Albany Cable Project Progress Update

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HTS Solutions for a New Dimension in Power

Superconductivity for Electric Systems – 2005 Annual DOE Peer Review – August 2-4, 2005

Project Team Members and Responsibilities

SuperPower, Inc - Schenectady, NY

- Wholly-owned subsidiary of Intermagnetics General Corporation
- Project Manager; Manufacture 2nd generation HTS conductor

Niagara Mohawk, a National Grid Company - Albany, NY

- Part of National Grid - 8th largest electric utility in the US
- Host utility, conventional cable & system protection, system impact studies

Sumitomo Electric Industries - Osaka, Japan

- Joined Program in 11/02
- Design, build, install, and test the HTS cable, terminations, & joint
- First manufacturer of a 3-core-in-a-single-cryostat HTS cable in the world

The BOC Group - Murray Hill, NJ

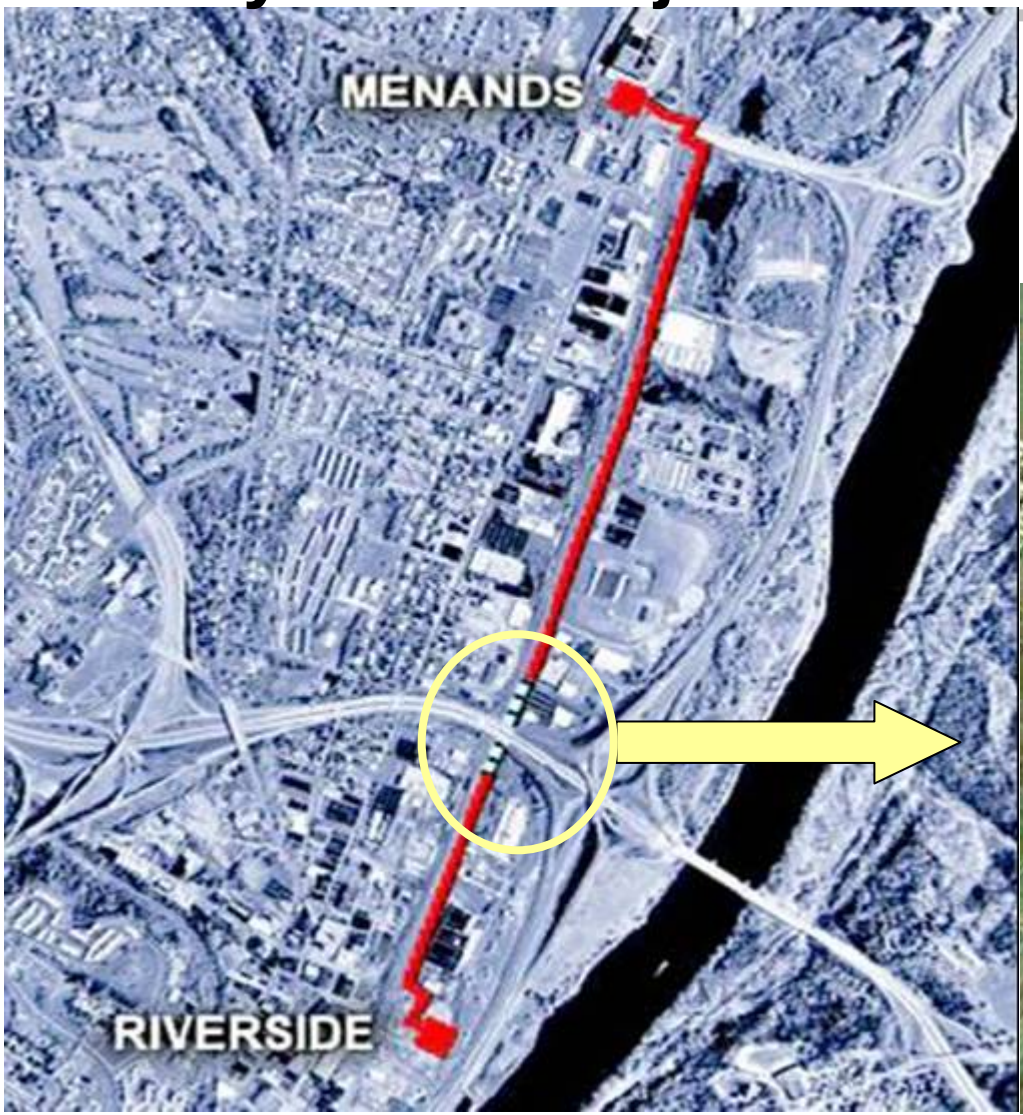
- Joined Program in 7/03
- One of the largest global industrial gas companies
- Design, construct and operate the Cryogenic Refrigeration System, and provide overall cable remote monitoring and utility interface

