	Document #	Date Effective
LAT MANAGEMENT DOCUMENT	**LAT-MD-00217-01**	June 25, 2002
	Author(s): AIM	Supersedes:
	System or Management Office: Instrument Project Office	
Document Title: **LAT Project Management Control System Description**		

DRAFT

LAT Project Management Control System Description

Prepared for the US Department of Energy (DOE) and National Aeronautics and Space Administration (NASA) under contract numbers:

DOE	Contract# DE-AC03-76SF00515 Project# KA050102-EQU01CC
NASA	Contract #NAS5-00147

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

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List of Acronyms

Abbreviation	Definition
ACT+COM	ACWP + Outstanding Commitments
ACTUALS	ACWP
ACWP	Actual Cost of Work Performed
BAC	Budget at Completion
BCWP	Budgeted Cost of Work Performed
BCWS	Budgeted Cost of Work Scheduled
BE	Budget Element
BUD+COM	BCWS + Planned Commitments
CAM	Cost Account Manager
CAP	Cost Account Plan
CAPW	Code Field Name for CAP Work Breakdown Structure
CCB	Configuration Control Board
CPI	Cost Performance Index
CPN	Code Field Name for Work Packages
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
GSFC	NASA Goddard Space Flight Center
HEPL	Hanson Experimental Physics Laboratory
LOE	Level of Effort
LRE	Latest Revised Estimate (EAC)
M&S	Materials & Services
MLEV	Milestone Level
NASA	National Aeronautics and Space Administration
NRL	Naval Research Laboratory
OBS	Organizational Breakdown Structure
PLANNED	BCWS
PMB	Performance Measurement Baseline
PMCS	Project Management Control System
PMT	Performance Measurement Techniques

List of Acronyms (cont)

Abbreviation	Definition
SLAC	Stanford Linear Accelerator Center
SPI	Schedule Performance Index
SSU	Sonoma State University
SV	Schedule Variance
UCSC	University of California at Santa Cruz
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

Exhibit List

SECTION 1.0

1.0 INTRODUCTION

The Gamma-ray Large Area Space Telescope (GLAST) Mission is a program involving both NASA and DOE in several different relationships. NASA is responsible for the overall GLAST mission, including the integrated GLAST observatory and ground systems, the spacecraft and the interfaces to the scientific instruments. NASA and DOE are responsible for funding committed to the GLAST Large Area Telescope (LAT) Project and for execution of the program represented by that funding. The GLAST Mission is managed by NASA's Goddard Space Flight Center (GSFC) through the GSFC GLAST Project Office.

This document outlines the processes and procedures utilized by the LAT Project Organization to assist in the management of the Gamma-ray Large Area Space Telescope Project (hereafter referred to as the LAT Project). The Project Management Control System (PMCS) provides the information for effective management of the LAT 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 LAT Project, while complying with these government and project directives.

- DOE Order # O 413.3 – Program and Project Management for the Acquisition of Capital Assets
- NASA Procedures and Guidelines (NPG) 7120.5A – NASA Program and Project Management Process and Requirements
- American National Standards Institute (ANSI) / Electronic Industries Alliance (EIA) Standard 748 – Earned Value Management Systems
- LAT Project Management Plan - LAT-MD-00054
- LAT Configuration Management Plan - LAT-MD-00068

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 LAT Project requirements;
- Provide for the orderly and systematic authorization of work, and project budget for the LAT 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 LAT Collaboration

The LAT Collaboration is an international collaboration that includes scientists from laboratories in France, Italy, Japan, Sweden, as well as scientists from Stanford Linear Accelerator Center (SLAC), which is a DOE federally-funded R&D facility at Stanford University, Stanford University, University of California at Santa Cruz (UCSC), University of Washington (UW), Sonoma State University (SSU), the Naval Research Laboratory, and GSFC's Laboratory for High Energy Astrophysics. The NASA funding of work at Stanford University on the LAT Project is carried out under contract NAS 5-00147. SLAC is operated by Stanford University under contract DE-AC03-76SF00515 with the U.S. Department of Energy. Activities at SLAC on the LAT Project are authorized under DOE Project Number KA050102-EQU01CC. The members of the LAT Collaboration receive their funding from their respective funding agencies, including DOE, NASA, and foreign funding agencies.

1.1.2 LAT Management

The LAT 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 Instrument Principal Investigator (IPI)

The IPI is responsible for all scientific, technical, organizational and financial affairs of the collaboration and is the ultimate authority within the LAT team for all decisions concerning the instrument development. The IPI is responsible for the overall development and delivery of the LAT, 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 instrument. The IPI is also the Spokesperson for the Collaboration.

1.1.4 Instrument Project Manager (IPM)

Decision-making authority flows from the IPI to the Instrument Project Manager (IPM) by delegation of all day-to-day decision-making and authority with regard to management of technical, cost, and schedule issues. The IPM manages the engineering development and delivery of the instrument, and ensures

compliance to cost, schedule, and technical performance. The IPM reports to the IPI.

1.1.5 Subsystem Managers

The subsystem managers are responsible for all aspects of development of their respective instrument and supporting ground subsystems. The subsystem managers direct and manage the efforts of the subsystem team members. Specific roles of individual subsystem managers are described in the PMP. The Subsystem Managers report to the IPM.

Subsystem Managers are referred to as Control Account Managers throughout this document. They are the managers in the LAT 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, subsystem 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 LAT 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 LAT team and sponsors. The PCM is responsible for supporting the work of the subsystem 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 Instrument Project Office (IPO) for all team member institutions. The Subsystem Managers are responsible for reporting cost and schedule data to the PCM. The PCM reports to the IPM.

The PCM is the leader of the Cost and Schedule Group within the IPO. The Cost and Schedule Group is the Instrument Project Manager'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 GLAST 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 Processor Databases with information provided by the LAT 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 Instrument Project Manager and the Subsystem 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 LAT Project Organization is displayed in Exhibit 1–A.

1.2.1 Baseline Development Process

The baseline for the LAT Project is provided in a series of documents that define the project scope, establish the baseline estimate of cost and project schedule, and contains the plan for completing the Project.The definition of the Project work scope is contained in the NASA Proposal AO 99-OSS-03, Dated November 1999 and supplementary documentation. 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 LAT Project Organization.

1.2.1.1 Cost Estimating

The Cost and Schedule Group of the LAT 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, that contains a level of detail consistent with DOE / NASA 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 LAT 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. The NASA Proposal AO 99-OSS-03 and

supplementary documentation provide the basis for the Work Breakdown Structure Dictionary. 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 Instrument Project Manager and communicated to the appropriate Subsystem Manager. The work authorization agreement from the Instrument Project Manager to the responsible Subsystem Managers consists of the statement of work, budget, and funding amounts. Charge Numbers are issued to provide employees of each institution involved in the LAT 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 subsystems and Control Accounts as well as at the total Project level.

The Instrument Project Office (IPO) 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 (IPO) 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 SU-SLAC, the University of California at Santa Cruz (UCSC), Goddard Space Flight Center (GSFC), Naval Research Laboratory (NRL), and Sonoma State University (SSU) that serve the Project. The financial accounting system provides monthly and ad hoc reports that portray the LAT 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 LAT 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 Subsystem Managers and the IPO 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. Subsystem Managers develop an Estimate to Complete for all Project work during formal Estimate at Completion reviews requested by the Instrument Project Manager.

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 LAT 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 Subsystem 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 Subsystem Managers and the IPO. 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/NASA 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 LAT 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

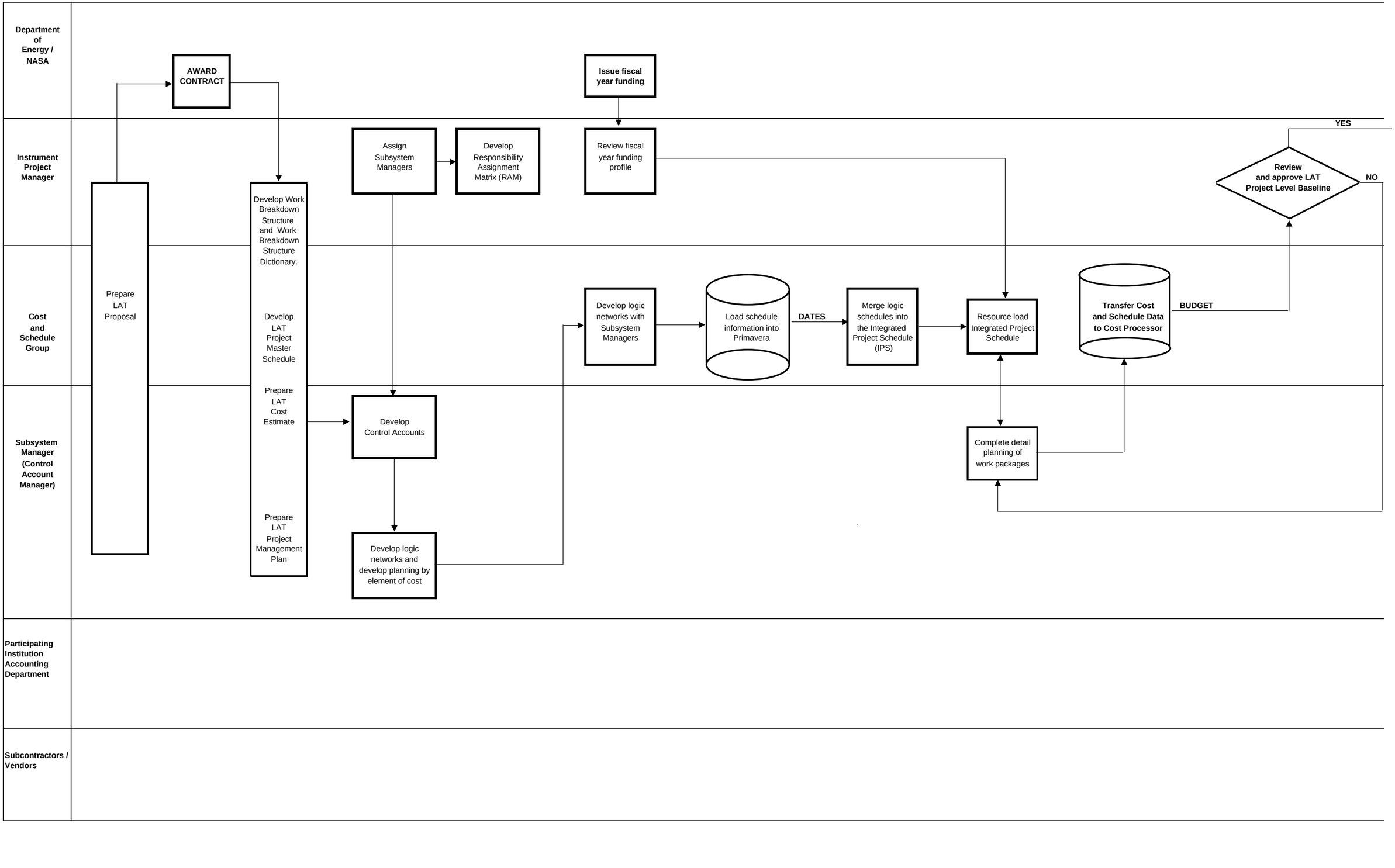
As the LAT Project progresses, there are events and conditions that necessitate changes be made to the cost, schedule and technical baseline(s). The Performance Measurement Baseline Maintenance process, which operates subordinate to the Project Configuration Control Plan, is used to coordinate the configuration 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 LAT 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 LAT Configuration Management Plan provides the details and approval process for making revisions. Cost, schedule, and technical reserves are under the control of the Instrument Project Manager as defined in the LAT Project Management Plan section 3.3 in Table 4, LAT Project Configuration Control Thresholds.

