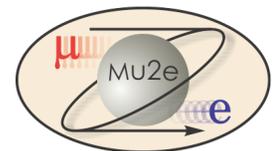




EVMS Implementation in Mu2e

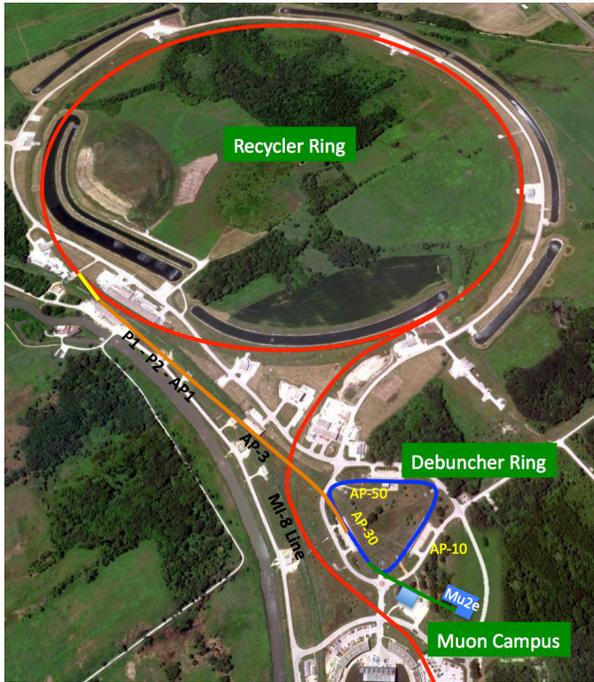
Ron Ray
Mu2e Project Manager
3/7/2016



Mu2e Project History

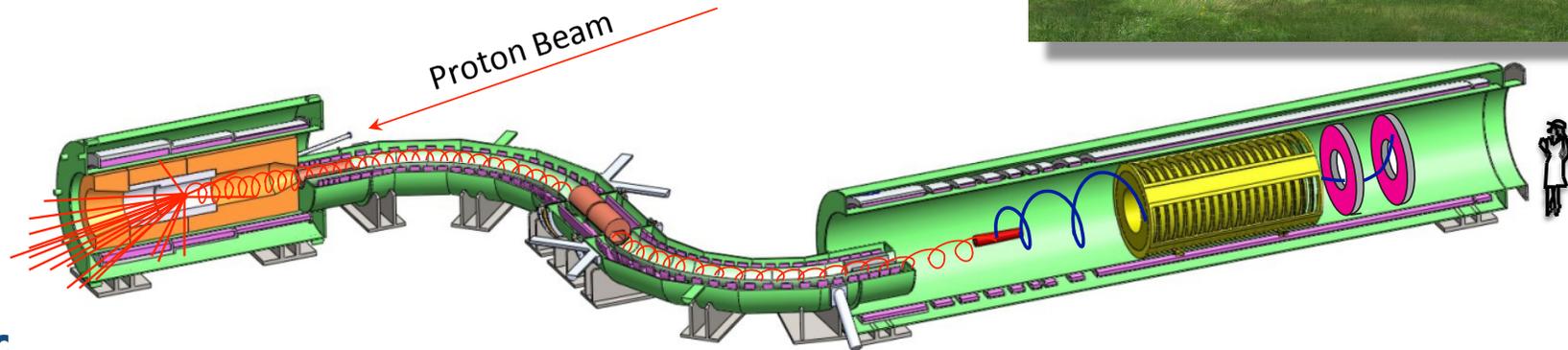
- November 2009 – CD-0
- July 2012 – CD-1
 - Cost range of \$200M - \$300M
- July 2014 – CD-3a
 - Authorized ~\$6M of long-lead procurements
- March 2015 – CD-2/3b
 - TPC of 273.677M
 - CD-3b authorized construction of detector hall and transport solenoid modules
- July 2016 – CD-3c
 - Continuation of construction and procurement
- FY2021 – CD-4 (Early Finish)
- FY2023 – CD-4 (with Float)

Mu2e Project Scope



Mu2e Project scope includes:

- New building to house experiment
- Modifications/additions to the accelerator complex
- Design and construction of the Mu2e apparatus
 - Superconducting Solenoids
 - Cosmic Ray Veto (not shown)
 - Tracker
 - Calorimeter
 - DAQ



Mu2e Scope

- Full scope is defined and described in the Mu2e WBS Dictionary,
 - under configuration control in Mu2e document database
 - Accessible from web page

Total Project Cost of \$274M

WBS 1.0 Project Management

Control Account	WBS Name	WBS Extended Definition
475.01.02	Management of Conceptual Design	<p>Cost Account Manager: R. Ray</p> <p>A. Technical Objective The technical objective is to provide level-of-effort management and management resources for the overall Mu2e Project during the conceptual design phase.</p> <p>B. Scope of Work 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.</p> <p>C. Deliverables Conceptual Design Report, Resource-Loaded Cost and Schedule and other documentation required for CD-1.</p> <p>D. Relationships/Interfaces to other WBS elements Project Management integrates across the entire project (management, regulatory compliance, quality assurance, safety, project controls, budget, risk management, review preparation, EVMS, monthly reporting and Project closeout).</p> <p>E. Assumptions None</p> <p>F. Status Completed</p>

