

Mu2e CD3c Review

WBS 475.02.06 Delivery Ring RF

Joseph E. Dey

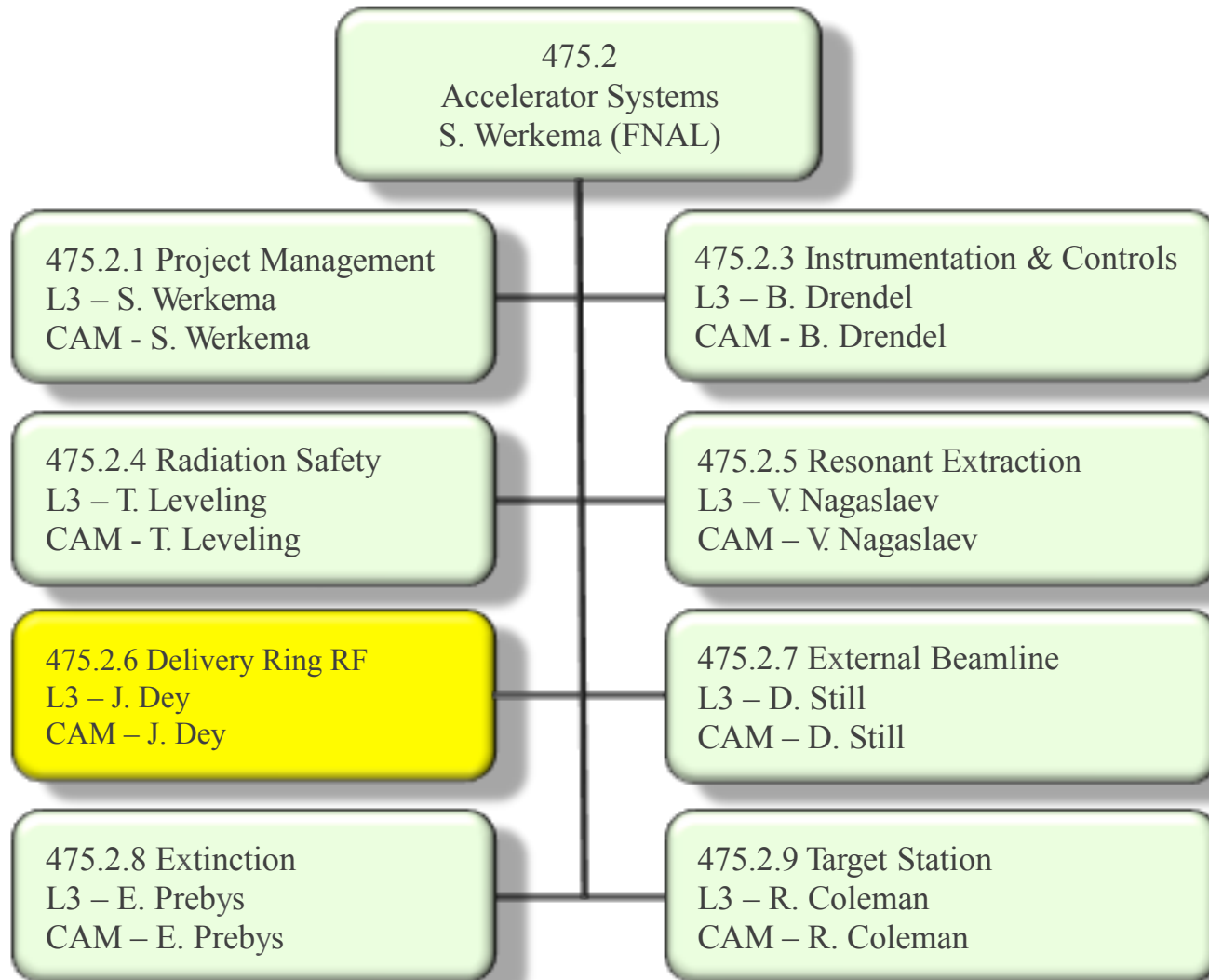
Mu2e Delivery Ring RF L3 Manager

4/19/16

Delivery Ring RF Team

- Joseph E. Dey : Senior RF Design Engineer
 - Delivery Ring RF L3 Manager
 - Recycler RF AIP L2 Manager
 - Accelerator Division RF Department
- Philip Varghese : Senior RF Design Engineer
 - Delivery Ring RF Low Level RF System
 - Recycler RF AIP Low Level RF System
 - Accelerator Division RF Department
- Brian Chase : Senior RF Design Engineer
 - Delivery Ring RF Low Level RF System
 - Recycler RF AIP Low Level RF System
 - Accelerator Division RF Department Deputy Head

