

U.S. MICE

Schedule, Cost, & Risks

Peter H. Garbincius

Mark Palmer, Alan Bross, Rich Krull

Fermilab

Presented at RAL – November 13, 2013

URL to Indico Site for RLS Review

<https://indico.cern.ch/conferenceDisplay.py?confId=282294>











MICE Resource Loaded Schedule review

chaired by Ian Robson (STFC)

Wednesday, 13 November 2013 from **09:00** to **19:00** (Europe/London)
at **Rutherford Appleton Laboratory (Conference room CR1 building 1)**
Chilton Didcot Oxon OX11 0QX

Description Documentation and Presentations for the
MICE Resource-Loaded Schedule Review

Material:

Report 	UK project management information 	US-MICE Cost-Schedule Overview 	
US-MICE Costs with contingency 	US-MICE Costs: No contingency 	US-MICE MS Project File 	
US-MICE Milestones 	US-MICE Project File 	US-MICE risk register 	

**US MICE MicroSoft Project Plan has 566 lines,
just to indicate size of WBS & level of detail**

*** numbers adjusted on November 11, 2013
from upload, still a work-in-process...**

Agenda

- **Schedule**
 - Milestones (some complete)
 - Key US Deliverables – relation to UK schedule
- **Cost Estimate for Construction**
 - Not including Experimental & Operations Support
 - Base costs & Contingency ~ 36% on average
 - Funding profile, constraints
 - Step VI is 29% of US total cost w/o Risk (24% w ½ Risk)
- **R&D Risks**
 - Risk Register (point out “retired” risks)
 - Risk model applied to funding profile

from Mark Palmer – US MAP Director – on indicio



Comments on the MICE-US Exercise to Level the Resource- Loaded Schedule

MICE-US Project Team | November 5, 2013

I'll just hit the highlights:

At the MICE Resource-Loaded Schedule (RLS) Review in May 2013, the MICE-US team presented a high-level analysis based on the anticipated U.S. budget profile in order to estimate a likely completion date for the MICE Experiment. This analysis took the existing US RLS, which was dominated by technical limitations, and applied contingency assumptions to reach the ***conclusion that, even in the absence of the remaining R&D risks to the program, the schedule would likely have to stretch by as much as 2 years in order to be “realistic.”***

The US schedule that has been uploaded *for this review* incorporates the core assumptions of this analysis along with recent adjustments to the MICE experimental plan. Specific changes include:

1. Stretch of planned activities to match the funding profile (including fabrication contingency) for the construction of MICE hardware in the US which was presented in May 2013;
2. Adjustments to fully incorporate the use of a Partial Return Yoke (PRY) for both Step IV and for Step V-VI operation;
3. Adjustments to match actual hardware production rates during US FY13;
4. Introduction of production contingency slack (float) on key production activities.

By technically limited in this case, budget limitations were only taken into account in the sense that they would constrain coupling coil fabrication and assembly of the RFCC units to be a serial production process. Once these basic assumptions were established, development of the schedule relied principally on technical limitations.

The resulting schedule is consistent with plans for deployment of the Step IV beam line hardware. Nevertheless, as of today, there has been insufficient time to prepare an integrated US-UK plan extending through Steps V and VI. We would hope to present that analysis at the next MICE review in Spring 2014.

There are *certain conclusions* that can be drawn from this revised schedule.

First of all, we believe the *new US schedule to be entirely consistent* with the simpler analysis that was presented to the RLSR committee in *May 2013*.

Secondly, the production sequence as presently laid out suggests *key issues that should be considered for future planning*. For instance, *if the initial CC magnet prototype* that will initially be operated in the MuCool Test Area (MTA) at Fermilab *achieves acceptable performance parameters for MICE operation, we should carefully consider the option of removing it from the MTA after testing is complete. This could enable shipping of the two Step VI RFCC modules to RAL in quick succession in 2018 and could significantly expedite the Step VI schedule.*

Furthermore, *combining the results of the US scheduling effort with a UK schedule fully incorporating likely contingencies will provide a much more realistic overall plan for completion of the experiment.*

