# Integrated Project Management Using Earned Value







- Welcome, Introductions and Administrative Items
- 2 Important Questions:
  - Why are we doing EVMS?
  - Why are we doing this training?





### Question #1 – Why are we doing EVMS?

- OMB Circular A-11, Part 7:
  - "All major acquisitions with development effort will include the requirement for the contractor to use an Earned Value Management System (EVMS) that meets the guidelines in ANSI/EIA Standard—748 to monitor contract performance."
  - "EVMS is normally used on Fixed-Price Incentive contracts and Cost Reimbursement contracts for major acquisitions. EVM shall also be used on Firm-Fixed Price and any other type of contract or task order that meets the major acquisition threshold if that contract or task order contains a significant amount of development effort."
  - "Agencies should have well documented thresholds clearly disseminated and implemented across the organization. Earned Value is required on all of these contracts because of their inherent risk."





## **EVMS Requirements Flow-down**



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http://energy.gov/management/office-management/operationalmanagement/project-management/earned-value-management



# **DOE EVMS Compliance**

### Projects with Total Project Cost (TPC) ≥ \$50M but < \$100M

- Requires contractor selfassessment
- Requires certification by Office of Science
- New Contractors who have replaced contractors with certified EVMS require re-certification
- >\$100M: APM participation in Certification Review

### Requirements

- Must use ANSI-748 Compliant Management System by Critical Decision (CD) 2
- Must attain certification no later than by CD-3
- Contract Performance Report (CPR) formats - DOE Guide 413.3-10 does not require CPR formats; tailoring suggested





# **DOE EVMS Compliance**

#### Projects with Total Project Cost (TPC) ≥ \$20M but < \$50M

 Requires contractor selfcertification

#### Requirements

- Must use ANSI-748 Compliant Management System by Critical Decision (CD) 2
- Contract Performance Report (CPR) formats - DOE Guide 413.3-10 does not require CPR formats; tailoring suggested





### **EVMS Certification**



Department of Energy Washington, DC 20585

SEP 1 5 2009

Dr. Samuel H. Aronson Director, Brookhaven National Laboratory President, Brookhaven Science Associates, LLC Brookhaven National Laboratory Directors Office, Building 460 Upton, New York 11973-5000

Dear Dr. Aronson:

It is a pleasure to inform you that Brookhaven Science Associates, LLC (BSA, LLC) at the Department of Energy Brookhaven National Laboratory has successfully demonstrated compliance of its Earned Value Management System (EVMS) for non-information technology capital asset projects greater than \$20 million with the American National Standards Institute/Electronic Industries Alliance (ANSI/EIA)-748-A.

This certification is based on the Department of Energy's EVMS review of Earned Value Management System Program Description, Version 1.4, dated April 2008. Your team is to be commended for attaining this EVMS certification. The acceptance of the BSA, LLC EVMS will apply to all company acquisition projects requiring EVMS.

The Department of Energy expects BSA, LLC to maintain its EVMS through surveillance programs. Recognizing that management systems are dynamic to meet changing business needs and to improve effectiveness, we encourage continuous improvement as long as compliance with the ANSI/EIA-748-A is maintained. BSA, LLC shall notify Office of Engineering and Construction Mangement of any changes to its EVM System.

The Department of Energy congratulates BSA, LLC on this certification. BSA, LLC has achieved a significant milestone by demonstrating a performance measurement system that provides valid data and is effective in managing project performance.

Sincerely. Paul Bosco

Director, Office of Engineering and Construction Management

cc: Daniel Lehman, SC-28 Jack Surash, EM-50 Tom Brown, SC-22.3 Frank Crescenzo, FPD-BSO



- BSA Contractor Certification for BNL Site Received Sept 15, 2008
- DOE Recertified EVMS with Surveillance Review held December 2011

### Annual EVMS Internal Surveillance Reviews Conducted



# **EVMS History**

- 1950's:
  - Program Evaluation Review Techniques [PERT] Implemented
- 1960's
  - 1960 Implementation of PERT resulted in 11 reporting formats, including "cost of work report
  - 1964 PERT Cost
  - 1967: Cost/Schedule Control Systems Criteria (C/SCSC)Effort led by U.S. Air Force; Department of Defense (DoD) implemented 35 Criteria for work over certain funding thresholds
- 1970's:
  - DOE—Performance Measurement System (PMS)
- 1990's:
  - 36 C/SCS Criteria revised down to 32 and ANSI/EIA-748 officially issued in 1998
- 2000's:
  - Oct 00 DOE Order 413.3
  - Mar 09 GAO Cost Estimating Guide
  - June 09 NDIA ANSI-748 Intent Guide
  - Nov 10 DOE Order 413.3B
  - Mar 13 ANSI-748C





## Question #2 – Why are we doing this training?

- This training is intended to provide the Project Managers, Control Account Managers, and the Project Controls Staff with a clear understanding of the BNL Earned Value Management System
- BNL conducts annual self-surveillance reviews
- BNL periodically undergoes a formal Surveillance Review by Office of Science.





### **EVM System Elements**







## **EVMS Processes**



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Project Execution Plan

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# Principles of EVMS (from ANSI/EIA-748C)

- Plan all work scope for the program from inception to completion
- Break down the program work scope into finite pieces that can be assigned to a responsible person or organization for control of technical, schedule, and cost objectives
- Integrate program work scope, schedule, and cost objectives into a performance measurement baseline plan against which accomplishments may be measured
- Use actual costs incurred and recorded in accomplishing the work performed





## Principles of EVMS (cont'd)

- Objectively assess accomplishments at the work performance level
- Analyze significant variances from the plan, forecast impacts, and prepare an estimate at completion based on performance to date and work to be performed
- Control changes to the baseline and maintain the baseline throughout contract execution
- Use EVMS information in the organization's management processes





# **EVMS Program Description**

### Organized into six sections:

- 1. Project Organization and Baseline Planning
- 2. Earned Value Analysis and Progress Reporting
- 3. Accounting
- 4. Subcontract Management
- 5. Change Control
- 6. Surveillance and Maintenance

### And four appendices:

- A. Crosswalk of the ANSI/EIA-748-B 32 Guidelines
- B. Abbreviations, Acronyms and Glossary of Terms
- C. Roles and Responsibilities
- D. EVMS Procedures
- On April 13, 2007, incorporated in BNL/BSA's:

Standards-Based Management System (SBMS)



### as Program Description document (became BSA/BNL policy).





# **EVMS Procedures**

### Eleven EVMS implementing procedures supplement the EVMS Program Description:

- PM-1.0 Preparation & Control of EVMS Procedures
- PM-1.1 Project Execution Plan
- PM-1.2 Project Work Breakdown Structure
- PM-1.3 Project Organizational Breakdown (OBS) & Responsibility Assignment Matrix (RAM)
- PM-1.4 Control Accounts, Work Packages & Planning Packages
- PM-1.5 Work Authorization
- PM-1.6 Project Schedule
- PM-1.7 Cost Estimating
- PM-1.8 Performance Measurement & Monthly Status/Reporting
- PM-1.9 Change Control

PM-1.10 EVMS Surveillance & Maintenance





### BNL Manages Projects with Proven Systems and Software



### **Cost/Schedule Baseline Development & Measurement**



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# **EVMS Terminology**

BCWS

BCWP

ACWP

SV

CV

BAC

EAC

VAC

PMB

CBB

- Budget Cost for Work Scheduled [PV]
- Budgeted Cost for Work Performed [EV]
  - Actual Cost of Work Performed
  - Schedule Variance [BCWP-BCWS]
  - Cost Variance [BCWP-ACWP]
  - Budget at Completion
  - Estimate at Completion
    - Variance at Completion [BAC-EAC]
    - Performance Measurement Baseline
    - Contract Budget Base





## **Assessing Accomplishments**

100

10

500

None

End of Month 3

### Given:

- Identical units to be produced:
- Units complete (with none in process): 40
- Budgeted/targeted hours for each unit:
- Hours expended to date:
- Non-recurring "setup" effort:
- Point in 5-month project:

### *Question:* What is our percent complete?







### **BCWS: The Time-Phased Budget Plan**







## **ACWP: What's Been Spent**







### BCWP: The Budget for the Completed Work







### **Calculating Schedule and Cost Variances**







## **Key Data Comparisons**



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## **Budget vs. Funds**

- Budget: Management-sanctioned estimate for total task phased over baseline schedule; basis for earned value performance measurement
- **Funds**: Current estimate of total dollar requirements, phased by distribution period





# What is EVMS?

- It's not:
  - A reporting requirement
  - A panacea for project problems
  - Just the EV metric, or the ability to generate the data elements
  - A software system

- What it is:
  - A systematic PM process that results in an integrated plan against which performance is measured objectively
  - A systematic approach for calibrating the health of a project
  - A tool for establishing meaningful forecasts of cost and schedule positions at project completion

### EVM doesn't solve problems. If done right it will only point them out.





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#### From:

Re-certification Approach Every two years or at contract midpoint

To:

Risk based, data driven Risk Matrix Portfolio focused Data sources include contractor self- assessments, project peer reviews, Integrated PARS II Why did they change?

Common Goal:

*Maximize results* via continuous, real-time feedback and assistance; benefits all stakeholders

Minimize surveillances costs by

reducing on-site reviews and **Office of Science** disruption to the projects





Stage 1 Surveillance – Ongoing Monthly Analysis and Risk Assessment

- Uses PARS II Reports
- Other data sources:
  - Contractor's EVMS selfsurveillance documentation
  - Assessments conducted relative to project performance and EVM system health
- Identify data disconnects, negative trends, and significant change that may point to systemic issues





#### Stage 2 Surveillance – Desk Top review

- Identifies the contractor's EVMS processes to be reviewed, the selected projects, and the anticipated timeframe.
- Uses a continuous, data-driven approach, the surveillance may be conducted over several months or during a single review.
- Most surveillances will be off-site reviews of individual projects.





Stage 3 Surveillance – On Site Review

- Interviews with CAMs, management, and other project staff
- Observation of demonstrations of tools and traces that could not be done remotely
- Physical verification of progress to assess reported work performed is accurately reflected
- A focused review, specifically to assess concerns raised in stages 1 and 2
- May result in Corrective Action Requests (CARs) that require formal responses by BNL- Corrective Action Plans (CAPs)



Stage 3 Surveillance – Scope of Review

- Is the EV data accurate, timely and reliable?
- Is the EVMS being used to manage the project?
- Does the EV data represent all of the required scope?
- Does the EVMS comply with ANSI/EIA-748?





## **Surveillance Focus**

### CAM Interviews will focus on these process areas:

- Organizing
- Scheduling
- Work/budget planning and authorization
- Accounting
- Indirect cost management

- Managerial analysis & Forecasting
- Baseline Change Control
- Performance Measurement for Material items
- Subcontract Performance Measurement





## **EVMS Processes**





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### **Unsuccessful projects?**









## Why Do Project Fail?

### Unclear requirements

- Unrealistic timescales or budgets
- Scope creep
- Poor risk management
- Poor processes/documentation




#### **Define Project Objectives**

- Develop the Work Breakdown Structure
- Define WBS Elements
- Identify Control Accounts
- Develop the project execution model [CPM]
- Estimate resources





#### **Project Execution Plan**

Project Execution Plan for the National Synchrotron Light Source II Project	Identifies the organization, plans, and systems used to manage project Identifies the mission need
September 30, 2009	<ul> <li>Defines project scope, cost and schedule</li> <li>From project planning to project completion to operations</li> <li>Complies with DOE 413.3B</li> <li>Complies with BSA/BNL's EVMS</li> </ul>





A product-oriented family of hardware, software, services, and other program/project elements which collectively represent the total scope of the project.

