Critical Decision 2a
Approval of Long Lead Procurement Budget
for the
Linac Coherent Light Source
at the Stanford Linear Accelerator Center

Office of Basic Energy Sciences
Office of Science

A. Purpose

The purpose of this paper is to document the review by the Office of Science Energy Systems Acquisition Advisory Board-equivalent for Critical Decision 2a (CD-2a), "Approval of Long Lead Procurement Budget" for the Linac Coherent Light Source (LCLS) project at the Stanford Linear Accelerator Center (SLAC).

B. Mission Need

The mission of the Office of Science 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 that mission.

The LCLS will be the world's first x-ray free electron laser (XFEL), serving as a research and development center for XFEL physics in the hard x-ray regime and as a facility for the application of XFEL radiation to experimental science.

The LCLS will be a source of coherent x-radiation with unprecedented intensity and pulse duration. It is based on the SLAC linac, which can accelerate electrons or positrons to 50 billion electron Volts (GeV).

The LCLS will be the first XFEL in the world operating in the 1.5 - 15 Å wavelength range utilizing the first harmonic of the undulator (shorter wavelengths are possible using higher harmonics). The emitted coherent x-rays will have unprecedented brightness with 10^{12} - 10^{13} photons/pulse in a 0.2 - 0.4% energy bandpass and an unprecedented time structure with a design pulse length of 230 femtoseconds.

The unique characteristics of the LCLS will open new realms of scientific applications in the chemical, materials, and biological sciences. The first experiments fall into two classes. The first follows the traditional role of x-rays to probe matter without modifying it while the second utilizes the phenomenal intensity of the LCLS to excite matter in fundamentally new ways and to create new states in extreme conditions.

C. LCLS Project

The LCLS project will build an XFEL facility at SLAC based on the existing linac. The LCLS requires a new 150 MeV injector to be built at Sector 20 of the 30-sector SLAC Linac to create the high brightness electron beam required for the XFEL. The last kilometer of the linac will be modified by adding two magnetic bunch compressors. Most of the linac, and its infrastructure, will not be changed. The existing components in the Final Focus Test Beam tunnel will be removed and replaced by a new 120 meter undulator and associated equipment. Two new experimental halls (50,000 – 70,000 gross square feet total) will be constructed. The single story Near Hall will be built approximately 40 meters downstream of the Undulator Hall. The Far Hall will be built approximately 300 meters downstream of the Undulator Hall. The two-story Far Hall will accommodate office and laboratory areas on the second floor. Provisions will be made for housing instrumentation and controls for the initial experiments.

D. LCLS Long Lead Procurement (LLP) Scope

The scope for critical decision 2a will be procurement of the injector system, undulator hardware, and several linac components. These components were selected for long lead procurement to mitigate risks identified during the R&D and conceptual design phases.

The specific components for long lead procurement include the following:

Injector system – drive laser, laser room, and main mechanical systems
Undulator system - magnet blocks, magnet poles, strongback, and magnetic measurement system
Linac system – superconducting wriggler, x-band RF system, and chicane magnets

E. LCLS LLP Cost and Schedule

Based on the conceptual and preliminary designs for the long lead procurement items, the cost is estimated to be $29.9 million. The funding profile for R&D, Project Engineering and Design (PED) and LLP funds for the LCLS is as follows:

Fiscal Year	Project Engineering and Design	Other Project Costs	Long Lead Procurement	Total Project Funding
2002		1,500		1,500
2003	6,000			6,000
2004	7,500	2,000		9,500
2005	20,000	4,000	29,900	53,900
2006	2,500			2,500
Total	36,000	7,500	29,900	73,400

Note: The Total Project Cost range for the LCLS project is $245M – 295M. The profile shown above does not include full construction and pre-operations funds.

The current project schedule is as follows:

CD-0	Approve Mission Need	June 13, 2001
CD-1	Approve Preliminary Baseline Range	October 16, 2002
CD-2a	Approve Long-Lead Procurement Budget	May 2003
CD-2b	Approve Performance Baseline	April 2004
CD-3a	Approve Start of Long-Lead Procurements	August 2004
	Authorize Long-Lead Procurement Funds	October 2004
CD-3b	Approve Start of Construction	2005
	Authorize Construction Funds	2005
CD-4	Approve Start of Operations	2008

F. Acquisition Execution Plan

The Acquisition Execution Plan was approved by the Under Secretary on October 16, 2002. The acquisition of the LCLS will be conducted through Stanford University - SLAC as a prime contractor. The LCLS project, in close cooperation with SLAC's Technical and Stanford Synchrotron Radiation Laboratory Divisions, will be responsible for accomplishing the project under the terms of Stanford University's M&O contract with the Department of Energy. SLAC will execute those parts of the project associated with conventional facilities and the acceleration and control of the electrons as well as overall system integration and management. The Advanced Photon Source Division at ANL will design and fabricate the undulator and associated systems. The Physics and Advanced Technologies Directorate at LLNL will design, fabricate, qualify, and commission the front-end x-ray optics. Project management at SLAC will control work at these laboratories in accordance with the Preliminary Project Execution Plan.

Project activities will be accomplished to the extent feasible using fixed-priced subcontractors competitively selected by SLAC and the collaborating laboratories on the basis of best value, price and other factors.

G. Environmental Strategy

The LCLS will be designed, constructed and operated in compliance with all requirements of the National Environmental Protection Act (NEPA) and its implementing regulations. Design, construction and operation activities have been evaluated in the NEPA Environmental Assessment (EA1426) for the LCLS Project. A Finding of No Significant Impact was issued on February 28, 2003.

H. Preliminary Hazard Analysis

A preliminary hazard screening for the LCLS facility was conducted in June 2002. The purpose was to identify potential hazards associated with the design, fabrication, construction, and testing phases the project. This assessment concluded that the LCLS requirements are well within existing safety and operating envelopes, the risks of all hazards will be similar in nature and magnitude to those already found in the present accelerator and synchrotron radiation programs, and the hazard impact will have only the potential for minor on-site and negligible off-site

impacts to people or the environment. The project will evaluate hazards and develop controls for the operation and research activities during the development of the Safety Assessment Document.

I. Energy Conservation and Sustainable Design

Sustainable building design principles will be applied to the siting, design, and construction of the LCLS conventional facilities. Additionally, standard practices, including the use of recycled material, the purchase of energy-efficient and water-efficient equipment, and substitution of less hazardous input materials, will be utilized. Project waste disposal and recycling requirements will be incorporated into the project procurement documents.

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.

Submitted by:

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Recommendations

The undersigned "Do Recommend" (Yes) or "Do Not Recommend" (No) approval of CD-2a, Approval of Long Lead Procurement Budget, for the Linac Coherent Light Source at SLAC as noted below.

ESAAB Secretariat, Construction Mgmt Support Division	7/1/2003 Date	Yes____	No____
Representative, Non-Proponent SC Program Office	7/1/03 Date	Yes ✓	No____
Representative, Financial Mgmt. Division	7/1/03 Date	Yes ✓	No____
Representative, Environmental, Safety and Health Division	7/1/03 Date	Yes ✓	No____
Representative, Security Mgmt. Team	Date	Yes____	No____
Representative, Laboratory Infrastructure Division	7/1/03 Date	Yes ✓	No____
Representative, Grants and Contracts Division	Date	Yes____	No____

Approval

Based on the material presented above and at this review, Critical Decision-2a, Long Lead Procurement Budget, is approved. Therefore, the Office of Basic Energy Sciences may submit a FY2005 budget request for the long lead procurement items for the Linac Coherent Light Source at the Stanford Linear Accelerator Center.

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7/2/03
Date