

Post Review Meeting

2003 Superconductivity Peer Review



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2003 Reviewer Findings - Projects

- **Highest Rated Projects of the FY2003 Annual Peer Review Produce World-Class Results:**
- 2nd Generation Wire
 - Coated Conductor Technology Scale-up at SuperPower
 - Development of 2G YBCO RABiTS Wires: ORNL-ASC CRADA
- Strategic Research
 - Wire Development Group – Enhancing Performance of Bi-2223 Wire (ASC, ANL, LANL, UW)
 - Reel-to-Reel Characterization of YBCO Coated Conductors (ANL, ORNL)
- SPI-Related Research
 - Superconducting Power Cable (ORNL, Southwire)

2003 Reviewer Findings - Programmatic

■ Reviewers' FY03 Comments on Program Teaming

- SPI program should be the standard for DOE, as well as the annual peer review. Kudos!
- Outstanding collaborations have been formed!
- The present arrangements are ingenious, especially for the SPI developments. It results in speedy development with value in mind.
- The progress in teaming is impressive, and the program management deserves a lot of credit. This sort of teaming has been encouraged in a number of ways, including the emphasis placed on this in the peer review.
- Coupling of industry with national labs has improved considerably within the past year.
- Excellent format for fostering collaborations for mutual benefits.
- The industry, university, and national lab teamwork in this program is outstanding!

2003 Reviewer Findings- Second Generation Wire Research

OVERALL COMMENTS

- Performance is great but 2004 plans are not ambitious enough
- May have too many collaborations with industry, each with a different focus
- Cooperation among the national laboratories is excellent
- Great advancements in microanalysis and microscopy
- Need to fabricate good, thicker YBCO films and longer tapes
- Emphasis should shift to a goal of 100 m with $I_c \sim 200$ A/cm-width
- Two “World Class” projects:
 - SuperPower – “Scale Up of Coated Conductor Technology at SuperPower,” Selva, Reeves, Peterson
 - ORNL and AMSC – “Development of 2G YBCO – RABiTS Wires,” Goyal, Paranthaman, Rupich

2003 Reviewer Findings-Strategic Research

OVERALL COMMENTS

- Bi-2223 remains the workhorse conductor
- Program management and execution are excellent
- More industrial participation is needed to encourage commercialization
- Strong, well-balanced efforts but need to focus on key issues for coated conductor commercialization
- Moving to 2G Coated Conductors may suggest a realignment of other WDG activities
- Development of reel-to-reel process control for coated conductors is extremely important
- High scoring projects:
 - Wire Development Group – “Understanding and Enhancing the Performance of Bi-2223 Wire,” Malozemoff, Hellstrom, Maroni, Holesinger, and Larbalestier
 - ANL and ORNL, “Reel-to-Reel Characterization of Time-Based Phase Evolution in YBCO Coated Conductors,” Lee and Maroni

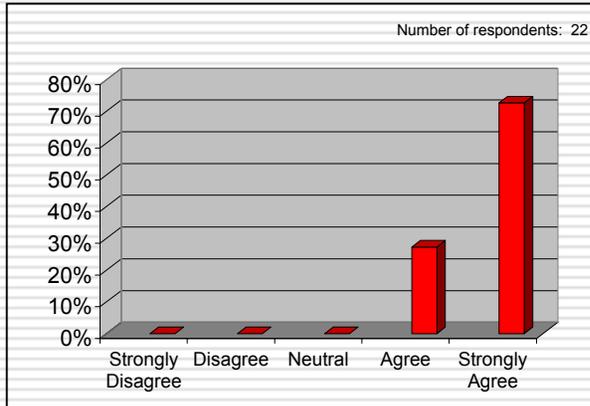
2003 Reviewer Findings - SPI

OVERALL COMMENTS

- Auditing projects at important phases should improve the chances for success
- Good focus on potential near-term applications for HTS
- Excellent integration among labs and private industry
- Increase number of power systems demonstration projects and further emphasize transition from R&D to practical uses
- Risk reduction and mitigation are of primary importance to these projects
- More communication outside the HTS SPI community would be useful
- World Class Project; ORNL, Southwire – “HTS Power Cable,” Demko and Lindsay

