



**Superconductivity News Update**  
**19 February 2007**

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## **High-Temperature Superconductivity at 21**

High-temperature superconductivity (HTS) turns 21 this month. For over a third of this time, we have been chronicling breakthroughs in this revolutionary electricity technology in "Superconductivity News Update." From pilot projects around the country to advances in scientific and technical understanding of how to make superconductivity work in the nation's electric utility systems, we have attempted to cover the major stories in this field in a style that is accessible to technological experts and non-experts alike.

In this issue, we are revisiting some of the most notable stories we have covered since late 1999, along with the 1986 news report on the initial discovery of high-temperature superconductivity. Since we have covered hundreds of different stories since 1999, the stories included here were chosen somewhat arbitrarily, but we feel that these stories illustrate the great strides that superconductivity applications for power systems have taken in just seven years. Some stories have been edited for brevity and clarity, and to remove details such as obsolete website addresses and outdated contact information.

Superconductivity News Updates issued since 13 May 2005 are posted to <http://www.superconductivitynewsupdate.com/newsletter.htm>. For copies of any updates issued before May 2005, please contact Jodi Hamrick at [superconduct@bl-a.com](mailto:superconduct@bl-a.com).

Due to budget issues in 2004, this newsletter was not published that year. Thus the 13 May 2005 issue covered developments during all of 2004 and up to May 2005.

As always, we encourage your comments and questions as we continue working in 2007 to highlight new developments in the field of high-temperature superconductivity for power systems.

## Highlights from “Superconductivity News Update”

1986: Superconductivity Achieved At Record High Temperatures

1990: BSCCO Discovery

1995: LANL Develops IBAD

1996: ORNL discovers RABiTS™

1999: EPRI Calls Superconductivity an Important Part of America’s Future Power Grid

2000: Southwire Dedicates First Working Superconducting Power Delivery System

2000: ES&H Impacts of Superconducting Power Equipment

2001: Southwire Celebrates One Year of Operating HTS Power Delivery System

2001: Vice President’s Energy Policy Task Force Makes Superconductivity

Recommendation

2001: White House Energy Event in Cleveland Focuses on Superconductivity

2001: Intermagnetics Announces Project to Install HTS Power Cable in Niagara

Mohawk’s Albany Grid

2002: Superconductivity Cited as “Enabling Technology” in EPA Climate Action Report

2002: Department of Energy Releases National Transmission Grid Study

2002: Southwire Reports “Outstanding Reliability” with Superconducting Cable Pilot

Project

2002: Superpower and National Laboratories to Develop Second Generation Wire

Technology

2003: Nobel Prize Awarded to Superconductivity Researchers

2004: Governor Pataki breaks ground for new superconducting cable project

2005: President Bush calls for reduced U.S. dependence on foreign oil

2005: American Superconductor receives HTS wire order from Ultera for Columbus,

Ohio, superconductor cable project

2005: Will Superconductivity Help Strengthen the Grid?

2006: Annual Peer Review Showcases R&D Activities and Superconductivity Partnership with Industry (SPI) Demonstration Projects

- SPI Project: *Columbus Bixby Substation Power Line*
- SPI Project: *Albany Power Line*
- SPI Project: *Long Island Power Line*
- SPI Project: *Fault Current Limiter*

2006: Message from DOE Superconductivity Program Manager Tells of Program Goals and Successes

2006: Intermagnetics claims superconductor performance milestone

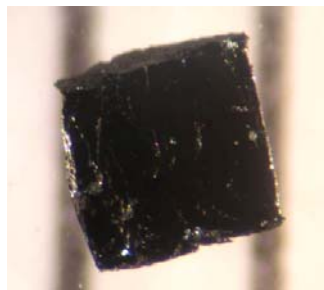
2006: New Superconducting Lines Deliver Power to Columbus Suburb

2006: Bodman on “A New Energy Plan for America”

## 1986: Superconductivity Achieved At Record High Temperatures

Zurich, Switzerland, January 28, 1986. Two physicists at an IBM research laboratory in Zurich, Switzerland have reported signs of resistance-free conduction of electric current at the unprecedented high absolute temperature of 35 Kelvin. Researchers Alex Müller and Georg Bednorz report that unlike low-temperature superconductors, which are metallic or semimetallic, these new compounds are ceramic and are capable of achieving superconductivity at temperatures of up to 35 K (-238 degrees C). Previously, superconductivity had been possible only at much lower temperatures, making widespread practical applications expensive and impractical. Industry observers and scientific experts predict that in the near future, superconductivity will be achievable at even higher temperatures, enabling the use of inexpensive, abundant and environmentally benign liquid nitrogen as a coolant. The same observers predict that superconducting utility power applications will become an important part of our nation's electrical infrastructure in the 21st century. (Müller and Bednorz went on to receive the 1987 Nobel Prize in physics for their discovery of HTS.)

