

Earned Value Management System (EVMS)

Reference Guide



**Project Management Office
Lawrence Berkeley National Laboratory
March 2009**



Revision 0

Purpose and Scope

This Reference Guide is designed to provide LBNL Control Account Managers (CAMs) and other project staff with a quick reference tool to key Earned Value Management System (EVMS) terms and processes. This reference guide is a supplement to the LBNL EVM System Description and implementing procedures maintained by LBNL's Project Management Office (PMO).

The LBNL EVMS complies with the criteria for project cost and schedule control as required by DOE Order 413.3A, DOE Manual 413.3-1, and the ANSI/ EIA-748 industry standard for EVM. The LBNL EVMS applies to the following work:

- Capital line item projects with a total project cost greater than \$20M
- All large and/or high-risk projects for which LBNL management determines that EVM is appropriate.

The EVMS provides for effective project planning and control and is designed around the integration of technical scope, schedule, and budget with existing LBNL policies and procedures as defined in the Earned Value Management System (LBNL-EVMS) Description. The primary objective of the EVMS is to verify that all elements of a project are planned, authorized, monitored, and controlled in a consistent, flexible, and cost-effective manner.

This reference guide should be useful to all project personnel, including CAMs, Project Managers, Functional Managers, and project office staff. However, EVMS users are responsible for being familiar with and following the LBNL EVM System Description and applicable procedures, which take precedence over this reference guide. The System Description and implementing procedures are available on the EVMS website (<http://www.lbl.gov/PMO>)

Quick Reference – EVMS Formulas

Cost-Related Calculations:

Cost Variance (CV)	$CV = BCWP - ACWP$
CV%	$CV\% = \frac{CV}{BCWP} \times 100$
Cost Performance Index (CPI)	$CPI = \frac{BCWP}{ACWP}$

Schedule-Related Calculations:

Schedule Variance (SV)	$SV = BCWP - BCWS$
SV%	$SV\% = \frac{SV}{BCWS} \times 100$
Schedule Performance Index (SPI)	$SPI = \frac{BCWP}{BCWS}$

Other Calculations:

% Spent	$\% \text{ Spent} = \frac{ACWP_{(cum)}}{BAC} \times 100$ EAC may be substituted in the denominator to determine the % of EAC spent (total funds required).
% Complete	$\% \text{ Complete} = \frac{BCWP_{(cum)}}{BAC} \times 100$
To-Complete Performance Index (TCPI)	$TCPI = \frac{BAC - BCWP_{(cum)}}{BAC - ACWP_{(cum)}}$ EAC may be substituted for BAC in the denominator to determine efficiency needed to complete within the EAC.

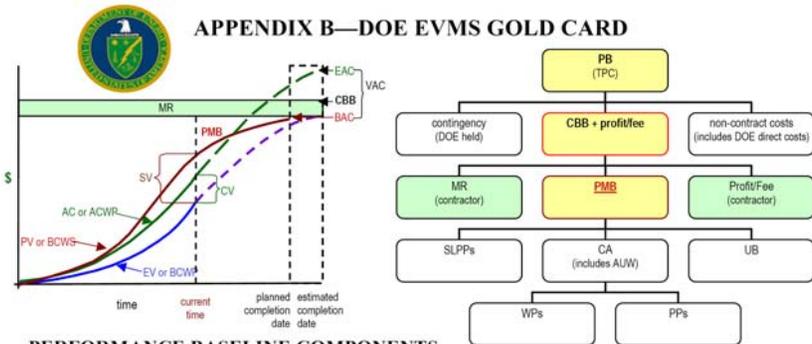
Definitions:

ACWP	Actual Cost of Work Performed
BAC	Budget at Completion
BCWP	Budgeted Cost of Work Performed
BCWS	Budgeted Cost of Work Scheduled
EAC	Estimate at Completion

Appendix B - DOE EVMS Gold Card

DOE G 413.3-10
5-6-08

Appendix B
B-1 (and B-2)



PERFORMANCE BASELINE COMPONENTS

PB	= CBB + contingency + non-contract costs	= performance baseline (TPC, total project cost)
contingency	=	= held by DOE & based on technical and programmatic risks
CBB	= PMB + MR	= contract budget base
PMB	= CAs + UB + SLPPs	= performance measurement baseline
MR	=	= management reserve (held by contractor based on contractor risks)
SLPP	=	= summary level planning package
AUW	=	= authorized unpriced work (contractually approved but not yet negotiated)
CA	= WPs + PPs	= control account (includes AUW, lowest WBS element assigned)
UB	=	= undistributed budget (activities not yet distributed to CA)
WP	=	= work package (near-term, detail-planned activities within a CA)
PP	=	= planning package (far-term activities within a CA)

EVMS BASIC COMPONENTS¹

AC	= actual cost	= ACWP	= actual cost of work performed
EV	= earned value	= BCWP	= budgeted cost for work performed
PV	= planned value	= BCWS	= budgeted cost for work scheduled
BAC	= cumulative PV	= cumulative BCWS	= budget at completion

VARIANCES¹

CV	= EV - AC	= BCWP - ACWP	= cost variance
SV	= EV - PV	= BCWP - BCWS	= schedule variance
CV %	= (EV - AC)/EV	= (BCWP - ACWP)/BCWP	= cost variance, percentage
SV %	= (EV - PV)/PV	= (BCWP - BCWS)/BCWS	= schedule variance, percentage
VAC	= BAC - EAC		= variance at completion

OVERALL STATUS

% scheduled	= PV_{cum}/BAC	= $BCWS_{cum}/BAC$	
% complete	= EV_{cum}/BAC	= $BCWP_{cum}/BAC$	
% budget spent	= AC_{cum}/BAC	= $ACWP_{cum}/BAC$	
WR	= $BAC - EV_{cum}$	= $BAC - BCWP_{cum}$	= work remaining
BR	= $BAC - AC_{cum}$	= $BAC - ACWP_{cum}$	= budget remaining

PERFORMANCE INDICES¹

CPI	= EV/AC	= $BCWP/ACWP$	= cost performance index
SPI	= EV/PV	= $BCWP/BCWS$	= schedule performance index
TCPI _{BAC}	= WR/BR		= to complete performance index, BAC
TCPI _{EAC}	= WR/ETC		= to complete performance index, EAC

COMPLETION ESTIMATES

EAC	= BAC/CPI_{cum}	= estimate at completion, general
EAC _{CPI}	= $AC_{cum} + WR/CPI_{cum}$	= estimate at completion, CPI
EAC _{composite}	= $AC_{cum} + WR/(CPI_{cum} * SPI_{cum})$	= estimate at completion, composite
LRE	=	= latest revised estimate (contractor's, assessed monthly, annual bottoms-up)
ETC	= $EAC - AC_{cum}$	= estimated to complete

¹ Calculations based on AC, EV, and PV may be based on various time periods, i.e. monthly, cumulative (cum), last 3 months...

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LBNL's Earned Value Management System

LBNL is committed to establishing and maintaining project management systems that provide LBNL management and our customers with reliable information related to the status of technical scope, schedule, and budget over the life of all projects.

LBNL's EVMS is defined around the following seven principles (as illustrated in the following figures):

1. Plan all work scope for the project to completion.
2. Break down the project work scope into finite pieces that can be assigned to a responsible person or organization for control of the technical, schedule, and cost objectives.
3. Integrate the project work scope, schedule, and cost objectives into a performance measurement baseline against which accomplishments may be measured. Control changes to the baseline.
4. Objectively measure actual progress, performance, and cost against a detailed project plan, including critical-path analysis of the schedule
5. Consistently report project status to management
6. Analyze significant variances from the plans, forecast impacts, and prepare an estimate at completion based on performance to date and work to be performed.
7. Use EVMS data to guide management decisions and implement management actions to mitigate risk and manage cost and schedule performance objectives.

These principles are integrated into a comprehensive system that develops and maintains the baseline; tracks project cost, schedule, and scope; and provides for the generation of timely performance measurement data and reports. Performance measurement reports provide management with objective project information critical to monitoring progress, identifying significant issues, and implementing corrective actions as needed.

Float or Total Float. The amount of time an activity can slip before it affects another activity's finish date. It is the difference between when an activity can happen and when an activity must happen.

Free Float. The amount of time that the early start of an activity can be delayed without delaying the early start of a successor activity.

Lag. An offset or delay from an activity to its successor.

Late Dates. Late start and finish dates are the latest dates an activity can be performed without delaying a successor activity.

Milestone. A schedule event marking the due date for accomplishment of a specified effort (work scope) or objective. A milestone may mark the start, an interim step or interface point, or the end of one or more activities.

Original Duration. The planned estimate of the number of work periods required to accomplish an activity.

Predecessor. An activity that must occur before another activity. A predecessor activity controls the early start or early finish date of its successors. An activity can have multiple predecessors, each with a different relationship type.

Relationship (Logic) Type. The condition that controls how an activity is related to its predecessors or successors.

Remaining Duration. The number of work periods forecasts to complete the activity.

Schedule Contingency. Duration added to a schedule to allow for the probability of possible or unforeseen events.

Start-to-Finish Relationship (SF). A relationship in which the start of the predecessor activity controls the Finish of a successor activity.

Start-to-Start Relationship (SS). A relationship in which the start of the predecessor activity controls the start of a successor activity.

Successor. An activity that occurs after another activity. An activity can have multiple successors, each with a different relationship type.

Baseline Schedule. The version of the schedule that reflects all formally authorized scope and schedule changes.

Critical Activity. Activity on the project’s critical path.