Supported by Federal (DOE) and NY State (NYSERDA) Funds

Major Milestones

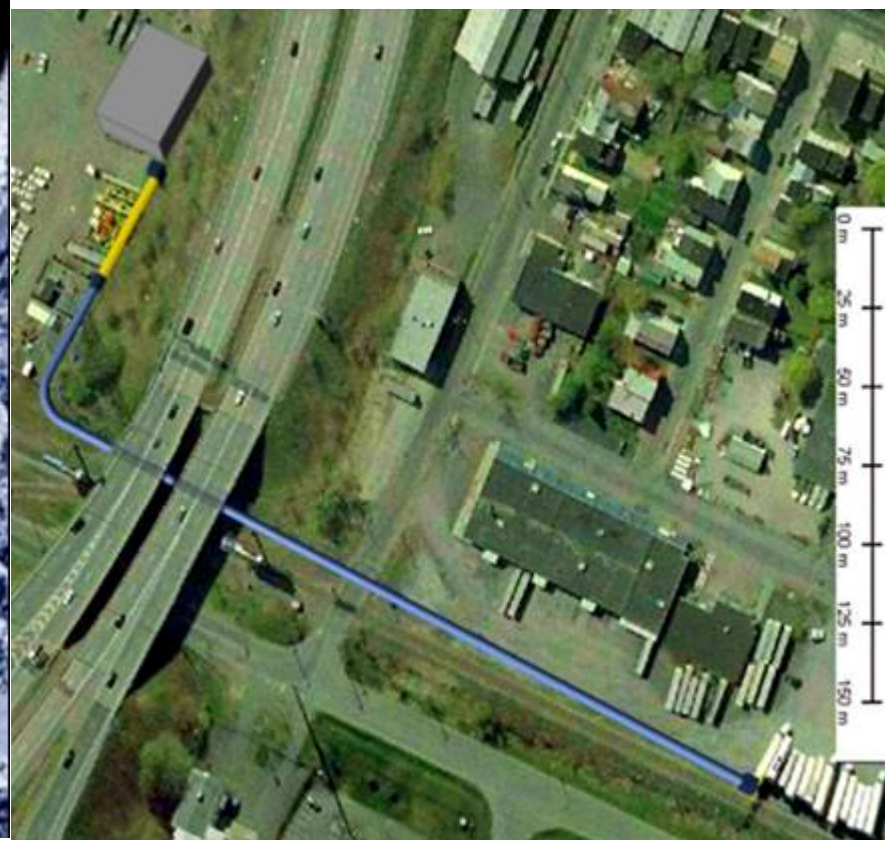
Conceptual Design Readiness Review Mtg.	December 03 √
Detailed Design Readiness Review Mtg.	November 04 √
Subsystem Testing of CRS	September 04 √
Site Infrastructure	February 05 √
CRS Installation & Functional Testing	June 05 √
BSSCO Cable Installation & Commissioning	February 06
YBCO Cable Installation & Commissioning	June 07