## 1990 – BSCCO Discovery



A small sample of the high-temperature superconductor BSCCO-2223. (The two lines in the background are 1 mm apart.)

BSCCO (pronounced "bisco") is shorthand for bismuth-strontium-calcium-copper oxide. Several domestic and foreign companies are now fabricating BSCCO tapes and wires in lengths of kilometers. They pack BSCCO in silver tubes and draw the tubes into wires or flatten them into tapes. BSCCO performs well in underground transmission cables and transformers at temperatures of 65 to 77 K and in higher magnetic fields at 20 to 30 K, BSCCO's grains are platelike, so when the material is rolled, they tend to line up in one direction more easily than YBCO grains.

Multi-filamentary HTS tapes fabricated by the oxide-powder-in-tube deformation process are typically composites of silver or silver alloy and one of the bismuth-based high temperature superconductors, either  $\text{Bi}_2\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_{10}$  or  $\text{Bi}_2\text{Sr}_2\text{Ca}_1\text{Cu}_2\text{O}_8$  (BSCCO-2223 or 2212). The combination of fine filaments (each of order 10 microns in thickness and 200 microns in width) with the metal matrix reduces crack formation and allows critical strains, whether tensile, compressive or bend, in a range of several tenths of a percent. Critical stresses, determined by the silver alloy sheath, typically range from 50 (for pure silver) up to 130 MPa. These tapes can be further strengthened by lamination, for example with stainless steel, giving critical strains up to 265 MPa.

BSCCO tapes are now commercially available through American Superconductor (AMSC) as a result of partnerships with the National Labs and the University of Wisconsin in the Wire Development Group (WDG). BSCCO is currently utilized in the Superconductivity Partnership with Industry (SPI) projects and other prototype power demonstrations. Continued partnerships further improvement of properties of BSCCO tapes which are critical to the continued technical advancements of the technology.

For more information, please visit:

[http://www.ornl.gov/info/ornlreview/rev29\\_3/text/hotwire.htm](http://www.ornl.gov/info/ornlreview/rev29_3/text/hotwire.htm) ;

<http://www.amsuper.com/products/library/001-187.pdf> ;

<http://www.lanl.gov/orgs/mpa/stc/highlights.shtml>

### **1995 – LANL Develops IBAD**

Researchers at Los Alamos National Laboratory (LANL) have addressed the weak link problem by dramatically improving a technique first used by Fujikura of Japan, called Ion Beam Assisted Deposition (IBAD). In 1995 LANL announced achieving record performance by pulsed laser deposition (PLD) of YBCO on a template layer of yttrium stabilized zirconia (YSZ). Later, in cooperation with Stanford University, LANL demonstrated a template formation process that is 100 times faster by replacing the YSZ template material with magnesium oxide (MgO). Both materials provide excellent characteristics for subsequent deposition of a buffer layer, and finally YBCO. Because of the high degree of crystalline texture, the YBCO layer is strongly linked and has outstanding current carrying ability. Additionally, wires made under this process eliminate the need for high-cost silver required in the manufacture of first generation wire, yielding a significant cost reduction for second generation wires.

For more information, please visit

[http://www.oe.energy.gov/DocumentsandMedia/IBAD\\_fact\\_sheet.pdf](http://www.oe.energy.gov/DocumentsandMedia/IBAD_fact_sheet.pdf)

### **1996: ORNL discovers RABiTS™**

A new superconducting wire developed at the Department of Energy's (DOE) Oak Ridge National Laboratory (ORNL) may pave the way for the future manufacture of practical yttrium- or thallium-based conductors for electric power applications.

ORNL researchers described a new type of high current density, thick-film superconductor on April 10, 1996, at the Materials Research Society meeting in San Francisco.

Oak Ridge researchers have produced a roll-textured, buffered metal, superconducting tape with a critical current density of 300,000 amperes per square centimeter in liquid nitrogen. The higher the current density the greater the amount of electric current that can be transmitted through the wire. Standard household wires typically carry less than 1000 amperes per square centimeter.

Superconductors have virtually no resistance to electric current, offering the possibility of new electric power equipment with improved energy efficiency, smaller size, and lower operating costs than today's devices. These systems could help reduce the U.S. requirements for new power plants, since electricity demand is expected to double by the year 2030.

