News Update

13 May 2005

Welcome back to Superconductivity News Update!

You may recall that this electronic newsletter circulated from 1999 through the end of 2003. Now, we are happy to announce its resumption by Bob Lawrence & Associates, working on behalf of the Superconductivity Program in the U.S. Department of Energy's Office of Electric Transmission and Distribution.

Superconductivity News Update focuses on accomplishments and innovations of the high-temperature superconductivity community at laboratories and in industry in the United States. In this and future Superconductivity News Updates, we plan to feature short summaries of stories that have appeared in various media in the United States and around the world, and provide links (where available) to these original articles.

Our primary goal is to keep key stakeholders informed and aware of developments that are bringing high-temperature superconductivity ever closer to full implementation in the nation's electric power infrastructure. Because the last issue of this newsletter was in December 2003, this issue covers a broader timeframe than future newsletters will cover.

Besides providing enormous potential benefits to the world's electric power systems, superconductivity companies and laboratories are creating local economic development, jobs and new opportunities in communities across the country. This newsletter will seek to capture some of the essence of these economic benefits, as well as the many other benefits offered by superconductivity, such as power reliability and quality, environmental benefits and a boosting of American international competitiveness.

Superconductivity is poised to deliver reliability, robust capacity and efficiency to our nation's electric power grid. Because of their inherently low resistance losses, new superconducting power applications will have the potential to revolutionize the way we generate and receive electricity – to create a superhighway for electricity much like what fiber optics did for the telecommunications industry.

If you have any questions or comments, please contact Craig Cox, whose contact information is provided at the end of this newsletter.

We hope you enjoy this newsletter and look forward to staying in touch with you.

Superconductivity News Update
13 May 2005

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

—Asks Congress for comprehensive energy legislation and highlights superconductivity in April appearances

In remarks delivered to the U.S.-Hispanic Chamber of Commerce in Washington on 20 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 the U.S. supply of energy "is not growing fast enough to meet the demands of our growing economy."

The President said that "Congress needs to send a sound energy bill that meets four important objectives." Bush specifically discussed the importance of the following items in an energy bill: "including improved conservation and efficiency…expansion of domestic energy production in environmentally sensitive ways… diversification through development of alternative sources of energy and modernization of our domestic energy infrastructure."

Bush said that "we need an energy bill that will help us modernize our domestic energy infrastructure. In some parts of the country, homes and businesses are receiving 21st century power through infrastructure built decades ago. Transmission lines and pipelines and generating facilities are deteriorating here in America. Different regions share electricity over unreliable transmission lines. And these strains on the system are leading to higher prices, bottlenecks in delivery and inefficient use of energy, which we can no longer afford." Finally, Bush called for mandatory electricity reliability rules and that that "[a]n energy bill should repeal outdated rules that discourage investment in new power infrastructure, should encourage the development of new technologies such as superconductive power lines to make the grid more efficient."

A week later, on 27 April, President Bush echoed the same themes in a speech to the National Small Business Conference in Washington. At that event, Bush said that "technology is the ticket" for greater energy independence and again highlighted the importance of superconductivity as part of a modern and more efficient electric power infrastructure:

> "[a]s 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."

New York energy companies get a "Bush Boost"
—SuperPower CEO hails President's remarks

R. J. Kelly reports in the 28 April 2005 Schenectady (N.Y.) Gazette: "President Bush's energy policy speech this week was music to the ears of alternative energy research companies in the Capitol Region."

Bush touted [in his 27 April speech] "the importance of superconducting power lines to improve the efficiency and reliability of delivering electricity."

"We're really pleased to see that we have the president's attention," said Philip Pellegrino, chief executive of SuperPower, Inc. In his article, reporter Kelly added that "[w]ith $13 million in U.S. Department of Energy funding a key to the four-year Albany underground cable project, Bush's support of the technology is priceless."

Superconductors ready to ramp up for the real world

Peter N. Spotts reports in the 23 December 2004 issue of the Christian Science Monitor that "[t]he Energizer bunny has nothing on Heike Kamerlingh Onnes. Nearly a century ago, the Dutch physicist stunned the scientific world when he discovered that if he chilled certain metals to extremely low temperatures, electricity raced through them without losing any energy…There was just one catch: The metals had to be frozen to such frigid temperatures that the technology made no commercial sense."

"More recent discoveries led to some niche applications. But today, researchers are on the cusp of applying that laboratory curiosity to a range of civilian and military technologies. They could dramatically boost the efficiency of everything from Navy destroyers to the wires that bring electricity into homes and businesses."

"Superconductors - as Onnes' discovery is known - are being tested as a way to dramatically cut the risk of widespread blackouts."

"It's going to work; it's really going to work," says an enthusiastic Robert Hawsey, director of the Oak Ridge National Laboratory's Superconductivity Technology Center. "Fiber optics [have become] the backbone of today's information superhighway…a new generation of superconductors are about to emerge from the shadows into large-scale applications."

New wave of electrical wires inches closer to market
—Performance of wires made from yttrium, barium, copper, and oxygen is getting "tantalizingly close" to what is needed to compete with conventional conductors

Robert F. Service writes in the 15 April 2005 issue of the journal Science that "[r]esearchers worldwide are banking on a second generation of high-tech HTS wire to drop prices and improve performance. These second-generation wires—made from yttrium, barium, copper, and oxygen (YBCO)—have been difficult to make in long lengths. Now, after a decade of slow and fitful progress, YBCO wires appear to be on the cusp of reaching the market."

"At a meeting [in San Francisco, Calif.] last month, three companies reported that they've developed manufacturing techniques to turn out YBCO wires up to 100 meters long; a few years ago, the best the industry could do was a mere meter or so."