Albany Cable Project – Site Layout



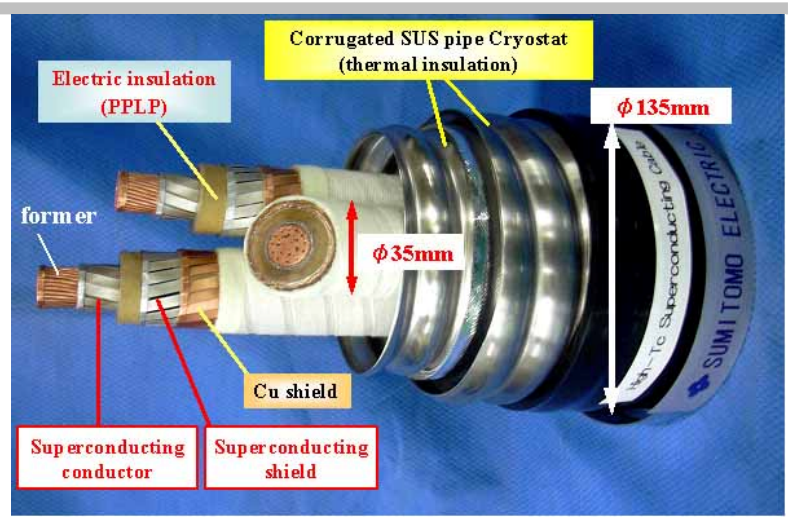
Installed between two Niagara Mohawk substations

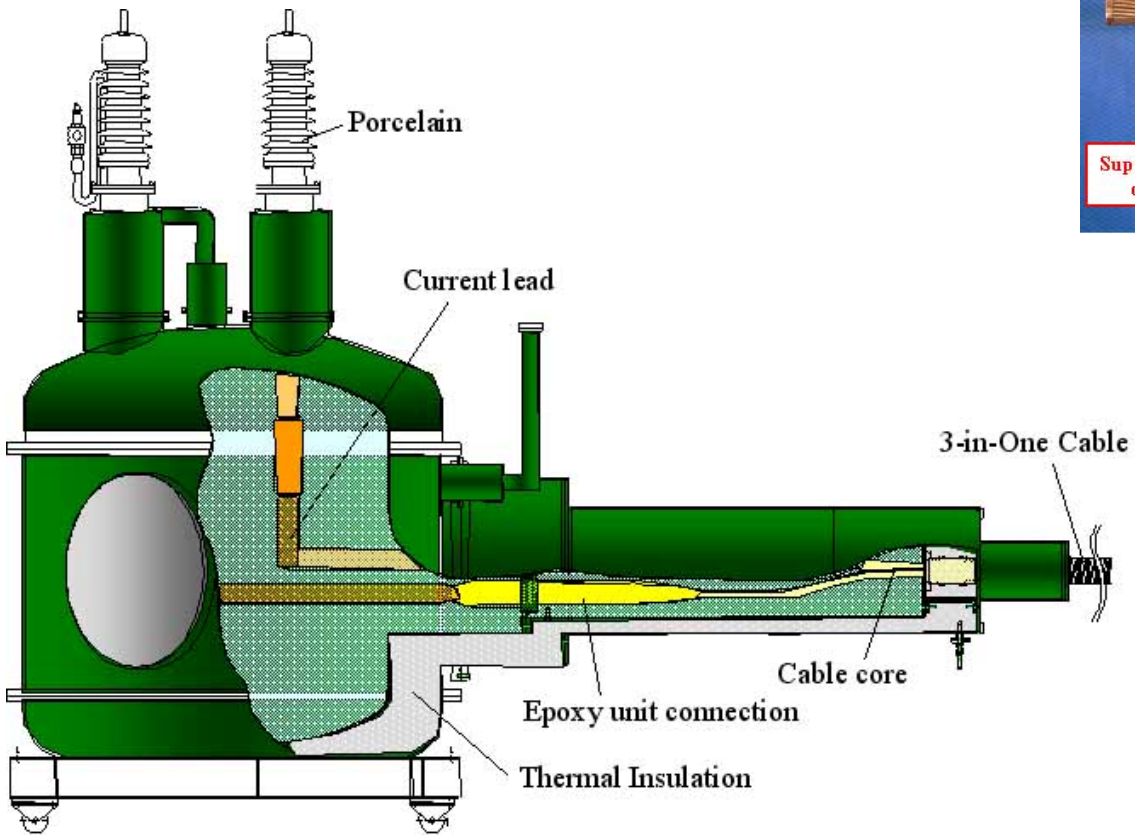
- Riverside-Menands
- Parallels new 34.5kV installation
- added to handle load growth



