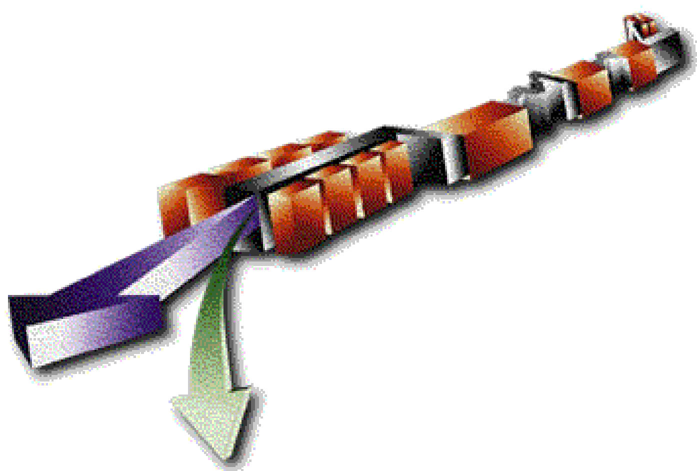
Acquisition Execution Plan
for
The Linac Coherent Light Source
(LCLS)



Stanford Linear Accelerator Center
Stanford, California
For the U.S. Department of Energy

LINAC COHERENT LIGHT SOURCE
ACQUISITION EXECUTION PLAN

I. LCLS Project Background and Objectives

A. Program Description

1. Program Authority and Identification: Director, Office of Science

In accordance with DOE Order 413.3 (Program and Project Management for the Acquisition of Capital Assets), the Director of Office of Science, SC-1, is the Acquisition Executive (AE) for the LCLS project. SC-1 has full responsibility for the planning and execution of LCLS and establishing broad policies and requirements for achieving project goals. Specific responsibilities for the LCLS project include:

- Chair the Energy Systems Acquisition Advisory Board (ESAAB) Equivalent Board.
- Approve Critical Decisions and Level 1 baseline changes.
- Approve the Project Execution Plan.
- Delegate approval authority for Level 2 baseline changes to the Federal Project Manager.
- Conduct Quarterly Project Reviews.
- Ensure formal project reviews are conducted.
- Recommend approval of the Acquisition Execution Plan to the Undersecretary.

2. Statement of Need

The mission of the Office of Science (SC) is "To advance basic research and the instruments of science that are the foundations for DOE's applied missions, a base for U.S. technology innovation, and a source of remarkable insights into our physical and biological world and the nature of matter and energy." The Linac Coherent Light Source (LCLS) project is a unique opportunity for a major advance in carrying out SC's mission.

The Office of Basic Energy Sciences (BES) within the DOE Office of Science currently operates four major synchrotron facilities: the National Synchrotron Light Source (NSLS) at Brookhaven National Laboratory (BNL), the Stanford Synchrotron Radiation Laboratory (SSRL) at the Stanford Linear Accelerator Center (SLAC), the Advanced Light Source (ALS) at Lawrence Berkeley National Laboratory and the Advanced Photon Source (APS) at Argonne National Laboratory (ANL). These four facilities provide world-class x-ray probes of matter to an enormous user community that spans a broad range of the physical and biological sciences. BES is dedicated to the stewardship of the current light sources, as evidenced by the ongoing upgrades to SSRL, and to advancing the state-of-the art in x-ray probes of matter through the development of next-generation sources and instruments.

In the early 1990s, it became clear that the next-generation x-ray light source would be based on a linac-driven, x-ray free electron laser (XFEL). As early as 1992, workshops began to better define the properties of such an XFEL and the science that would be enabled. In 1994, the National Research Council published a study, *Free Electron Lasers and Other Advanced Sources* *of Light, Scientific Research Opportunities* that reached the conclusion that FELs were not competitive with conventional lasers for scientific applications *except* in the x-ray region.

By 1997, SLAC had developed a concept for the LCLS, an XFEL based on the last third of the existing 50 GeV SLAC Linac. The proposed LCLS is truly a next-generation light source with properties vastly exceeding those of current synchrotron sources in three key areas: peak brightness, full spatial coherence, and ultrashort pulses. The peak brightness of the LCLS is some 10 orders of magnitude greater than current synchrotrons, providing 10^{12}-10^{13} x-ray photons at energies from 0.8 to 8 keV in a pulse with duration of 230 femtoseconds.

3. Background

The Basic Energy Sciences Advisory Committee (BESAC) has been actively involved with the development of the next-generation light source and keenly interested in new realms of science to be explored with such an XFEL. In 1997, the BESAC report *DOE Synchrotron Radiation Sources and Science* (known as the Birgenau-Shen Report) recommended funding an R&D program in next-generation light sources and that another BESAC panel be convened to focus on this topic. The result was the 1999 BESAC report *Novel, Coherent Light Sources* (known as the Leone Report). That report concluded:

> "Given currently available knowledge and limited funding resources, the hard x-ray region (8-20 keV or higher) is identified as the most exciting potential area for innovative science. DOE should pursue the development of coherent light source technology in the hard x-ray region as a priority. This technology will most likely take the form of a linac-based free electron laser using self-amplified stimulated emission or some form of seeded stimulated emission…"

In addition, the report observed for the first time that:

> "This is a symbiotic relationship between future accelerator-based sources and high-powered ultrafast lasers. Future light sources will involve a complete marriage of accelerator and laser principles…"

The latter observation had a profound impact on the nature of the development of scientific applications for the LCLS, setting in motion the merging of the community of scientists experienced in x-ray applications at synchrotrons with the community of scientists who use ultrafast lasers in the visible and ultraviolet spectral regions. The former is largely unfamiliar with the use of ultrashort pulses to probe dynamics, and with the interaction of intense radiation with matter, while the latter is largely unfamiliar with the use of x-rays to probe matter. An extensive series of workshops has brought these two communities together to develop the scientific applications of the LCLS and to form the nucleus of a user community.

