



EVMS Implementation in Mu2e

Ron Ray

Mu2e Project Manager

12/10/2014

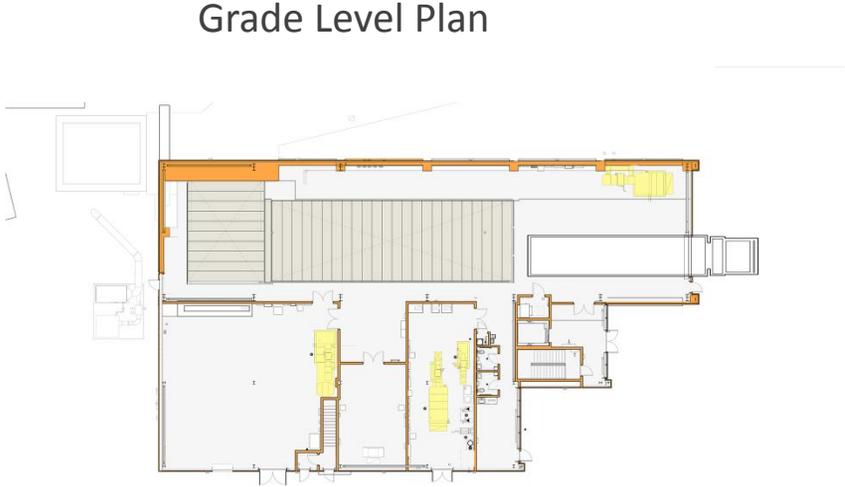
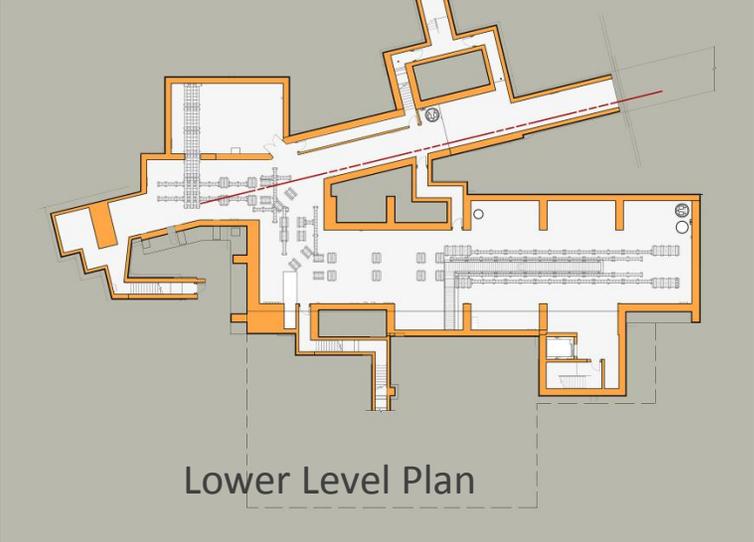


Mu2e Project History

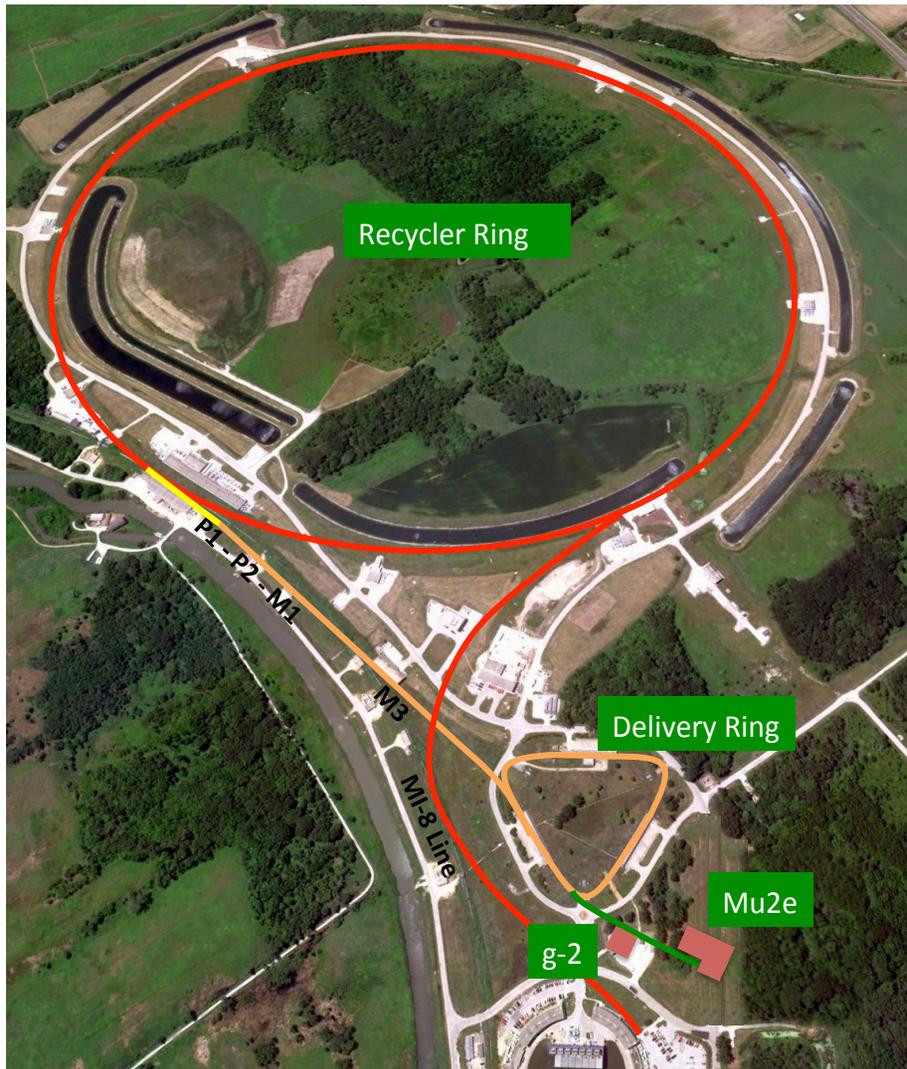
- CD-0 approved November 2009
- CD-1 approved July 2012
 - Cost range of \$200 - \$300M
- CD-3a approved July 2014
 - Authorizes procurement of long-lead superconducting cable for solenoids (~\$6M)
- CD-2/3b approval anticipated March 1, 2015
 - CD-3b authorizes construction of Detector Hall (~\$13M) and procurement of Transport Solenoid Modules (~\$6M, on critical path).
- CD-3c projected for Spring 2016
- CD-4 projected for early FY21
 - 24 months of schedule float

