



MICE – Final Step Forward Look

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STFC RAL

- **Final Step**

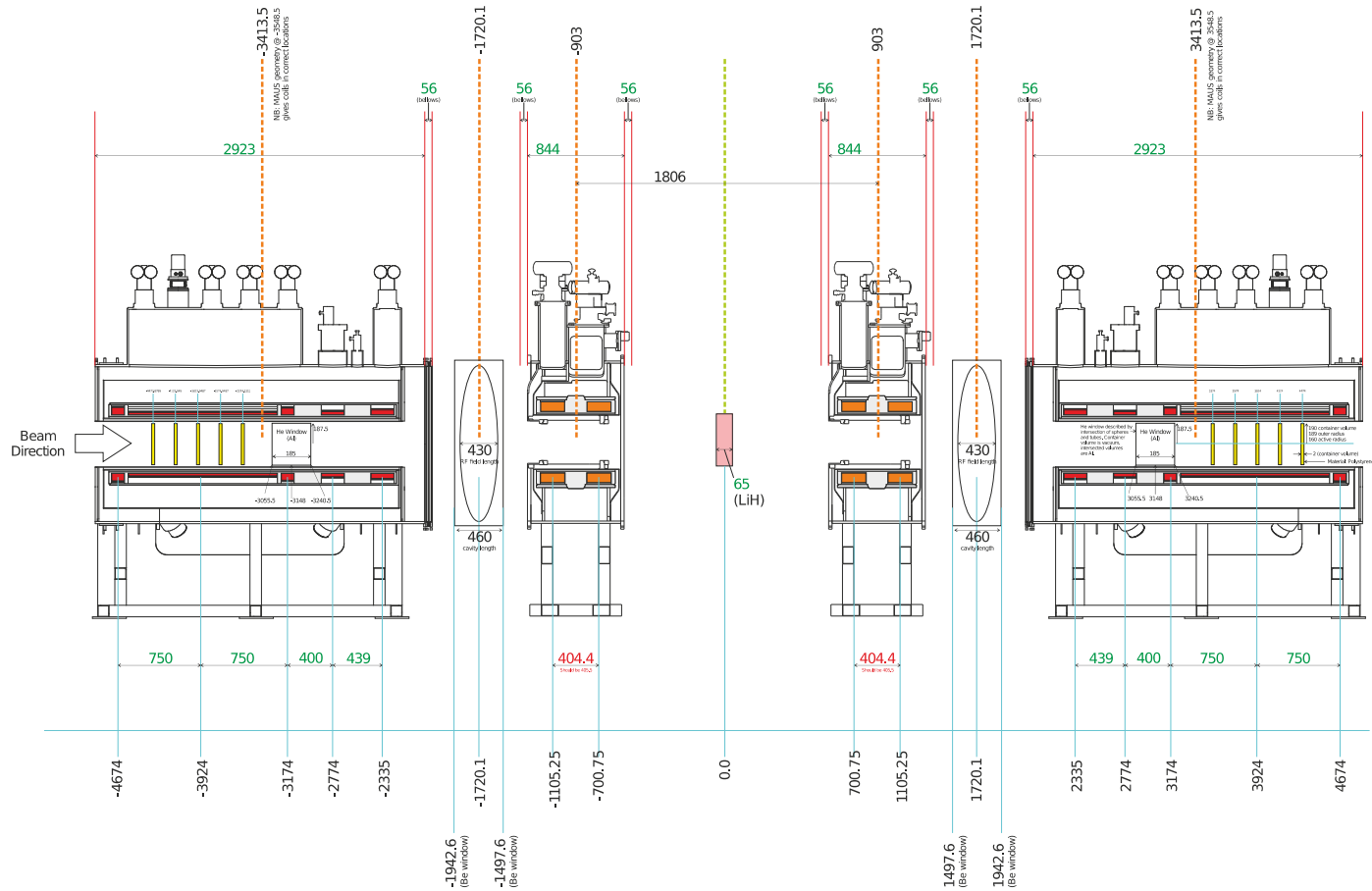
- Engineering
- Schedule
- Cost to completion
- Working Space
- Risk



