

**Document Approval:**

	Date Approved
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Revision History:

Revision	Date Released	Description of Change
R0	1/15/14	Original Release.

1 Scope

This procedure applies to all LCLS-II Project design and milestone reviews.

2 Requirements

All LCLS-II Project components, systems, installation and start-up activities are subject to the technical design and milestone review process. The primary objective of the Technical Design and Milestone Review Program is to enhance the probability of success by identifying potential or actual design problems associated with its design, installation or construction, and operations in a timely fashion to minimize cost, schedule and performance impacts.


The level of review will be commensurate with complexity, cost, or safety importance of the design. For example, a less formal design review is required for a vacuum drift tube than for a magnet design or a radiation safety stopper. Less complex types of items may be covered in a system design review or peer review rather than a component design review. However, all components must meet the design review requirements prior to implementation.

The reviews will be based upon an appropriate selection from the following system reviews:

- Conceptual Design Review (CDR)
- Preliminary Design Review (PDR)
- Systems Integration Review (SIR)
- Final Design Review (FDR)
- Readiness Review (RR)
- System Safety Review (SR)

3 Responsibilities**3.1 Design Review Plan**

The primary responsibility for the planning and execution of the design review process rests with the assigned Control Account Manager. Control Account Managers (CAMs) shall develop a design review plan that lists the components and systems requiring a technical review, safety review, and any planned installation, fabrication, construction or operational readiness reviews. The design review plan

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will be incorporated in the project Primavera P6 schedule. The review plan shall be updated as needed to maintain consistency with current project planning.

CAMs should periodically brief the project team at management meetings on the status of his/her design and milestone review plan.

The Systems Integration Manager has review and approval authority over the system design and milestone review plan.

3.2 Conduct of Independent Design Review

The CAMs are responsible for seeing that the design reviews are held in accordance with the Review Plan. The LCLS-II Systems Integration Manager is responsible for scheduling and coordinating the execution of the design reviews held at SLAC. The CAM is responsible for scheduling and coordinating the execution of the design reviews held at Partner Laboratories.

The CAM shall appoint key technical experts as review team members. If the required discipline expertise is not available within SLAC (or Partner Laboratory), membership from outside of SLAC (or Partner Laboratory) should be considered. In addition, the following members of the project will be invited to all reviews:

- LCLS-II Project Director
- LCLS-II Project Technical Director
- LCLS-II Systems Integration Manager
- Applicable System Manager
- LCLS-II Environmental, Safety and Health Representative
- LCLS-II Quality Assurance Manager
- LCLS-II Subject Matter Expert, as appropriate (Controls, Cryogenics, Diagnostics, Electrical, Facilities, Laser, Mechanical Engineering, Metrology, Power Conversion, Radiation Physics, RF System, Safety Systems, Technical Planning-AD, Vacuum,)

The System Manager shall determine if additional participants in the review should represent such disciplines as:

- Design
- Manufacturing
- Affected engineering disciplines (i.e., power conversion, controls, etc.)
- Purchasing
- User
- Maintenance
- Fire Protection
- Stress Analysis
- Radiation Physics
- Safety Officers

Prior to each review, the System Manager will develop a charge for the review team. The CAM will develop an agenda for the review.



The CAMs assures that the presenters are prepared and that the review packages are issued on time. A review presentation package is to be prepared containing the review scope in sufficient detail for a technical person to reasonably understand the design and make a proper evaluation as to its adequacy. The presentation package, ideally, should be given to each member of the review team a minimum of 5 working days before the review is scheduled to take place. The design review presentation is to be made with supporting view-graphs, which may be a summation of the material contained in the presentation package.

It is the responsibility of the appointed design review chair to prepare and publish a report of the review with all the requests for actions within 5 days of a design review, unless otherwise agreed to in advance. It is also the responsible lead engineer's responsibility to assure that all Requests for Action are closed out to the satisfaction of the review team.

SLAC ESH Project Review Procedure is documented in SLAC-I-720-0A24C-001 and addresses both Experimental Projects and Conventional Projects.

The SLAC ES&H Building Inspection Office provides review, oversight, and authorization for conventional projects, modifications, renovations, demolition, use, occupancy, alteration, and retrofits of all buildings, structures at SLAC in accordance with the *SLAC BIO Project Review and Authorization Manual*, SLAC-I-730-2A24Z-001. This process applies to the attachment/support and interface of scientific or experimental equipment and devices to building/tunnel structures and building systems at SLAC. The applicable SLAC Integration Engineer shall ensure compliance with SLAC Project Review policies.

