U.S. DEPARTMENT OF ENERGY

FIELD WORK PROPOSAL

1. WORK PROPOSAL NO.:	2. REVISION NO.:	3. DATE PREPARED: 7/05
JLAB-HEP-xx	2	Updated 02/06

4. WORK PROPOSAL TITLE:	5. BUDGET AND REPORTING CODE:
Development of a Superstructure for the ILC based on Large grain/single crystal high purity niobium	

6. WORK PROPOSAL TERM: 2 years

7. HEADQUARTERS OFFICE PROGRAM MANAGER:	8. HEADQUARTERS ORGANIZATION:
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11. CONTRACT WORK PROPOSAL MANAGER:	12. CONTRACTOR NAME:
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13. Work Proposal Description

Principal Investigators: P. Kneisel, J. Sekutowicz (DESY), G. Ciovati and G.R. Myneni

This Field Work Proposal addresses the International Linear Collider cryomodule development efforts. In particular it proposes the use of large grain/single crystal high purity niobium for the fabrication of cavities based on the low loss shape, which then will be combined to a superstructure (SST). Both, the large grain/single crystal niobium and the SST based on the low loss cavity shape promise an opportunity for significant cost savings for the ILC. Calculations for a SST configuration will decide whether the low loss shape or the standard "TESLA" shape of the cavities will be more suitable.

14. CONTRACTOR WORK PROPOSAL MANAGER	15. OPERATIONS OFFICE REVIEW OFFICIAL
Signature Date	Signature Date

16. DETAIL ATTACHMENTS

____ a. Facility Requirements	____ f. Technical Progress	__x__ k. Deliverables
____ b. Publications	____ g. Future Accomplishments	____ l. Performance measures/expectations
__x__ c. Purpose	__x__ h. Relationships to Other Projects	____ m. ES&H Considerations
____ d. Background	____ i. NEPA Projects	____ n. Human/Animal Subjects
__x__ e. Approach	____ j. Milestones	____ o. Other (Specify)
____		

WORK PACKAGE REQUIREMENTS FOR OPERATING/EQUIPMENT
OBLIGATIONS AND COSTS

CONTRACTOR NAME:	WORK PROPOSAL #:	REV. #:	DATE PREPARED:
Southeastern Universities Research Association, Inc. Thomas Jefferson National Accelerator Facility (Jefferson Lab)	JLAB-HEP-xx	0	7/05 **Updated 02/06**

	FY 2006 target	FY 2007 target	FY2008 Target	FY 2007 Requirements	FY 2007 Authorized
17. STAFFING (IN STAFF YEARS)					
a. SCIENTIFIC		0.5	0.7		
b. OTHER DIRECT		0.5	0.5		
c. TOTAL DIRECT		1	1.2		
18. OPERATING EXPENSE (in thousands)					
a. TOTAL OBLIGATIONS (B/A)		160	130		
b. TOTAL COSTS (B/O)		160	130		
19. EQUIPMENT (in thousands)					
a. EQUIP OBLIGATIONS (B/A)					
b. EQUIPMENT COSTS (B/O)					

20. MILESTONE SCHEDULE (Tasks)	Dates	Proposed $	Authorized $
Prototype cavity fabrication and testing	Dec 05	100k	
Improved BCP system	Nov 05	10k	
Superconducting joint cavity	Oct 05	10k	
Development of sc joint technology	Aug.06	40 k	
Optimization studies for SST	Feb 06	50 k	
2 SST niobium cavities	Sept/Nov. 06	100 k(FY06/07)	
engineering package for SST	Dec. 06	100 k	
auxiliary parts for SST assembly(tuners, fixtures, Ti-He-vessels ….	March 07	100 k	

21. REPORTING REQUIREMENTS (Description):

TITLE:	BUDGET AND REPORTING CODE	DATE PREPARED
Development of a superstructure for the ILC based On large grain/single crystal high purity niobium		7/05; updated 2/06
WP NUMBER	CONTRACTOR NAME:	
JLAB-HEP-xx	Southeastern Universities Research Association, Inc., Thomas Jefferson National Accelerator Facility (Jefferson Lab)	

16. c. Purpose

The work described here is done under the program of the US ILC collaboration in coordination with the goals and activities of the International GDE. The purpose is to offer Jlab's recent technological developments on large grain/single crystal niobium on cavities as an opportunity for cost savings for the ILC. In combination with the earlier proposed and successfully demonstrated superstructure (J. Sekutowicz et al., "Superconducting Superstructure for the TESLA Collider; A Concept", PR-ST AB,1999; J. Sekutowicz et al, PAC2003, paper ROAA 003) based on a low loss cavity design further significant cost reduction could potentially be realized. This approach – if successfully executed – would offer an alternative to the presently anticipated baseline design for the ILC accelerator.