Program Comments – 2003

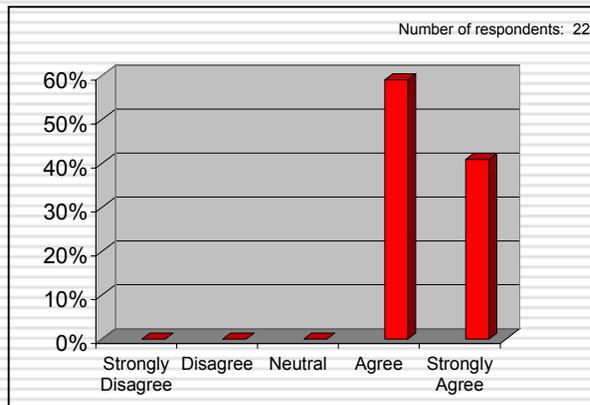
The Program's research mission and goals are adequately defined and reflect the present status of science, technology and needs of U.S. industry.



Reviewers unanimously agreed with the adequacy of the program's defined research mission and goals (27% agree and 73% strongly agree). This represents a 31% increase over 2002 in those who strongly agreed with this statement.

- Mission and goals are really excellent.
- Increase the number of power system applications and demonstration projects.

The program is moving into applications at the proper pace to meet market needs.

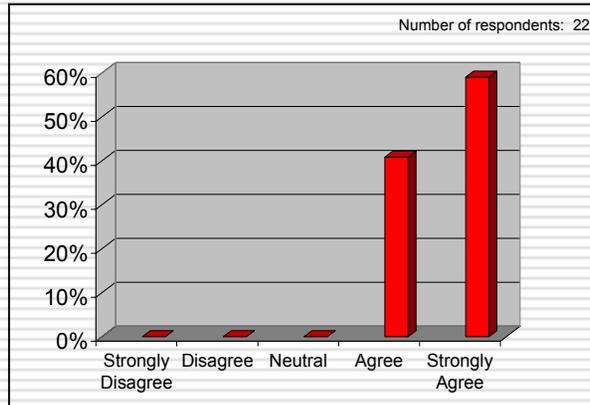


Reviewers unanimously agreed that the program is moving into applications at the proper pace (59% agree and 41% strongly agree). In 2002 only 68% of respondents either agreed or strongly agreed with the pace of progress towards applications.

- As wire becomes available in the next two years, more emphasis should be given to devices using HTS conductors.
- Emphasis should now shift to 100 m length demo and cost-effective fabrication approaches.

Program Comments – 2003

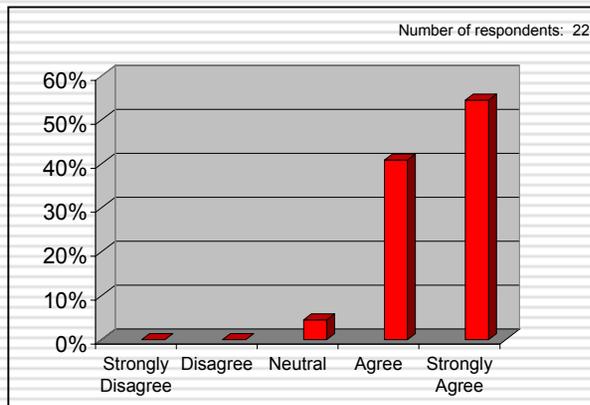
The Program's research productivity has been remarkable and world class.



Reviewers' responses were unanimous that the program's research productivity has been remarkable and world class (41% agree, 59% strongly agree). In 2002, 90% of the respondents either agreed or strongly agreed with this statement.

- This year's progress has been the best in years.
- Productivity has been great but the two high-profile failures point to a need for project risk mitigation and audit.

The Program's accomplishments have provided a strong technology base for power applications.

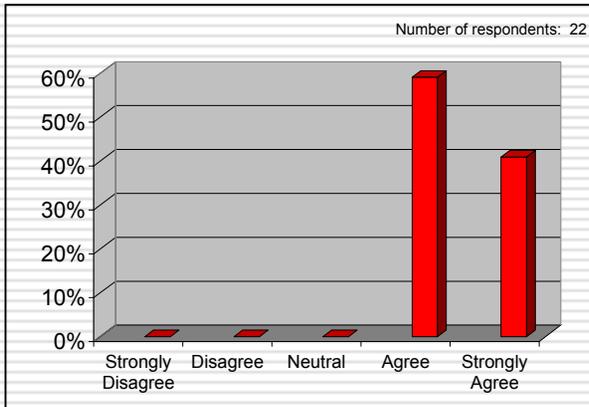


No reviewers disagreed that the program's accomplishments have provided a strong technology base for power applications. Only one respondent was neutral on this question. All others either agreed (41%) or strongly agreed (55%).

