ADDENDUM

to a

MEMORANDUM OF UNDERSTANDING

between the

INTERNATIONAL LINEAR COLLIDER
GLOBAL DESIGN EFFORT

and

the Stanford Linear Accelerator Center Laboratory

for the period

October 1, 2005 to September 30, 2006

1. *Introduction*

This Addendum constitutes the Statement of Work to be performed by SLAC in support of the International Linear Collider (ILC) for the period of October 1, 2005 to September 30, 2006. During this time period it is anticipated that the baseline design for the ILC will be derived under the auspices of the GDE and a reference design report and cost estimate will be started. It is conceivable that during the time period of this Addendum more emphasis and thus more resources may be allocated to the R&D efforts described in this Addendum. Alternatively it is possible that more emphasis will be placed on the reference design report and cost estimate. Such decisions are expected to be made jointly by the GDE and SLAC within the context of the international collaborative R&D program.

The activities detailed in this document falls within the scope of the Memorandum of Understanding (MoU) between the GDE and SLAC dated November 28, 2005. The terms and conditions under which the work will be carried out are found within the MoU and are in force for the duration of time covered by this Addendum.

Work at SLAC for the period covered by this Addendum will primarily involve Accelerator Design of all areas of the machine, R&D on RF Power sources, instrumentation, and controls, and work at facilities such as ATF, ESA, ESB, SMTF, STF and TTF. A detailed description of the work to be performed will be developed by SLAC and the GDE as one of the first FY06 tasks. This description will include a summary of the manpower and costs assigned to each task. Funds at the level of $$$$ for ILC R&D will be established at SLAC in FY06 by transfer from the DOE as recommended by the GDE-Americas Region Director.

2. *Statements of Work*

This Section contains the Statements of Work to be done at SLAC during the period of time covered by this Addendum.

Statements of costs and commitments incurred for each work package will be submitted at the end of each fiscal year quarter to the GDE-Americas Regional Office.

Semi-annual technical progess reports for each work package will be submitted at the mid-point and close of the fiscal year to the GDE-Americas Regional Office. These reports will contain descriptions of technical progress, statements of goals for the next reporting period, and indications of long-range plans.

Within two months following the end of the fiscal year, a final technical report for each work package will be submitted, in which the actual work accomplished will be compared with the scope defined in the work package in this MoU.

2.1 ILC-Americas WBS

The ILC-Americas WBS categories are listed below. The work packages defined in the next section are numbered according to this WBS.

WBS	Description
1	Program direction and administration
2	Accelerator design, including RDR
2.1	Management
2.2	Global systems
2.3	Electron sources
2.4	Positron sources
2.5	Damping rings
2.6	Ring to Main Linac
2.7	Main Linacs: Optics, beam dynamics, instrumentation
2.8	Main Linacs: RF systems
2.9	Main Linacs: Cavities and Cryomodules
2.10	Beam delivery system
2.11	Conventional facilities
3	Research and development
3.1	Management
3.2	Global systems

3.3 Electron sources
3.4 Positron sources
3.5 Damping rings
3.6 Ring to Main Linac
3.7 Main Linacs: Optics, beam dynamics, instrumentation
3.8 Main Linacs: RF systems
3.9 Main Linacs: Cavities and Cryomodules
3.10 Beam delivery system

4 Engineering and cost estimation in support of RDR
4.1 Management, technical and engineering services
4.2 Global systems
4.3 Electron sources
4.4 Positron sources
4.5 Damping rings
4.6 Ring to Main Linac
4.7 Main Linacs: Optics, beam dynamics, instrumentation
4.8 Main Linacs: RF systems
4.9 Main Linacs: Cavities and Cryomodules
4.10 Beam delivery system
4.11 Conventional facilities

5 Infrastructure and test facilities
5.1 Management
5.2 Global systems
5.3 Electron sources
5.4 Positron sources
5.5 Damping rings
5.6 Ring to Main Linac
5.7 Main Linacs: Optics, beam dynamics, instrumentation
5.8 Main Linacs: RF systems
5.9 Main Linacs: Cavities and Cryomodules
5.10 Beam delivery system
5.11 Conventional facilities

6 Reserve

2.2 ***Scope of Work***

Category 1

WBS 1.1: SLAC Program Management

Description:
This work package covers the management of the SLAC ILC effort. It includes the program director, office and computing support, ES&H compliance, and travel.

Motivation:
None.

Collaboration with other institutions:
One of the management tasks is collaboration with other institutions in the GDE as detailed below.

Milestones and deliverables:
M&S costs are divided between 300k$ for travel, 60k$ for computing, and 60k$ for office support and ES&H compliance.

Key personnel:
Tor Raubenheimer – 95%; Cindy Lowe – 100%; Nick Arias – 100%; Naomi Nagahashi – 40%; Gerry Aarons – 10%; Keith Jobe – 30%; Janice Nelson – 20%; Albe Larsen – 25%

Total Cost summary for WBS 1.x:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
4.2 FTE	420 + 10	215	1149

Expectations for FY07 and beyond:
This work is expected to continue into FY07 and beyond at the same level.

Category 2.1

WBS 2.1.1 Accelerator Design Management

Description:
This work package covers the management of the SLAC accelerator design effort.

Motivation:
SLAC is contributing to the BCD and RDR designs for the electron and positron sources, damping rings, bunch compressors, main linac optics, beam delivery system, conventional facilities, operations, availability and controls.

Collaboration with other institutions:
One of the management tasks is collaboration with other institutions in the GDE as detailed below.

Milestones and deliverables:

Dec 05 BCD Document complete
Dec 06 RDR Document complete

Key personnel:
Nan Phinney – 100%; Summer Students – 30%

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
1.3 FTE			

Expectations for FY07 and beyond:
This work is expected to continue into FY07 and beyond at the same level.

Category 2.2

WBS 2.2.1 Global systems design

Description:
This task includes availability studies, design for operability, design of the Machine Protection and Personnel Protection Systems, and Instrumentation design and specification.

Motivation:
The availability studies allow a comparison of various configuration options and specification of the required reliability for various hardware items. As the ILC design is fleshed out, further work will be needed to compare the availability of various options. The operability studies will consist of careful examination of how the machine will be operated given how various things can go wrong with the goal of specifying any additional hardware or software that may be needed to ease the commissioning and running. The MPS and PPS design studies are to develop a sufficiently detailed design to be costable for the RDR.

Collaboration with other institutions:
The availability simulation was implemented at SLAC for the USLCTOS and further extended in FY05 in collaboration with DESY. DESY is also taking the lead on benchmarking the simulation with HERA data. There is also DESY effort on categorizing failure modes as input to the MPS design.

Milestones and deliverables:

March 2006: Complete MPS conceptual design, reviewed by the collaboration.
May 2006: Memo on diagnostic (and other) needs in excess of those already specified by other groups.

Much of the work will be done in close contact with other groups and the results will show in the documents they write.

Key personnel:
Tom Himel 75%, Janice Nelson 20%

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
0.95 FTE			

Expectations for FY07 and beyond:
We expect this type of work to continue into future years gradually going into deeper details of the design.

2.2.2 Control system design

Description:
This task includes design of the basic architecture of the control system.

Motivation:
The ILC will require unprecedented reliability for an accelerator and carefull design is needed to struture the control system architecture so that is possible.

Collaboration with other institutions:
Collaborators include John Cawardine (ANL) and Patty McBride (FNAL) as well as Ferdi Willeke (DESY) and others.

Milestones and deliverables:

Dec 05 BCD Document complete
Dec 06 RDR Document complete

Key personnel:
Ray Larsen 25%, Marc Ross 20%, Steve Molloy 35%

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
0.8 FTE			

Expectations for FY07 and beyond:
We expect this type of work to continue into future years gradually going into deeper details of the design.

Category 2.3

WBS 2.3.1: Electron Source Design

Description:
This package includes detailed design of the polarized electron source for the BCD and RDR and polarized photocathode research.

Motivation:
The baseline design adopted at Snowmass 2005 was based on the SLC source, but a detailed design must be developed for the BCD and RDR. The laser to generate the ILC bunch train has to be demonstrated. Current work on polarized photocathodes is focused on reoptimizing the cathode parameters for the ILC bunch train format, and on further improvements in available quantum efficiency and polarization.

Collaboration with other institutions:
Collaboration with Saclay is just beginning.

Milestones and deliverables:

Dec 05 BCD Document complete
Dec 06 RDR Document complete

In FY 06, simulation tools will be developed that can be used to improve the polarized electron source design. The simulations will extend from the electron source through pre-bunching and final bunching section and also cover pre-acceleration up the damping rings.

Key personnel:
Axel Brachmann 25%, postdoc 50%, Mechanical engineer 75%

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
1.50 FTE			

Expectations for FY07 and beyond:
In FY07, the simulations and design for an ILC polarized gun are expected to have developed into a design that reflects the demonstrated state of the art (HV performance, photocathode design).

Category 2.4

WBS 2.4.1: Positron source

Description:
This package is the design and documentation of an undulator-based positron source for the BCD and RDR, including detailed designs all of the subsystems including the undulator, capture section, pre-acceleration, electron bypass lines, positron transport line, pre-DR collimation and energy compressor.

Motivation:
This work is relevant to complete the positron source design for the RDR.

Collaboration with other institutions:
SLAC has had a long term collaboration with LLNL on target materials and damage studies, which was focused in 2005 on the actual design of the positron target. Post-Snowmass the target effort was expanded to include Liverpool University, UK which is working on the mechanical design of the positron target under the auspices of the EuroTeV project and a small group from UC Berkeley which is calculating long term target degradation. A collaboration was formed with Daresbury Laboratory, UK to look at undulator design and prototyping and a second with ANL on start-to-end simulations of the positron system from upstream of the target to the damping ring.

