Large Synoptic Survey Telescope Camera Management Plan	Document No. **LCA-228-C** Author(s) N. Kurita C. Brackett Subsystem ? Project Management	Status ? LSST Camera APPROVED Effective Date: 3 Aug 2015
Document Title **LSST Camera Project Control Plan**		

1 Change History Log

Revision	Effective Date	Description of Changes
	20 October 2011	Initial draft.
	1 November 2011	Second draft.
A	13 November 2014	Update for CD-2.
B	26 June 2015	Update for CD-3 Release per LCN-1361
C	3 August 2015	Correction to variance analysis requirements. Release per LCN-1407.

2 Contents

3 List of Tables

4 List of Figures

No table of figures entries found.

5 Applicable Documents

The following documents are cited for reference only, and do NOT form a part of this document:

Table 1: Reference Documents

Ref #	Document Number and Title
[1]	GAO-09-3SP; GAO Cost Estimating and Assessment Guide
[2]	LCA-98; Camera Design Review Plan
[3]	LCA-125; LSST Camera WBS Dictionary
[4]	LCA-10894; Cost Assumptions
[5]	LCA-10931; Contingency Estimation Methodology for the LSSTCam Project
[6]	SLAC-I-051-101-000; Project Management System Description
[7]	SLAC-I-051-201-000; PMS Control Account and Work Package Planning Procedure
[8]	SLAC-I-051-201-001; PMS Change Control Procedure

Ref #	Document Number and Title
[9]	SLAC-I-051-201-002; PMS Project Schedule Procedure
[10]	SLAC-I-051-201-003; PMS Cost Estimating Procedure
[11]	SLAC-I-051-201-004; PMS Monthly Status and Reporting Procedure
[12]	SLAC-I-051-201-006; PMS Accrual Procedure

6 Definitions

6.1 Acronyms

Table 2: Acronyms List

Acronym	Definition
BCR	Baseline Change Request
BOE	Basis of Estimate
CAM	Camera Account Manager
CPM	Camera Project Manager
EAC	Estimate at Completion
EVMS	Earned Value Management System
FTE	Fulltime Equivalent
FY	Fiscal Year
LSST	Large Synoptic Survey Telescope
LSSTC	Large Synoptic Survey Telescope Corporation
M&S	Material and Services
OECM	Office of Engineering and Construction Management
PCP	Project Control Plan
PMB	Performance Measurement Baseline
PMCS	Project Management Cost and Schedule
PMO	Project Management Office
SLAC	National Accelerator Laboratory
WBS	Work Breakdown Structure

7 Introduction

7.1 Purpose

This Project Control Plan (PCP) documents the approach to implementing Earned Value Management (EVM) for the Large Synoptic Survey Telescope (LSST) Camera project. The processes identified in the plan support the standard high-level EVM practices used for various projects at SLAC (for example, PEP-II/BaBaR, SPEAR3, GLAST, and LCLS/LUSI). Using SLAC EVM processes as a foundation, LSST Camera project can properly manage baseline cost and schedule and can provide accurate and timely reporting to the DOE and to LSST Corporation (LSSTC) customers.

7.2 Project Background

LSST is a large-aperture, wide-field, ground-based telescope that can survey the visible sky every few nights in six photometric bands. The 10-year survey will produce a database suitable for answering a wide range of important questions in astrophysics, cosmology, and fundamental physics. LSST is designed as a public facility. Images, alerts, and catalogs resulting from LSST can be made available to a broad community with no proprietary period. A sophisticated data management system can provide easy access to these data, enabling simple queries from individual users (both professionals and laypersons). The data management system can also enable computationally-intensive scientific investigations that utilize the entire dataset.

7.3 Project Baseline

This PCP covers processes used to create a baseline for the LSST Camera project. The PCP also covers processes used to maintain and report of the baseline during life cycle of the project. The project baseline defines the original design, cost, and project schedule. The baseline enables the Project Management Office (PMO) at SLAC to exercise effective change control.

7.4 PMO Responsibility

The PMO is responsible for implementing this PCP. The PMO also manages and provides personnel necessary to implement procedures covered in the PCP processes. The PCP processes have been documented and approved by SLAC management. The processes have also been validated through EVM surveillances run through the Office of Engineering and Construction Management (OECM).