For more information, please visit: <http://www.ornl.gov/sci/htsc/documents/archives/rabits.htm>

## **1999: EPRI Calls Superconductivity an Important Part of America's Future Power Grid**

In its new "Electricity Technology Roadmap," the Electric Power Research Institute (EPRI) says that the "reliability of America's power grid is increasingly threatened."

High-temperature superconductivity is featured repeatedly in the "roadmap" as an essential part of our country's future power grid. In a press conference rolling out the report, EPRI president and CEO Kurt Yeager said that HTS would help improve reliability and meet increased demand, "especially in crowded downtown areas where there is no room for new cables." He characterized HTS and other new electric power technologies as essential in maintaining America's prosperity, economic competitiveness and environmental protection.

—From Superconductivity News Update of 16 December 1999

## **2000: Southwire Dedicates First Working Superconducting Power Delivery System**

Secretary of Energy Bill Richardson joined Georgia Governor Roy Barnes and Southwire Company Chairman Roy Richards, Jr. in a ceremony to dedicate the world's first industrial application of high-temperature superconducting cables to transmit electricity. The cables were activated on 5 January.

This new power delivery system includes three 100-foot superconducting power distribution cables and provides electricity to three Southwire manufacturing plants in Carrollton, Georgia. It represents a breakthrough in making the difficult transition from laboratory testing to a practical field application.



Secretary Richardson said "this is an exciting step toward the first practical deployment of superconducting technology, which promises to do for electric transmission what fiber optics is doing for communication. These cables, developed through a partnership with the Energy Department and the private sector, will move large amounts of electricity using the same space or less space than traditional cable, increasing energy efficiency, enhancing grid reliability and reducing costs for businesses and consumers."

Southwire's partners in this project include the U.S. Department of Energy, which has co-funded the project, and Oak Ridge (Tennessee) and Argonne (Illinois) National Laboratories. Industrial partners include Intermagnetics General Corporation of Schenectady, New York and EURUS Technologies, Inc. of Tallahassee, Florida. Electrical utility partners include Southern Company, Georgia Transmission Corporation and Southern California Edison.

—From Superconductivity News Update of 23 February 2000

## **2000: ES&H Impacts of Superconducting Power Equipment**

Argonne National Laboratory has issued a report by Alan M. Wolsky describing the likely environmental, safety and health (ES&H) effects on the general population that would follow from the adoption of superconducting power equipment by the electric power sector and its principal customers. This report was based on work done for the International Energy Agency's "Implementing Agreement for a Cooperative Program for Assessing the Impacts of High-Temperature Superconductivity on the Electric Power Sector."

Describing the potential ES&H impact of specific superconducting power applications, as well as coolant technology, Wolsky concludes that "[t]he principal likely ES&H benefit arising from the possibility of increased power density [offered by superconductivity] is increased capacity in the distribution system with no concomitant ES&H impact. This will be particularly valued in densely populated urban areas, where conventional methods of increasing capacity have detrimental ES&H effects."

Other benefits cited by Wolsky include the environmental benefits offered by superconductivity, such as oil-free transformers and the ability to increase the capacity of existing substations, making new construction unnecessary. He also cites the possibility of increased fuel efficiency in gas turbines and better use of solar and geothermal resources.

—From Superconductivity News Update of June 2000

## **2001: Southwire Celebrates One Year of Operating HTS Power Delivery System**



Carrollton, Georgia, January 5, 2001. A year after activating its high-temperature superconducting (HTS) power delivery system, Southwire Company provided a glimpse into the superconductor project's future today as it celebrated the anniversary and the system's

recent milestone of operating for 5,000 hours at a 100-percent load.

"A year ago, we brought to life the first high-temperature superconducting power delivery system to provide power for an industrial use. In the year and more than 5,000 hours since, the system has exceeded our greatest expectations," said R.L. Hughey, Southwire's superconductor project manager. "As we look ahead, we hope to advance HTS technology by building cables that are longer and that carry more current at higher voltage. We are equally as excited and confident that our future efforts will meet with the same level of success."

Activated on Jan. 5, 2000, Southwire's power delivery system provides power to three manufacturing plants at the company's Carrollton, Georgia headquarters. Nearly immune to resistance, Southwire's HTS cables lose only about a half-percent of power during transmission, compared to 5 to 8 percent lost by traditional cables. The cables also deliver more power, about three to five times more than traditional power cables.

—From Superconductivity News Update of 29 January 2001

## **2001: Vice President’s Energy Policy Task Force Makes Superconductivity Recommendation**

The National Energy Policy Development Group, chaired by Vice President Dick Cheney, strongly endorsed high-temperature superconductivity in its final report, recommending that the “President direct the Secretary of Energy to expand the Department’s research and development on transmission reliability and superconductivity.”