Final Step

Engineering

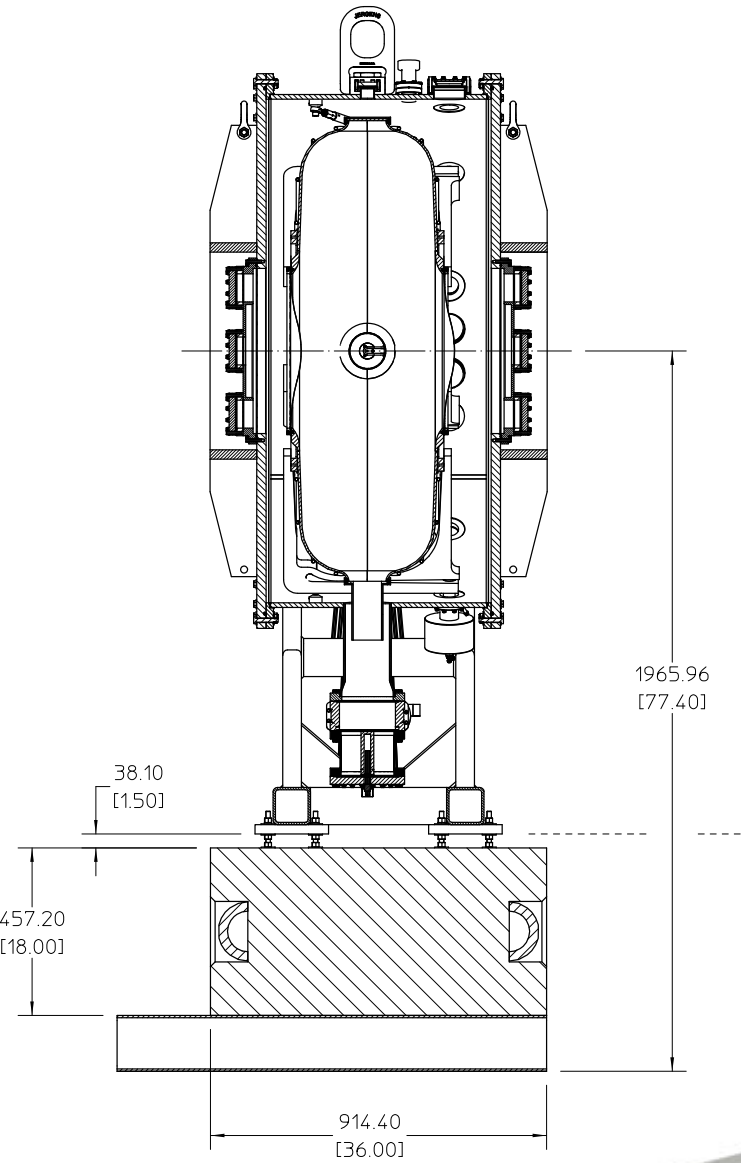




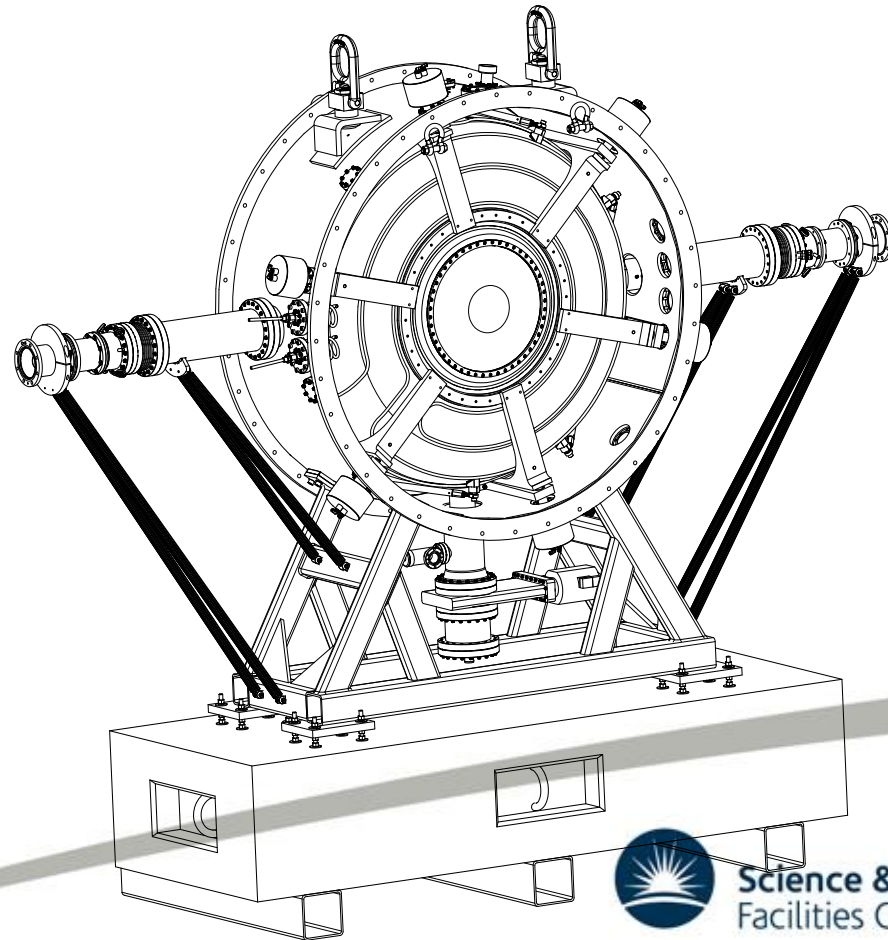
- Dimensions for the analysis have been found
- Tracker must be protected from possible damage during cavity operations
- Central Volume holding main absorber dependant on the physics and magnetic analysis
- Central volume reasonably simple engineering
- *Engineer the chamber to allow change of material during operations?*