Mu2e Accelerator Systems Organization



Scope

WBS 475.02.06
Delivery Ring RF System
Joseph Dey / Fermilab

475.02.06.01 Low Level RF System

Design, fabrication, and installation of the Delivery Ring RF system low level electronics required for the high level RF cavity system.

475.02.06.02 Delivery Ring RF Studies & Tuning

Design and implementation of the beam studies and tuning facilities of the Delivery Ring RF system.

475.02.06.05 Technical Documentation

This WBS item contains management and administrative support activities for the design and implementation of the Delivery Ring 2.4 MHz RF System. These activities include: Delivery Ring RF System project management support, TDR preparation, and BOE preparation and maintenance.

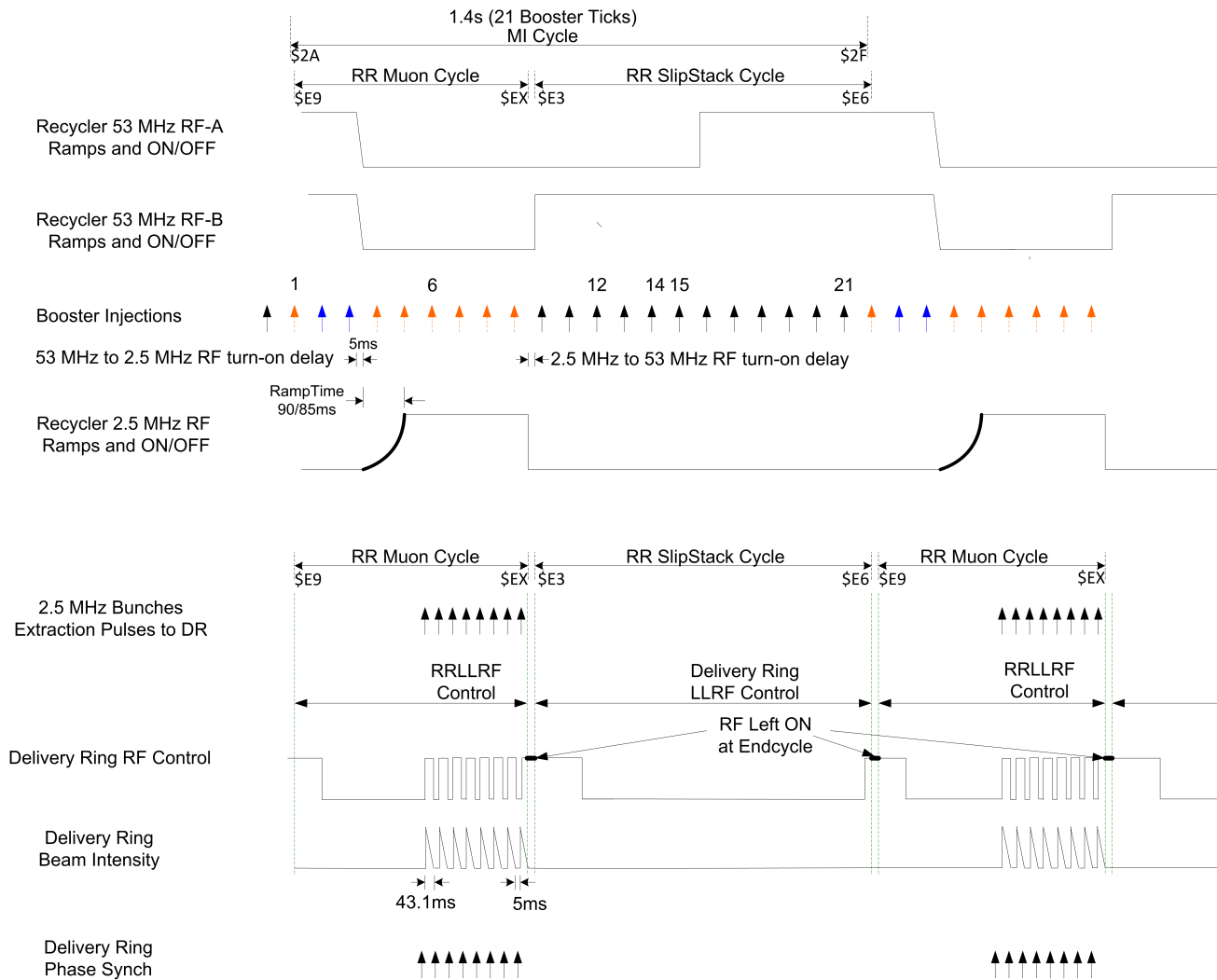
Requirements

- The Mu2e Accelerator Requirements and Derived Parameters are found in the following document:
 - Mu2e-doc-1374
- The Mu2e Technical Design Report.
 - Mu2e-doc-4299