The Leone Report also recommended the start of an R&D program to explore key issues with regard to the LCLS. Following this recommendation, BES began funding a 4-year LCLS R&D program for the period FY 1999–FY 2002. SLAC and SSRL, in partnership with ANL, BNL, Los Alamos National Laboratory, Lawrence Livermore National Laboratory (LLNL), and the

University of California at Los Angeles, formalized a broad program of R&D to address the technical issues. A Technical Advisory Committee (TAC) and a Scientific Advisory Committee (SAC) were formed by SLAC to review the progress of the R&D program, and each has met regularly.

4. Acquisition Alternatives

Stanford University, which operates SLAC for the Department, is the best choice to serve as the lead contractor for acquisition of the Linac Coherent Light Source. The option for DOE to directly manage and handle all procurements was evaluated and eliminated because it is disallowed by OMB A-76. Another option, rejected by BES, was for DOE to go out for full and open competition for the entire project, including design, material, equipment, and construction. These types of services are contracted out in accordance with OMB A-76. An outside contractor would not be as familiar with the existing SLAC Linac and its support facilities, and more importantly, would not be as motivated to provide the most scientific capability for the available funds. As the future owner and operator of LCLS, it is certainly in Stanford's best interests to deliver a quality product on time and within budget. On the other hand, it is simply not feasible for DOE to directly handle all LCLS procurements because the DOE Stanford Site Office does not have anywhere near the number and types of staff needed and SC does not have the funds to augment the Federal staff on site.

The plan is for all work associated with the LCLS to be managed or performed by SLAC. It is worth noting that LCLS is similar in scope to the recently completed B-Factory project that SLAC successfully managed and executed on the site. As previously mentioned, the LCLS project will make extensive use of accelerator facilities and infrastructure at the SLAC site. These facilities are in continuous shared use for DOE-supported research in high-energy physics and accelerator R&D. The LCLS design must preserve the unique capabilities of the SLAC accelerator complex; furthermore, the LCLS construction project must be managed so as to minimally affect ongoing SLAC programs. By selection of SLAC as the lead contractor for LCLS, DOE ensures that LCLS project activities will be well integrated with ongoing SLAC operations and research

Stanford will collaborate with two national laboratories (ANL and LLNL) to construct the LCLS. This collaboration has been effective during the R&D phase of the project and will continue through the execution phase. ANL will be responsible for the design and fabrication of the undulator magnet system. The LLNL will be responsible for the design and fabrication of the x-ray beam transport and diagnostic systems.

Other national laboratories, such as BNL and ANL, have sufficient space to accommodate an x-ray free-electron laser. The SLAC site is the best choice among alternative sites for the LCLS, because it makes use of a portion of the two-mile linac as the source of a high-quality electron beam for the LCLS free-electron laser. There is no other linac or synchrotron in the world capable of providing a 14 billion electron Volt (GeV) electron beam with properties suitable for the LCLS. Duplication of the SLAC linac facilities to be used for LCLS would cost more than $300 million. Duplication of the core competencies and support staff necessary to operate the linac (required for other programs at SLAC) would incur significant additional annual expenditures beyond the operating cost of the LCLS that would certainly exceed $30 million. The linac facilities will be shared between LCLS and other programs; however, 75 percent of the operations schedule of the linac will be available for LCLS.

At this time there exists no other free-electron laser facility in the world that can approach LCLS capabilities. The LCLS will provide the opportunity to develop critical experimental techniques necessary for exploiting the extraordinary brightness of an x-ray FEL, at a fraction of the cost of constructing and operating a multi-user facility.

A significant component of the LCLS budget as well as technical risk are associated with the undulator magnets that induce oscillatory motion of the electron beam as it passes through the magnets. Undulator magnets have been constructed for light sources and lasers at several laboratories around the world. The US lab with the most recent and comprehensive experience in undulator design and construction is Argonne National Laboratory. Argonne is operated by the University of Chicago under contract with the Department of Energy. Since 1993, the APS has designed, procured and tested over 35 undulators and wiggler magnets, totaling over 80 meters in length. This is to be compared with the required 33 undulators, totaling 112 meters, required for the LCLS. These undulators were designed by APS personnel and procured commercially. Final testing and adjustment were carried out at the APS using its unique facilities. Due to APS experience in undulator magnets, SLAC has collaborated with this laboratory for the LCLS.

Because the LCLS is a source of unprecedented peak x-ray power, the development of optical elements to collimate, focus and filter the beam poses unique challenges. Though it is impossible to create LCLS-like x-ray beams without actually building the LCLS, LLNL has extensive related experience in development of precision high-power optics within its laser programs. Livermore has high-power laser facilities, which can be used for testing materials under conditions approximating the LCLS laser beam. Finally LLNL has already developed the computer simulation codes that can predict the effect of the LCLS beam on materials. For this reason, LLNL will manage the acquisition of x-ray beam handling systems to be put in the path of the x-ray beam. An alternative would be to re-develop this expertise at SLAC, incurring considerable delay and additional expense.

