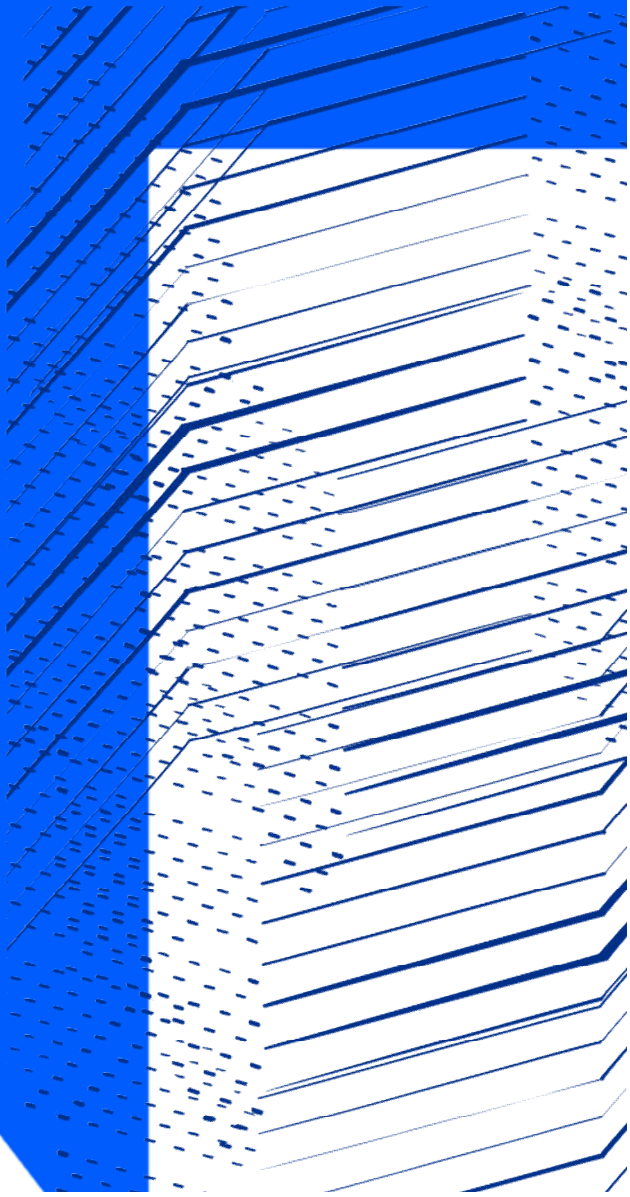
LBNF Target PI/PM Report to IB

24th August 2021

Chris Densham, Peter Loveridge

(STFC Rutherford Appleton Laboratory)



Science and Technology Facilities Council

WARWICK THE UNIVERSITY OF WARWICK

DUNE DEEP UNDERGROUND NEUTRINO EXPERIMENT

Fermilab Long-Baseline Neutrino Facility

US LBNF/DUNE project status update
(as of 23rd June 2021)

1. DoE funding guidance anticipated for US project (schedule assumes by end of August)
2. New subproject strategy being implemented
   - Beamline + Near Site Conventional Facilities now a separate subproject from Far Site subprojects
3. P6 schedule files being merged, including UK Phase 2 (construction) project
4. CD-1RR Director's 'Reaffirm' Review: expected January 2022
5. CD-1RR DoE Independent Project Review: expected April 2022
6. Timing of subproject CD2/3 reviews still TBD
7. Target Station Integration Building (TSIB) included by name in the Presidential Budget with $15.5M allocated as requested
   - Crucial for integration of UK components – good news

US DoE feedback on beamline presentations to IPR

Ref. presentation by Densham on the day of the last IB meeting 11th Jan

U.S. DEPARTMENT OF ENERGY

2.1 Beamline

A. Sy, TJNAF and S. Peggs, BNL/
Subcommittee 1

OFFICE OF SCIENCE

- **Comments**

- The Beamline team has made good technical progress since the last IPR.
  - The committee commends the Beamline team and their international partners for this effort. Keep up the good work!