Critical Path. The series of tasks in a network schedule representing the longest duration for a project. Any slippage of tasks along the critical path increases the duration of the project. In a project network diagram, the series of logically linked activities that determine the earliest completion date for the project. The Critical Path might change from time to time, as activities are completed ahead of or behind schedule. Although normally calculated for the entire project, the Critical Path can also be determined for a milestone or a subproject. The Critical Path is usually defined as those activities with float less than or equal to a specified value, often zero.

Critical Path Method (CPM). A network analysis technique used to predict project duration by analyzing which sequence of activities (which path) has the least amount of scheduling flexibility (the least amount of float). Early dates are calculated by means of a forward pass using a specified start date. Late dates are calculated by means of a backward pass starting from a specified completion date to result in zero total float for each activity.

Current Schedule. The schedule that reflects the actual start and finish dates plus forecasted start and finish dates from today forward.

Duration. The number of work periods (not including holidays or other nonworking periods) required to complete an activity or other project element, and usually expressed as workdays or workweeks. Sometimes incorrectly equated with elapsed time.

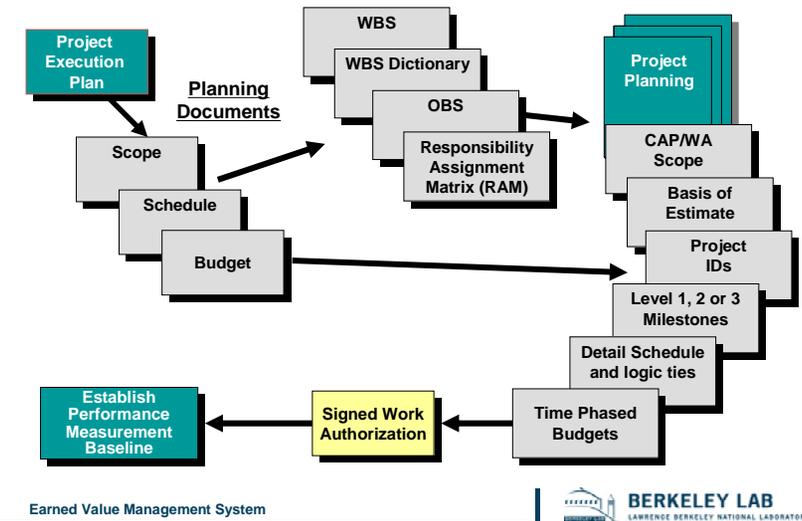
Due Date. The date by which a milestone or task is scheduled to be completed.

Early Dates. Indicate the earliest start and finish dates when an activity can be performed if all preceding activities have been completed.

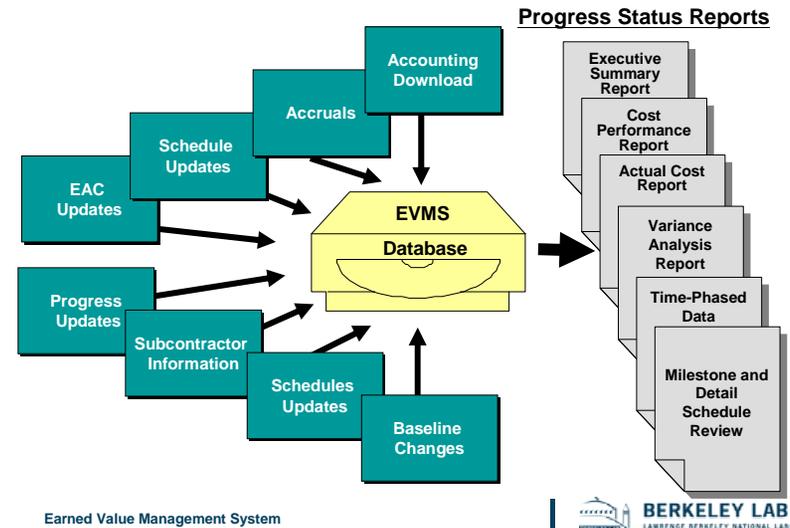
Finish-to-Finish Relationship (FF). A relationship in which the finish of a predecessor activity depends on the finish of its predecessor activity.

Finish-to-Start Relationship (FS). A relationship in which the predecessor activity must finish before its successor activity can start.

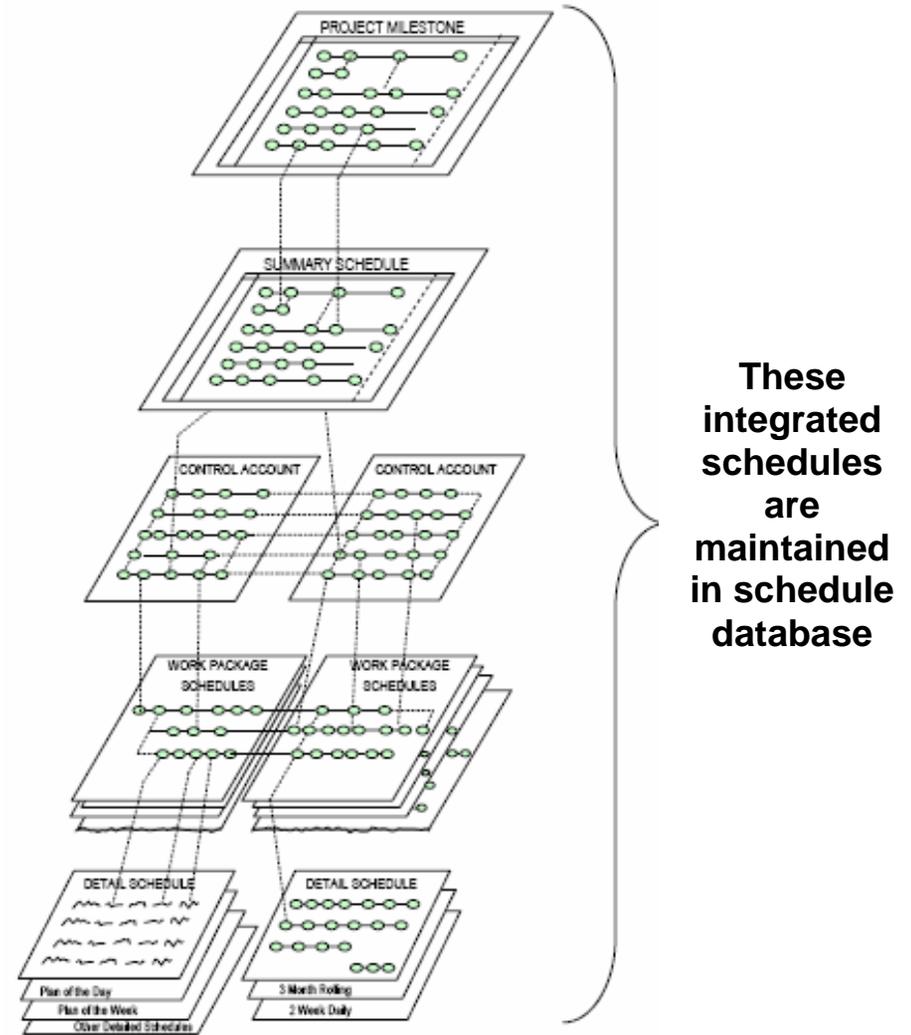
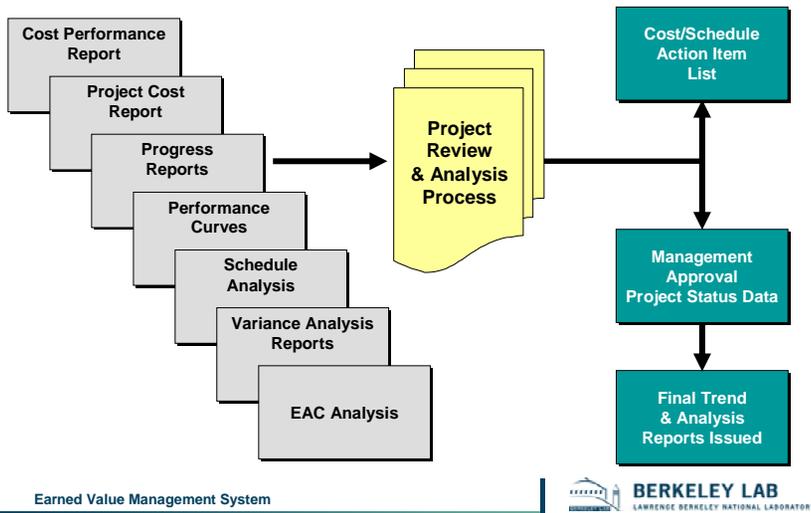
Principles No. 1, 2 and 3: Organization, Planning Budgeting and Scheduling



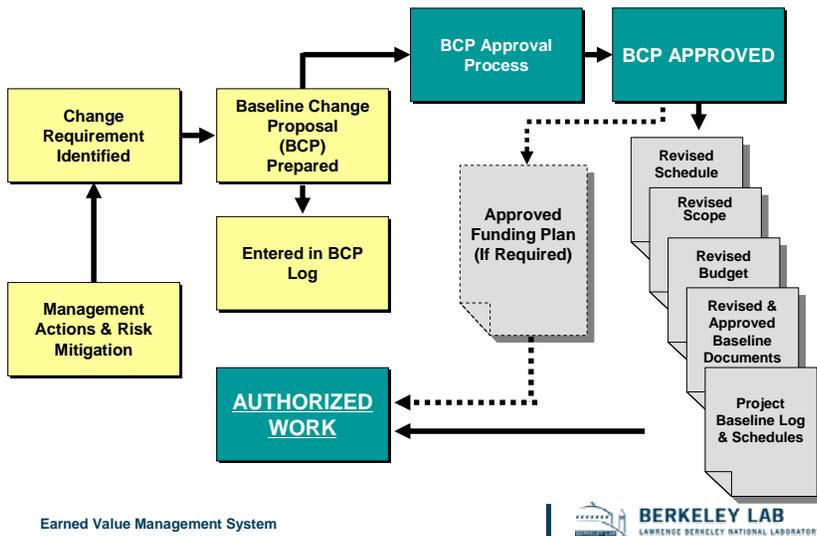
Principle No. 4: Objectively Measure Progress and Performance



Principles No. 5 and 6: Analyzing and Reviewing Monthly Data



Principle No. 7 Management Actions and Change Control



The following terms are commonly used in developing and maintaining schedules:

Activity. A short work effort that occurs over time, usually consumes resources, and usually has an associated product, objective, or milestone. Also referred to as a task.