Milestones and deliverables:

Nov, 2005 – Positron Source Recommendation
Dec, 2005 – Positron Source Decision (BCD)
Jan, 2006 – Layout (draft version)
Mar, 2006 – Layout
Apr, 2006 – Parts list
May, 2006 – Draft RDR text
Sep, 2006 – Text deliverable

Key personnel:
John Sheppard 100%, Vinod Bharadwaj 100%, Yuri Batygin 50%, Mark Woodley 20%, postdoc 50%, Heinz Vincke 10%, Mechanical engineer 25%

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
3.55 FTE			

Expectations for FY07 and beyond:

The work in FY07 and beyond includes continued optimization studies directed at reducing the costs of construction and operation as well as improving the operability and availability of the positron system.

Category 2.5

WBS 2.5.1: Damping Ring Design

Description:
This package covers SLAC work on the damping ring design, including optics studies, evaluation of dynamic acceptance, space charge effects and classical instabilities, simulations of electron cloud and fast ion instabilities, and design of pre-ring energy and bunch length compressors.

Motivation:
A sufficiently detailed lattice of the damping rings along with the specifications of its components for the baseline configuration is vital for validating the achievement of basic requirements of the design and supporting a reliable cost estimate. It also servers a reference point to further optimize the design. Although, this work package does not cover all aspects to the design, it does cover many critical and technically difficult ones.

Many years of experience with PEP-II, SPEAR-3, SLC, and NLC is utilized and applied to the design of the damping ring.

Collaboration with other institutions:
This work is part of a collaborative effort with LBNL, Cornell, ANL and FNAL.

Milestones and deliverables:

- Complete all optical functions that are necessary for the baseline lattice, such as injection, extraction, RF, tune, wiggler, and coupling bumps.
- Finalize a realistic specification of magnetic errors for all magnets and wigglers in the damping ring to ensure an adequate acceptance and dynamic aperture.
- Develop a solid impedance budget and specify feedback systems to control the conventional instabilities in the damping rings.
- Continue to simulate the effects of electron cloud in the positron ring and specify the essential properties of the vacuum pipe to mitigate the instabilities that caused by the electron cloud.
- Develop a faster and reliable computer program to simulate the fast ion effects in the electron ring and specify a proper vacuum system to control the instability.

Dec 05	BCD Document complete
Mar 06	Lattice decks for damping rings with specification of major components.
Sep 06	Sections of the RDR describing lattice designs for damping rings and beam dynamics in the damping rings.
Dec 06	RDR Document complete

Key personnel:

Yunhai Cai 50%, Mauro Pivi 30%, Lanfa Wang 100%, Karl Bane 25%, Sam Heifits 25%

LBNL – A. Wolski, Cornell – ?, ANL – K.J. Kim, FNAL – ?

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
2.3 FTE			

Expectations for FY07 and beyond:

Optimization of lattices and study of beam dynamics relevant to the damping rings will be an ongoing process as the engineering design proceeds. Many issues expected to be raised during the hardware design requires further refinement of the lattices. The design work will continue at the level of 3 FTE at SLAC in future years.

Category 2.6

WBS 2.6.1: Ring to Main Linac Design, incl. Bunch Compressor

Description:
This package includes the detailed design of the bunch compressors as well as the spin rotation, pre-linac collimation, 180º tunraround, diagnostics, dumps and all other transport lines between the DR and ML.

Motivation:
This work is part of developing a complete costed design for the BCD and RDR..

Collaboration with other institutions:
This work is a collaborative effort primarily with Cornell and LBNL, with some participation of PAL. In FY05, LBNL was integral to the bunch compressor design effort, and may contribute to tuning simulations once the DR BCD is resolved. PAL proposed an alternate bunch compressor design. Cornell is presently designing the spin rotation section.

Milestones and deliverables:

Nov 05	Optimize the layout of the BCD 2-stage compressor
Dec 05	Complete BCD documentation
Jan 06	Complete comparative study of different 2-stage BC designs
Jun 06	Develop a complete set of lattices for the entire RTML
Jun 06	Complete tuning studies of the BCs and spin rotation
Sep 06	Complete tuning studies of the full RTML
Sep 06	Document design and studies for RDR

Key personnel:
Peter Tenenbaum 40%, Sergei Seletskiy 70%, Mark Woodley 20%

LBNL – A. Wolski, Cornell – D. Sagan, FNAL – S. Nagaitsev, PAL – E.S. Kim

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
1.3 FTE			

Expectations for FY07 and beyond:

The work described here is expected to largely be completed by FY07. It will continue as needed to support the RDR and TDR or be reassigned to other topics.

Category 2.7

WBS 2.7.1: Linac beamline design

Description:
This package covers work on the optics and beam dynamics design for the main linac. It also covers work on the overall layout of cryomodules and rf components for the main linac. The main issues that need to be finalized are the cavity spacing, two-phase distribution system, refrigerator spacing, cryo maintenance length, vacuum segmentation, quad/bpm package size, and design of the rf distribution system to minimize both cost and the rf overhead required for the variation in cavity performance.

Motivation:
This work is part of developing a complete costed design for the BCD and RDR..

Collaboration with other institutions:
The optics work is being done in collaboration with Cornell and FNAL in the US and with CERN and KEK. FNAL is studying sensitivity to quad spacing and BPM resolution. Cornell is comparing various BBA algorithms and various codes. Both groups will contribute to studies of curved vs kinked vs straight linacs. The cryomodule and rf layout work is being done in collaboration with FNAL, KEK, INFN and DESY. The ILCTA and TTC meetings will be used to reach an international consensus on the issues.

Milestones and deliverables:

Dec 05	Complete BCD
Feb 06	Complete comparison of simulation codes
Jun 06	Complete tuning and sensitivity studies for a curved linac
Sep 06	Finalize design and document it for RDR

Key personnel on Optics:
Peter Tenenbaum 20%, Sergei Seletskiy 10%

Cornell – D. Sagan, FNAL – S. Nagaitsev, KEK – K. Kubo, CERN – D. Schulte

Key personnel on Cryomodule and rf design:
Chris Adolphsen 25%, John Weisend 25%, Chris Nantista 25%, Cryo-engineer 50%

FNAL – T. Peterson, KEK – N. Ohuchi, INFN - C. Pagani, DESY - B. Peterson, S. Choroba

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
1.55 FTE			

Expectations for FY07 and beyond:

The optics work described here is expected to largely be completed by FY07. It will continue as needed to support the RDR and TDR or be reassigned to other topics. The rf work beyond FY06 will be very dependent on how engineering efforts are organized through the GDE.

WBS 2.7.2: Linac wakefields

Description:
This package covers the work being done to compute the long-range wakefields in the superconducting cavities and to understand their effect on beam transport. Of particular concern are trapped modes in the 4-8 GHz range due to cavity imperfections, and the effect of mode polarization on coupling the horizontal and vertical beam motion. The wakefields are computed using parallel processing techniques, and the cavities and HOM couplers are modeled in 3-D.

Motivation:
This work is being done to gain further confidence that the cavity long-range wakefields will not significantly degrade the small beam emittances in the ILC linacs.

Collaboration with other institutions:
A group at DESY lead by Jacek Sekutowicz made significant progress in this area a few years ago, especially in measuring the strengths and Q values of dipole modes below cutoff (~ 2 GHz). This group and others at JLab and KEK are now concentrating on computing the wakefields for high-gradient cavity designs, but they will also support work toward better understanding the wakefields in the TESLA cavities.

Milestones and deliverables:

Summer 06 Present modeling and beam transport simulation results at ILC meetings

Key personnel:
Karl Bane 25%, Roger Jones 10%, Andreas Kabel 25%, Lixin Ge 100%, Zenghai Li 70%, Gennady Stupakov 25%

FNAL – N. Solyak, DESY – J. Sekutowicz

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
2.55 FTE			

Expectations for FY07 and beyond:

The work in FY07 will depend on the process made this year, but will likely continue at a similar pace.

Category 2.10

WBS 2.10.1: Beam Delivery system accelerator design

Description:
This package covers work on the design for the beam delivery systems.

Motivation:
This work is part of developing a complete costed design for the BCD and RDR..

Collaboration with other institutions:
The BDS design is being done by a collaboration of several institutions. The basic optics is a SLAC design. The collimation and machine protection system is being designed together with Fermilab and UK labs. The fast feedback systems are being developed by QMUL/Oxford UK, with strong participation of SLAC. The superconducting magnets for a larger crossing angle IR are developed by BNL with SLAC providing the optics requirements. The magnets for a smaller crossing angle are being developed by Saclay/Orsay. The extraction beamlines for a smaller crossing angle IR wer developed by Daresbury (UK) together with SLAC. For the beam dumps and civil layouts, SLAC is working with Japan, and UK groups.

Milestones and deliverables:

Dec 2005 – Complete BDS BCD
Feb 2006 – Following BCD decision, reoptimize BDS to match the choosen configuration
Mar 2006 – Complete design of systems which are presently not completely finalized, such as tune-up extraction lines, diagnostics sections, beam dump.
Jul 2006 – Proceed with detailed evaluation of performance in terms of tunability, integration simulation, evaluation engineering specs for the components.
Aug 2006 – Understand site specific designs including civil and radiation issues.
Sep 2006 – Evaluate cost of the BDS.

Completion of the listed items constitutes the deliverable for ILC BDS at the end of 2006. The BDS group will also be involved in finalizing the design of the ATF2 facility at KEK and preparation for commissioning. The group will also be involved in preparation of BDS related experiments at the ESB facility at SLAC.