Exhibit 1-A
PMCS Overview Flow Chart

Exhibit 1-A

BASELINE DEVELOPMENT



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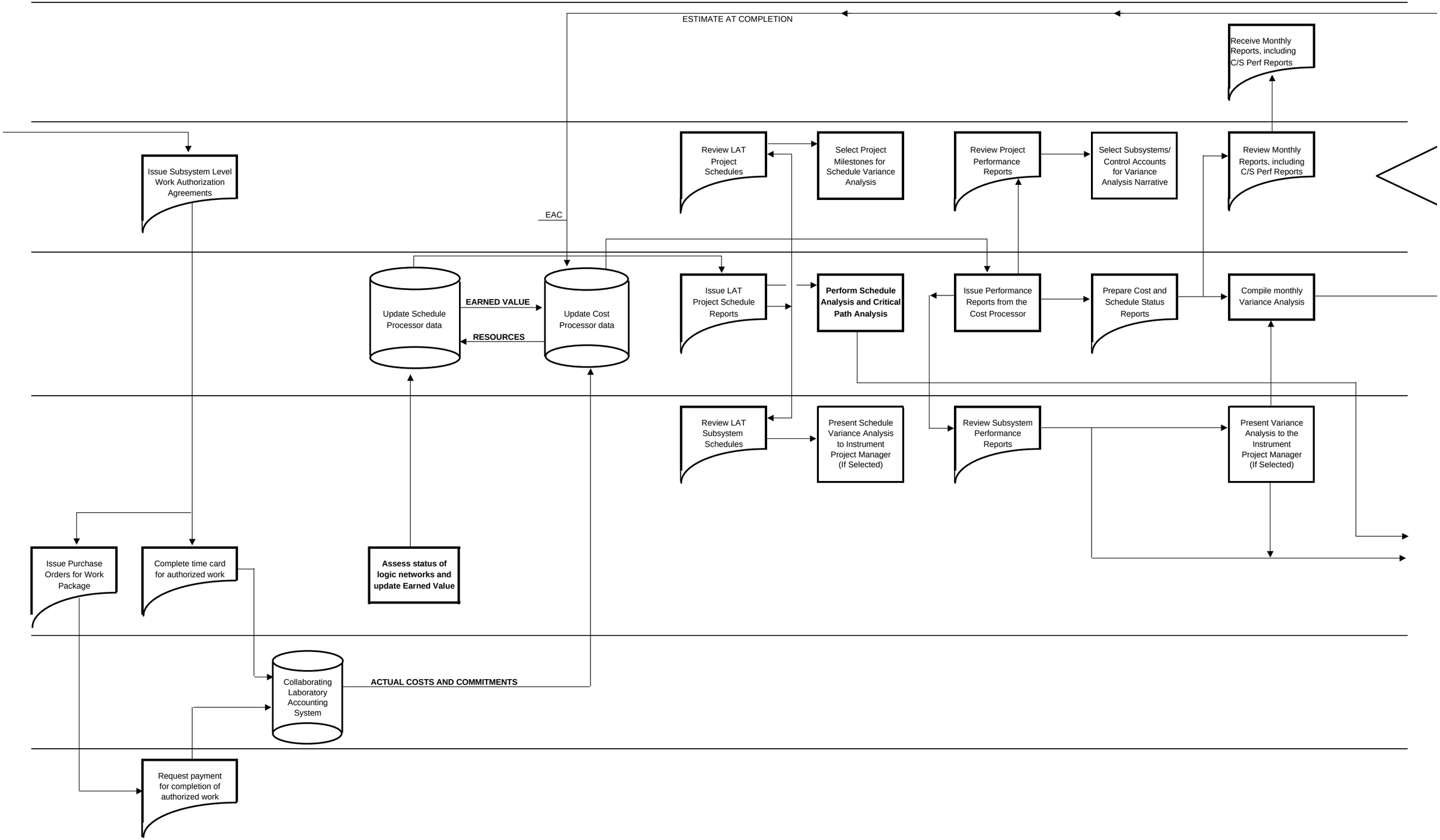
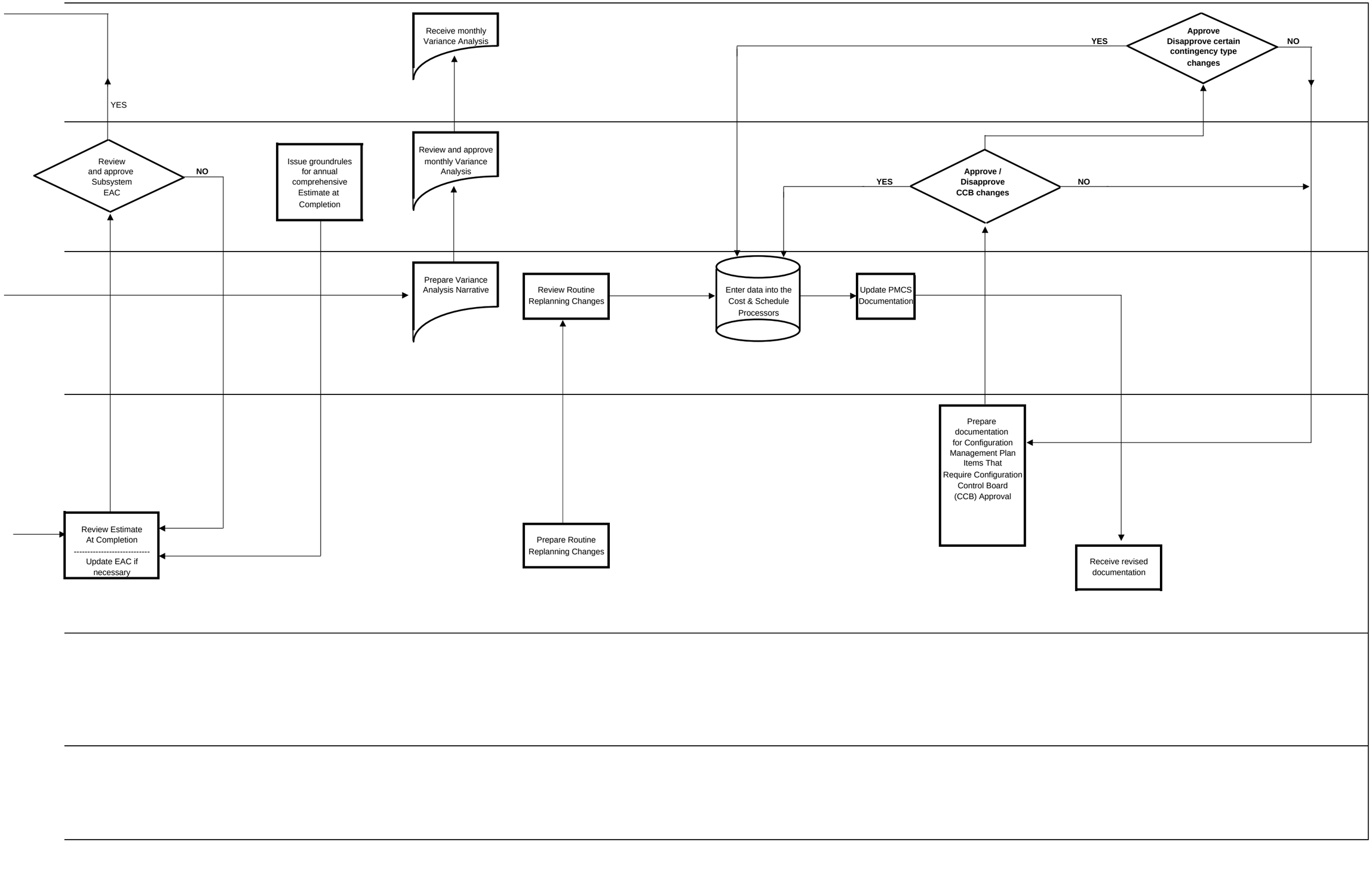


PERFORMANCE MEASUREMENT BASELINE MAINTENANCE



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 LAT Cost Estimate;
2) The NASA Proposal AO 99-OSS-03 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 NASA Proposal AO 99-OSS-03 (subsequently referred to in this document as the LAT 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 LAT 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 Instrument Project Manager authorizes the work to the applicable responsible Subsystem 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 LAT 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 LAT Cost Estimate-information to the Instrument Project Manager for issuance of budgets to the Subsystem 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 LAT Cost Estimate

The LAT Cost Estimate originated in November 1999 with a Department of Energy request to define the Project scope, establish the baseline estimate of cost and schedule for the LAT Project, and develop a plan for completing the project.

This report was the LAT Cost Estimating Plan. The LAT collaboration produced a comprehensive and detailed cost estimate for the development and equipment fabrication. The Cost Estimating Plan 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 LAT 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 2000 to FY2006.

2.1.2.2 Basis

The basis for the LAT Cost Estimate was a detailed bottom-up estimate for each subsystem. These estimates were based on FY99 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 subsystems and divides each of those subsystems 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 Subsystem 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 subsystem costs. The Subsystem Managers have kept the documentation for the basis of the LAT Cost Estimate.

2.1.2.3 Costing Methodology

There were two ways in which the LAT Cost Estimate was compiled for developing the baseline. Initially, a Microsoft Excel database was 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 subsystem was compiled into the schedule processor for preparation of all subsystem cost reports.

2.1.2.4 Risk Analysis Contingency

The LAT 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 LAT 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 Configuration Management Plan, traceability to the initial cost assumptions associated with the conceptual design estimate are maintained.

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

The LAT Proposal forms the initial LAT Project technical baseline. Subsequently, the technical baseline consists of the approved documentation used to define the physical and functional requirements of the system and subsystems, 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 Configuration Management 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 LAT Summary Level Work Breakdown Structure.

The Work Breakdown Structure for the LAT 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 LAT 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 LAT Proposal and supplementary documentation;
- 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 LAT Project management. Exhibit 2-A is an extract from the LAT 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 LAT Project organization that has been established. Exhibit 2-C is an extract from the LAT 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 LAT 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 LAT Subsystem 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 LAT 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, Material and Services, Travel, and GSFC taxes (three characteristics of which the first two are the same as the organization code; 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 Instrument Project Manager and communicated to the appropriate responsible Subsystem Manager. This process allows the responsible Subsystem 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 LAT Project:

(1) Instrument Project Manager to Subsystem 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 Instrument Project Manager authorizes the responsible Subsystem Manager (Control Account Manager) at the third level of the Work Breakdown Structure. Subsequently, each Subsystem 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 Subsystem 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 Instrument Project Manager 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 Instrument Project Manager'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 Subsystem Manager for review. Once both have agreed to the contents of the Work Authorization Agreement, the Instrument Project Manager and the Subsystem 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
LAT ORGANIZATION CHART

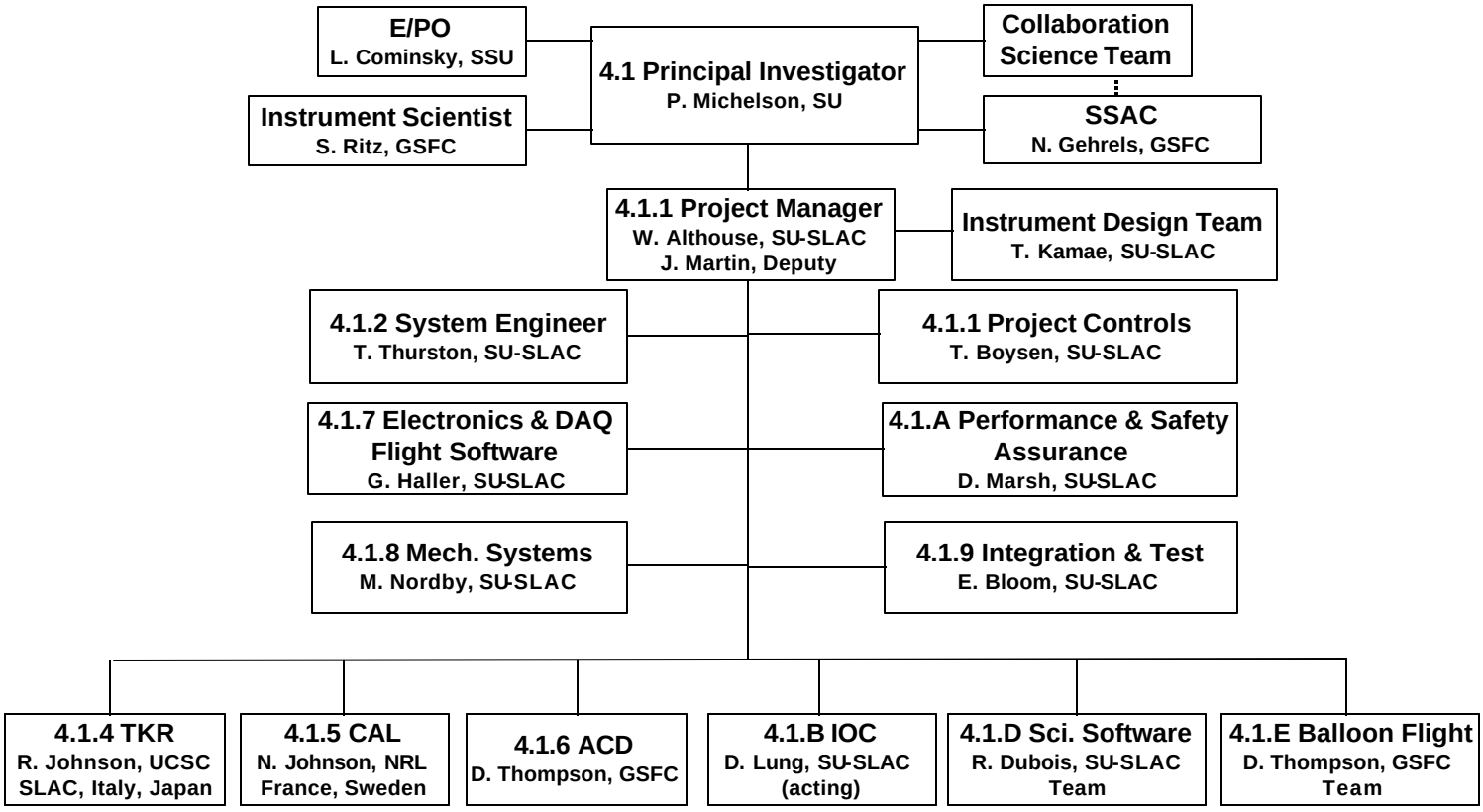


EXHIBIT 2-B
LAT SUMMARY LEVEL WORK BREAKDOWN STRUCTURE
(WBS Level 4 and Dictionary)

