

**2010 Advanced Cables and Conductors Peer Review
Project Summary**

Project Title:	Update on SuperPower's 2G SFCL Device and Modules
Organization:	SuperPower, Inc.
Presenters:	Juan-Carlos Llambes, Ph.D.
FY 2010 Funding:	\$192,650

Overall Project Purpose and Objectives:

The objective of this program is the demonstration of feasibility and evaluation of performance of sub-cooled SFCL superconducting modules for distribution and transmission-level SFCL devices.

2010 Approach and Results:

In FY10 SuperPower constructed and studied the performance of a sub-cooled 2G SFCL device. The SFCL device is comprised of two types of modules with two different types of 2G HTS superconductors, one with larger shunt impedance to limit the fault more efficiently and another with larger thermal mass and lower impedance for recovery at a higher current level in a shorter time. These two configurations are studied under sub-cooled and pressurized conditions.

By sub-cooling the SFCL device, the critical current of the superconductor is increased and the recovery can be shortened considerably. The sub-cooled performance at 65K is approximately double the current capabilities at 77K and leads to reduction in recovery time by a similar factor. This improvement is achieved with recovery under load operation and recovery under no load. The modules, cryogenics and overall system can be reduced by half when operating with sub-cooled LN₂ at 65K at a pressure of approximately 130 Torr versus the conventional open bath temperature of 77K.

Another relevant objective of these tests is to improve the dielectric performance of the SFCL device and the modules. Therefore, a wide range of pressures and temperatures is studied to determine the best operating conditions where the dielectric strength of the LN₂ bath and the superconductor performance are improved. As a result, the dynamics and the dielectric strength of the SFCL modules can be improved by optimizing the operating pressures and temperatures. This optimization serves to reduce the size and cost of any distribution and/or transmission-level device using a modular SFCL approach.

2011 Plans and Expectations:

SuperPower plans to construct, assemble and test a complete alpha (single phase) SFCL deemed capable of being connected to power distribution lines. The distribution alpha prototype SFCL device will be constructed utilizing the improved sub-cooled module designs. The device will be tested at a high-power test facility.

Technology Transfer, Collaboration, Partnerships:

SuperPower has a close collaboration with the Center for Advanced Power Systems (CAPS) at Florida State University, where the high power testing characterization has been performed. The study, simulation and testing of a wide range of shunt impedances has been done very efficiently using the powered switching capabilities available at this center. Oak Ridge National Laboratory has been providing testing and analysis of high voltage configurations of tape structure and LN₂ properties, as well dielectric studies. Rensselaer Polytechnic Institute has also been an important partner in this SFCL program. Additionally, there has been a strong interaction with the wire development and manufacturing group of SuperPower to study different wire configurations specific to SFCL.