

EVMS Processes Using Flow Diagrams and Visuals - Table of Contents

EVMS Official Definition	3
EVMS Principles	4
FNAL EVMS Procedures (System)	5
EVMS Responsibility	6
EVMS Elements/Gold Card	8
Project Life Cycle CD Model	10
FNAL EVMS Tools	11
EVMS 748 Standard (Five Categories)	17
**Category 1 - Organization	18
WBS (Work Breakdown Structure)	19
OBS (Organizational Breakdown Structure)	20
RAM (Responsibility Assignment Matrix)	21
Control Account	22
Baseline Traceable Data Flow	24
Work Authorization	25
**Category 2 - Planning, Scheduling, Budget	29
Burden Cost and Excalation	31
Scheduling Flowchart	32
Planning Package vs Work Package	34
Schedule Traceability: Vertical/Horizontal	35
Schedule Codes	36
Schedule Resources	39
Schedule Float and Critical Path	40
Schedule Contingency	43
Schedule Margin	44
PMT (Performance Measurement Technique)	45
Cost Estimate	48
Risk & Uncertainty Analysis	52
BOE (Basis of Estimate)	55
Contingency, MR & UB	59

**Category 3 - Accounting Considerations	60
Collecting Costs and Hours	61
Accruals	63
**Category 4 Analysis and Management Reports	69
Monthly Reporting Flowchart	70
Process Calendar	71
Monthly Process (Graphical in & outputs)	72
Update Schedule	74
CPR (Cost Performance Report)	75
Variance Analysis Thresholds	76
VAR (Variance Analysis Report)	77
Corrective Action Log	86
Management Reports	87
EAC - How to Calculate	89
EAC - Cobra Calculated PF=1	91
EAC - Manual Calc Using P6	93
**Category 5 - Revisions and Data Maintenance	95
Change Control Flowchart	96
Revisions and Data Maintenance via BCR	97
BCR Form	102
BCR Log	103
BCR Work Authorization	108

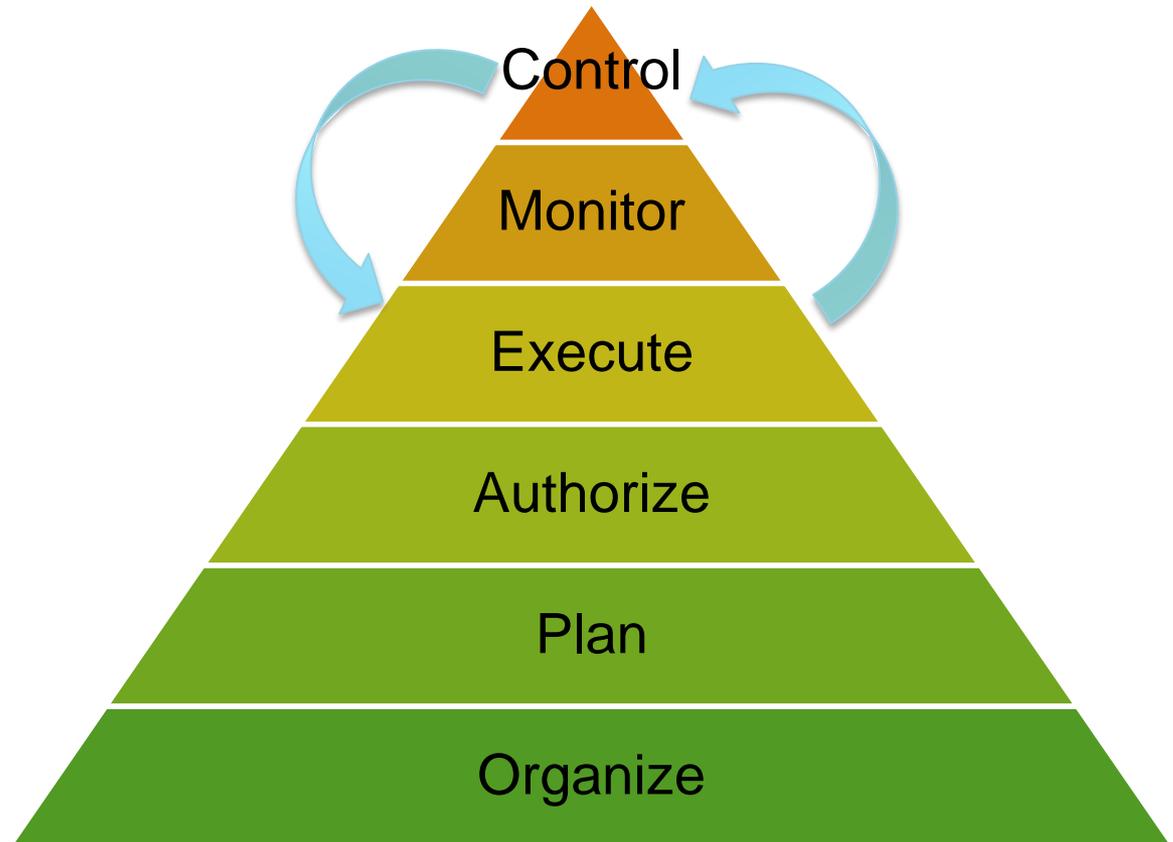
EVMS Official Definition

An Earned Value Management System (EVMS) is the overall methodology that organizations use to plan, manage, control, and analyze the **cost** and **schedule performance** of projects. It encompasses organizational policies, business processes, automation support, standards, and accountability for results.

ANSI-EIA Standard 748

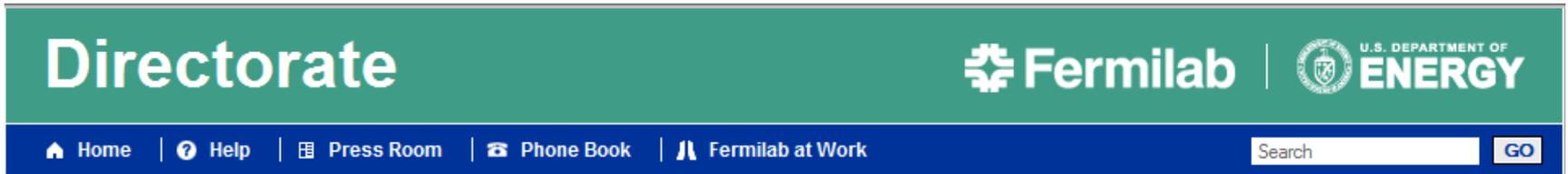
EVM Principles

- Organize
- Plan
- Authorize
- Execute
- Monitor
- Control



FNAL EVMS Procedures (System)

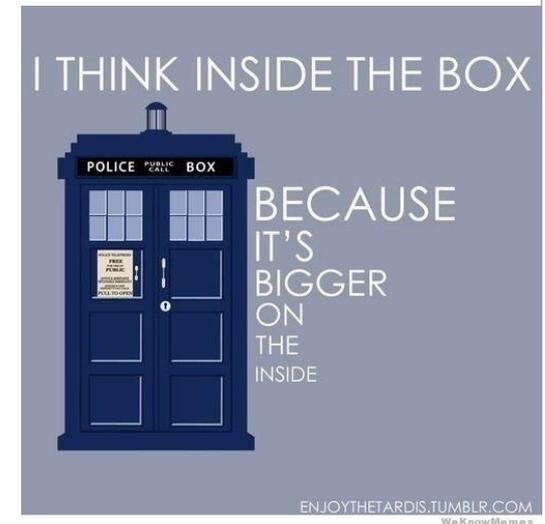
<http://www.fnal.gov/directorate/OPMO/PolProc/home.htm>



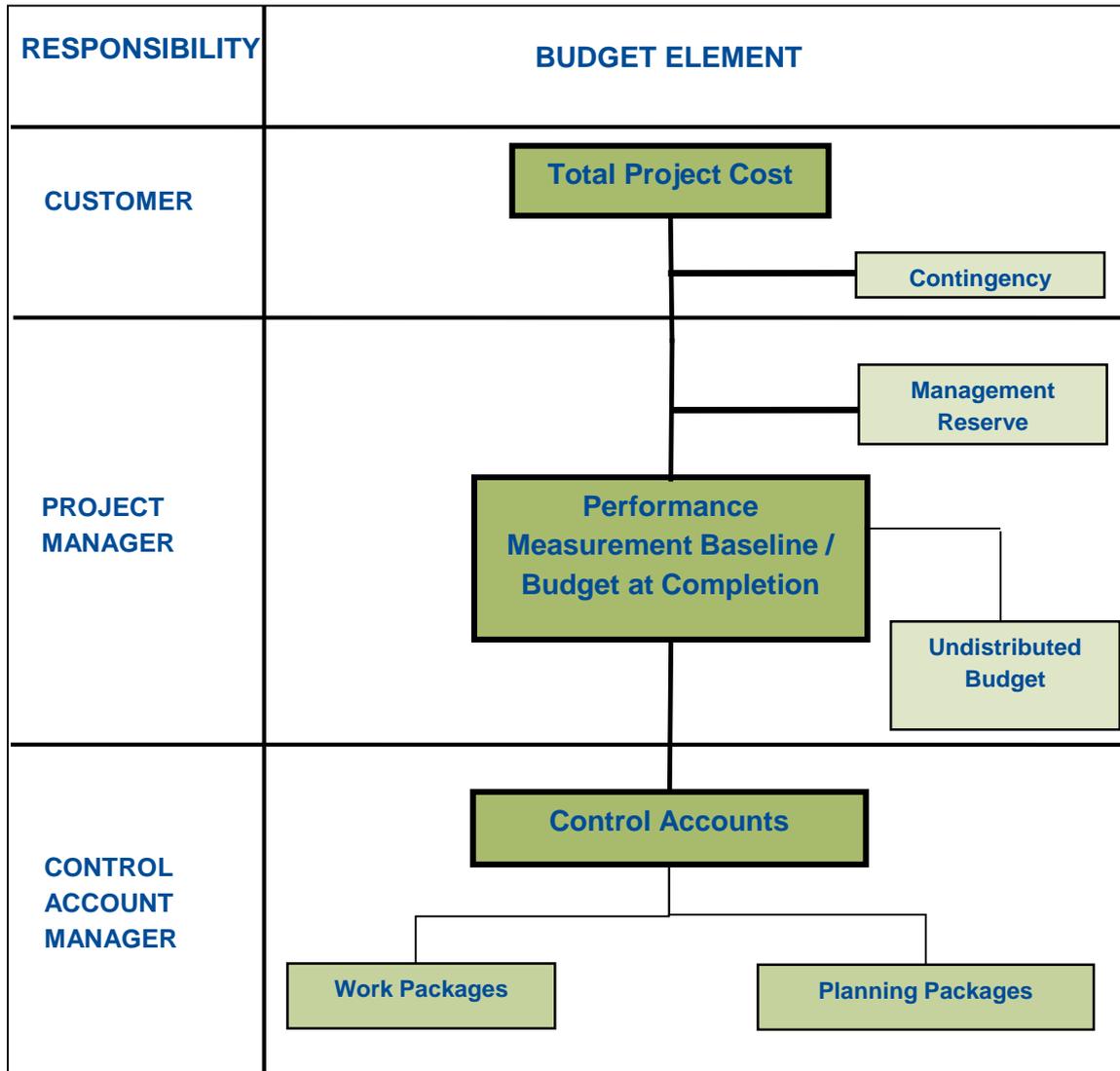
Directorate

Policies and Procedures

- Project WBS, OBS, RAM (12.PM-001)
- Control Accounts, Work Packages, Planning Packages (12.PM-002)
- Work Authorization (12.PM-003)
- Project Scheduling (12.PM-004)
- Cost Estimating (12.PM-005)
- Monthly Status Reporting (12.PM-006)
- Change Control (12.PM-007)
- EVMS Surveillance & Maintenance (12.PM-008)
- EVMS Description (12.PM-009)



EVMS Responsibility seen from 40,000 Feet



CAM Summary Responsibilities on Next Slide

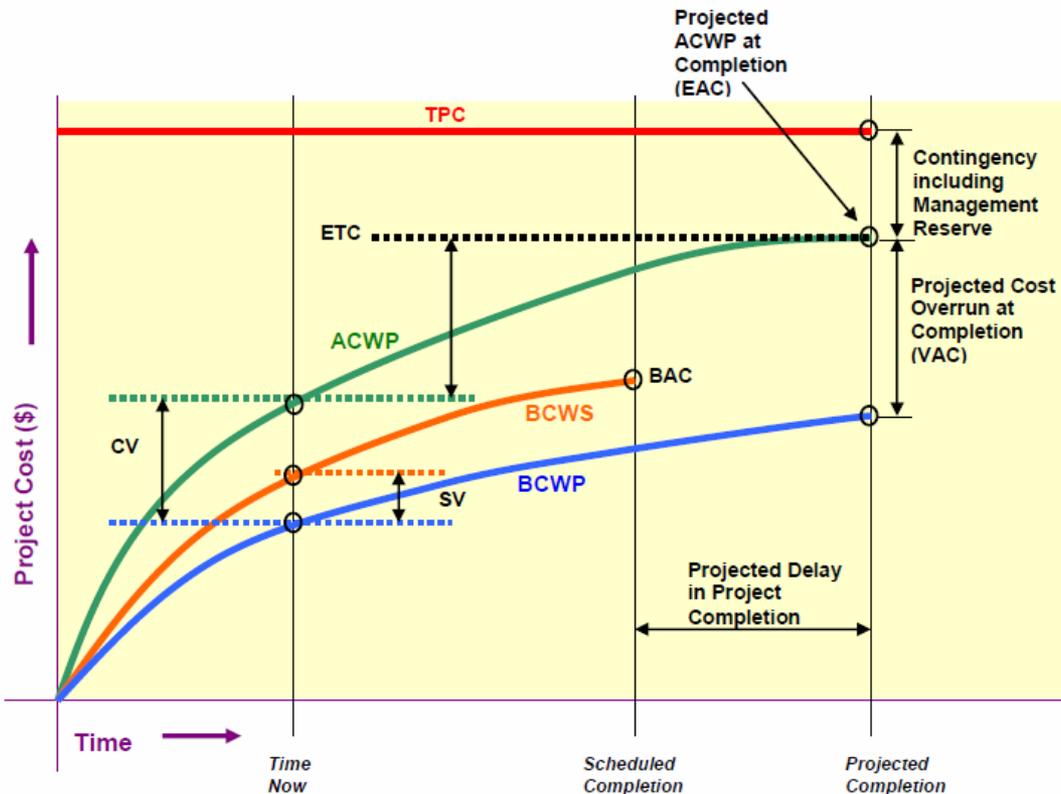
Control Account Manager (CAM) Responsibilities

High Level Overview of Responsibilities



- Oversight & Planning
- Establish Baseline Schedule
- Establish Baseline Budget
- Execution of Work Scope
- Manage Risk
- Monitor and Analyze
- Control Scope Creep
- Report and Communicate

EVMS Elements



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

Performance Formulas

$$CV = BCWP - ACWP$$

$$SV = BCWP - BCWS$$

$$CPI = BCWP / ACWP$$

$$SPI = BCWP / BCWS$$

$$VAC = BAC - EAC$$

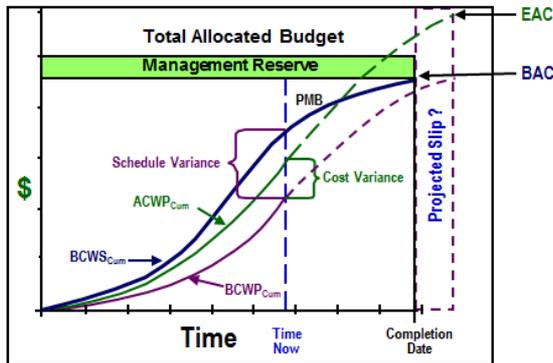
Overall Status

$$\text{Percent Complete} = BCWP_{CUM} / BAC$$

$$\text{Percent Spent} = ACWP_{CUM} / BAC \text{ (OR EAC)}$$

EVM Gold Card – EVMS Terminology/Definitions

DAU EARNED VALUE MANAGEMENT ‘GOLD CARD’



VARIANCES Positive is Favorable, Negative is Unfavorable	OVERALL STATUS
Cost Variance $CV = BCWP - ACWP$	% Schedule $= (BCWS_{CUM} / BAC) * 100$
Schedule Variance $SV = BCWP - BCWS$	% Complete $= (BCWP_{CUM} / BAC) * 100$
Variance at Completion $VAC = BAC - EAC$	% Spent $= (ACWP_{CUM} / BAC) * 100$
	$VAC \% = (VAC / BAC) * 100$

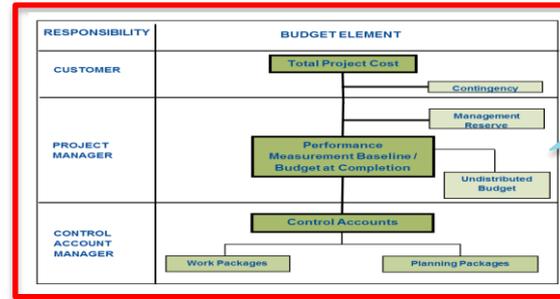
EFFICIENCIES	
Cost Efficiency $CPI = BCWP / ACWP$	Favorable is > 1.0, Unfavorable is < 1.0
Schedule Efficiency $SPI = BCWP / BCWS$	Favorable is > 1.0, Unfavorable is < 1.0

BASELINE EXECUTION INDEX (BEI) & Hit Task %
 $BEI = \text{Total Tasks Completed} / (\text{Total Tasks with Baseline Finish On or Prior to Current Report Period})$
 $\text{Hit Task \%} = 100 * (\text{Tasks Completed ON or PRIOR to Baseline Finish} / \text{Tasks Baselined to Finish within Current Report Period})$

ESTIMATE@ COMPLETION = ACTUALS TO DATE + [(REMAINING WORK) / (PERFORMANCE FACTOR)]
 $EAC_{CPI} = ACWP_{CUM} + [(BAC - BCWP_{CUM}) / CPI_{CUM}]$
 $EAC_{Composite} = ACWP_{CUM} + [(BAC - BCWP_{CUM}) / (CPI_{CUM} * SPI_{CUM})]$

TO COMPLETE PERFORMANCE INDEX (TCPI) #
 $TCPI_{Target} = \text{Work Remaining} / \text{Cost Remaining} = (BAC - BCWP_{CUM}) / (Target - ACWP_{CUM})$

To Determine the TCPI for BAC, LRE, or EAC Substitute TARGET with BAC, LRE, or EAC
 # To Determine the Contract Level TCPI for EAC, You May Replace BAC with TAB



This block has been modified to better Represent FNAL

ACRONYMS

ACWP Actual Cost of Work Performed	Cost actually incurred in accomplishing work performed	= ACTUAL COST
AUW Authorized Unpriced Work	Work contractually approved, but not yet negotiated / defined	
BAC Budget At Completion	Total budget for total contract thru any given level	
BCWP Budgeted Cost of Work Performed	Value of completed work in terms of the work's assigned budget	= EARNED VALUE
BCWS Budgeted Cost of Work Scheduled	Time-phased Budget Plan for work currently scheduled	= PLANNED VALUE
CA Control Account	Lowest CWBS element assigned to a single focal point to plan & control scope / schedule / budget	
CBB Contract Budget Base	Sum of NCC & AUW	
EAC Estimate At Completion	Estimate of total Cost for total contract thru any given level generated by Ktr, PMO, DCMA, etc. = $EAC_{Ktr} / PMO / DCMA$	
LRE Latest Revised Estimate	Ktr's EAC or EAC_{Ktr}	
MR Management Reserve	Budget withheld by Ktr/PM for unknowns / risk management	
NCC Negotiated Contract Cost	Contract Price Minus profit or fee(s)	
OTB Over Target Baseline	Sum of CBB + additional budget approved for remaining work	
PAC Price At Completion	EAC Plus Adjusted Profit or Fee(s)	
PMB Performance Measurement Baseline	Contract time-phased budget plan	
PP Planning Package	Far-term CA activities not yet defined into WPs	
SLPP Summary Level Planning Package	Far-term contract activities not yet defined into CAs	
TAB Total Allocated Budget	Sum of all budgets for work on contract = NCC, CBB, or OTB	
TCPI To Complete Performance Index	Efficiency needed from 'time now' to achieve a Cost Target = BAC, LRE, or EAC	
UB Undistributed Budget	Broadly defined activities not yet distributed to CAs or SLPPs	
WP Work Package	Near-term, detail-planned activities within a CA	

EVM POLICY: Interim DoDI 5000.02, Enclosure 1, Table 8.

EVMS in accordance with ANSI/EIA-748 is required for cost or incentive contracts, subcontracts, intra-government work agreements, & other agreements valued $\geq \$20M$ (TY\$). Contracts $\geq \$50M$ (TY\$) require that the EVMS be formally validated by the cognizant contracting officer.
 EVM is discouraged on Firm-Fixed Price, Time & Material Contracts, & LOE activities regardless of cost.
 Refer to the IPMR Implementation Guide for IPMR Tailoring Guidance.

DoD's EVM CONTRACTING REQUIREMENTS:

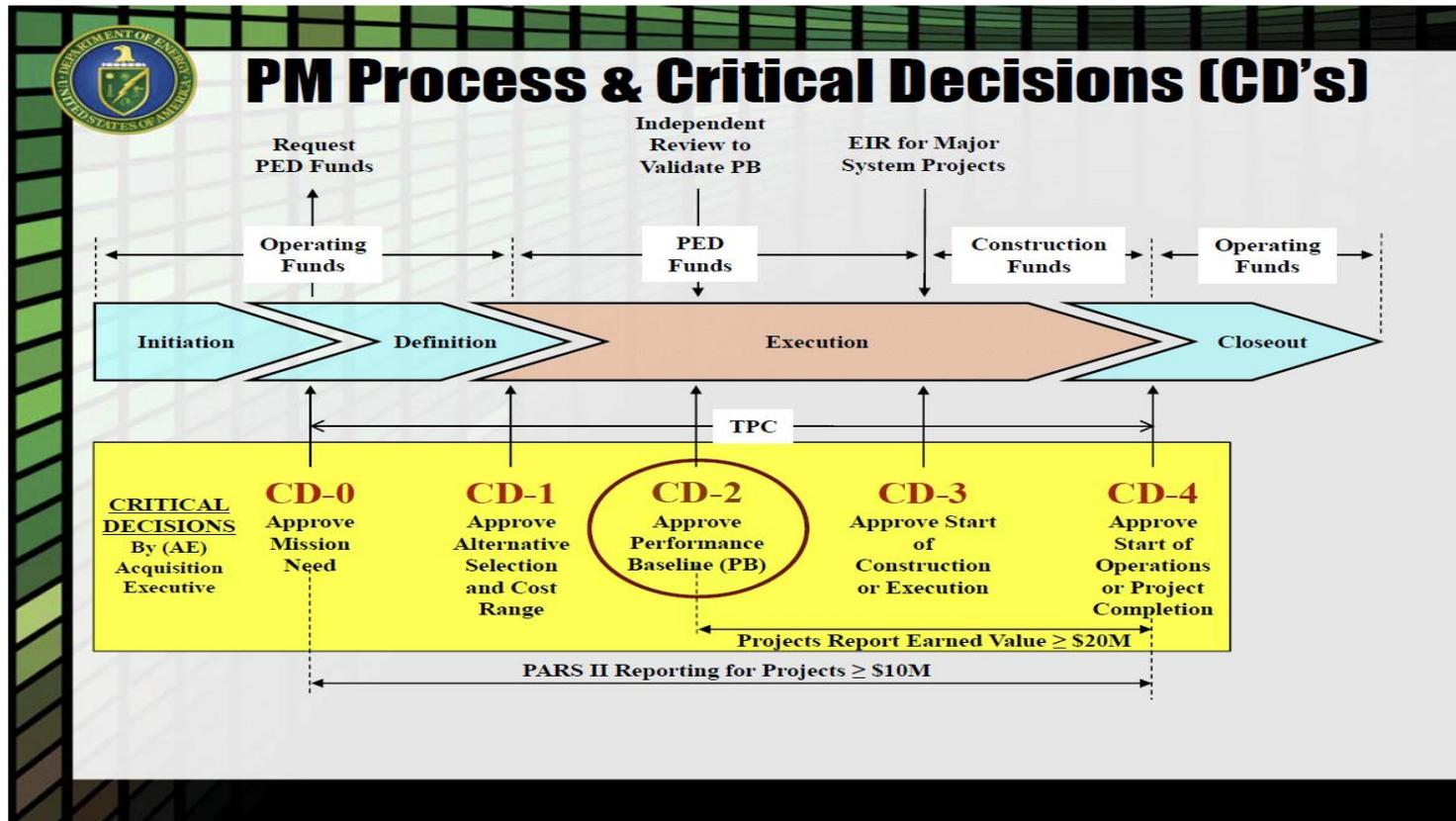
DFARS CLAUSES	252.234-7001 "NOTICE OF EVMS" FOR SOLICITATIONS
	252.234-7002 "EVMS" FOR SOLICITATIONS & CONTRACTS
	252.242-7005 "CONTRACTOR BUSINESS SYSTEMS" FOR SOLICITATIONS & CONTRACTS
CONTRACT PERFORMANCE REPORT DI-MGMT-81466A	5 FORMATS = WBS, ORGANIZATION, BASELINE, STAFFING, EXPLANATIONS & PROB ANALYSIS
INTEGRATED MASTER SCHEDULE DI-MGMT-81650	MANDATORY FOR DoD EVMS CONTRACTS
Integrated Program Mngt Report DI-MGMT-81861	7 FORMATS = WBS, CBS / IPT, BASELINE, STAFFING, EXPLANATIONS & PROB ANALYSIS, IMS, HISTORY / FORECAST COST

INTEGRATED BASELINE REVIEW MANDATORY FOR ALL EVMS CONTRACTS
WBS For Defense Materiel Items MIL-STD-881-C