GLAST/LAT Work Breakdown Structure

WBS	Task	Description	Responsibility	Manager
4.1	**GLAST LAT**	**All effort, materials and services required by the LAT team during formulation and hardware phases, from selection announcement (February, 2000) through launch. In... instrument hardware and software development, fa... integration, test, calibration, and delivery; ground s... software development (including equipment & soft... launch data handling and analysis); supporting management and administration, systems engineering, performance and safety assurance, education & public outreach; support after delivery of the LAT instrument to the observatory contractor; and a balloon flight prototype test and other prototyping activities.**	**Stanford**	**Michelson**
4.1.1	**Instrument Management**	**All effort by the Instrument Principal Investigator, Instrument Project Manager, Instrument Technical Manager, and Instrument Scientist, including cost and schedule control (PMCS) management & staff, administrative support for the Instrument Project Office at SLAC and on the Stanford campus, and associated supplies, equipment, consultants and travel.**	**Stanford**	**Althouse**
4.1.1.1	Project Management	Provide the direction to complete the GLAST scientific investigation, and development of the LAT flight instrument and supporting elements. Includes the LAT Instrument Principal Investigator and administrative support at the Stanford campus, as well as the Instrument Project Manager, Instrument Technical Manager, and administrative support at SLAC, and associated supplies, equipment, consultants, and travel.	Stanford	Althouse
4.1.1.2	Cost & Schedule Control	Provide project control to develop and maintain instrument project master schedule and budget. Track actual costs (for DOE and NASA-funded activities) and schedule performance of all subsystems and institutions, and analyze performance compared to budget via the Project Management Control System (PMCS).	SLAC	Boysen
4.1.1.3	Instrument Scientist	In consultation with, and at the direction of, the LAT PI and LAT project office, the Instrument Scientist sets policy and plans: observation methodology, background rejection, onboard science, requirements and interface analysis, science operations planning and review, instrument calibration, instrument integration and test planning and review, observatory integration and test planning and review.	GSFC	Ritz
4.1.1.4	Science Preparation	Perform studies of observation and analysis methods, background, source characteristics (both point and diffuse emissions), AGN and GRB transient detection and analysis, and other generally related science issues as directed by the PI.	SLAC	Althouse

EXHIBIT 2-C
LAT Resource Assignment Matrix

WBS ELEMENT		INSTITUTIONS (LEAD)	
4.1	LAT implementation	SU (Michelson)	
4.1.1	Management	SU-SLAC (Althouse)	Team
4.1.2	System Engineering	SU-SLAC (Thurston)	
4.1.3	(reserved)		
4.1.4	Tracker	UCSC/SCIPP (R. Johnson)	INFN, JGC, SU-SLAC
4.1.5	Calorimeter	NRL (N. Johnson)	French Team, SGC
4.1.6	AntiCoincidence Detector	GSFC/LHEA (Thompson)	
4.1.7	Electronics, Data Acquisition & Flight Software	SU-SLAC (Haller)	CEA/DAPNIA, GSFC/LHEA, NRL, SU-HEPL, TAMUK
4.1.8	Mechanical Systems	SU-SLAC (Nordby)	
4.1.9	Instrument Integration & Test	SU-SLAC (Bloom)	Team
4.1.A	Performance & Safety Assurance	SU-SLAC (Marsh)	Team
4.1.B	Instrument Operations Center	SU-SLAC (Lung - acting)	
4.1.C	Education & Public Outreach	SSU (Cominsky)	Team
4.1.D	Science Analysis Software	SU-SLAC (Dubois)	Team
4.1.E	Suborbital Flight Test	GSFC/LHEA (Thompson)	NRL, SU-HEPL, SU-SLAC, UCSC/SCIPP
8.X	Mission Ops and Data Analysis	(WBS under development)	

Exhibit 2-D
LAT Project Cost Accumulation Structure

WBS	OBS	WPNO	BE	Cumulative Actual Dollars	Cumulative Actual Hours	COST_TYPE	Period Ending_DATE
						AC	
						AC	
						AC	
						AC	
						AC	
						AC	
						AC	
						AC	
Total				0.00	0		

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

OBS Organizational Breakdown Structure

PARTICIPATING INSTITUTIONS

U.S. Domestic
DG GFSC
DH SU HEPL
DL SU SLAC
DN NRL
DS SSU
DU UCSC
DW University of Washington

France
FD CEA/DAPNIA
FL IN2P3/LPNHEX
FP IN2P3/PCC
FC IN2P3/CENBG

Italy
IN INFN Italy
IA ASI
IC IFC/CNR
IB University of Bari
IG University of Perugia
IP University of Pisa
IR University of Rome 2

Japan
JT University of Tokyo
JC ICRR
JS ISAS
JH Hiroshima University

Sweden
SK KTH Sweden
SS Stockholms Universitet

WPNO Work Package Number
Charge Number where Budget Elements are assigned actual costs

BE Budget Element
Labor
Material & Services (excluding Travel)
Travel

The Budget Element distinguishes between Labor, Material & Services (excluding Travel), and Travel for each OBS. The code for the Budget Element contains three characters. The first two characters are the same as the OBS. The third character is either L (Labor), O (Material & Services excluding Travel), and T (Travel).

Example: GFSC
DGL GFSC Labor
DGO GFSC Material & Services (excluding Travel)
DGT GFSC Travel

Cumulative Actual Dollars
Cumulative Burdened Dollars charged to a Work Package

Cumulative Actual Hours
Cumulative Labor Hours charged to a Work Package

COST_TYPE
AC Actual Cost

Period Ending DATE
Institution's Accounting Period close date

EXHIBIT 2-E
LAT WORK AUTHORIZATION AGREEMENT

GLAST-LAT PROJECT
WORK AUTHORIZATION AGREEMENT

WBS #: 4.1.4	**WBS Title:** Tracker	**Work Pkg. #:** All	**Document No.:** LAT-MD-00478-01	**Date:** 12/13/01

ORIGINATOR	**RECEIVER**
Name: Bill Althouse x (Signature on original) Approval	**Name:** Robert Johnson x (Signature pending) Approval
TOTAL PROGRAM BUDGET	
Total Budget: $ 9,681 **($000)** **Schedule Start Date:** April 1, 2000	**Net Change:** $ N/A **This Revision** **Schedule Completion Date:** March 30, 2006
FISCAL YEAR FUNDS	
FY:2002 **Budget:** $ 2,693 **($000)** **Schedule Start Date:** October 1, 2001	**Net Change:** $ N/A **This Revision** **Schedule Completion Date:**September 30, 2002

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 4.1.4 Tracker as outlined in the GLAST/LAT Work Breakdown Structure (LAT-MD-00033-05). Expenditure of funds, however, is limited to the cumulative value of the funds authorized through FY 2002.

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

Prepared by:Tanya Boysen E-mail: tkb@slac.stanford.edu Tel #: (650) 926-5461

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 LAT 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/NASA, the Instrument Principal Investigator, Instrument Project Manager, Subsystem 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 LAT 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 LAT Cost Estimate.

2.3.2 Scheduling Methodology

The Integrated Project Schedule is the primary tool used by the LAT Project to integrate all work for the entire project and to develop the Performance Measurement Baseline. The primary objective in developing the LAT Integrated Project Schedule and the detailed system and subsystem 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 Subsystem 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 (Subsystem Manager), the Instrument Project Manager, and the Instrument Principal Investigator;
- 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 LAT 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 / NASA.

LEVEL	**ORGANIZATIONAL RESPONSIBILITY**
Milestone Level - 1	Controlled by the DOE Headquarters
Milestone Level - 2	Controlled by the DOE / NASA Project Manager
Milestone Level - 3	Controlled by the Instrument Project Manager
Milestone Level - 4	Controlled by the Subsystem Manager
Milestone Level - 5	Not in use

2.3.2.2 Detail Schedules

Control Account (subsystem) 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 LAT 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.;
- NASA Proposal AO 99-OSS-03;
- 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 (Subsystem Manager) effort for each system, subsystem 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 Instrument Project Manager, 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 Instrument Project Manager, as well as by the Instrument Principal Investigator 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 (Subsystem) 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:

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

However, summary schedule reports may be generated at the subsystem 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 LAT 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 / NASA to manage and control the schedule baseline use the LAT Project Master Schedule. As such, it contains all DOE / NASA controlled milestones, a DOE / NASA approval block and revision number assignment.

2.3.3.2 Intermediate Schedules

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

2.3.4 Milestone Dictionary

The LAT Cost and Schedule Group maintains a milestone dictionary for the LAT Project. The dictionary contains all milestone levels from Level 1 controlled by the DOE / NASA through Level 4 controlled by the LAT Subsystem 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 LAT 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 LAT Project:

4.1.1 Instrument Management
4.1.2 Systems Engineering
4.1.3 (Reserved)
4.1.4 Tracker
4.1.5 Calorimeter
4.1.6 Anti-Coincidence Detector (ACD)
4.1.7 Electronics
4.1.8 Mechanical Systems
4.1.9 Instrument Integration & Testing
4.1.A Performance & Safety Assurance
4.1.B Instrument Operations Center
4.1.C Education & Public Outreach
4.1.D Science Analysis Software
4.1.E Sub-orbital Flight Testing

Control Account Manager

The Control Account Manager (Subsystem Manager) determines the sufficiency of detail for those activities within the critical path method network. He schedules each Work Breakdown Structure level 3 Subsystem 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 subsystem 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 engineer's and Instrument Principal Investigator'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 Plan**
Activity Code 2	**Organization Breakdown Structure (OBS) - Responsible Institution**
Activity Code 3	**Funding Source:** Collaborators – C; DOE – D; NASA – N; SLAC – S
Activity Code 4	**Work Breakdown Structure (WBS) at the 3rd Level**
Activity Code 5	**Work Breakdown Structure (WBS) at the 4th Level**
Activity Code 6	**Work Breakdown Structure (WBS) at the 5th Level**
Activity Code 7	**Work Breakdown Structure (WBS) at the 6th Level**
Activity Code 8	**Phase** — Used to describe the particular phase that a task is associated.
Activity Code 9	**Work Package Number** — Associated work package number from the Cost Accumulation Structure.
Activity Code 10	**Responsible Party** — Manager / Organization assigned to oversee a group of tasks.
Activity Code 11	**Milestone Level** — Indication of the level of authority required for change. See paragraph 2.4.2.1.
Activity Code 12	**EV Technique:** 50 / 50 – E; LOE - A
Activity Code 13	**Not Used**
Activity Code 14	**Available Milestone** — Indicates the milestone type.
Activity Code 15	**Need Milestone**

Activity Code 16 **Summary Schedule:** Identifies the corresponding summary schedule

Activity Code 17 **Configuration Change Control Number –** Identifies the number assigned to the revision

Activity ID Code 1 **Project ID –** Identifies the subproject. First 2 digits of all activities