Dollarized Ram

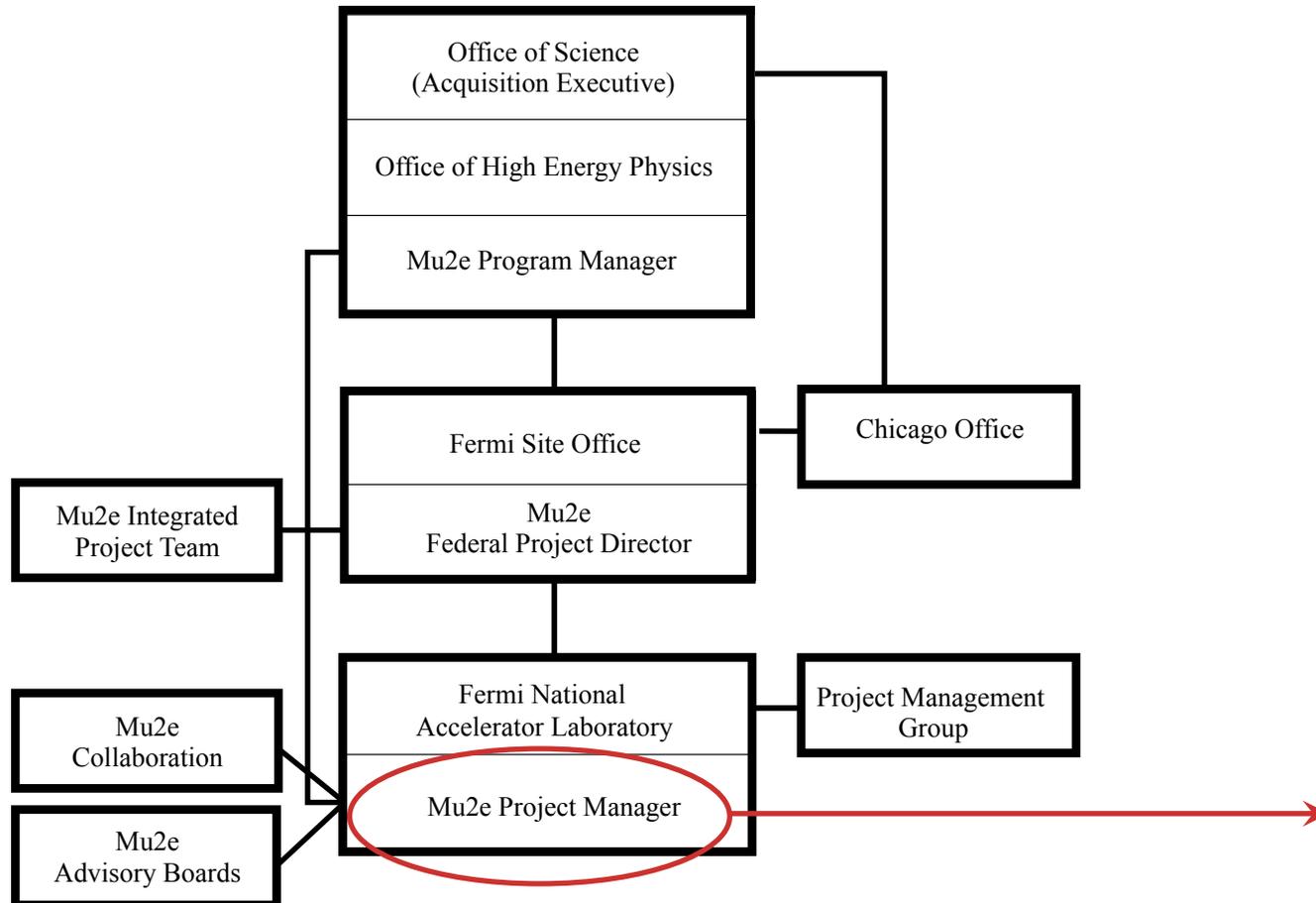
Currency reported in: Dollars in Thousands

Work Package.WBS (2) (All)

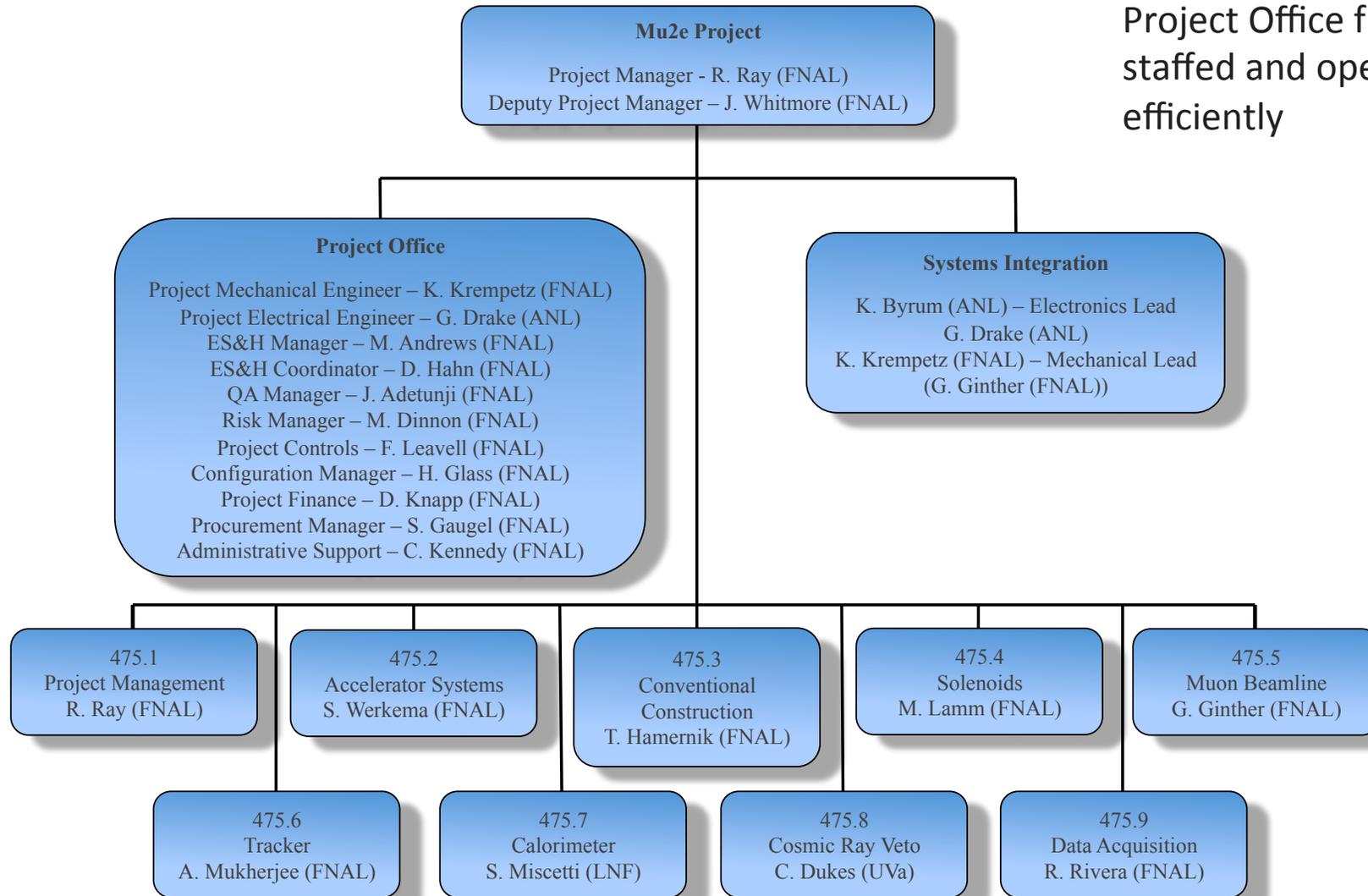
Control Account	CAM											
	09462N Ray, Ron	08689N Werkema, Steve	09990N Drendel, Brian	03438N Leveling, Tony	13469N Nagaslaev, Vladimir	09734N Dey, Joe	08969N Still, Dean	13371N Prebys, Eric	05374N Coleman, Rick	16496N Hamernik, Thomas J	06093N Lamm, Mike	123 Kas Vad
475.01.02 Project Office Conceptual Design (Post CD-0: OPC)												
Total Budget (\$K)	4,696											
% of LOE	100%											
475.01.03 Project Office Preliminary & Final Design Phase to CD-2/3												
Total Budget (\$K)	5,981											
% of LOE	100%											
475.01.04 Project Office Implementation & Close-out to CD-4												
Total Budget (\$K)	12,005											
% of LOE	100%											
475.02.01 Project Management												
Total Budget (\$K)		3,729										
% of LOE		98%										
475.02.03 Instruments and Controls												
Total Budget (\$K)			1,975									
% of LOE			12%									
475.02.04 Radiation Safety and Improvments												
Total Budget (\$K)				2,044								
% of LOE				18%								
475.02.05 Resonant Extraction System												
Total Budget (\$K)					5,412							
% of LOE					7%							
475.02.06 Rings RF												
Total Budget (\$K)						1,579						
% of LOE						11%						
475.02.07 External Beamline												
Total Budget (\$K)							6,955					
% of LOE							4%					
475.02.08 Extinction Systems												
Total Budget (\$K)								3,057				
% of LOE								13%				
475.02.09 Target Station												
Total Budget (\$K)									11,103			
% of LOE									13%			