* Combines & Supersedes DI-MGMT-81466A & 81650; Effective July 1, 2012

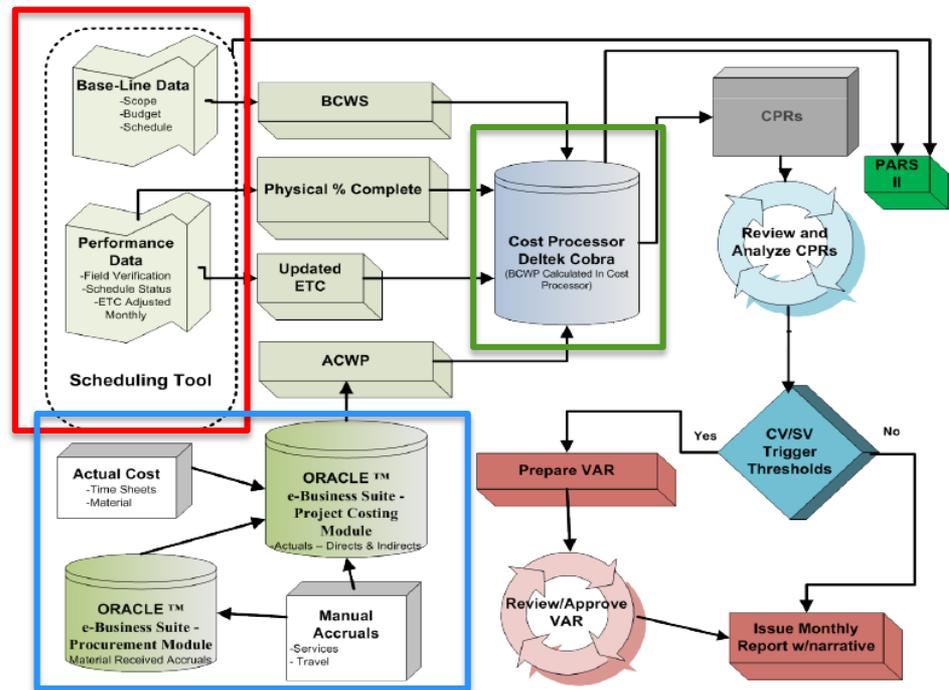
EVM CoP: <https://acc.dau.mil/evm>
 eMail Address: EVM.dau@dau.mil
 Revised January 2014

Project Life Cycle – Models



EVMS Tools

- CAMs are **not** expected to be experts at tools used in our EVMS. However, they must know how they are used to control their accounts.
- Four primary data tools
 1. Primavera P6
 2. Excel/MS Word
 3. Accounting DB
 4. Cobra
- Three reporting tools
 1. Cobra
 2. P6
 3. Excel



Next 5 Slides Describe Tool Details

FNAL Data Tools - Primavera P6

- Scheduling tool
 - Performance dates
 - Critical path
 - Schedule or time constraint analysis
 - Schedule reports
- Used to feed Cobra
 - Planned & Actual Dates
 - Resource assignments
 - Some code information
- Not used for
 - Official budget information (pass through only)
 - Actual cost information
 - Forecast information

FNAL Data Tools – Excel or MS Word

- Used for
 - Documentation of Basis of Estimates
 - Secondary reporting
 - Graphs/Charts
 - Preliminary data analysis
 - Registers or logs
 - Intermediary status tool
- Not used for
 - Primary reporting
 - Project scheduling

FNAL Data Tools – Accounting DB

- Used for
 - Actual cost data
 - Actual Cost
 - Actual Hours
 - Accruals
 - Validate actual Cobra data
- Not used for
 - Earned value management

Change Control

- After Baseline is established
 - All changes to Plan are prohibited without proper authority and documentation
 - Never change history
- Reason to change baseline includes
 - Scope changes
 - Schedule changes
 - Unforeseen Risk Mitigation
 - Manage Control Account (changes from Plan...Future)
- Baseline does not change for
 - Past Inadequate planning
 - Past Poor estimates
 - Performance variations (good/bad)

FNAL Data Tools – Cobra

- Used for
 - PMB data control
 - Retaining all historical and current EVM data
 - BCWS
 - BCWP
 - ACWP
 - PMT and Other EVM required coding
 - Forecasting
 - Performance and cost reporting
 - Primary EVM data reporting
 - Variance analysis and reporting
- Not used for
 - Scheduling
 - Logs and registers

EVM ANSI 748 Standard (Five Categories)

- Industry-wide standard for EVMS – ANSI 748
 - Organized into five categories containing 32 Criteria
 - Organization - *5 criteria*
 - Planning, Scheduling, and Budgeting - *10 criteria*
 - Accounting Considerations - *6 criteria*
 - Analysis and Management Reports - *6 criteria*
 - Revisions and Data Maintenance - *5 criteria*



National Defense Industrial Association
Integrated Program Management Division

Earned Value Management Systems
ANSI/EIA-748-C Intent Guide

April 29 2014

National Defense Industrial Association (NDIA)
2111 Wilson Blvd., Suite 400
Arlington, VA 22201
(703) 522-1820
Fax (703) 522-1885
www.ndia.org

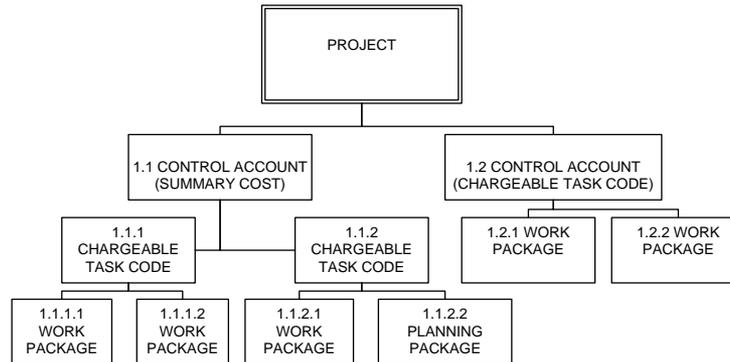
© 2014 National Defense Industrial Association, Integrated Program Management Division (IPMD)
Permission to copy and distribute this document is hereby granted provided that this notice is retained on all copies, that copies are not altered, and that the NDIA IPMD is credited when the material is used to form other copyrighted documents.
The ANSI/EIA-748-C guidelines shaded in grey within this document are reprinted with permission. The guidelines were excerpted from the ANSI/EIA-748-C Standard and are the copyright of TechAmerica. All rights reserved. For a complete copy of ANSI/EIA-748-C Standard, go to <http://webstore.ansi.org>.

EVM Cat 1 – Organization (GL1-5)

1. Define Work Scope (WBS)
2. Define Project Organization (OBS)
3. Integrate Processes
4. Identify Overhead Management
5. Integrate WBS/OBS to Create Control Accounts

Work Breakdown Structure & Dictionary -Example (12.PM-001)

What



Appendix C

EXAMPLE OF WBS AND DICTIONARY (OUTLINE FORMAT)

This example is a representation of part of the LBNE WBS. WBS elements 130.01 through 130.05 are only shown to WBS level 2. WBS element 130.06 has been expanded to WBS level 5 to show additional detail in this area.

WBS Element #	WBS Element Name	WBS Description
130	LBNE	LBNE project will construct a 700-kW beamline and Muon detector on the FNAL site and build a large surface liquid argon detector with associated cryogenics system as a far detector at Sanford Underground Research Facility in South Dakota, all with required conventional facilities.
130.01	Project Office	Staff labor assembled in the Project Office, who administer and manage activities that encompass the entire project, such as liaison with DOE and Laboratory management, project management, reporting, regulatory compliance, quality assurance, risk, budget, document management, safety, project controls, etc. Also included is M&S and travel to support the staff and the office functions, as well as M&S for project-wide activities such as contracting for the NEPA process
130.02	Beamline	Includes all phases of design, procurement, construction, installation, commissioning, and testing of the LBNE Beamline at Fermilab. The conventional, horn-focused neutrino beam shall be of sufficient intensity and appropriate energy to meet the goals of the LBNE project with respect to Long-Baseline neutrino-oscillation physics
130.03	Near Detector Systems	Includes management, systems engineering and integration support, design, procurement, installation and testing, and commissioning of the Near Detector Complex.
130.04	Water Cherenkov Detector - Conceptual Design	Conceptual design of a Water Cherenkov Detector (WCD) in an underground cavern at a site ~1300 km from Fermilab
130.06	Conventional Facilities	Includes all phases of design, procurement, installation and construction of facility improvements necessary to support the projects technical components including the Beamline and Far Detector. This includes all site improvements, tunnels, halls, service buildings and caverns at Fermilab and the Far Site

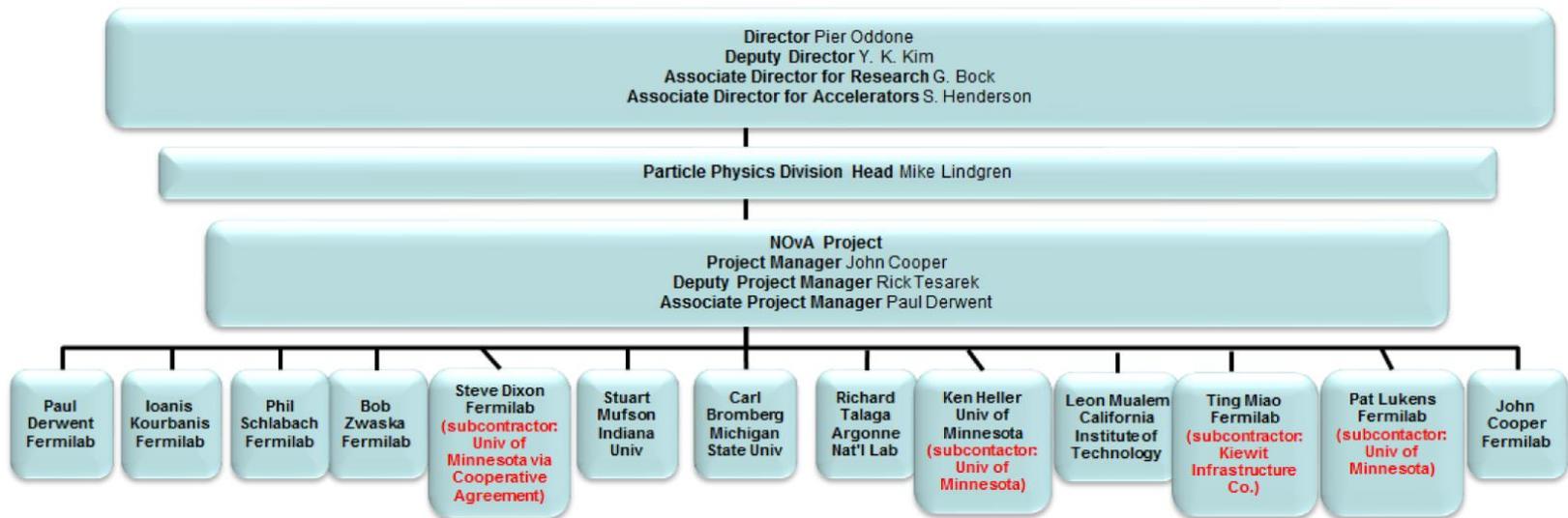
WBS related to EVMS Guidelines
1, 3, 5, 17, 18, 19 & 25

Organizational Breakdown Structure -Example (12.PM-001)

Who

Appendix D EXAMPLE OF OBS

This example OBS shows an organizational structure from the Fermilab Directorate to the project's control account managers and supervisory staff.



OBS Related to EVMS Guidelines 2, 3, 5, 6, 9

Responsibility Assignment Matrix – RAM (12.PM-001)

Who & What

USCMS Upgrade Project Responsibility Assignment Matrix (RAM)

December 2015			Control Account Managers									Total BAC	Total Remaining BCWS	
Note: Shown in Dollars			16263N Nahn, Steve	06318V Heintz, Ulrich	15111N Hirschauer , James F	09291V Kubota, Yuichi	04888V Johns, Will	10711N Cheung, Harry	14304N Verzocchi, Marco	12345V Ecklund, Karl	00515V Smith, Wesley H.			07889 Rumerio, Paolo
Control Account	% Complete	%LOE	BAC											
401.01 Project Management In-progress	51%	100%	6,140,944										6,140,944	3,003,262
401.02.02 HCAL Management In-progress	50%	100%										338,924	338,924	169,823
401.02.03 HF Front-End In-progress	93%	0%		1,980,261									1,980,261	141,461
401.02.04 HB/HE Front-End In-progress	34%	3%			9,377,908								9,377,908	6,221,948
401.02.05 HCAL Back End In-progress	83%	3%				1,556,463							1,556,463	269,229
401.03.02 FPIX Management In-progress	71%	71%					433,760						433,760	125,275
401.03.03.01 Components - Module In-progress	56%	0%												
401.03.03.02 Components - Electronics In-progress	75%	10%												
401.03.03.03 Components - Mechanical Structures & Cooling In-progress	87%	0%												
401.03.04 Assembly & Testing In-progress	38%	23%												
401.03.05 Pilot System In-progress	100%	35%												
401.04.02 Trigger Management In-progress	65%	100%												
401.04.03 MUON Trigger In-progress	64%	20%												
401.04.04 Calorimeter Trigger In-progress	77%	23%												
Grand Total	59%	25%	6,140,944	1,980,261	9,377,908	1,556,463	433,760	9						

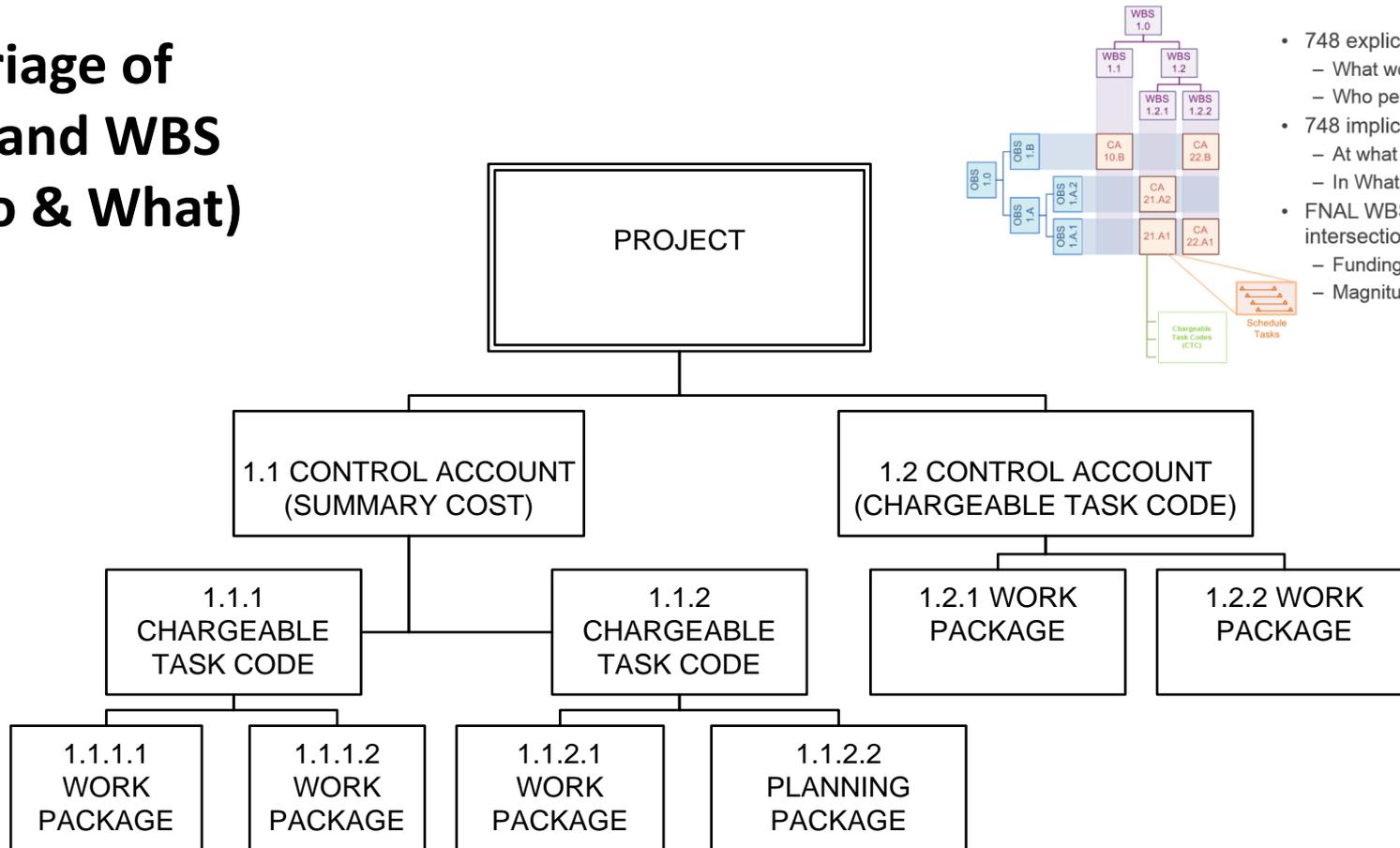
Utility Upgrade Project Responsibility Assignment Matrix (RAM)

April, 2015 Current Data	Control Account Manager			Grand Total
	Aiber, Russell J	Wielgos, Randal J	Fedorowicz, Charles A	
600.01 Project Management				
BAC	2,737,948	-	-	2,737,948
% Complete	26%	-	-	26%
%LOE	100%	-	-	100%
600.02 High-Voltage Electrical Upgrade				
BAC	-	13,518,896	-	13,518,896
% Complete	-	10%	-	10%
%LOE	-	19%	-	19%
600.03 Industrial Cooling Water Upgrade				
BAC	-	-	14,015,128	14,015,128
% Complete	-	-	12%	12%
%LOE	-	-	16%	16%
600.04 Other Project Costs (OPC)				
BAC	-	-	1,100,000	1,100,000
% Complete	-	-	68%	68%
%LOE	-	-	68%	68%
Total BAC	2,737,948	13,518,896	15,115,128	31,371,972
Total % Complete	26%	10%	16%	14%
Total %LOE	100%	19%	20%	26%

RAM Related to EVMS Guidelines 2, 3, 5, 9 & 18

Control Account (Key Element Touched by All Procedures)

Marriage of OBS and WBS (Who & What)

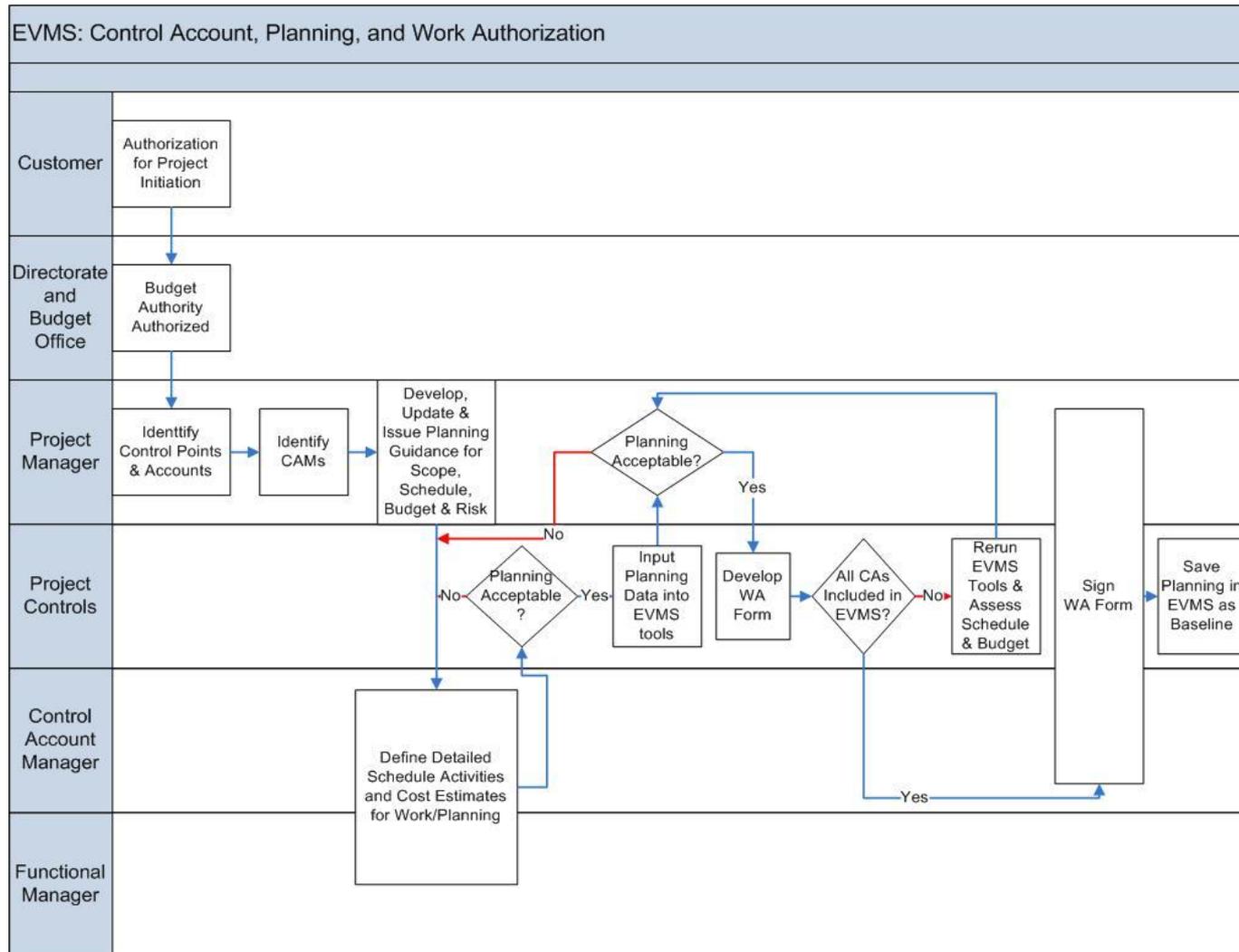


- 748 explicit definition CAs
 - What work (WBS)
 - Who performs (OBS)
- 748 implicit definition CAs
 - At what Cost (CTC)
 - In What Time (Schedule)
- FNAL WBS/OBS intersection considerations
 - Funding (who)
 - Magnitude

Further Details Next 2 Slides (Planning & Authorization Flow chart and Data Flow)

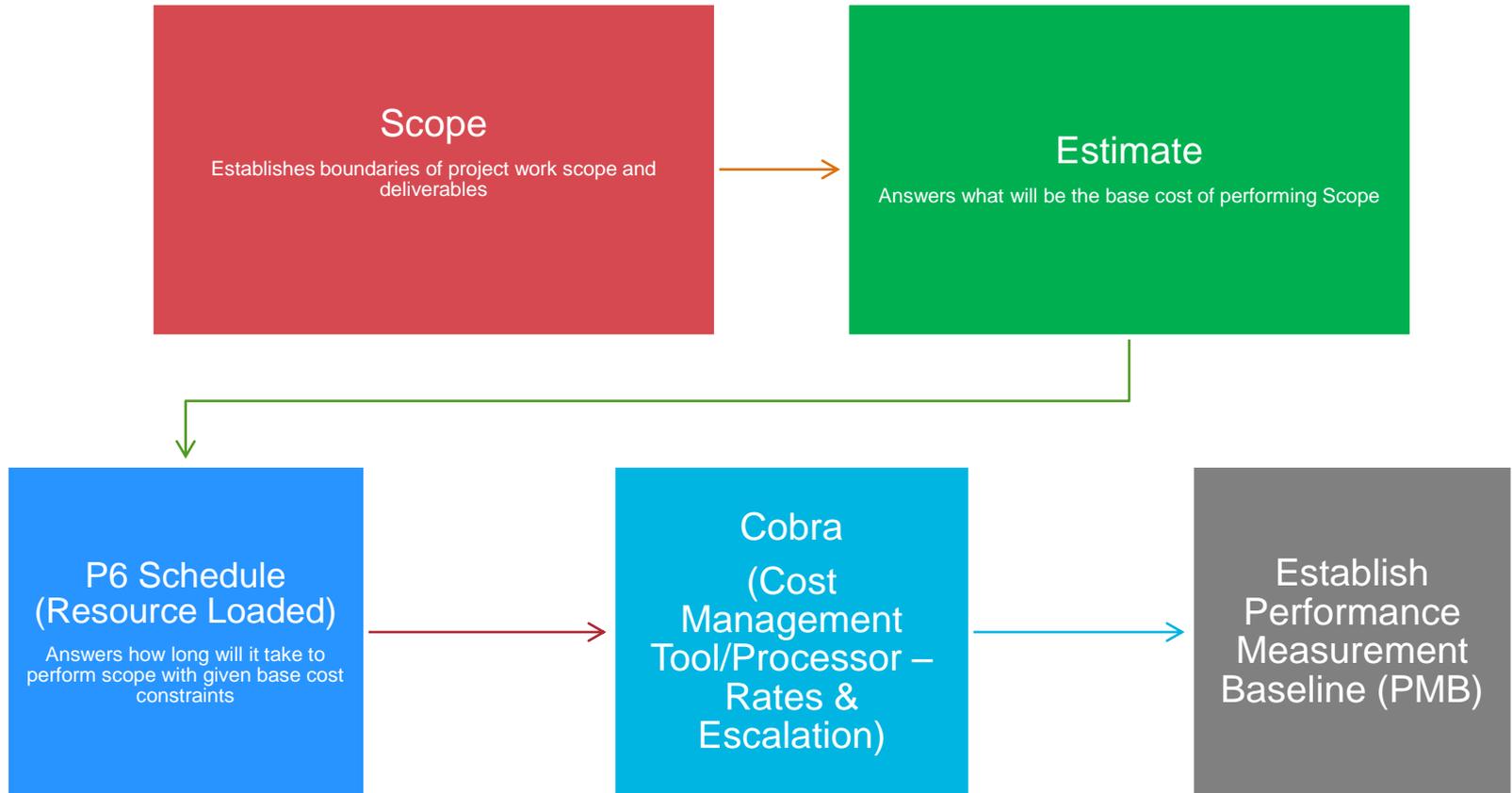
CA Related to most EVMS Guidelines as it relates to RAM, Schedule, WBS, WAD, Etc.

Control Account, Planning, and Authorization Flowchart



Establish Baseline – Data Flow Traceability

- Data Flow build on Foundation built by WBS, OBS, RAM
- Control Account is Key Control Point



Work Authorization Document – Example (12.PM-003)

Work Authorization Document

Control Account Manager: Ray, Ron

Control Account: 475.01.02

Control Account Description: Project Office Conceptual Design (Post CD-0: OPC)

Work Scope:

Provide labor resources during the conceptual design phase for Project Management, Project Engineering, Project Controls, Finance, ES&H and simulations infrastructure. Most of the labor is in the form of Level-of-Effort and is based on assigned personnel and estimated effort. Activities are divided up by funding type and fiscal year. Provide funds for support of guest scientists, for Project Office staff travel, training and equipment.

