
Linac Coherent Light Source

Stanford Linear Accelerator Center

Stanford Synchrotron Radiation Laboratory

# LCLS
# Project Management Control System (PMCS) Description

Submission and Approvals

This Project Management Control System Description provides for the planning, budgeting, and authorization for an integrated cost, schedule, and technical baseline for managing the Linac Coherent Light Source.

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# Acronyms

| Abbreviation | Definition |
|---|---|
| ACWP | Actual Cost of Work Performed |
| ANL | Argonne National Laboratory |
| BAC | Budget at Completion |
| BCR | Baseline Change Request |
| BCWP | Budgeted Cost of Work Performed |
| BCWS | Budgeted Cost of Work Scheduled |
| BE | Budget Element |
| BNL | Brookhaven National Laboratory |
| CAM | Control Account Manager |
| CAP | Control Account Plan |
| CCB | Change Control Board |
| CM | Configuration Management |
| CPI | Cost Performance Index |
| CPR | Cost Performance Report |
| CSSR | Cost/Schedule Status Report |
| CV | Cost Variance |
| DOE | Department of Energy |
| EAC | Estimate At Completion |
| ETC | Estimate To Complete |
| EV | Earned Value (BCWP) |
| FTE | Full Time Equivalent |
| FTE_FY | Full Time Equivalent per Fiscal Year |
| LLNL | Lawrence Livermore National Laboratory |
| LOE | Level of Effort |
| LRE | Latest Revised Estimate (EAC) |
| LANL | Los Alamos National Lab |
| M&S | Materials & Services |
| MS | Milestone |
| OBGL | Obligation |
| OBS | Organizational Breakdown Structure |
| PMB | Performance Measurement Baseline |
| PMCS | Project Management Control System |
| PMT | Performance Measurement Techniques |
| RAM | Responsibility Assignment Matrix |
| SLAC | Stanford Linear Accelerator Center |
| SM | System Manager |
| SPI | Schedule Performance Index |
| SV | Schedule Variance |
| UCLA | University of California at Los Angeles |
| VAR | Variance Analysis Report |
| WBS | Work Breakdown Structure |
| WP | Work Package |

COST PERFORMANCE ANALYSIS

| | |
|---|---|
| Cost Variance | CV = BCWP - ACWP |
| Cost Variance in Percent | CV% = CV / BCWP |
| Schedule Variance | SV = BCWP - BCWS |
| Schedule Variance in Percent | SV% = SV / BCWS |
| Cost Performance Index | CPI = BCWP / ACWP |
| Schedule Performance Index | SPI = BCWP / BCWS |
| Estimate at Completion | EAC = Cumulative FY ACWP + Remaining BCWS |

## Exhibit List

# SECTION 1.0

## 1.0 INTRODUCTION

The Linac Coherent Light Source (LCLS) will be the world's first x-ray free electron laser when it becomes operational in 2009. LCLS is currently in the detailed project engineering and design phase, with a construction start planned in Fiscal Year 2005. Pulses of x-ray laser light from LCLS will be many orders of magnitude brighter and several orders of magnitude shorter than what can be produced by any other x-ray source available now or in the near future. These characteristics will enable frontier new science in areas that include discovering and probing new states of matter, understanding and following chemical reactions and biological processes in real time, imaging chemical and structural properties of materials on the nanoscale, and imaging non-crystalline biological materials at atomic resolution. The LCLS project is funded by the U.S. DOE and is a collaboration of several national laboratories and universities.

This document outlines the processes and procedures utilized by the LCLS Project to assist in the management of the LCLS. The Project Management Control System (PMCS) provides the information for effective management of the LCLS Project through the establishment of guidance and reporting requirements and the development and implementation of operating procedures for the PMCS.

The Project Management Control System satisfies the management needs of the LCLS Project, while complying with these government and project directives.

- DOE Order 413.3, Program and Project Management for the Acquisition of Capital Assets
- DOE Manual 413.3-1, Project Management for the Acquisition of Capital Assets
- American National Standards Institute (ANSI) / Electronic Industries Alliance (EIA) Standard 748 – Earned Value Management Systems
- LCLS Project Management Plan

The Project Management Control System provides for the integration of formal management control systems and processes - cost estimating, work scope structuring and authorization, scheduling, performance measurement, reporting,

funds management and baseline configuration control - using the Work Breakdown Structure and the Organizational Breakdown Structure.

The processes outlined in the Project Management Control System provide for the planning, budgeting, and authorizing of an integrated cost, schedule and technical baseline, which facilitates timely comparisons of actual versus planned performance in relation to these project baselines.

This system description groups these management processes into three topics.

- Section 2.0 -- The Development of the Baseline (Cost Estimating, Work Scope Structuring and Authorization, Scheduling, and Performance Measurement Baseline)
- Section 3.0 -- Project Execution and Reporting (Status Reporting and Data Collection, Performance Analysis and Forecasting, Generating Management Reports, Accounting Management, Risk Management, and Funds Management)
- Section 4.0 -- Baseline Maintenance (Baseline Configuration Control)

The basic objectives of the Project Management Control System are:

- Establish and maintain an integrated cost, schedule and technical baseline within the framework of the LCLS Project requirements;
- Provide for the orderly and systematic authorization of work, and project budget for the LCLS Project;
- Develop and publish timely management reports which compare actual cost, funding and schedule status to baseline plans;
- Compare actual costs, forecasted costs, and schedule status against the performance measurement baseline to determine the current and forecasted future performance;
- Maintain a clear documented audit trail of all changes to the Performance Measurement Baseline through the Work Breakdown Structure; and,
- Identify potential problem areas in sufficient time to implement the proper management actions

## 1.1 Organization, Roles, and Responsibilities

### 1.1.1 LCLS Collaboration

The LCLS Collaboration includes Livermore, Argonne, Los Alamos, Brookhaven National Laboratories, as well as scientists from Stanford Linear Accelerator Center (SLAC), which is a DOE federally-funded R&D facility at Stanford University, and University of California, Los Angeles (UCLA). SLAC is operated by Stanford University under contract DE-AC03-76SF00515 with the U.S. Department of Energy. Activities at SLAC on the LCLS Project are authorized under DOE Project Number KA050102-EQU01CC. The members of the LCLS Collaboration receive their funding from their respective funding agencies, including DOE.

### 1.1.2 LCLS Management

The LCLS Project Management Plan (PMP) describes the management organization, processes and plans for this project. The principal elements of the organization and their roles and responsibilities are described in the PMP. The relationships between the multiple government and university based technical organizations are also discussed in this document. The PMP should be referred to for this information. Throughout this System Description the PMP is referenced when appropriate for convenience.

### 1.1.3 Project Director

The Project Director is responsible for all scientific, technical, organizational and financial affairs of the collaboration and is the ultimate authority within the LCLS team for all decisions concerning the project. The Project Director is responsible for the overall development and delivery of the LCLS, the quality of the scientific investigation, and the dissemination of results; timely delivery of required documentation, software, and data within budget limitations; and the final performance and calibration of the LCLS. The Project Director is also the Spokesperson for the Collaboration.

### 1.1.4 Chief Engineer

Decision-making authority flows from the Project Director to the Chief Engineer by delegation of all day-to-day decision-making and authority with regard to management of technical, cost, and schedule issues. The Chief Engineer manages the engineering development and delivery of the LCLS, and ensures compliance to cost, schedule, and technical performance. The Chief Engineer reports to the Project Director.

### 1.1.5 System Managers

The system managers are responsible for all aspects of development of their respective areas and supporting Systems. The system managers direct and manage the efforts of the system team members. Specific roles of individual system managers are described in the PMP. The System Managers report to the Chief Engineer.

System Managers are referred to as Control Account Managers throughout this document. They are the managers in the LCLS organization who are responsible for the planning, control, and accomplishment of the work scope, and for the scheduling and time phasing of the budget associated with one or more assigned Work Breakdown Structure elements (known as Control Accounts). If necessary, system managers may designate lower level managers as control account managers.

Control Account Managers are involved in all aspects of the Performance Measurement Control System. In fact they are the crucial element of the system. Throughout this document, the roles and responsibilities of the Control Account Manager are delineated. Without their actions and cooperation, the LCLS Performance Measurement Control System would not function appropriately.

### 1.1.6 Project Control Manager (PCM)

The PCM establishes and maintains the integrated Project Management Control System (PMCS) (which incorporates the baseline budget and schedule, and captures and records actual data for cost and schedule performance measurement), and reports cost/ schedule status to the LCLS management and supporting team members. The PCM is responsible for supporting the work of the system development teams through the tracking and reporting of cost and schedule performance, and managing the configuration control of all cost and schedule baselines for the project. The PCM is also the primary financial interface in the Project Office (IPO) for all team members. The System Managers are responsible for reporting cost and schedule data to the PCM. The PCM reports to the Chief Engineer.

The PCM is the leader of the Cost and Schedule Group within the Project Office. The Cost and Schedule Group is the Project Director's designated focal point for the integration of the schedule and cost baselines with the technical baseline. The Cost and Schedule Group is responsible for the design, implementation and documentation of the Project Management Control System. This includes providing the operating procedures contained within various sections of the system description, including guidance, training, and direction for the implementation of the Project Management Control System within the LCLS Organization, as required.

The Cost and Schedule Group compiles the Monthly Cost/ Schedule Performance Report. To generate the statistical data for this report and others, the Cost and Schedule Group establishes and maintains the Integrated Project Schedule and Cost Databases with information provided by the LCLS Organization.

The Cost and Schedule Group establishes, maintains and publishes a monthly reporting schedule that includes all activities relative to the cost and schedule baselines. Specific responsibilities of the Cost and Schedule Group include the following:

1) Advise the Project Director, Chief Engineer and the System Managers on critical areas and progress toward milestones;
2) Provide cost and schedule support to the Configuration Control Board;
3) Support the development of the fiscal year funds allocations;
4) Analyze cost and schedule variances from the baseline plan;
5) Develop solutions to problems causing cost and schedule variances;
6) Coordinate project wide Estimate at Completion studies;
7) Maintain the Work Breakdown Structure, the Work Breakdown Structure Dictionary and the Responsibility Assignment Matrix;
8) Provide support for the cost and schedule computer system and databases; and,
9) Interface with the participating institutions on matters related to fiscal year funds allocations and expenditures, collection and reporting of actual costs.

## 1.2 Executive Overview

The three major management processes are integrated to provide a continuous process that formally maintains the Project's cost, schedule and technical baselines, while providing for the development and generation of timely performance measurement data and reports. The performance measurement data and the corresponding reports provide management with the necessary visibility to track progress and identify the most significant problems and issues in order to establish and implement corrective action.

An integrated flow chart of the Project Management Control System depicting the roles and responsibilities of the LCLS Project Organization is displayed in Exhibit 1–A.

### 1.2.1 Baseline Development Process

The baseline for the LCLS Project is provided in a series of documents that define the project scope and schedule, establish the baseline cost estimate, and contains the overall plan for completing the Project. The plans for accomplishing the Project, including major Project milestones, are specified in the Project Management Plan.

The Performance Measurement Baseline development process integrates the cost, schedule and technical baselines to ensure that defined Project objectives are achieved. Hence, the Performance Measurement Baseline is the **ONLY** baseline against which all cost, schedule and technical progress is measured. Additionally, the Performance Measurement Baseline is used to develop reports for LCLS Project Organization.

#### 1.2.1.1 Cost Estimating

The Cost and Schedule Group of the LCLS Project Organization is responsible for maintaining a project cost estimate. By incorporating all approved Configuration Management Plan actions and thus maintains a continuous cost estimate audit record, which contains a level of detail consistent with DOE orders, from the inception of the Project to its conclusion.

#### 1.2.1.2 Work Scope Structuring and Authorization

The Work Scope Structuring process provides the framework against which all contract effort for the LCLS Project is planned, authorized, scheduled, budgeted, measured and reported for performance measurement purposes.

The Work Breakdown Structure is used to organize and subdivide the Project effort into manageable work elements. This dictionary provides a synopsis of the technical work and associated cost for each Work Breakdown Structure element. The Work Breakdown Structure and the Organizational Breakdown Structure are integrated to establish a Responsibility Assignment Matrix, which is used to identify Control Accounts.

The objective of the Responsibility Assignment Matrix is to assure that each Control Account is assigned to one organizational entity that is responsible for the management of the work. The cost accumulation structure, associated charge numbers, and Control Accounts are employed to plan all Project activities and subsequently to collect the actual costs incurred for all Project effort.

The Work Authorization process ensures that all defined Project work is planned; and the portion of the work that is funded is authorized by the Project

Director and communicated to the Chief Engineer. The work authorization agreement from the Project Director and Chief Engineer to the responsible System Managers consists of the statement of work, budget, and funding amounts. Charge Numbers are issued to provide employees of each institution involved in the LCLS Project with the authority to perform work on specific activities.

#### 1.2.1.3 Scheduling

The Scheduling process ensures that the Project schedules are integrated with the Project's cost estimate and authorized budgets. The Integrated Project Schedule contains all Project requirements and constraints, which affect the cost, schedule and technical baselines on the Project. This schedule incorporates the Major Project Milestones, key decision points, logic relationships, and interdependencies into an integrated hierarchy of networks that establish and maintain vertical and horizontal relationships between and among designated Systems and detail schedules. The Integrated Project Schedule is a logic network that is integrated to display all constraints and interface points, as well as the critical path for the Project.

#### 1.2.1.4 Performance Measurement Baseline

The Performance Measurement Baseline process ensures that the cost, schedule and technical parameters of the Project are integrated into a single Performance Measurement Baseline, to enable timely and valid performance data and reports to be generated throughout the lifetime of the Project. The Performance Measurement Baseline is hierarchical in nature; the baseline exists within each of the Systems and Control Accounts as well as at the total Project level.

The Project Office is responsible for administering formal configuration control procedures to maintain the integrity of the Performance Measurement Baseline. Control Account and work package planning guidance and procedures exist to assure that this integrity is maintained at the performing level, as well.

The process further helps to assure that the total cost does not exceed the approved Project Budget Baseline. The Performance Measurement Baseline is one of the data elements used to ensure that the near-term budget expenditure profile, plus planned commitments and termination liability, conforms to the authorized funding profile.

### 1.2.2 Project Execution and Reporting

Once the Project has integrated the cost, schedule and technical baselines to form the Performance Measurement Baseline, the Project Execution and Reporting aspects of the Project are initiated.

As the Project progresses, status is reported against the baseline plans developed during the Baseline Development Phase. Accounting data is gathered, work performance is assessed, internal and external reports are provided to project management, forecasts of future performance are made and corrective action plans are developed to arrest or minimize potential cost and schedule problems.

Actual costs and estimates to complete are continually monitored by the Project Office to ensure that expenditures plus commitments do not exceed the annual authorized spending levels.

These performance measurement and funding processes are supported by the financial accounting systems of SLAC, LLNL, and ANL that serve the Project. The financial accounting system provides monthly and ad hoc reports that portray the LCLS Project costs.

#### 1.2.2.1 Status Reporting and Data Collection

The Status Reporting and Data Collection process provides a formal and systematic mechanism to develop a monthly status for the LCLS Project. This process is used to develop management performance reports for the review and, analysis by project management and the development of corrective action plans. A cornerstone to this Project status is the Control Account detail schedules, which are updated and combined within the Integrated Project Schedule.

The progress reported on the various integrated schedules is the basis for determining earned value for all Project effort on a monthly basis. The earned value (performance), when compared to the associated Budget and the corresponding actual costs for each Control Account, Work Breakdown Structure element, and the Organizational Breakdown Structure, provides insights that enable System Managers and the Project Office to focus resources to rectify and/ or mitigate cost and schedule problems.

Performance reports are used in conjunction with other Project reports to assess future performance and assess progress towards meeting technical, cost and schedule objectives for the Project. System Managers develop an Estimate to Complete for all Project work during formal Estimate at Completion reviews requested by the Project Office.

#### 1.2.2.2 Performance Analysis and Forecasting

The Performance Analysis and Forecasting process provides for a consistent and objective means to analyze the work accomplished on the LCLS Project. The analysis forms the basis for the development of forecasts of future performance and the supporting rationale for Estimate to Complete studies.

The Project has established variance analysis criteria to identify potential cost and schedule problems and to facilitate the concentration of resources on the most significant problems. The System Managers are the focal point for coordinating the corrective action process.

#### 1.2.2.3 Generating Management Reports

The management reporting process extracts the performance data and analysis from the Status Assessment and Data Collection and the Performance Analysis and Forecasting processes to generate a series of internal and external reports for use by the System Managers and the Project Office. These reports are published on a monthly, quarterly, and ad hoc basis in support of the various objectives for the Project.

The internal reports consist of performance data developed by the Project Management Control System, manpower and cost reports generated by the financial accounting system and ad hoc reports to meet intermittent requirements. The monthly reports submitted to DOE include the Cost/ Schedule Status Report (C/ SSR), Progress Report and Schedule Reports.

#### 1.2.2.4 Accounting Management

The Accounting Management process provides for timely and accurate collection of all costs associated with the LCLS Project. The costs are accumulated and reported at the Work Breakdown Structure and the Organizational Breakdown Structure levels.

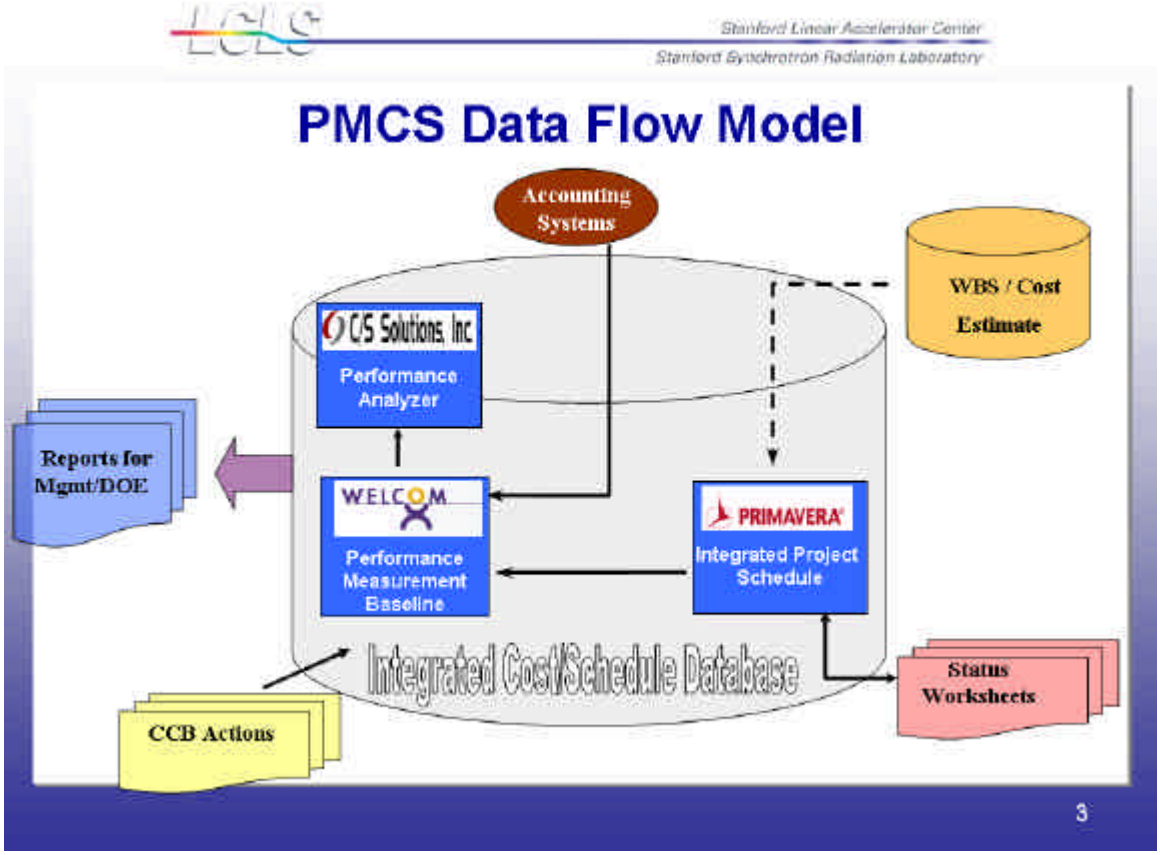
The Code of Accounts Structure is a uniform coding scheme that enables costs to be identified to charge numbers for summarization to higher levels for reporting purposes. Charge numbers are linked to the Code of Accounts Structure to collect costs by element of cost. The system does not allow for retroactive adjustments to accounting data, except to correct errors or allowed accounting adjustments.

### 1.2.3 Performance Measurement Baseline Maintenance

As the LCLS Project progresses, there are events and conditions that necessitate changes be made to the cost, schedule and technical baseline(s). The Performance Measurement Baseline Maintenance process, which operates subordinate to the Project Configuration Control Plan, is used to coordinate the configuration change requests for the purpose of making adjustments to the budgets, work scope and Project Milestones. The Performance Measurement Baseline Maintenance process ensures all changes and the associated impacts to cost and schedule data are reflected in a timely manner.

The LCLS Project maintains the cost, schedule and technical baselines throughout the lifetime of the Project. As the Project progresses it is necessary to make modifications to these baselines in order to achieve overall Project objectives. The LCLS Configuration Management Plan provides the details and approval process for making revisions. Cost, schedule, and technical reserves are under the control of the Project Director as defined in the LCLS Project Management Plan.

# Exhibit 1-A
# PMCS Overview Flow Chart



# SECTION 2.0

## 2.0 Baseline Development Process

The baseline development process is initiated at the beginning of the project and involves the development of three major baseline documents:

1) The LCLS Detailed Cost Estimate;
2) The DOE Order 413.3 and DOE Manual 413.3-1 and supplementary documentation; and,
3) The Integrated Project Schedule reflects the schedule baseline for the program.

The **Work Scope Structuring Process** generates several planning documents to facilitate the management of the project. All project plans are developed in conformance with the DOE Order 413.3 and DOE Manual 413.3-1 DOE Order 413.3 (subsequently referred to in this document as the LCLS Proposal) and supplementary documentation, the Work Breakdown Structure, and the Organizational Breakdown Structure.

The Control Account and Work Package are the primary point of control where budgets are assigned and planned, performance measurement is assessed, costs are collected, and forecasts of future performance are made. The Work Breakdown Structure Dictionary is developed to define the project work. A Cost Accumulation Structure and corresponding charge numbers are used to ensure that all costs are collected against the proper Work Breakdown Structure by the appropriate element of cost.

The **Scheduling Process** integrates the Cost Estimating and Work Scope Structuring processes to enable the entire project work scope effort to be planned, scheduled and controlled throughout the lifetime of the project.

The Integrated Project Schedule consists of the LCLS Project detail schedules merged into one logic network utilizing interface milestones to provide horizontal linkage. It is the data source for summary schedule reports. Control

Account/ work package budgets are developed by element of cost for project work and are integrated with the project schedules.

Project effort is issued through a formal **Work Planning and Authorization Process.** The Project Director authorizes the work to the applicable responsible System Manager.

The **Performance Measurement Baseline Process** provides the basis for evaluating the work accomplished and for developing cost and schedule performance reports for the project's management.

Throughout this system description the phrases schedule processor and cost processor are used. Unless a change in project tools is made, the schedule processor refers to Primavera Project Planner (P3), and the cost processor refers to Cobra.

## 2.1 COST ESTIMATING

### 2.1.1 Introduction

The cost estimating process is used when necessary throughout the duration of the LCLS Project. The cost estimating process supports the following objectives:

- Ensure that all cost estimates can be summarized to the Work Breakdown Structure and the Organizational Breakdown Structure;
- Support the development of the project's Performance Measurement Baseline by providing LCLS Detailed Cost Estimate–information to the Project Director for issuance of budgets to the System Manager level;
- Support the operation of the Configuration Management Plan by validating and/ or preparing estimates of cost impact(s) associated with proposed changes in work scope and subsequently updates the cost estimate, at the lowest level of detail, to reflect approved Configuration Management Plan actions;
- Support the preparation of estimates, as applicable, in accordance with Project phases, maintaining a distinction between Total Estimated Cost and Total Project Cost; and,
- Support the capability to accommodate Project Estimates to Complete and Estimates at Completion.

### 2.1.2 LCLS Detailed Cost Estimate

The LCLS Detailed Cost Estimate originated with a Department of Energy request to define the Project scope, establish the baseline estimate of cost and

schedule for the LCLS Project, and develop a plan for completing the project. The LCLS collaboration produced a comprehensive and detailed cost estimate for the development and equipment fabrication. The Project Execution Plan (PEP) defined the guidelines and methodology that will be used during the entire cost estimating process.

#### 2.1.2.1 Objective

A primary objective of the Cost Estimate was to develop a comprehensive bottom up estimate of the total LCLS Project cost. These included costs for the engineering, design, analysis, procurement, fabrication, assembly, and management of the project itself. Project costs were accumulated starting from the beginning of the project, defined to be from FY 2002 to FY 2008.

#### 2.1.2.2 Basis

The basis for the LCLS Detailed Cost Estimate was a detailed bottom-up estimate for each System. These estimates were based on FY 2004 dollars. The Cost and Schedule Group applied escalation factors. Cost estimates were developed based on the Project Work Breakdown Structure.

The Work Breakdown Structure delineates all Systems and divides each of those Systems into multiple lower levels. Cost items define the Labor, Material and Supplies (M&S), and Travel required for each of the fourth level Work Breakdown Structure elements.

In addition to developing detailed cost items, each System Manager developed their Cost Estimate Basis, which contained supporting information to substantiate each cost data item. This information was used during both internal and external reviews of the System costs. The System Managers have kept the documentation for the basis of the LCLS Detailed Cost Estimate.

#### 2.1.2.3 Costing Methodology

There were two ways in which the LCLS Detailed Cost Estimate was compiled for developing the baseline. Initially, a Microsoft Project and Microsoft Excel databases were use to collect information in some cases. The other means was to use the schedule processor. During the work package planning phase, the cost detail for each system was compiled into the schedule processor for preparation of all System cost reports.

#### 2.1.2.4 Risk Analysis Contingency

The LCLS Project will have some uncertainty and cost risk. Estimates were made prior to final design and include projections of expected development and engineering tasks. Thus, a "contingency estimate" was generated to account for these uncertainties. A risk estimate was created using the bottoms up approach. This method was based on the evaluation of technical, cost and schedule risk for each Work Breakdown Structure element.

### 2.1.3 Maintenance of the LCLS Detailed Cost Estimate

Maintenance of the cost estimate is a continual process. As the Project design matures and technical revisions are processed in accordance with the Project Execution Plan traceability to the initial cost assumptions associated with the conceptual design estimate are maintained.

The LCLS Detailed Cost Estimate is the basis for the Performance Measurement Baseline, which in turn is the basis for funds requests and budget authority to execute the Project's work scope.

The Estimate at Completion for the various Control Accounts/ Work packages in the Project Management Control System is then the official cost estimate for the LCLS Project. Therefore, the Estimate at Completion is maintained in sufficient detail to provide confidence in the estimate's value to plan funding requests and also to facilitate the calculation of Control Account resources and to schedule activity durations.

The maintenance process begins with the Cost and Schedule Group's participation in the preparation and/ or evaluation of proposed Baseline Change Request actions that affect the Performance Measurement Baseline as well as the Estimate at Completion.

This review insures that the estimate is at the level comparable to the LCLS Detailed Cost Estimate; e.g., material quantities, craft hours, rates, etc. The Cost and Schedule Group also reviews the proposed revisions to the Work Breakdown Structure Dictionary to ensure that these changes are consistent with the proposed cost revision.

### 2.1.4 Preparation of Cost Estimates

The techniques used for preparing cost estimates vary based on the phase of the project acquisition, extent of the project definition, complexity of the work element being estimated, availability of prior performance data, and the level-of the Work Breakdown Structure element being estimated. These conditions will determine which estimating technique or combinations of techniques are used to

estimate the cost of a particular item, activity or Work Breakdown Structure element.

## 2.2 Work Scope Structuring and Authorization

### 2.2.1 Introduction

Work scope structuring provides the framework from which effort for the LCLS Project is planned, scheduled, budgeted, authorized, measured and reported. The guidance provided in this section establishes a formalized process for subdividing project work into manageable segments, assigning responsibility for the accomplishment of the work, and for providing adequate descriptions of all project effort provide effective management of the LCLS Project.