US MICE Key Deliverables & Interfaces

WBS	L4 - Milestones	Forecast Date
1.05.02.01.05.01.02	SS#2 Arrives at RAL -completed	10/07/13
1.05.02.01.05.02.02	SS#1 Arrives at RAL	05/08/14
1.05.03.01.01.05.03	MICE Step IV Magnetic Shielding Received at RAL	06/26/14
1.05.03.01.01.07	MICE IV Magnetic Shielding - Complete	08/08/14
1.05.02.02.05.03.04	CCM Prototype Testing Complete	02/05/16
1.05.03.01.02.05.03	MICE Step V-VI Magnetic Shielding Received at RAL	06/30/17
1.05.03.01.02.07	MICE V-VI Magnetic Shielding - Complete	01/05/18
1.05.02.02.05.13.03	MICE RFCC#1 Arrives at RAL (UK Desired by 01/03/17)	03/06/18
1.05.02.02.05.08.03	MICE Opt. RFCC Arrives at RAL (UK Desired by 04/01/18)	07/26/18
1.05.02.02.05.14.03	RFCC#1 Installation & Commissioning at RAL - Complete	08/29/18
1.05.02.02.05.19.03	MICE RFCC#2 Arrives at RAL (UK Desired by 04/01/18)	09/06/19
1.05.02.02.05.20.03	RFCC#2 Installation & Commissioning at RAL - Complete	03/09/20

↑ opportunity
*

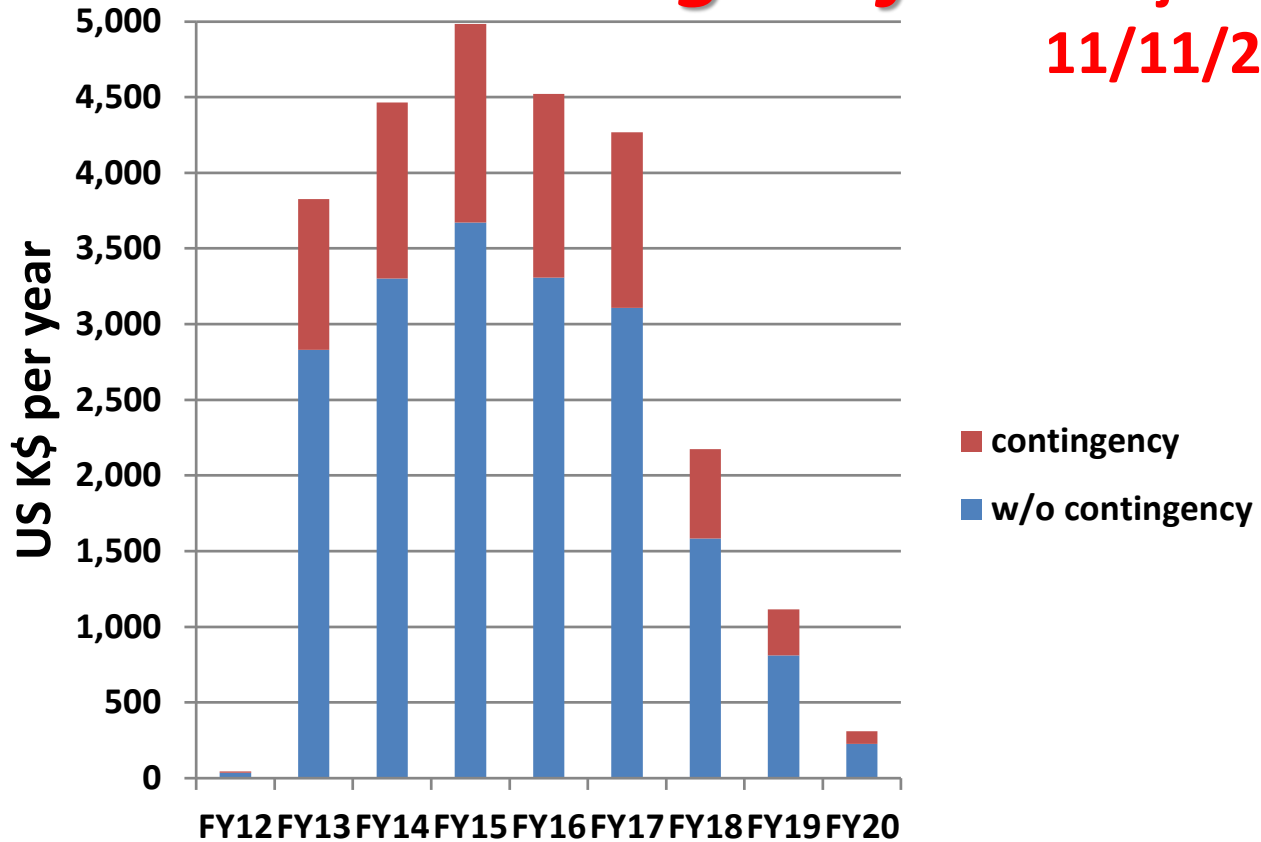
(Did not adjust for most recent estimated duration of Mag Shield fabrication from BNL)