On superconductivity, the report noted that:

“Promising technologies exist that will improve the transmission, storage, and reliability of renewable energy. An example of recent technological success that will allow for increased access to all forms of energy, including renewable energy, is the high-temperature superconducting underground power transmission cables that the Department of Energy is developing in partnership with industry. These cables will allow a 300 percent increase in capacity without excavation to lay new transmission lines.”

—From Superconductivity News Update of 31 May 2001

## **2001: White House Energy Event in Cleveland Focuses on Superconductivity**

—1,600-hp Superconducting Motor Demonstrated for Transportation Secretary Mineta



*David Driscoll of Rockwell Automation explains the finer points of superconductivity while Secretary Mineta looks on. (Photo courtesy Rockwell Automation)*

Secretary of Transportation Norman Y. Mineta chose the U.S. DOE Energy Efficiency and Renewable Energy Program’s superconducting motor project to highlight the Administration’s national energy strategy. On 16 July, Rockwell Automation presented an overview of the company’s energy efficiency initiative before Secretary Mineta, Ohio Governor Bob Taft, and a number of Ohio elected officials at the company’s Advanced Development Laboratory in Euclid, Ohio.

“On behalf of President Bush and Vice President Cheney, I congratulate you and your exceptional team on the success of your commercial-scale 1,000 horsepower high-temperature superconductor motor,” commented

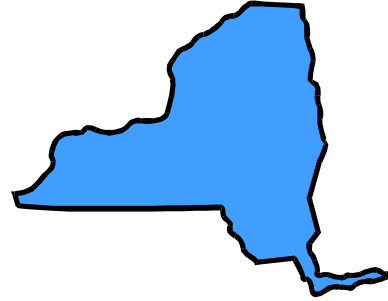
Mineta. “With so many potential applications, this motor serves as an excellent example of a new era in America.”

—From Superconductivity News Update of 19 July 2001

## **2001: Intermagnetics Announces Project to Install HTS Power Cable in Niagara Mohawk's Albany Grid**

—Design Intended to Demonstrate Evolution of Key Technology in Standard Urban Right-of-Way

Intermagnetics General Corporation announced on 14 August that its IGC-SuperPower subsidiary will lead a \$20 million project to install an underground, high-temperature superconducting (HTS) power cable in Albany, N.Y. The cable, to be installed in Niagara Mohawk Power Corporation's power grid and to incorporate components manufactured by Nexans, is designed to demonstrate enhanced capacity, reliability and power quality of HTS cables.



“The one-quarter-mile cable, believed to be four times the length of any previously installed HTS cable, will be designed to provide more power and operate at significantly lower loss levels than other HTS installations,” said Glenn H. Epstein, president and chief executive officer of Intermagnetics. “It also is targeted to be the first HTS cable installation within a standard underground urban right-of-way. We believe the participation of Niagara Mohawk and Nexans, both leaders in their respective fields, will help ensure the ultimate success of the project.” Although first-generation HTS material will be used for this particular project, IGC-SuperPower intends to separately build a laboratory scale section of HTS cable using second-generation conductor in order to test its properties. Second-generation materials employ less labor-intensive methods and less expensive materials. SuperPower is working to develop a commercial-level manufacturing process for second-generation HTS conductor, which is believed to be necessary to achieve the cost-performance levels required for commercialization of HTS cables and devices.

—From Superconductivity News Update of 5 September 2001

## **2002: Superconductivity Cited as “Enabling Technology” in EPA Climate Action Report**



The “U.S. Department of State, U.S. Climate Action Report 2002” was recently released by the U.S. Environmental Protection Agency (EPA). Constituting the “Third National Communication of the United States of America Under the United Nations Framework Convention on Climate Change,” this document takes a close look at the climate-change issue and various technological and policy approaches.

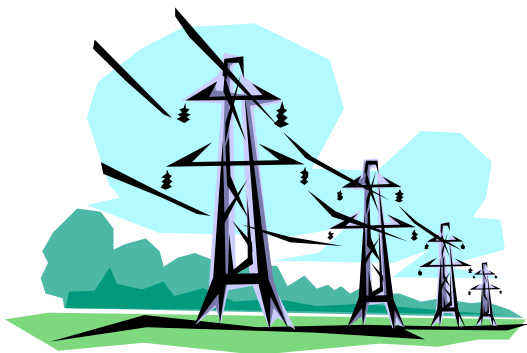
Along with a number of renewable energy and energy efficiency technologies, the report calls the high-temperature superconductivity program out for special attention, noting on page 56 of the report that superconductivity “would allow more electricity to reach consumers and perform useful work with no increase in fossil CO<sub>2</sub> emissions.” In a special summary sheet on superconductivity, the report notes on page 188 that the program [also]

“has non-greenhouse gas environmental benefits, such as reducing SOx emissions; improves energy reliability; reduces strain on the electric grid infrastructure; cuts transmission losses by half; and allows electrical equipment to be reduced in size dramatically (which opens more potential site applications).”

