Project Execution Plan
for the
Linac Coherent Light Source

Stanford Linear Accelerator Center
for the Department of Energy

Revision 1

Approval

Department of Energy

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Revision Record

	Description	Date
Revision 0	Preliminary Project Execution Plan for Approval of Preliminary Baseline (CD-1)	Sept 2002
Update	Updated PPEP for Approval of Long Lead Procurement Budget (CD-2a)	June 2003
Revision 1	Revised Project Execution Plan for Approval of Performance Baseline (CD-2b)	August 2004

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1. INTRODUCTION

1.1 Overview

The purpose of the Linac Coherent Light Source (LCLS) project is to provide laser radiation in the x-ray region of the spectrum that is 10 billion times greater in peak power and peak brightness than any existing x-ray light source. This advance in brightness is similar to that of a synchrotron over a 1960's laboratory x-ray tube. Synchrotron light sources have revolutionized science across disciplines ranging from atomic physics to structural biology. Advances from the LCLS are expected to be equally dramatic. The LCLS will provide the world's first demonstration of an x-ray free-electron-laser (XFEL) in the 1.5 – 15 Δ range and will apply these extraordinary, high-brightness x-rays to a unique set of scientific problems. The LCLS project is organized as a three-laboratory partnership, led by SLAC that includes Argonne and Lawrence Livermore National Laboratories (ANL and LLNL). This will capitalize on each laboratory's technical strengths: SLAC – accelerators; ANL – undulators; and LLNL – x-ray optics.

1.2 Purpose

The LCLS Project Execution Plan (PEP) provides an overview of the roles, responsibilities and management interactions between the Department of Energy (DOE) and the Stanford Linear Accelerator Center in executing the LCLS project. The PEP was prepared in accordance with DOE Manual 413.3-1, *Project Management for the Acquisition of Capital Assets.* In accordance with DOE Manual 413.3-1, the LCLS is subject to the requirements specified for "Other Projects". The Director, Office of Science (SC-1) is the Acquisition Executive (AE) as delegated in memorandum from Under Secretary to Director, Office of Science, dated April 11, 2003.

This PEP documents plans for the design, fabrication, construction and pre-operational phases of the project. It establishes the underlying principles for managing LCLS, provides details related to project authority, approval and funding; as well as the details of management structure, organization and project baselines for cost, schedule, and technical scope.

1.3 Approval and Revisions

Approval of the PEP occurs as an element of Critical Decision 2b (CD-2b) Approval of Performance Baseline. As the AE, SC-1 is the approval authority for the PEP. The PEP will be reviewed annually and updated as necessary to incorporate other changes as required.

2. MISSION NEED AND JUSTIFICATION

The mission of the Department's 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." In turn, SC's Office of Basic Energy Sciences

(BES) is charged with planning, constructing, and operating user facilities to provide special scientific and research capabilities to serve the needs of U.S. universities, industry, and Federal laboratories.

The mission of SLAC is to advance the understanding of the fundamental nature of matter and energy by providing leadership and resources for qualified researchers to probe the structure of matter at the atomic scale with x-rays and at much smaller scales with electron and positron beams. The B-factory utilizes the first two thirds of the linear accelerator to provide electron and positron beams for collisions in the BaBar detector to study the imbalance between matter and anti-matter. This program is supported by the Office of High Energy Physics.

The Stanford Synchrotron Radiation Laboratory (SSRL), a division of SLAC, provides synchrotron radiation from the SPEAR storage ring as well as ancillary equipment. The facility, which comprises 24 experimental stations, is used each year by over one thousand researchers from industry, other government laboratories, and universities including astronomers, biologists, chemical engineers, chemists, electrical engineers, environmental scientists, geologists, material scientists, and physicists. The LCLS project will expand the capabilities at SSRL with a new x-ray free electron laser (XFEL).

2.1 Mission Need

The LCLS will serve as a research and development center for XFEL physics in the hard x-ray regime and as a scientific user facility for the application of XFEL radiation to experimental science. The LCLS is a high priority for the Office of Science as described in the "*Facilities for the Future of Science: A Twenty-Year Outlook"*. The LCLS ranked third in near term priorities. A full description of how the LCLS Project furthers the mission of SLAC and the mission of the Department of Energy, Office of Science is found in the LCLS Justification of Mission Need (CD-0) document approved in June 2001, the *"Facilities for the Future of Science: A Twenty-Year Outlook"* and the Office of Science Strategic Plan, February 2004.

2.2 Project Goals

The LCLS will be located within the SLAC complex as shown in Figure 1. Figure 2 and 3 shows the above and below grade conventional facilities and figure 4 shows a conceptual drawing of the Central Laboratory Office building. The specific goal for the LCLS project is to produce coherent x-ray pulses with a 0.15 nm wavelength and a sub-picosecond pulse length.

The project team will design, construct and commission this facility, which is described in detail in the Conceptual Design Report and other technical design reports. Scheduling and budgetary goals are to complete construction and commissioning by the end of FY 2008 for a Total Estimated Cost (TEC) of $273 million and a Total Project Cost (TPC) of $315 million.

