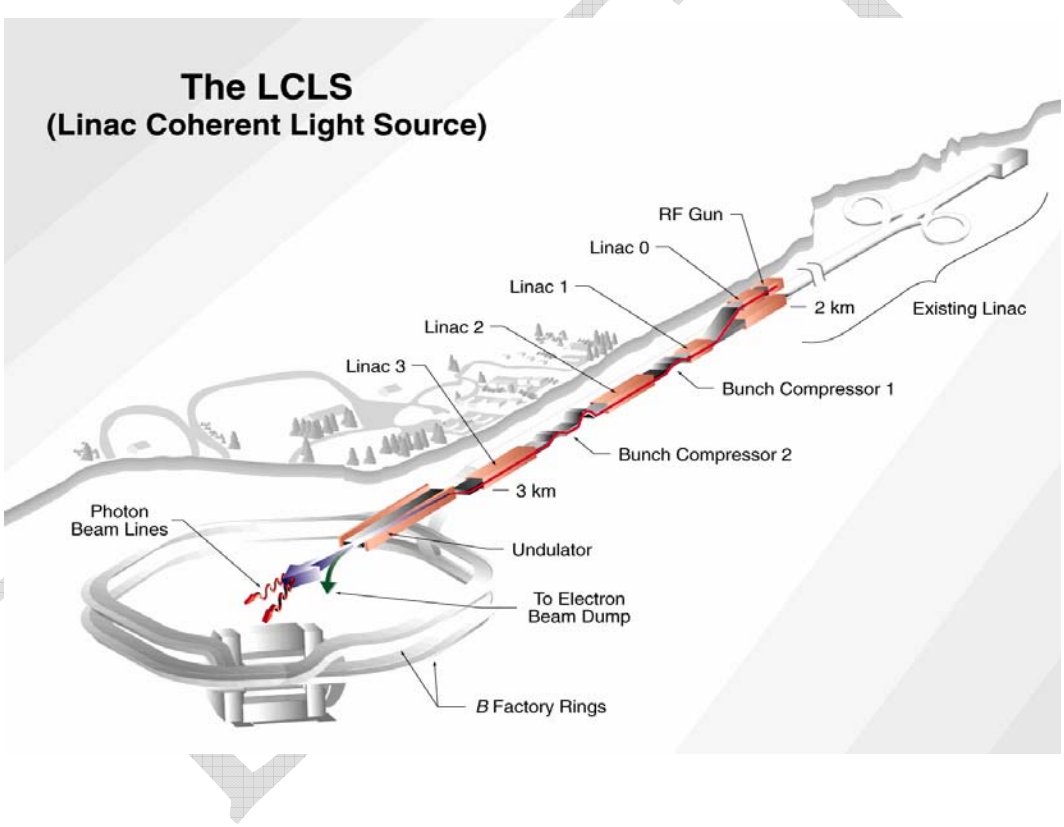
Linac Coherent Light Source (LCLS)

An X-Ray Free Electron Laser



Project Management Plan

PMD-001-rev0 – July 2004

Prepared for the US Department of Energy under contract numbers:

SLAC	DE-AC03-76SF00515
ANL	W-31-109-ENG-38
LLNL	W-7405-ENG-48

Submission and Approval

This Project Management Plan (PMP) defines the plans, organization and systems for managing the Linac Coherent Light Source (LCLS) Project at the Stanford Linear Accelerator Center (SLAC). The LCLS PMP is in accordance with the Department of Energy (DOE) M 413.3-1, *Project Management for the Acquisition of Capital Assets*, and subject to the requirements specified for projects with a Total Project Cost (TPC) of less than $400 million.

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List of Acronyms

Abbreviation	Definition
ACWP	Actual Cost of Work Performed
AE	Acquisition Executive
ANL	Argonne National Laboratory
AY	Actual Year
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
CPR	Cost Performance Report
DOE	U.S. Department Of Energy
EAC	Estimate at Completion
ES&H	Environment, Safety, and Health
ESAAB	Energy Systems Acquisition Advisory Board
FAC	Facilities Advisory Committee
ILCC	Inter-Laboratory Coordinating Committee
IPS	Integrated Project Schedule
LCLS	Linac Coherent Light Source
LLNL	Lawrence Livermore National Laboratory
M&O	Managing and Operating
OPC	Other Project Cost
PMCS	Project Management Control System
PMP	Project Management Plan
QA	Quality Assurance
R&D	Research & Development
RMP	Risk Management Plan
SAC	Scientific Advisory Committee
SASE	Self-Amplified Spontaneous Emission
SLAC	Stanford Linear Accelerator Center
SSO	DOE Stanford Site Office
TEC	Total Estimated Cost
TPC	Total Project Cost
XFEL	X-Ray Free Electron Laser
WBS	Work Breakdown Structure

Section I – Introduction

Purpose of this Project Management Plan

This Project Management Plan (PMP) defines the plans, organization, responsibilities and systems for managing the Linac Coherent Light Source Project (hereafter referred to as LCLS) to be constructed at the Stanford Linear Accelerator Center (SLAC). The PMP is a field-level plan documenting agreements between the Department of Energy (DOE) Stanford Site Office and SLAC on the execution of the LCLS project. The PMP supplements the DOE Project Execution Plan.

Additional information on the LCLS may be found at: http://www-ssrl.slac.stanford.edu/lcls/.

Purpose and Scope of the LCLS Project

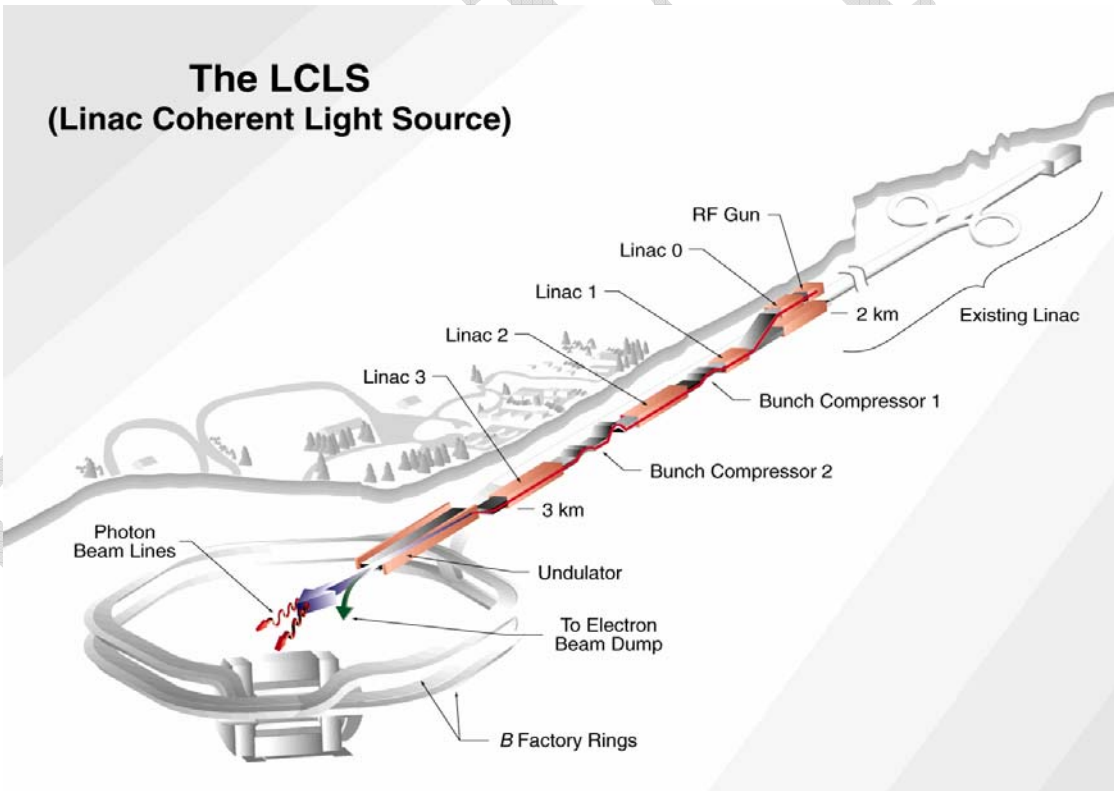
The primary purpose of the LCLS Project is to create a world class research facility delivering coherent laser radiation in the x-ray region of the spectrum ten billion times greater in peak power and peak brightness than any existing x-ray light source. Utilizing the principles of Self-Amplified Spontaneous Emission (SASE), the LCLS will provide the world's first demonstration of an x-ray free-electron-laser (XFEL), operating in the 1.5–15 Angstrom (Å) range and utilize the extraordinary, high-brightness x-ray pulses as a powerful tool for research spanning such areas in the physical and life sciences as:

- Atomic physics
- Plasma physics
- Structural studies on single particles and bio-molecules
- Femtosecond chemistry
- Studies of nanoscale dynamics in condensed matter physics

- X-ray laser physics

Given the short duration of the LCLS pulse (230 femtosecond and shorter), the LCLS will provide an opportunity to observe the ultra-fast processes of atomic transition, chemical bond formation and breaking, and transitions in condensed matter structures. With a sufficiently short pulse the LCLS can, in effect, function as a stroboscopic flash for freeze-frame photography of atomic, molecular and nanoscale structures as they evolve.

The LCLS will be located within the SLAC complex as shown below:



The Linac Coherent Light Source (LCLS) at SLAC

The specific goal for the LCLS project is to produce a coherent x-ray pulse with a 0.15 nm wavelength and a subpicosecond pulse length. In order to achieve this goal, the project proposes to build an XFEL Facility on the SLAC site. This will require a new 135 MeV injector constructed at Sector 20 of the 30-sector SLAC

Linac to create the high brightness electron beam required for the XFEL. The last one-third of the linac will be modified by adding two magnetic bunch compressors. Most of the linac, and its infrastructure, will not be changed. The existing components in the Final Focus Test Beam tunnel will be removed and replaced by a transfer line across the SLAC Research Yard. An undulator tunnel passing through the berm east of the research yard will house a 120-meter undulator and associated equipment. Two experimental halls will be constructed. A Near Hall will be constructed approximately forty meters downstream of the undulator and a Far Hall will be constructed approximately two hundred fifty meters downstream of the Near Hall. Provisions will be made for x-ray endstation enclosures, as well as instrumentation and controls for identifying and characterizing the x-ray beam. A research center, currently titled the LCLS Central Lab Office (CLO) Complex, will be constructed to facilitate the operations and research of the LCLS program.

The SLAC site has been selected for the LCLS because it makes use of the last kilometer of the SLAC linac as a source of a high-quality electron beam for the LCLS FEL. In addition, the experienced SLAC support staff and existing infrastructure provide the optimum location for LCLS construction and operations.

The LCLS operational plan calls for a simultaneous use of the Linac by the PEP-II High-Energy Physics Experimental Program. At least 75% of the annual operating schedule for the last third of the SLAC linac will be dedicated to the LCLS. The remaining 25% of operation time may be scheduled for test beams and fixed-target experiments requiring up to 50 GeV beams. LCLS has been designed to switch from LCLS operations to 50 GeV operations in 24 hours. For injection, LCLS has no impact on PEP-II.

Participants/Contracts

The LCLS Collaboration consists of a team of scientists and engineers from the Brookhaven National Laboratory (BNL), Argonne National Laboratory (ANL), Los Alamos National Laboratory (LANL), Lawrence Livermore National

Laboratory (LLNL), SLAC and the University of California at Los Angeles (UCLA).

During the design and construction phase, the LCLS project is organized as a three-laboratory partnership, led by SLAC in collaboration with ANL and LLNL. This partnership allows each laboratory to bring their unique technical strengths: SLAC – accelerators; ANL – undulators; and LLNL – x-ray beam transfer optics to the LCLS project thus reducing the need to duplicate core competencies and support staff. SLAC, as the Host Laboratory for the LCLS, will use existing personnel and proven systems and procedures to manage the project.

The LCLS project is sponsored by the DOE Office of Science. Work for the LCLS will be performed under the following DOE contracts:

SLAC	DE-AC03-76SF00515
ANL	W-31-109-ENG-38
LLNL	W-7405-ENG-48

Overall DOE management responsibilities for the LCLS are detailed in the *Project Execution Plan for the Linac Coherent Light Sourc*e (hereafter referred to as the LCLS PEP). An update to the LCLS PEP will include the construction start-up phases of LCLS. In accordance with DOE M 413.3-1, *Project Management for the Acquisition of Capital Assets*, the Director of Office of Science, SC-1, is the Acquisition Executive (AE) for the LCLS project. The DOE's Stanford Site Office (SSO) reports to the Office of Science and administers the Managing and Operating (M&O) contact for SLAC with Stanford University, which includes the day-to-day oversight of SLAC. The SSO Director delegates responsibility and authority for execution of the LCLS project to the LCLS Federal Project Director. A complete description of the roles and responsibilities within the LCLS project as they apply to the DOE, SLAC and its partner labs, ANL and LLNL, is described in Section III.

Other Important Documents

Acquisition Execution Plan (AEP)

The Acquisition Execution Plan (October 2002) has been prepared by the DOE Stanford Site Office within the DOE Office of Science. The AEP describes the mission need and initial pre-planning strategies and key decisions for the LCLS project from the DOE perspective.

Conceptual Design Report (CDR)

The LCLS Conceptual Design Report (April 2002) provides the detailed overall systems requirements and defines the technical criteria for each of the major systems for the project.

DOE Project Execution Plan (PEP)

The DOE Project Execution Plan for the LCLS (July 2004) has been prepared by the DOE Stanford Site Office within the DOE's Office of Science. This Project Plan includes a Project Charter and describes LCLS management, organization, and roles and responsibilities from the DOE perspective.

Environmental Assessment for the LCLS Experimental Facility

The Environmental Assessment for the LCLS Experimental Facility (December 2002) provides an evaluation and summary of potential environmental effects of the LCLS project on the SLAC site. A finding of No Significant Impact was issued in February 2003.

LCLS Global Requirements Document

The LCLS Global Requirements Document specifies the performance requirements for the LCLS x-ray free-electron laser to be constructed at the Stanford Linear Accelerator Center (SLAC).