5. Milestones

Critical Decision 0, Approval of Mission Need, was granted by the Director of the Office of Science on June 13, 2001. At that time, the Total Estimated Cost (TEC) range was estimated to be $165 - 225 million with project completion scheduled for early FY 2007. As a result of completing conceptual design, these estimates have been refined (see section I.C below) to reflect a TEC of $200 – 240 million and completion in late FY 2008. The scope has basically remained unchanged.

Based on a Project Engineering and Design (PED) funding profile for FY 2002 – FY 2006 that is contained in the FY 2003 President's Budget Request, the anticipated schedule for the remaining Critical Decisions leading up to construction is as follows:

September 2002 - Critical Decision 1, Approval of Preliminary Baseline Range.

February 2003 – Critical Decision 2a, Approval of Long-Lead Procurement Budget

April 2004 - Critical Decision 2b, Approval of Performance Baseline

2004 – Critical Decision 3a, Approval to Start Long-Lead Procurements

2005 – Critical Decision 3b, Approval to Start Construction

Critical Decisions 2 and 3 are phased for long lead procurement (LLP) items. After CD-2a approval, the LLP budget will be submitted for FY 2005 funding. CD-3a approval will allow budget authority for the LLP items. The undulator and photoinjector will be procured in FY 2005 to reduce the technical and schedule risks for the project. The undulator magnets are highly specialized devices and based on past experience at ANL this item would be the critical path for the LCLS. The photoinjector creates the electrons that will produce the x-ray beam in the undulator. The laser that drives the photoinjector will operate at 120 hertz and at present there is no laser operating at that frequency. Advancing the procurement to FY 2005 will reduce the technical risk by allowing additional time to commission the photoinjector.

B. Applicable Conditions

The laboratories participating in the LCLS construction collaboration are SLAC, ANL, and LLNL. These laboratories have DOE-approved procurement systems and practices. All three laboratories have recent experience in construction of scientific facilities of a scale comparable to the LCLS. There are no significant requirements for compatibility with existing systems or unusual cost, schedule and performance constraints associated with this project.

C. Cost

The scope of the project includes design and construction of modifications to the SLAC Linac, an extension of the Final Focus Test Beam enclosure, two experiment halls including laboratory and office space, and a tunnel to house the beam path between the two halls. As proposed in the FY 2004 PED Project Data Sheet, this project has a preliminary TEC range of $200 - 240 million, and the Total Project Cost is in the range of $245 - 295 million.

At this stage of the project, there is reasonable confidence in these preliminary ranges because they were developed using a bottoms-up approach as part of the conceptual design process. The cost estimate will be further developed during Title I and II design prior to CD-2b.

1. Life-cycle cost

Operating costs of the LCLS, including power and maintenance but excluding programmatic research costs, are estimated to be in the range $25 - 35 million per year in FY 2009 dollars. It is expected that the facility will have a useful operating life of about 30 years.

Any estimate of decommissioning cost is highly dependent upon what assumptions are made about the operation of the SLAC linac for other purposes. Removal and disposal of LCLS-specific hardware from the SLAC linac, undulator hall and LCLS experiment halls would cost less than $30 million in FY 2002 dollars. The new buildings provide office, laboratory and high bay space, with no special decommissioning requirements apart from recycling/disposal of lead shielding. These buildings would likely be re-programmed rather than decommissioned when LCLS operations cease.

There is insufficient excess space at SLAC that could be eliminated to offset the square footage of the two new LCLS experimental halls, which are expected to total 50,000 – 70,000 gross square feet. While a DOE-wide process has yet to be defined for how excess space at other sites might be used to offset the new space associated with projects like LCLS, it is anticipated that SSO and SC would pursue some kind of trade with another site or request a waiver to this requirement.

2. Design-to-cost

The LCLS conceptual design was developed to include systems essential to the initial operation of the x-ray laser as well as additional facilities to accommodate an x-ray experimental program that will grow as the facility matures. As previously stated, based on the conceptual design, the TEC range for the LCLS is $200-240 million. Design-to-cost strategies will be employed to maintain the project baselines for cost, schedule and scope.

3. Application of Should-Cost

The estimated TEC of the LCLS is based on a thorough and well-grounded "bottoms-up" cost analysis of the conceptual design. Contingency in the estimated TEC was also determined by "bottoms-up" assessment of risk in design and fabrication of components and subsystems. For special high-risk items, prototypes have been constructed and tested to provide accurate information on cost and performance. The TEC is largely determined by the cost of systems and components, which are similar to equipment, previously constructed at SLAC and other DOE laboratories participating in LCLS construction.

D. Capability

The LCLS is designed to produce extraordinarily bright pulses of x-ray radiation in the wavelength range 0.15-1.5 nanometers. The radiation produced by the free-electron laser mechanism will be spatially coherent, highly collimated, and tunable. Peak laser power levels of 8 GW will be produced. The project goal for the duration of the laser pulse is 230 femtoseconds, though the facility will be designed with the intent to provide even shorter pulses as operational capability of the facility matures. The LCLS will include two experimental halls, with associated office and laboratory space, where the x-ray beam will be utilized for research in physics, chemistry and biology.