In his article, Service details a number of technical advances that laboratories and industry have made in overcoming issues related to commercializing superconducting power applications. "Together, these advances have enabled companies for the first time to come within striking distance of the current-carrying benchmarks set down by the U.S. Department of Energy (DOE) and sister organizations in other countries. DOE's goals call for 2G wire to carry 300 amps over 100 meters by 2006 and 1000 amps over 1 kilometer by 2010."

"'We're getting to the point where it's very interesting,' says Dean Peterson, who directs the YBCO superconducting tape development program at Los Alamos National Laboratory in New Mexico. 'We can start to think about tapes and coils.' Adds David Larbalestier, a superconductivity researcher at the University of Wisconsin, Madison: 'There's no doubt now it can work. Now it's all about the cost.' But therein could lie the rub. Some electrical industry watchers worry that unless

2G HTS wire ends up vastly superior to conventional copper cables, ultraconservative utilities won't make the switch, leaving HTS companies high and dry. Smaller applications, such as making motors and magnets, may bolster the bottom line of HTS companies. But utilities represent the biggest bulk customers."

From Science, Vol. 308, www.sciencemag.org, 15 April 2005

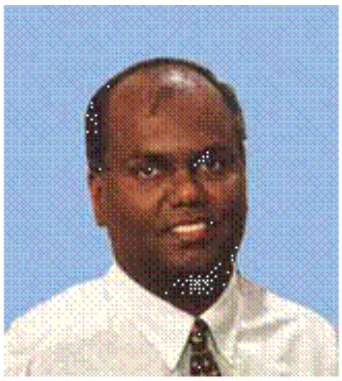
Leaders in superconductor wire development named superconductor industry person of the year

Superconductor Week, the leading publication on superconductor business and technology, announced on 25 April 2005 that it has named two pioneers in the development of high temperature superconductor (HTS) wire as "Superconductor Industry Person of the Year 2004."

The industry's most prestigious international award in the development and commercialization of superconductors goes to Alex Malozemoff, Chief Technical Officer at American Superconductor Corp, and Venkat "Selva" Selvamanickam, Program Manager of Materials Technology at SuperPower, Inc., a subsidiary of Intermagnetics General Corporation (see following story for detailed profile of Selvamanickam).

"The most important achievements in superconductivity in 2004 were the improvements in length and electrical performance of second generation (2G) HTS wire," commented Mark Bitterman, Superconductor Week's Executive Editor. "In naming Dr. Selvamanickam and Dr. Malozemoff jointly as Person of the Year 2004, we call particular attention to the leadership of these two extraordinary scientists in developing 2G HTS wire. Their work in this exceedingly challenging field is setting the pace in the global effort to bring superconductivity to the forefront in addressing the most pressing needs of the 21st century."

A panel of nine recognized leaders in science, industry, and government in North America, Europe, and Asia selected the winners from dozens of nominations by peers around the world. Superconductor Week panelist Dr. Donald Gubser, Superintendent of the Materials Science and Technology Division at the U.S. Naval Research Laboratory, commented: "Selva and Alex are leading two of the largest industrial development programs on HTS wires in the world. With the vision of establishing HTS power devices as a new industry, each of them has leveraged internal expertise as well as R&D efforts at National Laboratories and Universities, leading coalitions of the nation's top scientists."



"It's been my privilege to work closely with Alex for the past 13 years," said Greg Yurek, Chief Executive of American Superconductor. "At a time when the world was just waking up to the global industry that HTS would spawn, Alex was already forging ahead to develop the next generation of this technology. Alex's work, acknowledged by Superconductor Week's award, has put 2G HTS wire technology well ahead of most expectations, and our manufacturing scale-up is now actively underway."

Glenn Epstein, President and CEO of Intermagnetics General, SuperPower's parent company, commented: "Since shortly after the discovery of HTS in 1986, Intermagnetics has invested substantial resources in HTS technology--beginning with the development and production of first generation conductor, and then moving, with Selva as the chief proponent, to 2G wire more than six years ago. As we approach the advent of the commercialization of 2G HTS wire, Intermagnetics is gratified to see Selva's dedication and leadership recognized by his peers in the industry."

From BusinessWire press release.

Superman behind SuperPower
—Venkat Selvamanickam

Richard A. D'Errico writes in the 29 April 2005 edition of the [Albany] Business Review: "At 6 feet 4 inches, Venkat Selvamanickam stands above his co-workers at SuperPower Inc…Selvamanickam stands out among his peers in the superconducting industry as well…He is one of the key figures behind SuperPower's development of high-temperature superconducting wires, which increase the reliability of electric power transmission."

"Selvamanickam, 39, has been working on superconductivity since 1987, but he's not jaded...'Superconductivity is really magical in a way,' he said. 'I start getting goose bumps.'"

D'Errico's complete story on Venkat Selvamanickam's important contributions to his company and to the progress of superconductivity is available at http://www.bizjournals.com/albany/stories/2005/05/02/focus1.html.

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.

"New York State is a national leader in promoting advanced energy technologies that are helping clean our air, improve our energy security, and encourage sustainable economic development," Governor Pataki said. "We're proud to support innovative projects like the HTS cable that offer the potential to enhance reliability and provide additional, affordable power for utility customers while protecting our environment. Smart investments like these are helping New York achieve our ambitious goal of becoming a world leader in the development of clean and renewable energy technologies."

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.