Preliminary Hazards Analysis Document

A Preliminary Hazards Analysis Document was completed by SLAC and approved by DOE/SSO in June 2002. This document provides an early evaluation of potential hazards that may impact the construction phase of the LCLS.

Risk Assessment and Management Plan

A Risk Assessment and Management Plan identifies and quantifies key risks to the LCLS project. This document provides an early assessment of the potential risks to the LCLS project and formulates mitigation strategies and funds to address the risks to the LCLS.

Copies of all documents can be obtained in the LCLS Project Office. Additional Information on the LCLS project and its scientific program can be found on the LCLS website at http://www-ssrl.slac.stanford.edu/lcls.

Section II – Objectives

The primary objective of the LCLS project is to construct the world's first x-ray free electron laser (XFEL) that will serve as a facility for the application of XFEL radiation to experimental science and a research and development center for XFEL physics in the hard x-ray regime. This objective will be accomplished within the cost and schedule requirements accepted by the DOE and the LCLS Project.

Technical Objectives for the LCLS

The primary technical objective of the LCLS is to provide coherent radiation of extraordinary brightness with greater than 10^{11} photons per pulse in a 0.2%-0.4% energy bandpass with a pulse duration of 230 femtosecond or less. The LCLS facility will include two experimental halls, with associated office and laboratory space, where the x-ray beam will be utilized for research in physics, chemistry and biology. The Key Design Operating Parameters List for the LCLS are defined in the LCLS Global Requirement Document (GRD 1.1-001), which can be found on the LCLS website.

Project Schedule Objectives

The LCLS project formally began in Fiscal Year (FY) 2002 with DOE funding for Research & Development activities. Project Engineering and Design (PED) funds were available in FY2003 with completion of PED scheduled for the fourth quarter of FY2006. LCLS construction is planned to begin in the first quarter of FY2006 to be followed by a staggered commissioning phase. LCLS operations are scheduled to begin in the first quarter of 2009. The LCLS Project Level 1, Level 2 and Level 3 milestones (including dictionary), which form the basis of the LCLS schedule baseline, are provided in Appendix B.

Project Cost Objectives

The Total Estimated Cost (TEC) for the LCLS project is $273.0 Million Actual-Year (AY) dollars and the Total Project Cost (TPC) is 315.0 Million Actual-Year dollars.

The TEC and TPC profiles for the LCLS project, along with projections of DOE funding are shown in Appendix C.

Section III – Management Organization and Responsibilities

Department of Energy

The roles, responsibilities, and authorities of the U.S. DOE Office of Science participants are described below. Appendix D depicts the relationships between the DOE and the partner laboratories as they apply to the LCLS project.

Office of Science

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

- Chair the ESAAB Equivalent Board.
- Approve Critical Decisions and Level 1 baseline changes.
- Approve the Project Execution Plan.
- Delegate approval authority for Level 2 baseline changes to the Federal Project Director.
- Conduct Quarterly Project Reviews.
- Ensure independent project reviews are conducted.

Office of Basic Energy Sciences

Within DOE's Basic Energy Sciences Division (BES), the Associate Director for Basic Energy Sciences (SC-10) is responsible for planning, construction, and operation of 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 Users Division (SC-12) has direct responsibility for providing funding, and programmatic guidance to the LCLS project. The LCLS Program Manager in SC-12 will be the primary point of contact for DOE Headquarters (HQ) with responsibilities that include:

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

DOE Stanford Site Office (SSO)

The SSO reports to the Office of Science and administers the M&O contract for SLAC with Stanford University, which includes day-to-day oversight of SLAC. The SSO Director delegates responsibility and authority for execution of the LCLS project to the LCLS Federal Project Director whose specific responsibilities include:

- Monitor, review, evaluate, and report on the performance of the project against established technical, cost, and schedule performance baselines.
- Ensure environment, safety and health is integrated into the project.
- Lead the Integrated Project Team.
- Approve Level 2 change control proposals as delegated by the AE. Review and provide recommendations to the AE for Critical Decisions and Level 1 change control proposals.
- Monitor Level 3 change control proposals.

- Authorize use of project contingency in accordance with the levels described in this PMP.
- Participate in Quarterly Project Reviews, ESAAB Equivalent Board meetings, Critical Decisions and project reviews conducted by the LCLS project and DOE HQ.
- Conduct management meetings to monitor and review status of project activities.
- Keep SC management informed of progress and problems in a timely manner.
- Maintain project data current in the DOE Project Assessment and Reporting System (PARS).
- Issue Project Directive Authorizations for disbursement of funds and work authorizations.
- Prepare project documents such as the Project Execution Plan, Acquisition Execution Plan and Project Quarterly Report.
- Coordinate matrix support from the SC Integrated Support Centers.

SLAC, ANL and LLNL Project Management, and Advisory Committees

Appendix E provides an organizational chart illustrating the relationships (for the purposes of this project) between SLAC, ANL and LLNL laboratory management; LCLS Project Management; and various advisory committees. An explanation of the responsibilities of key managers, are provided below:

SLAC Director

The SLAC Director has the ultimate responsibility for designing and constructing the LCLS Project in keeping with the requirements of the SLAC DOE contract DE-AC03-76SF00515. The Director has delegated the authority to manage and execute the LCLS project to the LCLS Project Director, and will ensure that the LCLS Project Director has priority access to all of SLAC's resources for that purpose.

The SLAC Director has established a separate LCLS Division during the PED and construction phase of the LCLS project. This reorganization of creating a separate LCLS Division will establish the LCLS Project Director as an Associate Director of SLAC reporting directly to the SLAC Director. (See Appendix F for additional details.) Key personnel for the LCLS Project will report to the LCLS Division establishing a direct line management organization to support the activities of the LCLS project. Other personnel will be matrixed from other SLAC divisions to provide support to the LCLS Project.

ANL/LLNL Directors

The ANL and LLNL Directors ensure that the appropriate resources for their laboratories are applied to support the project in keeping with their DOE contracts. The Directors jointly review with the SLAC Director the findings of the Machine Advisory Committee, and initiate adjustments in program direction as needed. The ANL and LLNL Directors will appoint representatives to the Inter-Laboratory Coordinating Council (ILCC). The Directors will ensure that issues raised by the ILCC are addressed in a timely manner.

The ANL Director and LLNL Director have worked with the SLAC Director to approve Memoranda of Understanding (MOU's), which describe the terms of agreement with respect to their laboratories' participation in the LCLS project. Each year, a Technical Addendum to the MOU is written between SLAC and its partner laboratories to define the annual scope of work, resources and

schedule requirements for the LCLS. An example of the Technical Addendum between SLAC and ANL/LLNL is shown in Appendix G.

Facilities Advisory Committee

The Facilities Advisory Committee (FAC) is a standing committee appointed by the LCLS Project Director, with concurrence from the SLAC, ANL and LLNL Directors, to provide advice on the progress of LCLS construction. Members of this group will be selected from the international scientific community with expertise in the project areas of interest. The FAC not only advises the three laboratory Directors, but has a primary role in providing guidance and feedback to the Project Director and his management team. The FAC meets and publishes a status report on the LCLS project biannually.

Scientific Advisory Committee

The Scientific Advisory Committee (SAC) is a standing committee appointed by the LCLS Project Director, with concurrence from the SLAC, ANL and LLNL Directors, to provide guidance on the LCLS scientific research program. Members of this group will be selected from throughout the scientific user community with expertise in atomic, plasma and laser physics, femtosecond chemistry and biology, and nanoscale physics and will provide advice and recommendations on the initial direction of LCLS programmatic research. The SAC meets and publishes a status report on the LCLS scientific program biannually.

Inter-Laboratory Coordinating Committee

The purpose of the Inter-Laboratory Coordinating Committee (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 shall appoint 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 will meet quarterly or spontaneously should

an immediate need arise. The Federal Project Director will be invited to attend ILCC meetings.

LCLS Management

Appendix H provides an overview of the organization chart for the LCLS Project. The roles and responsibilities of the LCLS Project Management organization are described below:

LCLS Project Director

The LCLS Project Director reports to the SLAC Director and is responsible for the direction of LCLS design and construction activities and the research and development program to support the LCLS, including coordination of SLAC, ANL, and LLNL personnel assigned to the project. The LCLS Project Director is responsible for approving the selection of staff for the design, construction, commissioning, and initial operation of the LCLS facility. Specific responsibilities include:

- Day-to-day management and overall direction of the LCLS project.
- Ensuring that ES&H responsibilities and requirements are integrated into the project.
- Establishing technical and administrative controls to ensure project is executed within approved cost, schedule and technical scope.
- Directing and coordinating supporting R&D and commissioning activities with construction activities
- Representing the project in interactions with the DOE and other laboratories. Participating in management meetings with DOE and communicates project status and issues.
- Chairing the Configuration Control Board

- Chairing the Inter-Laboratory Coordinating Council
- Chairing the Change Control Board.
- Approving Level 3 change control proposals. Preparing and providing recommendations to the Federal Project Director for Level 1, and 2 change control proposals, as required.
- Identifying and managing project risks.
- Member of the Integrated Project Team.

LCLS Chief Engineer

The LCLS Chief Engineer reports to the Project Director and has the following responsibilities:

- Carrying out the LCLS Project Director functions when the LCLS Project Director is unavailable.
- Providing support for all the functions performed by the LCLS Project Director.
- Facilitating and overseeing interlaboratory coordination.
- Serving as the Configuration Manager of the Configuration Control Board.
- Coordinating engineering work for the entire project.
- Directing project planning, scheduling, and budgeting and overseeing the Project Management Control System.
- Defining estimating rules, practices, and procedures and managing periodic project re-estimates.
- Establishing, maintaining, documenting, and enforcing engineering standards.
- Establishing technical definitions of all project procurements.
- Member of Integrated Project Team.

System Managers (*Injector, Linac, Undulator, etc.*)

The LCLS System Managers report to the LCLS Project Director and have the following responsibilities:

- Planning and managing the design, construction, installation, and commissioning of their respective LCLS system.
- Serving as the Cost Account Managers for all cost accounts in their LCLS system.
- Participating in project planning, scheduling and cost estimating for their LCLS system.
- Approving Level 4 change control proposals.
- Ensuring that work in their respective LCLS system is planned and executed in accordance with SLAC ES&H policy.
- Serving as members of the Configuration Control Board.

System Physicists (*Injector, Linac, Undulator, etc.*)

The LCLS System Physicists report to the LCLS Project Director and have the following responsibilities:

- Acting as a liaison for the respective LCLS System Manager with SLAC operational infrastructure and personnel.
- Ensuring that the physics performance of the respective LCLS system will meet the operational requirements of the LCLS and the SLAC Linac.
- Establishing and documenting performance specifications and physics parameters of their respective LCLS system.
- Establishing and documenting specifications for operational and controls parameters of their respective LCLS system.

- Developing commissioning goals and procedures and optimize the physics performance of the LCLS.

LCLS Project ES&H Officer

The LCLS Project ES&H Officer reports to the LCLS Project Director and is responsible for:

- Providing all levels of LCLS management with advice, information and other resources appropriate to the LCLS project safety oversight.
- Assisting line management in writing environment, safety, and health documents, or authoring these documents as assigned by the LCLS Project Director.
- Reviewing proposed designs, procedures, and practices for environment, safety, and health considerations.
- Acting as a liaison for the LCLS Project in dealings with the SLAC Environment, Safety, and Health (ES&H) Division and the SLAC Safety Oversight Committee (SOC) to ensure that laboratory-wide environment, safety, and health policies are followed.
- Coordinating with the SLAC ES&H Division on training requirements for LCLS Project members.
- Acting as LCLS Project liaison in environment, safety, and health audits conducted by the DOE or the ES&H Division.
- Supporting of line management's activities to determine if environment, safety, and health requirements are being followed.
- Advising LCLS management on progress toward completion or monitoring of project schedules of environment-, safety-, and health-sensitive milestones.

- Recommending to the LCLS Project Director corrective action for situations where environment, safety, or health conditions pose an imminent danger or significant environmental harm.
- Serving as a member of the Configuration Control Board.
- Stopping work authority for unsafe activities.

LCLS Project Quality Assurance Officer

The LCLS Project Quality Assurance (QA) Officer reports to the LCLS Project Director and is responsible for:

- Advising LCLS management as to conformance with project-specific quality-control procedures and practices.
- Providing advice to System Managers for the implementation of QA-related activities (for example the QA Officer may provide guidance on developing inspection plans or developing vendor control programs).
- Providing or coordinating project-specific QA training for LCLS Project members.
- Reviewing completion of QA-related milestones as provided in project schedules.
- Providing advice to all levels of the project line management to ensure the completion of critical planned QA activities are not compromised due to cost, schedule, or other constraints.
- Performing QA audits as requested by the LCLS Project Director.
- Participating individually or as part of a team in vendor surveys, vendor qualifications, and source inspections.
- Serving as a member of the Configuration Control Board.

LCLS Project Budget Officer

The LCLS Project Budget Officer reports to the LCLS Project Director and is responsible for:

- Acting as the primary office of communication between LCLS and other financial offices of SLAC, ANL and LLNL including Accounting, the Business Office, and the Budget Office.
- Acting as the primary contact between LCLS and Procurement in tracking requisitions and purchase orders and expediting issues related to purchase orders.
- Providing monthly summaries of budgets, costs, open commitments and obligations in a format useful to the LCLS management team.
- Maintaining original and electronic copies of MOU's and SOW's for the LCLS project.
- Providing gate-keeping oversight to the requisition process. Approve requisitions on-line for off-line signatories. Supervise administrative staff in work related to requisition preparation.
- Tracking the overhead on individual requisitions and ensuring that adequate funds are set aside for indirect costs.
- Tracking labor effort on the LCLS project and providing reports to management indicating time and cost charged as compared to labor profile estimates.
- Tracking costs against SLAC credit cards used for LCLS business and ensure that transfers are being made to the appropriate cost account.