Organization

Project Management Organization



Organization



Project Office fully
staffed and operating
efficiently

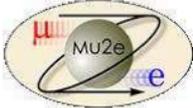
Project Controls and Finance

- 3 Project Controls specialists
- 1 Financial Field Officer
- 73 Control Accounts, 30 CAMs
- CAMs were fully trained prior to CD-2 baseline
 - 2-day EVMS training
 - Series of 1 hour presentations by R. Marcum
 - Bill Freeman, former NOvA Project Control Lead shared his experiences with CAMs from Mu2e, CMS and g-2 at an *EVMS Bootcamp*.
- All CAMS went through refresher training in October
- Project Controls Specialists meet regularly with FNAL Project Controls Manager to ensure consistent application of standards.



Baseline Cost and Schedule

- Activity-based RLS established over a period of several years
- Cost and schedule baseline established in March 2015
 - TPC of \$274M
 - BAC of \$221M
 - Contingency estimate built from two separate analysis
 - Activity-by-activity estimate uncertainty based on design maturity
 - Risk analysis
- RLS now under Change Control

		Mu2e CD-2/3 Schedule									
Activity ID	Activity Name	Duration - Work Days	Start	Finish	Predecessors	BOE Docdb #	Cobra PMT Code	Resource Information	FY2010		
47502.01.03.001070	Project Management LOE FY18 Equipment & Travel	250.00	10/2/17	9/28/18	FY18902	1888	A	M&S Standard: FY12 Base Year 45403	F	F	
47502.01.03.001080	Project Management LOE from FY19 to CD-4 Review Labor	365.00	10/1/18	3/17/20	FY19902	1888	A	Accelerator Physicist Experimental 7343; Mechanical Design Engineer Sr 8344			
47502.01.03.001090	Project Management LOE from FY19 to CD-4 Review Equipment & Travel	365.00	10/1/18	3/17/20	FY19902	1888	A	M&S Standard: FY12 Base Year 45403			
47502.01.03.001100	L4 - Implementation Tasks Complete (Ready for Verification that Key Performance Criteria are met)	0.00		3/17/20	47502.06.02.00105, 47502.03.001050, 47502.03.001060, 47502.04.05.00110, 47502.07.06.00200, 47502.08.001100, 47502.06.05.00114, 47502.01.03.00106, 47502.04.001000	Mile	B				

Work Authorization

- After baseline has been established, Project Office authorizes work through Authorization Documents (WADs)
 - We have 67 open Control Accounts.
 - WADs have been put into place for these control accounts
- WAD must be in place before new control accounts or any of its chargeable task codes can be opened
 - Dale Knapp, our Financial Officer, is responsible for making sure the requirements have been satisfied before opening any CTCs.
- WADs must be updated if the Control Account is impacted by an approved change.
- WADs are approved electronically

Work Authorization Document

Work Authorization Document			
Control Account Information			
Control Account Manager:	Page, Tom		
Control Account Number:	475.04.04		
Control Account Description:	Detector Solenoid		
Period of Performance			
Start:	7/2/2012	Finish:	11/4/2020
WAD Scope			
BCR# 024 FY16 Rate Update_Impact: Cost \$38,786 & Sched Days 0			
BCR# 018 Detector Bldg Constr Change Order; Argonne Support_Impact: Cost -\$12,680 & Sched Days 0			
BCR# 017 PS/DS Vendor Pay Milestones; Remote Handling Design_Impact: Cost \$29,774 & Sched Days -28			
BCR# 015 Establish CD-2 Baseline_Impact: Cost \$29,358 & Sched Days -14			
<p>Develop the design of the conductor for the Detector Solenoid. Procure the conductor from industry and oversee the contract. Perform QC on the conductor and ship the conductor to the magnet vendor.</p> <p>Develop the reference design and procurement specification for the Detector Solenoid. Evaluate vendor proposals for completing the DS final design and fabrication, select a vendor to complete the work and oversee the contract with the chosen vendor.</p> <p>Develop the design and drawings of the DS support frame and procure the frame from industry.</p>			
Budget	HOURS	DIRECT	BAC
Funding Type DOE.HEP.LNI.CNSTR	8,426.70	7,964,869.99	8,903,086.13
Labor	8,426.70	273,096.22	962,723.44
Material	0.00	7,691,773.77	7,940,362.69
Funding Type DOE.HEP.LNI.PED	12,072.58	6,513,354.02	7,238,072.53
Labor	12,072.58	659,596.22	1,317,706.01
Material	0.00	5,853,757.80	5,920,366.52
Funding Type DOE.HEP.OPC	15.43	424,913.87	488,301.10
Labor	15.43	143.00	143.00
Material	0.00	424,770.87	488,158.10
Total Budget:	20,514.71	14,903,137.88	16,629,459.75

Work Authorization

- Fermilab labor is reported to open CTCs through Kronos time and effort system
- Weekly reports from Kronos made available to CAMs and Project Office for accuracy checking
 - Shows hours reported to each CTC by name

Project Number	(All)
Service Type Code	(All)
Row Labels	Hours
Biery, Kurt	68.8
475.09.04	68.8
475.09.04.02 Data Processing Pilot System (PED)	
475.496	68.8
KWARCIANY, RICHARD	38.0
FLUMERFELT, ERIC	24.5
RECHENMACHER, RONALD	6.3
Brandt, Jeff	34.0
475.04.09	26.0
475.04.09.01 Ancillary Equipment: Magnet Assembly Equipment Design (PED)	
475.255	26.0
MCCONOLOGUE, FRANK	10.0

- Monthly financial reports include same information for the month along with associated costs, obligations, RIPs.

Work Authorization

Moving funds to other institutions requires a Statement of Work and a Purchase Requisition.

I. Preamble

This Statement of Work (SOW) is made between Northern Illinois University (NIU) and the Mu2e Project in the Fermi National Accelerator Laboratory Particle Physics Division (Fermilab). This document represents an understanding between NIU and Fermilab in connection with Mu2e design and R&D activities.

II. Responsibilities

1. Activities

This SOW applies to two sets of activities:

1. Second Iteration Design of the Muon Beamstop.

This work will include engineering design, analysis and documentation of the second iteration of the muon beam stop and muon beam stop support mechanisms, as well as tests of a prototype of the muon beam stop support at the detector rail system mockup.