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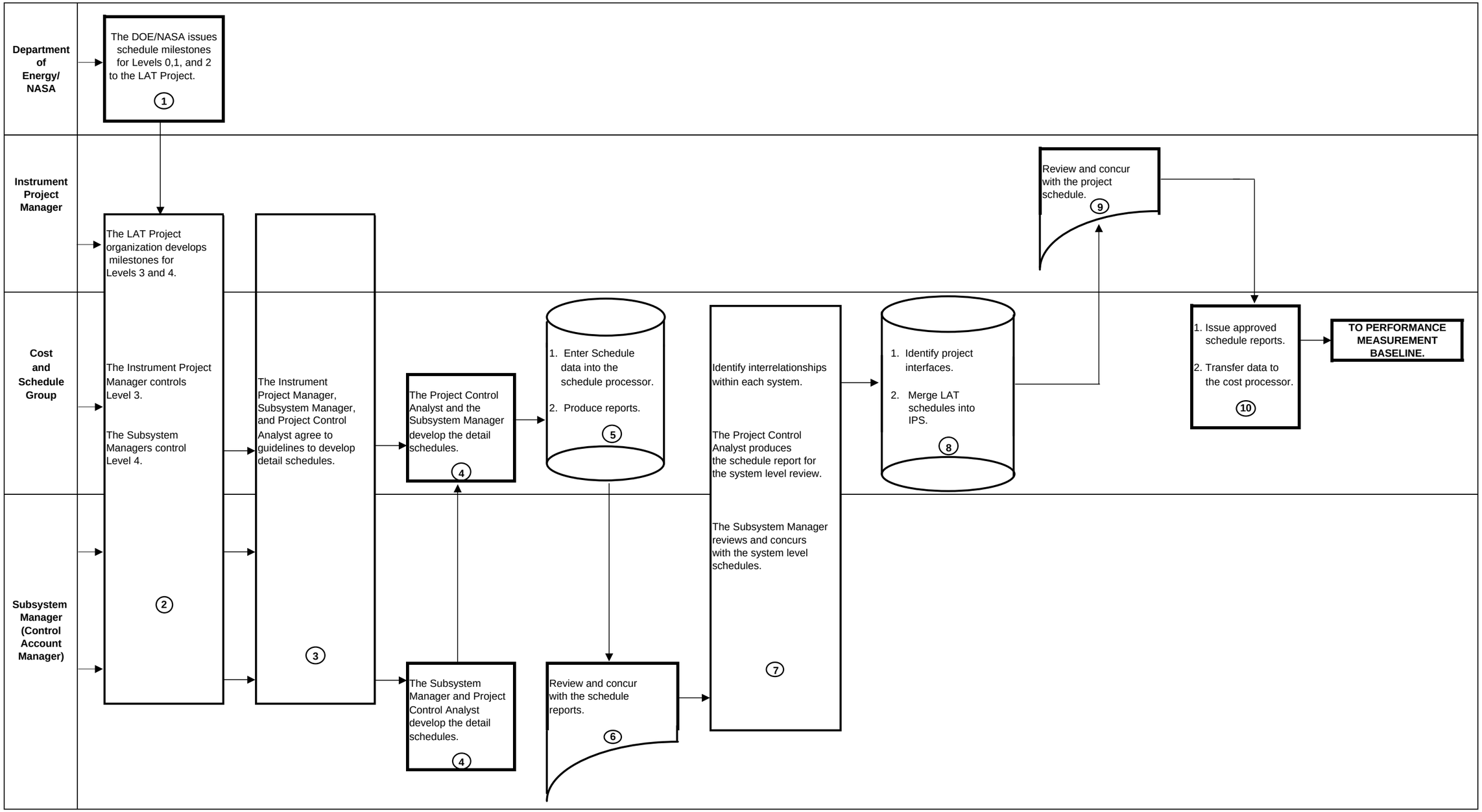
The Schedule Development Flow Chart graphically depicting the responsibilities, interfaces, and activities that are to be performed to produce the various schedules for the LAT Project is shown in Exhibit 2–F. The following pages contain a step-by-step narrative of Exhibit 2–F, the Schedule Development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

Exhibit 2-F
Schedule Development Flow Chart

SCHEDULE DEVELOPMENT FLOW CHART
Exhibit 2-F

Exhibit 2-F



Procedure

Responsible Organization	Step No.	Action/Activity
DOE / NASA	1	DOE / NASA issues the schedule for Milestone Levels 1 and 2 to the LAT Project. DOE Headquarters controls schedule milestones at Milestone Level 1, and the DOE / NASA Project Managers control the schedule milestones at Milestone Level 2.
Instrument Principal Investigator / Instrument Project Manager / Subsystem Managers / Cost and Schedule Group	2	The LAT IPO develops the schedule milestones for Milestone Levels 3 and 4. The Instrument Project Manager approves the completion of milestones at level 3, and Subsystem Managers control milestones at level 4.
Instrument Project Manager / Subsystem Managers / Cost and Schedule Group	3	The Instrument Project Manager, Subsystem Manager, and the Project Control Analyst agree to the guidelines under which each subsystem detail schedule will be developed.
Subsystem Managers / Project Control Analyst	4	The Project Control Analyst meets with each Subsystem 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 LAT Cost Estimate as a guide.

Procedure (continued)

Responsible Organization	Step No.	Action/Activity
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. The Project Control Analyst produces schedule reports for the Control Account.
Subsystem Manager	6	The Subsystem 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.
Instrument Project Manager / Subsystem Managers / Project Control Analyst	7	An Integration meeting is held with the Instrument Project Manager, Subsystem 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. The Subsystem 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.

Procedure (continued)

Responsible Organization	Step No.	Action/Activity
Cost and Schedule Group	8	The Cost and Schedule Group identify the interface relationships between the various systems within the LAT Project. The system schedules are then merged into an overall LAT 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 Instrument Project Manager's review.
Instrument Project Manager	9	The Instrument Project 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	10	The Cost and Schedule Group issues the approved schedule reports from the Integrated Project Schedule database to the appropriate LAT Project personnel.

Exhibits

2–F Schedule Development Flowchart

2.5 Performance Measurement Baseline

2.5.1 Introduction

The LAT 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 LAT 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 LAT 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 LAT 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 Subsystem Manager. These accounts are discussed below in paragraph 2.5.3. Undistributed Budget is established by, and is under the control of the Instrument Project Manager. 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 (LAT 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 Subsystem 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 LAT Cost Estimate

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

The LAT Project Organization generates detail schedules by Work Breakdown Structure for all subsystems of the project. After the Control Account detail schedules have been completed, the Cost and Schedule Group and the Instrument Project Manager 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 subsystem) interfaces.

After the initial review and approval process, the LAT Cost Estimate data was assigned to the Integrated Project Schedule (within the schedule processor). The LAT 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 LAT 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 LAT 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 Subsystem 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 LAT 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 LAT Cost Estimate. The Subsystem 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.

For the LAT project the Subsystem Managers are limited to using the 50-50 and the Level of Effort methods. If the Subsystem Managers feel one of the other methods would be more appropriate, they must obtain permission from the Project Control Manager and the Instrument Project Manager.

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 LAT 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**	**Month #3**	**Month #4**	**Total BAC**
		? 1		? 2	
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**	**Month #3**	**Month #4**	**Total BAC**
		? 1		? 2	
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 Subsystem 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 / NASA.

Annually, subsequent to allocation of the fiscal year funds, the Instrument Project Manager and the Cost and Schedule Group in conjunction with the responsible Subsystem 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).

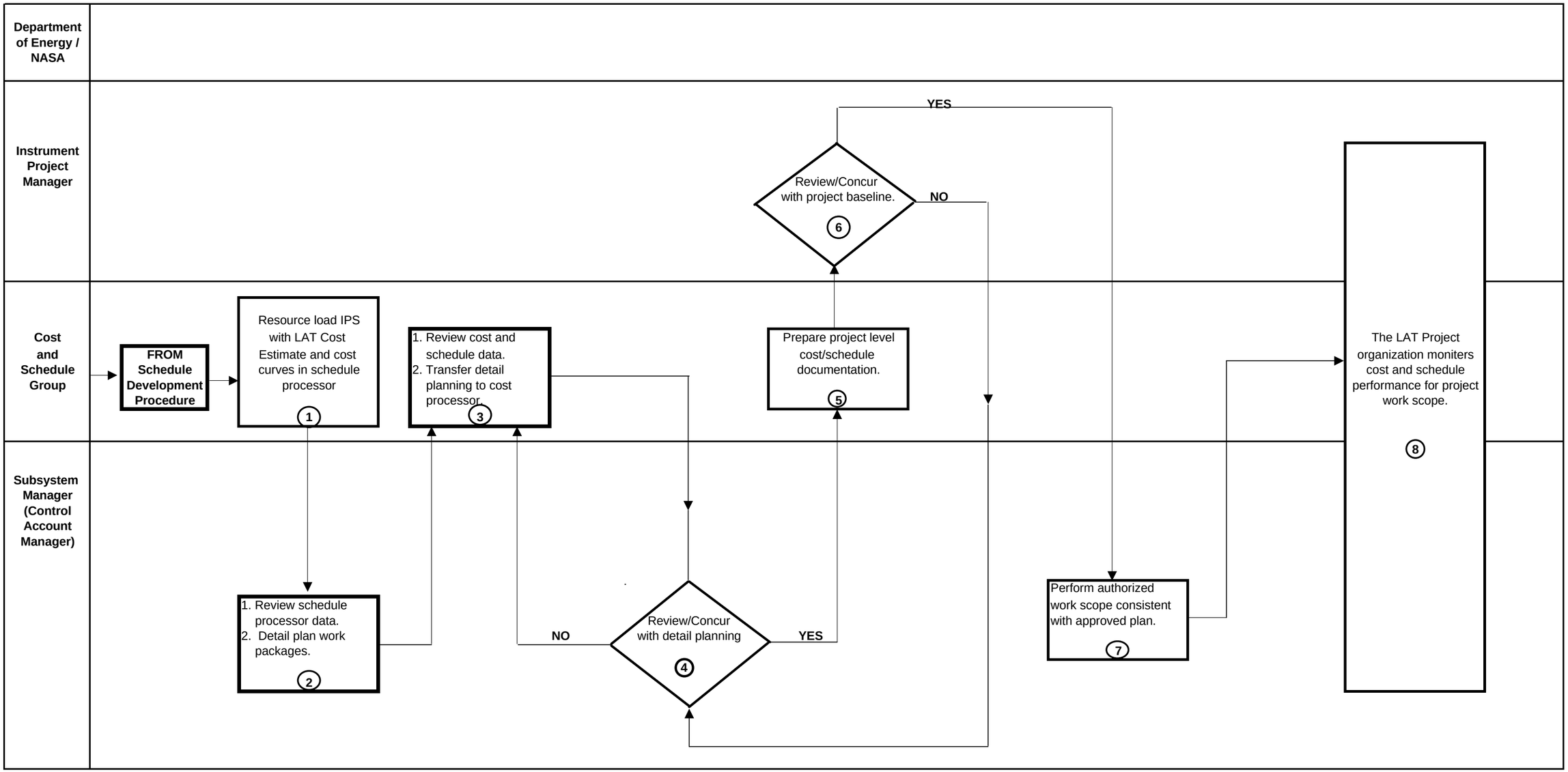
In the event that the schedule adjustment cannot be incorporated without violating one of the above listed parameters, then a Configuration Control Board Plan action is initiated. Required revisions to the Performance Measurement Baseline resulting from the annual funds management process are incorporated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

PERFORMANCE MEASUREMENT BASELINE DEVELOPMENT FLOW CHART
Exhibit 2-G



Procedure

Responsible Organization	Step No.	Action/Activity
Subsystem 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 LAT Cost Estimate (updated with approved configuration management changes if necessary) and cost curves.
Subsystem Managers (Control Account Managers)/ Project Control Analyst	2	The Subsystem 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 LAT Cost Estimate. This data includes: 1) The start and completion dates. 2) The total resources applied to each work package (i.e. hours and dollars for Labor; dollars for Material and Supplies and Travel. 3) Activity completions that have been identified as earned value (performance) milestones. 4) The time phasing of resources applied to the work package. The Subsystem Manager (Control Account Manager) completes the detail planning with assistance from the Project Control Analyst by: 1) Ensuring that the time phasing of resources corresponds to the manner in which the work scope of the work package is planned.