- The technology base for power applications needs to be demonstrated.
- Need more emphasis on stability, quench, and ac loss.

Program Comments – 2003

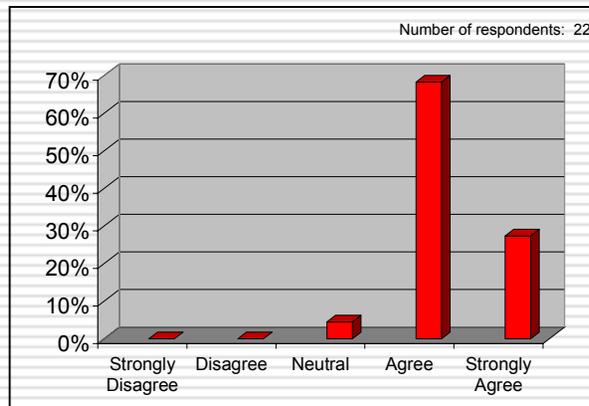
The quality of the proposed FY 2003 R&D activities is impressive and ambitious.



Reviewers were unanimous in their endorsement of the quality of the proposed FY 2004 R&D activities (59% agree, 41% strongly agree). In 2002 this number was only 80% for the proposed FY 2003 projects.

- The scientific quality of FY 2004 R&D activities is excellent.
- R&D planning may need updating given the recent progress with YBCO.

Key research areas are receiving sufficient emphasis and will enable the achievement of program goals.

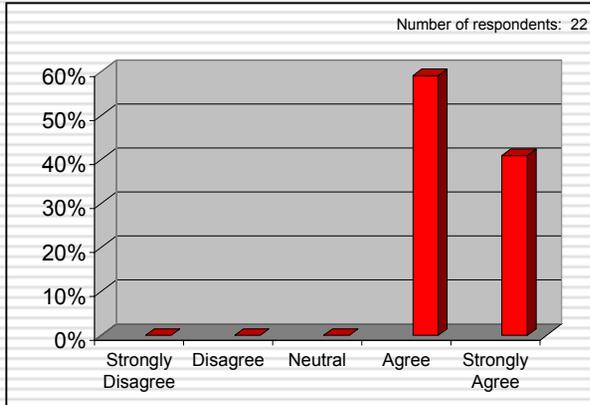


One reviewer responded as neutral to this question. All others either agreed (68%) or strongly agreed (27%). This represents an increase of 23.5% in affirmative responses over 2002.

- Key research areas are adequately covered, with the exception of the applications demo.
- More fundamental research may be added.

Program Comments – 2003

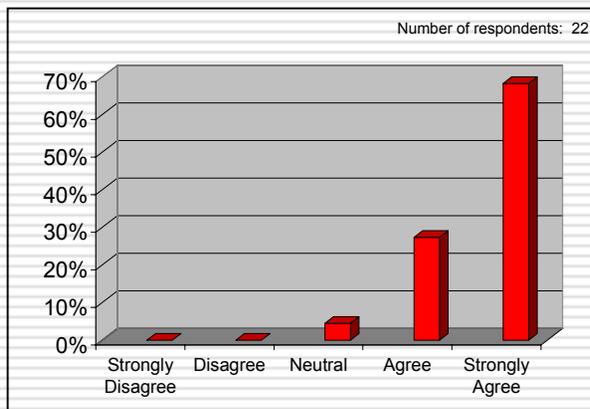
The R&D milestones are realistic and achievable.



Reviewers were unanimous in their agreement that the R&D milestones are realistic and achievable (59% agree, 41% strongly agree). In 2002, only 74% of respondents considered the milestones to be realistic and achievable.

- On target with risk mitigation measures.
- Labs should focus more on processing.
- The FY 2004 R&D activities are excellent . . . and milestones are more and more realistic.