Key personnel:
Andrei Seryi 70%, Glen White 70%, Mark Woodley 30%, Lew Keller 40%, Yuri Batygin 50%, Yuri Nosochkov 50%, Takashi Maruyama 50%, Eric Doyle 70%, Cherrill Spencer 30%, post-doc 70%

BNL – B. Parker, FNAL – N. Mokhov, CCRLC – D. Angal-Kalinin, QMUL/Oxford – P. Burrows, Orsay – P. Bambade, Saclay - ?

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
5.3 FTE			

Expectations for FY07 and beyond:
The work described here will continue as needed to support the RDR and TDR.

Category 2.11

WBS 2.11.1: Conventional Facilities

Description:
This package covers work on the design for the sites and conventional facilities. A sample site for each region is to be selected for inclusion into the Baseline Configuration Document (BCD) by December, 2005.

Motivation:
This work is part of developing a complete costed design for the BCD and RDR..

Collaboration with other institutions:
The SLAC ILC Conventional Facilities (CF) group is working in close collaboration with FNAL on the ILC design and evaluation of several sites in Northern Illinois. SLAC is also collaborating with the Center for Integrated Facility Engineering (CIFE) at Stanford University to implement a Virtual Design and Construction computer simulation program to facilitate the top-level assessment of major trade-off choices of various sites.

Milestones and deliverables:

Dec 05 Complete BCD
Sep 06 Finalize design and document it for RDR

Key personnel:
Gerry Aarons 70%, Fred Asiri 80%, Clay Corvin 80%, Keith Jobe 20%, J.H. Kim 50%

FNAL – V. Kuchler, CERN – J.L. Baldy, KEK – T. Shidara

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
3.0 FTE	100		

Expectations for FY07 and beyond:
The work will continue at a similar level in FY07 and beyond.

Category 3.1

WBS 3.1.1 R&D Management

Description:
This work package covers the management of the SLAC R&D effort.

Motivation:
SLAC is contributing to the BCD and RDR designs for the electron and positron sources, damping rings, bunch compressors, main linac optics, beam delivery system, conventional facilities, operations, availability and controls.

Collaboration with other institutions:
One of the management tasks is collaboration with other institutions in the GDE as detailed below.

Milestones and deliverables:

Dec 05 BCD Document complete
Dec 06 RDR Document complete

Key personnel:
Tom Markiewicz – 80%

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
0.8 FTE			

Expectations for FY07 and beyond:
This work is expected to continue into FY07 and beyond at the same level.

Category 3.2

WBS 3.2.1: High Availability (HA) Power Supplies

Abstract: The ILC will need roughly a factor of 50 improvement in the availability of the magnet power supplies. Design a high availability power supply for the ILC based on a 4/5 redundant modular power supply. The extra module improves reliability by a 25% excess capacity in each module. The modules have a docking system for quick replacement in the rack assembly. These supplies are large up to about 50kW, meaning 10kW modules. A final focus test facility at KEK, the ATF2, would be an ideal demonstration of these power supplies. This facility will be built internationally, with contributions from all regions. It is suggested that, as one of the contributions, SLAC develop and produce the high availability (HA) power supplies for the ATF2 magnets, using principles that can also be used for ILC.

Project Description: Develop a modular system that can reside in a tunnel or an alcove, but designed with hot-swappable modules such that with appropriately quick replacement of the first module failure, the system should never fail except for a (far less likely) problem with signal, control, and power cables. Test the power supplies by constructing roughly 60 of them for installation in the ATF2.

Motivation: One of the main problem areas with any accelerator are the power supply systems. Many single magnets that are crucial to operation are powered by non-redundant supplies that are prone to failure due to dirt, moisture, cracked insulation, connectors, ambient heating, faulty interlock devices etc. If the ILC is built of such components it will never run. The DESY TTF2 design includes a redundant module which is a step forward, but much more needs to be done in the areas of hot-swapping for highest possible Availability, intelligent diagnostics, and especially ability to remotely service such systems buried deep inside tunnels, whether one tunnel or two. These hostile environments present a serious safety hazard to personnel and machine alike.
a) Modular Design for High Availability – The power supplies will be configured from a small set of modules for ease in assembly, installation, servicing and replacement. A 1/n redundancy in the power converter design will assure that the supply can operate around failed modules, significantly reducing the risk from single-point failures. The subsystem design will support an overall subsystem Availability of better than 0.99.

b) Lower Unit Cost – If a wide range of supplies can be simple configured by stacking standard modules or modules, the mechanics will become very cheap to manufacture in comparison to present systems of heavy units with manual hard-wiring. Standard board designs with independent controllers that can current share without interference will greatly simplify operations and maintenance.

c) Smaller Physical Unit Size – Modules will be designed for small size for ease of servicing.

d) Easier Safer Servicing - Tunnel servicing consists of quickly replacing relatively light individual modules are removable in a horizontal assembly. This process can be automated which in a single tunnel design is crucial to High Availability as well as improved personnel safety.

e) Efficiency – Small modular units based on buck regulators, for example, have efficiencies in the range of 96-99%.

f) ATF-2 – The global motivation is to build the ATF2 facility that will be used for ILC BDS and final focus related studies. The motivation in particular for the power supplies is that they need to be stable at the level of 25-100ppm (part per million) for the optics to be stable. The number of power supply channels is more than 60, most of them have the same current and voltage ratings, making it possible and also optimal, to apply HA concepts in their design. The PS will be a high efficiency, switch-mode type, designed with a modular approach to achieve commonality of types, maximized use and redundancy, and to lower the spare parts inventory. The high availability will be achieved by using an "N out of N+1" configuration, with peer-peer current sharing arrangement, to minimize a failure affecting the neighboring PSs. The required high stability of the power supplies will be achieved by use of passive filters as well as with active control using high precision, stable, zero flux transductors. A suitable power supply controller, with an Ethernet communication port and integrated EPICS IOC, will be chosen and used for these power supplies.

Milestones and Deliverables:

Benchmarks	Date
Design prototype HA power supply	Apr 2006
Build one power supply system	Jun 2006
Final design of HA supplies	Jan 2007
Installation at ATF2	Nov 2007

Key Personnel:
Andrei Seryi, project leader
Paul Bellomo 15%, Antonio DeLira 10%, Ray Larsen, Marc Ross, Cherrill Spencer 10% (SLAC), Ryunei Sugahara, Toshiaki Tauchi, Junji Urakawa (KEK contacts).

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
0.35 FTE	200		

Expectations for FY07 and beyond:
The work described here will continue in FY07 at a level of 0.8 FTE and 250K M&S.

WBS 3.2.2: High Availability Kicker

Abstract: A large number of collaborators are working on various techniques for fast kickers for damping rings in an effort to shorten the pulses as much as possible in turn to make the rings smaller. Some of these look promising including some commercial offerings, but even if a unit were to be available at this time that met the desired pulse shape, repetition rate and baseline cleanliness, there is much engineering to be done to create an operational high availability design. Just recently several pulsers were tried on a kicker at the ATF in KEK with mixed results. The unit designed by LLNL with SLAC support is an induction cell stack driven by parallel fast switching FETs. It was first operational a few days before being shipped to Japan and it tested well, although with not quite as short a pulse as desired. However it has promise and with its ability to drive a bipolar pulse out of each end to the deflector plates of the kicker, is an elegant design.

Project Description: The main direction proposed for further effort is to continue working on pulser design, and also to begin a simulation program to determine the requirements and design specifications for a complete system of N pulsers and kicker sections. Once again, for HA design, one or more redundant sections should be included in the kicker train, and controls and diagnostics will be critical for this design. The program will also continue with testing at ATF.

Motivation: Kicker performance is a potential avenue to shorten the rings, which would be a tremendous cost savings in both civil and ring costs. Individual pulser schemes are being investigated but there is no clear winner in sight. Regardless of the outcome, a system engineering problem remains and should be attacked. Preparing such a system in advance will provide a platform for testing any of a number of kickers in a realistic setting. The final matching of devices poses problems of reflections from mismatch at couplers, cable losses, timing mismatch, drift of timing as circuits heat and so on. We propose to take a high level systematic approach to evaluating a total systems model, and to build the controls and timing framework to handle the needed number of kickers in a system, plus a management system for hot swapping failed units.

a. Modular Design for High Availability – Kickers in general are vulnerable as single points of failure and an HA machine cannot tolerate this vulnerability. It will take about 50 units to inject and extract the beams and time and amplitude stability are critical. The design goal should be for 100% uptime with automated switchover of a failed module, and hot swapping of spares by remote means if necessary to avoid machine interruption.

b. Reliability – Each module must be robust and engineered to operate over temperature excursions with a safety margin, Kicking the beam errantly can damage structures including the kicker system. All developmental units need testing through a temperature range.

e. In-Tunnel Servicing - Tunnel servicing consists of quickly replacing relatively light individual units. A modular design that quickly drops into a slot and makes up the needed power and signal connections on a backplane is highly desirable. Similar topologies are proposed for electronics modules in the tunnels including beam instrumentation, power supplies and modulators. Quick replacement without machine interruption is crucial to High Availability as well as improved personnel safety.

Key Personnel:
Ed Cook, LLNL for FET driver design; Chris Pappas 10% for kicker and driver modeling and switch evaluation; Craig Brooksby for mechanical design, Richard Cassel for kicker and system

design, Anatoly Krasnykh 10% for kicker design and evaluation, Minh Nguyen 15% for circuit and controls design, Marc Ross for overall program direction.

