Office of Electricity Delivery and Energy Reliability

Superconductivity Power Equipment

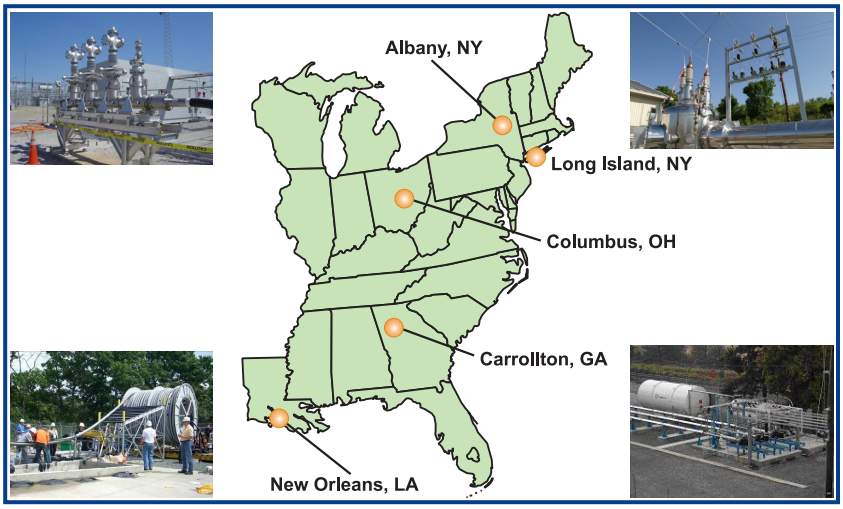
Plugging America Into the Future of Power

High-Temperature Superconductivity Cable Demonstration Projects

"A National Effort to Introduce New Technology into the Power Delivery Infrastructure"

What is being done to modernize electricity transmission and distribution?

In a national effort to introduce new, beneficial technology into the power delivery infrastructure, the U.S. Department of Energy's (DOE) Office of Electricity Delivery and Energy Reliability is partnering with industry to sponsor projects showcasing the use of high-temperature superconducting (HTS) cables in enhancing the performance of electricity transmission and distribution systems. Several teams have formed to focus on different aspects of cable design and different needs of the electric system. This effort involves equipment manufacturers and suppliers from around the world.



Map of DOE sponsored HTS cable projects

DOE announced the first round of cable projects in 2003. These three projects are hosted by electric utility companies in Albany, New York; Columbus, Ohio; and Long Island, New York. All three of the projects have been energized. The planned total investment in the three projects is $85,480,000 (DOE $42,740,000; private sector $40,855,000) appropriated over a four-year period.

A team led by SuperPower Inc. has demonstrating a 350-meter, 34.5-kilovolt HTS cable connecting two National Grid Company substations. The cable ran along the Hudson River in Albany, New York. A section of the cable has been the first ever grid installation of a device using "second generation" HTS wire, a conductor made with new materials that are expected to enable a better cost/performance ratio.

ULTERA (a partnership between Southwire and nkt cables) led the development of a 200-meter, 13.2-kilovolt HTS cable that has been installed in a substation in the American Electric Power grid in Columbus, Ohio. The cable is designed to carry 3,000 amps of current and features a promising new design in which all three phases are carried in a single cable through three different concentric layers of HTS wires.

A team led by American Superconductor energized a power cable on Long Island that connects two Long Island Power Authority (LIPA) substations nearly one-half mile apart. The 138-kilovolt cable is the first ever application of an HTS cable in the utility grid at transmission voltages.

In June 2007, DOE announced that it will provide funding that will be cost-shared with industry for two additional cable projects that will help to modernize the Nation's electricity grid. Also included in the recent DOE funding award were three HTS fault current limiter projects.

"In order to meet President Obama's ambitious energy goals, we must modernize the nation's electrical grid to improve the transmission, storage and reliability of clean energy across the country and help to move renewable energy from the places it can be produced to the places it can be used. The Department of Energy is working with industry partners to develop the next generation of clean energy technologies, such as high-temperature superconducting cables, that will enhance the performance and capacity of the country's electricity transmission and distribution systems. These highly energy efficient cables will help reduce electricity lost in transmission and save energy nationally," said Energy Secretary Steven Chu.

www.oe.energy.gov **Phone: 202-586-1411**

Office of Electricity Delivery and Energy Reliability, OE-1
U.S. Department of Energy – 1000 Independence Avenue, SW – Washington, DC 20585.

Contact Information:

Albany Cable:
Drew Hazelton, SuperPower
(518) 346-1414
dhazelton@superpower-inc.com

Columbus Cable:
David Lindsay, ULTERA
(770) 832-4916
david_lindsay@southwire.com

Long Island Cable:
Jim Maguire
American Superconductor
(508) 621-4143
jmaguire@amsuper.com

DOE Program:

Debbie Haught, DOE
(202) 586-2211
debbie.haught@hq.doe.gov

One of the two new projects is led by the Southwire Company with DOE cost share of $13.3 million. Southwire will use a 13.8-kilovolt superconducting cable to connect two existing substation sites that are 1.1 miles apart which will solve a real-world electrical load problem near downtown New Orleans.

The other project is led by the American Superconductor Corporation (AMSC) with DOE cost sharing funds of $9 million. AMSC will develop the key components required to commercially deploy second-generation, high-temperature superconducing cables and demonstrate a single-phase prototype cable in the Long Island Power Authority grid.

What is Superconductivity?

Superconductivity is a property that only a few materials are known to possess. When cooled to very cold temperatures, these materials are able to carry electricity without resistance, meaning that less electricity is lost while being conducted through those materials. Prior to 1986, it was thought that materials needed to be cooled to near absolute zero to exhibit superconductivity, but two IBM researchers in that year discovered a class of materials that would superconduct at much "warmer" temperatures, around minus 320°F. This meant that they could be cooled with inexpensive, abundant, and inert liquid nitrogen.

Today the DOE participates in a suite of projects in which electric utility devices using superconducting wires are being demonstrated. DOE is matching industry funding with federal funding to demonstrate devices that will typically be half the size and have half the energy losses compared to conventional equipment.

What can HTS cables do for me?

HTS cables, with their increased efficiency, have the potential to reduce the amount of electricity lost in transmission and distribution. The grid in the United States loses an estimated 10 percent of all electricity generated before it can be sold to the customer—an amount roughly equal to the electricity generated in the entire country of Brazil. The amount of lost electricity is growing every year, as load centers move further away from power plants and as electricity must be conducted for longer distances. The cost of this lost electricity is passed on to the customers of electric utilities. HTS cables have the potential to reduce that cost.

More immediately, HTS cables can pack more current through available spaces. In congested urban areas, expanding the capacity of an underground power line can involve digging up streets and can be expensive and disruptive. In addition to improved efficiency, HTS cables offer additional environmental and safety benefits. HTS cables use liquid nitrogen as a coolant instead of the dielectric oil commonly used in some conventional high-voltage cables, which can be hazardous, flammable, and potentially polluting.

Why are public sector dollars funding these projects?

Traditional systems for generating, transmitting, and using electrical current have been designed with a brute-force approach to overcoming electrical resistance. Because high-temperature superconductors make it possible to conduct electricity without resistance, they offer the potential to dramatically reshape the nature of the electrical grid.

However, the materials used in HTS wires are brittle, expensive, and often difficult to work with, making HTS research a very high-risk, high-reward endeavor. Electric transmission and distribution companies face a growing uncertainty that investments in new technology can be recovered through the rate base.