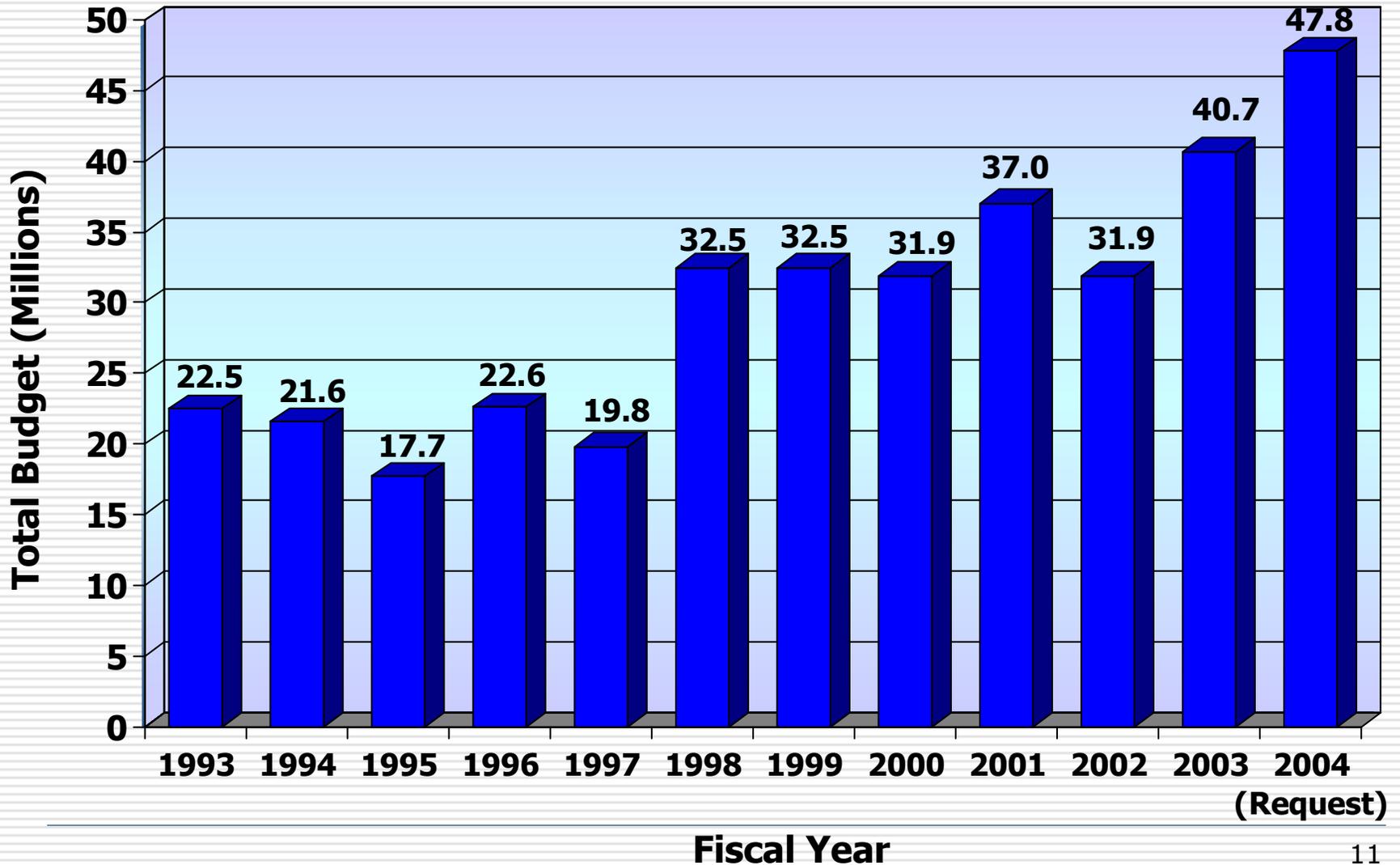
Teaming between industry, universities, and the national laboratories is an important element of the program. Present arrangements are appropriate for success and future commercialization.



Again, only one respondent was neutral to this statement. 27% agreed and 68% strongly agreed with the statement. In 2002, 90% of reviewers either agreed or strongly agreed. There was an increase in 2003 of about 23% in the number who strongly agree.

- Outstanding collaborations have been formed.
- Industry needs to take the lead in identifying needs.

10-Year Funding History



FY 2004 Strategy

- Maintain emphasis on 2G wire research
- Hold “readiness reviews” on SPI projects to mitigate prototype testing problems
- New Thrusts on supporting technologies and longer 2G wires

Key 2004 Thrusts

Solicitations (New Starts)

- University Research
- Cryogenics for Electric Power Applications
- Second-Generation Superconducting Wire Scale-Up Process Research
- Title III

Title III Collaborative Funding Plan

Multiple Source – Title III YBCO Phase II					
	<u>2004</u>	<u>2005</u>	<u>2006</u>	<u>2007</u>	<u>Totals</u>
Title III	3.7M				3.7M
DOE	2.0M	2.0M	2.0M	1.5M	7.5M
Navy (Adm. Cohen)		2.0M			2.0M
AF (UFR)		2.0M			2.0M
OSD (UFR)		6.0M	4.0M		10.0M
DOD Source				2.0M	2.0M
Totals	5.7M	6.0M	6.0M		
		extra funds may slide out	extra funds may slide out		
Grand Total					\$24.0M (max amount federal funds sought)

This initiative will establish a domestic production capacity for YBCO, a high temperature superconductor material, which could significantly enhance the development of future directed energy weapons and electric power generation.