Site Infrastructure/Preparations

Cable Component Fabrication





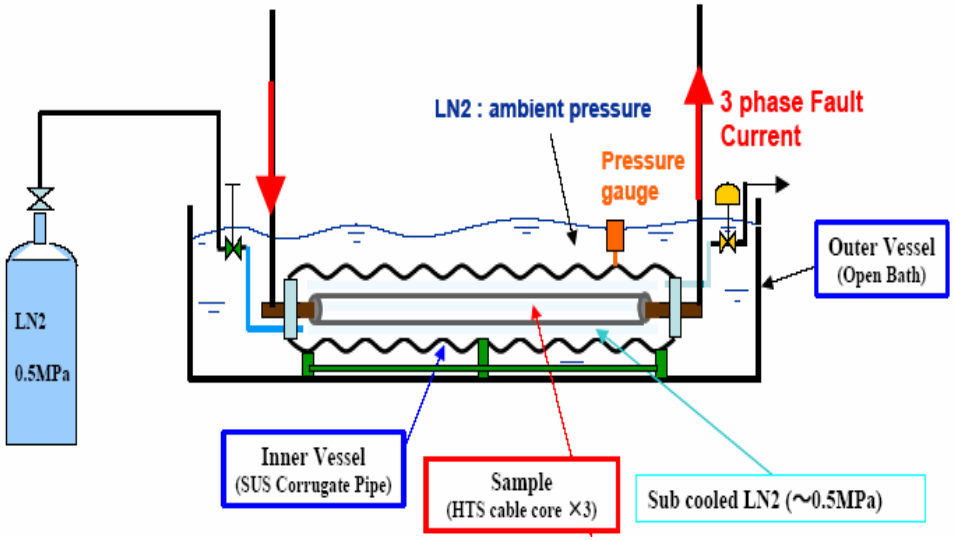
Fault Current Testing

Fault Current Conditions

- 23 kA maximum
- 1st Contingency = 8 cycles (133 ms)
- 2nd Contingency = 38 cycles (633 ms)

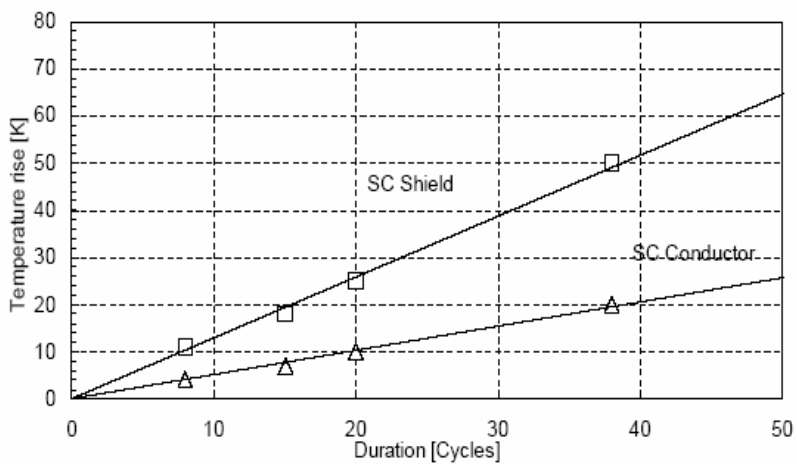
Through Fault Conditions

- 9 kA for 25 cycles (417 ms)
- 2.7 kA for 55 cycles (917 ms)