- Single cavity test chamber design would fit with the requirements.
- Investigations are continuing
 - Vacuum envelope
 - Fitting a solid absorber as close as possible
- A chamber and cavity have been assembled and currently being tested in the MTA



Section A-A



- Additional engineering work
 - Rolling platforms / Floor mounting positions for the Focus Coils, central Absorber volume and RF Cavity volumes
 - Floor drilling / changes to accommodate the additional Partial Return Yoke materials
 - Waveguides to the new positions
 - Physical layout can be done in the R9 lab area
 - According to the design routing some adjustments to false floor, cable tray, water line
- Deliverables
 - USA
 - Two RF cavities and chamber
 - RF cavity vacuum equipment
 - RF Tuners and windows
 - Additional Partial Return Yoke plate and Frame sections
 - LiH Absorbers (number and dimensions to be completed and agreed)
 - UK
 - RF Infrastructure and Power generation
 - RF LLRF and HPRF control systems
 - Platforms for magnet and cavity support
 - Vacuum chamber for the main absorber volume
 - Engineering and manufacture relating to Tracker protection Absorbers
 - Europe
 - Upgrades and maintenance to current particle identification detectors
 - Japan
 - All deliverables achieved



Final Step

Schedule

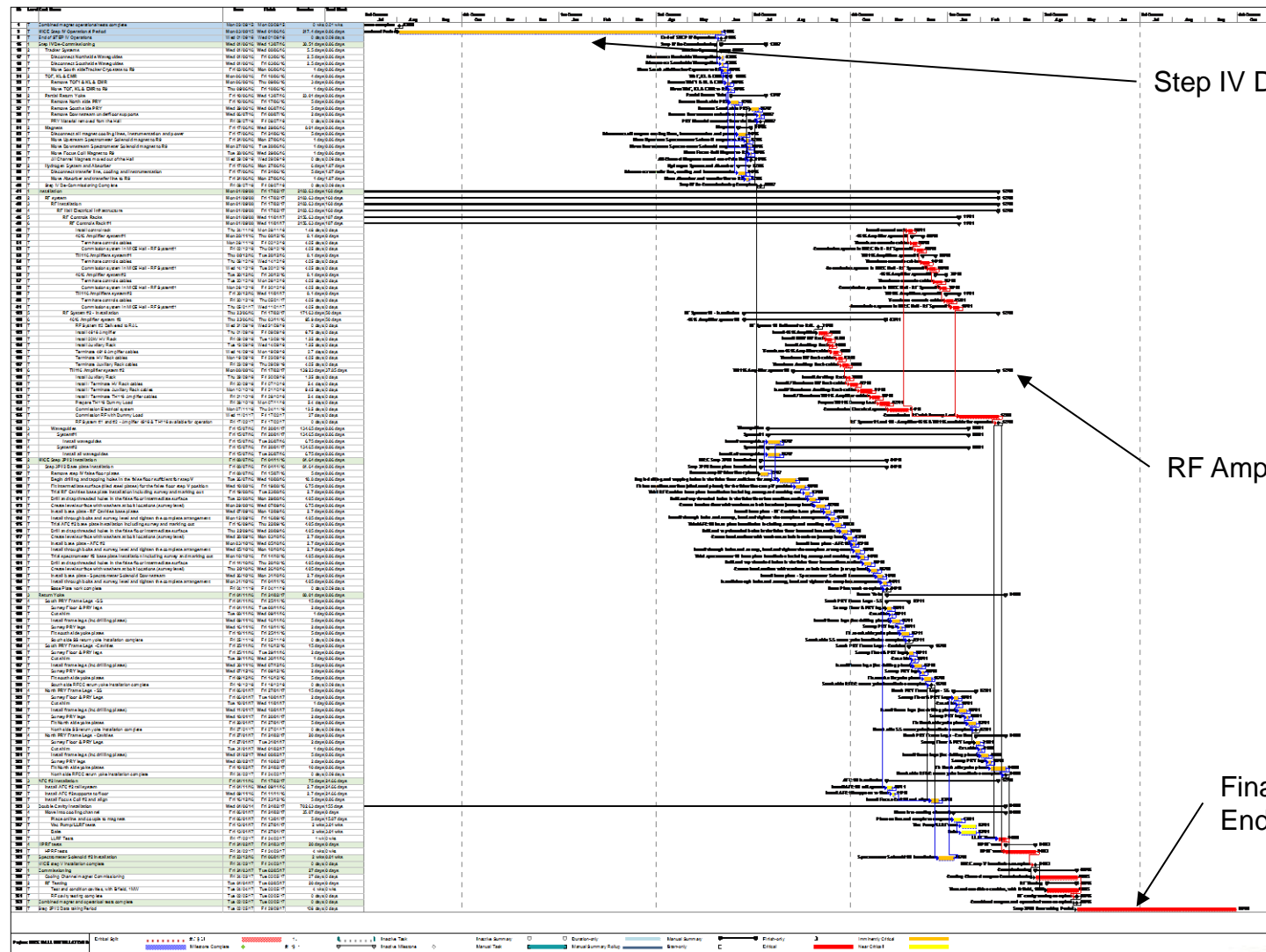


Schedule to completion – Critical and Near

Step IV Data Taking – End June 2016

RF Amplifier installation in the hall

Final Step data taking period – End March 2018

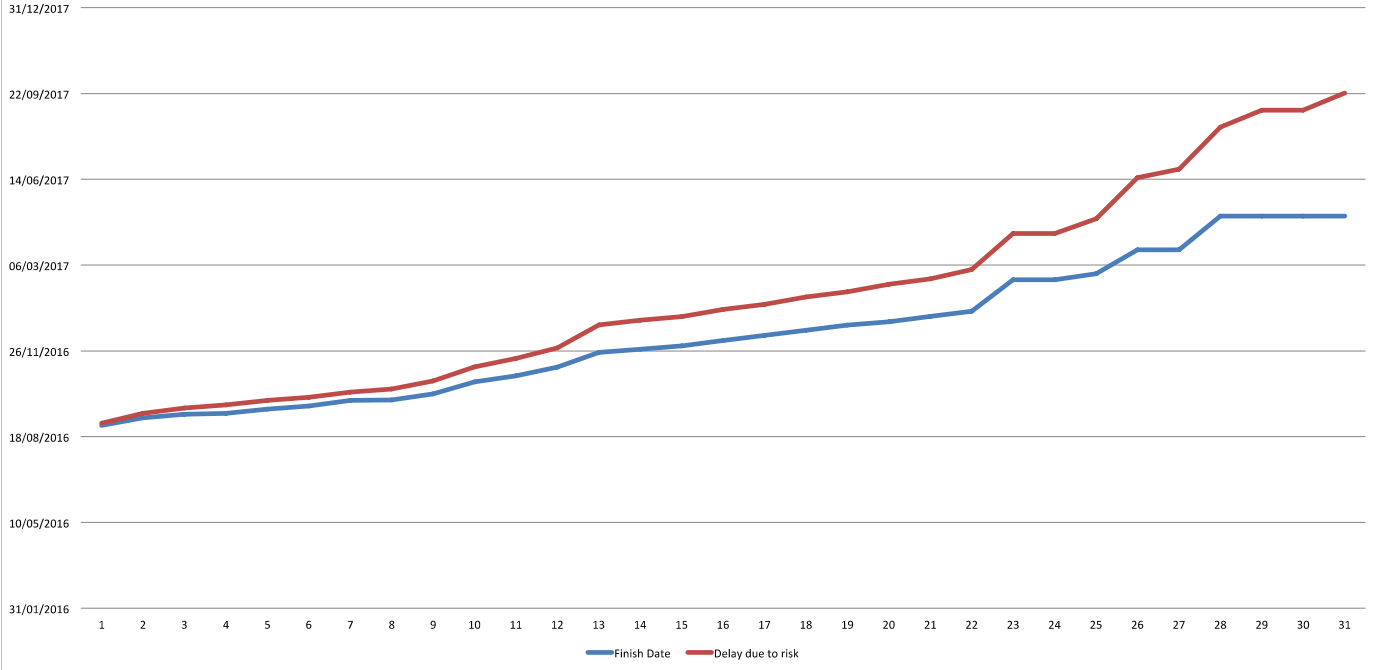


Schedule to completion

WBS	Name	Finish Date	Risks_Level	Risk_Impact	Risk Level Duration	Probability	Delay due to risk	Sequential Delay
6.1.1.1.3.1.8	RF System #2 Delivered to RAL	31/08/2016	(RISK)-(R5)	Late delivery	5	0.5	02/09/2016	2.5