2. Second Iteration Design and prototyping of Detector Support and Installation System.

This work will include engineering design, analysis and documentation of aspects of the detector support and installation system as well as evaluation of the prototype system.

2. Personnel

The contact person and supervisor for these Mu2e activities at NIU is Professor David Hedin (hedin@nicadd.niu.edu). The contact person at Fermilab is Ron Ray (rray@fnal.gov)

3. Payment Authorization

The appropriate Cost Account Manager will notify NIU when funds have been approved for specific tasks covered by this MOU. This notification will usually consist of a Fermilab purchase order.

Monthly Reporting Process

Project Controls
Lead issues a
monthly schedule
reminder to the
CAMs

Frances Leavell February 22, 2016
To: Ron Ray <r-ray@fnal.gov>, Anna_Pla-Dalmau <pla@fnal.gov>, Anthony F Leveling, Aseet Mukherjee, Brian E Drendel, Robert Group, Darryl F Orris, and 26 more... [Tra](#)
Cc: Dale R Knapp JR., David A. Leeb, Michael Gardner
Month End February 2016 - Deliverables/Deadlines

February month end is Monday, February 29, 2016

Please note the following deliverables/deadlines:

- Final Accruals due to Finance. February 24, 2016
- BCR028 approved and implementation complete February 26, 2016
- Turnaround Report posted (docdb 2999). February 26, 2016
- Turnaround conferences / P6 status & remaining units on or before March 2, 2016
- Preliminary schedule performance reports issued. March 3, 2016
- Actual costs in Cobra / Final schedule status March 4, 2016
- NOTE: If Home Code is not Mu2e, Fermi labor is January 25th through February 21st*
- PRELIMINARY performance reports issued March 7, 2016
- Forecast review/update (dates and resources) March 9, 2016
- Any March BCRs identified and initiated March 11, 2016
- FINAL performance reports issued March 10, 2016
- Variance Analysis Report (VAR) complete March 14, 2016

If you have questions, please contact me.

Thank you,

Fran Leavell
Mu2e Project Controls Lead
Office of Project Support Services
Fermi National Accelerator Laboratory
Phone: 630-840-8701
Office location: WH9E, 911A

Monthly Reporting Process

- Local CAMs have face-to-face meetings with Project Controls each month. Remote CAMs meet by phone.
 - Status schedule and milestones
 - Review ETC
 - Look ahead at new activities scheduled to begin soon
 - Make sure resources are available
- Project Controls synthesizes information to produce monthly performance reports including variances.
- FRA EVM Plan requires a variance analysis to be produced for every *Red* variance.
 - Mu2e also produces a variance analysis for *yellow* variances.
 - Want to keep yellow variances from turning red
 - Variance analysis includes corrective actions.

