LhARA Proposal overview

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Objectives

- Conceptual design of the LhARA facility
- Technical design of LhARA accelerator systems for Phase 1 and its integration with the source and the end station
- Technical design of accelerator systems for Phase 2 and its integration with the source and the end stations
- Design, construction and validation of the FFA magnet prototype for LhARA Phase 2 post-accelerator
- Design, construction and validation of the MA RF cavity prototype for LhARA Phase 2 post-accelerator

Deliverables

- CDR for the LhARA facility (24 months)
- TDR for the LhARA accelerator systems for Phase 1 (36 months)
- TDR for the LhARA accelerator systems for Phase 2 (60 months)

LhARA Stage 1

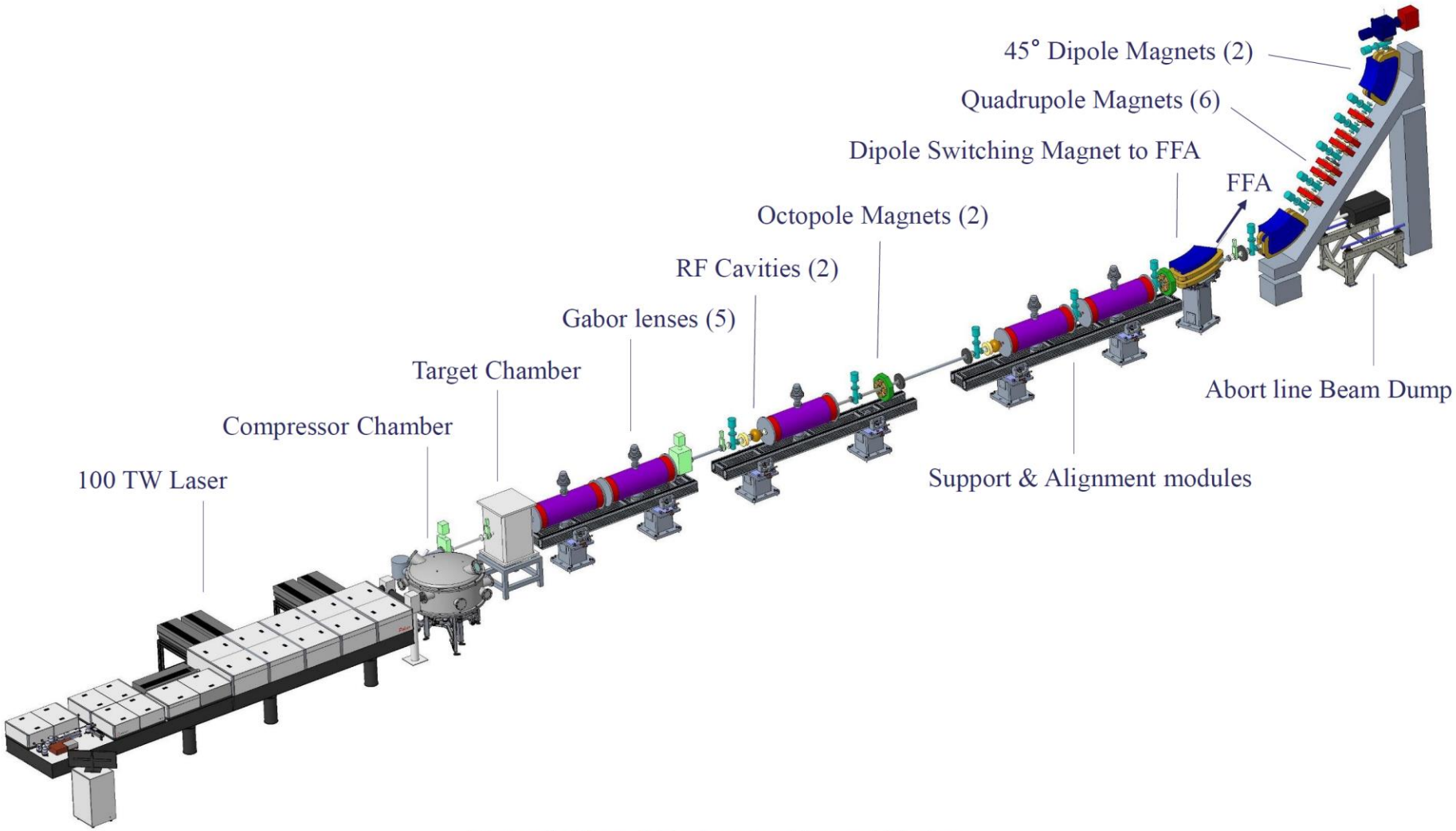


Figure #: Stage 1 Engineering Concept Design

Lhara Facility

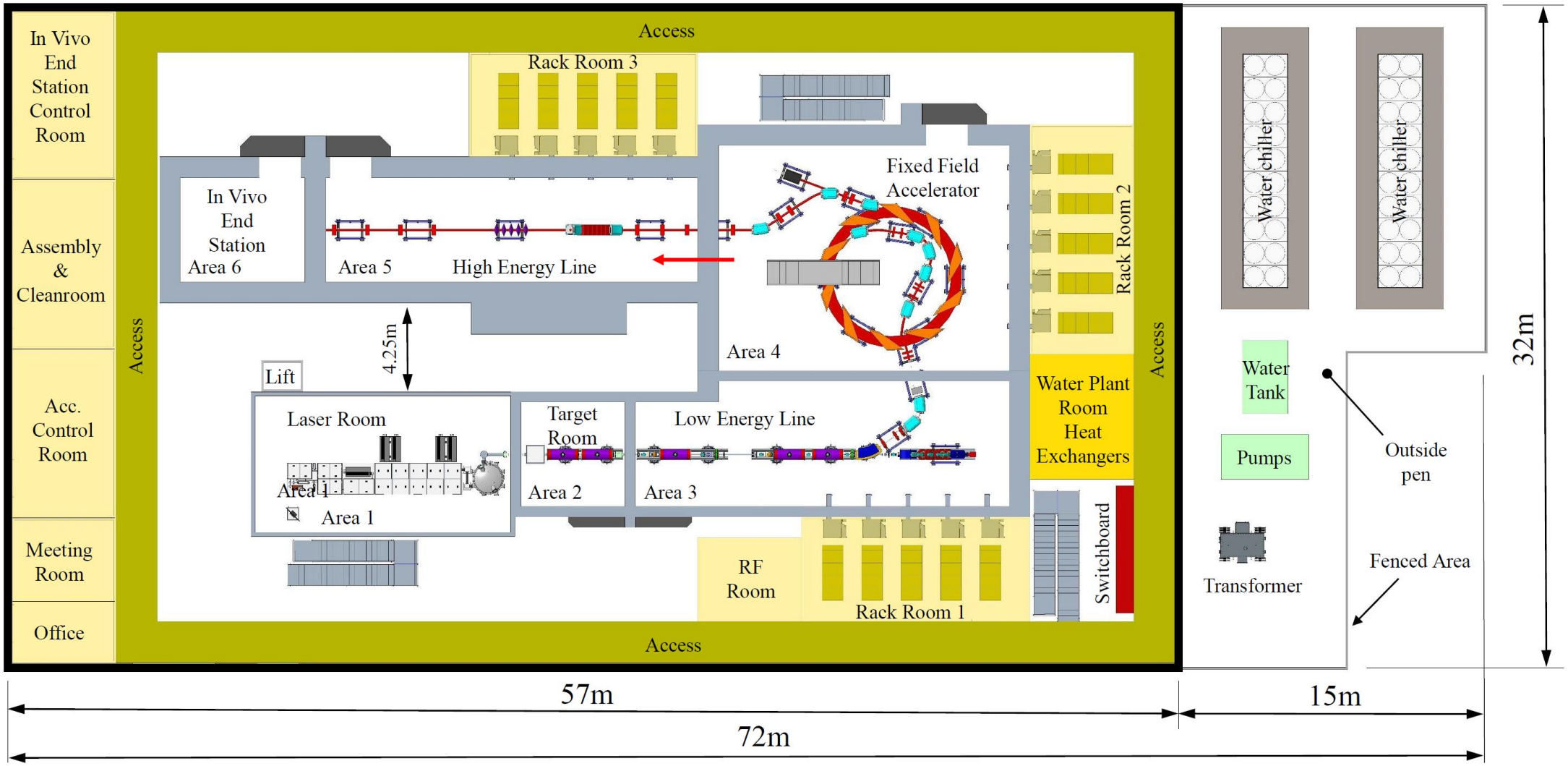


Figure #: Plan View Layout of Facility – Stage 1 & 2

Building concept

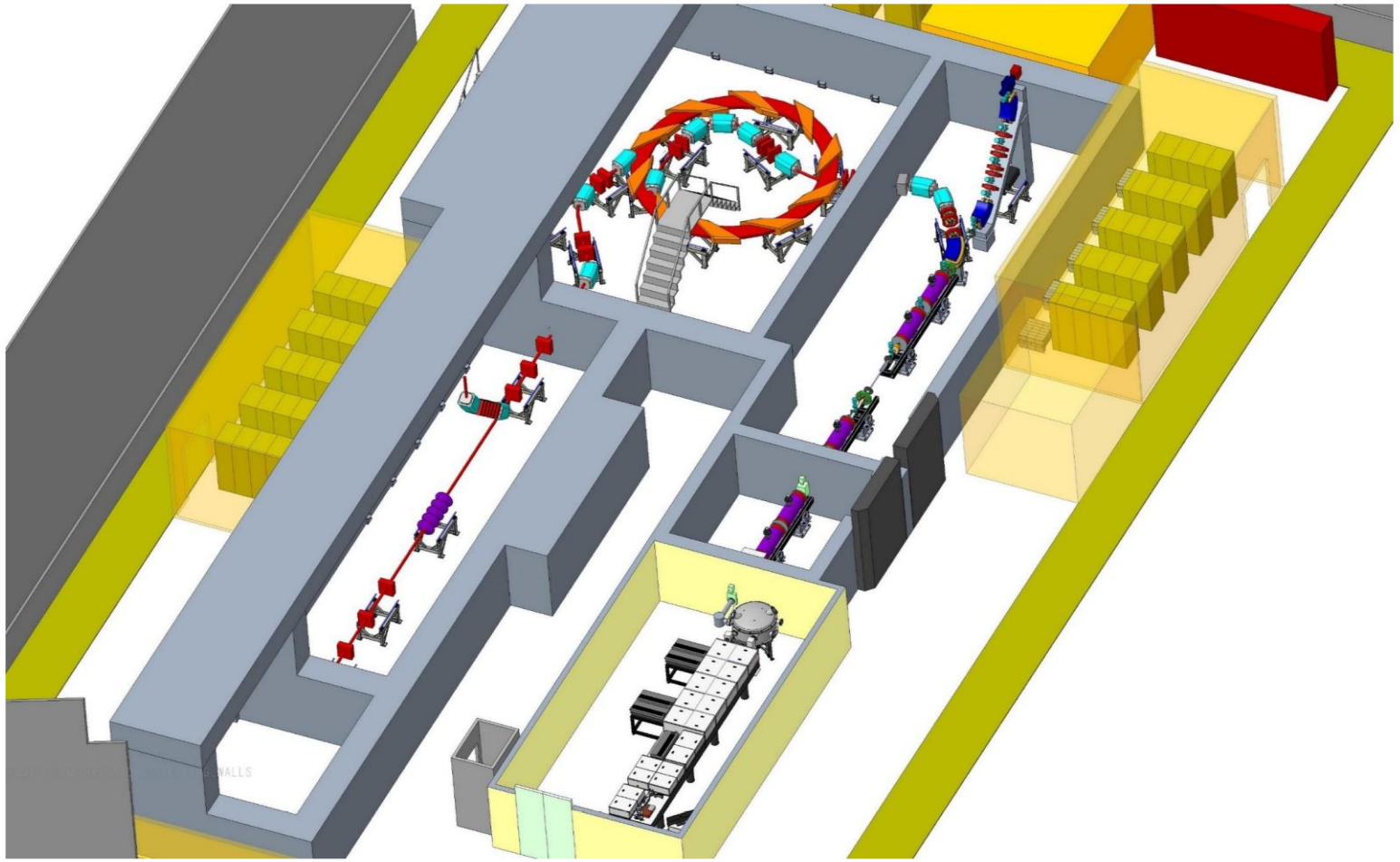


Figure #: Building Concept Design with cutaway to show equipment

Building concept (2)