Peter R. Smith, President of NYSERDA said, "This project exemplifies the kind of technology we fund to improve our energy future, while providing potentially significant economic development opportunities and environmental benefits." Michael J. Kelleher, Senior Vice President of Business Services and Economic Development, Niagara Mohawk, a National Grid Company said, "Niagara Mohawk applauds NYSERDA's forward-looking investment in an innovation that will represent an important advance in the delivery of energy to consumers. We're pleased to be working with them on the successful demonstration of this new technology."

To date, NYSERDA has committed $6.7 million to IGC SuperPower for HTS projects, including design-through-operation stages for a 5 megavolt-ampere HTS power transformer and the construction of a pulsed-laser deposition facility for the manufacture of long-length, second-generation, coated-conductor HTS wire, which will be demonstrated at this site.

From Governor Pataki's press release of 29 June 2004.

Intermagnetics announces agreement between superpower subsidiary and American Electric Power on MFCL project

—SuperPower and AEP to collaborate on Matrix Fault Current Limiter project; AEP commits to serve as host utility for transmission-level voltage device

Intermagnetics General Corporation announced on 15 November 2004 that its Energy Technology subsidiary, SuperPower, Inc., has executed a collaboration agreement with AEP EmTech, LLC, a subsidiary of American Electric Power Company, Inc. of Columbus, Ohio, for the development, installation and demonstration of a Beta Prototype high-temperature superconducting (HTS) Matrix Fault Current Limiter (MFCL) device. The MFCL, a device that would protect utility grids from damaging surges in current, is based on proprietary patent-protected technology developed at SuperPower."

Glenn H. Epstein, chairman and CEO of Intermagnetics said, "This is a significant move forward in the program as it will allow for the installation and demonstration of a 138 kV, three-phase, Beta prototype MFCL device at an AEP transmission substation." SuperPower successfully completed a proof-of-concept prototype MFCL device in July 2004 and is now in the design stage of developing and testing a single phase,138 kV Alpha prototype device.

Richard Verret, senior vice president - transmission at American Electric Power said, "By formalizing its collaboration with SuperPower, AEP is building on its early membership on

SuperPower's MFCL Technical Advisory Board. We look forward to hosting the world's first demonstration of a transmission level superconducting fault current limiter. Our commitment to the development of this device is evidence of the need we have seen for this technology for at least 20 years. That need will increase as the demand for reliable electricity continues to grow. This technology can help us address the challenge of maintaining a reliable grid at the lowest possible cost. The MFCL is being designed to integrate effectively with existing assets."

The $12.2 million MFCL development program has been underway at SuperPower since June 2002. Early in the project, the Electric Power Research Institute (EPRI), a non-profit energy research consortium of utilities, committed $600,000 toward the effort. The U. S. Department of Energy announced program funding of $6.1 million in August 2003 and, at the same time, SuperPower announced that Nexans SuperConductors GmbH had joined the development team as a strategic partner in the project. Nexans is supplying its patented "melt cast" superconductors for the device and is sharing the uncovered costs of the program with SuperPower.

James Daley, superconductivity program director at the U. S. Department of Energy said, "The electric power industry has great interest in new technologies for grid reliability enhancement. The MFCL has the potential to protect at transmission level voltages, where there are no conventional alternatives. There is an immediate need that the MFCL could fill, and it also promises to be a cost effective solution."

SuperPower executed a Cooperative Research and Development Agreement (CRADA) with Oak Ridge National Laboratory to tap the lab's substantial expertise in high voltage engineering and cryogenics. Similar agreements may also be executed with Los Alamos and Argonne National Laboratories in the areas of testing and analytics, respectively, if DOE funding permits.

Clark Gellings, vice president of power delivery and markets at EPRI, said, "The MFCL that is being developed by SuperPower and Nexans is a superconducting technology that is needed by utilities today. It addresses present day challenges that are being faced by utilities as new sources of power are being added to existing transmission & distribution systems, leading to increased fault current."

From SuperPower press release.

Related story: "Superpower Inventors Receive 2005 'Inventor of the Year' Award"

Intermagnetics' Superpower subsidiary achieves new world-record performance in second-generation HTS wire

—Achieves 7,000 Amp-Meters in 100-meter 2G HTS wire

Intermagnetics General Corporation's Energy Technology subsidiary, SuperPower, Inc., announced on 4 August 2004 that it has achieved performance of 70 amperes with high uniformity in a 100 meter second-generation (2G) high temperature superconducting (HTS) wire. This performance surpasses the 6,000 amp-meter performance announced in March 2004 that gave the world record to SuperPower. "Amp-meter" is a common measure of HTS wire performance achieved by multiplying critical current carrying capacity in amperes by length in meters.

Glenn H. Epstein, chairman and chief executive officer of Intermagnetics, said, "The achievement of

100 meter 2G wire piece lengths is of particular significance as we work toward product commercialization, since this is the minimal piece length that will be required for fabricating commercial devices. SuperPower continues to demonstrate its position as a global leader in 2G wire performance as we move toward scale-up to commercial manufacturing.

"Annual production capacity in 2006 is planned to be about 1,000,000 meters, which can easily be scaled up or down to meet market requirements due to the modularity of our production processes."

William Parks, then-Acting Director, Office of Electric Transmission and Distribution at the Department of Energy (DOE), noted that, "This latest in a series of industrial partner achievements helps to validate DOE's decade-long investment on behalf of the taxpayer in HTS technology. We must maintain this momentum and the associated funding by the federal government to enable manufacturing scale-up and commercialization by domestic companies."