16. e. Approach

Jefferson Lab has since approx. Nov. 2004 pursued with industry (CBMM) the possibility of fabricating superconducting cavities from large grain ingot material rather than from fine grain niobium sheet. This effort resulted in some exceptionally good cavity performances and a whole range of potential advantages such as less expensive fabrication, less elaborate QA procedures and streamlined surface treatments. However, more statistics is needed to verify the initial successes.Therefore, several more cavities from different ingot material- preferably single crystal niobium – have to be fabricated and tested.

To achieve very smooth surfaces in the cavities during buffered chemical polishing it is important to agitate the acid mixture appropriately; the presently applied process at Jlab of just flowing the acid through the cavities needs to be improved in a way that during the flow through, the acid is indeed agitated. This can be accomplished with a "stirrer-system" – such a system has been used at ACCEL for the bulk-chemical treatment of the SNS cavities, providing very uniform material removal both in the equator region of the cavity and the iris region. Such a system is commercially available.

The development of a superstructure needs initially plenty of electromagnetic field and HOM damping calculations to optimize a design with respect to number of cells/cavity, damping requirements for HOM's, location of dampers, inter-cavity coupling requirements, field flatness requirements . . . etc. This work can start immediately and we intend to involve the SLAC computational group under Kwok Ko into this work.

As far as the hardware approach to the SST is concerned, we believe that because of the size/length the 2-cavity superstructure cannot be electron beam welded and surface treated as one unit, but needs to be flanged together. This requires the development of a superconducting connection between the two sub-units. Therefore a program has to be started to develop such a joint. This will be done by fabricating a TM_{010} – single cell cavity, which is split in the equator plane (currents have to pass through this plane) and can be flanged together with appropriate flange and gasket combinations.

For the above-mentioned demonstration of the superstructure concept at DESY, a special tuning system ("plate tuners") has been developed. We believe that this system can be adopted or borrowed for the superstructure test of the proposed development. Also, much of the engineering and design from the DESY test can be incorporated into this proposal, reducing the required engineering at Jlab.

As has been pointed out in the past, one of the draw-backs of the superstructure concept is the need for fundamental input couplers with twice the power carrying capability of single cavity couplers. However, already presently there exist power coupler designs and prototypes, which fulfill these requirements. Nevertheless, more work especially in the direction of reliability needs to be done. This development work however is presently not part of the 2 years proposal as outlined in this document. Couplers have to be available for a demonstration with beam; but the non-availability does not prevent cryomodule testing of a superstructure.

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16. h. Relationships to Other Projects

This work will be done in collaboration with ILC_Europe and ILC_Asia efforts. As already pointed out, a close collaboration with DESY and DESY experts is being sought and one of the co-principal investigators is J. Sekutowicz, who has initiated and "sheparded" the superstructure concept and verification at DESY.

This proposal counts on the contributions from DESY (electromagnetic field calculations, engineering for existing SST at DESY, "blade tuner") and from SLAC (electromagnetic field calculations, SST optimization), which are not taken into account in this cost estimate.

A close collaboration with the niobium producing industry is also essential for developing single crystal niobium of the size, required for ILC_cavities at 1300 MHz.

The development of high power fundamental input couplers – even though not part of this 2 year proposal – will be closely connected to developments for the X-FEL and ERL activities worldwide.

16. k. Deliverables

We hope to be able to deliver the following items, if the funding request is granted:

- several single cell and at least one multi-cell cavity of the LL design, made from large grain/single crystal niobium
- an improved buffered chemical polishing system for producing very smooth rf surfaces on large grain/single crystal material
- a test cavity for superconducting rf joint investigations
- results from these investigations with the goal to incorporate the most promising design into the superstructure
- an extensive optimization study of the superstructure configuration based on the Low Loss cavity design with emphasis on number of cells/subunit, HOM damping requirements, interconnection coupling requirements, field flatness requirements
- two low loss cavities suitable to be combined into a superstructure
- an engineering package for the completion of a superstructure assembly ready for cold tests