E. Delivery Requirements

A three-year construction schedule has been proposed, with groundbreaking in October 2005 and completion of commissioning in September 2008. PED-funded work is to start in October 2002, making it possible to prepare major solicitations for release as soon as line item construction funding is authorized. A relatively aggressive ramp-up of funding and construction activities is made possible by the cooperation of the three-laboratory collaboration in executing the project.

F. Trade-offs

Acquisition tradeoffs were analyzed in determining the strategy described in this plan. For the most part, the risks associated with the success of the LCLS project are typical of accelerator construction projects, which have been successfully managed by SLAC in the past; SLAC procedures for management of safety, operations, procurement and project management are designed to manage these risks. Certain risks and associated trade-offs specific to the technical challenges of the LCLS are described below.

The design parameters of the LCLS have been chosen as a cost/risk trade-off to reach the design goal of 0.15 nanometer radiation at extraordinary power levels. Technical risks are evaluated in terms of reduced performance of the LCLS as an x-ray source over its specified spectral range. The technical risk element is the performance of the source of electrons at the beginning of the linac. The consequence of a performance shortfall in the injector is reduced power in the free-electron laser output at the short-wavelength end of the LCLS operating range. The consequence level is negligible for laser operation over the wavelength range 1.5-0.2 nanometer, and marginal to significant for wavelengths in the range 0.2-0.15 nanometer. This risk can be mitigated by increasing the maximum energy of the electron beam in the LCLS, or by lengthening the undulator channel. The most efficient means of risk mitigation here is to provide space for lengthening the undulator channel, while deferring a commitment to procure a longer undulator.

The design parameters for the LCLS were based on aggressive but realistic assessments of electron source performance measured at several laboratories around the world. The length of the undulator hall was determined based on assessment of "worst case" estimates of technical risks in electron beam injector performance. The length of the hall would allow the installation of a 150-meter undulator channel. The total length of the undulators to be procured, 112 meters, was based on a more realistic (less pessimistic) prediction of linac performance. In this way, some technical risk is ventured in exchange for speedy and economical delivery of the world's first x-ray free-electron laser.

G. Risk

The risks associated with this project and acquisition strategy are deemed to be acceptable. Continuing R&D efforts in theoretical and experimental free-electron laser physics, and optics development will minimize the technical risks. The design and construction of the experimental halls are straightforward. SLAC and the partnering laboratories have DOE-approved procurement systems with established processes for selecting A/E, general contractors, and technical equipment vendors.

The following is a brief description of the risks associated with the LCLS Project, broken down into eight categories. In general, the risks are very similar to those associated with other projects that have been successfully completed at SLAC, such as the PEP-II B-Factory. SLAC has well-developed technical expertise and management systems to control LCLS Project risks.

Safety: A Preliminary Hazard Analysis has been carried out which itemizes the hazards anticipated during LCLS construction. For each hazard, applicable SLAC and DOE standards and practices for Integrated Safety Management have been identified. The LCLS Operating and Safety Envelopes will be well within the Safety Envelope for the SLAC linac. With proper management, safety risk levels for LCLS will be low[1].

Environment: A NEPA Environmental Assessment has been carried out. No significant environmental impact is expected as a result of the construction and operation of the LCLS. With proper management, environmental risk levels for LCLS will be low.

Disposition: The components and subsystems of the LCLS are very similar to those of the SLAC linac; activation of accelerator components by the electron beam is minimal, and disposition of accelerator hardware can follow standard SLAC procedures. Likewise, chemical and mechanical hazards are of a scale and character that may be managed using standard SLAC policies and practices. Disposition risk levels for LCLS will be low.

Support: Based on the presently proposed schedule, the LCLS will be the only hard x-ray laser research facility in the world for 3-4 years. Modification of the funding profile may be considered unlikely (probability between 0.1 and 0.4), while consequence could range from negligible to significant. The overall risk factor will range from low to moderate.

Procurement: For the most part, LCLS procurement activities will be very similar to other projects managed by the Office of Science. Properly managed, risk levels may be considered low. The highest-risk procurement will be the undulators, a set of high-precision permanent magnets that will induce an electron beam to emit the x-ray beam. At present, there are very few qualified vendors worldwide for some of the raw materials and for the assembly of these undulator magnets to the necessary performance specification. Technical, schedule and procurement risk consequences for the undulators could be significant if not properly handled, with moderate overall risk level. To mitigate this risk, the LCLS Project team includes the APS Division at ANL who has recent experience in design, procurement and quality assurance for undulator magnets that meet LCLS specification. A prototype undulator has been constructed to LCLS specification by ANL. Based on knowledge gained in testing this prototype, this procurement can have a low risk level.

