



Schedule and Milestones

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STFC RAL

MICE UK Cost to completion review
26th April 2016

Schedule: Step IV.

Planned data-taking until end 2016 – possible to run until Mid 2017.

Decay Solenoid. – Returned – repaired – recommissioned – returned to service.

QP/QD

- New system designed by FNAL - FPGA channels – reprogramming at FNAL
- Installation plan by S Griffiths @ DL - commissioning starts May 2016.

Hydrogen system

- X-ray investigation of internal absorber body ‘crack’- thermal cycling.
- Vacuum end-caps progressing through PED 5500 – delivery June 30th.
- Heat load modelling in progress – plan to improve emissivity, reduce heat load.
- Ongoing co-operation with original designer Prof. Shigeru Ishimoto
- Pre-cool magnet coil before return to MICE Hall – save 21 day cool-down period.

Cooling water system

- Split system installation in progress.
- Target date May 20th.



Schedule UK Costs and funding

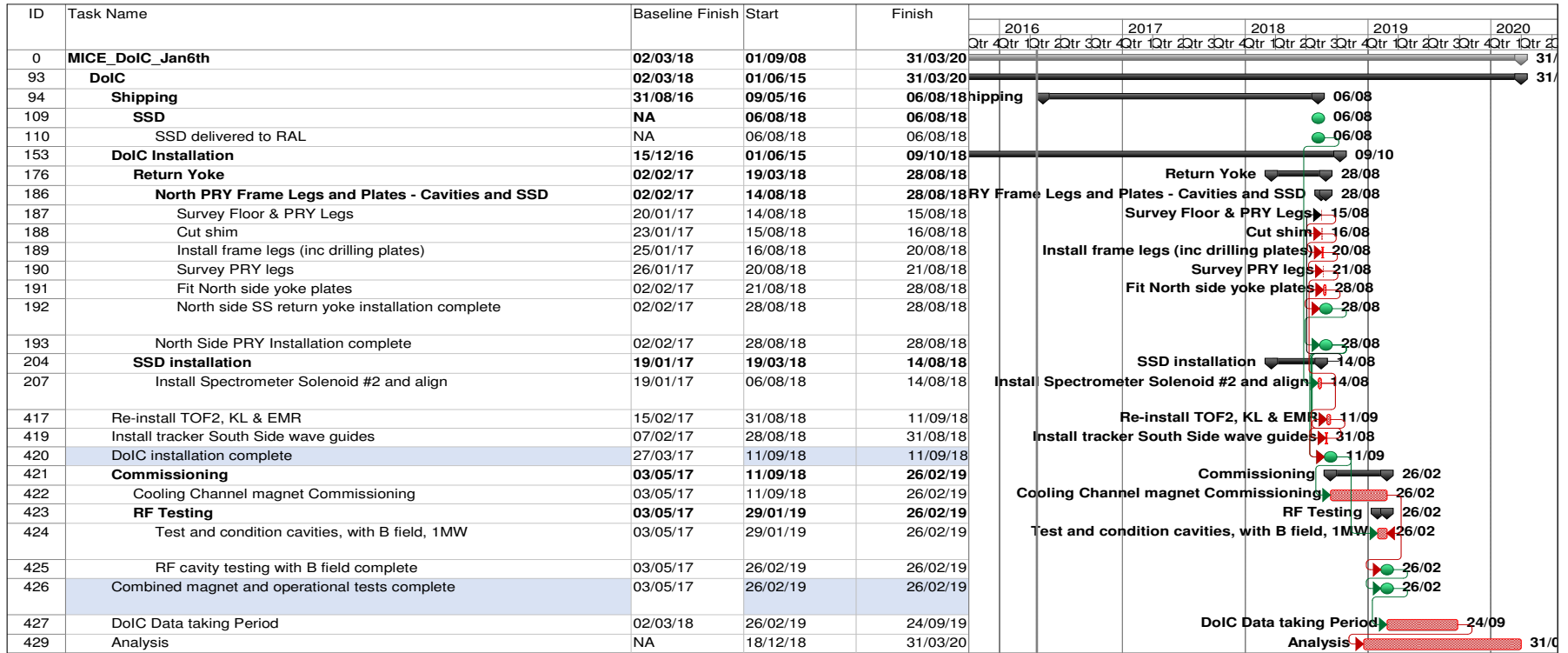
Baseline timetable as created from 'MICE Demonstration of Ionisation Cooling'