LCLS Project Cost & Schedule Manager

The LCLS Project Cost & Schedule Manager heads the Project Management and Control System (PMCS) Group, consisting of coordinators for the major

LCLS systems. The LCLS Project Cost and Schedule Manager reports to the LCLS Chief Engineer and is responsible for:

- Maintaining the baseline cost estimate and baseline schedule.
- Establishing and maintaining the Project Management and Control System (PMCS).
- Establishing, coordinating and updating all reporting of project earned values measurements, including costs and schedule variances.
- Collecting monthly all actual costs for the LCLS project.
- Producing the monthly LCLS Cost and Schedule Status Report.
- Analyzing actual cost reports from the participating laboratories for correctness of charges.
- Assisting the Project Director, Chief Engineer and System Managers in forecasting budgets.
- Training and supervising the project's technical and administrative staff in the use of the costs and schedule system.

LCLS Database Manager

The LCLS Database Manager reports to the LCLS Chief Engineer and is responsible for designing, developing, maintaining, and qualifying the major databases that support the project including:

- Providing definitions of the appropriate hardware and software for administrative and machine design purposes.
- Maintaining Oracle and Windows-based cost, schedule, drawing, and configuration control systems for the LCLS Project.
- Maintaining a system to track purchase order progress against MOU's and SOW's.
- Establishing and maintaining an LCLS document control system that can be utilized as the central repository to ensure that all relevant

documents are maintained in an accurate and logical hierarchical system.

- Installation of the appropriate hardware and implementing software, including the parameter list, to support the LCLS Project.

Section IV – Work Plan

To build an XFEL Facility at SLAC, the LCLS project proposes to construct the following main elements:

a) A photoinjector and a short linac, at Sector 20 of the 30-sector SLAC Linac, where a bright electron beam is generated and accelerated to 135 MeV,
b) Modification to the last kilometer of the 3-kilometer SLAC Linac, where the electron bunch is compressed and accelerated to 14.3 GeV,
c) Removal of the Final Focus Test Beam tunnel and construction of a transport system to the undulator,
d) An undulator, ~120m in length, where the electrons emit FEL and spontaneous radiation,
e) The undulator-to-experimental area transport line,
f) A Near Experimental Hall, ~40 meters downstream of the undulator, will include three enclosures for x-ray diagnostics equipment,
g) A photon beam transport line connecting the Near Experimental Hall to the Far Experimental Hall.
h) A Far Experimental Hall, ~250 meters downstream of the Near Experimental Hall and constructed as an underground cavern, will include three enclosures for x-ray diagnostics equipment,
i) The LCLS Central Laboratory Office (CLO) Complex, constructed on grade near the Experimental Halls, to accommodate LCLS users and scientific and operations staff. Parking will be provided adjacent to the LCLS CLO.

Work Breakdown Structure

The detailed activities to design, fabricate, construct, install and commission the LCLS project are described in its Work Breakdown Structure (WBS). Each element (activity) of the WBS has cost, manpower, and schedule associated with it and is the key element (activity) for planning and controlling cost and schedule.

Organization of the WBS

The levels of the WBS reflect a logical breakdown of the work by major system. Each lower level breaks down the previous level by subsystem and task. Level 1 defines the total LCLS project as follows:

1	LCLS Total Estimated Cost (TEC)	Includes all Project Engineering and Design (PED) and construction effort for this project.
2	LCLS Other Project Cost (OPC)	Includes all research and development (R&D), commissioning (pre-operations) and spares for this project.

The LCLS Total Project Cost is defined at any time as the sum of the TEC and OPC. WBS Level 2 defines the major LCLS systems organized according to geography. Each LCLS system's WBS captures their respective TEC and OPC as follows:

WBS#	**LCLS System**
1.1, 2.1	Project Management, Administration & Integration
1.2, 2.2	Injector System
1.3, 2.3	Linac (Accelerator) System
1.4, 2.4	Undulator System
1.5, 2.5	X-Ray Transport, Optics & Diagnostics System
1.6, 2.6	X-Ray Endstations System
1.9, 2.9	Conventional Facilities

Each system includes related common tasks and activities such as controls, alignment and installation, such that it is a fully integrated system that captures all costs, resources, tasks and activities necessary to complete each LCLS system. Each system contains progressively lower levels to further define the sub-elements down to the lowest WBS.

The WBS Dictionary

A WBS Dictionary has been established to define the WBS scope. An index for the LCLS WBS and WBS Dictionary for each element through Level 2 is provided in Appendix I. A copy of the complete WBS and the WBS Dictionary is available in the LCLS Project Office.

The LCLS Cost and Schedule Manager is responsible for maintaining the current WBS and WBS Dictionary and the records of all changes. All changes must be approved by the Project Director prior to implementation.

When specified by this management plan, such changes will be forwarded to the Federal Project Director for approval after review by the Configuration Control Board. Once approved, the changes will be implemented in the WBS. A record of such changes will be maintained.

Work Execution

Engineering, Design, and Drawings

Each partner laboratory participating on LCLS agrees to furnish complete documentation of the quality control and performance checks on deliverables supplied to the LCLS project. Documentation will include all engineering drawings of equipment, full schematics of electronics, operating and maintenance specifications, 'as-built' dimensions of all deliverables, magnetic measurements,

and documentation of all software. All drawings, specifications, operating and maintenance documentation will be stored on the LCLS Database at SLAC.

Make-vs-Buy Policy

The LCLS Chief Engineer will review, on a case-by-case basis, fabrication requirements and recommend whether to use in-house capabilities or buy the item from an outside supplier. The program applies to the fabrication of hardware and services. The goals of this program are;

a) Meet the LCLS Project mission, cost, design, and schedule requirements effectively.
b) Comply with obligations to support small, small disadvantaged, and minority-owned business enterprises.
c) Efficiently use and maintain the participating laboratories' capabilities according to their mission and DOE objectives.

R&D and Commissioning Activities

R&D and commissioning activities that support the construction project will be carried out primarily by employees of the participating laboratories using the facilities and resources of the laboratories. Management of the R&D work and coordination of R&D with the construction project is the responsibility of the LCLS Project Director.

Commissioning functions and activities are to be integrated into SLAC operations and are subject to all SLAC ES&H and operations policies and procedures. Should there be any conflict between SLAC ES&H and/or SLAC Operations and the LCLS PMP, SLAC's policies will take precedent.

Section V – Cost and Labor Estimates

Cost Estimates

As described previously, Appendix C provides a year-by-year summary of LCLS cost estimate (TEC, OPC), at WBS Level 2 and compared with anticipated funding plans. The LCLS cost estimate is a detailed "bottoms-up" estimate with resources loaded at the lowest activity. Resources defined in the detailed estimate are applied to the tasks established in the schedule to generate a time-phased budget. All estimates are assessed in dollars in the actual year (AY) spent.

The LCLS cost estimate has been developed using appropriate standard estimating methodologies, and integrated with the work scope definition. The cost estimate is supported and documented with the LCLS Basis of Estimate, which provides the methodology used to estimate the cost at the lowest WBS as well as the supporting documentation for the LCLS Cost Estimate. A copy of the LCLS Basis of Estimate is available in the LCLS Project Office.

Labor Estimates

The labor required for the project has been estimated by labor type and distributed by the cognizant manager to support the scope of work. Labor rates for each labor type have been developed. These labor estimates sum up to the total project labor estimate. Appendix J shows the current labor estimate required for the LCLS Project by partner laboratory per fiscal year. This labor will be provided by existing personnel at SLAC, ANL, LLNL, and where necessary, by additional contract and term appointment labor.

Section VI – Funding and Cost Management

Funding Management

Funds will be available to the DOE in support of the LCLS Project on an annual basis following the passage of legislation by the U.S. Congress. Funds for LCLS PED and construction costs shall be directed to SLAC via congressional budget line item, with LCLS R&D and commissioning funds as a modification to SLAC's M&O contract with DOE.

The financial resources required to perform the work scope at ANL and LLNL will be determined by SLAC's LCLS Project Management organization. To assure these resources are transferred in a timely manner to meet future expenditures and procurements, LCLS Project Management will prepare annual Technical Addenda to the ANL and LLNL Memoranda of Understanding (MOU) for work scope and necessary funding by August 1 of the preceding fiscal year. The addenda (see Appendix G) authorize an annual funds transfer via subcontracting agreement between SLAC and its partner labs. At mid-year and at the beginning of the fourth quarter, SLAC may request adjustments to obligations to ANL and LLNL if necessary.

The ANL and LLNL annual addenda authorize a defined scope of work and the necessary resources at the lowest level of the WBS for each Lab. Laboratory labor resources, if necessary to accomplish the work scope, will be identified explicitly in the addendum. Each partner lab will make every effort to carry out their institutional responsibilities consistent with the LCLS project schedule, which may have to be changed as the project progresses. To optimize available resources, LCLS management may transfer, modify or redefine future work scope, through modification of the addenda, to achieve the LCLS technical, cost and schedule requirements.

Cost Management

Cost Account Managers for each of the WBS level 2 systems will be responsible for ensuring that only work budgeted will be authorized and for controlling expenditures against their accounts. The costs and commitments incurred in these accounts will be transmitted to the LCLS project office monthly and reported in the monthly Cost Performance Report.

In addition, each laboratory has a signature authority procedure to assure that only authorized personnel can approve requisitions. Signature authority is delegated by the LCLS Project Director to LCLS Cost Account Managers as follows:

LCLS Manager	Signature Authority
LCLS Project Director	$100,000
LCLS Chief Engineer	$15,000
LCLS System Managers (SLAC, ANL, LLNL)	$5,000

Procurement and item purchases exceeding the delegated limit will be authorized by the LCLS Project Director in advance of obligation by the partner laboratory's Procurement Department.

Section VII – Configuration Management

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 LCLS project management will control and evaluate changes to its cost, schedule and work scope baseline through a change control process designed to promote an orderly evolution from the initial baseline design, and ensure that the effect of changes on cost, schedule, and performance are properly evaluated and documented.

Configuration Control Board

A Configuration Control Board (CCB) consisting of the key members of the LCLS Project will be established to advise (not approve) changes to the LCLS technical, cost and schedule baseline. The board will consist of a standing committee consisting of a chairman, a configuration manager, and board members. Their roles are described below:

CCB Chairman

The LCLS Project Director is the CCB Chairman. The Chairman reviews and may approve changes that come before the CCB. The Chairman will coordinate DOE approval if the impact of a change to cost, schedule, or technical performance requires DOE approval.

Configuration Manager

The Chief Engineer is the Configuration Manager, and is responsible for managing change control activities, maintaining and enforcing control procedures, organizing the agenda for change control meetings, and ensuring changes are properly evaluated and documented.

Board Members

In addition to the CCB Chairman and the Configuration Manager, the Cost and Schedule Manager, the System Managers, and representatives from QA and ES&H constitute the Configuration Control Board.

In addition to the standing CCB committee, the LCLS Federal Project Director will attend all CCB reviews requiring DOE approval, and is invited to sit in on CCB reviews below DOE approval threshold. Although any member of the LCLS project can propose a baseline change, it must be sponsored by one or more board members. The CCB members review the technical, cost, and schedule implications of changes and advise the Chairman. All System Managers must review every change to assess impact and ensure that system interfaces have been properly considered. The Cost and Schedule Manager must review every change to evaluate the impact to overall project cost and schedule.

Baselines

The initial technical, cost, and schedule baseline provides the reference point from which to begin configuration control. The baseline will evolve through the configuration control process. At any time, the current baseline will be traceable to the original baseline through the records of approved changes. Approved changes may affect the LCLS parameters list, hardware or software designs, and the project WBS Dictionary, cost and schedule.

Approval of LCLS Critical Decision (CD) 2b: Approve LCLS Performance Baseline by the Director of the DOE's Office of Science, will constitute the initial technical cost, and schedule baseline. The CD-2b is accompanied by an initial cost and schedule baseline, contingency, and forecasted funding profiles, along with the approved LCLS technical performance requirements. As Configuration Manager, the Chief Engineer is responsible for maintaining and documenting the technical baseline through the configuration control process. The LCLS Cost and Schedule Manager will incorporate approved changes into the project's WBS

Dictionary and cost and schedule baselines. The Cost and Schedule Manager will maintain a record of approved changes that affect cost and schedule.

Change Thresholds

The thresholds for Configuration Change Control approval are given in Appendix K. All changes for Level 1, 2 or 3 must be reviewed by the Configuration Control Board and approved by the LCLS Project Director prior to being submitted to the DOE for additional approval.

Configuration Control Process

The configuration control process will be applied to all proposed changes, including those initiated by subcontractors and suppliers, which affect technical performance, cost, or schedule of the LCLS baseline. The process proceeds as follows:

- Any member of the project can request a change proposal by informing the responsible System Manager. The technical merits and cost/schedule impact are evaluated under the direction of the System Manager.
- The System Manager submits a Baseline Change Request (BCR) to the Chief Engineer (Configuration Manager), complete with a concise impact statement of the technical, cost, and schedule changes related to the BCR. The proposal is added to the agenda of a future change control meeting. The BCR must be signed by the System Manager(s) proposing the change.
- The Configuration Manager will send copies of new BCR's to all members of the CCB well in advance of the CCB meeting. The new proposed changes constitute the agenda of a future Configuration Control Board meeting.
- The Configuration Manager convenes the Configuration Control Board to discuss new change proposals. Each change is discussed, and each System Manager signs the change proposals. The CCB process is designed to ensure that the technical, cost and schedule impact of changes that may

affect more than one LCLS system are correctly evaluated. There is a standing meeting of the CCB scheduled monthly, which can be cancelled if no BCR's are proposed.

- As chairman of the Configuration Control Board, the Project Director approves, disapproves the proposal, or requests further information concerning each proposal.
- Approved changes are transmitted to the DOE Federal Project Director.

Section VIII – Risk and Contingency Management

Risk Management

Managing risk is a key element of the project management process for both planning and performance phases of the LCLS. As such, the LCLS management has developed a Risk Management Plan (RMP) which identifies and quantifies risks to the LCLS Project, determines their impact and exposure to risk and develops mitigation and correction strategies to employ when risks become reality. Risks to the LCLS project are identified to be in the following categories;

- Technical
  - Design and Equipment Complexity
  - Environment, Safety & Health
  - Procurements
  - Programmatic (Scientific Mission)
  - Resources (Funding and Staffing)
- Cost (includes currency and inflation)
- Schedule

The RMP assesses and quantifies risks to the LCLS project and documents the high risk areas in the LCLS Risk Registry. The LCLS Risk Registry is a living document used throughout the life of the LCLS project and, like contingency management, is under configuration control. The LCLS RMP and Risk Registry are regularly reviewed and updated by the CCB to reflect any reassessment of risks to the LCLS project. A copy of the LCLS RMP and the current Risk Registry are available in the LCLS Project Office.