—From Superconductivity News Update of 11 June 2002

## **2002: Department of Energy Releases National Transmission Grid Study**

—Report Focuses on Improving Reliability and Reducing Electricity Costs



Energy Secretary Spencer Abraham released the National Transmission Grid Study on 8 May. Including 51 specific recommendations on improving reliability and reducing electricity costs to consumers, the study was conducted in response to suggestions in the President’s National Energy Policy to identify transmission bottlenecks and measures to eliminate them.

This report discusses the important contribution that high-temperature superconducting technology applications make toward the enhancement of our nation’s electric power grid. In particular, the report notes that “one class of technologies that could be used seeks to improve throughput of electricity over existing transmission corridors by using advanced composite materials for new overhead conductors and high-temperature superconducting (HTS) cables that can carry five times as much electricity as copper wires of the same size.”

—From Superconductivity News Update of 11 June 2002

## **2002: Southwire Reports “Outstanding Reliability” with Superconducting Cable Pilot Project**

—Pilot Project Logs Over 16,500 Hours On-line in “Real World” Application



Southwire Company of Carrollton, Georgia, reports that its superconducting pilot project continues to operate with “outstanding reliability.” According to the company’s project manager David Lindsay, “as of 28 August, the system has provided 100% of the required power to the Southwire manufacturing complex [in Carrollton] for over 16,500 hours.” Lindsay adds that the “cable system has operated in a fully automated mode for 14 months...Southwire has no plans to decommission this site.”

—From Superconductivity News Update of 4 September 2002

## **2002: SuperPower and National Laboratories to Develop Second Generation Wire Technology**

—New Agreement to Advance Important New Superconducting Power Application



*Photo courtesy IGC SuperPower*

SuperPower, Inc., a wholly owned subsidiary of Intermagnetics General Corporation of Schenectady, N.Y., and Oak Ridge National Laboratory announced on 10 October that they have executed a Cooperative Research and Development Agreement (CRADA) to develop second-generation High Temperature Superconductor (HTS) technologies.

In its press release, SuperPower notes that it is “aggressively scaling up second-generation HTS technology under its current CRADA with Los Alamos and Argonne National Laboratories. Meter-long second-generation HTS tapes with good performance are being produced in the pilot manufacturing facilities in Schenectady.”

Through this new partnership the two groups will work to help achieve the Department of Energy’s vision of low-cost, high-performance YBCO coated conductor that would offer significant reductions in electrical losses and operating costs, as well as increased power transfer capacity.

—From Superconductivity News Update of 21 October 2002

## **2003: Nobel Prize Awarded to Superconductivity Researchers**

—Two Americans, Russian Win Nobel Physics Prize for Pioneering Efforts In Superconductivity

The Royal Swedish Academy of Sciences announced on 7 October that three scientists would receive the Nobel Prize for Physics: Russian Vitaly L. Ginzburg, and American Alexei A. Abrikosov of Argonne National Laboratory, for their work on superconductivity, and American Anthony J. Leggett of the University of Illinois, Urbana, for describing how liquid helium can become a “superfluid.”

—From Superconductivity News Update of 17 December 2003

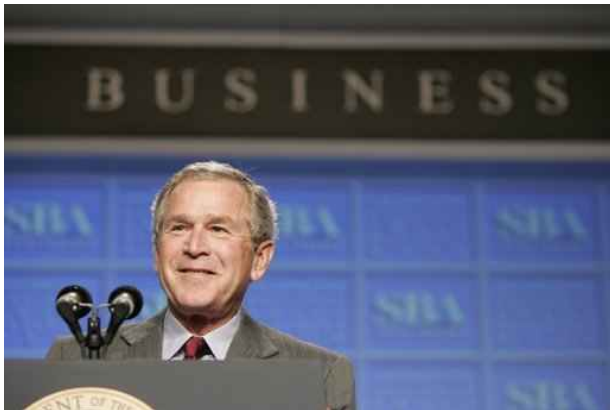
## **2004: Governor Pataki breaks ground for new superconducting cable project**

On 28 June 2004, New York Governor George E. Pataki joined officials from SuperPower, Inc., Sumitomo Electric Industries, Niagara Mohawk, and the BOC Group to break ground on a high temperature superconducting (HTS) power cable demonstration project for downtown Albany. The HTS cable project can carry three to five times more current than conventional power lines to help meet the growing demand for power in our major cities.