WAD after BCR shows how CA is effected by BCR

Period of Performance			
Start:	11/25/2009	Finish:	1/30/2015

Budget Detail	HOURS	DIRECT	BAC
Funding Type DOE.HEP.OPC	30,547.85	3,043,378.73	4,950,582.83
Labor	23,012.36	1,265,111.43	2,986,489.71
Material	0.00	876,364.94	892,248.73
Non-Fermi Labor	7,535.49	901,902.36	1,071,844.40
Total Budget:	30,547.85	3,043,378.73	4,950,582.83

Authorization Signatures	
CAM:	Date:
Project Manager:	Date:

Work Authorization Document			
Control Account:	Hays, Steven L		
Control Account:	475.04.06		
Control Account Description:	Magnet Power System		
Period of Performance			
Start:	1/2/2013	Finish:	10/16/2018
WAD Scope			
BCRF 004 Cost leveling; new CD-3c strategy_impact: Cost \$19,039 & Sched Days 0			
This includes design, analysis, procurement, assembly, acceptance testing, installation, commissioning and close-out activities for the magnet power system. The magnet power system includes the power supplies, the dump switch, and the dump resistor.			
Budget			
Funding Type DOE.HEP.LNI.CNSTR	HOURS	DIRECT	BAC
Labor	2,201.00	784,946.33	1,159,471.82
Material	0.00	690,468.00	883,794.62
Funding Type DOE.HEP.LNI.PED	2,582.95	78,361.73	330,113.86
Labor	2,582.95	53,810.65	305,562.78
Material	0.00	24,551.08	24,551.08
Total Budget:	4,783.95	863,308.06	1,489,585.68
Authorization Signatures			
CAM:	Date:		
Project Manager:	Date:		

WAD Related to EVMS Guidelines 3, 6, 8 & 29

WAD Attachments Examples: Schedule & CAP



Control Account Plan

Control Account Manager	Control Account	Point Type	CA Start	CA Finish	CA Type	WAD	Resource Type	2014	2015	2016	2017	Budget Total	
Control Account Manager	600-00 Program Management	000	3/23/2014	1/1/2016	CNC	WAD	Labor	100.00	47.87			100.00	
								30.00				30.00	
								140.00				140.00	
								34.00	37.87	17.00	36.83	107.87	
								300.00	47.87	34.00	37.87	36.83	307.87
								300.00				300.00	
								300.00				300.00	
								300.00				300.00	
								300.00				300.00	
								300.00				300.00	
								300.00				300.00	
								300.00				300.00	
								300.00				300.00	
								300.00				300.00	
								300.00				300.00	

- WAD information is incomplete without these attachments
- Procedure outlines required fields for these reports



EVM Cat 2 – Planning, Scheduling, and Budgeting (GL6-15)

6. Schedule with Network Logic
7. Set Measurement Indicators
8. Establish Budgets for Authorized Work
9. Budget by Cost Elements
10. Create Work Packages, Planning Packages

EVM Cat 2 – Planning, Scheduling, and Budgeting (GL6-15)

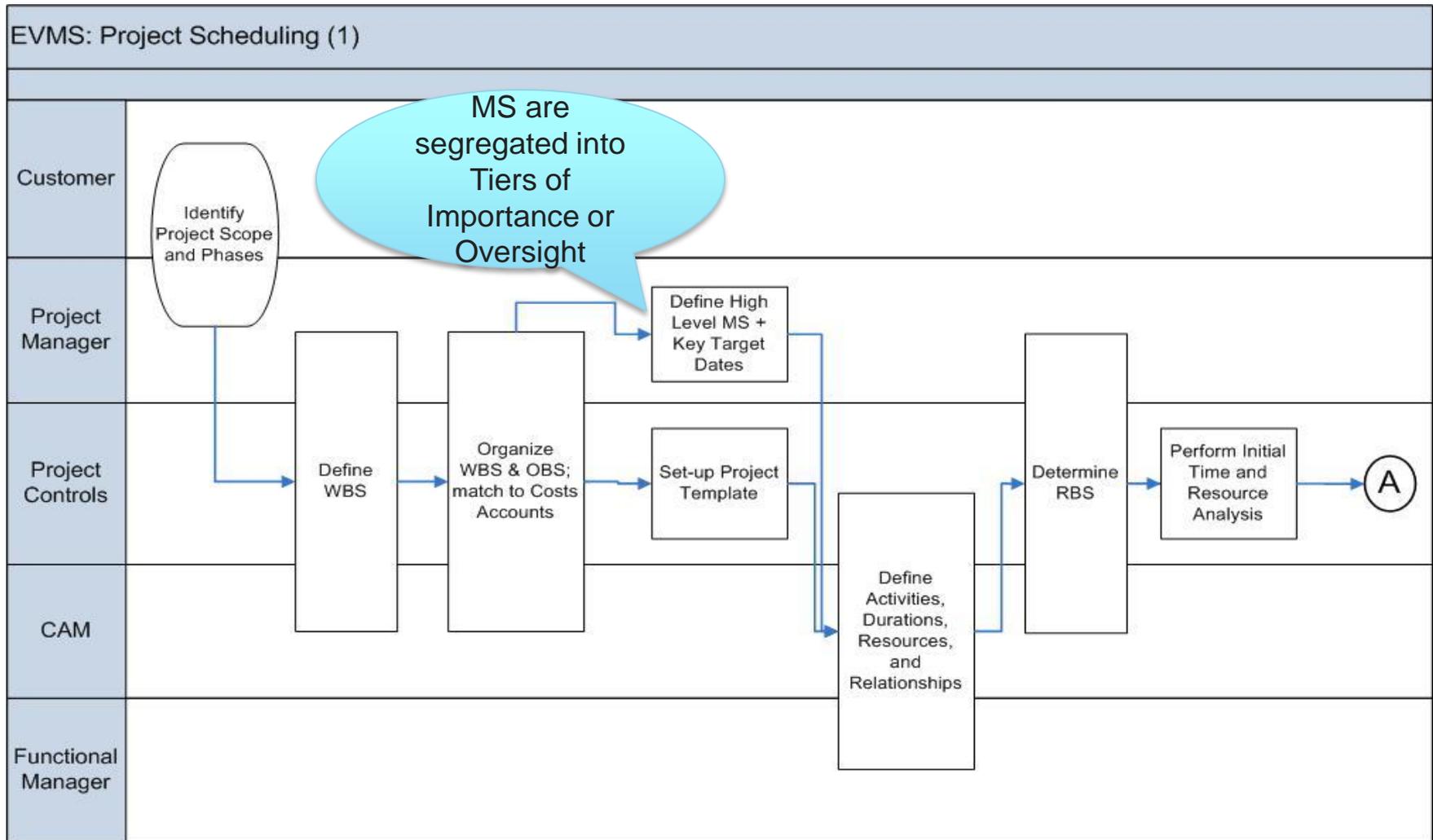
11. Sum Detail Budgets to Control Account
12. LOE Planning and Control
13. Establish Overhead Budgets
14. Identify Management Reserve and Undistributed Budget
15. Reconcile to Target Cost Goal

Burden Cost and Escalation

	FY15	FY16	FY17	FY18	FY19	FY20	FY21
Labor	2.9%	3.0%	3.2%	3.3%	3.4%	3.5%	3.6%
M&S	1.7%	1.9%	1.9%	1.9%	2.0%	2.0%	2.0%

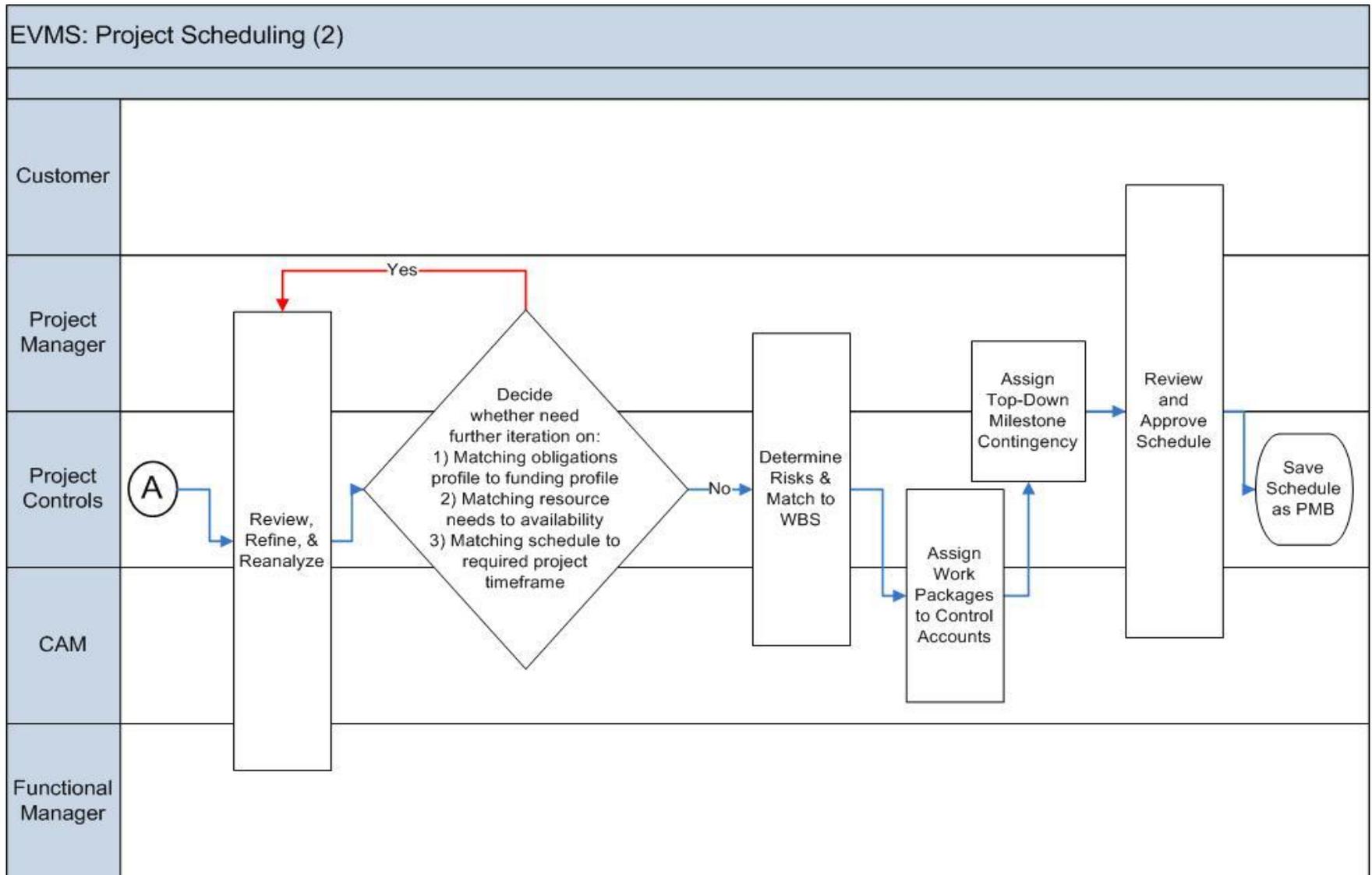
- FNAL Budget Office Develops and Determines
 - Escalation Rates
 - Indirect Rates
- The Accounting Department is responsible for developing Labor Burdens to be incorporated in Rates
- Rates are Communicates to OPSS to incorporate into systems
 - Input into FNALs Cost Processor (Cobra) Rate Tables
 - Rate Table Changes are Communicated to Projects for Incorporation and Result in Processed of BCRs

Scheduling Flowchart (12.PM-002)

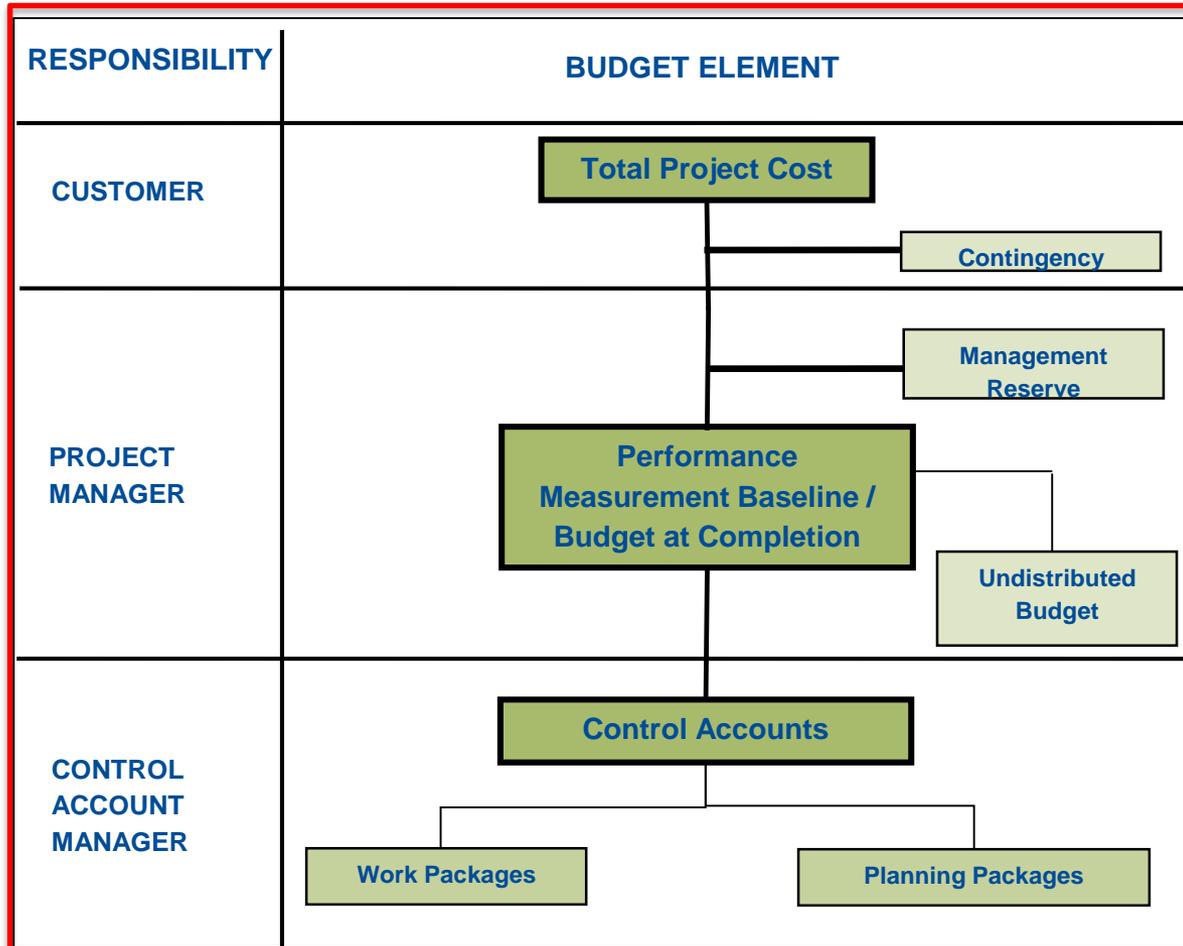


Schedule Related to EVMS Guidelines 3, 5, 6, 7, 8, 10, 11, 12, 15, 22, 23 & 28

Scheduling Flowchart (Cont.)

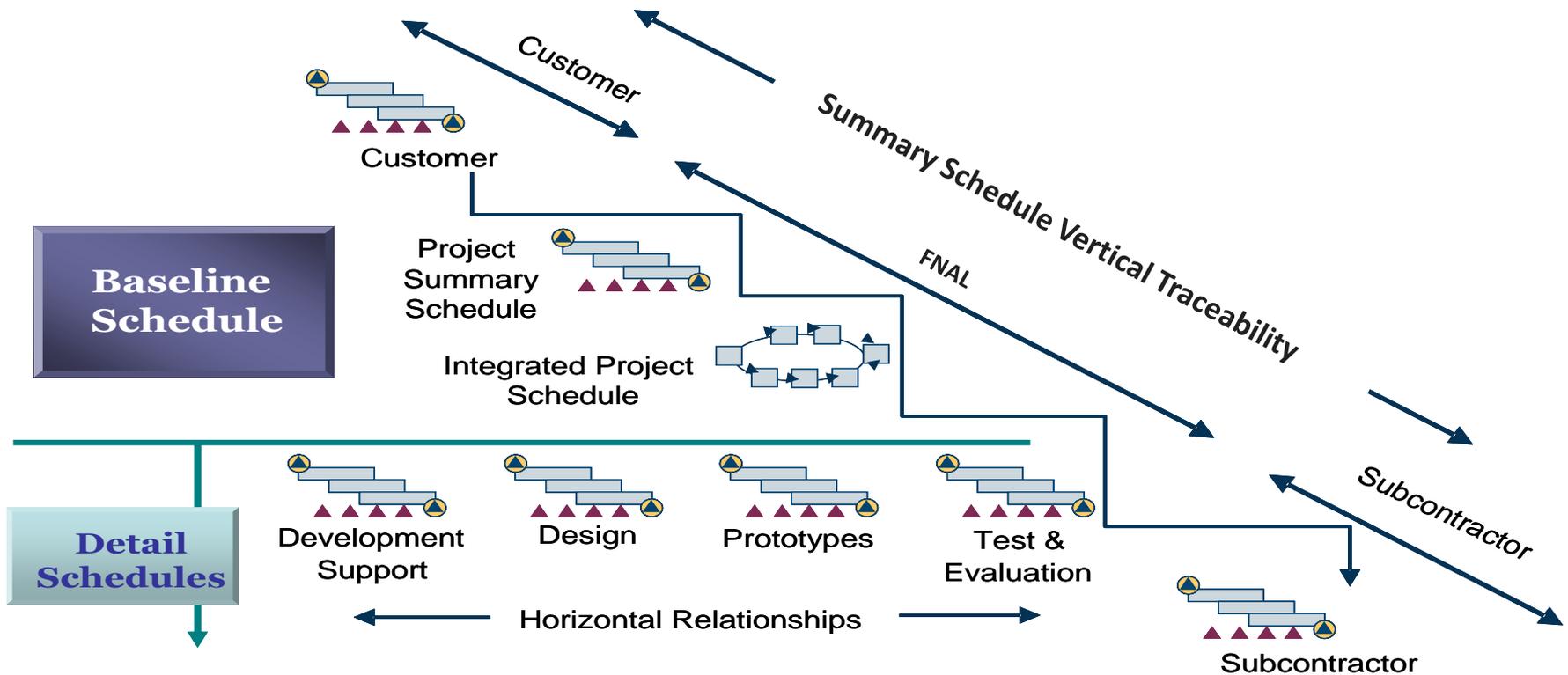


Planning Package Vs Work Package



- Less defined
- Higher Estimate Uncertainty
- Converted to WP prior to 1 Month before working
- Longer Duration

Schedule Traceability: Vertical & Horizontal



- Vertical traceability ensures that external schedules and dependencies, including the client and subcontractor, are in sync the project schedule
- Horizontal traceability ensures project interdependencies and scope, including control accounts, work packages, and planning packages are accounted for

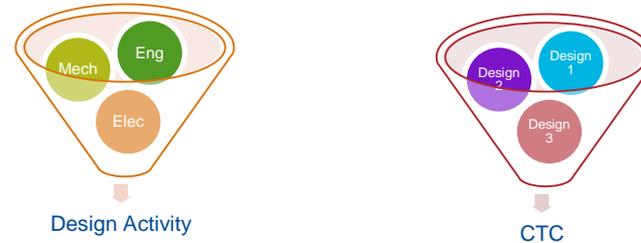
Project Scheduling Key Codes

- Needed for Cobra Integration
 - Cobra PMT Code (Performance Measurement Technique)
 - Chargeable Task Code (CTC)
 - Control Account (CA)
 - Funding Type
 - Agency-Funded Laboratory
 - Responsible & Performing Institutions
 - Cost Classes
- Needed for Reports
 - Control Account Manager
 - Responsible Person
 - ETC.

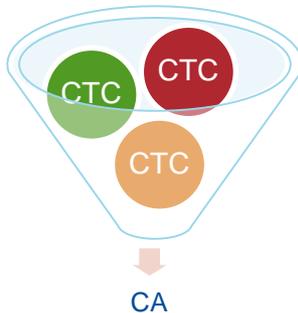
General	Status	Resources	Codes	Predecessors	Successors	Notebook	Steps	Relationsh
			Activity	2253.501				
Activity Code	Code Value	Description						
Agency-Funded Laboratory	FN	Fermi National Accelerator Laboratory						
Chargeable Task Code	476.A306	2.2.5 Dump - IP						
Cobra PMT Code	K	Planning Package						
Control Account	476.02.02	Target Station						
Control Account Manager	08969N	Still, Dean						
Cost Class 1	MC	BCWS - M&S						
Cost Class 2	CM	Contingency M&S						
Cost Class 3	FMC	Forecast PO						
EDIA Reporting Category	C/F	Construction & Fabrication: Bldg, land, E						
Funding Type	DOE.HEP.MIE	DOE-High Energy Physics-funded Major						
Project Phase/Operational State	3	Construction (Post CD-3)						
Responsible Person	08969	Still, Dean						
Cost Class 4	FCM	Forecast contingency material						

Defining Other Required Key Codes

- Chargeable Task Code (CTC)
 - Collection of Actuals (ACWP)
 - Only One Funding Type per CTC
 - Many Resources to One Activity
 - Many Activities to One CTC



- Control Account (CA)
 - CAs can be at various WBS level
 - Code Defines
 - Many CTCs to One CA



476-B-2.02.03	Beamlines	485
476-B-2.02.03.1	Beamlines Conceptual Design	19
476-B-2.02.03.1	Final Focus on Target Station	48
476-B-2.02.1	Preliminary Design	15
476-B-2.02.1	Final Design	2
476-B-2.02.1	Implementation	28
476-B-2.02.03.1	Target Station to Delivery Ring	149
476-B-2.02.1	M2 Line	68
476-B-2.1	Preliminary Design	22
476-B-2.1	Final Design	8
476-B-2.1	Implementation	38
476-B-2.02.1	M3 Line	66
476-B-2.1	Preliminary Design	23
476-B-2.1	Final Design	4
476-B-2.1	Implementation	39

Defining Other Required Key Codes (Cont.)

- Funding Type

- DOE OPC
- DOE MIE
- NSF



- Cost Classes

- Budgeted Cost
- Obligation
- Contingency



Determine Resources for Activity

Consult with SME's, Prior Experience, to Determine needed Resources
Reflecting Basis of Estimates (BOE)

- Assigned to Tasks or Activities
- Resource ID Encoded
- Labor
- M&S

The screenshot shows a software interface with a main window and an 'Assign Resources' dialog box.

Main Window Table:

Resource ID Name	Resource ID	Role	Budgeted Units / Time	Budgeted Units	Estimate Uncertainty Factor
FNFE_CFS_DESIGN_EN.CFS Design Engineer	FNFE_CFS_DESIGN_EN	Alber R	75%	1350h	0.20
FNFE_CFS_DESIGN_EN.CFS Design Engineer	FNFE_CFS_DESIGN_EN	2	75%	1350h	0.20
FNFE_CFS_DESIGN_EN.CFS Design Engineer	FNFE_CFS_DESIGN_EN	3	10%	180h	0.20
FNFE_CFS_DESIGN_EN.CFS Design Engineer	FNFE_CFS_DESIGN_EN	4	1250%	22500h	0.20
FNFE_CONST_COORDNATR.Construction Coordinator	FNFE_CONST_COORDNATR		5%	90h	0.20
FNES_U_GENERAL_ESH.General ES&H Uncosted	FNES_U_GENERAL_ESH		20%	360h	0.20
FNBS_U PROCUREMENT.Procurement Uncosted	FNBS_U PROCUREMENT		20%	360h	0.20
FNDO_PRJ_CTRL_LEAD.Project Controls Lead	FNDO_PRJ_CTRL_LEAD		25%	450h	0.20
FNFE_PRJ_FINANCE.Project Finance	FNFE_PRJ_FINANCE		5%	90h	0.20

Assign Resources Dialog Box Table:

Resource ID	Resource Name	Resource Type	Unit of Measure	Primary Role
FNFE_CFS_DESIGN_EN	CFS Design Engineer	Labor		
FNFE_CFS_OPERTNS_EN	CFS Operations Engineer	Labor		
FNFE_CFS_OPERTNS_SR	CFS Operations Engineer Sr	Labor		
FNFE_CFS_TECH_MNGR	CFS Technical Manager	Labor		
FNFE_CLERICAL	Clerical	Labor		
FNFE_CONST_COORDNATR	Construction Coordinator	Labor		
FNFE_CONST_SAFETY	Construction Safety	Labor		
FNFE_FACILITIES_MGMT	Facilities Management	Labor		
FNFE_GENERAL_ADMIN	General Administrative	Labor		
FNFE_GENERAL_ESH	General ES&H	Labor		
FNFE_GEOG_INFO_SYSTEM	Geographic Information System	Labor		

Identify Critical Activities (Float and Critical Path)

Two Key Terms

- Activity Float
 - Free - Immediate Relationship
 - Total - Project Completion
- Critical Path

General	Status	Resources	Codes	Predecessors	Successors	Notebook	Steps
Activity 2253.502							
Duration							
Planned							1d
Actual							0d
Remaining							1d
At Complete							1d
Total Float							373d
Free Float							119d

Activity ID	Activity Name	Duration - Work Days	Start	Finish	Predecessors	BOE Doc#	Code
M3 Line							
23223.510	Preparation for installation	5d	06-Jul-15	03-Oct-16	A10032, A62850	687	C
23223.530	Rigging crew remove AP-3 devices	25d	13-Jul-15	14-Aug-15	23223.510	687	C
23223.580	Install magnets in M3 Line - M&S	30d	01-Aug-16	12-Sep-16	WAIT001, 23223.570, A10342, 23223.530, 23223.590	687	K
23223.680	Install vacuum components	40d	08-Aug-16	03-Oct-16	23223.670, 23223.580	687	K
49AT001	Waiting for next shutdown and FY17 funds	240d	17-Aug-15	28-Jul-16	23223.530	687	C
Delivery Ring							
503	DR Straight Sections Reconfiguration	50d	20-Jan-17	30-Mar-17			
D38 Straight Sections Reconfiguration							
23413.680	Reinstall DR components IM side	30d	20-Jan-17	02-Mar-17	A1970, 23413.550.0, 2353.719	595	K
23413.720	Close up tunnel work	20d	03-Mar-17	30-Mar-17	23413.670, 23413.680, 23413.700	595	K

The Gantt chart displays the project schedule from FY2016 to FY2017. It shows the 'Preparation for installation' activity (red bar) starting in July 2015 and ending in October 2016. This activity is followed by 'Rigging crew remove AP-3 devices' (red bar) from July 2015 to August 2015. Other activities include 'Install magnets in M3 Line - M&S' (red bar) from August 2016 to September 2016, 'Install vacuum components' (red bar) from August 2016 to October 2016, and 'Waiting for next shutdown and FY17 funds' (red bar) from August 2015 to July 2016. The chart also shows 'Reinstall DR components' (red bar) from January 2017 to March 2017 and 'Close up tunnel work' (red bar) from March 2017 to March 2017.

