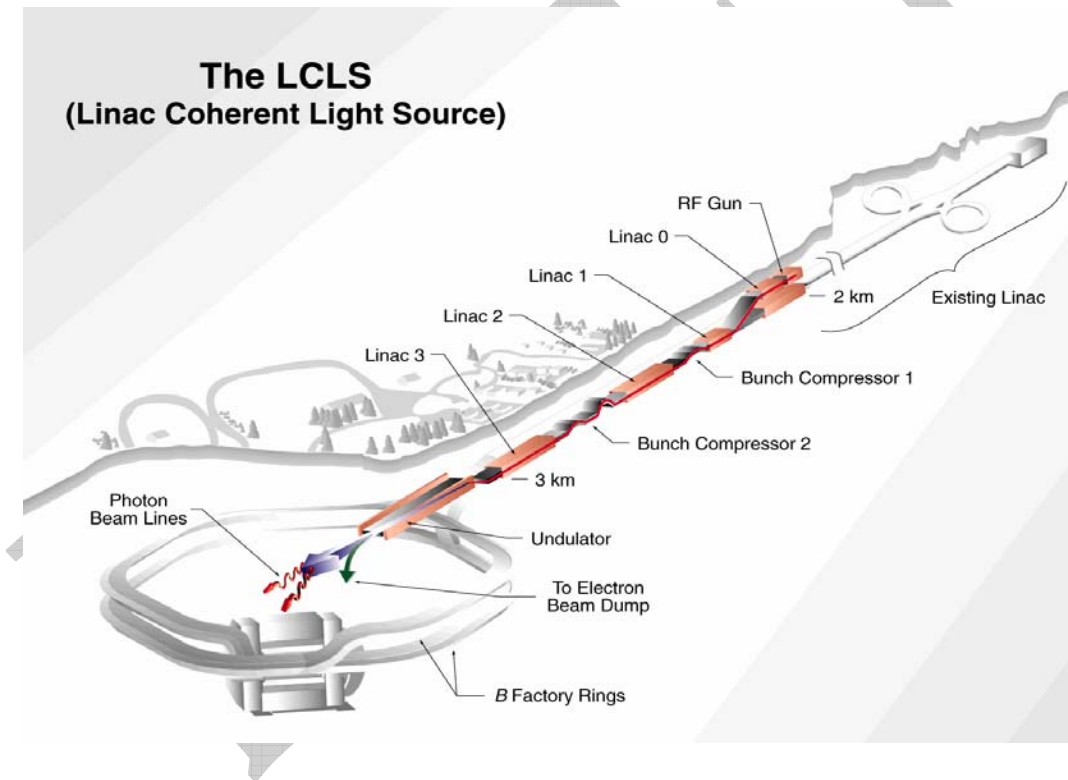


Linac Coherent Light Source (LCLS)

An X-Ray Free Electron Laser



Quality Implementation Plan

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Quality Implementation Plan (QIP) For the LCLS Project

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Section I – Purpose/Scope

The purpose of this Quality Implementation Plan (QIP) is to promote an environment of quality assurance (QA) and quality control (QC) and to establish processes to ensure that proper standards are met and maintained for the Linac Coherent Light Source (LCLS) Project to be constructed at the Stanford Linear Accelerator Center (SLAC). This document will define the LCLS processes and functions that ensure to:

- Design in quality and reliability.
- Promote early detection of problems to minimize failure costs and impact on schedule.
- Develop appropriate documentation to support construction and operational requirements.
- Assure that personnel have the necessary training as needed before performing critical activities, especially those activities that have environment, safety, or health consequences.
- Define the general requirements for design and readiness reviews including environment, safety, and health issues related to LCLS and collaboration hardware, software, and processes.

This Quality Implementation Plan (QIP) defines the responsibilities for carrying out a quality assurance program for the LCLS project, in keeping with the *SLAC Institutional Quality Assurance Program Plan* (hereafter referred to as the Institutional QA Plan) for all projects with a Total Project Cost greater than \$10M. The LCLS QIP is also in accordance with the Department of Energy (DOE) Order 414.1B, *Quality Assurance*.