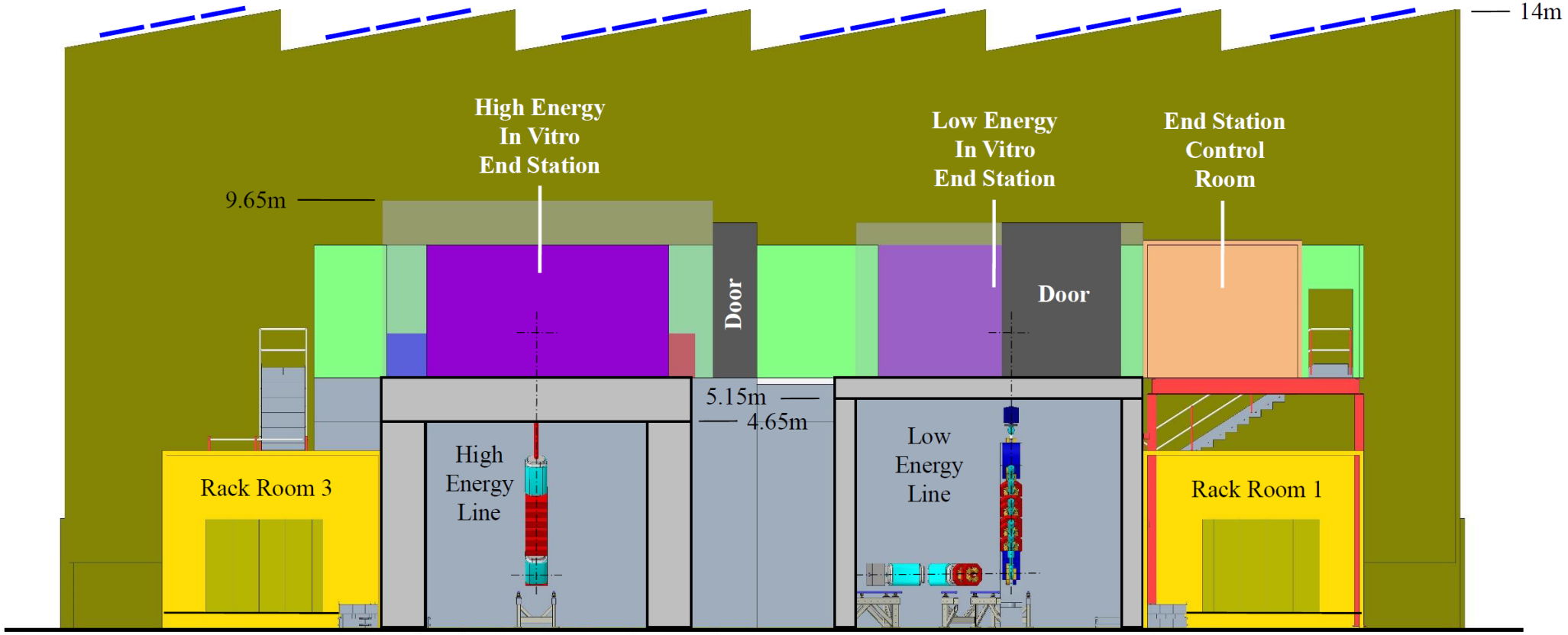


Figure #: Cross section through building

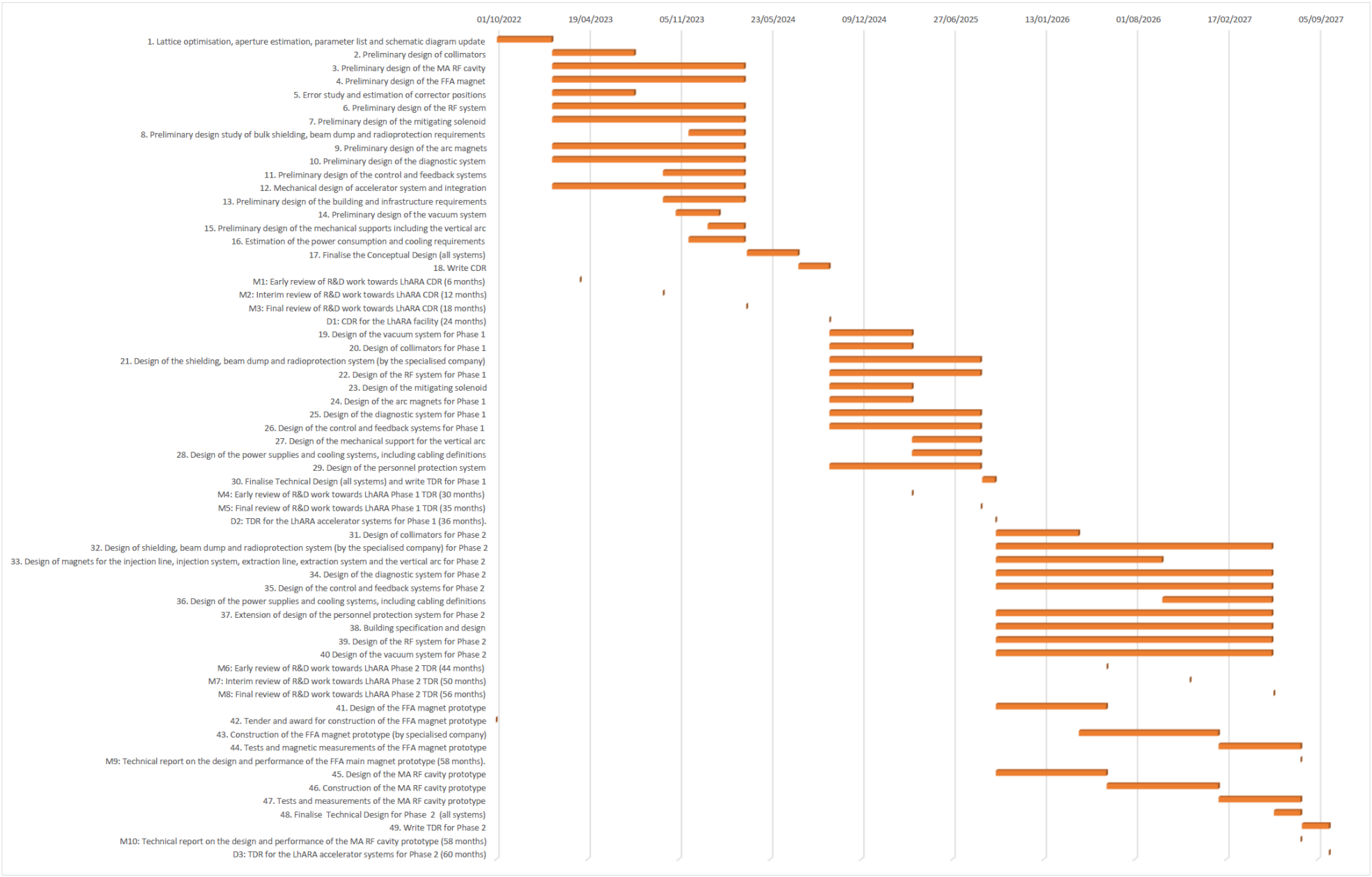
WP6 costs

LhARA WP6 Design and integration	N. Bliss, J. Pasternak										27/04/2022	
Staff	**Year 1**		**Year 2**		**Year 3**		**Year 4**		**Year 5**		**Total**	
	Fraction	**£k**	**Fraction**	**£k**	**Fraction**	**£k**	**Fraction**	**£k**	**Fraction**	**£k**	**Fraction**	**£k**
CDR and conceptual design development												
Imperial Physics												
Imp Staff 1	0.1	10	0.1	10	0.1	10	0.1	10	0.1	10	0.5	50
Imp PDRA1	0.5	50	0.5	50	1	100	1	100	1	100	4	400
Imp PDRA2					1	100	1	100	1	100	3	300
Imp PG1			0.5	70							0.5	70
RF eng.					0.3	30	0.6	60	0.6	60	1.5	150
Diagnostics expert					0.3	30	0.5	50	0.5	50	1.3	130
RHUL Physics												
RHUL PDRA1	0.5	50	0.5	50	1	100	1	100	1	100	4	400
RHUL PG1			0.5	70							0.5	70
CDR and technical design studies												
STFC Technical												
STFC WP management	0.2	20	0.25	25	0.25	25	0.25	25	0.25	25	1.2	120
Mechanical engineering design specification	0.5	50	0.8	80	1	100	1.2	120	1.2	120	4.7	470
Electrical engineering design specification	0.05	5	0.55	55	0.9	90	1.1	110	1.1	110	3.7	370
Controls specification	0.05	5	0.25	25	0.35	35	0.65	65	0.7	70	2	200
Technical services specification			0.4	40	0.5	50	0.5	50	0.5	50	1.9	190
Vacuum specification			0.2	20	0.5	50	0.3	30	0.3	30	1.3	130
Radiation Protection Advisor	0.03	2.75	0.08	7.5	0.1	10	0.1	10	0.1	10	0.4	40.25
Cost of risk mitigation, staff												
Staff total:	1.9275	**192.75**	**4.625**	**502.5**	**7.3**	**730**	**8.3**	**830**	**8.35**	**835**	**30.5025**	**3090.25**