Total Project Cost (TPC). Total cost for the project, including all costs regardless of sources or type of funds.

Undistributed Budget (UB). Budget associated with specific work scope or contract changes that have not been assigned to a control account or summary-level planning package. Not used at LBNL

Work Breakdown Structure (WBS). A product-oriented grouping of project elements that organizes and defines the total scope of the project. The WBS is a multilevel framework that organizes and graphically displays elements representing work to be accomplished in logical relationships. Each descending level represents an increasingly detailed definition of a project component. Project components may be products or services. It is the structure and code that integrates and relates all project work (technical, schedule, and cost) and is used throughout the life cycle of a project to identify and track specific work scopes.

Work Breakdown Structure Dictionary. A listing of work breakdown structure elements with a short description of the work-scope content in each element.

Work Package. A task or set of tasks performed within a control account.

Scheduling Terminology

Schedules are organized in a hierarchy that is logically tied within a critical-path method (CPM) network. The resource-loaded schedule becomes the basis for scheduling work activities, time-phasing resources, monitoring and evaluating deviations, and exercising schedule control. Detailed schedules are monitored and updated first and are then summarized upward to summary-level schedules (see the following figure). Project schedules are maintained in a database that allows summarization as well as vertical and horizontal integration.

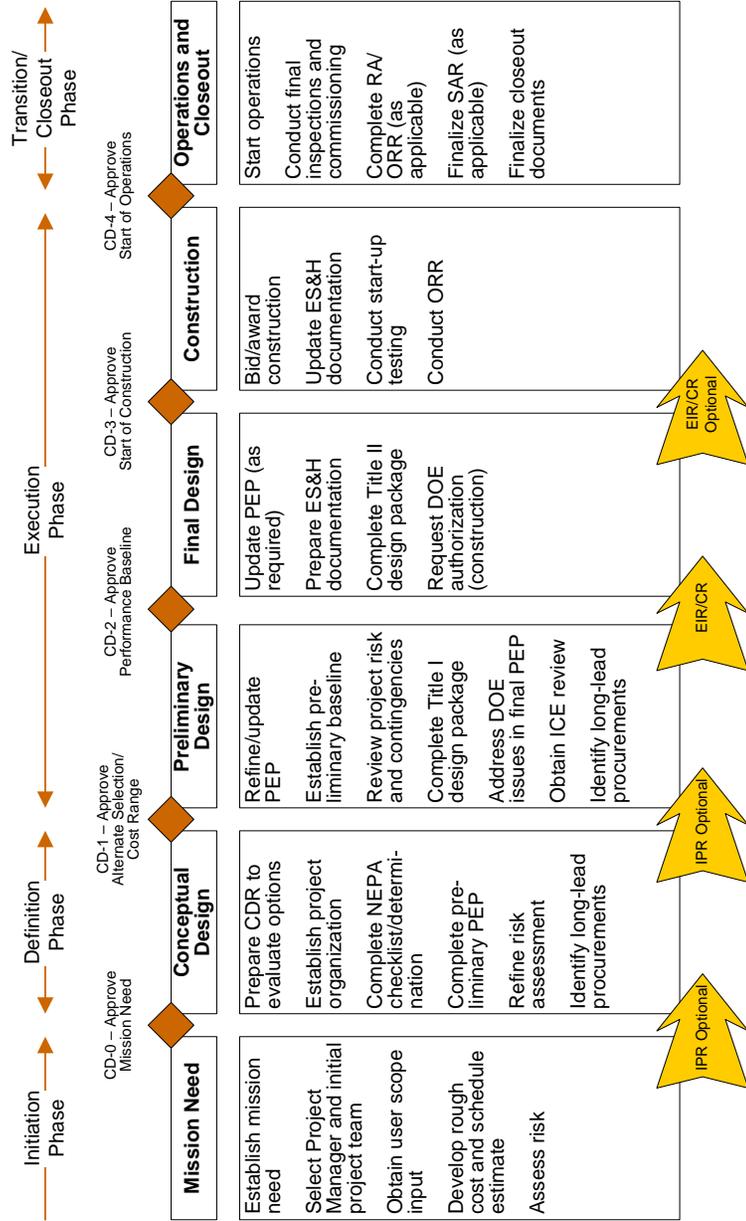
The LBNL-EVMS is designed to provide project managers with a tool to promote optimal planning, accurate reporting, and effective control through the standardization of processes used in project scope, schedule, and budget management.

LBNL's EVMS is a project management technique that contributes to successful project performance through disciplined and integrated planning, responsible management of assets, determination of true performance, and prediction of cost and schedule results to provide objective and timely information for decision making at all levels of the organization and throughout the project life cycle. The EVMS is used to assess risks throughout the project life cycle and then implement the management controls necessary to execute the baseline as planned.

Implementation of the EVMS process begins early in the life of a project, with the approval of the project mission need. While LBNL applies EVMS techniques during all phases of project work, DOE Order 413.3A *requires* that the formal EVMS process begin after approval of Critical Decision 2, "Approve Performance Baseline" (as illustrated in the following figure). At this time, a Performance Measurement Baseline is established and formal (required) EVMS reporting begins.

The elements of an EVMS are listed below:

- Work Breakdown Structure (WBS)
- Organizational Breakdown Structure (OBS)
- Responsibility Assignment Matrix (RAM)
- Full financial reporting requirements
- Fully integrated resource-loaded schedule
- Performance Measurement Baseline (PMB)
- Assignment of CAMs and implementation of EVMS for CAs within the WBS elements
- Rolling-wave concept for baseline planning
- Full implementation of EVMS performance metrics
- Accessibility of EVMS data throughout the project structure
- Formal baseline change control procedures.



Standard Acquisition Process

The standard DOE acquisition process (Critical Decisions 0-4) can be tailored on a project-specific basis (e.g., CDs and reviews can be combined to accommodate alternative acquisition strategies). See the Appendix for definition of acronyms.

particular outcome, and (2) the *consequences/impacts* of failing to achieve that outcome.

Risk Management. The act or practice of controlling risk. An organized process that reduces risk, prevents a risk from happening, or mitigates the impact if it does occur.

Schedule. A plan that defines when specified work is to be done to accomplish program objectives on time.

Schedule Control. Controlling changes to the project schedule and preparing workaround plans to mitigate the impact of adverse results/delays by others.

Schedule Performance Index (SPI). A schedule performance indicator relating work accomplished to the planned schedule (EV/PV). A value greater than one denotes favorable performance.

Schedule Variance (SV). A metric for the schedule performance on a program. It is the algebraic difference between Earned Value and the Budget (Schedule Variance = Earned Value – Budget). A positive value is a favorable condition while a negative value is unfavorable. The SV is calculated in dollars or work units, and is intended to complement network analysis, not to supersede or replace it.

Scope of Work (SOW). The document that defines the work-scope requirements for a project. It is a basic element of control used in the processes of work assignment (scope) and the establishment of project schedules and budgets.

System. A collection of interdependent equipment and procedures assembled and integrated to perform a well-defined purpose. It is an assembly of procedures, processes, methods, routines, or techniques united by some form of regulated interaction to form an organized whole.

Total Estimated Costs (TEC). The Total Estimated Cost of a project is the specific cost of the project, whether funded as an operating expense or construction. It includes the cost of land and land rights; engineering, design, and inspection costs; direct and indirect construction costs; and the cost of initial equipment necessary to place the plant or installation in operation, whether funded as an operating expense or construction.

Planned Value (PV). The sum of the budgets for all work (work packages, planning packages, etc.) scheduled to be accomplished (including in-process work packages), plus the amount of level of effort and apportioned effort scheduled to be accomplished within a given time period. Also referred to as Budgeted Cost for Work Scheduled (BCWS).

Planning Package. A logical aggregate of work, usually future efforts that can be identified and budgeted, but which is not yet planned in detail at the work package or task level.

Program Office. The DOE headquarters organizational element responsible for managing a program.

Project. In general, a unique effort that supports a program mission; has defined start and end points; is undertaken to create a product, facility, or system; and contains interdependent activities planned to meet a common objective or mission. A project is not constrained to any specific element of the budget structure (e.g., operating expense or plant and capital equipment). Construction, if required, is part of the total project. Projects include planning and execution of construction, renovation, modification, environmental restoration, decontamination and decommissioning efforts, and large capital equipment or technology development activities. Tasks that do not include the above elements, such as basic research, grants, ordinary repairs, maintenance of facilities, and operations, are not considered projects.

Project Execution Plan (PEP). The plan for the execution of the project, which establishes roles and responsibilities and defines how the project will be executed. Every project implementing Earned Value management will have a unique project execution plan.

Remaining Duration. The time needed to complete an activity.

Responsibility Assignment Matrix (RAM). A structure that relates the project organization structure to the work breakdown structure to help ensure that each element of the project's scope of work is assigned to a responsible individual.

Risk. A measure of the potential inability to achieve overall project objectives within defined cost, schedule, and technical constraints, and has two components: (1) the *probability/likelihood* of failing to achieve a

LBNL's Applicable Documents

As a DOE Laboratory, LBNL follows the requirements in DOE Order 413.3A Program and Project Management for the Acquisition of Capital Assets and its accompanying DOE Guides and DOE Manual 413.3-1, which mandates earned value requirements. All line item construction projects and selected complex and high-risk programmatic activities at LBNL are executed under the requirements of DOE Order 413.3A.