- The committee was again encouraged by the participation of international partners in Beamline talks during this review.

- The committee notes and encourages early prototype testing to mitigate risks that are large cost or schedule risk drivers.

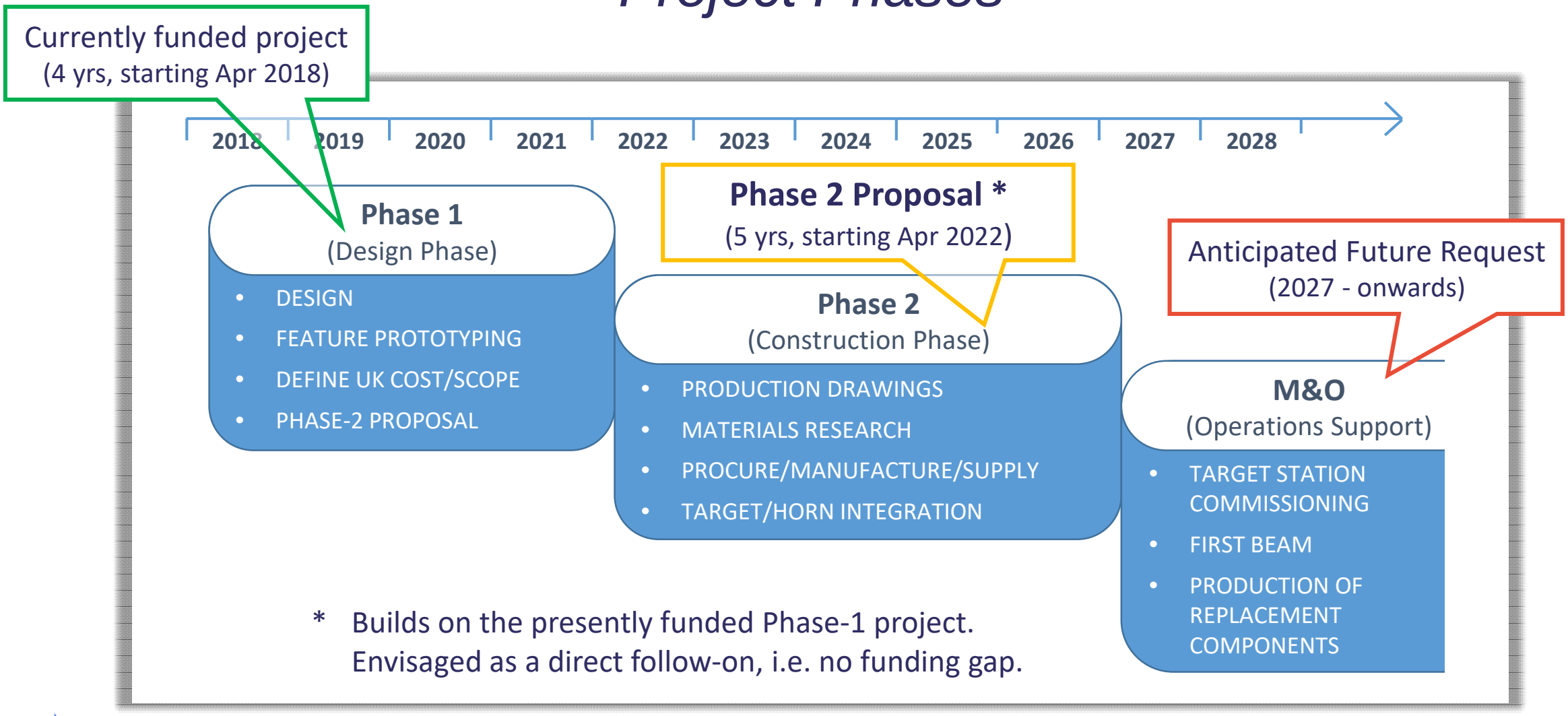
- The Beamline team continues to adapt well to challenges associated with COVID-19.