January Performance by Control Account

Mu2e Project
January 31, 2016
Currency in: \$K

Control Account	Current Period							Cumulative to Date							At Complete						
	Budget	Earned	Actuals	SV (\$)	SV (%)	CV (\$)	CV (%)	Budget	Earned	Actuals	SV (\$)	SV (%)	CV (\$)	CV (%)	SPI	CPI	BAC	EAC	VAC	% Spent	% Complete
475.01.02 Project Office Conceptual Design (Post CD-0: OPC)	0	0	0	0	0%	0	0%	4,696	4,696	4,696	0	0%	0	0%	1.00	1.00	4,696	4,696	0	100%	100%
475.01.03 Project Office Preliminary & Final Design Phase to CD-2/3	0	0	0	0	0%	0	0%	5,981	5,981	5,973	0	0%	8	0%	1.00	1.00	5,981	5,973	8	100%	100%
475.01.04 Project Office Implementation & Close-out to CD-4	204	204	285	0	0%	(80)	-39%	2,403	2,403	2,737	0	0%	(334)	-14%	1.00	0.88	12,005	13,007	(1,002)	21%	20%
475.02.01 Project Management	37	37	31	0	0%	6	17%	1,839	1,839	1,820	0	0%	19	1%	1.00	1.01	3,729	3,780	(51)	48%	49%
475.02.03 Instruments and Controls	4	8	15	4	122%	(7)	-92%	484	475	534	(9)	-2%	(59)	-12%	0.98	0.89	1,975	2,047	(72)	26%	24%
475.02.04 Radiation Safety and Improvements	11	3	8	(7)	-69%	(4)	-133%	474	457	486	(17)	-4%	(29)	-6%	0.96	0.94	2,044	2,124	(80)	23%	22%
475.02.05 Resonant Extraction System	16	54	52	38	232%	2	3%	1,590	1,539	1,606	(51)	-3%	(67)	-4%	0.97	0.96	5,412	5,509	(97)	29%	28%
475.02.06 Rings RF	3	2	(7)	(1)	-28%	9	393%	388	378	398	(10)	-3%	(20)	-5%	0.97	0.95	1,579	1,603	(24)	25%	24%
475.02.07 External Beamline	37	36	34	(1)	-3%	2	6%	1,372	1,252	1,350	(120)	-9%	(98)	-8%	0.91	0.93	6,955	7,054	(100)	19%	18%
475.02.08 Extinction Systems	28	4	27	(24)	-87%	(23)	-619%	1,001	866	1,130	(135)	-14%	(264)	-31%	0.86	0.77	3,057	3,310	(253)	34%	28%
475.02.09 Target Station	55	85	56	30	54%	28	34%	3,519	3,398	3,438	(121)	-3%	(40)	-1%	0.97	0.99	11,103	11,167	(64)	31%	31%
475.02.10 Accelerator Conceptual Design/R&D (OPC)	0	0	0	0	0%	0	0%	5,045	5,045	5,045	0	0%	(1)	0%	1.00	1.00	5,045	5,045	(1)	100%	100%
475.03.01 Conv.Constr. Conceptual Design	0	0	0	0	0%	0	0%	537	537	537	0	0%	(0)	0%	1.00	1.00	537	537	(0)	100%	100%
475.03.02 Conv.Constr. Preliminary/Final Design	8	8	3	0	0%	5	65%	2,077	2,077	2,073	0	0%	4	0%	1.00	1.00	2,162	2,148	14	97%	96%
475.03.03 Conv.Constr. Construction Phase Oversight	52	52	46	0	0%	6	11%	1,098	1,098	590	0	0%	507	46%	1.00	1.86	1,926	1,607	318	37%	57%
475.03.04.01 Mu2e Detector Service Building & Hall Fixed Price	689	702	702	14	2%	0	0%	7,601	6,814	6,839	(787)	-10%	(25)	0%	0.90	1.00	12,975	13,000	(25)	53%	53%
475.03.04.02 Delivery Ring Upgrades	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-	352	352	0	0%	0%
475.03.04.03 Fermi Procured Items and T&M	156	156	156	0	0%	(0)	0%	438	438	394	0	0%	43	10%	1.00	1.11	1,866	1,824	42	22%	23%
475.03.04.04 Accelerator Absorber	0	0	2	0	0%	(2)	-	332	310	253	(22)	-7%	56	18%	0.93	1.22	332	268	64	94%	93%
475.03.04.05 Building Controls	0	0	1	0	0%	(1)	-	56	56	39	0	0%	18	31%	1.00	1.46	148	131	18	30%	38%
475.03.05 Conv.Constr. Project Close	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-	315	334	(19)	0%	0%
475.04.01 Solenoids Project Management	30	30	19	0	0%	11	37%	1,745	1,745	1,748	0	0%	(3)	0%	1.00	1.00	3,578	3,576	2	49%	49%
475.04.02 Production Solenoid	883	535	539	(348)	-39%	(5)	-1%	5,854	5,656	5,525	(199)	-3%	131	2%	0.97	1.02	16,234	16,208	26	34%	35%
475.04.03 Transport Solenoids	591	293	278	(297)	-50%	15	5%	10,418	10,120	11,027	(299)	-3%	(907)	-9%	0.97	0.92	27,386	28,352	(966)	39%	37%
475.04.04 Detector Solenoid	959	611	633	(349)	-36%	(22)	-4%	7,972	6,813	6,742	(1,159)	-15%	71	1%	0.85	1.01	16,629	16,598	32	41%	41%
475.04.05 Cryogenic Distribution System	246	121	60	(125)	-51%	61	51%	3,516	2,511	2,432	(1,005)	-29%	79	3%	0.71	1.03	9,706	9,677	30	25%	26%
475.04.06 Magnet Power System	0	0	2	0	0%	(2)	-	338	298	357	(40)	-12%	(59)	-20%	0.88	0.83	1,492	1,554	(62)	23%	20%
475.04.07 Quench Protection and Monitoring System	17	72	74	55	329%	(3)	-4%	843	763	810	(79)	-9%	(47)	-6%	0.91	0.94	2,982	3,046	(65)	27%	26%
475.04.08 Magnetic Field Mapping System	68	80	31	12	18%	49	61%	317	262	231	(55)	-17%	32	12%	0.83	1.14	1,243	1,294	(51)	18%	21%
475.04.09 Solenoids Ancillary Equipment	7	14	16	7	98%	(2)	-16%	115	41	46	(73)	-64%	(5)	-11%	0.36	0.90	944	946	(2)	5%	4%
475.04.10 Solenoids System Integration, Installation & Commissioning	10	12	5	2	15%	6	55%	612	521	502	(91)	-15%	19	4%	0.85	1.04	5,193	5,190	2	10%	10%
475.04.11 Solenoids Conceptual Design/R&D (OPC)	0	0	0	0	0%	0	0%	6,028	6,028	6,028	0	0%	(0)	0%	1.00	1.00	6,028	6,028	(0)	100%	100%
475.05.01 Muon Beamline Project Management	33	33	18	0	0%	15	44%	1,226	1,226	1,149	0	0%	77	6%	1.00	1.07	3,424	3,355	68	34%	36%
475.05.02 Vacuum System	8	29	35	20	240%	(6)	-22%	676	490	409	(186)	-28%	81	17%	0.72	1.20	3,274	3,172	102	13%	15%
475.05.03 Collimators	0	3	2	3	-	1	29%	276	276	316	(0)	0%	(40)	-14%	1.00	0.87	1,287	1,338	(51)	24%	21%
475.05.04 Upstream External Shielding	6	6	3	(1)	-11%	3	47%	388	345	324	(44)	-11%	21	6%	0.89	1.06	1,944	1,943	2	17%	18%
475.05.05 Stopping Target	5	1	1	(5)	-86%	(1)	-87%	75	37	36	(38)	-51%	1	4%	0.49	1.04	181	185	(4)	19%	21%
475.05.06 Stopping Target Monitor	7	1	0	(7)	-92%	1	100%	31	8	6	(23)	-74%	2	21%	0.26	1.27	342	348	(6)	2%	2%
475.05.07 DS Internal Shielding	7	7	7	(0)	-2%	0	0%	106	70	73	(36)	-34%	(3)	-5%	0.66	0.95	390	409	(19)	18%	18%
475.05.08 Muon Beam Stop	0	3	7	3	-	(4)	-113%	288	273	349	(15)	-5%	(76)	-28%	0.95	0.78	814	895	(80)	39%	34%
475.05.09 Downstream External Shielding	1	5	12	4	311%	(7)	-130%	503	416	418	(87)	-17%	(1)	0%	0.83	1.00	3,411	3,488	(77)	12%	12%
475.05.10 Detector Support Structure	10	18	17	9	90%	2	10%	642	592	633	(50)	-8%	(41)	-7%	0.92	0.94	2,527	2,565	(38)	25%	23%
475.05.11 Muon Beamline Systems Integration	0	0	0	0	0%	0	0%	40	40	42	0	0%	(1)	-3%	1.00	0.97	158	160	(2)	26%	26%
475.05.13 Muon Beamline Conceptual Design/R&D (OPC)	0	0	0	0	0%	0	0%	1,979	1,979	1,979	0	0%	0	0%	1.00	1.00	1,979	1,979	0	100%	100%
475.06.01 Tracker Project Management	17	17	19	0	0%	(2)	-10%	762	762	792	0	0%	(30)	-4%	1.00	0.96	1,947	1,977	(30)	40%	39%
475.06.02 Straws	0	11	22	11	-	(11)	-103%	293	315	356	22	7%	(42)	-13%	1.07	0.88	1,293	1,320	(27)	27%	24%