LBNL's Earned Value Management System (EVMS) process and organization was certified in January 2006 to comply with the American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA) Standard (ANSI/EIA-748 Earned Value Management Systems). The LBNL EVMS is a key component of the organization, methods, and procedures adopted by LBNL to ensure that its projects are properly executed. In addition to the LBNL EVMS System Description, a set of LBNL Project Management Office (PMO) procedures have been developed and will be used for the management of the projects utilizing EVMS. The documents used in the surveillance process are:

- PMO-LBID-2570 Lawrence Berkeley National Laboratory Earned Value Management System (LBNL EVMS) Description
- PMO-1.0 Preparation & Control of Project Management Office Procedure's
- PMO-1.1 Project Plan
- PMO-1.2 Project Work Breakdown Structure (WBS)
- PMO-1.3 Project Organizational Breakdown Structure (OBS)
- PMO-1.4 Control Accounts, Work Packages & Planning Packages
- PMO-1.5 Control Account Plan/ Work Authorization
- PMO-1.6 Project Schedule
- PMO-1.7 Cost Estimating
- PMO-1.8 Monthly Status/ Reporting
- PMO-1.9 Change Control
- PMO-1.10 LBNL Earned Value Management System Surveillance Plan

These procedures provide the basis and this document provides guidance for performance of the LBNL EVMS Surveillance Review.

ANSI EIA-748-B-2007 identifies 32 guidelines for establishing and applying an integrated EVMS and categorizes these guidelines into five functional groups. The LBNL EVM System Description addresses these guidelines and functional areas in detail. This Reference Guide is organized around the five functional groups as follows:

- Organization
- Planning, Scheduling, and Budgeting
- Accounting Considerations
- Analysis and Management Reports
- Revisions and Data Maintenance.

This reference guide also contains an appendix with information on acronyms and terminology. The back cover of the guide provides a quick reference to key earned value formulas.

that does not lend itself to the measurement of discrete accomplishment. It is generally characterized by a uniform rate of activity over a specific period of time. Value is earned at the rate that the effort is being expended.

Line Item. An appropriation by Congress for a specific effort, activity, or project. All budgets are appropriated by Congress through line items.

Management Reserve/Contingency. An amount of the total allocated budget held for management control purposes by the contractor. Management reserve/contingency is not part of the Performance Measurement Baseline. The usage of the term *management reserve/contingency* throughout this document is **not** the same as contingency held by DOE.

Milestone. A scheduled event marking the due date for accomplishment of a specified effort (work scope) or objective. A milestone may mark the start, an interim step, or the end of one or more activities.

Mission Need. A performance gap between current performance and what is required.

Network Schedule. A schedule format in which the activities and milestones are represented along with the interdependencies between activities. It expresses the logic (how the program will be accomplished) and the time frames (when). Network schedules are the basis for critical-path analysis, a method for identification and assessment of schedule priorities and impacts.

Organizational Breakdown Structure (OBS). A depiction of the project organization arranged to indicate the line-reporting relationships within the project context.

Other Project Costs (OPC). Costs for engineering, design, development, startup, and operations, which are essential for project execution and are operating-expense funds.

Performance Measurement Baseline (PMB). The collected key performance, scope, cost, and schedule parameters. The Performance Measurement Baseline defines the threshold and boundary conditions for a project.

roads, walks, and parking areas; outside lighting and communications systems; central utility plants; utilities supply and distribution systems; and other physical-plant features.

Final Design. Completion of the design effort and production of all the approved design documentation necessary to permit procurement. Construction, testing, checkout, and turnover to proceed. Final design occurs between Critical Decision-2 and -3.

Firm Fixed Price Contract. Fixed price contracts provide for a firm price or, under appropriate circumstances, may provide for an adjustable price for the supplies or services that are being procured. In providing for an adjustable price, the contract may fix a ceiling price, target price (including target cost), or minimum price. Unless otherwise provided in the contract, any such ceiling, target, or minimum price is subject to adjustment only if required by the operation of any contract clause that provides for equitable adjustment, escalation, or other revision of the contract price upon the occurrence of an event or a contingency.

Independent Cost Estimate (ICE). A “bottoms up” documented, independent cost estimate that serves as an analytical tool to validate, crosscheck, or analyze cost estimates developed by project proponents.

Independent Cost Review (ICR). An essential project management tool used to analyze and validate an estimate of project costs. An independent cost review is typically conducted on all projects at the point of baseline approval. Such reviews may be required by the U.S. Congress, DOE management, DOE headquarters program offices, or field project management staff. The requiring office or agency will provide specific requirements for such reviews. An ICR may be performed by an independent internal or external organization.

Indirect Rate. Indirect rate means the percentage or dollar factor that expresses the ratio of an indirect expense incurred in a given period to a direct labor cost or another appropriate base for the same period.

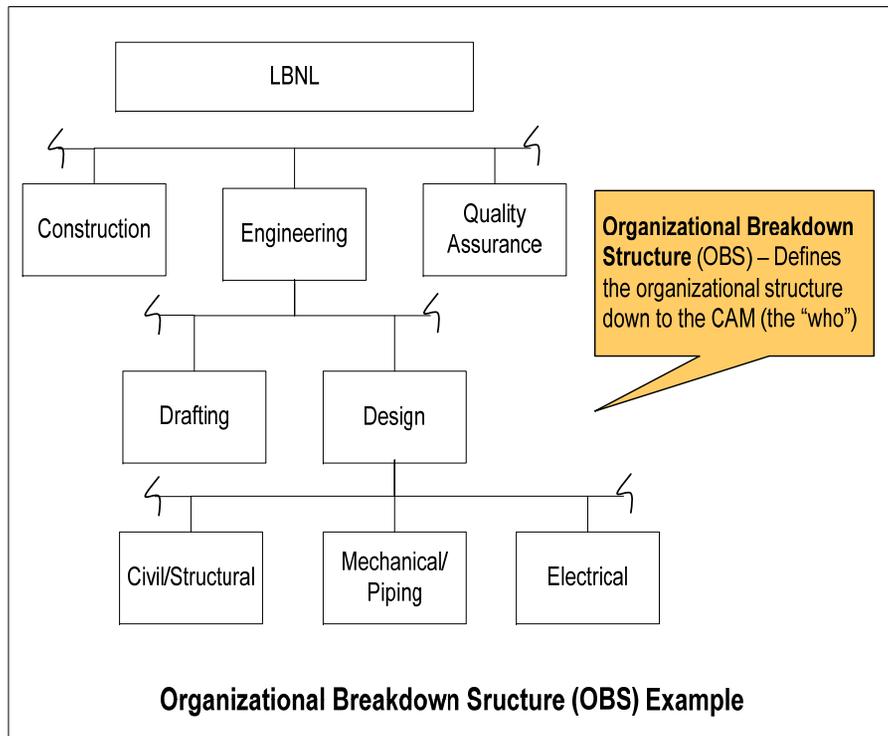
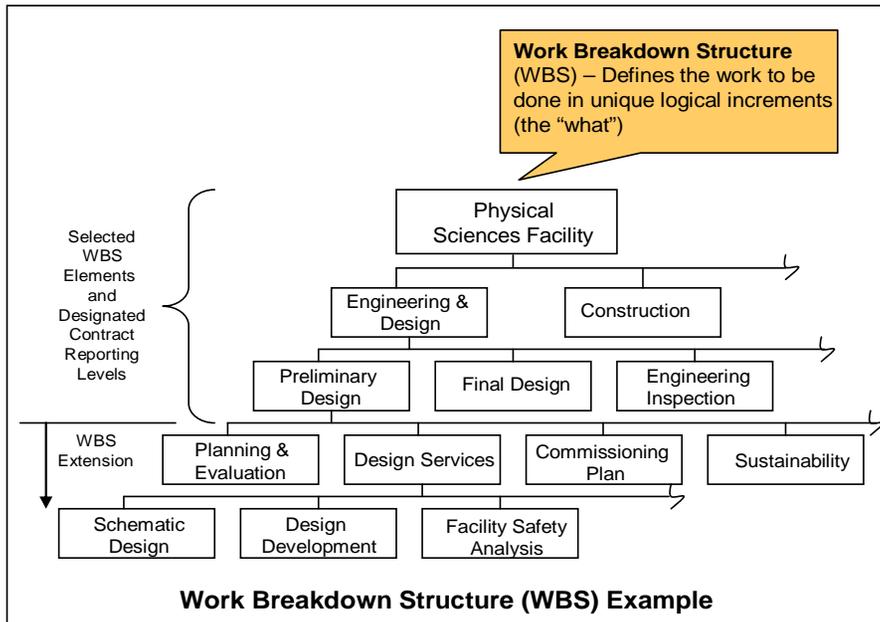
Integrated Project Team (IPT). An IPT is a cross-functional group of individuals organized for the specific purpose of delivering a project to an external or internal customer.

