Project Fact Sheet

Albany HTS Power Cable

This project involves the development and demonstration of a High Temperature Superconducting (HTS) cable, including first-of-a-kind applications of a cable splice and a section of cable fabricated using second generation superconducting wire cable, in the power grid in Albany, New York.

What are its Primary Applications?

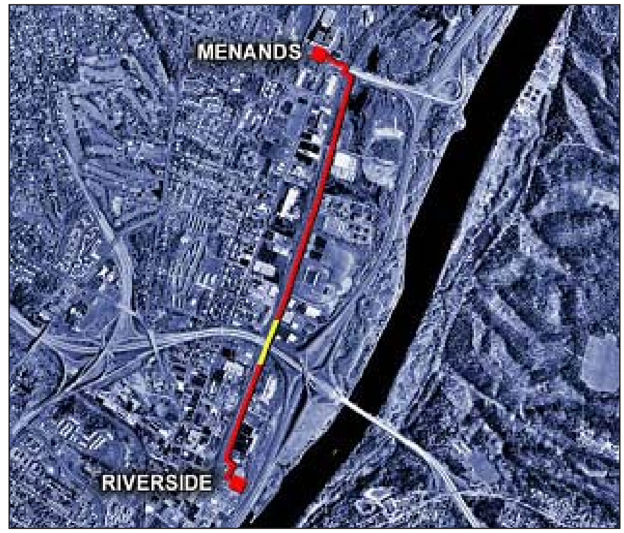
HTS power cables are used for power transmission and distribution. The Albany cable will be a distribution cable, conducting electricity within a local grid.

What are the Benefits to Utilities?

HTS is an advanced technology that can both strengthen and improve the electrical system. Superconducting cables offer higher capacity and greater efficiency in the delivery of electric power. HTS cables can carry three to five times more power than conventional cable and can meet increasing power demands in urban areas via retrofit applications, eliminating the need to acquire new rights-of-way and to dig new cable pathways. Since electrical resistance is minimal, power can be delivered at lower voltages, eliminating the need for some transformers along the delivery path. In addition, HTS cables are cooled with liquid nitrogen – a material compatible with the atmosphere – in contrast to the hazardous, flammable, and potentially polluting oil used to cool some conventional cables.

What is the Market Potential?

The growing economy depends on reliable, efficient electricity delivery. As energy demands increase and environmental concerns heighten, underground HTS cable will provide the necessary alternative to meet power supply needs. Power transmission in underground HTS cables can substitute for overhead transmission lines when environmental and other concerns prohibit overhead installation. The development of commercially viable HTS transmission cable will allow U.S. industry to capture a large portion of the growing national transmission cable market. In addition, international markets are estimated to be 10 times larger than the U.S. market, and growing more rapidly.



The route of the power cable in Albany showing the section that will be replaced with a superconducting cable (yellow).

The latter stage of this project will result in the first demonstration of a transmission cable that uses second generation (2G) or "coated conductor" superconducting wire. The new wires are expected to have both performance and cost advantages over earlier HTS wires, and to hasten HTS technology's entry into the cable market.

What are the Project Accomplishments to Date?

The project was awarded in July 2003. The preliminary design of the cable is being completed. The cable is being designed to carry 800 amps at 34.5 kV. The project team expects to use "three-core HTS cable

What is the Status of the Project?

The project was awarded in July 2003. The team has completed the conceptual design phase, and is currently testing key components and sub-systems of the cable, cryogenic system, terminations, and the cable joint. Advancements in the development of second generation wire are continuing on track at SuperPower and at Los Alamos National Laboratory.

Office of Electric Transmission and Distribution, TD-1
U.S. Department of Energy – 1000 Independence Avenue, SW – Washington, DC 20585.

Goal:

To demonstrate the technical and commercial viability of High Temperature Superconducting (HTS) cables by operating a 350-meter superconducting cable, including a 30 meter section made from 2nd generation HTS wire, between two Niagara Mohawk substations.

Team:

SuperPower (Project Lead and 2G HTS Wire)

BOC (Cryogenic System)

Sumitomo Electric (Cable Production)

New York State Energy Research and Development Authority (Additional Funding)

Niagara Mohawk (Host Utility)

Period of Performance:

7/2003 – 5/2007

Cumulative Project Funding:

Private $12.86 Million (50%)
DOE $12.86 Million (50%)
Total: $25.71 Million

What is it?

A power cable is designed to carry large amounts of electrical current over short or long distances.

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Part of the Albany cable will use second-generation wires, a Yttrium superconductor coated on a metal substrate.

technology," which means the cable will have three separate copper cores in a single cryogenic pipe, or cryostat. Each core is surrounded by layers of HTS wire and electrical insulation, and the whole assembly is then surrounded by liquid nitrogen coolant and thermal insulation. The design uses a "cold dielectric" scheme in which the cryogenic fluid and thermal insulation surrounds the electrical insulation in the cable.

The 350-meter cable will be installed underground in Albany, running along the Hudson River and under Interstate 90, and will connect two Niagara Mohawk substations. Plans include the first ever demonstration of a splice in an HTS cable 30 meters from one end. In the latter stages of the project, the 30-meter section will be replaced with a section of cable made with 2G HTS wires. Meanwhile, cryogenic system manufacturer BOC is focused on producing a refrigeration system that will meet the stringent reliability and efficiency standards required by the utility industry. The cable is expected to be operational in 2005, with demonstration of the 2G wire and cable occurring in 2006.

Alignment with Administration Priorities:

National Energy Policy: " …expand the Department's research and development on transmission reliability and superconductivity"

National Transmission Grid Study: " … accelerate development and demonstration of its technologies, including high-temperature superconductivity…

Secretary of Energy: "… focuses R&D dollars on long-term, potentially high-payoff activities that require Federal involvement to be both successful and achieve public benefit."

Energy Information Agency: "Of [advanced power delivery] technologies, superconductivity holds the most promise for yielding significant efficiency gains."

How Does it Work?

Conventional conductors of copper or aluminum are replaced by HTS wire, enabling the cable to carry greater amounts of current with fewer losses due to resistance. The cable requires a cooling system to refrigerate the HTS conductors to a temperature at which resistance is minimized.

To date, HTS cable demonstration projects have relied on first-generation superconductors, which consist of a powder-like Bismuth-based superconductor packed into silver tubes and extruded to form wires. Silver has been the only metal found that has the electrical, chemical, and structural properties to create high quality HTS wire, and its high cost has kept HTS cables from being an economical solution for relieving electrical bottlenecks.

This project will incorporate a new kind of wire in which a Yttrium-based superconductor is chemically coated on a non-silver metal substrate. Although the process is still being refined, research has already resulted in HTS wire with superior performance and dramatically reduced manufacturing costs.