January Performance by Control Account

Control Account	Budget	Earned	Actuals	SV (\$)	SV (%)	CV (\$)	CV (%)	Budget	Earned	Actuals	SV (\$)	SV (%)	CV (\$)	CV (%)	SPI	CPI	BAC	EAC	VAC	% Spent	% Complete
475.06.03 Straw Assemblies	11	40	(1)	29	261%	41	102%	840	670	823	(170)	-20%	(153)	-23%	0.80	0.81	3,713	3,890	(178)	21%	18%
475.06.04 Tracker Front End Electronics	32	18	17	(14)	-43%	1	4%	473	398	499	(75)	-16%	(102)	-26%	0.84	0.80	2,370	2,492	(122)	20%	17%
475.06.05 Tracker Infrastructure	0	0	0	0	-	0	100%	135	99	57	(36)	-27%	42	42%	0.73	1.73	956	922	34	6%	10%
475.06.06 Detector Assembly & Installation	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-	69	69	0	0%	0%
475.06.07 Tracker Conceptual Design/R&D (OPC)	0	0	0	0	0%	(0)	-	1,679	1,675	1,685	(4)	0%	(11)	-1%	1.00	0.99	1,679	1,694	(15)	99%	100%
475.07.01 Calorimeter Project Management	5	2	1	(3)	-55%	2	75%	160	157	151	(3)	-2%	6	4%	0.98	1.04	271	264	6	57%	58%
475.07.02 Crystals	0	4	30	4	-	(26)	-587%	94	70	154	(24)	-26%	(84)	-120%	0.74	0.45	2,618	2,711	(93)	6%	3%
475.07.03.02 Radiation & Temperature Monitoring	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-	162	162	0	0%	0%
475.07.04 Photodetectors	0	0	4	0	0%	(4)	-	196	163	210	(33)	-17%	(47)	-29%	0.83	0.77	777	862	(85)	24%	21%
475.07.05 Electronics	0	0	0	0	0%	0	0%	109	109	112	0	0%	(3)	-2%	1.00	0.98	109	112	(3)	100%	100%
475.07.06 Calibration System	7	9	54	2	30%	(46)	-537%	117	133	228	16	14%	(95)	-71%	1.14	0.58	567	695	(127)	33%	23%
475.07.07 Calorimeter Power	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-	3	3	0	0%	0%
475.07.08 Calorimeter Installation	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-	304	308	(4)	0%	0%
475.08.01 Cosmic Ray Veto Project Management	18	6	6	(12)	-65%	(0)	0%	185	173	167	(12)	-6%	6	3%	0.94	1.04	544	532	12	31%	32%
475.08.02 Cosmic Ray Veto Mechanical Design	11	12	0	1	10%	12	100%	141	107	127	(34)	-24%	(20)	-19%	0.76	0.84	216	236	(21)	54%	50%
475.08.03 Scintillator extrusions	32	0	0	(32)	-100%	(0)	-	251	196	265	(55)	-22%	(69)	-35%	0.78	0.74	1,049	1,122	(73)	24%	19%
475.08.04 Cosmic Ray Veto Fibers	3	20	0	18	650%	20	100%	47	65	50	18	38%	15	23%	1.38	1.29	455	441	14	11%	14%
475.08.05 Photodetectors	8	17	2	10	128%	15	88%	443	427	367	(16)	-4%	60	14%	0.96	1.16	812	742	70	49%	53%
475.08.06 Cosmic Ray Veto Electronics	47	25	17	(22)	-47%	8	32%	654	577	726	(77)	-12%	(149)	-26%	0.88	0.79	1,902	2,074	(172)	35%	30%
475.08.07 Cosmic Ray Veto Module Fabrication	10	15	34	5	46%	(19)	-125%	315	265	279	(51)	-16%	(14)	-5%	0.84	0.95	1,500	1,553	(53)	18%	18%
475.08.08 Detector assembly and installation	4	0	0	(4)	-100%	0	0%	42	38	38	(4)	-10%	(0)	0%	0.90	1.00	228	229	(1)	16%	17%
475.08.09 Cosmic Ray Veto Conceptual Design/R&D (OPC)	0	0	2	0	0%	(2)	-	503	503	502	0	0%	1	0%	1.00	1.00	503	502	1	100%	100%
475.09.01 TDAQ Project Management	7	7	29	0	0%	(22)	-337%	804	804	800	0	0%	4	0%	1.00	1.00	1,222	1,219	3	66%	66%
475.09.02 TDAQ System Design and Test	0	0	0	0	0%	0	0%	294	294	294	0	0%	0	0%	1.00	1.00	368	368	(0)	80%	80%
475.09.03 Data Acquisition	0	0	0	0	0%	0	0%	975	975	1,040	0	0%	(65)	-7%	1.00	0.94	1,948	2,015	(68)	52%	50%
475.09.04 Data Processing	0	12	11	12	-	1	9%	293	251	241	(42)	-14%	9	4%	0.86	1.04	874	865	9	28%	29%
475.09.05 Controls and Networking	8	18	11	10	133%	7	38%	211	241	264	30	14%	(23)	-10%	1.14	0.91	612	637	(25)	42%	39%
Total	4,406	3,457	3,428	(950)	-22%	29	1%	94,936	89,633	91,348	(5,303)	-6%	(1,715)	-2%	0.94	0.98	224,409	227,838	(3,429)	40%	40%

- Cost managed at the Control Account level
- Reports generated down to the Chargable Task Code Level to facilitate diagnosis of problems.

Variance Thresholds

Mu2e uses the default FRA thresholds

FRA Thresholds

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

Variance Reports

Variance Analysis Report									
CA: 475.03.04.01 Mu2e Detector Service Building & Hall Fixed Price					Project: Mu2e Conventional Construction				
CAM: Hamernik, Thomas J					Period Ending: December 31, 2015				
Report in \$K									
Period	Budget	Earned	Actuals	SV (\$)	SV (%)	CV (\$)	CV (%)	SPI	CPI
Current:	959	325	351	(633)	-66%	(26)	-8%	0.34	0.93
Cumulative:	6,912	6,112	6,136	(801)	-12%	(25)	0%	0.88	1.00
	BAC	EAC		VAC (\$)	VAC (%)				
At Complete:	12,956	12,981		(25)	0%				
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:	The current schedule variance reflects a lack of recovery from the November work stoppage as well as increased variance due to lack of productivity. The Subcontractor has not met their end of December Structural Concrete milestone. Lost productivity has been attributed to weather and to an underestimation of time needed to respond to recent Fermi-requested changes.								
Cumulative:	The cumulative variance aggregatest the current and previous periods variances.								
Impact:									
The schedule variance is impacting the delivery of Fermi-procured Overhead Cranes. We are working with the crane vendor to re-schedule delivery based on Whittaker's schedule recovery plan (description, below). Provided Whittaker's recovery plan achieves its objectives, there will be no impact to the overall project.									
Corrective Action:									
Early projections for January 2016 continue to show increasing Schedule Variance. We have directed the Subcontractor to prepare a Schedule Recovery Plan having the objectives to maintain the Beneficial Occupancy date as well as achieve the current end-of-April Building Weather-tight milestone. One strategy under consideration is to defer non-critical path work. We are coordinating a meeting to review this plan with the Subcontractor next week.									
Monthly Summary:									
Prepared by:	T Hamernik		CAM	Date:	January 15, 2016				
Reviewed by:	M Gardner		PCS	Date:	January 15, 2016				
Approved by:	R Ray		PM	Date:	January 15, 2016				

Variance Reports

Variance reports are approved electronically

MU2E DocDB Document 4764-v9
Variance Report for 47503.04.01
(Document Status: Approved)

Abstract:
FY2015 Variance Analysis Reports for the Mu2e Conventional Facilities - Mu2e Detector Service Building & Hall - Control Account

Files in Document:

- [475030401 VAR Report](#) (475030401 VAR Report \$K Dec-TJH.xlsx, 20.9 kB)

Get all files as [tar.gz](#), [zip](#).