Mu2e Scope

- New building to house the experimental apparatus



Mu2e Scope



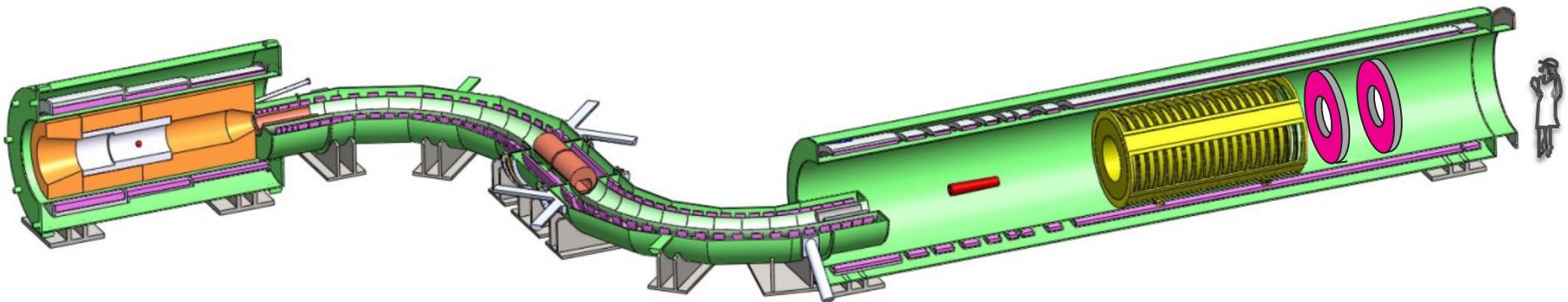
Modifications and additions to the existing accelerator complex



Mu2e Scope

Mu2e apparatus

- Superconducting Solenoids
- Tracker
- Calorimeter
- Cosmic Ray Veto (not shown)
- DAQ



Mu2e Scope

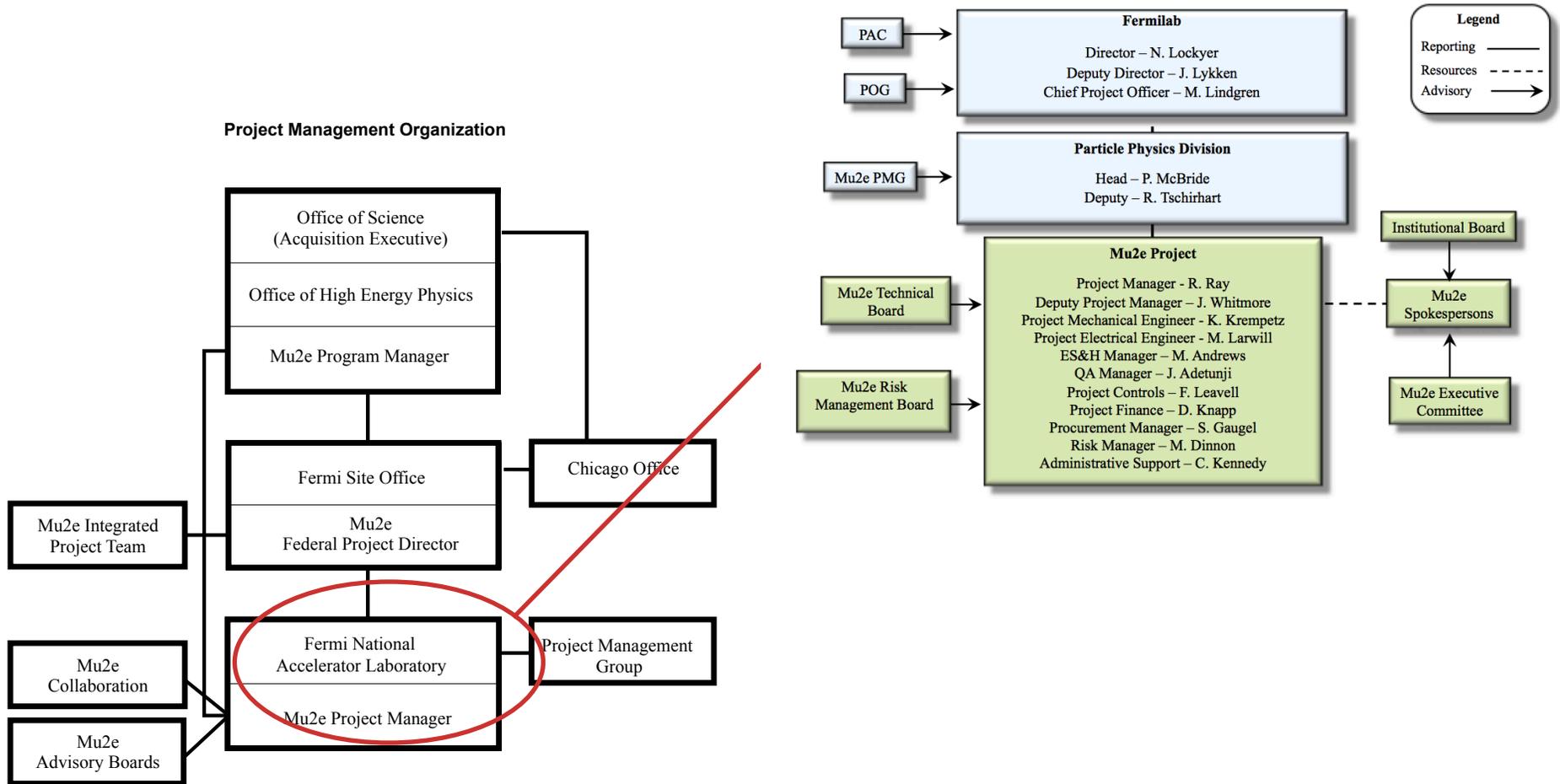
- Full scope is defined and described in the Mu2e WBS Dictionary,
 - under configuration control in Mu2e document database
 - Accessible from web page