Originally developed by the DoD as a cost estimating tool, the WBS is a key ingredient to an integrated PM process and serves many purposes





# **Generic WBS Sample**



Figure II-1. Product-Oriented WBS Example



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nsls-I	NSLS II	16-Oc		
WATIONAL SYNCHROTRON LIGHT SOURCE	WBS List	Total Activities	-	
	NSLS-II Project	2823	1	
1.01	Project Management	180		
Page 1.01.01	Project Management.	32	]	
1.01.01.01	Director	18		
1.01.01.02	Deputy	8	1	
<b>a</b> 1.01.01.03	Committees	6		
Page 1.01.02	Environmental, Safety & Health	40		
1.01.02.01	ESH Management	33		
1.01.02.02	Shielding Analysis	Ζ		
Page 1.01.03	Project Support	70		
1.01.03.01	Project Support Management	6		
1.01.03.02	Business Operations	14	]	
4.01.03.03	Project Controls	8		
4 1.01.03.04	Office Management	7		
1.01.03.05	Procurement	7		
<b>H</b> 1.01.03.06	Information Technology	12		
Page 1.01.03.06.01	Enterprise IT Services	5		
<b>1.01.03.06.02</b>	Business Systems Development	7		
1.01.03.07	Human Resources	5		
1.01.03.08	Facility	4		
1.01.03.09	Space and Utilities	7		
<b>1</b> .01.04	Quality Assurance	25		
1.01.04.01	QA Management	6		
1.01.04.02	Quality Engineering	6		
1.01.04.03	Supplier Quality	6		
1.01.04.04	Quality Assessment	6		
1.01.04.05	Production Support	1		
<b>L</b> 1.01.05	Configuration Management & Document Control	13		
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Page 1.01.05.02	Document and Records Management	6	]	
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#### **WBS Standards**

#### An effective project WBS should have these attributes:

- Product (or deliverable) oriented
- Reflects ALL work scope associated with the project (even far-term effort not planned in detail)
- Clearly identifies every element as to content and distinguishes from all other elements
- Correlates every element to the statement of work
- Detailed enough to support effective management (i.e., extended to the control account level)
- Provides the necessary framework to identify the effort to the performing organization(s)





#### **WBS Dictionary example**

Tank/Silo Vessel

The Tank/Silo vessel is the main Tank/Silo container. This includes the metal, plastic, concrete or wood structure of the container, and shielding and insulation integrated into the container structure.

It includes the combination of labor that results in the design, development, construction, and/or operation of the Tank/Silo Vessel. This includes any Professional, Engineering, and Scientific Labor (e.g., engineers, analysts, programmers, scientists, and architects), Craft/Trades Labor (boilermakers, pipefitters, sheet metal workers, insulators, electricians, welders, etc.), General Labor, and Management and Administrative Labor.

This does not include support structure for the tank/silo superstructure, any piping or conveying systems for loading and unloading equipment, or insulation and shielding not integrated into the container structure (access and finishes).





#### **Responsibility Assignment Matrix [RAM]**



# Sample BNL Project ram



Control Accounts

#### **Control Account Characteristics**

- Control Accounts (CAs) represent natural decomposition of WBS designed to support responsibility assignment and accountability for cost, schedule, and technical performance
  - CAs assigned to only one responsible Control Account Manager (CAM)
  - CAM may rely on one or more organizations to execute CA work
  - Control Account is authorized via a formal Work Authorization Document that identifies scope, budget, schedule and responsibility
  - Detailed plans are established in Control Account Plan (CAP)





#### **Dollarized RAM**

WBS	Level	Description	<u>CA #</u>	<u>OBS</u>	<u>CAM</u>	% Complete	<b>Budget</b>
10109020271	6	PROJ AREA 12 WEST PIDs	12345	F & I	Johnson	60.5	\$4,234,555
1010902027101	7	Project Management	12346	F & I	Wilder	36.3	\$1,162,122
1010902027102	7	AREA 12 W PIDs	12347	Engineering	Eastwood	85.2	\$836,448
1010902027103	7	AREA 12 W PIDs	12348	Engineering	Wilson	65.5	\$2,179,585
101090202710301	8	05 AREA 12 W PIDs	12349	Engineering	Jackson	82.6	\$509,508
1010902027103A1	8	06 Substation 6-1-3401 Zone 1	12350	Construction	Smith	100	\$79,356
1010902027103A2	8	Substation 6-1-3402 Zone 1	12351	Construction	Coulter	56.7	\$119,728
1010902027103B1	8	U12G Sub 12-2A-1/2 Replace OFC w/PMH7 Zone 1	12352	Construction	Hunter	48.6	\$83,294
1010902027103B2	8	U12G Portal Yard Disconnect OFC/Abandon in Place Zone 1	12353	Construction	Sandman	8.5	\$14,576

- The RAM is a valuable tool for both contractor and DOE:
  - Identifies each CA and the resources assigned
  - Identifies responsible CAM
  - Provides for assessing manageability of each CA



#### **Control Account Manager (CAM)**

#### Who is a CAM?

- Could be first line supervisor, scientist, cognizant engineer, second line manager (or even the PM on a small project)
- Technically qualified to:
  - Manage Control Account effort
  - Understand EV information as management input
  - Make decisions regarding CA work execution
- Assigned via a formal Work Authorization Document





## Control Account Manager (CAM) (cont'd)

#### CAM Responsibilities

- Make significant contributions in development of project baseline plan [WPs, activities, resources etc.]
- Manage execution of work according to authorized CA Plan
- Monitor performance, communicate progress and forecasts
- Analyze deviations from baseline plan and implement corrective action plans
- Monitor and manage risks and opportunities
- Identify and manage changes to scope and baseline plan

In other words, the CAM is

Fully responsible for cost/schedule/technical performance

> Key to the success of the contractor's EVMS!





#### Help and Support for CAMs

#### Project Controls Personnel

- Facilitators of entire EVMS process
- Are NOT the CAMs but support their planning, scheduling and reporting needs
- Gate keepers for integrated schedule/budget baseline for project
- Responsible to Project Manager for ensuring that EVMS provides valid, timely and accurate information





# Help and Support for CAMs(cont'd)

- Project Controls Personnel Responsibilities:
  - Ensure that EVMS-compliant and management-approved processes are documented
  - Provide a robust EVMS training program to entire project team
  - Ensure that project team is using EVMS information correctly
  - Ensure that implementation of EVMS complies with approved company processes and procedures
  - Ensure that baseline and performance information is generated correctly
  - Ensure that only authorized and appropriate changes are made to baseline
  - Ensure that EVMS data is truly reflective of objectivelydetermined progress and forecasts





#### **EVMS Processes**



#### **Baseline Concepts**

- The project has a single integrated baseline which is Performance Measurement Baseline (PMB)
- The PMB represents resource plan for work phased to meet contract milestones
- The PMB and current work plan are normally different
- PMB is altered only through formal change control process





#### **Performance Baseline**

- A performance baseline deals with the approved TPC, CD-4 completion date, or performance and scope
- There is only one original PB and it is documented at CD-2 Approval. The PB represents DOE's commitment to Congress to deliver the project's defined scope by a particular date at a specific cost.
- It represents something different from the PMB





#### **Control Account Planning and Scheduling**







#### **Work Package Description**

- A work package is a natural subdivision of work within a control account
  - It is a task or grouping of work items...
- A work package has a scope of work, with timephased resources, and has a method for assessment of accomplishments while work is in process (EV technique)
  - It is comprised of one or more activities in detailed schedule...





#### **Typical Work Packages**



- Design drawing package
- Develop quality plan
- Establish fire protection design basis
- Conduct design review
- Develop computer simulation

- Construct concrete wall
- Place concrete slab, Area 31
- Install 3" pipe, Area 2c
- Install stack liner

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Test instrumentation equipment

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#### **Schedule Development Process**

- 1. Define scope and required activities
- 2. Establish sequence/relationships
- 3. Estimate activity durations
- 4. Estimate activity resources
- 5. Define calendars
- 6. Let scheduling software determine the project schedule
- 7. If necessary, makes changes to 1-5





#### **Types of PDM Relationships**







#### **Finish-to-Start**



# Activity D can start as soon as A finishes Conventional (Default) Relationship







#### Activity D can start 5 days after A finishes





#### Start-to-Start



#### Activity B can start after A starts





#### **Finish-to-Finish**



#### Z cannot finish until Y finishes





#### **Start-to-Finish**



- The successor can't finish until the predecessor starts (huh?)
- Seldom used





#### **Calculating The Network**

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- 1. Activity Durations
- 2. Forward Pass
- 3. Backward Pass



#### **Estimate Task Durations**

- Developed for each activity, preferably by activity "owner"
- Expert Judgement/History
- Shorter is generally better than longer [but realistic is most important!]
- Generally assumes normal conditions (manpower, equipment, calendar, etc.)
- Neither "success oriented" nor padded
- Document assumptions







#### **CAM Schedule Responsibilities**

The CAM owns the schedule and has the responsibility of ensuring all activities and [realistic] durations are included in the P6 schedule and are completed as established.

CAMs must be aware of the timing for procurement activities and must incorporate them into the general project planning.





#### **Program Evaluation Review Technique (PERT)**



- a optimistic time estimate
- b pessimistic time estimate
- m most likely time estimate







6/8/10

7/15/10

The project duration is equal to the sum of durations for the longest path of activities/tasks through the network.





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#### **Activity C**



18 Days20 DaysBest CaseLikely

26 Days Worst Case

Best Case: "We could finish in 10% less time if..."

Most Likely: "Typical" CPM Estimate

Worst Case: "But it might take as much as 30% longer if..."





# At what confidence level are you willing to make a commitment to your customer?





### **Activity Types**



Duration estimate based on amount of calendar time necessary for task completion.



Duration estimate based on amount of effort required to complete activity.



Milestone: An important / critical event that must occur during project; start, completion of significant activity.




#### **Project A Network**







### Network A: When can we finish?







#### **Network A Forward Pass**







#### **Backward Pass: When must we finish?**





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#### **Total Float**

"How much an activity can be delayed before it impacts the project finish date







#### **Free Float**

*"How much an activity can be delayed before it impacts a direct successor activity"* 







# **Calculating Float**







### Assumption #1: EF is earlier than LF







#### **Assumption #1: LF is Before EF**





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### So, when will we finish?









# Questions

- How many hours in a shift?
- How many shifts per day?
- How many productive hours are in a shift
- Should we plan to work on weekends and/or holidays?
- Will anyone go on a vacation?
- What did the duration estimates assume?





#### Calendars

#### August

#### September

S	М	т	w	т	F	S	S	М	т	W	т	F	S
				1	2	3	1	2	3	4	5	6	7
4	5	6	7	8	9	10	8	9	10	11	12	13	14
11	12	13	14	15	16	17	15	16	17	18	19	20	21
18	19	20	21	22	23	24	22	23	24	25	26	27	28
25	26	27	28	29	30	31	29	30					





#### Calendars







#### **Assigning Resources to the Schedule**

- Labor
- Materials
- Equipment
- Facilities
- Rentals
- Subcontractors
- Other suppliers





## **Project A Network**







### **Duration – resource assumptions**

Activity	Duration	Total Resources
А	2	4
В	4	12
С	3	9
D	7	7
E	10	20
F	5	5
G	3	15
Н	8	16
I	2	2
J	4	12
k	6	<u>12</u>
	Total	114





#### **Resource profile: early dates**



#### **Resource profile: Late dates**





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#### **Resource profiles**







#### Assumption #1: EF = LF







### **Schedule Reserve**

- Float, where EF < LF</p>
- EF=LF, with buffer activity added
- Intermittent buffers at the end of major project phases





#### Assumption #1: EF < LF







#### **Reserve Buffer**



You would be well advised to included some buffer before establishing/agree to a baseline finish date







#### **BCWS: Integrated Baseline**







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#### **Earned Value Metric**

- COMPLETED TASKS
   +
  - Budget target

IN-PROCESS TASKS

- Estimate of budget for completed portion
- % Complete x BAC
  - Important to use logical technique to ensure accuracy of result!

or...