SuperPower also announced that it recently provided the first shipment of 2G HTS wire for the Albany HTS Cable Project. Philip J. Pellegrino, president of SuperPower, said, "We recently supplied more than 60 meters of wire to Sumitomo Electric Industries for testing a one meter HTS cable, in advance of the 30 meter 2G HTS cable section that will be installed in 2006. SuperPower plans on supplying a total of 8,000 meters of 2G wire for the Albany

SuperPower reports that much of the progress being made is the result of work being done under a Cooperative Research and Development Agreement (CRADA) with Los Alamos National Laboratory (LANL). This spans a wide range of topics and has enabled SuperPower to develop overall superior 2G wire.

From SuperPower press release.

Intermagnetics Subsidiary approaches commercial viability for second-generation HTS wire with new performance milestone

Intermagnetics General Corporation's Energy Technology subsidiary, SuperPower, Inc., announced on 19 January 2005 that it has broken its July 2004 performance record by achieving critical current performance of 103.7 amperes per centimeter width in a nearly 100-meter second-generation (2G) high-temperature superconducting (HTS) wire. This corresponds to a performance of 10,050 amp-meters, surpassing SuperPower's world-record breaking 7,000 amp-meter performance announced at the 2004 DOE Peer Review meeting. Amp-meter is a common measure of HTS wire performance achieved by multiplying critical current carrying capacity in amperes by length in meters. SuperPower announced the breakthrough at the Department of Energy (DOE) Wire Development Workshop in St. Petersburg, Florida.

"Achieving better than 10,000 amp-meter performance propels SuperPower past an important threshold as we approach our fundamental objective of consistent production of commercially viable HTS technology," said Glenn H. Epstein, chairman and chief executive officer of Intermagnetics. "The 100-meter length is considered a key parameter to enable utilizing HTS wire in device applications. We continue to be on track for commercial viability before the end of 2005 and for full scale production in 2006."

Philip J. Pellegrino, president of SuperPower, added: "It is particularly significant that this new

milestone was achieved with wire produced by SuperPower's proprietary MOCVD (metal organic chemical vapor deposition) process. We believe our MOCVD process is capable of producing wire at a much higher throughput than competing processes, which we expect will result in a competitive advantage. We have obtained significant and encouraging improvements in the stability of the process, as well as uniformity of performance."

In addition to announcing this new performance milestone at the DOE Wire Development Workshop, Pellegrino also noted that SuperPower achieved critical currents of greater than 400 amperes in short samples, 265 amperes over 1 meter and 200 amperes over 8 meters. The critical currents indicated are per centimeter width and all the wires were produced with MOCVD.

SuperPower's 2G HTS wire development effort has received consistent funding from the DOE since 2000. The company also has Cooperative Research and Development Agreements (CRADAs) with several of the National Laboratories, including a two-year, $3.4 million CRADA with Los Alamos National Laboratory (LANL) to scale up second-generation HTS technology to manufacturing. The program is also jointly funded under Title III of the Defense Production Act by DOE and the U.S. Department of Defense (DOD).

From SuperPower press release.

Widespread use of high-temperature superconductors on horizon

PhysOrg.com reported on 29 April 2005: "From improvements in cellular base stations to the development of more efficient electric transmission lines and energy storage systems, high-temperature superconductors (HTS) are nearing their commercial viability."

Venkat Selvamanickam, program manager of materials technology at SuperPower Inc. in Schenectady, New York, recently gave a presentation to the University of Houston (Texas) on Second-generation HTS Conductors. His comments focused on the latest developments in the scale-up R&D of second-generation HTS conductors, as well as detailing the remaining challenges for successful use of HTS in commercial applications.

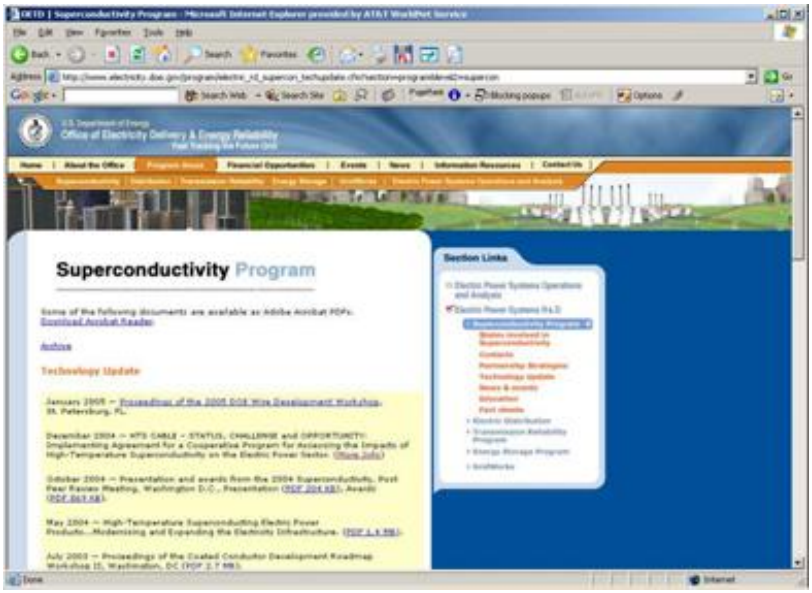
As PhysOrg.com reports, second-generation HTS conductors will have applications…in advanced MRIs and better transmission lines…[t]he discovery of high-temperature superconductors that can operate using inexpensive liquid nitrogen as a coolant has opened doors to applying superconductivity to electric power devices. These HTS devices offer both performance advantages and environmental benefits."

From PhysOrg.com.

Superconductivity technology updates available on U.S. DOE website

The website of the United States Department of Energy's Office of Electric Transmission and Distribution (OETD) has a detailed list of technology updates related to the department's Superconductivity Program.

