The Future of Superconducting Transmission

BY STEPHEN ASHWORTH

SKEPTICS HAVE SAID that fusion will always be the energy source of tomorrow – never today. Similarly, superconductivity has been labeled the transmission technology of tomorrow – never today.

But with superconductivity, tomorrow is coming in the form of superconducting underground power cables. Two such two cables exist in the U.S. power grid: one operated by National Grid at Albany, N.Y., and a second by AEP in Columbus, Ohio. By the end of the year, a third will carry power for LIPA on Long Island, N.Y.

These cables use a "high-temperature" superconductor cooled to about –320 degrees F using liquid nitrogen. The Albany cable was manufactured by Sumitomo; the AEP cable, by Ultera, a South Wire subsidiary. The Long Island cable is being made by Nexans.

Tomorrow is coming, because the cables are operated by utilities and manufactured by cable companies. These are not laboratory-based demonstrations made as "specials" by, for example, one of the national laboratories such as Los Alamos National Laboratory or Oak Ridge National Laboratory, as was the case for the previous generation of low-temperature superconducting cables.

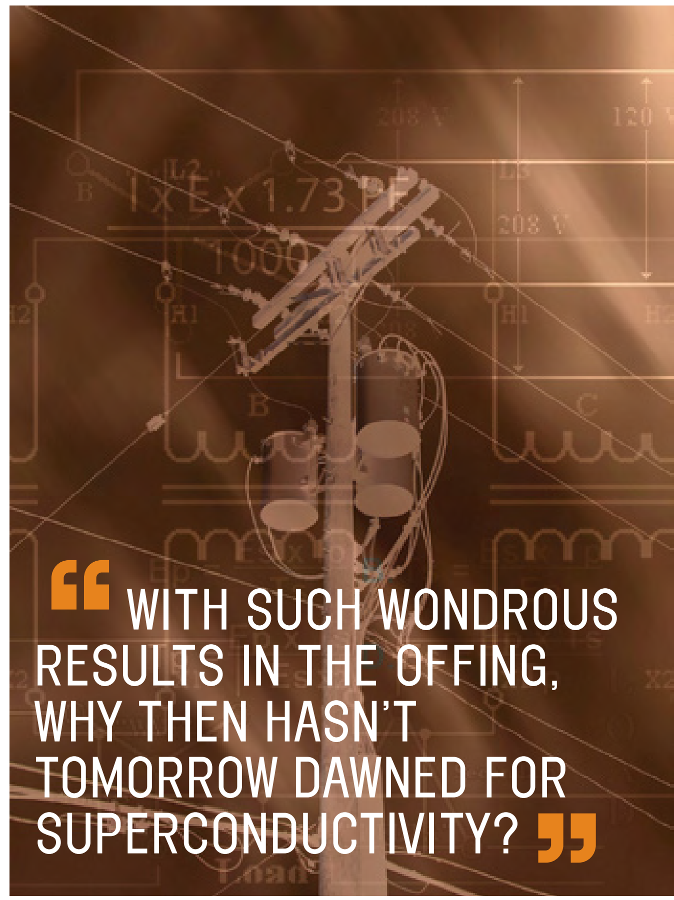
The U.S. Department of Energy's Office of Electricity Delivery and Energy Reliability (OEDER) deserves to be complimented for its Superconductivity Partnership Initiative. This program provided co-funding for these cable projects and mandated that the deliverable be a cable operating in a utility power grid. This decision ensured that the cable had to be manufactured by a cable company. A research engineer working at a national laboratory would have a hard time persuading a utility engineer to accept onto the grid a cable at that lab. But when Nexans or Sumitomo or Southwire builds the cable, that's different. The cable projects benefited in large measure from expertise shared by national laboratories, but the laboratories were not the prime movers.

A further consequence of these projects is that the cable companies are now delivering product to existing customers and are capable of delivering product to prospective customers – and customers are important to them. The cable manufacturers are striving to make the superconductivity aspect of the cable as invisible as possible. The utility doesn't want to see liquid nitrogen or have to train people in superconductivity. The utility simply wants to carry current reliably. To paraphrase part of a discussion with a utility engineer on what signals to send to the control room from a superconducting cable: "I only want a green light or a red light – signaling the cable is available or not – and I never want to see a red light."

So what can these cables offer technically? The cables arrive at a site reeled on a standard drum. They can be drawn into existing ducts with basically standard techniques. Their installation offers the possibility of removing an existing cable from a duct and increasing the duct's transmission capacity by a factor as great as five while maintaining the same voltage.

With such wondrous results in the offing why then hasn't tomorrow dawned for superconductivity?

One reason is that a superconducting cable isn't just a cable. It requires a cooling system. The currently available cooling system needs further development to make it more compact, more reliable, more efficient and less expensive.



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A second reason is the cost of the cable itself. Although the three existing projects aren't sufficient to establish a market price for cables, we already know that the superconductor itself is far too expensive. Again kudos must go to the DOE because the cost problem was realized some time ago, and an initiative was launched at Los Alamos National Laboratory to develop a second-generation superconductor with a cost target of $10 per kiloampere per meter. The 2G technology was transferred to U.S. industry, and the first cable using a 2G superconductor will soon go into the grid.

The DOE has accepted proposals for another round of demonstration projects whose successful completion promises to advance transmission technology. But the DOE-OEDER funding request for federal fiscal year 2008 calls for a 30 percent reduction in superconductivity funding over the current year which could significantly slow the development of superconducting transmission.

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