Other Important Documents Related to the LCLS QIP

DOE Project Execution Plan (PEP)

The DOE Project Execution Plan for the LCLS 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.

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).

LCLS Project Management Plan

The LCLS Project Management Plan defines the plans, organization, responsibilities and systems for managing the LCLS to be constructed at SLAC. The PMP supplements the DOE Project Execution Plan.

LCLS Advance Procurement Management Plan

The LCLS describes the procurement process and organization as it applies to the LCLS project. This document also identifies critical procurements within the LCLS and develops an Advanced Procurement Plan to be implemented for more complex purchases.

Risk Assessment and Management Plan

The LCLS 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 – Organization/Responsibility/Authority for Quality Assurance

The organizational structure of the LCLS Project is defined in the LCLS Project Management Plan (PMP). Although there are many other organizations that provide support to the project that are not shown on the organizational chart, the LCLS Project Director has the overall QA responsibility for the LCLS Project.

Responsibilities and Authorities

Laboratory Director

The SLAC Laboratory Director approves the QIP for the LCLS Project with concurrence from the Directors of collaborating laboratories. The Director is responsible for overall approval of funding and staffing to support the QA effort for the LCLS project.

The Director can intervene in significant disputes, if any, that cannot be resolved at a lower level, between the LCLS Project Management and other SLAC management. The Director can also intervene in significant disputes, if any, that can not be resolved at a lower level, between the LCLS Project Management and the management of other laboratories.

LCLS Project Director

The LCLS Project Director:

- Recommends approval of budgets and staffing to support QA activities.
- Appoints the LCLS Quality Assurance Manager, who reports directly to the Project Director.
- Considers intervention in significant disputes, if any, which cannot be resolved within the LCLS Project Management.

- Recommends adjustments as needed to budgets, resources and schedules to provide the proper balance between cost, schedule, and quality assurance objectives of the overall project.
- May direct the QA Manager for the LCLS Project to conduct audits of the project.
- Approves this QIP.

LCLS Chief Engineer

The LCLS Chief Engineer:

- Assures that System Managers under his/her control implement the requirements of this QIP.
- Monitors the performance of line-management personnel providing support to the portion of the project under his/her control to assure that problems with implementation of the QIP are identified and resolved.
- Has primary responsibility for resolving significant disputes regarding work under his/her control that can not be resolved at a lower level.
- Approves all project schedules that are related to the work under his/her control, including those milestones related to quality assurance.
- Approves all system schedules that are related to the work under his/her control including those related to quality assurance.
- Recommends for approval by the Project Director resources and staffing necessary to complete the quality objectives.
- May appoint improvement teams as they pertain to assuring quality.
- Approves this QIP.

LCLS System Managers and Cost Account Managers

This group includes the LCLS System Managers as well as the respective Cost Account Managers for Controls, Mechanical and Vacuum Systems, Radio-Frequency Systems, and Electrical Systems, etc.. These individuals are responsible for:

- Managing activities under their control in keeping with this QIP.
- Assuring that QA activities are planned, incorporated into Project and System schedules, and completed.
- Recommending to the LCLS Project Director or LCLS Chief Engineer as applicable the resources and staffing necessary to complete the quality objectives.
- Seeking out and using as applicable modern quality assurance, manufacturing, and reliability approaches.

QA Assurance Manager for the LCLS Project

The QA Manager for the LCLS Project:

- Provides consultation to System Managers to implement QA-related activities, (for example the QA Manager could provide guidance on developing inspection plans, developing vendor control programs, etc.).
- Provides project specific QA training to System Managers on this QIP and other topics that may be of interest to the project personnel.
- Reviews completion of QA-related milestones as provided in project schedules and reports results to project management.
- Works with the Project Director to prevent situations where completion of critical planned QA activities are compromised due to cost, schedule or other constraints.