The work scope structuring process encompasses the following activities:

- Development of the Work Breakdown Structure;
- Creation of the Work Breakdown Structure Dictionary;
- Generation of the Responsibility Assignment Matrix;
- Development of a Code of Accounts Structure; and,
- Authorization of charge numbers.

The LCLS Project Organization is responsible for accomplishing activities associated with the work scope structuring process. The LCLS Organization structure is shown in Figure 2-A.

The LCLS Proposal forms the initial LCLS Project technical baseline. Subsequently, the technical baseline consists of the approved documentation used to define the physical and functional requirements of the system and Systems, including specifications, interface control documents and drawing packages.

The Work Breakdown Structure Dictionary is the document that summarizes all of the technical requirements and activities contained in each Work Breakdown Structure element. It is the responsibility of each Control Account Manager to maintain the technical baseline through the Project Execution Plan process.

### 2.2.2 Work Breakdown Structure (WBS)

The Work Breakdown Structure segregates the work scope requirements of the project into definable product elements and related services and data. It is a direct representation of the work scope defined in the statement of work and

breaks that work scope into appropriate elements for cost accounting and work authorization. The Work Breakdown Structure is a multi-level hierarchical breakdown that shows how project costs are summarized from the lower elements to the total project level. Exhibit 2-A is the LCLS Summary Level Work Breakdown Structure.

The Work Breakdown Structure for the LCLS Project was developed to its terminal elements. This development process utilized the following Work Breakdown Structure characteristics as guidance:

- Define a framework for identifying work objectives separate from performing organization objectives;
- Assist in the preparation of clear, concise and complete statements of work for subsequent inclusion in the Work Breakdown Structure Dictionary;
- Focus attention on work objectives;
- Define categories for estimating work in a formal and consistent manner; and,
- Provide traceable summations of the statement of work, technical requirements, cost and schedule data

The LCLS Work Breakdown Structure provides the following:

- Provides the framework for: organizing, planning, budgeting, collecting status, reporting, analyzing and maintaining the cost baseline, throughout the lifetime of the project;
- Contains all authorized work. This is defined to be all of the work as defined in the approved financial plans;
- Establishes the terminal Work Breakdown Structure elements by extending the structure to the appropriate level based on: (1) Where the element is managed; (2) Its criticality to the overall project; and (3) The visibility needed for effective management and control; and,
- Structured and numbered in a hierarchical manner, such that direct costs summarize from the Control Account level through the Work Breakdown Structure to the total project level without allocation of lower level Work Breakdown Structure elements to two or more higher level Work Breakdown Structure elements.

Revisions to the Work Breakdown Structure are approved through the Configuration Management Plan process prior to implementation. This includes revisions through the terminal level of the Work Breakdown Structure.

### 2.2.3 Work Breakdown Structure Dictionary

The Work Breakdown Structure Dictionary is prepared by providing a brief description of the products or output of work to be produced. The dictionary lists and defines each terminal level Work Breakdown Structure element established by LCLS Project management. Exhibit 2-A is an extract from the LCLS Work Breakdown Structure Dictionary.

The Work Breakdown Structure Dictionary is one of several documents that may be used to evaluate proposed changes to the cost, schedule and technical baseline. Therefore, changes affecting the Work Breakdown Structure are accompanied by a revised Work Breakdown Structure Dictionary definition. Additionally, all changes to the Work Breakdown Structure Dictionary, irrespective of whether the Work Breakdown Structure is affected or not, require approval as required by the Configuration Management Plan process.

### 2.2.4 Responsibility Assignment Matrix (RAM)

The Responsibility Assignment Matrix is developed from the Work Breakdown Structure and the LCLS Project organization that has been established. Exhibit 2-C is an extract from the LCLS Project Responsibility Assignment Matrix.

The Responsibility Assignment Matrix is maintained as a tabular display of the intersection of the Work Breakdown Structure element and the individual that is responsible for managing the cost, schedule and technical objectives of the Control Account.

The Responsibility Assignment Matrix includes the following information:

- The Work Breakdown Structure element identifier;
- The organization identifier; and,
- The Control Account Manager assigned.

The Responsibility Assignment Matrix may evolve and change throughout the life of the project; e.g., new or revised Control Account(s) due to Configuration Management Plan actions, reassignment of personnel, etc. Revisions to Control Account Manager assignments on the Responsibility Assignment Matrix are subject to approval and concurrence by LCLS Project management. Revisions to budgets at the Control Account level (work breakdown structure identifier and organizational identifier) are subject to the Configuration Management Plan process.

The primary objective of the Responsibility Assignment Matrix is to assure that each Control Account is assigned to a LCLS System Manager directly

responsible for the management of the work. The Control Account is the principle internal management control point at which project performance is measured; e.g., earned value is compared to both budget and actual costs.

### 2.2.5 Control Accounts

Control Accounts are established based on evaluation of the following factors:

- Type and magnitude of resources required;
- Amount of the Control Account budget;
- Duration of the Control Account work scope;
- Technical complexity of the work scope; and,
- Degree of risk associated with the work scope.

Based on these factors, the budget value and period of performance for Control Accounts will vary substantially. However, Control Account budget values should be greater than $100K and less than $20M with a period of performance greater than twelve (12) months.

Once the Control Accounts are designated, each Control Account is assigned to a responsible Control Account Manager who is responsible for the planning, control and accomplishment of the work scope, and for the scheduling and time phasing of the budget associated with that Control Account. Control Account Manager's duties include:

- Plan labor and non-labor resource budgets and schedules;
- Manage technical performance groups who accomplish work;
- Control labor and non-labor resources using the Project Management Control System;
- Evaluate Control Account performance and perform variance analysis, as required;
- Develop and execute immediate corrective actions when required;
- Provide forecasts of future cost and schedule trends

The Cost and Schedule Group assists with all of the above duties.

### 2.2.6 Cost Accumulation Structure/ Charge Numbers

The Cost Accumulation Structure used by the LCLS Project is displayed in Exhibit 2-D. The Cost Accumulation Structure consists of the following components:

- The Work Breakdown Structure element number;

- The code of the organization responsible for performing the work (two characters);
- Work Package Number;
- The budget element used by the accounting system to differentiate the type of cost, i.e., Labor, Shop Services, Material and Services and Travel, and
- The Cost Type (two characters) – either an actual cost or a commitment.

The designated Control Account Manager is responsible, via the work planning and authorization process, for opening and closing the charge numbers, as required. The Project Control Manager assists in this process within the SLAC PMCS.

### 2.2.7 Work Planning and Authorization

#### 2.2.7.1 Work Planning and Authorization Objective

The objective of work planning and authorization is to ensure that all defined project work is authorized by the Project Office and communicated to the appropriate responsible System Manager. This process allows the responsible System Manager/ Control Account Manager to plan and schedule the entire work scope; while the authorization to perform work is limited to the cumulative fiscal funding allocated through the current fiscal year.

The Work Authorization Agreement form is used to document this process. The Cost and Schedule Group maintain an audit trail of all Work Authorization Agreements from the beginning of the project to its completion. This process precludes work to begin without the appropriate plans and prior approval(s).

The work planning and authorization process involves management approval of the expenditure of project resources to accomplish a specified scope of work within an agreed to budget, schedule and technical objectives. This process is utilized throughout the life of the project. Work may not begin without an approved Work Authorization Agreement. Additionally, revised work scope, budget, or schedule may not be implemented without an approved Configuration Change Request that has resulted from the Configuration Management Plan process.

The work planning and authorization process assures that work assigned together with associated time-phased cost estimates and work schedules are all integrated with each other and are related to the Work Breakdown Structure within the funding limitations on the Project. Formal work planning and authorization provides a means for effective internal coordination, communication and a process to obtain the required management approvals.

Work planning and authorization establishes the initial work scope baseline (Statement of Work, baseline schedule and Performance Measurement Baseline budget). Changes to these parameters are only approved and implemented through the Configuration Management Plan process.

Changes to authorized or planned work are specifically identified through the organizing, defining and planning processes. Changes are coordinated and communicated; management approvals are obtained; and specific direction is issued to the responsible organization to initiate work on the change through the use of the work planning and authorization process.

#### 2.2.7.2 Guidance / Requirements

There are two levels of work authorization within the LCLS Project:

(1) Project Office to System Manager Work Authorization Agreements; and,

(2) Charge Numbers at the Control Account.

Although similar in nature, each type of work authorization has unique features. The Project Director authorizes the responsible System Manager (Control Account Manager) at the third level of the Work Breakdown Structure. Subsequently, each System Manager has a charge number assigned to each Control Account prior to starting work.

The Cost and Schedule Group is responsible for preparing the Work Authorization Agreement (Exhibit 2-E, Work Authorization Agreement Form), for all the System Managers at the appropriate third level Work Breakdown Structure elements. The sum of the budgets for all of the Work Authorization Agreements must equal the Performance Measurement Baseline.

The Work Authorization Agreements issued by the Project Office limit the expenditure of resources to funds available through the current fiscal year. Therefore, as a minimum, these agreements must be revised annually prior to the beginning of the fiscal year.

#### 2.2.7.3 Work Authorization Agreement

The Project Office's Work Planning and Authorization Agreements will normally include the following information:

- Work Breakdown Structure element identifier;
- Activity identification or description;
- Originating organization;

- Receiving organization;
- Budget;
- Period of performance;
- Revision history; and,
- Fiscal year funds authorization, including fund source, and type.

The following information may be included by reference:

- Statement of work;
- Quality Assurance Requirements;
- Configuration Control Requirements; and,
- List of milestones affected by or limiting this work planning.

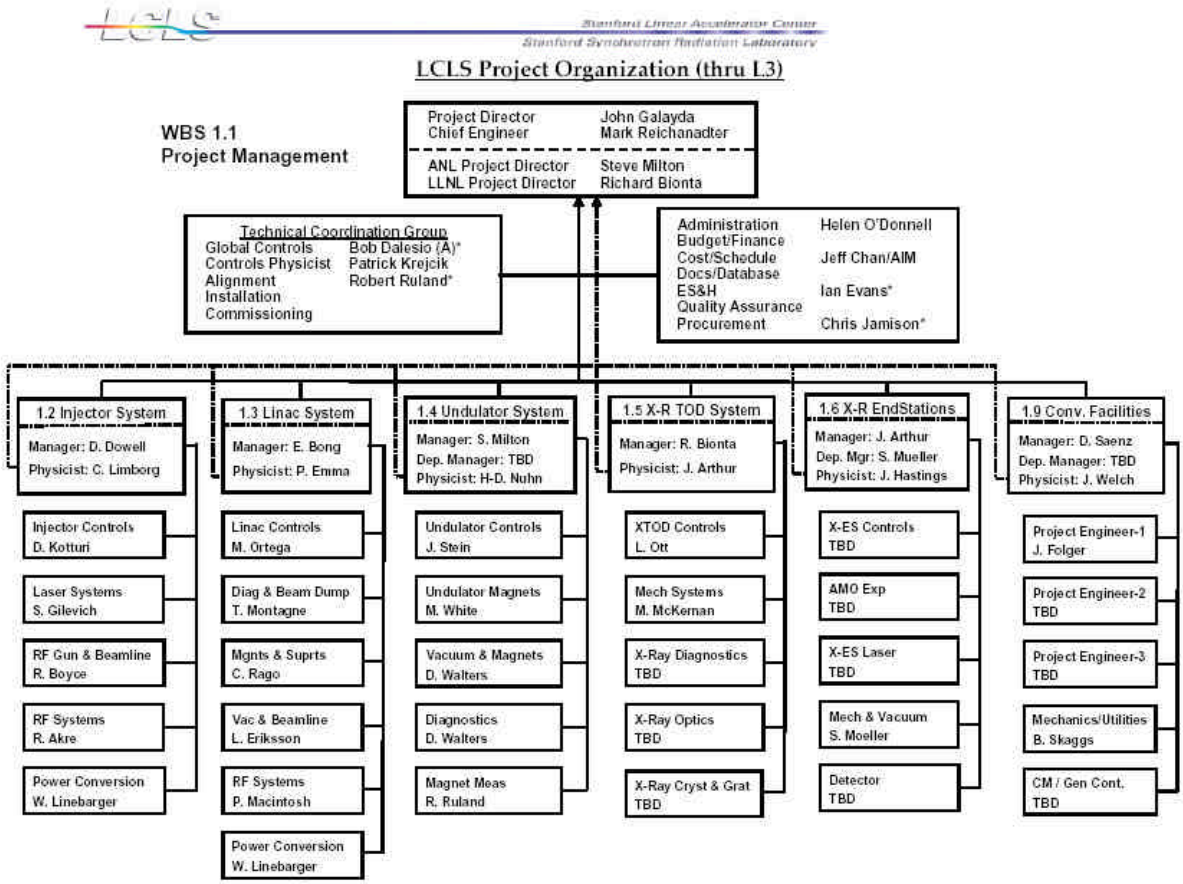
2.2.7.4 Work Authorization Approvals

The Work Authorization Agreements are prepared by the Cost and Schedule Group and forwarded to the appropriate System Manager for review. Once both have agreed to the contents of the Work Authorization Agreement, the Project Director and the System Manager sign it.

2.2.7.5 Control Account Charge Numbers

Once the appropriate control account planning has been completed, the Cost and Schedule Group assigns the work package number and budget element codes. Participating institutions work package numbers are coordinated with each respectively. This information is then given to the accounting department that then opens the charge number.

# EXHIBIT 2-A
# LCLS ORGANIZATION CHART



# EXHIBIT 2-B,C
# LCLS SUMMARY LEVEL WORK BREAKDOWN STRUCTURE/RAM
# (WBS Level 3 and Dictionary)

| WBS Level | | | Description | Responsible Person |
|---|---|---|---|---|
| 1 | 2 | 3 | | |
| | | | LINAC COHERENT LIGHT SOURCE (TPC) | |
| 1 | | | LCLS PROJECT - PED & CONSTRUCTION | |
| 1 | 01 | | LCLS PROJECT MGMT, PLANNING & ADMN (TEC) | M. Reichanadter |
| 1 | 01 | 01 | Environment, Safety & Health | M. Reichanadter |
| 1 | 01 | 02 | Project Management | M. Reichanadter |
| 1 | 01 | 03 | Technical Integration | M. Reichanadter |
| 1 | 01 | 04 | Education Support | M. Reichanadter |
| 1 | 02 | | INJECTOR SYSTEM | D. Dowell |
| 1 | 02 | 01 | Injector System Management & Integration | D. Dowell |
| 1 | 02 | 02 | Injector Controls Subsystem | D. Dowell |
| 1 | 02 | 03 | Injector Lasers | D. Dowell |
| 1 | 02 | 04 | RF Gun, Load Lock & Supports | D. Dowell |
| 1 | 02 | 05 | Gun to Linac Section (GTL) | D. Dowell |
| 1 | 02 | 06 | Injector Linac Structures | D. Dowell |
| 1 | 02 | 07 | L0-1 to L0-2 Section (L0-1TL0-2) | D. Dowell |
| 1 | 02 | 08 | Linac to DL1 (LTDL1) | D. Dowell |
| 1 | 02 | 09 | Dog Leg 1 Bend (DL1) | D. Dowell |
| 1 | 02 | 10 | DL1 to Linac (DL1TL) | D. Dowell |
| 1 | 02 | 11 | Straight Ahead Beamline (SAB) | D. Dowell |
| 1 | 02 | 12 | Injector RF Waveguide Subsystem | D. Dowell |
| 1 | 02 | 13 | Injector RF Subsystem | D. Dowell |
| 1 | 02 | 14 | Cathode Processing (CP) Station | D. Dowell |
| 1 | 02 | 15 | Injector Laser Heater Subsystem | D. Dowell |
| 1 | 02 | 16 | Injector Protection & Pwr Conv Subsystem | D. Dowell |
| 1 | 02 | 17 | Injector Installation & Alignment | D. Dowell |
| 1 | 03 | | LINAC SYSTEM | E. Bong |
| 1 | 03 | 01 | System Management & Integration | E. Bong |
| 1 | 03 | 02 | Linac Controls & Power Conversion Subsystem | E. Bong |
| 1 | 03 | 03 | Linac Magnets & Supports | E. Bong |
| 1 | 03 | 04 | Linac Vacuum Subsystem | E. Bong |
| 1 | 03 | 05 | Linac Electron Diagnostics | E. Bong |
| 1 | 03 | 06 | Linac RF Subsystem | E. Bong |
| 1 | 03 | 07 | Linac Installation & Alignment | E. Bong |
| 1 | 04 | | UNDULATOR SYSTEM | S. Milton |
| 1 | 04 | 01 | Undulator System Management & Integration | S. Milton |
| 1 | 04 | 02 | Controls | S. Milton |
| 1 | 04 | 03 | Undulator Magnet & Support | S. Milton |
| 1 | 04 | 04 | Vacuum System | S. Milton |
| 1 | 04 | 05 | Diagnostics | S. Milton |
| 1 | 04 | 06 | Undulator System Installation and Alignment | S. Milton |
| 1 | 05 | | X-RAY TRANSPORT & DIAGNOSTICS SYSTEMS | R. Bionta |
| 1 | 05 | 01 | System Management & Integration | R. Bionta |
| 1 | 05 | 02 | Controls | R. Bionta |
| 1 | 05 | 03 | Mechanical & Vacuum Subsystem | R. Bionta |
| 1 | 05 | 04 | Optical Subsystem | R. Bionta |
| 1 | 05 | 05 | Diagnostics Subsystem | R. Bionta |
| 1 | 05 | 06 | X-Ray Transport System Installation & Alignment | R. Bionta |
| 1 | 06 | | X-RAY END STATION SYSTEMS | J. Arthur |
| 1 | 06 | 01 | System Management & Integration | J. Arthur |
| 1 | 06 | 02 | Controls Subsystem | J. Arthur |
| 1 | 06 | 03 | Mechanical/Vacuum Subsystem | J. Arthur |
| 1 | 06 | 04 | Laser Subsystem | J. Arthur |
| 1 | 06 | 05 | X-Ray Detectors | J. Arthur |
| 1 | 06 | 06 | System Installation & Alignment | J. Arthur |
| 1 | 09 | | CONVENTIONAL FACILITIES | D. Saenz |
| 1 | 09 | 01 | System Management & Integration | D. Saenz |
| 1 | 09 | 02 | Title 1 & Title 2 Conventional Facilities | D. Saenz |
| 1 | 09 | 03 | Construction-T3 Conventional Facilities | D. Saenz |

# LCLS WBS DICTIONARY
## 1.3 LINAC SYSTEM

### 1.3 LINAC SYSTEM

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

#### 1.3.1 System Management & Integration

The Linac is made up of a number of individual devices and systems. These devices and systems must be integrated into functional blocks. In consecutive order with respect to the electron beam the functional blocks or areas are: Linac 1 (L01), Bunch Compressor Chicane 1 (BC1), Linac 2 (L02), Bunch Compressor Chicane 2 (BC2), Linac 3 (L03), Linac-to-Undulator Transport Line (LTU), and Main Electron Dump (E-Dump).

##### 1.3.1.1 Linac Mechanical Integration

Linac Mechanical Integration defines a physical envelope for the LCLS modifications in the Accelerator Housing and Klystron Gallery. Mechanical Integration also ensures that existing Linac systems are, once modified by LCLS, returned to an acceptable level of function along with complete documentation.

###### 1.3.1.1.1 L01 System Integration

L01 accelerates and 'chirps' the electron beam in preparation for first stage BC1 compression. Representing an LCLS Linac functional block, it is here where the functional requirements for systems and components are presented, reviewed, and documented. The mechanical top assembly of this functional area is completed here.

###### 1.3.1.1.2 BC1 System Integration

BC1 applies first stage bunch compression to the electron beam. Representing an LCLS Linac functional block, it is here where the functional requirements for systems and components are presented, reviewed, and documented. The mechanical top assembly of this functional area is completed here.

###### 1.3.1.1.3 L02 System Integration

L02 accelerates and 'chirps' the electron beam in preparation for first stage BC1 compression. Representing an LCLS Linac functional block, it is here where the functional requirements for systems and components are presented, reviewed, and documented. The mechanical top assembly of this functional area is completed here.

# Exhibit 2-D
# LCLS Project Cost Accumulation Structure

Linac Coherent Light Source: LCLS Actual Dollars, Hours and Commitments (encumbrances)

| WBS | OBS | FUND | WPNO | BE | Cumulative Actual Hours | Cumulative Actual Dollars | COST_TYPE | Period Ending_DATE |
|---|---|---|---|---|---|---|---|---|
| 1.04.03.03.04 | A | PED | 82402-01 | AL | 350.25 | 25000.85 | AC | 6/30/2004 |
| 1.04.03.03.04 | A | PED | 82402-01 | AS | 280.00 | 14200.40 | AC | 6/30/2004 |
| 1.04.03.03.04 | A | PED | 82402-01 | AT | | 1500.00 | AC | 6/30/2004 |
| 1.04.03.03.04 | A | CON | 83X02-01 | AP | | 300.00 | AC | 6/30/2004 |
| 1.04.03.03.04 | A | CON | 83X02-01 | AP | | 4500.00 | CM | 6/30/2004 |
| | | | | | | | | |
| 1.04.04.02.02 | A | CON | 83X02-07 | AL | 105.30 | 8515.57 | AC | 6/30/2004 |
| 1.04.04.02.02 | A | CON | 83X02-07 | AP | | 15550.60 | CM | 6/30/2004 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Total | | | | | 735.55 | 69567.42 | | |

**WBS** Work Breakdown Structure
Work Breakdown Structure code corresponding to Work Package

**OBS** Organizational Breakdown Structure
PARTICIPATING INSTITUTIONS
A Argonne National Lab
L Lawrence Livermore National Lab
S Stanford Linear Accelerator Center

**FUND (Type)**
PED Project Engineering & Design
CON Project Construction
R&D Research and Development
PRE Pre-Operations
SPR Spares

**WPNO** Work Package Number
Charge Number/Cost Code where Budget Elements are assigned actual costs

**BE** Budget Element
Labor
Service Centers
Procurements
Travel

The Budget Element distinguishes between Labor, Service Centers, Procurements and Travel for each OBS. The code for the Budget Element contains two characters. The first character is the same as the OBS. The second character is either L (Labor), S (Service Centers), P (Procurements), or T (Travel).

Example: ANL
AL ANL Labor
AS ANL Service Centers
AP ANL M&S
AT ANL Travel

**Cumulative Actual Dollars**
Cumulative-to-Date, Burdened Dollars charged to a Work Package

**Cumulative Actual Hours**
Cumulative Labor Hours charged to a Work Package

**COST_TYPE**
AC Actual Cost
CM Commitments (encumbrances)

**Period Ending Date**
Institution's Accounting Period close date

# EXHIBIT 2-E
# LCLS WORK AUTHORIZATION AGREEMENT

| WBS #: | WBS Title: | Work Pkg. #: | Document No.: | Date: |
|---|---|---|---|---|
| 1.01 | Proj Mgmt, Planning &Admin | All | | |

| ORIGINATOR | RECEIVER |
|---|---|
| **Name:** Bill Althouse<br><br>x _(Signature on original)<br>Approval | **Name:** Bill Althouse<br><br>x _(Signature on original)<br>Approval |

| TOTAL PROGRAM BUDGET | |
|---|---|
| **Total Budget:** $ _____<br>**($000)**<br><br>**Schedule Start Date:** October 1, 2002 | **Net Change**: $ N/A<br>**This Revision**<br><br>**Schedule Completion Date:** September 30, 2008 |

| FISCAL YEAR FUNDS | |
|---|---|
| **FY**:2003 **Budget:** $ _____<br>**($000)**<br><br>**Schedule Start Date:** October 1, 2003 | **Net Change:** $ N/A<br>**This Revision**<br><br>**Schedule Completion Date:**September 30, 2003 |

**Statement Of Work: The statement of work for this Work Breakdown Structure element is contained in the Work Breakdown Structure Dictionary and/or supplementary information, which is attached.**

**SUPPLEMENTARY INFORMATION**

This Work Authorization Agreement permits the planning of all activities associated with the completion of WBS 1.01 Project Management, Planning & Administration as outlined in the LCLS Work Breakdown Structure. Expenditure of funds, however, is limited to the cumulative value of the funds authorized through FY 2003.

Changes to the cost, schedule, or technical parameters of this Work Authorization Agreement will be made in compliance with the LCLS Configuration Management Plan (LAT-MD-00068-01).

## 2.3 SCHEDULING

### 2.3.1 Introduction

The scheduling process provides the framework for time-phasing the authorized project work scope as defined by the Work Breakdown Structure and it's Dictionary. The objectives of the LCLS Project Scheduling process are as follows:

- Ensure that all authorized project work scope is planned, in a disciplined and consistent manner, to meet critical need dates;
- Provide a basis for establishment of an approved formal baseline schedule to compare actual to planned performance for all activities and milestones;
- Ensure that only changes authorized through the Performance Measurement Baseline Maintenance process (See Section 4.0) is incorporated into the schedule baseline.
- Identify all constraints and decision points required for work accomplishment, as well as defining activity logic relationships, interdependencies and critical path activities to accomplish the technical baseline;
- Establish a hierarchy of summary schedule reports to provide summarization of Integrated Project Schedule status to successively higher levels of the Work Breakdown Structure;
- Support milestones that are assigned and controlled by DOE, the Project Director, System Manager; or are required for physical work measurement;
- Establish a schedule baseline that facilitates and supports the forecast of completion dates for project milestones, activities, events and the completion date of the project itself;
- Provide information (such as, critical path and target date schedule analysis) to make timely management decisions; and as required, take corrective action(s);
- Establish resource loaded schedules for the accurate time-phasing of the LCLS Detailed Cost Estimate and the development of the Performance Measurement Baseline; and,
- Provide the basis for the Performance Measurement Baseline within the cost processor by integrating the project schedules with the Work Breakdown Structure, the Organizational Breakdown Structure and the LCLS Detailed Cost Estimate.

### 2.3.2 Scheduling Methodology

The Integrated Project Schedule is the primary tool used by the LCLS Project to integrate all work for the entire project and to develop the Performance Measurement Baseline. The primary objective in developing the LCLS Integrated Project Schedule and the detailed system and System networks is to adequately cover the entire scope of work required to complete the project. The Integrated Project Schedule consists of all the Control Account detail schedules merged into one logic network utilizing interface milestones to provide horizontal linkage.

The Cost and Schedule Group generates the Integrated Project Schedule with data (detail schedule activities) provided by the System Manager (Control Account Manager). The characteristics of the Integrated Project Schedule are as follows:

- Displays activity for the lifetime of the project;
- Contains level 1 through 4 milestones;
- Approved by the Control Account Manager, System Manager, and the Project Office;
- Status is reported monthly by the Control Account Manager through the Cost and Schedule Group;
- Consists of all Control Account detail schedules and therefore reflects all approved Configuration Management Plan actions, and is revised in compliance with the configuration control process contained in Section 4.0 of this Project Management Control System Description; and,
- Structured per the Work and Organizational Breakdown Structures.

The best means of developing the Integrated Project Schedule (IPS) is to simply schedule the Work Breakdown Structure. Each terminal Work Breakdown Structure level element is defined, and the activities, duration's, relationships, and interfaces necessary to complete that element are developed

#### 2.3.2.1 Milestone Levels and Types

The schedule milestones that summarize the overall LCLS Project schedule are established at different levels of authority and priority. Only the appropriate level of organizational responsibility can alter the target date associated with a particular milestone as indicated below. Thus level 2 and above milestones can only be altered by progressive levels of DOE.

| LEVEL | ORGANIZATIONAL RESPONSIBILITY |
|---|---|
| Milestone Level - 1 | Controlled by the DOE Headquarters |
| Milestone Level - 2 | Controlled by the DOE/ Project Manager |
| Milestone Level - 3 | Controlled by the Project Director |
| Milestone Level - 4 | Controlled by the System Manager |
| Milestone Level - 5 | Not in use |

2.3.2.2 Detail Schedules

Control Account (System) detail schedules must contain all of the activities required to complete the project work scope (technical baseline). However, the detail planning of activities for near term effort; (12 - 18 months) may be more detailed than the planning for effort further out in the future.

The most important process in generating this schedule is gathering and assimilating the project data. The LCLS Project scheduling teams (which include the Control Account Manager and representative from the Cost and Schedule Group) utilize the following resources for the data gathering process:

- Statement of Work, Deliverables, etc.;
- Design Specification Documents;
- Work Breakdown Structure and Dictionary;
- Acquisition Plans;
- Project Milestones; and,
- Interviews with applicable managers, engineers and scientists.