Contingency Management

Contingency funds are utilized during the LCLS project for corrective actions to technical risks realized during the project, recovering from schedule delays, and providing resources for errors and omissions in the baseline cost estimate. Contingency funds are estimated, at the lowest WBS, based on a risk assessment

of; (1) design maturity of the component(s) and/or cost estimate, and (2) judgment factors, which considers environmental factors such as beyond the state of the art technology, single vendor procurements, currency and pricing variations, etc..

At any time, the project contingency is defined as the difference between the project TEC and the sum of the current estimates at completion at Level 2 of the WBS. All contingency for the project will be held at SLAC under the control of the LCLS Federal Project Director and LCLS Project Director as governed by the Baseline Change Control process. Increases in the WBS L2 Estimate-at-Completion (EAC) above the Level 3 cost threshold require submitting a Baseline Change Request (BCR) to the LCLS Configuration Control Board (CCB). The BCR will include the basis for the change and the implications for cost, schedule, and system interfaces.

The CCB will review the request and make a recommendation to the LCLS Project Director. If the Project Director concurs, the BCR is approved unless the change thresholds require the approval of higher levels of authority. An approved cost-related BCR results in the increase of the baseline estimate for that WBS element, and unless there are offsets, will reduce the available contingency by an equal amount. After performance baselines have been established, the LCLS Project Director will make every effort to find offsets within the project, without impacting the technical performance baseline, to mitigate draws on contingency. A change control log will be maintained by the LCLS Cost and Schedule Manager to document all approved BCR's.

The principals of contingency management for the LCLS project are as follows:

- The actual allocations of contingency at any level of the WBS will be reflected in a new EAC to be updated quarterly.
- The sum of these contingency allocations may not exceed the amount in the LCLS contingency amount.
- All changes from baseline costs shall be traceable to the CD-2b Performance Baseline.

Section IX – Project Management Control System

The LCLS Project has established a Project Management Control System (PMCS) using Primavera Project Planner (P3) as a schedule planner and COBRA as a cost processor to derive earned value progress on the project. Modeled after past DOE projects at SLAC, namely the B-Factory Project (PEP-II and BaBar), GLAST-LAT Project and the SPEAR-3 Project, the LCLS PMCS is the integration for the schedule and cost baselines and provides the necessary tools to monitor cost, schedule, and technical performance on a monthly basis. The LCLS PMCS satisfies all requirements of DOE Manual 413.3-1.

The LCLS cost and schedule baseline consists of a Baseline Cost Estimate (BCE) and the Integrated Project Schedule (IPS), which uses a project-wide logic network, resource-loaded tasks, and a hierarchy of schedule milestones. Both the BCE and IPS are maintained by the LCLS Project's PMCS Group and are subject to change control under Configuration Management.

The policies and procedures for maintaining and changing the BCE and the IPS and those for reporting schedule status are set forth in Section VIII – Configuration Management of this PMP and/or the supporting PMCS documentation written and distributed by the LCLS PMCS Group. The LCLS PMCS Group is managed and operated by the LCLS Cost and Schedule Manager and reports to the LCLS Chief Engineer.

Monthly performance measurement figures will be based on three quantities: schedule status submitted by the LCLS Cost Account Managers each month, actual financial status (costs and commitments) for the month, and the cost and schedule baseline.

A Cost Performance Report (CPR) will be prepared and issued monthly by the Cost and Schedule Group. Reporting will be by WBS element to the lowest element. For each element, the following data will be reported: actual cost of work performed (ACWP), budgeted cost of work performed (BCWP), and

budgeted cost of work scheduled (BCWS). Cost and schedule variances, and cost and schedule performance indices, will be documented in the CPR.

A monthly report on the LCLS Project progress will be issued by the LCLS Project Office and distributed to appropriate DOE offices and other organizations outside the project. This report will provide information at WBS level 2 and higher and will discuss the overall status of the LCLS Project. A "Highlights" section will address the total project schedule overview and any significant project accomplishments. An "Assessment and Issues" section will cite any areas of concern to the project management. The LCLS monthly report will also document monthly and cumulative project cost and schedule performance at WBS level 2 and progress against DOE level 2 milestones.

Section X – Supporting Functions

Each partner laboratory participating in the LCLS project, agrees to furnish indirect support to the project from its support departments, which may include:

- Accounting and Budgeting
- Environment, Safety and Health
- Facilities Management
- Information and Business Services
- Human Resources
- Legal
- Quality Assurance
- Procurement and Purchasing (if separate from Business Services)

All support functions will be provided through the partner laboratory's organizational lines of authority and responsibility. LCLS will direct questions of priority needs for support through normal lines of authority within the organization.

Section XI – Information and Reporting

Documents and Reports Prepared by DOE

- Accelerator Readiness Review
- Annual Project Validation Report
- Congressional Project Data Sheet
- Justification of Mission Need Statement
- Project Execution Plan
- Quarterly Project Director's Progress Report

Documents and Reports Prepared by the LCLS Project

- Advance Procurement Plan
- Conceptual Design Report
- Construction Project Data Sheet
- Environmental Assessment and Finding of No Significant Impact (FONSI)
- Final Safety Assessment Document
- Fire Hazards Analysis
- Hazards Analysis Report
- Monthly Project Report (includes Cost and Schedule Performance)
- Preliminary Safety Assessment Document
- Project Management Plan
- Quality Implementation Plan
- Risk Management Plan
- Start-Up and Commissioning Plan

Project Meetings and Reviews

Meetings and Reviews with DOE

The following meetings will be held between the DOE and the LCLS Project:

- DOE/LCLS Management Meeting (weekly). A meeting held between the DOE Federal Project Director, the LCLS Project Director and relevant LCLS staff to discuss current business and management issues.

- DOE/LCLS Status Meeting (monthly). A meeting held between the DOE BES Director, DOE LCLS Program Manager, DOE Federal Project Director, LCLS Project Director and relevant LCLS staff to review the current status of project work and to discuss outstanding issues.

- DOE/LCLS Quarterly Review (quarterly). A meeting held between the Office of Science Acquisition Executive, DOE-BES Director, DOE-LCLS Program Manager, DOE Federal Project Director, an Office of Engineering and Construction Management representative, relevant federal managers outside DOE-BES, LCLS Project Director, and relevant LCLS staff to review the current status of project work and to discuss outstanding issues.

- DOE/LCLS Project Review (semiannual). A review held by the DOE's Office of Science on the LCLS project's technical cost, schedule and management performance. Presentations by key project personnel will address issues on an agenda agreed to in advance by DOE and the LCLS Project Director. A report is issued with findings, comments, and recommendations.

Additional LCLS Project Meetings

Project reviews will be held whenever relevant to vet key decisions in the R&D and construction phases of the LCLS project. In addition, the following regular meetings will be conducted within the LCLS project:

- Inter-Laboratory Coordination Committee (ILCC) meetings (quarterly), chaired by the LCLS Project Director. This meeting includes the DOE Federal Project Director, LCLS Project Director, Chief Engineer, and System Manager(s) with work scope at the partner lab, and a representative from each partner lab with line authority for resource allocation to the LCLS project. This meeting will primarily focus on issues affecting resource allocation to the LCLS project at the partner laboratories and optimization and coordination of LCLS resources with all three laboratory activities. Meeting minutes will be recorded.

- LCLS Management Coordination Meeting (monthly), chaired by the LCLS Project Director. This meeting includes the DOE Federal Project Director, LCLS Project Director, Chief Engineer, the System Managers, the Integration Managers (Controls, Alignment, and Installation), the Cost and Schedule Manager, the PMCS Group, ES&H and QA officers, and a representative of the SLAC Purchasing Department. This meeting will focus on integration and coordination of the LCLS project and across functional groups within the partner laboratories. Meeting minutes will be recorded.

- LCLS Management Meeting (weekly), chaired by the LCLS Project Director. This meeting will involve the LCLS Project Director, Chief Engineer, the System Managers, the Integration Managers, the Cost and Schedule Manager, the PMCS Group, and will focus on the day-to-day management issues within the LCLS project. Meeting minutes will be recorded.

- LCLS Physics Coordination Meeting (weekly), chaired by the LCLS Project Director. This meeting will involve the Project Director, Chief Engineer, Institutional Liaisons, and System Managers, and provide the highest level of physics support and coordination for the LCLS project. This meeting will primarily focus on the R&D, liaison and commissioning support during the construction phase of the project.

- LCLS Change Control Board Meetings (monthly), chaired by the LCLS Project Director. This meeting will involve the DOE Federal Project Director, LCLS Project Director, Chief Engineer, the System Managers, the Integration Managers (Controls, Alignment, and Installation), the Cost and Schedule Manager, the PMCS Group, ES&H and QA officers, and a representative of the SLAC Procurement Department.

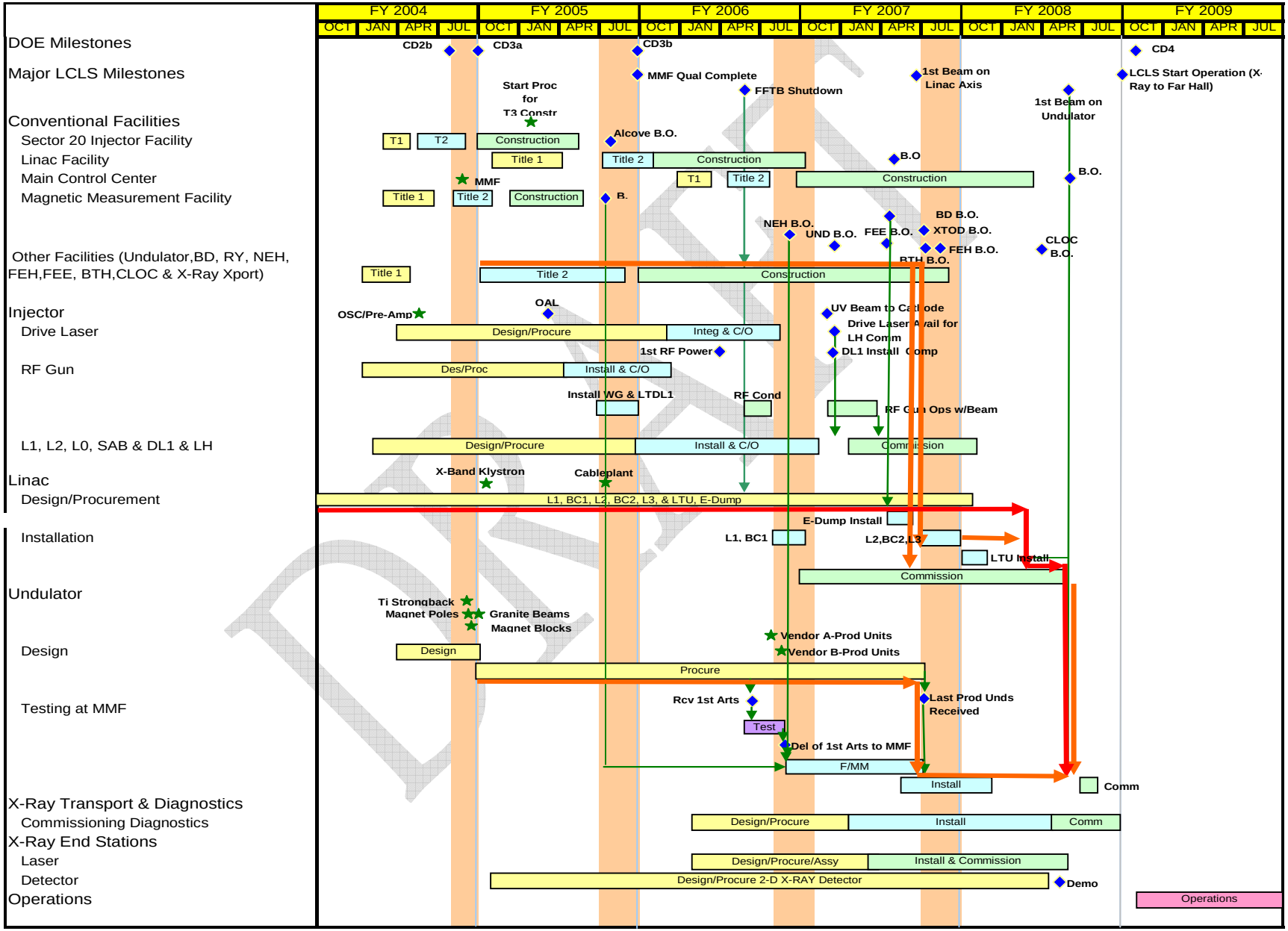
- LCLS Facilities Advisory Committee (FAC) Meetings (semiannual), appointed by the LCLS Project Director. The FAC is a standing committee made up of leading physicists in the scientific community charged to provide advice on the progress of LCLS construction, and to ensure that the LCLS project meets or exceeds the technical performance as defined in Appendix A.

- LCLS Scientific Advisory Committee (SAC) Meetings (semiannual), appointed by the LCLS Project Director. The SAC is a standing committee made up of leading physicists in the scientific user community charged to provide advice on the progress of LCLS scientific program, to provide guidance on the initial LCLS scientific research program.

Section XII – Project Management Plan Review and Modifications

After its adoption, this Project Management Plan shall be periodically reviewed by the DOE Federal Project Director and the LCLS Project Director. Proposals for its modification may be initiated by the DOE Federal Project Director, the LCLS Project Director, SLAC, ANL and LLNL Directors, or any other member of the Integrated Project Team. Significant changes to the PMP require an amended PMP and the approval of Director of the DOE's Stanford Site Office, DOE Federal Project Director, LCLS Project Director, and the Laboratory Director's at SLAC, ANL and LLNL.