- May recommend to the Project Director that work be stopped based on an investigation that indicates that work is of inadequate quality as defined below (It is important to note, that this stop work recommendation should be based on issues of quality, and not on issues relating to hazardous conditions). Reviewing situations where potentially hazardous conditions exist should be handled through the Project Environment, Safety and Health Office).
- May facilitate improvement teams or provide training to others to facilitate these efforts.
- May perform QA audits as requested by the Project Director.
- May participate individually or as part of a team in vendor surveys, vendor qualifications, and source inspections.
- Maintains this QIP, subject to approval of the LCLS Chief Engineer, LCLS Project Director, Associate Director of the Environment, Safety and Health Division, and the Laboratory Director.

Physicists, Engineers and other Technical Personnel

Physicists, engineers and other technical personnel involved in the LCLS project are required to perform QA activities and provide proposals that are in keeping with the requirements of this QIP.

Non-SLAC collaborating members of the LCLS Project

Non-SLAC collaborating members of the LCLS Project are required to perform activities in keeping with this QIP. In rare situations and for specific requirements, an exemption may be granted in writing by the Project Director. The request for an exemption will be considered if comparable and compatible quality assurance systems are available at the non-SLAC institution, when it is impractical for the requirements to be effectively applied, and if the

construction goals and the operational goals for the project are not compromised.

Stop Work Authority

Relating to Work of Inadequate Quality

Any individual involved in the LCLS project that becomes aware of an operation, process or workmanship that he/she believes to be of inadequate quality should bring the condition(s) to the attention of their immediate supervisor. It is the responsibility of the supervisor to investigate the condition(s) believed to be of inadequate quality, to communicate the problem to the affected LCLS Project management, and to take appropriate corrective actions based on the condition(s). The LCLS Project Director or LCLS Chief Engineer have the authority to stop work of inadequate quality if deemed appropriate.

Relating to Hazardous Operations or Conditions

The policy on stop work authority relating to hazardous operations or conditions is provided in ES&H Bulletin #8, *Stopping Hazardous Operations*. This Bulletin is interpreted to include stop work authority for any LCLS supervisor, any LCLS System Manager, or any member of the project management team reporting to the LCLS Project Director. The SLAC ES&H Office and not the Project QA Manager should be notified in the event of a stop work situation relating to hazardous operations or conditions. Issues relating to stop work based on potentially hazardous operations or conditions should be communicated to the persons identified in ES&H Bulletin #8, and the Project ES&H Office.

Section III – Work Standards and Processes

Standards

Mandatory Environment, Safety and Health Standards

The mandatory standards for environment, safety, and health are listed in the *Environment, Safety and Health Manual*, (SLAC-I-720-72100-100) and the Work Smart Standards in Appendix U of the DOE-Stanford University contract. These mandatory standards are to be applied to the LCLS Project, as applicable.

SLAC and Additional Industry Standards

System Managers should document additional SLAC or industry standards, if any, that are applicable to their work on the LCLS. System Managers should seek to identify opportunities for work across the project where standardization may be possible, and to recommend to the Project Director additional standards that should be generated or applied.

Personnel Training and Qualification

The LCLS System Managers are responsible for assuring adequate training of each project participant under their direct management. SLAC personnel performing activities including but not limited to structural welding, electrical work, hazardous waste handling, fork lift operation, and operation of hoists and cranes should have proper training. If proper training is not practical for project participants, the work should be performed by properly trained persons outside the project.

When the LCLS Project has been completed, personnel responsible for its operation are required to receive classroom and on-the-job training, and testing, before being deemed certified to operate the LCLS.

Documents That Describe Work Processes

During the design, construction and commissioning phase of the project, work will be performed according to the *LCLS Project Management Plan*. Work that involves significant safety and health issues should be performed to written procedures. System Managers should specify which work is sufficiently complex or involves sufficient hazard to be performed to written work procedures.