Procedure (continued)

Responsible Organization	Step No.	Action/Activity
Subsystem Managers (Control Account Managers) / Project Control Analyst	2 (cont.)	2) Choosing the optimum earned value technique for each work package. 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. 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. 5) If the apportioned effort method is employed, the discrete base and the apportioned percentage should be documented. 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 Subsystem Manager (Control Account Manager). The sum of all Control Accounts for each Subsystem Manager must not exceed the budget issued on

Procedure (continued)

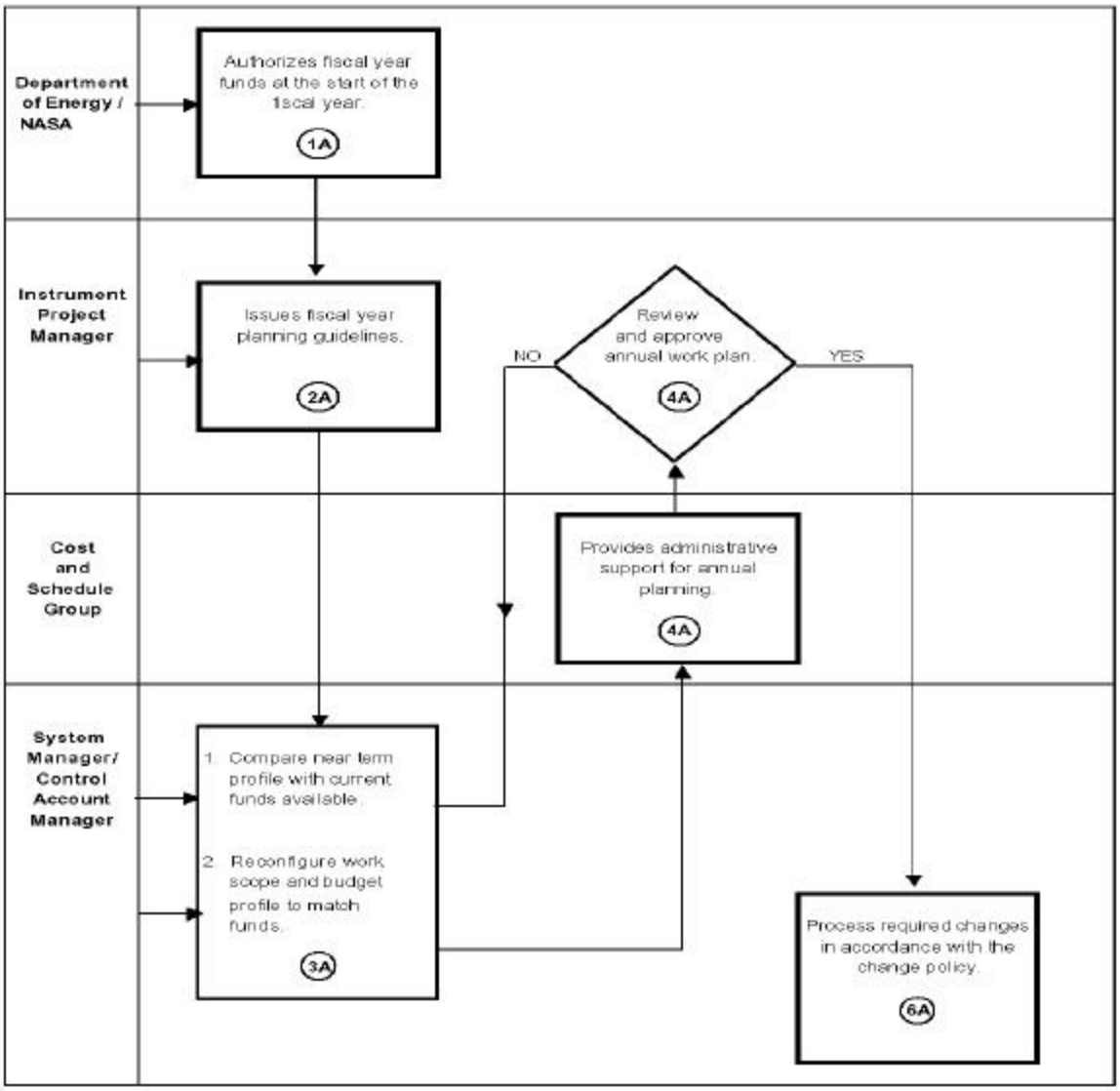
Responsible Organization	Step No.	Action/Activity
Project Control Analyst	3 (cont)	the Work Authorization Agreement. If inconsistencies exist, the Subsystem Manager and the Project Control Analyst resolve the differences. The schedule processor data is then transferred at the work package level to the cost processor. This information includes the start and completion dates for the work package, work package time phased budgets, and earned value methods / milestones. Control Account Plan information is then developed and sent to the Subsystem Managers for their review.
Subsystem Manager (Control Account Manager)	4	The Subsystem 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 Instrument Project Manager to review.
Instrument Project Manager	6	The Instrument Project Manager reviews and concurs with the project level baseline. If discrepancies exist, these are resolved with the individual Subsystem Managers. The LAT Project is officially baselined upon approval.
Subsystem Manager (Control Account Manager)	7	Subsystem Managers perform their authorized work scope consistent with the Control Account Plan.

Procedure (continued)

Responsible Organization	Step No.	Action/Activity
LAT Project Organization	8	The LAT 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.

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 LAT 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 / NASA / Other Funding Entities	1A	DOE / NASA / Other funding entities authorize fiscal year funds at the beginning of each fiscal year.
Instrument Principal Investigator / Instrument Project Manager / Cost and Schedule Group	2A	The Instrument Principal Investigator and Instrument Project Manager review and compare the funds available to the funds requested. Based on this review, the Instrument Project Manager issues fiscal year planning guidelines through the Cost and Schedule Group that are utilized in implementing any necessary changes to the Performance Measurement Baseline.
Subsystem Managers	3A	The Subsystem 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. 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

Instrument Project Managers and the

FISCAL YEAR BUDGET REVIEW / ADJUSTMENT (continued)

Responsible Organization	Step No.	Action/Activity
Cost and Schedule Group	4A (cont)	Subsystem Managers for the annual work plan process.
Instrument Principal/Instrument Project Manager	5A	The Instrument Principal Investigator and the Instrument Project Manager review and approve the annual fiscal year work plan for the LAT Project New Work Authorization Agreements reflecting the approved funding amounts are issued through the Cost and Schedule Group.
Subsystem 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
LAT Project Configuration Change Control Log

LAT Contingency Log

Page 1

Item #	CR #	Approval Date	WBS #	Subsys	Description	Contingency			WBS Cost Estimate				Revised Baseline
						Decrease	Increase	Existing	Existing	Decrease	Increase	New Estimate	
					INITIAL BALANCE			21,386,583					94,366,417
1	546	27-Feb-02	4.1.4	TKR	Tray Closeout Material Purchase	0	12,647	21,399,230	9,681,438	12,647	0	9,669,791	94,353,770
2	547	27-Feb-02	4.1.4	TKR	Electronics Modules	27,000	0	21,372,230	9,668,791	0	27,000	9,695,791	94,380,770
3	548	02-May-02	4.1.4	TKR	Sidewall Material	50,001	0	21,322,229	9,695,791	0	50,001	9,745,792	94,430,771
4	549	02-May-02	4.1.1	MGMT	Manpower Increase	1,143,444	0	20,178,785	11,306,654	0	1,143,444	12,450,098	95,574,215
5	684	02-May-02	4.1.4	TKR	FY01 Reconciliation	254,000	0	19,924,785	9,745,792	0	254,000	9,999,792	95,828,215
6	685	02-May-02	4.1.9	I&T	New I&T Plan	0	153,138	20,077,923	7,294,386	153,138	0	7,141,248	95,675,077
7	686	02-May-02	4.1.7	ELEX	New I&T Plan	0	180,000	20,257,923	16,520,459	180,000	0	16,340,459	95,496,078
8	691	02-May-02	4.1.6	ACD	New ACD Plan	69,872	0	20,188,051	9,960,326	0	69,872	10,030,198	95,564,950
9	699	02-May-02	4.1.5	CAL	New Base Program	2,324,460	0	17,863,591	13,377,941	0	2,324,460	15,702,401	97,889,410
10	700	02-May-02	4.1.5	CAL	CDE Bonding Studies	417,552	0	17,446,039	15,702,401	0	417,552	16,119,953	98,306,962
11	703	02-May-02	4.1.2	SYS	System Test Plan	707,307	0	16,738,732	4,091,625	0	707,307	4,798,932	99,014,269
12	711	08-May-02	4.1.4	TKR	ASIC Delay	0	0	16,738,732	9,999,792	0	0	9,999,792	99,014,269
13	713	08-May-02	4.1.5	CAL	Electronics Parts, Qual & Test	921,012	0	16,817,720	16,119,953	0	921,012	17,040,965	99,935,281
14	716	08-May-02	4.1.8	MECH	New Baseline	4,322,193	0	11,495,527	8,287,906	0	4,322,193	12,610,099	104,257,474
15	743	22-May-02	4.1.5	CAL	New Base Program - Correction	47,698	0	11,447,829	17,040,965	0	47,698	17,088,663	104,305,172
16	Pend	22-May-02	4.1.5	CAL	Phase Definition	0	2,548	11,450,377	17,088,663	2,548	0	17,086,115	104,302,624

Prepared by LAT PMCS Group

All numbers in escalated dollars.

6/25/02

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 GLAST 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 LAT 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 LAT 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 LAT Project Organization as well as provided to DOE/NASA 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 Instrument Project Manager directs a comprehensive Estimate at Completion to be performed for the entire LAT 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 LAT 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 Subsystem 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 Subsystem 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 Subsystem Managers to update their monthly schedule status.

The Subsystem 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:

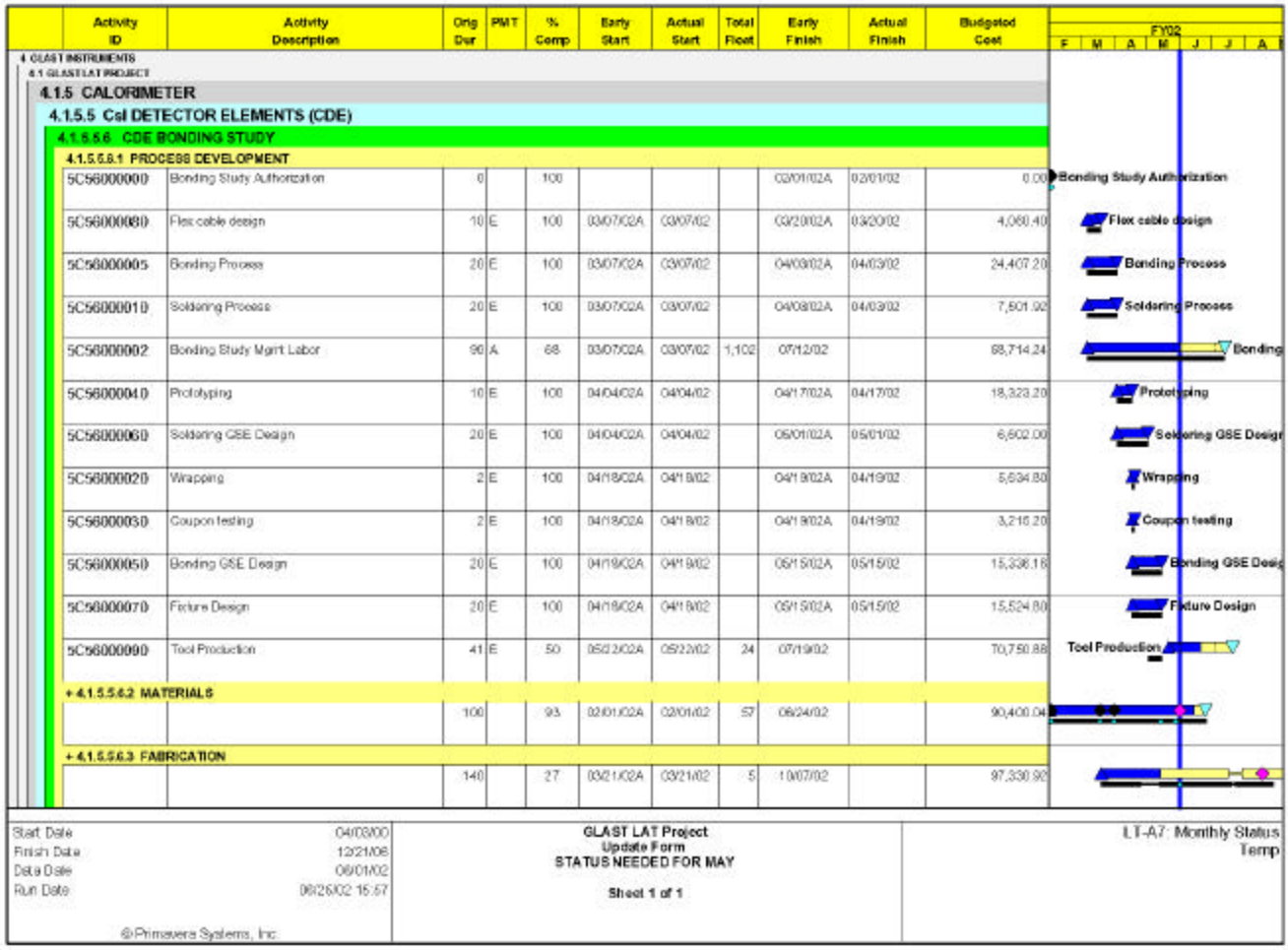
- Work-in-process earns Performance consistent with the earned value method assigned to that effort;
- Completed work packages / Control Accounts are fully credited with Performance equal to Budget at Completion;
- Unopened work packages and planning packages cannot earn Performance;
- Effort is considered 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 Subsystem 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 Subsystem Manager can elect to submit a revised Estimate at Completion, as appropriate, at one of the weekly review meetings with the Instrument Project Manager. Only after obtaining the Instrument Principal Investigator's approval is the new estimate incorporated into the cost processor. This process of incorporating the Subsystem 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
LAT Schedule Status Worksheet