MICE UK Oversight Committee requested options:

1. Flat Cash + 10%
 2. Flat Cash
 3. Completion of Step IV
 4. De-scope options – below flat cash.
- Replacement SSD available Aug '18.
 - 6 Months system commissioning.
 - 7 months running – particle rate improvements.
 - 6 months analysis – 'next day' reconstruction now working.
 - 2nd RF amplifier installation in hall delayed until FY 18/19.



Flat Cash + 10%



Step IV can continue until mid 2017 without schedule impact.

Key Dates

- SSD August 2018.
- Construction complete 11/09/18.
- Commissioning complete 26/02/19.
- Data-taking complete 24/09/19.
- Analysis complete 31/03/20.

Completion of Step IV

Schedule

- Continue with Step IV until July 17.
- Additional running to provide contingency for H2 system.
- Complete data-taking 'Matrix' as opposed to 'cross'
- Student funding continued to complete PhDs.
 - 3.5 yr course start October 2016; end April 2020

Key Dates

- Magnet Readiness review May 2016.
- Commissioning complete end June 16.
- H2 available from September 16.
- Data-taking complete July 17
- Analysis complete March 18.



De-scope options

Options that reduce complexity -

- Stop remedial work on the LH2 vessel;
- Stop work on the second high-power amplifier chain
 - one amplifier will serve both cavities in the cooling cell implemented to demonstrate ionization cooling. $\Delta\varepsilon/\varepsilon$ decreases from -5.8% to \sim -4.8%

Options that reduce cost below flat cash -

- Replace LiH secondary absorbers with plastic disks in the solenoid bore;
 - $\Delta\varepsilon/\varepsilon$ decreases from -5.8% to \sim -3.4%
- Stop work on the second high-power amplifier chain
- Maximise scientific exploitation of Step IV but do not deliver the cooling demonstration. See slide above.

Options that mitigate non-recovery of SSD.

- Addition of one or more tracker planes, re-positioning of the principal lithium-hydride absorber and rotation of SS1 through 180° may be considered.
- All sorts of slightly to extremely exotic ideas not fit for public consumption – yet.

De-Scope Options

Stop H2 remedial work

- Small cost saving (~£60k), most resources are already committed.
- Small, (significant?) reduction in complexity
- Large reduction in science output

1 RF Amplifier

- Cost analysis completed
 - Integrated saving of ~£350k.
- Reduce accelerating gradient by factor ~0.7
- Moves measurement accuracy required closer to limit of tracker resolution.
- Adds complexity to RF system.
- May require use of full EMR resolution
- $\Delta\varepsilon/\varepsilon$ decreases from -5.8% to ~ -4.8%



£10M – integral

Cuts

- De-scope to 1RF system.
- Reduce Ops and Analysis by 2 post-doctoral positions - 8 FTEs
- Zero ISIS technical support 3FTEs
- Zero PPD support 1.75 FTEs

Impact

- Substantial decrease in flexibility and resilience of operations
- Reduced UK analysis activity.
 - Substantially reduce the ability of the UK to lead delivery of physics from the experiment.