# The budget associated with completed work! (BCWP)





# **BNL EV Approach**

Product of	Duration of Work Effort	Duration of Work Effort >3 Measurement Periods			
Work	Less than three Measurement Periods				
Tangible	Fixed Formula • 50/50 Percent • 0/100 Percent • % Complete	<ul> <li>Weighted Milestone</li> <li>Percent Complete of Milestones</li> </ul>			
Intangible	Apportioned Effort     Level of Effort				





#### **BNL EV Measurement Methods**

#### Tangible Outcomes [Discretely Measurable]:

- 0/100 EV taken at completion
- 50/50 EV taken 50% when start, 50% when finished, e.g., spec writing
- Predefined weighted milestones
- Percent Complete with Steps based on objective physical progress of the activity (duration > 3 months).
- Level of Effort: EV = the budget planned for the month, e.g., Project Management
- **Apportioned Effort:** Not used at BNL but provided for in ANSI-748
- **Material Purchases:** BCWP earned and ACWP accrued on receipt
- Subcontracts Contractor schedule incorporated into project schedule once approved. EV based on milestones/contractor schedule status





# 0-100

#### Used for Short Tasks (within an Accounting Period)







## 50-50

- Used for short tasks (usually less than 3 months)
- Ideally equal milestone resources





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#### Milestones

- Used for longer tasks
- Ideally should have milestone each month
- Milestones should be weighted based on resources



# **Percent Complete with Steps**

- Used for longer tasks (task >3 months)
- Step and %'s captured in Primavera
- Steps should be weighted based on resources



#### Large Subcontracts

#### Schedule from subcontractor

- Detailed schedule short duration activities
- Logic based incorporated into project schedule
- Cost Loaded by activity
- Contractor (Construction) required to use Primavera
- Contractor owns schedule and submits monthly updates
- Earned value based on physical % complete x activity resources

#### Not FFP? Require S/C to implement EVMS





# Subcontracts - Units complete

- Used for tasks where a physical count is appropriate
- Units are identical or similar
- Same budget value for each unit
- BCWS = Planned Qty x unit value
- BCWP = Actual Qty completed x unit value



#### Percent complete (Subjective – No Steps)

- 3 Months or less to minimize subjectivity
- Used when no interim milestones/steps are possible
- Based on an individual's assessment of percent complete of the total work to be performed
- Should be as objective as possible



# **Apportioned effort**

#### Based on:

- Parent/child Relationship
- Historical Estimating Factor
- Not used very often

For every 10 hours of production work, there is .5 hour of QC Inspection... Production WP Idu PV 100 300 500 **600** EV 140 400 **Inspection WP** 5 15 25 PV 30 7 20 FV



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# Level of effort

- Support type effort; doesn't drive the schedule
- No product or accomplishment criterion
- Based on passage of time
- EV = PV (always)
- No schedule variance


### **Examples of LOE work**

- Project Management Personnel
- Subcontract Management
- Security Guards
- Direct charge administrative staff





### Effect of loe on metrics

CA1 LOE	PV = 400	EV = 400
CA 2 Discrete	<u>PV = 800</u>	<u>EV = 700</u>
Total WBS	PV = 1200	EV = 1100
SV % with LOE = 8.3% SV % without LOE = 1	2.5%	





# **Understanding Earned Value**

#### Exercise





## Given:

- 1. Time now is the end of October
- 2. WP 3 reported a total % complete last month 10% and this month is now 15% complete
- 3. WP 4 is apportioned against WP 1 @ 10%
- 4. WP 5 reported a total % complete last month of 10% and this month is now 20% complete
- 5. All of the filled in milestones ( $\mathbf{\nabla}$ ) were completed in the scheduled month,
- 6. Actual hours charged in October were 300 and cumulative-to-date are 650.

#### **Questions**:

- 1. What is the BAC for the Control Account?
- 2. What is the BCWP for the month of October for the Control Account?
- 3. What is the BCWP cumulative to date for the Control Account?
- 4. What are the current period and cumulative to date cost and schedule variances







#### Planning and Budgeting: Identify Work Packages, LOE, Apportioned Effort



# Planning Package Concept

**Planning Package:** A planning package represents future work that cannot be defined into specific work packages, or for which there is insufficient information to make detail planning practical.

- Higher-level scope of work (less detail)
- Specific schedule with start and end dates
- Time-phased budget (at higher level of detail)
- Consistent with CA budget, schedule, and scope of work requirements
- Usually longer in duration than work packages
- For planning only, no performance measurement or actual cost collection
- Broken down into work packages over time





# **Rolling Wave Concept**

- All work is planned in the timeframe in which it is expected to be accomplished
- Work that cannot readily be planned in detailed work packages is planned in planning packages
- CA plans generally include the next 1-3 months of work detail, planned as work packages
- Planning packages are re-planned as work packages as soon as possible
  - Certainly before the work enters the current reporting period





# **Rolling Wave Planning**



# **Vertical Traceability**

Consistency Between Different Levels of Detail

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#### **Horizontal Traceability**

#### Consistency at the Same Level of Detail

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### **Budget Relationships in EVMS**



Time

\*SLP = Summary Level Planning





#### **DOE Budget Relationships**



#### **DOE Budget Relationships – Operating Contract**



#### **EVMS Processes**







# Work authorization

Formal WA required in order to ensure that:

- All/only effort required by the project is performed; and
- A meaningful plan is in place for all work







# **Work authorization**

#### Approved Project Execution Plan





- Identifies the organization, plans, and systems used to manage project
  - Identifies the mission need
  - Defines project scope, cost and schedule
  - From project planning to project completion to operations
- Complies with DOE 413.3B



- Agreement between CAM and Project Director
- Documents delegation of work to CAM
- Scope, schedule and budget authorized
- Changes made through formal Change Control
- Allocates incremental funding

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The Center for Functional Nanomaterials at BNL 2D-4a ESAAB-Equivalent Review

> Office of Basic Energy Sciences Office of Science

CD-4a, Approve Building Occupation for the Center for Functional Nanomaterials (CFN) A Nanoscale Science Research Center at Brookhaven National Laboratory

A. Purpose

The purpose of this paper is to document the review by the Office of Science Energy Systems Acquisition Advisory Board-equivalent for the Critical Decision "Approve Building Occupatis (CD-4a)" for the Center for Functional Nanomaterials (CFN), a Nanoscale Science Research Center (NSRV) at Brookhaven National Laboratory (BNL).

B. Mission Need

The Center for Punctional Mesoneutrichi (CPN) will serve as the nucleus of no integrated ISM, program in nanocines. In will facilitate models we directions in ISM-2 meerid and chemical research programs, and gready separad the capabilities a validate is a satisfauity and the effective integration of the capabilities are analysis of the capabilities of the effective integration and exclusion of the programs of the capabilities and the projective hardware integration of the capabilities are analysis of the capabilities projective hardware and exclusion of the programs of the capabilities and the specific hardware and the capabilities of the capabilities in the capabilities in the specific programs of the capabilities of the capabilities in the capabilities in the specific programs of the capabilities in the capabilities in the capabilities in the specific programs of the capabilities in the capabilities in the capabilities in the specific programs of the capabilities in the capabilities in the capabilities in the specific programs of the capabilities in the capabilities i

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- Agreement between BNL and subcontractors, suppliers, vendors
- Documents Scope, schedule and dollars authorized
- Changes made through formal Change Control



#### **Cost Components**



#### **Application of Rates**

	Labor Hours	Direct \$	Fully Loaded
BCWS <sub>CUM</sub>	100	\$5.0 K	\$10.0 K
BCWP <sub>CUM</sub>	80	\$4.0 K	\$8.0 K
ACWP <sub>CUM</sub>	90	\$4.7 K	\$9.8 K

BCWS/P Rates = \$50/Hr (Labor), 100% OH ACWP Rates = \$52/Hr (Labor), 110% OH





#### **Material Performance Measurement**

Four Key Assumptions:



- Adequate purchasing capability
- Adequate inventory management
- Accounting for commitments
- Accounting for booked material costs

Thus...

•True purpose is **not** materials/inventory management but visibility into program progress.

•Therefore, material considered a resource to be expended toward accomplishing project work.





#### **Planning Material BCWS**



When should BCWP be taken?Answer drives BCWS timing





#### **EV for Material Items: Accruals are Essential!**

- <u>J</u><u>F</u><u>M</u> BCWS \$10K
- BCWP \$10K
- ACWP \$ 0K \$10K



CV= +\$10k CV= -\$10k

#### • At BNL:

- Material purchases accrued automatically
- Subcontracts and outside services require CAM involvement!





# Measure Progress By

# Update integrated project schedule Record earned value

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# **Monthly Status Meetings**

#### Monthly Status Meetings to:

- Discuss Schedule Status
- Current and upcoming Procurement Status
- Discuss Estimates at Completion

#### Attendees:

- CAM
- Project Controls
- Procurement
- Budget Office

STANDING MONTHLY SCHEDULE UPDATE MEETINGS Building 830NM – Conference Room 12011 DATETIME/EACH MONTHNAME9:00 – 9:30 a.m.Toshi Tanabe9:30 – 10:00 a.m.Scott Buda10:00 – 10:30 a.m.Bob Dalesio11:30 – 12:00 p.m.Om Singh1:00 – 1:30 p.m.Timur Shaftan1:30 – 2:00 p.m.Sushil Sharma/Lewis Doom2:20 – 2:00 p.m.Disk Usauh										
	Building 830NM – Conference	Room 1								
2011 DATE	TIME/EACH MONTH	NAME								
	9:00 – 9:30 a.m.	Toshi Tanabe								
	9:30 – 10:00 a.m.	Scott Buda								
December 1	10:00 – 10:30 a.m.	Bob Dalesio								
December 1	11:30 – 12:00 p.m.	Om Singh								
	1:00 – 1:30 p.m.	Timur Shaftan								
	1:30 – 2:00 p.m.	Sushil Sharma/Lewis Doom								
	2:30 – 3:00 p.m.	Dick Hseuh								
	3:00 – 3:30 p.m.	Jim Rose								





# **Scheduling Status Questions**

- When did activity/WP start?
- If scheduled start date has passed, when will it start?
- What is task's physical % complete based on assigned EV technique?
- When did activity finish?
- When will activity finish?
- What resources will be required to finish?