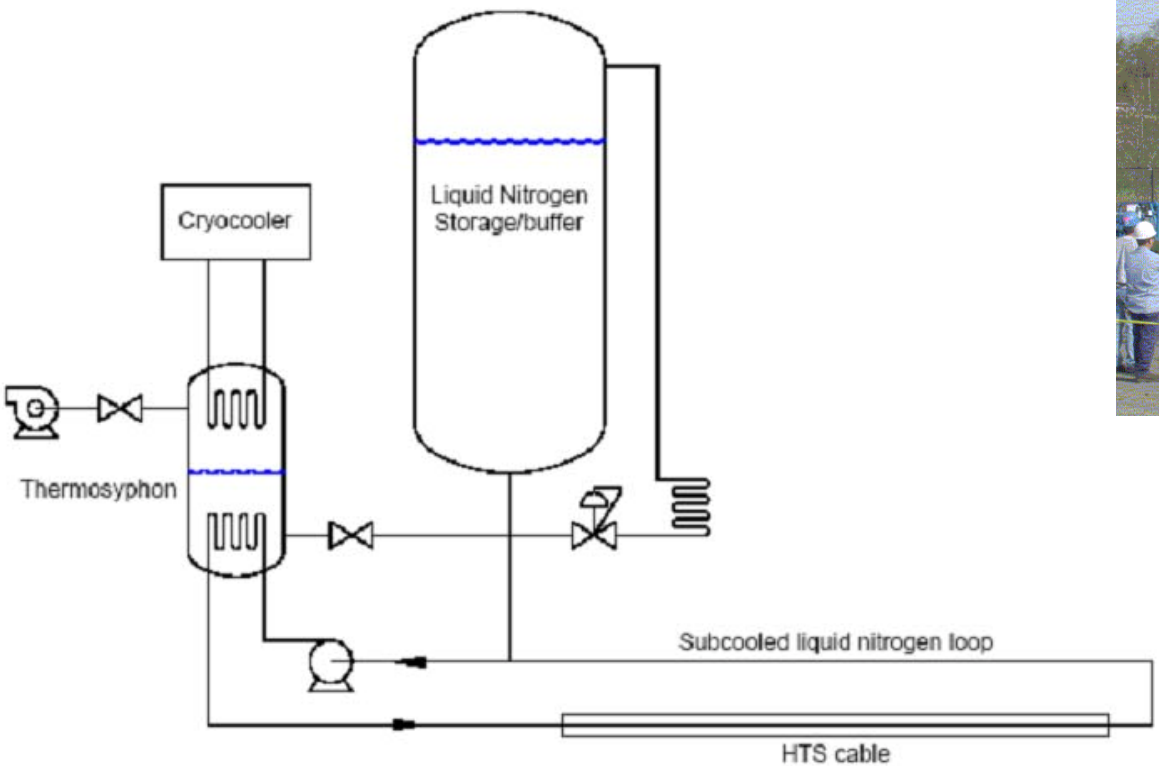


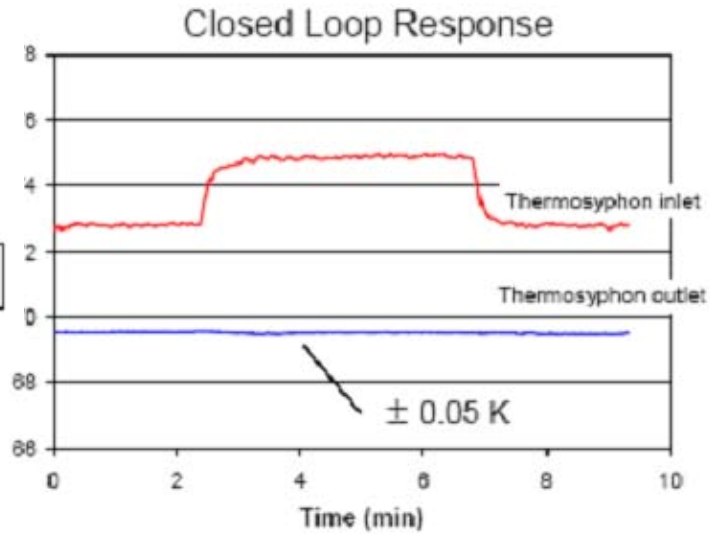
Test Results

- No damage to the HTS tapes or electrical insulation
- No degradation of critical current
- Temperature Rise
  - 8 cycles
    - 4 K Conductor layer
    - 11 K Shield layer
  - 38 cycles
    - 20 K Conductor layer
    - 50 K Shield layer
  - ΔT very small for through fault conditions



Cryogenic Refrigeration System: Built, Tested & Installed





Cryogenic Refrigeration System: Status

Initial Hazardous Operations Review Complete (HazOp) - 12/03

- Coordinated by certified HazOp facilitator. Detailed “what if” reviews of the system to ensure a safe and operable plant

Laboratory testing of core CRS system - 9/04

Final HazOp complete - 2/05

Skid mounted CRS delivered to Albany site - 4/05

All mechanical and control equipment installed and operational - 6/05

Initial operation and performance testing of all equipment onsite - 7/05

- Controls and communication
- Cryocooler and backup liquid operation
- All systems meeting or exceeding specifications

Risk Management Strategy

Risks Addressed through several channels