Major cities with extensive underground cable routes and radial wiring configurations are key targets for this technology. This Albany demonstration is a first step in testing the cable in an urban radial network used in major cities, particularly New York City.

—From Superconductivity News Update of 13 May 2005

## **2005: President Bush calls for reduced U.S. dependence on foreign oil**



In remarks delivered to the National Small Business Conference in Washington on 27 April, President Bush urged the U.S. Congress to pass quickly an energy bill that is designed to reduce American dependence on oil imports, saying that:

“as we conserve energy at home and on the road, technology will help us deliver it more efficiently. New technologies such as superconducting power lines can help us bring our electrical grid into the 21st century, and protect American

families and businesses from damaging power outages.”

—From Superconductivity News Update of 13 May 2005

## **2005: American Superconductor receives HTS wire order from Ultera for Columbus, Ohio, superconductor cable project**

American Superconductor Corporation announced on 3 May 2005 that it has received an order for 48,760 meters (approximately 30 miles) of high temperature superconductor (HTS) wire from Ultera™ to manufacture a 200-meter-long HTS power cable to serve the electrical distribution load fed from a large substation in Columbus, Ohio. The cable will be operated starting in mid-2006 by American Electric Power.

When complete in the summer of 2006, the HTS cable is expected to supply power to approximately 8,200 residential and industrial AEP customers. The new cable would replace existing overhead aluminum bus in the 13 kV portion of the substation.

—From Superconductivity News Update of 13 May 2005

### **2005: Will Superconductivity Help Strengthen the Grid?**

As the nation marks two years since the massive blackout in the northeastern United States, observers have been looking at how the recently enacted Energy Policy Act of 2005 will strengthen our electric power infrastructure and provide increased electricity reliability.

In comments to the 2005 Superconductivity Peer Review, American Superconductor president and CEO Greg Yurek cited the U.S.-Canada Power System Outage Task Force's April 2004 conclusion that "...the blackout on August 14, 2003 was preventable. It had several direct causes and contributing factors including a failure to maintain adequate reactive power support..." Yurek highlighted his company's expanded reactive power (VAR) product line that he said would provide greater stability to the nation's power grid.

American Superconductor's John Howe added that the Energy Policy Act of 2005 will help pave the way for business development for superconductors and a range of advanced grid technologies in the coming decades. Howe said that the new law should generate significant demand for new transmission investments around the country.

—From Superconductivity News Update of 24 August 2005

### **2006: Annual Peer Review Showcases R&D Activities and Demonstration Projects**

—Progress of four "real-world" superconductivity projects highlighted

The 2006 Superconductivity Peer Review was held near Washington, D.C. from 25 to 27 July. Attracting nearly 200 leaders in the field from around the world, the presentations at this annual event underlined the ongoing progress of research into high-temperature superconductivity as it edges closer to market readiness.

During each year's Superconductivity Peer Review, reviewers score each project, with half the score determined by an assessment of the project's performance versus plans for the year, as well as research integration with other institutions. The other half is determined by productivity — whether world-class results were produced in the past year.

As superconductivity moves toward adoption by electric utilities, attention focuses on demonstration projects where the superconducting power equipment undergoes rigorous testing in real-world conditions. Four such projects from the Superconductivity Partnership with Industry (SPI) program were highlighted at this year's Peer Review: the Columbus cable project, the Albany cable project, the Long Island cable project and the fault current limiter project. Each one of these SPI projects is described below, and background materials from all presenters (including copies of each presenter's slides, providing detailed information on each project) are available at <http://www.energetics.com/meetings/supercon06/agenda.html>.

- ***SPI Project: Columbus Bixby Substation Power Line***

Led by Ultera (a joint venture between Southwire and nkt cables), this project is a 200-meter, 13.2 kV, 3.0 kAmps (69 MVA) superconducting power line at AEP's Bixby substation in Columbus, Ohio. The Bixby project is the highest-current superconducting power line project in the world, and its cable was energized with 13 kV line voltage in a voltage soak test on 18 July.

At the Peer Review, Ultera's David Lindsay gave an overview of the project's status. Members of the Columbus Bixby Substation Power Line Project team are: Ultera, AEP, Oak Ridge National Laboratory, Praxair and American Superconductor.

