NOKIAN CAPACITORS

Enclosed capacitor banks for medium voltage

Power factor correction systems, especially automatic ones, have increased their presence in the power utilities, large industrial and commercial consumer environments during the last years. The main reason behind this increase is the need to maintain voltage at acceptable levels and to compensate reactive power to reduce losses in medium voltage distribution systems.

Enclosed capacitor banks designed by Nokian Capacitors Ltd. are used for power factor correction, voltage support, harmonic suppression and to maximize network capacity in industrial applications and distribution systems. They supply individual, group or central reactive power compensation of fluctuating loads in three-phase networks from 3 kV up to 36 kV.

General features

- Modular, compact and robust design optimised for easy future expansion of the system, facilitating transport, storage and installation.
- Galvanised steel enclosures available for indoor and outdoor installations, with different ventilation systems. Protection class ranges from IP30 to IP54.
- Design and testing complies with the requirements of the latest edition of relevant standards and the specific technical requirements set by the customers.
- Use of simplified design and proven components ensures high reliability and low maintenance costs.
- Several communication protocols and the possibility of using arc sensors available in protection relays.
- Optimised to give a low environmental load by using recyclable materials.
- The banks are supplied as fully assembled units, factory tested and ready for connection.

Types of banks

Nokian Capacitors Ltd. manufactures capacitor banks in three basic types:

Fixed banks

Formed by capacitor units and reactors mounted in a common enclosure with no stepping capability. The bank is connected on continuous mode directly to the loads and provides a fixed quantity of reactive power at all times. This method of correction is suitable for example for large machines operating at steady loads.

These banks can be permanently connected to the loads or they can be switched by means of devices located in customer's switchgear.

Fixed banks with switching device

The construction of these banks is basically the same as the fixed banks, but they are fitted with a switching device (off-load disconnector, contactor or circuit breaker), that allows them to be connected and disconnected from the network at any time.

Automatic banks

Formed by different steps, each one composed of capacitor units, reactors and switching devices, mounted in a common enclosure. They can improve the power factor by providing the required amount of reactive power under varying load conditions.

The operation, control and monitoring of the different steps is carried out by a microprocessor based controller according to the need for reactive power. The controller also provides network data and alarm conditions.

Configuration of banks

A bank is usually formed by an incoming cubicle where the main circuit breaker, earthing switch and control and protection relays are placed. Next to it there are one or more step cubicles where capacitors, reactors, fuses and the switching devices are located. Banks can be manufactured with various options and configurations to meet virtually all customer needs.

Protection devices

Typical system protection might include:

- Capacitor units equipped with internal fuses and discharging resistors
- Unbalance current protection
- Overcurrent and earth-fault protection
- Over and undervoltage protection
- Protection relays with arc-sensors
- Arc-fault tested enclosures
- Monitoring of internal enclosure temperature
- HV-HRC fuses with failure indication
- Earthing switches
- Quick discharge transformers

Switching components

Switching devices with tested capacitive switching capability are used, like off-load disconnectors and vacuum or SF6 contactors and circuit breakers.

Reactors

Depending on the harmonic level of the network to which the bank is connected, and the number of steps needed, the banks can be fitted with air-cored or iron-cored damping reactors or blocking reactors.

Capacitor units

Depending on the capacitor connection configuration, the banks are divided into two groups:
Banks with one-phase capacitor units connected in star or double-star, rated up to 12000 kvar up to 36 kV.
Banks with three-phase capacitor units connected in star, rated up to 4800 kvar up to 7.2 kV.

Additional components

Voltage indicators, ventilation fans, cooling units, anti-condensation heaters, earthing terminals, arc contain-ment relief vents, enclosure illumination, key locks, electrical locks, key interlocking systems, bottom or side wall cable entries, door contact switches.