Float and Critical Path Details in next two Slides

Float

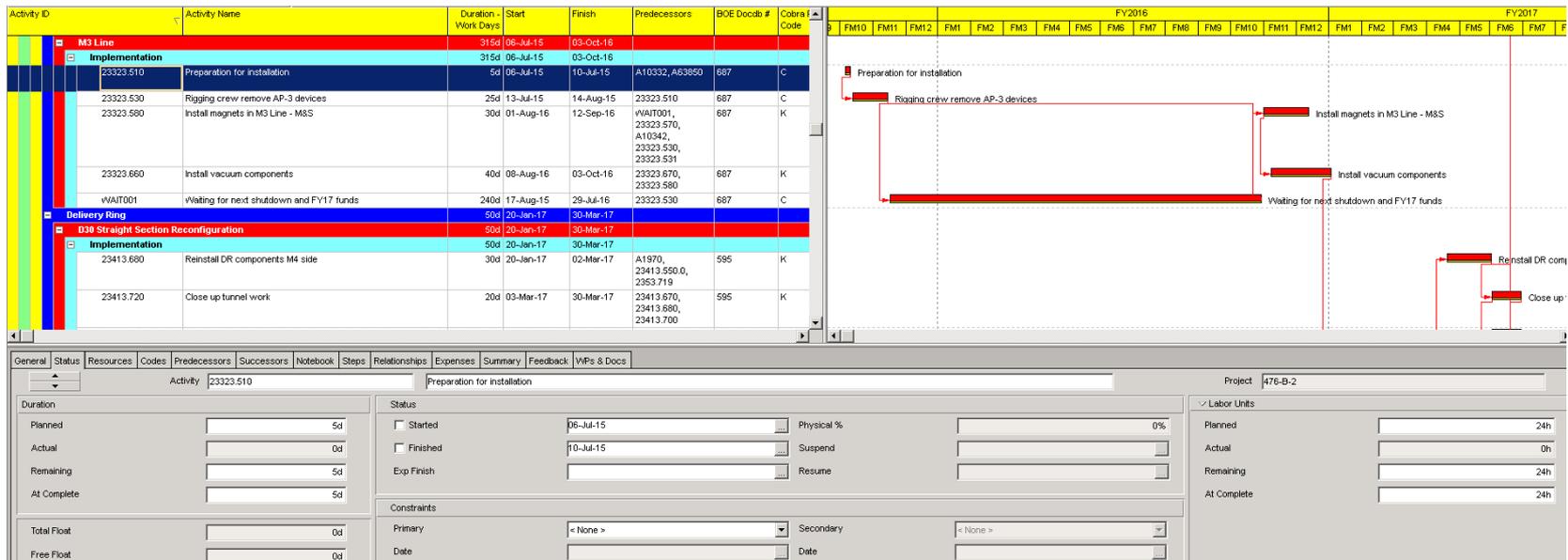
Float – Difference between early dates and late dates; if difference is >0 , the activity has float

- Zero float – Longest path of logically related activities through network that cannot slip without impacting project duration
- Total float – The amount of time an activity can be delayed before it impacts the project end date
- Free float – The amount of time an activity can be delayed before it impacts the succeeding activity

Activity ID	Activity Name	Duration - Work Days	Early Start	Late Start	Early Finish	Late Finish	Free Float	Total Float
 <input type="checkbox"/> Implementation		565d	15-Aug-14	06-Jul-15	11-Nov-16	30-Mar-17	0d	92d
23323.510	Preparation for installation	5d	06-Jul-15	06-Jul-15	10-Jul-15	10-Jul-15	0d	0d
23323.520	Remove AP-3 devices	25d	13-Jul-15	24-Feb-17	14-Aug-15	30-Mar-17	314d	406d
23323.530	Rigging crew remove AP-3 devices	25d	13-Jul-15	13-Jul-15	14-Aug-15	14-Aug-15	0d	0d
23323.531	Rigging crew remove AP-3 devices - Obligation	1d	13-Jul-15	29-Jul-16	13-Jul-15	29-Jul-16	264d	264d
23323.540	Repair repurposed magnets	30d	08-Aug-16	17-Feb-17	19-Sep-16	30-Mar-17	24d	131d

Critical Path

- Critical path – Activities that **cannot** slip a day without increasing total project duration or delaying completion; if float < 1, the activity is on the critical path
- Technical Critical path – What aspect of the work is critical? IE – piece of equipment needs to be ordered early; foreign order, etc.



Schedule Contingency

Definitions or Methods:

1. Duration added to a schedule activity to allow for the probability of possible or unforeseen events. This Method is not recommended as the contingency is hidden and may be misused.



2. A unique (SVT) activity used to model specific float available to a project phase. Used in this manner gives ownership of float to those activities and or responsibility entity.



3. An added Constraint to Schedule used to model specific float available to a project phase.



SVT = Schedule Visibility Task

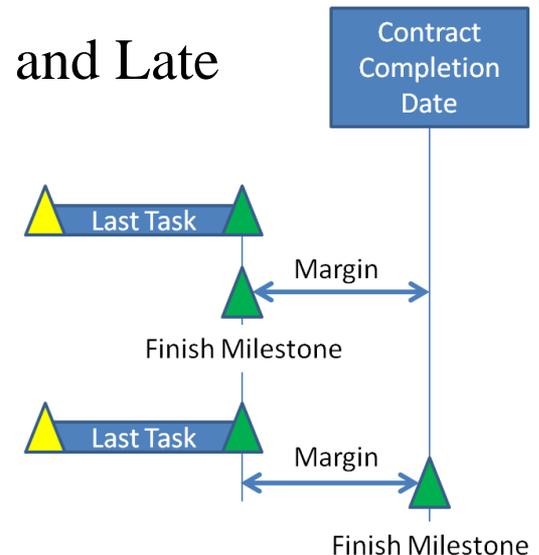
Baseline Schedule Margin (new Term for FNAL)

- **What is Schedule Margin?**

- Schedule margin is a project management **tool** for **dealing** with **schedule contingencies**. Schedule margin provides a separately designated "buffer" in the schedule to "protect" the delivery dates.
- Established with Monti Carlo Risk Analysis
- Traditionally call Float from Tier CD-4 early and Late Milestones

- **Traditionally referred to as Schedule Contingency at FNAL.**

- Incorrect or Less Explicit Term
- Use Industry Standard Terminology
- SVTs (Schedule Visibility Tasks)



Performance Measurement Technique

- Earned Value falls into 2 main categories:
 - Non-discrete (aka management tasks - LOE)
 - Discrete (specific deliverable)

- Level of Effort is an example of non-discrete EV methods

- Guidance for LOE Activities
 - Keep LOE to Minimum less than 15-19%
 - Control Account Cost
 - Project Cost
 - Don't mix LOE and Discrete Work
 - Separate CTCs
 - Separate Reports
 - Ensure LOE i.e. You Can't Measure Progress

Assign PMT (Cont.)

- Examples of discrete EV methods:
 - 0/100 (performance is earned after all work is complete)
 - 100/0 (performance is earned at the start of the work)
 - 50/50 (50% earned at start; 50% earned at finish)
 - Physical % complete (incremental earning based on PMs assessment of %)
 - Units complete
 - Milestones (30% design, 60% design, etc.)

- Remember, the method you choose must be objective and consistent throughout the project

Assign PMT (Cobra PMT Code)

Performance Measurement Technique (PMT)

- A = Level of Effort
 - Time based activity
 - Has no Deliverable
 - BCWP=BCWS
 - No Schedule Variance
 - LOE vs. Discrete < 15%
- C = Physical Percent Complete
 - Most Widely Used
 - Incremental Earning Based on Quantitative Assessment of %
 - Milestones
 - Peg Points
 - Steps
 - Note How Used and Tracked
- D = Units Completed
 - Need total units identified
 - Only One (1) Resource on Activity
- E = 50-50
 - 50% at start
 - 100% at finish
 - Use with Caution
 - Max Two Reporting Periods
- F = 0-100
 - 0% until activity completed
 - Use with Caution
 - Max One Reporting Period
- K = Planning Package
 - 6 Month Rolling Window
 - No BCWP

Cost Estimate – Classifications (12.PM-005)

Cost Estimate Classification	Primary Characteristics	
	Level of Definition (% of Complete Definition)	Cost Estimating Description (Techniques)
Class 5, Concept Screening	0% to 2%	Stochastic, most parametric, judgment (parametric, specific analogy, expert opinion, trend analysis)
Class 4, Study or Feasibility	1% to 15%	Various, more parametric (parametric, specific analogy, expert opinion, trend analysis)
Class 3, Preliminary, Budget Authorization	10% to 40%	Various, including combinations (detailed, unit-cost, or activity-based; parametric; specific analogy; expert opinion; trend analysis)
Class 2, Control or Bid/Tender	30% to 70%	Various, more definitive (detailed, unit-cost, or activity-based; expert opinion; learning curve)
Class 1, Check Estimate or Bid/Tender	50% to 100%	Deterministic, most definitive (detailed, unit-cost, or activity-based; expert opinion; learning curve)

Critical Decision	Suggested Estimate	AACEI Estimate Classification
CD-0	Cost estimate range	Class 5
	Estimate of costs to be incurred prior to CD-1	Class 3
CD-1	Estimate of near term preliminary design cost	Class 3
	LCC of likely alternatives that are being considered	Class 5
	TPC range	Class 4
CD-2	Single point estimate representing entire project:	
	Low risk projects	Class 3
	High risk projects	Class 2
CD-3	Cost estimate based on Final Design [or sufficiently mature to start construction]:	
	Low risk and final design complete	Class 1
	Low risk and final design not complete	Class 2
	High risk (final design or not)	Class 2
CD-4		N/A

Cost Estimates related to EVMS Guidelines 8, 9, 10, 11, 12, 13, 14, 21 & 24

Estimate Types / Uncertainty for M&S

Code	Type of Estimate	Contingency %	Description
M&S Guidelines			
M1	Existing Purchase Order	0%	Items that have been completed or obligated. (Note: Contact Change Orders are considered a Risk and should not be included as estimate uncertainty contingency)
M2	Procurements for LOE / Oversight work	0%-20%	M&S items such as travel, software purchases and upgrades, computers, etc. estimated to support LOE efforts and other work activities.
M3	Advanced	10%-20%	Items for which there is a catalog price or recent vendor quote based on a completed or nearly completed design or an existing design with little or no modifications and for which the costs are documented.
M4	Preliminary	20%-40%	Items that can be readily estimated from a reasonably detailed but not completed design; items adapted from existing designs but with moderate modifications, which have documented costs from past projects. A recent vendor survey (e.g., budgetary quote, vendor RFI response) based on a preliminary design belongs here.
M5	Conceptual	40%-60%	Items with a documented conceptual level of design; items adapted from existing designs but with extensive modifications, which have documented costs from past projects
M6	Pre-Conceptual - Common work	60%-80%	Items that do not have a documented conceptual design, but do have documented costs from past projects. Use of this estimate type indicates little confidence in the estimate. Its use should be minimized when completing the final estimate.
M7	Pre-Conceptual - Uncommon work	80%-100%	Items that do not have a documented conceptual design, and have no documented costs from past projects. Its use should be minimized when completing the final estimate.
M8	Beyond state of the art	>100%	Items that do not have a documented conceptual design, and have no documented costs from past projects. Technical requirements are beyond the state of the art.

Estimate Types / Uncertainty for Labor

Code	Type of Estimate	Contingency %	Description
LABOR Guidelines			
L1	Actual	0%	Actual costs incurred on activities completed to date.
L2	Level of Effort Tasks	0%-20%	Support type activities that must be done to support other work activities or the entire project effort, where estimated effort is based on the duration of the activities it is supporting.
L3	Advanced	10%-25%	Based on experience with documented identical or nearly identical work. Development of activities, resource requirements, and schedule constraints are highly mature. Technical requirements are very straightforward to achieve.
L4	Preliminary	25%-40%	Based on direct experience with similar work. Development of activities, resource requirements, and schedule constraints are defined at a preliminary (beyond conceptual) design level. Technical requirements are achievable and with some precedent.
L5	Conceptual	40%-60%	Based on expert judgment using some experience as a reference. Development of activities, resource requirements, and schedule constraints are defined at a conceptual level. Technical requirements are moderately challenging.
L6	Pre-conceptual	60%-80%	Based only on expert judgment without similar experience. Development of activities, resource requirements, and schedule constraints are defined at a pre-conceptual level. Technical requirements are moderately challenging.
L7	Rough Estimate	80%-100%	Based only on expert judgment without similar experience. Development of activities, resource requirements, and schedule constraints is largely incomplete. Technical requirements are challenging.
L8	Beyond state of the art	>100%	No experience available for reference. Activities, resource requirements, and schedule constraints are completely undeveloped. Technical requirements are beyond the state of the art.

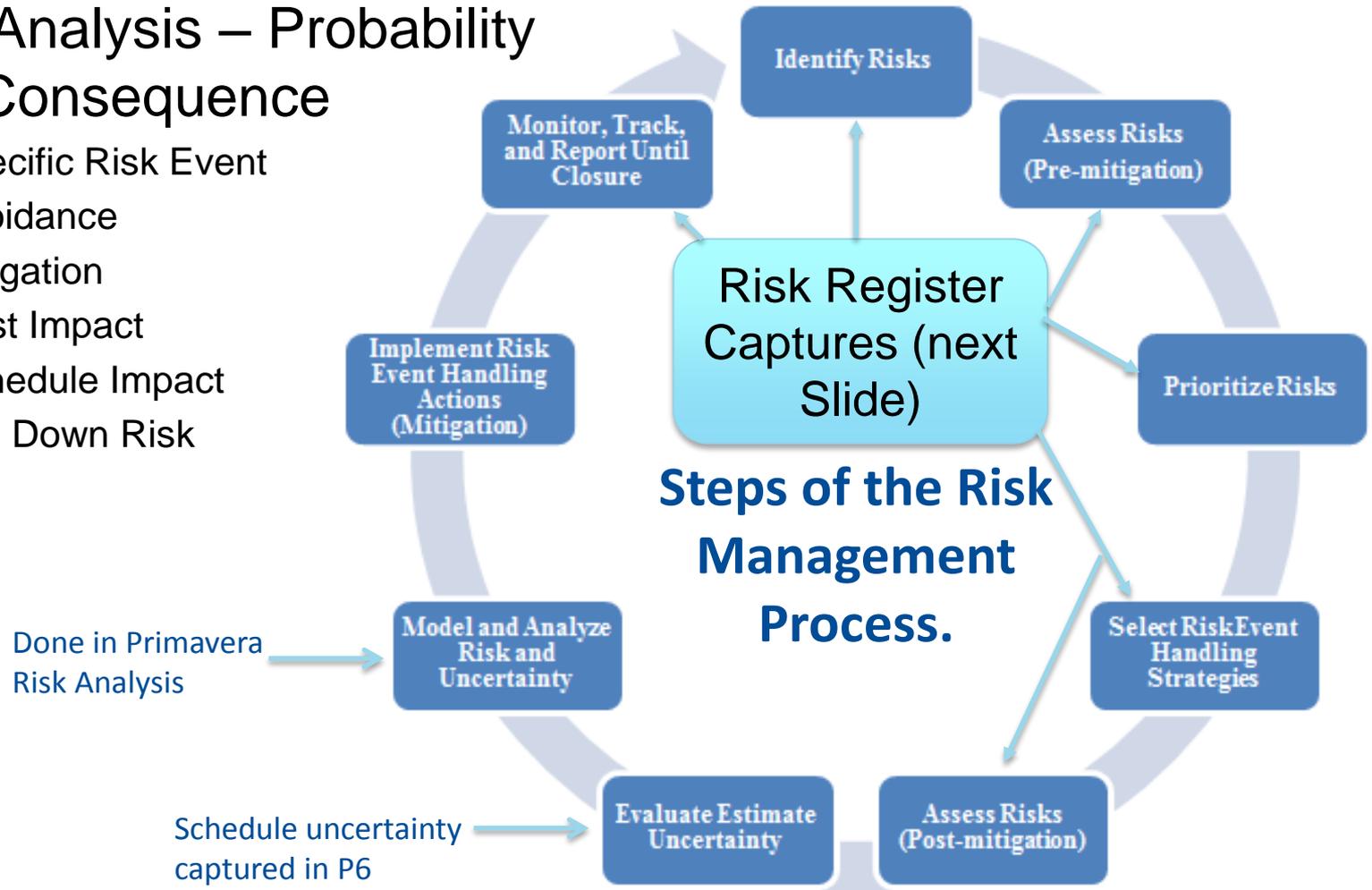
Estimate Types / Uncertainty for Conventional Facilities

Code	Type of Estimate (Desing Maturity)	Contingency %	Description	Contributing Factors
Conventional Facilities				
C1	Contract Award	0-5%	Contract Award	<div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;">Contract Type</div> </div> <p>Fixed Price ←————→ Time and Materials</p>
C2	Final Design	5-20%	Bid Docs Complete	<div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;">Project Complexity</div> </div> <p>Straightforward Contributing Factors ←————→ Complex Contributing Factors</p> <div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;">Project Unique Factor</div> </div> <p>Independent Reviews ←————→ No Review</p> <div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;">Peer Review</div> </div>
C3	Preliminary	10-30%	30% design complete	<div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;">Technical Requirements</div> </div> <p>Traditional Building Type / Requirements ←————→ Distinct Building Type /Requirments</p>
C4	Conceptual	20-40%	10-15% design complete	<div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;">Unit Cost Source</div> </div> <p>Detailed Documents ←————→ Immature Design</p> <div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;">Quantity Take Off basis</div> </div> <p>Bottoms Up ←————→ Parametric Scaling</p>
C5	Project Definition	40-100%	Scope Developed	<div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;">Estimate Type</div> </div> <p>Quote ←————→ Guess</p> <p style="text-align: center;">Estimating Guide</p>

Risk & Uncertainty Analysis – Conceptual

- Risk Analysis – Probability and Consequence

- Specific Risk Event
- Avoidance
- Mitigation
- Cost Impact
- Schedule Impact
- Top Down Risk