7.5 Scope of this Document

Standard SLAC EVMS processes used by the LSST Camera project are defined in the documents cited previously [6-12]. For convenience, the SLAC processes are summarized briefly in Section 8 of this document. Sections 9 through 13 of this document focus on implementation of the SLAC processes by the LSST Camera project in four critical areas:

- Cost estimating.
- Schedule development.
- Contingency analysis.
- Control accounts.
- Earned value management.

8 Summary of Standard SLAC EVMS

This section briefly summarizes standard SLAC processes used by the LSST Camera project.

8.1 Project Cost Estimating

The SLAC cost estimating process is a bottom-up methodology to establish an initial estimate of project cost. The estimate is used to develop the schedule and cost baseline. The cost estimate is based on a logically-networked schedule, resource-loaded at the lowest activity level. The estimate assumes that all required labor, material and procurement contract types have been identified and that contract rates and burdens have been developed. The cost estimate also assumes that applicable managers have accurately determined the labor, material, and procurement requirements needed to support the scope of work.

The cost estimate reflects scope of work as defined in the project WBS. The schedule supports all agreed-upon key event milestones. The schedule activity resource amounts are used to generate the time-phased cost estimate based on the activity start and finish dates. All estimates are assessed in dollars in the actual year spent. All estimating guidelines and methodologies are established by the PMO and implemented through the SLAC cost estimator and/or project controls team.

8.2 Project Schedule Development

The SLAC schedule development process results in a logically-networked schedule that reflects the entire work scope of the project. The schedule incorporates control milestones that identify the timing of key events in the project life cycle. The milestones are organized as a hierarchy of levels (Level 1, Level 2, Level 3, and so on). The levels correspond with granularity of work associated with each event. Level 1 represents the entire scope of a project. Levels 2 and lower represent incrementally smaller portions of work. The schedule is resource-loaded. Resource loading ensures that the schedule and cost plans are in agreement.

The process specifies baseline, current, and supplemental schedules. The baseline schedule is the official plan against which project performance is measured and reported to higher-levels of management. The current schedule is used to manage all project activities, reflecting current status of schedule performance. The current schedule provides the road map for all future activities on a project.

When compared to a baseline schedule, the current schedule provides a measure of how well a project is progressing against the original plan. At the beginning of a project (or baseline reset action), the baseline and current schedules are the same. Once monthly status reporting begins, the current schedule reflects the current conditions on a project. The baseline does not change unless there is an approved Baseline Change Request (BCR).

Supplemental schedules are used as needed to help the project team plan for contingencies, perform what-if analysis, or for operational planning and management purposes. They are not part of the baseline or current schedule.

8.3 Project Control Account and Work Package Planning

The SLAC control account process is a way to organize, plan, budget, and execute the work for a project. Control accounts are natural management control points, because they identify who is responsible for specific work elements based on the WBS and organization breakdown structure (OBS). A control account is a point at which (resource plans) and actual costs can be accumulated and compared to earned value.

Within the financial accounting system, cost collection is performed at the control account level. Control accounts roll up into summary level accounts, which in turn roll up to an overall project summary account. No charges are directly charged or recorded at any summary level account. Accounts are associated with Activity IDs in the accounting system. Activity IDs are commonly referred to as charge numbers.

Multiple charge numbers, representing individual work packages, may feed into a summary charge number, which is the control account. While multiple charge numbers may roll up into a summary control account charge number, a charge number is never divided among multiple control accounts. In all cases, the control account has a unique charge number that is related to its WBS activity identifier.

A work package is a subdivision of a control account and consists of a discrete or level of effort task that has been planned and budgeted in detail. The budget for each work package is segregated into elements of cost. Work packages constitute basic building blocks used in planning, measuring accomplishment, and controlling project work.

8.4 Project Change Control

The SLAC change control process ensures that any project changes are identified, evaluated, coordinated, controlled, reviewed, approved, and documented in a manner that best serves the project and assures compliance with the applicable DOE guidance documents. Change control provides the methods used to ensure the integrity of project cost, schedule, and work-scope baselines. It enables the implementation of timely and auditable changes to the baseline. Finally, it ensures that no work is performed without prior authorization.