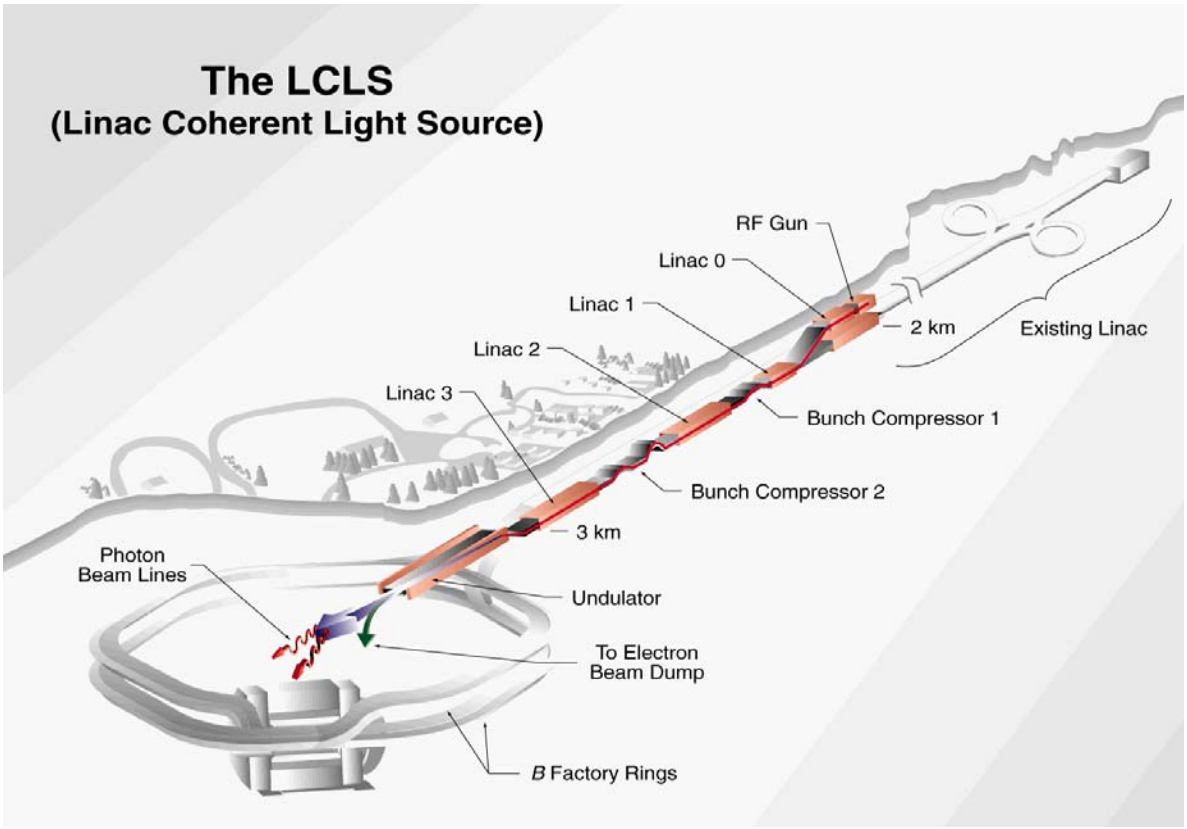


Figure 1
LCLS Facility

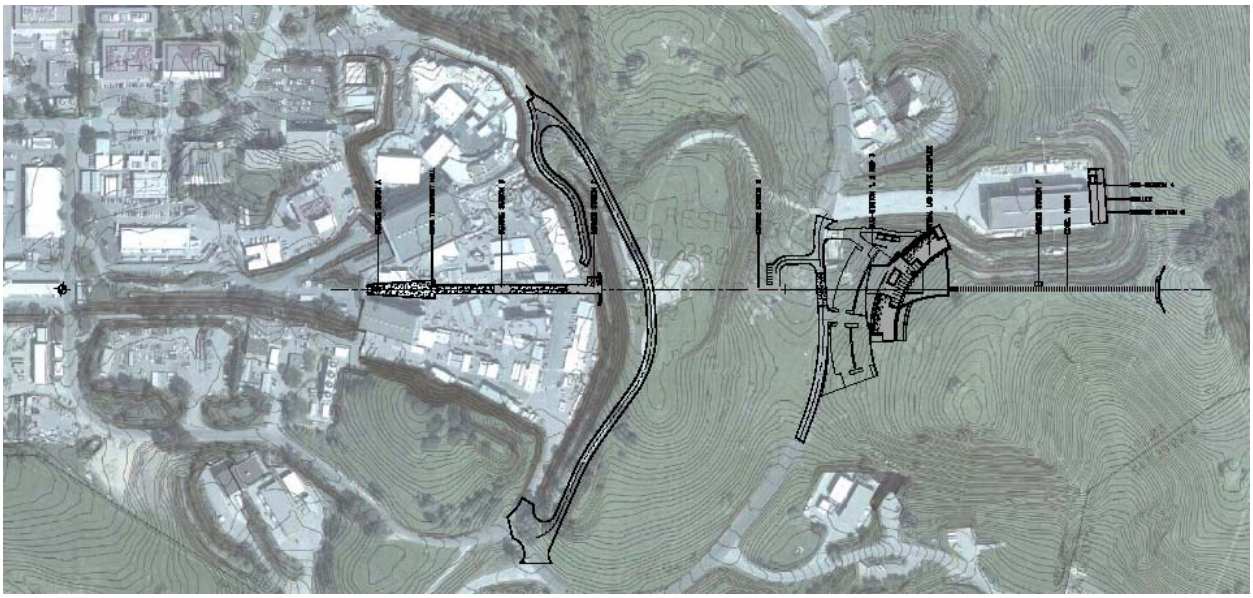


Figure 2
Above Grade Conventional Facilities

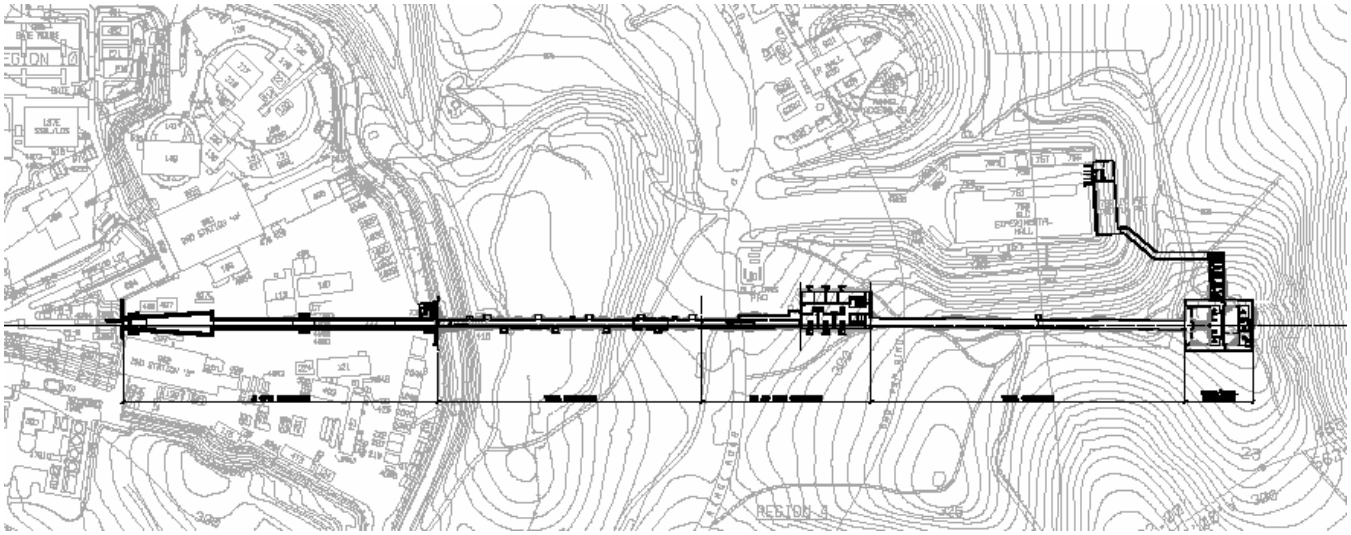


Figure 3
Below Grade Conventional Facilities

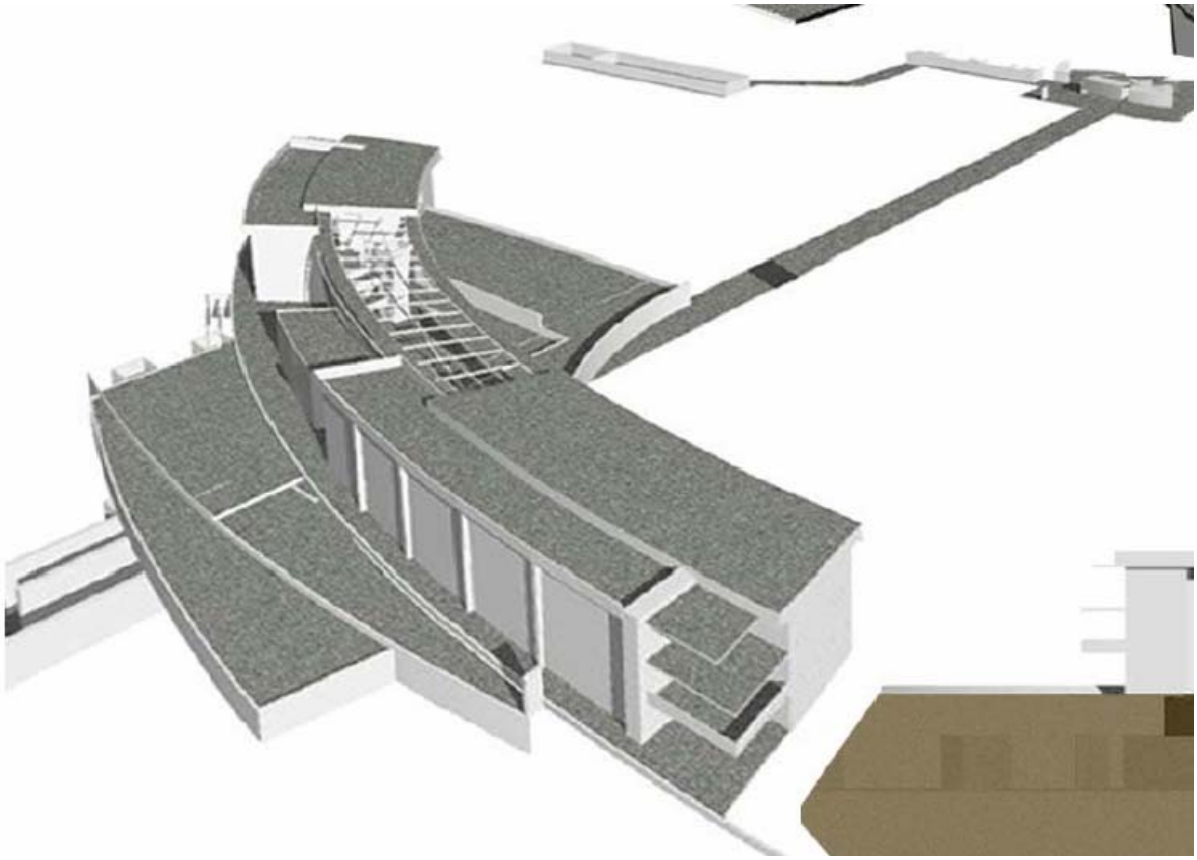


Figure 4
Central Laboratory Office Building

3. PROJECT DESCRIPTION

The project will construct an XFEL facility at SLAC. It requires a new 135 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 one-third 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 beam transfer hall. A 120-meter undulator will installed in a below grade tunnel with associated equipment. Provision will be made for x-ray endstation enclosures, as well as instrumentation and controls for identifying and characterizing the x-ray beam. Two experimental halls will be constructed. A Near Hall will be constructed near the PEP ring road and a Far Hall will be constructed further east. A Central Laboratory Office building will be constructed at the Near Hall site.

The project has been organized into a Work Breakdown Structure (WBS) for purposes of planning, managing and reporting project activities. The project WBS is shown below. Work elements are defined consistent with discrete increments of project work and the planned method of accomplishment.

LCLS Work Breakdown Structure

1.0 LCLS Construction Project (Total Estimated Cost)

- 1.1 Project Management, Planning and Administration
- 1.2 Injector System
- 1.3 Linac System
- 1.4 Undulator System
- 1.5 X-ray Transport and Diagnostic System
- 1.6 X-ray End Station System
- 1.7 Unused
- 1.8 Unused
- 1.9 Conventional Facilities

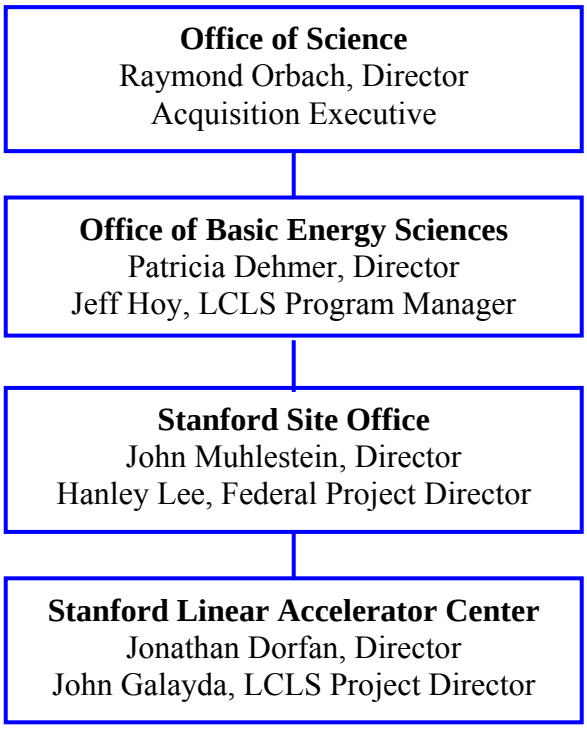
2.0 LCLS R&D, Spares, Commissioning (Other Project Costs)

- 2.1 Project Management, Planning and Administration
- 2.2 Injector System
- 2.3 Linac System
- 2.4 Undulator System
- 2.5 X-ray Transport and Diagnostic System
- 2.6 X-ray End Station System

4. ORGANIZATION AND RESPONSIBILITIES

SC is the DOE program office responsible for the LCLS project, and SC's Office of Basic Energy Sciences (BES) provides funding for the LCLS project directly to SLAC via approved financial plans. As the Management and Operating (M&O) contractor for SLAC, Stanford University will be responsible to DOE for carrying out the LCLS project. The University has delegated to SLAC responsibility for the research and development, conceptual design, construction, and operation of the LCLS. The organizational lines of authority and accountability for the LCLS project are shown in Figure 5. The roles, responsibilities, and authorities of the relevant managers are described below.

