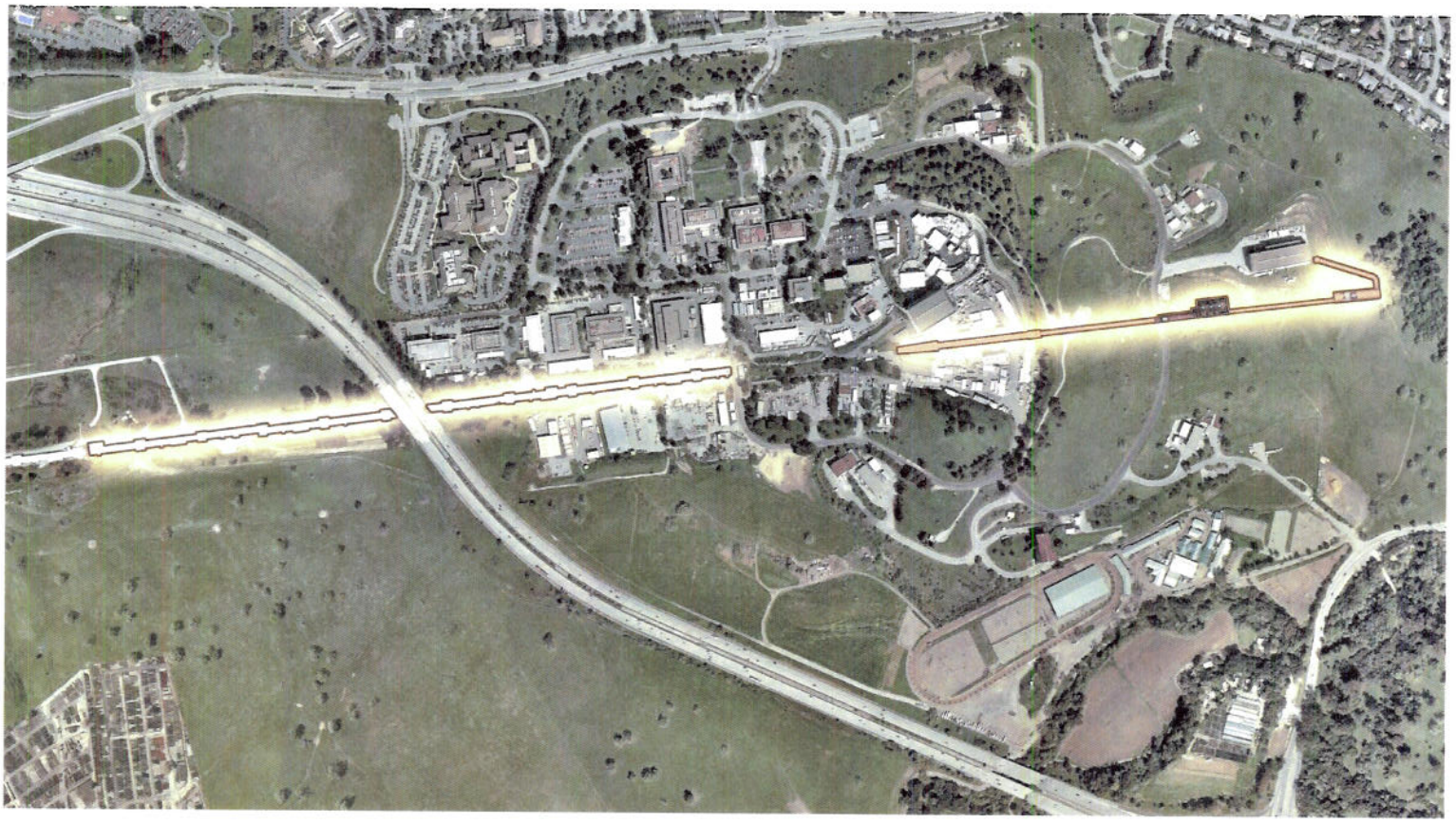
Project Execution Plan for the Linac Coherent Light Source



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Stanford Linear Accelerator Center

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Revision Record

	Description	Date
Revision 0	Preliminary Project Execution Plan for Approval of Preliminary Baseline (CD-1)	September 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)	March 2005
Revision 2	Revised Project Execution Plan for Approval of Start of Construction (CD-3b)	March 2006
Revision 3	Revised Project Execution Plan reflecting the Directed Change to the cost and schedule baselines as a result of the delay and reduction in funding caused by the FY2007 Continuing Resolution; and to reflect renovation of 2 existing buildings to fulfill office functionality in support of LCLS operation instead of new construction.	November 2007

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1. INTRODUCTION

1.1 Overview

The purpose of the Linac Coherent Light Source (LCLS) Project is to provide laser-like radiation in the x-ray region of the spectrum that is 10 billion times greater in peak brightness than any existing coherent x-ray light source. This advance in brightness is similar to that of a synchrotron over a 1960's laboratory x-ray tube. Synchrotrons revolutionized science across disciplines ranging from atomic physics to structural biology. Advances from the LCLS are expected to be equally dramatic. The LCLS Project will provide the first demonstration of an x-ray Free Electron Laser (XFEL) in the 1.5 - 15 Ångstrom range and will apply these extraordinary, high-brightness x-rays to scientific problems. The LCLS experimental program will commence with: measurements of the x-ray beam characteristics and tests of the capabilities of x-ray optics; instrumentation; and techniques required for full exploitation of the scientific potential of the facility. This will be the world's first such facility.

A separate Major Item of Equipment project, the LCLS Ultrafast Science Instruments (LUSI), will design and fabricate additional instrumentation to capitalize on the unique capabilities of the LCLS to further the experimental program.

The LCLS is based on the existing Stanford Linear Accelerator Center (SLAC) linac. The SLAC linac can accelerate electrons or positrons to 50 GeV for colliding beam experiments and for nuclear and high-energy physics experiments on fixed targets. At present, the first two-thirds of the linac is being used to inject electrons and positrons into PEP-II, and the entire linac is used for fixed target experiments. When the LCLS is completed, the latter activity will be limited to 25 percent of the available beam time and the last one-third of the linac will be available for the LCLS a minimum of 75 percent of the available beam time. For the LCLS, the linac will produce high-brightness 5 - 15 GeV electron bunches at a 120 Hertz repetition rate. When traveling through the new 120 meter long LCLS undulator tunnel, the electron bunches will amplify the emitted x-ray radiation to produce an intense, coherent x-ray beam for scientific research.

The LCLS makes use of technologies developed for SLAC and the next generation of linear colliders, as well as the progress in the production of intense electron beams with radiofrequency photocathode guns. These advances in the creation, compression, transport, and monitoring of bright electron beams make it possible to base this next generation of x-ray synchrotron radiation sources on linear accelerators rather than on storage rings.

The LCLS will have properties vastly exceeding those of current x-ray sources (both synchrotron radiation light sources and so-called "table-top" x-ray lasers) in three key areas: peak brightness, coherence (i.e., laser-like properties), and ultra-short pulses. The peak brightness of the LCLS is 10 billion times greater than current synchrotrons, providing 10^{11} x-ray photons in a pulse with duration of less than 230 femtoseconds (10^{-15} seconds). These characteristics of the LCLS will open new realms of scientific application in the chemical, material, and biological sciences.

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, authorities 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 Order 413.3A, *Program and Project Management for the Acquisition of Capital Assets.* In accordance with DOE Order 413.3A, the LCLS is subject to the requirements specified for "Non-Major System Projects". The Director, Office of Science (SC-1) is the Acquisition Executive (AE).

This revised PEP documents plans for the design, fabrication, construction and pre-operational phases of the project. It establishes the revised cost and schedule baselines due to the Directed Change as a result of the FY2007 Continuing Resolution, the organization and technical scope, frames the underlying principles for managing LCLS, provides details related to project authority, approval and funding; as well as the details of management structure.