Each detail schedule represents the originating Control Account Manager (System Manager) effort for each system, System or service for which the Control Account Manager is responsible. The level of detail displayed on the detail schedule is developed by the responsible scheduling team; with the advice and guidance of Project Director, and is based upon the complexity and degree of risk involved. The content of detail schedules includes activities and events and identifies all interface points to machines, systems, or other networks outside the originating Control Account Manager's control.

Once the scheduling team completes an individual detail schedule, it is reviewed and approved by the Project Director, or his representative. The status of detail schedules are reported at least monthly by obtaining estimated/ actual start/ completion. The monthly progress is then electronically transmitted to the Cost and Schedule Group to create an updated Integrated Project Schedule. This process is further discussed in Section 3.1 "Status Reporting and Data Collection" of this Project Management Control System Description.

#### 2.3.2.3 Integrated Project Schedule

After the Control Account (System) detail schedules have been reviewed and approved, the Cost and Schedule Group generates the Integrated Project Schedule. All Control Accounts are included in both the detail and Integrated Project Schedules.

The Integrated Project Schedule is updated on a monthly basis with the schedule status. Once the monthly progress is incorporated into the cost processor, earned value is calculated for purposes of performance analysis and reporting. This process is further discussed in Section 3.1 " Status Reporting and Data Collection".

### 2.3.3 Summary Schedule Reports

Summary schedule reports are summarizations of detail data contained within the Integrated Project Schedule database. Hence, all reporting schedules are derived from a common database and are therefore consistent in terms of baseline and working schedule dates, as well as reported status.

Summary schedule reports contain designated milestones and activities, as required, to reflect the planned and reported progress for that portions of the project that is displayed. Additionally, all summary schedule reports reflect baseline schedule revisions that have been approved through the Configuration Control Board process and included in the Integrated Project Schedule.

There are two (2) primary summary schedule reports as follows:

- LCLS Project Master Schedule; and,
- Intermediate Schedules.

However, summary schedule reports may be generated at the System or lower as requested. Summary schedule report parameters are custom designed to suit the needs of the requester. As such, they include only selected milestones and activities. Summary schedule reports are generated and distributed by the Cost and Schedule Group on a monthly basis.

#### 2.3.3.1 Project Master Schedule

The LCLS Project Master Schedule is the highest-level graphic representation of Project planning/ progress consisting of:

- A summary of Integrated Project Schedule detail data to the 2nd level of the Work Breakdown Structure; and,
- All Project Level - 1 Milestones.

Project Management and DOE to manage and control the schedule baseline use the LCLS Project Master Schedule. As such, it contains all DOE controlled milestones, a DOE approval block and revision number assignment.

#### 2.3.3.2 Intermediate Schedules

The LCLS Intermediate Schedule Reports are a graphic representation of Project planning/ progress consisting of:

- A summary of Integrated Project Schedule detail data to the 3rd level (or less of the Work Breakdown Structure; and,
- Selected milestones (level 1 milestones, level 3 commissioning and facility milestones, etc.).

The LCLS Intermediate Schedule reports provide the System Managers with a summary status of their respective areas of responsibility.

### 2.3.4 Milestone Dictionary

The LCLS Cost and Schedule Group maintains a milestone dictionary for the LCLS Project. The dictionary contains all milestone levels from Level 1 controlled by the DOE through Level 4 controlled by the LCLS System Managers. This dictionary contains the definition of completing the milestone, the date of completion (baseline completion, latest forecasted, and actual completion), and the organization or person responsible for completing the milestone.

# Procedure

## 2.4 SCHEDULE DEVELOPMENT

### Purpose

This procedure describes the process to be used to schedule authorized project work scope within the LCLS Project. It provides guidelines and detailed instructions for establishing the schedule baseline. It establishes methods, defines responsibilities, and provides example formats for scheduling activities. This procedure further develops the guidance and requirements provided in Section 2.3.

### General

Critical Path Method (CPM) network schedules are developed for each of the following major systems comprising the LCLS Project:

| | |
|---|---|
| 1.01 | Project Management |
| 1.02 | Injector |
| 1.03 | Linac |
| 1.04 | Undulator |
| 1.05 | X-Ray Endstations |
| 1.06 | X-Ray Transport and Diagnostics |
| 1.09 | Conventional Facilities |

**Control Account Manager**

The Control Account Manager or System Manager determines the sufficiency of detail for those activities within the critical path method network. He schedules each Work Breakdown Structure Level 3 System by detailing the tasks required to complete the Work Packages.

**Project Control Coordinator**

A Project Control Analyst (PCA) from the Cost and Schedule Group is selected to work with each of the major systems in developing the critical path method network for that system. This individual is the focal point for coordinating the scheduling activities for the assigned system.

**Scheduling Calendar**

A standard scheduling calendar must be used when performing time computations for the System schedule in order to ensure consistent results. The standard calendar is based on a 1 shift, 5 day/ wk, 8-hr/ day-work week with 11 holidays/ year, and a Christmas shut down period. A different calendar may be used only when absolutely necessary such as when a subcontractor's holiday schedule is significantly different than the standard calendar or for international contributors.

The use of hard dates (constraints), which serve to constrain either the start or end of an activity, should be avoided. Constraint dates inhibit the networking system from freely deriving start and end dates for all activities. Misused, constraint dates will mask or alter the critical path and can serve to redirect the Project Director's attention away from the real critical project areas.

Each schedule activity needs to be coded with the following relevant information:

| | |
|---|---|
| *Activity ID* - | Any unique identifier, 8 characters or less |
| *Activity Description* | A clear, concise, descriptor of the task |
| *Duration* - | In general, an activity's duration should not exceed 3 months, and the dollar value of the work represented by an activity should range between $100K to $500K |
| *Relationship* | Logic between two activities should be expressed as Finish-to-Start (FS), Start-to-Start (SS), and Finish-to-Finish (FF) |
| *Activity Codes* | Seventeen (17) activity codes will be required for the Integrated Project Schedule: |
| *Activity ID Code* | There is only one activity ID code per activity |

## ACTIVITY CODES and ACTIVTY ID CODE

| | |
|---|---|
| Activity Code 1 | **Control Account Manager** |
| Activity Code 2 | **Work Breakdown Structure** |
| Activity Code 3 | **Control Account Number** |

Activity Code 4 **Work Package Number**

Activity Code 5 **Phase**

Activity Code 6 **Fund Type (PED, Construction, R&D, Pre-Ops, Spares)**

Activity Code 7 **Milestone Level**

Activity Code 8 **Location**

Activity Code 9 **Miscellaneous**

Activity Code 10 **Performance Measurement Technique**

Activity Code 11 **WBS Level 3**

Activity Code 12 **WBS Level 4**

Activity Code 13 **Not Used**

Activity Code 14 **Basis of Estimate**

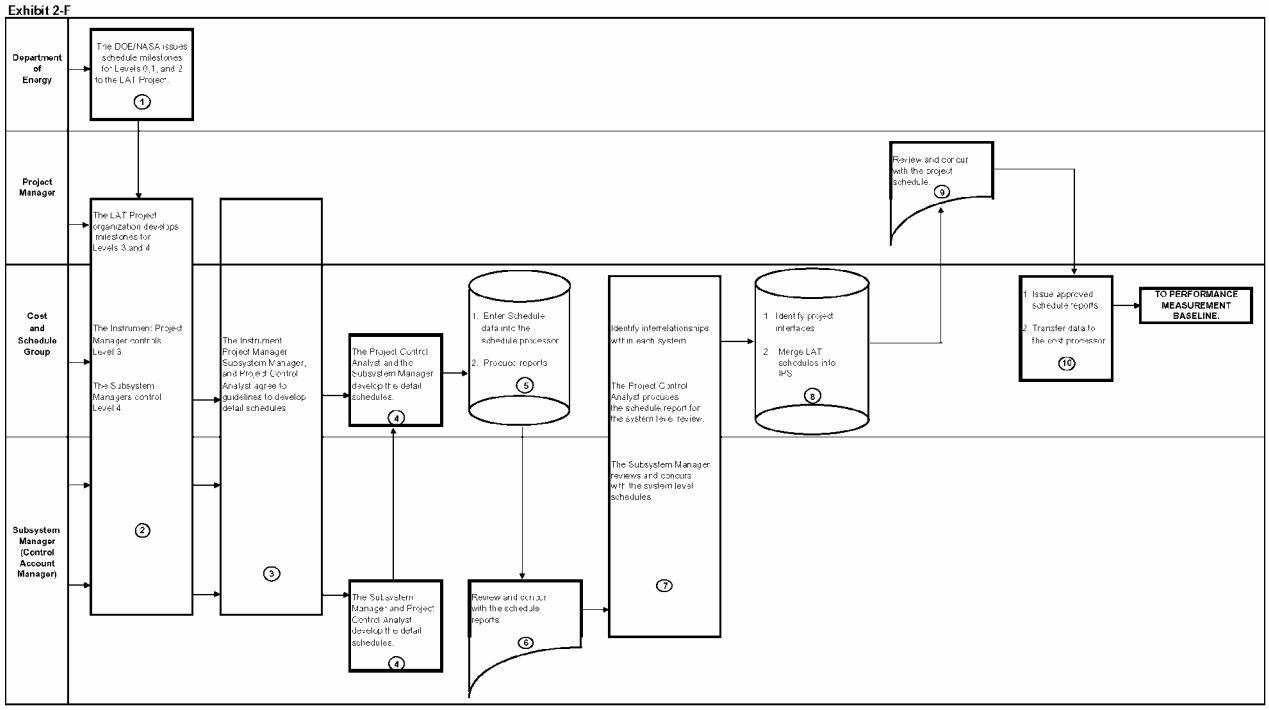
Activity Code 15 **Critical Path**

Activity Code 16 **Baseline Change Request**

---

The Schedule Development Flow Chart graphically depicting the responsibilities, interfaces, and activities that are to be performed to produce the various schedules for the LCLS Project is shown in Exhibit 2–F. The following pages contain a step-by-step narrative of Exhibit 2–F, the Schedule Development Flow Chart.

## Exhibit 2-F
## Schedule Development Flow Chart




## Procedure

| Responsible Organization | Step No. | Action/Activity |
|---|---|---|
| DOE | 1 | DOE issues the schedule for Milestone Levels 1 and 2 to the LCLS Project. DOE Headquarters controls schedule milestones at Milestone Level 1, and the DOE Project Managers control the schedule milestones at Milestone Level 2. |
| Project Director/ System Managers/ Cost and Schedule Group | 2 | The LCLS Project develops the schedule milestones for Milestone Levels 3 and 4. The Project Director approves the completion of milestones at level 3, and System Managers control milestones at level 4. |

| | | |
|---|---|---|
| Project Director/ System Managers/ Cost and Schedule Group | 3 | The Project Director, System Manager, and the Project Control Analyst agree to the guidelines under which each System detail schedule will be developed. |
| System Managers/ Project Control Analyst | 4 | The Project Control Analyst meets with each System Manager to collect the necessary information to develop the detail Control Account schedules by defining the activities, duration's, logic, and identifying interface milestones using the LCLS Detailed Cost Estimate as a guide. |
| Project Control Analyst | 5 | The Project Control Analyst enters the scheduling data into the schedule processor and codes each schedule activity with related project information. For each activity within the Control Account the data listed above in the general section is coded.<br><br>The Project Control Analyst produces schedule reports for the Control Account. |
| System Manager | 6 | The System Manager reviews and concurs with the schedule reports. Due to the iterative nature of the schedule development process, it may be necessary to have more than one cycle for concurrence. |
| Project Director/ System Managers/ Project Control Analyst | 7 | An Integration meeting is held with the Project Director, System Manager, and the Project Control Analyst to identify the interrelationships within that system The schedule reports generated in the above steps are used during this process. |

| | | |
|---|---|---|
| | | The Project Control Analyst produces schedule reports for the system level review.<br><br>The System Manager reviews and concurs with the schedule reports. Due to the iterative nature of the schedule development process, it may be necessary to have more than one cycle for concurrence. |
| Cost and Schedule Group | 8 | The Cost and Schedule Group identify the interface relationships between the various systems within the LCLS Project. The system schedules are then merged into an overall LCLS Integrated Project Schedule using these interfaces and the multi - project capability of the schedule processor. (Resource loading of the Integrated Project Schedule can begin at this time. However, for the sake of discussion, this activity is covered in Section 2.6 - Performance Baseline Development Procedure.) The Cost and Schedule Group develop reports for the Project Director's review. |
| Project Director | 9 | The Project Director reviews and concurs with the schedule reports. Due to the iterative nature of the schedule development process, it may be necessary to have more than one cycle for concurrence. |
| Cost and Schedule Group | 10 | The Cost and Schedule Group issues the approved schedule reports from the Integrated Project Schedule database to the appropriate LCLS Project personnel. |

## Exhibits

2–F Schedule Development Flowchart

## 2.5 Performance Measurement Baseline

### 2.5.1 Introduction

The LCLS Detailed Cost Estimate was established at the beginning of the project and is the basis for the Performance Measurement Baseline. Subsequently, the Performance Measurement Baseline is the **ONLY** baseline against which all cost, schedules and technical progress is measured. Additionally, the Performance Measurement Baseline is used to develop reports for the various levels of LCLS Project management. The objectives for establishing a Performance Measurement Baseline on this project are to:

- Ensure that the cost, schedule and technical parameters of the project are integrated into the Performance Measurement Baseline, such that timely and valid performance measurement data is provided to management for review and corrective action, as required;
- Ensure that the total budget value is authorized and accounted for within the Performance Measurement Baseline;
- Establish a time-phased Performance Measurement Baseline to provide a basis for an orderly, consistent and documented configuration change control process;
- Ensure that budgets for Control Accounts are traceable to the LCLS Detailed Cost Estimate and that these budgets are time-phased in accordance with the Integrated Project Schedule;
- Assign and authorize near-term budgets that are consistent with the fiscal year funding profile allocated to the LCLS Project; and,
- Document chronologically the changes made to the Performance Measurement Baseline in order to preserve its integrity throughout the lifetime of the project.

Integrating the processes of Cost Estimating, Work Scope Structuring and Work Authorization, and Scheduling achieve these objectives.

The Cost and Schedule Group is responsible for establishing and maintaining the Project Performance Measurement Baseline which consists of budgets for the following elements:

- Control Accounts;
- Undistributed Budget;

Control Accounts are established by, and are under the control of each responsible System Manager. These accounts are discussed below in paragraph 2.5.3. Undistributed Budget is established by, and is under the control of the Project Director. Undistributed Budget may be established for one of several reasons as follows:

- Additional funds made available to the project; e.g., distribution of contingency, which because of time constraints has not been incorporated into the benefiting Control Account; and,
- Funds withheld from the Performance Measurement Baseline due to a pending make/ buy decision.

Thus, Undistributed Budget is only a temporary "holding account" to report budget associated with in process planning actions. Undistributed budget is planned in the appropriate Control Account as soon as possible.

Additionally, the Cost and Schedule Group ensures that only approved and properly documented changes (LCLS Configuration Management Plan actions) are incorporated into the Project Performance Measurement Baseline. The configuration control process outlined in Section 4.0 "Performance Measurement Baseline Maintenance" of this Project Management Control System Description administers changes to the Project Performance Measurement Baseline.

### 2.5.2 Establishing Control Accounts

The process of establishing the Project Performance Measurement Baseline begins with each System Manager and the Cost and Schedule Group determining which Work Breakdown Structure elements will be designated as Control Accounts. This is extremely important, as the Control Account is the principal management control point at which project performance (technical, schedule and cost) is measured. The Control Account is where earned value is compared to both budget and actual costs for variance analysis purposes. Control Accounts are established at the appropriate level based on the evaluation of the following factors:

- Type and magnitude of resources required;
- Amount of the Control Account budget;
- Duration of the Control Account work scope;
- Technical complexity of the work scope; and,
- Degree of risk associated with the work scope.

The identification number assigned to the Control Account includes an identifier for the Work Breakdown Structure element, as well as one for the Organizational

Breakdown Structure. Thus, the Control Account is an integral part of the cost accumulation structure, the Work Breakdown Structure, the Organizational Breakdown Structure and the project schedules supporting the Integrated Project Schedule.

### 2.5.3 Integration of the Integrated Project Schedule and LCLS Detailed Cost Estimate

The Integrated Project Schedule and the LCLS Detailed Cost Estimate are integrated to produce the Performance Measurement Baseline. This integration occurs at the work package level.

The LCLS Project Organization generates detail schedules by Work Breakdown Structure for all Systems of the project. After the Control Account detail schedules have been completed, the Cost and Schedule Group and the Project Director review them. Subsequently, the Cost and Schedule Group generates the Integrated Project Schedule consisting of all the Control Account detail schedules merged into one network with logic applied to horizontal (system and System) interfaces.

After the initial review and approval process, the LCLS Detailed Cost Estimate data was assigned to the Integrated Project Schedule (within the schedule processor). The LCLS Detailed Cost Estimate was broken down and assigned to the various work packages/ activities. The resulting time-phased resource plan initially established the foundation for the Performance Measurement Baseline. The resource loaded cost and schedule data within the Integrated Project Schedule database was then transferred to the cost processor.

The cost processor now contains the official cost and schedule baseline data, which can be audited by the Government or other agencies. The Integrated Project Schedule contains baseline schedule dates and forecast schedule dates. The Integrated Project Schedule also contains budget/ resource information. This allows the project to perform timely what-if analysis.

### 2.5.4 Work Package Planning

Work packages are detail planned in monthly increments for the entire period in which the work can be properly planned; and, as a minimum, the next twelve months of work in a Control Account should be planned in work packages. Budgets for out year work are not required to be planned in monthly increments, but may be planned as a planning package within the Control Account. The process of developing planning packages results in a time-phased plan that supports the Government fiscal year funding cycle to ensure that performance measurement data can be used to forecast funds requirements.

The goal of performance measurement is to establish a plan in which Budget, performance (Earned Value), and Actual Costs are expected to occur in the same accounting period. This ensures that any attendant variance(s) is realistic. To a large degree the choice of appropriate earned value methods influences this goal. Therefore, each Control Account Manager analyzes the work content of their work package(s) carefully. Since there are no specific rules governing the size of work packages, each Control Account Manager makes this determination based on several factors as follows:

- The number of hours/ dollars involved;
- The duration of the activity;
- The technical complexity; and,
- The Control Account Manager's experience in the management of similar activities

A work package is a natural subdivision of the Control Account work scope and is planned to reflect the way work is to be performed. It is the level where detailed planning and performance data are generated. The following are the characteristics of work packages:

1) They have a specific scope of work, clearly distinguishable from other work packages, and are performed by a single organization.
2) They have a unique identification to the organization responsible to accomplish the work.
3) They are categorized as discrete, representing units of work at the levels where work is performed and are assigned a single earned value method.
4) They have scheduled start and completion dates, representative of physical accomplishments.
5) They have specific budgets in terms of dollars by element of cost (e.g., Engineering, Design and Inspection; Materials and Supplies; and Labor).
6) They are integrated with, and scheduled consistent with, the Integrated Project Schedule and are planned as far in advance as possible.

Different performance measurement techniques have been utilized for work-in-process (earned value) measures:

- Milestone Method;
- 50-50 Method;
- Objective Indicators;
- Percent Complete;

- As-Consumed (Material, ODC and Subcontracts only);
- Apportioned Effort; and,
- Level-of-Effort.

These methods are discussed in detail in Section 2.6, "Performance Measurement Baseline Procedure". Initially, the Control Account Manager time-phased the work by identifying work packages and resource type; e.g., Labor, Material and Supplies (M&S), and Travel in the then year dollars, which were escalated from the LCLS Detailed Cost Estimate for each, work package.

The resources are time-phased in the fiscal month in which they are expected to be expended, and the appropriate performance measurement technique is assigned to the work package.

Material is planned in the period that it is to be consumed and/ or received. However, material procurements vary in complexity; as such, material procurements are segmented into two categories:

- Low value and/ or commercial off-the-shelf items; and,
- High value ($100K or more per purchase order) and/ or long-lead time items (six months or more)

Low value and/ or commercial off-the-shelf items are budgeted in the accounting month in which they are scheduled for delivery, which normally is one or two months before its scheduled usage. Small material purchases (the lesser of 15% of the Control Account budget or $20K) may be planned using the level of effort method. No special management requirements are utilized for this type of procurement.

High value ($100,000 or more per purchase order) and/ or long-lead time procurements require that the vendor develop a performance measurement plan. This plan provides the responsible manager with information regarding the vendor's progress to ensure the timely receipt of the material. In this case, the budget for the period preceding the delivery is based on progress billings related to the physical accomplishment of work or milestones negotiated with the vendor.

Control Accounts are generally supported by the required detailed work package planning for effort to be performed within the next 12 to 18 months. The budget for future contractual effort, not presently capable of being defined in sufficient detail, is assigned to a planning package within the Control Account. Planning packages represent future work composed of one or more activities not able to be detail planned in the near term and have the following characteristics:

1) Generally scheduled to begin 12 or more months in the future.

2) Not assigned an earned value technique.

3) The scheduled start and completion dates are consistent with the overall Control Account and higher-level schedules.

4) Contain a time-phased budget by element of cost expressed in hours and dollars.

5) Contain a satisfactory work description to substantiate the budget and schedule and demonstrate traceability to the next higher schedule.

Planning packages are ultimately converted into one or more work packages as more information becomes available to the Control Account Manager. The Control Account Manager reviews the planning packages in the Control Account routinely, no less than quarterly, and divides them into work packages. Work is not allowed, under any circumstances, to continue to be categorized as a planning package within the current plus one accounting period.

The Control Account Manager ensures that the total of the entire work package budgets plus planning packages equals the budget for the Control Account. Additionally, an analysis of resources required versus the resources available must be made. Any deviation between required and available resources must be resolved prior to proceeding with the planning effort. The resolution can take one of many forms as determined by management; e.g., make versus buy decisions, acquisition of additional personnel, etc.

### 2.5.5 Project Performance Measurement Baseline

The Cost and Schedule Group consolidates all of the LCLS Project's resource profiles into the cost processor. Subsequently; Undistributed Budget, if any, is added to complete the establishment of the Project Performance Measurement Baseline.

The Cost and Schedule Group then analyzes the resulting Project Performance Measurement Baseline to ensure that it meets the following criteria:

- The total of work package budgets and planning packages in a Control Account equals the Control Account budget;
- The total of the Control Account budgets within a Work Breakdown Structure element equals the budget for the Work Breakdown Structure Element;
- The total of the Control Account budgets for a System Manager does not exceed the budget value on the Work Authorization Agreement Form;
- The total escalated dollars plus Undistributed Budget and contingency do not exceed the approved total project cost; and,

- The near-term budget expenditure profile, plus planned commitments, conforms to the authorized funding profile.

Once the Project Performance Measurement Baseline is reviewed and approved it becomes subject to the configuration control process discussed in Section 4.0 "Performance Measurement Baseline Maintenance" of this Project Management Control System Description. Work Packages and planning packages are revised only as described in Section 4.0. Additionally, the monthly reporting of status, analyzing and reporting cycles can begin.

These processes are discussed in Sections 3.1 "Assessing Status and Data Collection", 3.4 "Performance Analysis and Forecasting", and 3.7 "Generating Management Reports" of this Project Management Control System Description.

# Procedure

## 2.6 PERFORMANCE MEASUREMENT BASELINE

### Purpose

This procedure defines the process by which the Performance Measurement Baseline data is established within the LCLS Project Management Control System. It provides guidelines and detailed instructions for establishing the Performance Measurement Baseline to monitor and control the project from its inception to its completion. It establishes methods, defines responsibilities and provides example forms and reports for project budgeting activities.

### General

The Performance Measurement Baseline is the time-phased budget plan against which cost, schedule and technical performance is measured. It is the summation of all time-phased Control Accounts and Undistributed Budget. The baseline is initially established in the schedule processor using the Integrated Project Schedule and the LCLS Detailed Cost Estimate. The System Manager can then provide the proper time phasing, earned value method, and earned value milestones for each of their work packages. The cost and schedule data is then transferred to the cost processor.

The available earned value methods used to accomplish the detail planning are as follows:

1) Discrete Methods;
   - A) Milestone
     - 0-100
     - 50-50
     - Value Milestone
   - B) Objective Indicators Units Complete Equivalent Units
   - C) Percent Complete
   - D) As consumed (Material and ODC)
2) Level of Effort Method; and,
3) Apportioned Effort Method.

The following paragraphs explain in detail the earned value methods listed above:

**Milestone Methods**

1) The Milestone Method is used when interim milestones can be identified to represent work package performance. Value is earned as the milestones are completed. The following guidelines apply when using the milestone method:
   A) Each milestone is uniquely identified and the completion criteria are defined and specified.
   B) Milestones are not redefined or rescheduled after they have been completed.
   C) The value of a milestone is the budget associated with its completion.
   D) Each milestone has a discrete completion date
2) Each milestone requires specific definition on the Control Account plan. The Milestone description provides the completion criteria. "Start" and "Stop" are not adequate definitions of milestones.
3) If more than one milestone is planned in a month then the budget related to each of the milestones is identified within the cost processor.
4) Examples of milestones are:
   A) Completion of a specification or drawing;
   B) Completion of a test or test report;
   C) Completion of a computer program design or testing;
   D) Completion of a hardware unit or manufacturing operation;
   E) Completion of a design review; and

F) Receipt of material.

**0 - 100% Method**

The first derivative of the Milestone Method is the 0-100 methods. The advantage of this method is that there is no subjective evaluation of status required. When the task is complete and the completion milestone is achieved, then 100 percent of the budgeted value is awarded as earned value.

This method is best suited for tasks that are 30 days or less in duration. However, for short span tasks that begin in the middle of one accounting month and are scheduled to complete during the next accounting month, 0-100 may be more appropriate than 50-50. Consideration is given to the amount of labor that is expected during the first

accounting period. Clearly when 50 percent or more of the task is planned in the first period, 50-50 is the better choice.

**50% Start - 50% Complete Method**

The second derivative of the Milestone Method is the 50-50 method. When the work package is started, 50 percent of the budgeted value is earned and when the work package is complete, and the completion milestone is achieved, the remaining 50 percent of the budgeted value is earned.

This work in process measure is best suited for work packages that begin and end in adjacent accounting periods. However, it may be used for tasks that span three accounting periods. Use of 50-50 methods for a three-month work package is only permitted when the expected Actual Costs in the middle month will not cause a large variance for that Control Account. The middle month has no Budget and hence (assuming the task started on schedule) there will be no earned value (performance) in that month. Therefore, the Actual Costs incurred in this period will generate a negative cost variance.

Additionally, care must be exercised to ensure that the work package is not opened with only a few hours of effort applied to the task. In this case the earned value is relatively large, and the Actual Costs are small thereby creating a false positive cost variance.

**Value Milestone Method**

The third derivative of the Milestone Method is the Value Milestone Method. This method may be used when milestones cannot be identified for all months in a work package. As effort progresses in a month without milestones, the Control Account Manager must make an accurate assessment of progress.

The Control Account Manager may earn the entire budget in that month if the work is judged to be on schedule. This does not include any performance that may be earned during the period for completion of a late milestone (i.e., one scheduled for completion in a prior month).

For a month with a milestone and the milestone is not completed, the Control Account Manager must make an accurate assessment of progress. The Control Account Manager may earn up to 80 percent of the value of the milestone as performance. The remaining 20 percent is earned when the milestone is complete. No further performance for the work package may be earned until that milestone is completed.

This guideline ***can have exceptions*** in cases where tangible evidence can provide an accurate calculation of a percent complete on the milestone above 80 percent. The LCLS

Project Controls Manager must agree to these exceptions prior to entering earned value into the cost processor.

**Value Milestone Example**

The Control Account Manager has decided that this work package has two milestones to complete, one in month #2 and the other in month #4. The work package is planned as below:

| | Month #1 | Month #2 ? 1 | Month #3 | Month #4 ? 2 | Total BAC |
|---|---|---|---|---|---|
| BUDGET | 16,000 | 20,000 | 20,000 | 32,000 | $88,000 |
| EARNED VALUE | | | | | |

Total work package = $88,000
Milestone #1 = $36,000 and 40.9% of work package
Milestone #2 = $52,000 and 59.1% of the work package

| | |
|---|---|
| ? | Scheduled Milestone Completion |
| ? | Milestone Completed on Schedule |
| ? -----? | Milestone Completion Expected to Slip |
| ? -----? | Milestone Completed Late |

At end of month #1 the Control Account Manager calculates that 50% of milestone 1 has been completed. The cost processor is updated with this information. Resulting data for month 1 is:

| | Month #1 | Month #2 ? 1 | Month #3 | Month #4 ? 2 | Total BAC |
|---|---|---|---|---|---|
| BUDGET | 16,000 | 20,000 | 20,000 | 32,000 | $88,000 |
| EARNED VALUE | 18,000 | | | | |
| Time Now | | | | | |

At end of month 2, the Control Account Manager has not accomplished milestone 1. The Control Account Manager feels the milestone will be complete in a matter of days.

