High Temperature Superconducting Testing Facilities

Improving the Power Grid with Superconducting Technology.

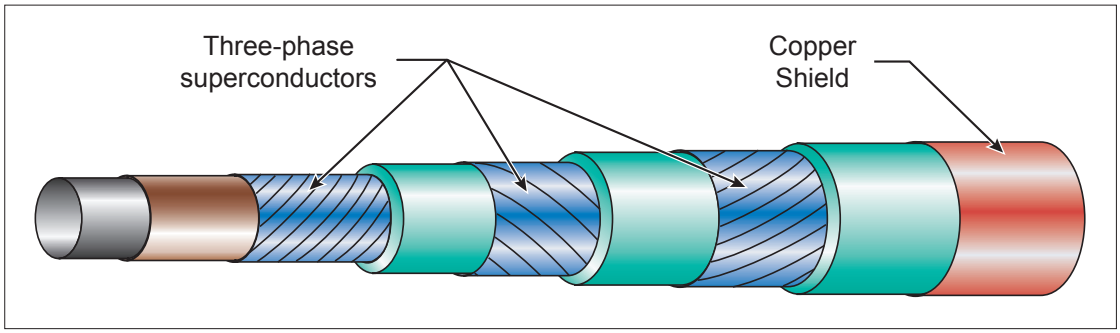
New superconducting technology will help America reduce the demand for additional electric power generation and modernize the transmission infrastructure during the next three decades. Superconducting materials are important to meeting the nation's future energy needs because they have virtually no resistance to electric current, offering the possibility of new electric power equipment with more energy efficiency and higher capacity than today's systems.

The U.S.-Canadian power outage of August 2003 underscored the importance of improving the adequacy and reliability of the nation's power grid. ORNL's High Temperature Superconductivity Technology Center is helping to make the goal of high-temperature superconductivity a reality by blending materials research and wire development through industry partnerships.

Working with Industry to Develop Electric Power Applications

Superconducting technologies developed in partnerships with ORNL and industry have the potential to dramatically increase the transmission capacity, reliability and stability of the power grid, in particular, within existing urban power system infrastructures. ORNL's Applied Superconductivity Group leads DOE Office of Electricity Delivery and Energy Reliability's effort in the research, development and demonstration of high temperature superconducting (HTS) application. Areas of current interest include:

- HTS cables with Southwire Company (Ultera). Utility hosts include American Electric Power (Columbus, Ohio), Entergy (New Orleans, Louisiana) and Con Edison (New York, New York).



Ultera's three-phase triaxial cable.

- HTS Fault Current Limiter with an international team led by SuperPower (Schenectady, New York).
- HTS Transformer with Waukesha Electric Systems (Wisconsin).
- Prototyping applications of second generation HTS tapes, cables and coils.
- Cryogenic dielectrics R&D, including nano-dielectric materials.
- Cryogenic system development for applications in electric utilities, industry, energy and space.

ORNL's Unique Cable Test Facility

In order to facilitate the prototype design, development and testing of HTS and non-HTS power equipment with industry, ORNL has invested substantial resources in the development and operation of many unique facilities. These include the Cable Test Facility, Coil Test Facility, High Voltage Test Facility and Dielectric Research Facility. The Cable Test Facility combines high power capability, cryogenic testing environment and high fault current capacity in the same setting, which makes it a unique resource in the world. Capabilities include:

Staff performing cable bend test.

- Testing of HTS cables and cable components, including power supplies, terminations, joints, and cryogenic systems.
- Cables up to 10 - 20 meters long can be tested (straight configuration with bends up to 90 degrees).
- Cables up to 50 meters long can be tested after completion of upgrades.
- 200-kV impulse testing capability for cables and components.
- 100-kV AC withstand testing.
- Pulse testing with 25,000 amp DC supply.
- Continuous DC current to 25,000 A 1-phase, AC current to 4000 A 3-phase, AC current to 2500 A.
- Fault current up to 40,000 AC at 500-V after upgrades.
- Liquid nitrogen cable cooling system with subcooling to 70 K (1.5 kW) and pressurization to 10 atmospheres.

Cryogenic tank for HTS cable testing.

Substation providing power to the HTS cable test facility.

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