Activity ID	Activity Description	Orig Dur	PMT	% Comp	Early Start	Actual Start	Total Float	Early Finish	Actual Finish	Budgeted Cost
4 GLAST INSTRUMENTS										
4.1 GLAST LAT PROJECT										
4.1.5 CALORIMETER										
4.1.5.5 CsI DETECTOR ELEMENTS (CDE)										
4.1.5.5.6 CDE BONDING STUDY										
4.1.5.5.6.1 PROCESS DEVELOPMENT										
5C56000000	Bonding Study Authorization	0		100				02/01/02A	02/01/02	0.00
5C56000080	Flex cable design	10	E	100	03/07/02A	03/07/02		03/20/02A	03/20/02	4,060.40
5C56000005	Bonding Process	20	E	100	03/07/02A	03/07/02		04/03/02A	04/03/02	24,407.20
5C56000010	Soldering Process	20	E	100	03/07/02A	03/07/02		04/08/02A	04/03/02	7,601.92
5C56000002	Bonding Study Mgmt Labor	90	A	68	03/07/02A	03/07/02	1,102	07/12/02		68,714.24
5C56000040	Prototyping	10	E	100	04/04/02A	04/04/02		04/17/02A	04/17/02	18,323.20
5C56000060	Soldering GSE Design	20	E	100	04/04/02A	04/04/02		05/01/02A	05/01/02	6,602.00
5C56000020	Wrapping	2	E	100	04/18/02A	04/18/02		04/19/02A	04/19/02	5,634.80
5C56000030	Coupon testing	2	E	100	04/18/02A	04/18/02		04/19/02A	04/19/02	3,216.20
5C56000050	Bonding GSE Design	20	E	100	04/19/02A	04/19/02		05/15/02A	05/15/02	15,336.16
5C56000070	Fixture Design	20	E	100	04/19/02A	04/18/02		05/15/02A	05/15/02	15,524.80
5C56000090	Tool Production	41	E	50	05/22/02A	05/22/02	24	07/19/02		70,750.88
+ 4.1.5.5.6.2 MATERIALS		100		93	02/01/02A	02/01/02	57	06/24/02		90,400.04
+ 4.1.5.5.6.3 FABRICATION		140		27	03/21/02A	03/21/02	5	10/07/02		97,330.90

FY02: F M A M J J A

Bonding Study Authorization; Flex cable design; Bonding Process; Soldering Process; Bonding; Prototyping; Soldering GSE Design; Wrapping; Coupon testing; Bonding GSE Design; Fixture Design; Tool Production

Start Date 04/03/00
Finish Date 12/21/06
Data Date 09/01/02
Run Date 09/26/02 15:57

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GLAST LAT Project
Update Form
STATUS NEEDED FOR MAY

Sheet 1 of 1

LT-A7: Monthly Status Temp

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 LAT 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 Subsystem 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 LAT 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 Instrument Project Manager. After receiving the monthly schedule status information from the Subsystem Manager and highlighting changes or effects to the critical path, the Cost and Schedule Group provides this information to the Instrument Project Manager.

The Instrument Project Manager and the appropriate Subsystem 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 Subsystem 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 Subsystem 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 LAT 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 Instrument Project Manager and the Subsystem Managers. The three (3) standard performance reports available from the cost processor for use by the LAT 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 Subsystem Managers in order to prepare the required report formats for the LAT 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.

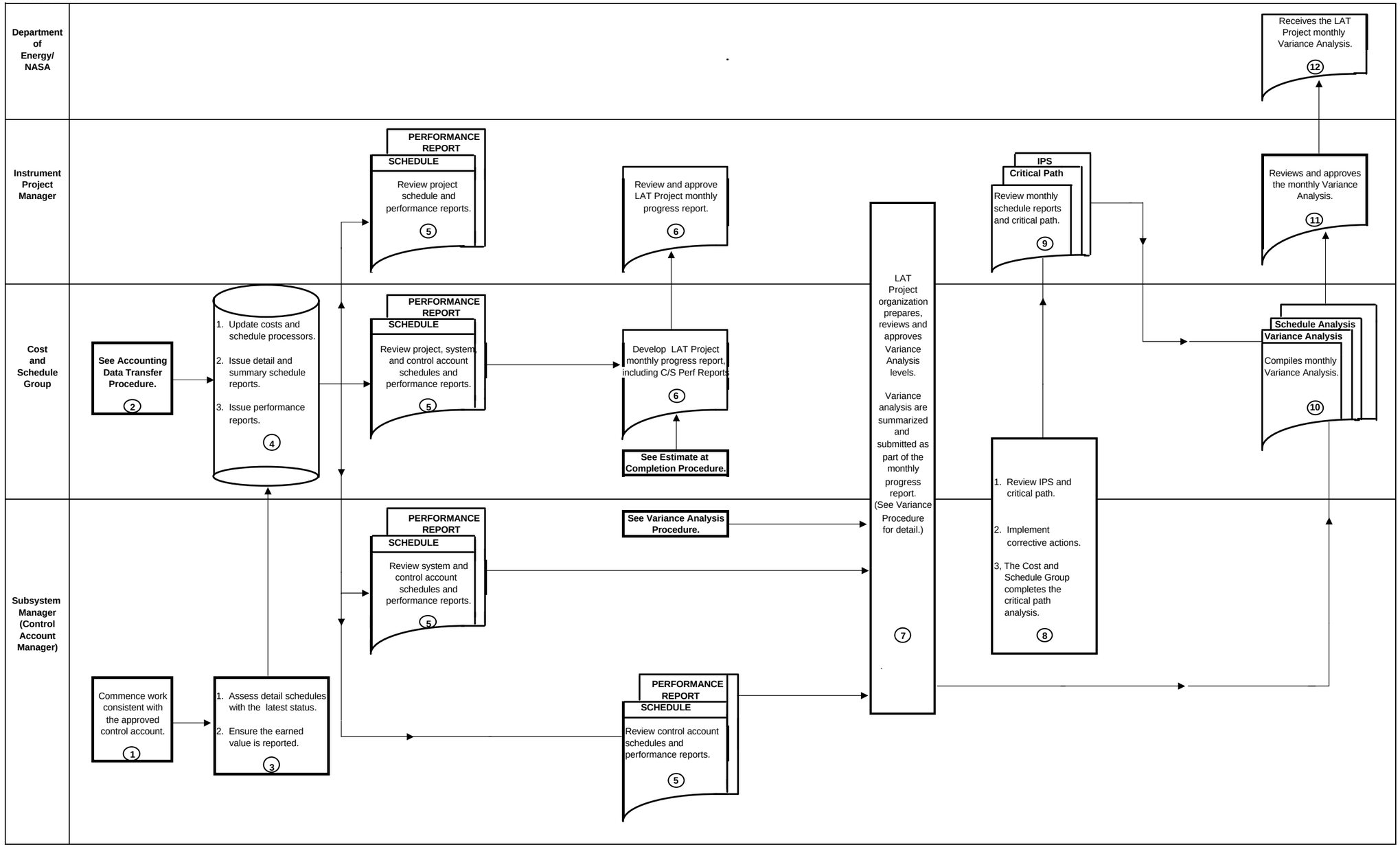
3) Monthly Technical Progress Report: Project Controls Manager's concise narrative assessment of the status of the work being performed under the contractual agreement.

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 LAT 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

STATUS ASSESSMENT AND REPORTING FLOW CHART
Exhibit 3-B

Exhibit 3-B



Procedure

Responsible Organization	Step No.	Action/Activity
Subsystem Manager (Control Account Manager)	1	The Subsystem 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.)
Subsystem Manager (Control Account Manager)	3	The Subsystem 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 Subsystem 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 LAT Project Subsystem Managers, Instrument Project Manager, and the Instrument Principal Investigator. These schedule reports contain a comparison of the baseline and the current working schedule. The Cost and Schedule Group issues the project performance reports from the cost processor to LAT Subsystem Managers, Instrument Project Manager, and the Instrument Principal Investigator.
LAT Project Organization	5	All levels of management for the LAT Project review their schedule reports and Project Performance Reports.
Cost and Schedule Group / Instrument Project Manager / DOE / NASA	6	The Cost and Schedule Group develops the Cost / Schedule Status Report from the cost processor database. The Estimate to Complete / Estimate at Completion data is kept current based on the approved changes as described in the Estimate at Completion procedure. The Cost and Schedule Group compiles the narrative assessments

from the Subsystem Managers and the Cost/Schedule Status Report into the monthly LAT Project Progress Report.

Procedure (continued)

Responsible Organization	Step No.	Action/Activity
Cost and Schedule Group/Instrument Project Manager/DOE/NASA	6 (cont.)	The Instrument Project Manager reviews and Project Controls Manager approves the LAT Project Monthly Progress Report prior to sending it to DOE/NASA.
Instrument Project Manager/Subsystem Managers/ Cost and Schedule Group	7	The LAT 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/Subsystem Managers	8	The Cost and Schedule Group and Subsystem Managers review the Integrated Project Schedule. If errors exist, the Subsystem Managers provide corrections to the Cost and Schedule Group. If the Subsystem 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. The Cost and Schedule Group reviews the Project critical path. An initial Critical Path Analysis is prepared. This is reviewed with the Subsystem Managers. Corrective

actions are made to improve the factors affecting the critical path.

The Cost and Schedule Group completes the Critical Path Analysis

Procedure (continued)

Responsible Organization	Step No.	Action/Activity
Cost and Schedule Group / Subsystem Managers	8 (cont.)	based on information from the Subsystem Manager meetings. The revised Integrated Project Schedule, Summary Schedule Reports, and the Critical Path Analysis are issued to the Instrument Project Manager.
Instrument Project Manager	9	The Instrument Project Manager 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 Subsystem Managers
Instrument Project Manager	11	The Instrument Project Manager reviews and approves the LAT Project Monthly Variance Analysis.

Exhibits

Exhibit 3-C
Monthly Cost and Schedule Activities

This is a simplified description of the PMCS cycle of activities which will occur monthly in order to provide timely information to subsystem managers and project management, and meet DOE/NASA reporting requirements.

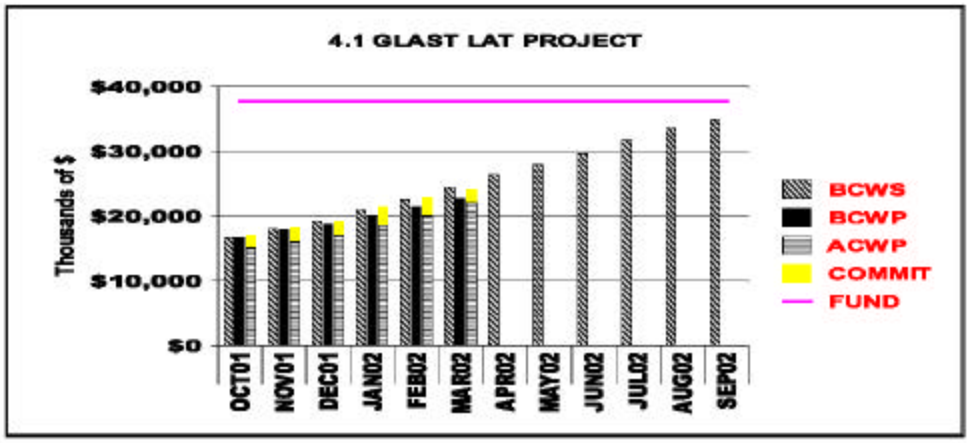
WHO	What	Due Date (Day from Beginning of Month)
PMCS Team	Issue worksheets to Subsystem Managers for collection of schedule status and earned value assessment.	1st
Subsystem Managers	Provide schedule status and earned value information to PMCS Team	5th
PMCS Team	Input schedule status into project scheduling software (Primavera Project Planner - P3).	9th
PMCS Team	Iterate / review schedule reports and critical path with Subsystem Managers for their concurrence.	10th through 18th
Institutional Accounting Interface / Contact	Provide actual cost, commitment, and manpower data, in template format, to PMCS Team.	17th
PMCS Team	Import actual costs 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 IPO.	17th through 24th
Subsystem Managers PMCS Team	Review cost & schedule performance reports. Identify & investigate major variances. Analyze trends.	24th through 27th
Instrument Project Office (IPO)	Meet with Subsystem Managers to discuss status. Review cost & schedule performance reports with Subsystem Managers.	28th
Project Controls Manager	Submit GLAST LAT Project Monthly Progress Report to DOE / NASA.	+7th