Non-staff		**£k**		**£k**		**£k**		**£k**		**£k**		**£k**
CDR and conceptual design development												
FFA magnet prototype								50.00		50.00		100.00
FFA MA Cavity prototype						50.00		75.00		75.00		200.00
Sotfware		2.50		2.50		2.50		2.50		2.50		12.50
CDR and technical design studies												
Radiation Protection Study (specialist company)						45.00		45.00				90.00
Equipment total:		**2.50**		**2.50**		**97.50**		**172.50**		**127.50**		**402.50**
Inflation:						43.90		82.57		105.49		231.97
Work package management (meetings)		15.00		15.00		25.00		25.00		25.00		105.00
Consumables		3.00		3.00		3.00		3.00		3.00		15.00
Travel		5.00		5.00		10.00		10.00		10.00		40.00
Cost of risk mitigation, equipment (not yet implemented):												
Working margin:						82.75		100.25		96.25		279.25
Contingency, equipment:						19.50		34.50		25.50		79.50
Contingency, CG staff:												479.00
Contingency, all staff:						146.00		166.00		167.00		479.00
Total:		**218.25**		**528.00**		**1157.65**		**1423.82**		**1394.74**		**4722.47**

WP6 Risks

Number	Name	Description	Likelihood	Impact	Score	Mitigation	Mitigated Likelihood	Mitigated Impact	Mitigated score
1	Fixed Field Accelerator (FFA) Performance.	FFA does not deliver parameters in performance specification.	3	5	15	Continue R&D on the critical item that is the FFA spiral magnet. Construct a prototype before production of 10 magnets.	1	5	5
2	Gabor lens performance	Gabor lens does not deliver parameters in performance specification.	4	5	20	Continue a R&D plan that involves the construction of a prototype Gabor lens and have a back up plan available that uses solenoid magnets in the place of Gabor lens.	2	5	10
