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| Large Synoptic Survey Telescope<br>Camera System Plan | Document #<br>**LCA-226-G**<br>Author(s)<br>Vincent Riot | Status<br>LSST Camera APPROVED<br>Effective Date 29 Jan 2019 |
| | Subsystem/Office<br>Project Management | |

Document Title

# LSST Camera Project Management Plan

## 1. Change History Log

| Revision | Effective Date | Description of Changes |
|---|---|---|
| A | 2 August 2011 | Initial Review |
| B | 30 October 2011 | Updated. Presented at CD-1 |
| C | 21 October 2014 | Updated. Presented at CD-2 |
| D | 26 June 2015 | Updated for CD-3, Released per LCN-1361. |
| E | April 20, 2017 | Updated to include variance thresholds for project. Update org chart. Release per LCN-1786. |
| F | November 20, 2017 | Added production manager and refined deputy project manager role. Released per LCN-1973. |
| G | January 29, 2019 | Added Camera Operations Physicist role. Updated org chart to match current structure. Released per LCN-2277. |

## 2. Contents

## 3. Acronyms

The following acronyms are used in this document.

| Acronym | Definition |
|---|---|
| AE | Acquisition Executive |
| AURA | Association of Universities for Research in Astronomy |
| BCCB | Baseline Change Control Board |
| BNL | Brookhaven National Laboratory |
| CAM | Control Account Manager |
| CCB | Change Control Board |
| CD | Critical Decision |
| CD-2 | Critical Decision 2 |
| CDM | Configuration and Document Manager |
| CPM | Camera Project Manager |
| CPR | Cost Performance Report |
| CR | Continuing Resolution |
| CX | Categorical Exclusion (a NEPA determination) |
| DOE | U.S. Department Of Energy |
| EAC | Estimate at Completion |
| EIR | External Independent Review |
| EIS | Environmental Impact Statement |
| ES&H | Environment, Safety, and Health |
| EVMS | Earned Value Management System |
| FNAL | Fermi National Accelerator Laboratory |
| FPD | Federal Project Director |
| HEP | DOE Office of High Energy Physics |
| HEPAC | High Energy Physics Advisory Committee |
| HQ | Headquarters |
| I&T | Integration and Test |
| ICD | Interface Control Document |
| IN2P3 | Institute National de Physique Nucleaire and de Physique des Particules |
| IPS | Integrated Project Schedule |

| Acronym | Definition |
|---|---|
| IPT | Integrated Project Team |
| ISEMS | Integrated Safety and Environmental Management System |
| KPP | Key Performance Parameter |
| LLNL | Lawrence Livermore National Laboratory |
| LLP | Long Lead Procurement |
| LSST | Large Synoptic Survey Telescope |
| LSSTC | LSST Corporation |
| LSSTCAM | LSST Camera Project (DOE funded) |
| M&O | Managing and Operating |
| MIE | Major Item of Equipment |
| MNS | Mission Need Statement (CD-0 pre-requisite) |
| NEPA | National Environmental Policy Act |
| NSF | National Science Foundation |
| O&SHA | Operating and Support Hazard Analysis |
| OECM | Office of Engineering and Construction Management |
| OPC | Other Project Cost |
| PARS II | Project Assessment and Reporting System II |
| PB | Performance Baseline |
| PEP | Project Execution Plan |
| PHA | Preliminary Hazard Analysis |
| PHAR | Preliminary Hazard Assessment Report |
| PMCS | Project Management Control System |
| PMOG | Project Management Oversight Group |
| PMP | Project Management Plan |
| PSA | Performance and Safety Assurance |
| QA | Quality Assurance |
| RQM | Requirements Manager |

## 4. Applicable Documents

The following documents are cited in this plan.

| Ref # | Document Number and Title |
|---|---|
| [1] | DOE 414.1D; Quality Assurance |
| [2] | DOE 413.3B; Program and Project Management for the Acquisition of Capital Assets |

| Ref # | Document Number and Title |
|---|---|
| [3] | LPM-18; LSST Safety Plan |
| [4] | LCA-14; Preliminary Hazard Analysis |
| [5] | LCA-15; Hazard List |
| [6] | LCA-29; Risk Management Plan |
| [7] | LCA-30; Camera Risk Registry |
| [8] | LCA-31; System Safety Program Plan |
| [9] | LCA-38; System Engineering Management Plan |
| [10] | LCA-39; Configuration Management Plan) |
| [11] | LCA-40; Integration and Test Plan |
| [12] | LCA-98; Design Review Plan |
| [13] | LCA-138; Performance and Safety Assurance Plan |
| [14] | LCA-139; Hardware Protection Plan |
| [15] | LCA-140; Hardware Protection Protocol List |
| [16] | LCA-141; Value Management Plan |
| [17] | LCA-226; Project Management Plan |
| [18] | LCA-227; Quality Implementation Plan |
| [19] | LCA-228; Project Control Plan |
| [20] | LCA-238; Verification Test Plan |
| [21] | LCA-278; Grounding and Shielding Plan |
| [22] | LCA-279; Contamination Control Plan |
| [23] | LCA-280; Mechanical Standards |
| [24] | LCA-282; Operations Concept Document |
| [25] | LCA-379; LSST Camera Meeting and Review Listing |
| [26] | LCA-10031; Mechanical Standards: Factors of Safety |
| [27] | LCA-10032; Electro-Static Discharge Control Plan |
| [28] | LCA-10098; Electronics Standards |
| [29] | LCA-10099; Software Standards |

# 5. Introduction and Scope

## 5.1. Introduction

The Project Management Plan (PMP) is consistent with and supplements the DOE Project Execution Plan (PEP). This PMP and the PEP (LCA-10882) describe the management and project execution processes and plans that are used to ensure that the LSSTCAM project scope is completed on time and within budget. This document describes the Camera organizational framework and overall management systems for the LSSTCAM project, identifies roles and responsibilities of the project participants, and identifies the project policies, plans and standards.

## 5.2. Project Background

The construction and operation of the Large Synoptic Survey Telescope (LSST) is a joint initiative of the National Science Foundation (NSF), U.S. Department of Energy (DOE) Office of High Energy Physics, and the LSST Corporation, a non-profit 501C(3) corporation located in Tucson, AZ. LSST will be situated on the El Peñón peak of Cerra Pachón in Chile, at a site managed by the Association of Universities for Research in Astronomy (AURA). The Office of High Energy Physics (HEP) has named SLAC National Accelerator Laboratory (SLAC) as the lead DOE contractor to host the HEP LSST Project Office. All current DOE funded LSST R&D efforts and proposed future fabrication and operations efforts, as well as related "off-project" efforts required for the success of the LSST experiment, will be coordinated and managed by the SLAC LSST Project Office. Major collaborators include Lawrence Livermore National Laboratory (LLNL), Brookhaven National Laboratory (BNL), a consortium of U.S. based universities, and laboratories for the Institut National de Physique Nucléaire and the Physique des Particules in France (IN2P3).

## 5.3. Description of Camera

The LSST camera is a large aperture optical imager that provides a wide 3.5 degree field of view (FOV) with 0.2 arcsecond/pixel sampling. It is positioned in the middle of the telescope, where the cross-sectional area is constrained by optical vignetting, and where heat dissipation must be controlled to limit thermal gradients in the optical beam.