The project budget baseline and the performance measurement baseline are two important budget entities for which full control and accountability must be maintained. A detailed change log is maintained to record all changes to authorized work and to reconcile original budgets and schedules and all changes for the WBS elements. All changes to performance measurement baseline (PMB) made as a result of contractual changes, formal reprogramming, internal replanning, construction Field Change Orders, or the use of management reserve to include new scope items are documented and reported to the customer, as required.

Scope additions are added following confirmation that all project work authorization documents capture the additional scope. Changes that impact the PMB are formally controlled and documented through the formal change-control process.

8.5 Project Accrual

The SLAC accrual process provides a way to account for costs based either of the following: (1) Consultant or Contractor invoices that have not been vouchered into the accounting system; and (2) Consultant or Contractor costs that have not been invoiced (billed) to the project. Project accruals include products and/or deliverables received but not yet paid. Accruals are automatically entered into the accounting system using an existing process managed by the Office of the Chief Financial Officer.

The accrual process must be in line with the monthly accounting close of business. The accounting close of business is the last day of the month. When the last day of the month falls on a weekend, close of business is the Friday prior to the last day of the month. Approximately five days prior to the accounting close of business, the project accrual process must be complete.

Project accruals appear as actuals against the Performance Measurement Baseline (PMB) with correct change codes in order for cost variances to be assessed at the appropriate WBS level. Actuals also allow the PMO to review and assess project Estimate at Completion (EAC) in a timely fashion.

8.6 Project Monthly Status and Reporting

The SLAC monthly status and reporting process is used to collect schedule and cost data and produce project performance reports on a monthly basis. The process ensures that status and performance is assessed, reviewed, and reported consistently and on a regular basis during the life cycle of the project. Timely status and performance information enables project management to ensure that technical, cost, and schedule objectives are met.

Central to reporting is a project tracking and status tool used by everyone on the project. It is an integrated schedule, cost, and financial tool that captures detailed and summarized project data in a central repository. The tool combines source information from the schedule, cost management, and accounting systems.

The results of the monthly status assessment are captured in a monthly project report. Variance thresholds are defined for the project and can be used for performance analysis and reporting. Thresholds might change during the life of a project, depending on management needs of the project and agreement with the Federal Project Director (FPD), where applicable.

9 LSST Camera Project Cost Estimating

This section contains additional information on cost estimating for the LSST Camera project.

9.1 General Guidelines for Control Account Managers

Control Account Managers for the LSST Camera project are instructed by the Camera Project Manager (CPM) to use their best judgment to make realistic estimates of labor and materials. Historical data and recent multiple vendor quotations are the best methodology for obtaining defensible cost estimates.

Engineering judgment should be backed by real analysis of the given situation. Expert opinion combined with a step-by-step dissection of the processes and procedures required for a given work package should be developed where there is no other reliable costing guides. Estimates of labor and materials should cover the entire scope of work defined in the project WBS documented in configuration-controlled document LCA-125 [3] for the relevant cost account.

Technical readiness of the project is monitored through a formal review process documented in configuration controlled document LCA-98 [2], and estimates should ensure that this review process is included as part of the estimates.

9.2 Guidelines for the CPM and PMCS Lead

Following are the cost assumptions to be followed by the CPM and Project Management Cost and Schedule (PMCS) Lead:

- Labor rates and material rates have indirects applied in Cobra.
- Labor and material lab indirect rates are the official rates provided by each institution.
- The CPM or delegate shall review contingency.
- Labor rates are escalated by 3.5percent (burden percentage is fixed)
- Exception Brookhaven National Laboratory (BNL) escalation starts in FY17. Use CFO rates for FY15 and FY16 (already escalated).
    - M&S costs are escalated by 2.5percent (overhead percentage is fixed).

- FTEs are calculated assuming 1 FTE=1760 hours.

9.3 Guidelines for the Resource Loaded Schedule

For a comprehensive list of resource-loaded schedule guidelines to be followed by the CAM, see document LCA-10894 [4]. Following are some examples:

- Be organized consistent with project WBS.
- Include logical ties for all activities.
- Include all key milestones and deliverables.
- Include traceability between detail, integrated, and summary schedules.