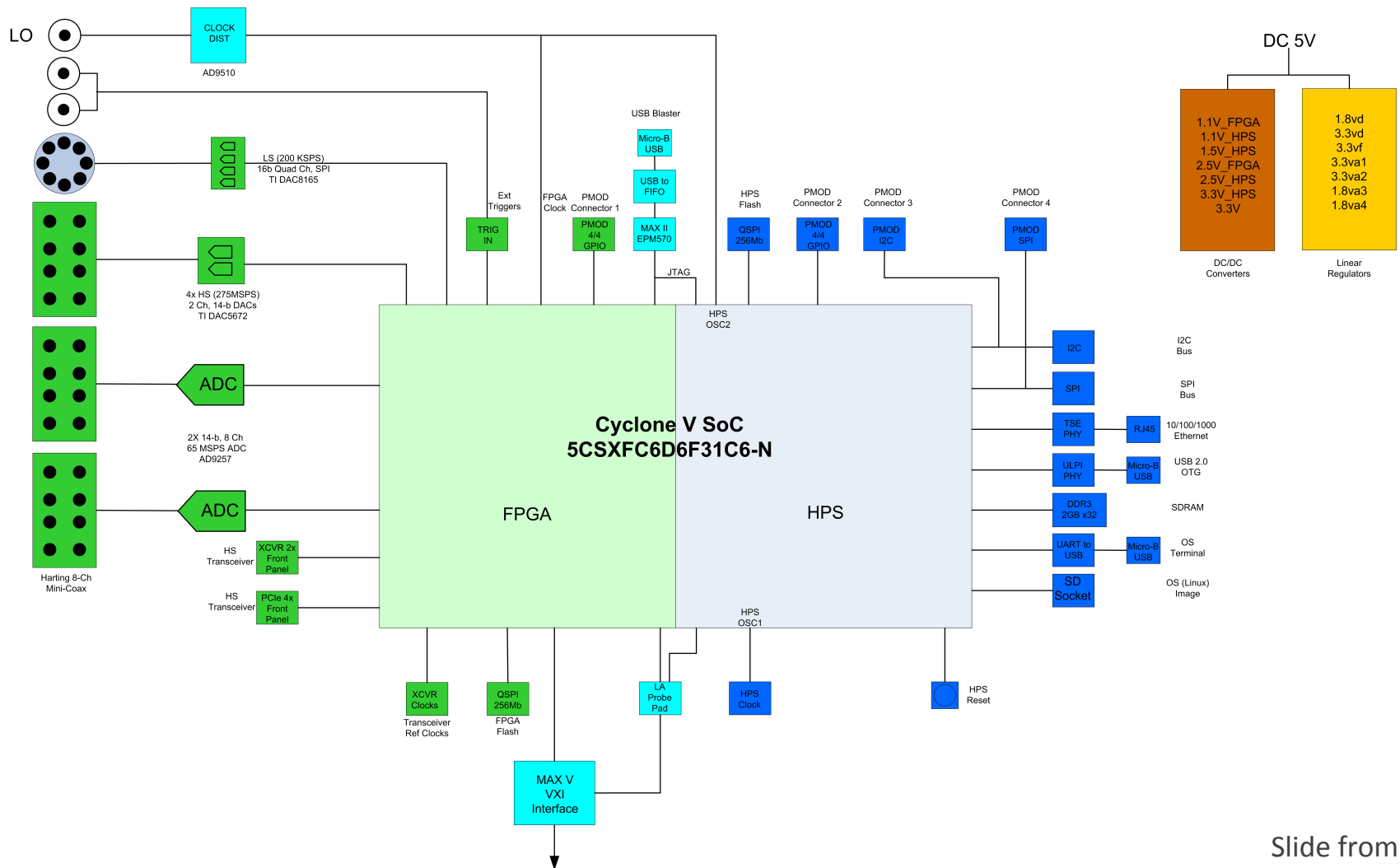
Independent Design Review

- An Independent Design Review of the Mu2e Delivery Ring RF was held on November 19, 2015.
- The review committee consisted of experts in accelerator systems.
 - Craig Drennan - Fermilab Booster
 - David Peterson - former Fermilab Antiproton Source
- Review Proceedings can be found at:
 - <https://indico.fnal.gov/conferenceDisplay.py?confId=10838>
- Final Review Report (Mu2e-doc-6861)

Design – NOvA / Mu2e Timeline



Design – SOC MFC – LLRF card based on SOC FPGA



Design Maturity

Accelerator Subsystem	Design Completion	Remaining Work/Risks
Delivery Ring RF	100%	
External Beamline	90%	Beamline vacuum system and LCW designs remain to be completed – Low Risk
Extinction Systems	85%	<ul style="list-style-type: none">• Optimization of upstream horizontal collimator location could require design change to fit into limited space – Low Risk• Waiting to finalize parts selection for Extinction Monitor to take advantage of technology improvements (opportunity).

Fabrication Plan

- In Fabrication, the latest ALTERA Cyclone FPGA and SOC will be used.

