Industrial Participation
&
SRF Infrastructure at Fermilab

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Outline

- Goals for SRF infrastructure
- Why industrial participation?
- Industry interest
- Examples of current participation (not including construction related industries)
- On-going industrial cost study
- Review charge question #5: Does the SCRF plan for FY08 and beyond make use of and develop U.S. industry at an appropriate level?
- Next steps

Goals for SRF Infrastructure

- To perfect U.S. fabrication & processing of SRF cavities and modules and to demonstrate performance with a full range of testing (including beam)
  - Deploy ILC design / processing / assembly techniques
  - Establish process controls to reliably achieve high gradient cavity operation and module performance
  - Test cavities and modules at the component level and in a systems test to demonstrate yield, reproducibility and beam performance
- To facilitate commercial production of SRF components and modules
  - Train and transfer SRF technology to the US industry
  - Allow industrial participation and input to the process
    - Similar to SC cable and magnet technology transfer
- To participate in SRF Research and Development
  - Develop expertise in SRF technology and provide training base for construction and operation of future accelerators
  - Our attempt to fit into the world's SRF community

All of this work will be carried out with US/international collaboration

Why Industrial Participation?

- It is expected that U.S. industry must play a large role in the production of mass produced cavities and cryomodules.
- Limited experience currently exists in U.S. industry, particularly for cavity fabrication and processing.
- U.S. industry has expertise in reducing mass production costs, particularly if engaged early in the development cycle.
- Fermilab initiated the formation of a network of industrial companies to stimulate interest and participation in the ILC.

Linear Collider Forum of America

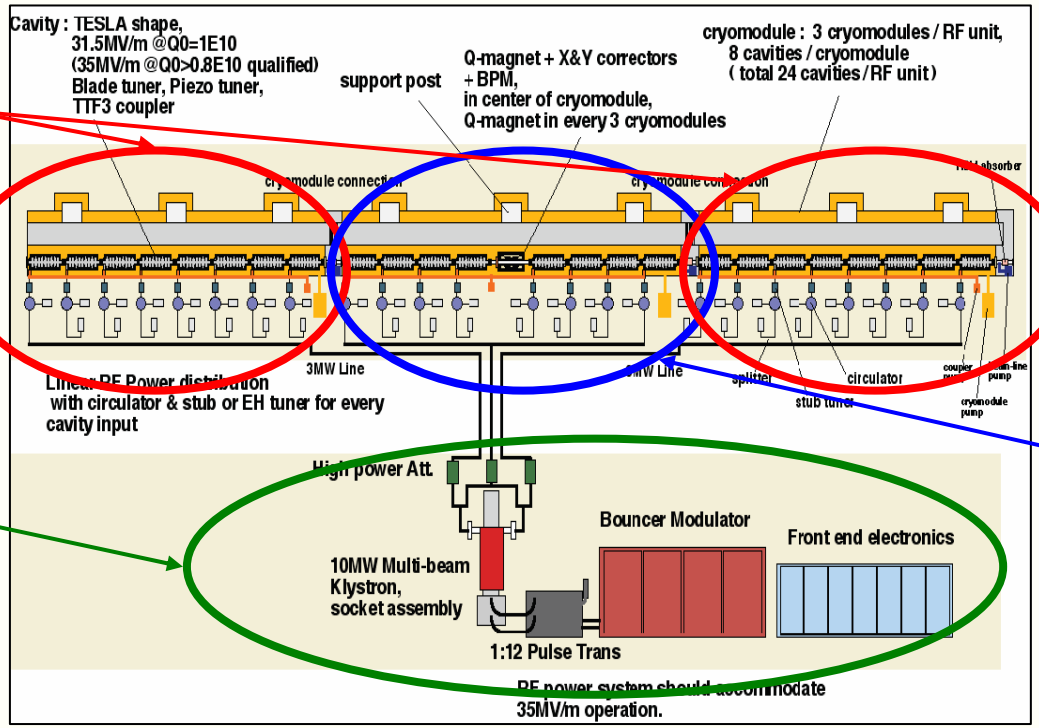
- (from LCFOA mission statement) LCFOA provides a formal network for its U.S. industry members with a common business interest to interact with U.S. government funded R&D efforts during the design and siting of the ILC.
- The LCFOA was formed in September 2005 and has met three times (~twice per year). The fourth meeting is planned for March 2007 in Washington, D.C.
- The LCFOA lists 24 members, six of whom contributed to the RF Unit cost study.