The Control Account Manager would like to report 95% of the milestone as complete but is limited to earning 80%. Resulting data for month #2 is:

| | **Month #1** | **Month #2** | **Month #3** | **Month #4** | **Total BAC** |
|---|---|---|---|---|---|
| | | ? 1----------? | | ? 2 | |
| BUDGET | 16,000 | 20,000 | 20,000 | 32,000 | $88,000 |
| EARNED VALUE | 18,000 | 10,800 | | | |
| Time Now | | | | | |

During month 3 the Control Account Manager completed milestone 1. The Control Account Manager reports that milestone 2 will not be complete until month 5. The Control Account Manager also reports that milestone 2 is approximately 25% complete.

| | **Month #1** | **Month #2** | **Month #3** | **Month #4** | **Month #5** | **Total BAC** |
|---|---|---|---|---|---|---|
| | | ? 1----------? | | ? 2----------? | | |
| BUDGET | 16,000 | 20,000 | 20,000 | 32,000 | 0 | $88,000 |
| EARNED VALUE | 18,000 | 10,800 | 20,200 | | | |
| Time Now | | | | | | |

During month 4 the Control Account Manager reports that milestone 2 is 75% complete.

| | **Month #1** | **Month #2** | **Month #3** | **Month #4** | **Month #5** | **Total BAC** |
|---|---|---|---|---|---|---|
| | | ? 1----------? | | ? 2----------? | | |
| BUDGET | 16,000 | 20,000 | 20,000 | 32,000 | 0 | $88,000 |
| EARNED VALUE | 18,000 | 10,800 | 20,200 | 26,000 | | |
| Time Now | | | | | | |

During month 5 the Control Account Manager reports that milestone 2 has been completed. The remaining 25% of milestone 2 is earned as performance.

| | Month #1 | Month #2 | Month #3 | Month #4 | Month #5 | Total BAC |
|---|---|---|---|---|---|---|
| | | ? 1----------? | | ? 2----------? | | |
| BUDGET | 16,000 | 20,000 | 20,000 | 32,000 | 0 | $88,000 |
| EARNED VALUE | 18,000 | 10,800 | 20,200 | 26,000 | 13,000 | $88,000 |
| Time Now | | | | | | |

**Objective Indicators**

The objective indicator method is appropriate when the work package contains similar units or subtasks to be completed. Value may be earned based on units completed, portions of units complete (equivalent units), or standard hours completed.

**Units Complete**

Units Complete is used when performance is based on the successful completion of a product or unit. Each unit is assigned a value. The value associated with that unit is earned as each unit is completed. The specific unit (e.g., drawings, components, etc.), the number of units and the budget per unit are identified on the Control Account plan. Units are scheduled based upon the expected completion period. This way, Budget can be properly time-phased. The following example illustrates 80 drawings budgeted at $2000 per drawing.

| | Month #1 | Month #2 | Month #3 | Month #4 | Total |
|---|---|---|---|---|---|
| Drawings Planned | 20 | 20 | 20 | 20 | 80 |
| Drawings Completed | 10 | 20 | 20 | 30 | 80 |
| BUDGET | 40,000 | 40,000 | 40,000 | 40,000 | 160,000 |
| EARNED VALUE | 20,000 | 40,000 | 40,000 | 60,000 | 160,000 |

**Equivalent Units**

Some work packages produce units over long periods of time, so that while the work is on schedule, no units are completed in some months. For this situation, it is usually possible to identify progress points for the units and assign budget values to these. For example, fifty drawings may be in work but none are complete. If drawings are partially completed and progress can be measured (e.g., 5 at 20 percent completion each), performance may be earned each month based on the measured progress.

**Percent Complete Method**

The Percent Complete Method is appropriate when the work is discrete but none of the foregoing methods are appropriate. The Percent Complete Method is appropriate when no discrete milestone or objective indicators can be defined. Performance is earned based on an estimate of work completed by the Control Account Manager. This technique is less objective than the other discrete methods. Therefore, no more than 80 percent of the total budget may be earned prior to completion. The final 20 percent is earned upon completion.

The following illustrates the status of the Percent Complete method. The maximum cumulative performance earned, if the work package is incomplete, is equal to 80 percent of the budget at completion for the work package. The additional $2,000 may be earned when this work package is complete.

| | Month #1 | Month #2 | Month #3 | Month #4 | Total |
|---|---|---|---|---|---|
| Estimated Percent | 10% | 35% | 60% | 80% | 100% |
| Month BUDGET | 1,000 | 2,000 | 3,000 | 4,000 | $10,000 |
| Month EARNED VALUE (EV) | 1,000 | 2,500 | 2,500 | 2,000 | $8,000 |
| CUM EV | 1,000 | 3,500 | 6,000 | 8,000 | $8,000 |

Time Now

**As Consumed (Material and Services)**

Earned value is based upon the material/ service that is consumed. The types of material that utilize this Earned Value Method are purchased direct to the contract. Purchased direct to contract is considered consumed at the point of receipt. Material that is held in inventory is not considered consumed until it is actually required and pulled from inventory.

The required need dates (time-phased budget) for the material is established by the scheduling system. Material is scheduled by the responsible Control Account Manager to support the needs of the program; e.g. laboratory equipment must be available to support scheduled laboratory activities. The Budget is a function of the unit(s) required

(scheduled) for the time period times the budgeted value of the material required for each scheduled item.

Services are planned (scheduled) when the service is expected to be required; e.g. computer charges are planned at the point in the task where computer support is expected to be required, travel is planned at the point trips are expected to be made, etc.

The performance for material, such as engineering material or special test equipment, is earned after receipt and accounts payable distribution. ODC performance is earned when the service is actually performed. Like material, the budgeted value of the service is awarded as earned value.

**Level of Effort (LOE)**

The Level of Effort represents work where definable end products cannot be identified and scheduled. The following guidelines apply.

1) The value of earned value (performance) is set equal to Budget for both the current month and cumulative to date.
2) The use of Level of Effort is kept to a minimum.
3) The amount of Level of Effort activity in a discrete Control Account should not exceed 20 percent.
4) Level of Effort budgets are separately planned as labor, material, and other direct costs.
5) The following provides an example of Level of Effort status. Notice Level of Effort Does not mean level loaded. Performance is earned exactly equal to the monthly Budget as time passes.

| | Month #1 | Month #2 | Month #3 | Month #4 | Month #5 | Total |
|---|---|---|---|---|---|---|
| BUDGET | 5,000 | 10,000 | 15,000 | 12,000 | 10,000 | $52,000 |
| EARNED VALUE | 5,000 | 10,000 | 15,000 | | | |
| Time Now | | | | | | |

**Apportioned Effort**

The apportioned effort represents work directly related in consistent proportion and dependent upon discrete effort. The following guidelines are used:

1) The work cannot be readily divided into short-span work packages.
2) A direct relationship exists between the two tasks and is supported by historical data.
3) The discrete effort reference and apportioned percentage is identified on the Control Account plan.
4) Multiplying the discrete effort Budget plans budget for the apportioned effort by the established percentage. Earned Value (performance) is earned in the same manner.
5) The planning of apportioned effort work is based on a historical relationship with discrete effort. The relationship may also include a schedule offset. The offset and how the offset was developed, when the apportioned effort is offset from the references discrete effort (e.g., three weeks), is also described in the Control Account documentation.

The following illustrates apportioned effort planning and status:

**Discrete Effort Base Account**

| | Month #1 | Month #2 | Month #3 | Month #4 | Total |
|---|---|---|---|---|---|
| BUDGET | 1,000 | 2,000 | 500 | 1,500 | $5,000 |
| EARNED VALUE | 500 | 1,000 | 1,500 | 2,000 | $5,000 |
| Time Now | | | | | |

**Apportioned Effort at 20%**

| | Month #1 | Month #2 | Month #3 | Month #4 | Total |
|---|---|---|---|---|---|
| BUDGET | 200 | 400 | 100 | 300 | $1,000 |
| EARNED VALUE | 100 | 200 | 300 | 400 | $1,000 |
| Time Now | | | | | |

Each of the above Budgets and Earned Value are factored at the established Apportioned Effort Percentage.

The System Managers coordinate, review, and approve the completed Control Account plans for all Control Accounts subordinate to the second level Work Breakdown Structure element for which they are responsible.

The Cost and Schedule Control Group maintains a Project Configuration Change Control Log that tracks increases and decreases to the Performance Measurement Baseline. This document records authorized budget by Work Breakdown Structure element (Control Account) and responsible organization (Exhibit 2–I is an example of the Project Configuration Change Control log).

The Cost and Schedule Group maintain cost and schedule data for a Control Account within the cost processor. The cost processor contains Labor data in both hours and dollars. Travel and Material and Supplies cost data are maintained in dollars in this database. The schedule processor contains baseline schedule dates and forecast schedule dates. The cost processor contains the official cost and schedule data that can be audited by DOE.

Annually, subsequent to allocation of the fiscal year funds, the Project Director and the Cost and Schedule Group in conjunction with the responsible System Manager review and compare the funds available to the funding requirements of the previously established Performance Measurement Baseline.

This review includes fund source and includes material and subcontract commitments, as well as a forecast of termination liability. Normally this analysis reveals that the Performance Measurement Baseline requirement is more or less than the funds available. In either case, the Performance Measurement Baseline profile is reconfigured to meet the expected funds available. The reconfiguration is accomplished by either moving ahead, or deferring previously planned schedule activity(s). Normally, any necessary schedule adjustment is accommodated without:

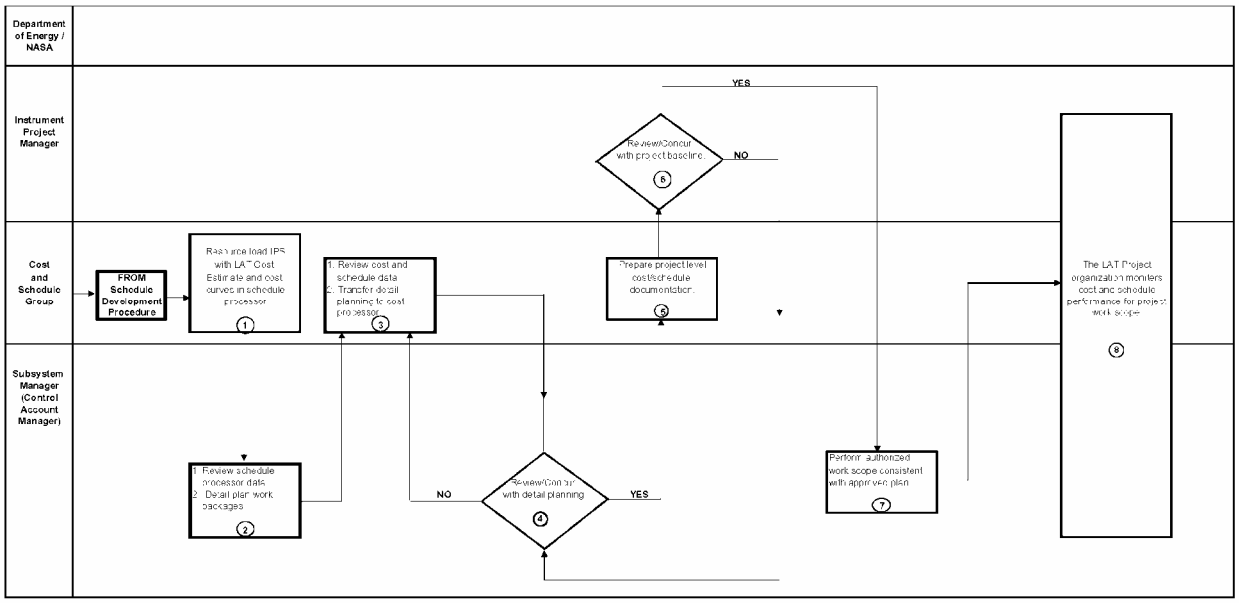
1) Breaching the established Control Account boundaries of budget, baseline schedule and technical; or
2) Impacting level 3 or higher project milestones (creating or increasing negative Float).

In the event that the schedule adjustment cannot be incorporated without violating one of the above listed parameters, then a Configuration Control Board Plan action is initiated. Required revisions to the Performance Measurement Baseline resulting from the annual funds management process are incorporated in accordance with Section 4.0, Performance Measurement Baseline.

The Cost and Schedule Group monitors the expenditure of funds plus commitments and termination liability, on an annual basis to ensure that the total budget authority is not exceeded. In the event a year adjustment is required, the process described in paragraph above is applied. The Cost and Schedule Group maintains a forecast of funding requirements including commitments and termination liability for the entire duration of the project.

The Performance Measurement Baseline Flow Chart graphically depicting the responsibilities, interfaces, and activities performed to produce the Performance Measurement Baseline for the LCLS Project is shown in Exhibit 2–G. The following pages contain a step-by-step narrative of Exhibit 2–G.

# Exhibit 2-G
# Performance Measurement Baseline Flow Chart



## Procedure

| Responsible Organization | Step No. | Action/Activity |
|---|---|---|
| System Managers (Control Account Managers)/ Cost and Schedule Group | 1 | After schedule information (start dates, completion dates, duration, etc.) has been developed and input into the schedule processor, the Integrated Project Schedule is resourced loaded with budget information from the LCLS Detailed Cost Estimate (updated with approved configuration management changes if necessary) and cost curves. |
| System Managers (Control Account Managers)/ Project Control Analyst | 2 | The System Manager, with the assistance of the Project Control Analyst, reviews the schedule processor data at the work package level. This data should be consistent with the Integrated Project Schedule and the LCLS Detailed Cost Estimate. This data includes:<br>1) The start and completion dates.<br>2) The total resources applied to each work package (i.e. hours and dollars for Labor; dollars for Material and Supplies and Travel.<br>3) Activity completions that have been identified as earned value (performance) milestones.<br>4) The time phasing of resources applied to the work package.<br><br>The System Manager (Control Account Manager) completes the detail planning with assistance from the Project Control Analyst by:<br>1) Ensuring that the time phasing of resources corresponds to the manner in which the work scope of the work package is planned. |

| Responsible Organization | Step No. | Action/Activity |
|---|---|---|
| System Managers (Control Account Managers)/ Project Control Analyst | 2 (cont.) | 2) Choosing the optimum earned value technique for each work package.<br><br>3) If a milestone earned value method is employed, the earned value milestones must be chosen, the completion dates for those milestones must be assigned, and a percentage value for each milestone must be assigned. These milestones must also be added to the schedule processor database.<br><br>4) If an objective indicator method is employed, documentation should be supplied explaining what the objective indicators are and how they relate to the development of earn value.<br><br>5) If the apportioned effort method is employed, the discrete base and the apportioned percentage should be documented.<br><br>6) (Optional) Placing work scope that does not have a planned start date within the next 12-month period into planning packages. |
| Project Control Analyst | 3 | The Project Control Analyst reviews the cost and schedule data planned by the System Manager (Control Account Manager). The sum of all Control Accounts for each System Manager must not exceed the budget issued on |
| Project Control Analyst | 3 | the Work Authorization Agreement. If |

| | | |
|---|---|---|
| | (cont) | inconsistencies exist, the System Manager and the Project Control Analyst resolve the differences.<br><br>The schedule processor data is then transferred at the work package level to the cost processor. This information includes the start and completion dates for the work package, work package time phased budgets, and earned value methods/ milestones.<br><br>Control Account Plan information is then developed and sent to the System Managers for their review. |
| System Manager (Control Account Manager) | 4 | The System Manager reviews and concurs with the completed Control Account Plan. |
| Cost and Schedule Group | 5 | The Project Control Group prepares project level cost and schedule documentation for the Project Director to review. |
| Project Director | 6 | The Project Director reviews and concurs with the project level baseline. If discrepancies exist, these are resolved with the individual System Managers. The LCLS Project is officially baselined upon approval. |
| System Manager (Control Account Manager) | 7 | System Managers perform their authorized work scope consistent with the Control Account Plan. |
| LCLS Project Organization | 8 | The LCLS Organization monitors the cost and schedule performance for the project scope of work. If a change is required to the Performance Measurement Baseline because of the |

Annual Program Guidance steps 1A through 6A of this procedure are followed. For all other changes refer to Section 4.0 Performance Measurement Baseline Maintenance.

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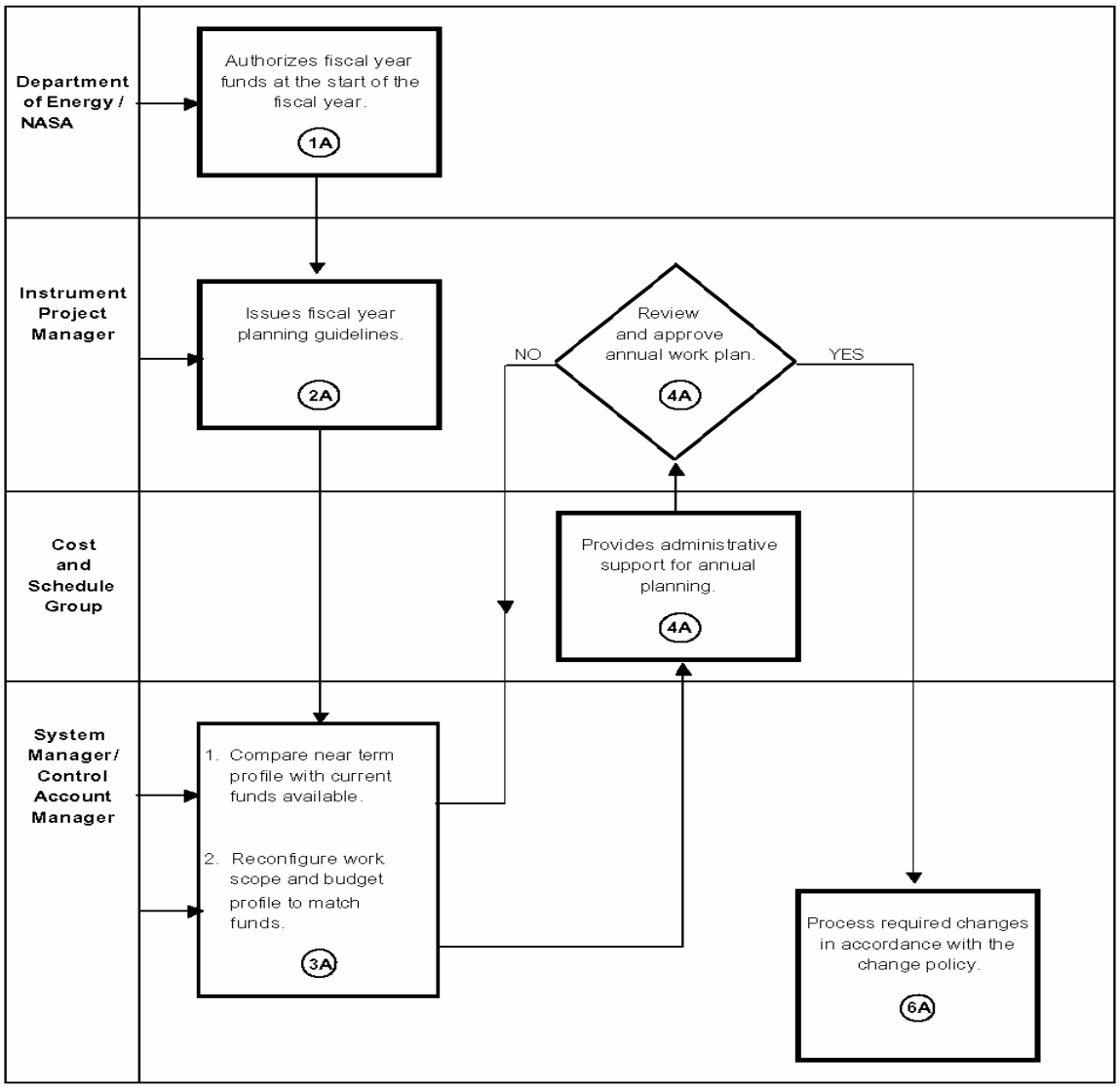
The Fiscal Year Budget Review and Adjustment Flow Chart graphically depicting the responsibilities, interfaces, and activities performed annually to review and adjust the Performance Measurement Baseline for the LCLS Project is shown in Exhibit 2–H. The following pages contain a step-by-step narrative of Exhibit 2-H.

# Exhibit 2-H
# Fiscal Year Budget Review/Adjustment Flow Chart



## FISCAL YEAR BUDGET REVIEW / ADJUSTMENT

| Responsible Organization | Step No. | Action/Activity |
|---|---|---|
| DOE/ Other Funding Entities | 1A | DOE/ Other funding entities authorize fiscal year funds at the beginning of each fiscal year. |
| Project Director/ Cost and Schedule Group | 2A | The Project Director review and compare the funds available to the funds requested. Based on this review, the Project Director issues fiscal year planning guidelines through the Cost and Schedule Group that are utilized in implementing any necessary changes to the Performance Measurement Baseline. |
| System Managers | 3A | The System Mangers compare the near-term (current and subsequent two fiscal years) planned budget expenditure profile, including planned commitments, with the current authorization of funds available and projected funds for the next two fiscal years. Normally, this analysis reveals that the budget requirement is more or less than the funds available. In either case, the budget profile is reconfigured to meet the expected funds available.<br><br>This reconfiguration is accomplished by either moving ahead, or deferring previously planned schedule activity(s). (Reference above paragraph in General section relating to Funds Management.) |
| Cost and Schedule Group | 4A | The Cost and Schedule Group provides administrative support to the Project Directors and the |

| Responsible Organization | Step No. | Action/Activity |
|---|---|---|
| Cost and Schedule Group | 4A (cont) | System Managers for the annual work plan process. |
| Project Director | 5A | The Project Director review and approve the annual fiscal year work plan for the LCLS Project New Work Authorization Agreements reflecting the approved funding amounts are issued through the Cost and Schedule Group. |
| System Managers (Control Account Managers) | 6A | After approval of the annual fiscal year work plan for the Control Account, any required revisions to the Performance Measurement Baseline are processed in accordance with Section 4.0, Performance Measurement Baseline Maintenance. |

## Exhibits

2–G Project Measurement Baseline Development Flow Chart
2–H Fiscal Year Budget Review/ Adjustment Flow Chart
2–I Project Configuration Change Control Log

# Exhibit 2-I
# LCLS Project Configuration Change Control Log

**LCLS Contingency Log**

Page 1

| BCR Level | Approval Date | BCR Description | Originator | WBS System Base Cost Estimate | | | Contingency | | New LCLS Project Base Cost Estimate |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Previous Estimate | Increase (Decrease) | New Estimate | Increase (Decrease) | Balance | |
| | | INITIAL BALANCE | | | | | | | |
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| | | | | | | | | | |

# SECTION 3.0

## 3.0 Project Execution and Reporting Process

The Project Execution and Reporting phase of the project is initiated once the Performance Measurement Baseline has been established. As the project progresses, the baseline plans created during the Baseline Development phase are updated with the latest status, performance measurement data is gathered and internal and external reports are generated and provided to the managers. The Control Account Manager and the other managers use the performance data to forecast performance and develop management responses, as required.

The **Status Assessment and Data Collection** process enables the appropriate performance data to be gathered and incorporated into a management format for managers to easily analyze and determine potential courses of action. The process begins with updating the status on the project schedules. The Integrated Project Schedule contains the baseline schedule that displays the overall project status, including network relationships and associated impacts.

The **Performance Analysis and Forecasting** process involves the identification of cost and schedule variances, which exceed prescribed variance criteria and the process of review and resolution of the potential problems associated with these variances. The process is supplemented by several performance indices that are used by management to statistically analyze the performance data. This performance data is used to assess performance and verify Estimate-at-Completion calculations.

The **Management Reporting** process provides the LCLS Project Organization with a periodic analysis of the cost, schedule and technical progress on the project. There are internal, as well as external reports that fulfill this need. The Cost/ Schedule Performance Report and the Schedule Reports are provided to depict the overall performance of work associated with the Project.

### 3.1 STATUS ASSESSMENT AND DATA COLLECTION

#### 3.1.1 Introduction

One of the primary objectives of the Project Management Control System is to provide an objective, timely and accurate assessment of project status to Project Management. This helps to assure that all cost, schedule and technical objectives

are managed to their successful completion. The achievement of this objective is accomplished by:

1) Defining the key performance data elements,
2) Establishing a monthly data gathering and status process,
3) Identifying the minimum requirements that must be adhered to in developing timely and accurate performance data for management use and for incorporation into the Cost/ Schedule Performance Report.

The Assessing Status and Data Collection process provides the mechanism to:

1) Formally gather performance data;
2) Report key project documentation status; and,
3) Develop management summary reports for review, analysis and development of corrective action plans.

### 3.1.2 Requirements

The Assessing Status and Data Collection process is integrated with the Work Breakdown Structure, the Integrated Project Schedule, and the Performance Measurement Baseline to ensure that progress, performance data and performance measurement is provided at the appropriate Work Breakdown Structure and Organizational Breakdown Structure levels.

As such, the requirements that must be adhered to in meeting the objectives for the Status Reporting and Data Collection process are as follows:

- Update all project schedule status beginning with the lowest level of detail within the Integrated Project Schedule;
- Collect actual costs at the Control Account level by each of the budget elements of cost (i.e. Labor, Materials and Travel);
- Record actual costs using acceptable costing techniques that are consistent with schedules and budgets; which provide cost information in a timely manner. This is particularly critical with material procurements where the management and control of funding, recognition of termination liability and generation of performance measurement must be simultaneously met;
- Quantify the following data elements at the Control Account level on a monthly basis. These are reconcilable with the scheduling, budgeting, configuration change control and accounting processes: Budget (time-phased), Performance (earned value), Actual Costs, Estimate at Completion, Budget at Completion, variances in terms of cost elements,

with the reasons for the variances; including an assessment of the technical problems; and,

- Summarize the data elements itemized in the above paragraph through the Organizational Breakdown and Work Breakdown Structures to the designated reporting levels in the Cost/ Schedule Performance Reports.

### 3.1.3 Performance Data Elements

For performance measurement purposes, there is a unique set of data elements that need to be gathered each month in order to produce accounting and performance measurement reports for internal use by the LCLS Project Organization., as well as for external use in reporting project status. This section discusses how each of these unique data elements supports the internal and external management needs of meeting the objectives of performance measurement. They are:

- **Budget —** is the time-phased budget plan (baseline) which represents the project work plan;
- **Performance —** is the "earned value" or the planned value of work that was accomplished; and,
- **Actual Costs** — consists of the direct and indirect costs applicable to the work which has been performed.

A comparison of the Budget and the Performance indicates whether more or less work was accomplished than was scheduled. The difference represents the schedule variance in terms of dollars. Comparing the Performance with the Actual Costs results in a cost variance that indicates whether the work that was actually accomplished cost more or less than it was planned to cost.

Analysis of cost and schedule variances enable management to identify problems, determine reasons for deviation from plans, formulate corrective action plans, and report the results.

#### 3.1.3.1 Budget

The Budget represents the time phased resources as revised by approved Performance Measurement Baseline changes. These changes are necessary to accomplish the work scope assigned to a Control Account. This time phased plan by type of resource is used as the baseline against which the schedule status is assessed; thereby providing schedule performance measurement at the Control Account.

The Budget is always related to a given time period, and its value is derived by totaling the budgets for all work scheduled during that period. The work package budgets are progressively summarized at higher levels of the Work Breakdown Structure and Organizational Breakdown Structure for all elements of cost.

#### 3.1.3.2 Performance (Earned Value)

Performance is the determination of all work performed during a given time period in terms of its budget value. Earned value is reported at the work package level and is the summation of the budget for all work accomplished within the work package in a given time period.

There are various methods to derive earned value based on the type of work being performed. These earn value methods are discussed in Sections 2.5.4 and 2–6, the "Performance Measurement Baseline Procedure".

