Waukesha Electric partners with SuperPower and UH to build fault current limiting superconducting transformer for Dept. of Energy

EurekAlert

Dec. 21, 2009 ?Waukesha Electric Systems, SuperPower, University of Houston, Oak Ridge National Laboratory and Southern California Edison are partnering in a $10.7 million smart grid demonstration project award announced by U.S. Department of Energy Secretary Steven Chu on November 24. The funds will be used to manufacture a transformer for electric utilities that will boost the reliability of the nation's power grid.

"The project is for a fault current limiting (FCL) superconducting transformer. Waukesha Electric will build the transformer, SuperPower will manufacture the superconducting wire that will be used in the transformer, and will collaborate on the development of a new wire architecture and testing of its functionality with the Texas Center of Superconductivity at the University of Houston," said Venkat (Selva) Selvamanickam, M.D. Anderson Chair Professor, Department of Mechanical Engineering. "We look forward to seeing our technology employed in a physical device when the transformer is installed four years from now in California's largest grid at the Southern California Edison utility substation."

According to the U.S. Department of Energy, the technology used by utilities has not changed much in decades and in some cases has not changed for over 100 years. It is estimated that 40 percent of the nation's total grid energy losses are from aging conventional transformers and that the use of superconducting transformers could reduce energy losses on the grid by one-third ? equivalent to eliminating about 15 million tons of CO_2 annually.

"Superconducting transformers are half the size and weight of conventional transformers and occupy less space, which results in increased power handling capability without the requirement for more or larger substations in already crowded urban areas. Additionally, they can be installed within buildings since they don't use flammable oil for cooling, which is a benefit in urban areas," said Selvamanickam.

Beyond the energy savings, there are substantial environmental benefits. According to Drew Hazelton, principal engineer and project lead for SuperPower, "Conventional transformers are filled with toxic and flammable oil for cooling. Approximately one transformer catches fire or explodes each day in the U.S. A fault current limiting superconducting transformer mitigates both of these risks because it is cooled with liquid nitrogen, an inexpensive and readily available and benign substance that will result in safer and 'green' devices."

Protecting the electrical grid from faults that result from lightning strikes, downed

power lines and other system interruptions is critical to ensure a safe and reliable flow of power for consumers. The growing demand for electricity over the next century and the aging conventional transformers challenge the grid beyond its capability, compromising reliability through voltage fluctuations that crash digital electronics, brownouts that disable industrial processes and harm electrical equipment, and power failures like the North American blackout in 2003 that affected 50 million people and caused approximately $6 billion in economic damage over the four days of its duration.

"The superconducting wire we are working on here at the University of Houston has a unique property in that it allows electricity to flow without any resistance, but at the same time it limits the current flow to tolerable levels in instances of a sudden spike in power. It's like a power valve," said Selvamanickam. "Utilities use circuit breakers that are very expensive and, if they trip, the customer doesn't have power for a period of time. The transformer that will be constructed in this project will have inherent fault current limiting features, providing an added bonus," said Selvamanickam.

The fault current limiting feature of the transformer provides critical protection and significantly reduces wear and tear for circuit breakers and other power equipment in existing substations. This reduces capital equipment costs for replacement or upgrade of such equipment and provides flexibility in routing power during emergency situations.

"We are delighted to partner with Waukesha Electric and SuperPower to add the superconducting transformer, with a unique fault current liming function to the smart grid technology," said Donald Birx, vice president for research at UH. "The University of Houston was the birthplace of high temperature superconductivity in 1987 by Paul Chu and colleagues, with the discovery of YBa2Cu3O7 that broke the liquid nitrogen barrier for superconducting temperature. The Texas Center for Superconductivity at the University of Houston (TCSUH) is the largest university-based center in the world that is focused on superconductor research. With the return of Dr. Venkat Selvamanickam to the University, a strong, world-class applied research program in second-generation high-temperature superconducting (2G HTS) wires has been created."

SOURCE [1]

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[1] http://www.eurekalert.org/pub_releases/2009-12/uoh-wep122109.php