Nexans

Info note

Superconducting fault-current limiters: New tools in the box for handling high short-circuit power

Power grids of the future

An increasingly decentralised supply of power, higher power flows and the present backlog of investment in equipment will require stronger adaptations to the power network in the coming years. In this context, high short-circuit currents play an essential role. For example, in power networks short circuits can arise due to lightning strikes or failures of system components and of power lines, resulting in high fault currents. These cause extremely high dynamic and thermal loads which all system components of the power network must resist.

Due to their modular construction, superconducting fault-current limiters can be used for various nominal voltages and currents and can be adapted to particular limiting characteristics in case of short circuits.

Innovation superconducting fault-current limiters

Electrical equipment that controls high fault currents can increase the security of the network and allow power equipment to be designed more cost-effectively. The superconducting fault-current limiter is such a device. In contrast to a high-voltage fuse it does not disconnect the line in case of a short circuit but limits the very high currents to defined values. In addition, it allows electrical interconnections of existing systems, which would not be possible without limiters.

Functional and inherently safe

During operation, the superconductors of the limiter are cooled to a temperature of around -200 °C, which is easily and cost-effectively accomplished by means of liquid nitrogen. At these temperatures, the materials used have virtually no electrical resistance – even at nominal power loads. However, if the so-called "critical current" (above the nominal current) is exceeded, the material suddenly loses its superconducting properties and behaves like a "normal" resistor. This relatively high resistance limits the current to a predefined value. These material properties only make superconductors ideal self-actuating current limiting elements.

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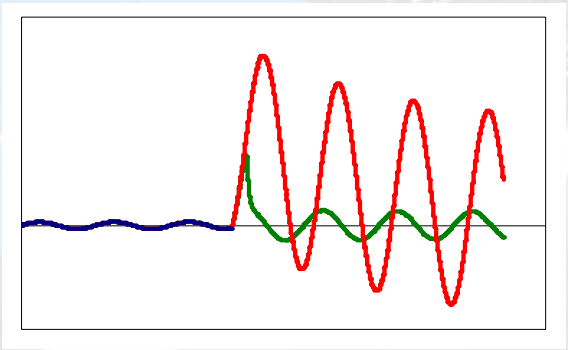
power in its safest form

Maintenance-free operation

After a short circuit, the limiter must be powered off for a short period so that it can automatically return to the operational state by means of cooling. After a few seconds or minutes, depending on the design, the limiter can again accept the nominal power and is ready for the next short circuit event.

The compactly designed current limiter provides nearly ideal operating conditions. In normal operation, it is virtually "transparent" to the network; in case of a fault, it limits the short-circuit current automatically and reliably – independent of its level. In using superconducting fault-current limiters as a protection device, networks can be coupled without causing the short circuit currents to be added.



A short circuit current (red) is limited to a defined value by the current limiter within milliseconds (green).

Possible uses

Typical uses of superconducting fault-current limiters are:

- Busbar coupling while retaining the switching equipment
- Transformer in-line protection
- Protection of local networks in industrial areas or chemical parks
- Protection of the house load in power plants
- Coupling of networks for the reduction of harmonics

Additional advantages of superconducting fault-current limiters

- Due to the passive limiting characteristics of the superconductor, the current is reliably limited within the first half cycle in the presence of a short circuit.
- The superconducting fault-current limiter is inherently safe and is free from wear and maintenance; on-site activation is not required. Thus, no additional operating costs arise from a short circuit.
- Considerable cost savings can be attained within the initial installation or revision of switching equipment, since the equipment can be scaled down to lower short circuit power.
- The peak limited current and the symmetrically limited current can be defined independently of each other.
- In case of a short circuit, the power flow is not interrupted completely, so that existing protection designs can be retained.
- During a short circuit, system components are subject to less mechanical and thermal stresses. This can significantly increase their lifetime.

Service

In addition to the design, production and installation of current limiters, Nexans can also provide for their maintenance and service. Thus, the continuous security and reliability of the equipment is guaranteed.

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