Organization:	**SuperPower, Niagara Mohawk, Sumitomo Electric Industries, The BOC Group,**
Project Title:	**Albany HTS Cable Project**
Presenter(s):	Chuck Weber (SP), Ron Lee (BOC), Takato Masuda (SEI)
FY 2005 Funding:	$4,350K (DOE to SuperPower & Sumitomo),

I. Project Purpose and FY 2004 Objectives

Project Purpose: The project objective is to develop a flexible, cold-dielectric, three phase in one cryostat HTS cable for operation in the power grid at 34.5kV, 800A_{rms} continuous current. The cable system will be designed and tested to handle second contingency fault currents conditions (23kA_{rms}, 38 cycles). A field installed joint will be included to allow the replacement of a 30m section of the BSCCO based cable (Phase 1) with a 30m section of YBCO cable (Phase 2). The purpose of this project is to develop a commercially viable cable system that meets or exceeds commercial reliability standards.

FY2005 Objectives: The primary FY2005 objectives were to conclude the detailed design task, complete component and sub-system testing, fabricate all major cable system components and commence installation of the cable system at the Albany site. This includes the site infrastructure, the cryogenic refrigeration system (CRS), and the HTS cable, terminations and joint.

II. FY 2005 Performance and FY 2006 Plans:

Summary of FY 2005 performance:

A summary of FY2005 accomplishments include:

1. Finalize the detailed design and conclude all component and sub-system testing
2. Completion of the site infrastructure, including the installation of the underground vault, the conduit system, the termination support pads, the ground grid, and the control building. Minimal work remains to allow for connection to the existing overhead line.
3. Completion of the cryogenic system, including installation into the control building, preliminary connection with the Remote Operations Center, and testing with a dummy load.
4. Completion of the HTS cable manufacture, including all required pre-shipment acceptance electrical and mechanical testing.
5. Completion of the termination and joint manufacture, including all required pre-shipment acceptance testing.
6. The HTS cable, return cryostat, terminations, and joint are presently being shipped from Japan.

FY 2006 Plans:

1. Complete installation of HTS cable system (cable, return pipe, joint & terminations).
2. Complete initial cooldown and off-grid performance testing
3. Commence on-grid operation of the HTS cable system
4. Complete the cable design for the YBCO cable
5. Fabricate YBCO conductor for the 30-m Phase 2 cable
6. Complete fabrication and factory testing of the 30m YBCO cable

III. FY 2005 Results:

1. The detailed design task was completed and a second readiness review meeting was held in November 2004. Risk items identified during the 1st readiness review meeting were addressed. Some items were shown to be a non-significant risk, some have prompted re-assessment or re-design and some have helped define the testing program. Component and sub-system testing was carried out on all critical components such as the CRS thermosyphon concept, termination & joint epoxy bushings, fault current analysis.
2. The site infrastructure was completed.
    a. Three conduits were installed underground from the location of the termination pads to the underground vault; from the underground vault to the 90 degree bend; from the 90 degree bend, dipping down under the road, to the far termination pad.
    b. The 10' by 10' by 30' underground vault was installed and connected to the conduits.
    c. The termination pads and grounding grids were examined by a PE and installed to meet both Niagara Mohawk and Sumitomo Electric specifications.
    d. A building was constructed to house the cryogenic refrigeration-system and includes office and conference space.
3. The cryogenic refrigeration system (CRS) was completed, installed, and successfully passed all pre-commissioning testing.
4. The BSCCO-based cable was manufactured.
    a. Short sections of the cable were tested to industry standards for voltage withstand, BIL, bend tests, and other as required by applicable American standards. In addition, critical current testing was conducted.
    b. The 30m section and 320m section of the BSCCO base cable were completed and shipped.
    c. The cable terminations were manufactured to ASME pressure vessel code, tested, and shipped.
    d. The cable joint was manufactured to applicable code, tested and shipped.
    e. The 350m long return cryostat was manufactured, tested, and shipped.
5. Short trial cables were wound from the YBCO HTS conductor. Initial tests show comparable or better performance as compared to the BSCCO cable.

IV. Research Integration:

There is a very high level of research integration on this project within the broad expertise of the project team. The project team consists of the following organizations and respective responsibilities:

1. **SuperPower, Inc** - Schenectady, NY: Project manager; manufacture 2nd generation HTS conductor
2. **Niagara Mohawk**, a National Grid Company - Albany, NY: Host utility, conventional cable & system protection, system impact studies
3. **Sumitomo Electric Industries** - Osaka, Japan: Design, build, install, and test the HTS cable, terminations, & joint
4. **The BOC Group** - Murray Hill, NJ: Design, build, install, and test the cryogenic refrigeration system