In each of these methods, the key principles used to derive earned value are that the earned value can never exceed the total budget value and that earned value is determined in the same manner that the Budget was planned. As such, the same performance measurement methods are used for establishing the Budget and for calculating earned value.

#### 3.1.3.3 Actual Costs

The Actual Costs are accumulated through the participating institution accounting systems. The accounting system provides the method for collecting, summarizing and generating accounting-type reports. The accounting data is downloaded to the cost processor for the purpose of generating performance reports for project use. The same data is used to generate the Cost/ Schedule Performance Report, which is used by the LCLS Project Organization as well as provided to DOE on a monthly basis.

#### 3.1.3.4 Budget at Completion (BAC)

The Budget at Completion is the sum of all time-phased work packages, apportioned and level of effort budgets, and planning packages. As the project progresses, the Budget at Completion is updated by authorized changes incorporated through the Configuration Management Plan process. A Budget at Completion exists for each Control Account, each Work Breakdown Structure element and for the project itself.

#### 3.1.3.5 Estimate at Completion (EAC)

The Project Director directs a comprehensive Estimate at Completion to be performed for the entire LCLS Project at various times as required during the course of the project. This estimate is performed on all Control Accounts. The scope of work for a comprehensive Estimate at Completion is consistent with the scope of work initially estimated in the LCLS Detailed Cost Estimate as modified by approved Configuration Management Plan process.

Pending or proposed changes (not yet approved through the Configuration Management Plan process) are not included in the scope of work for a comprehensive Estimate at Completion. Knowledgeable personnel at various levels of the organization develop estimates at completion. The System Manager (Control Account Manager) is the primary contributor; however, inputs to this process are required from the Cost and Schedule Group for rate and other actual cost impacts.

The System Manager as the primary contributor develops an estimate of the resources required to complete the remaining authorized work scope for each element of cost. The Estimate at Completion is reviewed at various levels of management to assure coordination with resource planning, forward pricing and in consideration of project funding objectives. Estimate at Completion studies that exceed specified parameters may be subject to the Configuration Management Plan process.

### 3.1.4 Control Account Performance Measurement

Control Account performance is reviewed, and status is assessed at the close of each calendar month. This is a very comprehensive process that encompasses:

- Incorporation of approved Configuration Management Plan process;
- Assessment of status for the appropriate schedules;
- Calculation of earned value;
- Review and update of the Estimate at Completion, if required; and,
- Review of the expenditures (including commitments) compared to the authorized fiscal year funding by source and type.

#### 3.1.4.1 Assessment of Schedule Status

The Cost and Schedule Group generates a schedule status worksheet from the schedule processor (Exhibit 3–A) for each of the System Managers to update their monthly schedule status.

The System Managers provide status on all Control Account activities at the work package level by indicating the accomplishment of activities and/ or incremental progress towards the completion of work scope. The work package/ activity status is submitted to the Cost and Schedule Group for incorporation into the Integrated Project Schedule.

Each month the Cost and Schedule Group performs a critical path analysis of the Integrated Project Schedule. The critical path is the sequence of related activities with the longest cumulative duration or the least amount of total float. Hence, critical path analysis reviews those sequences of activities required to complete the project.

The analysis of the critical path involves a study of the predecessor/ successor relationships among the activities along and near the critical path. This analysis may result in the refinement of activity relationships, spans and/ or float. Month to month project changes; i.e., approved through the Configuration Management Plan process, as well as refinements in the schedule may change the critical path. Hence, the need for performing the analysis on a monthly basis.

#### 3.1.4.2 Calculation of Earned Value

The schedule status of the activities for each Control Account forms the basis for determining the earned value for the Control Account. The earned value calculation is based on the earned value method (indicator; e.g., 50-50 method) that was associated with the activity during the planning and scheduling process.

The value associated with the performance of each indicator is part of the Control Account planning process, and that value is recorded as having been earned if the requirements of the indicator have been met during the month. For example, if the indicator is the completion of a particular milestone, then the value for the milestone will be recorded as "earned value" in the cost processor when the milestone is assessed as complete in the Integrated Project Schedule. Earned value methods are used to measure incremental and cumulative progress of the completion of individual work packages.

The following are guidelines to assist in the calculation of earned value:

- Work-in-process earns Performance consistent with the earned value method assigned to that effort;
- Completed work packages/ Control Accounts are fully credited with Performance equal to Budget at Completion;
- Unopened work packages and planning packages cannot earn Performance;

- Effort is considered complete when all the activities and milestones associated with it are complete. This may occur prior to, or subsequent to the scheduled completion date;

- Effort that is scheduled to start but has not started is reviewed and an estimated start date and, if necessary, an estimated completion date is established. The new status for each date (**current working schedule**) is reflected on the appropriate schedules related to the Control Account; and,
- In the event that earned value is erroneously calculated (over or understated), the correction of the error is made at the close of the month in which the error was discovered. Under no circumstances are retroactive changes to earned value permitted. Clerical errors discovered prior to the month end close may be corrected during that month's status assessment process. Corrections are always made in the current month so that the prior Cost/ Schedule Performance Report cumulative values, plus the current period (including the correction of prior period errors), are always equal to the new cumulative value.

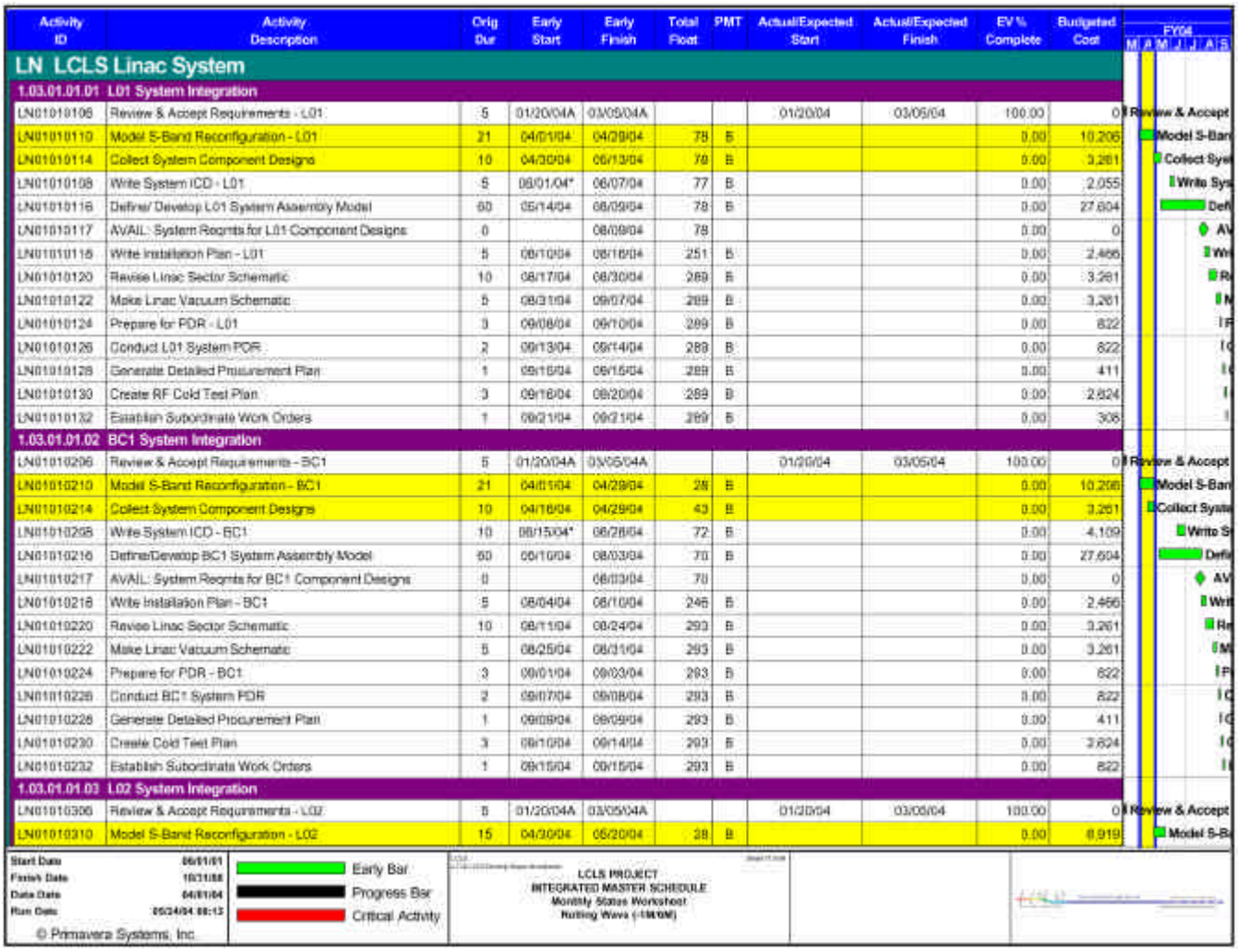
#### 3.1.4.3 Monthly Estimate at Completion Update

The Estimate at Completion is reviewed monthly by the System Manager (Control Account Manager) to ensure its accuracy. This review is based on the current status of the work in the Control Account, actual costs incurred to date, prevailing conditions and the anticipated performance on the future authorized work scope.

Based on these factors the System Manager can elect to submit a revised Estimate at Completion, as appropriate, at one of the weekly review meetings with the Project Director. Only after obtaining the Project Director's approval is the new estimate incorporated into the cost processor. This process of incorporating the System Manager's revised Estimate at Completion is described in Sections 3.4.4 and 3.6, the "Estimate at Completion" procedure. Estimates at Completion, which exceed the previously approved amount, may be subject to the Configuration Management Plan process.

# EXHIBIT 3-A
# LCLS Schedule Status Worksheet

| Activity ID | Activity Description | Orig Dur | Early Start | Early Finish | Total Float | PMT | Actual/Expected Start | Actual/Expected Finish | EV % Complete | Budgeted Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| **LN LCLS Linac System** | | | | | | | | | | |
| **1.03.01.01.01** | **L01 System Integration** | | | | | | | | | |
| LN01010106 | Review & Accept Requirements - L01 | 5 | 01/20/04A | 03/05/04A | | | 01/20/04 | 03/05/04 | 100.00 | 0 |
| LN01010110 | Model S-Band Reconfiguration - L01 | 21 | 04/01/04 | 04/29/04 | 78 | B | | | 0.00 | 10,206 |
| LN01010114 | Collect System Component Designs | 10 | 04/30/04 | 05/13/04 | 70 | B | | | 0.00 | 3,261 |
| LN01010108 | Write System ICD - L01 | 5 | 06/01/04* | 06/07/04 | 77 | B | | | 0.00 | 2,055 |
| LN01010116 | Define/ Develop L01 System Assembly Model | 60 | 05/14/04 | 08/09/04 | 78 | B | | | 0.00 | 27,604 |
| LN01010117 | AVAIL: System Reqmts for L01 Component Designs | 0 | | 08/09/04 | 78 | | | | 0.00 | 0 |
| LN01010118 | Write Installation Plan - L01 | 5 | 08/10/04 | 08/16/04 | 251 | B | | | 0.00 | 2,466 |
| LN01010120 | Revise Linac Sector Schematic | 10 | 08/17/04 | 08/30/04 | 269 | B | | | 0.00 | 3,261 |
| LN01010122 | Make Linac Vacuum Schematic | 5 | 08/31/04 | 09/07/04 | 269 | B | | | 0.00 | 3,261 |
| LN01010124 | Prepare for PDR - L01 | 3 | 09/08/04 | 09/10/04 | 269 | B | | | 0.00 | 822 |
| LN01010126 | Conduct L01 System PDR | 2 | 09/13/04 | 09/14/04 | 269 | B | | | 0.00 | 822 |
| LN01010128 | Generate Detailed Procurement Plan | 1 | 09/15/04 | 09/15/04 | 269 | B | | | 0.00 | 411 |
| LN01010130 | Create RF Cold Test Plan | 3 | 09/16/04 | 09/20/04 | 269 | B | | | 0.00 | 2,624 |
| LN01010132 | Establish Subordinate Work Orders | 1 | 09/21/04 | 09/21/04 | 269 | B | | | 0.00 | 308 |
| **1.03.01.01.02** | **BC1 System Integration** | | | | | | | | | |
| LN01010206 | Review & Accept Requirements - BC1 | 5 | 01/20/04A | 03/05/04A | | | 01/20/04 | 03/05/04 | 100.00 | 0 |
| LN01010210 | Model S-Band Reconfiguration - BC1 | 21 | 04/01/04 | 04/29/04 | 28 | B | | | 0.00 | 10,206 |
| LN01010214 | Collect System Component Designs | 10 | 04/16/04 | 04/29/04 | 43 | B | | | 0.00 | 3,261 |
| LN01010208 | Write System ICD - BC1 | 10 | 06/15/04* | 06/28/04 | 72 | B | | | 0.00 | 4,109 |
| LN01010216 | Define/Develop BC1 System Assembly Model | 60 | 05/10/04 | 08/03/04 | 70 | B | | | 0.00 | 27,604 |
| LN01010217 | AVAIL: System Reqmts for BC1 Component Designs | 0 | | 08/03/04 | 70 | | | | 0.00 | 0 |
| LN01010218 | Write Installation Plan - BC1 | 5 | 08/04/04 | 08/10/04 | 246 | B | | | 0.00 | 2,466 |
| LN01010220 | Revise Linac Sector Schematic | 10 | 08/11/04 | 08/24/04 | 293 | B | | | 0.00 | 3,261 |
| LN01010222 | Make Linac Vacuum Schematic | 5 | 08/25/04 | 08/31/04 | 293 | B | | | 0.00 | 3,261 |
| LN01010224 | Prepare for PDR - BC1 | 3 | 09/01/04 | 09/03/04 | 293 | B | | | 0.00 | 822 |
| LN01010226 | Conduct BC1 System PDR | 2 | 09/07/04 | 09/08/04 | 293 | B | | | 0.00 | 822 |
| LN01010228 | Generate Detailed Procurement Plan | 1 | 09/08/04 | 09/09/04 | 293 | B | | | 0.00 | 411 |
| LN01010230 | Create Cold Test Plan | 3 | 09/10/04 | 09/14/04 | 293 | B | | | 0.00 | 2,624 |
| LN01010232 | Establish Subordinate Work Orders | 1 | 09/15/04 | 09/15/04 | 293 | B | | | 0.00 | 822 |
| **1.03.01.01.03** | **L02 System Integration** | | | | | | | | | |
| LN01010306 | Review & Accept Requirements - L02 | 5 | 01/20/04A | 03/05/04A | | | 01/20/04 | 03/05/04 | 100.00 | 0 |
| LN01010310 | Model S-Band Reconfiguration - L02 | 15 | 04/20/04 | 05/20/04 | 28 | B | | | 0.00 | 8,919 |



# Procedure

## 3.2 STATUS ASSESSMENT AND REPORTING

### Purpose

This procedure defines the process by which the cost and schedule status is assessed and reported as required for the LCLS Project. It provides guidelines and detail instructions for assessing and reporting the cost and schedule status. It establishes methods, defines responsibilities and provides example forms and reports for assessing and reporting cost and schedule status.

### General

Data accumulation and reporting is achieved through integration of several computer-processing systems providing consistent project and functional reporting. Management to plan, monitor, and control project performance uses these reports. The Project Management Control System provides for the collection of direct labor, material, other direct costs, etc., by element of cost at the work package level. Work package data is then summarized into Control Accounts for performance analysis and reporting purposes.

The System Managers provide the Cost and Schedule Group through the use of computer input screens with the monthly schedule status to update the Integrated Project Schedule. The same information provided to update the Integrated Project Schedule is used to provide earned value for the Control Account.

### Assessing Status

Assessing the detail schedule status monthly involves:

1. Assessing and recording the performance of work for activities that are in process; e.g.;
    - Recording actual starts and/ or completions of activities, and
    - For started but not completed activities, recording the estimated remaining duration or expected completion.
2. Forecasting early/ late start/ completion dates for remaining activities. This is accomplished in the schedule processor by re-running a time analysis. This process may or may not change previous forecasts. When

the new forecast differs from the previous forecast, the working schedule is analyzed to determine the overall impact to the LCLS Project and to assess the need for a work around schedule.

## Schedule Analysis

Critical Path Analysis

The Cost and Schedule Group will analyze the project schedules on a monthly basis to identify and review project critical paths. This effort includes developing a critical path report that provides analysis and identifies areas requiring corrective action. Cases of incorrect logic or deficient status will be identified to the responsible Control Account Manager for coordinated correction.

The majority of the information for the Critical Path Analysis is obtained during a review of the critical path chaired by the Project Director. After receiving the monthly schedule status information from the System Manager and highlighting changes or effects to the critical path, the Cost and Schedule Group provides this information to the Project Director.

The Project Director and the appropriate System Manager develop the impacts and corrective action alternatives for the changes to the critical path. This is then provided to the Cost and Schedule Group. (See Exhibit 3-B "Monthly Cost and Schedule Activities" for a complete list of the monthly status and reporting activities.)

Baseline Comparison

Each month the Cost and Schedule Group will compare the baseline Integrated Project Schedule with the working Integrated Project Schedule. They will also compare the working Integrated Project Schedule from the prior month to the current month. An audit of these schedules identifies the differences that are then analyzed. The responsible System Manager reconciles any discrepancies outside of those approved by the Configuration Control Board process with the concurrence of the Cost and Schedule Group.

## Schedule Reports

Scheduling networks and Gantt charts are updated monthly based on the status provided by the System Manager. Schedule reports are produced monthly (more frequently if required) at all levels of the schedule hierarchy.
Displaying a solid bar within the scheduled activity graphically represents an approximation of work accomplished. This is equal to the degree of completion of the activity and relative to time now (status date). Such that a visual

representation of the ahead of schedule (solid bar exceeds the time now line), on schedule (solid bar coincident to the time now line) or behind schedule (solid bar less than the time now line) schedule condition is graphically represented.

## Cost Processor Reports

The cost processor is used to accumulate and report internal LCLS Project cost and schedule data. The cost processor summarizes Control Account/ Work Package Budget, Performance, Actual Cost, Budget at Completion, and Estimate at Completion data by Work and Organization Breakdown Structures to produce tabular and graphic reports. The cost processor can generate reports for the Project Director and the System Managers. The three (3) standard performance reports available from the cost processor for use by the LCLS Project are:

- Schedule vs Performance vs Actual Costs; and,
- Control Account Status Report; and,

In addition to these reports, graphs of all the cost and schedule data elements are available. Exhibits 3-D and 3-E are examples of the standard reports.

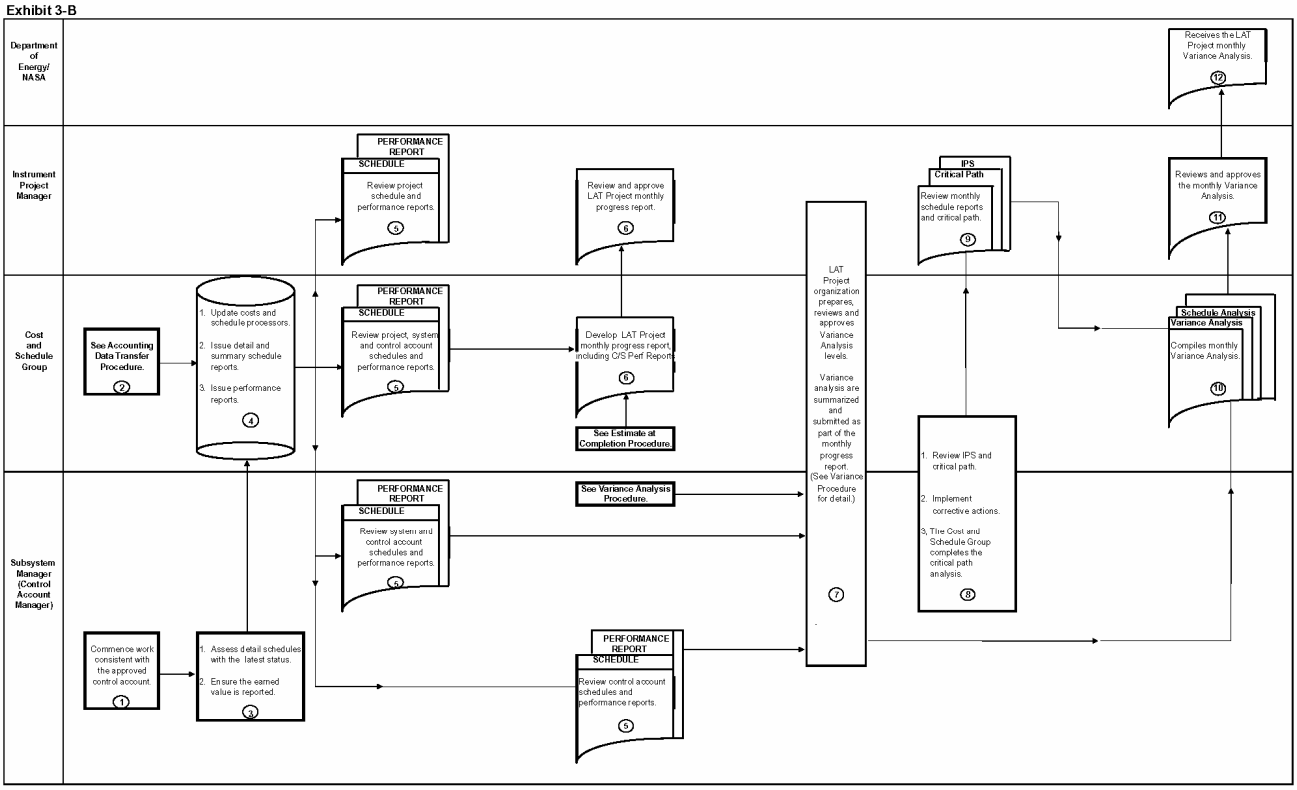
## Project Reports

The Cost and Schedule Group compiles the cost and schedule data from the various System Managers in order to prepare the required report formats for the LCLS Project Organization. The Cost and Schedule Group also compiles the Monthly Progress Report. This report may consist of the following elements:

1) Cost/ Schedule Performance Report: Displays cost and schedule performance data by Level Three Work Breakdown Structure elements.
2) Variance Analysis: A narrative discussion of the Project's selected variances (cost or schedule or technical) at the third level of the Work Breakdown Structure. Variance at completion, undistributed budget, and baseline changes are also discussed in this section.
3) Monthly Technical Progress Report: Project Controls Manager's concise narrative assessment of the status of the work being performed under the contractual agreement.

The Status Assessment and Reporting flow chart graphically depicting the responsibilities, interfaces, and activities that are to be performed to produce the cost and schedule data for the LCLS Project is shown in Exhibit 3-B. The following pages contain a step by step narrative of Exhibit 3-B, the Status Assessment and Reporting Flow Chart.

# Exhibit 3-B
# Status Assessment Flow Chart



## Procedure

| Responsible Organization | Step No. | Action/Activity |
|---|---|---|
| System Manager (Control Account Manager) | 1 | The System Manager starts work consistent with the activities planned in the approved Control Account (see Performance Measurement Baseline procedure). |
| SLAC Accounting/ Participating Institutions | 2 | Perform monthly accounting closings. The participating institutions also transfer actual cost data via electronic file to the Cost and Schedule Group at the end of each month. (See Accounting Data Transfer Procedure.) |
| System Manager (Control Account Manager) | 3 | The System Managers update their detail schedules with the latest monthly status. This is done using the computer data report provided by the Cost and Schedule Group. The information that should be provided is discussed in the paragraph in the General section entitled assessing status. This information is then returned to the Cost and Schedule Group. |
| Cost and Schedule Group | 4 | The Cost and Schedule Group transfers the cost and schedule data from the System Managers and the participating institutions into the schedule processor and the cost processor. |

## Procedure (continued)

| Responsible Organization | Step No. | Action/Activity |
|---|---|---|
| Cost and Schedule Group | 4 (cont.) | The Cost and Schedule Group issues detail and summary schedule reports to LCLS Project System Managers, Chief Engineer, and Project Director. These schedule reports contain a comparison of the baseline and the current working schedule.<br><br>The Cost and Schedule Group issues the project performance reports from the cost processor to LCLS System Managers, and Project Director. |
| LCLS Project Organization | 5 | All levels of management for the LCLS Project review their schedule reports and Project Performance Reports. |
| Cost and Schedule Group/ Project Director/ DOE | 6 | The Cost and Schedule Group develops the Cost/ Schedule Status Report from the cost processor database.<br><br>The Estimate to Complete/ Estimate at Completion data is kept current based on the approved changes as described in the Estimate at Completion procedure.<br><br>The Cost and Schedule Group compiles the narrative assessments from the System Managers and the Cost/ Schedule Status Report into the monthly LCLS Project Progress Report. |

| Responsible Organization | Step No. | Action/Activity |
|---|---|---|
| Cost and Schedule Group/ Project Director/ DOE | 6 (cont.) | The Project Director reviews and Project Controls Manager approves the LCLS Project Monthly Progress Report prior to sending it to DOE. |
| Project Director/ System Managers/ Cost and Schedule Group | 7 | The LCLS Project Organization prepares variance analysis at various levels of the Work Breakdown Structure that are summarized at the System Level and submitted as part of the Monthly Progress Report (see Variance Analysis Procedure for detail). |
| Cost and Schedule Group/ System Managers | 8 | The Cost and Schedule Group and System Managers review the Integrated Project Schedule. If errors exist, the System Managers provide corrections to the Cost and Schedule Group. If the System Managers concur with the Integrated Project Schedule, the Cost and Schedule Group proceeds with the monthly process involved with developing the a Critical Path Analysis.<br><br>The Cost and Schedule Group reviews the Project critical path. An initial Critical Path Analysis is prepared. This is reviewed with the System Managers. Corrective actions are made to improve the factors affecting the critical path.<br><br>The Cost and Schedule Group completes the Critical Path Analysis |

| Responsible Organization | Step No. | Action/Activity |
|---|---|---|
| Cost and Schedule Group/ System Managers | 8 (cont.) | based on information from the System Manager meetings.<br><br>The revised Integrated Project Schedule, Summary Schedule Reports, and the Critical Path Analysis are issued to the Project Director. |
| Project Director | 9 | The Project Director reviews the monthly issue of the Integrated Project Schedule, Summary Schedule Reports, and the Critical Path Analysis. |
| Cost and Schedule Group | 10 | The Cost and Schedule Group compiles the Variance Analysis, which includes the Variance Analysis Narrative, and the Schedule Analysis. The narrative variance analysis section is based on the variance analysis provided by the System Managers |
| Project Director | 11 | The Project Director reviews and approves the LCLS Project Monthly Variance Analysis. |

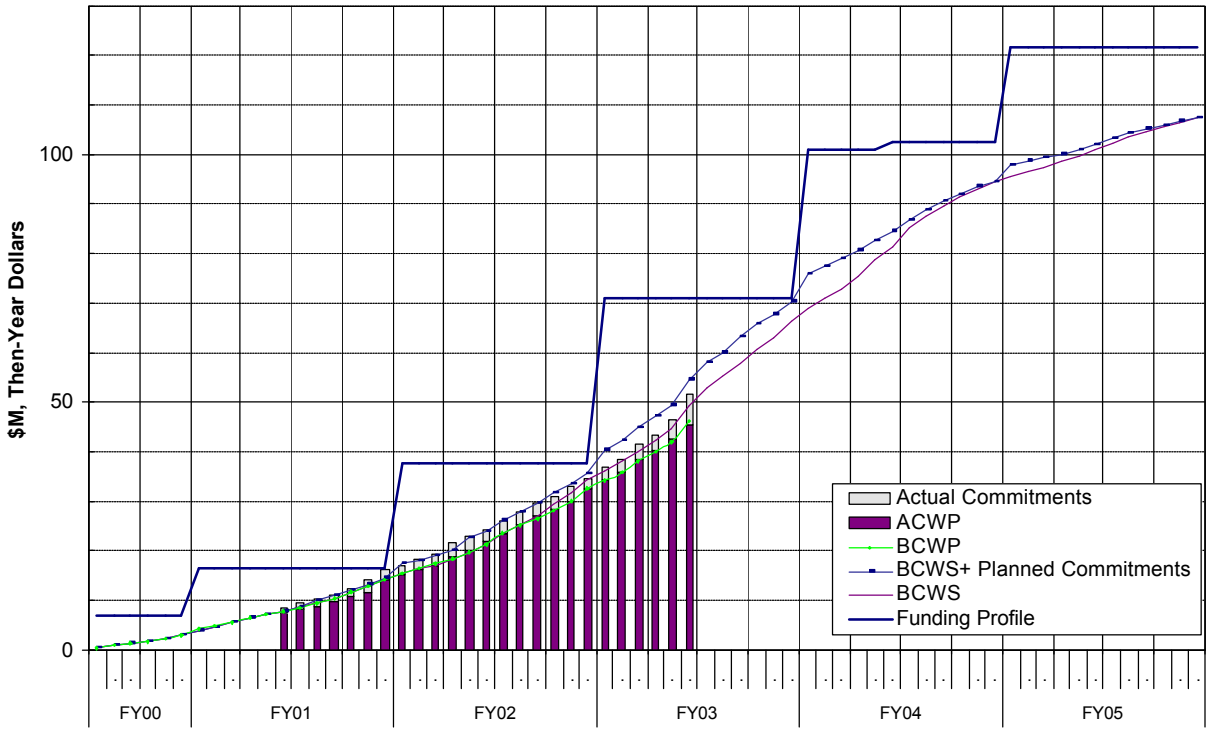
## Exhibits

3–B Status Assessment and Reporting Flow Chart
3–C Cost and Schedule Monthly Reporting Cycle
3–D Schedule Vs Performance Vs Actual Report
3–E Control Account Status Report