Appendix A – LCLS Summary Schedule (Jul04)



Appendix B – LCLS L1/L2/L3Milestone Dictionary

#	Milestone Level	Milestone Description	Milestone Definition	Scheduled Date
1	1	CD-0 Approve Mission Need	Completion of this milestone is defined as an approved Decision document signed by the Acquisition Executive (SC-1) from DOE.	June-01 (A)
2	1	CD-1 Approve Preliminary Baseline Range	Completion of this milestone is defined as an approved Decision document signed by the Acquisition Executive (SC-1) from DOE.	October-02 (A)
3	1	CD-2a Approve Long-Lead Procurement Budget	Completion of this milestone is defined as an approved Decision document signed by the Acquisition Executive (SC-1) from DOE.	July-03 (A)
4	1	CD-2b Approve Performance Baseline	Completion of this milestone is defined as an approved Decision document signed by the Acquisition Executive (SC-1) from DOE.	July-04
5	1	CD-3a Approve Start of Long-Lead Procurement	Completion of this milestone is defined as an approved Decision document signed by the Acquisition Executive (SC-1) from DOE.	September-04
6	1	CD-3b Approve Start of Construction	Completion of this milestone is defined as an approved Decision document signed by the Acquisition Executive (SC-1) from DOE.	September-05
7	1	CD-4 Approve Start of Operations	Completion of this milestone is defined as an approved Decision document signed by the Acquisition Executive (SC-1) from DOE.	October-08
8	2	DOE External Independent Review (EIR) Complete	conducted an External Independent Review (EIR) of the LCLS.	June-04 (A)
9	2	Fire Hazard Analysis Approved	Office accepts the FHA report and issues their acceptance letter.	December-04
10	2	Sector 20 Alcove Beneficial Occupancy	This milestone is complete when the LCLS CF group can release the facility or portion thereof for use by the system end user, prior to final acceptance.	July-05
11	2	Preliminary Safety Assessment (PSAD) Document Approved	Office accepts the PSAD report and issues their acceptance letter.	August-05
12	2	Start Drive Laser Commissioning (Drive Laser RCV from vendor)	This milestone complete when the drive is installed and tested by the vendor at S20 Alcove.	December-05
13	2	Magnetic Measurement Facility (MMF) Qualified & Ready to Measure Production Undulators	MMF, incl. the completion of the calibration of the test stands, and the acceptance sign-off by the APS project physicist	September-05
14	2	Injector Accelerator Readiness Review (ARR) Complete	Office accepts the ARR report and issues a letter authorizing operation.	April-06
15	2	Start Injector Commissioning	sections and their RF systems are installed and RF conditioning begins.	May-06
16	2	Shutdown of Final Focus Test Beam (FFTB) Operations	This milestone is complete when the FFTB ceases operations and is ready to be decommissioned and dismantled in preparation of the LCLS.	June-06
17	2	Research Yard Modifications Beneficial Occupancy	This milestone is complete when the LCLS CF group can release the facility or portion thereof for use by the system end user, prior to final acceptance.	June-06
18	2	Near Experimental Hall (NEH) Beneficial Occupancy	This milestone is complete when the LCLS CF group can release the facility or portion thereof for use by the system end user, prior to final acceptance.	September-06
19	2	MMF Ready to Magnetic Measure/Fiducialize	certified ready for precise measurement of the 1st article undulator	October-05
20	2	Dog-Leg-1 (DL1) Installation Completed	This milestone is complete when the LCLS Injector Dog Leg 1 components have been installed and checked out.	October-06
21	2	Drive Laser: UV Beam to Cathode	This milestone is complete when the first UV beam from the drive laser is sent to the gun photocathode.	November-06
22	2	Undulator Facility Beneficial Occupancy	This milestone is complete when the LCLS CF group can release the facility or portion thereof for use by the system end user, prior to final acceptance.	December-06
23	2	Front-End Enclosure Beneficial Occupancy	This milestone is complete when the LCLS CF group can release the facility or portion thereof for use by the system end user, prior to final acceptance.	April-07

Appendix B – LCLS L1/L2/L3Milestone Dictionary (continued)

#	Milestone Level	Milestone Description	Milestone Definition	Scheduled Date
24	2	Linac Facility Beneficial Occupancy	This milestone is complete when the LCLS CF group can release the facility or portion thereof for use by the system end user, prior to final acceptance.	April-07
25	2	Linac Accelerator Readiness Review (ARR) Complete	Office accepts the ARR report and issues a letter authorizing operation.	May-07
26	2	First Beam on Linac Axis	This milestone is complete when the LCLS Injector first delivers beam to the LCLS Linac.	June-07
27	2	Undulator Production Units Received	This milestone is complete when the 33rd production undulator has been received at SLAC.	June-07
28	2	Beam Transport Hall Beneficial Occupancy	This milestone is complete when the LCLS CF group can release the facility or portion thereof for use by the system end user, prior to final acceptance.	July-07
29	2	X-Ray Transport Beneficial Occupancy	This milestone is complete when the LCLS CF group can release the facility or portion thereof for use by the system end user, prior to final acceptance.	July-07
30	2	Far Experimental Hall Beneficial Occupancy	This milestone is complete when the LCLS CF group can release the facility or portion thereof for use by the system end user, prior to final acceptance.	August-07
31	2	Start Bunch Compressor-1 (BC1) Commissioning	This milestone is complete when electrons are delivered to BC1 and BC1 systems are first activated.	September-07
32	2	Start Bunch Compressor-2 (BC2) Commissioning	This milestone is complete when electrons are delivered to BC2 and BC2 systems are first activated.	January-08
33	2	Final Safety Analysis Document (FSAD) Approved	Office accepts the FSAD report and issues their acceptance letter.	March-08
34	2	Central Lab Office (CLO) Complex Beneficial Occupancy	This milestone is complete when the LCLS CF group can release the facility or portion thereof for use by the system end user, prior to final acceptance.	March-08
35	2	Hall Readiness Review (ARR) Complete	Office accepts the ARR report and issues a letter authorizing operation.	April-08
36	2	Undulator System Installation Complete	All undulator system installation, alignment, and basic checkout is complete, and the system is ready for beam.	April-08
37	2	Start Linac-to-Undulator (LTU) Commissioning	This milestone is complete when electrons are delivered to LTU and LTU systems are first activated.	April-08
38	2	Start Undulator Commissioning	1st beam through the undulator system	June-08
39	2	Start X-Ray Transport, Optics and Diagnostics Commissioning	This milestone is complete when x-rays are first delivered to the x-ray transport system.	June-08
40	2	Final LCLS Readiness Review Report and Corrective Action Plan (CAP) Complete	This milestone is complete when the DOE Stanford Site Office accepts the ARR report and issues a letter authorizing operation.	September-08
41	2	LCLS Start Operations	operation approval, sign off from pertinent SLAC Citizen Safety Committees and a Beam Authorization Sheet has been issued.	October-08
42	3	Advanced Procurement Plan Complete	This milestone is complete when a draft of the LCLS Advance Procurement Plan is complete.	February-04 (A)
43	3	CRIT: Start Procurement for T3 Construction	This milestone is complete when the pre-qualifications and pre-selection phases have commenced.	April-04
44	3	A&E Serv (S20, MMF, MCC not incl) Title 1 Complete	completed and all action (or corrective action) items have been resolved.	April-04 (A)
45	3	A&E Serv Sector 20 Title 1 Complete	completed and all action (or corrective action) items have been resolved.	April-04 (A)
46	3	Project Management Plan (PMP) Complete	This milestone is complete when a draft of the LCLS Project Management Plan is complete.	April-04 (A)

Appendix B – LCLS L1/L2/L3Milestone Dictionary (continued)

#	Milestone Level	Milestone Description	Milestone Definition	Scheduled Date
47	3	Resource Loaded Cost & Schedule (Final) Complete	TEC and TPC baselines have been accepted by the LCLS Project Office.	April-04 (A)
48	3	1st Monthly Report (with Earned Value) Submitted	monthly report on the LCLS TEC and TPC using earned-value assessments.	April-04 (A)
49	3	Risk Management Plan Complete	This milestone is complete when a draft of the LCLS Preliminary Safety Assessment Document is complete.	April-04 (A)
50	3	Prelim Safety Assessment Doc (PSAD) Submitted	This milestone is complete when a draft of the LCLS Risk Management Plan is complete.	April-04 (A)
51	3	CRIT: Start Procurement Package - PMCS Support	Procurement Plan for the PMCS Support Award is submitted to SLAC Purchasing.	May-04
52	3	CRIT: Start Procurement for Drive Laser	This milestone is complete when the contract for the injector drive laser is awarded to a vendor.	May-04
53	3	CRIT: Start Procurement of Magnet Poles	Preparation of bid packages for the procurement of the magnet poles begun.	June-04
54	3	CRIT: Contract - Ti Strongback	Comments of the internal design review have been incorporated into the bid package for the Ti Strongbacks.	June-04
55	3	A&E Services MMF Title 1 Comp	This milestone is complete after a final Title I review has been completed and all action (or corrective action) items have been resolved.	June-04
56	3	Project Mgmt Cost & Sched (PMCS) Review Complete	conducted an independent review of the LCLS PMCS System and Controls.	June-04
57	3	CRIT: Start Procurement of Magnet Blocks	Preparation of bid packages for the procurement of the magnet blocks has begun.	July-04
58	3	LCLS Performance Baseline Completed	performance baselines have been accepted by the LCLS Project Office and configuration controls of the baseline are implemented.	July-04 (A)
59	3	FY04 Shutdown: HW Reqd for Installation	This milestone is complete when the HW is available for installation of the injector shield wall at S20.	August-04
60	3	CRIT: T3 Const. Pkg. RF Hut & Alcove	This milestone is complete when a contract is awarded to the successful bidder.	August-04
61	3	Complete 2-D X-Ray Detector Statement of Work	This milestone is complete when a Statement of Work has been prepared for the 2-D X-ray Detector development program, and approved by project management.	August-04
62	3	CRIT: (MMF) Construction Contract	This milestone is complete when a contract is awarded to the successful bidder.	September-04
63	3	A&E Services Sector 20 Title 2 Comp	This milestone is complete after a final Title II review has been completed and all action (or corrective action) items have been resolved.	September-04
64	3	A&E Services MMF Title 2 Comp	This milestone is complete after a final Title II review has been completed and all action (or corrective action) items have been resolved.	September-04
65	3	FY04 Shutdown Completed	This milestone is complete when the FY04 shutdown of the SLAC Linac has been completed.	September-04
66	3	CRIT: Start Procurement of Granite Beams	This milestone is complete when the APP for the Undulator supports is submitted to the LCLS Project Office.	October-04
67	3	CRIT: Start Procurement of X-Band Klystron	Procurement funds are received and once fabrication of the klystron has started	November-04
68	3	Award Initial Funding for 2-D X-Ray Detector	This milestone is complete when an MOU or contract is signed with an outside party, commencing the first phase of development of the 2-D X-ray detector.	February-05
69	3	RF Hut Beneficial Occupancy	This milestone is complete when the LCLS CF group can release the facility or portion thereof for use by the system end user, prior to final acceptance.	February-05
70	3	Optics Assembly Lab Available	This milestone is complete when the Optics Assemble Lab is available for the assembly, testing and storage of optical components for the injector.	March-05

Appendix B – LCLS L1/L2/L3Milestone Dictionary (continued)

#	Milestone Level	Milestone Description	Milestone Definition	Scheduled Date
71	3	Drive Laser for Integration	installed and is available for integration into the injector system.	December-05
72	3	FY05 Shutdown: HW Reqd for Installation	installation during the FY05 shutdown is ready for installation.	July-05
73	3	CRIT: Start Linac Cableplant Installation Procmt	This milestone is complete after FY06 construction funds are received and once the cable plant installation contract is placed for bid.	September-05
74	3	Magnetic Msmt Facility(MMF) Beneficial Occupancy	This milestone marks the date when the MMF becomes available for the installation of equipment	July-05
75	3	Laser Room PPS Equip ready for Install	System equipment is available for installation at S20 Laser Room.	August-05
76	3	A&E Serv (S20, MMF, MCC not incl) Title 2 Comp	This milestone is complete after a final Title II review has been completed and all action (or corrective action) items have been resolved.	August-05
77	3	LO-1TLO-2 Installed	This milestone is complete when the LCLS Injector L01-to-L02 components have been installed and checked out.	August-05
78	3	Gun Solenoid Ready for Installation	This milestone is complete when the gun solenoid has be fabricated, characterized at magnetic measurements and mounted on its mechanical supports	September-05
79	3	LTDL1 Installed	This milestone is complete when the LCLS Injector Linac-to-Dog-Leg 1 components have been installed and checked out.	September-05
80	3	FY05 Shutdown Completed	This milestone is complete after all hardware scheduled for installation during the FY05 has been installed and tested.	September-05
81	3	L0-2 Structure Ready for Install	This milestone is complete when the LCLS Injector L0-1 structure is assembled and tested.	October-05
82	3	MMF Ready to Magnetic Measure/Fiducialize	This milestone marks the date when the primary magnetic measurements and fiducialization systems are installed and ready for commissioning	October-05
83	3	RF Gun Assembly Ready for Install	This milestone is complete when the RF gun assembly which includes the gun and solenoid and vacuum valve on a common support is ready for installation on the beamline.	October-05
84	3	LINAC Solenoid Ready for Installation	This milestone is complete when the LCLS Injector Solenoid is assembled and tested.	December-05
85	3	GS Installed	system is installed on the beamline and under vacuum. The GS system consists of the spectrometer dipole, three quadrupoles, vacuum chamber and diagnostics all mounted onto one support.	December-05
86	3	Design Review #2 for 2-D X-Ray Detector	This milestone is complete upon completion (with written report) of the first formal design review of the 2-D X-ray detector development project.	December-05
87	3	CP Load Lock Ready for Install	This milestone is complete when the cathode load lock system is ready for installation on the gun.	January-06
88	3	GTL Installed	This milestone is complete when the Gun to Linac (GTL) components are installed	January-06
89	3	RF Gun Installed & Aligned	This milestone is complete when the RF gun is installed and aligned on the beamline	January-06
90	3	Hydrostatic Level System Complete	This milestone marks the date when the HLS is ready to take measurements	October-07
91	3	COMP: Design Package - Tunnel Mech/Vac	This milestone is complete when the LCLS X-TOD transport tunnel hardware design is complete.	May-06
92	3	Injector MPS Equip ready for Install	This milestone is complete when the Injector Machine Protection System is on site and available for installation.	May-06
93	3	A&E Services MCC Title 1 Comp	This milestone is complete after a final Title I review has been completed and all action (or corrective action) items have been resolved.	May-06
94	3	L0-1 Structure Ready for Install	This milestone is complete when the LCLS Injector L0-2 structure is assembled and tested.	May-06
95	3	1st Article Vendor A Undulator 1 received	1st article undulator from vendor A has arrived at ANL.	May-06

