

Superconducting Technologies for Smart Grids

Smart Grid, Green Innovation

The superconducting technologies that Furukawa Electric possesses are likely to offer excellent solutions to environmental and energy issues.

Feature of smart grid

- High-efficiency**
HTS (high-Tc superconducting) power cable, HTS DC cable
- High reliability, self-resilience**
Real time monitor, advanced control system, FCL (fault current limiter)
- High quality**
Power storage system, high voltage power device, FCL
- Dispersed power source**

Superconductivity

Superconductivity is an electrical resistance of exactly zero, occurring in certain materials below a characteristic temperature. It was discovered by Heike Kamerlingh Onnes in 1911. High Tc superconductor, which has superconducting properties in liquid nitrogen temperature, was discovered in 1986. The many promising HTS applications include electric power transmission, transformers, power storage devices, electrical generators, and fault current limiters in a high-performance smart grid. HTS is also expected to use electric motors and magnetic levitation devices as in-vehicle propulsion, ship propulsion, and Maglev trains.

SMES

Electrical power storage device



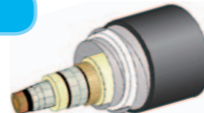
HTS power cable

Low loss and compact power transmission cable



DC HTS cable

Long-distance transmission cable



HTS wind generator

Low loss and compact wind generator

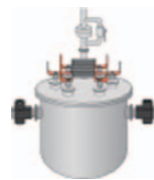
Fly wheel

Electrical power storage device



FCL

Fault current limiter for short circuit accident

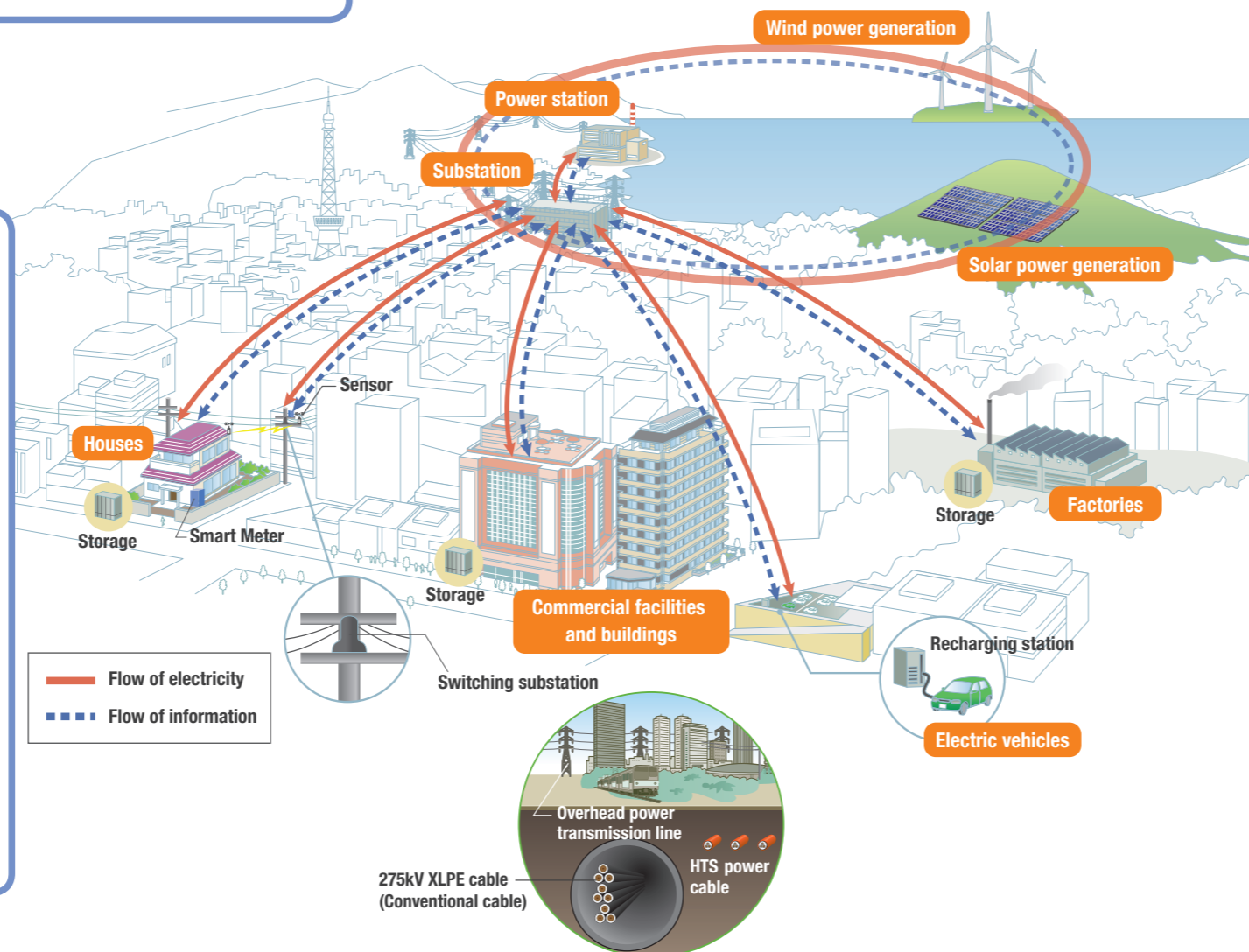
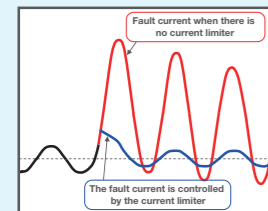