6.1.1.1.3.1.9	Install 4616 Amplifier	09/09/2016	(RISK)-(R4)	Unable to access the hall or shipping area	10	0.25	14/09/2016	5
6.1.1.1.3.1.10	Install 20kV HV Rack	13/09/2016	(RISK)-(R4)	Unable to access the hall or shipping area	10	0.25	20/09/2016	7.5
6.1.1.1.3.1.11	Install Auxiliary Rack	14/09/2016	(RISK)-(R4)	Unable to access the hall or shipping area	10	0.25	24/09/2016	10
6.1.1.1.3.1.12	Terminate 4616 Amplifier cables	19/09/2016					29/09/2016	10
6.1.1.1.3.1.13	Terminate HV Rack cables	23/09/2016					03/10/2016	10
6.1.1.1.3.1.14	Terminate Auxiliary Rack cables	29/09/2016					09/10/2016	10
6.1.1.1.3.2.8	Install Auxiliary Rack	30/09/2016	(RISK)-(R4)	Unable to access the hall or shipping area	10	0.25	12/10/2016	12.5
6.1.1.1.3.2.9	Install / Terminate HV Rack cables	07/10/2016	(RISK)-(R4)	Unable to access the hall or shipping area	10	0.25	22/10/2016	15
6.1.1.1.3.2.10	Install / Terminate Auxiliary Rack cables	21/10/2016	(RISK)-(R4)	Unable to access the hall or shipping area	10	0.25	07/11/2016	17.5
6.1.1.1.3.2.11	Install / Terminate TH116 Amplifier cables	28/10/2016	(RISK)-(R4)	Unable to access the hall or shipping area	10	0.25	17/11/2016	20
6.1.1.1.3.2.12	Prepare TH116 Dummy Load	07/11/2016	(RISK)-(R4)	Unable to access the hall or shipping area	10	0.25	29/11/2016	22.5
6.1.1.1.3.2.13	Commission Electrical system	24/11/2016	(RISK)-(R3)	Expert Personnel not available	20	0.5	26/12/2016	32.5
6.1.1.1.1.3	Install control rack	28/11/2016	(RISK)-(R5)	Expert Personnel not available	5	0.25	31/12/2016	33.75
6.1.1.1.1.4.1	Terminate controls cables	02/12/2016					04/01/2017	33.75
6.1.1.1.1.4.2	Commission system in MICE Hall - RF System#1	08/12/2016	(RISK)-(R4)	Expert Personnel not available	10	0.25	13/01/2017	36.25