- ***SPI Project: Albany Power Line***

Led by SuperPower, Inc., this project uses 350 meters of superconducting power line to link two Niagara Mohawk substations (Riverside and Menands). This superconducting power line parallels a new 34.5kV installation and has been added to handle load growth (i.e., it is not used solely for demonstration purposes).

At the Peer Review, Niagara Mohawk's Chuck Weber described the project team's progress, which led to a ribbon-cutting shortly after the Peer Review on 2 August.

Members of the Albany Power Line Project team are: SuperPower, Sumitomo Electric, BOC, National Grid (Niagara Mohawk), NYSERDA and the U.S. Department of Energy.

- ***SPI Project: Long Island Power Line***

Powering LIPA's Holbrook Substation, this 610-meter, 138kV project is led by American Superconductor and is the world's first installation of a transmission-voltage superconducting power line.

James Maguire of American Superconductor provided details on the progress of this project at the Peer Review. Maguire detailed the status of systems and cryogenics tests and reported that the project is on track for commissioning in the spring of 2007.

Members of the Long Island Power Line Project team are American Superconductor, the Long Island Power Authority, Air Liquide, Nexans and the U.S. Department of Energy.

- ***SPI Project: Fault Current Limiter***

A fault current limiter uses superconductors to instantaneously limit electrical surges before they reach a circuit breaker. SuperPower, Inc. is a leader in developing matrix fault current limiters, which would demonstrate the concept at transmission-level voltage of 138kV.

In his update at the Peer Review, project manager Roger Farrell of SuperPower said that his group's goal was to demonstrate SFCL feasibility at transmission level voltage of 138kV. This project, with a current estimated cost of \$23.6 million, is estimated to be completed in June 2009. Farrell noted that the cost is higher and the completion date is later than originally projected

because of a switch from melt case BSCCO to second generation (2G) wires and the attendant issues in optimizing the 2G wires for this application.

Members of the Fault Current Limiter Project team are SuperPower, Sumitomo Electric, BOC, AEP, EPRI, the U.S. Department of Energy and two DOE national laboratories: Los Alamos and Oak Ridge National Laboratories.

### **2006: Message from DOE Superconductivity Program Manager Tells of Program Goals and Successes**

—Daley highlights high leveraging of DOE funding with private sector dollars

In a message to all participants of the 2006 Superconductivity Peer Review, the U.S. Department of Energy program's team leader, James Daley, lays out his program's goals and accomplishments in an excellent one-page overview:

The U.S. Department of Energy (DOE) Superconductivity Program for Electric Systems has the lead Federal role in developing electric power applications of high-temperature superconductivity (HTS). Superconductivity is the ability of special materials to carry large electrical currents without the resistance energy losses of conventional conductors such as copper wires. In parallel, large-scale electric systems such as transmission cables, transformers, and motors using HTS wire are under development. Effective public/private partnerships are essential to meeting program goals. The U.S. industry provides the leadership needed for future commercialization, while the DOE laboratories and universities address technology barriers.

Wire development activities focus on raising current-carrying capacity and magnetic field tolerance in short samples of wire. Also, the program supports improving the capability of private partners to achieve this high performance in the long lengths needed by applications. The program's "Second Generation Wire" is now scaling up breakthroughs at Los Alamos National Laboratory and Oak Ridge National Laboratory that promise unprecedented performance and low cost by processes that apply HTS coatings to specially prepared metal strips. Several promising manufacturing approaches are being explored in collaborations between national laboratories and the private sector for this important priority.

System development activities are carried out by vertically integrated industrial teams composed of a technology user (a power supply company), a manufacturer, and an HTS wire supplier in the "Superconductivity Partnership With Industry" (SPI) part of the program. The project teams usually include a DOE National Laboratory which performs specific supporting activities. Each project is reviewed quarterly at field locations. The SPI portfolio presently includes cryogenic dielectrics, generator, motor, flywheel system, fault current limiter, and cable projects.

The Superconductivity Program leverages HTS research in other Federal programs, chiefly in the DOE Office of Science, as well as in the DOD, and NIST. Work with private companies involves 50% cost-sharing (DOE provides half the funding and the private company provides the remainder). Program funding is thus highly leveraged. Participating companies continue to set most of the world's HTS benchmarks in the electric power field.

Prototype HTS power equipment is beginning to undergo field trials at a critical time for the electric power industry. The electric grid is becoming stressed due to economic growth and changes in delivery pathways as greater competition is introduced. Also, the overall electricity infrastructure is aging (a majority of transformers and other equipment are at or past their design lifetimes) and will need replacement during the next 20 years. HTS equipment will be more reliable and have higher capacity ratings than conventional alternatives. Commercial versions of the technologies now being developed will become available at a time to meet the needs of a growing economy and a more competitive energy marketplace.