A fault current limiter (FCL) that uses superconducting materials is a power device that suppresses fault currents.

FCL will be an essential element in the smart grid, maintaining its reliability and improving its resilience and flexibility.

Features

- High-speed circuit break
- Self-restitution



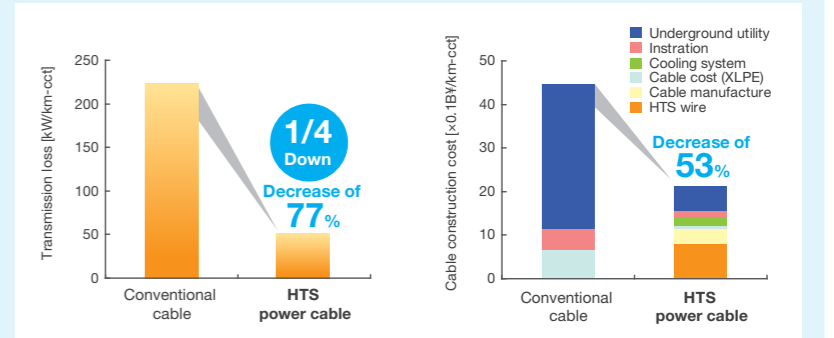
Superconducting power cable

The transmission cables of the future are likely to be HTS power cables rather than conventional cables.

Advantage of HTS power cable

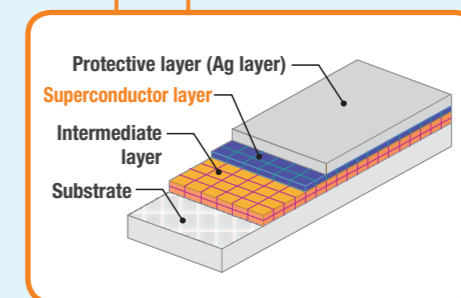
- Compact
- Large transmission capacity
- Low transmission loss
- EMI suppression by an HTS shield

A high-Tc superconducting power cable (HTS power cable) will provide a 1/4 reduction in transmission loss between power plants and users compared to conventional cables using copper or aluminum.



275kV HTS power cable

66kV HTS power cable



YBCO tape

YBCO is a crystalline chemical compound with the formula $YBa_2Cu_3O_7$. This material, a renowned "high-temperature superconductor," achieved prominence because it was the first material to achieve superconductivity above the boiling point of nitrogen.

Demonstration of 500 m HTS power cable



The 500 m HTS cable demonstration was conducted in the NEDO project.

- Period of demonstration: March 2004-February 2005
- Manufacturing and installation: Furukawa Electric
- Test: CRIEPI, Yokosuka Research Laboratory

The test layout had two 180-deg bending sections of 5-m radius, an underground laying section, a 10-m rising and falling section, and a cable offset section to simulate actual cable laying.



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