#### **Data Accumulation**







### **Progress Updates**





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### **Progress Updates**





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#### **Baseline Vs. Current schedule**





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#### **Variance Analysis**





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### Monthly Reports posted to IPD

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# **Monthly Reports by Control Account**

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	Labor Only Cost Porfs	rmance Report												



#### **EVMS Cost Performance Reports**

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- ✓ Generated monthly for project, BNL, and DOE management
- ✓ Project and cost account level
- Based on PMB from Cobra/Excel

D - Windows Inter	net Explorer											
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WS	493,071,389 513,2	74,668 537,171,414	556,466,031	573,996,678 59	1,160,597	608,446,389	624,112,40	6 642,228	008 658,3	34,581 67	3,330,253 6	85,492,9
WP	476,391,640 494,9	03,558 514,838,734	533,985,031									
WP	466,719,400 486,5	60,208 514,160,675	526,473,938									
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hedule Var (SV)	-16,679,7	49 -18,371,111	-22,332,679	-22,480,999								
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(1)	(2)	(8)	(4)	(3)	(9)	(7)	(8)	(9)	(10)	(11)	(14)	(15)	(16)		
1.01 Project Management															
WBS[3]Totals:	150,430	150,430	80,054	0	70,366	2,875,340	2,875,340	2,801,327	0	74,012	7,445,412	7,445,412			
1.01.02 Environmental, Safety & Health	26.004	86.004	00 0.4E		9.751	1 000 504	1 000 504	2 260 677		221.142	0 154 501	6 454 504	200		
1.01.03 Project Support	00,054	00,054	03,043	v	-0,701	1,555,354	1,000,004	2,200,017		1021,140	0,134,331	0,434,351	-300		
WBS(3)Tetals:	739,558	739,558	714,990	0	24,567	15,842,812	15,842,812	16,214,535	-0	-371,723	37,878,194	39,305,194	-1,427		
WBS[3]Tetals:	56,630	56,630	45,719	0	10,911	1,174,198	1,174,198	832,280	0	341,917	3,073,212	3,073,212			
1.01.05 Configuration Management & Document Control WRS131Temater	29.502	20 5/10	19 201		10 517	773.554	773 554	665 776		157 970	1 977 547	1 977 547			
WBS[2]Totals:	1,062,219	1,062,219	950,009	<u> </u>	112,210	22,555,437	22,555,437	22,674,545	4	-119,107	56,523,975	58,250,975	-1,727,		
1.02 R&D and Conceptual Design													_		
WBS[3]Totals:	81,946	63,208	29,055	-18,738	34,153	9,455,180	9,146,192	9,186,740	-308,988	-40,548	11,460,078	11,460,076			
1.02.02 Experimental Systems R&D WRS19/Totale	207 977	497 700	820 504	289 725	.322 803	12 184 790	11 646 820	10 997 128	517 961	649 700	19 165 550	19 163 545			
1.02.03 Conceptual Design - Accelerator Systems	eur,3//	401,002	way, 334	690,160	-vec.000	14,107,730	11,079(023	19,291,120	507,001	v <del>4</del> 0,700	14, 199, 330	14, 194, <b>P</b> 13	-		
WBS[3]Totals: 1.02.04 Concentral Decise Europianettal Explicitor	0	0	0	0	0	12,998,214	12,998,214	12,953,517	0	44,697	12,998,214	12,998,214			
WBS[3]Totals:	0	0	0	0	0	709,445	709,445	712,450	0	-3,005	709,445	712,450	3		
1.02.05 Conceptual Design - Conventional Facilities WIRS(SITember				0		1,836,952	1 888 452	3 872 878		14.074	1 888 952	1 886 952			
1.02.05 Conceptual Design - Project Management & Support	ľ		0			3,000,932	3,000,332	3,072,070	0	14,074	3,000,932	3,000,302			
WBS[3]Totals: 1 02 07 Period Management R&D	0	0	0	0	0	7,086,188	7,086,188	7,325,314	0	-239,126	7,086,188	7,325,314	-235		
WBS(3)Totals:	36,959	36,959	14,191	0	22,768	4,777,142	4,777,142	4,782,021	0	-4,878	5,305,339	5,066,213	235		
WBS[2]Totals:	326,883	597,869	863,840	270,987	-265,971	51,097,911	50,250,962	49,830,048	-846,950	420,914	60,612,763	60,612,763			
1.03.01 Accelerator Systems Management	-														
WBS(3)Totals: 1.03.0.2 Annulastic Elements	94,418	94,418	90,751	0	3,668	2,453,145	2,453,145	2,353,903	0	99,242	6,019,099	6,298,099	-279		
WBS[3]Totals:	230,007	230,007	194,943	0	35,065	3,408,307	3,408,307	2,888,227	0	520,080	10,071,767	10,071,767			
1.03.03 Injection System	205 211	156.000	122.204	149 221	17 000	2 506 425	2 028 404	1 550 560	559 021	479 742	42 601 224	42 121 224	570		
1.03.04 Storage Ring	360,311	130,000	130,204	199,221	17,000	2,380,433	2,000,404	1,000,000	1000,001	470,743	42,031,324	42,121,324	5/6		
WBS(3)Totals: 1.02.05 Controls Sustained	1,755,826	1,602,507	1,974,083	-153,319	-371,576	18,019,938	15,952,077	16,283,138	-2,067,882	-331,061	148,213,284	152,566,284	-4,353		
WBS[3]Totals:	211,993	164,103	219,945	-47,890	-55,842	4,383,802	3,556,178	3,638,253	-827,624	-82.075	20,207,065	20,207,065			
1.03.05 Appelerator Safety Systems WB 01217.em/s	75.041	2 162	67.055	73 741	60 853	812 795	252 598	642 224	150 898	0.554	4 471 222	4 471 232			
1.03.07 Insertion Devices	10.040	2,192	42,000	-14.141		000,700	002,000	010,004	-130,030	0,004	1,1/1,636	4,471,202			
WBS(3)Totals: 1.02.08 Accelerates Exhibiting Exciling	124,454	19,151	32,414	-105,303	-13,263	1,383,517	983,669	516,951	-399,848	466,718	24,225,288	24,225,288			
WBS[3]Totals:	294,945	193,491	132,912	-11,454	60,579	5,808,254	4,264,751	4,137,064	-1,343,503	127,687	6,961,411	7,381,411	-421		
WBS[2]Totals: 4.04 Excercise and Excellation	3,002,797	2,461,869	2,846,207	-540,927	-384,338	38,657,185	33,309,419	32,020,531	-5,347,766	1,288,889	262,860,470	267,342,470	-4,482		
1.04.01 Experimental Facilities Management	-														
WBS[3]Tetals:	139,105	139,105	90,922	0	48,183	1,817,117	1,817,117	2,177,746	0	-360,629	4,828,335	5,357,673	-53		
WBS(3)Totals:	0	1,295	0	1,295	1,295	21,887	14,246	0	-7,641	14,246	69,585	69,585			
1.04.05 User Instruments WBS/3/Treals:	235 183	233 300	220 624	.1 893	12 878	3 739 956	3,685,802	2 591 583	-54 (164	1 094 330	63 573 /084	63 573 084			
1.04.05 Front End User Requirements Development		100,000	220,024	-1,000	12,070	0,000,000	0,000,002	2,001,000	-34,004		00,070,004	00,070,004			
WIDS(3)Totels: 1.04.07 Optics Labs	°	0	0	0	0	456	456	1,205	-0	-749	456	1,205			
WBS[3]Tetals:	12,146	12,146	-14	0	12,160	843,917	645,243	554,549	-198,674	90,694	2,072,162	2,072,162			
WDojcji otalik 1.05 Conventional Facilities	386,433	385,845	311,531	-588	74,314	6,423,334	6,162,955	5,325,063	-260,379	837,893	70,543,623	71,083,710	-540		
1.05.01 Conventional Facilities Management															
WDS(3) totals: 1.05.02 Conventional Facilities Engineering and Design	253,107	253,107	198,544	0	54,563	4,882,010	4,682,010	4,611,782	0	z70,229	14,187,003	14,868,590	-681		
WBS[3]Tetals:	116,765	251,258	132,710	134,494	118,548	18,570,758	18,546,214	15,483,717	-24,545	3,052,497	22,563,410	22,553,410			
1.00.03 Conversional Paolities Construction WBSI3ITotals:	5.076.817	8,595,969	4,857,811	3,519,151	3,738,158	39,191,751	44,637,309	41,374,346	5.445.558	3,262,963	217,540,505	237,238,846	-19,69		
1.05.04 Integrated Controls & Communications															
wtbs(s) rotals: 1.05.05 Standard Equipment	1 °	0	0	0	0	139,236	13,539	13,594	-125,697	-55	561,273	961,273	-40		
WBS[3]Totals:	0	0	0	0	0	0	0	0	0	0	1,025,586	1,025,586			
WBS[3]Tetals	5,000	0	0	-5,000	0	35,000	67,819	36,518	32,819	31,301	578,000	578,000			
WBS[2]Totals:	5,451,689	9,100,334	5,189,065	3,643,645	3,911,269	62,818,755	68,146,891	61,519,957	5,328,136	6,626,934	256,455,778	277,235,706	-20,779		
1.06.01 Management - Pre Ops	1										-				
WBS[3]Totals: 1.05.02 Asseluctor Sustance Dec One	0	0	0	0	0	0	0	0	0	0	20,170,700	20,170,700			
WBS[3]Totals:	0	0	0	0	0	0	0	0	0	0	17,071,591	17,071,591			
1.06.03 Experimental Facilities - Pre Ops											1 010 040	1 015 0***			
1.06.04 Spares	1 °	0	0	0	0	1 °	0	0	0	0	3,823,660	3,823,960			
WBS[3]Totals:	0	0	0	0	0	0	0	0	0	0	9,134,454	9,134,454			
n Cost of Money	- 0	0	0	0	0	0	0	0	0	0	50,200,405	50,200,405 0			
s. Gen. and Admin.	0	ō	0	ō	0	0	0	ō	ō	0	0	0			
<ol> <li>Uncest. Dwaget</li> <li>Sub Total</li> </ol>	10,230,020	13,608,137	10.160,657	3.378.117	3,447,484	181,552,673	180.425.665	171,370,142	-1.126.958	9.055.573	3,789,341 760,986,358	555,000 785,281,078	3,234		
f. Contingency/Management Reserve	40.000	43.000.000	40.400.000	0.070.4.7		404 550 555	400.407	(74.070		0.0000	151,013,644				
9. rotal 9. Reconciliation to CEB	10,230,020	13,608,137	10,160,652	3,378,117	3,447,484	181,552,623	180,425,685	1/1,3/0,142	-1,126,958	9,055,523	912,000,000				
a. Variance Adjustment							_								
I. Total Contract Variance															



#### Variance Analysis: Reporting Levels





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#### Significant Variance As a Reporting and Control Tool

- Defined by FPD at WBS reporting level
  - % Variance
  - \$ Variance
  - Critical Path Element
  - Risk/Complexity
  - Cost & Schedule Drivers
- BNL PM defines "significant" internally so as to be supportive of reporting level needs
- In theory, if BNL takes effective corrective actions at CA level, no reportable variances will be identified at reporting level





#### **Calculating Variances as a Percentage**






## Variance Analysis

- Should identify problems, causes, impacts, corrective actions and effects on EAC
- Should be closely linked to risk analysis to focus on schedule, technical, and cost drivers
- Documented on a Variance Analysis Report (VAR) developed by CAM
- Summarized in monthly submission to customer (sometimes referred to as "Format 5")