Linac Coherent Light Source
Project Management Relationships
Figure 5



4.1 Department of Energy

Office of Science

The Director of the Office of Science (SC-1) is the Program Secretarial Officer Acquisition Executive (AE) for the LCLS project. As such, SC-1 has full responsibility for project planning and execution, and for establishing broad policies and requirements for achieving project goals. Specific responsibilities for the LCLS project include:

- Chair the 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 Director.
- Conduct Quarterly Project Reviews.
- Ensure independent project reviews are conducted.

Office of Basic Energy Sciences

Under the Energy Policy Act of 1992, SC's Director for Basic Energy Sciences (SC-10) is responsible for planning, constructing, and operating user facilities to provide special scientific and research capabilities to serve the needs of U.S. universities, industry, and private and Federal laboratories. Within BES, the Scientific User Facilities Division (SC-12) has direct responsibility for providing funding, and programmatic guidance to the LCLS project. The LCLS Program Manager, in SC-12, will be the primary point of contact for DOE Headquarters (HQ) with responsibilities that include:

- Oversee development of project definition, scope and budget.
- Prepare, defend, and provide project budget with support from the field organizations.
- Review and provide recommendations to the AE on Level 0 and 1 baseline changes.
- Monitor Level 1 and 2 technical, cost, and schedule milestones.
- Participate in Quarterly Reviews, ESAAB Equivalent Board meetings, and project reviews.
- Ensure ES&H requirements are implemented by the project.
- Coordinates with other SC Staff offices, HQ program offices and the Office of Engineering and Construction Management (OECM).

DOE Stanford Site Office (SSO)

The SSO reports to the Office of Science and administers the Management and Operating (M&O) contract with Stanford University, which includes day-to-day oversight of SLAC. In carrying out its oversight responsibilities, the SSO obtains matrix support in various technical disciplines from the SC Integrated Support Centers. The SSO Director delegates responsibility and authority for execution of the LCLS project to the Federal Project Director whose specific responsibilities include:

- Day-to-day oversight of the project and provides direction to ensure its timely execution.
- Monitor, review, evaluate, and report on the performance of the project against established technical, cost, and schedule performance baselines.
- Ensure environment, safety and health is integrated into the project.

- Lead the Integrated Project Team.
- Approve Level 2 change control proposals as delegated by the AE. Review and provide recommendations to the AE for Level 0 and 1 change control proposals.
- Authorize use of project contingency in accordance with the levels described in this PEP.
- Participate in Quarterly Project Reviews, ESAAB Equivalent Board meetings, and project reviews conducted by the LCLS project and DOE HQ.
- Conduct management meetings to monitor and review status of project activities.
- Maintain project data current in the DOE Project Assessment and Reporting System (PARS).
- Issue Project Directive Authorizations for disbursement of funds and work authorizations.
- Prepare project documents such as the Project Execution Plan, Acquisition Strategy (formerly the Acquisition Execution Plan) and Project Quarterly Reports.
- Coordinate matrix support from the SC Integrated Support Centers.

4.2 Stanford Linear Accelerator Center

SLAC Director

The SLAC Director is responsible for managing all activities at the SLAC site. This includes assuring that all laboratory programs meet the requirements of the Stanford University - DOE Contract DE-AC03-76SFO0515. The Director has delegated the authority to manage and execute the LCLS project to the LCLS Project Director, and will ensure that the latter has priority access to all of SLAC's resources for that purpose.

LCLS Project Director

The LCLS Project Director will be responsible to the Director of SLAC for managing the design, fabrication, installation, and commissioning of the LCLS as well as the supporting R&D efforts. He is also responsible for the LCLS organization and staff selection at SLAC and at the other institutions collaborating in the LCLS project. Specific responsibilities include:

- Manages day-to-day execution of the project at SLAC and at collaborating institutions.
- Establishes technical and administrative controls to ensure project is executed within approved cost, schedule and technical scope.
- Ensures that ES&H responsibilities and requirements are integrated into the project.
- Directs overall project planning.
- Oversees R&D program, design, fabrication, installation, construction and commissioning.
- Represents the project in interactions with the DOE. Participates in management meetings with DOE and communicates project status and issues.
- Chairs the Change Control Board.
- Approves Level 3 change control proposals. Prepares and provides recommendations to the Federal Project Director for Level 0, 1, and 2 change control proposals.
- Identifies and manages project risks.

4.3 Collaborating Institutions

The LCLS project is a collaboration between SLAC, ANL, and LLNL. ANL will be responsible for the Undulator System and LLNL will be responsible for the X-ray Transport and Diagnostics System. The scope of work of these two collaborating laboratories is controlled by Memoranda of Understanding (see Appendix A).

4.4 Integrated Project Team

The LCLS Integrated Project Team (IPT) supports the Federal Project Director in fulfilling his/her responsibilities to successfully execute the project. The IPT will draw upon functional specialists as members when needed. Team membership will vary depending on the deliverables required during each phase of the project life-cycle. An important role of the IPT is to ensure open and timely communications of project progress and concerns with all levels of management. Core members of the Integrated Project Team (IPT) and their roles and responsibilities are as follows.

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

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

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

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

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

Steve Milton – ANL Project Director. The ANL Project Director is responsible for Undulator system.

Richard Bionta – LLNL Project Director. The LLNL Project Director is responsible for the X-ray Transport, Optics and Diagnostics system.

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

Additional support will be provided by SLAC, SSO and the SC Integrated Support Centers staff in all functional areas (e.g., legal, budget, finance, ES&H, public affairs).

5. RESOURCE REQUIREMENTS

5.1 Budget Authority

Funding requirements are outlined in the latest Project Data Sheet. The TEC is $273M and Other Project Cost (OPC) is $42M, which includes R&D, pre-operations, and spares. The TEC and OPC totals to the TPC of $315M. The overall project schedule and milestone dates are based on receiving project funds detailed in the annual submission of a Project Data Sheet. The LCLS funding profile is shown below in Table 1.

Table 1
LCLS Funding Profile
(in $K)

Fiscal Year	Project Engineering and Design	Long Lead Procurement	Construction	Other Project Cost	Total
2002	0	0	0	1,500	1,500
2003	5,925	0	0	0	5,925
2004	7,456	0	0	2,000	9,456
2005	20,075	30,000	0	4,000	54,075
2006	2,544	0	83,000	3,500	89,044
2007	0	0	90,000	16,000	106,000
2008	0	0	34,000	15,000	49,000
Total	36,000	30,000	207,000	42,000	315,000

5.2 Work Breakdown Structure

All work required for completion of the LCLS Project is covered in the WBS shown in section 3, beginning with the first year of PED funding in FY 2003 and continuing through project completion (CD-4). The WBS contains a complete definition of the project's scope and forms the basis for planning, execution, and control. A WBS Dictionary is contained in Appendix B.

5.3 Acquisition Strategy

The acquisition of the LCLS will be conducted through Stanford University as an M&O contractor. The project makes extensive use of existing SLAC facilities including the last one-third of the linear accelerator. The installation must be carefully coordinated with other research activities at the laboratory. Therefore, it is infeasible to have a separate subcontract with another organization to manage this project. The project is similar in scope to the B-Factory project, which was successfully executed by SLAC management. SLAC has the resources to manage and direct this project and the resources, with the collaborating laboratories, to execute the project.

The LCLS Project is responsible for accomplishing the project under the terms of Stanford University's contract with DOE. 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. ANL's Advanced Photon Source Division will design and fabricate the undulator and associated systems, and LLNL's Physics and Advanced Technologies Directorate will design, fabricate, qualify, and commission the x-ray transport optics and diagnostics. Project management at SLAC using the Memoranda of Understanding in Appendix A and project reporting tools will control work at these laboratories.

Project activities will be accomplished to the extent feasible using fixed-priced subcontractors selected on the basis of best value, price and other factors. Further details can be found in the LCLS Acquisition Execution Plan (currently known as the Acquisition Strategy) and the project Advance Procurement Plan.

5.4 Work Authorization

DOE Manual 413.3-1 defines five Critical Decisions that are formal determinations or decision points in a project lifecycle that allows the project to proceed to the next phase and commit resources. Each decision constitutes a work authorization for a specific phase of the project's existence. This section describes the basis of each Critical Decision for the LCLS project and specifies the DOE authority required for approval of each decision.

As described below, Critical Decisions 2 and 3 are phased for long lead procurement (LLP) items that consist of the undulator, injector, and accelerator components. With CD-2a approval, the DOE submitted the LCLS LLP budget in the Department's FY 2005 request. CD-3a approval will authorize the FY 2005 funds for long lead procurements. The long lead items will be procured and modifications to existing facilities will be accomplished, to test the long lead equipment in FY 2005. This will reduce the technical and schedule risks for the project.

Critical Decision 0: Approve Mission Need
Authority: Director, Office of Science
The Acting Director, Office of Science approved the Justification of Mission Need for the LCLS project, on June 13, 2001.

Critical Decision 1: Approve Preliminary Baseline Range
Authority: Director, Office of Science
Approval of CD-1 authorized the Project Engineering and Design funds to proceed with Title I (preliminary) and Title II (final) design. The Director, Office of Science approved the Preliminary Baseline Range on October 16, 2002.

Critical Decision 2a: Approve Long Lead Procurement Budget
Authority: Director, Office of Science
Approval of CD-2a enabled submission of the FY 2005 budget request for the LLP. The Acting Director, Office of Science approved CD-2a on July 2, 2003.

Critical Decision 2b: Approve Performance Baseline
Authority: Director, Office of Science
Approval of CD-2b will establish the technical, schedule and cost performance baselines for the project.

Critical Decision 3a: Approve Start of Long Lead Procurement
Authority: Director, Office of Science
Approval of CD-3a will authorize long lead procurement activities scheduled for FY 2005.

Critical Decision 3b: Approve Start of Construction
Authority: Director, Office of Science
Approval of CD-3b will authorize the project to start construction of the LCLS.