Milestones and Deliverables:

FY06
Procure silicon switch and integrated driver on same substrate (LLNL)
Complete fast switch evaluation (LLNL)
Design, build 2nd Prototype w/ faster switches, lab test (LLNL)
Begin simulations full systems model of n+1 units (SLAC)
Model full system availability (SLAC-LLNL)
Test new model at ATF. (SLAC-LLNL-KEK)

FY07
Develop full system model, perform simulations, thermal analysis, circuit drifts in amplitude, timing, Z matching issues (SLAC-LLNL)
Design fast timing and control system for n+1 units (SLAC-LLNL)
Build 3rd prototype, evaluate control system with two units. (LLNL)
Test dual units at ATF (SLAC-LLNL)

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
0.35 FTE	50 + 200		

Where 200k$ will be transferred to LLNL in support of this program.

Expectations for FY07 and beyond:
This work is expected to continue into FY07 at the same level. 100k$ will be transferred to LLNL to support this work.

WBS 3.2.3: Diagnostic Processor for Power Supply

Abstract: The Diagnostic Processor is a system of small embedded boards that reside inside of power systems units to provide intelligent interlock trip management. A system of boards is needed for modular systems. The collection of boards from a single unit such as a modulator or power supply will be read out through an IOC into the central controls system to assist with managing operations and maintenance of power systems throughout the accelerator.

Project Description: Design, build, and test a generic diagnostic control system card for power supplies and modulators that can reside on every sub-unit or cell. It will communicate by separate serial fiber or wireless link to a local diagnostic network that sends the sub-unit's status at all times to Central Control. The card will also have simple intelligence to take some actions such as changing set-points for interlocks, sampling and transmitting power switching waveforms etc. The implementation covered in this proposal is to provide a system for the new Marx prototype modulator. A major program will be needed to develop the Middleware layer of software to make optimum use of improved diagnostics without introducing failure modes that defeat the intended purpose.

Motivation: Systems in the ILC designed for High Availability require much better diagnostics, so conditions leading to faults that trip the machines can be avoided by intelligent monitoring and both local and global decisions. Minimizing downtime increases luminosity and minimizes exposure of personnel to hostile tunnel environments.

Milestones and Deliverables:

Benchmarks	Date
Detailed design of Diagnostic controller card (PLS Collaboration)	2005
Construct diagnostic tester controller	2006
Test with prototype Diagnostic controller card	2006
Test on single Marx cell	2005
Construct set of modules for full Marx prototype (16)	2006
Install and test	2006
Develop commercial specification hardware & software	2007
Develop commercial suppliers	2007
Order prototypes	2007
Evaluate samples	2008

Key Personnel:
Paul Bellomo, 10% project leader; Dr. S. Nam 100% (funded elsewhere), Diagnostic Processor collaboration with Pohang Accelerator Laboratory.

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
0.1 FTE	60		

Expectations for FY07 and beyond:
This work is expected to continue into FY07 at 0.2 FTE and 20K M&S.

WBS 3.2.4: High Availability Control System & Standard Instrument Modules

Abstract: The 1999 baseline design for the NLC was a dual star communications topology with assumed redundancy and automated switchover at the central processor farm. Separate communications systems were visualized for all controls and data, and for fast clocks and timing. Some significant work was done through an SBIR to develop prototype Front End controllers to demonstrate (a) new high speed on-chip processors and logic; (b) gigabit/s transceivers, and (c) robust noise immune protocols. All this work was interrupted and delayed by higher program priorities both in NLC and at the Lab so the testing of this system is still underway. A fast timing fiber optic temperature compensated link was successfully prototyped. Now that the technology decision has rearranged priorities we are now able to revive these important projects.

Project Description: Very recent commercial developments have given us the tools to consider a control system of unprecedented robustness at small incremental cost. We intend to advance both the hardware and software studies through FY07 as well as conduct experiments with High Availability hardware and software. We are investigating a new commercial standard modular processor architecture (ATCA) designed for System Availability of 0.99999, which is the range of availability needed in each system of the ILC to reach a full system availability of 0.99. In addition, the Front End instrument modules need a new design to take advantage of modern chip architectures featuring gigabit serial communications, air or liquid cooling, and stand-alone module capabilities using a single DC power source and cooling air ducts or water. Concepts have been drawn up and we are moving toward investigations of commercial options as well as customized adaptors for the FE modules, all to be designed within an HA framework.

Motivation: Present control systems contribute significantly to accelerator downtime, and a machine ten times the size of the largest present linac and damping rings demands more robust fail-soft architectures and HA replacement strategies to be a successful production machine. Some of the features of a new design will be:

a. Modular Design for High Availability – There are three levels of implementation of standard modules: Central control farm, Sector communication hubs and concentrators, and Front End instrument modules that reside in or near the beam-line tunnel. Each of these levels will be designed with a dual star fabric communications architecture with gigabit bandwidth. The basic components for Levels 1 and 2 are commercially available, and the FE will use the same architecture but in a custom, potentially standard package. We have begun to seek inter-lab collaboration on all these projects. The total subsystem design goal will be to achieve an overall ILC Availability of 0.99.

b. Lower Unit Cost – Standard designs can address many different users other than HEP which will broaden markets, lower costs and create a stronger design and collaboration base. We are seeking collaboration with both industry and other interested labs.

c. Easier Safer Servicing - Tunnel servicing consists of quickly replacing relatively light individual units that simply drop into place in a horizontal assembly. This process can be automated which in a single tunnel design is crucial to High Availability as well as improved personnel safety.

Key Personnel:

Robert Downing, Downing Inc., on industrial and new instrument standards; Ron Chestnut, head of SLAC controls, on overall architecture and EPICs software; Rusty Humphrey, head of Controls Dept.; Eric Siskind, NYCB Real Time Computing on system architecture and backbone communications processors; Craig Brooksby, LLNL/Bechtel for robotics design; plus collaborators.
Ray Larsen, Software engineer 50%, Hardware engineer 50%

Milestones and Deliverables:

FY05
Start FE controller testing at SLAC
Arrange ATCA system seminars at SLAC
Build industry contacts
Procure, evaluate ATCA components, software
Begin design new FE standalone standard serial module
Revive ILC controls system architecture, software collaboration
Schedule collaboration workshop(s) for Fy06

FY06
Complete FE prototype testing
Conduct HA workshops, seminars, vendor contacts & events
Assign SLAC personnel to GDE Controls collaboration team
Bring up HA test station, tools for high performance hardware, software evaluation
Map BPM design to new HA platform module to advance cost model
Contribute to Collaboration activities:
- Baseline, Alternate Configuration Design (BCD, ACD)
- Baseline HA software configuration design
- Overall plan for software development tasks
- Complete RDR modeling and cost analysis

FY07
Investigate robotics modular replacement system (w/LLNL)
Within Controls Collaboration:
- Identify commercial, custom module sources for (a) controls, (b) FE systems
- Build development systems for hardware, software collaboration
- Develop commercial version of FE module mechanics

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
1.0 FTE	100		

Expectations for FY07 and beyond:
This work is expected to continue into FY07 at a level of 1.8 FTE and 100K M&S.

Category 3.3

WBS 3.3.1: Polarized Electron Source

Status: The baseline design for an ILC polarized electron source has been chosen at the Snowmass ’05 Workshop. As anticipated, the baseline design will be similar to the SLC polarized electron source. It also has been recognized that the decreased space charge limitation of a higher voltage DC-gun will be beneficial for the pre-buncher design. Furthermore, the clear advantages of an RF-gun have been pointed out and the decision was made to conduct R&D towards a polarized RF-gun as an advanced concept for the ILC polarized electron source.

The SLAC Polarized Photocathode research collaboration will continue to develop high polarization photocathodes for the ILC; we anticipate that with the relatively low current bunch train, polarization levels greater than 90% will be achieved. This work will be done in collaboration with the polarized photocathode group at Nagoya University. A demonstration of a long pulse (>1 ms) is needed from the photocathode to verify that there are no charge limiting effects. Photocathode R&D is also supported by an SBIR to develop techniques to increase the photocathode quantum efficiency. Additional SBIR’s are planned to develop and improve structures for high polarization materials.

The construction of a new laser laboratory is in its final phase, and the development of the laser system needed to demonstrate the bunch train generation will start in FY 2006.
An application for a phase I SBIR will be submitted at the end of the year to collaborate with industry to aid in the development of a source laser system.

The normal-conducting structures for the electron and positron sources will be tested in the L-band rf power test facility in End Station B during 2006. A design for a polarized gun will begin in 2006. A collaboration for a polarized-rf gun is in its initial phase and a first meeting will be held in November ’05 at Fermilab. An application for an SBIR is prepared to develop the vacuum technology needed for a successful polarized rf-gun.

Work on the optics simulations and design for the electron source has begun and a collaboration on this subject has been started with the Saclay (France) group.

Project Description: The electron source must generate the ILC bunch structure. The source will be designed to delivered twice the bunch charge required at the IP. According to the present state of the art the source will be composed of a laser system generating the time structure of the pulse train, an SLC type electron gun using a strained layer GaAs photocathode, the necessary subharmonic bunching and preacceleration of the electron beam to 500 MeV, which is the electron energy before entry to the damping ring. The polarized source development will also include polarization control throughout the machine. For all parts of the program simulations and modeling as well as an experimental program are crucial.

Scientific Motivation:

Simulations:

The structure for the e- pulse train will be created by the source laser system. Simulations are necessary to determine the minimum cathode bias voltage necessary to reduce space charge effects in the gun and during transport of the beam to the injector accelerating structure.

Laser system:

A laser system that can be used for an ILC electron source does not exist. The development of an ILC source laser system that provides the wavelength, time structure, pulse length and intensity as well as the required stability requires a significant R&D effort. Commercial laser systems that fulfill the ILC requirements are not available and due to the particular ILC requirements it is not feasible to rely on a commercial solution. Advances in related laser technology have been made at DESY's TTF 2 facility. However, these laser systems are designed to operate an RF gun and are not suited for photocathode and e^- gun technology proposed for the ILC.