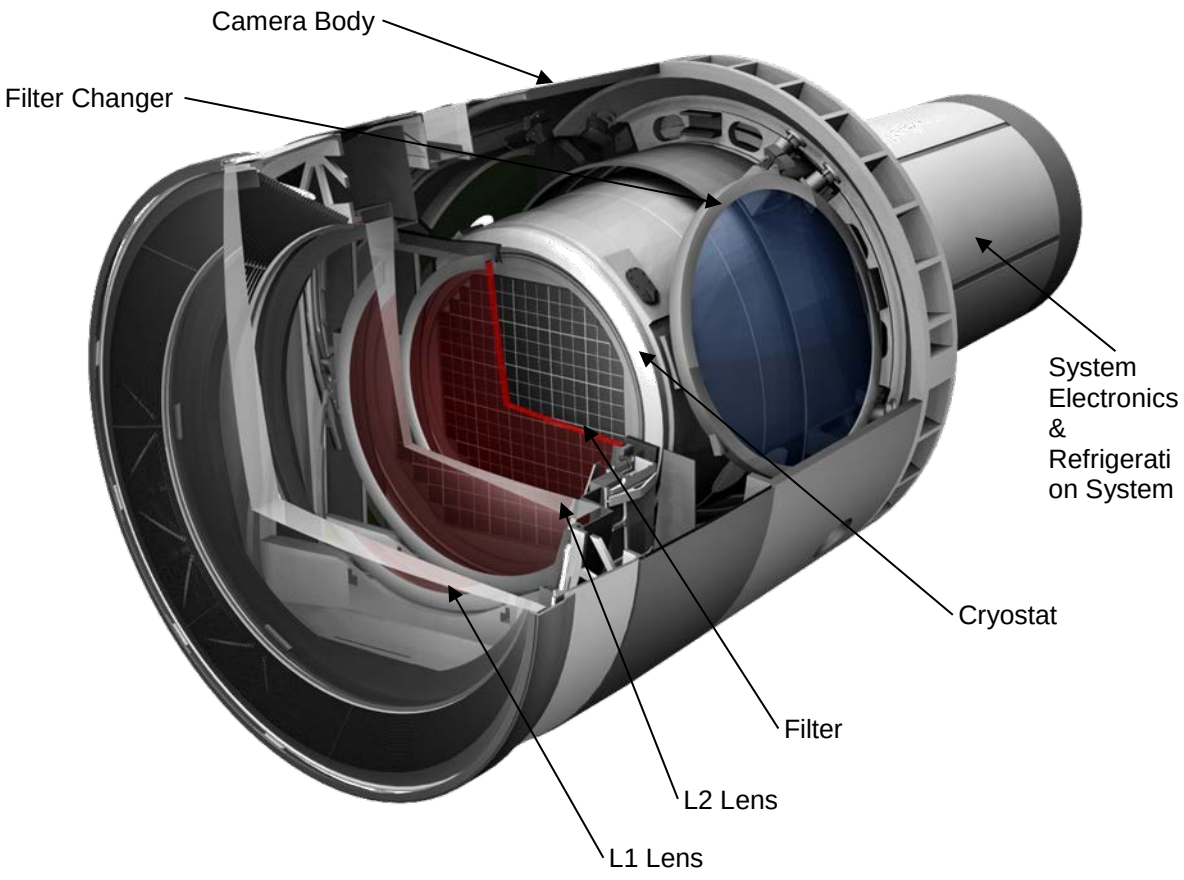


***Figure 1: Camera Section View***

The camera is a fully-enclosed, self-contained assembly, composed of functional sub-assemblies that themselves are modular. The large L1 refractive lens forms the entrance window to the camera. This is followed by the L2 lens that shares a common support structure with L1. The filter is the third optical element, lying just up-beam of the shutter. Five filters are stored on-board the camera in the storage carousel, while the companion autochanger allows for quick filter changes during observing runs. The shutter lies just behind the filter, providing accurate exposure control and blocking stray light from illuminating the focal plane when closed.

The fourth and final optical element is the L3 lens, which forms the entrance window to the cryostat and is the final focusing element for the LSST optical system. Just behind L3 inside the cryostat lies the 634 mm diameter focal plane. The focal plane is comprised of a tiled mosaic of 189 charge-coupled devices (CCDs), providing approximately 3.2 Gigapixels per image. The detector array on the focal plane operates at -100°C to achieve the desired detector performance. The detector array is contained within an evacuated cryostat, which also houses the front-end analog and digitizing electronics. Within the cryostat, structural support along with thermal and vacuum control systems maintain a suitable operating environment and isolate the detector array on the focal plane from external dynamic and transient loads. The outer camera housing supports the structural loads of the entire 3060 kg camera, cantilevered off of the telescope rotator, while forming a hermetic envelope around the entire camera to maintain cleanliness plus thermal and environmental control.

Electronics for power conditioning, data handling, and cryogenic services are mounted behind the Camera in a utility trunk. The utility trunk also serves as the entrance point for utilities and service lines that are routed up the telescope structure. The entire Camera structure has a diameter of 1650 mm and is over 3.7 m long. Total power dissipated within the Camera is over 2.4 kW.

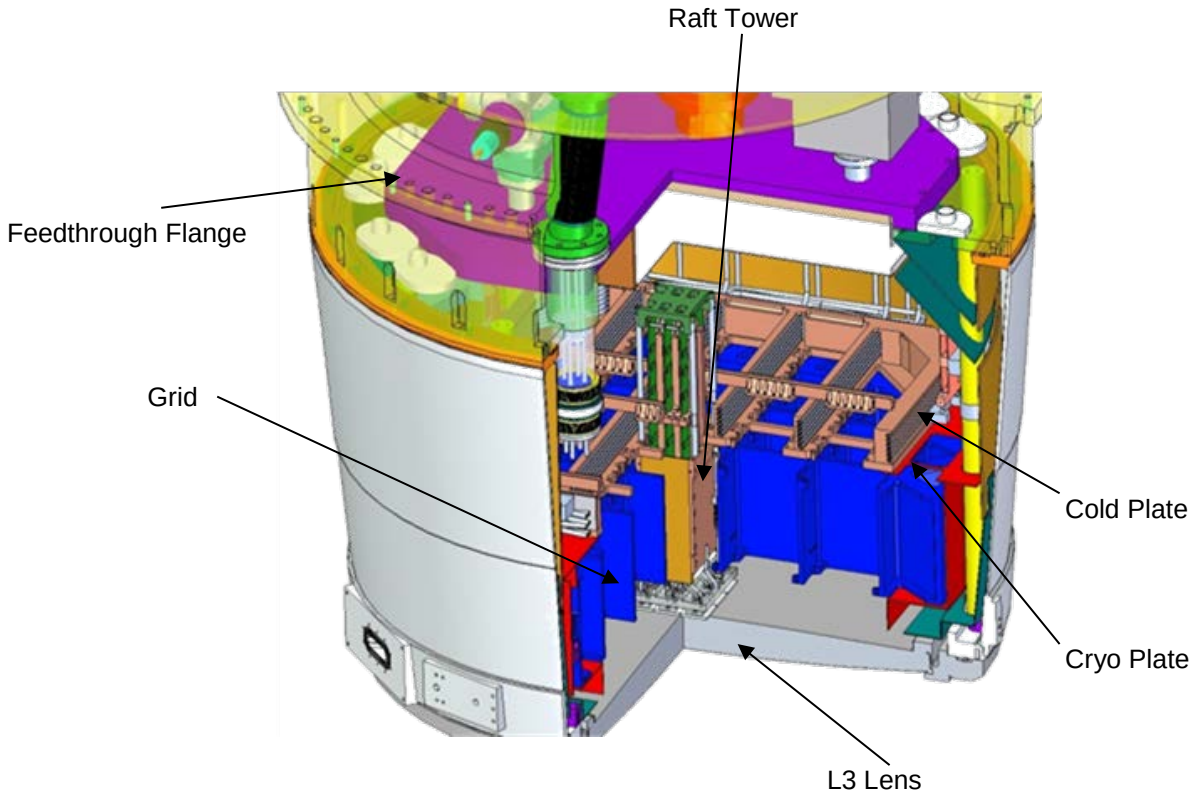


***Figure 2: Cryostat Section View***

# 6. Project Organization

## 6.1. LSST Project Organization

The LSST Project Execution Plan (LPM-54) describes the long-term vision and the near-term policies and procedures guiding the LSST Project through design and development, construction, and operations.

DOE and National Science Foundation (NSF) are proposed co-sponsors of the LSST project. The DOE has lead responsibility to fund the construction of the Camera system. The DOE has identified SLAC as the lead organization to direct this portion of the project. SLAC has, in turn, involved and manages the activities of a number of other DOE high-energy physics laboratories and universities. Funds for the camera will flow directly from DOE to SLAC and fiscal responsibility for the DOE funds will reside at SLAC.

Unless otherwise requested or specified by the DOE, AURA will not have fiduciary responsibility for DOE funds and will not exercise oversight or draw administrative fees. If and when DOE and NSF fiscal processes and regulations are not in full agreement, DOE funds will be subject to DOE processes and regulations.