6.1.1.1.1.5.1	Terminate controls cables	14/12/2016					19/01/2017	36.25
6.1.1.1.1.5.2	Commission system in MICE Hall - RF System#1	20/12/2016	(RISK)-(R4)	Expert Personnel not available	10	0.25	27/01/2017	38.75
6.1.1.1.1.6.1	Terminate controls cables	26/12/2016					02/02/2017	38.75
6.1.1.1.1.6.2	Commission system in MICE Hall - RF System#1	30/12/2016	(RISK)-(R4)	Expert Personnel not available	10	0.5	11/02/2017	43.75
6.1.1.1.1.7.1	Terminate controls cables	05/01/2017					17/02/2017	43.75
6.1.1.1.1.7.2	Commission system in MICE Hall - RF System#1	11/01/2017	(RISK)-(R4)	Expert Personnel not available	10	0.5	28/02/2017	48.75
6.1.1.1.3.2.14	Commission RF with Dummy Load	17/02/2017	(RISK)-(R4)	Expert Personnel not available	10	0.5	11/04/2017	53.75
6.1.1.1.3.2.15	RF System #1 and #2 - Amplifier 4616 & TH116 available for operation	17/02/2017					11/04/2017	53.75
10.3.4	LLRF Tests	24/02/2017	(RISK)-(R3)	Additional testing time required	20	0.5	28/04/2017	63.75
16	MICE step V installation complete	24/03/2017	(RISK)-(R2)	Delay due to currently non-critical items reaching critical path	40	0.5	15/06/2017	83.75
11.1	HPRF tests	24/03/2017	(RISK)-(R3)	Additional testing time required	20	0.5	25/06/2017	93.75
17.1	Cooling Channel magnet Commissioning	02/05/2017	(RISK)-(R2)	Commissioning of the channel is an unknown	40	0.25	13/08/2017	103.75
17.2.1	Test and condition cavities, with B field, 1MW	02/05/2017	(RISK)-(R2)	Additional testing time required - testing in the MTA	40	0.5	02/09/2017	123.75
17.2.2	RF cavity testing complete	02/05/2017					02/09/2017	123.75
18	Combined magnet and operational tests complete	02/05/2017	(RISK)-(R2)	Delay due to currently non-critical items reaching critical path	40	0.5	22/09/2017	143.75