1.3 Approval and Revisions

The initial approval of the PEP occurred as an element of Critical Decision 2b (CD-2b), Approval of Performance Baseline. Given the revised TPC of $420M, SC-1 is the approval authority for the revised PEP. The PEP will be reviewed annually and updated to incorporate changes as necessary and appropriate.

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. This will allow discoveries in photon science at the frontiers of the ultra-small and ultra-fast in a wide spectrum of physical and life sciences.

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" (November 2003).* 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 DOE 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). The LCLS CD-0, the Mission Need Statement, was approved in FY2001.

3. PROJECT DESCRIPTION

The LCLS project is constructed on the SLAC site such that future expansion of the LCLS will be possible. The LCLS 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. 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 replaced by a Beam Transfer Hall (BTH). The undulator system will be installed in a below grade tunnel with associated equipment. Provisions will be made for x-ray endstation enclosures. Two experimental halls will be constructed. A Near Experiment Hall (NEH) will be constructed near the PEP ring road and a Far Experiment Hall (FEH) will be constructed further east. Two existing SLAC buildings will be renovated to provide office space for operations staff when LCLS becomes operational. Also, the LCLS project will fabricate the Atomic, Molecular and Optical (AMO) physics instrument for installation in NEH.

The LCLS Ultrafast Science Instruments (LUSI) project will design and fabricate 3 additional instruments to capitalize on the unique capabilities of the LCLS to further the experimental program. This Major Item of Equipment project is separately funded by the Office of Basic Energy Sciences.

The LCLS project has been organized into a Work Breakdown Structure (WBS) for purposes of planning, managing and reporting project activities. The project WBS is shown in Table 1. Work elements are defined consistent with discrete increments of project work and the planned method of accomplishment. A WBS Dictionary is maintained by the project as a separate document which defines the activities to the lowest WBS level. Figure 1 depicts the LCLS on the SLAC site with identified level 2 WBS.

Table 1
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 Other Project Costs (R&D, Spares, Commissioning)
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
2.7 Unused
2.8 Unused
2.9 Conventional Facilities

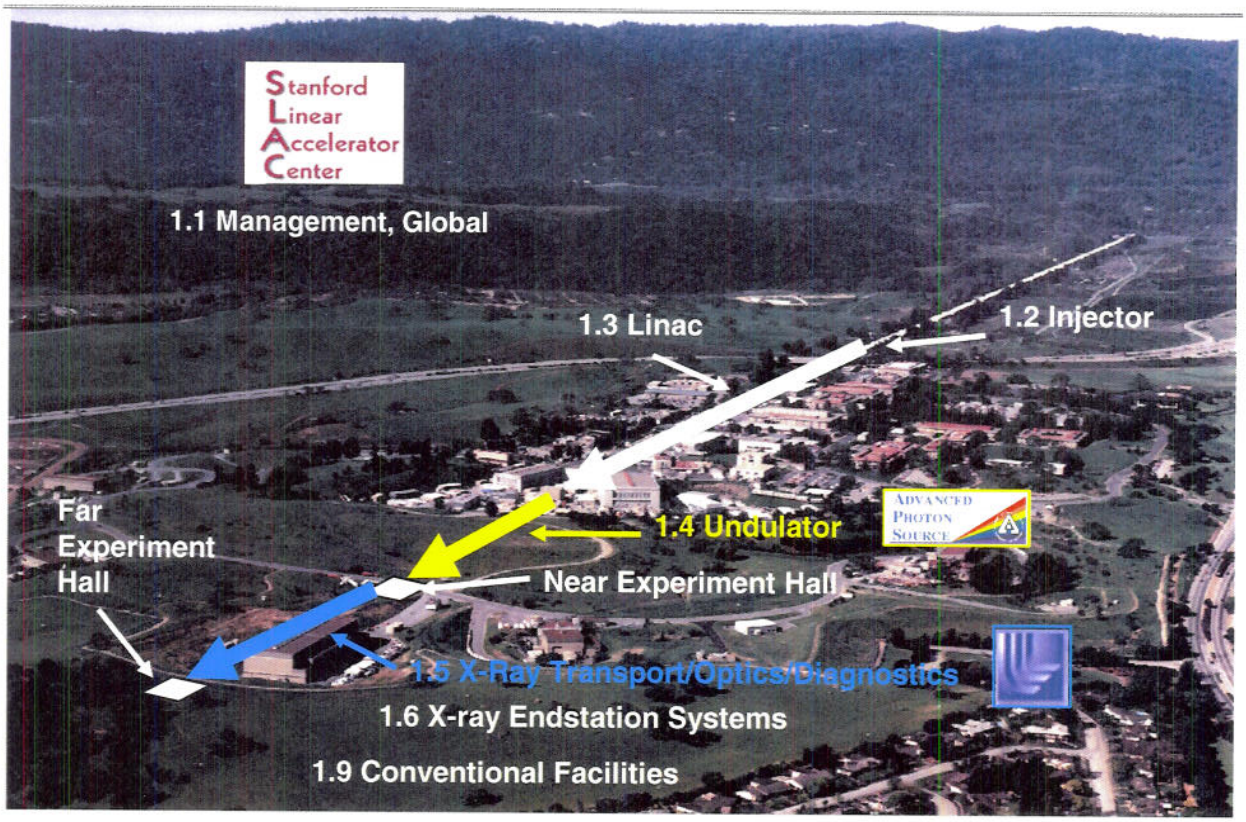
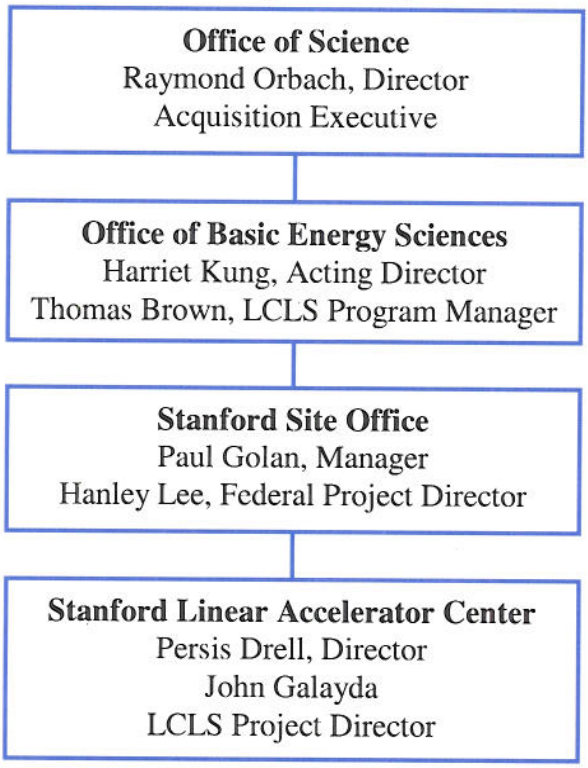


Figure 1

4. ORGANIZATION AND RESPONSIBILITIES

Office of Science is the DOE program office responsible for the LCLS project, and SC Office of Basic Energy Sciences (BES) provides federal oversight and funding to SLAC for the LCLS project 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, design, construction, and operation of the LCLS. The organizational lines of authority and accountability for the LCLS project are shown in Figure 2. The roles, responsibilities, and authorities of the relevant managers are described below.

Figure 2
Project Management Organization



4.1 Department of Energy

Director, Office of Science

The Director, Office of Science is the Acquisition Executive (AE) for the LCLS project. As such, the AE 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:

- Chairs the ESAAB Equivalent Board.
- Approves Critical Decisions and Level 1 baseline changes.
- Approves the Project Execution Plan.

- Delegates approval authority for Level 2 baseline changes to the Federal Project Director.
- Conducts Quarterly Project Reviews.
- Ensures independent project reviews are conducted.