9.4 Estimating Labor and Materials and Supplies

CAMs for the LSST Camera project are instructed by the CPM to make realistic estimates of labor and Materials and Services (M&S) for each task they are responsible for. For a comprehensive list of guidelines, see document LCA-10894 [4]. Following are some examples:

- M&S costs are to be supported by quotes or previous work and may not have any hidden contingency.
- M&S costs are NOT to include prevailing overheads.
- The base year for all cost estimates is FY14.
- Labor hours are to be supported by documented estimates without any hidden or embedded contingency.

9.5 Estimating Scientist Labor

The LSST Project is instructed to apply a different labor cost allocation for scientists working on LSST. Scientists are defined as persons that actively engage in research and whose institution evaluates the performance of that individual based upon his or her research activities. For a comprehensive list of guidelines for scientist labor, see document LCA-10894 [4]. Following are some examples:

- University scientists and scientists from laboratories or institutions are not charged to the project, with the exception of scientists who are not supported by base funding.
- Subsystem physicists who work with the engineering managers do not charge their effort to the project if they are supported by in-kind, or agency base funding.
- Contributed scientific labor consists of scientists, graduate students, or undergraduate students with salaries provided by in-kind university, laboratory, or agency base funding. This labor would be tagged in the Basis of Estimate (BOE) as “Contributed Labor.”

9.6 Estimating Overhead Labor or Program Support

There is labor that is provided by the laboratory through the overhead of that laboratory. The decision to include the effort that is supported by the overhead or program in the cost estimate is optional. The CAM may decide to include this if it is beneficial to manage his or her resources and activities. This cost might apply to safety, performance assurance, lab managers, procurement officers, or physicists.

9.7 Estimating Use of Facilities

Various facilities are used during execution of the project. The development of those facilities as well as general furniture items are not part of the cost as it is supported by the responsible institutions. Cost of the consumables as well as specific measurement and test equipment is included in the cost estimate. The facilities used are as follows:

- Integration and test (I&T) clean room: main clean room that is used for integration and test of the Camera located at SLAC in the Interaction Region 2 building.
- Sensor acceptance clean room: main clean room that is used to receive science sensors and guide sensors, conduct sensor acceptance testing and assembly, and test of the science raft towers. This clean room is located at BNL.
- Sensor characterization laboratory: facility located at Harvard University and used to conduct wavefront sensor characterization and guide sensor risk mitigation testing.

10 LSST Camera Project Schedule Development

This section contains additional information on schedule development for the LSST Camera project.

10.1 Milestone Levels

The LSST Camera project schedule specifies resource-loaded activities that are based on the CAMs input to the BOEs. The resource structure and assignments align with the collaborating laboratories and institutions.

The project schedule uses six levels of milestones. All milestones are under formal configuration-control at CD-2. The levels of milestones are:

- **Level 1.** Controlled by DOE HQ.
- **Level 2.** Controlled by DOE Stanford Site Office.
- **Level 3.** Controlled by LSST Project Director or Deputy Project Director.
- **Level 4.** Controlled by CAM.
- **Level 5.** Subsystem interfaces.
- **Level 6.** NSF interfaces.

10.2 Interface Milestones

To address the collaborative nature of the LSST Camera project, special emphasis is given to Level 5 (interface) milestones. The Level 5 milestones ensure visibility of interdependencies across Camera subsystems. The interdependencies are characterized as Need-Avail pairs. Each Need of a subsystem is matched to an Avail from another subsystem. The Need-Avail pairs are reconciled to ensure nothing is missed in the schedule.

Needs and Avails might be design specifications or physical deliverables; anything that represents an interface between two subsystems. The two subsystems might be associated with the same or different laboratories or institutions.

11 LSST Camera Project Contingency Analysis

This section contains information on contingency analysis used by LSST Camera project for project cost estimating and schedule development.

11.1 Contingency Factors

The BOE contains a list of all activities to be executed in order to deliver project deliverables. Each activity undergoes a risk assessment and is assigned a contingency factor.