The Camera system is a distinct logical and physical entity, separated from other LSST systems by clear Interface Control Documents (ICDs).. A memorandum of understanding (MOU) between the LSST Corporation and SLAC describes how the overall system-level performance requirements of the Observatory will be met. Both parties to the MOU recognize that the LSST Director (appointed by AURA and SLAC), Project Scientist, and Project Manager are the lead managers responsible for system-level decisions. This team, working with the System Engineer, will establish and maintain coordinated schedule milestones and ICDs that cross the boundary between the parties. Both parties will participate in the LSST Change Control Board, Systems Engineering Group, Science Council, and project meetings. Each agency requires project fiscal and technical reviews that occur multiple times per year. The entire project will support and participate as appropriate in project reviews.

## 6.2. Camera Project Execution

Figure 3 shows organization of the LSSTCAM project.

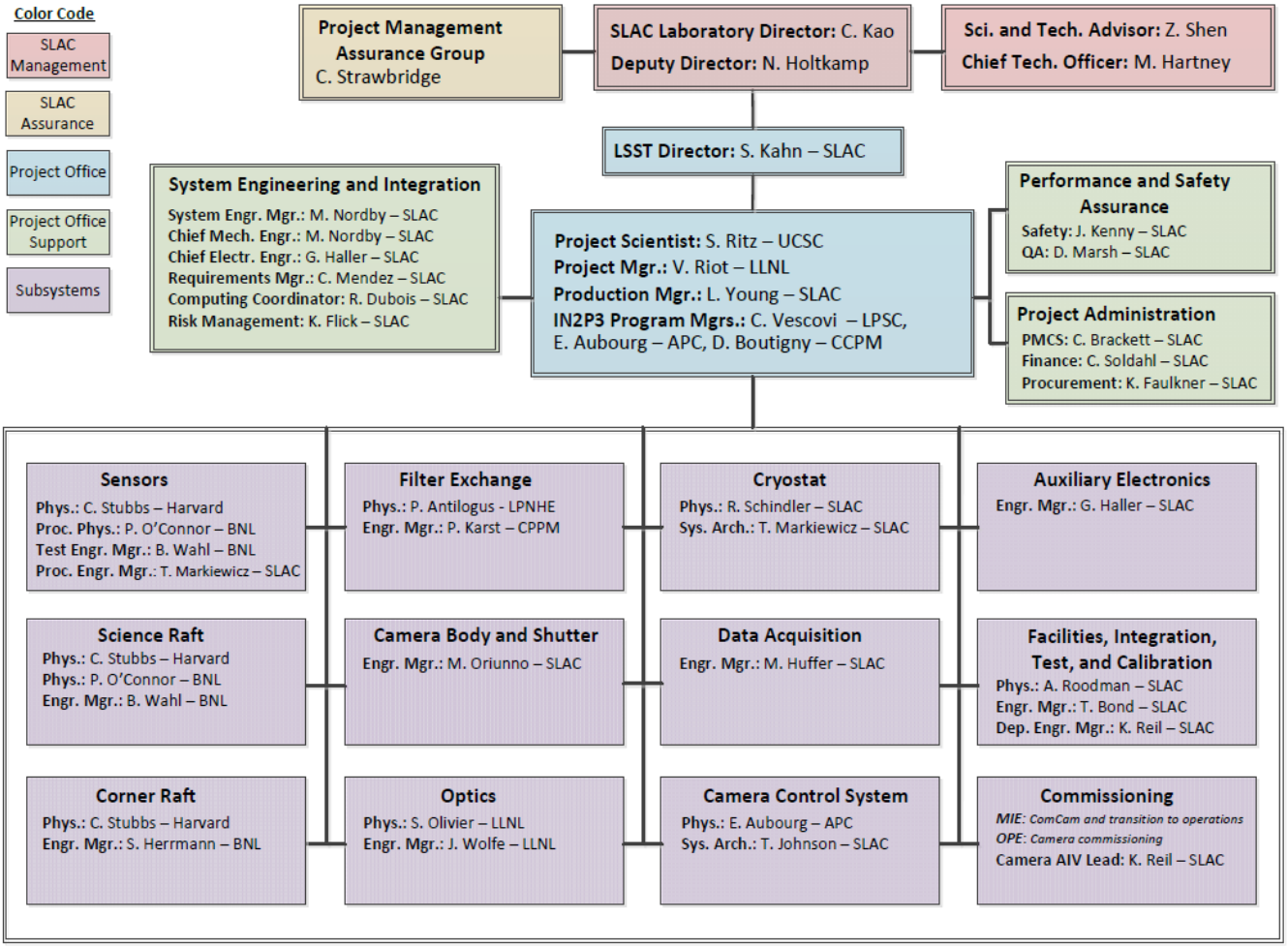


***Figure 3: LSST Camera Organization Chart***

LSST Project Director

The LSSTCAM project will be executed by a SLAC project team that is headed by the LSST Project Director. The LSST Project Director is responsible for ensuring that the delivered Camera meets the CD-0 mission need. The LSST Project Director also is responsible for ensuring adequate direct, indirect, and support resources are available for the successful execution of the project.

The LSST Project Director has approved a project organization to accomplish the LSSTCAM project. The organization includes project management and controls, Environmental, Safety and Health (ES&H), Quality Assurance (QA), procurement, and finance support.

The LSST Project Director provides senior management oversight, provides direct access to the SLAC Associate Laboratory Directors and Laboratory Director, and reviews and approves the Baseline Change Requests (BCRs) before submission for DOE approval.

Specific LSSTCAM project responsibilities of the LSST Project Director include, but are not limited to, the following:

- Approves project organization.
- Oversees Camera Project Manager and support the DOE SLAC Site Office Federal Project Director (FPD) in implementing project processes.
- Represents the project in interactions with the DOE.
- Coordinates the LSSTCAM project activities with LSST Corporation as appropriate.
- Establishes clear and achievable project objectives (KPPs).
- Validates that the Camera requirements will meet the needs of Dark Energy Stage IV research.
- Ensures that the design and performance of the Camera will meet the mission need.
- Participates in the Baseline Change Control Board (BCCB) and review and approve the BCRs.
- Reviews the federal budget documents, including the Project Data Sheet and the OMB Exhibit 300.
- Participates in management meetings and communicates the project status and issues to the overall project.

The LSST Project Director also serves as the LSST DOE Principal Investigator and LSST overall director.

Camera Project Manager

The Camera Project Manager (CPM) reports to the LSST Project Director and is responsible for the successful execution and closeout of the LSSTCAM project. Authority flows from the LSST Project Director to CPM by delegation of all day-to-day decision-making. The CPM manages engineering development and delivery of the Camera and ensures compliance to cost, schedule, and technical performance. The responsibilities of the CPM include, but not limited to, the following:

- Supports the FPD to initiate the Project Charter and to develop and maintain a performance baseline.
- Establishes technical and administrative controls and monitoring to ensure the project is executed within the approved cost, schedule, and technical scope.
- Implements an Earned Value Management System (EVMS) to track performance against the approved project baseline.
- Oversees Camera design, construction and acceptance.
- Identifies and manages project risks.
- Executes the project in compliance with the National Environmental Policy Act (NEPA) and other applicable ES&H rules and regulations.
- Ensures that safety, environmental, quality assurance safeguards and security responsibilities and requirements are integrated into all phases of the project, and that project activities are conducted in a safe and environmentally-sound manner.
- Provides input on project documents and develop and maintain project documentation.
- Reviews and submits monthly and quarterly progress reports to the FPD.
- Leads project meetings, participates in management meetings, and communicates project status and issues.
- Balances the demand for project quality, scope, time, and cost.
- Chairs the BCCB and approve the BCRs before submission to the DOE for approval.

- Appoints Control Account Managers (CAMs) for the project, who will be responsible for managing bid package(s), overseeing daily technical and managerial oversight of specific assigned WBS tasks from design through construction, and for preparing change requests in conformance with Baseline Change Control.
- Coordinates with the Project Financial Representative to prepare and submit timely Federal Budget documents, including the OMB Exhibit 300.