Level of Effort (LOE). Effort of a general or supportive nature without a deliverable end product. An activity (e.g., vendor or customer liaison)

Organization

Project organization is the first and most important function of project management. The project organization process ensures that the work is adequately defined, identifies the organizations responsible for performing the work, and assigns responsibilities for managing and performing the work to the appropriate internal or external organization. An effective project organization uses the following tools (illustrated in the following figures):

- **WBS** – A WBS is a hierarchical grouping of project elements that organizes and defines the total work scope of the project. The WBS forms the basis for planning and scheduling work, budgeting, and reporting. It documents the hierarchy and describes the tasks to be performed and relationship of the tasks to the project deliverables.
- **WBS Dictionary** – The WBS Dictionary further defines the WBS elements and is typically developed at the CA level. It describes how work will be conducted to develop, design, construct, equip, and manage the project.
- **OBS** – The project-specific OBS shows how project personnel are organized and defines roles, responsibilities, and reporting levels, from the highest levels of the customer’s organization down to local project participants, including local customer management, LBNL line management, Project Directors, Champions, Facilities Management; LBNL Project Manager and the core project team members including LBNL’s procurement staff, project controls staff, financial accounting staff, construction management staff, and other subject matter experts.
- **RAM** – The RAM provides an overview of the relationship of the CAs to the WBS and OBS. The RAM is created by locating the intersection of the responsible functional organization with the WBS. It identifies all CAMs and their line management organizations and shows the relationship of each CA to its associated WBS element.



Critical Decision (CD). A formal determination made by the AE and/or designated official (Mission Need Statement) at a specific point in a project life cycle that allows the project to proceed. Critical Decisions occur in the course of a project, for example, prior to the commencement of conceptual design (CD-1), the commencement of execution (CD-3), and turnover (CD-4).

Design Criteria. Those technical data and other project information identified during the project initiation and definition (conceptual design and/or preliminary design phases). They define the project scope, construction features and requirements, and design parameters; applicable design codes, standards, and regulations; applicable health, safety, fire protection, safeguards, security, energy conservation, and quality-assurance requirements; and other requirements. The project design criteria are normally consolidated into a document, which provides the technical base for any further design performed after the criteria are developed.

Directed Change. A change imposed on a project(s) that affects the project’s baseline. Example of directed changes include, but are not limited to, (1) changes to approved budgets or funding and (2) changes resulting from DOE policy directives and regulatory or statutory requirements.

Earned Value (EV). (1) A method for measuring project performance that compares the value of work performed (EV) with the value of work scheduled (Planned Value [PV]) and the cost of performing the work (Actual Cost [AC]) for the reporting period and/or cumulative to date; (2) the budgeted cost of work performed for an activity or group of activities. Also referred to as Budgeted Cost for Work Performed (BCWP)

Estimate at Completion (EAC). The latest revised cost estimate for a given work scope (EAC = cumulative AC + ETC).

Estimate to Complete (ETC). Estimate of costs to complete all work from a point in time to the end of the project.

Estimated Cost. An anticipated cost for an applied work scope.

Facilities. Buildings and other structures; their functional systems and equipment, including site-development features such as landscaping,

Contractor. An individual, partnership, company, corporation, or association having a contract with a contracting agency (Federal government) for the design, development, maintenance, modification, or supply of deliverable items and services under the terms of a contract.

Subcontractor. In this document, refers to contractors having a contract with UC, as the maintenance-and-operations contractor to DOE, for work at LBNL.

Control Account. A management control point at which budgets (resource plans) and actual costs are accumulated and compared to earned value for management control purposes.

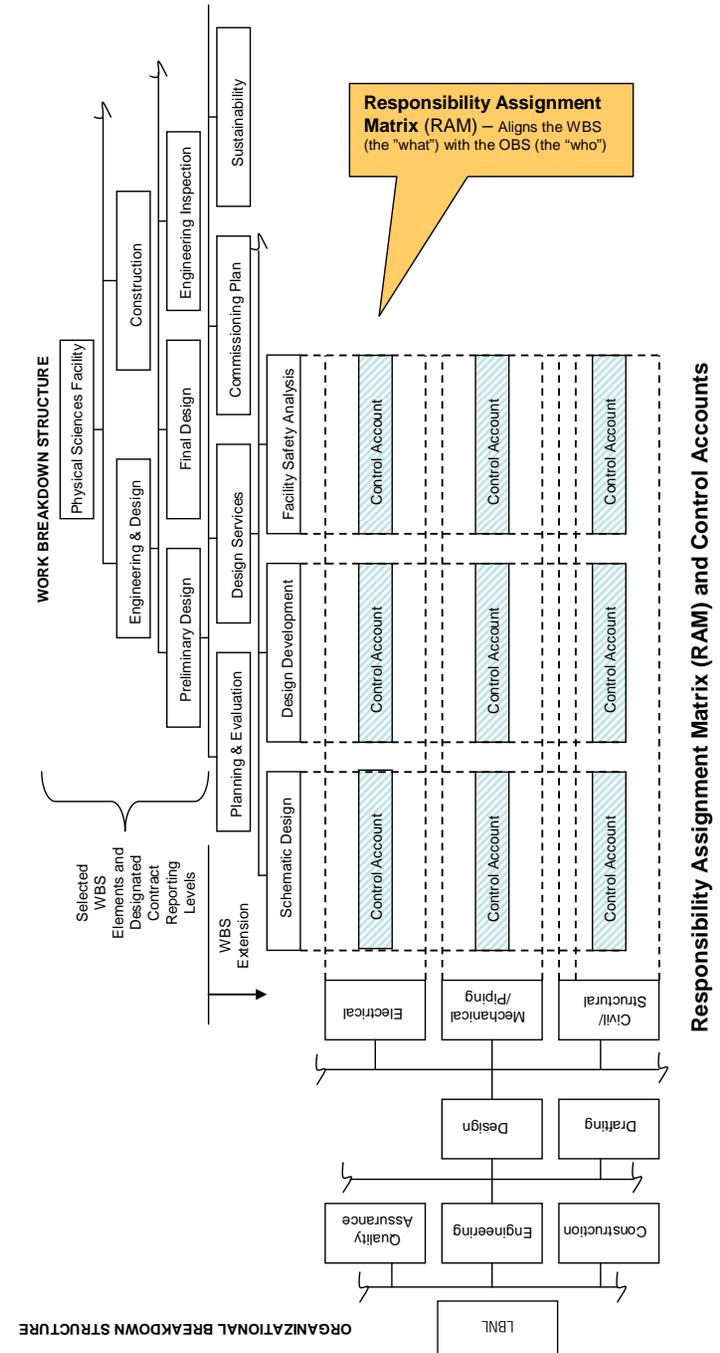
Cost Estimate. A documented statement of costs estimated to be incurred to complete the project or a defined portion of a project.

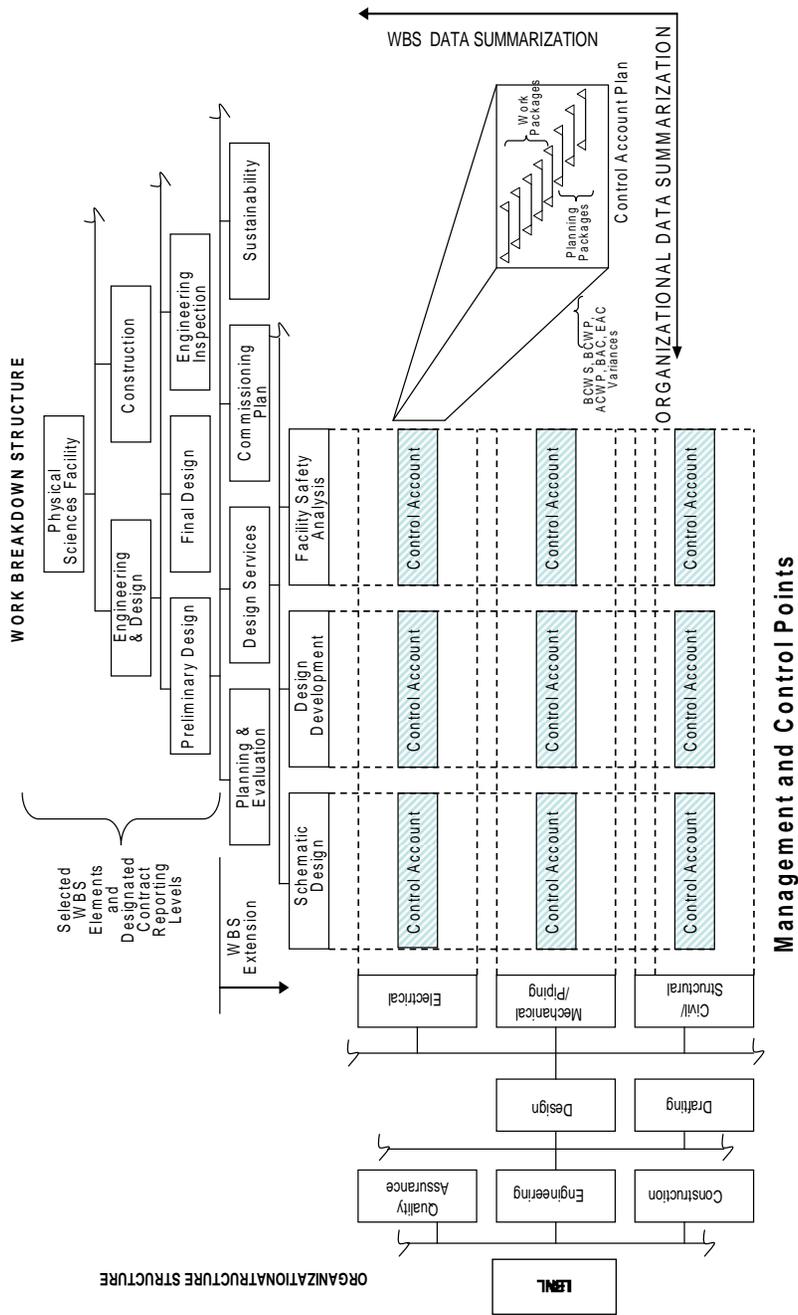
Cost Variance. The algebraic difference between Earned Value and Actual Cost (Cost Variance = Earned Value – Actual Cost.) A positive value indicates a favorable condition, and a negative value indicates an unfavorable condition.