Cost Estimating Assumptions

- Showing FY 13 onward – construction costs only (not including experimental & operations support)
- Prior to FY 13, invested 5 years at \$ 1.5-2 M/year = ~ \$ 9 M in the construction effort for:
 - Spectrometer Solenoids,
 - Detector Systems,
 - RF Cavity fabrication for RFCC #1 and #2
- Does not include “standing army” costs of experimental collaboration
- Consider use MTA test Prototype CCM for RFCC#2
***decision after testing prototype CCM 5feb2016
this will save ~ \$ 2.6 M ← “opportunity”***
- remaining US est thru full stage VI w new RFCC#2:
base \$ 18.9 M, w contingency \$ 25.7 M, w ½ Risk \$ 31.4 M

US MICE Funding Profile

* adjusted
11/11/2013



US Fiscal Year - (Oct 1-Sept 30)

* \$ 18.9 M w/o “construction” contingency,

* \$ 25.7 M with contingency – average ~ 36%

does *not* include estimate to mediate R&D Risk

US MICE

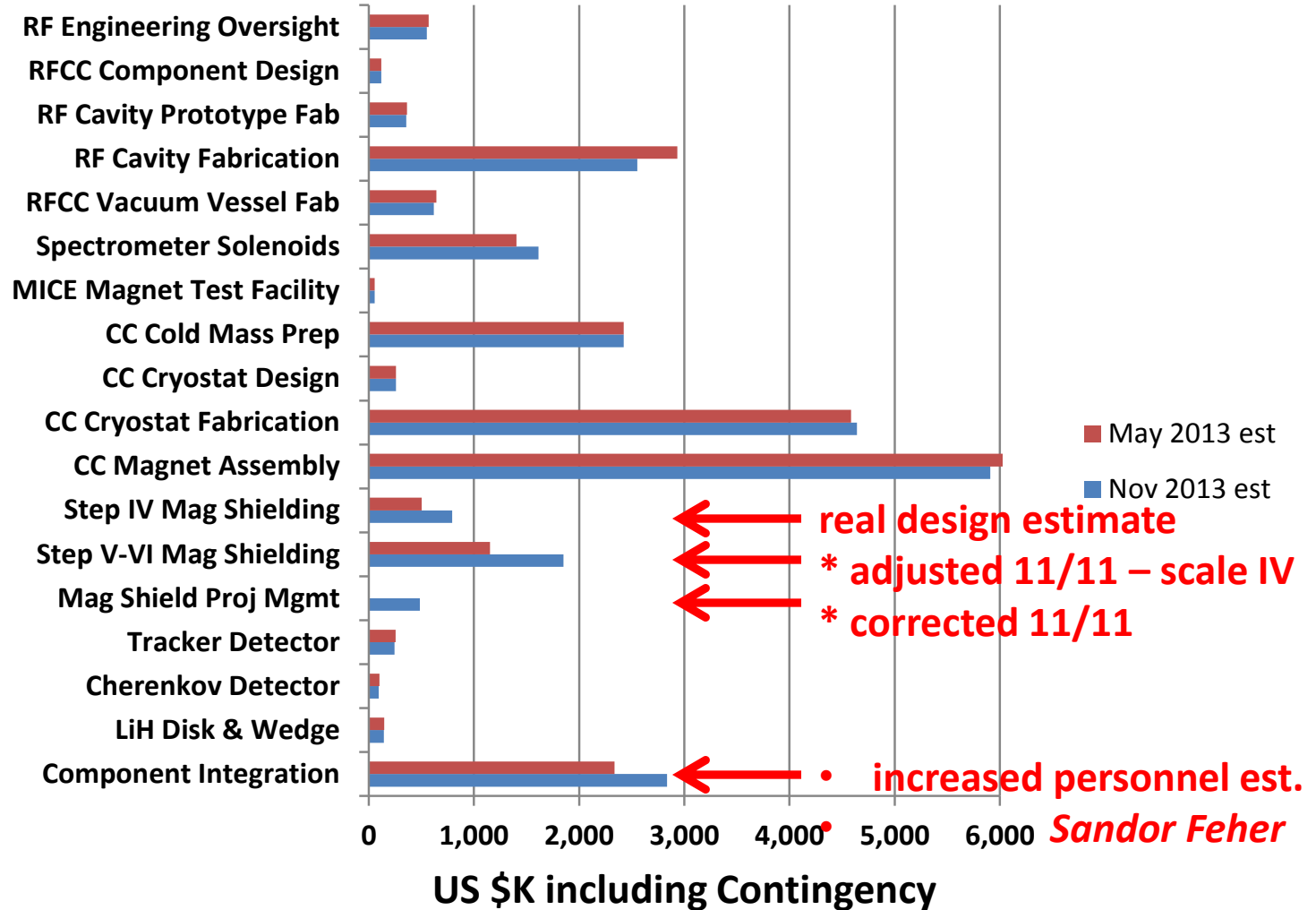
May 2013

VS.