This site's current documents include:



January 2005
Proceedings of the 2005 DOE Wire Development Workshop in St. Petersburg, Fla.

December 2004
HTS Cable – Status, Challenge and Opportunity: Implementing Agreement for a Cooperative Program for Assessing the Impacts of High-Temperature Superconductivity on the Electric Power Sector.

October 2004
Presentation and awards from the 2004 Superconductivity, Post Peer Review Meeting, Washington D.C.

May 2004
High-Temperature Superconducting Electric Power Products...Modernizing and Expanding the Electricity Infrastructure

July 2003
Proceedings of the Coated Conductor Development Roadmap Workshop II, Washington, D.C.

July 2003
Proceedings of the 2003 DOE Annual Peer Review Meeting, Washington, D.C.

Information sheets on the latest techniques for making coated superconductor wire:
IBAD
ISD
RABiTS™

Wright-Patterson nears power breakthrough
—Superconducting generator would change air combat

Timothy R. Gaffney writes in the 26 September 2004 Dayton Daily News that "[a]fter decades of quiet work, researchers at Wright-Patterson Air Force Base are poised for a breakthrough they believe will change the future of air power."

"The Air Force Research Laboratory at Wright-Patterson is preparing to award a contract…to demonstrate an electrical system with a superconducting generator, a device the size of a beer keg that can power a small city - or the next generation of airborne energy weapons."

[…]

"Such a system opens the door to so-called directed energy weapons that need megawatts of electric power, from metal-piercing lasers to electromagnetic beams that can disable weapons or shock troops without killing."

[…]

"Once developed for weapons, researchers say, the superconducting generator technology will find a wider range of airborne uses. 'We believe superconducting is not just an enabler for directed energy weapons but an enabler for all of the Air Force platforms for the future,' commented Lt. Col. JoAnn Erno, chief of the Power Division in AFRL's Propulsion Directorate. "We really think it is a technology that is going to be a game-changer."

San Diego contractor a lift for Navy
—"Superconducting motor promises gentler rides and cost savings"

In the 8 April 2005 San Diego Union-Tribune, Reporter Bruce V. Bigelow writes about the development of a new electromagnetic aircraft launch system for Navy carriers that uses a 36.5-megawatt superconducting DC electric motor for ship propulsion.

Bigelow writes that the "electric-based designs would replace the steam-powered catapults and hydraulic landing systems now used aboard carriers. Because the electronic systems can be calibrated more precisely, the forces exerted during carrier takeoffs and landings should be smoother."

"It's a gentler ride for the aircraft and the pilot," said Michael R. Reed, vice president of General Atomics' electromagnetic systems division. The systems also will be less costly to operate and easier to maintain, he said.

When implemented, this project could lead to significant cost savings for the Navy, as these quotes from Bigelow's article illustrate:

> "The Navy estimates that an electromagnetic aircraft launcher also will need about 30 percent fewer sailors to operate and will require far less maintenance than steam-powered catapults"
> —Michael R. Reed, vice president of General Atomics electromagnetic systems division.

> "Ships could potentially go out on a mission and use half the power, and that is a big deal for the Navy. The Navy burns a lot of fuel. It is a significant part of the budget."
> —Steve Schreppler, program officer for electric ship propulsion systems at the Office of Naval Research comments that

Getting more from less
—Rockwell scientists hope research puts them at the front of an energy revolution

Rick Barrett reports in the 5 February 2005 Milwaukee Journal-Sentinel on Rockwell Automation's "thin strip of coated metal that could spark an energy revolution."

"It's a short piece of superconductor wire that, when cooled to about minus 325 degrees Fahrenheit, can carry as much electricity as a copper cable several inches thick."

"Unlike conventional cable, there's almost no energy loss in the superconductor wire because it has no measurable resistance to electric current. In the real world, that could mean $50,000 a year in energy savings for a 5,000-horsepower industrial motor running 24 hours a day, seven days a week."

Barrett adds that the U.S. Department of Energy estimates that large motors (greater than 1,000 horsepower) use more than one-third of the electricity produced in the United States. He quotes Rich Schiferl, director of advanced technology at Rockwell's Power Systems division in Cleveland: "There could be huge energy savings from the development of superconductor motors…We see this as the future of large motors."

Barrett goes on to report that Rockwell has about a dozen scientists developing superconductor motors and says that Rockwell has demonstrated some of the world's first superconductor motors, including a 1,600 horsepower model in Cleveland. The company recently agreed to work with SuperPower Inc., of Schenectady, N.Y., in designing and building motors and generators using SuperPower's wire.

Rockwell Automation Signs Cooperative Agreement with SuperPower, Inc.
—Moves closer to commercial release of high-efficiency motors and generators

Rockwell Automation, Inc. of Greenville, S.C. announced on 16 November 2004 that it has signed an exclusive agreement with SuperPower, Inc. of Schenectady, NY to work together to design, develop, build and install High-Temperature Superconducting (HTS) electric motors and generators for high-horsepower commercial, industrial and military applications. Superconducting motors have been identified as a key emerging technology for delivering significant energy savings across a variety of industries.

Under terms of the agreement, Reliance™ industrial, commercial and marine motors and generators will incorporate SuperPower's groundbreaking ceramic-based Second Generation (2G) coated conductor technology. SuperPower is developing a 2G HTS wire that demonstrates superior performance over commonly used "first generation" wire. The enhanced current carrying performance at higher operating temperatures makes SuperPower's 2G wire an essential component for more energy efficient and cost effective industrial motors and generators.