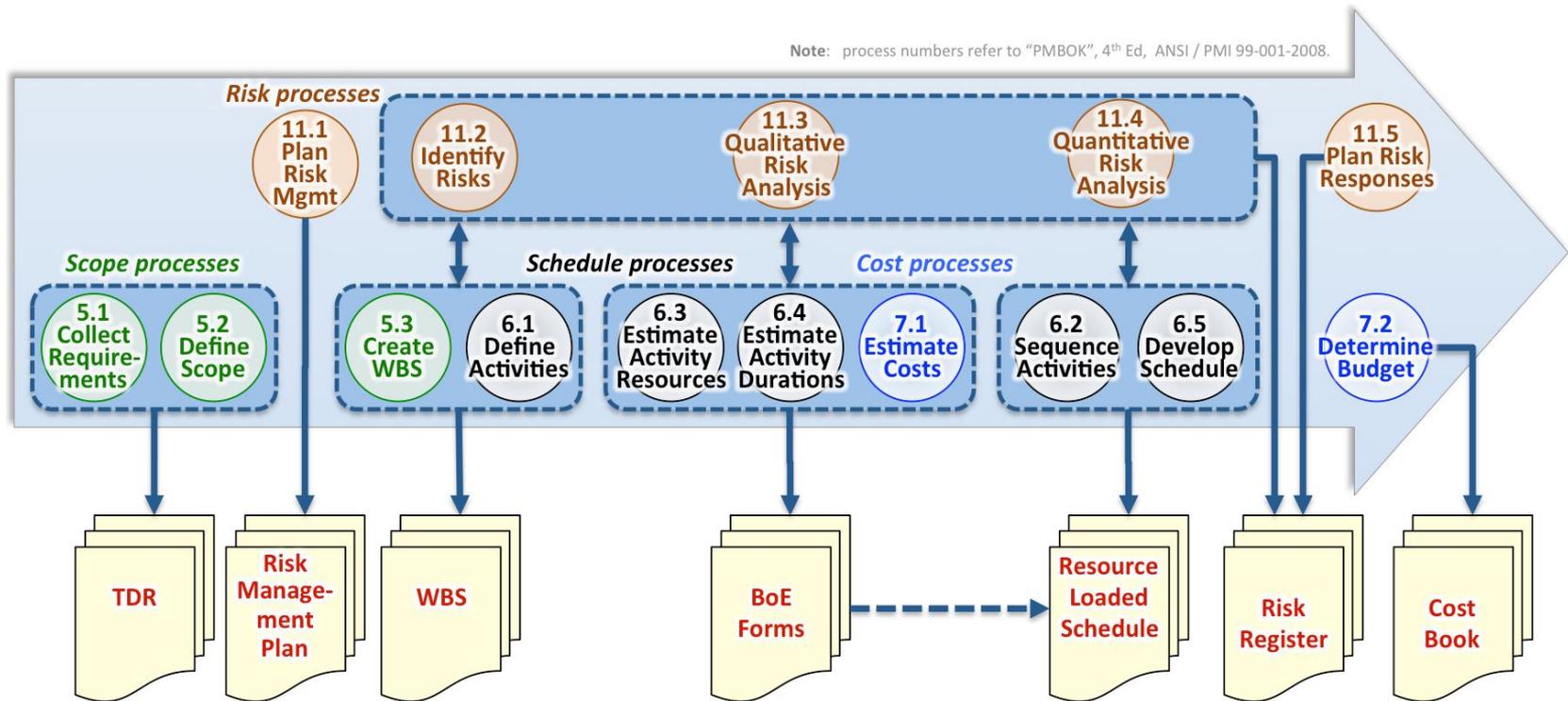
Risk Register - Example

DocDb#4320		Next ID 205		Post-Initiation										Risk Contingency \$K										
Risk ID	Risk Form DocDb #	Type	Title	Date of Risk	Mitigation Cost (Included in baseline)	Category	Probability	Schedule Delay Level 3 Milestone or Project Critical Path by 3 Days	Cost	Technical	ES&H	Score	Owner	Point estimate (cost\$)	Point estimate (sched-delay)	Point estimate (prob)	EXPECTATION VALUE IN \$K	EXPECTATION VALUE IN Days	Prob Range	Prob RMS	80% CL	85% CL	90% CL	
ACCEL-011	222.2	Threat	Inadequate AD Engineering Resources	FY15-FY19		CurrentRisk	M	L	N	N	N	L	Ron Ray	\$ 75	80	25%	\$ 19	15	25.0%	7.5.0%	14.4%	\$27	\$38	\$59
ACCEL-015	222.1	Threat	Injection dam pen required for Delivery Ring	FY15-FY19		CurrentRisk	L	N	N	VM	N	H	J. Morgan	\$ 125	0	10%	\$ 19	0	10.0%	3.0.0%	4.2%	\$22	\$32	\$34
ACCEL-020	222.2	Threat	Can not use Tools to control beam losses	FY15-FY19		CurrentRisk	L	N	VM	N	N	H	T. Laveling	\$ 2,000		2%	\$ 40	0	10.0%	3.0.0%	4.2%	\$289	\$298	\$311
ACCEL-028	224.4	Threat	Rediate target will not operate in the beam.	FY15-FY20	\$ 100,000	CurrentRisk	L	N	M	N	N	M	R. Coleman	\$ 175		10%	\$ 18	0	10.0%	3.0.0%	4.2%	\$30	\$31	\$32
CL-170	442.2	Threat	Inability to purchase OT generator from Russia	FY15-FY19		CurrentRisk	M	N	L	N	N	L	Frank Porter	\$ 90	0	50%	\$ 45	0	25.0%	7.0.0%	14.4%	\$51	\$52	\$55
CON-ST-049	222.1	Opportunity	Conventional construction bids are lower than estimated cost.	FY15		CurrentRisk	M	N	VM	N	N	H	T. Lackowski	\$ (1,200)		50%	\$ (600)	0	25.0%	7.0.0%	14.4%	(\$64)	(\$704)	(\$728)
RM-010	222.9	Threat	Increase in Fermilab overhead rates	FY15-FY20		CurrentRisk	M	N	VM	N	N	H	Ron Ray	\$ 1,500	0	50%	\$ 750	0	25.0%	7.0.0%	14.4%	\$655	\$660	\$910
RM-048	222.0	Threat	Significant injury or beam associated with MUBS construction (baseline)	FY15-FY20	\$ 25,000	CurrentRisk	VL	H	VM	N	VM	M	R. Ray	\$ 1,000	260	1%	\$ 10	2.6	0.0%	1.0.0%	2.9%	\$51	\$54	\$58
RM-142	222.7	Threat	Current fluctuations on foreign procurements	FY17-FY18		CurrentRisk	L	N	VM	N	N	L	Ron Ray	\$ 100	0	10%	\$ 10	0	10.0%	3.0.0%	4.2%	\$17	\$18	\$18
RM-155	224.4	Opportunity	Commodity prices decrease	FY15-FY18		CurrentRisk	L	N	VM	N	N	H	Ron Ray	\$ (1,172)		50%	\$ (587)		10.0%	3.0.0%	4.2%	(\$257)	(\$325)	(\$370)
RM-154	224.2	Threat	Commodity prices escalate faster than inflation	FY15-FY18		CurrentRisk	L	N	VM	N	N	H	Ron Ray	\$ 1,172		10%	\$ 117		10.0%	3.0.0%	4.2%	\$201	\$205	\$219
SOL-070	222.9	Threat	Interface problems with the solenoids.	FY17-FY20		CurrentRisk	L	H	VM	N	N	H	M. Lamm	\$ 1,000	80	10%	\$ 200	12	10.0%	3.0.0%	4.2%	\$204	\$209	\$215
SOL-127	222.9	Threat	Solenoid fringe field impacts performance of nearby equipment	FY17-FY20	\$ 100,000	CurrentRisk	L	N	L	L	VL	L	K. Krampetz	\$ 100		10%	\$ 20	0	10.0%	3.0.0%	4.2%	\$30	\$31	\$32
SOL-148	222.7	Threat	Production Solenoid must be installed through PS hatch using a large tracked crane	FY18-19		CurrentRisk	M	N	H	N	N	H	T. Page	\$ 200		50%	\$ 150	0	25.0%	7.0.0%	14.4%	\$171	\$176	\$192
SOL-155	222.4	Opportunity	Cryo Order Bookin Box Funded by ONS AIP	FY15-FY17		CurrentRisk	M	VM	VM	N	N	H	M. Lamm	\$ (2,500)		50%	\$ (1,250)	0	25.0%	7.0.0%	14.4%	(\$1,425)	(\$1,466)	(\$1,517)
SOL-178	456.6	Threat	Completed cryostat magnet does not pass acceptance tests at vendor	FY20		CurrentRisk	VL	M	N	N	N	L	M. Lamm	\$ 1,000	125	10%	\$ 100	12.5	0.0%	1.0.0%	2.9%	\$81	\$84	\$88
SOL-179	456.1	Threat	Vendor failure not caused by FNAL	FY18-19		CurrentRisk	L	L	N	N	N	L	M. Lamm	\$ 500	85	25%	\$ 130	16.25	10.0%	3.0.0%	4.2%	\$115	\$117	\$121
SOL-180	456.6	Threat	Magnet is damaged during shipping and handling	FY20		CurrentRisk	VL	H	N	N	N	L	M. Lamm	\$ 2,000	250	5%	\$ 100	12.5	0.0%	1.0.0%	2.9%	\$128	\$135	\$142
SOL-181	456.6	Threat	Operational failure during final acceptance tests at FNAL	FY20		CurrentRisk	VL	VM	VM	N	N	M	M. Lamm	\$ 4,500	500	5%	\$ 225	25	0.0%	1.0.0%	2.9%	\$288	\$303	\$321
SOL-182	456.7	Threat	Delay in FNAL supplied processes or components	FY17-19		CurrentRisk	L	L	N	N	N	L	M. Lamm	\$ 500	85	15%	\$ 76	9.75	10.0%	3.0.0%	4.2%	\$69	\$100	\$109
SOL-182	456.6	Threat	TS Magnet fabrication failure due to supplied process or components	FY20	\$ 200,000	CurrentRisk	M	L	M	N	N	H	M. Lamm	\$ 600	85	40%	\$ 248	26	25.0%	7.0.0%	14.4%	\$232	\$242	\$355
SOL-190	457.5	Threat	Building not Ready-Urable to start infrastructure installation	FY16		CurrentRisk	L	M	N	N	N	M	M. Lamm	\$ 1,000	125	15%	\$ 250	21.25	10.0%	3.0.0%	4.2%	\$101	\$126	\$132
VETO-161	456.2	Opportunity	UVA on-campus space can be found for mod use factory.	FY17-18		CurrentRisk	M	N	L	N	N	L	C. Dumas	\$ (100)	0	50%	\$ (50)	0	25.0%	7.0.0%	14.4%	(\$57)	(\$59)	(\$61)
VETO-162	456.2	Opportunity	Production on yield exceeds requirements	FY15		CurrentRisk	M	N	L	N	N	L	C. Dumas	\$ (100)	0	50%	\$ (50)	0	25.0%	7.0.0%	14.4%	(\$57)	(\$59)	(\$61)
VETO-163	456.2	Opportunity	Wider sources can be extruded that meet specifications.	FY15		CurrentRisk	M	N	L	N	N	L	C. Dumas	\$ (200)	0	50%	\$ (100)	0	25.0%	7.0.0%	14.4%	(\$114)	(\$117)	(\$121)
VETO-164	456.2	Threat	More CRV coverage is needed.	FY17-FY20		CurrentRisk	H	N	VM	N	N	L	C. Dumas	\$ 60	0	80%	\$ 48	0	67.5%	9.2.5%	7.2%	\$50	\$51	\$51
					\$ 4,247,000								\$ 5,711	\$,987		\$ 3,145	71.2	\$ 0		\$6,492	\$6,720	\$7,002		
					\$ 40,000																			
					\$ 2,685,000																			
					\$ 470,000																			
					\$ 6,542,000																			
																	Total of 24 Project Level Risks							
																	Risk Contingency \$							
																	80% CL							
																	\$ 6,492,000							

Risk Contingency \$
80% CL
\$ 6,492,000



Risk & Uncertainty Analysis – Overall Plan

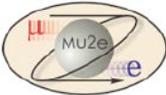


Risk management processes in the context of the overall planning process.

Basis of Estimate (BOE)

- Focus on Scope
- Account for
 - Risk
 - Estimate Uncertainty
- Identify Funding Source
- Keep it Simple and Traceable
- Determine Who & How
 - Labor
 - M/S
- Responsibilities
 - CAM
 - PM
- BOE includes
 - Work scope description
 - Explanation of the assumptions made to develop the budget
 - Quantification of risk through application of contingency
 - Labor hours
 - Non-labor units
 - Quantity and cost
 - Justification or How estimate was developed
 - Type of estimate
 - How Value or Performance will be measured

Basis of Estimate (BOE) - Example

Example Basis of Estimate Form	
 Mu2e BASIS of ESTIMATE (BoE)	Date of Estimate: 5 / 29 / 2013
	Prepared by: R. Ray
	Docdb #: xxxx
WBS number: 475.01.03.01	WBS Title: Design Phase Management
WBS Dictionary Definition: Management of the Project during the design phase from CD-1 to CD-3. This includes all activities related to the management, administration, quality assurance and safety, change control, document control, cost/schedule reporting and control systems, configuration management, systems engineering, and general computing infrastructure.	
Supporting Documents (including but not limited to): see Electronic docdb file referenced above for supporting documentation. <i>P6 schedule spreadsheet corresponding to this BOE (Excel)</i>	
Quality Control Process Applied: by _____ date _____	
Assumptions: Assume CD2/3 approval at the end of FY14. <ul style="list-style-type: none"> • BOE only covers activities from FY14 onward. Activities prior to FT 14 are entered into the schedule as actuals with 0% contingency. • Costs are in 2014 dollars. • 1 FTE = 1768 hours for an average year. P6 uses the actual calendar for each year with the exact number of work days. • Project Management labor is level of effort. Estimates based on assigned personnel and estimated effort. • Simulation infrastructure is included in Project Management because it is a general service made available to the entire Project. Support for simulations goes away after designs are complete and we are in the construction phase of the Project. 	

Details of the Base Estimate (explanation of the Work, Contingency and Duration)

All activities related to the Management of the Project during the design phase from CD-1 to CD-3. Labor is all level-of-effort for each fiscal year. Labor estimates are based on assigned personnel and scope of work. Actuals from FY13 are incorporated into FTE estimates.

Currently Assigned Personnel

- Project Manager – R. Ray
- Deputy Project Manager – D. Glenzinski
- Project Mechanical Engineer – K. Kremetz – Also serving as Head of PPD Mechanical Engineering Department.
- Project Electrical Engineer – K. Larwill – Also serving as Head of PPD Electrical Engineering Department.
- Project Financial Officer – D. Knapp – Assigned full time.

BOE – M&S Example

M&S Base Estimate:

Project Management M&S includes Project Office travel, computers for Project Office staff, software and training, visitor support. M&S base estimate is extrapolated from FY13 actuals.

M&S Actuals for FY13

Item	Actual Cost (\$k)
Computers, Software, Licenses	0
Visitor Support	\$20.7
Travel	\$2.2
Misc.	\$4.0
Total	26.9

Show % not \$ to prevent continual iterative updates

Project Management LOE FY14 (M&S) – 47501.3.1.001240

Item	Cost (\$k)	Contingency	Contingency Rule	Comments
Computers, Software, Licenses	\$5	30%	3	Assume need to replace 1 - 2 computers per year. Cost of computers well known.
Visitor Support	\$20	30%	3	Same level of support as in FY13
Travel	\$10.0	30%	3	More travel in FY14 due to site visits to solenoid vendors.
Misc.	\$4.0	50%	4	Assume similar to FY13, but with large uncertainty.
Total	39.0	32%		

M&S Contingency:

Overall contingency of 32% based primarily on extrapolation from FY13 actuals. See table above.

M&S Duration

Fiscal year task – 1 year duration.

BOE – Labor Example

Labor Base Estimate:

Project Management labor is level of effort. Estimates based on assigned personnel and estimated effort. Estimates for FY14 based on actuals from FY13.

Project Management Labor Actuals for FY13

Resource	FY13 Actuals	Comments
Project Manager	1.00	Assigned Full-time
Deputy Project Manager	0.66	Spends time on CDF wrap-up and Mu2e @ Project X
ES&H Manager	0.08	Effort relatively flat over the year.
Project Mechanical Engineer	0.50	Activity ramped up as year progressed as integration and installation planning activities increased
Project Electrical Engineer	0.51	Effort relatively flat over the year.
Finance	1.00	Assigned Full-time
Project Controls	1.74	Gardner (100%) + ramp up of Brown
Project Controls – Contract Labor	1.80	Leeb (80%) and Nordhoff (100%)
Risk Manager	0.15	Activities ramped up as year progressed as we got into risk evaluation and costing for CD-2.

Labor Contingency:

Overall contingency of 29% based on extrapolation from FY13 actuals. See table above.

Labor Duration

Fiscal year task – 1 year duration.

Simulation Infrastructure Labor Actuals for FY13

Resource	FY13 Actuals	Comments
Engineering Physicist	0.57	Effort relatively flat over the year.
Applic Dev & Sys Analyst	0.55	Effort relatively flat over the year.
Comp Science Researcher	0.24	Effort relatively flat over the year.
Computational Physics Dev	0.75	Effort relatively flat over the year.

Simulations Infrastructure LOE FY14 – 47501.3.1.001260

Resource	FY14 Estimate (FTEs)	Contingency	Contingency Rule	Comments
Engineering Physicist	0.50	30%	3	Extrapolated from increasing effort in FY13. Contingency rule 3 applies because effort is based on previous effort.
Applic Dev & Sys Analyst	0.50	30%	3	Extrapolated from increasing effort in FY13. Contingency rule 3 applies because effort is based on previous effort.

Contingency, Management Reserve & Undistributed Budget

- **Contingency Established**
 - Estimate Uncertainty
 - Statistical Evaluation of Risks (PRA)
 - Controlled By DOE
- **Management Reserve**
 - Allowed by DOE field Office
 - Limit as Defined by PEP
 - Use of MR\$ controlled by PM
 - Reduced and Replenished by BCRs
- **Undistributed Budget**
 - Draws from MR
 - Field Changes
 - Authorized Un-priced Work



Contingency, MR or UB
**are outside of CAMs control or
access.**

CAMS cannot and do not count on any of these to “bail them out”, “make them whole” or otherwise reduce impacts of over-runs.

EVM Cat 3 – Accounting Considerations (GL16-21)

16. Record Direct Costs
17. Summarize Direct Costs by WBS Elements
18. Summarize Direct Costs by OBS Elements
19. Record/Allocate Indirect Costs
20. Identify Unit and Lot Costs
21. Track and Report Material Costs and Quantities

Collecting Costs

- **Fermilab's Oracle eBS** (electronic Business Suite)
 - Collects Actual Costs
 - Accruals
 - Automatic for Material Received at Fermilab
 - Manual for Services & Materials Received Elsewhere
 - Indirects are applied
 - Rates set at Least Annually by CFO
 - Adjusted at Fiscal Year End to reflect Actual Indirect Costs at Fermilab
 - May be Adjusted at Interim Dates
 - Opportunities for Pass-through Rates
 - Cap for Large Qualified Purchase Orders at \$500K

Collecting Actual Costs and Hours

- **Labor**
 - **Kronos collects Fermilab Labor Hours & Feed eBS**
 - **Labor at other Institutions**
 - Actual Costs are Collected as M&S
 - Scheduled as “Non-Labor” in Primavera P6
- **M&S**
 - **Actual Costs input to eBS accounting system**
 - **Accruals (virtual actuals) are input to eBS accounting sys**
- **Monthly Interface with Cobra**
 - Actual Costs and Hours are Extracted from eBS
 - Loaded into Cobra by PCS (See Graphic on Monthly Status Reporting Cycle)
 - Cobra and eBS Totals are Reconciled

Note: eBS is electronic Business Suite

Accrual Basics

- Accrual is the amount owed and not invoiced for work performed or goods received
- Accrued amounts can be more or less than the actual invoice for the quantity received.
 - Since the invoice amount is entered into the system when the invoice is matched to the PO line, the actual costs can be higher or lower than the previously accrued amount.

Accrual is NOT needed

- Once an invoice is entered and matched to the PO lines
 - The amount matched is “costed” to that project/task immediately at that point in time. Regardless of invoice paid status.
 - There will be no need for an accrual because the invoice match process creates the actual cost transaction at that point.
- Recommend Put in Monthly Accrual to Ensure System has not let you down.

Accrual is needed

- For service invoices (SN), goods received (GR), or goods not-received (GN) i.e. items shipped to somewhere off site
 - A receipt is entered into Oracle
 - SN “receipts” are entered by the finance person via spreadsheet sent to accounting
 - GR item receipts are entered upon receipt at of the item Fermilab by the receiving department.
 - GN item receipts are entered when someone [requestor or FFM] notifies receiving to do so
 - The PO line is eligible for accruals when the quantity received is greater than the quantity invoiced.
- **Acceptance** of the goods or services is **not** the initiator of an accrual **unless** other arrangements are made with accounting.

Accrual Process

(Unless other arrangements are made with accounting):

- At the end of the month, the system looks for PO lines with quantities received in excess of quantities invoiced (payment status is not a factor in the process).
- For anything where quantity received is greater than quantity invoiced, an accrual cost entry is generated.
- The next month on or around the first day of the month, all prior month accruals are reversed via generation of accrual reversal cost entries.
- If during the next month accrual process for the same PO line
 - The same mismatch is present the same amount will be accrued.
 - The mismatch quantity increases the accrual will increase
 - The mismatch quantity decreases the accrual will decrease

Accrual Process Goods received then Returned:

- Regardless of whether the goods are received and kept or received and returned, the accrual will follow the process described above. This means unless other arrangements are made with accounting, that:
- If the invoice is rejected, and quantity is recorded as removed
 - There will be no PO line where quantity received exceeds quantity invoiced to “re-accrue” against.
 - Since the invoice was rejected no cost was incurred.
 - The outcome of the accrual reversal with no actual cost would be a negative cost.

Accrual Process Goods received then Returned (Cont.):

- If the invoice is not rejected, and the quantity is recorded as removed
 - The Invoice will be matched to the PO line, costs will be in the system as actual costs.
 - The PO line quantity invoiced now exceeds the quantity received.
 - There will be no Accrual until the quantity received exceeds the quantity invoiced.
- Unless credit is requested, after rejecting the invoice, justified by returning the material, the payment will remain in your actuals.

EVM Cat 4 – Analysis and Management Reports (GL 22-27)

- 22. Calculate Schedule Variance and Cost Variance
- 23. Identify Significant Variances for Analysis
- 24. Analyze Indirect Cost Variances
- 25. Summarize Information for Management
- 26. Implement Corrective Actions
- 27. Revise Estimate at Completion (EAC)

Monthly Process Calendar

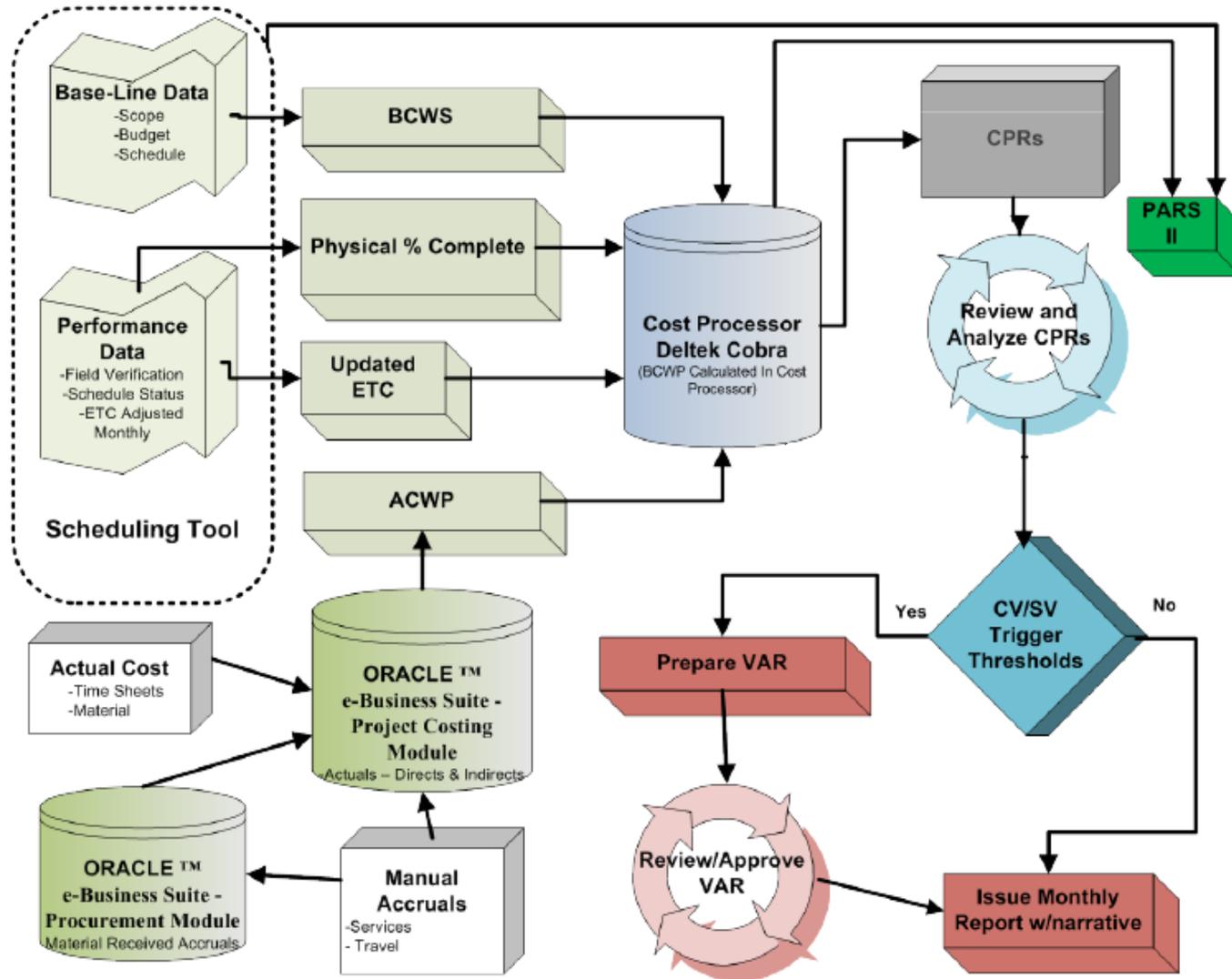


- DD = last day of calendar month
- Final Status/Actuals Upload
- ETC Review/Approval
- BCR Package Ready
- Process approved BCR
- PMG

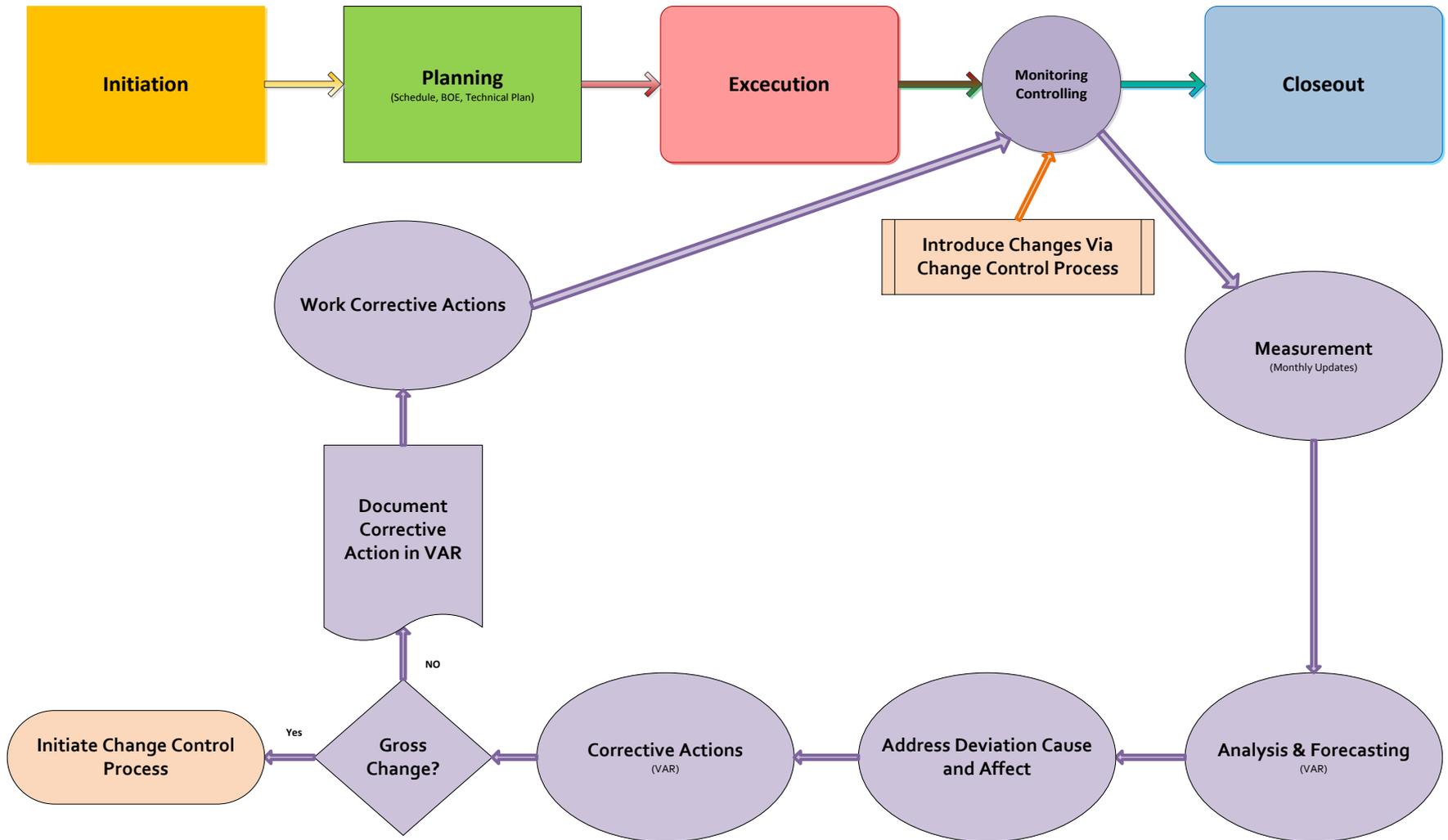
- Turnaround Rpt issued
- Prelim Variance Analysis
- Final P6-Cobra integration
- Start Accrual Process
- Holiday
- POG

- P6 Prelim Status
- P6-Cobra integration
- VARs Approved
- Accruals Due by Noon
- Accounting Month-end Close
- PARSII/OHEP written report due for previous month's data

FRA EVMS Process – Analysis & Management Reporting



Project Life Cycle – Monitor & Control Review



Update the Schedule - Verify

#	Activity ID	Activity Name	Planned Duration	Activity % Complete	Start	Finish	Total Float	Predecessors	FY2014	FQ4, FY2014	FQ1, FY2015	FQ2, FY2015
2638	38412.300.4	(SPLIT) (APD) Generate Drawings for Edge & Gap shims	12d	100%	12-May-14	28-May-14	A	38411.100	28-May-14	A		
2639	38411.150.0	(SPLIT) Design trolley and NMR probes	56d	50%	02-Jun-14	19-Aug-14	133d	START:JUNE20	19-Aug-14			
2640	38411.161	Procure tilt sensor and gap sensor - Obligation	1d	80%	02-Jun-14	01-Jul-14	276d	38411.160	01-Jul-14			
2641	38412.300.0	(SPLIT) (APD) Generate Drawings for Edge & Gap shims	53d	75%	02-Jun-14	14-Aug-14	442d	START:JUNE20	14-Aug-14			
2642	38412.330.0	(SPLIT) (APD) Purchase trolley position readout	76d	40%	02-Jun-14	17-Sep-14	143d	START:JUNE20	17-Sep-14			
2643	A2970	L5 Preliminary Design on Passive Shims Ready for Review	0d	0%		02-Jun-14	A	38411.130, 38411.140, 38411.160	27-Aug-14			
2644	38411.160	Procure tilt sensor and gap sensor -M&S	41d	0%	01-Jul-14	27-Aug-14	235d	38411.140, 38411.160	27-Aug-14			
2645	38412.320	(APD) Purchase material for trolley and probes	30d	0%	20-Aug-14	01-Oct-14	133d	A2970, 38411.160	01-Oct-14			
2646	38412.321	(APD) Purchase material for trolley and probes - Obligation	1d	0%	20-Aug-14	20-Aug-14	192d	38412.320	20-Aug-14			
2647	38411.180	Test gap sensors	23d	0%	28-Aug-14	30-Sep-14	235d	38411.160	30-Sep-14			
2648	476-B.03.08.04.01.02	Final Design										
2649	38412.350	Machine parts for NMR probes	40d	35%	02-Jun-14	16-Feb-15	133d	38412.340, 38412.350	16-Feb-15			
2650	38412.310	Procure the Edge and Gap Shims	40d	0%	02-Oct-14	26-Nov-14	409d	38412.300.0, 38412.310	26-Nov-14			
2651	38412.340	Machine parts for shimming trolley	30d	0%	02-Oct-14	12-Nov-14	133d	38412.320, 38412.310	12-Nov-14			
2652	38412.311	Procure the Edge and Gap Shims - Obligation	1d	0%	02-Oct-14	02-Oct-14	448d	38412.310	02-Oct-14			
2653	38412.380	Test trolley probes	10d	0%	17-Feb-15	02-Mar-15	133d	38412.350	02-Mar-15			
2654	A3770	L5 Passive Shims Final Design Complete	0d	0%		02-Mar-15	133d	38412.380	02-Mar-15			

#2639 started on time, is ahead of schedule and is projected to finish on time.