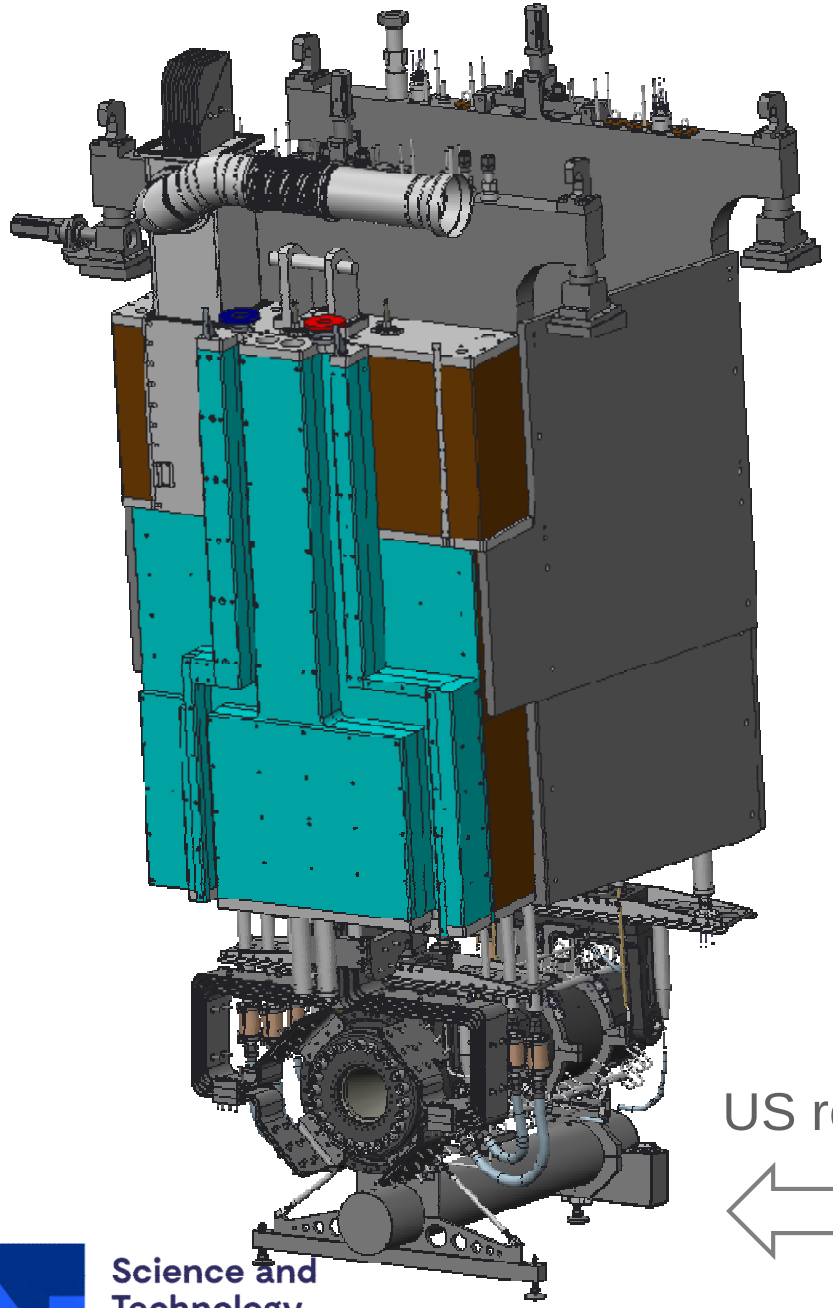
UKRI Scienc Techno Faciliti

UK Project Management and Reporting since last IB

1. Reports and presentations to LBNF target Oversight Committee
   - 26th January 2021 (feedback received 3rd March)
   - 24th June 2021 (feedback received 9th July)
2. Reports to STFC Project Review Committee (PRC)
   - PM (Loveridge) has updated monthly reporting format
   - To align reporting requirements for the PRC with the Oversight Committee, additional requests from the LBNF/DUNE PM and streamline the reporting process overall
3. Project Planning Document:
   - US revised version of PPD (Part 2) returned to UK PI to incorporate scope revisions in Phase 2 proposal
4. Phase 2 (construction) project proposal
   - Status report at end