Camera Deputy Project Manager

The Camera Deputy Project Manager (Deputy CPM) reports to the CPM and functions with his or her authority. The Deputy CPM supports the CPM in his or her daily activities with respect to both technical and programmatic issues. The Deputy CPM position does not cover the entire project duration; in particular it is not planned to have this position in early R&D phases or later as project sub-systems reach completion. The Deputy CPM focuses on critical sub-systems as directed by the CPM and in this role is responsible for the following:

- Provides focused oversight of selected sub-system to ensure work is executed within the approved cost and schedule.
- Reviews cost and schedule changes for the selected focus sub-system(s) in the broader project framework and collects information for approval by the CPM. Reviews and assesses risk for the selected focus sub-system(s) in the broader project framework and works with the risk manager to ensure project-level coordination.
- Coordinates resource needs within the selected focus sub-system(s) to ensure optimal execution.
- Collects information as it relates to key decisions for review and approval by the Project Director, Camera Project Scientist, and CPM.

Camera Project Scientist

The Camera Project Scientist is responsible for ensuring that the project meets the Dark Energy Experiment objectives as described in the approved Mission Need Statement (CD-0). The Project Scientist reports to the Principal Investigator. The responsibilities of the Project Scientist include, but are not limited to, the following:

- Provides the project with oversight regarding the technical specifications to ensure that the project will meet the LSST scientific goals.
- Communicates with the LSST Project Scientist and the LSST Project Science team to negotiate any revisions or clarifications to the Camera requirements.
- Works with the Camera Systems Engineering team to ensure that the science requirements are flowed to the camera components and that the requirements are being adequately verified.
- Work with the CPM and Deputy CPM to evaluate the impact of revisions to requirements.

Camera Quality Assurance Manager

The Camera Quality Assurance Manager reports directly to the CPM. The responsibilities of the Quality Assurance Manager include, but are not limited to, the following:

- Maintains the Performance and Safety Assurance Plan (PSAP) and referenced documents that form a part of the quality program.
- Provide consultation to the CPM and Subsystem Managers in implementing established QA procedures and policies (for example, developing subsystem or institutional vendor control

programs, establishing review procedures).
- Provides or coordinates project-specific QA training for project members.
- Coordinates completion of QA-related milestones as provided in project schedules.
- Works with the CPM and Subsystem Managers to avoid situations where completion of critical planned QA activities are compromised due to cost, schedule or other constraints.
- Recommends to the CPM to stop work based on an investigation that indicates that work is of inadequate quality.
- Performs QA audits as requested by the CPM.
- Participates individually or as part of a team in vendor surveys, vendor qualifications, and source inspections.
- Works with institutional QA representatives to establish the Institutional Quality Implementation Plan (IQIP), to ensure that local programs are in place, and to audit the programs as needed through the life of the project.

Camera Production Manager

The Camera Production Manager supports all Camera sub-systems and ensures manufacturing and assembly is conducted in an optimal manner both from the technical and resource standpoint for assigned institutions. The Camera Production Manager reports to the CPM and is part of the project office. The responsibilities of the Camera Production Manager include the following:

- Reviews manufacturing and assembly plans for the sub-systems that are ready for manufacturing within the assigned institution to ensure the plans are technically sound.
- Reviews production resources and personnel and defines strategy to optimize cost, schedule and performance during fabrication and assembly within the assigned institution in concurrence with sub-system managers and the CPM. This includes defining best resource assignment and manufacturing priorities.
- Supports and assists sub-systems in managing day-to-day activities during fabrication and assembly within the assigned institution.
- Coordinates the weekly production meeting with sub-systems in support of the activities outlined above within the assigned institution.

Camera Safety Officer

The Camera Safety Officer reports directly to the CPM. The Safety Officer is the focal point for all safety activities involved in implementing the Camera PSAP. The Safety Officer influences the design when necessary in the interest of safety, with the goal of minimizing the overall hazard-level of the Camera design and operations.

The Safety Officer is actively involved in many aspects of the project. The responsibilities of the Safety Officer include, but are not limited to, the following:

- Maintains this PSAP and referenced documents that form a part of the ES&H and system safety program.
- Provides consultation to the CPM and Subsystem Managers in implementing established ES&H and system safety procedures and policies.
- Stops any work that indicates inadequate consideration for personnel or system safety or impact on the environment.
- Participates as a member of the LSST Safety Council.
- Participates in design reviews.

- Prepares the system safety program deliverable documents.
- Supports the LSST system safety program implementation and providing the primary interface to the Camera.
- Develops and establishes safety design criteria and safety design requirements as needed.
- Reviews and approves selected drawings, specifications, and procedures.
- Participates in hazardous testing and system safety testing.
- Evaluates design changes for their impact on safety.
- Provides oversight and direction to institutional safety officers at collaborating institutions. Develops Institutional Safety Implementation Plans (ISIPs), and ensures that procedures and work processes are implemented as deemed necessary. Also audits the ES&H and system safety programs at collaborating institutions as necessary.
- Serves as SLAC institutional safety officer, overseeing all Camera work at SLAC.

Camera System Integration Manager

The Camera System Integration Manager (SIM) reports to the CPM and is responsible for the cost and schedule of the System Integration Team and for overseeing the activities of this group. The SIM works with the discipline Chief Engineers and they are responsible for the following:

- Integrated design,
- System-level engineering analysis,
- Generating performance estimates,
- Requirements and verification management, this includes flow-down from LSST,
- Interface Control, this includes Camera to Telescope and Camera to Data Management interfaces.
- Oversee and support subsystems to ensure they will meet their overall objectives,
- Communicate to the Project Office any technical issues, roadblocks, or non-compliance.

LSST Camera Operations Physicist

The Camera Operations Physicist (COP) serves the role of lead operator of the LSST Camera. This individual is responsible for arranging, coordinating, and maintaining oversight for all operational activities involving final Camera hardware during the I&T Phase of the project at SLAC. The role encompasses efforts necessary to ensure the safe operation of the individual hardware components and the operation of the Camera as a whole. Responsibilities include:

- Coordination of Camera operations among relevant sub-system experts.
- Monitoring and evaluation of Camera operational performance.
- Development and maintenance of the documentation for Camera operation.
- Development and implementation of modifications to Camera operating parameters.
- Safe operation of the Camera and the operation of both hardware and software safety systems.

The COP is instrumental in defining the final operating procedures for the completed Camera. A key document that will be authored and maintained by this person is the Camera Operations Concept Document (OCD). The individual will work closely with the LSST Safety Officer and will be the final authority for the activation of major subsystems as they are brought on-line within the overall Camera configuration context. The COP reports to the Camera I&T sub-system physicist.

Camera Chief Engineers/Coordinators

The Camera Chief Engineers work within the system integration group and report to the CPM. They provide technical expertise for the overall project and system engineering support for their specific area. The mechanical Chief Engineer ensures that all sub-systems are compatible from a mechanical standpoint and comply with all mechanical standards and plans. The Electrical Chief Engineer ensures that all sub-systems are compatible from an electrical standpoint and comply with all mechanical standards and plans. The computing coordinator ensures that software effort is coordinated across all sub-systems and comply with all software standards and plans. The Chief Engineers work with the SIM and they are responsible for the items listed under the SIM.

Camera Configuration and Document Manager

The Camera Configuration and Document Manager (CDM) reports to the SIM and provides support for maintaining the configuration-control system. The CDM also supports the LSSTCAM project with technical writing.

Camera Requirements Manager

The Camera Requirements Manager (RQM) reports to the SEM and works with the technical teams to develop and track and verify Camera requirements.

Camera Risk Manager

The Camera Risk Manager reports to the SEM to support the maintenance of the risk registry. The Risk Manager also executes the Monte Carlo simulations used to determine the residual risk cost and residual risk schedule of the project.

Camera Subsystem Physicist Managers

The Camera Subsystem Managers report to the Project Scientist and are responsible for ensuring that the subsystem deliverables will meet scientific performance. They work with the Engineering Managers/System Architects to technically manage.

Engineering Managers/System Architects

Each subsystem has an Engineering Manager or System Architect. The Engineering Manager reports to the Subsystem Manager. The Engineering Managers are responsible for programmatic and technical management of their subsystems. They ensure that subsystem technical deliverables meet performance requirements described in the subsystem specifications and that deliverables are on time and on budget. They provide the day-to-day management of the subsystem and also performs the role of Cost Account Manager (CAM). Each subsystem CAM is responsible for the status of the baseline cost and schedule for his or her subsystem. He or she is also responsible for producing variance reports. All of the CAM data and reports produced will be reviewed and approved by the CPM.