#2640 started on time, but has not completed as planned (was planned as one day duration).

#2644 should have started one period ago but did not. Duration is expected to happen as planned.

#2647 is being pushed by predecessor, #2644 not finishing as planned.

#2649 is suspect of poor status or not meeting planned expectations as it started very early, but appears to be finishing very late.

#2653 and MS #2654 are being pushed by #2649 finishing late.

- P6 is a dynamic scheduling tool
 - resource loaded
 - logically tied
- analyze schedule after every update
 - Scheduler
 - CAM
 - ensure proper status has been taken

Data date



Monthly Reporting: Cost Performance Report Example

CONTRACT PERFORMANCE REPORT FORMAT 1 - WORK BREAKDOWN STRUCTURE													
1. CONTRACTOR				2. CONTRACT				3. PROGRAM			4. REPORT PERIOD		
a. NAME				a. NAME				a. NAME			a.FROM 01-Feb-2008		
								Sample Project			b.TO 29-Feb-2008		
B. PERFORMANCE DATA													
ITEM (1)	CURRENT PERIOD					CUMULATIVE TO DATE					AT COMPLETION		
	BUDGETED COST		ACTUAL COST	VARIANCE		BUDGETED COST		ACTUAL COST	VARIANCE		BUDGETED (14)	ESTIMATED (15)	VARIANCE (16)
	WORK SCHEDULED (2)	WORK PERFORMED (3)	WORK PERFORMED (4)	SCHEDULE (5)	COST (6)	WORK SCHEDULED (7)	WORK PERFORMED (8)	WORK PERFORMED (9)	SCHEDULE (10)	COST (11)			
EQ DOE													
1.3 Title I													
Fully burdened AY\$	63,546	61,156	36,733	(2,390)	24,423	219,019	145,073	161,960	(73,946)	(16,887)	320,302	337,189	(16,887)
2.3 Title II													
Fully burdened AY\$	95,440	109,061	105,777	13,621	3,284	561,688	582,399	582,955	20,711	(556)	1,216,518	1,219,287	(2,769)
3.3 Far Site Construction													
Fully burdened AY\$	35,570	30,013	29,888	(5,557)	125	167,816	143,905	151,672	(23,912)	(7,767)	560,022	579,514	(19,492)
4.3 Project Management													
Fully burdened AY\$	2,155	1,158	36,357	(997)	(35,199)	55,167	55,167	92,224	0	(37,057)	685,869	725,189	(39,320)
Funding Type Totals:	196,711	201,388	208,755	4,678	(7,366)	1,003,691	926,544	988,811	(77,147)	(62,267)	2,782,711	2,861,179	(78,468)
Undist. Budget											0	0	0
Sub Total	196,711	201,388	208,755	4,678	(7,366)	1,003,691	926,544	988,811	(77,147)	(62,267)	2,782,711	2,861,179	(78,468)
Management Resrv.											517,289		
Total	196,711	201,388	208,755	4,678	(7,366)	1,003,691	926,544	988,811	(77,147)	(62,267)	3,300,000		

Variance Analysis Thresholds (Default)

Variance Analysis Thresholds for Control Accounts with Standard Resources		
Green Thresholds – Cost and Schedule Performance falling outside of yellow or red thresholds		
Yellow Thresholds		
Cost Variance Schedule Variance	Type	Threshold limit
Dollars	Current Period	$\geq \pm 5\%$ to $< \pm 10\%$ and $\geq \$50K$
	Cumulative	$\geq \pm 5\%$ to $< \pm 10\%$ and $\geq \$100K$
Red Thresholds		
Cost Variance Schedule Variance	Type	Threshold limit
Dollars	Current Period	$\geq \pm 10\%$ and $\geq \$100K$
	Cumulative	$\geq \pm 10\%$ and $\geq \$200K$

Note that:
Uncosted Labor Hours is Optional

Variance Analysis Thresholds for Control Accounts with Optional <u>Uncosted</u> Labor Hours		
Green Thresholds – Cost and Schedule Performance falling outside of yellow or red thresholds		
Yellow Thresholds		
Cost Variance Schedule Variance	Type	Threshold limit
Hours	Current Period	$\geq \pm 5\%$ to $< \pm 10\%$ and ≥ 350 hrs
	Cumulative	$\geq \pm 5\%$ to $< \pm 10\%$ and ≥ 700 hrs
Red Thresholds		
Cost Variance Schedule Variance	Type	Threshold limit
Hours	Current Period	$\geq \pm 10\%$ and ≥ 700 hrs
	Cumulative	$\geq \pm 10\%$ and ≥ 1400 hrs

Note: This applies to SV% (Schedule Variance in %) or CV% (Cost Variance in %) and th

Changed by Exception

- FRA Management
- Project Requirements
- FRA Management
- Project Requirements
 - Risk
 - Budget
- Reflected in PMP

Monthly Reporting: Variance Analysis Report Example

Variance Analysis Report									
CA:			Project:						
CAM:			Period Ending:						
Report in \$K									
Period	Budget	Earned	Actuals	SV (\$)	SV (%)	CV (\$)	CV (%)	SPI	CPI
Current:	137	204	122	67	49%	82	40%	1.49	1.68
Cumulative:	8,059	7,565	8,309	(493)	-6%	(744)	-10%	0.94	0.91
	BAC	EAC		VAC (\$)	VAC (%)				
At Complete:	25,164	26,006		(842)	-3%				
Variance thresholds: Yellow \pm \$50K & \pm 5% Current; \pm \$100K & \pm 5% Cumulative. Red \pm \$100K & \pm 10% Current; \pm \$200K & \pm 10% Cumulative									
Explanation of Variance/Description of Problem:									
Current:									
Cumulative:									
Impact:									
Corrective Action:									
Monthly Summary:									
Prepared by:			CAM			Date:			
Reviewed by:			PCS			Date:			
Approved by:			PM			Date:			

Verify that EAC makes sense and that you understand why it is showing the numbers it is on the report

Be sure you understand the Variance At Completion (VAC) numbers. How is it calculated and can you justify over or under-runs?

Reporting Tools – Understand ETC

Time-Phased ACWP, BCWS & ETC in hours

Results			HOURS																			
Sum of Value Control Account	Resource.CATE	Cost Set	Date																			
			9/30/2014	10/31/2014	11/30/2014	12/31/2014	1/31/2015	2/28/2015	3/31/2015	4/30/2015	5/31/2015	6/30/2015	7/31/2015	8/31/2015	9/30/2015							
475.09.01 TDAQ Project Management	EE Electrical Engineer	Actuals	4.0																			
		Budget																				
	IT Information Technology	Actuals	45.8															36.0	85.0	39.0		
		Budget																				
	PM Project Management	Budget	60.2	66.0	51.6	57.4	57.4	57.4	57.4	63.1	63.1	57.4	63.1	63.1	63.1	60.2	60.2					
		ETC		66.0	51.6	57.4	57.4	57.4	57.4	63.1	63.1	57.4	63.1	63.1	63.1	60.2	60.2					
475.09.02 TDAQ System Design and Test	EE Electrical Engineer	Budget																6.4	22.4	60.8		
		ETC																	11.7	10.7	67.2	
	IT Information Technology	Budget																	9.6	33.6	72.0	
		ETC																		17.6	16.0	81.6
	SC Scientist	Budget																		12.8	44.8	44.8
		ETC																			23.5	21.3
475.09.03 Data Acquisition	EE Electrical Engineer	Actuals	243.5																			
		Budget	189.0	171.0	94.3	76.7			90.0	110.0	110.0	108.0	198.0	144.0								
		ETC		94.8	128.0	101.7	65.0	93.3	105.7	105.7	111.3	198.0	144.0									
	IT Information Technology	Actuals	51.3																			
		Budget	126.0	138.0	108.0	78.0		108.0	132.0	132.0	120.0	132.0	96.0									
		ETC		126.0	138.0	108.0	78.0	112.0	128.0	128.0	124.0	132.0	96.0									
	SC Scientist	Budget	63.0	69.0	54.0	39.0		54.0	66.0	66.0	60.0	66.0	48.0									
		ETC		63.0	69.0	54.0	39.0	56.0	64.0	64.0	62.0	66.0	48.0									
	475.09.04 Data Processing	EE Electrical Engineer	Actuals	4.0																		
			Budget	42.0	28.0	17.1	46.9						4.0	44.0	32.0							
			ETC		15.2	29.9	69.7	42.0	28.0												4.0	44.0
		IT Information Technology	Budget	84.0	92.0	72.0	52.0		72.0	88.0	88.0	80.0	88.0	64.0								
ETC				30.4	25.6	45.6	84.0	92.0	72.0	101.8	53.3	113.8	53.3	57.8	88.0							
SC Scientist		Budget	63.0	69.0	54.0	39.0		54.0	66.0	66.0	60.0	66.0	48.0									
	ETC		22.8	19.2	34.2	63.0	69.0	54.0	76.3	40.0	85.3	40.0	43.3	66.0								
475.09.05 Controls and Networking	EE Electrical Engineer	Actuals	16.0																			
		Budget	63.0	51.0	22.3	24.7		32.4	39.6	22.0	24.0	66.0	48.0									
		ETC		24.0	43.3	74.7	51.0	32.9	42.5	13.3	28.4	13.3	51.4	81.0								
	IT Information Technology	Actuals	17.0																			
		Budget	42.0	46.0	36.0	26.0		36.0	44.0	44.0	40.0	44.0	32.0									
		ETC		16.0	26.0	42.0	46.0	36.0	50.9	26.7	56.9	26.7	50.9	54.0								
	SC Scientist	Budget	42.0	46.0	36.0	26.0		36.0	44.0	44.0	40.0	44.0	32.0									
		ETC		16.0	26.0	42.0	46.0	36.0	50.9	26.7	56.9	26.7	50.9	54.0								

Reporting Tools – Understand ETC

Time-Phased ACWP, BCWS & ETC in Dollars

Control Account	Results	30SEP2014	31OCT2014	30NOV2014	31DEC2014	31JAN2015	28FEB2015	31MAR2015	30APR2015	31MAY2015	30JUN2015	31JUL2015	31AUG2015	30SEP2015	Cumulative
475.09.02 TDAQ System Design and Test	Actuals	-0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.35
	OVERHEAD Actuals	-0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.35
475.09.03 Data Acquisition	Scheduled	0.00	0.00	0.00	15,454.42	38,636.06	3,863.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57,954.09
	Actuals	-0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.53
	Estimate to c	0.00	0.00	0.00	15,454.42	38,636.06	3,863.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57,954.09
	DIRECT_AYS Scheduled	0.00	0.00	0.00	12,598.37	31,495.93	3,149.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47,243.90
	Estimate to c	0.00	0.00	0.00	12,598.37	31,495.93	3,149.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47,243.90
	OVERHEAD Scheduled	0.00	0.00	0.00	2,856.05	7,140.13	714.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10,710.19
	Actuals	-0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.53
	Estimate to c	0.00	0.00	0.00	2,856.05	7,140.13	714.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10,710.19
475.09.04 Data Processing	Scheduled	0.00	0.00	0.00	10,933.40	27,333.49	2,733.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41,000.24
	Estimate to c	0.00	0.00	0.00	10,933.40	27,333.49	2,733.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41,000.24
	DIRECT_AYS Scheduled	0.00	0.00	0.00	8,912.85	22,282.13	2,228.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33,423.20
	Estimate to c	0.00	0.00	0.00	8,912.85	22,282.13	2,228.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33,423.20
	OVERHEAD Scheduled	0.00	0.00	0.00	2,020.54	5,051.36	505.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7,577.04
	Estimate to c	0.00	0.00	0.00	2,020.54	5,051.36	505.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7,577.04
475.09.05 Controls and Networking	Scheduled	0.00	0.00	0.00	3,350.02	8,375.05	837.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12,562.57
	Estimate to c	0.00	0.00	0.00	3,350.02	8,375.05	837.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12,562.57
	DIRECT_AYS Scheduled	0.00	0.00	0.00	2,730.92	6,827.30	682.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10,240.95
	Estimate to c	0.00	0.00	0.00	2,730.92	6,827.30	682.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10,240.95
	OVERHEAD Scheduled	0.00	0.00	0.00	619.10	1,547.75	154.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2,321.62
	Estimate to c	0.00	0.00	0.00	619.10	1,547.75	154.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2,321.62
Grand Total	Scheduled	0.00	0.00	0.00	29,737.84	74,344.60	7,434.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	111,516.90
	Actuals	-0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.88
	Estimate to c	0.00	0.00	0.00	29,737.84	74,344.60	7,434.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	111,516.90

Reporting Tools – Understand ETC

Time-Phased BCWS & ETC

Sum of Value	Column Labels												
Row Labels	10/31/2014	11/30/2014	12/31/2014	1/31/2015	2/28/2015	3/31/2015	4/30/2015	5/31/2015	6/30/2015	7/31/2015	8/31/2015	9/30/2015	Grand Total
HOURS	1,535.9	1,360.0	1,329.3	776.7	1,457.4	1,629.7	1,584.7	1,502.5	1,890.0	1,661.5	896.9	948.9	16,573.5
EE Electrical Engineer	384.0	334.8	394.6	158.0	276.7	298.8	252.0	275.8	519.3	473.6	203.1	211.0	3,781.5
Budget	250.0	133.6	148.4		122.4	149.6	132.0	136.0	308.0	266.4	107.4	99.8	1,853.6
ETC	134.0	201.2	246.2	158.0	154.3	149.2	120.0	139.8	211.3	207.2	95.7	111.2	1,927.9
IT Information Technology	448.4	405.6	351.6	208.0	456.0	514.9	520.4	474.2	536.4	455.4	246.4	280.6	4,898.0
Budget	276.0	216.0	156.0		216.0	264.0	264.0	240.0	264.0	237.6	118.6	111.0	2,363.2
ETC	172.4	189.6	195.6	208.0	240.0	250.9	256.4	234.2	272.4	217.8	127.8	169.6	2,534.8
PM Project Management	132.0	103.3	114.7	114.7	114.7	126.2	126.2	114.7	126.2	126.2	120.5	120.5	1,440.0
Budget	66.0	51.6	57.4	57.4	57.4	63.1	63.1	57.4	63.1	63.1	60.2	60.2	720.0
ETC	66.0	51.6	57.4	57.4	57.4	63.1	63.1	57.4	63.1	63.1	60.2	60.2	720.0
SC Scientist	571.6	516.4	468.4	296.0	610.0	689.8	686.0	637.8	708.0	606.3	326.9	336.8	6,454.0
Budget	368.0	288.0	208.0		288.0	352.0	352.0	320.0	352.0	281.6	89.6	89.6	2,988.8
ETC	203.6	228.4	260.4	296.0	322.0	337.8	334.0	317.8	356.0	324.7	237.3	247.2	3,465.2
FTEM	9.5	10.7	9.4	5.5	10.3	10.5	10.2	10.7	12.2	10.7	6.1	6.4	112.2
EE Electrical Engineer	2.4	2.6	2.8	1.1	2.0	1.9	1.6	2.0	3.4	3.1	1.4	1.4	25.6
Budget	1.5	1.1	1.1		0.9	1.0	0.9	1.0	2.0	1.7	0.7	0.7	12.4
ETC	0.8	1.6	1.7	1.1	1.1	1.0	0.8	1.0	1.4	1.3	0.6	0.8	13.2
IT Information Technology	2.8	3.2	2.5	1.5	3.2	3.3	3.4	3.4	3.5	2.9	1.7	1.9	33.2
Budget	1.7	1.7	1.1		1.5	1.7	1.7	1.7	1.7	1.5	0.8	0.8	15.9
ETC	1.1	1.5	1.4	1.5	1.7	1.6	1.7	1.7	1.8	1.4	0.9	1.1	17.2
PM Project Management	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	9.8
Budget	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4.9
ETC	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4.9
SC Scientist	3.5	4.1	3.3	2.1	4.3	4.5	4.4	4.5	4.6	3.9	2.2	2.3	43.7
Budget	2.3	2.3	1.5		2.0	2.3	2.3	2.3	2.3	1.8	0.6	0.6	20.2
ETC	1.3	1.8	1.8	2.1	2.3	2.2	2.2	2.3	2.3	2.1	1.6	1.7	23.5
F-BDN-AYS	127,511.8	111,227.7	112,684.0	65,666.3	113,276.6	125,775.1	121,114.5	115,661.7	154,269.8	137,463.4	76,030.7	82,188.0	1,342,869.6
EE Electrical Engineer	44,480.7	38,780.8	45,714.5	18,304.3	32,051.9	34,613.4	29,194.2	31,948.9	60,164.8	54,660.9	23,045.7	24,224.3	437,184.5
Budget	28,962.5	15,477.6	17,192.2		14,180.1	17,331.2	15,292.2	15,755.6	35,681.8	30,659.3	11,962.7	11,341.8	213,837.0
ETC	15,518.1	23,303.3	28,522.3	18,304.3	17,871.8	17,282.3	13,902.0	16,193.3	24,483.0	24,001.6	11,083.0	12,882.5	223,347.4
IT Information Technology	61,226.1	55,382.0	48,008.7	28,401.0	62,263.8	70,304.7	71,063.3	64,751.9	73,248.0	61,945.5	33,076.0	38,054.7	667,725.7
Budget	37,686.0	29,493.4	21,300.8		29,493.4	36,047.5	36,047.5	32,770.4	36,047.5	32,203.3	15,628.8	14,897.0	321,615.4
ETC	23,540.1	25,888.6	26,707.9	28,401.0	32,770.4	34,257.2	35,015.8	31,981.5	37,200.5	29,742.2	17,447.2	23,157.8	346,110.3
PM Project Management	21,805.1	17,064.8	18,960.9	18,960.9	18,960.9	20,857.0	20,857.0	18,960.9	20,857.0	20,857.0	19,909.0	19,909.0	237,959.5
Budget	10,902.5	8,532.4	9,480.5	9,480.5	9,480.5	10,428.5	10,428.5	9,480.5	10,428.5	10,428.5	9,954.5	9,954.5	118,979.7
ETC	10,902.5	8,532.4	9,480.5	9,480.5	9,480.5	10,428.5	10,428.5	9,480.5	10,428.5	10,428.5	9,954.5	9,954.5	118,979.7

VAR – Narration (Four Elements)

Explanation of Variance/Description of Problem:

Current Period:

Schedule Variance is within threshold
Cost Variance is within threshold

Cumulative:

Schedule Variance is within threshold
Unfavorable Cost Variance is due to Task 47504.4011144 , marked complete in April without the creation of an accrual. Because the missing accrual was prior to the initial baseline date of 4/30/14, the S=P=A balancing transaction removed the budget from the control account. When the material was received in July, an accrual was entered in the accounting system, and the variance became apparent.

Impact:

The paid invoice for Task 47504.4011144 is reflected in the EAC and is the primary contributor to the forecast overrun at completion.

Corrective Action:

When the baseline is established, followed CD-2 approval, setting the baseline equal to actual cost will restore the correct budget amount.

Monthly Summary

Prepared by:

Date:

Approved by:
Marc Buehler

Date:
10/10/2014

- **Explanation of Variance**
- **Impact**
- **Corrective Action**
- **Summary (Optional)**



VAR – Narration (First Two Elements)

Explanation of Variance/Description of Problem:

Current Period:

Schedule Variance is within threshold

Cost Variance is within threshold

Cumulative:

Schedule Variance is within threshold

Unfavorable Cost Variance is due to Task 47504.4011144 , marked complete in April without the creation of an accrual. Because the missing accrual was prior to the initial baseline date of 4/30/14, the S=P=A balancing transaction removed the budget from the control account. When the material was received in July, an accrual was entered in the accounting system, and the variance became apparent.

Impact:

The paid invoice for Task 47504.4011144 is reflected in the EAC and is the primary contributor to the forecast overrun at completion.

Explanation of Variance

- **Current**
- **Cumulative**
 - **Cost**
 - **Schedule**
 - ✓ **What**
 - ✓ **Why**
- **Justify EAC and VAC**

Impact

- **Schedule**
- **Cost**
- **CA**
- **Think Successors**
- **Project**

VAR – Narration (Last Elements)

Explanation of Variance/Description of Problem:

Current Period:

Schedule Variance is within threshold
Cost Variance is within threshold

Cumulative:

Schedule Variance is within threshold
Unfavorable Cost Variance is due to Task 47504.4011144 , marked complete in April without the creation of an accrual. Because the missing accrual was prior to the initial baseline date of 4/30/14, the S=P=A balancing transaction removed the budget from the control account. When the material was received in July, an accrual was entered in the accounting system, and the variance became apparent.

Impact:

The paid invoice for Task 47504.4011144 is reflected in the EAC and is the primary contributor to the forecast overrun at completion.

Corrective Action:

When the baseline is established, followed CD-2 approval, setting the baseline equal to actual cost will restore the correct budget amount.

Monthly Summary

Prepared by:

Date:

Approved by:

Marc Buehler

Date:

10/10/2014

Corrective Action

- Plan to Return to PMB
- Time-frame to Correction
- Track Actions to Completion

Summary (not Required)

- Accomplishments
- Technical Challenges
- Look Ahead

Ensure your VAR is Approved (Project Manager)

Cobra Reports –VAR Bad Example

CLASSIFICATION (When Filled In)			
CONTRACT PERFORMANCE REPORT			FORM APPROVED
FORMAT 5 - Explanations and Problem Analysis			OMB No. 0704-0188
1. CONTRACTOR	2. CONTRACT	3. PROGRAM	4. REPORT PERIOD
a. NAME	a. NAME	a. NAME	a. FROM (YYYYMMDD)
b. LOCATION (Address and ZIP Code)	b. NUMBER	b. PHASE	2014 / 08 / 01
	c. TYPE	d. SHARE RATIO	b. TO (YYYYMMDD)
		c. EVMS ACCEPTANCE	(YYYYMMDD) 2010 / 01 / 28
		No X Yes	2014 / 08 / 31
5. Evaluation			

	Budget	Earned	Actuals	SV in \$	SV in %	CV in \$	CV in %	SPI	CPI
Current:	24	24	-80	0	0%	104	441%	1.00	-
Cumulative:	1,062	1,062	1,037	0	0%	25	2%	1.00	1.02
	BAC	EAC	VAC in \$	VAC in %	TCPI to BAC	TCPI to EAC			
At Complete:	3,456	3,436	20	1%	0.99	1.00			

Explanation of Variance/Description of Problem:

Current Period:

Schedule Variance is within threshold

The favorable Cost Variance results from the transfer of 1036 hours of labor to an uncosted scientific effort charge code. This month's cost transfer corrects the cumulative actual costs for this uncosted scientific effort that was previously incorrectly credited to a 475.04.01 chargeable task code.

Cumulative:

Schedule Variance is within threshold

Cost Variance is within threshold

Impact:

None, except to correct an error in labor assignment.

Corrective Action:

No corrective action is required.

Monthly Summary (to include technical causes of VARs, Impacts) and Corrective Action(s):

The positive cost variance is understood. It is caused by a one-time transfer to hours from 475.04.01 chargeable task code to an uncosted scientific effort charge code.

Why and how would uncosted labor cause Cost Variance?