Critical Decision 4: Approve Start of Operations
Authority: Director, Office of Science
CD-4 approval will authorize the start of research operations of the LCLS facility. Prior to operations, a period of commissioning and performance testing for the LCLS will be completed as technical systems and facilities are installed. A Commissioning Plan will be prepared to define objectives that ensure LCLS systems are integrated and functioning as designed. The goal of commissioning is to generate x-rays in the LCLS undulator and to detect them in the Far Hall. This goal will demonstrate that the LCLS facility was designed, fabricated, installed and systems are functioning as designed. Office of Science projects are scientific state-of-the-art facilities that require operational experience to achieve project design operating parameters. Therefore, the commissioning goals allow project completion and closure of the line item construction funding to begin operations. Experience gained operating the facility will allow SLAC to achieve project design operating parameters.

5.5 Life Cycle Cost

Operating costs of the LCLS, including power and maintenance but excluding programmatic research costs, are estimated to be in the range $50 million - 60 million per year in FY 2009 dollars. It is expected that the facility will have a useful operating life of about 30 years.

5.6 Contingency Management

In developing the project's performance baseline cost estimate, the contingency associated with each system was estimated based on an assessment of risk and on experience with similar systems.

All contingency for the project will be held at SLAC under the control of the Federal Project Director and LCLS Project Director as governed by the Baseline Change Control process in section 7.2. An increase above the threshold in a WBS Level 3 Estimate-at-Completion (EAC) will require submitting a Baseline Change Proposal (BCP) to the LCLS Change Control Board (CCB). The BCP will include the reason for the change and the implications for cost, schedule, and system interfaces.

BCP approvals are based on the Baseline Change Control Thresholds. The LCLS Project Director approves Level 3 changes, the Federal Project Director approves Level 2 changes and SC-1 approves Level 1 changes. Approval of the BCP is to increase the baseline estimate for that WBS element, and unless there are any offsets, it will reduce the available contingency by

an equal amount. After the project performance baselines have been approved, the LCLS Project Director will make every effort to find offsets within the project, without impacting the technical performance baseline, to mitigate draws on contingency. A change control log will be maintained by the project to document all approved BCPs.

6. PROJECT BASELINES

The project technical scope, cost and schedule performance baselines are established and approved at CD-2b. The project will be measured against these baselines during execution to ensure successful completion. The following sections describe the baselines.

6.1 Technical Scope

The LCLS project requires a 135 MeV injector to be built at Sector 20 of the 30-sector SLAC linac to create the electron beam required for the XFEL. Portions of the last one-third of the linac will be modified by adding two magnetic bunch compressors. Most of the linac and its infrastructure will remain unchanged. The existing components in the Final Focus Test Beam tunnel will be removed and will be replaced with a Beam Transfer Hall (BTH) through the beam switchyard. A 120-meter undulator will be installed after the BTH. Two new experimental buildings, the Near Hall and the Far Hall will be constructed and connected by the x-ray beam line tunnel. The Near Hall will be built near the PEP ring road. The Far Hall will be built approximately 400 meters downstream of the Undulator Hall. Provisions will be made for housing instrumentation and controls for the initial experiments. A Central Laboratory Office building will be constructed at the Near Hall site. Key design operating parameters (to be attained at full routine operations after CD-4) are identified as follows:

Key Design Parameters at Full Routine Operation

0.8 – 8 KeV Self-Amplified Spontaneous Emission (SASE) Free Electron Laser
Electron Beam Energy 4.5 – 14.1 GeV, from SLAC Linac
Peak Power in SASE bandwidth 8 GW
Peak Brightness 1×10^{33} photons/s (mm^2 $mrad^2$ 0.1%BW)
Pulse Duration 230 femtoseconds
Pulse Repetition Rate 120 Hz

6.2 Cost

The Level 1 cost baseline was determined after preliminary (Title 1) design. The Total Estimated Cost is $273 million and the Total Project Cost is $315 million.

6.3 Schedule

The Level 1 baseline schedule for the project is shown below. Level 2 and 3 milestones are identified in the LCLS Project Management Plan. As noted in Section 5.4, CD-2 and CD-3 are

phased to permit long lead procurements to be initiated in FY 2005. The summary project schedule is shown in figure 6.

Milestone	Milestone Description	Scheduled Date
CD-0	Approve Mission Need	June 2001 (A)
CD-1	Approve Preliminary Baseline Range	Oct 2002 (A)
CD-2a	Approve Long-Lead Procurement Budget	July 2003 (A)
CD-2b	Approve Performance Baseline	July 2004
CD-3a	Approve Start of Long-Lead Procurement	Sept 2004
CD-3b	Approve Start of Construction	Sept 2005
CD-4	Approve Start of Operations	Oct 2008

(A) – Indicates actual milestone completion date.

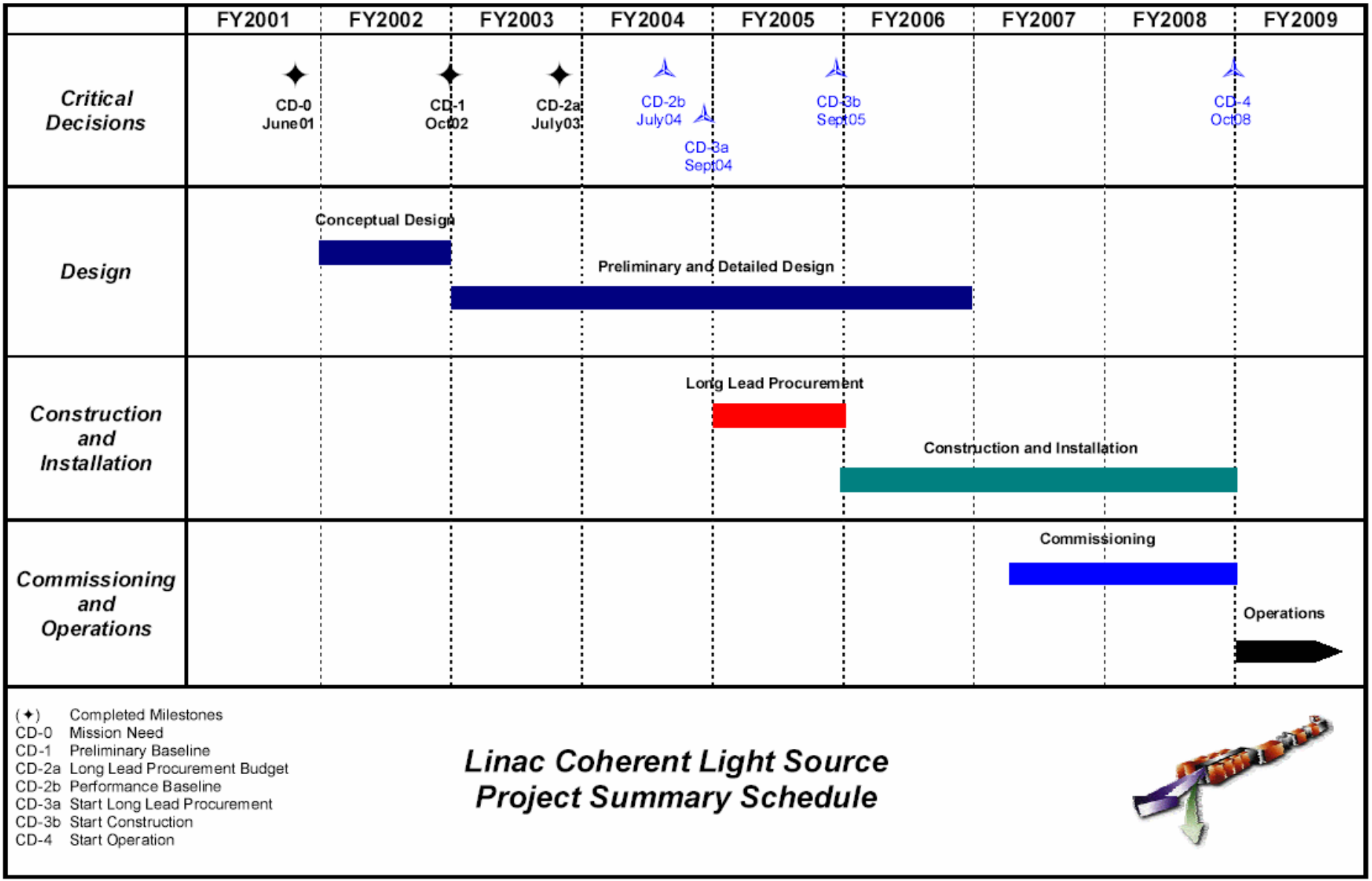

FY2001
FY2002
FY2003
FY2004
FY2005
FY2006
FY2007
FY2008
FY2009
Critical Decisions
CD-0 June01
CD-1 Oct02
CD-2a July03
CD-2b July04
CD-3a Sept04
CD-3b Sept05
CD-4 Oct08
Design
Conceptual Design
Preliminary and Detailed Design
Construction and Installation
Long Lead Procurement
Construction and Installation
Commissioning and Operations
Commissioning
Operations
(✦) Completed Milestones
CD-0 Mission Need
CD-1 Preliminary Baseline
CD-2a Long Lead Procurement Budget
CD-2b Performance Baseline
CD-3a Start Long Lead Procurement
CD-3b Start Construction
CD-4 Start Operation
Linac Coherent Light Source
Project Summary Schedule

Figure 6

7. PROJECT MANAGEMENT, CONTROL, AND REPORTING

7.1 Project Performance

The LCLS Project Director will monitor, track, and report project progress to the Federal Project Director. Together they will evaluate variances in cost, schedule and scope and document the results on a monthly basis (see Section 7.3). The LCLS Project Director will initiate a BCP when a change in cost, schedule or scope exceeds any of the thresholds identified in Table 2.