SSD Procurement

	Bare Cost	Staff	Total (incl VAT)	Cost Inc VAT + contingency	
	£k	£k	£k	£k	\$k
Full Magnet	1115	75	1413	1554	2220
Cold Mass+ re-fit	775	160	1090	1308	1869
US cost model (cold mass +re-fit)			1327	1792	2560

VAT	0.2	1.2
Cost of SY at RAL	50	
Exchange rate (\$1=£)	0.7	
Contingency (RAL, full magnet)	0.1	1.1
Contingency (RAL, cold mass)	0.2	1.2
Contingency (US)	0.35	1.35



SSD Procurement

Progress to date

- Meeting with Peter Clarke – confirmed timelines and schedule for procurement.
- Three MICE Magnet team registered on Emptoris to manage procurement process.
- Documentation started.
- “Comfort Letter” required from the US DoE.

Work in Progress

- Interface issues:
 - Magnetic profile for spectrometer – Jaroslaw Pasternak.
 - MICE experiment interfaces – dimensions from FC and Bellows - C Whyte
 - Electrical – to quench detection and monitoring system – S Griffiths to supply specifications
 - Mechanical interfaces – a custom drawing is in preparation
- Coil positions from MICE Note documentation
- Costs and risks associated with the cold mass replacement only option.
 - satisfying ourselves that vessel can meet the PED requirements may be difficult.
- Evaluating test of the Luvata wire to ~350A in the SCU turret as a proof test.
- JB to contact Alan Bross for sample wire section
- JB to request spool lengths of the wire.



Schedule comparison – SSD Procurement

Item	Cold Mass only Procurement	Full Magnet Procurement
Place Contract	5 months	5 months
Manufacture	6 to 8 months	20 months
Cold test	3 months	NA
Shipping	1 months	1 week
Remove cold mass from SSD	[3] months	NA
PED 5500	[3] months	NA
Electrical interfacing	[2] months	[2] months
Supplier oversight	[2weeks]	[2weeks]
Post delivery work @ RAL	3 to 4 months	[2weeks]
Total	21-24 Months	29 Months

Task times shown in [brackets] can be parallelised and so are not considered when calculating totals

Schedule

RF Project

Project includes offline testing of the RF cavities.

- RF staff resource requirement levelled due to re-planning caused by SS.
- RF personnel supplemented with additional key staff in controls
- MICE RF engineer now LM through ISIS RF Team – RF amplifier commissioning will be fully integrated with ISIS RF support
- RF expert development through ISIS/Cern collaboration.
- Staff from IHEP, China, equivalent 1+FTE RF relevant

Mechanical installation

- confined space access and working considerations – potential knock-on effects.
- Design services/power for south PRY plate removal – potential knock-on effects.
- PRY design tolerances tightened where appropriate.
- Floor plates/translation stages ordered.
- RF co-axial line design advanced
- Clean room facility in procurement.
- Bellows in procurement.