Cobra Reports – VAR Good Example

CLASSIFICATION (When Filled In)										
CONTRACT PERFORMANCE REPORT									FORM APPROVED	
FORMAT 5 - Explanations and Problem Analysis									OMB No. 0704-0188	
1. CONTRACTOR	2. CONTRACT		3. PROGRAM				4. REPORT PERIOD			
a. NAME Fermilab	a. NAME Mu2e		a. NAME Mu2e Cosmic Ray Veto Aug2014				a. FROM (YYYYMMDD) 2014 / 08 / 01			
b. LOCATION (Address and ZIP Code)	b. NUMBER 475		b. PHASE Electronics				b. TO (YYYYMMDD) 2014 / 08 / 31			
	c. TYPE	d. SHARE RATIO	c. EVMS ACCEPTANCE No X Yes				(YYYYMMDD) 2010 / 01 / 28			
5. Evaluation										
475.08.06 Cosmic Ray Veto Electronics										
	Budget	Earned	Actuals	SV in \$	SV in %	CV in \$	CV in %	SPI	CPI	
Current:	67	0	29	-67	-100%	-29	-	0.00	0.00	
Cumulative:	364	148	202	-216	-59%	-55	-37%	0.41	0.73	
	BAC	EAC	VAC in \$	VAC in %	TCPI to BAC	TCPI to EAC				
At Complete:	1,720	1,635	85	5%	1.04	1.10				
<p>Explanation of Variance/Description of Problem:</p> <p>Current Period:</p> <p style="padding-left: 40px;">Schedule Variance is within the threshold Cost Variance is within the threshold</p> <p>Cumulative:</p> <p style="padding-left: 40px;">The unfavorable schedule variance results from the completion dates of the Counter Motherboard and Readout Controller activities being extended from September to the end of December. The reason for the delay is due to the consideration of an alternative readout chip, VMM2 being fabricated at BNL. Evaluation of this alternative took longer than anticipated and resulted in delays to the prototype electronics fabrication.</p> <p style="padding-left: 40px;">Cost Variance is within threshold</p> <p>Impact:</p> <p style="padding-left: 40px;">There is sufficient float that there is no schedule impact. The VMM2 chip was found not to meet requirements.</p> <p>Corrective Action:</p> <p style="padding-left: 40px;">Reschedule the electronics activities to be completed in January 2015.</p> <p>Monthly Summary (to include technical causes of VARs, Impacts) and Corrective Action(s):</p>										
Prepared by: Michael Gardner, Project Controls			Date: 10/8/2014		Approved by: Craig Dukes, CAM - via email			Date: 10/9/2014		



Monthly Reporting: Management Analysis Report Example

Report Period: Feb-09	Cur. Period	BCWS (AYS)	BCWP (AYS)	ACWP (AYS)	SV (AYS)	SV (%)	CV (AYS)	CV (%)	SPI	CPI	Cumulative	BCWS (AYS)	BCWP (AYS)	ACWP (AYS)	SV (AYS)	SV (%)	CV (AYS)	CV (%)	SPI	CPI	BAC (AYS)	
R&D																						
1.0.0 ANU CDR COSTS	0				0	0%	0	0%	1.00	1.00	0										0	
1.0.1 RIR Upgrades	457,056	100,207	121,072	-355,049	-78%	-0.88	-20,869	-4%	0.22	0.83	1,324,028	1,154,549	1,233,813	-169,479	-13%	-79,284	-7%	0.87	0.84	5,248,686		
1.0.2 Upgrades	44,062	36,463	20,431	-7,599	-17%	-0.53	1,79	0%	0.53	1.79	109,572	142,050	151,884	42,478	39%	42,478	39%	1.39	0.84	1,037,303		
1.0.3 NLMU Upgrades	238,849	20,992	31,674	-217,857	-91%	-10.52	-173	0%	0.09	0.86	411,941	771,482	426,192	-359,549	-87%	345,230	45%	1.87	0.81	2,118,285		
1.0.4 ANU Beam Physics	6,792	7,469	0	977	14%	1.05	7,469	105%	1.10	N/A	36,165	41,578	0	5,413	15%	41,578	100%	1.15	N/A	82,092		
1.0.5 ANU Project Management	0	0	-1,373	0	-1,373	-100%	0	0%	1.373	-100%	344,888	344,698	258,892	0	0%	86,008	25%	1.00	1.33	344,698		
1.1 Site and Building R&D	11,940	4,221	2,248	-7,718	-65%	-0.99	-1,976	-16%	0.35	1.88	2,274,519	2,274,519	1,686,483	0	0%	608,036	27%	1.00	1.36	2,274,519		
1.2 Liquid Scintillator R&D	11,940	4,221	2,248	-7,718	-65%	-0.99	-1,976	-16%	0.35	1.88	263,858	258,164	211,138	-7,694	-3%	45,026	18%	0.97	1.21	271,245		
1.3 WLS Fiber R&D	25,303	87,109	100,942	81,807	323%	1.88	18,888	75%	3.44	0.86	172,208	234,014	290,922	61,807	35%	28,907	17%	1.36	0.90	340,990		
1.4 PVC Extrusion R&D	81,085	0	19,829	-81,085	-100%	-0.00	0	0%	0.00	0.00	1,006,723	938,211	974,916	-68,512	-7%	-38,708	-4%	0.93	0.86	1,348,394		
1.5 PVC Module R&D	286,736	25,200	0	-261,535	-91%	-25.20	0	0%	0.00	N/A	828,196	550,292	1,041,055	-278,904	-34%	-450,763	-69%	0.68	0.53	1,589,549		
1.6 Electronics R&D	155,840	19,443	14,471	-136,397	-88%	-4.92	-978	0%	0.12	1.34	429,049	313,030	549,846	-116,810	-27%	-236,816	-76%	0.73	0.57	1,473,437		
1.7 DAQ R&D	125,175	1,747	17,983	-123,428	-99%	-16.28	0.01	0.10	0.01	0.10	339,419	218,044	798,136	-121,375	-36%	-580,892	-266%	0.64	0.27	1,383,728		
1.8 Detector Assembly R&D	260,125	13,117	36,482	-247,007	-95%	-23.36	0	0%	0.05	0.36	1,270,768	878,966	1,733,144	-391,802	-31%	-854,178	-37%	0.69	0.51	2,850,906		
1.9 Project Management R&D	0	0	0	0	0%	0%	0	0%	1.00	1.00	9,184,127	9,184,127	9,359,785	0	0%	175,658	2%	1.00	0.98	9,184,127		
Construction																						
2.0.1.1 Recycler Ring Modifications	25,264	2,347	1,033	-22,917	-91%	-1.14	0	0%	0.09	2.27	25,264	2,347	1,033	-22,917	-91%	-1,314	0%	0.09	2.27	7,916,804		
2.0.1.2 Recycler Kicker System	164,666	4,207	344	-160,459	-97%	-3.83	0	0%	0.03	12.22	164,666	4,207	344	-160,459	-97%	-3,863	0%	0.03	12.22	7,910,714		
2.0.1.3 Recycler Instrumentation	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	1,421,482		
2.0.2.1 MI Modifications	1,637	0	0	-1,637	-100%	0%	0	0%	0.00	0.00	1,637	1,395	0	-242	-15%	1,395	85%	0.85	N/A	373,332		
2.0.2.2 MI RF Cavities	10,572	1,945	14,602	8,626	82%	1.28	12,857	123%	0.18	0.13	10,572	3,891	14,602	-6,681	-63%	-10,711	-274%	0.37	0.27	1,433,052		
2.0.3.1 NuMI Primary Proton Beam	116,304	0	7,487	-116,304	-100%	-7.487	0	0%	0.00	0.00	116,304	13,636	7,487	-102,668	-88%	-6,148	-5%	0.12	1.82	1,450,655		
2.0.3.2 NuMI Target Hall Technical Components	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	1,634,201		
2.0.3.3 NuMI Target Hall Infrastructure	0	22,148	8,635	-22,148	-100%	-13.53	0	0%	0.00	2.56	8,635	22,148	10,683	13,519	156%	1,884	N/A	2.56	1.18	1,718,959		
2.0.3.4 NuMI Decay Pipe/Hadron Absorber/Utilities	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	928,793		
2.0.4 Project Management - ANU - Construction	67,852	67,852	24,936	0	0%	42.915	0	0%	1.00	2.72	274,403	274,403	250,793	0	0%	23,610	9%	1.00	1.09	5,159,684		
2.1 Site Preparation Package	13,820	13,820	23,000	0	0%	-9,180	0	0%	1.00	0.60	384,006	368,859	281,707	-17,147	-4%	85,152	23%	0.96	1.30	11,530,402		
2.1.2 Far Detector Building	83,769	420,841	23,000	337,072	402%	397,841	352%	5.02	18.30	96,226	1,055,889	675,909	959,663	597%	379,579	35%	10,97	1.56	36,637,247			
2.1.2.1 Site and Building Security	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	195,804		
2.1.4 Management - Site and Building - Construction	15,653	0	0	-15,653	-100%	0%	0	0%	0.00	0.00	15,653	0	0	-15,653	-100%	0%	0%	0.00	1.00	171,599		
2.10 Project Management - Nova Project - Construction	61,975	61,975	55,200	0	0%	6,775	0	0%	1.12	730,227	730,227	588,898	0	0%	141,330	19%	1.00	1.24	5,561,928			
2.2.1 Mineral Oil	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	12,687,277		
2.2.2 Pseudocumene	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	1,289,109		
2.2.3 Waveshifters and Stadis 425	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	2,242,996		
2.2.4 Blending	3,358	3,358	0	0	0%	3,358	100%	N/A	1.00	N/A	3,358	3,358	0	0	0%	3,358	100%	1.00	N/A	747,442		
2.2.5 Transport - Liquid Scintillator	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	1,455,419		
2.2.6 Management - Liquid Scintillator - Construction	1,854	1,854	0	0	0%	1,854	100%	N/A	1.00	N/A	1,854	1,854	0	0	0%	1,854	100%	1.00	N/A	93,772		
2.3.1 Procurement - WLS Fiber	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	84,360		
2.3.2 Production - WLS Fiber	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	9,958,779		
2.3.3 Management - WLS Fiber - Construction	863	863	0	0	0%	863	100%	N/A	1.00	N/A	863	863	0	0	0%	863	100%	1.00	N/A	37,646		
2.4.1 Procurement - PVC Extrusions	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	177,691		
2.4.2 Extrusion Pre-Production	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	1,172,758		
2.4.3 Extrusion Production	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	21,778,474		
2.4.4 Production Quality Assurance and Extrusion Evaluation	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	605,199		
2.4.5 Shipping & Handling - PVC Extrusions	71,296	0	0	-71,296	-100%	0%	0	0%	0.00	1.00	71,296	0	0	-71,296	-100%	0%	0%	0.00	1.00	782,062		
2.4.6 Management - PVC Extrusions - Construction	8,637	1,402	0	-7,235	-84%	-1.402	0.16	N/A	0.16	N/A	8,637	1,402	0	-7,235	-84%	-1,402	0%	0.16	N/A	781,816		
2.5.1 End Seats	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	1,798,372		
2.5.2 Optical Connector Production	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	118,077		
2.5.3 Module Production	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	7,603,658		
2.5.4 Management - PVC Modules - Construction	12,092	12,092	0	0	0%	12,092	100%	N/A	1.00	N/A	61,067	61,067	0	0	0%	61,067	100%	1.00	N/A	785,531		
2.6.1 APD Module Production	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	6,288,235		
2.6.2 Readout - FEB	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	2,610,747		
2.6.3 Readout Infrastructure	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	2,905,067		
2.6.4 Management - Electronics - Construction	751	751	0	0	0%	751	100%	N/A	1.00	N/A	751	751	0	0	0%	751	100%	1.00	N/A	38,179		
2.7.1 DAQ Software	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	778,255		
2.7.2 DAQ Hardware	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	2,100,306		
2.7.3 Integration - DAQ	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	441,042		
2.7.4 Detector Control System	0	0	0	0	0%	0%	0	0%	1.00	1.00	0	0	0	0%	0%	0	0%	1.00	1.00	204,894		
2.7.5 Management - DAQ - Construction	213	213	0	0	0%	213	100%	N/A	1.00	N/A	2											

Monthly Reporting: Customer Analysis Report Example

Report Period: Dec-08												
WBS Level 2	Current Period					Cumulative						
	BCWS (AY\$)	BCWP (AY\$)	ACWP (AY\$)	SPI	CPI	BCWS (AY\$)	BCWP (AY\$)	ACWP (AY\$)	SV (AY\$)	CV (AY\$)	SPI	CPI
R&D												
1.0 ANU R&D	11,282	148,680	34,144	13.18	4.35	1,469,499	2,239,748	1,763,926	770,249	475,822	1.52	1.27
1.1 Site and Building R&D	35,558	16,001	265,893	0.45	0.06	2,203,404	2,274,519	1,493,436	71,115	781,083	1.03	1.52
1.2 Liquid Scintillator R&D	8,436	8,436	2,441	1.00	3.46	243,482	243,507	200,578	25	42,929	1.00	1.21
1.3 WLS Fiber R&D	12,635	11,149	28,816	0.88	0.39	146,905	143,189	159,848	-3,716	-16,659	0.97	0.90
1.4 PVC Extrusion R&D	0	6,198	12,405	N/A	0.50	925,639	931,837	948,616	6,198	-16,780	1.01	0.98
1.5 PVC Module R&D	0	3,239	128,231	N/A	0.03	540,108	512,507	1,020,264	-27,600	-507,757	0.95	0.50
1.6 Electronics R&D	0	2,748	17,600	N/A	0.16	273,209	286,484	523,098	13,275	-236,614	1.05	0.55
1.7 DAQ R&D	0	2,053	1,593	N/A	1.29	214,243	216,297	778,955	2,053	-562,658	1.01	0.28
1.8 Detector Assembly R&D	50,788	21,031	81,415	0.41	0.26	919,841	865,571	1,628,883	-54,270	-763,312	0.94	0.53
1.9 Project Management R&D	0	0	0	1.00	1.00	9,184,127	9,184,127	9,359,813	0	-175,686	1.00	0.98
Construction												
2.0 ANU Construction	0	1,167	30,671	N/A	0.04	206,551	221,354	214,470	14,804	6,885	1.07	1.03
2.1 Site and Building	13,820	474,404	46,000	34.33	10.31	368,823	768,167	865,617	399,344	-97,450	2.08	0.89
2.10 Project Management - Nova Project - C	61,975	61,975	39,585	1.00	1.57	606,278	606,278	491,909	0	114,369	1.00	1.23
2.2 Liquid Scintillator	0	0	0	1.00	1.00	0	0	0	0	0	1.00	1.00
2.3 WLS Fiber	0	0	0	1.00	1.00	0	0	0	0	0	1.00	1.00
2.4 PVC Extrusions	0	0	0	1.00	1.00	0	0	0	0	0	1.00	1.00
2.5 PVC Modules	12,092	12,092	0	1.00	N/A	36,882	36,882	0	0	36,882	1.00	N/A
2.6 Electronics	0	0	0	1.00	1.00	0	0	0	0	0	1.00	1.00
2.7 DAQ	0	0	0	1.00	1.00	0	0	0	0	0	1.00	1.00
2.8 Near Detector Assembly	0	0	0	1.00	1.00	0	61,242	0	61,242	61,242	N/A	N/A
2.9 Far Detector Assembly	8,492	8,492	0	1.00	N/A	27,930	27,930	4,692	0	23,238	1.00	5.95
R&D SubTotal (WBS 1.0-1.9)	118,698	219,534	572,538	1.85	0.38	16,120,458	16,897,786	17,877,417	777,328	-979,631	1.05	0.95
Construction SubTotal (WBS 2.0-2.9)	96,380	558,131	116,256	5.79	4.80	1,246,463	1,721,853	1,576,687	475,390	145,166	1.38	1.09
Project Total	215,078	777,665	688,794	3.62	1.13	17,366,921	18,619,638	19,454,104	1,252,718	-834,465	1.07	0.96

How to Manually Calculate ETC

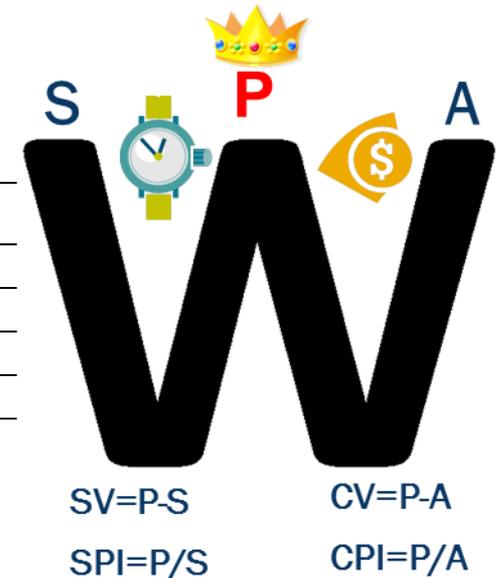
Information Needed to Start

- **BAC = Budget at Completion**
- **BCWS_{CTD} = Cumulative BCWS**
- **BCWP_{CTD} = Cumulative BCWP**
- **ACWP_{CTD} = Cumulative ACWP**

Calculations

- **EAC = ACWP_{CTD} + ETC**
- **ETC = EAC - ACWP_{CTD}**
- **ETC = BAC - BCWP_{CTD}**
- **VAC = BAC - EAC**

Cumulative to Date						
BCWS	BCWP	ACWP	BAC	ETC	EAC	VAC
1,000	500	700	10,000	9,500	10,200	-200
1,000	1,000	700	10,000	9,000	9,700	300
1,000	1,000	1,000	10,000	9,000	10,000	0
1,000	1,500	1,000	10,000	8,500	9,500	500



How to Calculate ETC (Cont.)

$$EAC = ACWP_{CTD} + ETC$$

$$ETC = EAC - ACWP_{CTD}$$

$$ETC = BAC - BCWP_{CTD} + \text{Known Future Deviations}$$

$$VAC = BAC - EAC$$

Cumulative to Date										
BCWS	BCWP	ACWP	BAC	ETC	EAC	VAC	SPI	CPI	CV	Known Future Deviation
1,000	500	700	10,000	9,500	10,200	-200	0.50	0.71	-200	
1,000	1,000	700	10,000	8,600	9,300	700	1.00	1.43	300	-400
1,000	1,000	1,000	10,000	9,000	10,000	0	1.00	1.00	0	
1,000	1,500	1,000	10,000	10,500	11,500	-1500	1.50	1.50	500	2000
1,000	1,500	1,000	10,000	8,500	9,500	500	1.50	1.50	500	



EVMS is:

- **Management Tool**
- **Communication Tool**

Cobra Calculated PF=1 EAC

Statistical Forecasts:

- Allow a calculated revised ETC and forecast values without manual input
- Cobra has many ways to Calculate EAC
- Performance Factor (PF)=1 is the most commonly used at FNAL

PF=1

- Assumes that the project will perform all remaining work according to budget
- Calculates ETC by subtracting BCWP or EV from Budget at Completion

Example Calculation:

$ETC = (BAC) 1000 - (BCWP) 700 = 300$ (+/- affect of escalation)

$Forecast = (ACWP) 900 + (ETC) 300 = 1200$

Cobra Calculated PF=1 EAC Used to Validate

Use Calculations to Validate CAMs Assumptions

- **PF=1 Does not account for past Performance Variations**
 - Assumes past performance (Negative or Positive) were not indicative of future performance.
- **CAM Assesses and Analyzes Future Work (ETC):**
 - If the following are True than PF=1 is appropriate
 - Remaining Baseline Resource Assumptions are still applicable i.e. will not increase or decrease
 - Past Performance is not expected to continue in the future or Performance for future work has already be accounted for via processed BCR or applied Manual Forecast
 - PF=1 Calculated EAC realistically reflects CAMs analysis
 - All Anticipated deviations from Baseline Cost Must be either:
 - Manually entered via. Manual EAC
 - Accounted for in Processed BCRs for future work

See 12.PM-006 (allows calculated EAC to Validate CAMs EAC Assumptions)

How to Calculate ETC using P6 (Manual EAC)

P6 update included forecast dates and resource remaining units

Activity ID: 2253.501, Activity Name: Procure Dump Parts/Material - M&S

Activity Type: Task Dependent, Duration Type: Fixed Units, % Complete Type: Physical

WBS: 476-B-2.02.02.05.03 Implementation

Activity ID	Activity Name	Activity % Complete	BL Start	BL Finish	Start	Finish	Variance - BL Finish	Total Float
Project: 475.02-20140930			5/1/14	9/25/20	4/30/14 A	10/20/20	-17	518
Control Account: 475.02.01 Accelerator Project Management			10/1/14	9/21/20	10/1/14	10/20/20	-21	498

Activity ID	Activity Name	Activity % Complete	BL Start	BL Finish	Start	Finish	Variance - BL Finish	Total Float
47502.07.03.002000	Final LCW system design (remaining)	0%	8/1/14	11/21/14	8/1/14 A	12/15/14	-14	250
47502.07.03.001117	Final Vacuum Design	16.4%	7/7/14	12/26/14	8/1/14 A	1/27/15	-19	224
47502.07.03.002010	Final compressed air system design	0%	8/1/14	11/21/14	10/1/14	1/29/15	-42	222

Activity % Complete	Performance % Complete	Schedule % Complete	Physical % Complete	Units % Complete	Labor Cost % Complete
100%	100%	100%	100%	100%	0%
100%	100%	100%	0%	100%	0%
0%	0%	100%	0%	0%	0%
16.4%	16.4%	12.23%	16.4%	15.3%	0%

Activity: 47502.07.03.001117, Final Vacuum Design

Role	Resource ID	Resource Name	Start	Finish	Planned Units	Remaining Units
	FNAD_ELEC_ASMBY_TECH	Electrical Assembly Technician	8/1/14 A	1/27/15	80.00h	64.00h
	FNAD_ENGRING_PHYST	Engineering Physicist	8/1/14 A	1/27/15	40.00h	32.00h
	FNAD_MECH_DESIGN_EN	Mechanical Design Engineer	8/1/14 A	1/27/15	200.00h	166.00h
Hurd D	FNAD_MECH_DRAFTER	Mechanical Drafter	8/1/14 A	1/27/15	380.00h	331.00h

How to Calculate ETC using P6 (cont.)

P6 Forecast dates and remaining units integrated into Cobra

Code	Description	Cntrl Acct	WP	Description	CAM	Budget	Hours Budget	BAC	Hours B
		475.02.07	47502.07.03.001117	Final Vacuum Design		\$38,792.71	355.83	\$76,464.75	
		475.02.07	47502.07.03.001210	Develop Vacuum Installation Schedule		\$0.00	0.00	\$3,087.26	
		475.02.07	47502.07.03.001000	Refinement Design of the ICM System P&ID		\$43,533.00	350.00	\$43,533.00	

General Resource Assignments Milestones/Steps Notes

Class Filter: All Classes
Cost Set Filter:

Resource Assignment:

Time Phase:

Resource	Description	Class	Class Description	Result	Units	TOTAL	31OCT2014	30NOV2014	31DEC2014	31JAN2015
FNAD_ENGNRING_PHYST	Engineering Physicist	CB	Current Budget (BCWS)	Percent		100.00	29.49	23.08	25.64	21.79
FNAD_MECH_DESIGN_EN	Mechanical Design Engineer	CB	Current Budget (BCWS)	HOURS	HOURS	64.00	18.87	14.77	16.41	13.95
FNAD_MECH_DRAFTER	Mechanical Drafter	CB	Current Budget (BCWS)	FTEM	HEADS	0.45	0.12	0.12	0.12	0.10
FNAD_ELEC_ASMBY_TECH	Electrical Assembly Technician	CL	Contingency - Labor	FTEY	HEADS	0.04	0.01	0.01	0.01	0.01
FNAD_ENGNRING_PHYST	Engineering Physicist	CL	Contingency - Labor	DIRECT	\$	1,736.32	511.99	400.69	445.21	378.43
FNAD_MECH_DESIGN_EN	Mechanical Design Engineer	CL	Contingency - Labor	ESCA	\$	46.88	13.82	10.82	12.02	10.22
FNAD_MECH_DRAFTER	Mechanical Drafter	CL	Contingency - Labor	FRINGE	\$	1,053.16	310.55	243.04	270.04	229.53
FNAD_ELEC_ASMBY_TECH	Electrical Assembly Technician	Earned	Performed (BCWP)	OVERHEAD	\$	2,866.71	845.31	661.55	735.05	624.80
FNAD_ENGNRING_PHYST	Engineering Physicist	Earned	Performed (BCWP)	Total Currency		5,703.07	1,681.67	1,316.09	1,462.32	1,242.98
FNAD_MECH_DESIGN_EN	Mechanical Design Engineer	Earned	Performed (BCWP)							
FNAD_MECH_DRAFTER	Mechanical Drafter	Earned	Performed (BCWP)							
FNAD_ELEC_ASMBY_TECH	Electrical Assembly Technician	FCB	Forecast non-PD							
FNAD_ENGNRING_PHYST	Engineering Physicist	FCB	Forecast non-PD							
FNAD_MECH_DESIGN_EN	Mechanical Design Engineer	FCB	Forecast non-PD							
FNAD_MECH_DRAFTER	Mechanical Drafter	FCB	Forecast non-PD							

General Resource Assignments Milestones/Steps Notes

Status: In-progress Description: Final Vacuum Design Work Package Manager:

Dates: Start: 07/07/2014 Finish: 12/26/2014

Baseline: 07/07/2014

Actual: 08/01/2014

Forecast: 08/01/2014 01/27/2015

Early: 08/01/2014 01/27/2015

Late: 08/01/2014 12/14/2015

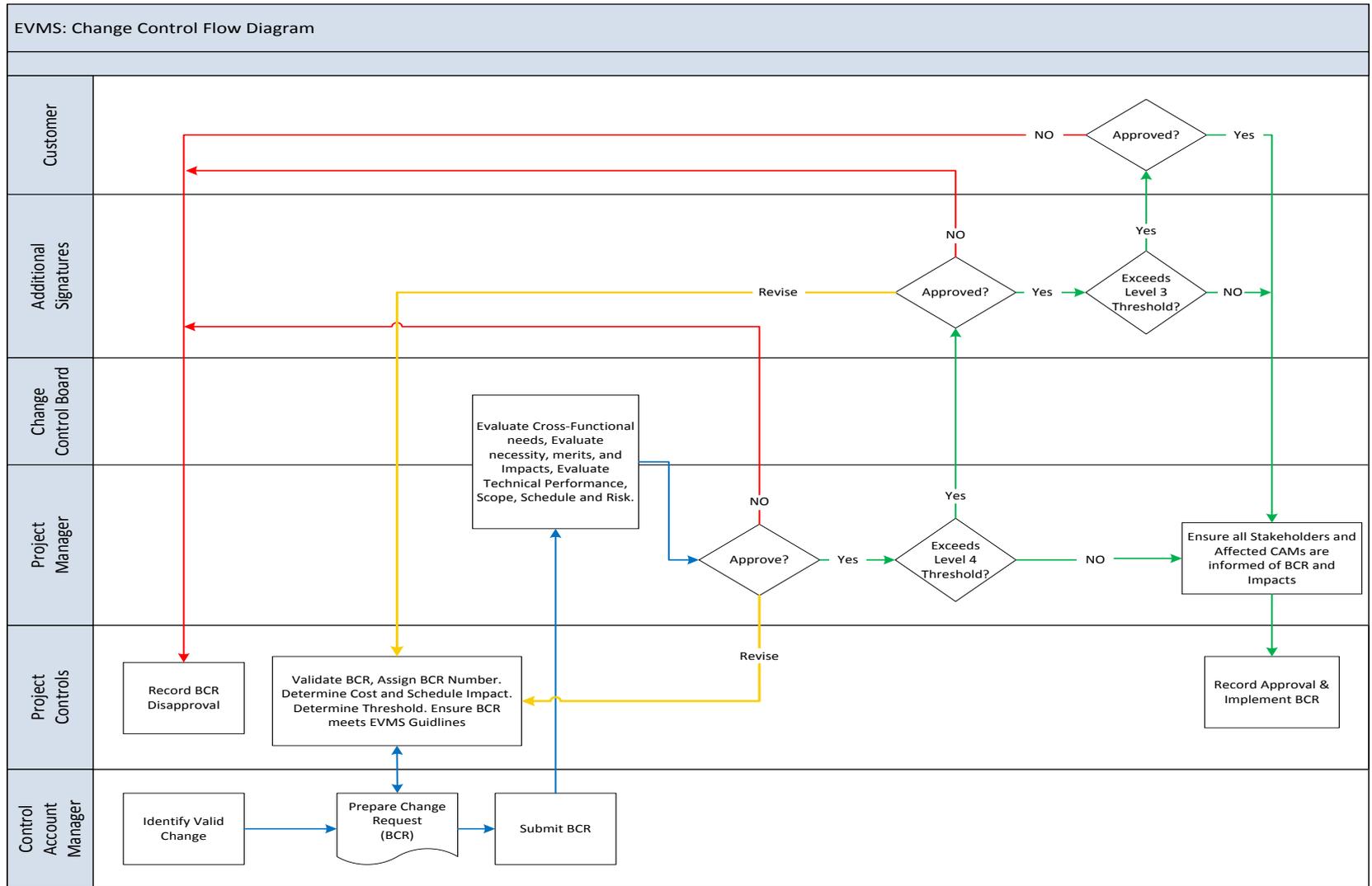
Pending: 10/01/2009 10/01/2009

Earned Value Technique
EVT: % Complete
% Completed: 16.40

EVM Cat 5 – Revisions and Data Maintenance (GL 28-32)

- 28. Incorporate Changes in a Timely Manner
- 29. Reconcile Current to Prior Budgets
- 30. Control Retroactive Changes
- 31. Prevent Unauthorized Revisions
- 32. Document PMB Changes

Change Control Flowchart (12.PM-007)



Schedule Related to EVMS Guidelines 28, 29, 30, 31 & 32

Revisions and Data Maintenance via BCR

- **Changes Only on Future Work**, not to change past performance
- **Change Control Thresholds are Project Specific**
 - High level Thresholds (DOE's) are Identified in the Project Execution Plan (PEP).
 - Lower level Thresholds (FRA's) are Identified in the Project Management Plan (PMP)
- Example

	DOE THRESHOLDS				FRA THRESHOLDS		
	Secretarial Acquisition Executive (Level 0-A) Deputy Secretary	Acquisition Executive (Level 0-B) SC-1	Associate Director OHEP (Level 1)	DOE NOvA Federal Project Director (Level 2)	Fermilab Associate Director (Level 3)	NOvA Project Manager (Level 4)	Subproject Manager (Level 5)
Technical	A change in scope that affects the ability to meet a Key Performance Parameter (KPP) and the ability to satisfy the mission need.	A change in scope that affects the ability to meet a KPP and the ability to satisfy the mission need.	Any change in the KPPs as referenced in PEP section 3.2.	Any significant change to the technical scope (as described in PEP sect. 5) that affect ES&H requirements or meeting Project Close-out definitions in PEP Table 7.2.	Major technical changes that are significant departures from the technical baseline. Changes that affect ES&H or impact PoT projections by more than 10%. Out-of-scope changes to upgrade physics capabilities.	Related technical changes to multiple subprojects that do not diminish performance	Minor technical changes to a single subproject that does not diminish performance
Schedule	≥ 6 month (cumulative) delay in the CD-4 completion date.	a 3 to 6 month (cumulative) delay in the CD-4 project completion date.	Any change to a level 1 milestone > 3 months, or up to a 3 month delay in CD-4 project completion date.	Any change to a Level 2 milestone > 1 month or a Level 1 milestone < 3 months.	Any change that results in the delay of a Level 3 Director's milestone.	Any change that results in the delay of a Level 4 milestone by more than one month.	Any change that results in the delay of a Level 5 milestone by more than one month
Cost	Increase in excess of \$25M or 25% (cumulative) of the CD-2 Total Project Cost baseline.	Any increase in the CD-2 Total Project Cost baseline.	Any change in Total Estimated Cost or Total Project Cost.	Any cumulative use of contingency of > \$1M.	Increase in the cost of a single item by more than \$250k. Increase in the Project base cost exceeding \$500k during the previous 12 months.	Increase in the cost of a single item by more than \$100k.	Increase in the cost of a single item by more than \$25k.