SLAC ES&H also reviews and approves new installations involving pressure vessels and cryogenic systems.

3.3 Records

All design review presentation material is to be electronically submitted to the LCLS-II Quality Assurance Manager in the source (Word, PowerPoint, etc.) format. The QA Manager will submit the design review records to the LCLS-II Documentation Specialist for posting.

4 Reviews

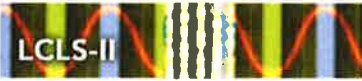
4.1 Conceptual Design Review [~5-15% Design Maturity]

The Conceptual Design Review (CDR) is held to assure that the objectives and requirements of the item being designed are understood and that the proposed approach will meet these requirements. The emphasis should be on the requirements, how they flow down, the proposed design concept and the definition of the major system interfaces.

The CDR should occur early enough so that the concept can be modified without a major impact on the project. The review should present the major design alternatives considered, the relative risk for each and the reasons for the approach chosen by the design team.

The CDR should address the following items:

- Design Objective
- Science Requirements (PRDs)
- Technical Requirements
- Organizational Interfaces
- Technical Interfaces



- On-going or future trade studies
- Safety Hazards (Design for Safety)
- Risk Areas
- “Proof of Concept” Models
 - Proposed Design Approach
 - System Design
 - Mechanical
 - Electrical
 - Software
- Consideration of major design alternatives
- Lessons learned from previous projects or experience
- Preliminary Budget and schedule

The output of the CDR is a baseline design (subject to the closure of any action items resulting from the review). A successful CDR allows the design effort to proceed to the preliminary design phase.

4.2 Preliminary Design Review [~30-50% Design Maturity]

A Preliminary Design Review (PDR) is held when the design is advanced sufficiently to begin some bread board testing and /or the fabrication of design models. Detail designs are not expected at this time, but design analyses is required to demonstrate compliance with requirements. A presentation of the design and interfaces by means of block diagrams, signal flow diagrams, schematics, logic diagrams, configuration and layout sketches, analyses, modeling and any early results are required. Supporting data and analyses for mechanical, power, thermal, and reliability assessments should be shown.

A PDR should cover the following items:

- Documented technical requirements (PRDs, FRSS, ESDs, ICDs)
- Changes to science/technical requirements
- Closure of actions from previous review
- Interface requirements
- Mechanical/structural design and analyses
- Electrical/thermal design and analyses
- Software requirements and design
- Preliminary layouts, drawings
- Reliability and maintainability
- Assessment of risk areas
- Plan forward for obtaining required safety approvals (i.e., SLAC Safety Officer or Building Inspection Office)
- Lessons learned from previous projects or experience



- Safety hazards
- Baseline cost and schedule

The completion of the PDR and the closure of any actions generated by the review establish the basis for proceeding with the detailed design. With the approval of the design review committee, long lead items may be procured.

4.3 System Integration Review [~30-50% Design Maturity]

A Systems Integration Review (SIR) verifies that all interfaces for the integrated system have been properly addressed and that the requirements will be met with the proposed design. This review may be a part of the PDR. The SIR should address the following, as applicable:

- Structural integrity under required design load cases
- Pressure relief venting adequacy under required design load cases
- Controls Systems – verify that the electrical design and controls interface are appropriate and sufficiently mature to ensure the system will function to meet requirements.

4.4 Final Design Review [~90-100% Design Maturity]

The Final Design Review (FDR) presents a final detailed design using substantially completed drawings, analyses and breadboard/engineering model evaluation testing to show that the design will meet the final performance and interface specifications and the required design objectives. The FDR should represent a complete and comprehensive presentation of the entire design. It should present the final design and interfaces by means of product breakdown structure, block diagrams, signal flow diagrams, interface circuits, layout drawings, detail drawings, assembly drawings, software logic flow and timing diagrams, modeling results, engineering model test results and all changes required to the design presented at the PDR. The FDR should include all of the items specified for a PDR, updated to the final present stage of development process, plus the following additional items:

- Closure of Actions from the Previous Review(s)
- Revised science/technical objectives, requirements and specifications (PRDs, FRS, TRS , ESDs, ICDs)
- Interface Requirements
- Final implementation plans including: engineering models, prototypes and spares
- Engineering model test results and design margins
- Design status of any electrical, control and/or mechanical systems
- Final detailed design with layouts, drawings and analysis
- Software requirements and design
- Fabrication, assembly, integration/installation, and test plans
- Progress/status and control methods for all safety hazards identified at, but not limited to, the PDR
- Plan forward for obtaining required safety approvals (i.e., SOC, Safety Officer, Building Inspection Office)
- Lessons learned from previous projects or experience
- Assessment of risk areas



- Cost and schedule

Completion of the FDR and resolution of all the action items generated by it constitutes the baseline design for the item to be built. A successful FDR allows procurement of items and full scale fabrication and assembly.