Total Project Cost of \$271M

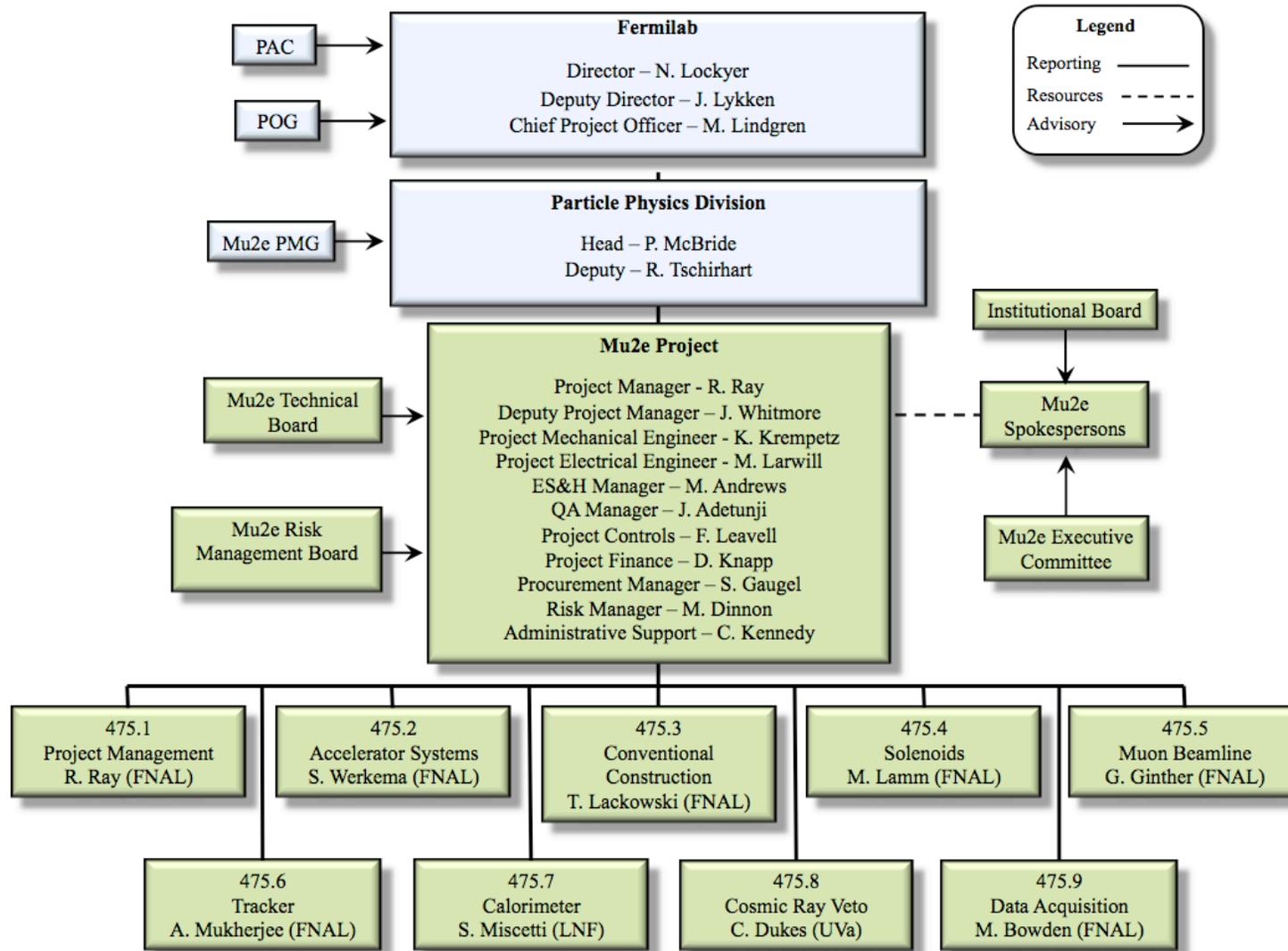
WBS 1.0 Project Management

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>

Organization



Organization



L2 Managers



1
Project Management
R. Ray
FNAL



2
Accelerator
S. Werkema
FNAL



3
Conventional Construction
T. Lackowski
FNAL



4
Solenoids
M. Lamm
FNAL



5
Muon Beamline
G. Ginther
FNAL

6
Tracker
A. Mukherjee
FNAL

7
Calorimeter
S. Miscetti
Frascati

8
Cosmic Ray Veto
C. Dukes
UVa.

9
Trigger and DAQ
M. Bowden
FNAL



Cost Methodology

General Procedure

- Activity-based RLS. M&S, labor hours, resources and durations established at activity level.
- Estimators instructed to use 85% C.L. base estimates
- Estimate uncertainty is added to each activity based on the level of design maturity.
- A statistical evaluation of the cost associated with risk exposure adds additional contingency to the Project

TPC = base estimate +
100% estimation uncertainty +
statistical evaluation of risks at 80% C.L.
+ application of burdening and escalation

Resource Loaded Schedule

- Activity based RLS contains
 - 6924 activities
 - 4710 Work Packages
 - 3538 current budget
 - 793 contracted labor/material purchases
 - 375 obligations
 - 74 Control Accounts (56 open) and 30 CAMs
 - 1109 milestones
 - 236 Constraints
 - 12 are accelerator shutdowns
 - 12 are Muon Campus milestones
 - 212 are reporting milestones
- Critical Path, Near Critical Path and sub-project Critical Paths all identified using the RLS.
- Work schedule, obligations, resource profiles are derived from the RLS