Since 1987, Rockwell Automation engineers have been pioneering new technologies to make superconductivity a viable energy-saving solution. In 2001, Rockwell Automation demonstrated a 1600 horsepower superconducting motor using first generation wire.

"The results of our future efforts under this joint agreement will make a significant impact on the successful commercialization of second-generation HTS rotating machinery leading to cost-effective electric motors and generators that are ultra-efficient, lighter, and substantially more power dense than those that are available today," said Joseph D. Swann, president, Rockwell Automation Power Systems. "This is a significant step forward in the continued development of the world's first commercial HTS motor and generator. We are all extremely excited about the potential of this vital energy-saving technology, as well as the total cost of ownership benefits it could provide to our customers."

SuperPower president Philip J. Pellegrino added, “This agreement validates SuperPower’s continued commitment to the development and manufacture of enabling 2G HTS wire and highly engineered applied devices. We believe this collaboration will be absolutely critical to the ultimate success of superconducting rotating machines.”

Los Alamos develops new coating technology

The Santa Fe New Mexican reported in its 21 February 2005 edition that a new coating technology developed at Los Alamos National Laboratory costs less than other methods and can work on both large and irregular surfaces. Creating a high-quality film, the newspaper reports that the method is called “polymer-assisted deposition. Researchers apply a few drops of the water-based PAD solution to a silicon wafer. The wafer is rotated at high speed until coated, and then it’s heated to remove the water. It’s heated again to oxidize the metal.”

“This technology provides a cost-effective approach to grow electronic and optical materials, which would find wide applications in any fields where the material is needed in the film form,” Dean Peterson, director of the Superconductivity Technology Center, said in a news release.

The New Mexican goes on to point out that metal oxides are useful in photovoltaic devices, gas sensors, microelectronics and corrosion-protection devices.

American Superconductor and Siemens form strategic alliance to develop and commercialize advanced grid reliability technology
—‘Fault Current Limiters’ to rely on second generation superconductor wire to improve performance and decrease costs for new power grid reliability solution

American Superconductor Corporation and the Corporate Technology unit of Siemens AG announced on 8 February 2005 that the two firms have formed a strategic alliance to develop and explore the commercialization aspects of high temperature superconductor (HTS) fault current limiters by building and testing FCL components based on AMSC’s second generation (2G) HTS wire. Fault current limiters (FCLs) are expected to serve as high-voltage surge protectors for power grids.

Prior to establishing this alliance, Siemens and AMSC, in close contact with electric utilities across Europe, Canada and the U.S., defined specific customer needs that meet their performance and economic requirements for today’s complex power networks. Based on their input, the companies jointly crafted a roadmap to demonstrate FCLs based on AMSC’s 2G HTS wire and Siemens’ fault current limiter design.

Under the terms of their agreement, Siemens will develop performance requirements for its FCL design and AMSC will tailor its standard 2G HTS wire to meet those specifications. Siemens and AMSC have been involved in developing fault current limiters since the beginning of the 1990s, utilizing different configurations of available HTS materials. The first deliveries of 2G HTS wire to Siemens are expected to be made from AMSC’s pre-pilot manufacturing line in 2005.

What is a Fault Current Limiter?

When a short circuit occurs in an electrical transmission or distribution system, an electrical generator feeding power into that system responds by creating a surge of current throughout the grid. Unless circuit breakers open up to stop this surge (technically, a "fault current"), it can damage expensive equipment, such as transformers, located in electrical substations and elsewhere on the grid. As grids around the world grow, the current level in the surges grows, increasing the need for utilities to upgrade breakers or consider other solutions such as FCLs that protect the grid. Worldwide, the resulting cost to electric utilities amounts to hundreds of millions of dollars each year, according to the U.S. Department of Energy.

A fault current limiter (also called a fault current controller) uses superconductors to instantaneously limit electrical surges -- or reduce them to more normal levels -- before they reach a circuit breaker. (Fault current limiters based on conventional electrical conductors do not exist. Only superconductors possess the unique physical properties that allow them to react instantaneously to current changes, passing electricity along at normal levels while dampening the surges.)

To learn more about FCLs please see http://www.amsuper.com/products/htsWire/FaultCurrentLimiters.cfm and http://www.electricity.doe.gov/.

American Superconductor receives HTS wire order from Ultera for Columbus, Ohio, superconductor cable project

—American Superconductor selected to join Ultera/Department of Energy superconductor cable project team

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 (TM) 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.

The U.S. Department of Energy is providing half of the $8.65 million of funding for this cable demonstration project. 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. Details of the project are available at http://www.electricity.doe.gov/documents/columbus_cable.pdf.

"Superconductivity is one of several promising technologies that we expect to play a significant role in solving the nation's power grid problems," said Kevin Kolevar, Director of DOE's Office of Electricity and Energy Assurance. "This project is a very important step in the development of new, high capacity HTS cables that are necessary to assure the security and reliability of the nation's power networks."

Ultera is a joint venture between two of the world's leading wire and cable firms, Southwire Company, located in Carrollton, Georgia, and nkt cables, based in Cologne, Germany. Ultera is dedicated to the development and commercialization of HTS power cables.

"We decided to use AMSC's wire in our HTS cable after a thorough evaluation of HTS wires from vendors around the world," said Stuart Thorn, chief executive of Southwire. "AMSC's wire is clearly the best in class. And we are proud to have them join our project team because of their deep experience and knowledge in superconductivity and transmission planning, both of which are vital to

the successful deployment of HTS power cable systems."

AMSC has joined the Ultera/DOE project team that, in addition to the host electric utility, AEP, comprises Praxair for cryogenic systems, TechCenter for power controls, and Oak Ridge National Laboratory for supporting technology and research.

