the SVC's area will be supplied by Nokian Capacitors.



EQUIPMENT AND WORKS SUPPLIED BY THE CLIENT

Civil works
All civil works are in scope of the buyer. The foundation for SVC equipment shall be done according to the guidelines and instructions given by Nokian Capacitors.

Nokian Capacitors will provide the foundation guidelines with dimensions of the concrete foundations above the ground level and the load on the foundations. The design of the foundation under the ground surface depends on the earth quality and this design is not included in Nokian Capacitors' part of the delivery.

Miscellaneous works
Grounding network for SVC equipment, outdoor lighting and fencing around thyristor valve area and around outdoor equipment is in the buyer's scope. Also the buyer should provide the needed water for the cooling system.

Equipment
Equipment like current and voltage transformers connected to the PCC are supplied usually by the customer.

Auxiliary voltage
Nokian Capacitors will provide the AC and DC panels to which the customer will bring the needed AC and DC voltage and power.

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.

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