Costs to Date. Costs incurred to date by the contractor and reported to DOE, which are recorded as accrued costs. They represent all charges incurred for goods and services received and other assets required, regardless of whether payment for the charges has been made. Costs to date include all completed work and work in process chargeable to the contract; specifically, they include invoices for (1) completed work to which the prime contractor has acquired title; (2) materials delivered to which the prime contractor has acquired title; (3) services rendered; (4) costs billed under cost reimbursement, or time and material subcontracts for work to which the prime contractor has acquired title; (5) progress payments to subcontractors that have been paid or approved for current payment in the ordinary course of business (as specified in the prime contract); and (6) fee profits allocable to the contract.

Cost Performance Index (CPI). The ratio of earned value to actual costs (EV/AC). A value greater than one denotes favorable performance. CPI is often used to predict the magnitude of possible cost deviations from the baseline.

Cost Variance %. The percentage of CV from what has been earned to date.





Deviation. A deviation occurs when the current estimate of a performance, technical, scope, schedule, or cost parameter is not within the threshold values of the Performance Baseline for that parameter. It is handled as a deviation, not through the normal change control system.

Budget at Completion (BAC). The total authorized budget for accomplishing the scope of work. It is equal to the sum of all allocated budgets plus any undistributed budget. (Management reserve/contingency is not included.) The Budget at Completion will form the Performance Baseline.

Budgeting. The process of translating resource requirements into a funding profile.

Burden. Costs that cannot be attributed or assigned to a system as direct cost. An alternative term for Overhead.

Capability. A measure of the system's ability to achieve mission objectives, given the system's condition during the mission.

Change Order. A bilateral or sometimes unilateral order signed by the government contracting officer that directs the contractor to make a change that the *change clause* authorizes usually with, but sometimes without, the contractor's consent.

Conceptual Design. The concept for meeting a mission need. The conceptual design process requires a mission need as an input. Concepts for meeting the need are explored and alternatives considered determining a set of alternatives that are technically viable, affordable, and sustainable.

Configuration Management. To control changes to, and to record and report changes to, data sets, reports, and documents.

Contingency (OECM names this "Management Reserve"). An amount of the total allocated budget withheld by the contractor for management control purposes. Contingency is not part of the Performance Measurement Baseline. The usage of the term *contingency* throughout this document is **not** the contingency held by DOE.

Contract. A mutually binding agreement that obligates the seller to provide the specified product and obligates the buyer to pay for it.

OPC	Other Project Cost
ORR	Operational Readiness Review
PBB	Project Budget Baseline
PEP	Project Execution Plan
PMB	Performance Measurement Baseline
PP	Planning Package
QA	Quality Assurance
RAM	Responsibility Assignment Matrix
RA	Readiness Assessment
SAR	Safety Analysis Report
SBMS	Standards-Based Management System
SOW	Statement of Work
SPI	Schedule Performance Index
SV	Schedule Variance
TAB	Total Authorized Budget
TCPI	To-Complete Performance Index
TEC	Total Estimated Cost
TPC	Total Project Cost
UB	Undistributed Budget
VAC	Variance at Complete
WBS	Work Breakdown Structure

EVMS Terminology

Accrual Method. An accounting method in which revenue is recognized when earned rather than when collected, and in which expenses are recognized when incurred rather than when paid. Accrual-basis accounting is essential to accurate performance and progress information on contracts.

Acquisition Executive (AE). The individual designated by the Secretary of Energy to integrate and unify the management system for a program portfolio of projects, and implement prescribed policies and practices.

Acquisition Strategy. A high-level business and technical management approach designed to achieve project objectives within specified resource constraints. It is the framework for planning, organizing, staffing, controlling, and leading a project. It provides a master schedule for activities essential for project success, and for formulating functional strategies and plans.

Actual Cost of Work Performed (ACWP). Total costs incurred (direct and indirect) in accomplishing an identified element or scope of work during a given time period. Also referred to as Actual Cost (AC).

Planning, Scheduling, and Budgeting

Baseline planning and development can be defined as making decisions today with a view toward the future. This planning considers the “who,” “what,” “why,” “when,” and “where” for a particular effort today while trying to anticipate its effect at some future date. This future-oriented process involves setting objectives, gathering and organizing information, determining feasible courses of action, selecting and implementing courses of action, and monitoring results.

A product of the planning process is the development of an integrated baseline that is used to measure and control project work activities during the project life cycle. The integrated baseline consists of three components: a technical baseline, a schedule baseline, and a budget baseline, as described below:

- **Technical baseline** – The work scope and technical specifications that the project must meet
- **Schedule baseline** – The time-phased logical relationship of interdependent activities required to complete the project
- **Budget baseline** – The time-phased approved planned expenditures to complete the project’s work scope based on the project baseline schedule.

Baselines are established, monitored, and controlled through all phases of the project. The Project Baseline Budget (PBB) is established during customer negotiations or through the Critical Decision process and includes the PMB, contingency, and management reserve. The following figure depicts the steps for planning and establishing the PMB.

Earned value techniques to measure accomplishment of work are established at the activity level of the intermediate project schedule. On a monthly basis, schedule activities are assessed to compare the work that was accomplished with the baseline plan. The CAMs determine Performance accomplished during the reporting period. Earned value comparisons are then used to evaluate performance for all activities.

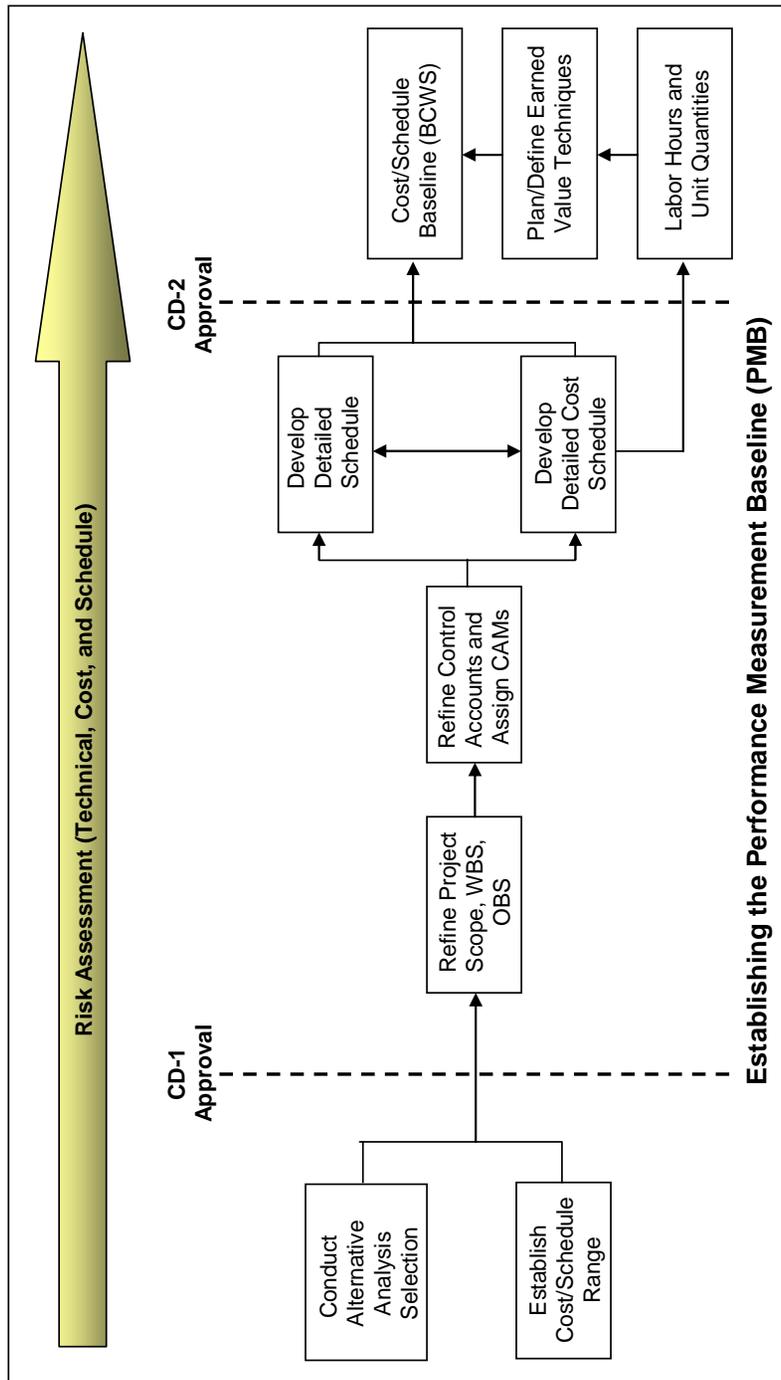
Appendix A

The following information is provided in this appendix:

- A list of acronyms
- EVMS terminology
- Scheduling terminology

Acronyms

ACWP	Actual Cost of Work Performed or Actual Cost (AC)
BAC	Budget at Completion
B&R	Budget and Reporting
BCR	Baseline Change Request
BCWP	Budgeted Cost of Work Performed or Earned Value (EV)
BCWS	Budgeted Cost of Work Scheduled
CA	Control Account
CAM	Control Account Manager
CD	Critical Decision
CDR	Conceptual Design Report
CPI	Cost Performance Index
CPM	Critical Path Method
CPR	Cost Performance Report
CV	Cost Variance
D&D	Demolition and Decontamination
DOE	(U.S.) Department of Energy
EAC	Estimate at Completion
EIR	External Independent Review
ES&H	Environment, Safety, and Health
ETC	Estimate to Complete
EVMS	Earned Value Management System
G&A	General and Administrative
GPP	General Plant Project
ICE	Independent Cost Estimate
IPR	Independent Project Review
IPS	Integrated Project Schedule
IPT	Integrated Project Review
LOE	Level of Effort
M&O	Management and Operations (contract)
NEPA	National Environmental Policy Act
MR	Management Reserve
NNSA	(DOE's) National Nuclear Security Administration
OBS	Organizational Breakdown Structure



Typical Baseline Change Control Thresholds and Approval Levels		
	DOE Deviation (Level 0)	DOE/HQ (Level 1)
Technical scope	Any change not in conformance with current approved Critical Decision Document.	Any change affecting the Project mission or siting goals and objectives
Budget	Increase in excess of \$25M or 25% (cumulative) of the original cost baseline.	Any increase to the TEC or TPC
Schedule	6 months or greater delay in the project completion date	3-month delay of a Level 1 milestone date
	DOE/BSO Federal Project Director (Level 2)	LBNL Project Manager (Level 3)
Technical scope	Any revision to the end state document that would affect the future use of the site.	Any revisions to the end state document that would affect the future use of the site.
Budget	An increase of \geq \$1 million at Level 2 WBS	An increase \geq \$50K at Level 3 WBS
Schedule	Any delay of a Level 1 milestone date or a 3-month delay of a Level 2 milestone date	1-month delay of a Level 2 or 3-month delay of a Level 3 milestone date.