## **BNL Variance Analysis Report**

🖉 IPD - Windows Internet Ex	cplorer									- X
S http://ipd.ls.br	l.gov/details/Variance_Report.aspx	?wbs_id=3303&Fiscal_Year=2	2013&Fiscal_Month=Ja	anuary	*	😽 🗙 🐠	Ask Search			<b>P</b> -
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Light Sources DIRECTORATE	NSLS-II PROJECT							BRO	OKHAVEN	RY
Home	WBS 1 04 05 03					Pop	orting Poriod	. 12/31/201	2 1/31/2013	
Project Details	Undulator Beamline 3, Co	oherent Hard X-ray Scatte	eri (Andrei Flueras	u [24037])		Kep	orang renou	. 12/31/201	2 - 1/3/1/2013	
Project Details Home		· · · · ·								
Predefined EVMS Rollup		BCWS	BCWP	ACWP	SV in \$	SV in %	CV in \$	CV %	SPI CPI	
Custom EVMS Rollup	Current:	556,720	1,096,595	1,122,771	539,874	97%	-26,176	-2%	1.97 0.98	
Project/Activity List	Cumulative:	5,891,588	5,017,580	4,590,804	-874,008	-15%	426,776	9%	0.85 1.09	
Signature Authority List	At Complete:	10.371.639								
Variance Status List		10,011,000								
Display All Variance Reports	Threshold(s) Exceeded	: Current Period Schedu	ile, Cumulative Scl	hedule						
Variance Approval List	Explanation of Varianc Current period SV: appow hutch fabrication and inst Cumulative CV: Delays in beamline. The mechanica management account. Impact: Minimal Corrective Action: Work with hutch vendor to	e/Description of Proble al of the CHX Optics FDF allation (-639k), delays in hiring was the initial cat al engineer is in fact supp o improve performance. (	em: R report (-661k) ha n shutter procurem use of the under-cc porting the entire E	ppened in January lent (-45k), and de sst position. The c experimental Facil	/ but the plan wa elays in the appr jurrent plan for th ities engineering nsible for design	as for approval in oval of the CHX ne mechanical ( group and cha group and cha	n December. ( diffractometer engineer is for rges much of i n of the beam	Cumulative S FDR report full time effo her time to t	SV: Delays in (-57k). he	
_	Prepared By: Andrei Fluerasu [24037]	s components, and safet	Date: 3/12/2013	App Aes	roved By: pok Byon [23958	3]		Date: 3/26/2013	acaam	
-	Unlock			Revie	W					>



Thresholds defined in PEP

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## Variance Analysis (cont'd)

- Should discuss CV and SV separately
- Should discuss Current period and Cumulative period separately
- Should clearly discuss the root cause(s) of each variance
- Should emphasize problems in Control Accounts
- Should quantify variances
- Should be specific, not general





### **Example Root Causes of Variances**

#### **Schedule** Variance

#### **Cost Variance**

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Lack of resources due to... Work is more complex than Unfavorable anticipated because... Late vendor deliveries because... Extensive Design Review comments Rework required due to... have resulted in... Work more complex than expected Material price escalation due to... because... The estimate was understated Unclear requirements in the areas because.... of... Efficiencies being realized Increased efficiency due to... because... Favorable Work less complex than anticipated We used less expensive resources in the areas of... to accomplish the work and... Fewer revisions and rework We negotiated a lower price with the because... supplier due to... Subcontractor ahead of schedule The new CAD system reduced the because... time required...



### **Root Cause Analysis?**

- Spent more than I planned
- Someone charged extra hours
- I didn't earn enough EV
- System variance
- See last month's report





## **Corrective Actions Plan Questions**

- What actions are/can/should be taken?
- Are any scarce resources needed?
- Who's responsible?
- What are the get well dates?
- What are the cost trade-offs?
- Which is more important: cost or schedule?





#### **Developing the Estimate At Completion**







## **EACs Updates**

- Comprehensive annual update
- Monthly CAM review
- Whenever a "significant" variance occurs
- Project manager / customer request





## Who's Responsible For EACs?

### Primary:

- Project Manager
- Control Account Managers
- Support:
  - Functional managers
  - Project control/business management
  - Subcontract management
  - Finance/accounting





## **EAC Issues to Consider**

- Outstanding commitments?
- Accruals?
- Future resources/rates?
- Scope issues?
- Future risks?



# **EVM Data Analysis**





## **Beginning of Project Data**

- Scope:
- Schedule:
- Budget:
- BAC:
- Plan:

- 200 drawings
- 10 months
- 30 hours per drawing
- \$300K (6000 hrs x \$50/hr)
- 20 drawings per month





#### Contractor Reported Status Information for Month 5

- 100 Drawings Planned
- 70 Drawings Completed
- 2450 Hours Charged
- \$52/Hour Average Cost

	BCWS	BCWP	ACWP	sv	си	BAC	EAC	VAC
Hours	3000	2100	2450	(900)	(350)	6000	6000	0
Dollars	150.0	105.0	127.4	(45.0)	(22.4)	300.0	300.0	0



## **Calculating Percent SV**







## **Schedule Performance Index**







### **Cost Variance as a Percentage**







### **Cost Performance Index**







#### To-Complete Performance Index: Performance Required to Achieve EAC (TCPI<sub>EAC</sub>)







## **TCPI<sub>BAC</sub> To Not Exceed the BAC**









## **Index Comparisons**

CPI <sub>CUM</sub> = 82%
TCPI <sub>BAC</sub>= 113%
TCPI <sub>EAC</sub>= 88%





#### **Schedule Conversions: Ahead/behind**







### **Ahead/behind At-Completion Projection**







#### **Assessing Realism of Reported EAC**







#### **IEAC\*** Based on Performance to Date



\*Independent Estimate at Completion

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#### **IEAC Based on Recent Performance**







#### IEAC Based on Combination of Cost and Schedule Performance – One Option





#### IEAC Based on Combination of Cost and Schedule Performance – Most Frequently Used Option







## **IEAC Formulas Used by PARS II**

- 1. IEAC1=ACWPcum+(BCWR/CPIcum)
- 2. IEAC2=ACWPcum+(BCWR/CPIcum X SPIcum)
- 3. IEAC3=ACWPcum+(BCWR/CPI3-mo avg)
- 4. IEAC4=ACWPcum+(BCWR/SPIcum)
- 5. IEAC5=ACWPcum+(BCWR/(0.8CPIcum x 0.2SPIcum)
- 6. Note: Weights assigned to CPI and SPI for IEAC5 calculation cannot be changed by user.





## **EAC Comparisons**





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### **EVMS Processes**



# **Change Control Objectives**

- Maintain the integrated technical, schedule, and budget baseline, ensuring that it reflects all authorized work.
- To incorporate authorized changes to the PMB in a timely and traceable manner
- To allow only authorized changes and revisions
- Document changes to maintain the PMB's integrity





## **PMB Baseline Management**

- Crucial for properly documenting, approving and implementing changes to PMB
- For determining if the project is in danger of exceeding the Contract Budget Baseline or the Program Baseline
- Contract changes are required for implementation of changes to the Contract Budget Base [CBB]





## **Change Control Challenges**

- It is important that the change control process to provide traceability (visibility) to what is being changed (scope, budget, schedule), what prompted the change, and budget sources
- Changes not processed to solely to correct variances
- Baseline changes cannot change history!





### **Baseline Traceability**









### **Project Baseline Log**

Entry Description	Distributed Budget		Undistributed Budget		Management Reserve		Contract Budget Base	
		Total		Total		Total		Total
1. Initial Baseline	+250.5	+250.5	+10.0	+10.0	+20.0	+20.0	+280.5	280.5
2. MR to WBSE 1.2.4	+2.6	253.1		10.0	-2.6	17.4		280.5
3. Approved CR #21	+3.4	256.5		10.0	+.3	17.7	+3.7	284.2



BROOKHAVEN NATIONAL LAT SATORY BROOKHAVEN SCIENCE
### BNL PCR National Synchrotron Light Source II Project Change Request (PCR)

#### Instructions: 1. Provide detailed attachments as appropriate and check the box to indicate a document is attached.

#### Section A

U.S. DEPA

Origination (ddMonyy) (type In expandable field)	PCR title:
WBS No(s)	
Type of change (Check all that apply; give details in Section B.)	Directed shange? Y Brief reason for shange:
Technical Schedule	Level of change (Level affects signatures needed in Concurrence section.)
Cost Administrative	4 3 2 1B 1A 0
Use of management reserve? Y	Project Levels
Use of contingency funds? Y N	If this PCR requires a phased implementation, check here.
Section B	
Summary of change: Attachments? Y	
Technical change Description (include interfaces with other of	elements) Attachments? Y
Detailed cost estimate with basis for estimate Description	with basis Total change in \$K. Attachments? Y
Cost baseline impact Orig. cost, \$K Est. revised, \$#	K Est. chonge, \$K Final budgeted cost, \$K
Description Attachments? Y 🗖 EAC or Risk ID #	
Schedule impact Attachments? Y	
Administrative impact Labor costs 🗌 Malerial costs 🗌 Cl	hanges WBS dictionary? Y 🔲 N 📄 if Y, highest WBS level affected: 4 🗌 3 🗌 2
Major(>\$100K) procurement 🗖 Description 🛛 Docume	entation update required? Y N N Attachments? Y N
Rection C (as all Zerroration of the second	A A A A A A A A A A A A A A A A A A A

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Page 1

# BNL PCR

Funding source and impacts on funding		Contingenc Before: \$ This requisition: \$ New net: \$			Mgmt, Res.(\$K) \$ \$ \$			
Funding spread (BA) by FY	FY09	FY10	Fri1	FY12	FY13	FY14	TOTAL	
Cost Baseline In \$K Baseline Proposed Change (BCW8) Management Reserve ( Confingency	FY09	FY10	Fr11	FY12	FY13	FY14	TOTAL	
Total Project Cost (TPC) In \$K	Baseline DOE	PCR		Change	Ph	Proposed Baseline PCR		
WB8 1.1 Project Management WB8 1.3 Accelerator Systems WB8 1.4 Experimental Facilities			<u> </u>					-
WB8 1.5 Conventional Facilities Management Reserve								_
Total Estimated Cost (TEC) Contingency Total Estimated Cost								-
WB8 1.2 R&D and Conceptual Design WB8 1.8 Pre-Operations								-
Other Project Costs (OPC) Contingency Total OPC								_
Total Project Costs (TPC)								- ,
S. DEPARTMENT OF ENERGY		18	32				NATIONAL LAI BROOKHAVEN SCIE	82TOR





### **Examples of Allowable Changes**

- Use MR to revise CA budgets for new work within the scope of the contract
- Re-plan future WPs and future portion of open WPs within CA constraints
- Transfer work and associated budget between CAs
- Re-plan [re-baseline?] per customer agreements





### **Examples of Unallowable Changes**

- Retroactively change budgets or costs for accomplished work
- Budget is not transferred with work
- Re-open closed work packages
- Make undocumented or untraceable changes to project baseline





### Re-planning vs. Re-baselining\*

- Re-planning can lead to minor changes in baseline phasing, but is not a form of re-baselining
  - Relates to routine re-planning actions associated with:
    - Rolling wave process
    - "Typical" MR transactions
    - Shifts of work and planning packages that don't affect any higher level milestones or control account constraints
- Re-baselining relates to broad (i.e., many control accounts), significant:
  - Increases/decreases to future work and budgets
  - Shifts in phasing of work and, possibly
  - Shifts in timing of contractual milestones

\* These are unofficial definitions since there are no formally documented definitions for these terms



### **Re-baselining is done when?**

- Major changes to technical approach
- Changes in funding [does not necessarily result in "single point adjustments" to existing variances]
- Significant rate changes





# **EV Report Analysis**

### Exercise





# **Earned Value Report Analysis**

Questions:

- 1. What are the cumulative cost and schedule variances in dollars and percent?
- 2. What variance, if any, is the contractor forecasting to the PMB? To the contract target cost?
- 3. Calculate the SPI and CPI.
- 4. What is the project percent completion?
- 5. At what level of efficiency must the contractor perform the balance of work in order to meet the reported EAC?
- 6. Calculate an independent EAC using whatever performance factor you consider appropriate.
- 7. Can you forecast projected months ahead/behind at completion?