Nov 2013

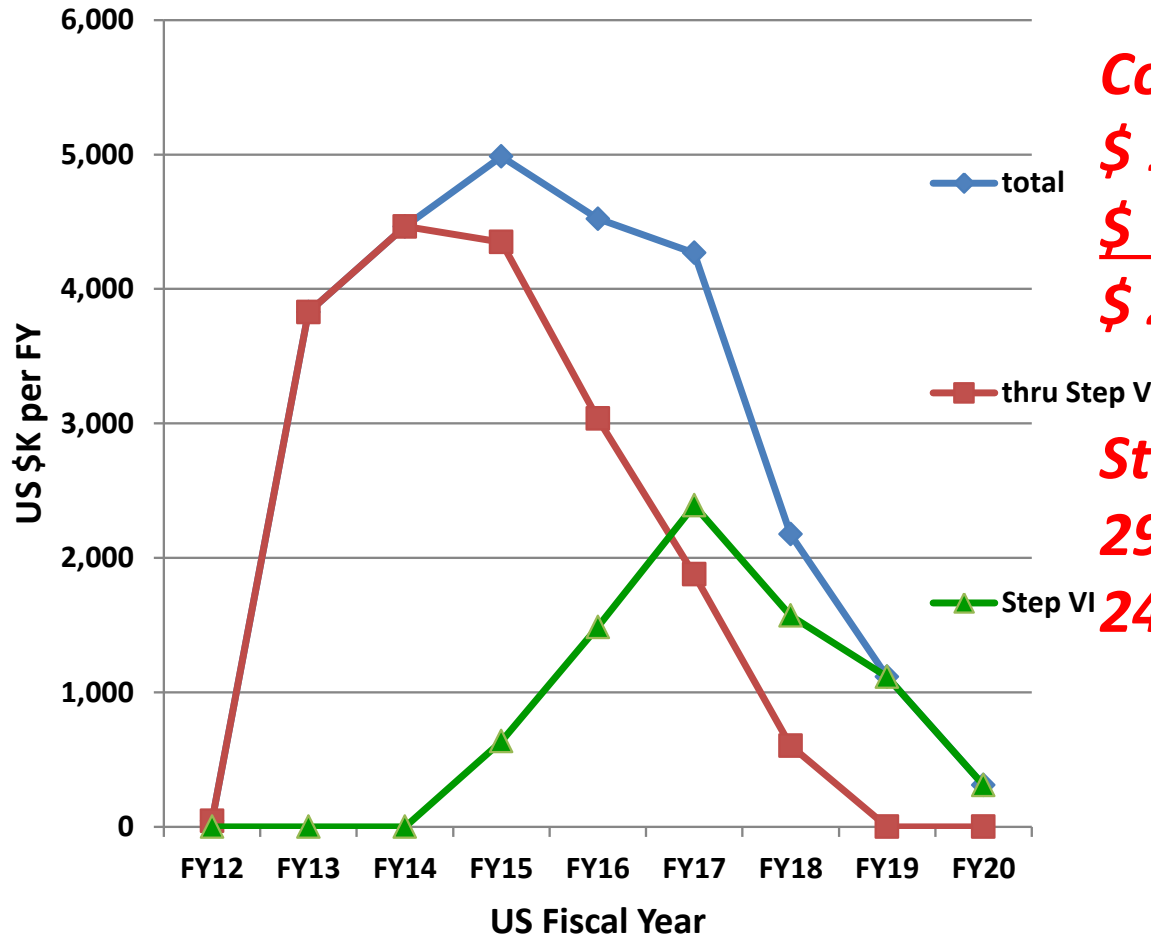
Estimates

US MICE May 2013 vs. Nov 2013 Estimates



MICE Step VI is ~ 29% of US MICE * adjusted 11/11/2013

US MICE Spending Profile including contingency ~ 36%



Costs w Contingency:
\$ 18.2 M thru Step V *
\$ 7.5 M for Step VI *
\$ 25.7 M thru Step VI *