The three key components for EVMS metrics are Actual Cost for Work Performed (ACWP), Budgeted Cost for Work Performed (BCWP) or Earned Value (EV), and Budgeted Cost for Work Scheduled (BCWS) or Planned Value (PV) (see table below). These values are always expressed in dollars. Two other key performance elements are schedule variance (SV) and cost variance (CV).

Performance Metrics	
ACWP	The actual cost charged to the project, plus accruals for work completed but for which associated payments have not been finalized.
BCWP	The sum of the budgets for completed work packages and completed portions of open work packages, plus the appropriate portion of the budgets for level of effort and apportioned effort.
BCWS	The sum of the budgets for all work packages, planning packages, etc., scheduled to be accomplished within a given time period.
CV	The difference between BCWP and ACWP.
SV	The difference between BCWP and BCWS.

The three basic methods for measuring performance are listed below:

- **Discrete effort.** Discrete tasks are those tasks that are quantifiable to individual work products or predetermined tangible measurements. Techniques used for discrete effort include the following:
 - Fixed formula (0/100, 50/50, 25/75, etc.)
 - Weighted milestone (predetermined percent complete based on internal milestones within the work package)
 - Expert opinion - Percent complete (predefined earning methodology based on detailed steps or hours necessary to complete the task).
- **Scheduled-based effort.** This method accumulates the portion of budget that is earned as it relates to the actual and/or forecasted completion dates of the detailed schedule activities. If activities are

completed ahead of schedule, budget is earned in advance of the baseline time-phased plan. Conversely, if activities are completed behind schedule, a lower amount of budget is earned and an unfavorable schedule variance occurs.

- **Level of effort (LOE).** Used for those activities that do not have measurable deliverables. This method is generally applied only to management and project support efforts. The LOE method is limited to those schedule activities that cannot be measured discretely to avoid distorting project performance data. Budgets for LOE activities must still have a documented basis of estimate and be time phased to properly reflect when work will be accomplished. The earned value amount for LOE activities equals the time-phased budget; therefore, no schedule variances can occur.

Material or subcontract items also use an effective performance measurement that allows for earned value to be claimed in the same accounting period as actual costs. In general, material performance is earned as follows:

- **Engineered equipment.** Engineered materials are budgeted and costed for performance measurement reporting purposes when the material is received and accepted or based on a verifiable progress payment schedule.
- **Field or bulk materials.** Field materials are budgeted and costed for performance measurement reporting purposes when the material is withdrawn from stores.
- **Subcontracts.** Requirements for EVMS are flowed down to appropriate subcontracts to ensure project performance expectations are maintained. Subcontracts are budgeted and costed (including accrued cost) for performance measurement as physical work is accomplished.

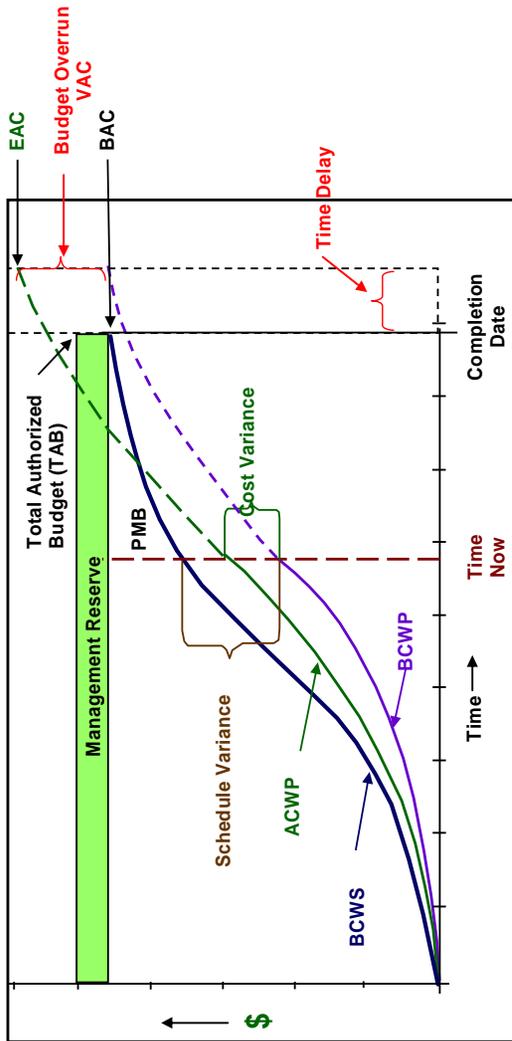
Revisions and Data Maintenance

Managing project changes is an important element of project planning and baseline management. The objective of an effective baseline change control process is to provide an orderly and efficient method for incorporating approved changes into the integrated project baseline. Key elements of an effective change control process include the following:

- Addresses only changes to the work scope or changes to the budget or schedules that are the result of a change in scope.
- Provides a disciplined process for incorporating approved actions into the project baseline.
- Provides an appropriate level of approval before the change is incorporated into work activities.
- Documents all approved changes to the project baseline.
- Ensures that baseline changes are clearly defined, well documented, and approved through a process that delineates the management level required for review and approval.
- Provides accountability and traceability throughout the approval and decision-making process when changes are made to the baseline.

The purpose of establishing and controlling changes to the project baseline is not only to control “scope creep” but also to facilitate measurement of actual performance in relation to planned performance. Performance can only be assessed against baseline activities. If effort is expended against additional work that is not in the baseline, performance will not be recognized, therefore, it is imperative that changes to the scope be formally made through the change control process...or something similar. Poor performance is not a valid reason for requesting a change to a baseline.

The following table illustrates a typical change control methodology.



Control Account EVMS Metrics Example

Performance Formulas

$CV = BCWP - ACWP$
 $SV = BCWP - BCWS$
 $CPI = BCWP / ACWP$
 $SPI = BCWP / BCWS$
 $VAC = BAC - EAC$

Overall Status

Percent Complete = $\frac{BCWP_{cum.}}{BAC}$
 Percent Spent = $\frac{ACWP_{cum.}}{BAC \text{ (or EAC)}}$

Definitions

- ACWP Actual Cost of Work Performed
- BCWP Budgeted Cost of Work Performed
- BCWS Budgeted Cost of Work Scheduled
- BAC Budget at Completion
- CPI Cost Performance Index
- CV Cost Variance
- EAC Estimate at Completion
- ETC Estimate to Complete
- SPI Schedule Performance Index
- SV Schedule Variance
- VAC Variance at Completion

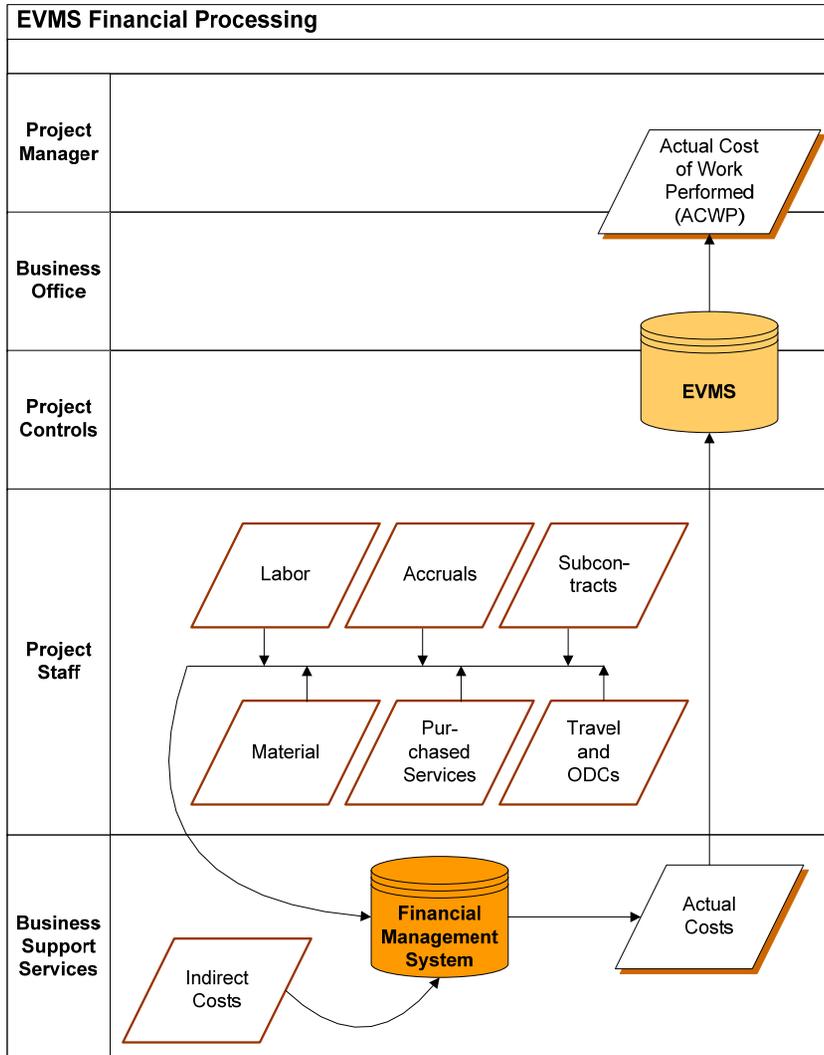
Accounting Considerations

Existing LBNL financial and business management systems are used as the basis for cost and commitment reporting (as illustrated in the following figure). Actual costs and obligations are gathered through several systems including the time card system, travel system, procurement system, and subcontracts management system. Costs and obligations are collected at the lowest level of the WBS and imported into the integrated project controls system on a monthly basis. Direct cost is brought into the integrated project controls system consistent with the way budgets have been established to ensure effective performance management.