Office of Basic Energy Sciences (SC-22)

Under the Energy Policy Act of 1992, the Director for Basic Energy Sciences 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-22.3) has direct responsibility for providing funding, and programmatic guidance to the LCLS project. The LCLS Program Manager, in SC-22.3, is the primary point of contact with the following responsibilities:

- Oversees development of project definition, scope and budget.
- Prepares, defends, and provides project budget with support from the field organizations.
- Reviews and provides recommendations to the AE on Level 0 and 1 baseline changes.
- Monitors Level 1 project milestones.
- Participates in Quarterly Reviews, ESAAB Equivalent Board meetings, and project reviews.
- Ensures ES&H policies and requirements are appropriately applied to the project.
- Coordinates with other SC Staff offices, HQ program offices and the OECM.

Stanford Site Office (SSO)

The SSO reports to the Office of Science and administers the 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 Manager delegates responsibility and authority for execution of the LCLS project to the Federal Project Director whose responsibilities include:

- Day-to-day oversight of the project and provides direction to ensure its timely execution.
- Monitors, reviews, evaluates, and reports on the performance of the project against established technical, cost, and schedule performance baselines.
- Ensures environment, safety and health (ES&H) is integrated into the project and that the applicable requirements are implemented effectively.
- Monitors Level 1 and Level 2 project milestones.
- Leads the Integrated Project Team.
- Approves Level 2 change control proposals as delegated by the AE. Review and provide recommendations to the AE for Level 1 and 0 change control proposals.
- Authorizes use of project contingency in accordance with the levels described in this PEP.
- Participates in Quarterly Project Reviews, ESAAB Equivalent Board meetings, and project reviews conducted by the LCLS project and DOE HQ.
- Conducts management meetings to monitor and review status of project activities.
- Maintains project data in the DOE Project Assessment and Reporting System (PARS).
- Issues Project Directive Authorizations for disbursement of funds and work authorizations.
- Prepares project documents such as the Project Execution Plan, Acquisition Strategy (formerly the Acquisition Execution Plan) and Project Quarterly Reports.

- Coordinates matrix support from the SC Integrated Support Centers.
- Prepares and submits budget and funding documents to the BES program manager. (e.g. Construction Project Data Sheet)
- Ensures interface and coordination of requirements with the LUSI project

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-AC02-76SFO0515. 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 is organized as a Division of SLAC. The LCLS Project Director, as well as being the Associate Laboratory Director of the Division, 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. The LCLS organization chart is shown in figure 3. 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 project activities are conducted in a safe and environmentally sound manner.
- Ensures 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.
- Requests and coordinates internal and external peer reviews of LCLS.
- 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.
- Manages the interface and coordination of requirements with the LUSI project

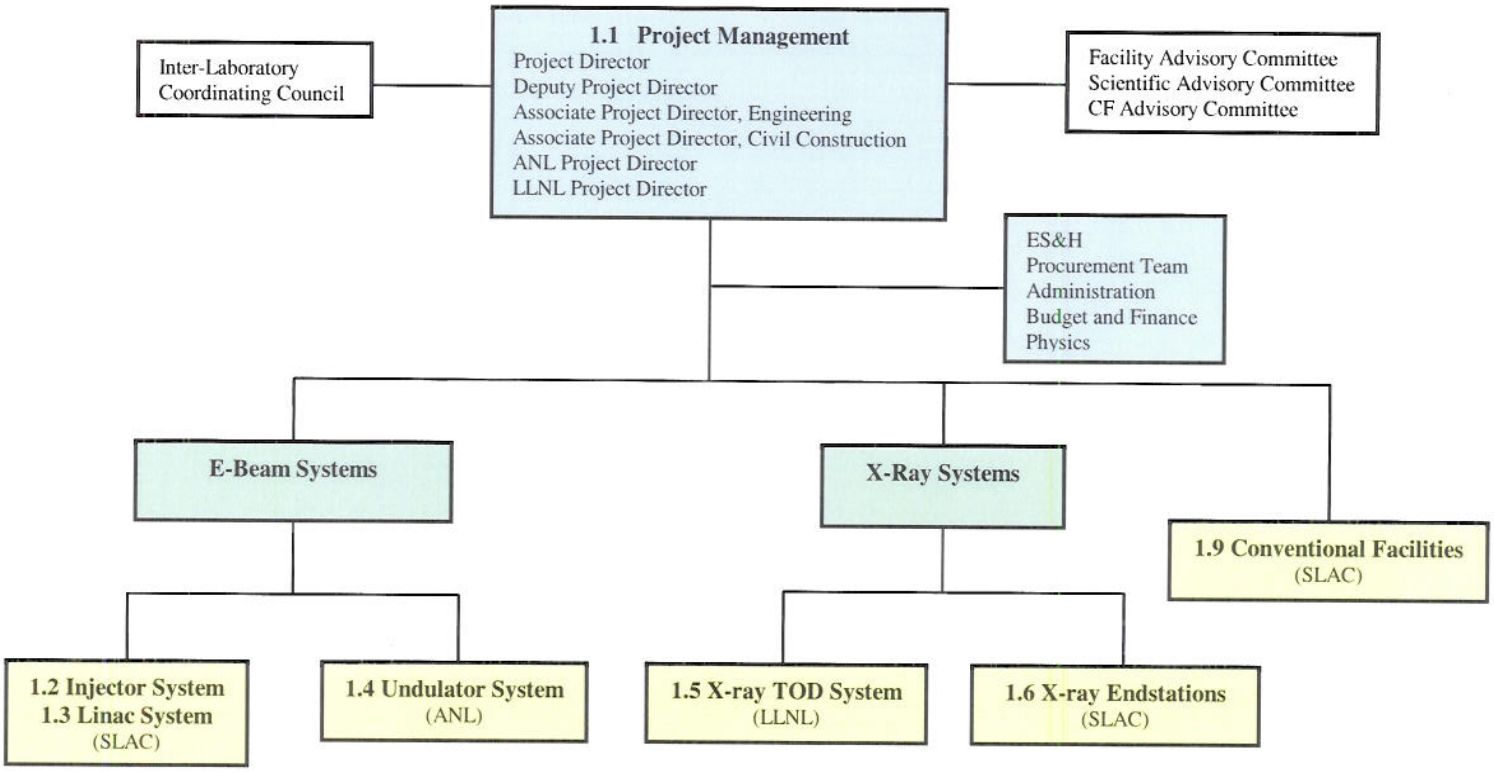


Figure 3 –*SLAC-LCLS Organization*

4.3 Collaborating Institutions

The LCLS project is a collaboration between SLAC, ANL, and LLNL. ANL is responsible for the Undulator System and LLNL is 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 B).

4.4 Inter-Laboratory Coordinating Council

The purpose of the Inter-Laboratory Coordinating Council (ILCC) is to address issues affecting resource allocation to the LCLS project at the partner laboratories, optimization of LCLS project resources with other laboratory activities, and coordination of partner laboratories' LCLS activities. Each laboratory Director appointed a representative to the ILCC with line responsibility for resource allocation to the LCLS project. The ILCC is chaired by the LCLS Project Director and meets bi-annually, or immediately when the need arises. The Federal Project Director is a participant at ILCC meetings.

4.5 LCLS Advisory Committees

The Facilities Advisory Committee (FAC) is a standing committee reporting to the SLAC Director and to the LCLS Project Director to provide advice on technical, strategic planning and

safety issues important to the success of LCLS construction. The FAC meets and publishes a status report on the LCLS project bi-annually.

The Scientific Advisory Committee (SAC) is a standing committee reporting to the Photon Science Division Director and the LCLS Project Director. It provides advice as needed for planning the LCLS scientific research program. The SAC meets and publishes a status report on the LCLS scientific program bi-annually.

The Conventional Facilities Advisory Committee (CFAC) is a standing committee appointed by the LCLS Project Director to provide guidance on the LCLS conventional facilities aspect of the project. The CFAC meets on an as needed basis to provide advice on the conventional facilities. A report is published after meetings.

4.6 Project Management Oversight Group

Recognizing the importance of the LCLS project, the SLAC Laboratory Director established a Project Management Oversight Group (PMOG) to carry out monthly status reviews to keep the Director and Senior Management Team informed of the status of the project, short term and intermediate term goals, problem areas, and resource limitations/needs. The reviews will cover programmatic issues of cost, funding, schedule, resources, and planning. Technical issues will be reviewed as necessary to evaluate their impact on the programmatic issues.