Topics:

- [Variance Reports:WBS 3 Conventional Construction](#)

Authors:

- [Thomas Hamernik](#)

Notes and Changes:
Version 8: December 2015
Version 7: November 2015
Version 6: October 2015
Version 5: September 2015 R1
Version 4: August 2015
Version 3: July 2015 (Hamernik)
Version 2: May 2015 (Lackowski)
Version 1: April 2015

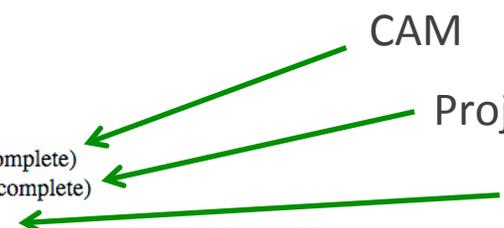
Signoffs:

- [Thomas J. Hamernik](#) (signature complete)
- [Michael R. Gardner](#) (signature complete)
- [Ronald E. Ray](#)

CAM

Project Controls

Project Manager



Corrective Action Log

Item # (date-CA-#)	Control Account #	Date Posted	Date Approved by PM	Responsible Person (CAM)	Corrective Action	(Open/Closed)	Status Details	Status Detail Date	Completion Date
02.15-1.2-001	475.01.02	19-Mar-15	19-Mar-15	Ray, Ronald	All work has been completed on this Control Account and the Chargeable Task Code has been closed. BCR015 will establish the CD-2 Baseline and cumulative variances will be eliminated - ECD March 2015.	Closed	All work has been completed on this Control Account and the Chargeable Task Code has been closed. BCR015 will establish the CD-2 Baseline and cumulative variances will be eliminated - ECD March 2015.	19-Mar-15	19-Mar-15
10.14-1.3-001	475.01.03	4-Dec-14	4-Dec-14	Ray, Ronald	BCR007 (implemented this period) shifted project management labor from Construction to PED for the period of Nov 2014 through Jan 2015.	Closed	BCR007 was approved by the PM on 11/5/14 and has been implemented in the schedule.	4-Dec-14	4-Dec-14
01.15-1.3-002 02.15-1.3-002	475.01.03	4-Mar-15 19-Mar-15	4-Mar-15 19-Mar-15	Ray, Ronald	DOE has told us that we can spend construction funds or PED funds on these activities since they are both considered TEC funds. They do want us to keep track of how much we spend on design vs. construction activities. We will close this Control Account effective March 1, 2015 and begin charging to 475.01.04.	Closed	DOE has told us that we can spend construction funds or PED funds on these activities since they are both considered TEC funds. They do want us to keep track of how much we spend on design vs. construction activities. We will close this Control Account effective March 1, 2015 and begin charging to 475.01.04. 3/19/15: Last Month: Close Control Account 475.01.03, effective March 1, 2015, and begin charging 475.01.04 - COMPLETE BCR015 will establish the CD-2 Baseline and cumulative variances will be eliminated - ECD March 2015.	19-Mar-15	19-Mar-15
10.14-1.4-001	475.01.04	4-Dec-14	4-Dec-14	Ray, Ronald	BCR007 (implemented this period) shifted project management labor from Construction to PED for the period of Nov 2014 through Jan 2015.	Closed	BCR007 was approved by the PM on 11/5/14 and has been implemented in the schedule.	4-Dec-14	4-Dec-14
01.15-1.4-002 02.15-1.4-002	475.01.04	4-Mar-15 19-Mar-15	4-Mar-15 19-Mar-15	Ray, Ronald	DOE has told us that we can spend construction funds or PED funds on these activities since they are both considered TEC funds. They do want us to keep track of how much we spend on design vs. construction activities. We will close Control Account 475.01.03, effective March 1, 2015, and begin charging to 475.01.04.	Closed	DOE has told us that we can spend construction funds or PED funds on these activities since they are both considered TEC funds. They do want us to keep track of how much we spend on design vs. construction activities. We will close Control Account 475.01.03, effective March 1, 2015, and begin charging to 475.01.04. 3/19/15: Last Month: Close Control Account 475.01.03, effective March 1, 2015, and begin charging 475.01.04 - COMPLETE BCR015 will establish the CD-2 Baseline and cumulative variances will be eliminated - ECD March 2015.	19-Mar-15	19-Mar-15
01.15-2.1-001	475.02.01	16-Feb-15	16-Feb-15	Werkema, Steve	1) Each of the individuals charging their time to this cost account have been informed (again) of the number of hours budgeted for their time per week and per month. They have been instructed not to exceed that budget without permission from the CAM	Closed	1) Each of the individuals charging their time to this cost account have been informed (again) of the number of hours budgeted for their time per week and per month. They have been instructed not to exceed that budget without permission from the CAM	16-Feb-15	16-Feb-15
01.15-2.1-002	475.02.01	16-Feb-15	16-Feb-15	Werkema, Steve	2) The CAM will track labor charges to this control account on a weekly basis using the Kronos time and labor reports published every week by the Mu2e project office.	Closed	2) The CAM will track labor charges to this control account on a weekly basis using the Kronos time and labor reports published every week by the Mu2e project office.	16-Feb-15	16-Feb-15

Change Control

- Change Control procedures described in Mu2e Change Management Plan
- Thresholds and signature authority defined in Mu2e PEP
- Processing baseline changes involves many people:
 - Initiator – usually a CAM
 - Configuration Manager – Processes documentation provided by initiator, enters into document database (docdb) and change log database
 - Project controls – determine impact of change and, after approval, implement the change into P6
 - Change Control Boards
 - Technical Board serves as CCB for changes at PM level
 - PMG serves as CCB for changes at FPD level
 - Approvers – PM, FPD, AE



Change Control



Mu2e Change Request

BCR Title: **DAQ Readout Controllers, Schottky Tune Measurements, and others**
Mu2e CR Num 27 Date submitted: 1/26/2016 Change Level: 3
Requestor: Frances Leavell Request Status: submitted

Change_type(s): Cost Schedule	WBS: <u>475</u> WBS Description: <u>Constr. Changes_CD3 Review Prep</u>
Supporting Documents: <u>6633</u>	Approvals: CCB Disposition Date: <i>Ron Ray</i> <u>1/26/16</u> Project Manager Date
L2 Subprojects: <u>Project</u> <u>Accelerator</u> <u>Conventional Construction</u> <u>Solenoids</u> <u>Cosmic Ray Veto</u> <u>Trigger and DAQ</u>	

Description:
475.01 Project Management: Update Muon g-2 Run milestones to coincide with the Muon g-2 schedule. The Run period calls for 6 months of commissioning, 18 months of production running, and 6 months of systematic studies.
475.02.01 Accelerator Project Management: CD-4 Prep Logic correction. Accelerator Maintenance Shutdown milestones were modified to align with the current Accelerator Division plan for future shutdowns to start in July.
475.02.03 Instruments and Controls: All of the effort to develop a tune measurement system is being put into the Schottky system instead of being divided between the Schottky and BBQ system.
475.02.04 Radiation Safety and Improvements: Reschedule safety system trunk line installation from Radiation Safety Improvements 475.02.04.04.5 to Conventional Construction Building Controls
475.03.04.05. Add two additional 20-conductor trunk line cables. The original trunk line pull was for one 4-conductor cable and one 20-conductor cable. The work scope now consists of one 4-pair individually shielded cable and three 20-conductor cables.
475.02.07 External Beamline: Deleted, modified and added activities in 475.02.07.07 (Implementation to provide better detail of the beamline implementation schedule for 2016-2020). The need for fabrication of an MDC magnet is no longer needed.
475.03.04.01, Detector Service Building & Hall Fixed Price: Rev 11: electrical & steel deduct. Rev 12 includes the following changes: Added Door 015B for remote handling room (plan and schedule), Shifted remote

Page 1 of 3

Form is produced by Access DB

- Stored as PDF in DocDB
- Contains signature box for approvals
- Lists cost, schedule impacts, supporting documents, change type and level, affected L2 subprojects, WBS, justification, technical & risk impacts...