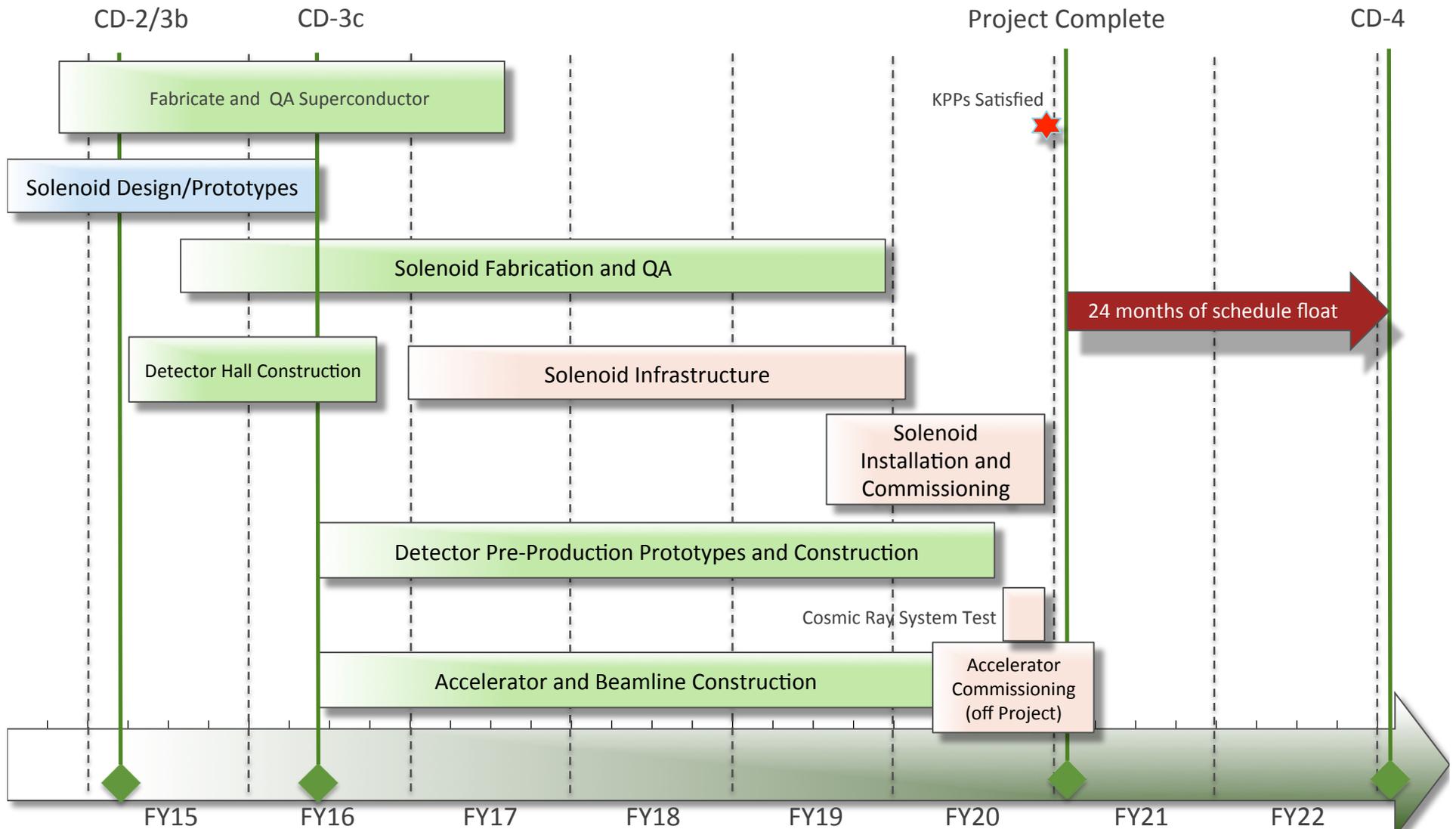
Mu2e CD-2/3 Schedule

Activity ID	Activity Name	Duration (Work Days)	Start	Finish	Predecessors	BOE Uocob #	Code PMT Code	Resource Information	FY2010
47502.01.03.001070	Project Management LOE FY18 Equipment & Travel	250.00	10/2/17	9/28/18	FY18002	1888	A	M&S Standard: FY12 Base Year 49403	
47502.01.03.001080	Project Management LOE from FY19 to CD-4 Review Labor	365.00	10/1/18	3/17/20	FY19002	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	FY19002	1888	A	M&S Standard: FY12 Base Year 49403	
47502.01.03.001100	L4 - Implementation Tasks Complete (Ready for Verification that Key Performance Criteria are met)	0.00		3/17/20			B		
								47502.06.02.00100, 47502.03.001050, 47502.03.001060, 47502.04.05.00110, 47502.07.05.00300, 47502.08.001100, 47502.08.05.00114, 47502.01.03.00108, 47502.04.001060, 47502.05.08.00100, 47502.07.001040, 47502.09.001070, 47502.01.03.00109, 47502.03.04.00111, 47502.08.04.00110, 47502.03.03.1.134, 47502.06.001050, 47502.05.001060, 47502.06.04.00120, 47502.08.03.00104, 47502.06.01.00121	
47502.01.03.001110	L4 - Ready for Operations	0.00		3/17/20			B		
47502.01.03.001120	Prepare for CD-4 Reviews	30.00	3/18/20	4/28/20			A	M&S Standard: FY12 Base	

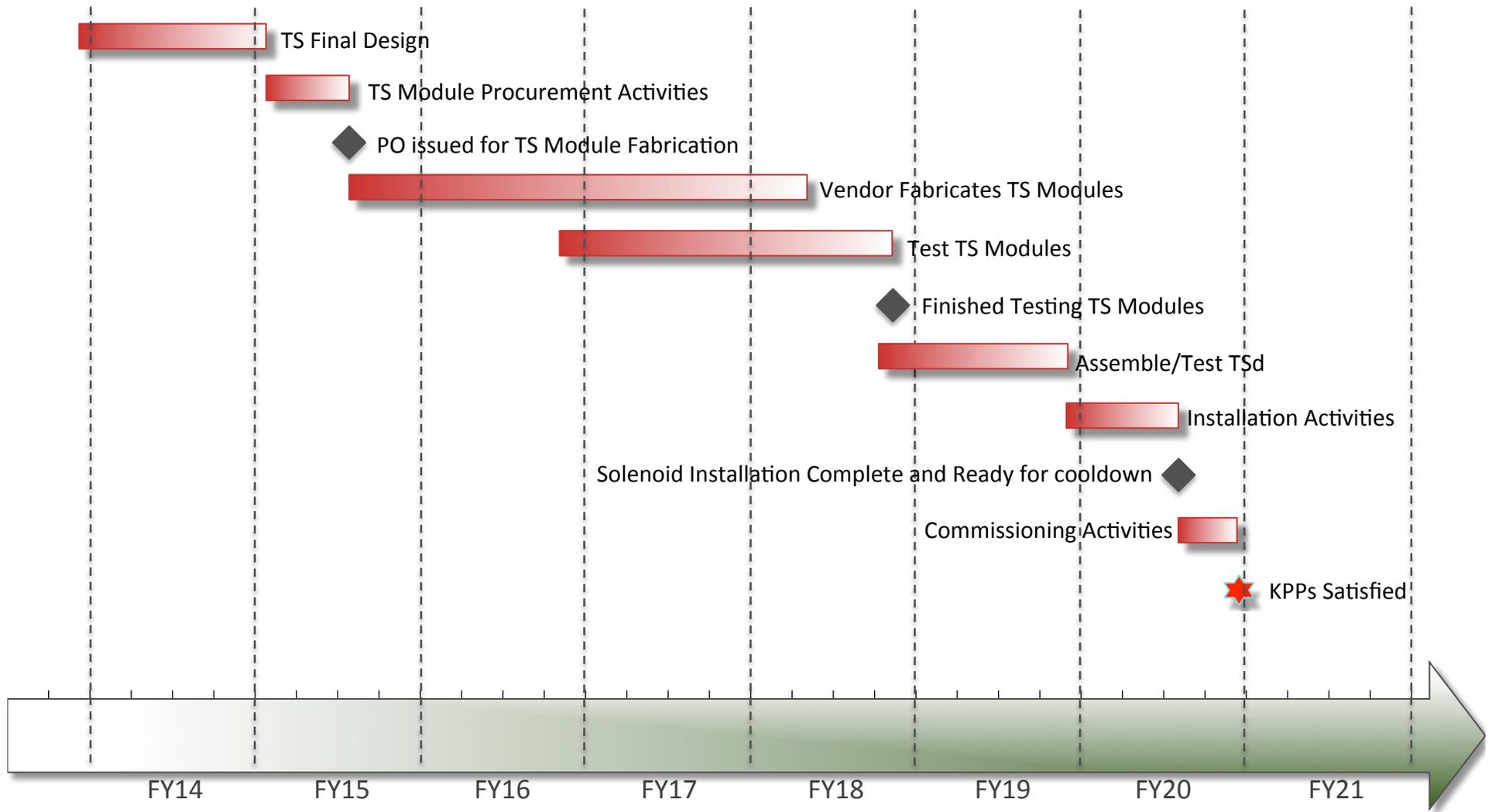
Rates and Assumptions

- Schedule trued-up with actuals through end of April 2014 and stasured through November 2014.
- Estimate developed in FY14\$
- One person-year = 1768 hours
 - 52 weeks x 40 hours/week x 0.85
- Applied burdening rates are based on where work is being done
 - Divisions/Sections at Fermilab may have different overhead rates.
 - Every Mu2e institution has their own rates.
 - Rates are subject to change.
- Average salary rates are used for each distinct resource
- Escalation rates for M&S, Labor.

Schedule



Critical Path



Work Authorization

- After baseline has been established, Project Office authorizes work through Authorization Documents (WADs)
 - We have 56 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.

Work Authorization Document

Work Authorization Document

Control Account Information	
Control Account Manager:	Ray, Ron
Control Account Number:	475.01.04
Control Account Description:	Project Office Implementation & Close-out to CD-4

Period of Performance			
Start:	10/1/2014	Finish:	11/9/2020

WAD Scope
Scope of Work: Provide labor resources during the implementation and closeout phases for Project Management, Project Engineering, Project Controls, Finance and ES&H. Includes preparations for CD-4. 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.