Current Discussions & Contracts

- CPI: Producing six 3.9 GHz couplers. Ordered twelve 1.3 GHz couplers based on DESY drawings and specifications. Fabrication scheduled to immediately follow the DESY TTF order.
- AES: Contract to fabricate four 9-cell 1.3 GHz TESLA design cavities. Order placed for six 9-cell GHz cavities with equal end group lengths. (Order for eight cavities of this type placed with ACCEL.) Plan to order 24 additional cavities in FY07.
- Niowave: Contract to design HPR system, including fabrication specifications and drawings.
- Roark & Niowave: Three phase contract to produce 1-cell 3.9 GHz, 1-cell 1.3 GHz and 9-cell 1.3 GHz cavities. Has subcontract with Niowave to do pre-weld chemistry.
- ABLE Electropolish: Chicago area company. Met with Fermilab a couple of times and visited JLab. Proposing to send a person to JLab for six months.

RF Unit Cost Study

2 Cryomodules with 8 Cavities Each



RF system to drive 3 Cryomodules

1 Cryomodule With 8 Cavities & 1 Magnet Package

- **Three cryomodules, eight cavities in each, with a magnet package in one cryomodule.**
- **Also includes: Klystron, Modulator, RF distribution, RF power couplers and Low Level RF.**

RF Unit Cost Study

- Contracted with AES (and team members Meyer and CPI) for an industrial cost study of an RF Unit.
- Kick-off on July 26, 2006. Work was completed final report (for comment) issued on January 26, 2007.
- Identified potential for cost reductions of up to 25% in cavity fabrication and 35% in power coupler fabrication.
- Identified other areas to pursue for cost reductions.

Review Charge Q5

- **Does the SCRF plan for FY08 and beyond make use of and develop U.S. industry at an appropriate level?**

Development of Industry

Cryomodule Process	Starts with		Transitions to
Cavity Fabrication	Lab/Industry Collaboration	→	**Industry**
Cavity Processing	Lab/Industry Collaboration	→	**Industry**
Low Power Test (VTS)	Laboratory	→	Laboratory
Cavity Dressing	Lab/Industry Collaboration	→	**Industry**
High Power Test (HTS)	Laboratory	→	Laboratory
Cryomodule Fabrication	Lab/Industry Collaboration	→	**Industry**
Cryomodule Test (CTS)	Laboratory	→	Laboratory

- **The technology for cavity fabrication, cavity processing, cavity dressing and cryomodule fabrication will be transferred to industry.**
- **Cryogenic testing of cavities and cryomodules along with beam tests will remain the responsibility of US laboratories.**

Required Funding

Fermilab

Infrastructure	M&S	SWF	Total with Indirect
Cavity Fabrication Infrastructure	$ 3,000	$ 675	$ 4,375
Cavity Processing Facilities	$ 11,100	$ 4,590	$ 15,690
Vertical Test Stand (VTS 2 & 3)	$ 2,625	$ 1,845	$ 5,590
Horizontal Test Stand (HTS 2)	$ 1,220	$ 1,057	$ 2,805
Cavity/Cryomodule Assembly Facilties (CAF_MP9 & ICB)	$ 690	$ 230	$ 1,105
Cryomodule Test Stand	$ 5,400	$ 2,970	$ 10,200
NML Facility (ILCTA_NML)	$ 18,270	$ 23,220	$ 50,980
Cryogenics for Test Facilities	$ 10,690	$ 945	$ 13,690
Illinois Accelerator Research Institute	$ 20,000	$ 4,050	$ 28,600
Material R&D	$ 870	$ 722	$ 1,960
Grand Total	**$ 73,865**	**$ 40,304**	**$ 134,995**

- **$5.5M is budgeted for industrialization both in FY08 and FY09 (not included in the infrastructure request above).**

Next Steps

- Close out AES RF Unit cost study contract and analyze information.
- Use cost study information to target cost drivers for cost reductions (i.e. DFM / value engineering, etc.)
- Early emerging targets: cavities and end group parts, power couplers, helium vessels, vacuum vessels, magnet package, cryomodule assembly….
- Plannning for $5.5M in FY08 and in FY09 for industrialization.
- Establish contracts with various companies to: assist in DFM, reduce fabrication costs, transfer technology, develop experience, qualify as vendors, ….
- We have not yet determined explicit work scopes.

Candidate Industrial Participation

- Design improvements in cavity end parts. Fewer, simpler parts.
- Develop high volume machining vendors for niobium parts.
- Stainless steel helium vessel.
- Design improvements in power couplers.
- Magnet package design.
- Vacuum vessel. Tooling and/or design changes/tolerance reductions to eliminate post weld machining of flanges.
- Cryomodule assembly.
- HOM housing. Cost reduction improvements in fabrication.
- Factory layout.

Conclusions

- There is no debate – U.S. industry needs to be involved in our pursuit of the ILC.
- Industry needs to be involved early to have the greatest impact on our designs.
- We need to develop industrial sources of competition for the components and systems we will purchase – now to support development, and in the future to support construction of the ILC.