- Step IV end of data taking – June 2016
- RF System #2 Delivered to RAL – end August 2016
- Final Step Construction Complete – end March 2017
- Final Step ready for data taking May 2017

Step 3PI/2 Critical Path



Final Step

Cost to Completion



UK Cost to completion

MICE UK Cost to Complete		2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	Totals
		£k	£k	£k	£k	£k	£k	£k
Staff effort								
MICE-UK								
1	Project management and project office	471.45	487.95	505.03	392.03			1856.46
2	Mechanical integration	158.44	175.08	146.75	85.45			565.72
3	Electrical Integration	258.79	133.87	209.48	97.07			699.21
4	Focus-coil module	121.98	126.25	130.67	135.25			514.15
5	Hydrogn Delivery System	33.51	34.68	21.85				90.04
6	RF power	429.46	342.33	350.03	302.13			1423.95
7	Vacuum	28.48	29.48	30.51	31.58			120.05
8	Magnetic Mitigation	10.85	11.23	11.62	6.02			39.72
9	Software and computing	287.93	160.10	148.39	153.58	170.00	170.00	920.00
10	Operations and analysis	805.53	921.21	916.01	934.61	600.00	600.00	4177.36
	Staff totals	2606.42	2422.18	2470.34	2137.72			10406.66
Non-staff								
MICE-UK								
1	Project management and project office	65.00	15.00	15.00	65.00			160.00
2	Mechanical integration	79.58	258.32	173.27	155.80			666.97
3	Electrical Integration	171.60	96.48	182.63	125.93			576.64
4	Focus-coil module	81.87	15.00	35.00	5.00			136.87
5	Hydrogn Delivery System	61.09	10.00	0.00	0.00			71.09
6	RF power	109.30	147.14	110.23	75.00			441.67
7	Vacuum	45.72	25.76	35.85	36.49			143.82
8	Magnetic Mitigation	102.13	107.53	55.00	0.00			264.66
9	Software and computing	25.38	15.00	15.00	15.00	20.00	20.00	110.38
10	Operations and analysis	175.93	153.68	224.67	171.95	15.00	15.00	756.23
	Non-staff totals	917.56	843.91	846.65	650.17			3328.29
Total staff and non-staff								
MICE-UK								
1	Project management and project office	536.45	502.95	520.03	457.03			2016.46
2	Mechanical integration	238.02	433.40	320.02	241.25			1232.69
3	Electrical Integration	430.39	230.35	392.11	223.00			1275.85
4	Focus-coil module	203.85	141.25	165.67	140.25			651.02
5	Hydrogn Delivery System	94.60	44.68	21.85	0.00			161.13
6	RF power	538.76	489.47	460.26	377.13			1865.62
7	Vacuum	74.20	55.24	66.36	68.07			263.87
8	Magnetic Mitigation	112.98	118.76	66.62	6.02			304.38
9	Software and computing	313.31	175.10	163.39	168.58	190.00	190.00	1010.38
10	Operations and analysis	981.46	1074.89	1140.68	1106.56	615.00	615.00	4918.59
	Sub-totals	3523.98	3266.09	3316.99	2787.89	805.00	805.00	13699.95
Grand totals	(Cost with time contingency and risk)	3523.98	3266.09	3316.99	2787.89	805.00	805.00	14504.95
Grand totals	(Cost with time contingency)	3378.98	3096.09	3136.99	2557.89	805.00	805.00	13779.95
MICE-UK								
	Cost of risk mitigation	145.00	170.00	180.00	230.00	0.00	0.00	725.00
	Staff element	45.00	20.00	10.00	10.00	0.00	0.00	85.00
	Non-staff element	100.00	150.00	170.00	220.00	0.00	0.00	640.00

- Construction complete – March 2017
- Commissioning complete – May 2017
- Data taking complete – March 2018
- Analysis and papers complete – March 2020