EARNED VALUE REPORT

**DOLLARS IN:** Thousands

Page 1 of 1

1. CONTRACTOR   2. CONTRACT   3. PROGRAM   4. REPORT PERSON     NAME Waste Processing LLC   a. NAME Waste Processing Plant   a. NAME Waste Processing Plant   a. NAME Waste Processing Plant   b. RIMMER AD0019-84-C-0157   b. RIMMER AD0019-84-C-0157   b. PROM_(CVY/MMDD) 20021231   20021231     Summyside, CA   C. UPF   d. SHARE RATIO 15/85 6/6/15   D. PHASE (X one) RDTAE   PRODUCTION   b. TO (CYY/MMDD) 20030168     AMME (Last, First, Middle Initial)   D. TITLE Prog Mgr   c. SIGNATURE   C. SIGNATURE   d. DATE (CCYYMMDD) 20030168     S. CONTRACT DATA   o. ORGINAL CONTRACT TARGET COST 528,900   b. NEGOTIATED CONTRACT CHANGES   c. CURRENT TARGET COST (a. + b.)   d. ESTIMATED COST oF AUTHORIZED UMPRICED WORK     S228,420   S03,520   S03,520   S292,420   s0   o. OVER TARGET BASELINE DATE (CCYYMMDD)   cCVPLETION (c f.)   b. OVER TARGET BASELINE DATE (CCYYMMDD)     S228,420   TEM   S0000169   S007   CONTRACT DATE   AT COMPLETION (c f.)   b. OVER TARGET BASELINE DATE (CCYYMMDD)     10   VORK BREAKDOWN STRUCTURE ELEMENT   2   20,775   25,346   32,224   4,477   4,887   76,324   76,584   -36							_						
a. NAME waste Processing Plant   a. NAME waste Processing Plant   a. NAME waste Processing Plant   a. NAME waste Processing Plant   a. NAME   a. PROM (CCV/YMMDD) 2021201     b. LOCATION (Address and ZIP code) Sumyside, CA   b. NUMBER ADD19-84-C-0157   b. TYPE   d. SHARE RATIO 15/85 85/15   b. PHASE (Yone) RDTAE   production   b. TCC 2021201   b. TCC 2021201     c. AUTHORIZED CONTRACTOR REPRESENTATIVE a. NAME (Last, First, Middle Initial)   b. TTLE Prog Mgr   c. SIGNATURE   c. SIGNATURE   d. BATE (CCYYMMDD) 2003108     c. CONTRACT DATA   a. ORIGINAL CONTRACT TARGET COST   b. NEGOTIATED CONTRACT CHANGES   c. SUGNATURE   d. ESTIMATED COST oF AUTHORIZED UNPROCED WORK \$30     s228,900   \$35,520   \$222,420   g. VARIANCE AT COMPLETION (e - f)   b. OVER TARGET RASELINE DATE (CCYYMMDD)     s222,420   g. VARIANCE AT COMPLETION (e - f)   h. OVER TARGET RASELINE DATE (CCYYMMDD)   tarting COST   b. OVER TARGET RASELINE DATE (CCYYMMDD)     s222,420   g. VARIANCE AT COMPLETION (e - f)   h. OVER TARGET RASELINE DATE (CCYYMMDD)   tarting COST   tarting COST     s222,420   g. VARIANCE MARCE   ATTOW COST   tarting COST   tarting COST   tarting COST     s222,420   g. Contract Barbet (1)	1. CONTRACTOR 2. C			2. CONTRACT				PROGRAM		4. REPORT PERIOD			
Waste Processing Plant   Waste Processing Plant   Waste Processing Plant   2002/1201     b. LOCATION (Address and ZIP code)   b. NUMBER A00019.44-C-0157   MIMBER A00019.44-C-0157   b. PHASE (X core)   D. TO (CCYYMMDD) 2002/121   2002/1201     s. AUTHORZED CONTRACTOR REPRESENTATIVE   c. SIGNATURE   RDT48E   PRODUCTION   d. BATE (X core) 2003/108   2002/1201     s. AUTHORZED CONTRACT CREPRESENTATIVE   c. SIGNATURE   c. SIGNATURE   d. DATE (CCYYMMDD) 2003/108     s. CONTRACT DATA   o. MEGOTIATED CONTRACT CRAGES \$63,520   c. CURRENT TARGET COST ( <i>a</i> .+ <i>b</i> .)   d. BATE (CCYYMMDD) 2003/108     s. CONTRACT BUDGET BASE ( <i>c</i> .+ <i>d</i> .)   f. MANAGEMENT ESTIMATE AT 228,400   g. VARIANCE AT COMPLETION ( <i>c f</i> .)   b. OVER TARGET BASELINE DATE (CCYYMMDD)     s. CONTRACT BUDGET BASE ( <i>c</i> .+ <i>d</i> .)   f. MANAGEMENT ESTIMATE AT 228,420   g. VARIANCE AT COMPLETION ( <i>c f</i> .)   b. OVER TARGET BASELINE DATE (CCYYMMDD)     s. WORK BREAKDOWN STRUCTURE ELEMENT 1. O Waste Processing Plant   2   29,775   25.348   22,226   4.442   6.887   76,234   76,584   -35     1. WORK BREAKDOWN STRUCTURE ELEMENT 1. O Waste Processing Plant   2   29,775   25.348   22,226   4.442   6.887 <td colspan="3">a. NAME a. NAME</td> <td colspan="3">E</td> <td>  a. I</td> <td>NAME</td> <td></td> <td></td> <td colspan="2">a. FROM (CCYYMMDD)</td>	a. NAME a. NAME			E			a. I	NAME			a. FROM (CCYYMMDD)		
b. LOCATION (Address and ZIP code)   b. HUMBER A00019-84-C-0157   Waste Processing Plant   b. PHASE (X one)   D. 2021231     Sunnyside, CA   c. TYPE   d. SHARE RATIO (CPF   b. PHASE (X one)   D. 20021231   2021231     6. AUTHORIZED CONTRACTOR REPRESENTATIVE a. NAME (Last, First, Middle Initial)   b. TITLE Prog Mgr   c. SIGNATURE   PRODUCTION   d. DATE (CCYYMMDD)     6. CONTRACT DATA   b. NEGOTIATED CONTRACT CHANGES   c. SUGNATURE   d. DATE (CCYYMMDD)   2003108     6. CONTRACT DATA   b. NEGOTIATED CONTRACT CHANGES   c. CURRENT TARGET COST (a. + b.)   d. ESTIMATED COST oF AUTHORIZED UNPRICISED WORK   2003108     5228,900   \$83,520   \$232,420   \$0   0.VER TARGET BASE INCE DATE COMPLETION   g. VARIANCE AT COMPLETION (c f.)   b. OVER TARGET BASELINE DATE (CCYYMMDD)     2324 20   TEM   MANACEMENT ESTIMATE AT COMPLETION   g. VARIANCE AT COMPLETION (c f.)   b. OVER TARGET BASELINE DATE (CCYYMMDD)   v.ensue     2324 20   TEM   MANACEMENT ESTIMATE AT COMPLETION   g. VARIANCE AT COMPLETION (c f.)   b. OVER TARGET BASELINE DATE (CCYYMMDD)   v.ensue     3030 01   TITEM   ESTIMATE D   VORK   VARIANCE AT COMPLETION (c f.) <t< td=""><td colspan="3">Waste Processing, LLC Waste</td><td colspan="4">Processing Plant</td><td>Vaata Draaaasin</td><td></td><td></td><td colspan="2">20021201</td></t<>	Waste Processing, LLC Waste			Processing Plant				Vaata Draaaasin			20021201		
A00019-84-C-0157   A00019-84-C-0157   PHASE (X ORe) CPF   D. HASE (X ORE) BTASE   D. TO (C CYYMMDD) 20021231     6. AUTHORIZED CONTRACTOR REPRESENTATIVE a. NAME (Lass, First, Middle InitBal)   b. TITLE Prog Mgr   c. SIGNATURE   d. DATE (CCYYMMDD) 20030108     6. CONTRACT DATA   b. NEGOTIATED CONTRACT CHANGES   c. SIGNATURE   d. DATE (CCYYMMDD) 20030108     6. CONTRACT DATA   b. NEGOTIATED CONTRACT CHANGES   c. CURRENT TARGET COST (a + b.)   d. ESTIMATED COST OF AUTHORIZED 3502     7228 900   \$53,520   523,420   50     e. CONTRACT BUDGET BASE (c. + d.)   f. MANAGEMENT ESTIMATE AT COMPLETION   g. VARIANCE AT COMPLETION (e f.)   h. OVER TARGET BASELINE BATE (CCYYMMDD)     1292,420   TTEM   EUDOFEDCOTT COMPLETION   ACTUAL COST WORK   VARIANCE   VARIANCE     1202,420   TITEM   EUDOFEDCOTT COMPLETION   ACTUAL COST WORK   VARIANCE   VARIANCE     1202,420   TITEM   EUDOFEDCOTT VARIANCE DATA   COMPLETION   KCUEDULE COST (e.)   NORE TARGET BASE (c. + d.)   h. OVER TARGET BASE (c. + d.)	b. LOCATION (Address and ZIP code) b. NUMB			ÆR				vaste Processin	ig Plant				
Sunnyside, CA   c. TYPE CPIF   d. SHARE RATIO 15/86 85/15   B. BASE RDTaE   PRODUCTION   20021231     5. AUTHORIZED CONTRACTOR REPRESENTATIVE a NAME (Last, First, Middle Initial) Prog Mgr   b. TITLe Prog Mgr   c. SIGNATURE   d. DATE (CCYYMMDD) 2003000     6. CONTRACT DATA   b. NEGOTIATED CONTRACT CHANGES \$228,900   c. CURRENT TARGET COST (a. + b.)   d. ESTIMATED COST oF AUTHORIZED UNPRICED WORK   d. BATE (CCYYMMDD) 2003000     5228,900   \$553,520   292,420   \$0   0 </td <td colspan="3">A00019</td> <td colspan="4">3-84-C-0157</td> <td></td> <td></td> <td></td> <td colspan="2">b. TO (CCYYMMDD)</td>	A00019			3-84-C-0157							b. TO (CCYYMMDD)		
CPF   15x85   RDT &   PRODUCTION     A. MUTHORZED CONTRACTOR REPRESENTATIVE   b. TITLE Prog Mgr   c. SIGNATURE   d. DATE   CCYYMMOD) 20030108     6. CONTRACT DATA   .   c. SIGNATURE   c. SIGNATURE   d. DATE   CCYYMMOD) 20030108     6. CONTRACT DATA   .   .   NEGOTIATED CONTRACT CHANGES   c. CURRENT TARGET COST 000000000000000000000000000000000000	Sunnyside, CA	с.	TYPE		d. Si	HARE RATIO	b. I	PHASE (X one)			20021231		
S. AUTHORIZED CONTRACTOR REPRESENTATIVE     a. NAME (Last, First, Middle Initial)   b. TITLE Prog Mgr   c. SIGNATURE   d. BATE (CCYYMMDD) 20030108     6. CONTRACT DATA   b. NEGOTIATED CONTRACT CHANGES   c. SIGNATURE   d. ESTIMATED COST of AUTHORIZED UNPRICED WORK     5228,000   563,520   523,230   500   500   500     5229,000   563,520   500   500   500   500   500   500     5229,200   563,520   1. MARAGEMENT ESTIMATE AT COMPLETION   Q. VARIANCE AT COMPLETION (c - 7)   b. OVER TARGET BASE LINE DATE (CCYYMMDD)     7. PERFORMANCE DATA   ITEM   EUDOCTECONT (0 (2)   ACTUAL CONT   MARCE WORK   SCHEDULE   COST   BUDOETEC   ESTIMATED   VARIANCE     1.0 Waste Processing Plant   2   29,775   25,348   32,225   -4,427   -6,887   76,234   76,634   -76     1.0 Waste Processing Plant   2   29,775   25,348   32,225   -3   -14   1,030   1,030   -76   -76   -76   -76   -76   -76   -76   -76   -76		C	PIF		15/	85 85/15		RDT&E	P	RODUCTION			
a. NAME (Last, First, Middle Initial) b. THLE Prog Mgr c. SIGNATURE d. DATE 20030108   6. CONTRACT DATA .	5. AUTHORIZED CONTRACTOR REPRESENT	ATIVE											
Prog Mgr   20030108     6. CONTRACT DATA   . <td< td=""><td>a. NAME (Last, First, Middle Initial)</td><td>b. TITLE</td><td></td><td></td><td colspan="7">c. SIGNATURE</td><td colspan="2">d. DATE (CCYYMMDD)</td></td<>	a. NAME (Last, First, Middle Initial)	b. TITLE			c. SIGNATURE							d. DATE (CCYYMMDD)	
S. CONTRACT DATA   S. CONTRACT DATA     a. ORIGINAL CONTRACT TARGET COST   b. NEGOTIATED CONTRACT CHANGES   c. CURRENT TARGET COST (a. + b.)   d. ESTIMATED COST OF AUTHORIZED     \$228,900   \$83,520   \$292,420   \$0     c. CONTRACT BUDGET BASE (c. + d)   f. MANAGEMENT ESTIMATE AT COMPLETION   g. VARIANCE AT COMPLETION (e f.)   h. OVER TARGET BASELINE DATE (CCYYMMDD)     \$292,420   TEM   FUNCTION   4CTUAL COST   VARIANCE AT COMPLETION (e f.)   h. OVER TARGET BASELINE DATE (CCYYMMDD)     \$292,420   TEM   \$UDOFTED COST   ACTUAL COST   VARIANCE   TAT COMPLETION (CYYMMDD)     \$292,420   TEM   \$UDOFTED COST   ACTUAL COST   VARIANCE   TAT COMPLETION (CYYMMDD)   VARIANCE     \$292,420   (1)   (2)   PERFORMED   FERORMED   BUDGETED COST   ACTUAL COST   VARIANCE     \$100 Waste Processing Plant   2   2.97.75   25.348   32.22.35   74.427   -6.887   76.234   76.534   -3.30     1.0 Waste Processing Plant   2   2.97.75   25.348   32.22.35   -4.427   -6.887   76.234   76.534		Prog Mgr								20030108			
Se CONTRACT DATA     a. ORIGINAL CONTRACT CARGET COST   b. NEGOTIATED CONTRACT CHARGES   c. CURRENT TARGET COST (a. + b.)   d. ESTIMATED COST OF AUTHORIZED UNPRICED WORK     \$228,900   \$53,520   \$292,420   \$0   contract Budget Base (c. + d.)   CONTRACT DATE   CONTRACT BUDGET BASE (c. + d.)     CONTRACT BUDGET BASE (c. + d.)   CONTRACT BUDGET BASE (c. + d.)   CONTRACT DATE   CONTRACT COMPLETION (c f.)     CONTRACT DATE   CONTRACT DATE   AT COMPLETION (c f.)     CUMULATIVE TO DATE   AT COMPLETION													
e. ORIGINAL CONTRACT TARGET COST   b. NEGOTIATED CONTRACT CHANGES   c. CURRENT TARGET COST (a + b.)   d. ESTIMATED COST of AUTHORIZED UNPRICED WORK     \$228,900   \$36,520   \$232,420   50     c. CONTRACT BUDGET BASE (c. + d)   f. MANAGEMENT ESTIMATE AT COMPLETION (c. + f.)   b. OVER TARGET BASELINE DATE   b. OVER TARGET BASELINE DATE     \$232,420   r. MANAGEMENT ESTIMATE AT COMPLETION   g. VARIANCE AT COMPLETION (c. + f.)   b. OVER TARGET BASELINE DATE     7. PERFORMANCE DATA   r. MANAGEMENT ESTIMATE AT COMPLETION   (c. + d.)   b. OVER TARGET COST   A COMPLETION (c. + f.)     1. PERFORMENCE DATA   r. MANAGEMENT ESTIMATE AT COMPLETION   (c. + d.)   b. OVER TARGET COST   A COMPLETION (c. + f.)   b. OVER TARGET COST   (c. YVMMDD)     7. PERFORMENCE DATA   r. CUMULATIVE TO DATE   A COMPLETION (c. + f.)   (c. YVMMDD)   (c. YVMMDD)     1.0 Waste Processing Plant   (c.)   (d.)	6. CONTRACT DATA												