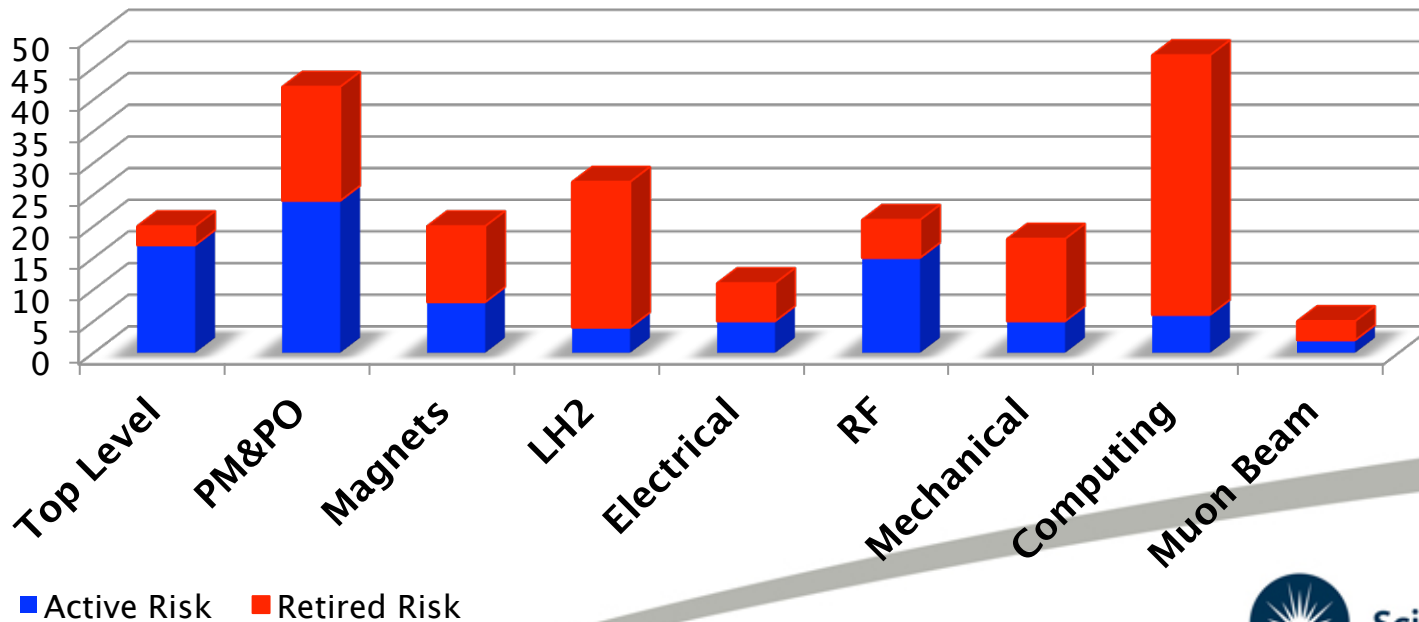
Risk Register

ID	Risk Description	Potential impact on project	Risk score			Ownership	Proposed Action	Post-action risk score			Cost of mitigation		Likely retirement of requirement		Year	Q	Category	Staff
			L	I	LxI			L	I	LxI	Staff years	Non-staff (€k)	Year	Q				
MICE 3	Magnetic field effecting operation of electrical equipment relating to the continuous 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 cover supply equipment to a dedicated room outside of the magnetic field.	1	4	4	0.2	100	End of Cooling Demo commissioning - may 2018	2018	2	Technical	0.04	
MICE 4	Extended period of re-training for the lattice of magnets for Step IV - SS10a/0202.	Timescales for the training period, cost of the amount of time required to carry out the training the availability of the experts. 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	1	100	End step IV commissioning - June 2016	2016	2	Technical	0.8	
MICE 8	Resourcing issues from the STFC and national labs.	Inability to complete significant sections of work on agreed time or cost scales.	4	5	20	MICE - UK / MAP	Realised. Escalation of the issue to the STFC and DOE.	2	4	8	2		Impacts Step IV and all other steps. March 2018	2018	1	Resource	0.8	
MICE 9	Senior management of the MAP collaboration / MICE-US changes.	Leadership and direction of the construction team unobscured.	4	5	20	MAP	Discussion with senior MAP and MICE management	2	4	8			End of Cooling Demo June 2019	2019	2	Resource		
MICE 10	Late delivery of the PRY and / or Cavities Cooling Demo 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.	1	5	5	20		End of Cooling Demo commissioning march 2017	2017	1	Technical	4	
MICE 11	US budget limits magnet manufacture, commissioning and delivery	Halling 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 and DOE management	2	4	8			Impacts Step IV and Cooling Demo commissioning may 2017	2017	2	Financial		
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 getting 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	4	8	2	75	End of Cooling Demo commissioning may 2017	2017	2	Technical	0.8	
MICE 14	Loss of key project and operational staff	Continuation of the funding to allow renewal of University contracts	3	5	15	MICE-UK	Discussions with The STFC senior staff. Preparation of funding profiles, plans and staffing to completion of the Cooling Demo.	1	5	5	10	50	November 2015	2016	2	Resource	2	
MICE 15	Restricted entry to the UK for key project and operational staff	Visa and invitation bureaucratic difficulties producing non-EU engineers and scientific staff from entering the UK to carry out work at the STFC RAL.	3	5	15	MICE-UK	Arrangements with the migration department of the STFC and request / escalating difficulties to the STFC senior staff	2	5	10	10	50	End of the Cooling Demo march 2018	2018	1	Resource	4	