The LCLS project will implement a project management control system (PMCS). This system will provide the essential earned value information needed for management control of the project and will form and maintain the database for progress reporting. The PMCS will integrate the cost and schedule baselines and will provide the tools to monitor project performance. The data from the PMCS will be the basis for information entered into the DOE Project Assessment and Reporting System (PARS).

7.2 Baseline Change Control Management

The LCLS project will control changes in functional and physical requirements and evaluate the impact of changes on cost and schedule through a baseline change control process. The essential elements of configuration control are a well-defined baseline, and an effective method of communicating, evaluating, and documenting changes to that baseline. The process will promote orderly evolution from the baseline design, and ensure the effect of changes on cost, schedule, and technical scope performance are properly evaluated and documented by project management. A Baseline Change Proposal (BCP) must be initiated when there will be an impact on any of the cost, schedule, or scope baselines. Thresholds for determining the BCP approval level during project execution are delineated in Table 2.

A Change Control Board (CCB) consisting of members of the LCLS project will be established. The board will consist of a Chairman (the LCLS Project Director), a change control manager, and board members. The board members review the technical, cost and schedule implications of changes and advise the Chairman. All BCP actions will be maintained in a change control log.

A Baseline Change Control Board (BCCB) will be convened for BCPs that are above Level 3 thresholds. The BCCB members are the CCB members, the Federal Project Director, and appropriate SC Program Managers. DOE approves BCPs above Level 3.

Table 2
Baseline Change Control Thresholds

	Secretarial Acquisition Executive (Level 0)	Acquisition Executive (SC-1) (Level 1)	Federal Project Director (Level 2)	LCLS Project Director (Level 3)
Technical	Any change in scope and/or performance that affects mission need requirements or is not in conformance with current approved Project Data Sheet	Change in siting or in the Key Design Parameters that affect mission need requirements	Changes that affect ES&H requirements or changes in facilities that do not affect Key Design Parameters	Changes in system requirements or design that do not affect Key Design Parameters
Schedule	6 months or greater increase (cumulative) in the original project completion date	≥ 3 months delay in any Level 1 milestones	Any delay in Level 1 milestones or ≥ 3 months delay in Level 2 milestones	Any change to Level 3 milestones or ν 3 months delay in Level 2 milestones
Cost	Increase in excess of $25M or 25% (cumulative) of the baseline TEC or TPC	Any increase in the baseline TEC or TPC	The smaller cumulative change of ≥ $1M or 25% of any WBS Level 2 cost	Any increase in WBS Level 2 cost ≥ $100K

7.3 Project Reporting

The LCLS Project Director will submit a monthly project progress report to the Federal Project Director containing information about the overall progress of the project. It will discuss project cost and schedule performance, accomplishments, issues, and upcoming milestones. It will also include the latest earned value data together with an explanation for any significant variances. The following data will be reported: actual cost of work performed (ACWP), budgeted cost of work performed (BCWP), and budgeted cost of work scheduled (BCWS). Cost and schedule performance will be evaluated and variances determined. Cost and Schedule variance thresholds used by the project are the PARS stoplight thresholds shown below at WBS level 1. The project uses these same thresholds at WBS Level 2 to give an early warning of potential variances to cost and schedule. The change control log will also be included in this report. The Federal Project Director will enter monthly progress information into PARS and discuss significant variances or any unusual parameter values.

The Federal Project Director will prepare a quarterly progress report and submit it to the LCLS Program Manager. The report will highlight cost, schedule and technical performance; provide status of completed milestones, and identify completed and upcoming milestones; and discuss issues.

Cost and Schedule Performance Indices Variance Reporting Thresholds	
GREEN	if the performance index is between .90 and 1.10
YELLOW	if the performance index is between .85 and .89 or if the performance index is between 1.11 and 1.20. The project will also be categorized yellow if it has not been updated in PARS within the past 45 days.
RED	if the performance index is below .85 or above 1.20 (any value outside of green or yellow).

7.4 Project Meetings and Reviews

LCLS project management will conduct internal project meetings and reviews. The purpose of the meetings is to provide project coordination and discuss system progress. Internal reviews will be held to evaluate system and component designs.

The Federal Project Director will hold weekly meetings with the LCLS Project Director and relevant staff to discuss project status, issues and current business.

During project execution, a project progress review will be held quarterly between the Federal Project Director, the LCLS Project Director, the LCLS Program Manager, and the Director of the Office of Basic Energy Sciences. The review is based on the quarterly progress report issued by the Federal Project Director. The quarterly review will be accomplished by teleconference or videoconference. The DOE Office of Engineering and Construction Management will be invited to this review.

Formal DOE reviews of the project's cost, schedule, technical, ES&H, and management performance will be conducted periodically by the Major Systems Assessment Division, SC-81, at the request of the Office of Basic Energy Sciences or the AE.

8. RISK MANAGEMENT

Risk management is based on a graded approach in which levels of risk are assessed for project activities and elements. This assessment is based upon the potential consequences of activity or element failure, as well as the probability of occurrence. The level of formality of the quality assurance requirements is tied to the potential failure consequences. Risk minimization is implemented by conducting research and development activities, prototyping components, long lead procurements, and planning alternatives.

Risk assessments are conducted throughout the project lifecycle. Risks identified include technical, cost and schedule risks. The project Risk Management Plan details the process for identifying, evaluating, mitigating, and managing risks in compliance with DOE Manual 413.3-1.

9. ENVIRONMENT, SAFETY AND HEALTH

9.1 Integrated Safety Management System

Environment, safety and health (ES&H) requirements are systematically integrated into management and work practices at all levels so that the LCLS project is executed while protecting the public, the worker, and the environment. The SLAC Safety Management System document and policies make it clear that the responsibility for safety and environmental protection starts with the SLAC Director and flows through the management chain to Associate Directors, to Department Heads and Group Leaders, to line supervisors, and finally to the workers. It is the responsibility of LCLS management to ensure that staff are trained and are responsible for ES&H in their assigned areas.

The LCLS project work at SLAC will be executed in accordance with SLAC ES&H policies to ensure hazards are identified and mitigated; work is authorized after ES&H analysis is completed; and oversight of work is conducted by LCLS management and staff. The SLAC ES&H Division and SLAC Citizen Committees provide technical support to the project and conducts independent oversight and reviews of project activities. Work at the collaborating laboratories will be executed in accordance with their existing ES&H policies.

9.2 National Environmental Policy Act

In compliance with the National Environmental Protection Act (NEPA), a determination was made to prepare an Environmental Assessment (EA). The effects of the LCLS project on the environment were assessed in the EA. This project will be executed in conformance with existing SLAC ES&H policies, systems and procedures to assure a minimum impact on the environment. The EA determined that an Environmental Impact Statement (EIS) was not needed and a Finding of No Significant Impact (FONSI) was approved in February 2002.

9.3 Safety Assessment Document

Specific ES&H hazards were identified in the LCLS Hazards Analysis report and the means for their mitigation is detailed in the LCLS Preliminary Safety Assessment Document (PSAD). The PSAD addresses the ES&H considerations in the design, fabrication, and installation of LCLS. The PSAD will be approved prior to starting LCLS construction (i.e., before CD-3b). The PSAD will form the basis for the LCLS Final Safety Assessment Document (FSAD). The FSAD will evaluate the ES&H considerations for operating the LCLS. The FSAD will be approved prior to operation and will serve as the basis for the Accelerator Readiness Review (ARR). The ARR will be accomplished in phases prior to commissioning and completed prior to starting operations (i.e., before CD-4).

10. TECHNICAL ANALYSES

10.1 Value Engineering

A Value Engineering (VE) Study was performed during Title I design. The study followed the traditional approach to VE. A review team evaluated alternative design approaches, evaluated the flexibility of the design for present and future research, reviewed sustainability design features, and evaluated specific energy applications. The project team and the architect-engineer design team will perform VE evaluations throughout the design of the conventional facilities portion of the LCLS project.

10.2 System Engineering

System engineering principles are being employed in the development of the project from conceptual design through construction and transition to operations.

10.3 Configuration Management

Documents defining the configuration of the project baseline are maintained through a formal configuration control process. Configuration definition documents for the project are identified in the LCLS Quality Implementation Plan.

10.4 Sustainable Building Design

Sustainable building design principles are being 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, are being evaluated and implemented. Project waste disposal and recycling requirements are being incorporated into the project procurement documents.

10.5 Reliability, Maintainability, Operability and Quality Assurance

10.5.1 Reliability, Maintainability, and Operability

The Title I and II designs will be reviewed for reliability, maintainability, and operability, of the conventional facilities portion of the LCLS, by the LCLS Project Director and the Construction Manager, if applicable. The primary objective of these reviews is to ensure the development of systems that will be reliable, safe, easy to operate, and maintainable with minimum resources.

10.5.2 Quality Assurance

A Quality Assurance Program has been established at SLAC in accordance with DOE Order 414.1A, Quality Assurance. The SLAC Institution Quality Assurance (QA) Program Plan (SLAC I-770-0A17M-001) dated September 2000, defines the management systems for quality assurance, including the general requirements for quality on projects such as LCLS. The LCLS Project Quality Assurance Officer is responsible for implementing the QA program requirements for the project, in accordance with the Quality Implementation Plan.

11. TRANSITION TO OPERATIONS

11.1 Final Inspection and Acceptance

The following items will be accomplished by the LCLS project team:

- Equipment, systems and facility checkouts
- Preliminary inspection and list of incomplete work
- Inspection walk-through and punch list

- Inspection of corrective activities and completion of punch list work
- Inventory of operations manuals, instructions, and guarantees
- Acknowledgment of completion and acceptance of work under subcontract

11.2 Commissioning

A Commissioning Plan will be prepared to test and evaluate system performance, both individually and collectively. Functional performance tests will be established and all systems will be tested against the Commissioning performance criteria. The LCLS will be commissioned in phases starting with the injector and ending with the Far Hall, as each system is completed. The commissioning goal is to generate x-rays in the LCLS undulator and detect them in the Far Hall. The Commissioning Plan will describe the requirements for meeting this goal.