The Annual Peer Review has played an important role in the program's success. You have our sincere thanks for taking the time and effort to assist us again this year.

—From Superconductivity News Update of 29 August 2006

### **2006: Intermagnetics claims superconductor performance milestone**

In the race to develop commercially viable superconductor wire technology, the parent of SuperPower Inc. announced on Wednesday that the Latham company had set a new world record for performance.

A 322 meter wire developed by the SuperPower team yielded a performance of 70,520 amp-meters, according to parent company Intermagnetics General Corp. (Nasdaq: IMGC). The previous record was 52,087 amp-meters using technology developed by a Japanese research and development organization.

The new performance level was achieved after SuperPower upgraded most of its pilot production equipment over the past several months, according Glenn Epstein, the chairman and chief executive officer of Intermagnetics.

"We now have demonstrated not only a significantly enhanced performance milestone, but also a production rate eight times faster than our nearest competitor -- using a superconductor that is only half the thickness employed by that competitor," Epstein said.

Researchers at SuperPower are working to develop superconducting wire to be used in electrical power components, underground transmission cables and other products. Intermagnetics makes components for medical equipment such as Magnetic Resonance Imaging systems.

From: <http://albany.bizjournals.com/albany/stories/2006/05/22/daily34.html>

### **2006: New Superconducting Lines Deliver Power to Columbus Suburb**

—Triax cable serves about 8,600 homes and businesses

A new technology that holds promise to transform the global transmission and distribution of electric power was formally energized on 18 September near Columbus, Ohio. The \$9 million project uses a second-generation High Temperature Superconducting (HTS) cable system to efficiently deliver electric power to approximately 8,600 homes and businesses in suburban Columbus.



the system distributing electric power to residential,

**Bixby substation, Columbus, Ohio**

*Photo from [www.supercables.com/Demonstration/demo.html](http://www.supercables.com/Demonstration/demo.html)*

on time and on budget.

The Columbus project is the first demonstration of the new Triax HTS cable design, which dramatically reduces the cost of superconducting systems and brings the technology one step closer to commercial viability. The system was developed by Southwire Company and its partners, American Electric Power, Praxair, American Superconductor and the U.S. Department of Energy's Oak Ridge National Laboratory.

Approximately 200 meters (660 feet) of Triax HTS cable from Southwire are part of the system distributing electric power to residential, commercial and industrial customers through AEP's Bixby substation in Groveport, Ohio. The installation phase of the two-year demonstration project came in

“This project demonstrates the potential role for superconductivity in modernizing our electricity system,” said Secretary of Energy Samuel W. Bodman. “This new development allows power lines to increase capacity in congested urban areas while using less space. I’m pleased to be part of this excellent and innovative team.”

Because HTS cables can carry more current at a lower voltage over short or long distances, large power transformers can be located farther away from urban centers, allowing urban planners to free up valuable real estate for development or green space. HTS technology also enables greater interconnectivity between electrical substations, creating redundancies that increase the reliability of the electrical grid.

—From Superconductivity News Update of 30 October 2006

### **2006: Bodman on “A New Energy Plan for America”**

In a year-end column in Newsweek’s “Issues 2007,” Energy Secretary Samuel W. Bodman writes:

“If we look at the global energy picture today, the challenges America faces are startling. Demand is rising rapidly and will continue to do so. And it’s clear that our world is overly

dependent on one source of energy: fossil fuels. For a host of reasons—related to our economic health, our environmental well-being and our national security—our current path is unsustainable. We need a safe, clean, affordable, diverse energy supply. Here are 10 ways to get there.”

The ninth recommendation on Bodman’s list discusses superconductivity:

“Modernize our power grid. As the Northeast blackout of 2003 demonstrated, our electricity grid is badly in need of an upgrade. We have made progress on modernization: repealing outdated rules that discourage investment; offering tax incentives for new transmission construction; developing technologies—like high-temperature superconducting materials—to improve the grid’s efficiency and reliability. More needs to be done, quickly.”

—From <http://www.msnbc.msn.com/id/16288772/site/newsweek/>

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## **ABOUT THIS UPDATE**

The High-Temperature Superconductivity News Update is compiled by Bob Lawrence & Associates Inc. on behalf of the superconductivity program and is issued periodically as events warrant. Current and past issues are available at <http://www.superconductivitynewsupdate.com/>.

Please let me know if you would like more information or story ideas on any of these news items involving high-temperature superconductivity---a clean and capable new electricity technology for the 21st century. If you have any other comments or questions, please let me know.

Thank you very much.

Jodi Hamrick  
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