Property Control Administration

Property shall be managed according to the SLAC property control program as defined by the Property Control Group. All LCLS project members shall adhere to the guidelines of this program.

Calibration Program Requirements

System Managers are responsible for developing formal calibration programs for measuring equipment with environment, safety, or health impact. System Managers are responsible for determining additional equipment, if any, that is to be part of a calibration effort based on the cost, scale, and potential programmatic significance of problems associated with calibration. All calibration documentation foreseen to be of value during the commissioning, operations or decommissioning of the LCLS shall be stored in the LCLS documentation database.

Section IV – Key Design Requirements and Specifications

To facilitate an integrated, high-quality design for the LCLS, the key design specifications and requirements for the LCLS systems and components are well-defined and formally approved and maintained as controlled documents within a centrally-available database. These documents, initially predicated upon the Mission Need of the LCLS and captured in the *LCLS Global Requirements Document*, are defined as;

- LCLS Global Requirements Document (GRD) – A single global-level requirements document that specifies the performance requirements for the LCLS x-ray free electron laser.
- Physics Requirements Documents (PRDs) – System-level documents that specify the performance requirements for the LCLS Systems. LCLS PRDs provide the functional goals and requirements needed by each LCLS System to meet the GRD.
- Engineering Specification Documents (ESDs) – System-and/or component level engineering specifications that provide the ‘design-to’ requirements needed by each LCLS System to meet the GRD.
- Room Specification Documents (RSDs) – Conventional facility engineering specifications that provide the ‘design-to’ requirements needed by each LCLS system for to meet the GRD.
- Interface Control Documents (ICDs) – Interface or boundary documents that describe the integration of systems, or define the boundaries between systems, for the LCLS (Inj, Lin, Und, etc.). ICDs are also used to define boundaries between functional equipment across system boundaries (i.e., Vacuum-Controls, Diagnostics-Controls).

The author of a key design requirement and/or specification (GRD, PRDs, ESDs, RSDs, or ICDs) for the LCLS is responsible for ensuring that his/her document remains in agreement with the Mission Need of the LCLS. Any revision to approved design requirements or specifications requires approval of the original

author and is submitted to the LCLS Change Control Board for approval. Design requirements and/or specifications that are no longer applicable will be considered “retired” and archived in the LCLS Documentation Database for historical purposes.

Section V – Documentation and Records

The LCLS Project manages all specifications, technical notes, database records, and drawings, associated with the LCLS effort under a central document control system. It is the responsibility of System Managers to ensure that all specifications, test and/or calibration results, drawings and technical notes are submitted to the document control organization by project members. Each System Manager should develop documentation that is adequate to procure, fabricate, review, install, locate, repair, and maintain systems that comprise the LCLS. Especially important is documentation for systems that have environment, safety and health impacts.

System Managers are also required to bring to the attention of the Project Director any existing PEP-II (in contrast to the LCLS) equipment that may be poorly documented where this condition could have an adverse impact on installation work, or compromise the performance or reliability goals for the LCLS project. Deficiencies in the documentation of existing systems should be identified early in the project, so remedial documentation efforts do not impact the project schedule.

Submitting Documents

Specifications, drawings and technical notes will be submitted to the group serving as the document control organization for the LCLS Project in either hard or soft (electronic) format, such that it is compatible with the long-term goals of the LCLS Documentation Database. Drawings, technical requirements, specifications, notes, and other documents provided to the document control organization, will have document numbers, document prefixes (i.e., PRDs, ESDs, RSDs, etc.), and approvals that meet the requirements of the LCLS project needs.

