Project Title:	**Cost Effective, Open Geometry HTS MRI System**
Organization(s):	**Oxford Instruments, Superconducting Technology**
Presenters:	K. Marken, G. Gilgrass (OMT) and T. Holesinger (LANL)
FY 2004 Funding:	\$550 K (DOE), \$550 K (Industry), \$200 K (LANL), \$200 K (NREL)

Project Purpose and FY 2004 Objectives: The purpose of this Phase II Superconductivity Partnership Initiative project is to build and operate a prototype Magnetic Resonance Imaging (MRI) system using HTS coils wound from low-cost, dip-coated BSCCO 2212 tape conductor. The planned milestones for FY 2004 were: (1) complete precursor powder manufacturing upgrades; (2) complete prototype conductor processing line; (3) begin conductor fabrication (4) complete design of cryogenics system and magnet.

FY 2004 Performance and FY 2005 Plans: FY2004 Performance includes: (1) Precursor powder cost reduction and performance studies were completed. Powder process facility upgrades were completed, and powder manufacturing is underway. (2) Conductor configuration was selected, and prototype conductor processing line was completed, including coating, sheathing and heat treatment. (3) Conductor qualification is underway, conductor manufacturing to begin in August. (4) Magnet and cryogenic modeling and design work has continued with completion scheduled for September.

The project was formally amended in August of 2003 to extend the period of performance one year, with no budget increase. The new project completion date is May 2006. There has been no delay in the revised schedule.

For FY 2005 plans include (1) Complete manufacture of powder. (2) Complete manufacture of tape. (3) Complete magnet and cryogenics system manufacture and test.

FY 2004 Results: Substantial improvements were demonstrated in precursor powder processing, and these were incorporated in a scaled up manufacturing line. This progress includes advances in precursor materials, precipitation line, calcine furnace, milling and characterization tools. Present powders have both 60% lower costs and 30% higher critical current performance (>3500 A/mm^2 at 4.2K, self field) than previous powders.

Three conductor configurations were compared, and a decision regarding conductor type was made in February. The conductor will be sheathed dip coated tape, between 20 and 25 mm wide, batch heat treated. This decision dictated the need for a larger furnace to accommodate minimum batch size of 500 m tape; a furnace was purchased and put into operation in June. This decision also dictated the need to scale up the sheathing line, and the reworked line was put into service in June. The coating line was rebuilt to accommodate wider tapes (up to 25 mm) and longer lengths (up to several km), and has shown excellent thickness control over hundreds of meters. Our partners at NREL demonstrated a 30% increase in Jc values obtained in short samples by addition of nanoparticle MgO, and trials with long lengths using this method are underway at OST. Our partners at LANL provided substantial characterization support during this period, including I_c testing as a function of temperature and field, powder characterization and optimization, and extensive microstructural work. Under subcontract, the Electromagnetic Technology Division at NIST has provided detailed measurements of critical current as a function of temperature, field, and angle with respect to field. These data are being used to refine the magnet design.

Design work has continued for the cryogenic systems and magnet.

Research Integration: This SPI team includes three industrial development partners (Oxford Superconducting Technology, SCI Engineered Materials, Oxford Magnet Technology), an industrial end user (Siemens Medical Solutions), and two national laboratories (LANL and NREL). This partnership vertically integrates a range of expertise and experience including powder synthesis, conductor design and fabrication, magnet and cryogenics design and manufacture, MRI imaging and analysis, and a broad range of analytical and characterization tools at the DOE Labs that complement the project objectives and activities. In addition this year we have partnered with the Electromagnetics Technology group at NIST for more extensive critical current characterization.