Programmatic: The LCLS is designed to operate over the wavelength range 1.5 – 0.15 nanometers. Achievement of specified performance at the short-wavelength end of the spectrum (below 0.2 nanometers) is most challenging in terms of the quality of the electron beam required. In the worst case, however, the peak brightness of the LCLS will be 10^8 times greater than any

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[1] Terms used to characterize risk probabilities, risk consequences, and overall risk factors are based on Figure 8-5, Table 8-7and Table 8-8 of <u>Program and Project Management Practices</u>, Chapter 8 (10/01/00)

existing x-ray source at the shortest wavelength. The LCLS facility is designed to allow extension of the undulator channel to recover full performance at 0.15 nanometers, if necessary. Without the option to extend the undulator channel, the probability of failure to achieve specified performance at 0.2 nanometer is very unlikely, while the probability of failure to achieve specified performance at 0.15 nanometers is unlikely. The consequence of failure to achieve specified brightness at 0.15 nanometers ranges from negligible to significant, depending on the specific needs of experiments envisioned for the LCLS. Preservation of the ability to lengthen the undulator channel converts the programmatic risk to a cost risk in the range of 5% of TEC. In this way the programmatic risk level for the LCLS is reduced to low levels.

Programmatic risk for x-ray optics is greatest at the long-wavelength end of the spectrum, where the intensity of the LCLS x-ray beam could damage conventional optics. For this reason, the project scope includes an experiment hall located nearly 300 meters from the x-ray source. The power density of the x-ray beam in this hall is low enough to allow use of conventional x-ray optics. The physical processes that would lead to damage of x-ray optics designed for the LCLS is of great scientific interest, and the study of these processes is an important part of the LCLS scientific mission. The LCLS includes an experiment hall located as close as possible to the x-ray source, where such processes may be studied most effectively.

Cost: The LCLS cost estimate, at the conceptual design stage, was developed to include a 30% contingency and several design-to-cost options that are consistent with successful achievement of the facility mission. The cost to extend the undulator channel, mentioned above, is approximately 5% of the TEC. The cost estimate will be refined as Title I and II design is completed, resulting in a greater confidence in the actual cost for the LCLS. The LCLS project has been planned to maintain a low risk level for cost.

Schedule: The majority of LCLS project activities can be planned to achieve low risk levels for schedule, with proven and DOE-approved management policies and procedures. The procurement of undulator magnets requires special attention however, and has been identified for long-lead procurement in FY2005, one year before the start of the LCLS construction project. With a FY2005 start, undulator deliveries can be completed one year before the start of operations, planned for FY2009. Commissioning of the electron beam can begin in 2006, and commissioning of the free-electron laser can proceed throughout 2008. Based on commissioning results, an extension of the undulator channel can be planned and completed before the end of the LCLS Project in October 2008.

Technical risk factors related to the performance of the electron source and the undulator magnets have been reduced as a result of focused R&D efforts since 1999. The facility is designed to allow straightforward extension of the undulator systems, making it possible to re-configure or expand the FEL for seeding or other configurations. A risk assessment for the project will be done as part of the planning for LCLS acquisitions in compliance with the DOE Order 413.3 and SC project management procedures.

H. Acquisition Streamlining

The collaborating institutions bring their unique core competencies to bear on LCLS construction. ANL, LLNL, and SLAC have well-developed project management capability. All three laboratories have DOE-approved procurement systems in place, and all three have recent experience in multi-laboratory construction collaborations.

Commercial and best business practices, and DOE approved purchasing systems will be used to accomplish all procurements. Partner laboratories will prepare advance procurement plans for key acquisitions, to be submitted to LCLS Management for approval.

Evaluation criteria will be chosen to best fit the technical and cost requirements of procurements based on past project management experiences at the partner laboratories. Firm fixed-price evaluation strategies will be used in most instances. Technical pre-qualification of offerors will be implemented as appropriate. Vendor qualification assessment will be accomplished by review of recent performance, inspection of vendor facilities, capabilities and quality control procedures, and (if appropriate) inspection of work samples. Single-source procurements may be necessary for certain components, such as magnetized neodymium-iron-boron blocks and certain optical components; at this time only one vendor has proven capability to produce these blocks to meet LCLS specification.

II. Plan of Action

A. Sources

The components and subsystems required for LCLS construction are generally similar to those required for the PEP-II and SPEAR-III projects at SLAC. Experience in these projects has shown that, in most cases, several qualified sources can be identified for most components and subsystems. Certain critical procurements such as permanent magnet materials will require technical pre-qualification of offerors. The undulator magnets are highly specialized devices for which only a small number of qualified commercial suppliers exist worldwide. Many laboratories in the U.S. and Europe have chosen to assemble these magnets in-house rather than developing a commercial source. Based upon Argonne's recent commercial procurement of undulator magnets, it is expected that, for LCLS, a commercial source will be sought for assembly of ANL-designed undulators.

Any large business firms awarded contracts on LCLS will be required to submit small business subcontracting plans as required ($0.5 million for supplies and equipment, $1 million or more for construction).

B. Competition

LCLS procurements will, to the maximum degree possible, be conducted under full and open competition. The project will optimize the participation of industry and make selections based on a best value evaluation under the constraints of technical, cost and schedule performance. Certain critical procurements will utilize a "lowest-price technically acceptable source" selection process for pre-qualification of vendors to minimize risk to the project. All will be accomplished using DOE-approved procurement procedures, emphasizing best business practices. To reduce schedule risk, multiple awards may be made for assembly of undulators. At this time, however, there is only one known commercial vendor qualified for undulator assembly. LCLS will explore alternative means of reducing schedule risk, perhaps by advance procurement of raw materials for the undulator prior to award of a contract for undulator assembly.