MICE 16	Failure of a Focus Coil Magnet	Internal cold mass or associated equipment deep within the assembly. LTS leads.	3	5	15	MICE-UK	Follow all specific operational aspects as defined by the experts for the superconducting magnet	2	5	10	3	500	End of the Cooling Demo march 2018	2018	1	Technical	1.2	
MICE 17	Failure of a Spectrometer Solenoid Magnet	Internal cold mass or associated equipment deep within the assembly. LTS leads.	3	5	15	MAP	Realised SSD.	3	5	15	3	500	End of the Cooling Demo march 2018	2018	1	Technical	1.6	
MICE 17.1	Failure of Upstream Spectrometer Solenoid Magnet	Internal cold mass or associated equipment deep within the assembly. LTS leads.	4	5	20	MAP	New quench protection system.	2	5	10	3	500	End of the Cooling Demo march 2018	2018	1	Technical	1.2	
MICE 18	Inability to procure Lithium Hydride for secondary absorbers	Reduction in scientific output and resulting cooling effect.	3	5	15	MICE-UK / MAP	Received updated quote from vendor. Purchase on hold pending C2C review.	1	5	5	0.2	30	June 2016	2016	2	Financial	0.04	
MICE 19	Failure of M2 in SSU	Reduction in scientific output and resulting cooling effect.	3	4	12	MICE-UK / MAP	Maximise data collection before turning off.	2	4	8	0.2	30	December 16.	2016	4	Technical	0.08	
MICE 20	Failure of Helium space feedthrough to SSD	Reduction in scientific output and resulting cooling effect.	3	4	12	MICE-UK / MAP	Low number of quenches	2	4	8	0.2	30	December 16.	2016	4	Technical	0.08	
MICE 21	Cannot agree program and budget	Only go to sleep	3	5	15	MICE-UK / MAP	Work to agree solution with partners - funding agencies	2	5	10	0.2	30	December 16.	2016	4	Financial	0.08	
MICE 22	SSD delivery on schedule, quality & cost	Delays to programme and/or poor compromised data	4	5	20	MAP	Discussion with senior MAP and MICE management	2	4	8			End of Cooling Demo June 2019	2019	2	Financial		
MICE 23	Risk of equipment failure/breakage	Cost of repair/replacement. Time lost during recovery	3	3	9	MICE-UK	Spare inventory / proper planned maintenance	3	1	3	0.2	50	End of Cooling Demo June 2019	2019	2	Financial	0.12	
MICE 24	Problems during magnet string commissioning	Further compromise of SSD / Delays to program	3	5	15	MICE-UK	Conservative magnet settings.	3	3	9	1	100	End of Cooling Demo June 2019	2019	2	Technical	0.6	
MICE 25	PED test of SSD vessel	Cost and time to remediate	5	3	15	MICE-UK	Early start of PED process - clear and well advanced planning.	5	2	10	0.5	100	Magnet delivery	2018	3	Technical		
MICE 26	Staffing - risk that project cannot procure required technical magnet expert staff	Cost and Time impact	4	4	16	MICE-UK	Start staff recruitment at earliest opportunity	3	4	12	1	100	Magnet delivery	2018	3	Technical		