Budget	HOURS	DIRECT	BAC
Funding Type DOE.HEP.LNI.CNSTR	78,116.11	4,098,147.27	11,179,514.48
Labor	77,896.11	3,889,782.79	10,921,643.31
Material	0.00	174,000.00	216,994.62
Non-Fermi Labor	220.00	34,364.48	40,876.55
Total Budget:	78,116.11	4,098,147.27	11,179,514.48

Authorization Signatures			
CAM: <i>Ron Ray</i>		Date:	12/5/2014
Project Manager: <i>Ron Ray</i>		Date:	12/5/2014

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

1	Project Number	475
2	Service Type Code	(All)
3		
4	Row Labels	Hours
5	▼ Biery, Kurt	
6	▼ 475.09.03	67.3
7	▼ 475.09.03.02 Data Acquisition Pilot System (PED)	
8	▼ 475.493	67.3
9	BIERY, KURT	0.5
10	RECHENMACHER, RONALD	14.8
11	DEUERLING, GREGORY	16.0
12	KWARCIANY, RICHARD	16.0
13	FLUMERFELT, ERIC	20.0
14	▼ Bowden, Mark	
15	▼ 475.09.01	4.5
16	▼ 475.09.01.02 Project Management: Preliminary Engineering Phase Design (PED)	
17	▼ 475.482	4.5
18	BIERY, KURT	0.5
19	BOWDEN, MARK	4.0
20	▼ Brandt, Jeff	
21	▼ 475.04.10	21.0
22	▼ 475.04.10 System Integration, Installation, and Commissioning Design (PED)	
23	▼ 475.264	21.0
24	BRANDT, JEFFREY	19.0
25	ARNOLD, DONALD	2.0
26	▼ Buehler, Marc	

- 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.
 - One SOW per fiscal year per institution.

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

- CAMs meet Project Controls Specialist each month
 - Status activities
 - Update milestones
 - Update ETC if necessary
- Mu2e has been doing status updates to the schedule since January to train the CAMs and establish the culture
- We have been generating CPRs since April
- Internal Baseline was established in September, prior to DOE CD-2 Review and after receiving funding profile.
- October is the first month of data since baselining
 - November CPR issued this week.

October Performance

Mu2e Project
October 31, 2014
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)	34	34	3	0	0%	31	91%	4,866	4,866	4,691	0	0%	175	4%	1.00	1.04	4,951	4,780	171	98%	98%
475.01.03 Project Office Preliminary & Final Design Phase to CD-2/3	0	0	256	0	0%	(256)	-	4,733	4,733	5,058	0	0%	(325)	-7%	1.00	0.94	5,215	5,540	(325)	91%	91%
475.01.04 Project Office Implementation & Close-out to CD-4	229	229	0	0	0%	229	100%	229	229	0	0	0%	229	100%	1.00	-	10,684	10,610	74	0%	2%
475.02.01 Project Management	37	37	54	0	0%	(17)	-45%	1,194	1,194	1,273	0	0%	(79)	-7%	1.00	0.94	3,338	3,444	(107)	37%	36%
475.02.03 Instruments and Controls	6	7	19	1	21%	(12)	-164%	396	406	411	11	3%	(4)	-1%	1.03	0.99	2,131	2,058	73	20%	19%
475.02.04 Radiation Safety and Improvements	4	8	11	3	75%	(3)	-45%	346	336	387	(11)	-3%	(51)	-15%	0.97	0.87	1,965	2,016	(51)	19%	17%
475.02.05 Resonant Extraction System	56	62	33	7	12%	30	47%	1,195	1,025	929	(170)	-14%	95	9%	0.86	1.10	5,313	5,265	48	18%	19%
475.02.06 Rings RF	3	3	0	0	0%	3	100%	262	262	277	0	0%	(15)	-6%	1.00	0.95	1,667	1,682	(15)	16%	16%
475.02.07 External Beamline	58	37	28	(21)	-37%	8	23%	1,030	901	889	(129)	-13%	12	1%	0.87	1.01	6,999	6,973	26	13%	13%
475.02.08 Extinction Systems	30	25	15	(5)	-17%	9	37%	875	798	742	(76)	-9%	56	7%	0.91	1.08	2,934	2,949	(15)	25%	27%
475.02.09 Target Station	83	50	56	(33)	-40%	(6)	-13%	2,138	2,051	1,876	(88)	-4%	175	9%	0.96	1.09	10,083	9,991	93	19%	20%
475.02.10 Accelerator Conceptual Design/R&D (OPC)	0	0	0	0	0%	0	0%	5,045	5,045	5,045	0	0%	0	0%	1.00	1.00	5,045	5,045	0	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	1	0	41	(1)	-100%	(41)	-	2,125	2,105	1,943	(20)	-1%	162	8%	0.99	1.08	2,258	2,117	141	92%	93%
475.03.03 Conv.Constr. Construction Phase Oversight	126	0	0	(126)	-100%	0	0%	126	0	0	(126)	-100%	0	0%	0.00	-	2,556	2,556	0	0%	0%
475.03.04.01 Mu2e Detector Service Building & Hall Fixed Price	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-	12,991	12,996	(5)	0%	0%
475.03.04.02 Delivery Ring Upgrades	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-	350	350	0	0%	0%
475.03.04.03 Fermi Procured Items and T&M	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-	1,883	2,016	(133)	0%	0%
475.03.04.04 Accelerator Absorber	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-	257	257	0	0%	0%
475.03.04.05 Building Controls	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-	111	111	0	0%	0%
475.03.05 Conv.Constr. Project Close	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-	374	374	(0)	0%	0%
475.04.01 Solenoids Project Management	41	41	141	0	0%	(100)	-245%	1,127	1,127	1,239	0	0%	(112)	-10%	1.00	0.91	3,092	3,263	(171)	38%	36%
475.04.02 Production Solenoid	5	2	13	(3)	-64%	(11)	-645%	1,554	1,551	1,745	(4)	0%	(194)	-13%	1.00	0.89	15,761	15,981	(220)	11%	10%
475.04.03 Transport Solenoids	269	95	289	(174)	-65%	(194)	-204%	5,465	5,049	5,651	(416)	-8%	(603)	-12%	0.92	0.89	23,673	24,293	(621)	23%	21%
475.04.04 Detector Solenoid	5	18	18	13	251%	(1)	-4%	934	975	1,397	41	4%	(421)	-43%	1.04	0.70	15,939	16,349	(409)	9%	6%
475.04.05 Cryogenic Distribution System	44	117	133	73	164%	(17)	-14%	1,088	1,185	1,215	96	9%	(31)	-3%	1.09	0.97	11,492	11,540	(49)	11%	10%
475.04.06 Magnet Power System	8	4	4	(4)	-54%	(0)	-8%	290	280	272	(10)	-3%	7	3%	0.97	1.03	1,474	1,467	7	19%	19%
475.04.07 Quench Protection and Monitoring System	52	0	24	(52)	-100%	(24)	-	472	410	491	(62)	-13%	(81)	-20%	0.87	0.83	2,917	3,004	(88)	16%	14%
475.04.08 Magnetic Field Mapping System	62	0	0	(62)	-100%	0	0%	87	21	38	(66)	-76%	(17)	-82%	0.24	0.55	1,037	1,056	(19)	4%	2%
475.04.09 Solenoids Ancillary Equipment	1	0	0	(1)	-100%	0	0%	2	18	1	16	1003%	17	97%	11.03	35.67	973	951	22	0%	2%
475.04.10 Solenoids System Integration, Installation & Commissioning	10	3	6	(7)	-72%	(3)	-124%	382	378	432	(4)	-1%	(53)	-14%	0.99	0.88	5,085	5,144	(59)	8%	7%
475.04.11 Solenoids Conceptual Design/R&D (OPC)	0	0	0	0	0%	0	0%	6,029	6,029	6,028	0	0%	1	0%	1.00	1.00	6,029	6,028	1	100%	100%
475.05.01 Muon Beamline Project Management	39	39	42	0	0%	(3)	-8%	764	764	724	0	0%	40	5%	1.00	1.06	3,280	3,262	18	22%	23%
475.05.02 Vacuum System	6	7	6	1	23%	1	16%	293	256	212	(37)	-13%	44	17%	0.87	1.21	3,216	3,163	54	7%	8%
475.05.03 Collimators	3	1	20	(2)	-72%	(19)	-2265%	173	173	174	(0)	0%	(1)	-1%	1.00	0.99	1,348	1,359	(11)	13%	13%
475.05.04 Upstream External Shielding	9	9	10	0	3%	(1)	-11%	292	276	262	(16)	-6%	14	5%	0.94	1.05	1,950	1,931	18	14%	14%
475.05.05 Stopping Target	18	0	0	(18)	-100%	(0)	-	28	10	12	(18)	-64%	(2)	-22%	0.36	0.82	176	178	(2)	7%	6%
475.05.06 Stopping Target Monitor	0	0	0	(0)	-100%	0	0%	18	3	0	(16)	-86%	2	88%	0.14	8.25	331	329	2	0%	1%
475.05.07 DS Internal Shielding	1	2	0	0	13%	1	88%	49	49	50	(0)	0%	(1)	-1%	1.00	0.99	386	387	(0)	13%	13%
475.05.08 Muon Beam Stop	6	5	16	(1)	-12%	(12)	-240%	179	176	213	(4)	-2%	(37)	-21%	0.98	0.82	758	797	(39)	27%	23%
475.05.09 Downstream External Shielding	8	2	4	(6)	-74%	(1)	-61%	367	360	403	(7)	-2%	(44)	-12%	0.98	0.89	3,324	3,366	(42)	12%	11%
475.05.10 Detector Support Structure	1	5	13	4	357%	(8)	-142%	385	388	434	3	1%	(46)	-12%	1.01	0.89	2,407	2,456	(49)	18%	16%
475.05.11 Muon Beamline Systems Integration	0	3	2	3	-	1	39%	46	46	32	0	0%	14	31%	1.00	1.45	162	148	14	22%	28%
475.05.13 Muon Beamline Conceptual Design/R&D (OPC)	0	0	0	0	0%	0	0%	1,980	1,980	1,979	0	0%	1	0%	1.00	1.00	1,980	1,979	1	100%	100%
475.06.01 Tracker Project Management	19	19	16	0	0%	3	17%	558	558	500	0	0%	57	10%	1.00	1.11	1,847	1,770	77	28%	30%
475.06.02 Straws	5	5	31	(1)	-10%	(27)	-580%	154	137	277	(17)	-11%	(140)	-102%	0.89	0.49	1,265	1,410	(145)	20%	11%
475.06.03 Straw Assemblies	41	57	22	16	38%	35	61%	442	380	439	(62)	-14%	(58)	-15%	0.86	0.87	3,520	3,566	(45)	12%	11%
475.06.04 Tracker Front End Electronics	29	13	8	(16)	-56%	4	34%	470	285	222	(184)	-39%	64	22%	0.61	1.29	2,262	2,143	119	10%	13%
475.06.05 Tracker Infrastructure	15	6	0	(9)	-59%	6	100%	70	28	40	(42)	-60%	(12)	-43%	0.40	0.70	952	935	17	4%	3%
475.06.06 Detector Assembly & Installation	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-	72	72	0	0%	0%
475.06.07 Tracker Conceptual Design/R&D (OPC)	0	0	1	0	0%	(1)	-	1,653	1,653	1,657	0	0%	(4)	0%	1.00	1.00	1,653	1,657	(4)	100%	100%
475.07.01 Calorimeter Project Management	3	3	4	0	0%	(2)	-61%	122	122	128	0	0%	(6)	-5%	1.00	0.95	268	274	(6)	47%	45%
475.07.02 Crystals	17	2	2	(15)	-90%	(0)	-21%	52	35	48	(17)	-33%	(13)	-39%	0.67	0.72	2,600	2,614	(14)	2%	1%