Based upon current market research, competition is unlikely for the highly specialized components such as magnet material, due to particularly significant technical risks associated with quality control in these deliverables. Prior to a Request for Proposal, every effort will be made to identify additional qualified offerors for such components. Technical qualification standards for candidate vendors will be developed for these procurements in FY 2003-2004. All qualifying vendors will be encouraged to bid. ANL will manage these procurements.

C. Source Selection Procedures

Source selection will be carried out in accordance with DOE-approved policies and procedures in effect at the responsible partner laboratory. Acquisition strategies will be chosen to obtain best value based on assessment of technical and cost risks on a case-by-case basis. Based on past project management experience at the partner laboratories, it is expected that, in most cases, LCLS Project needs will be met with selections by lowest price/technically acceptable evaluation or by best value. Application of this strategy for the LCLS will be done in accordance with the Federal Acquisition Regulation 15.101-2.

ANL has had excellent experience in applying a tradeoff process in selecting a source for undulator construction. The selection of vendor for undulators during the successful APS Project was carried out as a "best value source selection with technical criteria having greater weight than price". This strategy is prudent for acquisitions with a dominant component of technical risk. A tradeoff selection strategy will be applied to similar high-risk LCLS procurements in accordance with Federal Acquisition Regulation (15.101-1).

LCLS Project Management will identify major procurement items during the design and construction phases to ensure adequate lead time. An advanced procurement plan (APP) will be prepared for each major item. The APP will include discussion of the contract type; special contracting methods, e.g. "firm fixed-price", "lowest-price technically acceptable source"; special clauses or deviations required; determination of best value usage; and lease or purchase decisions. The APPs will be signed off by the LCLS Project Director, SLAC Procurement Manager, Federal Project Manager, and SSO Contracting Officer.

Source selection procedures will vary based on the acquisition process for each particular piece of LCLS, as described below:

- Title I, II, and III for the experiment halls and connecting tunnel of LCLS will be full and open procurements to pre-qualified offerors using standard SLAC procedures for solicitations ("Request For Proposals" and "Request For Quotations") of Architect and Engineering (A/E) services and construction subcontracts. SLAC has had recent satisfactory results with firm fixed-price contract awards for conventional construction at the SLAC site. A qualified A/E firm will be selected to perform Title I/Title II design. A qualified general contractor will be selected to facilitate the major conventional facilities components such as the experimental halls and the tunnel.

At present it is expected that undulator assembly will be awarded, by competitive bid, to multiple vendors who have met technical pre-qualification requirements. As stated earlier, the number of pre-qualified offerors is expected to be one or more, and recent history shows that several laboratories have found it necessary to build undulator magnets in-house to reduce technical risk. This is not a particularly attractive solution for LCLS because of the large volume of work involved. LCLS Project Management will explore means by which the risk perceived by potential vendors may be reduced in a cost-effective way so as to attract more bids from qualified sources. Such means may include requests for bids on construction to specified design and procedure rather than construction to a performance specification. It will be possible to identify more qualified vendors for undulator assembly if the responsibility for quality control of undulator magnet production were to be borne by LCLS Project personnel at Argonne and SLAC. This is feasible because correction of the most likely manufacturing problems is straightforward, if comprehensive and accurate magnetic field measurements are carried out on each magnet. The expertise and infrastructure required to perform such measurements is not readily available in industry. However SLAC and Argonne will have the capability to measure and correct the undulator magnets.

- Specialized x-ray optics for the LCLS pose special challenges. They are required in very low volume, and their fabrication will test the limits of the state-of-the-art. In some instances commercial procurement may be appropriate; however it may prove necessary for the project to make rather than buy certain x-ray optics components within the LCLS project or in partnership with another nonprofit research facility because outside vendors may not have the expertise to build these components. In this case, DOE approved make or buy procedures will be applied.

- Many of the low-volume or one-of-a-kind particle accelerator systems will be assembled at the partner laboratories from commercially available components and subsystems obtained through competitive procurements. These components will be assembled and integrated into systems by the LCLS partner laboratories. This approach has proven most effective in construction of research facilities at the national laboratories. It also maintains compatibility and interchangeability with existing hardware in the SLAC linac, and therefore minimizes maintenance costs.

- At this time, only one known vendor can meet the project-specific technical specifications for the magnetized material and it may be necessary to consider sole-source procurement of magnetized material for the undulators

D. Contracting

The partner laboratories responsible for the LCLS Project have well-developed systems for contract management that follow DOE-approved policies and procedures. Each partner laboratory will follow its own approved solicitation and contracting procedures to enter into and manage contracts in its assigned area of responsibility.

In most cases, fixed-price contracts on the basis of best value will be awarded for procurement of materials and services.

For certain activities such as installation of technical components, SLAC experience with carefully monitored fixed-rate contracts has been satisfactory. Therefore it is anticipated that, when circumstances dictate, the LCLS project will acquire a limited amount of installation labor and materials under "fixed price, time and material" contracts.

Two major procurements have been identified at this stage of the project. They are the design and construction of the experimental halls and the fabrication of the undulator magnets. Additional procurements may be identified during Title I and II design. These procurements will be evaluated on the basis of best value and acquisition strategies will be developed as part of preparing the Advanced Acquisition Plans.