Camera Project Management Control System Lead

A Camera Project Management Control System (PMCS) Lead reports to the CPM and is accountable for developing and maintaining the Project Baseline Cost and Schedule, as well as for producing the EVMS data from monthly status reported by CAMs. The PMCS Manager plays a key role in supporting the CPM with the essential programmatic tools to execute the project successfully.

Camera Finance

The Project Finance Manager is centrally managed by SLAC's Chief Financial Officer (CFO) Office and is 'field deployed' to the LSSTCam Project. The Finance Manager reports functionally to the CPM and is responsible for:

- Act as the primary office of communication between LSSTCam and other financial offices, (BNL, LLNL, Harvard University, University of Pennsylvania and University of Arizona); and SLAC Business Office, and the Budget Office.
- Provide monthly summaries of budgets, costs, open commitments.
- Responsible for working with the CAMs for monthly accruals. Validate monthly that they are being accounted correctly.
- Analyze monthly the funding balance at SLAC and the coloration institutions. Review invoices for proper overhead, charges and charglines. Approve procurements above $50K for sufficient funding.
- Track labor effort on the LSST project and providing reports on unusual charges.
- Track costs against SLAC credit cards.
- Maintain original and electronic copies of MOU's.

Camera Procurement Lead

A Camera Procurement Lead is assigned by the Laboratory Central Procurement Offices. The offices are the primary point of contact for the Camera contracts. The offices establish the standard timelines and prerequisites for procurements.

## 6.3. Camera Collaboration

A broad-based collaboration has been established to deliver the Camera. Formal MOUs and sub-contracts have been established with all of the collaborators. The primary roles of all of the major institutions are as follows:

- SLAC National Accelerator Laboratory: overall project management, Camera body and mechanisms, cryostat subsystems, corner raft electronics and mechanics, data acquisition and Camera controls, integration and test.
- Brookhaven National Laboratory: science sensors, electronics and raft assemblies.
- Lawrence Livermore National Laboratory: optics, corner raft assemblies, wavefront sensing.
- Institut National de Physique Nucléaire and the Physique des Particules (IN2P3-Collection of multiple labs): applied specific integrated circuits, sensor testing, filters, filter carousel, camera calibration, slow controls.
- University-based instrumentation groups: Harvard University, University of Pennsylvania, , University of Illinois, University of California Santa Cruz, University of Arizona, and University of California Davis.

## 7. Management Plans

The LSSTCAM project has established plans and implementation processes to manage Camera delivery. The management plans are organized into two categories, management plans and implementation plans, as shown in Figure 4. The higher level management plans describe the organization, processes, products, and methodology implemented by the Camera management team to ensure a coordinated development of the Camera. The implementation plans are details specific to the design, fabrication, and assembly of the LSST Camera.

This Camera Project Management Plan (PMP) specifies the overall management of the project and all of the lower management plans supporting successful project execution.

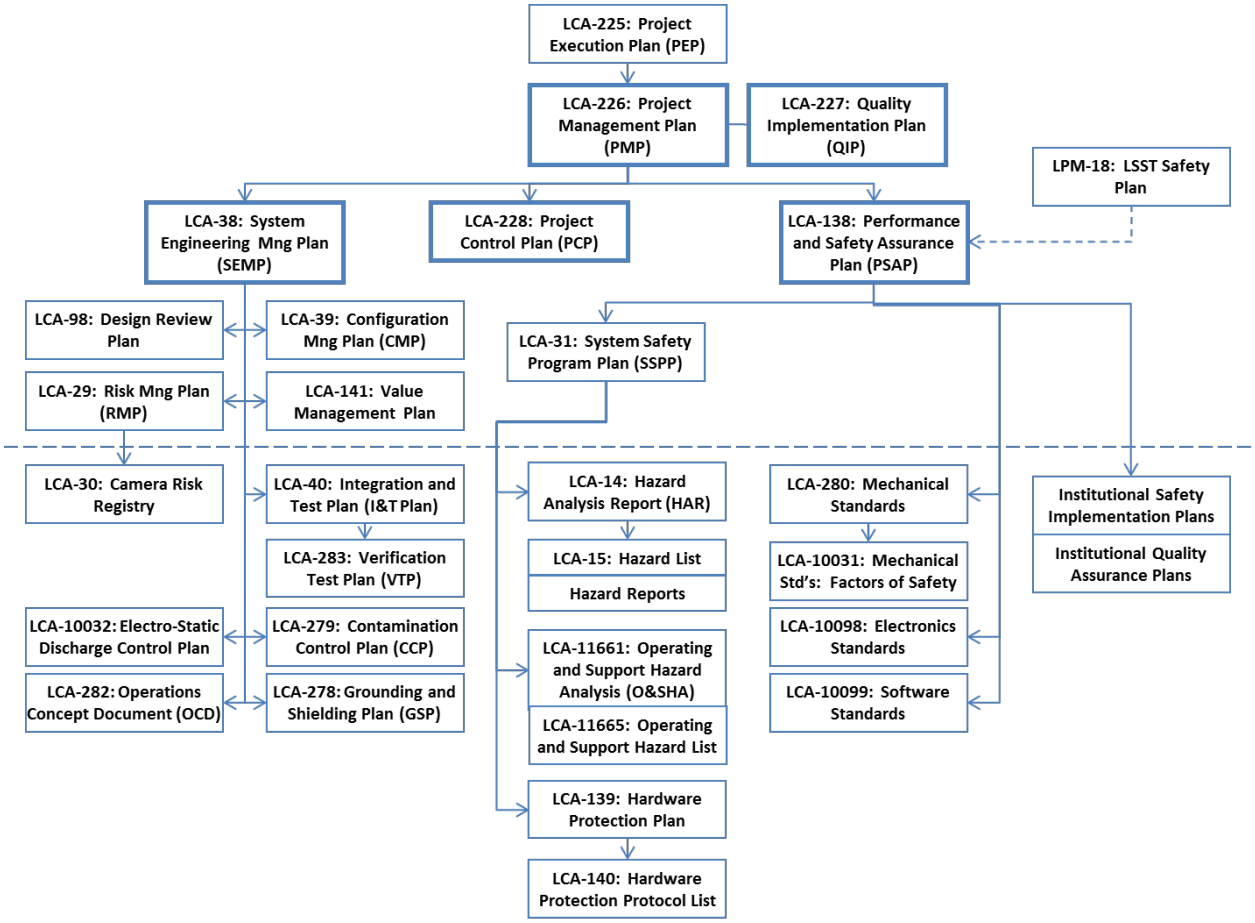


***Figure 4: LSST Camera Management and Implementation Plans***

## 7.1. System Engineering Management

The System Engineering Management Plan (SEMP) (LCA-38) describes the organization, processes, products, and methodology implemented by the Camera management team to ensure a coordinated development of the LSST Camera system. This plan includes:

- **Organizational responsibilities.** Relationships with the rest of the Camera management team, the LSST project, and Camera collaborating institutions.
- **Processes.** Requirements and interface management, operations concept development, integration and verification test planning, design value management, risk management, and configuration-control planning.
- **Methodology.** Plans for communication within the system engineering group and with the rest of the Camera and LSST team, description of system engineering involvement and planning for programmatic and other external reviews.

The Camera SEMP supports and is subordinate to the Camera Project Management Plan (PMP), LCA-226. The SEMP defines the technical management of the camera project, while the PMP specifies programmatic management.

The Camera SEMP provides the specific processes required to manage the system engineering effort at the Camera level of integration and lower. This includes the following lower-tier plans:

- Design Review Plan (LCA-98).
- Risk Management Plan (LCA-29).
- Camera Risk Registry (LCA-30).
- Configuration Management Plan (lCA-39).
- Value Management Plan (LCA-141).
- Integration and Test Plan (LCA-40).
- Verification Test Plan (LCA-283).
- Electro-Static Discharge Control Plan (LCA-10032).
- Contamination Control Plan (LCA-279).
- Operations Concept Document (LCA-282).
- Grounding and Shielding Plan (LCA-278).

The Camera SEMP is responsive to the LSST Observatory SEMP. The Observatory SEMP provides processes required to specify and control the functionality and requirements allocated to the Camera, interfaces between the Camera and other Observatory subsystems, and integration of the entire LSST system.