11.3 Start of Operations

When inspection, acceptance, and commissioning have been completed, technical equipment is installed and operational, and CD-4 has been approved by the AE, the project will formally transition to the operational phase.

11.4 Lessons Learned

During the project, instances of "what went right" and "what went wrong", as well as insights into what might have been done better, will be documented. At the conclusion of the project, the LCLS Project Director will analyze these lessons learned and review them with the DOE.

12. APPENDICES

A. Memoranda of Understanding with ANL and LLNL
B. WBS Dictionary

Appendix A

Memoranda of Understanding

1. Argonne National Laboratory
2. Lawrence Livermore National Laboratory

Memorandum of Understanding
between
Stanford Linear Accelerator Center
and
Argonne National Laboratory
Date: August 10, 2002

1.0 Introduction

The Linac Coherent Light Source (LCLS) Project is to be executed as a collaboration of three laboratories: Argonne National Laboratory (ANL), Lawrence Livermore National Laboratory (LLNL), and the Stanford Linear Accelerator Center (SLAC). The Linac Coherent Light Source is a single-pass x-ray free electron laser operating in the 1.5-15 Å wavelength region, using electron beams from the SLAC linac at energies up to 15 GeV. The LCLS is a multi-year, $200M, Department of Energy (DOE) sponsored project to construct a coherent light source sited at SLAC that will produce ultra-short pulse, coherent X-rays in the wavelength range 0.8-8 keV, with peak brightness 10^{10} times higher than any currently available x-ray source in the world. The facility will produce unprecedented levels of peak and average brightness of monochromatic and spontaneous x-ray radiation for use in scientific applications that are far beyond the reach of current 3rd generation synchrotron light sources. The DOE approved CD-0 for this project in June 2001, and a SLAC/LLNL/ANL team is responsible for completing it. SLAC will serve as lead laboratory for the collaboration and the central project management will reside there.

The partner laboratories have agreed upon a division of responsibilities that makes best use of expertise and available resources. LLNL plans to work in three main areas: x-ray optics, x-ray diagnostics, and x-ray beam transport. The areas of LLNL responsibility are identifiable in the LCLS work breakdown element entitled "X-Ray Transport, Optics and Diagnostics. ANL plans to take responsibility for LCLS WBS element entitled "Undulator Systems".

This Memorandum of Understanding is between ANL and SLAC. It provides the overall framework for the business relationship between SLAC and ANL (the Parties) for portions of the design, construction, installation and commissioning of the LCLS as outlined in addenda to this MOU. It does not constitute a legal contractual obligation on the part of either of the institutions. Definition of specific work packages in these and possibly other areas will be done in consultation with the SLAC LCLS Project Office and will be described separately in semiannual Statements of Work that constitute Addenda to this Memorandum of Understanding. ANL is managed and operated by the University of Chicago under DOE Contract No. W-31-109-ENG-38. All ANL work performed will be consistent with and under the terms and conditions of this W-31-109-ENG-38 Contract.

Management of the design, fabrication, construction, installation, and commissioning of the LCLS will be subject to the guidelines of the LCLS Project Management Plan. In particular, technical review will be an integral part of design and fabrication, and the change control process will govern parameter and/or cost changes. In all cases, work will be coordinated with the cognizant system manager.

1.1 Objective

The Objective of this Memorandum of Understanding (MOU) is to document the terms of agreement between SLAC and ANL so that required LCLS project work can be performed at ANL.

1.2 Scope

This MOU covers work to be performed by ANL during the multi-year LCLS construction project. It includes design and fabrication effort the undulator and related systems. . Furthermore, ANL will be responsible and accountable to project management for the cost, schedule and technical dimensions of the level –3 element "Undulator Systems", during design and construction phases of the project.
1.3 Roles and Responsibilities

1.3.1 Linac Coherent Light Source Management

SLAC LCLS management will be responsible for the overall definition, cost, schedule, and technical dimensions of the LCLS Project Baseline, as well as for delegation of project management and project leadership responsibilities to partner laboratories. SLAC management will be responsible for overall assignment of resources as required for the successful completion of the LCLS Project. SLAC LCLS management will control interfaces of responsibility between the laboratories participating in the LCLS Project.

1.3.2 Department of Energy

The Department of Energy (DOE) will be responsible for oversight of the project.

1.3.3 Argonne National Laboratory

Argonne National Laboratory will be responsible and accountable for assigned work products.

2.0 General Provisions

2.1 Introduction

Overall executive authority for managing the LCLS Project will be vested in the SLAC Associate Director for the LCLS Division who is also the LCLS Project Director and is vested with the authority to deal directly with partner laboratory project heads on LCLS matters. The LCLS Project Director's ability to effectively control work at the partner laboratories is facilitated by the Interlaboratory Coordinating Council, described below in 2.3. Lines of authority and responsibility will follow the organization structure established by LCLS management and documented in an organization chart updated as necessary.

2.2 Project Baselines and Management

Project baselines detailing the technical scope of work, cost estimates and project schedule will be developed, reviewed and approved by the Project and relevant partner laboratories as a prerequisite to formalizing the MOU. These baselines, once approved, will be under configuration management; changes must follow the procedures outlined in the management documents described below.

The Project Execution Plan (PEP) and the Project Controls Manual (PCM) contain the project management structures and methodologies to be employed in the conduct of the project, including reporting, communication, reviews, performance metrics, change control, funding mechanism and handling of contingency.

2.3 Inter-Laboratory Coordinating Council

The ANL Director will assign a representative to the LCLS Inter-Laboratory Coordinating Council, which is chaired by the LCLS Project Director. The purpose of the Council is to address issues affecting resource allocation to the LCLS project at the partner laboratories, coordination of LCLS Project activities with other laboratory activities, and coordination of partner laboratories' LCLS activities. The ANL representative will have line authority for resource allocation to the LCLS Project appropriate to achieve the Project Baseline. As specified in the Project Management Plan, the Council will be Chaired by the LCLS Project Director and will meet once per month, or spontaneously should the need arise.

2.4 Reporting

ANL will provide all necessary data to support the DOE-approved LCLS Project Management Control System. ANL will submit monthly progress reports, including schedule status and earned value for each of its work packages. These reports will contain brief descriptions of technical progress in all major areas, organized by "work package," along with an indication of key items for resolution in the next reporting period. Incurred costs and

commitments will be reported by WBS category for the total ANL effort. The report will be submitted on or before the tenth of the following calendar month to the LCLS Project Office.

2.5 Funding

Transfer of funds from SLAC to ANL will be via DOE Financial Plan Transfers (hereinafter referred to as LCLS project funding). Funding will typically be transferred at six-month intervals to provide timely adjustments as may be required to recognize changes in either the Scope of Work (via future Amendments to this MOU) or the definition of individual work packages (via Addenda to this MOU).

2.6 Full Cost Recovery

It is understood that ANL is operated by The University of Chicago for the Department of Energy as a full cost recovery facility. Amendments to this MOU will be issued in response to events such as major changes to the Scope of Work associated with rebaselining of the project, modifications to the project funding profile, or reassignments based on SLAC LCLS Project Office directives. Any such Amendments will be subject to the provisions of the LCLS project change control procedures. ANL will respond as quickly as possible, within DOE guidelines. However, LCLS project funding will cover all costs incurred as a result of work performed with the approval of, and on behalf of, the LCLS project.

2.7 Intellectual Property

"Intellectual Property" includes but is not limited to patents, copyrights, trademarks and maskworks. Rights to intellectual property created solely by one party under this MOU shall be retained by that party. Rights to intellectual property created jointly by the parties under this MOU shall be retained jointly by the parties and the parties shall agree among themselves as to protection and commercialization for such jointly owned property. The parties recognize that the Department of Energy has certain rights in and to any intellectual property created under this MOU by the parties.

2.8 Scientific Publication

All work covered by this MOU will be unclassified. Publications may be collaborative and either party has the right to publish information in part or in whole, independent of the other. Parties agree to secure prepublication review from each other which shall not be unreasonably withheld or delayed beyond thirty (30) days.

2.9 Amendments

This MOU may be modified or amended from time to time by written agreement of both Parties.

2.10 Overhead

Each partner laboratory shall set indirect costs charged to the LCLS project in accordance with their disclosed cost accounting practices in order to: 1) ensure the appropriate causal/beneficial relationship of indirect costs applied to the project; 2) minimize the fluctuations in the indirect cost charges over the life of the project. The accounting treatment for indirect costs will be reviewed during the annual negotiations on the projected work plans between ANL and LCLS management.

2.11 Contingency

Management and maintenance of contingency for the LCLS project is the responsibility of the SLAC LCLS Project Office and will be done in accordance with the change control process outlined in the Project Management Plan.

2.12 Equipment Ownership

All equipment items bought or fabricated using DOE-SLAC funds will be the property of DOE-SLAC and will be capitalized by SLAC. Any equipment purchased or fabricated using DOE-ANL funds, will be the property of DOE-ANL and will be capitalized by ANL. All equipment fabricated using LCLS Project funds as part of the Project technical baseline, and installed at SLAC as part of the LCLS Facility, will upon acceptance for installation become the property of DOE-SLAC and will be capitalized by SLAC.

2.13 Public Information Coordination

Subject to the Freedom of Information Act (5 U.S.C. 552), decisions on the disclosure of information to the public regarding the LCLS project shall be made by the SLAC Director and the SLAC LCLS Project Director following consultation with ANL representatives.

2.14 Project Staffing

ANL Management will select a Project Task Manager and provide a project management structure, subject to approval by LCLS Management.

3.0 MOU Implementation

3.1 Enactment

This document, when properly executed, will supersede any earlier versions of this MOU.

3.2 Effective Date

This Memorandum of Understanding shall become effective upon the latter date of signature of the parties. It shall remain in effect until superseded or until LCLS Project completion, whichever occurs first.