Example: Change Control Thresholds for Major System Projects, TPC \geq \$750M

	Acquisition Executive (Level 0)	Associate Director OHEP (Level 1)	DOE Federal Project Director (Level 2)	Fermilab Associate Director (Level 3)	Fermilab Project Manager (Level 4)	Subproject Manager (Level 5)
Scope	A change in scope that affects the ability to meet a KPP and the ability to satisfy the mission need.	Any change in the KPPs as referenced in PEP.	Any significant change to the technical scope (as described in PEP) that affect ES&H requirements or meeting Project Closeout definitions stated in PEP.	Major technical changes that are significant departures from the technical baseline. Changes that affect ES&H. Out-of-scope changes to upgrade physics capabilities.	Related technical changes to multiple subprojects that do not diminish performance	Minor technical changes to a single subproject that does not diminish performance
Schedule	> 6 month (cumulative) delay in the CD-4 project completion date.	Any change to a level 1 milestone > 3 months, or up to a 3 month delay in CD-4 project completion date.	Any change to a Level 2 milestone > 1 month or a Level 1 milestone < 3 months.	Any change that results in the delay of a Level 3 Director's milestone.	Any change that results in the delay of a Level 4 milestone by more than one month.	Any change that results in the delay of a Level 5 milestone by more than one month
Cost	Any increase in excess of the lesser of \$25M or 25% (cumulative) of the CD-2 Total Project Cost baseline.	Any change in Total Estimated Cost or Total Project Cost. The smaller cumulative change of greater than \$50M or 50% to each level 2 WBS cost	Any cumulative use of management reserve or contingency of > \$10M or 50% to each level 2 WBS cost.	Increase in the cost of a single item by more than \$2.5M. Increase in the Project base cost exceeding \$5M during the previous 12 months.	Increase in the cost of a single item by more than \$500k.	Increase in the cost of a single item by more than \$100k.

Example: Change Control Thresholds for Major System Projects, \$400M ≤ TPC < \$750M

	Acquisition Executive (Level 0)	Associate Director OHEP (Level 1)	DOE Federal Project Director (Level 2)	Fermilab Associate Director (Level 3)	Fermilab Project Manager (Level 4)	Subproject Manager (Level 5)
Scope	A change in scope that affects the ability to meet a KPP and the ability to satisfy the mission need.	Any change in the KPPs as referenced in PEP.	Any significant change to the technical scope (as described in PEP) that affect ES&H requirements or meeting Project Closeout definitions in PEP.	Major technical changes that are significant departures from the technical baseline. Changes that affect ES&H. Out-of-scope changes to upgrade physics capabilities.	Related technical changes to multiple subprojects that do not diminish performance	Minor technical changes to a single subproject that does not diminish performance
Schedule	a 3 to 6 month (cumulative) delay in the CD-4 project completion date.	Any change to a level 1 milestone > 3 months, or up to a 3 month delay in CD-4 project completion date .	Any change to a Level 2 milestone > 1 month or a Level 1 milestone < 3 months.	Any change that results in the delay of a Level 3 Director's milestone.	Any change that results in the delay of a Level 4 milestone by more than one month.	Any change that results in the delay of a Level 5 milestone by more than one month
Cost	Any increase in excess of the lesser of \$25M or 25% (cumulative) of the CD-2 Total Project Cost baseline.	Any change in Total Estimated Cost or Total Project Cost. The smaller cumulative change of greater than \$50M or 50% to each level 2 WBS cost	Any cumulative use of contingency of > \$10M or 50% to each level 2 WBS cost.	Increase in the cost of a single item by more than \$2.5M. Increase in the Project base cost exceeding \$5M during the previous 12 months.	Increase in the cost of a single item by more than \$500k.	Increase in the cost of a single item by more than \$100k.

Example: Change Control Thresholds for Major System Projects, $\$100M \leq TPC < \$400M$

	Acquisition Executive (Level 0)	Associate Director OHEP (Level 1)	DOE Federal Project Director (Level 2)	Fermilab Associate Director (Level 3)	Fermilab Project Manager (Level 4)	Subproject Manager (Level 5)
Scope	A change in scope that affects the ability to meet a KPP and the ability to satisfy the mission need.	Any change in the KPPs as referenced in PEP.	Any significant change to the technical scope (as described in PEP) that affect ES&H requirements or meeting Project Closeout definitions in PEP.	Major technical changes that are significant departures from the technical baseline. Changes that affect ES&H or impact PoT projections by more than 10%. Out-of-scope changes to upgrade physics capabilities.	Related technical changes to multiple subprojects that do not diminish performance	Minor technical changes to a single subproject that does not diminish performance
Schedule	a 3 to 6 month (cumulative) delay in the CD-4 project completion date.	Any change to a level 1 milestone > 3 months, or up to a 3 month delay in CD-4 project completion date.	Any change to a Level 2 milestone > 1 month or a Level 1 milestone < 3 months.	Any change that results in the delay of a Level 3 Director's milestone.	Any change that results in the delay of a Level 4 milestone by more than one month.	Any change that results in the delay of a Level 5 milestone by more than one month
Cost	Any increase in the CD-2 Total Project Cost baseline.	Any change in Total Estimated Cost or Total Project Cost.	Any cumulative use of management reserve or contingency of > \$1M.	Increase in the cost of a single item by more than \$250k. Increase in the Project base cost exceeding \$500k during the previous 12 months.	Increase in the cost of a single item by more than \$100k.	Increase in the cost of a single item by more than \$25k.

Example: Change Control Thresholds for Major System Projects, TPC < \$100M

	Associate Director OHEP (Level 1)	DOE Federal Project Director (Level 2)	Fermilab Associate Director (Level 3)	Fermilab Project Manager (Level 4)	Subproject Manager (Level 5)
Scope	Any change in the KPPs as referenced in PEP.	Any significant change to the technical scope (as described in PEP) that affect ES&H requirements or meeting Project Closeout definitions in PEP.	Major technical changes that are significant departures from the technical baseline. Changes that affect ES&H. Out-of-scope changes to upgrade physics capabilities.	Related technical changes to multiple subprojects that do not diminish performance	Minor technical changes to a single subproject that does not diminish performance
Schedule	Any change that causes a delay in CD-4 project completion date .	Any change to a Level 2 milestone > 1 month or a Level 1 milestone < 3 months.	Any change that results in the delay of a Level 3 Director's milestone.	Any change that results in the delay of a Level 4 milestone by more than one month.	Any change that results in the delay of a Level 5 milestone by more than one month
Cost	Any change in Total Estimated Cost or Total Project Cost.	Any cumulative use of management reserve or contingency of > \$1M.	Increase in the cost of a single item by more than \$250k. Increase in the Project base cost exceeding \$500k during the previous 12 months.	Increase in the cost of a single item by more than \$100k.	Increase in the cost of a single item by more than \$25k.

Change Request Form Example



Mu2e Change Request

Mu2e CR Num 3 Date submitted: 8/20/2014 Change Level: 4

Requestor: Frances Leavell Request Status: Approved

Change_type:

Cost

WBS: 475

WBS Description: Mu2e Project

Approvals: CCB OK:

Ron Rgy

Project manager Date 8/29/14 Approved

Supporting Documents:

4470

L2 Subprojects:

All

Description: Routine rate adjustments were made in July 2014 by Finance to more accurately reflect labor fringe and DSC overhead rates. The new rates were applied to the project resources. Cost impact: net decrease of 521,549.86.

Justification: Implementing the new rates provides up-to-date pricing of resources.

Cost Impacts:

Estimate type	Cost type	Labor resource type	Before amount	After amount	Cost Units
Final	M&S	none	107,025,671	106,434,256	dollars
Final	Labor	various	110,808,408	111,378,273	dollars

Schedule Impacts:

Task Description	Before			After			Duration units
	Start	End	Duration	Start	End	Duration	
none							

Technical Impact: None

Risk Impact: None

Example: Change Request Log (Summary)

PROJECT_BCR_log.xlsx

Baseline Change Summary Log

- Summary record of all changes
- Tracks contingency and mgmt reserve used

Project Baseline Change Summary

	BCWS	MR	Contingency	TCP	Start Date	Finish Date
Original Baseline	\$ 218,549,966	\$ 1,000,000	\$ 52,450,033	\$ 271,000,000		
Current Net Approved Adjusted Base Line	\$ 219,267,777	\$ (611,163)	\$ 55,020,385	\$ 273,677,000		

Project Log of Baseline Change Requests

BCR #	Description of change	Date Submitted	Level	BCWS Impact	MR Impact	Contingency Impact	TPC Impact	Schedule Impact (Days)	Approval Status	Date of Last Status	Month-Year of BCR Implementation	Reference Document
001	changes to remote target handling control room	8/20/2013	3	\$ 95,489	\$ (95,489)	\$ -	\$ -	0	approved			4412
002	recommendations from Director's Review.	8/8/2014	3	\$ 361,274	\$ (361,274)	\$ -	\$ -	9	approved			4448
003	New rate adjustments for labor fringe and overhead.	8/20/2014	3	\$ (21,550)	\$ 21,550	\$ -	\$ -	0	approved			4473
004	Cost leveling, new CD-3c strategy	10/2/2014	3	\$ 500,080	\$ (500,080)	\$ -	\$ -	-7	approved			4599
005	Resource/Code corrections	10/29/2014	3	\$ (34,284)	\$ 34,284	\$ -	\$ -	0	approved			4705
006	Corrections made to CRO02	11/7/2014	3	\$ (172,650)	\$ 172,650	\$ -	\$ -	0	approved			4731
007	Changes due to DOE Review recommendations	11/12/2014	2	\$ 78,083	\$ (78,083)	\$ -	\$ -	30 days (T2)	approved		Nov-14	4736
008	FY 15 Rate changes	11/13/2014	3	\$ (1,699,794)	\$ 806,442	\$ 893,352	\$ -	0	approved		Nov-14	4749
009	include central ES&H support	11/21/2014	3	\$ 518,178	\$ (518,178)	\$ -	\$ -	0	approved		Dec-14	4837
010	Solenoid (prototype TS coil module), minor CRV and Muon Beam line changes	11/24/2014	3	\$ 203,446	\$ (203,446)	\$ -	\$ -	47 days (T4)	approved		Dec-14	4840
011	CD-2/3b Approval Delay	12/11/2014	2	\$ 73,574	\$ (73,574)	\$ -	\$ -	76 days (T2)	approved		Dec-14	4969
012	PS & DS contract terms; Accelerator design reviews	1/7/2015	2	\$ 815,964	\$ (815,964)	\$ (1,000,000)	\$ -	68 days (T2)	approved	28-Jan-2015	Feb-15	5029
--	DOE Increased funding - extra amount added to contingency	1/26/2015				\$ 2,677,000	\$ 2,677,000		approved			

Approved Net Impact	\$ 717,811	\$ (1,611,163)	\$ 2,570,352	\$ 2,677,000
Pending Net Impact	\$ -	\$ -	\$ -	\$ -
Total Net Impact	\$ 717,811	\$ (1,611,163)	\$ 2,570,352	\$ 2,677,000

Data Check with Cobra change Log	\$ 219,267,776	\$ 1,000,000
Delta	\$ (1)	\$ 1,611,163

BCR Control Account Log (Control Account)

PROJECT_change_control_log.xlsx

Baseline Change Control Account Log

1 of 1

BCR #	BCR Description	Control Account	CAM	Prior Start	Revised Start	Start Impact (Days)	Prior Finish	Revised Finish	Finish Impact (Days)	Values		
										BAC Before	BAC After	Cost Impact Increase/(Decrease)
001										12,680,712.38	12,776,201.38	95,489.00
002										186,839,049.71	187,200,323.73	361,274.02
003										201,545,611.44	201,524,061.58	(21,549.86)
004										202,943,386.82	203,443,466.43	500,079.61
005										30,303,038.86	30,268,754.75	(34,284.11)
006										191,299,097.75	191,126,448.06	(172,649.69)
007										101,599,396.87	101,677,479.52	78,082.65
008										197,543,525.86	195,843,731.78	(1,699,794.08)
009										14,227,346.44	14,745,524.70	518,178.26
010										52,076,260.12	52,279,706.40	203,446.28
011	CD-2/3b Approval Delay	475.03.02	06758 N Laskowski, Thomas	7/2/2012	7/2/2012	0	2/15/2017	4/4/2017	-34	45,377.84	45,511.40	133.57
		475.03.04.01	06758 N Laskowski, Thomas	1/21/2015	1/21/2015	0	3/21/2016	5/6/2016	-34	12,991,260.76	13,058,780.11	67,519.35
		475.03.04.03	06758 N Laskowski, Thomas	4/8/2015	4/8/2015	0	10/15/2019	10/15/2019	0	752,873.32	758,424.48	5,551.16
		475.03.04.04	05374 N Coleman, Rick	11/21/2014	1/16/2015	0	6/3/2015	7/16/2015	-30	0.00	0.00	0.00
		475.03.05	06758 N Laskowski, Thomas	2/29/2016	2/29/2016	0	5/10/2017	6/28/2017	-39	374,466.35	374,836.53	370.18
011 Total										14,163,978.27	14,237,552.52	73,574.26
012										157,695,665.36	158,511,629.64	815,964.28
(blank)										0.00	0.00	0.00
Grand Total												717,810.60

BCR Documentation: Validation Reports (CA Impact i.e. Before & After)

Muong-2 BCR111 (example).xlsx

BCR Implementation Control Account Impact

1 of 1

BCR Comparison Data in K Dollars

Prior Fund Type

DOE.HEP.MIE DOE-...

DOE.HEP.OPC DOE-...

EC Early Career Grant

In Kind In-Kind Contri...

NSF National Scienc...

(blank)

BCR Fund Type

DOE.HEP.MIE DOE-H...

DOE.HEP.OPC DOE-...

EC Early Career Grant

In Kind In-Kind Contri...

NSF National Scienc...

(blank)



BCR #	BCR Description	WBS L2	CAM	Control Account	Control Account Description	Prior BAC	Revised BAC	Cost Impact	Prior Start	Revised Start	Start Impact (Days)	Prior Finish	Revised Finish	Finish Impact (Days)
111	Test of Reporting Data	476.01 Project Management	Polly, Chris	476.01	476.01 Project Management	3,974	4,037	-63	10/1/2012	10/1/2012	0	4/11/2017	4/11/2017	0
		476.01 Project Management Total				3,974	4,037	-63			0			0
111	Test of Reporting Data	476.02 Accelerator	Convery, Mary	476.02.01	476.02.01 Accelerator Project Management	2,622	2,622	0	10/1/2012	10/1/2012	0	4/13/2017	4/13/2017	0
111	Test of Reporting Data	476.02 Accelerator	Drendel, Brian	476.02.04	476.02.04 Controls & Instrumentation	1,822	2,089	-217	10/1/2012	10/1/2012	0	3/13/2017	3/13/2017	0
111	Test of Reporting Data	476.02 Accelerator	Morgan, Jim	476.02.03	476.02.03 Beamlines	11,768	11,451	317	10/1/2012	10/1/2012	0	3/30/2017	3/30/2017	0
111	Test of Reporting Data	476.02 Accelerator	Still, Dean	476.02.02	476.02.02 Target Station	1,548	1,652	-105	10/1/2012	10/1/2012	0	12/29/2016	12/29/2016	0
		476.02 Accelerator Total				17,759	17,764	-4			0			0
111	Test of Reporting Data	476.03 Ring	Allspach, Delwyn H	476.03.02	476.03.02 Magnet	3,473	3,446	27	10/1/2012	10/1/2012	0	2/19/2016	2/19/2016	0
111	Test of Reporting Data	476.03 Ring	Allspach, Delwyn H	476.03.04	476.03.04 Storage Ring Vacuum	713	744	-31	10/1/2012	10/1/2012	0	7/15/2016	7/15/2016	0
111	Test of Reporting Data	476.03 Ring	Allspach, Delwyn H	476.03.07	476.03.07 Controls & Instrumentation	658	658	0	10/1/2012	10/1/2012	0	10/29/2015	10/29/2015	0
111	Test of Reporting Data	476.03 Ring	Nguyen, Hogan	476.03.01	476.03.01 Ring Project Management	1,143	1,143	0	10/1/2012	10/1/2012	0	4/13/2017	4/13/2017	0
111	Test of Reporting Data	476.03 Ring	Nguyen, Hogan	476.03.03	476.03.03 Inflector	1,138	1,138	0	10/1/2012	10/1/2012	0	8/2/2016	8/2/2016	0
111	Test of Reporting Data	476.03 Ring	Nguyen, Hogan	476.03.05	476.03.05 Kickers	1,155	1,155	0	10/1/2012	10/1/2012	0	8/2/2016	8/2/2016	0
111	Test of Reporting Data	476.03 Ring	Tishchenko, V.	476.03.06	476.03.06 Quadrupoles	824	824	0	10/1/2012	10/1/2012	0	6/20/2016	6/20/2016	0
111	Test of Reporting Data	476.03 Ring	Winter, Peter	476.03.08	476.03.08 Precision Field	1,129	1,129	0	10/1/2012	10/1/2012	0	6/27/2016	6/27/2016	0
		476.03 Ring Total				10,232	10,236	-5			0			0
111	Test of Reporting Data	476.04 Detectors	Casey, Brendan	476.04	476.04 Detectors	670	670	0	10/1/2012	10/1/2012	0	4/13/2017	4/13/2017	0
		476.04 Detectors Total				670	670	0			0			0
111	Test of Reporting Data	476.05 BNL Equipment Disassembly & Transport	Polly, Chris	476.05	476.05 BNL Equipment Disassembly & Transport	4,183	4,183	0	10/1/2012	10/1/2012	0	5/28/2014	5/28/2014	0
		476.05 BNL Equipment Disassembly & Transport Total				4,183	4,183	0			0			0
		Grand Total				36,819	36,890	-72			0			0

BCR Documentation: Validation Reports (History Unchanged)

Before-After change PivotTable.xlsx

BCR Implementation History Unchanged Validation

1 of 2

Pivot From Prior Data (in K Dollars)		Pivot From BCR Data (in K Dollars)		Prior Data - BCR Data (in K Dollars)	
Fund Type	(Multiple Items)	Fund Type	(Multiple Items)		
Results	F-BDN-AY\$	Results	F-BDN-AY\$		
Sum of Value	Cost Set	Sum of Value	Cost Set	Date	Budget
Date	Budget	Date	Budget		
10/31/2012	535	10/31/2012	535	10/31/2012	0
11/30/2012	465	11/30/2012	465	11/30/2012	0
12/31/2012	418	12/31/2012	418	12/31/2012	0
1/31/2013	488	1/31/2013	488	1/31/2013	0
2/28/2013	464	2/28/2013	464	2/28/2013	0
3/31/2013	486	3/31/2013	486	3/31/2013	0
4/30/2013	509	4/30/2013	509	4/30/2013	0
5/31/2013	509	5/31/2013	509	5/31/2013	0
6/30/2013	463	6/30/2013	463	6/30/2013	0
7/31/2013	509	7/31/2013	509	7/31/2013	0
8/31/2013	509	8/31/2013	509	8/31/2013	0
9/30/2013	450	9/30/2013	450	9/30/2013	0
10/31/2013	754	10/31/2013	754	10/31/2013	0
11/30/2013	623	11/30/2013	623	11/30/2013	0
12/31/2013	621	12/31/2013	621	12/31/2013	0
1/31/2014	467	1/31/2014	467	1/31/2014	0
2/28/2014	373	2/28/2014	373	2/28/2014	0
3/31/2014	375	3/31/2014	375	3/31/2014	0
4/30/2014	349	4/30/2014	349	4/30/2014	0
5/31/2014	845	5/31/2014	845	5/31/2014	0
6/30/2014	954	6/30/2014	954	6/30/2014	0
7/31/2014	812	7/31/2014	812	7/31/2014	0
8/31/2014	933	8/31/2014	933	8/31/2014	0
9/30/2014	1,232	9/30/2014	1,232	9/30/2014	0
10/31/2014	1,055	10/31/2014	1,055	10/31/2014	0
11/30/2014	959	11/30/2014	943	11/30/2014	16
				12/31/2014	884
				1/31/2015	1,308
				2/28/2015	939
				3/31/2015	1,501
				4/30/2015	1,050
				5/31/2015	725
				6/30/2015	1,055
				7/31/2015	1,364
				8/31/2015	873
				9/30/2015	585
				10/31/2015	1,235
				11/30/2015	944
				12/31/2015	697
				1/31/2016	623
				2/29/2016	639
				3/31/2016	641
				4/30/2016	861
				5/31/2016	450
				6/30/2016	337
				7/31/2016	264
				8/31/2016	678
				9/30/2016	614
				10/31/2016	659
				11/30/2016	563
				12/31/2016	351
				1/31/2017	409
				2/28/2017	205
				3/31/2017	177
				4/30/2017	29
				Grand Total	36,819
				12/31/2014	858
				1/31/2015	1,223
				2/28/2015	966
				3/31/2015	1,875
				4/30/2015	1,221
				5/31/2015	945
				6/30/2015	853
				7/31/2015	930
				8/31/2015	622
				9/30/2015	687
				10/31/2015	1,266
				11/30/2015	929
				12/31/2015	669
				1/31/2016	715
				2/29/2016	694
				3/31/2016	725
				4/30/2016	1,326
				5/31/2016	747
				6/30/2016	542
				7/31/2016	255
				8/31/2016	190
				9/30/2016	154
				10/31/2016	583
				11/30/2016	632
				12/31/2016	317
				1/31/2017	341
				2/28/2017	291
				3/31/2017	170
				4/30/2017	23
				Grand Total	36,890
				12/31/2014	26
				1/31/2015	85
				2/28/2015	-27
				3/31/2015	-374
				4/30/2015	-171
				5/31/2015	-220
				6/30/2015	202
				7/31/2015	435
				8/31/2015	250
				9/30/2015	-102
				10/31/2015	-31
				11/30/2015	15
				12/31/2015	28
				1/31/2016	-91
				2/29/2016	-56
				3/31/2016	-84
				4/30/2016	-465
				5/31/2016	-297
				6/30/2016	-205
				7/31/2016	9
				8/31/2016	488
				9/30/2016	461
				10/31/2016	76
				11/30/2016	-69
				12/31/2016	34
				1/31/2017	67
				2/28/2017	-86
				3/31/2017	7
				4/30/2017	6
				Grand Total	-72

BCR revised WAD – Example

Work Authorization Document

Control Account Information	
Control Account Manager:	Hays, Steven L
Control Account Number:	475.04.06
Control Account Description:	Magnet Power System

Period of Performance			
Start:	1/2/2013	Finish:	10/16/2018

WAD Scope
BCR# 004 Cost leveling; new CD-3c strategy_Impact: Cost \$19,039 & Sched Days 0
This includes design, analysis, procurement, assembly, acceptance testing, installation, commissioning and close-out activities for the magnet power system. The magnet power system includes the power supplies, the dump switch, and the dump resistor.

Budget	HOURS	DIRECT	BAC
Funding Type DOE.HEP.LNI.CNSTR	2,201.00	784,946.33	1,159,471.82
Labor	2,201.00	94,478.33	275,677.21
Material	0.00	690,468.00	883,794.62
Funding Type DOE.HEP.LNI.PED	2,582.95	78,361.73	330,113.86
Labor	2,582.95	53,810.65	305,562.78
Material	0.00	24,551.08	24,551.08
Total Budget:	4,783.95	863,308.06	1,489,585.68

Authorization Signatures	
CAM:	Date:
Project Manager:	Date:

WAD after BCR shows how CA is effected by BCR

Work is Authorized to Proceed after BCR is Approved. WAD follows later.

WAD Related to EVMS Guidelines 3, 6, 8 & 29