### 7.1.1. Risk Management Plan

The Camera Risk Management Plan (LCA-29) describes the continuous risk management (CRM) process implemented by the project. CRM is a disciplined approach to managing project risks throughout the life cycle of the project. This plan is consistent with DOE O413.3B, “Project Management for the Acquisition of Capital Assets,” and strives to incorporate “best practices” from other large-scale, first-of-a-kind science projects. The primary goal of the plan is to manage the risks associated with the development and construction of the Camera. The plan establishes the methods of assessing risk of the Camera project down to the subsystem level. Project risk is managed throughout the life of the project, from development through construction and early commissioning phases.

Project risks are centrally managed but are the result of project-wide risk assessment. The project-wide risk assessment supports management decision-making by providing integrated and quantitative assessments of risk. Current and comprehensive risk updates provide management with

additional information in preparing for and reacting to contingent events and adverse outcomes to planned events.

The CRM process also provides a uniform language for tracking risk elements and communicating that information. A Camera Risk Registry (LCA-30) documents the risk assessment, mitigation strategy, and the residual risk after mitigation. The risk database includes information about all identified risks within the project, while the registry incorporates lessons learned in several recent SLAC projects.

#### 7.1.2. Design Review Plan

The Design Review Plan (LCA-98) provides the LSST technical staff with the guidelines for design reviews as discussed in the Camera SEMP (LCA-38). The Design Review Plan provides minimum requirements for design review technical and programmatic deliverables. The plan also establishes roles and responsibilities of the presenters and the review committee. Finally, the plan defines what role the review process plays in authorizing the transition to the next phase of the technical deliverable. Attendance and the final report are configuration-controlled documents. The action items from design reviews are tracked by Systems Engineering.

Design reviews provide an independent assessment of the continuing ability of the program to meet its technical and programmatic commitments and to provide value-added assistance to the project manager. Reviews will occur throughout the life cycle of the project and consists of periodic independent reviews.

Reviews are a resource offering an opportunity to add value to the project and to share knowledge by inviting outside experts that can provide confirmation of the approach and/or recommend options. The reviews serve as a tool for communication by formally providing an opportunity to organize, assess, and communicate critical data and information.

The objectives and important features of the major review classes are provided to guide project managers in the formulation and implementation of a series of hierarchical reviews. Reviews provide the opportunity to confirm the project approach or to offer options, if needed, and to communicate progress and risks toward meeting the success criteria. The output of these reviews (assessments, options, recommendations, and decisions) flow as inputs into subsequent reviews as appropriate to ensure alignment between providers, customers, and stakeholders. The output also ensures proper disposition of issues.

The PM and System Engineer have the flexibility to propose options to combine reviews to providers, customers, and stakeholders, provided that the objectives of each type of reviewer are met. The goal is to maximize the probability of mission success through added value and efficiencies. The major classes of reviews are:

- System Requirements Review (SRR).
- Conceptual Design Review (CDR).
- Preliminary Design Review (PDR).
- Final Design Review (FDR).
- Manufacturing Readiness Review (MRR).
- Pre-Ship Review (PSR).
- Safety Review (SR).
- Delta Review.
- Analyses Peer Reviews

### 7.1.3. Configuration Management Plan

The Configuration Management Plan (LCA-39) describes the process by which the LSSTCAM project documents the functional and physical characteristics of the Camera, controls changes to those characteristics, and provides information on the state of change action. The configuration-management process involves all levels of Camera management responsibility and consists of four ongoing stages:

- Configuration identification.
- Configuration change control.
- Configuration status accounting.
- Configuration verification.

Configuration identification is the process by which the Camera and its subsystems are defined through drawings and documents that specify the system components. The definition is in terms of functional and physical characteristics of each component and in terms of how each component is manufactured and tested. The documents and records describing Camera characteristics are defined as Configuration Items (CIs). Cis are listed and tracked in a Configuration Item Data List (CIDL), which is also used to assess the impact of proposed changes to CIs.

Change control is the process by which proposed changes are reviewed and approved. Change control ensures that the performance, functional, cost, schedule, and risk impacts of a change are considered before approval is granted.

Configuration status accounting is the process by which configuration information is tracked and relayed to key personnel in order to support management decisions and ensure that all work is performed according to the current design.

Configuration verification is the process that ensures that the current hardware and software configurations match the intended design by verifying the implementation of each approved change through periodic configuration audits.

Following is a list of some of the key project documents that will be configuration-controlled:

- Project Execution Plan (LCA-225).
- Preliminary and Final Hazard Analysis (LCA-14).
- Project Management Plan (LCA-226).
- System Engineering Management Plan (LCA-38).
- System Safety Program Plan (LCA-31).
- Quality Implementation Plan (LCA-227).
- Quality Assurance Plan.
- Risk Management Plan (LCA-29).
- WBS Dictionary (LCA-125).
- WBS documents for individual Camera subsystems.
- Requirements, Specifications and ICDs.
- Drawings.
- Design Review Reports.
- Performance Measurement Baseline documents.
- Approved Project Baseline Change Request (BCR) documents.

### 7.1.4. Value Management Plan

The Camera Value Management Plan (LCA-141) describes a Value Management (VM) as a tool for evaluating and executing major project alternatives. Value management is focused on those project

development alternatives that have progressed to the level requiring serious consideration and investigation. The Camera Value Management Plan meets the requirements for DOE Order 413.3B (29 November 2010), "Program and Project Management for the Acquisition of Capital Assets" and Office of Management and Budget (OMB) Circular A-131. Circular A-131 "requires Federal Departments and Agencies to use value engineering (VE) as a management tool, where appropriate, to reduce program and acquisition costs."

VM methodology is also known as value analysis, value engineering, or value planning. VM is defined as an organized effort directed at analyzing the functions of systems, equipment, facilities, services, and supplies for the purpose of achieving the essential functions for a project at the lowest life-cycle cost consistent with required performance, quality, reliability, and safety. VM is a collaborative technique directed toward analyzing the functions of an item or process to determine "best value" or the best relationship between worth and cost.

VM is an integral part of the overall project delivery process and is not a separate entity designed to "second guess" the integrated project team or design authority. The VM process is a standard engineering practice that was chosen to be a management tool that helps meet project objectives while providing maximum value for the entire system. Value Engineering (VE) studies will be conducted throughout the preliminary and final design phases of the project.

#### 7.1.5. Integration and Test Plan

The Camera Integration and Test Plan (LCA-40) describes the plan for integrating and testing the Camera at SLAC. The plan includes details of the Integration and Test (I&T) organization and responsibilities and major steps in the integration and test process. The plan also includes the flow of verification activities and responsibilities from Camera subsystem components up through the fully integrated Camera. Finally, the plan describes the I&T facilities and equipment to be used for the I&T process, and the plans for personnel and system safety during integration and test activities.

#### 7.1.6. Verification Test Plan

The Camera Verification Test Plan (LCA-283) describes the plan for verifying system-level Camera requirements during integration and test, prior to Camera delivery. The Camera Integration and Test Plan (LCA-40) describes the context in which these tests are performed in the integration and test process, along with plans for managing the process. The Camera Specification (LCA-48) lists all Camera system requirements that are addressed in this plan.

This plan includes a description of verification plans for all requirements in LCA-48. Verification might be by test, analysis, or some other method, including assignment of verification to subsystem-level testing, or incorporating subsystem requirements verification as part of system-level testing.

Note that this plan does not currently describe the verification methods for Camera interface requirements, except for the interface requirements have been incorporated into LCA-48.

#### 7.1.7. Electro-Static Discharge Control Plan

The Electro-Static Discharge Plan (LCA-10032) describes administrative and technical requirements of the electro-static discharge (ESD) control program used by the Camera. This plan supports the assurance and process control plans that are established in the LSST Camera Performance and Safety Assurance Plan (LCA-138). This plan complies with the ESD control program requirements of ANSI/ESD S20.20-2007, to ensure that the ESD-sensitive items in the Camera are fabricated, assembled, tested, handled, stored, and operated in a way that reduces the likelihood of damage or loss of function due to electrostatic discharge.

The requirements and programs in this plan apply to all manufacturing and test areas and operations where ESD-sensitive items are handled and to all institutions working on Camera components. The requirements and programs in this plan apply to all ESD-sensitive items susceptible to damage by electrostatic discharges greater than 100 volts Human Body Model (HBM), with the expectation that the requirements and programs adequately protect ESD sensitive devices down to 50 volts HBM.