Risks

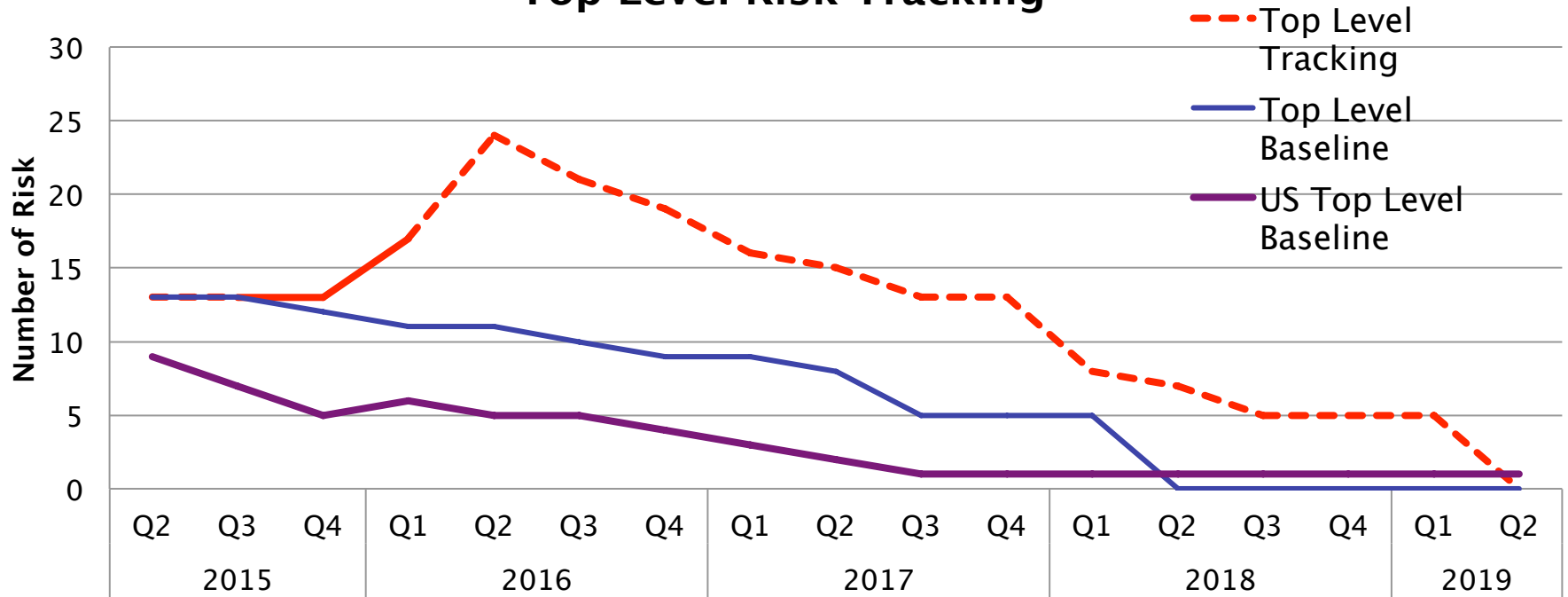
New Risks Added

- Failure of SSU – QD/QP upgrade mitigates
- Failure of M2 in SSD – mitigated as above
- Failure of Helium space feedthrough in SSD – mitigated as above
- Risks associated with SSD repair – both Cold mass and full magnet options.
- SSD delivery on schedule, quality & cost.
- Cannot agree program and budget.
- US management – refresh.
- Generic ‘failure of equipment’ – age related risk.
- H2 absorber – failure to cool adequately.



Risk

Top Level Risk Tracking



After mitigation

<i>From Top Level Risk</i>	<i>Number</i>	<i>Level</i>	<i>Average</i>
Technical	9	84	9
Financial	4	31	8
Resource	4	31	8
Total	17	146	9

Project Managers Risk Assessment	
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Summary

- Step IV data-taking/analysis now running smoothly
 - 2 more papers in preparation.
- Running can be extended due to SSD recovery.
- SSD recovery now running from RAL.
 - Funds transfer discussion DoE and STFC
- 5 scenarios analysed and costed.
 - Flat +10%
 - Flat
 - De-scope
 - Step IV
 - £10M.
- Risk Register updated