- **Hazardous Operations Study (HazOp)**
  - Similar to FMEA
  - Completed on CRS, cable, superconductor, dielectric, cryostat, terminations, and joint
  - Circle back after detailed design to ensure critical items have been addressed
- **DOE Readiness Review Meetings at critical stages**
  - Conceptual Design Review – December 2003
  - Detailed Design Review – November 2004
- **Comprehensive Testing & Validation Plan**
- **Prior experience of team members**

Risk Management Strategy - Testing & Validation Plan

Refrigeration System

- Factory acceptance testing (major equipment)
- Subsystem test of CRS at BOC facility
- Albany site: functional (Warm check out of CRS components and control)
- Albany site: pre-commissioning (Full cold testing without HTS cable)

Cable System

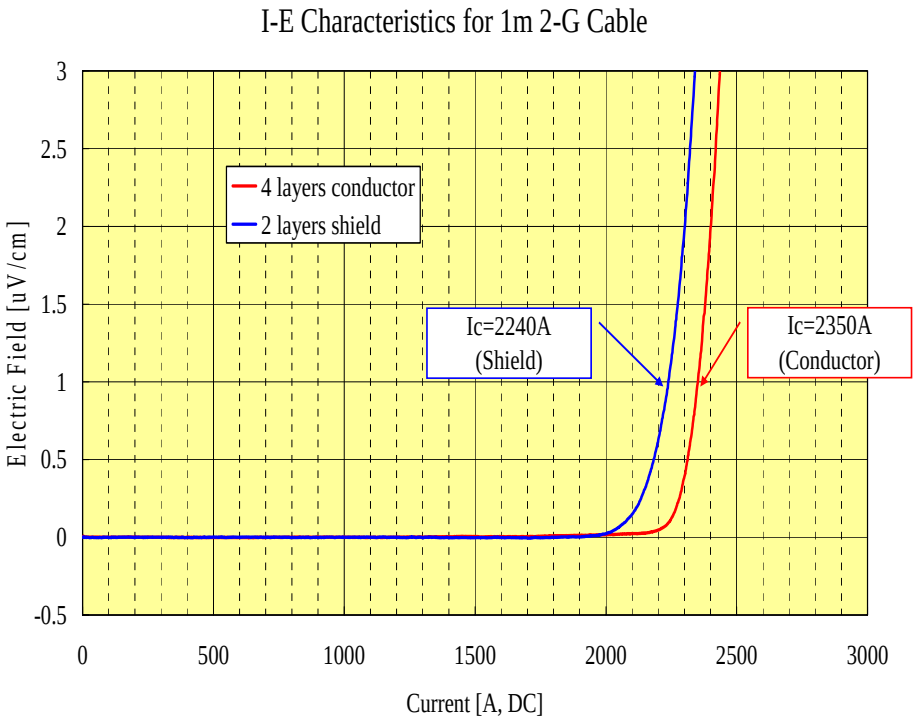
- Comprehensive validation of BSSCO and YBCO tapes
- Fault current testing of cable & cryostat
- Model fabrication and testing of cryostat, cable design, joint assembly, termination structure
- Pre-shipment testing – cryostat vacuum, cable Ic, AC loss, withstand, impulse, bending