Appendix B – LCLS L1/L2/L3Milestone Dictionary (continued)

#	Milestone Level	Milestone Description	Milestone Definition	Scheduled Date
96	3	RFI: RF BPM	This milestone is complete when the LCLS Undulator RF BPM's are assembled and tested.	May-06
97	3	COMP: Design Package - Flipper Mirror	Flipper Mirror assembly has been approved as ready for procurement.	May-06
98	3	BO1 & BO2 Dipoles Assembly Ready for Inst	This milestone is complete when the LCLS Injector B01 and B02 bend magnets are assembled and tested.	June-06
99	3	SAB Spectr. Dipole Assembly Ready for Install	This milestone is complete when the Straight Ahead Spectrometer (SAB) equipment is available for installation during the FY06 shutdown.	June-06
100	3	SAB Beam Dump/Shielding Ready for Install	Dump/Shielding are available for installation during the FY06 shutdown.	June-06
101	3	1st Article Vendor B Undulator 2 received	1st article undulator from vendor B has arrived at ANL.	June-06
102	3	Quad Mag Measure/Fiducialization Facility Ready	This milestone marks the date when the quadrupole field strength measurement test stand and the fiducialization system are ready for measurements	June-06
103	3	COMP: Network Design Review	This milestone is complete when an external review of the network layout to provide the required capacity and response for communication to the operator, data archiving, machine protection, and 120 Hz fast feedback.	June-06
104	3	COMP: Design Package - Far Hall Mech/Vac	This milestone is complete when the design of the mechanical and vacuum assemblies of the Endstation Systems that are located in the Far Experimental Hall has been approved as ready for procurement.	June-06
105	3	CRIT:Start Contract Opt Vendor A Proc-Prdn Units	1st article undulator from vendor A has passed the acceptance criteria at ANL.	July-06
106	3	FY06 Shutdown: HW Reqd for Installation	installation during the FY06 shutdown is ready for installation.	August-06
107	3	CRIT:Start Contract Op Vendor B Proc-Prdn Units	1st article undulator from vendor B has passed the acceptance criteria at ANL.	August-06
108	3	CP Station Installed	This milestone is complete when the Cathode Processing Station is installed in the Load Lock room at S20.	August-06
109	3	Light Path System Ready for Installation	This milestone is complete when the equipment for the optical paths from the drive laser to the rf gun and laser heater are available for installation.	May-06
110	3	A&E Services MCC Title 2 Comp	This milestone is complete after a final Title II review has been completed and all action (or corrective action) items have been resolved.	September-06
111	3	COMP: Design Package - Gas Attenuator	This milestone is complete when the design package for the gas attenuator system has been approved as ready for procurement.	September-06
112	3	AVAIL: DL1 Installation Complete	This milestone is complete when the LCLS Injector Dog Leg 1 components have been installed and checked out.	October-06
113	3	DL1TL Installed	This milestone is complete when the LCLS Injector Dog Leg 1-to-Linac components have been installed and checked out.	October-06
114	3	SAB Installed	This milestone is complete when the Straight Ahead Spectrometer (SAB) is installed and operational. This spectrometer consists of a dipole and two quadrupole magnets, the vacuum system, diagnostics and beam dump.	October-06
115	3	Component Installation Completed - L01	This milestone is complete when the L0-1 accelerator sector is in place on the beamline with its supports, aligned, connected to the rf waveguide and under vacuum.	October-06
116	3	Component Installation Completed - BC1	This milestone is complete when the LCLS Linac BC1 components have been installed and checked out.	October-06
117	3	COMP: Final Design Review Beamline Control	review of the hardware and software design for each subsystem: timing, machine protection, power supply control, beam position monitors etc.	October-06
118	3	FY06 Shutdown Completed	This milestone is complete after all hardware scheduled for installation during the FY06 has been installed and tested.	October-06
119	3	Laser System Final Design Review Completed	design review is finished and the drive laser contract is ready to be awarded.	November-06
120	3	Start Installation in Near Hall	as ready for installation of x-ray transport and optics components.	November-06

Appendix B – LCLS L1/L2/L3Milestone Dictionary (continued)

#	Milestone Level	Milestone Description	Milestone Definition	Scheduled Date
121	3	AVAIL: Solid Attenuator Ready to Ship to SLAC	has been completed by the vendor and is ready to ship to SLAC	December-06
122	3	Injector RF Subsystem Installed	This milestone is complete when the RF subsystem including the wave guide is installed	January-07
123	3	25% production undulators received	The 10th production undulator has been received at SLAC.	February-07
124	3	Award NH and FH Oscillator Laser/Pump	the laser oscillator/pump system to be located in the NEH is signed.	February-07
125	3	Drive Laser Checkout & Integration Completed	This milestone is completed when the drive laser is fully operational	December-06
126	3	LH Undulator for Installation	This milestone is completed when the Laser Heater Undulator has been mounted on it's support, characterized by magnetic measurements and the fiducials established for the magnetic centerline.	March-07
127	3	COMP: Design Package - Spectral Measurement	This milestone is complete when the designs of the spectral measurement instruments have been certified as ready for procurement	March-07
128	3	50% production undulators received	The 20th production undulator has been received at SLAC.	May-07
129	3	AVAIL: Indirect Imager Ready to Ship to SLAC	has been completed by the vendor and is ready to ship to SLAC	May-07
130	3	Laser Heater Installed	This milestone is complete when the laser heater vacuum chamber, undulator and optical system are installed.	June-07
131	3	Beam Dump Beneficial Occupancy	Facilities allows installation activities to begin in the Beam Dump enclosure	April-07
132	3	FY07 Shutdown: HW Reqd for Installation	installation during the FY07 shutdown is ready for installation.	July-07
133	3	First Atomic Physics Experiment	This milestone is complete upon initiation of the first atomic physics experiment using LCLS radiation.	July-07
134	3	75% Production Undulators Received	The 30th production undulator has been received at SLAC.	July-07
135	3	COMP: Solid Attenuator Installed & Commissioned	This milestone is complete when the solid attenuator system has been installed, tested with x-rays, and certified as meeting system requirements.	August-07
136	3	System Commissioning Completed - L01	This milestone is complete when LCLS Linac Subsystem L01 meets minimum performance requirements.	September-07
137	3	Component Installation Completed - L02	This milestone is complete when the LCLS Linac L02 components have been installed and checked out.	September-07
138	3	Component Installation Completed - BC2	This milestone is complete when the LCLS Linac BC2, components have been installed and checked out.	September-07
139	3	Component Installation Completed - L03	This milestone is complete when the LCLS Linac BC2 components have been installed and checked out.	September-07
140	3	FY07 Shutdown Completed	This milestone is complete after all hardware scheduled for installation during the FY07 has been installed and tested.	September-07
141	3	PPS Sys Ops for 3 Hutches in NEH Completed	This milestone is complete upon operational certification of the PPS system for the experimental hutches in the NEH.	September-07
142	3	Start Installation in Far Hall	This milestone is complete upon initiation of installation of the Endstation Systems in the FEH.	October-07
143	3	All Undulator Magnets Ready for Installation	Undulator 33 and its associated cradle and hardware system have been measured, tuned, and fiducialized in the MMF.	October-07
144	3	Laser Operating in the Far Hall	This milestone is complete upon completion of acceptance tests for the laser oscillator and amplifier system in the FEH.	November-07
145	3	COMP: FEE Mechanical/Vacuum Installed & Commiss	This milestone is complete when the mechanical and vacuum components of the Endstation Systems have been installed and certified as operational in the FEE.	November-07

Appendix B – LCLS L1/L2/L3Milestone Dictionary (continued)

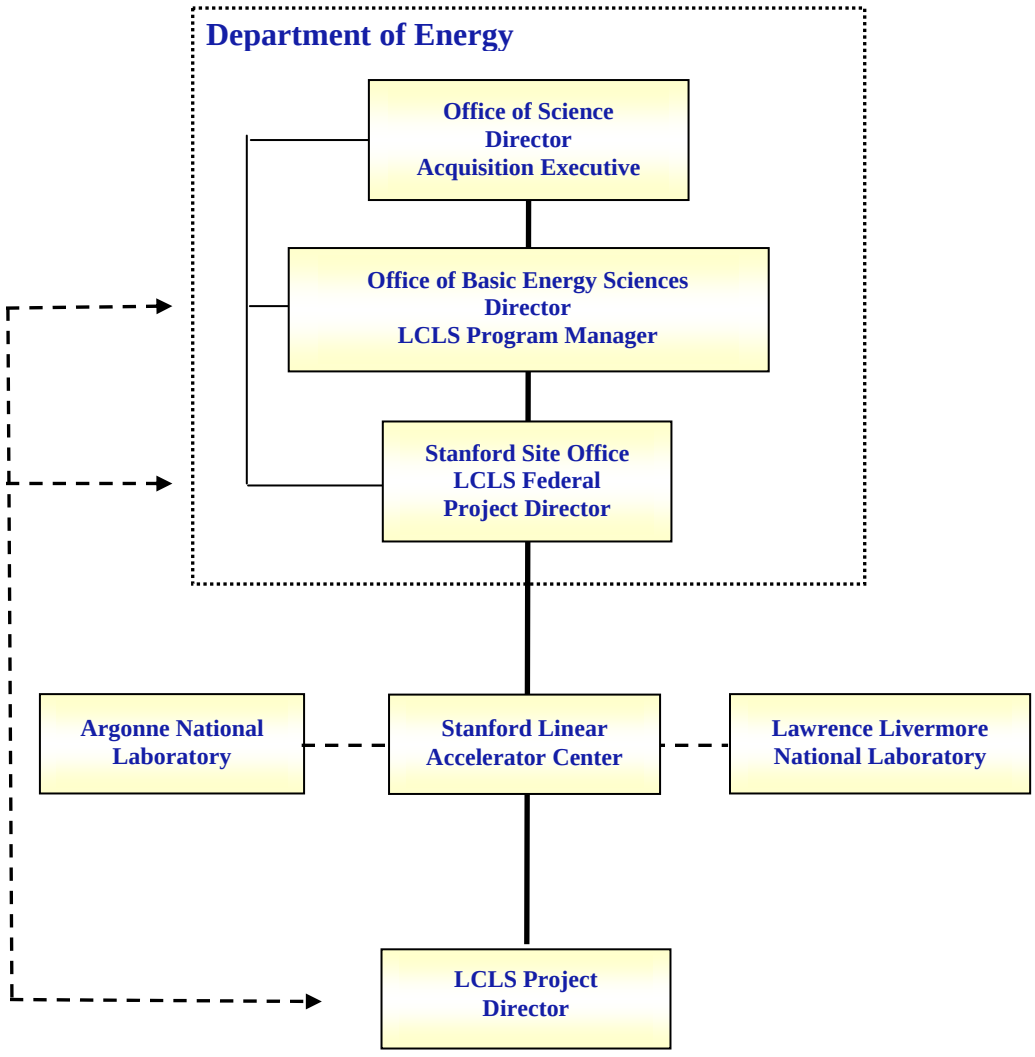
#	Milestone Level	Milestone Description	Milestone Definition	Scheduled Date
146	3	System Commissioning Completed - BC1	This milestone is complete when LCLS Linac Subsystem BC1 meets minimum performance requirements.	December-07
147	3	Component Installation Completed - LTU	This milestone is complete when the LCLS Linac LTU components have been installed and checked out.	December-07
148	3	Complete Beamline Control	Milestone is complete when the injector control system is fully operational.	December-07
149	3	Complete Mechanical & Vacuum - Ready to Commiss	This milestone is complete when the LCLS X-Ray Endstation beamline hardware is ready to accept x-rays.	December-07
150	3	PPS Sys Ops for 3 Hutches in FEH Completed	This milestone is complete upon operational certification of the PPS system for the experimental hutches in the FEH.	December-07
151	3	Injector System Commissioning Completed	This milestone is completed when the injector system is fully operational and ready to provide beams to the main linac.	January-08
152	3	Laser Operating in Near Hall	This milestone is complete upon completion of acceptance tests for the laser oscillator and amplifier system in the NEH.	January-08
153	3	COMP: Controls System Tests Complete	Milestone is complete when the LINAC control system is ready to support commissioning	February-08
154	3	System Commissioning Completed - L02	This milestone is complete when LCLS Linac Subsystem L02 meets minimum performance requirements.	April-08
155	3	System Commissioning Completed - BC2	This milestone is complete when LCLS Linac Subsystem BC2 meets minimum performance requirements.	April-08
156	3	Complete Near Hall Installation	This milestone is complete when all x-ray transport, optics, and diagnostics systems for the NEH have been installed and checked out.	April-08
157	3	System Commissioning Completed - L03	This milestone is complete when LCLS Linac Subsystem L03 meets minimum performance requirements.	May-08
158	3	Component Installation Completed - E-Dump	This milestone is complete when the LCLS Linac E-Dump components have been installed and checked out.	May-08
159	3	Complete Network & Cable - Ready to Commission	Milestone is complete when the facility network is installed to the MCC and ready for operation	May-08
160	3	COMP: Tunnel Mech/Vac Installed & Commiss	This milestone is complete when the LCLS X-TOD transport tunnel hardware has been installed and is ready for x-rays.	May-08
161	3	Main Control Center (MCC) Beneficial Occupancy	This milestone is complete when the LCLS CF group can release the facility or portion thereof for use by the system end user, prior to final acceptance.	May-08
162	3	First Beam into Undulator	This milestone is complete after the LCLS Linac sets up electron launch feedback and launches the first electron bunch into the FEL Undulator channel.	May-08
163	3	Injector Controls Installed	Milestone is complete when the LINAC control system commissioning is complete	July-08
164	3	System Commissioning Completed - LTU	This milestone is complete when LCLS Linac Subsystem LTU meets minimum performance requirements.	July-08
165	3	Start Beam Dump Commissioning	This milestone is complete when electrons are delivered to E-Dump and E-Dump systems are first activated.	August-08
166	3	System Commissioning Completed - E-Dump	This milestone is complete when LCLS Linac Subsystem E-Dump meets minimum performance requirements.	August-08
167	3	COMP: Gas Attenuator Installed & Commissioned	This milestone is complete when the gas attenuator system has been installed, tested with x-rays, and certified as meeting system requirements.	September-08
168	3	COMP: Total Energy Measurement Installed & Com	This milestone is complete when the total energy measurement system has been installed, tested with x-rays, and certified as meeting system requirements.	September-08
169	3	Complete Acceptance Tests for X-Ray Detectors	completed for all the x-ray detectors of the Endstation Systems.	September-08
170	2	Delivery of Undulator 1st Articles to MMF	This milestone is complete when ANL has delivered the first prototype undulator to the MMF facility at SLAC.	October-06