4.7 Integrated Project Team

The purpose of the Integrated Project Team (IPT) is to support the Federal Project Director (FPD) for the management and execution of the LCLS project. The IPT is led by the LCLS FPD and comprised of DOE and SLAC staff. 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. The IPT Charter identifies the team members and their roles and responsibilities for the oversight and management of the LCLS project.

IPT Charter

The LCLS IPT is committed to support the FPD in meeting the scope, cost and schedule baselines of the project while maintaining safety of the workers, the public and the environment. The charter of the IPT is to provide effective leadership and guidance to the LCLS project. The project will be executed through teamwork, clear identification of roles, responsibilities and authorities; accurate and timely reporting of project status; open and honest communications; and professional accountability by all IPT members. The membership of the IPT will change as the project progresses and support needs change.

The core members of the LCLS IPT are:

LCLS Federal Project Director, DOE-SSO
LCLS Deputy Federal Project Director, DOE-SSO

LCLS Program Manager, DOE-BES
LCLS Project Director, SLAC
LCLS Deputy Project Director, SLAC

The responsibilities of the IPT core members are delineated in sections 4.1 and 4.2 above.

The following staff will be members of the IPT depending on the phase of the project:

DOE Contracting Officer, DOE-SSO
DOE ES&H Coordinator, DOE-SSO
ANL-LCLS Project Director
LLNL-LCLS Project Director
LCLS Associate Project Director, Engineering, SLAC
LCLS Associate Project Director, Civil Construction, SLAC
LCLS ES&H Coordinator, SLAC
LCLS Procurement Manager, SLAC

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

Roles and Responsibilities

The FPD leads the IPT in executing the life cycle management for the project. The FPD has the following responsibilities:

- Provide IPT guidance
- Communicate project goals and requirements
- Conduct special IPT meetings when necessary
- Facilitate issue resolution
- Assess project performance with IPT input

IPT members are drawn from DOE and SLAC to work together in reaching the common goal of successfully executing the LCLS project within cost and schedule in a safe and responsible manner. IPT responsibilities include:

- Provide support to the FPD
- Establish effective working relationship between DOE and SLAC
- Develop and/or participate in project planning, baseline development and contracting
- Ensure all project interfaces are identified, defined, and managed during project execution
- Participate in project reviews, audits and appraisals, when necessary
- Prepare, review and comment on project documentation and Critical Decision packages in a timely manner
- Review and assess project performance and status against the project performance baseline

- Identify and resolve issues
- Plan and participate in ES&H oversight and accelerator readiness reviews
- Support the baseline change control process in reviewing change requests
- Support the preparation, review and approval of project completion and closeout documentation

Each member is responsible for supporting project performance, scope, schedule, cost, ES&H, and quality objectives; for identifying and meeting project milestones and commitments; and for maintaining effective communications with IPT members.

Communications

An important role of the IPT is to ensure open and timely communications of project progress and concerns with all levels of management. The LCLS FPD communicates project goals and purpose to the team; each team member's contribution to meeting the goals; and issues related to successful team performance. Open communication is encouraged to discuss and resolve issues transparently.

The core members of the IPT meet weekly, chaired by the LCLS FPD, to discuss project progress, emerging issues and resolution of problems. The meetings focus on current activities and priorities associated with the project. Identified Action Items are tracked to completion. Other IPT members are requested to participate on an as needed basis. An agenda is prepared for each meeting and minutes are documented.

5. RESOURCE REQUIREMENTS

5.1 Budget Authority

The FY2007 Continuing Resolution (CR) caused the project to evaluate impacts due to the delay and shortfall in funding. The impacts caused the project to delay procurements and defer activities which impacted the completion schedule. A significant contribution to the overall CR impact was that funding recovery would not occur until the FY2009 budget request.

The project prepared a revised baseline to address the Directed Change. The revised baseline funding requirement for the LCLS project is established in the Baseline Change Request and the revised FY2009 Construction Project Data Sheet as shown in Table 2 below. The new TEC is $352 million and Other Project Cost (OPC) is $68 million, which includes R&D, pre-operations, and spares. The TEC and OPC total to the TPC of $420 million. The re-baselined LCLS project schedule and milestone dates are dependent upon receiving project funds in accordance with the BA funding profile in Table 2.

Table 2; Linac Coherent Light Source Re-Baselined Funding Profile ($M)

	FY02	FY03	FY04	FY05[1]	FY06	FY07[2]	FY08	FY09	FY10	Total
TEC	0	5.93	7.46	49.67	84.69	101.16	51.35	36.50	15.24	352.00
OPC	1.50	0	2.00	4.00	3.50	13.00	15.50	17.00	11.50	68.00
TPC	1.50	5.93	9.46	53.67	88.19	114.16	66.85	53.50	26.74	420.00

[1] *FY2005 TEC funding includes $29,760,000 for long lead procurements.*

[2] *FY07 TPC funding reflects the ~$8M reduction as a result of the FY2007 CR and directed change.*

Figure 4 shows the estimated workforce needs for the LCLS project from July 2007 to the end of the project as a function of fiscal year. The workforce is ramping down after peaking in early FY2007. The figure depicts the integrated workforce from the three collaborating laboratories.

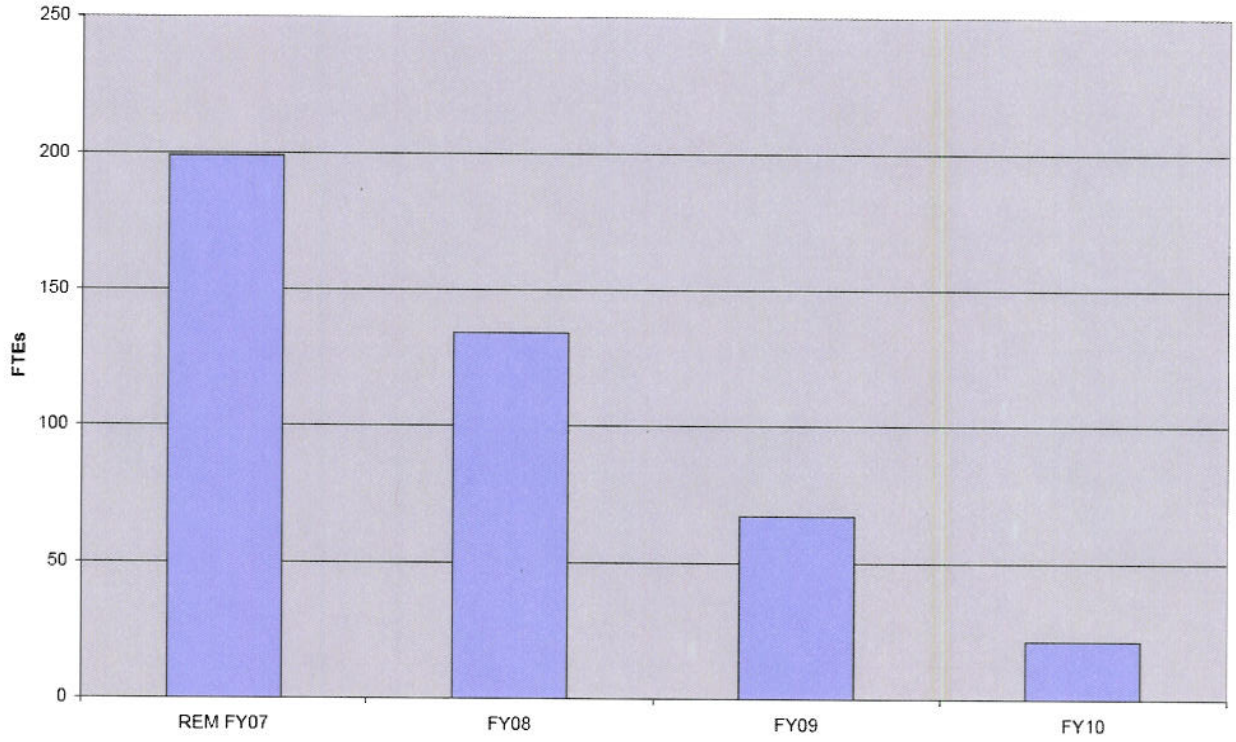


Figure 4 – LCLS Workforce

5.2 Work Breakdown Structure

All work required for completion of the LCLS project is included in the WBS shown in Table 1, beginning with the first year of funding in FY2002 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 maintained by the project as a separate document which defines the activities to the lowest WBS level.