3.3 Approvals

The undersigned concur in the terms of this Memorandum of Understanding:

James M. Paterson, Associate Director,
SLAC Technical Division

9/12/02
Date

Efim Gluskin
ANL LCLS Project Director, Interim

11 SEPT 2002
Date

Keith Hodgson, Associate Director,
SLAC SSRL Division

9/11/02
Date

J. Murray Gibson, Associate Director,
ANL Advanced Photon Source

11 SEPT 2002
Date

Jerry Jobe, Associate Director,
SLAC Business Services Division

9/19/2002
Date

John Galayda,
SLAC LCLS Project Director

11 SEPT 2002
Date

Jonathan Dorfan
Director, SLAC

9/22/02
Date

Herman A. Grunder Sept 11, 2002
Herman A. Grunder
Director, ANL

Date

Technical Addendum A.
to the
Memorandum of Understanding
between

Stanford Linear Accelerator Center

and
Argonne National Laboratory

August 10, 2002

A.0 Specific Provisions

This addendum defines technical and management responsibilities of Argonne National Laboratory as a participant in the Linac Coherent Light Source Project.

A.1 Statement of Work

ANL will carry out design and fabrication activities in the areas of undulator systems. Particular activities and deliverables will be specified and agreed upon by the ANL LCLS Project Head, the SLAC LCLS Project Director, the ANL Director, and the SLAC Director semiannually via the Addenda to the Memorandum of Understanding. The general scope of the ANL design and construction effort is described below:

A.1.1 Technical Responsibilities

SLAC and ANL agree that ANL will carry out Project Engineering Design activities in support of LCLS
:

- Development of specifications for LCLS systems and components
- Estimation of cost for LCLS systems and components
- Activities associated with optimizing design: alternatives assessment, prototyping, etc.
- Planning and scheduling resource allocations for construction activities
- Implementation of Project Management Controls System functions required by SLAC and DOE
- Other functions as necessary for compliance of LCLS with DOE project management guidelines

SLAC and ANL expect that ANL responsibility will extend to construction activities in areas for which ANL has carried out Project Engineering Design.

A.1.2 Management Responsibilities

SLAC and ANL agree that ANL has management responsibility for the Project Engineering Design and construction of the undulator system, identified by the work breakdown structure element 1.2.3.

A.2 Work Package Definition

At this time the overall definition of the ANL scope of work for the LCLS is that described in Chapter 8 of the LCLS Conceptual Design Report, SLAC R-593, dated April 2002, and WBS 1.2.3 of the associated cost estimate of April 2002. It is understood that this working definition is subject to revision based on DOE guidance and on progress of the PED process to maturity.

Specific near-term LCLS project engineering design (PED) and construction activities to be carried out by ANL will be defined and updated at least semiannually in addenda to the SLAC-ANL Memorandum of Understanding.

Memorandum of Understanding

between

Stanford Linear Accelerator Center

and

Lawrence Livermore National Laboratory

Date: August 10, 2002

1.0 Introduction

The Linac Coherent Light Source (LCLS) Project is to be executed as a collaboration of three laboratories: Argonne National Laboratory (ANL), Lawrence Livermore National Laboratory (LLNL), and the Stanford Linear Accelerator Center (SLAC). The Linac Coherent Light Source is a single-pass x-ray free electron laser operating in the 1.5-15 Å wavelength region, using electron beams from the SLAC linac at energies up to 15 GeV. The LCLS is a multi-year, $200M, Department of Energy (DOE) sponsored project to construct a coherent light source sited at SLAC that will produce ultra-short pulse, coherent X-rays in the wavelength range 0.8-8 keV, with peak brightness 10^{10} times higher than any currently available x-ray source in the world. The facility will produce unprecedented levels of peak and average brightness of monochromatic and spontaneous x-ray radiation for use in scientific applications that are far beyond the reach of current 3rd generation synchrotron light sources. The DOE approved CD-0 for this project in June 2001, and a SLAC/LLNL/ANL team is responsible for completing it. SLAC will serve as lead laboratory for the collaboration and the central project management will reside there.

The partner laboratories have agreed upon a division of responsibilities that makes best use of expertise and available resources. LLNL plans to work in three main areas: x-ray optics, x-ray diagnostics, and x-ray beam transport. The areas of LLNL responsibility are identifiable in the LCLS work breakdown element entitled "X-Ray Transport, Optics and Diagnostics. ANL plans to take responsibility for LCLS WBS element entitled "Undulator Systems".

This Memorandum of Understanding is between LLNL and SLAC. It provides the overall framework for the business relationship between SLAC and LLNL (the Parties) for portions of the design, construction, installation and commissioning of the LCLS as outlined in addenda to this MOU. It does not constitute a legal contractual obligation on the part of either of the institutions. Definition of specific work packages in these and possibly other areas will be done in consultation with the SLAC LCLS Project Office and will be described separately in semiannual Statements of Work that constitute Addenda to this Memorandum of Understanding. LLNL is managed and operated by the University of California under DOE Contract No. W-7405-76SF00515. All LLNL work performed will be consistent with the terms and conditions of this contract.

Management of the design, fabrication, construction, installation, and commissioning of the LCLS will be subject to the guidelines of the LCLS Project Management Plan. In particular, technical review will be an integral part of design and fabrication, and the change control process will govern parameter and/or cost changes. In all cases, work will be coordinated with the cognizant system manager.

1.1 Objective

The Objective of this Memorandum of Understanding (MOU) is to document the terms of agreement between SLAC and LLNL so that required LCLS project work can be performed at LLNL.

1.2 Scope

This MOU covers work to be performed by LLNL during the multi-year LCLS construction project. It includes design and fabrication effort in the three main areas: x-ray optics, x-ray diagnostics, and x-ray beam transport. Furthermore, LLNL will be responsible and accountable to project management for the cost, schedule and technical dimensions of the level –3 element "X-ray Transport, Optics and Diagnostics", during design and construction phases of the project.

1.3 Roles and Responsibilities

1.3.1 Linac Coherent Light Source Management

SLAC LCLS management will be responsible for the overall definition, cost, schedule, and technical dimensions of the LCLS Project Baseline, as well as for delegation of project management and project leadership responsibilities to partner laboratories. SLAC management will be responsible for overall assignment of resources as required for the successful completion of the LCLS Project. SLAC LCLS management will control interfaces of responsibility between the laboratories participating in the LCLS Project.

1.3.2 Department of Energy

The Department of Energy (DOE) will be responsible for oversight of the project.

1.3.3 Lawrence Livermore National Laboratory

Lawrence Livermore National Laboratory will be responsible and accountable for assigned work products.

2.0 General Provisions

2.1 Introduction

Overall executive authority for managing the LCLS Project will be vested in the SLAC Associate Director for the LCLS Division who is also the LCLS Project Director and is vested with the authority to deal directly with partner laboratory project heads on LCLS matters. The LCLS Project Director's ability to effectively control work at the partner laboratories is facilitated by the Interlaboratory Coordinating Council, described below in 2.3. Lines of authority and responsibility will follow the organization structure established by LCLS management and documented in an organization chart updated as necessary.

2.2 Project Baselines and Management

Project baselines detailing the technical scope of work, cost estimates and project schedule will be developed, reviewed and approved by the Project and relevant partner laboratories as a prerequisite to formalizing the MOU. These baselines, once approved, will be under configuration management; changes must follow the procedures outlined in the management documents described below.

The Project Execution Plan (PEP) and the Project Controls Manual (PCM) contain the project management structures and methodologies to be employed in the conduct of the project, including reporting, communication, reviews, performance metrics, change control, funding mechanism and handling of contingency.

2.3 Inter-Laboratory Coordinating Council

The LLNL Director will assign a representative to the LCLS Inter-Laboratory Coordinating Council, which is chaired by the LCLS Project Director. The purpose of the Council is to address issues affecting resource allocation to the LCLS project at the partner laboratories, coordination of LCLS Project activities with other laboratory activities, and coordination of partner laboratories' LCLS activities. The LLNL representative will have line authority for resource allocation to the LCLS Project appropriate to achieve the Project Baseline. As specified in

the Project Management Plan, the Council will be chaired by the LCLS Project Director and will meet once per month, or spontaneously should the need arise.

2.4 Reporting

LLNL will provide all necessary data to support the DOE-approved LCLS Project Management Control System. LLNL will submit monthly progress reports, including schedule status and earned value for each of its work packages. These reports will contain brief descriptions of technical progress in all major areas, organized by "work package," along with an indication of key items for resolution in the next reporting period. Incurred costs and commitments will be reported by WBS category for the total LLNL effort. The report will be submitted on or before the tenth of the following calendar month to the LCLS Project Office.

2.5 Funding

Transfer of funds from SLAC to LLNL will be via DOE Financial Plan Transfers (hereinafter referred to as LCLS project funding). Funding will typically be transferred at six-month intervals to provide timely adjustments as may be required to recognize changes in either the Scope of Work (via future Amendments to this MOU) or the definition of individual work packages (via Addenda to this MOU).

2.6 Full Cost Recovery

It is understood that LLNL is operated by the Department of Energy as a full cost recovery facility. Amendments to this MOU will be issued in response to events such as major changes to the Scope of Work associated with rebaselining of the project, modifications to the project funding profile, or reassignments based on SLAC LCLS Project Office directives. Any such Amendments will be subject to the provisions of the LCLS project change control procedures. LLNL will respond as quickly as possible, within DOE guidelines. However, LCLS project funding will cover all costs incurred as a result of work performed with the approval of, and on behalf of, the LCLS project.

2.7 Intellectual Property

Rights with regard to intellectual property are regulated, on the SLAC side, by the Trustees of Leland Stanford Junior University and the U.S. Department of Energy, and on the LLNL side, by the Regents of the University of California and the U.S. Department of Energy. “Intellectual property” includes but is not limited to inventions, technical data, and software. Intellectual property created exclusively by one party shall be exclusively the intellectual property of that party. Intellectual property created by collaboration between SLAC and LLNL shall be the joint intellectual property of both parties.