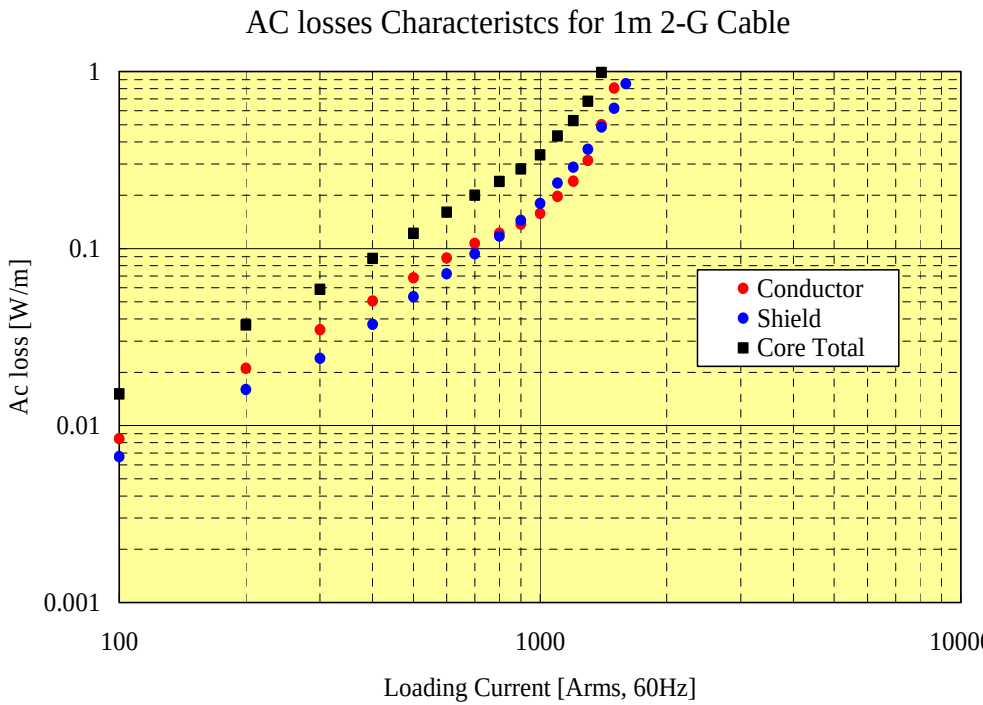
Field Testing

- Vacuum integrity, leak check, capacitance, Ic, DC withstand

Phase II - 30 Meter YBCO Cable Progress Update

- 2nd Delivery (over 100 meters) of 4mm wide YBCO from SP to SEI
- 2nd 1-m Sample Cable made and tested
- (4) conductor layers, PPLP, (2) shield layers
- Critical current & AC loss results shown below





Albany Cable Project Goals for FY06

FY06 (Program Year 4) – October 2005 thru September 2006

First Quarter – (October – December 2005)

- Install all HTS cable system components
- Third shipment of YBCO conductor to SEI for testing & evaluation

Second Quarter – (January – March 2006)

- Initial cool-down of cable system
- Commissioning and pre-grid testing (I_c, DC withstand)
- Begin on-grid demonstration of HTS cable system

Third Quarter – (April – June 2006)

- Finalize design of 2G cable
- Complete fabrication of YBCO tape & deliver to SEI

Fourth Quarter – (July – September 2006)

- Commence fabrication of 30m 2G cable