5.3 Acquisition Strategy

The acquisition of the LCLS has been on-going since CD-3a approval (start of long lead procurement) in December 2004. Procurements are processed by SLAC for the M&O contractor, Stanford University. As initially planned, the project makes extensive use of existing SLAC facilities including the last one-third of the linear accelerator. The installations are conducted in phases and carefully coordinated with other research activities at the laboratory. Therefore, it was determined that it was not feasible for DOE to have a separate subcontract with another organization to manage this project. SLAC has the unique resources to manage and execute this project, with the collaborating laboratories.

The LCLS Project Director is responsible for accomplishing the project under the terms of Stanford University's contract with DOE. SLAC is executing those parts of the project associated with conventional facilities, the injection, acceleration and control of the electrons, and the endstations as well as overall system integration and management. ANL is responsible for the design and fabrication of the undulator and associated systems, and LLNL is responsible for the design, fabrication, qualification, and commissioning of the x-ray transport optics and diagnostics. The LCLS Project Director at SLAC using the Memoranda of Understanding in Appendix B and project reporting tools will control work at these laboratories.

Project activities are being accomplished to the extent feasible using fixed-price subcontracts selected on the basis of best value, cost and other factors. Details can be found in the LCLS Acquisition Execution Plan (currently known as the Acquisition Strategy), approved by the DOE Under Secretary on October 16, 2002, and the LCLS Advance Procurement Plan.

The construction of the LCLS major conventional facilities are also continuing under a fixed-price incentive contract. The procurement is a combined construction manager/general contractor (CM/GC) agreement. This relationship structure is similar to the American Institute of Architects A121/CMc contract delivery method. The CM/GC solicited and awarded subcontracts to perform the conventional facilities construction work. Actual cost was determined by competitive bid from subcontractors. The CM/GC awarded contracts after review and approval by the LCLS Project and the LCLS procurement group. Subcontract bid award amounts are then added to the CM/GC contract.

Table 3 provides a list of planned procurements greater than $500,000 for the remainder of the project. The planned obligation date and estimated value of each procurement is provided. The duration of all procurements will last less than one year.

Table 3 – Planned Procurements

WBS Level 2	Major Procurement	Planned Obligation Date	Estimated Value	# Years in Contract
1.3	Phase 4 Electrical (Install Cable Plant - UH, BD, FEE)	28-Feb-08	$1,000,000	< 1
1.5	Electrical (Install Cable Plant - X-ray)	12-May-09	$500,000	< 1
1.5	X-Ray Fluorescence Detector (Qty 2)	19-Nov-08	$600,000	< 1
1.6	Cornell Contract (MOU) - CY08	1-Jan-08	$1,207,175	< 1
1.6	XES Laser System	17-Oct-08	$693,500	< 1
1.9	Design/Build of FEH Hutches	8-Oct-08	$2,876,000	< 1
1.9	Construction of Bldg. 28	7-Oct-08	$1,600,000	< 1
1.9	Construction of CEH Offices	24-Sep-08	$2,600,000	< 1
1.9	Feeders to I&C PS Racks in SBs 2.1, 2.2, 2.3, & 3.1	17-Mar-08	$668,000	< 1

5.4 Work Authorization

DOE Order 413.3A defines five Critical Decisions that are formal determinations or decision points in a project life cycle 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 indicated below, Critical Decisions 2 and 3 have been phased for long lead procurements (LLP) that consisted of the injector, undulator, accelerator components, undulator measurement system and modification of existing facilities at SLAC for testing of the LLP equipment. This approach has reduced the technical and schedule risks for the project. The section below outlines the process and the approved Critical Decisions to date and the planned critical decisions. .

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

Critical Decision 1: Approve Alternative Selection and Preliminary Baseline Range
Authority: Director, Office of Science
Approval of CD-1 authorized the expenditure of Project Engineering and Design funds to proceed with Title I (preliminary) and Title II (final) design. The Director, Office of Science approved CD-1 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 Deputy 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 established the technical, schedule and cost performance baselines for the project. The Deputy Director, Office of Science approved CD-2b on April 8, 2005.

Critical Decision 3a: Approve Start of Long Lead Procurement
Authority: Director, Office of Science
Approval of CD-3a authorized the start of long lead procurement activities in FY 2005. The Deputy Director, Office of Science approved CD-3a on December 10, 2004.

Critical Decision 3b: Approve Start of Construction
Authority: Director, Office of Science
Approval of CD-3b will authorize the project to start full-scale construction of the LCLS. The Deputy Director, Office of Science approved CD-3b on March 17, 2006.

Performance Baseline Change Approval (Level 0)
Authority: Deputy Secretary (S-2)
Approval of the proposed performance baseline change re-establishes the cost and schedule baselines for the Project and re-sets the current variances accordingly. This proposed Baseline Change Proposal is primarily due to the Directed Change resulting from the FY2007 Continuing Resolution impacts on the Project. Planned approval schedule: December 2007

Critical Decision 4: Approve Start of Operations
Authority: Director, Office of Science
Approval of CD-4 will signify project completion and authorize operation of the facility.
Planned approval schedule: July 2010

5.5 Life Cycle Cost

Upon CD-4 approval, LCLS will go into full operation in 4Q FY2010. LCLS operation includes power and maintenance however, excludes programmatic research costs. It is expected that the facility will have a useful operating life of about 30 years.

The total life cycle cost (TLCC) for the LCLS is estimated at $2.74 billion over the anticipated 30-year useful life span. When performing the life cycle cost analysis, the sum total of direct, indirect, recurring, nonrecurring, and other related costs incurred or estimated to be incurred over the anticipated useful life span was considered.

More specifically, the TLCC includes the TPC of the LCLS Project. The operations and maintenance (O&M) costs makes up the balance of the TLCC costs. The O&M costs were based on past experience and are estimated to be $50 million in FY2011 dollars. The total O&M costs for the life span of the science program along with the TPC results in the estimated TLCC of $2.74 billion, using DOE Escalation Guidance.

The TLCC does not include decommissioning and demolition (D&D) costs of the LCLS facility after useful life. Any estimate of D&D cost is highly dependent upon what assumptions are made about reuse of equipment and facilities at SLAC, amount of material recycled, and amount of contaminated material. There is the possibility that the machine would undergo a major upgrade in the future and the experimental equipment would be reused instead of being decommissioned.

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 is held under the central 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 Request (BCR) to the LCLS Change Control Board (CCB). The BCR will include the reason for the change and the implications for cost, schedule, technical scope and system interfaces.

BCR approval levels 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 the SC-1 approves Level 1 changes as the Acquisition Executive. Level 0 changes are approved at the Secretarial level (S-2). Approval of the BCR will increase the baseline cost estimate(s) for that WBS element, and unless there are any offsets, it will reduce the available contingency by an equal amount. The LCLS Project Director will make every effort to find offsets within the project, without impacting the technical performance baseline, to minimize use of contingency. A change control log will be maintained by the project to document all approved BCRs.

6. PROJECT BASELINES

The project technical scope, cost and schedule performance baselines were initially established and approved at CD-2b. The FY2007 Continuing Resolution resulted in a Directed Change. A baseline change request (BCR) was prepared for approval by the Deputy Secretary. Once the

level 0 BCR is approved, the project will be measured against the revised cost and schedule baselines through completion. The Technical Baseline is not affected by this Directed Change. The following sections describe the baselines.