1. A qualified Architect and Engineering (A/E) firm will be selected to carry out Title I/Title II design. A qualified general contractor will be selected to facilitate the major conventional facilities components such as the experimental halls and the tunnel. Full and open solicitations to pre-qualified offerors using standard SLAC procedures for solicitations ("Request For Proposals" and "Request For Quotations") of A/E services and construction subcontracts. SLAC has had recent satisfactory results with firm fixed-price contract awards.

2. At present it is expected that undulator assembly may be awarded, by competitive bid, to multiple vendors who have met technical pre-qualification requirements.

SLAC-designated University Technical Representatives (UTRs) will provide management oversight of contracts for design and construction of conventional facilities. For some work packages such as modifications to existing buildings, the UTRs will directly manage the work of subcontractors and/or in-house personnel. For the experiment halls and connecting tunnel, the UTRs will oversee the activities of the general contractor.

E. Budgeting and Funding

Funding requirements are outlined in the current PED Project Data Sheet. The preliminary Total Project Cost (TPC) range contained in the FY 2004 PED Project Data Sheet is $245 - 295 million and the preliminary TEC range is $200 - 240 million. The project schedule and milestone dates will be based on receiving project funds that are detailed in the annual submission of the Project Data Sheet. The approved PED funding profile is shown below in Table 1. The complete TPC/TEC funding profile will be established with the approval of Critical Decision 2. Other

Project Costs (OPC) in FY 2002 – 2005 are for the R&D program and development of the Conceptual Design Report.

Table 1
PED Budget Authority Profile
(in $K)

Fiscal Year	Project Engineering and Design	Other Project Costs	Total Project Funding
2002		1,500	1,500
2003	6,000		6,000
2004	15,000	4,000	19,000
2005	10,000	4,000	14,000
2006	2,500		2,500
Total	33,500	9,500	43,000

F. Product Description

The physical facilities comprising the Linac Coherent Light Source are:

- An injector linac located adjacent to sector 20 of the Two-Mile Accelerator
  - A laser system to illuminate the RF gun cathode
  - A linear accelerator providing 150 MeV electrons to the main linac
- Modifications to the Two-Mile Accelerator
  - A bunch compressor system (BC-1) downstream of the injector linac
  - A bunch compressor system (BC-2) at the 4.5 GeV point in the main linac
  - A reconfigured "dogleg" beam transport line downstream of the linac
- Modifications to the Final Focus Test Beam (FFTB) facility
  - A re-configuration and extension of the existing FFTB tunnel
  - A system of undulator magnets in the FFTB, to produce an x-ray beam
- Facilities for the conduct of experiments using the x-ray beam
  - A new experiment hall (the Near Hall) in the Research Yard Area
  - A new experiment hall (the Far Hall), 200 meters beyond the Near Hall
  - A tunnel connecting the two halls
  - Experimental facilities necessary for safe use of the x-ray beam

The programmatic purpose of the LCLS is to create the first "hard" x-ray laser in the world, for use in research supporting the mission of the DOE Office of Science.

G. Priorities, Allocations, and Allotments

There are no unique priorities, allocations or allotments associated with procuring the LCLS.

H. Contractor vs. Government Performance

SC has evaluated the option of handling the LCLS acquisition itself through its Stanford Site Office (SSO), and found that it would be more practical for the SLAC M&O contractor to do the work. The main reasons for this choice are that:

- The DOE SSO does not have the staff (numbers of people or expertise) needed to manage the design and construction of the facility and handle all the procurements. In addition, SC does not have the Program Direction funds to add the necessary staff at SSO.
- The SLAC site is owned by Stanford University and leased to DOE.
- SLAC has a vested interest in obtaining the best possible facility for the available funds.
- SLAC will be the operator of this scientific user facility and their staff will be conducting some of the research once it has been built. Hence, they must be directly involved throughout the design and construction process.

All work associated with the LCLS will be performed by contractor personnel. This is in accordance with OMB Circular A-76, Performance of Commercial Activities.

I. Inherently Governmental Functions

None of the project functions described in this AEP are inherently governmental functions, as described in the FAR 7 .503.

J. Management Information Requirements

LCLS Project will comply with the Contractor Requirement section of DOE Order *413.3 Program and Project Management for the Acquisition of Capital Assets*, at the frequency and intervals required by the order and the Federal Project Manager. The LCLS Project will use earned value reporting, track and report costs by Work Breakdown Structure, and provide progress schedules to measure performance. Also, Project Assessment and Reporting System (PARS) requirements will be met.

K. Make or Buy

"Make or buy" decisions for work assigned to the responsibility of one of the partner laboratories will conform to make/buy policy in place at that laboratory. Within the limits of each partner laboratory policy, make-or-buy decisions are subject to approval by LCLS Project Management.

L. Test and Evaluation

Standard construction acceptance processes will be used for any test and evaluation considerations for LCLS conventional facilities. Criteria that follow established industry practices will be developed for acceptance testing of all accelerator components and subsystems. Performance specifications, test criteria and testing procedures for these systems will be based on those of comparable systems developed and proven in the PEP-II B-Factory Project and the Stanford Linear Collider Project.

M. Logistic Considerations

Unique logistical considerations are not currently foreseen for the LCLS. Delivery of highly technical, one-of-a-kind equipment items may require close scrutiny to ensure project objectives are met.