3	MA Cavity construction	Delay or technical difficulties in construction of Magnet Alloy (MA) cavity	5	4	20	Establish close collaboration with CERN, J-PARC & KURNS institutes, where similar systems have been constructed and are in operation. Component parts manufactured by industry.	5	1	5
4	Injection and extraction magnets	Insufficient availablility of injection and extraction magnets suppliers.	3	4	12	Design and construct of injection and extraction magnets by STFC national laboratorie expertise. Component parts manufactured by industry.	3	2	6
5	Facility infrastructure	Facility infrastructure is not fit for purpose.	4	4	16	Include facility infrastructure design during the Conceputal Design Report (CDR) stage to provide a fit for purpose design that will inform the project cost and schedule.	1	4	4
6	Radiation protection	Radiation bulk shielding thickness, labyrinths and services penetrations are inadequate to meet specification.	4	5	20	Conduct radiation protection assessment during the CDR phase of the project to satisfy safety leglislation and identify construction method to inform cost and schedule.	1	5	5

WP6 Schedule



Summary

- We have the plan how to deliver LhARA
- This will be a very important facility to inform future hadrontherapy protocols -> many human lives to save!
- This research may also inform the technology for future ion therapy facility -> very important!
- We hope the funding will allow us to have new openings (postdoc level), engineering effort and new students to address LhARA R&D needs!