Superconductor Utility Applications Grow Steadily Worldwide

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Superconductor wire conducts more than 100 times the electrical current of equivalent sized copper wire. The wires on the right carry as much power as all of the copper on the left. Courtesy of American Superconductor

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According to a BCC Research analysis published in 2010, global revenues from superconductor applications amounted to an estimated $1.7 billion in 2009, a figure that BCC Research projects will double in 2015. That represents a projected compound annual growth rate of more than 12 percent.

Although superconducting magnets used in labs, research and development, and healthcare applications currently dominate the market, that segment is growing only slightly faster than the overall economy. A primary driver of future growth is expected to be modernizing electric utility infrastructure. The demand for newer superconductor electrical equipment such as transformers, generators, motors, fault current limiters, power storage, and cable could amount to more than $800 million in industry-wide revenues by 2015. This compares with $23 million spent on these applications in 2010.

CORNUCOPIA OF APPLICATIONS

Numerous utility demonstrations of superconductor cabling have taken place over the last two decades. High-temperature superconducting (HTS) power cables are on the cusp of becoming a commercial reality.

The Baiyin installation in Gansu Province, China, illustrates the multi-faceted capability of superconductivity in substation equipment. Baiyin includes a superconductor power cable system; a superconductor fault current limiter (essentially a high-voltage surge protector); a superconductor magnetic energy storage system that provides backup power; and a superconductor transformer that minimizes energy losses.

Because of the inherent advantage of HTS wire—in power transmission systems, a single wire can carry enough power to serve 10,000 U.S. households—potential applications range from ac and dc power transmission and distribution cables, fault current limiters, and surge-suppressing power cable systems to ship propulsion motors, degaussing systems for naval vessels, electromagnets, maglev trains, and wind turbine generators.

All of these applications will benefit from improved economics, but one with great potential is power transmission cable. Two factors are driving this—increasing electrification of the economy and modernizing grids in congested urban areas.

Since 2006, American Electric Power has used Southwire's Triax HTS cable to serve more than 50 MW of load to approximately 8,600 customers in Ohio. And in 2008, Long Island Power Authority commissioned an HTS power cable system, operating at 138 kV, in its Holbrook transmission right of way. Operated at full capacity, it can transmit up to 574 MW of power.

Con Edison is showcasing yet another aspect of HTS technology, namely the cabling's inherent fault current limiting capability. In the context of urban settings, the Con Edison project illustrates how the flexibility inherent in an HTS cable system can mitigate historical grid problems common to areas where large and growing concentrations of load need to be carried in constrained spaces.

The Tres Amigas interconnection in New Mexico could be the first application of HTS cables in a high voltage dc (HVDC) application. Cables proposed for this project are ultra-efficient, high capacity, HVDC transmission and, unlike any other technology, cannot only move power long distances, but can do so underground. Tres Amigas may use HTS cables to interconnect America's three power grids, creating a wider market for renewable energy resources, and greatly contributing to grid modernization.

Electric utilities and cable manufactures strive to deploy the best technology available. HTS will be critical to high capacity, flexible, fault-tolerant transmission, as well as HVDC transmission. Superconductor cables are expected to deliver gigawatts of electricity from multiple generation sites to multiple load centers. Such superconductor lines will be easy to site, highly efficient, controllable, and offer greater security than competing technologies, all underpinnings of the Smart Grid.

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