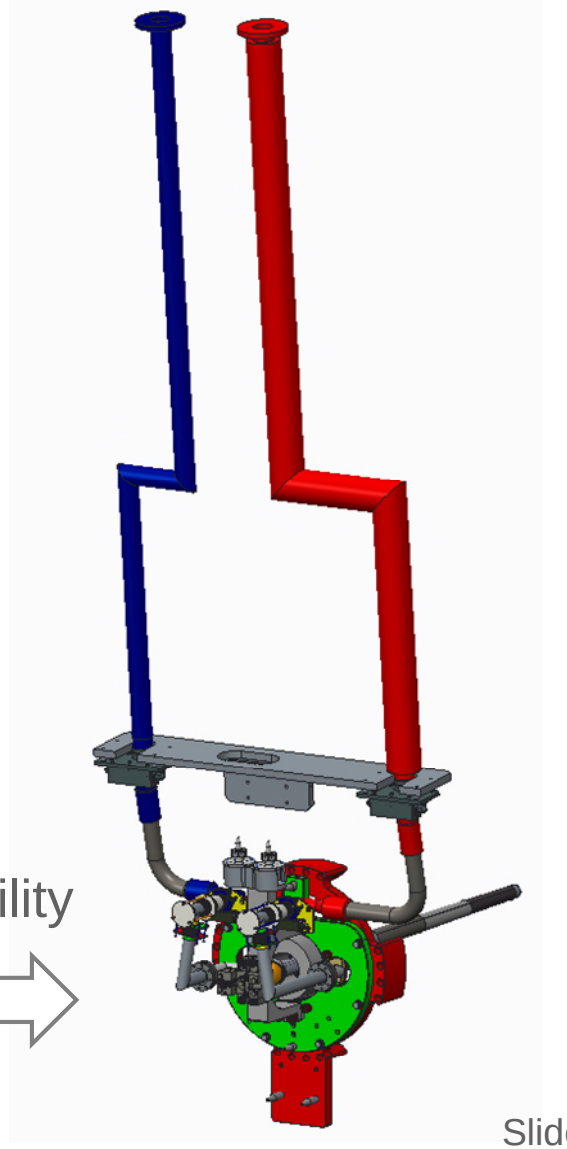
LBNF Target and Associated Equipment:
Project Phases