October Performance

Control Account	Budget	Earned	Actuals	SV (\$)	SV (%)	CV (\$)	CV (%)	Budget	Earned	Actuals	SV (\$)	SV (%)	CV (\$)	CV (%)	SPI	CPI	BAC	EAC	VAC	% Spent	% Complete
475.07.03.02 Radiation & Temperature Monitoring	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-	163	163	0	0%	0%
475.07.04 Photodetectors	1	6	22	5	530%	(16)	-264%	137	113	119	(24)	-17%	(6)	-6%	0.83	0.95	742	766	(24)	16%	15%
475.07.05 Electronics	0	0	59	0	0%	(59)	-	108	108	108	0	0%	0	0%	1.00	1.00	108	108	0	100%	100%
475.07.06 Calibration System	18	18	44	0	2%	(26)	-142%	84	174	48	89	106%	126	73%	2.06	3.64	718	582	136	8%	24%
475.07.07 Calorimeter Power	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-	4	4	0	0%	0%
475.07.08 Calorimeter Installation	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-	313	315	(2)	0%	0%
475.08.01 Cosmic Ray Veto Project Management	5	2	(40)	(3)	-53%	42	1702%	100	97	131	(3)	-3%	(34)	-35%	0.97	0.74	452	489	(37)	27%	21%
475.08.02 Cosmic Ray Veto Mechanical Design	0	0	1	0	0%	(1)	-	75	75	71	0	0%	4	5%	1.00	1.05	138	147	(9)	49%	54%
475.08.03 Scintillator extrusions	0	0	0	0	0%	0	0%	226	201	143	(25)	-11%	58	29%	0.89	1.40	1,033	995	38	14%	19%
475.08.04 Cosmic Ray Veto Fibers	12	4	14	(8)	-70%	(10)	-276%	37	19	43	(18)	-48%	(23)	-122%	0.52	0.45	461	460	1	9%	4%
475.08.05 Photodetectors	17	0	6	(17)	-98%	(6)	-1362%	389	310	300	(79)	-20%	10	3%	0.80	1.03	771	757	13	40%	40%
475.08.06 Cosmic Ray Veto Electronics	0	24	57	24	-	(32)	-133%	418	244	319	(173)	-41%	(75)	-31%	0.59	0.77	1,722	1,833	(111)	17%	14%
475.08.07 Cosmic Ray Veto Module Fabrication	11	3	6	(8)	-74%	(3)	-121%	229	167	156	(62)	-27%	11	7%	0.73	1.07	1,489	1,501	(12)	10%	11%
475.08.08 Detector assembly and installation	0	0	4	0	0%	(4)	-	23	23	37	0	0%	(14)	-63%	1.00	0.61	209	223	(15)	17%	11%
475.08.09 Cosmic Ray Veto Conceptual Design/R&D (OPC)	0	0	0	0	0%	0	0%	511	511	503	0	0%	8	2%	1.00	1.02	511	503	8	100%	100%
475.09.01 TDAQ Project Management	12	12	12	0	0%	(1)	-4%	673	673	673	0	0%	(0)	0%	1.00	1.00	1,206	1,188	18	57%	56%
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	367	366	0	80%	80%
475.09.03 Data Acquisition	40	27	42	(13)	-32%	(15)	-56%	635	605	628	(30)	-5%	(23)	-4%	0.95	0.96	1,892	1,917	(25)	33%	32%
475.09.04 Data Processing	17	2	1	(16)	-91%	1	62%	231	171	160	(60)	-26%	11	6%	0.74	1.07	883	861	22	19%	19%
475.09.05 Controls and Networking	13	5	5	(8)	-63%	(0)	-7%	166	131	133	(35)	-21%	(2)	-1%	0.79	0.99	603	604	(1)	22%	22%
Total	1,530	1,051	1,578	(480)	-31%	(527)	-50%	54,958	53,103	54,240	(1,856)	-3%	(1,137)	-2%	0.97	0.98	216,657	218,324	(1,668)	25%	25%
Management Reserve																	1,000	0			
TAB																	217,657	218,324			
Contingency																	53,343	52,676			
TPC																	271,000	271,000			