EXHIBIT 3-D
SCHEDULE vs PERFORMANCE vs ACTUAL COSTS GRAPH

Program:0201 Batch Report:41_1: Report #1

Report:	CURVE	GLAST LAT Project
Program:	201	
Date:	4/24/02	

CAPW[2]



	OCT01	NOV01	DEC01	JAN02	FEB02	MAR02	APR02	MAY02	JUN02	JUL02	AUG02	SEP02
BCWS	16,704	18,047	19,249	21,026	22,607	24,527	26,451	28,077	29,663	31,735	33,586	34,977
BCWP	16,748	17,893	18,819	20,101	21,497	22,832						
ACWP	15,088	16,076	17,122	18,556	20,070	22,065						
COMMIT	1,970	2,247	2,116	2,951	2,864	2,139						
FUND	37,747	37,747	37,747	37,747	37,747	37,747	37,747	37,747	37,747	37,747	37,747	37,747

Cobra (R) by WST Page 1

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: Contract Type/No: Project Name/No: GLAST LAT Project Report Period: 2/28/02 3/31/02

Location:

Quantity	Negotiated Cost	Est. Cost Authorized Unpriced Work	Tgt. Profit/ Fee %	Tgt. Price	Est. Price	Share Ratio	Contract Ceiling	Estimated Contract Ceiling
1	0	0	0 0	0	0		0	0

CAPW[3] OBS[1] CAPW[4] CPN[1] Item	Current Period					Cumulative to Date					At Completion		
	Budgeted Cost		Actual Cost	Variance		Budgeted Cost		Actual Cost	Variance				
	Work Scheduled	Work Performed	Work Performed	Schedule	Cost	Work Scheduled	Work Performed	Work Performed	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													
2600034 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													
2600035 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													
2600036 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	2,116	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
4.1.4.6 TRACKER TEST & CALIBRATION													
2600038 4.1.4.6 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)													
2600090 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													
2600091 4.1.4.8 Mission 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	-185	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 LAT Project to the Project Management Control System (PMCS) from the accounting systems at NRL, GSFC, UCSC, SSU, SU-HEPL and Stanford Linear Accelerator Center (SU-SLAC).

General

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

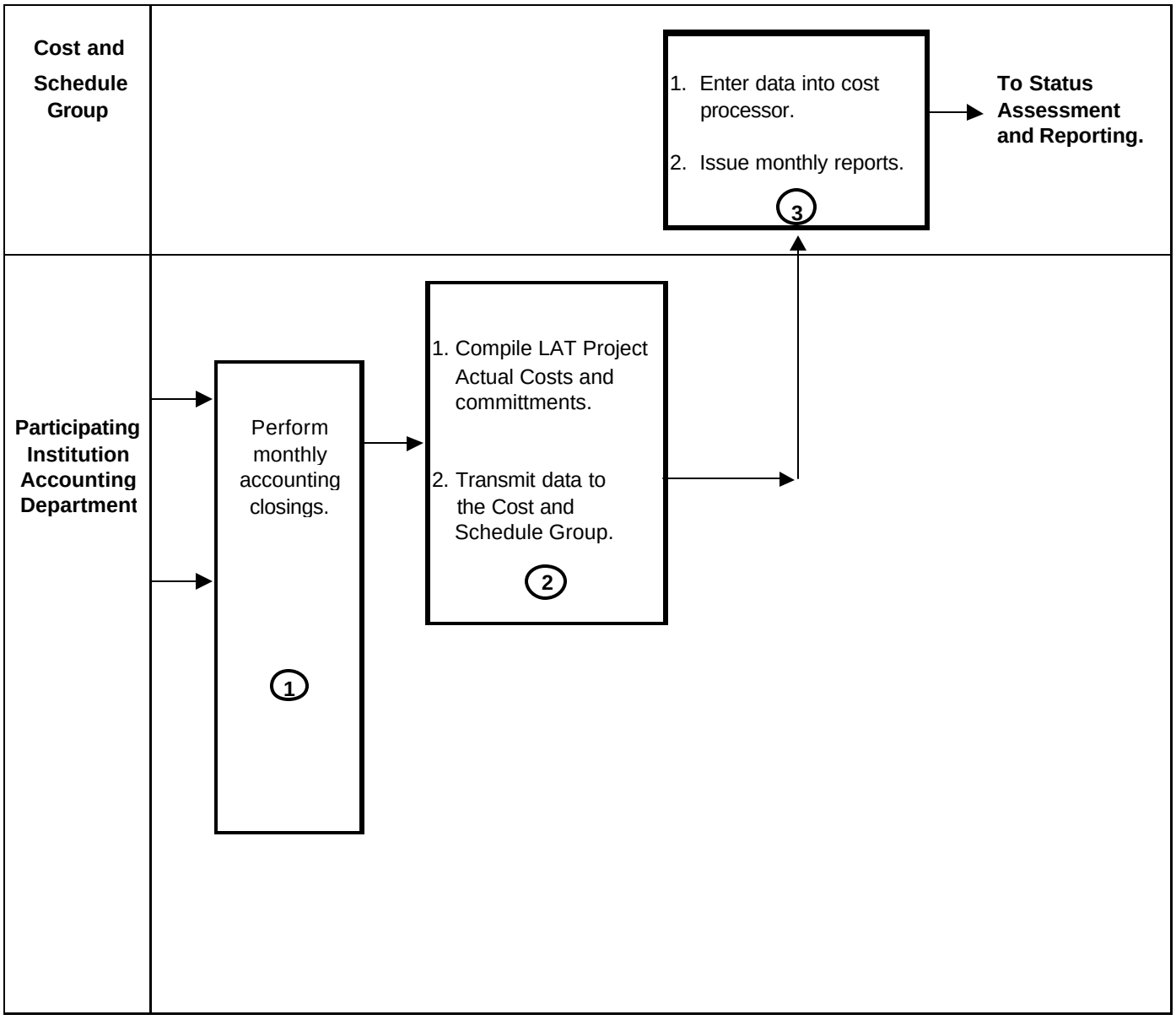
The Accounting Data Transfer Procedure Flow Chart graphically depicting the responsibilities, interfaces, and activities performed to transfer actual costs to the cost processor for the LAT Project is shown in Exhibit 3-F, the Accounting Data Transfer Procedure Flow Chart.

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 LAT Cost and Schedule Group.

Exhibit 3–H is an example of accounting data file transfer format for cumulative actual costs on the LAT Project. Exhibit 3–I is an example of accounting data file transfer format for Net Commitments on the LAT 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 / NASA on a monthly basis.

Exhibit 3-F
Accounting Data Transfer Flow Chart



Procedure

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

3–I Accounting Data File Transfer GLAST 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	
CECODE	Cost Element	Character	8	
Hours	Direct Hours	Numeric	12	2
Dollars	Direct Dollars	Numeric	12	2
Date	Period ending	Date	8	
Class	AC or CO	Character	2	

Exhibit 3-H
Accounting Data File Transfer LAT 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 LAT 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
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3.4 PERFORMANCE ANALYSIS AND FORECASTING

3.4.1 Introduction

The objective of the Performance Analysis and Forecasting process is to provide the LAT Project Organization and DOE/NASA a consistent assessment of the work accomplished on the LAT 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 Subsystem 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 Subsystem 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 LAT Project receive the most attention.

3.4.2 Variance Analysis Review Process

As a matter of regular business practice, the Instrument Project Manager and the Subsystem 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 Instrument Project Manager receives a Subsystem Schedule Report and a Subsystem Performance Report, (Exhibits 3–K and 3–L.)

Since schedule information is available earlier, the Instrument Project Manager can discuss schedule variances with Subsystem before cost variances can be discussed. The Subsystem 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 Instrument Project Manager 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 Instrument Project Manager along with the advice and assistance from the Cost and Schedule Group establishes this amount.

The Subsystem 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 Subsystem Schedule Report.

The Instrument Project Manager convenes a monthly Cost and Schedule Review Meeting where Subsystem Managers discuss cost and schedules concerns. If a variance analysis is required, the Subsystem Manager presents the information at this meeting. The Instrument Project Manager 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 Subsystem 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 Instrument Project Manager, Subsystem 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 Instrument Project Manager, as well as the Instrument Principal Investigator. 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 Instrument Project Manager/Engineer, as well as, the Instrument Principal Investigator if required. 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 Subsystem 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 Subsystem 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 Instrument Project Manager to prepare the formal comprehensive Estimate at Completion, each Subsystem 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 Subsystem 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 Subsystem Manager.

When requesting a change to the Estimate at Completion, the Subsystem 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 Instrument Project Manager for review and approval. It is then the Instrument Project Manager 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 Instrument Project Manager 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 Instrument Project Manager does not approve the requested increase in the Estimate at Completion, it is returned to the Subsystem Manager with specific direction as to what actions the Subsystem Manager is to take to reduce the Estimate at Completion.

Only after the Instrument Project Manager 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 Subsystem Manager and the Instrument Project Manager 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:

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

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

SUBSYSTEM 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	8		1,36	03APR00A	30SEP05	12	5,338,633.
4.1.4.3.1 SILICON STRIP DETECTORS (SSD)							
Subtotal	5		94	01JUN00A	23MAR04	502	1.065.137.
4T005400	10	Finalize SSD Design	7	01JUN00A	08SEP00A		0.0
4T005600	10	SSD Bidding process	6	30JUN00A	29SEP00A		0.0
4T005500	10	SSD Design Final	0	11SEP00A			0.0
4T005700	10	HPK Prototype run of flight layou	6	03OCT00A	25DEC00A		21.840.3
4T005800	10	Test of HPK prototype run	1	04JAN01A	31JAN01A		0.0
4T005900	10	Preproduction Run and Production Ramp-up	6	17JAN01A	20APR01A		0.0
4T006000	10	Ready to Begin SSD Production	0	23APR01A			0.0
4.1.4.3.1.1 SSD PRODUCTION							
Subtotal	4		85	02OCT00A	23MAR04	502	1,026,657.
4T007100	5	QC SSD's	657	02OCT00A	02JUN03	116	0.0
4T007200	4	43Detector long-term testing (UCSC	855	02OCT00A	23MAR04	1	11.604.2
4T006204	10	(PR) SSD Lot A-B (SLAC)	1	01MAY01A	01MAY01A		359,840.0
4T006202	10	SSD Lot A-B (Japan)	106	01MAY01A	28SEP01A		0.0
4T006206	10	(REC) SSD Lot A-B (SLAC)	1	28SEP01A	28SEP01A		0.1
4T006200	4	SSD Lot A-B (INFN)	45	01MAR02A	02MAY02	261	0.0
4T006300	0	SSD Lot 1-2 (Japan)	45	01APR02A	03JUN02	262	0.0
4T006500	2	SSD Lot 5-6 (ITALY)	45	08APR02A	10JUN02	245	0.0
4T31100000	0	(REC) SSD Lot A-B (SLAC) FY01 Recon	1	01MAY02*	01MAY02	968	124,999.7
4T006600	0	SSD Lot 7-8 (JAPAN)	4	01MAY02*	03JUL02	253	0.0
4T006700	0	SSD Lot 9-10 (ITALY)	6	01JUL02*	03OCT02	202	0.0
4T006800	0	SSD Lot 11-12 (JAPAN)	4	02OCT02*	03DEC02	182	0.0
4T006900	0	SSD Lot 13-14 (ITALY)	4	20NOV02*	31JAN03	151	0.0
4T007000	0	SSD Lot 15-16 (JAPAN)	4	31JAN03*	02APR03	129	0.0

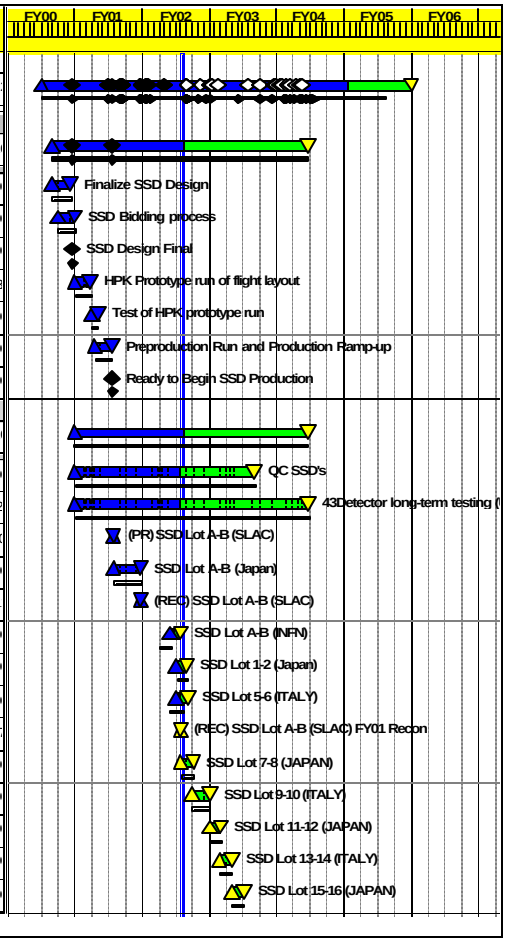

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EXHIBIT 3-L

SUBSYSTEM 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] OBS[1] CAPW[4] CPN[1] Item	Current Period					Cumulative to Date				At Completion		
	Budgeted Cost		Actual Cost	Variance		Budgeted Cost		Actual Cost	Variance			
	Work Scheduled	Work Performed	Work Performed	Schedule	Cost	Work Scheduled	Work Performed	Work Performed	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													
2600034 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													
2600035 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													
2600036 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	141	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	2,116	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													
2600038 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)													
2600090 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													
2600091 4.1.4.8 Mission 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 LAT 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 LAT 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 LAT 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 Subsystem Managers and the Cost and Schedule Group are responsible for providing the Instrument Project Manager 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 Instrument Project Manager determines which Work Breakdown Structure Level Elements require a variance analysis narrative for inclusion in the Cost/Schedule Performance Report.