Electron gun:

The electron gun will be based on the dc-biased SLC gun. The required charge for the ILC injector requires improvement of the HV performance of the gun to reduce space charge effects. This will be accomplished by implementing recent innovations in the area of electrode and insulator materials as well as new electrode preparation technologies. The current status of RF gun technology precludes them for an initial ILC polarized electron source.

Photocathode:

A GaAs photocathode will be used to generate polarized electrons. Currently, strained multilayer GaAs/GaAsP cathodes deliver ~ 90 % polarization at a quantum efficiency of ~ 0.5%, thereas the strained single layer variation produces a 85 % polarization and a quantum efficiency of ~ 1%. Refinement of cathode structure and surface preparation technology will improve polarization, quantum efficiency as well as lifetime of photocathodes used in the ILC injector.

R&D on gridded cathodes shows increased quantum efficiency by applying a bias across the cathode. This work will continue to investigate the bias effect on polarization

Subharmonic bunching and preacceleration:

The basic requirements for subharmonic bunching and preacceleration are outlined in the TESLA CDR and the US cold options study. Progress in gun development will positively impact the requirements for subharmonic bunching (e.g. improved HV performance of the e^-gun reduces the space charge effects and thereby allows the generation of shorter pulses).

Milestones and Deliverables (FY06-FY07)

Benchmarks	Date
Source lab upgrade (continue from FY05)	FY06
Simulations	FY06
Start ILC source laser development (Work will begin upon completion of lab upgrade)	FY06
Laser development – pulse train generation	FY06

Laser development – pulse train amplification	FY07
Gun development (Simulations and engineering) (Work on simulating HV increase on gun current and space charge effect has begun in FY05)	FY06
New gun materials R&D	FY06
Test of new cathodes for ILC bunch train generation	FY07
Test of improved HV gun structures	FY07
Gridded photocathode R&D (continue in FY06)	FY05
InGaP/GaAs superlattice R&D	FY06
Beam simulations	FY06

Key personnel:
Axel Brachmann 50%, Jym Clendenin 25%, Takashi Maruyama 50%, Katerina Ioakeimidi 100%, Dmitry Vasilyev 50% (of which 0.9 FTE supported by SBIR)

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
2.75 FTE (-0.9 SBIR)	100		

Expectations for FY07 and beyond:
The work described here will extend through FY07 and beyond. Planning for FY07 is for the same level of labor and an increase in M&S to 500K$.

Category 3.4

WBS 3.4.1: NC Positron Capture Structure

Description:
A five cell, pi-mode, standing-wave cavity with a 60 mm aperture has been designed for the ILC positron capture accelerator. A prototype cavity will be constructed at SLAC and installed in the NLCTA beamline in a 0.5 T solenoidial field, as would be witnessed in the ILC. Using the L-band source being constructed at NLCTA, the cavity will be powered with 5 MW, 1 ms pulses at 5 Hz to produce a 15 MV/m accelerator gradient. A single bunch beam with a variable injection time will be accelerated in the cavity to measure the variation of the gradient during the pulse.

Motivation:
The ILC positron capture cavities are required to have a large aperture (60 mm) and operate at about 15 MV/m for a good positron yield. The surface fields in this case are close to the sustainable limits for 1 ms long pulses at this frequency. In addition, the long-pulse operation produces about 5 kW of average power dissipation in each of the 11-cm-long cells, and the cavities close to a conventional target would absorb an additional 6 kW per cell from particle losses. Designing a cavity that can achieve these gradients and not significantly detune from pulsed and average power heating is a challenge. The cavity design presented in the TDR seems overly complicated, hard to cool and has high pulse heating. A prototype of the TDR design will be built by DESY, but it will have only a 30 mm aperture and will be mainly used for XFEL injector studies. Thus it is prudent a test a more realistic cavity design to verify that the requirements can be met.

Collaboration with other institutions:
None.

Milestones and Deliverables:

The basic cavity and cooling system design has been completed (the window design is nearing completion). Extensive modeling of the detuning that would occur during the pulse shows that it should manageable by small changes to the klystron amplitude and phase. The cells are currently being fabricated in the Klystron Shop.

Benchmarks	Date
Complete cavity design	Sept 2005
Build test cell	Nov 2006
Assembly 5 cell cavity	Mar 2006
High power test at NLCTA	June 2006

Key Personnel:
C. Adolphsen 25%, J. Wang 75%, G. Bowden 30%, J. Lewandowski 25%, R.Miller 25%, E. Jongewaard 25%, Z. Li 25%, Shop 150%

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)

3.8 FTE	140		

Expectations for FY07 and beyond:
The work is expected to be completed in FY06.

WBS 3.4.2: E-166 Positron Polarization Experiment

Description:
This package includes the E166 Positron Polarization demonstration experiment run in FY05 and FY06. This program is completed except for clean-up.

Motivation:
This work demonstrated undulator production of polarized positrons.

Collaboration with other institutions:
This experiment is an international collaboration.

Milestones and deliverables:

Jun 05 First experimental run
Sep 05 Second experimental run
Jun 06 Complete analysis and disassemble experiment.

Key personnel:
John Sheppard, Vinod Bharadwaj - Total 0.0 FTE

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
0.0 FTE	25K		

Expectations for FY07 and beyond:
The work will be completed in FY06.

Category 3.5

WSB 3.5.1: Electron Cloud Lab Measurements and PEP-II Studies

Abstract:
The electron cloud effect has been identified as one of the main issues in the positron DR. To reduce the electron cloud density confidently below the instability threshold, further R&D is needed.
From the *ILC Damping Rings Summary of Configuration Recommendations* document 15 Nov 2005 (to be presented for the Baseline Configuration Document):
"Electron-cloud effects make a single ring of circumference 6 km or lower unattractive, unless significant progress can be made with mitigation techniques. If techniques are found that are sufficiently effective at suppressing the electron cloud, a single 6 km, or possibly smaller, ring can be used for the positron damping ring. If electron cloud mitigation techniques are not found that are sufficient for the baseline positron ring (two 6 km rings), then a 17 km ring is a possible alternative; this would require addressing space-charge and acceptance issues."

SLAC has an extensive R&D program simulating cloud buildup and its effect on the circulating beam and studying a number of possible remedies to reduce the secondary electron yield below that required.

Possible cures in wiggler and dipole regions such as rectangular grooves and clearing electrodes although very promising need further R&D studies and a full demonstration.

Project Description: The program is to reduce and stabilize the surface secondary electron yield (SEY) below the threshold for the onset of the electron cloud in the damping ring. The requirement from simulations is an SEY<1.2.

- Project 1: Build prototype chambers with mm grooves for installation in PEP-II.
- Project 2: Build a dedicated chamber for installation in the PEP-II to test e- and photon conditioning.
- Project 3: Build dedicated chambers to test clearing electrodes technique.
- Laboratory measurements of the SEY.
- Developing new material alloys.
- Measurements of electron trapping mechanism in a quadrupole field.
- Fabrication ofchambers with rectangular grooves with μm size.
- Install a dedicated electron diagnostic in the Dafne positron ring, Frascati.

Motivation: In the beam pipe of the Damping Ring (DR) of a linear collider, an electron cloud may be produced by ionization of residual gas or photoelectrons and develop by the secondary emission process. For the ILC positron damping ring, the development of the electron cloud must be suppressed. Coupling between the electrons and the circulating beam can cause collective effects as coupled-bunch instabilities, coherent single-bunch instabilities or incoherent tune spreads that may lead to increased emittance, beam blow-up and ultimately to beam losses directly affecting the collider luminosity. Many of the electron cloud effects have been evaluated by simulations. Actions to suppress the electron cloud are required for the ILC positron damping ring.

Project status:

Laboratory measurements of samples with a rectangular grooved surface: very low SEY ≤ 0.7.
Testing the effect of ion bombardment and conditioning.
Project 1: Finalizing drawings of the prototype chambers with a grooved surface profile.
Project 2: Chamber drawings completed. Ready for construction of the dedicated chamber.
Project 3: Under study.
Fabrication of a novel TiCN alloy.
Ongoing collaboration with LANL to install special diagnostic in quadrupole magnets to measure the electron trapping mechanism.

Milestones and Deliverables:

Milestones	Date
Project 1. Fabrication of the prototype grooved chambers	03/06
Grooved chamber installation in PEP-II	06/06
Project 2. Fabrication of test chamber	Fall 05
Chamber installation in PEP-II	End 05
Measure electron trapping in quadrupole filed PSR LANL	Summer 06
Measure SEY of TiCN coating samples	10/05
Measure SEY micron grooved profile samples by electroforming	02/06
Installation of electron cloud diagnostic in Dafne ring	02/06

Collaboration with other institutions:

This work is in collaboration with:PEP-II - N. Kurita, LBNL - A. Wolski, LANL - R. Macek, Frascati - C. Vaccarezza.

Key Personnel:

M. Pivi 30%, R. Kirby 25%, G. Collet 25%, postdoc 20%.

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
1.0 FTE	140		

Expectations for FY07 and beyond:

The work described here only extends through FY06 but studies will continue as needed to support the RDR and TDR.

WBS 3.5.2: ATF Ring BPM Electronics

Abstract: This project involves the replacement of the electronic signal processing equipment used for the ATF damping ring BPMs. The present 'single-pass' system will be replaced with one which can be used to average data from many ring turns, resulting in more than 10x improvement in resolution (to 100nm) and a similar improvement in offset control. The multi-turn system includes a CW calibration system for controlling offsets and gain errors.

