Albany Cable Project Progress Update

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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
  - $\Delta T$ very small for through fault conditions

Temperature Rise Graph:
- SC Shield
- SC Conductor
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

**I-E Characteristics for 1m 2-G Cable**

- Ic=2240A (Shield)
- Ic=2350A (Conductor)

**AC losses Characteristics for 1m 2-G Cable**

- Conductor
- Shield
- Core Total
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