Step VI is:
29% of total w/o Risk
24% of total w ½ Risk

**If successful, use Proto MTA CCM
test complete 5feb2016**

instead of a new CCM#2:

Don't construct CCM#2 Cryostat
Move Integration to FY 17
Prep & Ship to FY 18
Integrate & Commission
@ RAL - split FY 18 & 19

With contingency:

New CCM #2:

Thru V \$ 18.2 M *

Step VI \$ 7.5 M *

Total \$ 25.7 M *

Use Proto MTA CCM

Thru V \$ 18.2 M *

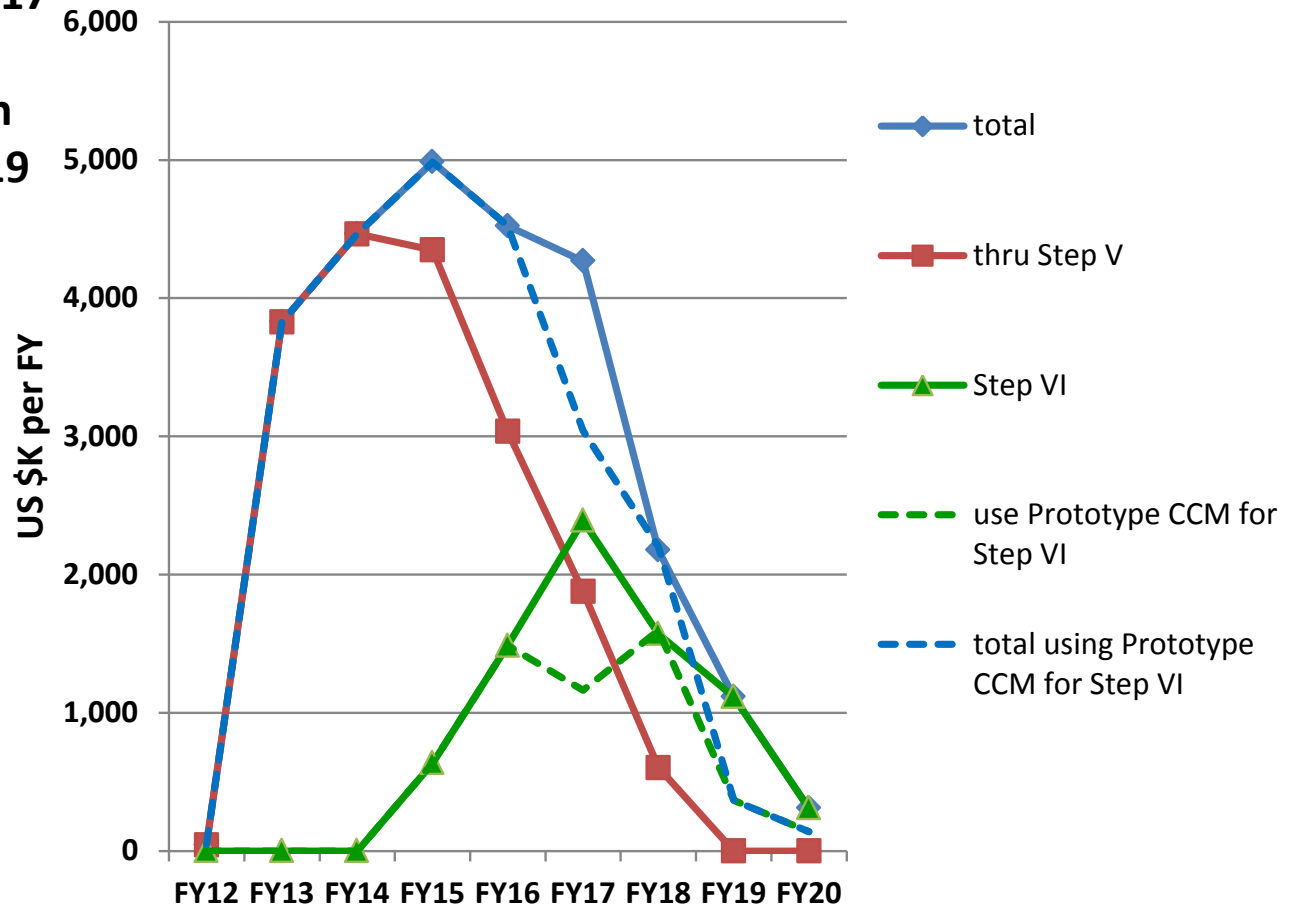
Step VI \$ 5.4 M *

Total \$ 23.6 M *

Savings = \$ 2.1 M *

**SAVE ~7% of cost incl ½ Risk (8% w/o Risk)
and DELIVER 1 year earlier**

**US MICE Spending Profile
including contingency ~ 36%**



US Fiscal Year
US MICE Schedule, Cost, Risks - Garbincius
@ RAL- November 13, 2013