Installation

Installation of the enclosed capacitor banks can be made to any point of the network. When measure-ments are done and harmonic distortion is known, the selection of compensation method can be made (figure 1):

a) Individual compensation: Bank connected directly to the terminals of the consumer
b) Group compensation: Bank connected to a distribution system that feeds a number of individual loads
c) Central compensation: Bank connected to the main busbar in large installations where many individual loads operate

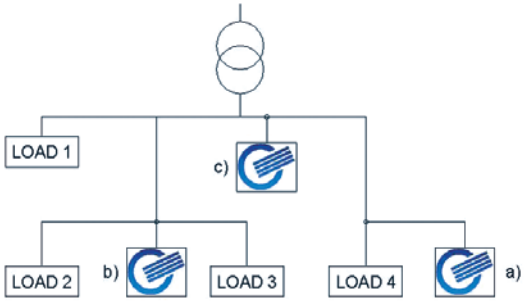

Figure 1: Installation of enclosed capacitor banks

Data required for design

An enclosed capacitor bank is defined with the following:

- Schematic diagram of the system to be compensated
- Rated voltage and frequency
- Reactive power needed
- Data of harmonic loads if any
- Insulation level
- Short circuit level of the system
- Indoor/outdoor installation
- IP class needed for the enclosure
- Protection systems needed
- Extra accessories needed

Applications

Large industrial power users and utilities can benefit from the compensation of power factor and harmonic mitigation. Typical applications include:

- Windfarms
- Automotive assembly
- Heavy manufacturing
- Large commercial institutions
- Mining
- Petrochemical
- Plastics
- Pulp & Paper
- Steel processing
- Power utilities

Range of technical performance

Rated voltage	3…36 kV
Rated frequency	50Hz or 60Hz
Rated power	50…12000 kvar
Number of steps	1…6
Capacitance tolerance	-5/+10%
Insulation level	Up to 70/170 kV
Short-circuit current	Up to 40 kA/1s
Overvoltage (12 hours/day)	1.1 x U_N (as per IEC 60871-1)
Continuous overcurrent	1.3 x I_N (as per IEC 60871-1)
Types of banks	Fixed, fixed with a switching device and automatic
Capacitor units	All-film design impregnated with environmentally safe dielectric liquid
Capacitor steps connection	- One-phase capacitor units connected in star or double-star up to 36 kV systems - Three-phase capacitor units internally connected in star up to 7.2 kV systems
Discharging devices	Resistors inside capacitor units, discharge to 75 V within 10 minutes of de-energisation
Reactors	Air-cored damping reactors or iron-cored blocking reactors
Control of steps	Power factor controller NC-12 or control supplied by the customer
Switching devices	Vacuum contactors or circuit breakers (SF6 on request)
Mounting arrangement	Indoor or outdoor
Installation elevation	< 1000m above sea level (higher elevations on request)
Enclosure IP class	IP30…IP54 (Standard constructions: indoor IP30, outdoor IP44)
Enclosure material	Hot dip galvanised steel
Enclosure colour	Light grey RAL 7032
Cooling method	Natural by air, electrical fan with thermostat or heat exchanger
Cable entry	Bottom or from side wall
Door locking system	Handle without lock, lock with key, electrical lock or special safety lock
Condensation protection	Thermostat controlled heater
Illumination	Fluorescent lamps with switch
Temperature class	Min. 0°C, max. +45°C - average (24 hours): +35°C - average (1 year): +25°C
Temperature of storage	Min. -25°C, max. +55°C
Temperature of transport	Min. -25°C, max. +70°C
Relative humidity	20% RH to 90% RH (non-condensing)
Tests	Routine and type tests for all components. Functional and electrical tests for the capacitor banks. Further tests on agreement.
Standards	IEC 60044-1, IEC 60071-1, IEC 60071-2, IEC 60129, IEC 60289, IEC 60298, IEC 60529, IEC 60694, IEC 60871-1, IEC 60947, IEC 61330, IEC 62271-106, IEC 62271-200, IEC 62271-301

Other configurations available on request.
The data and illustrations are not binding.

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

EN-HV05-01/2006

NOKIAN CAPACITORS

Nokian Capacitors Ltd.
Kaapelikatu 3, P.O. Box 4
FI-33331 Tampere, Finland
Tel. +358 3 3883 11, fax +358 3 3883 360
www.nokiancapacitors.com