Report Options

Report Name: Mu2e_Earned Value

Project File: Mu2e

Filter:

Criteria: Control Account

Calendar: 18 Required Set

Cost Sets: Scheduled, Performed, Actuals, Estimate at complete

Variance 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 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 $\geq \$200K$

Variations

- FRA Certified EVM System requires a variance analysis report for **red** variations.
- Mu2e PM requires variance analysis reports for yellow variations
 - We want to keep yellow variations from turning into red variations.

Variance Reports

Variance Analysis Report									
CA: 475.04.03 Transport Solenoids					Project: Mu2e Solenoids				
CAM: LOPES, MAURICIO DE LIMA					Period Ending: October 31, 2014				
Report in \$K									
Period	Budget	Earned	Actuals	SV (\$)	SV (%)	CV (\$)	CV (%)	SPI	CPI
Current:	269	95	289	(174)	-65%	(194)	-204%	0.35	0.33
Cumulative:	5,465	5,049	5,651	(416)	-8%	(603)	-12%	0.92	0.89
	BAC	EAC		VAC (\$)	VAC (%)				
At Complete:	23,673	24,293		(621)	-3%				
Explanation of Variance/Description of Problem:									
Current:	There is both a cost and a schedule variance. The schedule variance is largely due to TS design effort being put on hold to prepare for the CD-2/3b review. The cost variance is largely due to preparing the test facility for the Toshiba coil (a model magnet used for testing indirectly cooled solenoid magnet technology used for Mu2e solenoids). While good progress was made, due to the complexity of the test facility, it has taken significantly more effort to prepare the facility than was originally budgeted.								
Cumulative:	Both cost and schedule variances were generated during the summer. Improvements to the schedule variance were realized in September with significant earned value realized in the TS design. As explained in the "current" section above, the schedule variance was then adversely affected by the Cd2/CD3b review. With the CD2 review completed, we expect this cumulative schedule variance to improve going forward. The cumulative cost variance is mostly related to the test facility. For the reasons explained in the "current" section above, i.e. the complexity of preparing this facility has resulted in more effort than anticipated.								
Impact:									
Since the TS is on the critical path, any TS schedule variance could potentially delay the completion of the project. See corrective action below.									
Corrective Action:									
Further negative increases in the schedule variance are not anticipated. As TS is on the critical path, we are actively investigating ways to improve the overall schedule. It may be possible to shorten the fabrication and test time for the TS. These changes would reduce the cumulative schedule variance. It is not possible to recover the cost variance for the TS Test facility. We are re-evaluating the cost and schedule for the test facility, as it is an important part of the TS program. Additionally, as a result of the October CD-2/3b design review, we have been directed to focus our attention on testing the TS prototype coil module. Based on this mandated scope change, we will reorder and reassign resources in the RLS as needed to meet the CD-2/3b recommendation.									
Monthly Summary:									
Prepared by:	Mau Lopes	CAM			Date:	November 20, 2014			
Reviewed by:	David Leeb	PCS			Date:	November 20, 2014			
Approved by:	Ron Ray	PM			Date:	November 24, 2014			

Variance Reports

Variance Analysis Report									
CA: 475.02.05 Resonant Extraction System CAM: Nagaslaev, Vladimir					Project: Mu2e Accelerator Period Ending: October 31, 2014				
Report in \$K									
Period	Budget	Earned	Actuals	SV (\$)	SV (%)	CV (\$)	CV (%)	SPI	CPI
Current:	56	62	33	7	12%	30	47%	1.12	1.90
Cumulative:	1,195	1,025	929	(170)	-14%	95	9%	0.86	1.10
At Complete:	BAC	EAC		VAC (\$)	VAC (%)				
	5,313	5,265		48	1%				
Explanation of Variance/Description of Problem:									
Current:	NA								
Cumulative:	Schedule variance is due to resource availability during the annual accelerator shutdown in September-October. One engineer and all the techs were withdrawn from Mu2e to work on the shutdown. There is an lesson-learned here. Accelerator resources needed during shutdowns should be re-evaluated. There is also a substantial cost underrun in Technical documentation - will take this lesson in account in planning for the CD3c review series.								
Impact:									
No longterm impact is expected. As the corective action below is implimented, the BAC will trend back toward the EAC.									
Corrective Action:									
1) Need to administratively limit Mechanical Engineering (ME) resources and make schedule corrections in the forthcoming Change Request (CR): "Modify the electrostatic septum design schedule". Assuming ME availability at 1 FTE level from 12/2014-06/2015 and 0.5FTE from 07/2015-07/2016. Resources for this change will be redistributed from future tasks so that there is no net cost increase.									
2) Bring up to the Accelerator Division Management the need to finish magnet power supply prototyping which has been pending for a long time.									
3) Submit a CR to redistribute resources of the "CD-3c Review preparations" into new activities to accommodate Technical Review, Director's Review and CD-3c Review without overall cost change resulting from the redistribution of resources; and add the new estimated travel expenses that correspond to bringing the required experts to Fermilab to perform the new Technical Review activity.									
Monthly Summary:									
The current period is not above the threshold. The current month positive Cost Variance is coming mostly from underused engineering resources during the recent review cycle.									
Prepared by:	V Nagaslaev		CAM	Date:	November 18, 2014				
Reviewed by:	M Gardner		PCS	Date:	November 19, 2014				
Approved by:	R Ray		PM	Date:	November 24, 2014				

Variance Reports

- Variance reports are approved electronically

Mu2e Document 4771-v3

October 2014 Variance Report for 475.04.03

(Document Status: Approved)

Abstract:

This document contains files or links to other files in Mu2e-docdb that pertain to this control account.