"We are honored to join this outstanding industry-government partnership and to have been selected as the HTS wire supplier for this important cable project," said Greg Yurek, AMSC's chief executive. "We believe this project represents another key step in the growth of the new worldwide HTS industry and in the creation of solutions for our nation's aging power grid."

American Superconductor: 'more power' to developer kits

Frank J. Bartos, executive editor of Control Engineering, writes on 27 January 2005: "Developer kits are popular and useful tools for implementing board-level, microprocessor, and similar kinds of products. However, such kits usually cater to low-power levels. A recent announcement from American Superconductor Corp. (AMSC) raises the "power ante" dramatically, giving designers a means to quickly develop hardware and software elements of power conversion systems ranging from 60-225 kW for a wide range of applications-including motor drives. PowerModule PM1000 Developers Kit (PDK) accommodates ac-dc, dc-dc, and dc-ac types of power conversion."

"The PDK is an engineering and design kit said to free OEMs, VARs, system integrators, and end-users from many complex but essential tasks associated with power conversion. Kits are available for 480 and 690 V ac inputs, and contain all tools needed to configure American Superconductor's PM1000 power converter with the application or product under development."

What is power conversion?

Power conversion is a vital factor in designing products for many applications. Examples include motor drives (ship propulsion, industrial automation, transportation, etc.); distributed generation (fuel cells, wind turbines, and photovoltaics); and distributed power networks (standard and uninterruptible power supplies, and flywheel-backup systems).

From http://www.manufacturing.net/ctl/article/CA498330?spacedesc=industryUpdates

Harnessing wind energy with D-VAR® systems

American Superconductor Corporation's proprietary D-VAR® systems are being increasingly used around the world to provide voltage-control solutions for windfarms, as evidenced by the following recent news stories:

26 April 2005: Ontario wind farm taps American Superconductor's voltage regulation system

American Superconductor Corp. has received an order for one of its D-VAR voltage regulation systems to provide centralized control of the voltage for a zero-emission wind farm in Canada. The Kingsbridge Wind Power project, located near Goderich, Ontario, on the northern shore of Lake Huron, is a 39.6-megawatt facility that will contribute approximately 104,000 megawatt hours of renewable power annually.

It is the ninth wind farm in the United States or Canada and 10th worldwide to rely on Westborough-based AMSC's voltage control technologies to connect wind-generated power safely and reliably to transmission grids. Upon installation, 677 megawatts of electric power will be managed by AMSC's D-VAR systems - enough zero-emission energy to meet the needs of over 335,000 homes, according to the company.

6 April 2005: American Superconductor and GE Energy Receive Order for Low Voltage Ride- Through (LVRT) Solution for Hawaiian Wind Farm

American Superconductor Corporation and GE Energy announced that they have been selected by Hawi Renewable Development LLC (HRD) to provide a voltage control solution for the Hawi Wind Farm project located near Upolo Point on the Island of Hawaii.

Construction of the HRD wind farm, which will generate 10.56 megawatts (MW) of zero-emission electricity, is scheduled to be completed in November 2005. The wind farm will utilize 16 Vestas V47 wind turbine generators.

23 February 2005: American Superconductor Receives New D-VAR(R) Order for Connection of Canadian Wind Farm with Electric Transmission Grid

American Superconductor Corporation announced a new order for one of its D-VAR voltage regulation system for the Kettles Hill wind farm near the U.S.-Canadian border -- bringing to eight the number of wind-farm customers to select AMSC's products for connecting their power generation facilities reliably and safely to the electric transmission grid.

The Kettles Hill project is located in the vicinity of Pincher Creek at the southern end of Alberta, near the border with Montana and Idaho. It is being developed by Kettles Hill Wind Energy Inc., a joint venture between Creststreet Capital Corporation and Benign Energy Canada Inc. When completed in the spring of 2006, the facility will include 35 Vestas wind turbines for generating up to 63 megawatts (MW) of zero-emission energy.

5 January 2005: American Superconductor Books Additional Order for Wind Farm Voltage Regulation System

American Superconductor Corporation announced the sale of its D-VAR(R) voltage regulation system to the prime contractor for a Nebraska-based wind farm -- the seventh time customers have chosen AMSC's products to reliably and safely interconnect major wind-generated power facilities to the electrical transmission grid.

The Ainsworth Wind Turbine Project will be located south of Ainsworth, Nebraska, and is owned by Nebraska Public Power District (NPPD). The project will comprise 36 Vestas V82 wind turbines with an installed capacity of 60-megawatt (MW), and will be constructed on behalf of NPPD by RES America Construction Inc. of Austin, Texas.

High capacity power distribution cable successfully demonstrated in China's electric power network

—Superconducting power cable a key step in upgrading China's electric distribution and transmission system to meet booming power demands

American Superconductor Corporation announced on 11 April 2005 that a collaborative effort by four leading Chinese research and industrial institutions has successfully demonstrated a 75-meter, three-phase high temperature superconductor (HTS) power cable in a live distribution grid in northwest China. The cable was manufactured utilizing HTS wire manufactured by American Superconductor.

The Institute of Electrical Engineering (IEE), the Chinese Academy of Science (CAS), and the Technical Institute of Physics and Chemistry (TIPC, CAS), collaborated on the project with the Changtong Power Cable Company Ltd., who has operated the cable since December 2004 to supply power for Changtong's factories in Baiyin, Gansu Province.

According to Dr. Liye Xiao, director of the Academy's Applied Superconductivity Lab, the cable project is an important step in demonstrating that high capacity HTS power cables are a viable means to help meet the Chinese economy's growing demand for electric power.