\$228,900   \$53,520   \$292,420   \$0     e. CONTRACT BUDGET BASE (c. + d.) \$292,420   f. MANAGEMENT ESTIMATE AT COMPLETION   g. VARIANCE AT COMPLETION (e f.) CCYYMMDD)   h. OVER TARGET BASELINE DATE (CCYYMMDD)     7. PERFORMANCE DATA   ITEM   BUDGETEDCOST   ACTUAL COST   VARIANCE     1   TEM   BUDGETEDCOST   ACTUAL COST   VARIANCE     10   VASIE PERFORMED   PERFORMED   SCHEDULE   COST   BUDGETED   ESTIMATED   VARIANCE     10   VASIE PERFORMED   29,775   25,348   32,225   -4,427   -6,887   70,234   76,584   -6,685   -76     3.0 RX-1 Equipment   2   24,775   23,068   -2,144   -311   22,326   -2,4427   -6,887   76,234   76,584   -6,76     3.0 RX-1 Equipment   2   24,775   23,068   -1,126   -2,602   82,404   83,356   -76     3.0 Stystem Test   2   2,770   7,380   7,770   -368   -1,123   20,688   2,386   -31     1.0 Waste Processing Plant <td>a. ORIGINAL CONTRACT TARGET COST</td> <td>b. NEGOTIATED CO</td> <td>ONTR/</td> <td>ACT CHANGES</td> <td></td> <td>c. CURRENT 1</td> <td>TARG</td> <td>ET COST (a. +)</td> <td>b.) d</td> <td>. ESTIMATED CO</td> <td colspan="3">ESTIMATED COST OF AUTHORIZED</td>	a. ORIGINAL CONTRACT TARGET COST	b. NEGOTIATED CO	ONTR/	ACT CHANGES		c. CURRENT 1	TARG	ET COST (a. +)	b.) d	. ESTIMATED CO	ESTIMATED COST OF AUTHORIZED		
\$229,420   \$0     c. CONTRACT BUDGET BASE (c. + d.)   f. MANAGEMENT ESTIMATE AT COMPLETION   g. VARIANCE AT COMPLETION (e f.)   h. OVER TARGET BASELINE DATE (CCYYMMDD)     \$292,420   SO   SO     7. PERFORMANCE DATA   GWORK   GWORK   CUMULATIVE TO DATE   h. OVER TARGET BASELINE DATE (CCYYMMDD)     7. PERFORMANCE DATA   TTEM   EUGOFTED C37 WORK   ACTUAL COST WORK   VARIANCE   ACT COMPLETION     10   VASIE   EUGOFTED C37 WORK   ACTUAL COST WORK   VARIANCE   EUGOFTED   ESTIMATED   VARIANCE     10   VASIE PROFILED   QCYANDAN STRUCTURE ELEMENT   QCYANDAN STRUCTURE ELEMENT   CUMULATIVE TO DATE   COST   EUGOFTED   ESTIMATED   VARIANCE     10   Waste Processing Plant   2   29,775   26,348   32,235   -4,427   -6,887   76,234   76,694   -35     3.0   ASTINGTURE ELEMENT   2   29,775   26,348   32,235   -4,427   -6,887   76,234   76,694   -35     3.0   Structure ELEMENT   2   29,976   26,348   32,235										UNPRICED WORK			
e. CONTRACT BUDGET BASE (c. + d) 2022,420   f. MANAGEMENT ESTIMATE AT COMPLETION   g. VARIANCE AT COMPLETION (e f.)   h. OVER TARGET BASELINE DATE (C YYMMDD)     7. PERFORMANCE DATA     TEM   EUDOFFEOCOST NORK   ACTUAL COST YORK   VARIANCE   ESTIMATE D     11   EUDOFFEOCOST NORK   ACTUAL COST YORK   VARIANCE   ESTIMATE D   ESTIMATE D     10   VARIANCE DATE   2000   PERFORMED   SCHEDULE   COST   BUDGETED   ESTIMATE D     10   VASIE   200,775   25,348   32,235   -4,427   -6,887   76,234   76,594   -35     1.0 Waste Processing Plant   2   24,772   23,508   26,008   -1,266   -2,502   82,494   83,255   -76     3.0 RX-1 Equipment   2   2,999   6,185   6,496   -2,12   311   23,202   23,239   -4,427   -6,887   76,234   76,594   -35     3.0 RX-1 Equipment   2   2,999   6,185   6,496   -2,126   82,496   -31     0.0 Data   2   119 <td>\$228,900</td> <td>\$63,520</td> <td></td> <td></td> <td></td> <td>\$292,420</td> <td></td> <td></td> <td></td> <td colspan="4">\$0</td>	\$228,900	\$63,520				\$292,420				\$0			
COMPLETION   CCMPLETION   (CCYYMMDD)     3292,420	e. CONTRACT BUDGET BASE (c. + d.)	f. MANAGEMENT E	ESTIM	ATE AT		g. VARIANCE	AT (	COMPLETION (	9. – <i>f.</i> ) h	h. OVER TARGET BASELINE DATE			
\$292,420   Contract   CUMULATIVE TO DATE   AT COMPLETION     ITEM   BUDGETED COST   ACTUAL COST   VARIANCE     WORK   %ORK   %ORK   %ORK   SCHEDULED   EUIDOETED COST   ACTUAL COST   VARIANCE   ESTIMATED   VARIANCE     (1)   (2)   (3)   (4)   (5)   (6)   (7)   (8)   (9)     ACTUAL COST   VARIANCE     (1)   (2)   (5)   (4)   (6)   (7)   (8)   (9)     ACTUAL COST   VARIANCE     (1)   (2)   (5)   (4)   (6)   (7)   (8)   (9)     ACTUAL COST   VARIANCE   COST   BUDGETED COST   VARIANCE     (1)   (2)   (2)   (5)   (4)   (5)   (7)   (8)   (7)     ACTUAL COST   VARIANCE   COST   BUDGETED COST   VARIANCE     ACTUAL COST   VARIANCE   COST   F0   (8)   7)   70 <t< td=""><td></td><td>COMPLETION</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="4">(ССҮҮММДД)</td></t<>		COMPLETION								(ССҮҮММДД)			
VPERFORMANCE DATA     CUMULATIVE TO JET   ACTUAL COST   ACTUAL COST   BUDGETED COST   ACTUAL COST   BUDGETED   SCHEDULED   COMPLETION     ITEM   BUDGETED   ACTUAL COST   VARUACE   COST   BUDGETED   ESTIMATED   VARUACE     (1)   (2)   (3)   (4)   (5)   (6)   (7)   (8)   (8)     1.0 Waste Processing Plant   2   29,775   25,348   32,235   -4,427   -6,897   76,234   76,694   -35     2.0 Laboratory   2   24,772   22,306   26,000   -1,266   -2,002   82,494   83,225   -76     3.0 RX-1 Equipment   2   6,39   6,185   6,496   -214   -311   23,028   2,32,38   -2,388   -2,388   -2,388   -2,388   -2,388   -2,388   -2,388   -2,388   -2,388   -2,388   -2,388   -2,388   -2,388   -2,388   -2,388   -2,388   -2,388   -2,388   2	\$292,420					-							
ITEM   ACTUAL COST   BUDG ETED   ACTUAL COST	7. PERFORMANCE DATA												
ITEM   BUCRT   ACTUAL COST   VARANCE   VARANCE   VARANCE   VARANCE   VARANCE   BUDCETED   BUDCETED   BUDCETED   BUDCETED   BUDCETED   BUDCETED   BUDCETED   BUDCETED   BUDCETED   COST   BUDCETED   BUDCETED   VARANCE     1.0 Waste Processing Plant   2   29,775   225,348   32,235   -44,427   -6,887   76,534   83,255   -76     2.0 Laboratory   2   24,772   23,606   26,088   -1,266   -2,612   83,266   32,235   -44,427   -6,887   76,534   83,256   -76     3.0 RX-1 Equipment   2   6,399   6,185   6,496   -2,141   131,32,036   23,238   -2,338		CUMULATIVE TO DATE						AT COMPLETION					
WORK   WORK   WORK   WORK   WORK   WORK   WORK   SCHEDULE   PERFORMED   PERFORMED   SCHEDULE   EUDOETED   EUTMATED   WARWARE     10   (1)   (2)   (3)   (4)   (5)   (6)   (7)   (8)   (8)     a. WORK BREAKDOWN STRUCTURE ELEMENT   (2)   29,775   25,348   32,235   -4,427   -6,887   76,234   76,544   -36     2.0 Laboratory   2   24,772   23,506   26,008   -1,266   -2,502   82,494   83,255   -76     3.0 RX-1 Equipment   2   24,772   23,506   26,008   -1,426   -2,311   23,026   23,239   -2,113     4.0 Training   2   274   271   225   -3   -14   1,300   1,300   -2,302   23,239   -2,318   -2,318   -2,318   -2,318   -2,318   -2,318   -2,318   -2,318   -2,318   -2,318   -2,318   -2,318   -2,318   -2,318   -2,318   -2,318   -	ITEM			BUDGETED COST ACTUA			XOST VARIANCE						
Image: constraint of the symmetry of th				WORK	WORK	WORK	ĸ						
(1)   (2)   (3)   (4)   (5)   (6)   (7)   (8)   (9)     a. WORK BREAKDOWN STRUCTURE ELEMENT </td <td></td> <td></td> <td></td> <td>SCHEDULED</td> <td>PERFORME</td> <td>D PERFORM</td> <td>MED</td> <td>SCHEDULE</td> <td>COST</td> <td>BUDGETED</td> <td>ESTIMATED</td> <td>VARIANCE</td>				SCHEDULED	PERFORME	D PERFORM	MED	SCHEDULE	COST	BUDGETED	ESTIMATED	VARIANCE	
a. WORK BREAKDOWN STRUCTURE ELEMENT   Image: marked base interment dissed interment disterment dissed interment dissed interment dissed in	(1)	(2)	(3)	(4)		(5)	(6)	(7)	(8)	(9)			
1.0 Waste Processing Plant 2 29,775 26,348 32,235 -4,427 -6,887 76,34 76,684 -35   2.0 Laboratory 2 24,772 23,506 26,008 -1,206 -2,502 82,494 83,255 -76   3.0 RX-1 Equipment 2 6,399 6,185 6,496 -214 -311 23,026 23,239 -21   4.0 Training 2 274 271 285 -3 -14 1,930 1,930 1,930   5.0 Support Equipment 2 119 115 114 -4 1 2,366 2,386   6.0 System Test 2 6,487 5,655 6,976 -832 -1,320 26,681 26,995 -31   7.0 Project Management 2 7,670 7,380 7,470 -190 -90 8,862 30   9.0 Spares 2 0	a. WORK BREAKDOWN STRUCTURE ELEMEN												
1.1.5 Walks Hull 2 24,772 23,506 26,008 -1,266 -2,502 82,404 83,255 -76   3.0 RX-1 Equipment 2 6,399 6,185 6,496 -214 -311 23,026 23,239 -21   4.0 Training 2 274 271 285 -3 -14 1,930 1,930   5.0 Support Equipment 2 119 115 114 -4 1 2,386 2,386   6.0 System Test 2 6,487 5,655 6,975 -832 -1,320 26,681 26,995 -31   7.0 Project Management 2 7,570 7,380 7,470 -190 -90 18,836 18,836   8.0 Data 2 886 911 911 25 0 8,862 30   9.0 Spares 2 0	1.0 Waste Processing Plant		2	29,775	25,	,348 3	2,235	-4,427	-6,8	37 76,234	76,584	-350	
10 RX-1 Equipment 2 6,399 6,185 6,496 -214 -311 23,026 23,239 -21   4.0 Training 2 274 271 285 -3 -14 1,930 1,930   5.0 Support Equipment 2 119 115 114 -4 1 2,386 2,386   6.0 System Test 2 6,487 5,665 6,975 -832 -1,320 26,681 26,995 -31   7.0 Project Management 2 7,570 7,380 7,470 -190 -90 18,836 18,836   8.0 Data 2 886 911 911 25 0 8,362 8,062 30   9.0 Spares 2 0	2.0 Laboratory		2	24,772	23,	,506 2	8,008	-1,266	-2,5	)2 82,494	83,255	-761	
4.0 Training 2 274 271 285 -3 -14 1,930 1,930   5.0 Support Equipment 2 119 115 114 -4 1 2,386 2,386   6.0 System Test 2 6,487 5,655 6,975 -832 -1,320 26,681 26,995 -31   7.0 Project Management 2 7,570 7,380 7,470 -190 -90 18,836 18,836   8.0 Data 2 886 911 911 25 0 8,362 8,062 30   9.0 Spares 2 0 <	3.0 RX-1 Equipment		2	6,399	6,	,185	6,496	-214	-3	11 23,026	23,239	-213	
5.0 Support Equipment 2 119 115 114 -4 1 2,386 2,386   6.0 System Test 2 6,487 5,655 6,975 -832 -1,320 26,681 26,995 -31   7.0 Project Management 2 7,570 7,380 7,470 -190 -90 18,836 18,836   8.0 Data 2 886 911 911 25 0 8,362 8,062 30   9.0 Spares 2 0 0 0 0 0 6,699 6,699   [0H] - 0VERHEAD 2 0 0 0 0 0 0 0 0 0   b. COST OF MONEY 2 0<	4.0 Training		2	274		271	285	-3	-	1,930	1,930	0	
6.0 System Test 2 6,487 5,655 6,975 -832 -1,320 26,681 26,995 -31   7.0 Project Management 2 7,570 7,380 7,470 -190 -90 18,836 18,836 18,836 18,836 18,836 18,836 18,836 18,836 18,836 30   8.0 Data 2 886 911 911 25 0 8,362 8,062 30   9.0 Spares 2 0 0 0 0 0 0 6,699 6,	5.0 Support Equipment	119		115	114	-4		1 2,386	2,386	0			
7.0 Project Management 2 7,570 7,380 7,470 -190 -90 18,836 18,836 80   8.0 Data 2 886 911 911 25 0 8,362 8,062 30   9.0 Spares 2 0 0 0 0 0 6,699 <td>6.0 System Test</td> <td></td> <td>2</td> <td>6,487</td> <td>5,</td> <td>,655</td> <td>6,975</td> <td>-832</td> <td>-1,3</td> <td>20 26,681</td> <td>26,995</td> <td>-314</td>	6.0 System Test		2	6,487	5,	,655	6,975	-832	-1,3	20 26,681	26,995	-314	
8.0 Data 2 886 911 911 25 0 8,362 8,062 30   9.0 Spares 2 0 0 0 0 0 6,699	7.0 Project Management		2	7,570	7.	,380	7,470	-190	-	90 18,836	18,836	0	
9.0 Spares 2 0 0 0 0 6,699 6,699   [0H] - OVERHEAD 2 0	8.0 Data		2	886		911	911	25		0 8,362	8,062	300	
[0H] - 0VERHEAD 2 0	9.0 Spares		2	0		0	0	0		0 6,699	6,699	0	
b. COST OF MONEY   2   0	[0H] - OVERHEAD		2	0		0	0	0		0 0	0	0	
b. COST OF MONEY   2   0													
c. GENERAL & ADMINISTRATIVE 2 10,451 9,504 11,028 -947 -1,524 33,970 33,974 -18   d. UNDISTRIBUTED BUDGET 2 6 6 6 6 0	b. COST OF MONEY		2	0		0	D	0		0 0	0	0	
d. UNDISTRIBUTED BUDGET   2   0   0   0   0     e. SUBTOTAL (Performance Measurement Baseline)   86.733   78.875   91.522   .7.858   .12.647   280.422   291.080   .1.52	c. GENERAL & ADMINISTRATIVE		2	10,451	9,	,504 1	1,028	-947	-1,5	24 33,790	33,974	-184	
e SUBTOTAL (Devtormance Measurement Baseline) 86 733 78 875 91 522 .7 858 .12 647 280 428 281 060 .1 52	d. UNDISTRIBUTED BUDGET							0	0	0			
C. SOBTATHE (Contramente mensuremente baserine) 00,000 10,000 01,022 1,000 112,041 200,400 201,000 11,02	e. SUBTOTAL (Performance Measurement B		86,733	78,	,875 9	1,522	-7,858	-12,6	47 280,438	281,960	-1,522		
f. MANAGEMENT RESERVE 2 11,982	f. MANAGEMENT RESERVE		2							11,982			
g. TOTAL 86,733 78,875 91,522 -7,858 -12,647 292,420	g. TOTAL			86,733	78,	,875 9	1,522	-7,858	-12,6	47 292,420			