# Exhibit 3-C
# Monthly Cost and Schedule Activities

| WHO | WHAT | Due Date (Day from Beginning of Month |
|---|---|---|
| PMCS Team | Issue worksheets to Subsystem Managers for collection of schedule status and earned value assessment | Last Week of Previous Month |
| Subsystem Managers | Provide schedule status and earned value information to the PMCS Team | 1st Week of Current Month |
| PMCS Team | Input schedule status into project scheduling software (Primavera Project Planner - P3) | 2nd Week of Current Month |
| PMCS Team | Iterate/review schedule reports and critical path with Subsystem Managers for their concurrence | 2nd Week of Current Month |
| Institutional Accounting Interface/Contact | Provide actual cost, commitment and manpower data in template format to PMCS Team | 2nd Week of Current Month |
| PMCS Team | Import actual cost info into cost management software (COBRA), integrate schedule and earned value status information. Issue detailed cost and schedule report package (includes performance curves, cost performance report, schedule reports, etc) to Subsystem Managers and PMO | 3rd Week of Current Month |
| Subsystem Managers PMCS Team | Review cost & schedule performance reports. Identify & investigate major variances. Analyze trends. | 3rd Week of Current Month |
| LCLS Project Management Office | Meet with Subsystem Managers to discuss status. Review cost & schedule performance reports with Subsystem Managers | 4th/Last Week of Current Month |
| Project Controls Manager | Submit LCLS Project Monthly Progress Report to DOE | Last Week of Current Month |

# EXHIBIT 3-D
# SCHEDULE vs PERFORMANCE vs ACTUAL COSTS GRAPH



# Exhibit 3-E
# Control Account Performance Report

Program:0201 Batch Report:41X_3: Report #3

| Cost Performance Report - Work Breakdown Structure | | | | | | | | | | | | | Run Date: 4/23/02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contractor: Location: | | | | | Contract Type/No: | | | Project Name/No: GLAST LAT Project | | Report Period: 2/28/02 3/31/02 | | | |
| Quantity 1 | Negotiated Cost 0 | | Est. Cost Authorized Unpriced Work 0 | | Tgt. Profit/ Fee % 0 | Tgt. Price 0 | | Est Price 0 | Share Ratio | Contract Ceiling 0 | Estimated Contract Ceiling 0 | | |
| CAPW[3] | Current Period | | | | | Cumulative to Date | | | | | At Completion | | |
| OBS[1] CAPW[4] CPN[1] Item | Budgeted Cost Work Scheduled | Work Performed | Actual Cost Work Performed | Variance Schedule | Cost | Budgeted Cost Work Scheduled | Work Performed | Actual Cost Work Performed | Variance Schedule | Cost | Budgeted | Latest Revised Estimate | Variance |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| 4.1.4 TRACKER | | | | | | | | | | | | | |
| DL *** SLAC | | | | | | | | | | | | | |
| 4.1.4.1 TRACKER MANAGEMENT | | | | | | | | | | | | | |
| 2600024 4.1.4.1 Tracker Management | 29 | 29 | 26 | 0 | 2 | 470 | 470 | 492 | 0 | ***-22*** | 1,327 | 1,327 | 0 |
| CAPW[4]Totals: | 29 | 29 | 26 | 0 | 2 | 470 | 470 | 492 | 0 | -22 | 1,327 | 1,327 | 0 |
| 4.1.4.2 RELIABILITY & QUALITY ASSURANCE | | | | | | | | | | | | | |
| 2600025 4.1.4.2 Reliability and Quality Assurance | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | -4 | 0 | 0 | 0 |
| CAPW[4]Totals: | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | -4 | 0 | 0 | 0 |
| 4.1.4.3 TRAY SUB-ASSEMBLY | | | | | | | | | | | | | |
| 2600026 4.1.4.3 Tray Sub-Assembly | 0 | 0 | -328 | 0 | 328 | 927 | 927 | 1,300 | 0 | ***-374*** | 927 | 927 | 0 |
| 2600176 4.1.4.3.1 Silicon Strip Detectors (SSD) | 0 | 0 | 6 | 0 | -6 | 360 | 360 | 531 | 0 | ***-171*** | 890 | 890 | 0 |
| 2600177 4.1.4.3.2 Tray Mechanical | 0 | 0 | 11 | 0 | -11 | 0 | 51 | 82 | ***51*** | ***-31*** | 287 | 287 | 0 |
| 2600114 4.1.4.3.3 Tray Electronics | 0 | 0 | 0 | 0 | 0 | 461 | 461 | 319 | 0 | ***142*** | 461 | 461 | 0 |
| 2600178 4.1.4.3.3 Tray Electronics | 129 | 92 | 108 | -37 | -16 | 349 | 231 | 271 | ***-118*** | ***-40*** | 1,091 | 1,091 | 0 |
| 2600179 4.1.4.3.3.A Fab Flt Electronics Mods (SLAC/UCSC) | 2 | 0 | 0 | -2 | 0 | 6 | 4 | 0 | ***-2*** | ***4*** | 932 | 932 | 0 |
| 2600180 4.1.4.3.5 SLAC Assembly Facilities | 2 | 2 | 1 | 0 | 2 | 13 | 13 | 33 | 0 | ***-20*** | 63 | 63 | 0 |
| CAPW[4]Totals: | 133 | 94 | -203 | -38 | 297 | 2,115 | 2,046 | 2,536 | -69 | ***-490*** | 4,651 | 4,651 | 0 |
| 4.1.4.4 TOWER STRUCTURE & ASSEMBLY | | | | | | | | | | | | | |
| 2600181 4.1.4.4 Tower Structure (SLAC) | 70 | 0 | 379 | -70 | -379 | 340 | 270 | 379 | ***-70*** | ***-109*** | 575 | 575 | 0 |
| 2600182 4.1.4.4.3 Tower Assembly | 5 | 0 | 0 | -5 | 0 | 68 | 69 | 2 | ***1*** | ***67*** | 210 | 210 | 0 |
| CAPW[4]Totals: | 74 | 0 | 379 | -74 | -379 | 408 | 340 | 381 | ***-68*** | ***-42*** | 785 | 785 | 0 |
| 4.1.4.5 TRACKER TEST & CALIBRATION | | | | | | | | | | | | | |
| 2600028 4.1.4.5 Tracker Test And Calibration | 59 | 0 | 0 | -59 | 0 | 67 | 13 | 0 | ***-54*** | ***13*** | 263 | 263 | 0 |
| CAPW[4]Totals: | 59 | 0 | 0 | -59 | 0 | 67 | 13 | 0 | ***-54*** | ***13*** | 263 | 263 | 0 |
| 4.1.4.7 INSTRUMENT INTEGRATION & TEST (SLAC) | | | | | | | | | | | | | |
| 2600030 4.1.4.7 Instrument Integration And Test Support | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 217 | 217 | 0 |
| CAPW[4]Totals: | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 217 | 217 | 0 |
| 4.1.4.8 MISSION INTEGRATION & TEST SUPPORT | | | | | | | | | | | | | |
| 2600031 4.1.4.8 Misssion Integration &Test Support | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 30 | 0 |
| CAPW[4]Totals: | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 30 | 0 |
| OBS[1]Totals: | 295 | 123 | 202 | -172 | -80 | 3,060 | 2,868 | 3,413 | -192 | ***-545*** | 7,273 | 7,273 | 0 |
| DU *** UCSC | | | | | | | | | | | | | |
| 4.1.4.1 TRACKER MANAGEMENT | | | | | | | | | | | | | |
| 4141 4.1.4.1 Tracker Management UCSC | 28 | 28 | 11 | 0 | 17 | 669 | 669 | 340 | 0 | ***329*** | 1,937 | 1,937 | 0 |
| CAPW[4]Totals: | 28 | 28 | 11 | 0 | 17 | 669 | 669 | 340 | 0 | ***329*** | 1,937 | 1,937 | 0 |
| 4.1.4.3 TRAY SUB-ASSEMBLY | | | | | | | | | | | | | |
| 4143 4.1.4.3 Tray Sub-Assembly | 3 | 1 | 49 | -2 | -48 | 406 | 337 | 523 | ***-69*** | ***-186*** | 417 | 417 | 0 |
| CAPW[4]Totals: | 3 | 1 | 49 | -2 | -48 | 406 | 337 | 523 | ***-69*** | ***-186*** | 417 | 417 | 0 |
| 4.1.4.4 TOWER STRUCTURE & ASSEMBLY | | | | | | | | | | | | | |
| 4144 4.1.4.4 Tower Structure & Assy (SLAC) | 0 | 0 | 0 | 0 | 0 | 26 | 11 | 0 | ***-15*** | ***11*** | 69 | 69 | 0 |
| CAPW[4]Totals: | 0 | 0 | 0 | 0 | 0 | 26 | 11 | 0 | ***-15*** | ***11*** | 69 | 69 | 0 |

Cobra (R) by WST Legend: Italic=$ threshold exceeded; Underlined=% thresholds; Italic and Underlined=Both Report in Page 1

# Procedure

## 3.3 ACCOUNTING DATA TRANSFER

### Purpose

The purpose of this procedure is to document the activities involved in transferring accounting data for the LCLS Project to the Project Management Control System (PMCS) from the accounting systems at SLAC, LLNL and ANL.

### General

The PMCS tracks budgets, earned value, actual costs, and commitments at the Control Account level. The LCLS Project must acquire accounting data (actual costs and commitments) from SLAC and the other participating institutions on a monthly basis.

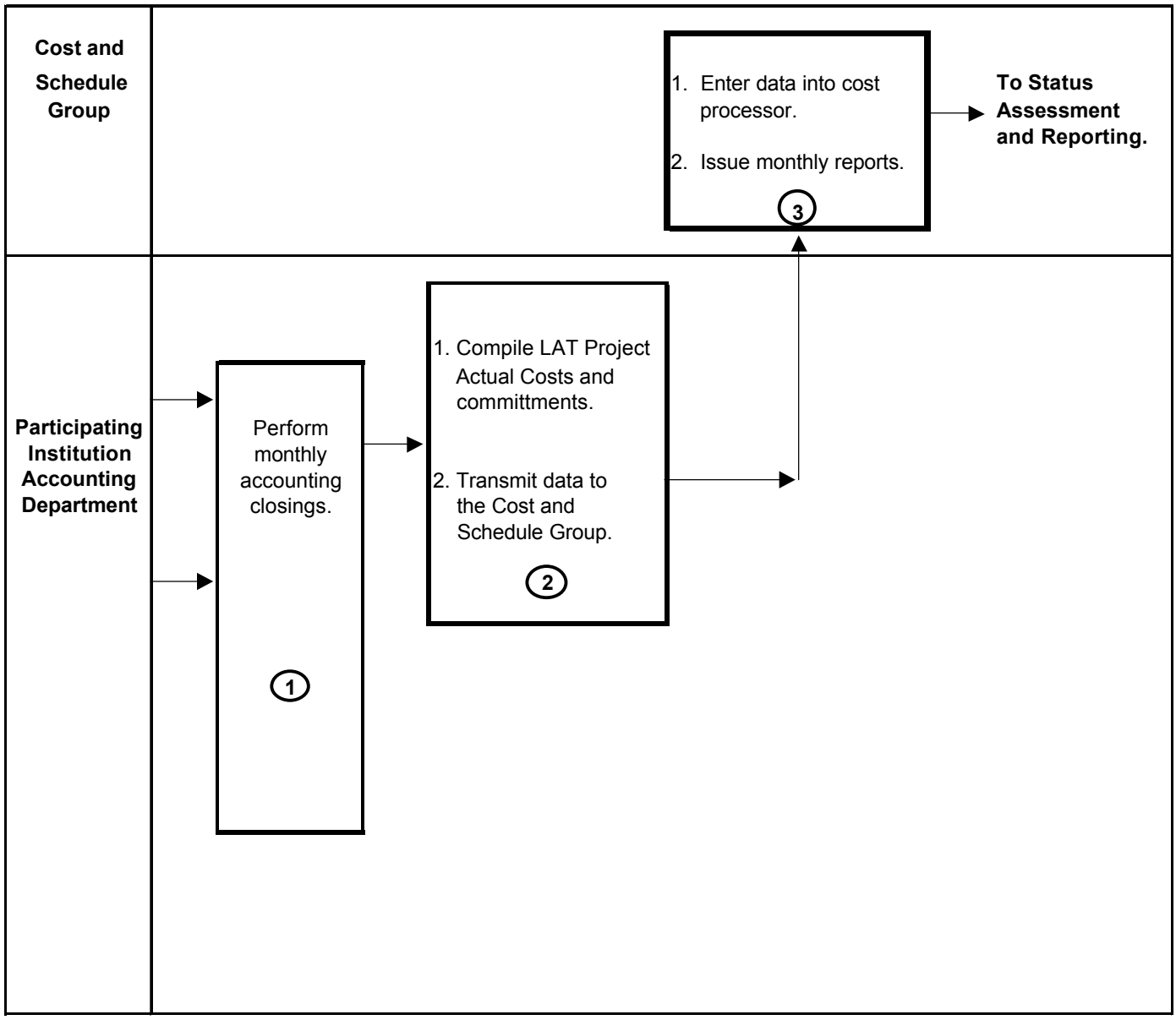
The Accounting Data Transfer Procedure Flow Chart graphically depicting the responsibilities, interfaces, and activities performed to transfer actual costs to the cost processor for the LCLS Project is shown in Exhibit 3–F, the Accounting Data Transfer Procedure Flow Chart.

Each participating institution provides the necessary cumulative accounting detail from their respective accounting systems that conforms to the file specification described in Exhibit 3–G to the LCLS Cost and Schedule Group.

Exhibit 3–H is an example of accounting data file transfer format for cumulative actual costs on the LCLS Project. Exhibit 3–I is an example of accounting data file transfer format for Net Commitments on the LCLS Project.

The Cost and Schedule Group electronically transfers this data into the Cost Processor of the PMCS. This accounting data along with other project data is then used for both internal management purposes and reporting to the DOE on a monthly basis.

# Exhibit 3-F
# Accounting Data Transfer Flow Chart



## Procedure

| Responsible Organization | Step No. | Action/Activity |
|---|---|---|
| SLAC Accounting/ Participating Institutions | 1 | Perform monthly accounting closings. |
| Participating Institutions | 2 | Compile LCLS cumulative actual cost data in both hours and dollars at the Control Account level in the format specified in Exhibit 3-H.<br><br>Compile LCLS net commitments at the Control Account level in the format specified in Exhibit 3-I.<br><br>Transmit LCLS cumulative actual cost data and net commitments electronically to the Cost and Schedule Group. |
| Cost and Schedule Group | 3 | Transfer participating institutions LCLS accounting data to ASCII Text files (See Exhibit 3–J for ASCII Text File example). |
| | | Enter participating institutions accounting data into Cost Processor database.<br>Issue monthly management reports and prepare Cost/ Schedule Performance reports. |

## Exhibits

3–F Accounting Data Transfer Flow Chart
3–G Actual Feed File Specification for Cobra Import.
3–H Accounting Data File Transfer Cumulative Cost.
3–I Accounting Data File Transfer Net Commitments.
3–J ASCII Text File

## Exhibit 3-G
## Actual Cost Feed File Specification for Cobra Import
## (Transaction File –Comma Separated Value (CSV))

| Field | Description | Type | Length | Decimal |
|---|---|---|---|---|
| WBS | WBS | Character | 9 | |
| OBS | OBS | Character | 4 | |
| WP_NO | Work Package# | Character | 10 | |
| CE_CODE | Cost Element | Character | 3 | |
| Hours | Direct Hours | Numeric | 12 | 2 |
| Dollars | Direct Dollars | Numeric | 12 | 2 |
| Class | AC or CO | Character | 2 | |
| Date | Period ending | Date | 8 | |

# Exhibit 3-H
# Accounting Data File Transfer LCLS Cumulative Costs

| WBS | OBS | WP_NO | CE_CODE | HOURS | DOLLARS | CLASS | DATE |
|---|---|---|---|---|---|---|---|
| 4.1.1.3 | DG | G13 | DGL | 0 | 840 | AC | 3/31/02 |
| 4.1.1.3 | DG | G13 | DGO | 7000 | 0 | AC | 3/31/02 |
| 4.1.1.4 | DG | G14 | DGL | 272600 | 435 | AC | 3/31/02 |
| 4.1.1.4 | DG | G14 | DGO | 174500 | | AC | 3/31/02 |
| 4.1.6 | DG | NG416 | DGL | 0 | 2195 | AC | 3/31/02 |
| 4.1.6.1 | DG | NG4161 | DGL | 338000 | 5388 | AC | 3/31/02 |
| 4.1.6.1 | DG | NG4161 | DGO | 165900 | | AC | 3/31/02 |
| 4.1.6.1 | DG | NG4161 | DGX | 481100 | | AC | 3/31/02 |
| 4.1.6.2 | DG | NG4162 | DGL | 142800 | 1746 | AC | 3/31/02 |
| 4.1.6.2 | DG | NG4162 | DGO | 0 | 0 | AC | 3/31/02 |
| 4.1.6.3 | DG | NG4163 | DGL | 271600 | 3612 | AC | 3/31/02 |
| 4.1.6.3 | DG | NG4163 | DGO | 326200 | | AC | 3/31/02 |
| 4.1.6.4 | DG | NG4164 | DGL | 427100 | 6924 | AC | 3/31/02 |
| 4.1.6.4 | DG | NG4164 | DGO | 286900 | | AC | 3/31/02 |
| 4.1.6.5 | DG | NG4165 | DGO | 4300 | | AC | 3/31/02 |
| 4.1.6.6 | DG | NG4166 | DGL | | 840 | AC | 3/31/02 |
| 4.1.6.B | DG | NG416B | DGL | | 362 | AC | 3/31/02 |
| 4.1.D | DG | NG41D | DGL | 208000 | | AC | 3/31/02 |
| 4.1.D.1.5 | DG | NG41D15 | DGL | 1950 | 146 | AC | 3/31/02 |
| 4.1.D.2.3 | DG | NG41D23 | DGL | 6070 | 87 | AC | 3/31/02 |
| 4.1.D.2.A | DG | NG41D2A | DGL | 7750 | 410 | AC | 3/31/02 |
| 4.1.D.2.B | DG | NG41D2B | DGL | 3800 | 84 | AC | 3/31/02 |
| 4.1.D.3.2 | DG | NG41D32 | DGL | 1030 | 197 | AC | 3/31/02 |
| 4.1.E | DG | G41E | DGL | 301000 | 1990 | AC | 3/31/02 |
| 4.1.E | DG | G41E | DGO | 66600 | | AC | 3/31/02 |
| 4.1.1.1 | DH | H11 | DHL | 296526 | 4635 | AC | 3/31/02 |
| 4.1.1.1 | DH | H11 | DHO | 58986 | | AC | 3/31/02 |
| 4.1.1.1 | DH | H11 | DHT | 35960 | | AC | 3/31/02 |
| 4.1.1.4 | DH | H14 | DHL | 203930 | 1898 | AC | 3/31/02 |
| 4.1.1.4 | DH | H14 | DHO | 1412 | | AC | 3/31/02 |
| 4.1.1.4 | DH | H14 | DHT | 17986 | | AC | 3/31/02 |
| 4.1.D.7.1 | DH | 2WCA115 | DHL | 146550 | 1377 | AC | 3/31/02 |
| 4.1.D.4.1 | DH | 2WCA120 | DHL | 3898 | 102 | AC | 3/31/02 |
| 4.1.D.4.2 | DH | 2WCA121 | DHL | 15140 | 271 | AC | 3/31/02 |
| 4.1.D.4.3 | DH | 2WCA122 | DHL | 18935 | 207 | AC | 3/31/02 |
| 4.1.7.1 | DH | 2WCA141 | DHL | 55539 | 517 | AC | 3/31/02 |
| 4.1.7.1 | DH | 2WCA142 | DHO | 46095 | | AC | 3/31/02 |
| 4.1.7.1 | DH | 2WCA143 | DHT | 14307 | | AC | 3/31/02 |
| 4.1.7.3 | DH | 2WCA144 | DHL | 593832 | 6564 | AC | 3/31/02 |
| 4.1.7.4 | DH | 2WCA147 | DHL | 106046 | 1769 | AC | 3/31/02 |
| 4.1.7.9 | DH | 2WCA149 | DHL | 38018 | 561 | AC | 3/31/02 |
| 4.1.E.1 | DH | 2WCA116 | DHL | 18045 | 249 | AC | 3/31/02 |
| 4.1.E.9 | DH | 2WCA145 | DHL | 68097 | 941 | AC | 3/31/02 |
| 4.1.E.6 | DH | 2WCA146 | DHL | 290881 | 4019 | AC | 3/31/02 |
| 4.1.E.6 | DH | 2WCA146 | DHO | 17839 | | AC | 3/31/02 |
| 4.1.E.C | DH | 2WCA148 | DHT | 33946 | | AC | 3/31/02 |

# Exhibit 3-I
# Accounting Data File Transfer LCLS Net Commitments

| WBS | OBS | WP_NO | CE_CODE | DOLLARS | CLASS | DATE |
|---|---|---|---|---|---|---|
| 4.1.1.1 | DL | 2600003 | DLO | 10600 | C1 | 3/31/02 |
| 4.1.1.2 | DL | 2600005 | DLO | 159452 | C1 | 3/31/02 |
| 4.1.2.1 | DL | 2600011 | DLO | 240567 | C1 | 3/31/02 |
| 4.1.2.3 | DL | 2600013 | DLO | 94446 | C1 | 3/31/02 |
| 4.1.4.1 | DL | 2600024 | DLO | 333 | C1 | 3/31/02 |
| 4.1.4.3 | DL | 2600026 | DLO | 136301 | C1 | 3/31/02 |
| 4.1.5.7.2 | DL | 2600040 | DLO | 12177 | C1 | 3/31/02 |
| 4.1.7.6 | DL | 2600064 | DLO | 24566 | C1 | 3/31/02 |
| 4.1.7.9 | DL | 2600067 | DLO | 42400 | C1 | 3/31/02 |
| 4.1.7.A | DL | 2600068 | DLO | 1314 | C1 | 3/31/02 |
| 4.1.8.1 | DL | 2600073 | DLO | 137800 | C1 | 3/31/02 |
| 4.1.9.1 | DL | 2600084 | DLO | 130789 | C1 | 3/31/02 |
| 4.1.A.2 | DL | 2600093 | DLO | 16033 | C1 | 3/31/02 |
| 4.1.8.3 | DL | 2600124 | DLO | 1272 | C1 | 3/31/02 |
| 4.1.8.7 | DL | 2600130 | DLO | 0 | C1 | 3/31/02 |
| 4.1.9.3 | DL | 2600153 | DLO | 3566 | C1 | 3/31/02 |
| 4.1.2.5 | DL | 2600173 | DLO | 96736 | C1 | 3/31/02 |
| 4.1.2.6 | DL | 2600174 | DLO | 28408 | C1 | 3/31/02 |
| 4.1.4.3 | DL | 2600176 | DLO | 47 | C1 | 3/31/02 |
| 4.1.4.3 | DL | 2600177 | DLO | 29705 | C1 | 3/31/02 |
| 4.1.4.3 | DL | 2600178 | DLO | 162323 | C1 | 3/31/02 |
| 4.1.4.3 | DL | 2600179 | DLO | 35717 | C1 | 3/31/02 |
| 4.1.4.3 | DL | 2600180 | DLO | 7818 | C1 | 3/31/02 |
| 4.1.7.4.3 | DL | 2600185 | DLO | 64236 | C1 | 3/31/02 |
| 4.1.C.4 | DS | SC4 | DSO | 20000 | C1 | 3/31/02 |
| 4.1.C.5 | DS | SC5 | DSO | 25000 | C1 | 3/31/02 |
| 4.1.C.8 | DS | SC8 | DSO | 15000 | C1 | 3/31/02 |
| 4.1.4.3 | DU | 4143 | DUO | 4793 | C1 | 3/31/02 |
| 4.1.4.1 | DU | 4141 | DUO | 50 | C1 | 3/31/02 |
| 4.1.1.3 | DG | G13 | DGL | 0 | C1 | 3/31/02 |
| 4.1.1.3 | DG | G13 | DGO | 0 | C1 | 3/31/02 |
| 4.1.1.4 | DG | G14 | DGO | 0 | C1 | 3/31/02 |
| 4.1.6.1 | DG | NG4161 | DGL | 89900 | C1 | 3/31/02 |
| 4.1.6.1 | DG | NG4161 | DGO | 5300 | C1 | 3/31/02 |
| 4.1.6.1 | DG | NG4161 | DGX | 129600 | C1 | 3/31/02 |
| 4.1.6.2 | DG | NG4162 | DGL | 0 | C1 | 3/31/02 |
| 4.1.6.3 | DG | NG4163 | DGL | 0 | C1 | 3/31/02 |
| 4.1.6.3 | DG | NG4163 | DGO | 9200 | C1 | 3/31/02 |
| 4.1.6.4 | DG | NG4164 | DGL | 92200 | C1 | 3/31/02 |

# Exhibit 3-J
# ASCII Text File

```
4.1.4.1,DU,4141,DUO,35568,,AC,4/30/02
4.1.4.1,DU,4141,DUT,23479,,AC,4/30/02
4.1.4.3,DU,4143,DUL,391477,13553,AC,4/30/02
4.1.4.3,DU,4143,DUO,154057,,AC,4/30/02
4.1.9.1,DL,113162,DLL,0,364.8,AC,4/30/02
4.1.9.6.1,DL,113162,DLL,0,648,AC,4/30/02
4.1.9.7,DL,113162,DLL,0,528,AC,4/30/02
4.1.9.9.2,DL,113162,DLL,0,1076,AC,4/30/02
4.1.D,DL,142610,DLL,0,18724.1,AC,4/30/02
4.1.D,DL,142610,DLO,0,,AC,4/30/02
4.1.D,DL,142610,DLT,0,,AC,4/30/02
4.1.E,DL,153145,DLL,0,1209.8,AC,4/30/02
4.1.E,DL,153145,DLO,0,,AC,4/30/02
4.1.1.1,DL,2600003,DLL,925859,11186,AC,4/30/02
4.1.1.1,DL,2600003,DLO,199059,,AC,4/30/02
4.1.1.1,DL,2600003,DLT,37442,,AC,4/30/02
4.1.1.2,DL,2600005,DLL,225512,3597,AC,4/30/02
4.1.1.2,DL,2600005,DLO,1411470,,AC,4/30/02
4.1.1.2,DL,2600005,DLT,3913,,AC,4/30/02
4.1.2.1,DL,2600011,DLL,197545,1903.2,AC,4/30/02
4.1.2.1,DL,2600011,DLO,1280803,,AC,4/30/02
4.1.2.1,DL,2600011,DLT,1534,,AC,4/30/02
4.1.2.3,DL,2600013,DLO,4664,,AC,4/30/02
4.1.2.4,DL,2600014,DLL,984,8.8,AC,4/30/02
4.1.4.1,DL,2600024,DLL,466260,6608.2,AC,4/30/02
4.1.4.1,DL,2600024,DLO,19235,,AC,4/30/02
4.1.4.1,DL,2600024,DLT,35570,,AC,4/30/02
4.1.4.2,DL,2600025,DLL,4153,70.4,AC,4/30/02
4.1.4.3,DL,2600026,DLL,223678,2963.7,AC,4/30/02
```

## 3.4 PERFORMANCE ANALYSIS AND FORECASTING

### 3.4.1 Introduction

The objective of the Performance Analysis and Forecasting process is to provide the LCLS Project Organization and DOE a consistent assessment of the work accomplished on the LCLS Project. The integrated baseline is designed to provide for an objective periodic assessment of cost and schedule performance.