Quality

- Delivery Ring RF System/ Low Level RF System included in Mu2e Quality Planning Document
 - Available on web page (docdb 6005)

<u>Sub-Project</u>	<u>Device / Equipment / Area / Item</u>	<u>Design Analysis</u>	<u>Design verification</u>	<u>Fabrication process control</u>	<u>Inspection / Acceptance Test Activities</u>	<u>Requirements/ Specifications</u>	<u>Standard / Procedure / Process Doc</u>	<u>Calibration Planning</u>	<u>Record (Data, Calibration, etc.)</u>	<u>Training and Qualifications</u>
Delivery Ring RF System	Low Level RF System	Analytical Model Component R&D	Technical Review; Prototyping in Laboratory Setting	Bench Testing	Beam Studies	Mu2e TDR (Mu2e-doc-4299)	Online Manual	Beam Quality Measurements	Operations Elog	Low Level RF Training; DSP Training; VXI Training

Quality Assurance / Quality Control

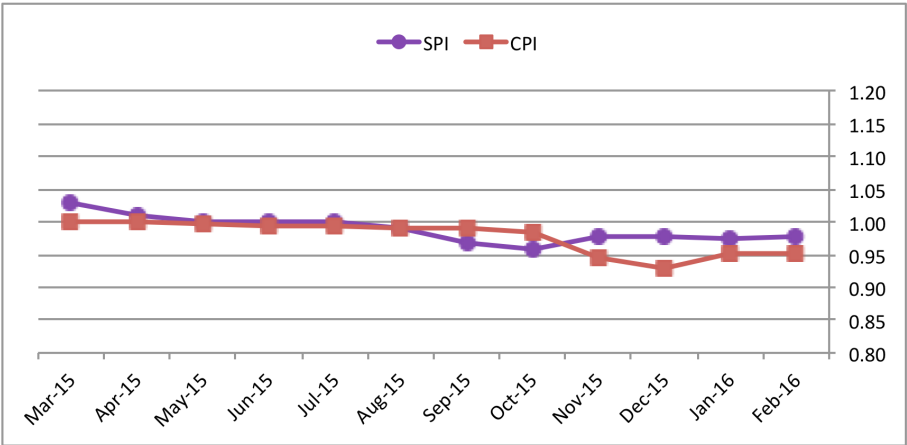
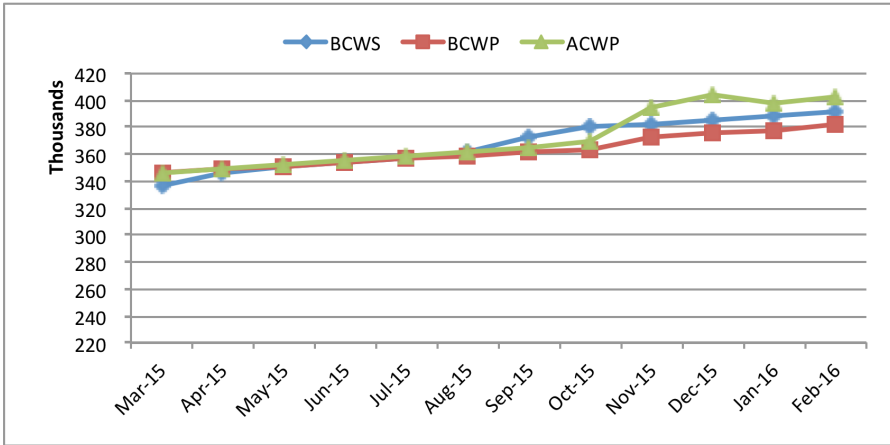
- QA: Low Level RF System will be checked under Laboratory Bench conditions while being developed.
- QC: Low Level RF System will be tested with the actual Beam supplied from the Recycler.