Transmission Level HTS Fault Current Limiter

Program Description

- Demonstrate HTS Fault Current Limiter at 138kV
- Uses existing Melt-Cast Processed BSCCO-2212

Milestones & Cost

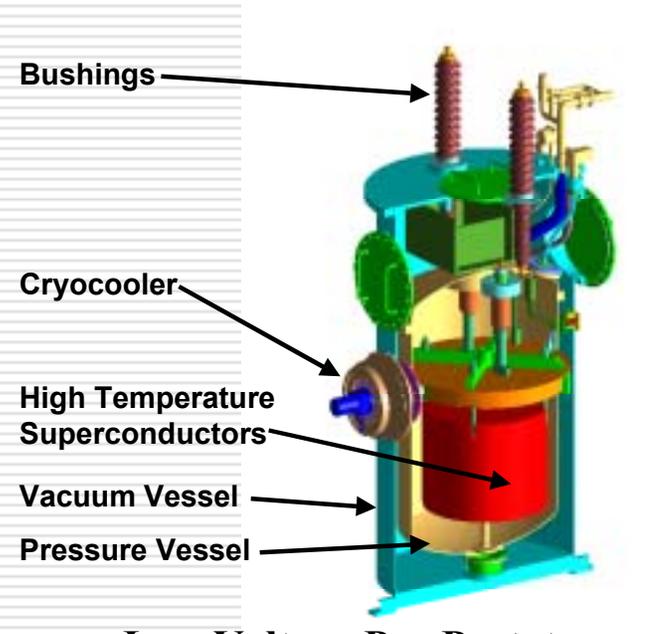
- 4 years, \$12.4M Total Cost [\$6.1M - DOE, \$600K - EPRI; \$5.5M - Private sector]
- In-grid test of 138kV three phase Beta Prototype at host utility by June 2006

Project Participants

- SuperPower, Inc - Project Lead
- Nexans Superconductors GmbH - Bulk BSSCO material supply
- DOE National Labs - ORNL, LANL, ANL
- EPRI - Program co-funding

Benefits

- Fast response to fault currents without active controls or power electronics - low cost
- Avoids expensive multiple circuit breaker upgrades
- Environmentally benign



Low Voltage Pre-Prototype
MFCL Concept

Distribution Cable Project

Project Description

- Demonstration of a 350-m underground HTS power cable (34.5 kV, 48 MVA) & cable-to-cable joint in Niagara Mohawk's grid
- Cold dielectric cable, closed-cycle LN₂ system, flexible, 3 phases-in-1 cryostat

Milestones & Cost

- 4 years, \$26M [\$13M - DOE, \$6M - NYSERDA; \$7M - Private sector]
- 2005 - Installation & testing of BSCCO cable
- 2006 - Installation & testing of 30m YBCO cable (replaces 30m of BSCCO cable)

Project Participants

- SuperPower, Inc (NY) - Project Mgt, YBCO
- SEI (Japan) - cable/terminations/joint
- BOC (NJ) - Refrigeration system
- Niagara Mohawk (NY) - Host utility

Projected Benefits

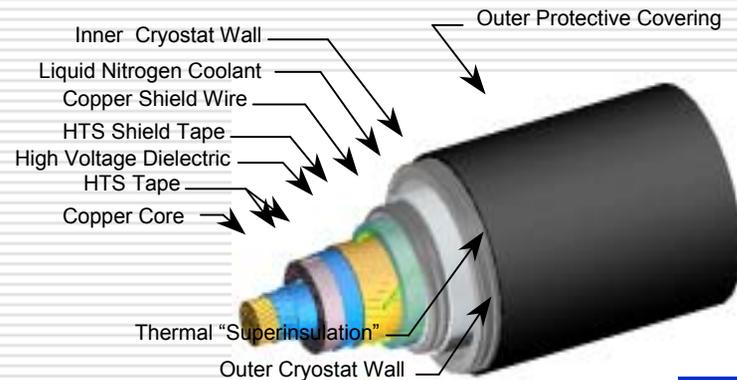
- 3-5 times capacity increase over existing cables with higher efficiency
- Environmentally benign
- Avoids expensive new conduit installation