The contingency factor to be applied to the cost values is generated by adding the following:

- **Technical risk factor.** This risk factor addresses the technical maturity of the component to be designed, manufactured, or procured. The risk factor is scaled by an additional technical risk weight based on whether the risk includes design, manufacturing, or both.
- **Cost risk factor.** This risk factor addresses the cost estimate maturity of the cost value for the component to be designed or procured. The risk factor is scaled by an additional technical risk weight based on whether the risk includes only material or labor or both.
- **Schedule risk factor.** This risk factor addresses the schedule sensitivity of the designed, manufactured or procured item and provides a mechanism to quantify schedule delays as a cost. The schedule risk weight is set to one (no additional weighting).
- **Source origination risk factor (also referred to as foreign procurement risk factor).** This risk factor addresses the source for the item and attempts to capture cost uncertainty due to foreign sources for design, manufacture, or procurement. It is primarily used for procurement activities, but it is also relevant to design and manufacturing of components executed at partner or subcontracted institutions. The source origination risk weight is set to one (no additional weighting).
- **Source availability risk factor (also referred to as the sole source risk factor).** This risk factor addresses the availability of various sources to perform the activity under assessment. While it also applies generally to procurement, it is also relevant to design and manufacturing of components executed at partner or subcontracted institutions requiring unique capabilities. The source availability risk weight is set to one (no additional weighting).

11.2 Contingency Factors Formula

The overall contingency factor is determined by the following formula:

Contingency Factor (%) = (Technical risk factor * Technical risk weight) +
(Cost risk factor * Cost risk weight) +
(Schedule risk factor * 1) +
(Source origination risk factor * 1) +
(Source availability risk factor * 1)

For factors and risk weights associated with risk types, see the contingency analysis document cited [5].

12 LSST Camera Control Subaccounts

To increase the accuracy of scheduling and cost estimating, the LSST Camera project has introduced the concept of control subaccounts. A CAM can resolve a control account into constituent subaccounts. The subaccounts correspond to different phases of work towards a deliverable; for example, engineering, prototype, procurement, fabrication, assembly, and test.

A CAM is able to open and close the subaccount as each phase starts and completes. Dividing work into phases enables CAMs to more easily track cost and earned value for deliverables and to isolate the cause of variances. CAMs can apply the information to estimating schedule and cost for similar deliverables in the future.

The control subaccounts are used internally and not reported outside of the LSST Camera project.

13 LSST Camera Project Earned Value Management

This section contains additional information on the monthly EVM status and reporting process used by the LSST Camera project.

13.1 Monthly EVM Procedure

The following procedure is used to collect and analyze project status on a monthly basis:

1) Each month, the PMCS scheduling team distributes a project schedule to CAMs highlighting the next three months work. The team also provides CAMs with a worksheet for providing status for the current month.
2) By the third business day of each month, CAMs submit schedule status for the prior month. CAMs provide percent complete on each activity. In addition, CAMs provide forecast start and finish dates for upcoming activities (to at least one month into the future).

   If duration of an activity is greater than three months, CAMs must provide documentation of the methodology to determine percent complete. The documentation must define the steps to complete the activity, provide a weighting of those steps, and provide the percent complete on each step. The documentation can be in incorporated into schedule status, or it can be provided as a separate spreadsheet or MSWord file.
3) The PMCS team enters CAM status into the scheduling tool. If necessary, the PMCS Lead and/or the CPM meet with CAMs for accuracy checking and to analyze any impacts to the schedule.
4) The PMCS team processes the final status information into EV data. If a control account exceeds a variance threshold, a CAM must do variance analysis for that control account and must establish a corrective action. Variance thresholds are described later in this section.
5) The CPM and Deputy CPM review and approve the variance analyses and corrective actions.
6) The CPM and Deputy CPM hold an EVM review meeting with the CAMs to discuss EV status, L3 milestones, trending, float, and variances.

13.2 Variance Thresholds

A CAM must do variance analysis for a control account if either of the following conditions is true:

- If any cumulative cost variance or schedule variance is +/- 10% AND greater than +/- $100K. Incremental variances are addressed as necessary within the cumulative variance.

Because of large dollar value and maturity of the procurements for L1-L2 and sensors, those items have augmented criteria for variance. For those items, variance analysis at the control account level is done if either of the following conditions is true:

- If any cumulative cost variance is +/- 10% AND greater than +/-$250K.