Each party hereto shall have, with regard to both intellectual property exclusively developed by the other party and intellectual property collaboratively developed, a nonexclusive, nontransferable, irrevocable, paid up (royalty free) right and license to the noncommercial use of that intellectual property in the design, construction, and operation of a free electron laser, or in such other noncommercial application(s) as may be desired by either party.

Rights with regard to commercialization of exclusively developed or created intellectual property are retained by the party that exclusively developed or created that intellectual property; commercialization of intellectual property jointly developed or created by LLNL and SLAC shall be jointly pursued. The U.S. Department of Energy has such rights in the intellectual property developed by the parties to this MOU as are separately set out in its independent contract with each party.

2.8 Scientific Publication

All work covered by this MOU will be unclassified. Publications will be collaborative, although either Party has the right to publish information in part or in whole, independent of the other. All publications and all intellectual

property jointly developed under this collaboration using DOE funds will respect SLAC and LLNL procedures, Stanford University's contract DE-AC03-76-SF00515 and the Regents of the University of California's contract

W-7405-ENG-48 with the U.S. Department of Energy, which requires that all publications receive prior copyright and invention review by the authors' home institution.

2.9 Amendments

This MOU may be modified or amended from time to time by written agreement of both Parties.

2.10 Overhead

Each partner laboratory shall set indirect costs charged to the LCLS project in accordance with their disclosed cost accounting practices in order to: 1) ensure the appropriate causal/beneficial relationship of indirect costs applied to the project; 2) minimize the fluctuations in the indirect cost charges over the life of the project. The accounting treatment for indirect costs will be reviewed during the annual negotiations on the projected work plans between LLNL and LCLS management.

2.11 Contingency

Management and maintenance of contingency for the LCLS project is the responsibility of the SLAC LCLS Project Office and will be done in accordance with the change control process outlined in the Project Management Plan.

2.12 Equipment Ownership

All equipment items bought or fabricated using DOE-SLAC funds will be the property of DOE-SLAC and will be capitalized by SLAC. Any equipment purchased or fabricated using DOE-LLNL funds, will be the property of DOE-LLNL and will be capitalized by LLNL. All equipment fabricated using LCLS Project funds as part of the Project technical baseline, and installed at SLAC as part of the LCLS Facility, will upon acceptance for installation become the property of DOE-SLAC and will be capitalized by SLAC.

2.13 Public Information Coordination

Subject to the Freedom of Information Act (5 U.S.C. 552), decisions on the disclosure of information to the public regarding the LCLS project shall be made by the SLAC Director and the SLAC LCLS Project Director following consultation with LLNL representatives.

2.14 Project Staffing

LLNL Management will select a Project Task Manager and provide a project management structure, subject to approval by LCLS Management.

3.0 MOU Implementation

3.1 Enactment

This document, when properly executed, will supersede any earlier versions of this MOU.

3.2 Effective Date

This Memorandum of Understanding shall become effective upon the latter date of signature of the parties. It shall remain in effect until superseded or until LCLS Project completion, whichever occurs first.

3.3 Approvals

The undersigned concur in the terms of this Memorandum of Understanding:

John Galayda
SLAC LCLS Project Director

13 SEPT 2002
Date

Jonathan Dorfan
Director, SLAC

9/22/02
Date

William H. Goldstein
Associate Director, LLNL
Physics and Advanced Technologies

9/6/02
Date

Michael R. Anastasio
Director, LLNL

9/9/02
Date

Technical Addendum A.
to the
Memorandum of Understanding
between

Stanford Linear Accelerator Center

and
Lawrence Livermore National Laboratory

August 10, 2002

A.0 Specific Provisions

This addendum defines technical and management responsibilities of Lawrence Livermore National Laboratory as a participant in the Linac Coherent Light Source Project.

A.1 Statement of Work

LLNL will carry out design and fabrication activities in the areas of x-ray transport, optics and diagnostics. Particular activities and deliverables will be specified and agreed upon by the LLNL LCLS Project Head, the SLAC LCLS Project Director, the LLNL Director, and the SLAC Director semiannually via the Addenda to the Memorandum of Understanding. The general scope of the LLNL design and construction effort is described below:

A.1.1 Technical Responsibilities

SLAC and LLNL agree that LLNL will carry out Project Engineering Design activities in support of LCLS
:

- Development of specifications for LCLS systems and components
- Estimation of cost for LCLS systems and components
- Activities associated with optimizing design: alternatives assessment, prototyping, etc.
- Planning and scheduling resource allocations for construction activities
- Implementation of Project Management Controls System functions required by SLAC and DOE
- Other functions as necessary for compliance of LCLS with DOE project management guidelines

SLAC and LLNL expect that LLNL responsibility will extend to construction activities in areas for which LLNL has carried out Project Engineering Design.

A.1.2 Management Responsibilities

SLAC and LLNL agree that LLNL has management responsibility for the Project Engineering Design and construction of the X-ray Transport, Optics and Diagnostics system, identified by the work breakdown structure element 1.3.1. LLNL has agreed to utilize SSRL personnel and resources to discharge its management responsibility for WBS element 1.3.1.5, entitled “Crystals and Gratings”.

A.2 Work Package Definition

At this time the overall definition of the LLNL scope of work for the LCLS is that described in Chapter 9 of the LCLS Conceptual Design Report, SLAC R-593, dated April 2002, and WBS 1.3.1 of the associated cost estimate of April 2002. It is understood that this working definition is subject to revision based on DOE guidance and on progress of the PED process to maturity.

Specific near-term LCLS project engineering design (PED) and construction activities to be carried out by LLNL will be defined and updated at least semiannually in addenda to the SLAC-LLNL Memorandum of Understanding.

Appendix B

WBS Dictionary

WBS Dictionary

1.0 LCLS CONSTRUCTION PROJECT

1.1 **Project Physics, Management and Administration.** This WBS covers the project management, planning and organization function of the PED and construction phases (TEC) of the LCLS Project.

1.2 **Injector System.** The injector generates the electron beam and accelerates it to 135 MeV. This system includes the laser, optical transport, the electron gun, the accelerator sections, the solenoids and other magnets, the diagnostics including a diagnostic section at the end of the injector, the LCLS timing system, and the laser room. The interface to the Linac is at the downstream end of Dog Leg 1 (DL1), ending at the valve at the entrance to linac section L1.

1.3 **Linac System.** The Linac accelerates the electron beam while preserving the transverse emittance and compressing the longitudinal size. This element includes modifications to the last third of the existing SLAC linac, Bunch Compressor 1 (BC1), Bunch Compressor 2 (BC2), beam transport to the Undulator (LTU), beam transport after the undulator, bend magnets and beam dump, the bypass system for transporting test beams to end station A, and diagnostics including characterizing both the electron and x-ray beams as they pass through the undulator. The interface with the undulator is a vacuum flange at each end of the undulator. This element includes the common beam line beyond the undulator for the electrons and x-rays until the electrons are deflected enough for an interface to the x-ray beam line.

1.4 **Undulator System.** The Undulator System Project Costs, including undulator magnets and supports, undulator diagnostics, vacuum systems, and controls for the undulator equipment are included herein. Integration and installation are also included within this area. Total cost for the LCLS undulator system planning, project management, design, construction, and installation are summed at this level.

1.5 **X-ray Transport and Diagnostic System.** The XTOD includes mechanical and vacuum systems for the x-ray beam path, attenuators, x-ray optics and x-ray diagnostics required for manipulation and characterization of the x-ray beam downstream of the undulator. "Manipulation" includes collimation, attenuation, focusing, splitting/delaying, turning, and monochromatizing. "Characterization" includes measurement of x-ray beam properties as necessary for commissioning and operation of the LCLS.

1.6 **X-ray End Station System.** This element includes the infrastructure required to integrate x-ray experiments with the LCLS source and conventional facilities. Specifically, this includes safety systems, computer and network systems, experimental chambers, synchronized laser systems, and prototype detectors that will be used by most of the foreseeable LCLS experiments. It also includes additional sample handling equipment needed for the first studies of FEL-atom interactions (Atomic Physics experiments).

1.7 Unused

1.8 Unused

1.9 **Conventional Facilities.** The Conventional Facilities for the Linac Coherent Light Source (LCLS) will include renovations to the existing SLAC facilities and the development of new facilities. Included will be all major systems and subsystems contained herein that will be required to support the facilities related to the LCLS programmatic requirements. The scope of the WBS will include 13 elements: Sector 20 Injector Facilities, Magnetic Measuring Facility, Main Control Center Modifications, Linac Upgrades, Beam Transport Hall, Research Yard Modifications, Undulator Hall, Front End Enclosure, Beam Dump, Near Experimental Hall, X-Ray Transport & Diagnostic Tunnel, Far Experimental Hall and the Free Electron Laser Center. Activities included within these elements are, site preparation and development (including establishment of survey monuments for site alignment), beam line housings including a beam dump, renovations to existing facilities, buildings, service buildings, utility systems (including cooling systems), fire protection systems, roads, sidewalks, landscaping, berms, fencing and parking areas.

2.0 R&D, SPARES, COMMISSIONING (OTHER PROJECT COSTS)

2.1 **Project Management, Planning and Administration.** This WBS covers the project management, planning and organization function of the R&D, Spares and Commissioning (OPC) phases of the LCLS Project.

2.2 **Injector System.** This WBS covers effort and costs associated with R&D, Spares, and Commissioning of the Injector System.

2.3 **Linac System.** This WBS covers effort and costs associated with R&D, Spares, and Commissioning of the Linac System.

2.4 **Undulator System.** This WBS covers OPC area for spares plus any R&D and commissioning for all elements including undulator magnets and supports, undulator diagnostics, vacuum systems, and controls for the undulator equipment are included herein.

2.5 **X-ray Transport and Diagnostic System.** This WBS covers effort and costs associated with R&D, Spares, and Commissioning of the XTOD System.

2.6 **X-ray End Station System.** This WBS covers effort and costs associated with R&D, Spares, and Commissioning of the X-ray End Station System.