The monthly status assessment process described in Section 3.2 " Status Assessment and Data Collection", defines how earned value is determined. When earned value is compared to actual cost, the resulting variance indicates whether the completed work has cost more or less than was budgeted for the work. A comparison of earned value and the work scheduled to date indicates whether more or less work was completed than scheduled.

Performance measurement data is also used to facilitate the process of developing forecasts of future performance and for supporting Estimate to Complete studies. There are a variety of statistical efficiency factors which can be used to assess completed work and to evaluate performance trends; such that, valid objective calculations of future performance and forecasts of the cost at completion can be made. These analytical tools complement the judgment and experience of the System Managers (Control Account Managers) in analyzing performance and validating the forecast of future costs.

The process of accumulating and comparing performance measurement data results in the identification of variances of a favorable, as well as an unfavorable, nature. Analysis of these variances is a fundamental component of performance measurement. The establishment of variance criteria enables management to focus their attention and resources on the significant cost, schedule and at-completion variances.

The System Managers are the key managers that facilitate the performance analysis, forecasting and corrective action process. This management by exception approach ensures that the variances with the highest potential impact to the LCLS Project receive the most attention.

### 3.4.2 Variance Analysis Review Process

As a matter of regular business practice, the Project Director and the System Managers conduct monthly review meetings for the Work Breakdown Structure elements for which they are responsible. Subsequent to the assessment of earned value and the publication of monthly performance reports, the cost,

schedule and technical progress of these Work Breakdown Structures elements are discussed during these review meetings. In addition, the Project Director receives a System Schedule Report and a System Performance Report, (Exhibits 3–K and 3–L.)

Since schedule information is available earlier, the Project Director can discuss schedule variances with System before cost variances can be discussed. The System Schedule Report is segregated into two parts. The first part lists by Control Account those activities/ work packages and project milestones which have slipped start/ completion dates by more than an established amount of time i.e. two weeks, 30 days, etc., or if float for an activity has decreased. The Project Director along with advice and assistance from the Cost and Schedule Group establishes this time period.

The second part of this report consists of reporting float degradation by Control Account of those activities/ work packages and project milestones whose float has deteriorated by an established amount or percentage. Again the Project Director along with the advice and assistance from the Cost and Schedule Group establishes this amount.

The System Performance Report lists the cost and schedule performance for all subordinate Control Accounts. The report is segregated into two parts. There are separate sections for the cumulative cost and schedule variances for the Control Accounts.

The report also identifies those Control Accounts, which represent the majority of the cumulative cost and schedule variances, respectively. These Control Accounts become the candidate Control Accounts for detailed review and corrective action planning discussions during the review meetings. The Control Accounts that are candidates for schedule variance discussion should be compared to those that have been highlighted on the System Schedule Report.

The Project Director convenes a monthly Cost and Schedule Review Meeting where System Managers discuss cost and schedules concerns. If a variance analysis is required, the System Manager presents the information at this meeting. The Project Director selects the WBS Elements, which will provide a Variance Analysis narrative for the Cost/ Schedule Performance Report based on the various cost and schedule reports, provided.

### 3.4.3 Variance Analysis Criteria

Regardless of the level of variance analysis required (either at the Control Account or at the System level) the same information is discussed. Variances that are required for the discussions contained in paragraph 3.4.2, should address the topics contained in the following sections.

#### 3.4.3.1 Schedule Variance Analysis

The Project Director, System Managers, and the Cost and Schedule Group perform an evaluation of the reported schedule variance in relation to the status reflected on the Integrated Project Schedule. This evaluation quantifies the extent of the schedule deviation, analyzes the schedule deviation in relation to the critical path and determines whether variance analysis is warranted.

The analysis of the schedule variance is usually analyzed in terms of hours, quantities and/ or dollars by element of cost. A schedule variance that requires analysis is addressed in terms of the following:

- Cause for the variance: e.g., insufficient resources; delays from vendors, rework, unforeseen complexities, late drawing or specification releases, tooling problems, increased/ reduced efficiency of labor resources; are examples of reasons to have a variance to schedule. The causes are defined in such a manner as to identify the problems for corrective action planning;
- Impact: The impact that this variance has or will have on other tasks within the Project. These are to be addressed in terms of schedule slippage and potential impact on cost caused by the slippage. Project schedules are assessed to reflect the schedule slippage and, as required, Estimates-at-Completion are revised. Any current or potential problem areas should be addressed for possible corrective action by project management; and,
- Corrective Action: After the cause and impact have been determined, corrective action plans are formulated to mitigate any unfavorable results of the variance. These plans are reviewed and approved by the responsible Project Director. They include a detailed explanation of what the corrective action(s) is, how the action(s) is expected to impact the variance and when the action will be implemented and effective. These corrective action plans also address required interfaces with other organizations.

#### 3.4.3.2 Cost Variance Analysis

Cost variances (Budget - Actual Costs) are expressed in hours and/ or dollars and by element of cost. A cost variance that requires analysis is addressed in terms of the following:

- Cause: Specific reasons why the variance occurred are explained. Therefore, each element of cost is reviewed for potential contribution to the overall variance. Contributors to a cost variance may include: labor rates, manpower levels, attrition, material price or usage variance, etc.;
- Impact: The impact to the Estimate at Completion is identified by element of cost. The cost performance index may be used to statistically determine a revised Estimate at Completion; but this Does not alleviate the requirement to perform an independent assessment of all the remaining effort; and,
- Corrective Action Plan: Whenever a cost variance meets the variance analysis criteria; work around or design to cost plans are developed which aim at achieving the approved budget. This may involve reallocation of resources, developing another design approach, etc. The corrective action plan is reviewed and approved by the Project Director. The plan contains a detailed explanation of what corrective action(s) is being (or will be) taken, how the action(s) is expected to impact the cost variance, and when the corrective action will be implemented and effective.

### 3.4.4 Estimate at Completion

A reassessment of the Estimate at Completion is the result of a thorough and detailed estimate of the resources required to complete the remaining authorized scope of work, plus the actual cost incurred to date. The System Manager (Control Account Manager) develops an Estimate to Complete, to which the actual costs incurred to date are added, which results in the Estimate at Completion.

Each System Manager is responsible for developing a time-phased Estimate to Complete by element of cost that defines the resources required to complete the authorized statement of work, as described by the Work Authorization Agreement (and the Configuration Change Control Requests that have been approved through the Configuration Management Plan process). When requested by the Project Director to prepare the formal comprehensive Estimate at Completion, each System Manager reviews the Estimate at Completion in view of current performance trends and, as required, develops a corrective action

plan or prepares and submits a revised Estimate at Completion for management review and approval.

To develop the Estimate to Complete, the System Manager reviews all work packages (in-progress as well as unopened) and/ or elements of cost, including open commitments, for the total authorized work scope (including planning packages, if any) of the Control Account.

Additionally, the status of work and the availability of resources are evaluated. The scope of work for the Estimate to Complete is consistent with the scope of work initially estimated in the project cost estimate as modified by approved Configuration Management Plan actions. Pending/ proposed Configuration Management Plan actions (not yet approved) are not included in the scope of work for the Estimate to Complete.

The Estimate to Complete is priced using the latest approved labor rates. Actual costs incurred to date, which are certified and provided by each participating institutions accounting department, are then added to the Estimate to Complete to arrive at the Estimate at Completion.

The Estimate at Completion process recognizes that it is not possible to remain within the initial cost objectives for every Control Account. Hence, there will be estimates-at-completion that are above, as well as below the Control Account budget. The responsibility for managing the Estimate at Completion for each Work Breakdown Structure element lies with the responsible System Manager.

When requesting a change to the Estimate at Completion, the System Manager prepares a written justification, by element of cost, for the requested change, including any design to cost alternatives that were evaluated, and submits the revision request to the Project Director for review and approval. It is then the Project Director responsibility to evaluate the requested change in terms of:

- Technical complexity of the work;
- Design to cost alternatives;
- Schedule impacts, if any; and,
- Total Estimate at Completion for the parent activity

When the Project Director determines that the revised Estimate at Completion is warranted and can be accepted without exceeding the budget objectives for the parent activity, it is approved and forwarded to the Cost and Schedule Group for incorporation into the Performance Measurement Baseline. If the Project Director does not approve the requested increase in the Estimate at Completion,

it is returned to the System Manager with specific direction as to what actions the System Manager is to take to reduce the Estimate at Completion.

Only after the Project Director approves an increased Estimate at Completion is it incorporated into the performance measurement system.

### 3.4.5 Performance Indices

There are several performance indices that are used in the analysis of performance variances. These indices may be calculated for all levels of the Work Breakdown Structure, as well as for each organizational unit active on the Project.

The following describe the most commonly used of these indices.

#### 3.4.5.1 Schedule Performance Index (SPI)

The schedule performance index is the ratio of the value of work accomplished to what was planned in the specified time period. The schedule performance index is expressed as:

$$SPI = \frac{\text{Performance}}{\text{Budget}}$$

If the result is greater than 1.0, the schedule performance index indicates that more work was accomplished than was planned in the specified time period. Conversely, if the result is less than 1.0, the schedule performance index indicates that less work was accomplished than was planned.

The schedule performance index can be plotted over time to graphically display schedule performance trends. The schedule performance indicator may be used to statistically calculate the Estimate at Completion when the effort is man-loaded. In this case the increased cost is directly proportional to schedule delays.

#### 3.4.5.2 Cost Performance Index (CPI)

The cost performance index is the ratio of the value of the work accomplished to the actual cost incurred to do the work. The cost performance index is expressed as:

$$CPI = \frac{\text{Performance}}{\text{Actual Costs}}$$

If the result is greater than 1.0, the cost performance index indicates the work was performed in a more cost efficient manner and for less cost than was planned. Conversely, if the result is less than 1.0, the cost performance index indicates a less efficient use of resources, at a greater cost than was planned.

The cost performance index can also be plotted over time to identify performance trends and to project the Estimate at Completion. These estimates are statistical in nature and assume a straight-line continuation of the prior performance; but they are useful in making projections and validating the existing Estimate at Completion.

One of many statistical equations used to project the Estimate at Completion using the cost performance index is as follows:

$$EAC = \frac{BAC}{CPI}$$

Use of this forecasting technique (formula) can not replace the need for the System Manager and the Project Director to make an independent assessment of the Estimate at Completion, based on technical knowledge, experience and judgment of the resources required to complete the remaining effort.

#### 3.4.5.3 To Complete Performance Index (TCPI)

The to-complete performance index is the ratio of the value of the work remaining to be accomplished, to the estimated value of the effort to finish the activity.

The to-complete performance index equation is expressed as follows:

$$TCPI = \frac{BAC\text{-}Performance}{EAC\text{-}Actual\ Costs}$$

If the ratio is greater than the cumulative cost performance index, the to-complete performance index indicates that the efforts expended to finish the activity must be done more efficiently than has been experienced to date in order not to exceed the Estimate at Completion.

If the ratio is less than the cumulative cost performance index, the to-complete performance index indicates that the balance of the effort could be accomplished at less than the Estimate at Completion factor provided that the balance of the activity is performed at the same efficiency factor experienced to date.

By substituting the Budget at Completion for the Estimate at Completion in the denominator of this equation, the efficiency factor that must be achieved to meet the budget at completion is derived. The to-complete performance index may also be graphically displayed over time to show performance trends.

As discussed above, a comparison of the To Complete Performance Index to the Cost Performance Index reveals a potential inconsistency between the performance that has been experienced to date and the performance that is anticipated to be achieved to complete the remaining effort. For instance; if the cumulative to date Cost Performance Index is .9 and the To Complete Performance Index is 1.1, an evaluation of the Estimate at Completion may be warranted.

3.4.5.4 Schedule Correlation

The schedule correlation calculation is a method of converting the dollar value of the schedule variance to a time variance. This calculation does not eliminate the requirement to analyze program schedules. But, is one of many methods used to evaluate project performance. There are several formulas used to calculate schedule correlation. One widely used formula compares the ratio of the value of the schedule variance to the amount of work that is scheduled in the current period. The schedule correlation is expressed as:

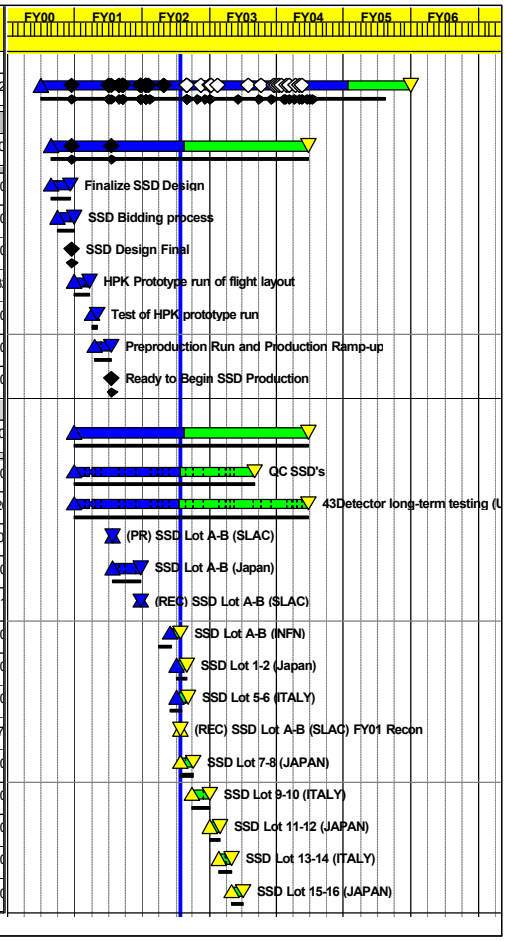
$$\text{Schedule Correlation} = \frac{\text{Cum Schedule Variance}}{\text{Current Period Budget}}$$

A correlation of 0 (zero) indicates that the work is on schedule. A correlation of -2.5, as an example, indicates a behind schedule condition of approximately 2.5 months based on the work scheduled to be accomplished in the current period. A positive correlation would therefore indicate an ahead of schedule condition. By changing the denominator to an average monthly budget or a three-month moving average of the budget, different correlations may be obtained based on the evaluator's view of recent activity.

# EXHIBIT 3-K

# SYSTEM SCHEDULE REPORT

| Activity ID | % Comp | Activity Description | Orig Dur | Early Start | Early Finish | Total Float | Budgeted Cost |
|---|---|---|---|---|---|---|---|
| 4.1.4.3 TRAY SUB-ASSEMBLY | | | | | | | |
| Subtotal | 83 | | 1,364 | 03APR00A | 30SEP05 | 120 | 5,338,633.2 |
| 4.1.4.3.1 SILICON STRIP DETECTORS (SSD) | | | | | | | |
| Subtotal | 52 | | 940 | 01JUN00A | 23MAR04 | 502 | 1,065,137.0 |
| 4T005400 | 100 | Finalize SSD Design | 72 | 01JUN00A | 08SEP00A | | 0.00 |
| 4T005600 | 100 | SSD Bidding process | 66 | 30JUN00A | 29SEP00A | | 0.00 |
| 4T005500 | 100 | SSD Design Final | 0 | 11SEP00A | | | 0.00 |
| 4T005700 | 100 | HPK Prototype run of flight layout | 60 | 03OCT00A | 25DEC00A | | 21,840.3 |
| 4T005800 | 100 | Test of HPK prototype run | 19 | 04JAN01A | 31JAN01A | | 0.00 |
| 4T005900 | 100 | Preproduction Run and Production Ramp-up | 67 | 17JAN01A | 20APR01A | | 0.00 |
| 4T006000 | 100 | Ready to Begin SSD Production | 0 | 23APR01A | | | 0.00 |
| 4.1.4.3.1.1 SSD PRODUCTION | | | | | | | |
| Subtotal | 47 | | 858 | 02OCT00A | 23MAR04 | 502 | 1,026,657.0 |
| 4T007100 | 59 | QC SSD's | 657 | 02OCT00A | 02JUN03 | 116 | 0.00 |
| 4T007200 | 45 | 43Detector long-term testing (UCSC) | 855 | 02OCT00A | 23MAR04 | 1 | 11,604.2 |
| 4T006204 | 100 | (PR) SSD Lot A-B (SLAC) | 1 | 01MAY01A | 01MAY01A | | 359,840.0 |
| 4T006202 | 100 | SSD Lot A-B (Japan) | 106 | 01MAY01A | 28SEP01A | | 0.00 |
| 4T006206 | 100 | (REC) SSD Lot A-B (SLAC) | 1 | 28SEP01A | 28SEP01A | | 0.1 |
| 4T006200 | 49 | SSD Lot A-B (INFN) | 45* | 01MAR02A | 02MAY02 | 261 | 0.00 |
| 4T006300 | 0 | SSD Lot 1-2 (Japan) | 45* | 01APR02A | 03JUN02 | 262 | 0.00 |
| 4T006500 | 25 | SSD Lot 5-6 (ITALY) | 45* | 08APR02A | 10JUN02 | 245 | 0.00 |
| 4T31100000 | 0 | (REC) SSD Lot A-B (SLAC) FY01 Recon | 1 | 01MAY02* | 01MAY02 | 968 | 124,999.7 |
| 4T006600 | 0 | SSD Lot 7-8 (JAPAN) | 45 | 01MAY02* | 03JUL02 | 253 | 0.00 |
| 4T006700 | 0 | SSD Lot 9-10 (ITALY) | 67 | 01JUL02* | 03OCT02 | 202 | 0.00 |
| 4T006800 | 0 | SSD Lot 11-12 (JAPAN) | 43 | 02OCT02* | 03DEC02 | 182 | 0.00 |
| 4T006900 | 0 | SSD Lot 13-14 (ITALY) | 43 | 20NOV02* | 31JAN03 | 151 | 0.00 |
| 4T007000 | 0 | SSD Lot 15-16 (JAPAN) | 43 | 31JAN03* | 02APR03 | 129 | 0.00 |

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# EXHIBIT 3-L

# SYSTEM PERFORMANCE REPORT

Program:0201 Batch Report:41X_3: Report #3

| Cost Performance Report - Work Breakdown Structure | | | | | | | | | | | | | Run Date: 4/23/02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contractor:<br>Location: | | | | | Contract Type/No: | | Project Name/No:<br>GLAST LAT Project | | Report Period:<br>2/28/02 3/31/02 | | | | |
| Quantity<br>1 | Negotiated Cost<br>0 | | Est. Cost Authorized Unpriced Work<br>0 | | Tgt. Profit/ Fee %<br>0 | Tgt. Price<br>0 | Est Price<br>0 | Share Ratio | Contract Ceiling<br>0 | Estimated Contract Ceiling<br>0 | | | |
| CAPW[3] | Current Period | | | | | Cumulative to Date | | | | | At Completion | | |
| OBS[1]<br>CAPW[4]<br>CPN[1]<br>Item | Budgeted Cost<br>Work Scheduled | Budgeted Cost<br>Work Performed | Actual Cost<br>Work Performed | Variance<br>Schedule | Variance<br>Cost | Budgeted Cost<br>Work Scheduled | Budgeted Cost<br>Work Performed | Actual Cost<br>Work Performed | Variance<br>Schedule | Variance<br>Cost | Budgeted | Latest Revised Estimate | Variance |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| 4.1.4 TRACKER | | | | | | | | | | | | | |
| DL *** SLAC | | | | | | | | | | | | | |
| 4.1.4.1 TRACKER MANAGEMENT | | | | | | | | | | | | | |
| 2600024 4.1.4.1 Tracker Management | 29 | 29 | 26 | 0 | 2 | 470 | 470 | 492 | 0 | ***-22*** | 1,327 | 1,327 | 0 |
| CAPW[4]Totals: | 29 | 29 | 26 | 0 | 2 | 470 | 470 | 492 | 0 | -22 | 1,327 | 1,327 | 0 |
| 4.1.4.2 RELIABILITY & QUALITY ASSURANCE | | | | | | | | | | | | | |
| 2600025 4.1.4.2 Reliability and Quality Assurance | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | -4 | 0 | 0 | 0 |
| CAPW[4]Totals: | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | -4 | 0 | 0 | 0 |
| 4.1.4.3 TRAY SUB-ASSEMBLY | | | | | | | | | | | | | |
| 2600026 4.1.4.3 Tray Sub-Assembly | 0 | 0 | -328 | 0 | 328 | 927 | 927 | 1,300 | 0 | ***-374*** | 927 | 927 | 0 |
| 2600176 4.1.4.3.1 Silicon Strip Detectors (SSD) | 0 | 0 | 6 | 0 | -6 | 360 | 360 | 531 | 0 | ***-171*** | 890 | 890 | 0 |
| 2600177 4.1.4.3.2 Tray Mechanical | 0 | 0 | 11 | 0 | -11 | 0 | 51 | 82 | ***51*** | ***-31*** | 287 | 287 | 0 |
| 2600114 4.1.4.3.3 Tray Electronics | 0 | 0 | 0 | 0 | 0 | 461 | 461 | 319 | 0 | ***142*** | 461 | 461 | 0 |
| 2600178 4.1.4.3.3 Tray Electronics | 129 | 92 | 108 | -37 | -16 | 349 | 231 | 271 | ***-118*** | ***-40*** | 1,091 | 1,091 | 0 |
| 2600179 4.1.4.3.3.A Fab Fit Electronics Mods (SLAC/UCSC) | 2 | 0 | 0 | -2 | 0 | 6 | 4 | 0 | ***-2*** | ***4*** | 932 | 932 | 0 |
| 2600180 4.1.4.3.5 SLAC Assembly Facilities | 2 | 2 | 1 | 0 | 2 | 13 | 13 | 33 | 0 | ***-20*** | 63 | 63 | 0 |
| CAPW[4]Totals: | 133 | 94 | -203 | -38 | 297 | 2,115 | 2,046 | 2,536 | -69 | ***-490*** | 4,651 | 4,651 | 0 |
| 4.1.4.4 TOWER STRUCTURE & ASSEMBLY | | | | | | | | | | | | | |
| 2600181 4.1.4.4 Tower Structure (SLAC) | 70 | 0 | 379 | -70 | -379 | 340 | 270 | 379 | ***-70*** | ***-109*** | 575 | 575 | 0 |
| 2600182 4.1.4.4.3 Tower Assembly | 5 | 0 | 0 | -5 | 0 | 68 | 69 | 2 | ***1*** | ***67*** | 210 | 210 | 0 |
| CAPW[4]Totals: | 74 | 0 | 379 | -74 | -379 | 408 | 340 | 381 | ***-68*** | ***-42*** | 785 | 785 | 0 |
| 4.1.4.5 TRACKER TEST & CALIBRATION | | | | | | | | | | | | | |
| 2600028 4.1.4.5 Tracker Test And Calibration | 59 | 0 | 0 | -59 | 0 | 67 | 13 | 0 | ***-54*** | ***13*** | 263 | 263 | 0 |
| CAPW[4]Totals: | 59 | 0 | 0 | -59 | 0 | 67 | 13 | 0 | ***-54*** | ***13*** | 263 | 263 | 0 |
| 4.1.4.7 INSTRUMENT INTEGRATION & TEST (SLAC) | | | | | | | | | | | | | |
| 2600030 4.1.4.7 Instrument Integration And Test Support | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 217 | 217 | 0 |
| CAPW[4]Totals: | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 217 | 217 | 0 |
| 4.1.4.8 MISSION INTEGRATION & TEST SUPPORT | | | | | | | | | | | | | |
| 2600031 4.1.4.8 Misssion Integration &Test Support | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 30 | 0 |
| CAPW[4]Totals: | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 30 | 0 |
| OBS[1]Totals: | 295 | 123 | 202 | -172 | -80 | 3,060 | 2,868 | 3,413 | -192 | ***-545*** | 7,273 | 7,273 | 0 |
| DU *** UCSC | | | | | | | | | | | | | |
| 4.1.4.1 TRACKER MANAGEMENT | | | | | | | | | | | | | |
| 4141 4.1.4.1 Tracker Management UCSC | 28 | 28 | 11 | 0 | 17 | 669 | 669 | 340 | 0 | ***329*** | 1,937 | 1,937 | 0 |
| CAPW[4]Totals: | 28 | 28 | 11 | 0 | 17 | 669 | 669 | 340 | 0 | ***329*** | 1,937 | 1,937 | 0 |
| 4.1.4.3 TRAY SUB-ASSEMBLY | | | | | | | | | | | | | |
| 4143 4.1.4.3 Tray Sub-Assembly | 3 | 1 | 49 | -2 | -48 | 406 | 337 | 523 | ***-69*** | ***-186*** | 417 | 417 | 0 |
| CAPW[4]Totals: | 3 | 1 | 49 | -2 | -48 | 406 | 337 | 523 | ***-69*** | ***-186*** | 417 | 417 | 0 |
| 4.1.4.4 TOWER STRUCTURE & ASSEMBLY | | | | | | | | | | | | | |
| 4144 4.1.4.4 Tower Structure & Assy (SLAC) | 0 | 0 | 0 | 0 | 0 | 26 | 11 | 0 | ***-15*** | ***11*** | 69 | 69 | 0 |
| CAPW[4]Totals: | 0 | 0 | 0 | 0 | 0 | 26 | 11 | 0 | ***-15*** | ***11*** | 69 | 69 | 0 |

Cobra (R) by WST Legend: Italic=$ threshold exceeded; Underlined=% thresholds; Italic and Underlined=Both Report in

# Procedure

## 3.5 VARIANCE ANALYSIS

### Purpose

This procedure defines the process to perform variance analysis of cost and schedule data for the LCLS Project. The Project Management Control System provides for the objective measurement, reporting, and analysis of cost and schedule performance against the Performance Measurement Baseline (PMB). This process provides all levels of management with early visibility of deviations from the Performance Measurement Baseline. It also facilitates the development of preventive or corrective action for significant variances. This procedure provides guidelines and detailed instructions for variance analysis. It establishes methods, defines responsibilities and provides examples for processing and reporting variances.

### General

Cost, schedule, and technical performance may deviate from plan as project work progresses. Minor variations typically occur in all Control Accounts, as well as at higher Work Breakdown Structure levels. The LCLS Project prepares a variance analysis at the third level of the Work Breakdown Structure as part of the monthly Cost/ Schedule Performance Report. Internally, the LCLS Project analyzes variances for selected Control Accounts, which supports the narrative provided the customer. Variances addressed in these analyses are (1) Schedule Variances (SV) (2) Cost Variances (CV) (3) Variance at Completion (VAC).

#### Cost Variance

Cost Variance (CV) is the mathematical difference between Performance (Earned Value) and Actual Costs. A negative value represents an overrun condition while a positive value represents an under run condition. Cost Variance percentage is the result of dividing Cost Variance by Performance, i.e., CV ÷ Performance x 100.

#### Schedule Variance

For schedule reports from the schedule processor, Schedule Variance is the time difference between actual completion dates and baseline schedule dates for activities and milestones. It is also the time difference between the forecaster completion dates

and the baseline schedule dates for activities and milestones that have not yet been completed.

For the report from the cost processor, Schedule Variance is the mathematical difference between Performance and Budget, i.e., Performance - Budget. A negative value represents a behind schedule condition while a positive value represents an ahead of schedule condition. Schedule Variance percentage is the result of dividing Schedule Variance by Budgeted Cost for Work Scheduled, i.e., SV ÷ BCWS x 100.

**Variance at Completion**

Variance at Completion is the mathematical difference between Budget at Completion (BAC) and Estimate at Completion (EAC), i.e., BAC - EAC. A negative value represents an expected overrun condition at completion while a positive value represents an expected under run condition. Variance at Completion percentage is the result of dividing Variance at Completion by Budget at Completion, i.e., VAC ÷ BAC x 100.

**Variance Analysis Preparation**

Internally, the System Managers and the Cost and Schedule Group are responsible for providing the Project Director the basis to prepare the variance analysis narrative that accompanies the Cost/ Schedule Performance Report. After reviewing the monthly Project Management Control System Cost/ Schedule Performance Reports, the Project Director determines which Work Breakdown Structure Level Elements require a variance analysis narrative for inclusion in the Cost/ Schedule Performance Report.