Appendix C – LCLS Cost Estimate and Proposed Funding Profile (AYM$)

Linac Coherent Light Source BCWS Profile (AYM$)									June 2004
WBS	**System**	**FY02**	**FY03**	**FY04**	**FY05**	**FY06**	**FY07**	**FY08**	**Total**
1.1	Project Mgmt., Admin. & Integration	0.00	1.43	2.50	3.74	3.98	4.05	3.30	19.01
1.2	Injector System	0.00	0.64	1.60	12.67	3.66	0.71	0.35	19.63
1.3	Linac System	0.00	0.18	1.17	5.51	12.75	5.27	1.00	25.89
1.4	Undulator System	0.00	0.57	1.90	9.80	14.17	18.65	0.44	45.53
1.5	X-Ray Transport & Diagnostics	0.00	0.70	0.75	3.82	9.52	7.58	1.50	23.88
1.6	X-Ray Endstations	0.00	0.00	0.46	0.55	4.11	10.04	1.43	16.59
1.9	Conventional Facilities	0.00	0.11	1.44	5.69	29.15	18.94	7.34	62.68
Estimated Base Cost		**0.00**	**3.64**	**9.82**	**41.79**	**77.34**	**65.24**	**15.37**	**213.20**
Contingency		0.00	0.00	0.00	8.08	7.84	22.42	21.45	59.80
Total Estimated Cost (Base + Contingency)		**0.00**	**3.64**	**9.83**	**49.87**	**85.18**	**87.67**	**36.82**	**273.00**
2.1	Project Mgmt., Admin. & Integration	1.50	0.00	0.67	1.83	1.63	5.22	9.55	20.40
2.2	Injector System	0.00	0.00	0.44	0.97	0.81	4.16	0.10	6.48
2.3	Linac System	0.00	0.00	0.00	0.00	0.00	1.22	0.77	1.99
2.4	Undulator System	0.00	0.00	0.02	0.30	0.47	4.98	0.08	5.84
2.5	X-Ray Transport & Diagnostics	0.00	0.00	0.78	0.89	0.00	1.94	1.17	4.78
2.6	X-Ray Endstations	0.00	0.00	0.00	0.23	0.96	0.81	0.51	2.50
2.9	Conventional Facilities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Project Costs		**1.50**	**0.00**	**1.91**	**4.21**	**3.87**	**18.33**	**12.18**	**42.00**
Total Project Costs (Base + Cont. + OPC)		**1.50**	**3.64**	**11.74**	**54.08**	**89.04**	**106.00**	**49.00**	**315.00**

Linac Coherent Light Source Funding Profile (AYM$)							
	FY02	**FY03**	**FY04**	**FY05**	**FY06**	**FY07**	**FY08**	**Total**
TEC Funding	0.00	5.93	7.46	50.08	85.54	90.00	34.00	273.00
OPC Funding	1.50	0.00	2.00	4.00	3.50	16.00	15.00	42.00
Total Funding	1.50	5.93	9.46	54.08	89.04	106.00	49.00	315.00

Appendix D – DOE Office of Science & LCLS Project Organization

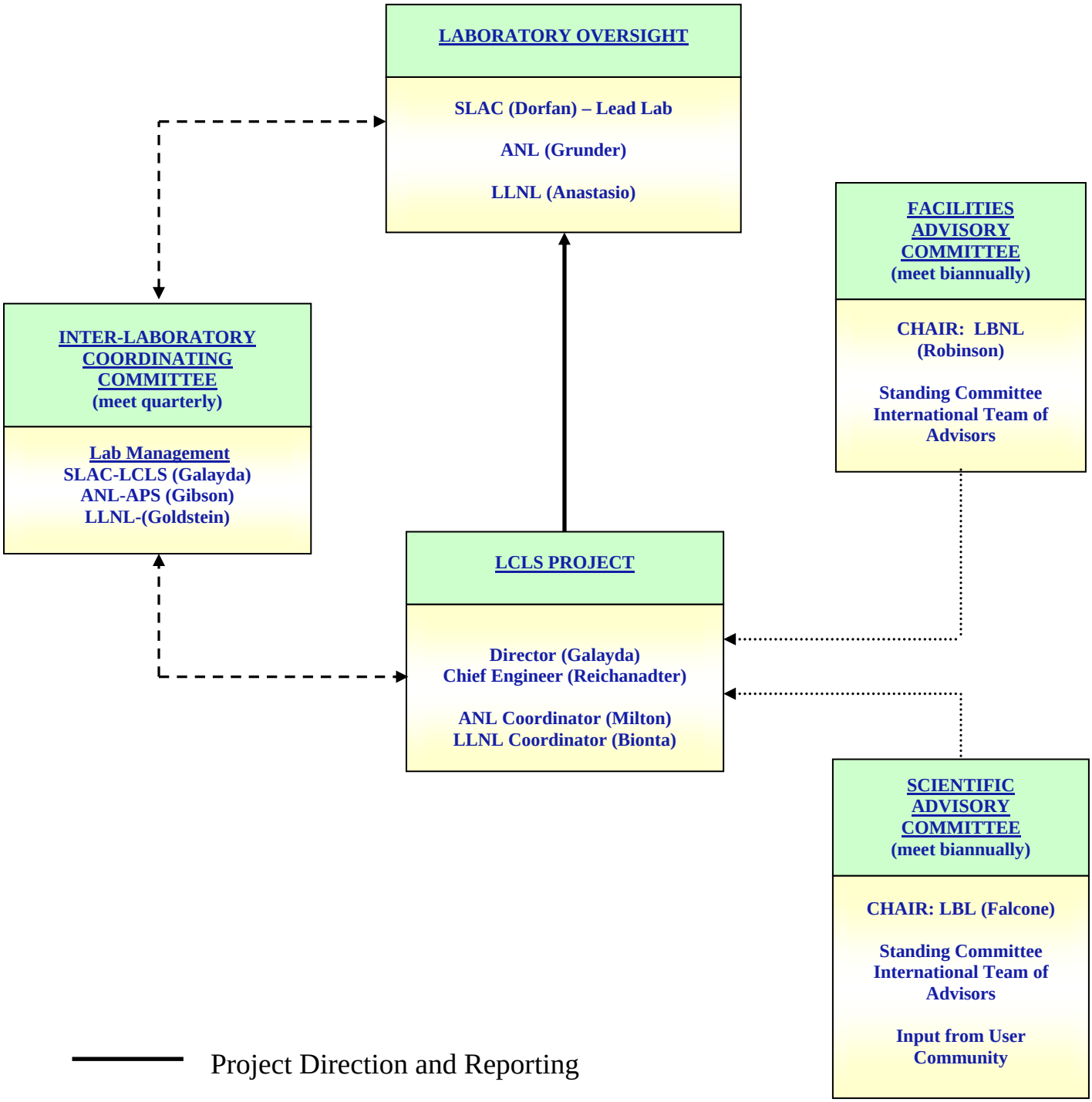


Program Direction and Reporting

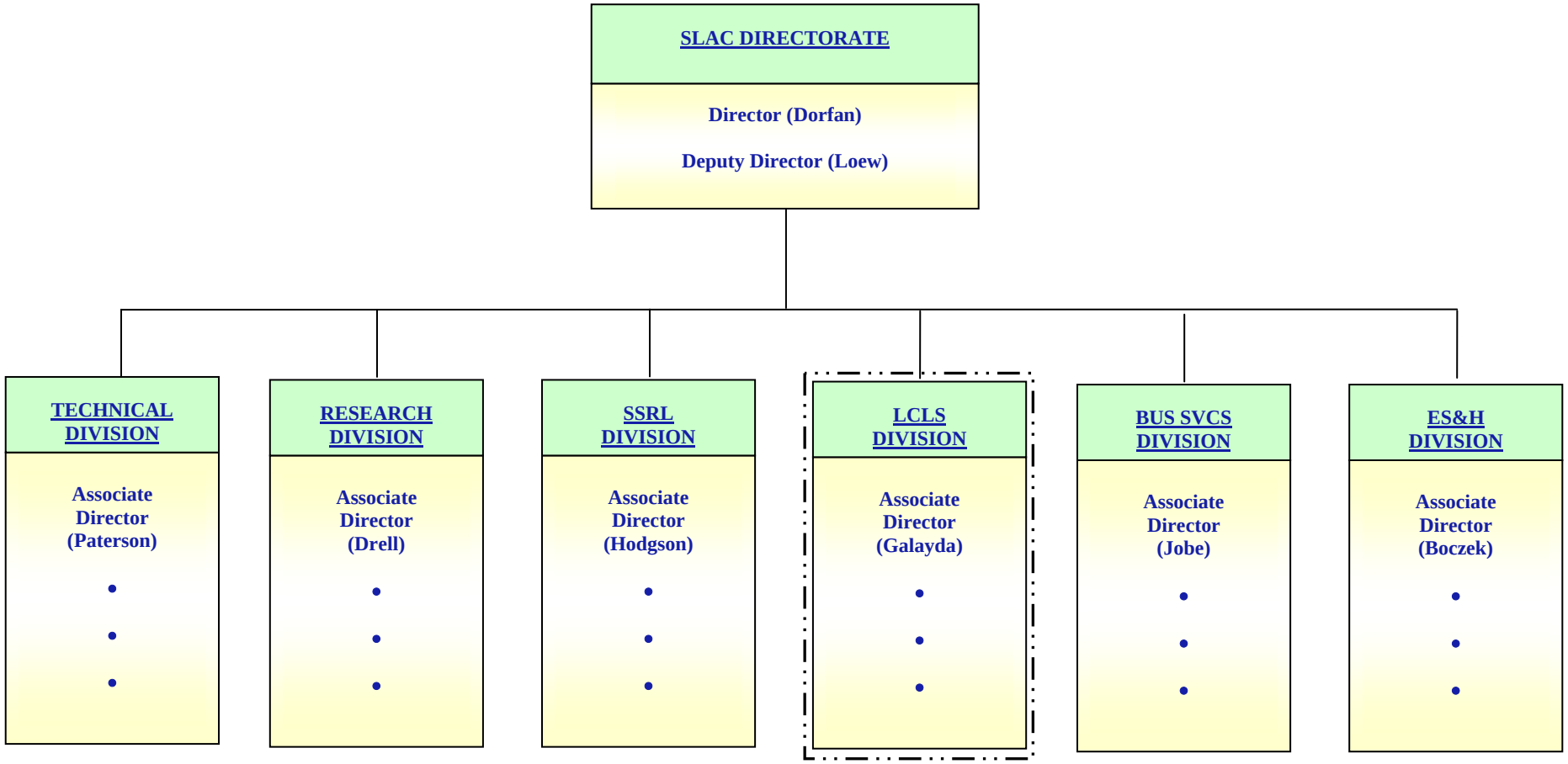
Communication and Coordination

DOE Administrative Direction and Work Authorization

Appendix E – LCLS Partner Lab Organization and Advisory Function



Appendix F – Proposed SLAC Organization



Appendix G – Technical Addendum to the LCLS MOU

TECHNICAL ADDENDUM <X>

to the

MEMORANDUM OF UNDERSTANDING

between the

STANFORD LINEAR ACCELERATOR CENTER

and the

LAWRENCE LIVERMORE NATIONAL LABORATORY

for the period

<insert period>

<insert date>

I. Introduction

This Technical Addendum C constitutes the Statement of Work to be performed by the Lawrence Livermore National Laboratory (LLNL) on behalf of the Linac Coherent Light Source (LCLS) Project. The Stanford Linear Accelerator Center (SLAC) is a signatory as part of its role in LCLS management oversight. This Statement of Work may be amended as required by the written agreement of both parties.

The work to be performed detailed in this document falls within the scope of the Memorandum of Understanding (MOU) between SLAC and LLNL dated August 10, 2002. The terms of agreement under which the work will be carried out are found within the MOU and continue to be in force.

The Appendix to this document contains (i) a detailed description of work, and (ii) total estimated cost for the current period organized by Work Breakdown Structure (WBS) for each area in which LLNL is involved. When manpower resources are required, every effort will be made to identify specific individuals assigned to the LCLS project.

Budgeted funds for the current period covered in this Technical Addendum include $XXX.XK (R&D Effort) and $XXX.XK (PED Effort) for a total of $XXX.XK.

II. Approval

The undersigned concur with this Technical Addendum C to the SLAC / LLNL Memorandum of Understanding dated August 10, 2002.:

_____	_____
John Galayda / Date	Richard Bionta / Date
SLAC LCLS Project Director	LLNL LCLS Project Head
	_____
	W. Goldstein/ Date
	PAT Associate Director, LLNL
_____	_____
Jonathan Dorfan / Date	M. Anastasio / Date
Director, SLAC	Director, LLNL

III. Appendix

This Appendix consists of the detailed Statement of Work (SOW) and associate budget and milestones for the work agreed to between the Stanford Linear Accelerator Center and the Lawrence Livermore National Laboratory with regard to the Linac Coherent Light Source (LCLS) Project.