Configuration Management:

- Technical Documents will be archived in the Mu2e Document Database.
- Drawings are part of FNAL drawing archive system.

Cost and Schedule Performance

475.02.06 Rings RF



Variiances

Mu2e Project
 February 29, 2016
 Currency in: \$K

Control Account, Work Package.CTC	Current Period								Cumulative to Date							
	Budget	Earned	Actuals	SV (\$)	SV (%)	CV (\$)	CV (%)	Budget	Earned	Actuals	SV (\$)	SV (%)	CV (\$)	CV (%)	SPI	CPI
475.02.06 Rings RF	4	4	5	1	25%	(1)	-14%	392	383	403	(9)	-2%	(20)	-5%	0.98	0.95
475.077 475.02.06.01 Low Level RF System (Line Item: Construction)	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-
475.081 475.02.06.02 Delivery Ring RF Studies & Tuning (Line Item: Con	0	0	0	0	0%	0	0%	0	0	0	0	0%	0	0%	-	-
475.085 475.02.06.04 Delivery Ring 2.4 MHz RF Design (PED)	0	0	0	0	0%	0	0%	277	277	277	0	0%	(0)	0%	1.00	1.00
475.658 475.02.06.05 Technical Documentation Design (PED)	1	2	5	1	90%	(3)	-168%	102	93	125	(9)	-9%	(33)	-35%	0.91	0.74
475.661 475.02.06.05 Technical Documentation (Line Item: Construction)	3	3	0	0	0%	3	100%	12	12	0	0	0%	12	100%	1.00	-

Control Account, Work Package.CTC	At Complete				
	BAC	EAC	VAC	% Spent	% Complete
475.02.06 Rings RF	1,579	1,604	(25)	0%	0%
475.077 475.02.06.01 Low Level RF System (Line Item: Construction)	859	859	0	0%	0%
475.081 475.02.06.02 Delivery Ring RF Studies & Tuning (Line Item: Con	210	210	0	0%	0%
475.085 475.02.06.04 Delivery Ring 2.4 MHz RF Design (PED)	277	277	(0)	0%	0%
475.658 475.02.06.05 Technical Documentation Design (PED)	102	135	(33)	0%	0%
475.661 475.02.06.05 Technical Documentation (Line Item: Construction)	131	123	8	0%	0%