Technical Notes will be identified with the “TN” prefix and further identified by the following sub categories for filing purposes:

LCLS- Accelerator Physics
LCLS- Electrical Engineering
LCLS- Mechanical Engineering
LCLS- Technical

OTHER NOTES- SLAC publications
OTHER NOTES- Conference Proceedings
OTHER NOTES- Journals

The following drafting and document administration standards are to be followed for developing drawings for the LCLS Project:

<u>Description</u>	<u>Document Number</u>
<i>Document Control Procedures</i>	<i>AP-041-300-01-R5</i>
<i>General Drafting Instructions</i>	<i>DS-016-110-01-R2</i>
<i>General Drafting Instructions Mechanical Design</i>	<i>DS-016-110-04-R2</i>
<i>LCLS Drawing Number System Definition</i>	<i>ESD 1.1-320</i>

Revision of Drafting and Document Administration Standards

A standard or revision to a standard may be initiated by any individual or group at SLAC. The process for standards creation and revision through a Standards Committee is described in the *Procedure for Adoption and/or Revision of SLAC Standards* (AP-041-110-01-R1).

Revision control at outside institutions shall follow approved revision processes for their respective institutions. Once submitted to LCLS, outside institution drawings are to be numbered consistent with *ESD 1.1-320*. All outside institution specifications, requirements and technical notes shall follow the LCLS documentation standards.

Control System Software Configuration Control

Computer codes that will directly support the commissioning, testing and/or operations of the LCLS are to have established access controls to assure that changes to operating system software will be performed in an orderly fashion.

Records Control

Records of design reviews, inspections, certifications, testing, and other important records (additional items as determined by the System Manager) are to be retained in files controlled by System Managers during the construction phase of the project. Before final commissioning of the project, an index of records will be submitted by System Managers to the Project Director to determine the most appropriate permanent storage location for the records.

Documents under configuration management during the duration of the LCLS Construction Project are the following;

- LCLS Project Management Plan (with Appendices)
- LCLS Quality Implementation Plan
- LCLS Advance Procurement Plan (with Critical Procurements Appendix)
- LCLS Risk Management Plan (with Risk Registry Appendix)
- LCLS P3 Cost & Schedule Database
- LCLS Baseline Change Requests (BCRs)
- LCLS L1-L2-L3 Milestones
- Technical Specifications Documents
 - GRD, PRDs, ESDs, RSDs, ICDs
 - WBS Dictionary

Copies of all controlled documents can be obtained through the LCLS Project Office.

Section VI – Assessment and Review

Reviews are considered a vital process for the success of the LCLS project, and the LCLS Project Director is committed to an on-going process of project reviews, which are used to refine the management, organization, processes and function of the project as it progresses.

Department of Energy Authorization/Reviews

The LCLS Project is subject to authorization by the Department of Energy, and is required to comply with DOE M 413.3-1. Project management personnel should be mindful of this requirement, and incorporate the necessary management and technical processes to obtain successful approval of the project. At a minimum, LCLS will also be subject to DOE progress reviews every six months for the duration of the project.

LCLS Project and System Reviews

At the project-level, the LCLS meets biannually with its Facilities Advisory Committee (FAC) and its Scientific Advisory Committee (SAC). The FAC is a standing committee of outside experts appointed by the LCLS Project Director, which provides advice on the progress of LCLS construction. The SAC is a standing committee of outside experts appointed by the LCLS Project Director to provide guidance on the LCLS scientific research program.

At the system-level, technical design reviews will be held at intervals consistent with the major decisions or events within each LCLS system. Typically, a major review might be held prior to a major procurement or a fundamental design choice that commits the LCLS in a specific direction. In addition, design reviews and/or workshops may be held to investigate specific options or variables that are relevant to the performance or operation of the LCLS.

The Project Director will determine when the need for a technical design review is needed for project-level or system-level reviews. System Managers will determine when the need for a technical design review is needed for subsystem-level design reviews.

Design reviews are to be conducted with personnel who are familiar with the technical aspects of the work, but are not directly responsible for the activity.