Project Description: The project goal is to apply digital receiver technology to all 100 ATF damping ring BPM's. This will result in 100 nm (multi-pass) resolution for emittance and beam dynamics studies. We expect this system will be needed for ATF2. Full system completion is at the end of JFY 2007. 1/2 the system will be in place at the end of JFY 2006.

Motivation: With this system, the ATF should be able to achieve 1 pm-rad vertical emittance through improved coupling and spurious vertical dispersion correction. This will be important for the ATF2 project and instrumentation tests in the extraction line. The present vertical emittance, as seen in the extraction line, is about 20 pm-rad.

Milestones and Deliverables:. Each channel (3 per BPM) consists of a coupler/calibration printed circuit card, a receiver /downmix printed circuit card and a high speed digital receiver. FY05 costs cover design and prototype work on the printed circuit boards. The software to control the digital receiver is in use at SPEAR III and was tested at ATF in June 2004. The system will be delivered by March 31, 2007. A pilot system consisting of all required infrastructure and about 10% of the ATF ring BPM's will be in place by March 31, 2006.

Benchmarks	Date
Prototype complete	October 31, 2005
Delivery ATF (10% pilot system)	March 31, 2005
Full system delivery	March 31, 2007

Key Personnel:
Marc Ross 15%, project leader, Steve Smith 40%, Tonee Smith 40%, Joe Frisch 20%, Justin May 20%, Maria Carballo 30%
Masao Kuriki, KEK, co-project manager

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
1.65 FTE	290		

Expectations for FY07 and beyond:
The work described here will continue in FY07 with about 0.5 FTE and 212K M&S. It is expected that a significant fraction will be covered by US-Japan funds.

Category 3.8

WBS 3.8.1: Marx Modulator

Abstract: The baseline design for the ILC modulator is a bouncer-style modulator produced by DESY/PPT/FNAL. A number of units have been built and are operational on 5MW klystrons. The design consists of a large, 6.5ton, oil-filled step up transformer located in the tunnel to produce the 120kV required for the klystrons, a bank of large storage capacitors to support the pulse length, and a single non-redundant switch and crowbar design. Costs are the order of $650K for the first units but this does not include the large parallel cable plant to each klystron. Efficiency is estimated at 85%.

Project Description: The Marx modulator project will develop an alternate to the baseline modulator design using a modular, compact, oil-free Marx generator topology. If successful after a period of evaluation, a new project will be started to refine and industrialize the modulator design.

Three companies have just been awarded Phase I SBIRs to industrialize this technology. In FY05-06 we plan to share our early test results with these companies to support their Phase I R&D efforts. In FY06-07 we will continue assisting these companies in their Phase II efforts towards Design for Manufacture (DFM) by providing updated ILC requirements, design guidance, and evaluating prototype SBIR modulators at our L-Band Test Facility.

Motivation: Klystron modulator topologies unthinkable a decade ago are becoming feasible with the advent of PC-board-level 4500V IGBTs, fast single junction HV diodes, high density capacitors, and sophisticated modeling software. Initial design studies show that a 120kV long-pulse solid-state Marx modulator would be competitive with existing modulator designs in numerous ways:

a) High Availability – The Marx stack and power converter will be modularized for ease in assembly, installation, servicing and replacement. Inherent redundancy in the stack and power converter design will assure that the Marx modulator can operate around failed cells, significantly reducing the risk from single-point failures. The subsystem design will support an overall ILC Availability of 0.99.

b) Lower Unit Cost – Detailed cost analysis needs to await successful construction and testing. However, the highly modular, PC board-level integration of the Marx design streamlines the assembly and QC processes both at the subassembly and tunnel installation level. The goal is to reduce system costs by 30-40%.

c) Smaller Physical Size – The Marx design requires 1/3 the floor space of existing transformer-based long pulse modulators. The low voltage (LV) high current cable plant is reduced in size by a factor of four and the large pulse transformer is completely eliminated. This would directly reduce civil engineering costs for the ILC tunnels and the installed costs for the modulator system.

d) Possible Major Reduction of Cable Plant and Improved Equipment Safety – With proper radiation shielding, in-tunnel placement of the Marx Modulator next to the klystron is feasible. The baseline requirement for 3300km of LV transmission cables can be reduced to a single short connection at each klystron, eliminating more than 90% of the $72M estimated LV cable plant cost. The LV cable plant under the tunnel walkway must transport peak power levels up to 600MW. Eliminating the cable plant would significantly improve fire safety in the tunnel, and klystron safety by reducing stored energy.

e) Easier, Safer Servicing - Tunnel servicing consists of quickly replacing relatively light individual units that simply drop into place in a horizontal assembly. This process can be automated, which in a single tunnel design is crucial to High Availability as well as improved personnel safety.

f) Efficiency – The low operating currents and simple switching requirements of a Marx bank yield considerably higher overall modulator efficiencies, in the range of 96-99%.

g) Oil-free Design – The high efficiency of the Marx Bank permits air cooling instead of oil immersion. This simplifies maintenance, and reduces mean repair times. Elimination of oil in the tunnel also improves both machine and personnel safety.

Milestones and Deliverables:

Benchmarks	Date
Verify 12kV switch module performance	Jun 2005
Evaluate cell components	Aug 2005
Test completed Marx cell	Sep 2005
Construct Marx 'short stack,' evaluate	Dec 2005
Short stack fault scenario testing complete	Jan 2006
Develop Marx bank active control system	Feb 2006
Full Marx modulator ready for water-load testing	Jun 2006
Marx modulator tested, ready for klystron	Aug 2006
Test on 5MW klystron in ESB	Sep 2006
Station development with 10MW klystron in ESB	2007
Refine design towards 'Design for Manufacture'	2007
Support tests of SBIR prototypes at SLAC	2007

Key Personnel:
Greg Leyh 90%, project leader, Piotr Blum 90%, Richard Cassel 10%, Ray Larsen 25%, Dan Moreno 30%, Software engineer 50%, Eshop 50%, Controls Tech 100%
Craig Brooksby, Ed Cook (LLNL)

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
4.45 FTE	240 + 130		

Where 130k$ was committed in FY05.

Expectations for FY07 and beyond:
The work described here will continue into FY07 with 2.2 FTE and 140K$ of M&S.

WBS 3.8.2: SC Linac Quad and BPM

Abstract: Develop high-resolution linac bpms and characterize the field properties of a prototype linac superconducting quadrupole magnet. Demonstrate the required bpm-to-quad magnetic center alignment accuracy using a quad shunting technique.

Project Description: A prototype SC linac quadrupole magnet will be obtained from DESY and a warm-bore cryostat will be built for it at SLAC. The quad magnetic field will be characterized with a rotating coil, in particular, to measure on a micron scale any motion of the magnetic center when the field strength is varied. In parallel to this program, high resolution rf cavity bpms will be developed for the ILC linacs. Ultimately, the quad and bpms will be tested with beam to demonstrate the required quad shunting performance (this will be submitted as a separate proposal).

Motivation: To preserve the small emittances in the ILC linacs will require beam-based alignment of the quadrupole magnets. The simplest technique proposed for this purpose requires that the alignment of the magnetic center of each quad be first measured relative to the electrical center of the nearby bpm. This involves changing the quad strength (shunting) and recording the resulting beam kick. To achieve the desired accuracy, the quad center cannot move by more than about 5 microns when the field strength is changed. Thus we want to verify that the field center is stable to this level in an ILC-like quad, which nominally has a large aperture (78 mm diameter) so may be prone to distortion when the magnetic forces are varied. For the quad alignment procedure, we also want to show that stable, high resolution (micron level) beam position measurements are achievable with the large aperture cavity bpms that are required in the linacs (DESY has had limited success with their TTF bpms). Such quad and bpm performance demonstrations are probably all that can be done experimentally to test the quad alignment procedure without having at least 100 m of beamline and low emittance beams. Other beam-based alignment methods are less local in their correction and so are even harder to evaluate in a meaningful way without a large-scale linac.

Milestones and Deliverables: A prototype linac quad has been built and is undergoing final tests at DESY. At SLAC, cryo-engineers are in the process of designing the cryostat. Also, the electrical and mechanical design of the bpms is complete and the bpms are in fabrication.

Benchmarks	Date
Receive Quad from DESY	Dec 2005
Cryostat Design Complete	Dec 2005
First Coil Measurements of Quad	Mar 2006
Fabrication of Three RF BPMs Complete	Jan 2006
Beam Test of BPMs in ESA	Mar 2006
Complete Magnet Tests with Coil	July 2006

Key Personnel:
Chris Adolphsen 25%, project leader
EunJoo Thompson 25% and Tom Weber 25% (SLAC engineers), Cherrill Spencer 10% and Zack Wolf 20% (SLAC Magnetic Measurements), Gordon Bowden 15%, Heiner Brueck (DESY contact) and Fernando Toral (CIEMAT contact in Spain).

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
1.2 FTE	205 + 45		

Where 45k$ was committed in FY05.

Expectations for FY07 and beyond:

The work described here should be completed in FY06.

WBS 3.8.3.1 Coupler Development

Abstract: This program will allow LLNL/SLAC to perform measurements to understand the rf processing limitations for the rf power couplers used in the DESY 1.3 GHz superconducting cavities. Various coupler sections will be tested to assess the impact of coupler coatings, bellows, and widows on processing time.

Project Description: Eleven coaxial sections (40 mm ID, 70 Ohm) will be prepared that vary in terms of material (SS or Cu), bellows (none or 5 or 10 folds) and windows (with and without). A general purpose waveguide (WR650) to coax adaptor will be designed to power the test sections in vacuum (one pair of adaptors will be used for all the tests). The tests will be done at the Coupler Test Stand that is being built as part of the L-band project at the NLCTA. The test sections will be instrumented to detect electron and gas activity to gauge processing performance.