“opportunity”

R&D Risks and Mitigation

- If something goes wrong: for example, SC coils do not successfully complete training, RF breakdown in magnetic field, etc.
- 4 risks have already been “retired”
- Risk Class ~ number of days delay in schedule
R3 < 60 days, 60 < R2 < 120, 120 days < R1
- All of the R&D Risks apply thru Step V
so thru Step V => \$ 18.2 M *
+ \$ 5.7 M (*½ R&D Risk*) = \$ 23.9 M *

Risk Register & Impacts

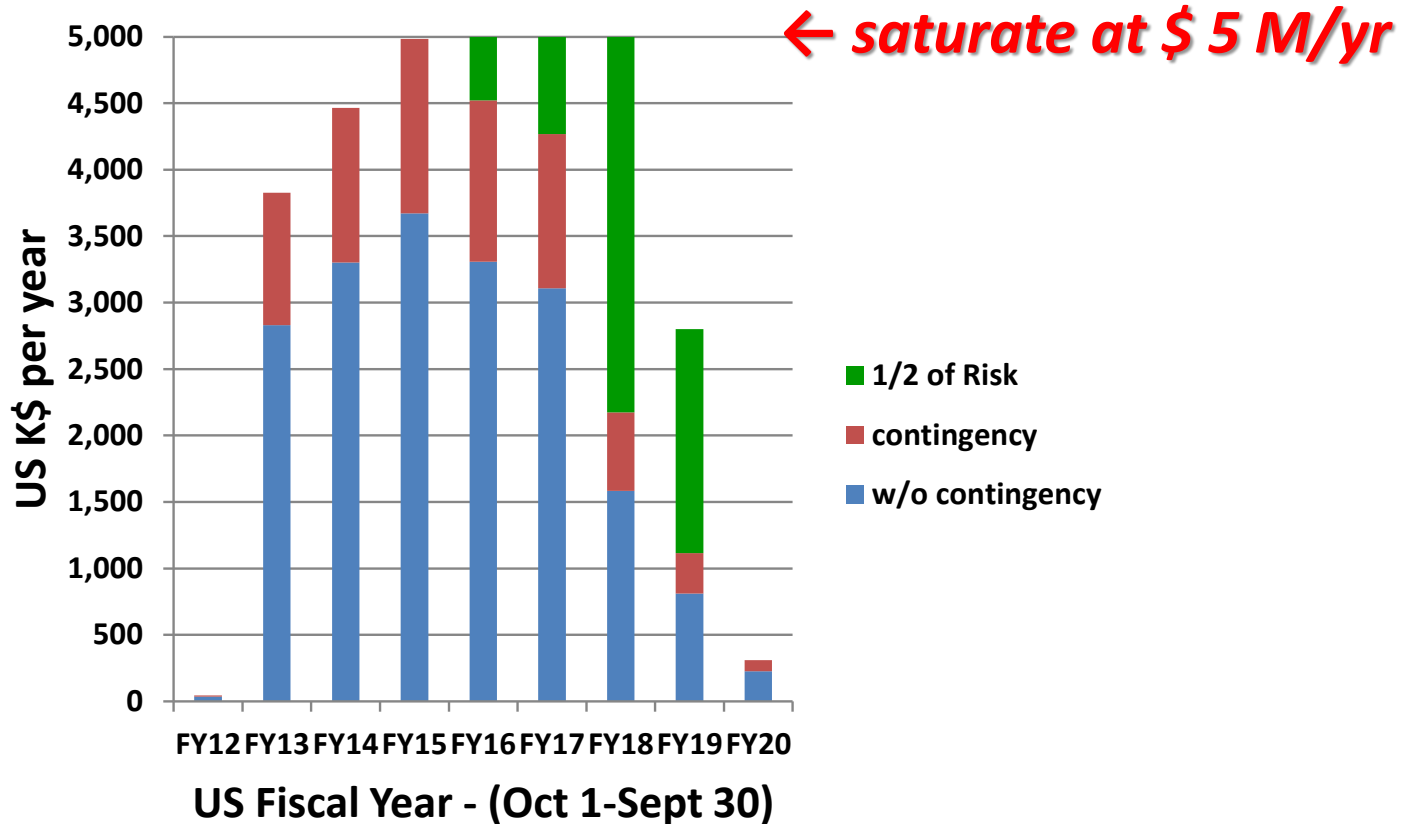
Risk ID #	WBS	Alan Bross - 6nov2013 - 12:30 PM - Risk Milestones	Start Date	Finish Date Extended Calendar Days	Mitigation on \$ K US	Risk Impact and Actions
	1.05.02.01.01.04	(RISK)-(R1) - Spectrometer Solenoid Controls Operational Readiness Certification	05/29/13	Completed		IMPACT:(Impacts include delayed magnet training and subsequently difficulty commissioning the full cooling channel beam line) - ACTION:(Continued improvements of SC magnet controls)
10	1.05.01.01.03.04.05	(R1) - 201 MHz All parts for SC MICE test at FNAL (Prototype) - Possible Costs for this R1 Risk (UID-1407)	12/03/13	175	423	IMPACT:(Delay in RFCC lite test) - ACTION:(Redesign of 201 MHz RF power coupler)
4	1.05.01.01.03.09	(R1) - 201 MHz Assembly MICE SC Test System (Prototype) - Possible Costs for this R1 Risk (UID-1414)	01/09/14	169	523	IMPACT:(Delay in final RF design) - ACTION:(Assess failure and modify design accordingly)
1	1.05.02.02.02.04.06	(R1) - CC Coil #1 Test - Possible Costs for this R1 Risk (UID-1564)	03/07/14	171	200	IMPACT:(Delay of Assembly and Testing of CCM Prototype) - ACTION: (Assess failure and incorporate necessary modifications into preparation of 2nd cold mass)
9	1.05.02.02.04.03.05	(R1) - CC Cryostat #1 (CCM Prototype) Arrived at FNAL - Possible Costs for this R1 Risk (UID-1657)	06/23/14	171	300	IMPACT:(Delay in CCM prototype assembly) - ACTION:(Assess problems with cryostat construction & correct)
7	1.05.02.01.05.07	(R1) - SS#1 & SS#2 Spectrometer Solenoids Ready for Operations - Possible Costs for this R1 Risk (UID-2208)	11/05/14	176	462	IMPACT:(Delay of start of Step IV) - ACTION:(Access problems & make corrections)
13	1.05.03.01.02.03.05	(R1) - MICE Step V-VI Magnetic Shielding 2 Week Review Window - Possible Costs for this R1 Risk (UID-1799)	06/17/16	173	1131	IMPACT:(Delay in finalization of Step V-VI shielding design) - Action(Increase engineering effort)
11	1.05.02.02.05.05.04	(R1) - RFCC Prototype Test (RFCC_Lite - Single Cavity) - Possible Costs for this R1 Risk (UID-1701)(Task Charged to MuCool Test Area Budget)	11/23/16	176	723	IMPACT:(Delay in RFCC#1 delivery to RAL) - ACTION:(Evaluation of design limitations and development of mitigation plan)
5	1.05.02.02.05.04.03	(R1) - RFCC_lite assembly/integration problems in MTA (UID-2180)	05/05/16	176	523	IMPACT:(Delay in RFCC_lite test & vetting of RF design) - Action:(Evaluate assembly issues and address)