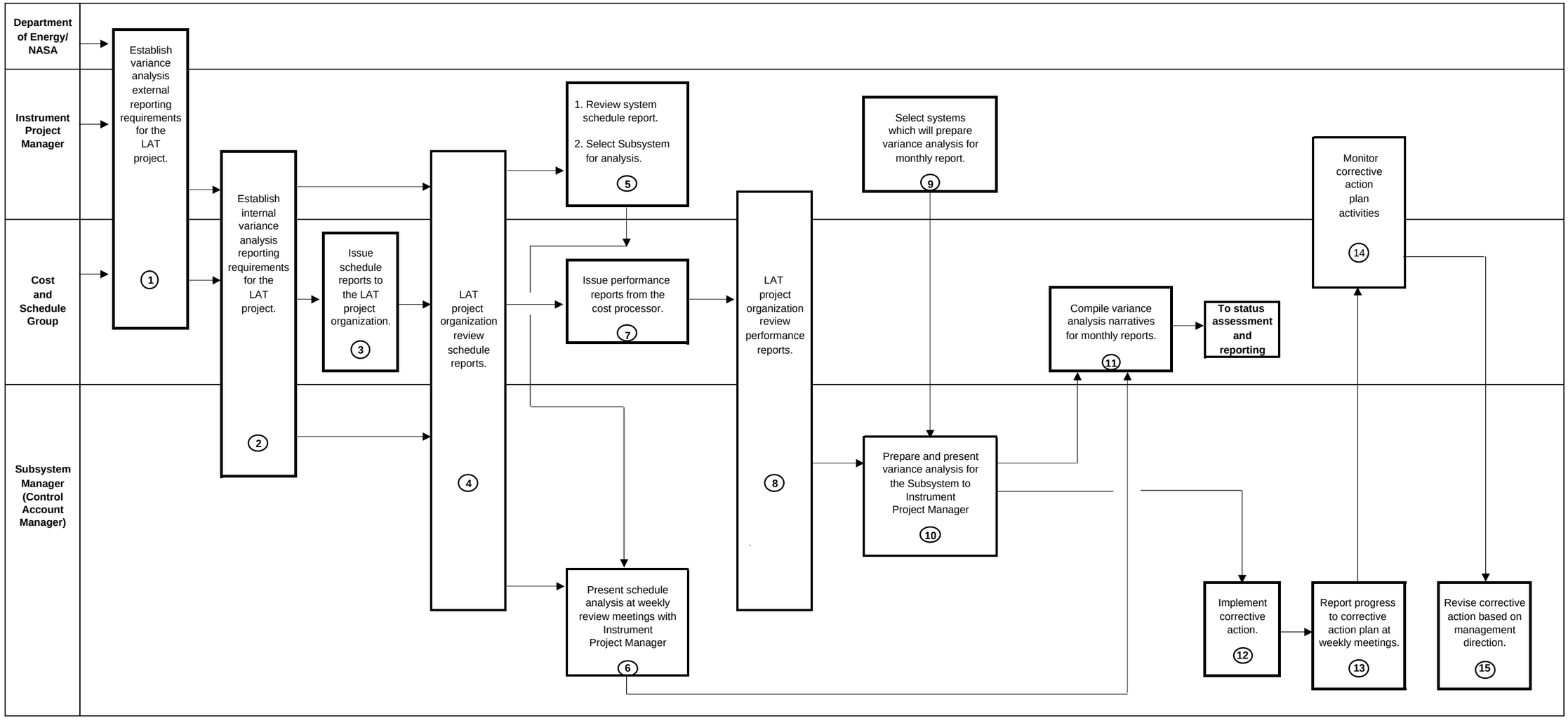
The Subsystem Managers for those elements requiring a variance analysis narrative will present their variance analysis to the Instrument Project Manager at the monthly Cost and Schedule Review Meetings. If the timing is such that this meeting will be convened later than the information is required, the Instrument Project Manager will convene a meeting to discuss the particular variance, or the Subsystem 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 Subsystem level, the Instrument Project Manager may select Control Accounts that are driving the cost and schedule variances of the Subsystems for analysis. Reviewing the monthly Project Management Control System Cost/Schedule Performance Reports may help the Instrument Project Manager 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

VARIANCE ANALYSIS FLOW CHART EXHIBIT 3-M



Procedure

Responsible Organization	Step No.	Action/Activity
DOE / NASA / Instrument Project Manager / Cost and Schedule Group	1	DOE / NASA, Instrument Project Manager, and the Cost and Schedule Group establish the variance analysis reporting requirements for the LAT Project. These requirements detail the monthly reporting of variances to DOE / NASA included in the Cost / Schedule Performance Report.
Instrument Project Manager / Subsystem Managers / Cost and Schedule Group	2	The Instrument Project Manager, Subsystem Managers, and the Cost and Schedule Group establish the internal LAT project variance analysis process. The cornerstone of this is the implementation of the variance analysis discussion at the monthly review meetings chaired by the Instrument Project Manager.
Cost and Schedule Group	3	The Cost and Schedule Group issues detail and summary schedule reports to the Instrument Project Manager and Subsystem Managers.
LAT Project Organization	4	The LAT Project Organization review the schedule reports.
Instrument Project Manager	5	Instrument Project Manager reviews the System Schedule Report and selects schedule variance analysis discussion.
Subsystem Managers	6	Selected Subsystem Managers present their schedule variance analysis to their Instrument Project Manager 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 Instrument Project Manager and Subsystem Managers.
LAT Project Organization	8	The LAT Project Organization review the performance reports from the cost processor.
Instrument Project Manager / Cost and Schedule Group	9	The Instrument Project Manager, with the advice of the Cost and Schedule Group analyzes and determines which Subsystems will have variance analysis narratives prepared for the Monthly Progress Report. These Subsystem Managers will present their variance analysis at the monthly Cost and Schedule Review Meeting.
Subsystem Managers	10	The Subsystem Managers prepare variance analysis for their Work Breakdown structure element(s). This variance analysis information is then presented to the Instrument Project Manager 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 Subsystem Managers. (See the Status Assessment and Reporting Procedure).

Procedure (continued)

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

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 LAT 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 LAT 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 LAT 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 LAT Project Organization to periodically (as required by the Instrument Project Manager) develop comprehensive estimates of costs at project completion, referred to as the Estimate at Completion. The Estimate at Completion process focuses on the Subsystem 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 LAT 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 Subsystem 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 Subsystem Manager (Control Account 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 Instrument Project Manager 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 LAT 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 LAT Project personnel from the schedule processor and cost processor databases. The performance reports generated by the Project Management Control System and utilized by the LAT 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 LAT 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 LAT Project, produces a wide variety of reports. All Subsystem 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 LAT 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 Instrument Project Manager. 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 LAT Project personnel each month. Each Subsystem Manager receives a detail schedule that shows the current progress and latest forecast against the baseline. Each Subsystem Manager also receives a summary schedule report that shows critical activities and all level 4 milestones and above. The Instrument Project Manager is issued the LAT Project Master Schedule on a monthly basis. The LAT 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 Instrument Project Manager.

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 Subsystem 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 LAT Project Organization provides the latest LAT Project Master Schedule to DOE / NASA 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: Location: | Contract Type/No: | Project Name/No: GLAST LAT Project | Report Period: 2/28/02 – 3/31/02

Quantity	Negotiated Cost	Est. Cost Authorized Unpriced Work	Tgt. Profit/ Fee %	Tgt. Price	Est. Price	Share Ratio	Contract Ceiling	Estimated Contract Ceiling
1	0	0	0	0	0		0	0

CAPW[3] OBS[1] CAPW[4] CPN[1] Item	Current Period: Budgeted Cost Work Scheduled	Current Period: Budgeted Cost Work Performed	Current Period: Actual Cost Work Performed	Current Period: Variance Schedule	Current Period: Variance Cost	Cumulative to Date: Budgeted Cost Work Scheduled	Cumulative to Date: Budgeted Cost Work Performed	Cumulative to Date: Actual Cost Work Performed	Cumulative to Date: Variance Schedule	Cumulative to Date: Variance Cost	At Completion: Budgeted	At Completion: Latest Revised Estimate	At Completion: 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													
2600034 4.1.4.1 Tracker Management	29	29	26	0	2	470	470	492	0	-21	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	-21	287	287	0
2600114 4.1.4.3.3 Tray Electronics	0	0	0	0	0	461	461	319	0	141	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	-39	297	2,116	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 Mission 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. (LAT 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 LAT project. Part of the purpose of the Configuration Management Plan is to

describe the configuration configuration change control process for the LAT 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 LAT Project Management Plan further defines the cost, schedule, and technical reserves under the control of the Instrument Project Manager in section 3.3 - Configuration Management and Table 4 - LAT Configuration Change Control Thresholds. The LAT 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 LAT 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/NASA or the LAT 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/NASA 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 LAT Cost:

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

The action of proceeding with work before Configuration Control Board approval at the appropriate level is allowed by DOE/NASA 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 Subsystem Manager and does not require a higher level of change control approval.

The Subsystem 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 Subsystem 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 LAT 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/NASA/Instrument Project Manager 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 Configuration Change Control Log

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

EXHIBIT 4-A
CONFIGURATION CHANGE REQUEST FORM (1 of 2)

GLAST	**LAT Project Change Request (CR)**	CR No. LAT-XR- -
ORIGINATOR:	PHONE:	DATE:
CHANGE TITLE:		REF. DCN #:

Change Description:

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

COST:

WBS No.	Work Pkg No.	Description	Escalated Baseline (K$)	Proposed Escalated Baseline (K$)	Changes (K$)
		TOTAL	0	0	0

SCHEDULE:

OTHER (specify – i.e. safety, reliability, requirements):

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EXHIBIT 4-A (cont.)
CONFIGURTION CHANGE REQUEST FORM (2 of 2)

CCB ACTION: ☐ APPROVE ☐ REJECT ☐ OTHER		CCB Minutes: LAT-LR-XXXX		
EXPLANATION:				
APPROVALS:				
	NAME	SIGNATURE	DATE	
ORIGINATOR				
CR Subsystem Manager				
CCB MEMBERS				
Instrument Project Manager, Chair	W. Althouse			
Deputy Project Manager	J. Martin			
Instrument Technical Manager	T. Kamae			
Instrument Scientist	S. Ritz			
Project Control Manager, Secretary	T. Boysen			
Instrument Systems Engineer	T. Thurston			
Chief Electronics Engineer	G. Haller			
Mechanical Systems Engineer	M. Nordby			
I & T Manager	E. Bloom			
Performance & Safety Assurance Manager	D. Marsh			
Science Analysis SW Manager	R. Dubois			
Tracker Manager	R. Johnson			
Calorimeter Manager	N. Johnson			
E/PO Manager	L. Cominsky			
IOC Manager	S. Williams			
ACD Manager	D. Thompson			
DOE LAT Project Manager	E. Valle			
NASA GLAST Project Manager	L. Citrin			
CEA/DSM Project Manager	D. Bederede			
INFN Project Manager	R. Bellazzini			
IN2P3 Program Manager	H. Videau			
☐ Check box if hardware change verification required Responsible Engineer:				

Form # LAT-FS-00129-04