Files in Document:

- [475.04.03 VAR October 2014](#) (475.04.03 VAR Analysis 201410.xlsx, 20.7 kB)

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

Topics:

- [Solenoids:Transport](#)
- [Variance Reports:WBS 4 Solenoids](#)

Authors:

- [Mauricio de Lima Lopes](#)

Signoffs:

- [Mauricio D. Lopes](#) (signature complete) ← Submitter
- [Michael J. Lamm](#) (signature complete) ← L2 Manager
- [David A. Leeb](#) (signature complete) ← Project Controls
- [Ronald E. Ray](#) (signature complete) ← Project Manager

Corrective Action Log

Item # (date-CA-#)	Control Account #	Date Posted	Date Approved by PM	Responsible Person (CAM)	Corrective Action	Status (Open/Closed)	Status Details	Status Detail Date	Completion Date
10.14-2.5-001	475.02.05	21-Nov-14	24-Nov-14	Nagaslaev, Vladimir	Need to administratively limit Mechanical Engineering (ME) resources and make schedule corrections in the forthcoming Change Request (CR): "Modify the electrostatic septum design schedule". Assuming ME availability at 1 FTE level from 12/2014-06/2015 and 0.5FTE from 07/2015-07/2016. Resources for this change will be redistributed from future tasks so that there is no net cost increase.	Open		21-Nov-14	
10.14-2.5-002	475.02.05	21-Nov-14	24-Nov-14	Nagaslaev, Vladimir	Bring up to the Accelerator Division Management the need to finish magnet power supply prototyping which has been pending for a long time.	Open		21-Nov-14	
10.14-2.5-003	475.02.05	21-Nov-14	24-Nov-14	Nagaslaev, Vladimir	Submit a CR to redistribute resources of the "CD-3c Review preparations" into new activities to accommodate Technical Review, Director's Review and CD-3c Review without overall cost change resulting from the redistribution of resources; and add the new estimated travel expenses that correspond to bringing the required experts to Fermilab to perform the new Technical Review activity.	Open		21-Nov-14	
10.14-2.7-001	475.02.07	20-Nov-14	24-Nov-14	Still, Dean	Attempting to allocate design resources and assess hours for LCW design in 47502.07. 03.002000. Should be an additional 2 or 3 months to correct design tasks.	Open		20-Nov-14	
10.14-2.9-001	475.02.09	20-Nov-14	24-Nov-14	Coleman, Rick	No additional progress will be stasured, the variance will remain until the end of March when the deliverable is completed and the variance will be normalized by the invoice.	Open		20-Nov-14	
10.14-3.2-001	475.03.02	20-Nov-14	1-Dec-14	Lackowski, Tom	The Preliminary /Final Design will be closed on receipt of DOE approvals of CD3b.	Open		20-Nov-14	
10.14-3.3-001	475.03.03	20-Nov-14	1-Dec-14	Lackowski, Tom	The contract will be implemented as soon as possible following the DOE approvals of CD3b.	Open		20-Nov-14	
10.14-4.3-001	475.04.03	20-Nov-14	24-Nov-14	Lopes, Mauricio	Further negative increases in the schedule variance are not anticipated. As TS is on the critical path, we are actively investigating ways to improve the overall schedule. It may be possible to shorten the fabrication and test time for the TS. These changes would reduce the cumulative schedule variance. It is not possible to recover the cost variance for the TS Test facility. We are re-evaluating the cost and schedule for the test facility, as it is a important part of the TS program. Additionally, as a result of the October CD-2/3b design review, we have been directed to focus our attention on testing the TS prototype coil module. Based on this mandated scope change, we will reorder and reassign resources in the RLS as needed to meet the CD-2/3b recommendation.	Open		20-Nov-14	
					When the baseline is established, following CD-2 approval, setting the baseline equal to actual cost will restore the correct	Open			

Change Control

- Change control thresholds are defined in the PEP
- Change process described in Mu2e Configuration Management Plan (docdb#509)
- Change mechanism described in Mu2e Change Control Procedure (docdb#2971)
- Mu2e Technical Board is the Level 3 CCB
- Mu2e PMG is the Level 2 CCB.

Table 6.0
Mu2e Project
Technical, Schedule, and Cost Baseline Control Levels

	Deputy Director for Science Programs Level 0	Associate Director of Science for HEP Level 1	Federal Project Director* Level 2	Fermilab/Mu2e Project Manager Level 3
Scope	Any change in scope and /or performance that affects the ability to satisfy the mission need or is not in conformance with the current approved PEP Section 2.1 and PDS.	Any addition to scope as described in PEP section 2.1 or major changes in technology or approach to Level 2 WBS components as shown in Section 2.4.	Major changes in technology or approach to Level 3 WBS components as shown Appendix 2.	Major changes to WBS below Level 3.
Cost	Increase in TPC, TEC, or OPC as shown in Table 2.2.	Any contingency usage over \$5M for a single item or any cumulative change greater than 50% of a Level 2 WBS.**	Cumulative contingency use of \$1M.**	Any change that increases the cost at Level 3 WBS or below by more than \$50k.
Schedule	Any change to CD-4 date as shown in Table 2.3.	Any changes to Tier 1 milestone as shown in Table 2.3.	Any changes to Tier 2 milestone shown in Table 2.3.	Any changes to milestones below Tier 2.
Funding	Any changes to funding profile as shown in Section 2.5 that negatively impacts the Performance Baseline.			

Change Control

Mu2e Change Request

Mu2e CR Num 4 Date submitted: 9/30/2014 Change Level: 4

Requestor: Frances Leavell Request Status: Approved

Change_type:
 cost
 schedule

WBS: 475.0
WBS Description: Mu2e Project

Approvals: CCB OK:

Ron Ray 10/27/14
Project manager Date Approved

Supporting Documents:
4598

L2 Subprojects:
All

Description: Cost leveled to match funding profile; New CD-3c strategy implemented; Reporting milestone strategy implemented; misc other changes

Justification: Continued development of performance measurement baseline, as well as contingency associated with estimate uncertainty, to meet DOE requirements.

Cost Impacts:

Estimate type	Cost type	Labor resource type	Before amount	After amount	Cost Units
Final	Labor	misc	106,434,256	107,177,799	dollars
Final	M&S	none	111,378,273	111,134,810	dollars

Schedule Impacts:

Task Description	Before		After		Duration units
	Start	End Duration	Start	End Duration	
T1 - DOE CD-4 Approval	11/16/2020		11/9/2020		
T0 - Project Complete	11/18/2022		11/11/2022		

Technical Impact: Added PS Conductor; Calorimeter quantities reduced; other - see descriptions in Doc #4598.

Risk Impact: None.

Printable form produced for each CR

- Stored as PDF in docdb
- Signature box for approvals
- Lists cost, schedule impacts, supporting documents, change type, other affected systems, justification, risk impacts...

Lessons Learned (and Incorporated)

- Don't baseline on early dates (Lesson Learned from NOvA)
- Annual accelerator shutdowns impact resource availability and should be reflected in schedule resource profile
- Reviews consume not only the time of managers but technical staff as well. That effort should be reflected in schedule.
- We systematically underestimate the amount of effort required to modify/upgrade existing equipment and systems.

CAM Training

- All Mu2e CAMs have received EVMS training
- The Lab has arranged several training sessions
 - 2-day EVMS training
 - Series of 1 hour presentations by R. Marcum on various EVMS topics
- Bill Freeman, former NOvA Project Control Lead shared his experiences with CAMs from Mu2e, CMS and g-2 at an *EVMS Bootcamp*.

Summary

- Mu2e is using the FRA EVM System to manage the Project.
 - Lessons Learned have been incorporated into the Project
- Change Control fully implemented
- All CAMs have received training, but the best training is actually doing it.