#### 7.1.8. Camera Operations Concept Document

The Camera Operations Concept Document (OCD) (LCA-282) describes all aspects of Camera operations for hardware and software elements resident on the Camera as well as in the summit facility. This document also describes support elements of the Camera that may be physically located on the summit or located as subsystem facilities elsewhere that are integral to the operation or maintenance of the Camera.

#### 7.1.9. Contamination Control Plan

The Contamination Control Plan (CCP) (LCA-279) describes the overall requirements necessary to achieve hardware cleanliness for the LSSTCAM project. All participants in the LSSTCAM project must adhere to technical and administrative requirements of contamination-control specified in this plan.

This plan was developed in compliance with government and industry standards and specifications to ensure that the contamination-critical and sensitive items in the camera are fabricated, assembled, tested, handled, stored, and operated in a way that reduces the likelihood of damage or loss of function due to contamination.

All institutions and facilities engaged in processing of contamination-controlled hardware shall comply with the requirements defined in this contamination control plan. The requirements and programs in this plan apply to all manufacturing and test areas and to all Camera operations where contamination-critical and sensitive items are involved.

This plan establishes the guidelines and practices to minimize contamination of critical hardware during all phases of the project, including engineering, design, developmental test, fabrication, assembly, acceptance test, integration, storage, transport, operations and maintenance.

Requirements for hardware inspections, surface cleanliness measurement techniques, precision cleaning, laboratory analyses of collected contamination, and clean room certification and monitoring are also included.

#### 7.1.10. Grounding and Shielding Plan

The Grounding and Shielding Plan (GSP) (LCA-278) describes requirements and design principles that ensure the Camera subsystems do not allow current flows or capacitive or inductive couplings that could cause electrical interference between Camera components.

The Camera contains many electrical and electronic components, all of which have the potential to electrically interfere with one another. Also, the area immediately surrounding the Camera has additional electrical and electronic components, including very large motors for the telescope and dome, that could cause interference with the operation of the Camera.

This plan defines shielding such that Camera subsystems do not couple into one another by way of electric (capacitive) or magnetic (mutual inductance) modes and so that on-telescope Camera subsystems are protected from external interference to the greatest extent possible.

In addition, this plan extends somewhat beyond just “grounding and shielding” by defining “best practices” for device selection and for device-to-device signaling to reduce the risk of internal interference.

## 7.2. Project Control

The Camera Project Control Plan (PCP) (LCA-228) documents the approach to implementing Earned Value Management (EVM) for the LSSTCAM project. The PCP meets the requirements for DOE Order 413.3B (29 November 2010), “Program and Project Management for the Acquisition of Capital Assets,” which requires the use of a certified Earned Value Management System (EVMS).

The PCP calls out all of the governing process in plans to produce and control the following:

- Cost estimating.
- Schedule management.
- Baseline development.
- Performance reporting.
- Status reporting and data collection.
- Account management.
- Performance analysis and forecasting.
- Performance measurement and baseline maintenance.
- Contingency management.

SLAC has a certified EVMS that complies with ANSI/EIA-748-B. This system provides the essential earned value information needed for management control of the project and maintains the database for progress reporting. The EVMS integrates the cost and schedule baselines and provides the tools to monitor project performance. The data from the EVMS is the basis for information entered into the DOE PARS II. Surveillance of the SLAC EVMS is conducted bi-annually.

The LSSTCAM EVMS is consistent with SLAC EVMS description documentation and provides an objective measure of actual costs and schedule performance against the plan.

## 7.3. Quality Implementation

This Camera Quality Implementation Plan (QIP) (LCA-227) introduces quality assurance plans by which the LSSTCAM project manages the development, fabrication, assembly, and testing of project deliverables to meet contract requirements and regulations. This plan is based upon and reflects the understanding and approach of the Camera project to the requirements and intent of DOE Order 414.1D, “Quality Assurance,” thus meeting the contract requirement of the DOE with Stanford University for a documented Quality Assurance (QA) program.

This QIP applies to all work involved in the development, fabrication, assembly, and testing of the LSST Camera, at all institutions where this work is carried out. By extension, this QIP also is applied to subcontractors as well as in involvement of LSSTCAM project personnel in support of LSST observatory activities.

## 7.4. Performance and Safety Assurance

The Performance and Safety Assurance Plan (PSAP) (LCA-138) describes implementation of the performance and safety assurance programs listed in the QIP (LCA-227). LSSTCAM needs the programs to comply with DOE Order 414.1D, "Quality Assurance," and with the LSST Safety Policy (LPM-18). The scope of the PSAP includes Camera system safety program, the environment, safety, and health (ES&H) plans; and the means that personnel and safety processes are managed across the Camera collaboration and quality management system for the LSSTCAM project.

The PSAP includes, by reference, the following lower-tier plans and standards:

- System Safety Program Plan (LCA-31).
- Mechanical Standards (LCA-280).
- Electronics Standards (LCA-10098).
- Software Standards (LCA-10099).
- Institutional Safety Implementation Plan.
- Institutional Quality Assurance Plan.

### 7.4.1. System Safety Program Plan

The Camera System Safety Program Plan (SSPP) (LCA-31) describes the tasks and activities associated with the Camera System Safety Program (SSP), which identifies the hazards of the Camera and imposes design requirements and management controls to prevent hazards and to mitigate the impact of hazards. The SSPP also defines the goals and requirements of the system safety effort and establishes the framework within which the goals are efficiently and effectively fulfilled. The SSP covers all phases of the LSSTCAM project, including design, development, fabrication, assembly, handling, transportation, storage, integration, test, and operation.

The SSPP refers to the following two lower-tier documents:

- Preliminary Hazard Analysis (LCA-14).
- Hardware Protection Plan (LCA-139).

The Hazard Analysis Report (HAR) (LCA-14) describes hazards associated with the design and operation of the Camera, assesses risks due to those hazards, and establishes controls needed to either eliminate the risks or to reduce them to acceptable levels. The hazard analysis considers hazards capable of causing injury to personnel, damage to the environment, or damage to critical hardware. Lower-tier Hazard List (LCA-15) and Hazard Report documents describe details of each hazard explicitly, including plans for mitigation and verification.

The Hardware Protection Plan (LCA-139) describes all aspects of the Camera Protection System (CPS), including CPS definition and development, architecture and high-level design, plans for implementation, and plans for testing and certification. The CPS includes all systems and components of the Camera that are used to monitor or detect, and actively protect against, a mishap or a hazard that would otherwise cause damage to Camera hardware. The Hardware Protection Plan refers to a Hardware Protection Protocol List (LCA-140), which describes details of each type of potential mishap addressed by the CPS.

### 7.4.2. Mechanical Standards

The Mechanical Standards document (LCA-280) defines the standards to ensure development of a unified, coherent, self-consistent, and standardized set of Camera analyses, drawings, procedures, and manuals. This document is one means by which the Camera quality is assured, and it forms one part of the quality assurance plans described in the Performance and Safety Assurance Plan. The use of the mechanical standards also allows for uniform and full descriptions of the delivered Camera hardware and all equipment needed to integrate, test, and service the Camera hardware.

The standards and provisions in this document cover all parts, components, and assemblies of Camera deliverable items and associated support equipment. Note that this includes mechanical aspects of electrical, electronic, and electromechanical (EEE) parts and assemblies.

The Mechanical Standards: Factors of Safety document (LCA-10031) serves as an addendum to the Mechanical Standards document. LCA-10031 describes how to calculate the factors of safety used in analysis and testing of Camera hardware, factoring in the material used, the criticality of the application, and the load-case operating on the hardware.

#### 7.4.3. Electronics Standards

The Electronics Standards document (LCA-10098) defines standards to ensure development of a unified, coherent, self-consistent, and standardized set of Camera analyses, schematics, procedures and manuals for electronic hardware.

#### 7.4.4. Software Standards

The Software Standards document (LCA-10099) defines standards to ensure development of a unified, coherent, self-consistent, and standardized set of computer code and firmware code.

## 8. Performance Baseline

This section documents the preliminary Performance Baseline (PB) that consists of the scope, cost, schedule, required funding profile, and other information related to the PB. The following lower tier documents capture the details and plans required for project execution, tracking and control.