Design reviews should include the following at the appropriate time:

- Technical adequacy of the design
- Elegance of the design
- Work instructions and operating specifications
- Review of test results and other applicable technical reports
- Design Calculations and Drawings
- Reliability and useful life considerations
- Calibration program for measurement and test data

Software Reviews

Critical computer codes especially those codes that are involved in controlling the operation of the LCLS controls network shall also be subjected to review. Some items to be considered during computer code review are provided below:

- Technical adequacy of the design
- Elegance of the design
- Documentation
- Code validation testing scheme
- Consistency of structure of code to any applicable standards
- Compatibility of code with other systems that may use data
- Consideration of hardware requirements to support system
- Maintenance of code
- Backup Systems

Safety Analysis

A Preliminary Safety Assessment Document (PSAD) and a Final Safety Assessment Document (FSAD) will be developed for the LCLS by those directed by the LCLS Project Director. The PSAD and the FSAD will be developed to fulfill the requirements of DOE Order 420.2A. Accelerator safety envelopes will be developed for the project.

A Fire Hazard Analysis (FHA) will be prepared during the early design phase to ensure fire protection requirements are designed into the LCLS facility. The FHA requires DOE approval.

Accelerator Readiness Review (ARR)

The LCLS Project Director will organize an Accelerator Readiness Review (ARR) based on the process described in DOE Order 420.2A, *Safety of Accelerator Facilities*. The ARR will be accomplished to support decisions to begin Commissioning and operating phases.

Quality Assurance and Compliance Audits

The SLAC Quality Assurance and Compliance Department has site-wide responsibility for environment, safety, health, and quality assurance audits. This auditing responsibility includes the LCLS Project.

At the request of the Project Director, the LCLS QA Manager may perform audits of the project to assess progress toward meeting the requirements of the LCLS QA program.

Self Assessment Program

The LCLS Project will participate in self appraisals as defined by the SLAC Self-Assessment Program. Tracking of significant findings from the Self-Assessment Program will be the responsibility of the Planning and Assessment Department.

Subcontractor Assessment

Project personnel who serve as University Technical Representatives (UTRs) as defined in subcontracts or purchase requisitions have the responsibility to oversee the technical and environment, safety, and health activities of subcontractors.

Citizen's Committee Review

Designs and projects with environment, safety and health impact are to be reviewed by Citizen's committees as described in the *SLAC Environment, Safety and Health Manual*.

Mandatory Design Reviews for Environment, Safety and Health Systems

For environment, safety and health protection systems, such as Personnel Protective Systems (PPS), Fire Protection Systems, and Radiation Monitoring Systems, design reviews are mandatory.

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Section VII – Procurement

Procurement Documentation

System Managers are responsible for developing purchase specifications for costly and complex items. Advanced Procurement Plans (APP's) are necessary for the LCLS Critical Procurements but can be used for any purchases to facilitate the procurement process (see the Advanced Procurement Management Plan (APMP) for more details). Off-the-shelf items with well developed specifications provided by the supplier may not require an APP.

The requester of an item is responsible for providing or referencing on drawings, technical specifications, or purchase requisitions any requirements for:

- Receiving inspection.
- Source inspection.
- Vendor qualifications.
- Vendor certifications.
- Compliance to industry standards.
- Acceptance sampling.

Vendor Qualification

Teams may be used to evaluate the capabilities of vendors supplying critical items. These teams, if needed, are to be composed of a Purchasing Representative, a Project Technical Representative, and the LCLS QA Manager.

Inspection and Acceptance Testing

System Managers are responsible for determining the need for receipt inspection on purchased items. While inspections for critical items at SLAC may be necessary for some devices, the vendor should usually provide any inspections (subject to SLAC verification if necessary), test reports, statistical process controls, or other quality assurance program activities to assure that purchased items meet the requirements.

The disposition of items failing inspection or testing should be clearly marked on the items in question.

Equipment that is used to determine the acceptability of purchased or fabricated items is to be controlled using an equipment calibration program. Standards for these calibration activities shall be traceable to a National Institute of Standards and Technology (NIST) primary standard if available.

Records from Inspections, Tests, and Qualifications

The results of inspections, tests, and qualification testing should be documented and stored in the LCLS Documentation Database.

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