CHARM Harmonic Filter

General

Electrical equipment generating harmonic currents are becoming more and more common. Such nonlinear loads usually contain power electronics – rectifiers, converters, soft-starters and home electronics (TVs, VCRs, PCs, etc.). These types of devices offer an efficient energy use, but at the same time they generate disturbances in the form of harmonics.

The most difficult harmonics generator is the electric arc furnace that generates all kinds of harmonics and inter-harmonics.

Problems

Harmonic currents can be amplified due to parallel resonance between inductive and capacitive parts of an electrical system. Harmonic currents cause higher electrical losses in the installation. Most equipment are designed for the fundamental frequency, 50 or 60 Hz. Voltage and current of other frequencies are energy that the machine or apparatus cannot make use of, it turns into heat losses. Furthermore, the harmonic currents cause a superimposed voltage that becomes an overload to the network and installation.

Many counters and meters use the voltage zero crossing for its operation. An amplified harmonic voltage may contain more zero crossings than the fundamental voltage and the measured result will then be wrong. An instrument designed for fundamental frequency may not take harmonics into account and measures wrongly.

High frequency harmonics may interfere with radio and telephone systems.

Requirements

Different countries address the matter of increasing harmonic currents in the electrical systems differently. Usually at least some recommendations of Total Harmonic Distortion (THD) at different voltage levels are issued. There are also international standards available or under way, IEEE Std. 19 and IEC 61000, dealing with power quality disturbances.

Solution

The installation of a filter is the most common method of reducing the harmonics in a system. ABB´s high voltage filter, type CHARM is built up by a capacitor bank connected in series with a reactor, and sometimes also a damping resistor. The filter forms a series resonance circuit for a given frequency, the tuning frequency, which means that for the tuning frequency an impedance minimum is created. Consequently, currents of frequencies close to the tuning frequency will be short-circuited through the filter.

A reduction of 50 - 100 % of the harmonic current content, depending on the tuning frequency, can be achieved by means of a filter. Capacitor bank switching transients will also be somewhat reduced due to the reactor impedance in series with the capacitor bank. (By introducing a synchronized switch the transients can be fully eliminated).

Design information

The following basic information is necessary in order to suggest a suitable filter for a certain application (see fig. 2):

- Single-line diagram
- Fault level (-s)
- Data of step-down transformer (power, voltage ratio, short circuit impedance)
- AC loads
- Harmonic current sources (types, power, location)

Technical data of CHARM

Models	BP, HP or C
Voltage	1- 500 kV
Power	> 1 Mvar
Fundamental frequency	50 or 60 Hz
Tuning frequency	Optional
Installation	Indoor or outdoor
Capacitors	HiQ
Reactor	Air or iron core

CHARM is certified according to EMC-directive 89/336/EEC.

ABB Capacitors is certified according to ISO 9001 (quality) and ISO 14001 (environment).

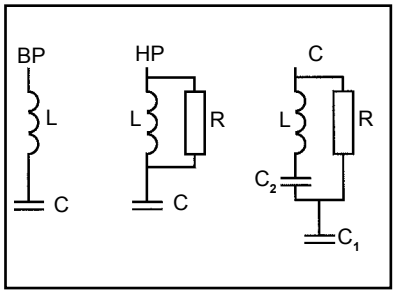

Fig. 1 Different models of filters.

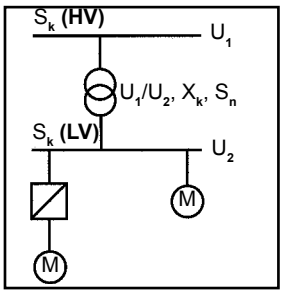

Fig.2 Typical single-line diagram.

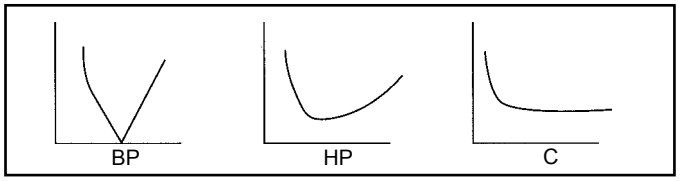

Fig. 3 Impedance characteristics of different filters.

Technical data and design can be subject to change and should be confirmed before ordering.

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