- WBS Dictionary (LCA-125).
- Camera Requirements (LSE-59).
- Camera Facility ICD (LSE-65).
- Guide Sensor and Telescope ICD (LSE-66).
- Wavefront Sensor and Telescope ICD (LSE-67).
- DAQ and DM ICD (LSE-68).
- CCS and DM ICD (LSE-69).
- OCS Communication Architecture (LSE-70).
- OCS and Camera Command Dictionary (LSE-71).
- Camera Specification (LCA-48) .
- Camera Design Report (LCA-11591).

### 8.1. Preliminary Scope Baseline

To achieve LSST science requirements within a preliminary baseline scope, the LSSTCAM project will deliver a 3.2 Gigapixel-capable Camera with the following major subsystems and components:

- Array of CCD science sensors.
- Guide sensors and wavefront sensors at four locations on the focal plane.
- Refractive optics.
- Optical filters.
- Filter exchange system.
- Shutter system.
- Utility trunk.

- Cryostat with cryogenic system.
- Control system and DAQ.
- Camera ground support equipment.

The LSST Camera WBS Dictionary (LCA-125) provides the complete Work Breakdown Structure (WBS) for the LSSTCAM project. The project work is organized as shown in the following table:

**Table 1—LSST Camera WBS Structure**

| WBS Number | WBS Name | WBS Description |
|---|---|---|
| 3.01 | Management | Labor, materials, travel and fixed costs associated with operations of the LSSTCAM Project Office, including environment, safety and health. |
| 3.02 | Systems Integration | Labor, materials, travel, and fixed costs associated with camera-wide system engineering effort for the LSSTCAM. It includes requirement management, external and internal interface management, risk management, quality assurance, configuration management, and document control. |
| 3.03 | Science Sensors | Labor, materials, travel, and procurement necessary to acquire, qualify and test the focal plane science sensors. It includes the design, labor, materials, fabrication, and procurement of the sensor test fixtures. |
| 3.04 | Science and Corner Raft | Labor, materials, travel, and procurement necessary to design, acquire, fabricate, qualify, and test the readout electronics and thermal and structural modules supporting the focal plane sensors. It includes the design, labor, materials, fabrication, and procurement of the test fixtures. |
| 3.05 | Optics | Labor, materials, travel, and procurement necessary to design, acquire, fabricate, qualify, and test the LSSTCAM refractive optics (including filters) and their opto-mechanical mounts. It includes the design, labor, materials, fabrication, and procurement of the test fixtures |
| 3.06 | Camera Body and Mechanisms | Labor, materials, travel, and procurement necessary to design, acquire, fabricate, qualify, and test the LSSTCAM body housing, filter exchange mechanism (without the actual filters) and shutter. It includes the design, labor, materials, fabrication and procurement of the control units and test fixtures. |
| 3.07 | Cryostat | Labor, materials, travel, and procurement necessary to design, acquire, fabricate, qualify, and test the LSSTCAM cryostat and refrigeration system. It includes the design, labor, materials, fabrication, and procurement of the control units and test fixtures. |
| 3.08 | Control System, Data Acquisition System and System Electronics | Labor, materials, travel, and procurement necessary to design, acquire, fabricate, qualify, and test the LSSTCAM control system which manages, monitors, and controls all Camera subsystem operations, as well as the LSSTCAM Data Acquisition system. It includes the design, labor, materials, fabrication, and procurement of the camera power management system and camera protection system. |
| 3.09 | Integration and Test | Labor, materials, travel, and procurement necessary to assemble, integrate, align, qualify, verify KPPs and make the Camera ready for shipment to the summit (CD-4). It includes the design, labor, materials, fabrication, and procurement of the test facility, test fixtures, and the interim Commissioning Camera unit test and shipment to a pre-designated test facility in U.S. |

### 8.2. Baseline Change Control

The LSSTCAM project controls changes in functional and physical requirements and evaluates the impact of changes on cost and schedule through a baseline change-control process. The mechanics of change control are covered in the System Engineering Management Plan (LCA-38). The essential elements of configuration control are a well-defined baseline and effective method to communicate, evaluate, and document changes to that baseline. The configuration control process promotes the orderly evolution of the baseline design, and it ensures that the effect of changes on cost, schedule, and technical scope performance are properly evaluated and documented by project management. A Baseline Change Request (BCR) must be initiated when there will be an impact on any of the cost, schedule, or scope baselines.

A Change Control Board (CCB) consisting of members of the LSSTCAM project has been established. The board includes a chairman (Camera Project Manager), a change control manager, and board members. The board members review the technical, cost and schedule implications of changes and advise the chairman. All BCR actions are documented in a change-control log.

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

The baseline change control framework which includes applicable change management processes, threshold requirements, and change control board charter and the procedures to be followed should be established or referenced. A summary table of baseline change control thresholds; and approval authority for scope, schedule, and cost should be included in the PEP. BCRs below Level 3 are documented and communicated but do not require formal approval.

### 8.3. Baseline Variance and Corrective Action

The LSSTCAM project generates variance reports and corrective actions using the SLAC online reporting tool Hammer.

The CAMs write variance reports at the control account level, and variances are reviewed monthly by the project office and all subsystem managers at the EVMS meeting. The Camera PM approves a variance and its corrective action. A CAM can recommend the corrective action for closure, and the action is closed after review and approval by the PM.

A CAM must do variance analysis for a control account if its cumulative schedule or cost variance exceeds any (or both) of the following variance thresholds: +/- 10% or +/- $100K. For control accounts 3.03.02.02 and 3.05.03, the dollar threshold is +/- $250K. This is because of the large value of the L1_L2 and Sensor procurements. Incremental variance issues are addressed in the cumulative variance analysis as necessary.

## 9. Procurement Process

Typically for procurement expected to be greater than $500K, LSSTCAM management holds a review before creating a request for proposal (RFP). The review evaluates the statement of work (SOW), the technical specification, and the procurement strategy (developed with the institution procurement office and the LSSTCAM Project Office).

Review and approvals are required by:

- LSST Director.
- LSST Project Scientist.

- LSST Project Manager.
- LSST System Engineer.
- LSST Camera Project Manager.
- LSST Camera Project Scientist.
- LSST Camera System Engineer.

Typically, both a business committee and a technical committee are assigned to a procurement. The individuals on the committees depend on the type of contract. A committee can include, for example, SLAC management, subsystem and/or engineering managers, procurement specialists, ES&H specialists, and others. Members can be from either the DOE-side or NSF-side of the LSST project.

Following are dollar thresholds at which various signatures are required for financial approval.

For procurements at SLAC:

- CAMs/WBS L2 Manager: up to $50K.
- Project Manager: above $50K and up to $1M.
- Project Director: above $1M and up to $5M.
- Lab Director/DOE: above $5M.

For procurements at partner institutions (in addition to the institution-specific financial approval authority):

- CAMs/WBS L2 Manager: up to $50K.
- Project Manager: above $50K.
- Project Director: above $1M.

## 10. Communication and Coordination Process

### 10.1. Project Reporting

The CPM submits a monthly project progress report to the Federal Project Director (FPD). The report contains information about the overall progress of the project, including project cost and schedule performance, accomplishments, issues, and upcoming milestones. After review by the FPD, the report is submitted to the DOE Office of High Energy Physics (HEP).

After CD-2 approval, the monthly project report will include the latest earned-value data and an explanation of any significant variances and corrective actions. The report is used to evaluate cost and schedule performance on a monthly basis. In addition, the Estimate at Completion (EAC) will be evaluated on at least an annual basis.

The FPD updates the Project Assessment and Reporting System (PARS) II database each month by reviewing and certifying the monthly performance data, by rating project performance based on calculated performance indices, and by providing a status report on progress and issues.

The FPD holds regular meetings with the CPM and relevant staff to discuss the project status, issues, and current business. Also, LSSTCAM management and the FPD have conference calls regularly with HEP to provide project status updates and to discuss issues.

During project execution, a project progress review is held quarterly, attended by the FPD, the CPM, the Director of HEP, and the SC Acquisition Executive. The review is based on the quarterly progress report issued by the FPD. The quarterly review is accomplished by teleconference or videoconference.

### 10.2. Meetings and Communication

One of the primary tools for communication is regular meetings with the overall project, LSST Board, funding agencies, and Camera subsystems. The Camera Meeting and Review List (LCA-397) documents all Camera member attended meetings. This document lists the title of the meeting, and the purpose and frequency of the meeting. Action item lists are created for the cross-subsystem meetings and are tracked through system engineering.