The LBNL financial management system complies with all applicable federal financial requirements, including Federal Acquisition Regulations, Cost Accounting Standards, the DOE Accounting Handbook, and the current LBNL Management & Operations (M&O) Performance-Based Management Contract (PBMC) for the management and operation of the Ernest Orlando Lawrence Berkeley National Laboratory (LBNL). DOE approves all labor and overhead rates annually as required by the M&O contract.

Retroactive changes to accounting records are *not* allowed. Prior period adjustments and corrections for mischarges, rate adjustments, or accounting errors are made in the current accounting month before the next month-end closeout. Accounting adjustments and cost transfers from one charge code to another are proposed by the project team and approved and processed by Business Support Services staff, consistent with LBNL cost-charging guidelines. Actual cost and commitment information reported in the project's Cost Performance Reports (CPRs) is reconciled each month and is consistent with the costs recorded in LBNL's financial system. The following paragraphs describe how costs are incorporated.

Cost collection. The cost-charging structure within LBNL's financial management system ensures that actual costs collected are directly compared with associated budgets for all work elements. Project IDs are established that uniquely identify costs down to WBS work packages and CAs, which allows costs to be accumulated and summarized to higher levels of the WBS.

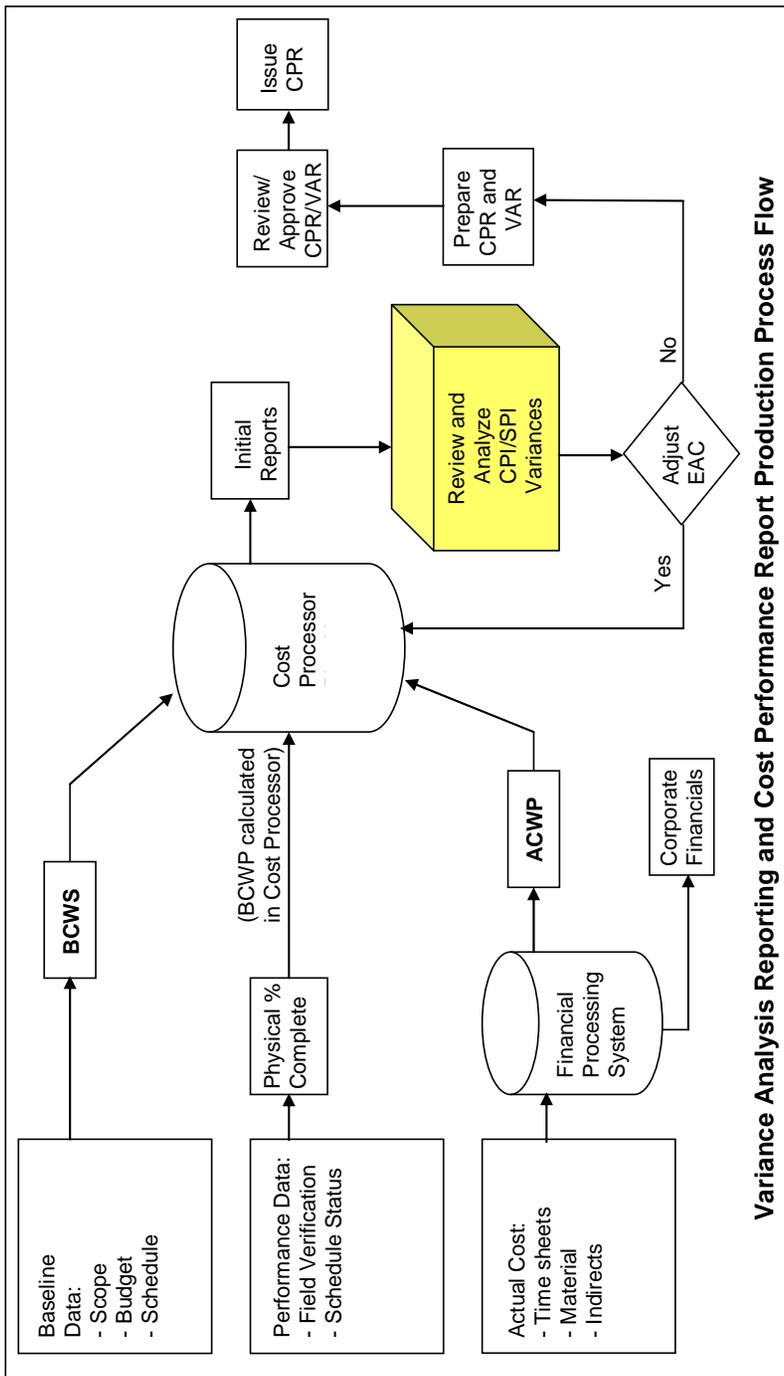


The following factors are considered in preparing an EAC:

- Actual cost and performance experienced to date
- Level of risk or technical complexity associated with the remaining work scope
- Projections of future economic escalations in labor or materials
- Forecasts of remaining resources based on current trends and performance
- Any unrecoverable schedule variances
- Uncompleted authorized work.

An EAC based on predictive performance measures increases the probability that the project can be executed within the overall budget objectives. Monthly EAC reviews are essential for management decisions, including planning for future project funding requirements. On a monthly basis, CAMs review the status of expended effort and the achievability of the forecast using all available information to arrive at the most accurate EAC.

The following figure illustrates cost and schedule performance metrics and their relationship with the Total Authorized Budget (TAB) (the PMB plus the management reserve/Contingency).



There is not necessarily a one-to-one correspondence between project IDs and control accounts. Multiple project IDs, representing individual work packages, may feed into the summary project ID, which is the control account. The project cost-charging structure ensures that actual costs are collected so that direct comparison with associated budgets can be made at the appropriate WBS level and to ensure performance measurement data integrity when summarized throughout the WBS.

Direct costs. A direct cost is any cost that is specifically identifiable with or attributable to a particular project; therefore, direct costs include costs identifiable with the assigned tasks of a specific project (e.g., labor, travel, subcontracts, and procurement costs).

Indirect costs. Indirect costs are those incurred for the operation of LBNL, and some subcontractors and collaborators, that cannot be directly or specifically associated with technical projects in a technical or direct program. Indirect and organizational overhead costs are established and tracked by the Office of the Chief Financial Officer for work performed by LBNL. Indirect costs are distributed to all projects through an allocation process by applying recovery rates to an appropriate allocation base.

Line item project cost classification and funding – In accordance with DOE requirements, all line item project costs are segregated into two categories: capital or expense. **Capital** costs include the more tangible and obvious elements of a project such as buildings, structures, infrastructure, and capabilities. Capital costs also include project design (preliminary and final), cost of land and improvements, software and/or hardware and development, special and standard equipment, major computer systems, site services, and project management. **Expense** costs include all costs incurred during conceptual planning of a project such as mission needs requests, demolition and decontamination, writing the Conceptual Design Report, preparing environmental compliance or quality documentation, and other project support functions during the project. A typical cost breakdown is shown in the following table.

Total Project Cost (TPC)*	
Total Estimated Cost (Capital)	Other Project Cost (Expense)
Title I and II design	Conceptual design/project development
Design phase management (project management and design management)	Conceptual design report
Construction phase management (project management and construction management)	Mission needs request (Critical Decision 0)
Construction	NEPA and environment, safety, and health documentation
Inspection and acceptance	Quality assurance plans
Equipment	Design criteria
Title III services	Selection of architect/engineer
Final closeout and management report	Statement of work preparation
	Operational Readiness Review (ORR)
	"Move-in" expenses
* TPC = total estimated cost (TEC) + other project cost (OPC)	

Analysis and Management Reports

Effective analysis of deviations from the project plan for both schedule and cost allows management to rapidly and effectively implement corrective actions (see the following figures).

Using the monthly CPR, the CAM can complete the following activities:

- Assess actual progress and costs incurred and compare them to baseline plans.
- Identify and analyze significant variances between planned and actual performance and determine corrective actions if needed.
- Structure and summarize the status, progress, and analytical data to report to all levels of management.
- Assemble and present the information in formal, contractually required reports for submittal to customer management.

CAMs are required to review, analyze, and report on all CAs with variances exceeding specified thresholds for the current month, cumulative, or at completion, as established in the PEP for the project. Variance analysis provides the means for the CAM to communicate scope, budget, schedule, and estimate at completion (EAC) divergences from the PMB. The following figure shows the activities associated with the monthly variance analysis and CPR process.

The EAC is a reassessment and thorough analysis of the resources needed to complete the remaining work scope on the project. A primary input to the EAC calculation is an updated project schedule that reflects the logical path required to complete the remaining technical baseline. The EAC is also the basis for cash flow analysis and funding for the life of the project.