"Demand for electric power in China continues to grow dramatically year-over-year," said Dr. Liye Xiao, director of the Chinese Academy of Science's Applied Superconductivity Lab. "We rapidly need to find innovative ways of delivering huge amounts of electricity -- the lifeblood of our growing economy -- to industrial, commercial and residential customers."

Power consumption in China is growing at double digit rates in major urban centers such as Beijing and Shanghai. The country's capacity to generate electricity has been increasing at a rate of about 7 percent per year while increases in the capacity of its transmission and distribution system -- the network of power lines that moves electricity from the generators to consumers -- has been growing at a lower annual rate. Grid congestion resulting from China's lower rate of build out in the power grid has been one of the key reasons for the many blackouts that have been experienced there in the last two years.

"There is clearly an increasing demand in China for ever-larger amounts of electricity to run factories, homes and businesses," said Greg Yurek, chief executive of AMSC. "There is also a growing recognition that the transmission and distribution system in China needs to expand significantly over the next several decades. We are delighted with the success of the Changtong cable project -- a project we believe will lead to larger demonstration projects and commercial deployment of high capacity HTS cable solutions in China during the remainder of this decade and beyond."

American Superconductor reports that the Changtong cable one of a number of similar demonstration projects underway around the world. The company says that additional cable demonstrations that utilize AMSC's wire include a transmission-level power cable being manufactured by Nexans for installation in the grid of Long Island Power Authority in East Garden City, Long Island, NY. Two other distribution-level power cable projects that utilize AMSC's wire are being carried out by LS Cable Company in the District of Gyeongbuk in South Korea and by Condumex Cable Company in Queretaro, Mexico. American Superconductor said it expects HTS wire orders in 2005 for additional cable demonstration projects to be carried out in 2006.

American Superconductor showcases its high temperature superconductor products at Hannover Fair 2005

—AMSC the sole U.S. company to participate in Fair's first 'SuperConducting City'

American Superconductor reported that it exhibited at the Hannover Fair 2005, the world's leading showcase for industrial technology, in Hannover, Germany.

The company reports that it was the only American company at the global trade show's special exhibition complex, "SuperConducting City" and adds that this is the first time that superconductor-based products are being highlighted at the Fair.

American Superconductor exhibited a model of its 36.5-megawatt (MW) HTS-based ship propulsion motor as well as HTS wire manufactured at its Devens, Mass., plant. "Products that utilize HTS wires, such as dynamic synchronous condensers for power grid reliability are entering the

commercial marketplace based on technology development under many successful industry-government partnerships over the last 15 years," said Kevin Kolevar, Director, Office of Electricity and Energy Assurance. "I am pleased to see these technologies and products highlighted at the prestigious Hannover Fair for the first time. This is another signal that our long-term investments in superconductor products are starting to pay off."

The international exhibition ran from April 11-15 and included more than 6,000 exhibitors from 60 countries.

$5 million grant funds college training programs for SuperPower workers

Richard A. D'Errico writes in the 31 March 2005 issue of the [Albany] Business Review that SuperPower Inc., Union College, and Schenectady County Community College have secured a $5 million matching grant to train a future work force SuperPower says it needs as it ramps up production of its superconducting cables.

"SuperPower CEO Philip Pellegrino announced the news Thursday during a breakfast of business leaders at Union College. 'I love New York,' he sang as he came to the podium, 'especially today.' He [Pellegrino] said he was sick and tired of seeing jobs leave New York."

"SuperPower, based in Schenectady, expects to grow from 50 people to 150 by 2010."

Quantum Design introduces new high temperature superconductor-based product for physical property measurements

—Electromagnetic coils supplied by HTS-110, Ltd. utilizing American Superconductor Corp.'s HTS wire at heart of new measurement system

Quantum Design, HTS-110 Ltd. and American Superconductor Corporation jointly announced on 16 March 2005 the introduction of a new product for measuring the fundamental physical properties of materials. The new instrument incorporates an electromagnetic coil built with HTS wire in order to increase its versatility and lower its operating costs relative to similar systems that utilize copper or low temperature superconductor wire.

"We are delighted to have built the electromagnetic coil for Quantum Design's new physical property measurement system," said Geoff Todd, CEO of HTS-110. "We believe this is one of many new commercial products that will utilize HTS wire in the near future, and we believe we are strongly positioned

Tiny superconductors withstand stronger magnetic fields

Ultra-thin superconducting wires can withstand stronger magnetic fields than larger wires made from the same material, researchers now report. This finding may be useful for technologies that employ superconducting magnets, such as magnetic resonance imaging.

As described in the Jan. 14 issue of the journal Physical Review Letters, researchers at the University of Illinois at Urbana-Champaign have created high-quality superconducting wires with molecular

dimensions, and measured their behavior in magnetic fields of various strengths. The observational results have confirmed that theories developed for bulk superconductors also apply to molecular-scale superconductors.

[…]

Because nanoscale superconductors don't repel magnetic fields, they could prove useful in a variety of superconducting applications. By incorporating nanowires as filaments in bigger superconducting wires, for example, more current could be carried without being destroyed by a magnetic field.

The work was performed by Alexey Bezryadin, professor of physics at the University of Illinois at Urbana-Champaign, postdoctoral research associate Andrey Rogachev and graduate research assistant Anthony Bollinger. Funding came from the National Science Foundation, the Alfred P. Sloan Foundation and the U.S. Department of Energy.

From 4 February 2005 UIUC press release.

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. Past issues are available on the U.S. Department of Energy's website.

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.

Craig Cox
303-679-9331