4.5 Readiness Reviews

The Readiness Reviews (RR) are to be performed prior to hardware installation, construction activities or operations. Readiness Reviews are typically referred to as an Installation Readiness Review, Procurement Review or Operational Readiness Review. The readiness review confirms the necessary staffing, installation plan or procedures, and that the requisite drawings are in place. It will identify equipment and systems having safety importance and show they meet criteria described in the Hazard Analysis Report (HAR) and have been appropriately tested, documented and evaluated to ensure adequacy and meet QA requirements. It will identify procedures necessary for safe operation and ensure that they have been developed, reviewed, verified and approved. The following topics, as a minimum, should be covered:

- Objectives
- Overall schedule
- Issues and concerns
- Documentation Status
- Quality Assurance and Safety
- Identification of residual risk items
- Open items and plans for close-out

Following a successfully completed RR and the close-out of any remaining items, hardware installation or operation is authorized to begin.

4.6 System Safety Review

For System Safety Reviews (SRs), the primary responsibility for ES&H is with the project line management. As such, a robust and proactive safety review process is necessary for ensuring the ES&H hazards of major or significant new activities (experimental equipment, facility construction, or facility modifications) are adequately analyzed and adequately controlled, and that a planned activity conforms to ES&H policy and requirements.

The intent of the System Safety Review is to ensure compliance with SLAC ES&H requirements and facilitate the process by projects are adequately reviewed by the appropriate safety subject matter experts. LCLS-II Project convened safety reviews may serve as a vehicle to ensure SLAC Safety Oversight reviews are fully integrated with project design in safety philosophy.

System Safety Reviews will be planned by the CAMs when requested by the project office.


The System Safety Review shall contain information regarding hazards of: the design, integration of components, and operational aspects of the equipment after integration. This review shall identify hazards associated with the completed, installed, ready for operations system and list mitigation strategies used by the project.

5 Procedure

Following are the steps included in the design and milestone review process.



- 1) Control Account Managers (CAMs) shall develop a design & milestone review plan and incorporate the plan in the project Primavera P6 schedule.
- 2) The CAM, or designee, shall schedule a design review when the applicable component or system to be reviewed is ready.
- 3) Any number of delta design reviews may be scheduled if, during the design stage, significant changes are made to the original concept, or significant portions of the original design could not be sufficiently completed for the Initial Design Review.
- 4) When the CAM schedules a design review, the CAM shall appoint someone to act as Design Review Chairman for the review. The selected chairman shall be familiar with the science and technology involved.
- 5) With input from the Design Review Chairman, the CAM shall appoint a group of reviewers who have experience and knowledge in the science and technology of the design requiring a review.
- 6) The CAM or designee shall notify all design review participants of the scheduled review and the type of review. The QA Manager shall maintain a log of design reviews listing at a minimum, the titles of items reviewed, the types of reviews (e.g. Conceptual, Preliminary, Final Design), and the dates of the reviews.
- 7) The CAM or designee will notify those that are appointed to participate in the review, approximately one week prior to the scheduled date of the review. The notification will also include copies of the design requirements and related schematics, layouts, or drawings (see Section 6).
- 8) The CAM and the cognizant engineer shall ascertain that the design review package contains sufficient information for the review scheduled. Design review package content for the applicable design review is delineated in Section 6.
- 9) The CAM or designee shall coordinate the review logistics (i.e., reserve a conference room, set-up remote communication devices, etc.).
- 10) The Design Review Chairman shall ensure that meeting results are taken and recorded in the Design Review Report. A template is available from the LCLS-II Controlled Document Website.
- 11) The Design Review Committee may request additional Design Reviews if they deem it necessary.
- 12) The Design Review Report shall include at a minimum:
 - a. the title of the item or system
 - b. a description of the item
 - c. the type of design review
 - d. the date of the review
 - e. the names and association of the reviewers
 - f. the findings/action items, comments and concerns of the reviewers
- 13) After obtaining concurrence from the committee members, the Design Review Chairman will submit the completed Design Review Report to the Project QA Manager. The QA Manager will distribute the report to all reviewers, affected groups/personnel.
- 14) The QA Manager shall ensure that all Findings/Request for Actions are formally addressed and closed out.

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The Design Review Report and responses to Findings/Requests for Actions shall be filed in the LCLS-II Project Office SharePoint Site with the design review presentation(s), design review report and responses to action items.