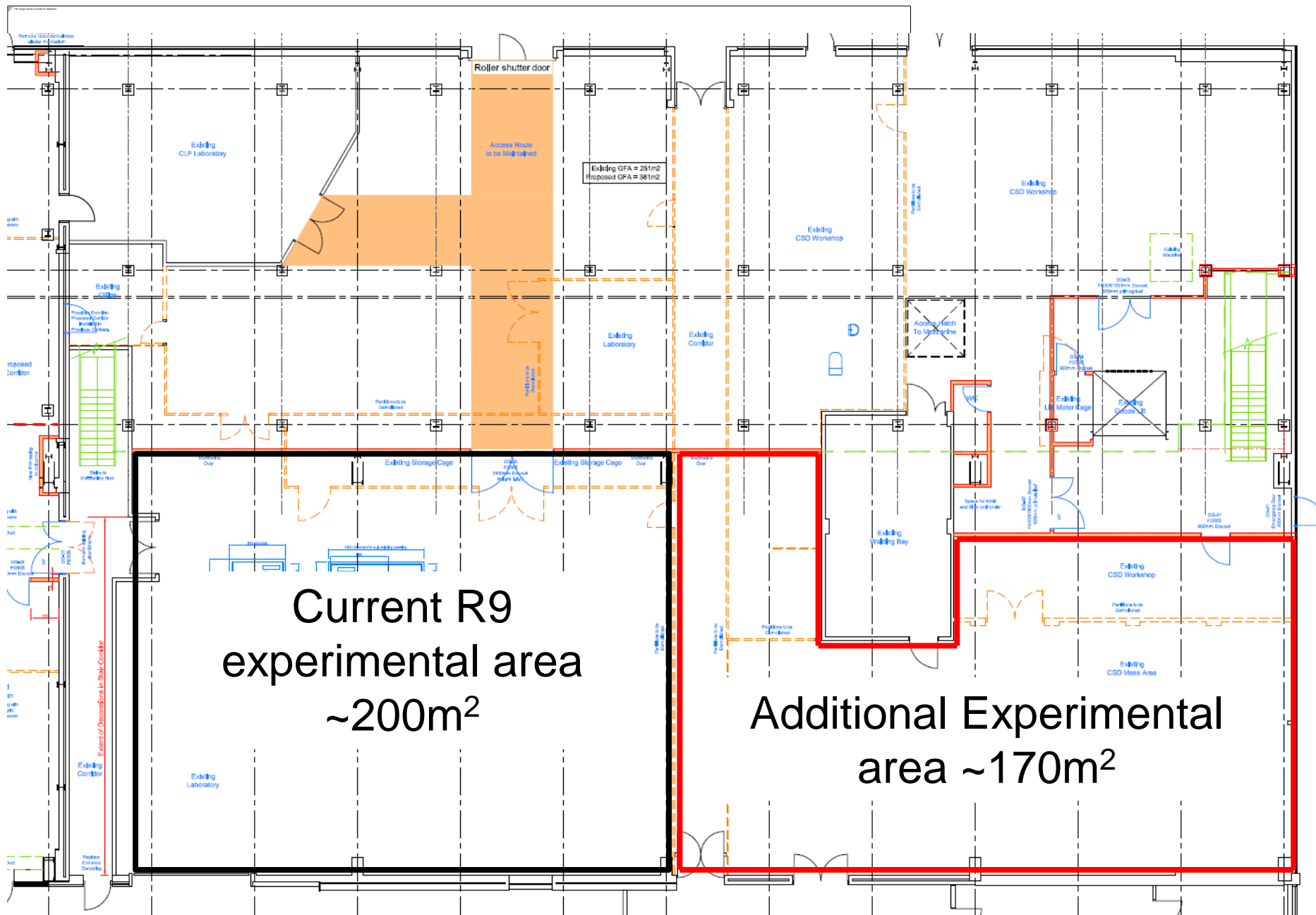


Final Step

Working Space



Working Space



**Current R9
experimental area
~200m²**

**Additional Experimental
area ~170m²**

Working Space

- Activity in the R9 Laboratory space
 - Area for storage of essential equipment moved from the current Didcot storage facility - £20k/year
 - *To end of project*
 - Clean lab
 - *To end of project*
 - Target operational space
 - *To end of project*
 - Waveguide layout and assembly
 - *6 months during 2015/16*
 - Storage of magnets and Partial Return Yoke materials during de-commissioning of Step IV (North sections)
 - *Removal - June 2016*
 - *Installation - January 2017*
 - Receiving area for RF cavities and chambers
 - *Delivery April 2016*
 - *Installation November 2016*
 - Receiving area for Final Step additional Partial Return Yoke sections
 - *Delivery March 2016*
 - *Installation October 2016 – January 2017*
 - Forklift parking area
 - *To end of project*