LCLS WBS, Estimated Cost and Deliverable

WBS	Task – Deliverable	Fund Type	Budget this Period (AYK$)*	EDIA*	M&S**
TOTAL					

* EDIA (Engineering, Design, Inspection & Administration.
** M&S (Materials & Services). Includes project-related travel.

PED Effort to be Performed this Period

R&D Effort to be Performed this Period

List of Scientific, Engineering, Technical and Administrative Personnel

As a planning tool, an estimate of LLNL personnel necessary to accomplish the work scope for the performance period, are shown below.

Staff Type	FTEs	Cost (K$)
Total		

The following LLNL personnel are identified as participating in the LCLS Program during this period of performance;

Name	Areas of Responsibility

* indicates that individuals will be assigned by the LCLS LLNL Project Director on an as needed basis.

Reporting and Procurement Authorization

The person responsible for the LCLS effort at LLNL is the LCLS X-Ray Transport, Optics and Diagnostics System Manager and LCLS LLNL Project Head, Dr. Richard Bionta. The LCLS group at LLNL agrees to furnish complete documentation for all deliverables supplied to the LCLS project as well as quality control, design and performance checks carried out in the performance of this work

The LCLS Group at LLNL will report monthly on or before the tenth working day of the following calendar month to the LCLS Project Office. All LCLS-related materials and services, travel and labor charges will be reported according to Work Breakdown Structure (WBS) category at the lowest WBS level. Major procurements (currently >$100k) must, in addition, have the written authorization of the LCLS Project Director. During this period of performance the LCLS Group at LLNL agrees to supply the above deliverables at a cost not to exceed the estimated base cost given in the LCLS WBS.

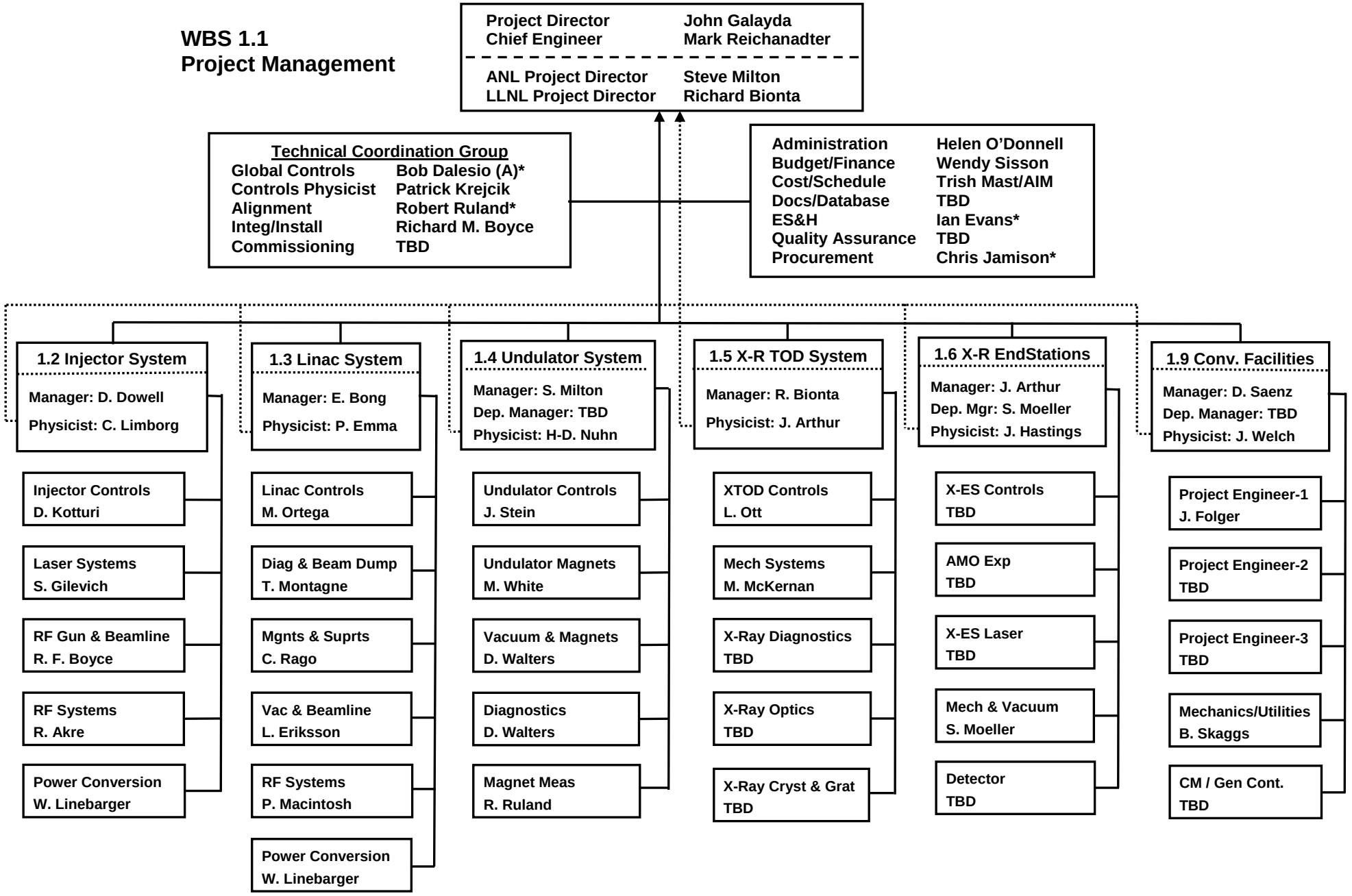
A high-level monthly report will also be generated by the LCLS LLNL Project Director and provided to the LCLS Chief Engineer by the tenth working day of the subsequent month. This report will describe major highlights on technical progress, an overall assessment of the project's status and should emphasize any problems or issues that require attention.

Schedule and Milestones

The LCLS group at LLNL will make every effort to carry out their institutional responsibilities consistent with the overall LCLS schedule. In this Statement of Work the project milestones for this period of performance relevant to the LCLS group at LLNL are shown in the table below:

Milestone ID	Milestone	Milestone Date

Appendix H – LCLS Project Organization (thru L3)



Appendix I - LCLS WBS Dictionary @ Level 2

1 LCLS Project — PED & Construction

This WBS covers the Total Estimated Cost (TEC) Estimate for the LCLS Project being constructed at SLAC. The LCLS TEC is supported through Project Engineering and Design (PED) and Construction funds by the U.S. Department of Energy.

1.1 Project Management, Planning & Administration (TEC)

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

1.2 Injector System

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

1.3 Linac System

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

1.4 Undulator System

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

1.5 X-Ray Transport, Optics and Diagnostic System

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

1.6 X-Ray Endstation Systems

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

1.9 Conventional Facilities

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

2 LCLS Project — R&D, Spares, Commissioning

This WBS covers the Other Project Cost (OPC) Estimate for the LCLS Project being constructed at SLAC. The LCLS OPC is supported through Research & Development (R&D), Spares and Commissioning funds by the U.S. Department of Energy.

2.1 Project Management, Planning & Administration (OPC)

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

2.2 Injector System (OPC)

Other Project Costs (OPC) Summary for the Injector System. It includes effort and costs associated with R&D, Spares, and Commissioning.

2.3 Linac System (OPC)

OPC Summary for the Linac System. It includes effort and costs associated with R&D, Spares, and Commissioning.

2.4 Undulator System (OPC)

The LCLS Undulator System OPC area includes spares plus any R&D and commissioning for all elements including undulator magnets and supports, undulator diagnostics, vacuum systems, and controls for the undulator equipment are included herein. Total cost for the LCLS undulator system Other Project Costs (OPC) including R&D, spares, and commissioning.

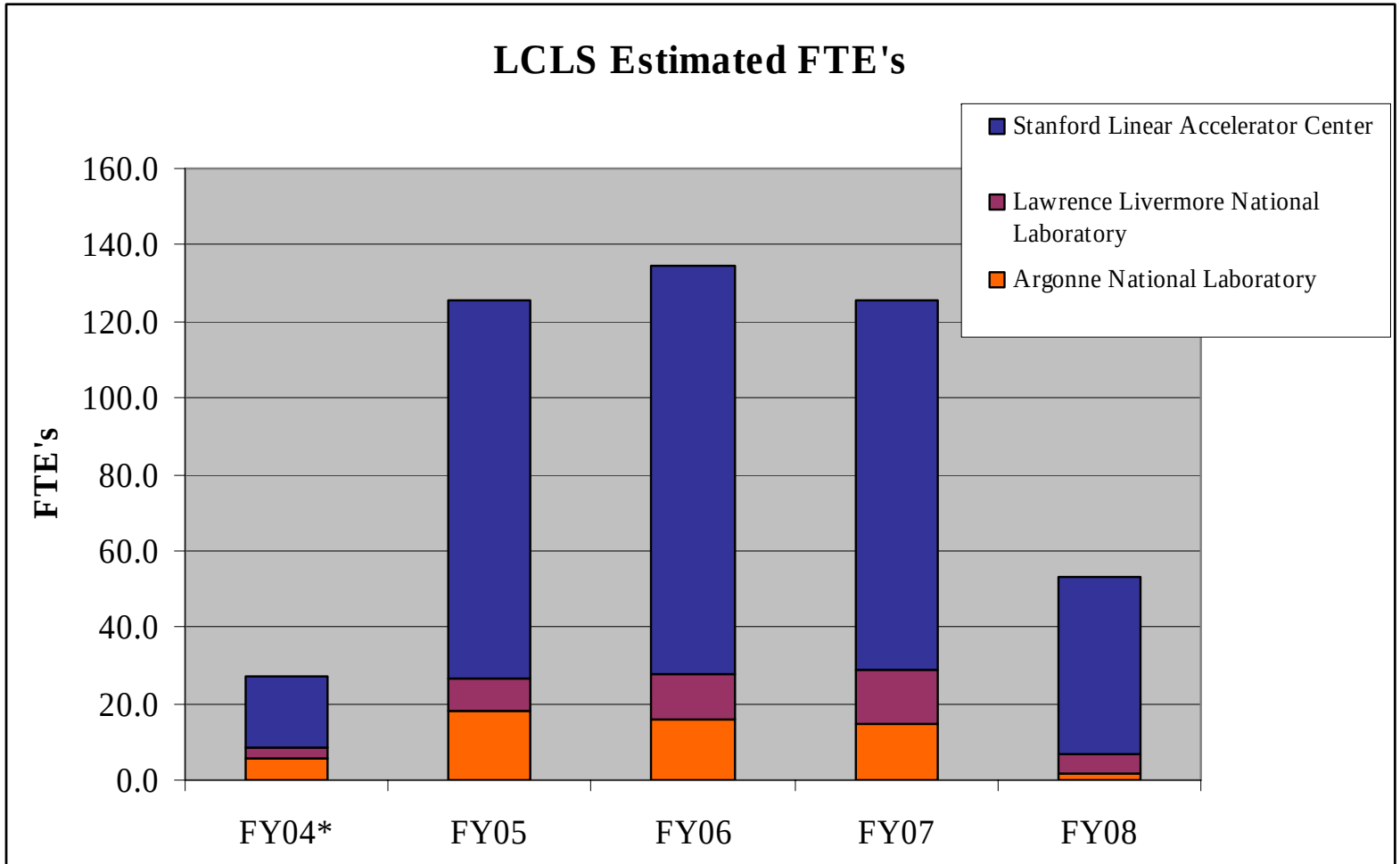
2.4 X-Ray Transport, Optics and Diagnostics System (OPC)

OPC Summary for the S-Ray Transport, Optics and Diagnostics System. It includes effort and costs associated with R&D, Spares, and Commissioning.

2.5 X-Ray End Station Systems (OPC)

OPC Summary for the X-Ray End Station System. It includes effort and costs associated with R&D, Spares, and Commissioning.

Appendix J – LCLS Estimated Full-Time Equivalents (by Laboratory)



LCLS Estimated FTE's	FY04*	FY05	FY06	FY07	FY08	Total
Argonne National Laboratory	5.6	18.2	15.9	14.5	1.8	**55.8**
Lawrence Livermore National Laboratory	2.7	8.6	11.6	14.4	5.0	**42.3**
Stanford Linear Accelerator Center	18.8	98.7	106.9	96.3	46.5	**367.2**
Total	**27.1**	**125.5**	**134.3**	**125.2**	**53.2**	**465.3**

*Apr04-Sep04 only

Appendix K – LCLS Project Baseline Change Request (BCR) Thresholds

LCLS Project Change Control Thresholds					
	Secretarial Acquisition Executive (Level 0)	**Acquisition Executive (SC-1) (Level 1)**	**DOE Federal Project Director (Level 2)**	**LCLS Project Director (Level 3)**	**LCLS System Manager (Level 4)**
Technical	Any change in scope and/or performance that affects mission need requirements or in not in conformance with current approved Project Data Sheet.	Change in siting or in Key Design Parameters that affect mission need requirements (see Appendix A).	Changes that affect ES&H requirements or changes facilities that do not affect Key Design Parameters (See Appendix A).	Changes in system requirements or design that do not affect Key Design Parameters (see Appendix A-1).	Changes in subsystem requirements or design that do not affect Key Design Parameters (see Appendix A-1).
Schedule	Six months or greater increase (cumulative) in the original project completion date.	≥ 3-month delay in a Level 1 milestones.	Any delay in Level 1 milestones or ≥ 3 months delay in Level 2 milestones.	Any change to the Level 3 milestones or < 3 months delay in Level 2 milestones.	Any change to the project schedule that does not impact, a Level 1, 2 , or 3 milestone.
Cost	Increase in excess of $25M or 25% (cumulative) of the baseline TEC or TPC.	Any increase in the baseline TEC or TPC.	The smaller cumulative change of ≥ $1M or 25% of any WBS Level 2 cost.	Any increase to WBS Level 2 ≥ $100K.	Any change to WBS Level 2 < $100K.