Motivation: By developing an understanding of which components in the coupler design lead to long conditioning times and delicate operational stability, RF coupler designs for the ILC can be developed that are more robust and less costly, both to build and to condition.

Milestones and Deliverables: The adaptors are being designed and the coaxial parts are being ordered. The test stand is being built as part of the L-band project.

Benchmarks	Date
Commission coupler test stand w/o sections	Feb 2006
Receive coupler bellows and window parts	Mar 2006
Commission coupler test stand with sections	Apr 2006
Perform measurements	May-Aug 2006
Analyze data and write report	Sept 2006

Key Personnel:

Brian Rusnak, project leader

Chris Adolphsen (Testing), Chris Nantista 10% (RF Designer), Gordon Bowden 20% (Mech Engineer), Tech 70%, Wolf-Dietrich Moeller (DESY contact), Terry Garvey (Orsay contact).

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
1.0 FTE	100		

Expectations for FY07 and beyond:

The work described here will be completed in FY06.

Category 3.9

WBS 3.9.1: TTF2 HOM Monitor

Abstract: Use of HOM BPM's in ILC has been recommended but not accepted. Initial testing of the concept has proved 3 micron resolution and has been very useful for TTF operations. Production is expected to finish November 8, 2005.

Project Description: The purpose of this project is to build, test and commission signal processing electronics for the higher order mode signals from all 5 cryomodules in the TTF VUV-FEL. The TTF VUV – FEL HOM BPM system consists of one single-line (TE111-6, 1701 MHz nom.) heterodyne receiver and a 14 bit 100MHz waveform digitizer for each HOM coupler (total of 80 couplers at present). The processing electronics is similar to that used for beam tests carried out at TTF in late 2004 and in spring and summer 2005.

Motivation: With this system, each of the TTF cavity HOM signals will be received and analyzed to obtain beam position information. We expect the resolution to be about 1 micron for single bunch beam. We expect offsets to be determined to 100um. For ILC and the XFEL, this technique will be used to test cryomodule construction precision.

Milestones and Deliverables:. The system will be delivered November 9, 2005. At that time, the group will work at DESY to commission the system using the TTF beam. The prototype cycle was complete July 31, 2005. SLAC is responsible for the production, testing, qualification and installation of the signal processing electronics from the HOM cable patch panel to the digitized signal.

Benchmarks	Date
Prototype complete	Aug 05 (complete)
Delivery TTF	Nov 05 (complete)

Key Personnel:
Marc Ross 20%, project leader, Joe Frisch 20%, Doug McCormick 25%, Justin May 25%, Tonee Smith 20%, Juan Cruz 10%, Maria Carballo 20%
Nicoleta Baboi, DESY, co-project manager

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
1.4 FTE	45 + 50		

Where 50k$ was committed in FY05.

Expectations for FY07 and beyond:
The work described here will be completed in FY06.

Category 3.10

WBS 3.10.1; Collimator Wakefield Test Facility at ESA

Description:
This package includes the work on the Collimator Wakefield Test Facility at ESA characterizing collimator shapes and materials.

Motivation:
This work is part of developing a complete collimator design for the RDR..

Collaboration with other institutions:
This work is a collaborative effort with Rutherford Appleton Laboratory in the UK where Nigel Watson is co-spokesperson with PT.

Milestones and deliverables:
Jan 06 Commission Wakefield Test Facility in ESA.
Apr 06 Complete measurements on 8 new collimator inserts in ESA.

Key personnel:
Peter Tenenbaum 10%, Sergei Seletskiy 20%

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
0.3 FTE			

Expectations for FY07 and beyond:
The work described here only extends through FY07 but futher collimator wakefield studies will continue as needed to support the RDR and TDR.

WBS 3.10.2: ATF2 Cavity BPM Electronics

Abstract: The ATF2 cavity BPM system is in the final design stage. Cavities will be produced by the Pohang group and tested at ATF December 2005.

Project Description: The purpose of this project is to build, test and commission signal processing electronics for 35 ATF2 cavity beam position monitors. The cavities are similar to those in use in the existing ATF extraction line, and the electronics design is based on the proven system used with those BPM's. The ATF2 Q-BPM system consists of 35 RF cavity BPM's, each with a 2 channel (x,y) heterodyne receiver and a 2 channel, 14 bit, 119 MHz waveform digitizer. SLAC is responsible for the production, testing, qualification and installation of the signal processing electronics from the heterodyne receiver to the final digitized signal.

Motivation: With this system, each ATF2 cavity BPM (Q-BPM) will be fully instrumented for calibration and operation. The BPM resolution will be better than 100 nm at nominal ATF single bunch current over a dynamic range of more than 1 mm. The system will also operate with multi-bunch trains with the same resolution, although this operational mode has not been experimentally verified.

Milestones and Deliverables:. The system will be delivered before March 31, 2006. Because actual beam testing using the final cavities will await the delivery and installation of the cavities, final testing will be later. The prototype cycle will be completed by December 1, 2005.

Benchmarks	Date
Prototype complete	Dec 05
Delivery ATF	Mar 06

Key Personnel:
Marc Ross 10%, project leader, Steve Molloy 20%, Joe Frisch 20%, Doug McCormick 25%, Justin May 25%, Tonee Smith 20%, Juan Cruz 15%, Maria Carballo 20%
Yosuke Honda, KEK, co-project manager

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
1.55 FTE	120		

Expectations for FY07 and beyond:
The work described here will be completed in FY06.

Category 5.5 Damping Ring Test Facilities

ATF Kicker Replacement

Program completed in October 2005– minimal costs in FY06.

ATF NanoBPM Program

Program completed in November 2005 – minimal costs in FY06.

WBS 5.5.1: ATF Beam Dynamics and Instrumentation Studies

Abstract: The study program at ATF is focused on development of the ILC low emittance source and development of precision beam instrumentation for position and profile measurements.

Project Description: There are seven ongoing projects: 1) ultra-high resolution cavity BPM's, 2) emission of coherent synchrotron radiation, 3) laser-based beam profile monitors (laserwire), 4) fast feedback, 5) optical stabilization, 6) generation of low emittance beams using precision BPMs and correction procedures and 7) development of fast pulse kickers. Items 1), 6) and 7) are collaborative efforts directed by (or substantially involving) SLAC. Separate proposal sheets describe those efforts.

Motivation: The projects listed have been identified in the TRC and 1st ILC workshop as important RD tasks. ATF is an unique test facility that provides ready access to ILC quality beams. The SLAC ILC group has more than 10 years experience working closely with the ATF and we provide both technical and logistical leadership to the teams working on the projects listed. Each of these tasks involves one or more graduate or post-doctoral students, for a total of around 25 (includes 30% Asian students).

Milestones and Deliverables:. Each of the projects listed has a funding and deliverable timeline established by the ILC, supporting funding agencies and the ATF operational schedule. Most of the projects will be complete by the end of 2007.

Benchmarks____Date________

Key Personnel:
Marc Ross 15%, project leader, Glen White 30%, Janice Nelson 20%, Mark Woodley 10%, Junji Urakawa, KEK, ATF Manager

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
0.75 FTE	80		

Expectations for FY07 and beyond:
The work described here will continue in FY07 at the same level.

Category 5.8 Linac test facilities

WBS 5.8.1: 1.3GHz RF Power Source

Abstract: Build a test stand that provides 1.3 GHz, 5 MW, 1.5 ms pulses at 5 Hz for testing normal-conducting structures, couplers and other ILC rf components.

Project Description: The test stand will initially consist of a HV modulator that is on loan from SNS, a 5 MW klystron, a high power rf distribution system and experimental test areas. One area will be used to process developmental couplers (and perhaps production versions), and another will be located in the NLCTA beam enclosure to test normal conducting structures, including accelerating beam with them. In the next few years, both the klystron and modulator will be replaced by ILC prototypes (these activities will be covered by separate proposals).

Motivation: SLAC has much experience in developing and operating rf power sources, and plans to become the US R&D leader in this area for the ILC. To gain experience with L-band sources and to provide power for warm rf component tests that we envision in FY06, we borrowed a modulator from SNS, and are buying a 5 MW klystron from Thales (until it arrives next year, we will use a somewhat lower power klystron that we recently acquired from Titan). Beside gaining long-pulse, low frequency rf operational experience with this system, the SNS modulator will be evaluated for its application in the ILC (it will likely be more efficient and less expensive than the ILC baseline design, but may be less reliable). Having this L-band source, we are in a good position do coupler development work and perhaps process the couplers that will be used for the FNAL cavities. With the NLCTA beam, we can demonstrate beam acceleration in the high-gradient, high-average-power cavities that we are developing for the ILC position capture linac. Finally, as SLAC expands its role in developing and evaluating ILC sources, the test stand will be upgraded with an ILC prototype modulator and klystron.

Milestones and Deliverables: All major components for the test stand have arrived at SLAC or are on order. Currently, the Titan klystron has been installed and the modulator is nearing final assembly.

Benchmarks	Date
Test the modulator with a water load at 70 A	11/2005
Upgrade modulator to drive at least 90 A	01/2006
Commission the Titan klystron	02/2006
First power to the NLCTA beamline enclosure	03/2006
Full 5 MW power capability with Thales klystron	06/2006

Key Personnel:
C. Adolphsen 25%, project leader
R. Larsen, F. Asiri 10%, D. Cassel 25%, J. Chan 25%, J. Frisch 30%, K. Jobe 20%, C. Pappas 60%, A. Young 60%, D. Moreno 35%, D. Anderson 35%, M. Larrus 25%, A. DeLira 20%, Klystron tech 20%, S. Smith 10%, T Lavine 20%, D. McCormick 30%, J. Nelson 20%, post-doc 50%, R. Swent 50%

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
5.7 FTE	280 + 350		

Where 350k$ was committed in FY05.