Final Step

Risk



Risk

ID	Risk Description	Potential impact on project	Risk score			Ownership	Proposed Action	Post-action risk score			Comment / Conclusion	Cost of mitigation		Likely retirement of requirement
			L	I	LxI			L	I	LxI		Staff years	Non-staff (€k)	
			MICE 3	Magnetic field effecting operation of electrical equipment relating to the continued operation of the cooling channel magnet systems and detectors.	Inability to operate the cooling channel			5	5	25		MICE - UK / MAP	Installation of a partial return yoke has mitigated the major risk. Movement of the control and power supply equipment to a dedicated room outside of the magnetic field.	
MICE 4	Extended period of re-training for the lattice of magnets for Step IV - SS1/AFC/SS2.	Timescales for the training period, cost of the amount of LHe required to carry out the training the availability of the LHe. Expert personnel required to be available for magnet operations over a protracted period of time.	4	5	20	MICE-UK / MAP	Discussions with BOC (or supplier) to agree delivery timescales and availability during heavy use periods. Magnet integration task force to define commissioning method to keep schedule and cost to a minimum.	4	4	16	Each re-cool and fill of the Spectrometer Solenoid can take upto 500L LHe, AFC around 100L. Each full lattice quench could cost in the region of £7k. Initial investigations with BOC show that the predicted amount of LHe will be available during the commissioning period.	1	100	End step IV
MICE 5	AFC Module #2 has the same type of fault as AFC module #1	Extended delay and uncertain cost burden.	4	5	20	MICE - UK	Bring forward test of module #2. Shorter timescale for training runs. Purchase of additional LHe if required to shorten timescale	2	4	8	Testing of the second Focus Coil has been successful. Some thermal performance required investigation	0.2	15	End Sept 14 after final soak test.
MICE 7	VAT payable on the delivery of all equipment imported from the non-UK collaborators	Budgetary constraints resulting in reduced work force and installation activities being carried out.	4	5	20	MICE UK	Escalation of the issue to the legal department of the STFC	2	4	8	At the moment it is unknown if the cost can be mitigated. STFC to bear the cost burden, 20% of the value of each item imported. With the shipping of the RFCC removed very large amounts are no longer possible.	0.1	100	Impacts final step
MICE 8	Resourcing issues	inability to complete significant sections of work on agreed time or cost scales.	4	5	20	MICE - UK / MAP	Escalation of the issue to the STFC and DOE.	2	4	8	Project scope has changed leading to a different labour profile required to complete the project.	2		Impacts Step IV and all other steps.
MICE 9	Senior management of the MAP collaboration / MICE-US changes.	Leadership and direction of the construction team unfocused.	4	5	20	MAP		n/a	n/a	n/a				End of Step 3PI/2
MICE 10	Late delivery of the PRY and / or Cavities for Step 3PI/2 after advanced scheduling.	Standing army cost for period after hall preparations are complete and receipt of the PRY materials / Cavities	3	5	15	MICE-UK / MAP	Interaction with the MICE-US construction team.	2	5	10	Cost will need to be borne as releasing and then re-forming the team will be difficult with an unknown timescale.	£90k / Month		End of Step 3PI/2
MICE 11	US budget cuts changing magnet manufacture, commissioning and delivery	Halting project installation and subsequent data taking. Loss of key personnel from the project. Inability to continue with full cooling program.	4	5	20	MAP	Discussion with senior STFC management.	2	4	8	DOE has assigned a budget profile of 9 / 6 / 3 for the next 3 US financial years.			Impacts Step IV and Step 3PI/2
MICE 12	RF Power systems are not available for cavity testing	The critical path items following the RF system installation will extend in time. Testing of the cavities with and without B field. Commissioning of the channel and gaining data for the final step	4	5	20	MICE UK	Discussions with UK senior management to gain sufficient staff to carry out the work required on the RF systems and controls. Additional technical staff from collaborating institutes for installation work.	2	5	10	Successful completion of the RF power system installation will result in delays leading to the US collaborators being unable to contribute to the data taking period for Step 3PI/2.	2	75	End of Step 3PI/2
MICE 13	Focus Coil 1 extended timescale for repairs to gain full operating current.	Repairs enabling the Focus Coil 1 to operate at the nominal currents for the experiment are not completed in time for installation and operation in the Step 3PI/2	4	5	20	MICE UK	Scientific substantiation for the need to run at the higher current. Discussions with the manufacturing company to gain realistic timescales and cost. MICE project interaction with the manufacturing company senior management and supply technical effort to expedite the repairs.	2	5	10	Following scientific substantiation there may not be the need to make repairs to the Focus Coil 1. This would remove the risk of late delivery back to the experiment. The current analysis for Step 3PI/2 uses the current rating that has already been achieved.	1	100	Decision point 15th November.

- Technical risk reduced
- No Second hydrogen system
- No Hydrogen absorber in final step
- Operational risk reduced from Step IV experience.
- To Focus Coils that will be operable during final step
- RF Power systems
 - Effort for build-up, testing and installation
- Changes in US budgets
 - Delivery of RF Cavities and Chambers late
 - PRY additional materials late