6.1 Technical Scope

The scope baseline of the LCLS project consists of 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 BTH. After the BTH, an Undulator Hall (UH) tunnel and associated equipment will be installed. Two new below grade experimental halls will be constructed. The NEH and the FEH will be built approximately 70 meters and 400 meters downstream of the UH, respectively. The NEH and the FEH will be connected by a tunnel that transports the x-ray beam. The instrumentation for the Atomic, Molecular, and Optical Physics (AMO) experiment will be fabricated as part of the project. To support operation of the LCLS, office space is required to house operations staff. Renovation of two existing SLAC buildings will provide the functional space required. Renovation of the existing buildings at SLAC was determined the most effective means for providing office space instead of construction of a new office building to mitigate risks of the high construction bids received for the civil construction. This approach takes advantage of the recent programmatic decision to shift the mission at SLAC from a High Energy Physics laboratory to Basic Energy Sciences. This engineered approach avoided significant cost to the Project and, as a result, increased the available contingency ensuring completion of the LCLS project without any impacts to the Key Performance Parameters and scientific capabilities of the facility.

Project Completion:

Project completion will be accomplished when the commissioning goals have been achieved. Prior to routine operations, a period of staged 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 goals that ensure LCLS systems are integrated and functioning as designed.

By way of demonstrating that all facilities are effectively integrated, the Commissioning Plan will include a measurement of the single-pulse x-ray spectral flux density in the Front End Enclosure just upstream of the Near Experimental Hall, at a minimum 10^6 photons/(mm^2 x 0.1%BW) at 1.5 Ångstrom wavelength. Measurement of this flux density will indicate that all accelerator, undulator, and beam transport components to the NEH have been installed and are working. Performance optimization of LCLS is expected to extend past the approval of CD-4.

Additional commissioning tests required for CD-4 include detection of x-rays in the Far Hall to confirm that the x-ray transport system to the endstations in the FEH is functional. These tests will indicate that the electron beam transport system is working properly, that the basic systems for transport of the x-ray beam are in place, that basic systems for characterization of the x-ray

beam are in place and functional, that full-energy beam can be achieved during routine operations, and thus that the facility is capable of functioning as an XFEL producing intense, coherent x-ray pulses.

CD-4 Deliverables:

Project completion (CD-4) will be accomplished when the scope defined in the WBS dictionary has been completed and demonstrated to be functioning by achieving the Key Performance Parameters listed below. The WBS Dictionary is under change control. After achieving the Key Performance Parameters, the project and DOE managers will recommend facility acceptance and approval of CD-4.

Key Parameters	**Performance**
Accelerator Facilities	
Electron energy	13 GeV
Electron charge	0.2 nano Coulomb
X-ray flux density at the FEE	Minimum of 10^6 photons/(mm^2 *0.1%BW)
Conventional Facilities	
LCLS Beam Line Area - Injector facility - Beam Transport Hall - Undulator tunnel - Near Experimental Hall - Photon transport tunnel - Far Experimental Hall	> 100,000 Total GSF
Experimental Facilities	
Physics instrument	One instrument installed and ready for commissioning with x-ray beam

6.2 Revised Cost Baseline

The Level 1 cost baseline was determined after preliminary (Title 1) design. After the FY2007 continuing resolution, the project revised the cost and schedule baselines. The revised Total Estimated Cost is $352 million and the Total Project Cost is $420 million. Table 4 shows the revised project TEC and OPC budget at WBS Level 2.

Table 4

WBS	System	Budget ($M)
1.1	Project Management	31.46
1.2	Injector System	23.87
1.3	Linac System	39.26
1.4	Undulator System	47.97

1.5	X-Ray Transport and Diagnostics	27.76
1.6	X-Ray Endstations	17.16
1.9	Conventional Facilities	132.38
	Total Base Budget	**319.86**
	Contingency	**32.14**
	TEC	**352.00**
2.1	Project Management	25.44
2.2	Injector System	5.34
2.3	Linac System	3.43
2.4	Undulator System	10.60
2.5	X-Ray Transport and Diagnostics	3.52
2.6	X-Ray Endstations	10.15
2.9	Conventional Facilities	1.52
	Total Base Budget	**60.00**
	Management Reserve	**8.00**
	OPC	**68.00**
	Total Project Cost	**420.00**

6.3 Revised Schedule Baseline

The Level 1 baseline milestones and Level 2 milestones are shown on table 5 below. 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 updated project schedule is shown in figure 5.

Table 5

Level I Baseline Milestones	Scheduled Date	Completion Date
CD-0 Approve Mission Need	June 2001	June 2001
CD-1 Approve Preliminary Baseline Range	October 2002	October 2002
CD-2a Approve Long-Lead Procurement Budget	May 2003	July 2003
CD-2b Approve Performance Baseline	April 2005	April 2005
CD-3a Approve Start of Long-Lead Procurement	December 2004	December 2004
CD-3b Approve Start of Construction	February 2006	March 2006
CD-4 Project Complete - Start of Operations	July 2010	

Level II Baseline Milestones[1]	Scheduled Date	Completion Date
WBS 1.1 - Project Management		
Prelim Safety Assessment (PSAD) Doc Comp	April 2004	April 2004
DOE External Independent Review (EIR) Complete	June 2004	June 2004
Fire Hazard Analysis Approved	June 2005	August 2005
Prelim Safety Assessment (PSAD) Doc Approved	February 2006	February 2006
Safety Analysis Document (SAD) Approved	August 2008	
LCLS ARR Complete (BTH thru FEH)	April 2009	
Initiate Early Experimental Operations[2]	September 2009	
WBS 1.2 - Injector		

Start Injector Commissioning (Drive Laser)	January 2007	January 2007
Start Injector Commissioning(UV Beam to Cathode)	April 2007	April 2007
Injector Laser Commissioning Review Complete	January 2007	December 2006
Injector Accelerator Readiness Review (ARR) Comp	January 2007	March 2007
WBS 1.3 - Linac		
Start Linac-to-Undulator (LTU) Commissioning	April 2009	
Linac (Li20-Li30) Ready for Commissioning	April 2008	
Linac (Li20-Li30) Commissioning Complete	September 2008	
Start Installation of Beam Transport Hall	February 2008	
WBS 1.4 - Undulator		
MMF Qualified & Ready to Measure Prod Undulators	August 2006	August 2006
Delivery of Undulator 1st Articles to MMF	July 2006	June 2006
Start Undulator Commissioning (1st Light)	July 2009	
Start Installation of Undulator Facility	February 2008	
WBS 1.5 - X-Ray Transport and Diagnostics		
Start FEE Commissioning with Beam	July 2009	
XT Start Tunnel Installation	May 2009	
First X-Rays into FEH	March 2010	
XT Start FEE Installation	August 2008	
WBS 1.6 - X-Ray Endstations		
First X-Rays into NEH	September 2009	
2-D Detector Shipped to SLAC	May 2009	
XE Start Installation in FEH	September 2009	
XE Start Installation in NEH	February 2009	
WBS 1.9 - Conventional Facilities		
Sector 20 Alcove Beneficial Occupancy	July 2006	April 2006
Linac Water/Power Available	July 2007	March 2007
Research Yards Mods Beneficial Occupancy	October 2006	August 2006
Beam Transport Hall Beneficial Occupancy	April 2008	
Undulator Facility Beneficial Occupancy	April 2008	
Front End Enclosure Beneficial Occupancy	April 2008	
Near Experimental Hall Beneficial Occupancy	April 2008	
X-Ray Transport Beneficial Occupancy	July /2008	
Far Experimental Hall Beneficial Occupancy	July 2008	
Central Utility Plant Beneficial Occupancy	April 2008	
Beam Path Project Close Out	September 2008	

[1] *Level 2 scheduled date includes ~2months float to the early finish milestone*

[2] *This level II milestone is approved by Director of the Office of Basic Energy Sciences.*