Change Control

MU2E DocDB Document 6633-v3

Change Request 27

Abstract:

Folder for documents related to BCR027, which incorporates Solenoids CD-3C Preparation and Review, Detector Service B Rev. 11 & 12 changes, and other changes noted in the Change Request documents.

Files in Document:

- [BCR027 change request form - signed](#) (BCR027_request_package.pdf, 265.9 kB)

Other Files:

- [BCR027 Before-After Cost Impact](#) (BCR027 Before-After Cost Impact.pdf, 188.8 kB)
- [BCR027 Before-After Schedule Impact](#) (BCR027 Before and After Schedule.pdf, 1.1 MB)
- [BCR027 Change Control Board Meeting Minutes](#) (BCR027 Change Control Board Meeting Minutes.pdf, 27.2 kB)
- [BCR027 Cost and Schedule Impact for BCR Review](#) (BCR027 Cost and Schedule Impact.pdf, 341.6 kB)
- [BCR027 Driving Critical Path](#) (BCR027 Driving Critical Path and major milestones.pdf, 101.0 kB)
- [BCR027 No SPA History Change](#) (BCR027 No SPA History Change_CA.xlsx, 1.6 MB)
- [BCR027 Summary of Changes table](#) (BCR027 Summary of Changes table Rev2.docx, 20.3 kB)

Get all files as [tar.gz](#), [zip](#).

Topics:

- [Project Management:Change Control](#)

Authors:

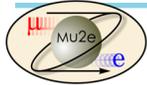
- [Brian Drendel](#)
- [E Craig Dukes](#)
- [Thomas Hamernik](#)
- [Michael J Lamm](#)
- [Fran Leavell](#)
- [Anthony F Leveling](#)
- [Darryl Orris](#)
- [Anna Pla-Dalmau](#)
- [Ryan Rivera](#)
- [Dean Still](#)
- [Steven J. Werkema](#)

Related Documents:

- Mu2e-doc-3675: [CD2 BOE 475.02.03.03.01 M4 Line Profile and Intensity Monitors](#)
- Mu2e-doc-6121: [M4 Beamline lattice](#)
- Mu2e-doc-3728: [CD2 BOE WBS 475.02.04.04.5 Safety System Trunk Line Cables](#)
- Mu2e-doc-6539: [External Beamline 475.02.07 BCR27 Document](#)
- Mu2e-doc-6371: [Rev 12 Drawings](#)
- Mu2e-doc-6523: [Conventional Construction Documentation in Support of BCR027](#)
- Mu2e-doc-6569: [Solenoids: CD-3 preparation costs](#)
- Mu2e-doc-6533: [CRV Change Request: January 12, 2015 \(BCR 27\)](#)
- Mu2e-doc-2981: [CRV Monthly Schedule Update](#)
- Mu2e-doc-6460: [Supporting Documentation for TDAQ Production Phase Material Change Request](#)

- Significant supporting information for each Change Request posted on docdb.
- Worked to improve traceability based on feedback from last year.

Change Request Log



Mu2e Change Request Log

updated

1/28/16

DocDB #4600

CR#	WBS	Description of change	Date Submitted	Level	Cost Impact	Schedule Impact	From Contingency or Mgmt Res Funds
13	475.0	Baseline reset (BAC = EAC)	2/13/15	2	\$ 2,533,716		contingency
14	475.02, .04, .06, .08	Scope added (SiPMS & Tracker), reduced (Magnet Power), deferred (Solenoids)	2/17/15	3	\$ 73,140		mgmt reserve
15	475	Establish CD-2 Baseline	4/2/15	2	\$ 351,698	60 days (T2)	mgmt reserve
16	475	Cryo distribution system moved off-project	5/6/15	3	\$ (424,838)	54 days (T5)	mgmt reserve
16		(continued)			\$ (2,243,421)		contingency
17	475	PS/DS Vendor Pay Milestones; Remote Handling Design	5/21/15	3	\$ 299,978	136 days (T5)	mgmt reserve
18	475	ANL Resources; Detector Building changes; misc	6/19/15	2	\$ 1,171,111	5 days (T4)	total
18		portion from MR			\$ 700,022		mgmt reserve
18		portion from contingency			\$ 471,089		contingency
--		reload MR from contingency			\$ 1,000,000		contingency
19	475	TS Module Fabrication Delay & misc.	7/30/15	3	\$ 151,591	60 days (T5)	mgmt reserve
20	475	Muons Plus simulations, Tracker added scope, CRV changes	8/28/15	3	\$ 399,094	21 days (T4)	mgmt reserve
21	475	Test Cryostat mods; Upstream pbar window transfer; CRV staff change	9/3/15	3	\$ 379,471	31 days (T3)	mgmt reserve
22	475	Detector Bldg changes; TS Module Fab award; Test Cryostat mods and more	10/19/15	2	\$ 439,584	80 days (T4)	total
		portion from MR			\$ 69,844		mgmt reserve
		portion from contingency			\$ 369,740		contingency
		reload MR from contingency			\$ 1,000,000		contingency
23	475	Recondition HAB Refrigerator	10/29/15	3	\$ 118,689		mgmt reserve
24	475	FY16 Rate Update	11/4/15	3	\$ 229,086		mgmt reserve
25	475	Beamline Optics, HAB Cryo Plant	11/16/15	2	\$ 1,823,269	-8 days (T3)	total
		portion from MR			\$ 652,225		mgmt reserve
		portion from contingency			\$ 1,171,044		contingency
		reload MR from contingency			\$ 1,000,000		contingency
26	475	Target Rem.Handling, Accel. CRRs, Scintillator QA	12/21/15	3	\$ 756,396	37 days (T3)	mgmt reserve
27	475	Constr. Changes, CD3 Review Prep	1/26/16	3	\$ 82,571	215 days (TX3)	mgmt reserve
Net cost of changes					\$ 4,181,945		
Reloaded MR after BCR025					\$ 1,000,000		
Changes after 025					\$ 838,967		
Remaining Management Reserve					\$ 161,033		
Original Baseline Contingency					\$ 52,450,033		
Changes					\$ 3,342,978		
Remaining Contingency					\$ 49,107,055		
Sum of Remaining MR and Contingency					\$ 49,268,088		

Keeps track of Contingency and Management Reserve

Mu2e has a \$1M MR.

FPD approval required to replenish.

Summary

- Mu2e is a large, complex and challenging project. Successful management of the project is made possible by:
 - proactive, vigorous management by a dedicated team of professionals
 - full support of the Laboratory
 - modern, functioning management tools
 - full buy-in from all stakeholders.
- We have implemented the Project Management Systems that we need to achieve success and they are working.
- Fermilab provides significant support to the Project, particularly in the area of management systems.
- I'm confident that Mu2e will deliver its required scope safely, on time and on budget.