17	1.05.05.01.03.04	(R1) - MICE-US RFCC Beam line Integration - Possible Costs for this R1 Risk (UID-1866)	05/16/18	170	562	IMPACT:(RF Integration problems)(Likely impact is a 6-12 month delay in MICE Step V readiness) - ACTION:(Re-visit integration issues and correct)
2	1.05.02.01.03.01.05	(R2) - SS#2 Re-Train and Re-Test - Possible Costs for this R2 Risk (UID-1501)	04/16/13	Completed	562	IMPACT:(Delay of MICE Step IV commissioning and experimental operations.) - ACTION: (Assess failure and repair magnet. Likely delay of >6 months r for final delivery)
12	1.05.03.01.01.03.05	(R2) - MICE Step IV Magnetic Shield Fabrication Decision - Possible Costs for this R2 Risk (UID-1775)	12/02/13	Completed	0	IMPACT:(Inability to deploy partial yoke shielding for Step IV resulting in increased experimental risk. Step IV baseline assumes no requirement for partial yoke solution, hence minimizing immediate impact) - ACTION:(Discontinue work on Step IV Partial)
3	1.05.02.01.04.02.05	(R2) - SS#1 Train and Test - Possible Costs for this R2 Risk (UID-1522)	12/13/13	118	723	IMPACT:(Delay of MICE Step IV commissioning and experimental operations) - ACTION:(Assess failure and repair magnet. Likely delay of >1 year for final delivery)
8	1.05.02.02.02.10.04	(R2) - Cold Mass #2 Winding (China) - Possible Costs for this R2 Risk (UID-1587)	06/02/14	113	523	IMPACT:(Delay in CCM Prototype and likely delay in MICE Step V in the event that the prototype cold mass (#1) fails) - ACTION:(Further development of winding procedures)
14	1.05.05.01.04.04	(R2) - MICE-US Shielding Step IV Component Integration - Possible Costs for this R2 Risk (UID-1873)	06/26/15	115	262	IMPACT:(6 month delay in MICE Step IV data) - ACTION:(Re-do integration engineering for partial yoke solution in MICE Hall)
6	1.05.01.01.04.08.07	(R2) - 201 MHz Production Cavity Assembly & Test (RFCC#1) (Production) - Possible Costs for this R2 Risk (UID-1443)	10/01/15	120	1269	IMPACT:(Re-work of critical hardware and potential delay of RFCC#1 delivery) - ACTION:(Assess failure and modify design)
15	1.05.05.01.02.04	(R2) - MICE-US SS Component Integration - Possible Costs for this R2 Risk (UID-1861)	12/11/15	118	562	IMPACT:(Delay of start of MICE step IV) - ACTION:(Continued improvements of SC magnet controls)
18	1.05.05.01.04.08	(R2) - MICE-US Shielding Step V Component Integration - Possible Costs for this R2 Risk (UID-1877)	07/02/18	113	562	IMPACT:(6-12 month delay in MICE Step V readiness) - ACTION:(Re-visit integration issues and correct)
2	1.05.02.01.03.03.05	(R3) - SS#2 Operation Failure with Iron Shield - Possible Costs for this R3 Risk (UID-1509)	09/03/13	Completed		IMPACT:(-) - ACTION:(-)
3	1.05.02.01.04.03.05	(R3) - SS#1 Operation Failure with Iron Shield - Possible Costs for this R3 Risk (UID-1529)	01/16/14	56		IMPACT:(Delay in SS1 mapping - Low risk.) - ACTION:(Access problems and implement fix)
16	1.05.05.01.01.08	(R3) - RFCC#1 Component Integration - Possible Costs for this R3 Risk (UID-1855)	10/22/18	57	1123	IMPACT:(Delay in MICE Step V/VI) - ACTION:(Access problems & apply appropriate modifications)