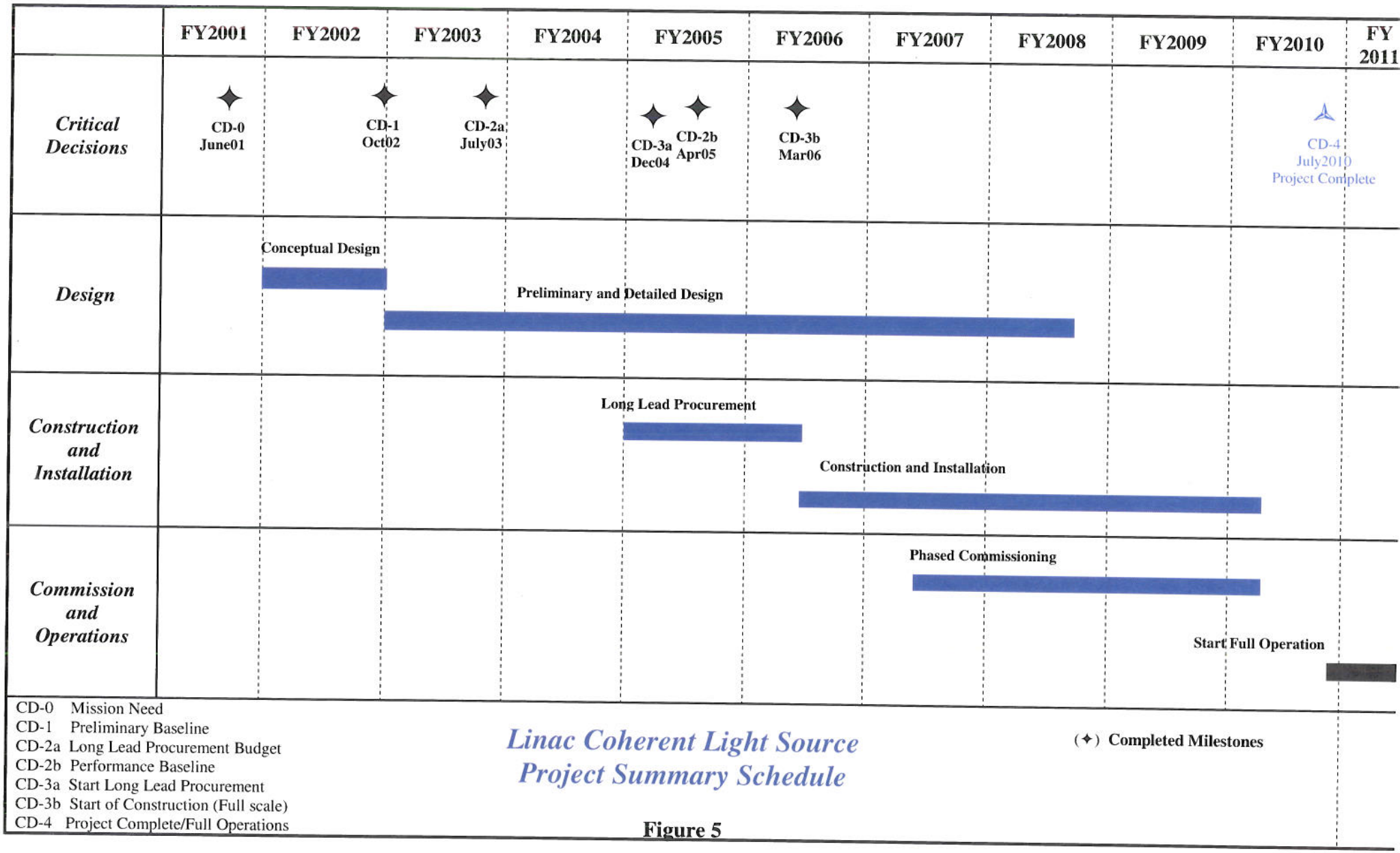

FY2001
FY2002
FY2003
FY2004
FY2005
FY2006
FY2007
FY2008
FY2009
FY2010
FY 2011
Critical Decisions
CD-0 June01
CD-1 Oct02
CD-2a July03
CD-3a Dec04
CD-2b Apr05
CD-3b Mar06
CD-4 July2010 Project Complete
Design
Conceptual Design
Preliminary and Detailed Design
Construction and Installation
Long Lead Procurement
Construction and Installation
Commission and Operations
Phased Commissioning
Start Full Operation
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 of Construction (Full scale)
CD-4 Project Complete/Full Operations
Linac Coherent Light Source
Project Summary Schedule
(✦) Completed Milestones

Figure 5

7. PROJECT MANAGEMENT, CONTROL, AND REPORTING

7.1 Project Performance

The LCLS Project Director monitors, tracks, and reports project progress to the Federal Project Director. Together they 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 BCR when a change in cost, schedule or scope exceeds any of the thresholds identified in Table 6.

The LCLS project implemented a project management control system (PMCS), in accordance with ANSI/EIA-748-A-1998, since CD-2b. This system provides the essential earned value information needed for management control of the project and maintains the database for progress reporting. The PMCS integrates the cost and schedule baselines and provides the tools to monitor project performance. The data from the PMCS is the basis for information entered into the DOE Project Assessment and Reporting System (PARS). The PMCS was reviewed by the Office of Engineering and Construction Management (OECM) in March 2006. The project submitted a corrective action plan (CAP) in June 2006 which was implemented. The PMCS is prepared for site-wide application at SLAC and accordingly DOE SSO is seeking a site-wide PMCS certification. Currently, OECM is re-evaluating the CAP and has not made a final determination for certifying the system.

7.2 Baseline Change Control Management

The LCLS project controls changes in functional and physical requirements and evaluates 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 promotes orderly evolution of the baseline design, and ensures the effect of changes on cost, schedule, and technical scope performance are properly evaluated and documented by project management. A BCR must be initiated when there will be an impact on any of the cost, schedule, or scope baselines. Thresholds for determining the BCR approval level during project execution are delineated in Table 6.

A Change Control Board (CCB) consisting of members of the LCLS project has been established. The board includes the 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 BCR actions are maintained in a change control log.

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

Table 6 - Baseline Change Control Thresholds

	Secretarial Acquisition Executive (S-2) (Level 0)	Acquisition Executive (SC-1) (Level 1)	Federal Project Director (Level 2)	LCLS Project Director (Level 3)
Technical Scope	A change in scope that affects the ability to satisfy the mission need, an inability to meet a Key Performance Parameter, or non-conformance with the current approved Project Execution Plan which must be reflected in the Project Data Sheet	Changes in siting or in the Key Design Parameters in section 6.1 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	A delay of 6 months or greater (cumulative) from the original project completion date	$\geq$ 3 months delay in any Level 1 milestones contained in section 6.3	Any delay in Level 1 milestones or $\geq$ 3 months delay in Level 2 milestones contained in section 6.3	Any delay in Level 3 milestones in the PMP or $<$ 3 months delay in Level 2 milestones contained in section 6.3
Cost	An increase in excess of the lesser of $25M or 25% (cumulative) of the original CD-2 cost baseline (TEC or TPC)	Any increase in the baseline TEC or TPC	The smaller cumulative change of $\geq$ $3M or 20% of any WBS Level 2 cost element in section 6.2[1].	Any increase $\geq$ $100K of any WBS Level 2 cost element in section 6.2

[1] *Level 2 approval is necessary when the cumulative change in cost of a WBS level 2 element increases above $3M or 20%, whichever is less. After level 2 approval, the level 2 baseline is set at the higher approved budget level and resets the cumulative changes to zero.*

7.3 Project Reporting

The LCLS Project Director submits a monthly project progress report to the Federal Project Director containing information about the overall progress of the project. The monthly report is submitted to the LCLS Program Manager. It discusses project cost and schedule performance, accomplishments, issues, and upcoming milestones. The report also includes the latest earned value data together with an explanation for any significant variances. The following data is reported: actual cost of work performed (ACWP), budgeted cost of work performed (BCWP), and budgeted cost of work scheduled (BCWS). Cost and schedule performance is evaluated and variances determined. In addition, the Estimate at Completion (EAC) will be evaluated and re-calculated on at least an annual basis.