Transmission Cable Project

- **Electrical Operating Characteristics**
 - Voltage/Power – 138kV/600MVA
 - Design Fault Current – 69,000A
- **Physical Characteristics**
 - Length – 610m
 - Three 610m long Phase Conductors
 - Six 161kV Outdoor Terminations
 - One 161kV Splice
 - One Refrigeration System
- **\$30M Project Value – 50% Industry Cost Share**

- **Provide LIPA with increased capacity within ROW constraints (2 - 5 times) to meet expected load growth**
- **Potential cost savings compared to upgrading to 345 kV transmission system**



Project Team



Prime Contractor
Wire Supplier



Installation
Operation



Power Cable
Assembly



Refrigeration

Worlds First Installation of a Transmission Voltage HTS Cable in the World

Performance Milestones

Milestones for High Temperature Superconducting Electric Power Equipment Prototypes

Metric	HTS Motors		HTS Generators		HTS Transformers		HTS Power Cables		
	Voltage	Power	Voltage	Power	Voltage	Power	Voltage	Power	Length
Current Status	4 kV	0.75 MW Tested in 2001 (Reliance)	10 kV	1.7 MW Tested 2003 (GE)	13.8 kV	1.7 MW Tested 2001 (Waukesha)	12.5 kV	25 MW	100 foot Operating since 2000 (Southwire)
2004					13.8 kV	10 MW			
2005			13.8 kV	170 MW					
2006							34.5 kV	30 MW	0.2 miles
2007	4 kV	5 MW			138 kV	50 MW	138 kV	600 MW	0.5 miles
2008			13.8 kV	340 MW					
2009							138 kV	600 MW	2 miles
2010	10 kV	5 MW	13.8 kV	850 MW	345 kV	340 MW	345 kV	750 MW	2 miles

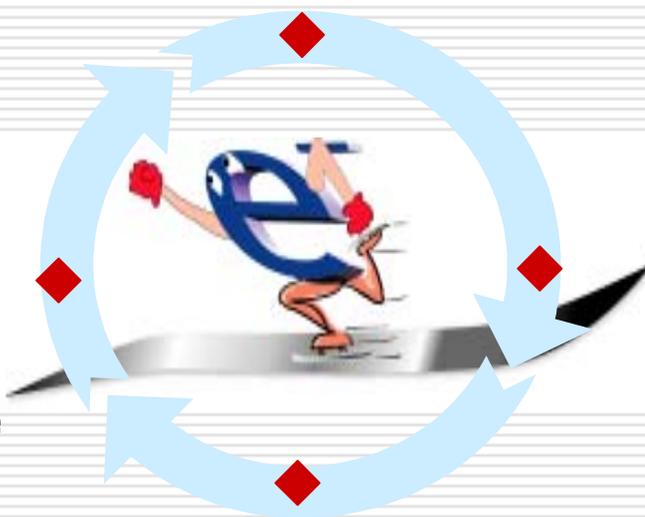
HTS and DC

- HTS DC conductors have no losses and current is limited only by materials properties
- NTGS: "DOE will study the Eastern and Western AC interconnections to assess the costs and benefits, including impacts on national security, of a series of smaller interconnections that are electrically independent of one another with DC links between them."
- Note: these interconnects could be miles long and offer opportunity for HTS in densely populated areas.

FY04 Communications and Reviews

FWP Meetings—Held separately in the Spring with a manager from each participating national lab. The most recent FWP (FY 2006) is discussed. Mid-course corrections in the current year's program are also discussed as well as priorities for the next year (FY 2005).

Workshop—Held February (at some place warm!). Timed to discuss technical research issues, define key problems and make plans to cooperatively address them during the current FY.



Peer Review—Held Summer at the L'Enfant Plaza Hotel. Timed to provide a basis for funding decisions in the FY 2005 initial financial plan.

Quarterly Performance and Review Meetings—Held each quarter at DOE to update and inform Program Management of the progress and needs of major projects.

Other Communications:

- **Monthly Newsletter: "Superconductivity News Update"**
- **Web site**
- **Fact sheets**
- **State Outreach**

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- Congratulations for a Great Review!