

## Superconductivity for Electric Systems 2006 Project Summary

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<b>PROJECT TITLE:</b>	<b>SPI Readiness Review Program</b>
<b>ORGANIZATION:</b>	<b>ORNL, LANL, DOE</b>
<b>PRESENTERS:</b>	M. J. Gouge (ORNL), S. P. Ashworth (LANL), P. Bakke (DOE-Golden)
<b>FY 2006 FUNDING:</b>	\$120K (ORNL), \$100K (LANL)

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### **Project Purpose and FY 2006 Objectives:**

The purpose of this HTS program initiative is to support the Superconducting Partnership with Industry (SPI) teams to help ensure SPI demonstration projects go as planned via a series of phased readiness reviews. The focus is on collaboration with the SPI team to identify potential failure modes; issues involving cryogenic temperatures, vacuum and high voltage dielectrics remain a major concern. Expertise is obtained as needed from national laboratories, universities, utilities and consultants. M. J. Gouge (ORNL) and Jim Daley (DOE) provided an overview of this proposed SPI oversight program at the January 2003 DOE Wire Development Workshop and the program began in March 2003. The objective for 2006 is to continue focused reviews as projects complete assembly/installation and commission HTS systems into the electric grid. At least one review per project is planned in 2006 and in 2007 as the present SPI projects proceed to initial commissioning and then technology demonstration.

### **FY 2006 Performance and FY 2007 Plans:**

All of the SPI projects had completed at least one review cycle by August 2004 with eleven additional reviews in FY 2005. A readiness review was conducted at General Electric Power Systems on September 27-28, 2005. This was the project Preliminary Design Review and the scope included all generator systems impacted by the HTS rotor addition. Reviewers were Mike Gouge from ORNL, William Hassenzahl-consultant from AEA, Charles Oberly from AFRL and Paul Bakke from DOE-Golden. GE made a public announcement in January 2006 that they had reached an agreement with DOE to discontinue work on this 100 MVA generator SPI project due to economic scaling issues with present superconducting tape and cryogenic technology. The MFCL project was in a reduced effort status since the last peer review due in part to reliability concerns with the bulk BSCCO tubes in the fault-limiting matrix; readiness reviews will resume when the SuperPower-led team establishes a new project technical baseline. Due to the above, the readiness reviews in 2006 focused on the three superconducting cable projects as they proceeded to assembly, commissioning and testing (Albany and Columbus/AEP cables) and prototype qualification and manufacturing (LIPA cable). We are encouraging all the SPI projects to develop risk identification and mitigation processes and to leverage R&D and prototyping to enhance success at full-scale and design levels of voltage/current. Based on continuing issues with the design and performance of dielectric materials at cryogenic temperatures and at high voltage, more emphasis will be placed on R&D and risk mitigation in this area by the grid-based SPI projects. A web-site was planned for 2006 with lessons-learned and general design guidance; this was not implemented due to budget restrictions and the effort focused on the higher priority readiness reviews.

A workshop on cryogenic dielectrics was held on October 16, 2005 in conjunction with the IEEE Conference on Electrical Insulation and Dielectric Phenomena (CEIDP), October 16-19, 2005 in Nashville. The workshop brought together many experts in the field of cryogenic dielectrics from the US, Europe and Asia. There were approximately 50 attendees with participation by SPI teams facing high voltage component qualification. There were ten presentations followed by a panel discussion on future needs. The agenda included some overview talks on liquid nitrogen dielectrics, solid dielectrics, HV design practices, etc. The organizers were Isidor Sauers and Randy James from ORNL, Alan Wolsky from Argonne National Laboratory and Toshikatsu Tanaka from Waseda University, Japan.

One of the recommendations from the 2005 SPI project(s) peer review was for the three cable project teams to look at generic technical issues in HTS cables. A generic cable issues session was organized on Feb 1, 2006 at the Wire Development Workshop and all three SPI cable teams participated. Real progress was made on understanding external (fault currents due to grid shorts) and internal (such as loss of vacuum in the cryostat) faults and their impact on the liquid nitrogen cooling system. A presentation was also made on cryostat reliability and lightning protection issues.

In 2007, readiness reviews will conclude on the three present superconducting cable projects as all three will be in the demonstration phase. As was done for the 5/10 MVA HTS transformer project, lessons-learned readiness reviews will be done as these projects end their planned demonstration periods in the next few years.

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A new program solicitation on superconducting power equipment is planned later in 2006. In 2007 the selected projects will begin. Shortly after this (typically during conceptual design), it is planned to hold an initial review of the proposed project's technical approach and identify those areas potentially likely to repeat past problems or lead to new ones. Also the team organization/resources will be reviewed to ensure sufficient capability to address technical challenges.

### **FY 2006 Results:**

- Multiple readiness reviews (led by Steve Ashworth, LANL) were conducted for the three HTS cable projects. Reviews were segmented where needed to focus on specific issues like cryogenic system commissioning and component high voltage qualification.
- A readiness review was conducted at the GE HTS Generator preliminary design meeting (project subsequently halted).
- An international workshop on cryogenic dielectrics was held in October 2005 as part of the IEEE CEIDP meeting.
- An HTS cable generic issues session was held at the 2006 Wire Development Workshop.

### **Research Integration:**

Since the reviews contain a large amount of proprietary material, the results and recommendations are typically shared only between the project being reviewed, the reviewers, and DOE. The reviewers, to the extent possible, highlight or flag potential problem areas that they have learned from other project reviews.

The cryogenic dielectrics international workshop and the generic cables issues session engaged many experts in the U.S. and abroad from industry, laboratories and universities.