BROOKHAVEN NATIONAL LABORATORY BROOKHAVEN SCIENCE

## **CBB vs. PMB Over Time**



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BROOKHAVEN NATIONAL LATOSTORY BROOKHAVEN SCIENCE

# **Monthly Data**

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	JAN 02	FEB 02	MAR 02	APR 02	MAY 02	JUN 02	JUL 02	AUG 02	SEP 02	OCT 02	NOV 02	DEC 02
BCWS	\$2,153	\$4,687	\$8,507	\$12,287	\$16,381	\$20,909	\$27,200	\$36,228	\$46,735	\$59,420	\$73,182	\$86,733
BCWP	\$1,845	\$4,347	\$7,032	\$9,929	\$13,735	\$18,060	\$24,045	\$32,428	\$41,147	\$52,558	\$65,671	\$78,875
ACWP	\$1,845	\$4,347	\$8,060	\$11,964	\$16,161	\$21,263	\$27,778	\$37,748	\$49,268	\$62,969	\$77,888	\$91,522
СВВ	\$228,900	\$228,900	\$241,992	\$262,151	\$271,323	\$294,393	\$292,420	\$292,420	\$292,420	\$292,420	\$292,420	\$292,420
PMB	\$208,071	\$208,071	\$219,992	\$238,319	\$246,657	\$271,042	\$269,068	\$269,068	\$269,068	\$269,068	\$269,068	\$280,438
EAC	\$208,071	\$208,071	\$223,326	\$243,323	\$249,990	\$273,102	\$274,883	\$276,983	\$281,600	\$283,388	\$283,438	\$281,960





### **EVMS Processes**







## **More Questions?**



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