Change Control

Control Account	CR #	CR Description	Prior Start	Revised Start	Prior Finish	Revised Finish	Values		Cost Increase / (Decrease)
							BAC Before	BAC After	
▼ 475.02.06	▼ 2	▼ Establish internal baseline and incorporate recommendations from Director's Review.	▼ -	▼ -	▼ -	-	2,708,670.91	2,617,219.56	(91,451.35)
	▼ 6	▼ Corrections made to CR002	▼ -	▼ -	▼ -	-	2,617,219.56	2,584,199.15	(33,020.41)
	▼ 3	▼ New rate adjustments for labor fringe and overhead.	▼ -	▼ -	▼ -	-	2,584,199.15	2,600,296.55	16,097.40
	▼ 4	▼ Cost leveling; new CD-3c strategy	▼ -	▼ -	▼ -	-	2,600,296.55	1,806,389.11	(793,907.44)
	▼ 8	▼ FY15 Rate changes	▼ -	▼ -	▼ -	-	1,806,389.11	1,666,660.67	(139,728.43)
	▼ 12	▼ Solenoids PS and DS Contract terms and Accelerator design reviews	▼ 2/5/13	▼ 2/5/13	▼ 12/2/19	12/2/19	1,666,660.67	1,682,473.81	15,813.14
	▼ 13	▼ Implement DOE Follow-Up CD-2/3b Recommendation (BAC=EAC)	▼ 2/5/13	▼ 2/5/13	▼ 12/2/19	12/2/19	1,682,473.81	1,752,473.81	70,000.00
	▼ 15	▼ Establish CD-2 Baseline	▼ 2/5/13	▼ 2/5/13	▼ 12/2/19	12/2/19	1,752,473.81	1,755,077.11	2,603.30
	▼ 24	▼ FY16 Rate Update	▼ 2/5/13	▼ 2/5/13	▼ 12/2/19	12/2/19	1,755,077.11	1,789,984.00	34,906.89
	▼ 26	▼ Target Rem.Handling, Accel. CRRs, Scintillator QA	▼ 2/5/13	▼ 2/5/13	▼ 12/2/19	12/2/19	1,789,984.00	1,631,157.74	(158,826.26)
	▼ 27	▼ Constr. Changes, CD3 Review Prep	▼ 2/5/13	▼ 2/5/13	▼ 12/2/19	10/8/19	1,631,157.74	1,578,957.81	(52,199.93)
475.02.06 Total							22,594,602.43	21,464,889.33	(1,129,713.10)

BCR026 – Removal of Stripline Detector work.

Interfaces

Internal Interfaces

Item	Interface	Descriptions	Owners	Reference
6.1.1	Instr. & Controls	Control, setting, read back and timing for the 2.36 MHz Delivery Ring RF system	475.02.03	Mu2e-doc-7176
5.1.2	Extinction	Beam sync signal for triggering AC Dipole ramp	475.02.08	Mu2e-doc-7176
5.1.6	Extinction Mon.	Beam sync signal for triggering extinction monitoring detectors	475.02.08	Mu2e-doc-7176

Interfaces

External Interfaces

Item	Interface	Descriptions	Owners	Reference
6.2.1	Mu2e Trigger & DAQ	Beam sync signal for triggering Mu2e detectors	475.09	Mu2e-doc-7176
6.2.2	Recycler RF AIP	Installation of the RF cavity(s) in the DR is most effective if combined with the g-2 installation, given that it's permitted by the schedule. The installation of the Recycler Ring cavities will require a shutdown and the installation of the Delivery Ring cavity (s) will commence with this.	Recycler RF AIP	
6.2.3	Recycler RF AIP	The design of the 2.5MHz cavities for the Delivery Ring is very much similar to that used for G-2 in the Recycler. RF cavities are being designed and built by the RR RF AIP. To ensure effective communication between projects, the same person is filling manager positions for RF in the Recycler Ring RF AIP and Mu2e project. The manager is a L2 for Recycler Ring RF AIP and a L3 for Mu2e.	Recycler RF AIP	

Integration

- Integration
 - Attend Mu2e Accelerator L3 Meetings.
- For the subsystem Low Level RF System
 - Integration Meetings will be scheduled when identified as needed by Mu2e Accelerator L3 Meetings.
 - March 18, 2016, Eric Prebys, Extinction & Extinction Monitoring, RF synchronization of the AC dipole system
 - January 20, 2016, Brian Drendel, Instruments & Controls, Mu2e Accelerator Timing and Beam Synch
 - Attend other Accelerator L3 Subsystem Integration Meetings when requested.

Environmental, Safety, and Health

- ESH is integrated into all phases of the Project
 - Design, Construction, Installation
- ESH requirements are clearly defined within the Project
 - FESHM, FRCM
- Design & installation review process includes an ESH component
- Utilize Fermilab's work planning requirements & processes
 - Hazard analysis
 - Daily work planning meeting

Summary

- Technical Design Review for Mu2e Delivery Ring RF was held on November 19, 2015.
- Low Level RF System will be a State of the Art System.
- The Delivery Ring RF is ready for CD-3 approval.