Expectations for FY07 and beyond:
The work described here will be completed in FY06.

WBS 5.8.2: HA Modulator IGBT Switch Array

Summary: The baseline design for the ILC modulator is a bouncer-style modulator produced by DESY/PPT/FNAL. A number of units have been built and are operational on 5MW klystrons. The FNAL team wishes to design a redundant switch for both machine and personnel safety against breakdown failure and operational reliability.

Project Description: The switch design is based on pervious work on stacked switches done at SLAC in the X-Band RF program. The switch is designed to a FNAL specification. SLAC is providing the design and first unit as a contribution to the ILC SMTF program at FNAL.

Key Personnel:
D. Cassel 15%, M. Nguyen 35%

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
0.5 FTE	20 + 70		

Where 70k$ was committed in FY05.

Expectations for FY07 and beyond:
The work described here will be completed in FY06.

Category 5.10 Beam Delivery Test facilities

WBS 5.10.1: Optics Design and fabrication of magnets for ATF2

Abstract: A final focus test facility at KEK, the ATF2 is proposed by the international community. This facility will allow the study of ILC Beam Delivery related issues such as optics tuning, development of instrumentation, achieving and maintaining nanometer scale beam. This facility will be build internationally, with hardware contributions from all regions. It is suggested that, as one of the contributions, SLAC will develop and produce some bending magnets and Final Doublet for ATF2.

Project Description: Design and fabricate the Final Doublet quadrupoles and seven bending magnets (three FF dipoles and four chicane dipoles) that will be used at the ATF2 final focus facility at KEK.

Motivation: The global motivation is to build the ATF2 facility that will be used for ILC BDS and final focus related studies. The motivation in particular for the FD magnets is that these magnets have to be carefully engineered and integrated together with the corrector and mover system. They must be extremely stable, both in terms of strength, temperature and position, and therefore represent R&D which is relevant for ILC magnets. The bending magnets are less challenging, however, they are an essential part of ATF2 optics and need to be provided. Other quadrupoles are being provided by KEK.

Milestones and Deliverables: The ATF2 optics design is completed and from these optics the requirements for the magnets and their power supplies have been provided.

Benchmarks	by this Date
Determine optimal technology for FD magnets	Dec 2005
Design chicane bends	Apr 2006
Design FF bends	Sep 2006
Design FD quads (one design)	Dec 2006
Fabrication of all bend magnets complete	Feb 2007
Fabrication of 2 FD quads complete	Jun 2007
Installation in ATF2 Complete	Oct 2007
Operation at ATF2	Jan 2008

Key Personnel:
Andrei Seryi 30%, project leader
Mauro Pivi 20%, Cherrill Spencer 50% (SLAC), Junji Urakawa, Ryunei Sugahara (KEK contacts).

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
1.0 FTE	130		

Expectations for FY07 and beyond:

The work described here will continue in FY07 at a level of 0.3 FTE and 142K M&S.

WBS 5.10.2 ESA Beamline Instrumentation Upgrade

Abstract: The SLAC Linac can deliver a high-energy beam with ILC parameters for bunch charge and bunch length to End Station A. We plan to use this facility to test prototype components of the Beam Delivery System and Interaction Region. The first experiments will study collimator wakefields and energy spectrometers. We also plan an interaction region mockup to investigate effects from backgrounds and beam-induced electromagnetic interference.

Project Description: The ESA program is described in a recent PAC paper available at the ILC-ESA website, http://www-project.slac.stanford.edu/ilc/testfac/ESA/esa.html.

The main project elements underway are:

1. ESA infrastructure. Facilities for beamline components. 2 wire scanners. DAQ. Bunch length diagnostics. Cableplant. Beamline, including vacuum. Will bring and measure a low emittance beam to ESA for the first time.
2. Energy spectrometers. We will have both a BPM-based and a synchrotron-stripe-based spectrometer, using a common 4-magnet horizontal chicane. 8 or 9 rf cavity bpms will be used – a bpm triplet prior to the chicane, 2 or 3 bpms at mid-chicane and a bpm triplet following the chicane. A wiggler will be placed in the 3rd leg of the chicane to generate a vertical synchrotron stripe. The goal of these tests is to study systematic effects that would compromise the desired 50-100 part-per-million precision in energy measurements at the ILC.
3. Collimator wakefields. The goal of these tests is to find optimal materials and geometry for the collimator jaws to minimize wakefield effects while achieving the required performance for halo removal. The diagnostics for the wakefield kicks will be the rf cavity bpms used in the energy spectrometer tests.
4. Linac rf BPM tests. We will install and test a triplet of S-band rf bpms that are being developed under the guidance of C. Adolphsen as prototypes for the ILC Linac bpms.

New projects in preparation/under study:

1. IP BPMs and kickers for fast intra-train feedback. We are investigating how to mimic aspects of the beam-beam interaction with either a 5% radiation length fixed target or a "spray beam" of low energy electrons. This system has been identified as one of the highest risks to delivering design luminosities, in part because of the difficulty of simulating the collision environment in a test beam. A test beam proposal for this is being developed by the UC London group and should be submitted by end of 2005.
2. Beam-induced EMI (electromagnetic interference). We plan to make measurements to quantify beam-induced EMI along the beamline and near features such as toroids, BPMs and bellows. We plan to measure the EMI frequency spectrum and its dependence on bunch charge and bunch length. EMI standards will be needed for accelerator and detector components in the IR.

3. Bunch length diagnostics. Several groups in the U.S. and UK are studying the possibility of prototype testing of ILC bunch length diagnostics at ESA.
4. BPM test stations. The beamline design is leaving two 1.2m sections to accommodate testing of new BPM designs for ILC.
5. IR Mockup. We are leaving beamline space to accommodate an IR mockup for beamline components within a few meters of the ILC IP. The first parts of this are likely to be the IP bpm test being developed by the UCL "FONT" group and the EMI study, both described above.

Motivation: This program involves both machine and detector physicists, reflecting the close connections in design and performance between the accelerator and experiment. Primary areas of study are collimation, backgrounds, precision energy measurements. It also plays an important role for the test beam program considered by the Worldwide Study on Detector test beams. SLAC's End Station A can be an important test beam facility for ILC and provide a test bed for advanced beam instrumentation, such as BPMs and bunch length diagnostics.

Project Status: We are preparing for 2 experimental runs of ~10-14 day duration each in FY06 and we plan 2 similar future runs in FY07. The first run in FY06 (Stage 1) is planned for ~March 1 and the 2nd FY06 run (Stage 2) is planned for ~July 1. SLAC's accelerator scheduling committee has scheduled us for a 5-day commissioning run Jan. 4-9, 2006 and has tentatively scheduled us for the Stage 1 and Stage 2 runs, dependent on issues with the FFTB schedule. Stage 1 will have a full setup for T-480 (Collimator Wakefield tests), but will not have the chicane and wiggler magnets for the energy spectrometer tests (T-474 and T-475). The magnets will be installed for the Stage 2 run. Stage 1 will include tests of new BPM installation in ESA for T-474 and new BPM processing electronics for it, and also test a prototype detector for T-475. Stage 1 will also include a test of Adolphsen's Linac bpm triplet.

FY05-06 Milestones and Deliverables:

Benchmarks	Date
Safety Overview Committee Review	May 05 (complete)
Physicist spec of Stage 1 beamline	May 05 (complete)
Mechanical designer completes Stage 1 beamline details	August - November 05 (95% complete)
Beamline installation-completion	October - December 05
Safety committee reviews	November – December 05
Commissioning beam test	January 06
1st Beam Test	March 06
Analysis and Reports on 1st Beam Tests	April - June 06
Physicist spec of Stage 2 beamline	December 05 – January 06 (80% complete)
Mechanical designer completes Stage 2 beamline details	February – March 06
4 Chicane magnets and wiggler ready	June 06
Stage 2 beamline installation – completion	April – June 06
Safety committee reviews	May 06
2nd Beam Test	June or July 06
Analysis and Reports on Stage 2 Beam Tests	July - September 06

Key Personnel:
Mike Woods 50% (SLAC) and Ray Arnold 50% (SLAC), project leaders.
Peter Tenenbaum (SLAC) and Nigel Watson (U. of Birmingham, UK), PIs for collimator wakefield test T-480.
Mike Hildreth (U. of Notre Dame), David Miller (University College London, UK), co-PIs for BPM energy spectrometer test T-474.
Eric Torrence (U. of Oregon), PI for Synchrotron Stripe Energy spectrometer test T-475.
Other SLAC support: postdoc 35%, Carsten Hast 40% (End Station A Facility Manager), Zen Szalata 25% (ESA DAQ)

Cost summary:

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
2.0	200		

Expectations for FY07 and beyond:
The work described here will continue in FY07 at the same level.

Total Cost summary for SLAC WBS:

Category 1

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
4.2 FTE	420 + 10	215	1149

Where 10k$ was committed in FY05.

Category 2

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
24.1 FTE	100	1077	4069

Category 3

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
21.7 FTE	1815 + 225 + 200	1115	5959

Where 225k$ was committed in FY05 and 200k$ is to be transferred to LLNL.

Category 5

Labor (K$)	M&S (K$)	Indirect cost (K$)	Total cost (K$)
9.9 FTE	710 + 420	516	2834

Where 420k$ was committed in FY05.