Total Risk **\$ 10.43 M**
4 Retired Risks **- 0.56 M**
Active Risk **\$ 9.87 M in FY 13 US\$**

4 “Retired” Risks

WBS	Retired Risks - 6nov2013	Cost of Mitigation \$ K US	Risk Impact and Actions
1.05.02.01.01.04	(RISK)-(R1) - Spectrometer Solenoid Controls Operational Readiness Certification		IMPACT:(Impacts include delayed magnet training and subsequently difficulty commissioning the full cooling channel beam line) ACTION:(Continued improvements of SC magnet controls)
1.05.02.01.03.01.05	(R2) - SS#2 Re-Train and Re-Test - Possible Costs for this R2 Risk (UID-1501)	562	IMPACT:(Delay of MICE Step IV commissioning and experimental operations.) ACTION: (Assess failure and repair magnet. Likely delay of >6 months r for final delivery)
1.05.03.01.01.03.05	(R2) - MICE Step IV Magnetic Shield Fabrication Decision - Possible Costs for this R2 Risk (UID-1775)		IMPACT:(Inability to deploy partial yoke shielding for Step IV resulting in increased experimental risk. Step IV baseline assumes no requirement for partial yoke solution, hence minimizing immediate impact) ACTION:(Discontinue work on Step IV Partial)
1.05.02.01.03.03.05	(R3) - SS#2 Operation Failure with Iron Shield - Possible Costs for this R3 Risk (UID-1509)		IMPACT:() - ACTION:()

(top down) Adding in 1/2 of the R&D RISK for full implementation of Step VI



Base Cost	* \$ 18.9 M	→	total
Contingency	* \$ 6.8 M	→	* \$ 25.7 M
1/2 R&D Risk	\$ 5.7 M	→	* \$ 31.4 M

DISCUSSION