Cost and Schedule variance thresholds used by the project are the PARS 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 Federal Project Director inputs monthly progress information into PARS and discusses significant variances or any unusual parameter values.

The Federal Project Director prepares a quarterly progress report and submits it to the LCLS Program Manager. The report highlights cost, schedule and technical performance; provides

status of completed milestones, and identifies completed and upcoming milestones; and discusses 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.
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 conducts internal project meetings and reviews. The purpose of the meetings is to provide project coordination and discuss system progress. Internal reviews are held to evaluate system and component designs.

The Federal Project Director holds weekly meetings with the LCLS Project Director and relevant staff to discuss project status, issues and current business. Additionally, there are weekly conference calls by LCLS management and the Federal Project Director with BES to provide project status updates, progress and discuss issues.

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

Formal DOE reviews of the project's cost, schedule, technical, ES&H, and management performance is conducted periodically by the Office of Project Assessment, SC-1.3, at the request of SC.

8. RISK MANAGEMENT

Risk management is an iterative process 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 life cycle. Risks identified include technical, cost and schedule risks. The recently revised LCLS Risk Management Plan (PMD 1.1-002-r2; August 2007) details the process for identifying, evaluating, mitigating, and managing risks in compliance with DOE Order 413.3A. Also, the Risk Registry, which tracks and

monitors the status of all project risks, has been updated as part of the level 0 BCR process. The risk registry is a living document under configuration control that is reviewed and updated monthly in coordination with the FPD.

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. LCLS follows SLAC Integrated Safety and Environmental Management System (ISEMS) and principles and the DOE Accelerator Safety Order, DOE O 420.2A. 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 is 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 conduct independent oversight and reviews of project activities. Work at the collaborating laboratories is 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 is 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 Preliminary Hazards Analysis report and their mitigation are 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 was approved on January 26, 2006 prior to authorizing start of full scale construction (i.e. prior to CD-3b). The PSAD forms 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. Accelerator Readiness Reviews (ARR) are conducted in phases as LCLS system commissioning progresses down the Linac. An

integrated ARR will also be completed prior to starting operations at NEH and FEH (i.e., before CD-4).

10. TECHNICAL ANALYSES

10.1 Value Engineering

Value Engineering (VE) studies are performed during LCLS design. The studies follow 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 perform VE evaluations throughout the design of the conventional facilities portion of the LCLS project. Additionally, the project conducts VE evaluations for the technical systems.

10.2 System Engineering

System engineering principles are employed in the development of the project from conceptual design through construction and transition to operations. In addition, specific interface control design documents are prepared to address system integration between LCLS and LUSI.

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. The LCLS will pursue the Leadership in Energy and Efficiency Design (LEED) certification, a voluntary national standard emphasizing state of the art strategies for sustainable site planning, water efficiency, energy efficiency and renewable energy, conservation of material and resources and indoor environmental quality.

10.5 Reliability, Maintainability, Operability and Quality Assurance

10.5.1 Reliability, Maintainability, and Operability

The conventional facilities designs have been reviewed for reliability, maintainability, and operability by the LCLS Project Director, the conventional facilities manager and relevant staff.

The primary objective of these reviews have been to ensure the development of systems that are 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 414.1C, 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 to implement the QA program requirements for the project, in accordance with the Quality Implementation Plan.

11. TRANSITION TO OPERATIONS

11.1 Final Inspection and Acceptance

As part of the the final inspection and acceptance, the following activities 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 spares, operations manuals, instructions, and guarantees
- Acknowledgment of completion and acceptance of work under subcontract

11.2 Commissioning and Operations

Once the facility is ready to produce an x-ray beam, a series of performance tests and commissioning will be undertaken to demonstrate that all components of the facility are working properly and in concert for producing x-rays. A Commissioning Plan will be prepared to define goals that ensure LCLS systems are integrated and functioning as designed.

The LCLS will transition to operations in a phased approach. As major parts of the facility are complete and achieve commissioning goals, that part of the facility will transition to "early" operation phase. As an example, in FY2008, upon completion of installation and commissioning of LCLS Linac through Bunch Compressor 2 (BC2), the entire LCLS Linac, up to the Beam Switch Yard (BSY), will be deemed "operational" and ready for taking the electron beam into the BSY. Once this milestone is achieved, a phased transition of project staff to LCLS Linac operation will commence.

Office of Science projects are scientific state-of-the-art facilities that require operational experience to achieve design operating parameters. Therefore, the commissioning goals are the performance requirements for project completion and closure of the line item construction

project. Following commissioning, experience gained operating the LCLS will allow SLAC to optimize the facility to achieve project design capabilities.

The DOE Program/Project team will conduct a Project Completion Review to meet the objective of the "operational readiness review" described in DOE Order 413.3A. This review and completion of Commissioning will be documented in a Project Completion Report. This report will serve as the basis for requesting the Acquisition Executive approval of CD-4 which will be the end of the construction phase of the project and the LCLS will enter the routine operations phase for research.

11.3 Lessons Learned

During the project, instances of "what worked" and "what did not work", 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. Acronym List
B. Memoranda of Understanding with ANL and LLNL

Appendix A

Acronym List

Abbreviation	Definition
ACWP	Actual Cost of Work Performed
AE	Acquisition Executive
AMOP	Atomic Molecular and Optical Physics
ANL	Argonne National Laboratory
ARR	Accelerator Readiness Review
AY	Actual Year
BCCB	Baseline Change Control Board
BCE	Baseline Cost Estimate
BCR	Baseline Change Request
BCWP	Budgeted Cost of Work Performed
BCWS	Budgeted Cost of Work Scheduled
BES	DOE Basic Energy Sciences
BTH	Beam Transfer Hall
CCB	Change Control Board
CFAC	Conventional Facilities Advisory Committee
CM/GC	Construction Manager/General Contractor
CPR	Cost Performance Report
CR	Continuing Resolution
DOE	U.S. Department Of Energy
EAC	Estimate at Completion
EA	Environmental Assessment
EIR	External Independent Review
EIS	Environmental Impact Statement
ES&H	Environment, Safety, and Health
ESAAB	Energy Systems Acquisition Advisory Board
FAC	Facilities Advisory Committee
FEH	Far Experiment Hall
FEL	Free Electron Laser
FONSI	Finding of No Significant Impact
FPD	Federal Project Director
GeV	Giga electron volt
HQ	Headquarters
ILCC	Inter-Laboratory Coordinating Committee
IPS	Integrated Project Schedule
IPT	Integrated Project Team
ISEMS	Integrated Safety and Environmental Management System
ISMS	Integrated Safety Management System
LCLS	Linac Coherent Light Source
LEED	Leadership in Energy and Efficiency Design
LLNL	Lawrence Livermore National Laboratory
LLP	Long Lead Procurement

LTU	Linac -to-Undulator
LUSI	LCLS Ultrafast Science Instruments
M&O	Managing and Operating
MOU	Memorandum of Understanding
NEH	Near Experiment Hall
NEPA	National Environmental Policy Act
OE	Operating Expenses
OECM	Office of Engineering and Construction Management
OMB	Office of Management and Budget
OPC	Other Project Cost
PARS	Project Assessment and Reporting System
PCM	Project Controls Manual
PEP	Project Execution Plan
PMCS	Project Management Control System
PMD	Project Manager Directive
PMOG	Project Management Oversight Group
PMP	Project Management Plan
PSAD	Preliminary Safety Assessment Document
QA	Quality Assurance
R&D	Research and Development
RMP	Risk Management Plan
SAC	Scientific Advisory Committee
SAD	Safety Assessment Document
SASE	Self-Amplified Spontaneous Emission
SC	Office of Science
SC-1	Director, Office of Science
SLAC	Stanford Linear Accelerator Center
SSO	DOE Stanford Site Office
TEC	Total Estimated Cost
TPC	Total Project Cost
VE	Value Engineering
WBS	Work Breakdown Structure
XFEL	X-Ray Free Electron Laser

Appendix B

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, 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, 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.