The System Managers for those elements requiring a variance analysis narrative will present their variance analysis to the Project Director at the monthly Cost and Schedule Review Meetings. If the timing is such that this meeting will be convened later than the information is required, the Project Director will convene a meeting to discuss the particular variance, or the System Manager will provide the required variance analysis to the Cost and Schedule Group

In order to provide early visibility of deviations from the Performance Measurement Baseline, facilitate the development of preventive or corrective action for significant variances, and provide documentation to prepare variance analysis at the System level, the Project Director may select Control Accounts that are driving the cost and schedule variances of the Systems for analysis. Reviewing the monthly Project Management Control System Cost/ Schedule Performance Reports may help the Project Director in selecting the Control Accounts.

Exhibit 3–M, the Variance Analysis Flow Chart, graphically depicts the responsibilities, interfaces, and activities that are to be performed to produce, approve, and monitor

variance analysis and corrective actions. The following pages contain a step-by-step narrative of the Variance Analysis Flow Chart.

## Exhibit 3-M
## Variance Analysis Flow Chart

| Responsible Organization | Step No. | Action/Activity |
|---|---|---|
| DOE/ Project Director/ Cost and Schedule Group | 1 | DOE, Project Director, and the Cost and Schedule Group establish the variance analysis reporting requirements for the LCLS Project. These requirements detail the monthly reporting of variances to DOE included in the Cost/ Schedule Performance Report. |
| Project Director/ System Managers/ Cost and Schedule Group | 2 | The Project Director, System Managers, and the Cost and Schedule Group establish the internal LCLS project variance analysis process. The cornerstone of this is the implementation of the variance analysis discussion at the monthly review meetings chaired by the Project Director. |
| Cost and Schedule Group | 3 | The Cost and Schedule Group issues detail and summary schedule reports to the Project Director and System Managers. |
| LCLS Project Organization | 4 | The LCLS Project Organization review the schedule reports. |
| Project Director | 5 | Project Director reviews the System Schedule Report and selects schedule variance analysis discussion. |
| System Managers | 6 | Selected System Managers present their schedule variance analysis to their Project Director at the monthly review meeting. |

## Procedure (continued)

| Responsible Organization | Step No. | Action/Activity |
|---|---|---|
| Cost and Schedule Group | 7 | The Cost and Schedule Group issues performance reports from the cost processor to the Project Director and System Managers. |
| LCLS Project Organization | 8 | The LCLS Project Organization review the performance reports from the cost processor. |
| Project Director/ Cost and Schedule Group | 9 | The Project Director, with the advice of the Cost and Schedule Group analyzes and determines which Systems will have variance analysis narratives prepared for the Monthly Progress Report. These System Managers will present their variance analysis at the monthly Cost and Schedule Review Meeting. |
| System Managers | 10 | The System Managers prepare variance analysis for their Work Breakdown structure element(s). This variance analysis information is then presented to the Project Director at the Cost and Schedule Review Meeting or a special meeting if required. |
| Cost and Schedule Group | 11 | If required, the Cost and Schedule Group will compile the narrative variance analysis for the Monthly Progress Report by using the variance analysis prepared by the System Managers. (See the Status Assessment and Reporting Procedure). |

## Procedure (continued)

| Responsible Organization | Step No. | Action/Activity |
|---|---|---|
| System Managers | 12 | If required, the System Managers will implement the agreed to corrective action. |
| System Managers | 13 | If required, the System Managers report progress to the corrective action as part of the monthly review meetings with Project Director. The System Manager documents monthly progress to corrective action and impacts to the project at these meetings until the problem is resolved. |
| Project Director/ Cost and Schedule Group | 14 | The Project Director with the assistance of the Cost and Schedule Group monitors the progress of the System Manager in implementing the corrective action as a matter of conducting normal business operations until the problem is resolved. |
| System Managers | 15 | If required, the System Manager revises the corrective action plan based on direction received from LCLS Management. This revised corrective action plan is presented at the following review meeting with the Project Director. |

## EXHIBITS

3–M Variance Analysis Flow Chart

# Procedure

## 3.6 ESTIMATE AT COMPLETION
**(This section is under development)**

### Purpose

This procedure defines the process to be used to initiate, prepare, and report Estimates at Completion (EAC) for the LCLS Project. Estimates at Completion are comprehensive in nature and represent the most current estimate of at completion cost for the work authorized within the project Performance Measurement Baseline.

Conversely, only work authorized within the project Performance Measurement Baseline is included in the Estimate at Completion. The LCLS Project cost policy requires responsible personnel to reduce potential cost growth through evaluation and implementation of design alternatives that result in achieving project technical objectives within the overall project budget.

The LCLS Project cost policy recognizes that it is not possible to remain within the initial cost objectives for every Control Account. Hence, there will be estimates at completion that are above, as well as below the Control Account budget. This procedure provides guidelines and detailed instructions for estimating completion costs. It establishes methods, defines responsibilities and provides example forms and formats for processing and reporting estimated at completion costs.

### General

The Project Management Control System requires the LCLS Project Organization to periodically (as required by the Project Director) develop comprehensive estimates of costs at project completion, referred to as the Estimate at Completion. The Estimate at Completion process focuses on the System Manager (Control Account Manager) to ensure resource requirements are realistic and phased in accordance with projected performance.

The Estimate at Completion is a summation of actual direct and indirect costs to date, allowable to the project, plus an estimate of direct and indirect costs to complete the remaining authorized work. The estimate of costs for remaining

work is referred to as the Estimate to Complete (ETC). Estimate at Completion is equal to Actual Costs plus the Estimate to Complete, i.e., EAC = Actual Costs + ETC.

The scope of work for the Estimate to Complete is consistent with the scope of work initially estimated in the LCLS Detailed Cost Estimate as modified by approved Configuration Management Plan process. Pending/ proposed Configuration Control Board actions (not yet approved) are not included in the scope of work for the Estimate to Complete.

The Estimate to Complete is a time-phased estimate starting in the month the Estimate at Completion analysis is conducted and ending in the month an activity is expected to complete. Normally, the Estimate to Complete is time-phased by month for active Control Accounts and work packages. Beyond that period of time, Cost and Schedule Group may extend the time phasing to quarterly or yearly.

Typical information utilized by the System Manager (Control Account Manager) in developing the Estimate to Complete/ Estimate at Completion includes:

- Performance trends;
- Remaining Work;
- Cost and schedule variances;
- Accomplishments to date;
- Technical complexity;
- Available resources;
- Overtime usage/ projections;
- Material commitments;
- Approved Configuration Control Board actions (scope and/ or schedule);
- Impact due to labor and/ or allocable cost rates; and,
- Resource allocation.

Estimates of remaining effort are examined by the appropriate System Manager to ensure Estimates at Completion are consistent with performance indicators and corrective action plans. At the time the Performance Measurement Baseline is established, the Estimate at Completion is equal to the Budget at Completion for each of the Control Accounts

The Project Director reviews and approves changes to the Estimate at Completion. Estimates at Completion are processed through the Cost and Schedule Group.

## 3.7 Management Reporting

### 3.7.1 Introduction

The objective of the Management Reporting process is to provide the LCLS Project Organization with timely and accurate performance data that is extracted from a common database, in order to facilitate the analysis and evaluation of the performance data and to enable corrective action planning to occur. This objective is met by providing periodic (monthly and/ or quarterly) progress reports that provide the following:

- Periodic analysis of the cost, schedule and technical progress (performance) as measured against the Performance Measurement Baseline as revised by approved Configuration Control Board actions;
- Periodic analysis of cost and schedule performance at the Control Account level which is summarized through the Work Breakdown Structure and the Organizational Breakdown Structures;
- Evaluation of schedule progress, including an analysis of critical paths; and,
- Identification of cost, schedule and at-completion variances which exceed established criteria. These criteria are designed to focus management attention and corrective action on the most significant cumulative to date performance problems.

### 3.7.2 Internal Management Reports

There are many reports available to LCLS Project personnel from the schedule processor and cost processor databases. The performance reports generated by the Project Management Control System and utilized by the LCLS Project Organization fall into the categories of actual cost reports, schedule reports, performance measurement reports, and material commitment reports.

#### 3.7.2.1 Actual Cost Reports

Actual cost detail reports are available from participating institutions. These report typically display charges sorted by Work Breakdown Structure/ work order number.

Managers at all levels of the LCLS Project Organization can review this report to ensure that recorded charges are reasonable and appropriate. Should a questionable charge appear, the responsible individual investigates the source of the charge and, if in error, initiates corrective action.

Material commitments are also provided in these reports. Material commitments are used for several purposes as follows:

- To ensure that material is scheduled to be delivered when needed;
- To compare budgeted values to actual committed values to predict future cost variances; and,
- To calculate the Estimate at Completion for the material element of cost.

#### 3.7.2.2 Performance Measurement Reports

The cost processor utilized on the LCLS Project, produces a wide variety of reports. All System Managers receive, on a monthly basis, the reports which are used for Control Account performance analysis. The three reports that are standard throughout the Laboratory are:

- Schedule Vs Performance Vs Actual; and,
- Control Account Status Report;

Exhibits 3–D and 3–D are examples of these reports. These reports are prepared and sorted by Work Breakdown and Organizational Breakdown Structure elements. Hence, the LCLS Project Organization, to analyze Control Account, as well as organizational component performance uses the reports.

As discussed in Section 3.4 "Performance Analysis and Forecasting", this report provides performance measurement data for the monthly variance analysis and corrective action meetings conducted by the Project Director. Additionally, this data may be plotted to determine performance trends for Work Breakdown Structure and Organizational elements at any desired level.

#### 3.7.2.3 Schedule Reports

Various schedule reports are issued to LCLS Project personnel each month. Each System Manager receives a detail schedule that shows the current progress and latest forecast against the baseline. Each System Manager also receives a summary schedule report that shows critical activities and all level 4 milestones and above. The Project Director is issued the LCLS Project Master Schedule on a monthly basis. The LCLS Project Master Schedule is also distributed project wide.

### 3.7.3 Management Reports

#### 3.7.3.1 Monthly Progress Reports

This report provides a summary of the monthly progress, as well as a summary status of the overall program performance as assessed by the Project Director.

The Monthly Progress Report provides an overview of the major accomplishments and problems experienced by the project in the current reporting period. In addition, a summary status of the overall cost, schedule and technical progress for the current and the previous period is included. The Technical Narrative portion of the Monthly Progress Report describes the technical progress and accomplishments.

#### 3.7.3.2 Cost/ Schedule Performance Report

The Cost/ Schedule Performance Report displays performance measurement data by Work Breakdown Structure for each element at the negotiated reporting level. Current period and cumulative data and the associated variances are displayed. All data elements that make up the cost baseline are included in the current period and cumulative data. (See Exhibit 3–N)

**Variance Analysis:** A narrative discussion of the Project's significant variances (cost or schedule or technical) at the System level of the Work Breakdown Structure are provided each month. Section 3.4.2 contains the guidelines for selecting the variances.

#### 3.7.3.3 Schedule Reports

The LCLS Project Organization provides the latest LCLS Project Master Schedule to DOE on a monthly basis. Other summary schedules are made available upon request.

# Exhibit 3-N
# COST/SCHEDULE PERFORMANCE REPORT

Program:0201 Batch Report:41X_3: Report #3

| Cost Performance Report - Work Breakdown Structure | | | | | | | | | | | | | Run Date: 4/23/02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contractor:<br>Location: | | | | | Contract Type/No: | | | Project Name/No:<br>GLAST LAT Project | | Report Period:<br>2/28/02 3/31/02 | | | |
| Quantity<br>1 | Negotiated Cost<br>0 | | Est. Cost Authorized Unpriced Work<br>0 | | Tgt. Profit/ Fee %<br>0 | Tgt. Price<br>0 | | Est Price<br>0 | Share Ratio | Contract Ceiling<br>0 | Estimated Contract Ceiling<br>0 | | |
| CAPW[3]<br>OBS[1]<br>CAPW[4]<br>CPN[1] | Current Period | | | | | Cumulative to Date | | | | | At Completion | | |
| | Budgeted Cost | | Actual Cost | Variance | | Budgeted Cost | | Actual Cost | Variance | | | Latest | |
| Item | Work Scheduled | Work Performed | Work Performed | Schedule | Cost | Work Scheduled | Work Performed | Work Performed | Schedule | Cost | Budgeted | Revised Estimate | Variance |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| 4.1.4 TRACKER | | | | | | | | | | | | | |
| DL *** SLAC | | | | | | | | | | | | | |
| 4.1.4.1 TRACKER MANAGEMENT | | | | | | | | | | | | | |
| 2600024 4.1.4.1 Tracker Management | 29 | 29 | 26 | 0 | 2 | 470 | 470 | 492 | 0 | ***-22*** | 1,327 | 1,327 | 0 |
| CAPW[4]Totals: | 29 | 29 | 26 | 0 | 2 | 470 | 470 | 492 | 0 | -22 | 1,327 | 1,327 | 0 |
| 4.1.4.2 RELIABILITY & QUALITY ASSURANCE | | | | | | | | | | | | | |
| 2600025 4.1.4.2 Reliability and Quality Assurance | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | -4 | 0 | 0 | 0 |
| CAPW[4]Totals: | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | -4 | 0 | 0 | 0 |
| 4.1.4.3 TRAY SUB-ASSEMBLY | | | | | | | | | | | | | |
| 2600026 4.1.4.3 Tray Sub-Assembly | 0 | 0 | -328 | 0 | 328 | 927 | 927 | 1,300 | 0 | ***-374*** | 927 | 927 | 0 |
| 2600176 4.1.4.3.1 Silicon Strip Detectors (SSD) | 0 | 0 | 6 | 0 | -6 | 360 | 360 | 531 | 0 | ***-171*** | 890 | 890 | 0 |
| 2600177 4.1.4.3.2 Tray Mechanical | 0 | 0 | 11 | 0 | -11 | 0 | 51 | 82 | ***51*** | ***-31*** | 287 | 287 | 0 |
| 2600114 4.1.4.3.3 Tray Electronics | 0 | 0 | 0 | 0 | 0 | 461 | 461 | 319 | 0 | ***142*** | 461 | 461 | 0 |
| 2600178 4.1.4.3.3 Tray Electronics | 129 | 92 | 108 | -37 | -16 | 349 | 231 | 271 | ***-118*** | ***-40*** | 1,091 | 1,091 | 0 |
| 2600179 4.1.4.3.3.A Fab Flt Electronics Mods (SLAC/UCSC) | 2 | 0 | 0 | -2 | 0 | 6 | 4 | 0 | ***-2*** | ***4*** | 932 | 932 | 0 |
| 2600180 4.1.4.3.5 SLAC Assembly Facilities | 2 | 2 | 1 | 0 | 2 | 13 | 13 | 33 | 0 | ***-20*** | 63 | 63 | 0 |
| CAPW[4]Totals: | 133 | 94 | -203 | -38 | 297 | 2,115 | 2,046 | 2,536 | -69 | ***-490*** | 4,651 | 4,651 | 0 |
| 4.1.4.4 TOWER STRUCTURE & ASSEMBLY | | | | | | | | | | | | | |
| 2600181 4.1.4.4 Tower Structure (SLAC) | 70 | 0 | 379 | -70 | -379 | 340 | 270 | 379 | ***-70*** | ***-109*** | 575 | 575 | 0 |
| 2600182 4.1.4.4.3 Tower Assembly | 5 | 0 | 0 | -5 | 0 | 68 | 69 | 2 | ***1*** | ***67*** | 210 | 210 | 0 |
| CAPW[4]Totals: | 74 | 0 | 379 | -74 | -379 | 408 | 340 | 381 | ***-68*** | ***-42*** | 785 | 785 | 0 |
| 4.1.4.5 TRACKER TEST & CALIBRATION | | | | | | | | | | | | | |
| 2600028 4.1.4.5 Tracker Test And Calibration | 59 | 0 | 0 | -59 | 0 | 67 | 13 | 0 | ***-54*** | ***13*** | 263 | 263 | 0 |
| CAPW[4]Totals: | 59 | 0 | 0 | -59 | 0 | 67 | 13 | 0 | ***-54*** | ***13*** | 263 | 263 | 0 |
| 4.1.4.7 INSTRUMENT INTEGRATION & TEST (SLAC) | | | | | | | | | | | | | |
| 2600030 4.1.4.7 Instrument Integration And Test Support | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 217 | 217 | 0 |
| CAPW[4]Totals: | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 217 | 217 | 0 |
| 4.1.4.8 MISSION INTEGRATION & TEST SUPPORT | | | | | | | | | | | | | |
| 2600031 4.1.4.8 Misssion Integration &Test Support | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 30 | 0 |
| CAPW[4]Totals: | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 30 | 0 |
| OBS[1]Totals: | 295 | 123 | 202 | -172 | -80 | 3,060 | 2,868 | 3,413 | -192 | ***-545*** | 7,273 | 7,273 | 0 |
| DU *** UCSC | | | | | | | | | | | | | |
| 4.1.4.1 TRACKER MANAGEMENT | | | | | | | | | | | | | |
| 4141 4.1.4.1 Tracker Management UCSC | 28 | 28 | 11 | 0 | 17 | 669 | 669 | 340 | 0 | ***329*** | 1,937 | 1,937 | 0 |
| CAPW[4]Totals: | 28 | 28 | 11 | 0 | 17 | 669 | 669 | 340 | 0 | ***329*** | 1,937 | 1,937 | 0 |
| 4.1.4.3 TRAY SUB-ASSEMBLY | | | | | | | | | | | | | |
| 4143 4.1.4.3 Tray Sub-Assembly | 3 | 1 | 49 | -2 | -48 | 406 | 337 | 523 | ***-69*** | ***-186*** | 417 | 417 | 0 |
| CAPW[4]Totals: | 3 | 1 | 49 | -2 | -48 | 406 | 337 | 523 | ***-69*** | ***-186*** | 417 | 417 | 0 |
| 4.1.4.4 TOWER STRUCTURE & ASSEMBLY | | | | | | | | | | | | | |
| 4144 4.1.4.4 Tower Structure & Assy (SLAC) | 0 | 0 | 0 | 0 | 0 | 26 | 11 | 0 | ***-15*** | ***11*** | 69 | 69 | 0 |
| CAPW[4]Totals: | 0 | 0 | 0 | 0 | 0 | 26 | 11 | 0 | ***-15*** | ***11*** | 69 | 69 | 0 |

Cobra (R) by WST Legend: Italic=$ threshold exceeded; Underlined=% thresholds; Italic and Underlined=Both Report in

# SECTION 4.0

## 4.0 Performance Measurement Baseline Maintenance

The objective of Performance Measurement Baseline Maintenance is to establish a timely process for incorporating those changes to the approved cost, schedule and technical baselines that impact the Performance Measurement Baseline and associated documents. The Performance Measurement Baseline Maintenance process achieves the following objectives:

- Provide an orderly and disciplined process for incorporating approved Configuration Management Plan items into the Performance Measurement Baseline. (LCLS Project Configuration Management Plan documents the process and procedure for approval of a cost, schedule or technical performance baseline configuration change control request);
- Document and record all approved changes to the Integrated Project Schedule and Project Milestones from Level 1 through Level 4;
- Ensure that Performance Measurement Baseline changes are clearly defined, well documented and approved through a process that clearly delineates the management level required for review and/ or approval;
- Provide accountability and traceability throughout the approval/ decision making process when changes are made to the Performance Measurement Baseline;
- Prohibit retroactive changes to cost and schedule performance data except to correct errors;
- Record all approved change requests and the corresponding Performance Measurement Baseline changes in the Project Baseline Log; and,
- Incorporate all approved changes to the Work Breakdown Structure and the Work Breakdown Structure Dictionary.

### 4.1 Configuration Management Plan

The Configuration Management Plan describes the configuration management responsibilities and processes that support the design and implementation of the LCLS project. Part of the purpose of the Configuration Management Plan is to describe the configuration change control process for the LCLS project. Through the use of the Configuration Management Plan, all proposed changes are

assigned a classification of Class I, Class II, or Class III based on the level of impact to the overall system (See class definitions in Section 3.2 and Figure 4 – Configuration Change Control Process of the Configuration Management Plan). The LCLS Project Management Plan further defines the cost, schedule, and technical reserves under the control of the Project Director in section 3.3 - Configuration Management and Table 4 - LCLS Configuration Change Control Thresholds. The LCLS Project Management Plan lists four levels of configuration change control thresholds.

Class I and Class II changes of the Configuration Management Plan process and proposed changes meeting Level 1, 2, and 3 LCLS Configuration Change Control Thresholds described in the Project Management Plan require Configuration Control Board approval. Changes of these types to the Performance Measurement Baseline are classified in one of four categories:

1) Transfers of budget and work scope within the Performance Measurement Baseline:

   The condition that affects the Control Account's budget at completion is the reassignment of work scope and budget between Control Accounts. This condition occurs when work is transferred from one Work Breakdown Structure element to another or from one organization to another.

2) Rescheduling of activities that affect Project Milestones Level 1 through 3 and/ or revising the baseline scheduled start or completion of a Control Account.

3) Changes to the total value of the Performance Measurement Baseline:

   This type of change involves the application of contingency or the removal of budget to contingency. Either DOE or the LCLS Project Organization may initiate a request for contingency. Application of contingency impacts the Budget at Completion of one or more Control Accounts. Incorporation of these types of changes may require approval by DOE and the subsequent release of the contingency funds (see Section 4.4 for an explanation for the approval authority for contingency changes).

4) Changes to the Total LCLS Cost:

   This type of change involves a directed change in total project work scope by DOE with appropriate funding. Changes to the total project work scope shall not be made without the appropriate change to the Total LCLS Cost.

The action of proceeding with work before Configuration Control Board approval at the appropriate level is allowed by DOE only as an exception. This exception is defined as "A change required to prevent a life threatening

situation." Changes that are critical to the maintenance of schedule should be properly staffed early enough in the process to secure proper levels of approval prior to performing any significant design work to investigate alternatives. No manufacturing, construction or contracting action shall be taken until formal Configuration Control Board approval.

### 4.2 Level 4 Cost or Schedule Changes

The maintenance process described in the following paragraphs describes and supplements the process described in the Configuration Management Plan (latest revision). This supplementary information defines the controls implemented for incorporating changes to the Performance Measurement Baseline and the Integrated Project Schedule that are Class III changes per the Configuration Management Plan and Level 4 per the Project Management Plan change control thresholds (In the case of a conflict, the Configuration Control Plan takes precedence). These types of baseline changes are defined as Routine Replanning.

Routine Replanning of a Control Account may be necessary to restructure the present plan for a variety of reasons as follows:

- Resource Reallocation;
- Technical and/ or Schedule Work Around Plans;
- Conversion of a planning package to a work package(s);
- Make/ Buy Decision; and,
- Revision of detail schedule logic

Specific changes of this nature which are accomplished within the established parameters of the Work Authorization Agreement are:

1) Replanning unopened work packages as long as:
    - Work package total budget is not changed;
    - No Level 3 or higher level Milestones are affected; and,
    - Budget within a fiscal year is not changed.
2) Replanning open work packages as long as:
    - Current month is not affected;
    - Work package total budget does not change;
    - The completion date of the work package is not changed; and,
    - No level 3 or higher level Milestones are affected.

These types of changes are classified as routine replanning. As such, this type of change is approved by the System Manager and does not require a higher level of change control approval.

The System Manager completes and forwards a configuration change request form (Exhibit 4–A) to the Cost and Schedule Group indicating the actions to be taken. The Cost and Schedule Group reviews the action for compliance with the provisions of routine replanning and subsequently incorporates the change. The System Manager retains the prior versions of the Control Account planning documents to provide a documented audit trail.

### 4.3 Contingency Management

The PCM is responsible for administering formal configuration change control procedures to maintain the integrity of the baseline. Control Account and work package planning guidance and procedures exist to assure that this integrity is maintained at the performing level as well. As the project progresses, there will likely be events and conditions that necessitate changes be made to the cost, schedule and technical baselines. This will be accomplished in compliance with the LCLS Configuration Management Plan. Revisions to the performance measurement baseline are classified into one of three categories, with differing levels of configuration change control required. The control processes are described in the Configuration Management Plan.

### 4.4 Approving and Incorporating Revisions

The primary objectives of the approval process are:

1) Ensure that all changes to the Performance Measurement Baseline, and the Integrated Project Schedule are processed in accordance with the provisions of this section.
2) Ensure that only appropriately approved changes are incorporated into the Integrated Project Schedule and the Performance Measurement Baseline.
3) Provide a process for DOE/ Project Director to authorize the use of contingency funds and to ensure that the Performance Measurement Baseline are revised in accordance with this configuration change control process.

Revisions may not be incorporated into the technical, schedule or cost baselines, until the Configuration Change Request form has been approved by the highest required approval authority.

Approved changes to the Performance Measurement Baseline are incorporated as soon as possible, but in no case later than 60 days after approval. Once a request has been approved, all affected documents must be revised and the transaction is recorded in the Project Configuration Change Control Log.

Revised documents are annotated with the configuration change control number and date of the change to provide an audit trail of all baseline changes. Documents and systems that must be reviewed and revised as appropriate are as follows:

- Work Authorization Agreement (If necessary, an approved Change Request attached to the original Work Authorization will provide an audit trail);
- Project Schedules;
- The Work Breakdown Structure;
- The Work Breakdown Structure Dictionary; and,
- The Cost Processor database

### 4.5 Project Baseline Change Control Log

The Project Baseline Change Control Log is the primary vehicle for tracking the Performance Measurement Baseline changes for the LCLS Project. The Project Change Control Log is maintained within the Cost and Schedule Group. (See Exhibit 2–I in Section 2.7.)

# EXHIBIT 4-A
# BASELINE CHANGE REQUEST FORM


| LCLS Project | Baseline Change Request (BCR) | CR No. BCR-XX-XX | LEVEL 4 |
|---|---|---|---|
| ORIGINATOR: | PHONE: | DATE: | |
| CHANGE TITLE: | | | |
| BCR JUSTIFICATION: | | | |

Enter Text Here

IMPACTS (ESTIMATE THE IMPACTS OF IMPLEMENTING OR NOT IMPLEMENTING THE PROPOSED CHANGE):

COST:

| Description | WBS | Work Pkg No. | Thru FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | TOTAL |
|---|---|---|---|---|---|---|---|---|
| Current Baseline | | | | | | | | 0 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Proposed Baseline | | | | | | | | 0 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Total Increase (Decrease) to Baseline | | | | | | | | 0 |

SCHEDULE (any impact on critical path(s)? What about impacts to adjoining systems?):

Enter Text Here

TECHNICAL (any impact on the LCLS Parameters?):

Enter Text Here

INTEGRATION (any impact on the global LCLS (controls, alignment, commissioning)? What about impacts to adjoining systems?)

Enter Text Here

Other (specify – i.e. ES&H, Spares, Quality, Procurements, etc. ):

Enter Text Here


| LCLS Project | Baseline Change Request (BCR) | CR No. BCR-XX-XX | LEVEL 4 |
|---|---|---|---|
| CCB ACTION: ☐ APPROVE ☐ REJECT ☐ OTHER | | | |
| EXPLANATION: | | | |

| APPROVALS: | NAME | SIGNATURE | DATE |
|---|---|---|---|
| **LEVEL 2** | | | |
| DOE Federal Project Director | H. Lee | | |
| | | | |
| **CCB MEMBERS (SIGNATURES AS REQUIRED)** | | | |
| **LEVEL 3** | | | |
| Project Director | J. Galayda | | |
| Chief Engineer | M. Reichanadter | | |
| | | | |
| **LEVEL 4** | | | |
| Injector System Manager | D. Dowell | | |
| Linac System Manager | E. Bong | | |
| Undulator System Manager | S. Milton | | |
| X-ray Transport, Optics and Diagnostics System Manager | R. Bionta | | |
| X-Ray Emission System Manager | J. Arthur | | |
| Conventional Facilities System Manager | D. Saenz | | |
| Global Controls Manager | B. Dalesio | | |
| | | | |
| **Affected Cost Account Managers** | | | |
| Cost Account Manager (CAM) | | | |
| Cost Account Manager (CAM) | | | |
| Cost Account Manager (CAM) | | | |
| | | | |
| **OTHER** | | | |
| Cost & Schedule Manager | | | |
| System Physicist Liason | | | |
| ES&H Officer (if applicable) | | | |
| Procurement Officer (if applicable) | | | |