N. Government-Furnished Property

The project intends to procure the raw magnetic material for the undulators and provide it directly to the undulator fabrication vendor as Government-Furnished Property. Since the undulator is an area of higher schedule risk, the plan is to initiate the procurement of this raw material and the selection of the fabrication vendor concurrently. This strategy would tend to reduce the schedule for undulator fabrication. The milestone for initiating the procurement of the raw magnetic material falls in the first quarter of FY 2005.

O. Government-Furnished Information

Solicitations will provide relevant specifications and references to applicable safety and documentation requirements required under the M&O contract between the Department of Energy and Stanford University. All offerors will receive the same information. This will be accomplished using DOE-approved procurement practices and procedures required by the participating laboratories.

P. Environmental and Energy Conservation Objectives

All work done on the LCLS will be in accordance with applicable Federal, state and local guidelines for environmental objectives. An Environmental Assessment will be prepared to evaluate the environmental impacts of the LCLS project. Additionally, energy conservation objectives are outlined in specification and drawing requirements, and comply with 10 CFR 435 (Energy Conservation requirements), and Executive Order 13101, Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition.

The conventional facilities will be designed and constructed to meet energy conservation performance standards. The analysis will be conducted during Titles I and II design phases to comply with California Title 24 and 10 CFR, Part 435.

Sustainable building design principles will be applied to the siting, design, and construction of the experimental halls. Standard practices, including the use of recycled material, purchase of energy-efficient and water-efficient equipment, and substitution of less hazardous materials will be utilized as much as practical.

All acquisition and construction activities will conform to the Environment, Safety and Health policies and procedures of each laboratory.

Q. Security Considerations

Normal security requirements will exist for LCLS activity, and access to and from the LCLS job site will be controlled appropriately. No aspect of LCLS, during construction and subsequently during operation, is classified.

R. Contract Administration

Surveillance of the LCLS work will be done at three basic levels. First, the Federal Project Manager will monitor and evaluate LCLS Project performance against technical, cost, and schedule baselines through monthly coordination meetings, quarterly performance project reviews, and in-depth reviews. Environment, safety and health performance will also be monitored by conducting periodic field observations, using subject matter experts as necessary. Second, SLAC has overall day-to-day project management responsibility, including monitoring progress on construction contracts to ensure that PED and construction work is proceeding as planned. Subject to oversight and approval by LCLS Project management at SLAC, the partner laboratories will award and administer contracts to ensure the timely and cost effective delivery of systems to enable full LCLS research operations on schedule. Lastly, the construction manager selected for conventional facilities will be responsible to monitor and evaluate the progress of construction contracts.

S. Other Considerations

There are no other significant considerations associated with the LCLS work.

T. Milestones for the Acquisition Cycle

The preliminary milestone schedule for major contracts is indicated below. Final milestones will be developed during Title I and II design and the milestones will be approved as part of Critical Decision 2b.

Acquisition Execution Plan Approval	4th Quarter FY 2002
Experimental Halls A/E Bid Solicitation (Title I and II)	1st Quarter FY 2004
Long Lead Items Bid Solicitations (Undulator, Injector)	1st Quarter FY 2005
Near Experimental Hall Construction Bid Solicitation	2nd Quarter FY 2006
Far Experimental Hall Construction Bid Solicitation	2nd Quarter FY 2007

U. Integrated Project Team

Key members of the Integrated Project Team (IPT) and their roles and responsibilities are as follows. All members of the IPT participated in the development of this plan.

John Galayda – SLAC LCLS Project Director. The Project Director has overall authority and responsibility to DOE for project execution.

Lowell Klaisner – SLAC LCLS Chief Engineer. The Chief Engineer has overall responsibilities for all aspects of the engineering effort for the LCLS project.

Bob Todaro – SLAC Procurement Officer. The Procurement Officer has overall authority and responsibility for the SLAC procurement system.

Jeff Hoy – DOE LCLS Program Manager. The Program Manager has responsibility for the day-to-day program management of the LCLS project.

Hanley Lee – DOE Federal Project Manager. The Federal Project Manager will provide overall project management oversight, issue work authorizations, provide necessary funds, submit key project documents to support critical decisions, report project progress, and assess SLAC project execution performance.

Tyndal Lindler – DOE Contracting Officer. The Contracting Officer provides oversight of the management and operating contract with Stanford University.

Galvin Brown – DOE Budget Officer. The Budget Officer provides guidance and direction for budget formulation for the project. Initiates contract modifications for placing LCLS project funds into the SLAC contract.

Patrick Burke – DOE Attorney. The Attorney provides legal support to the Integrated Project Team on issues related to the LCLS project.

Ralph Kopenhaver – DOE ES&H Director. The ES&H Director provides subject matter experts in all areas of environment, safety and health to the IPT. Expert ES&H oversight is provided by the ES&H Division staff throughout the project.

Additional support will be provided by SLAC, SSO and Oakland Operations Office staff in all functional areas on an as needed basis to support the IPT.

CONCURRENCES:

_______________________________________ Date:_______________
Tyndal L. Lindler
Contracting Officer, Stanford Site Office

_______________________________________ Date:_______________
Hanley W. Lee,
LCLS Federal Project Manager
Stanford Site Office

_______________________________________ Date:_______________
John S. Muhlestein
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Patricia M. Dehmer
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Raymond L. Orbach
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James A. Rispoli
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APPROVED:

_______________________________________ Date:_______________
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Under Secretary for Energy, Science and Environment