Definition of US/UK Scope

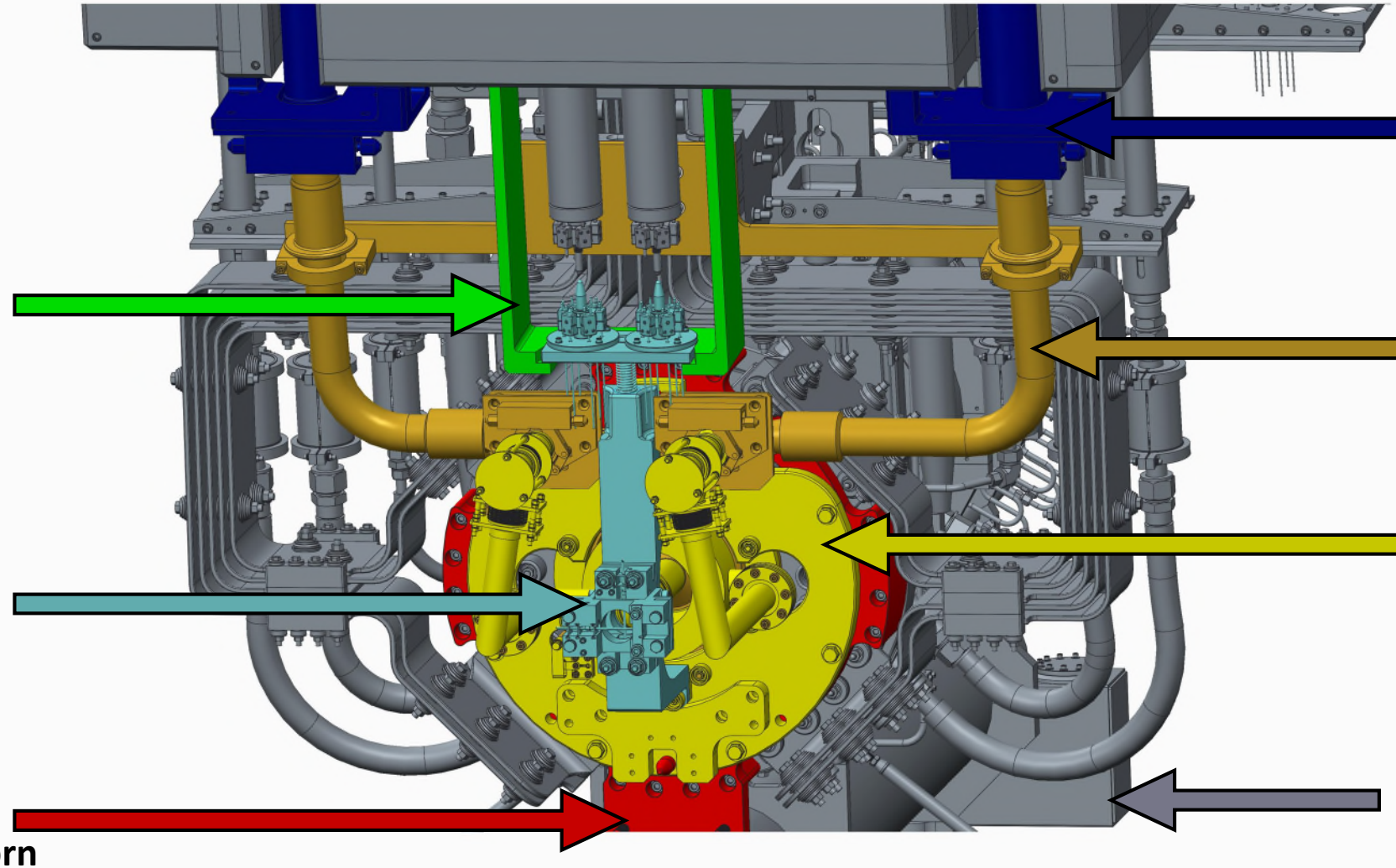
- Many interfaces to take care of
  - Between UK Workpackages
  - UK/US
  - Between LBNF Neutrino Beamline WBS elements (Targetry, Horns, Remote Handling, …)



US responsibility ⇐

⇒ UK responsibility

UK project interfaces - functional subassemblies



Helium assembly

Instrument connection bracket

Target Helium Lines
Removed when exchanging a horn

Target Module
Removed when exchanging a target, Removed when exchanging a horn

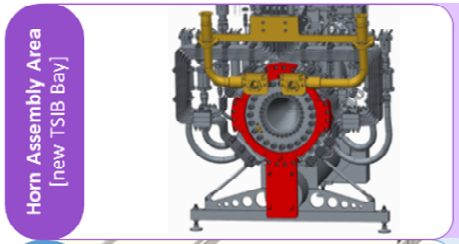
Target Position Thermometer Device

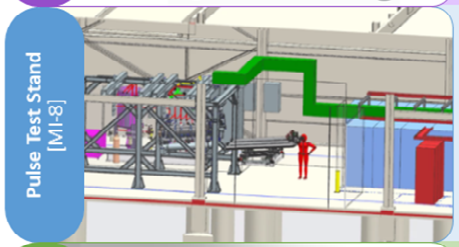
Not part of UK contribution

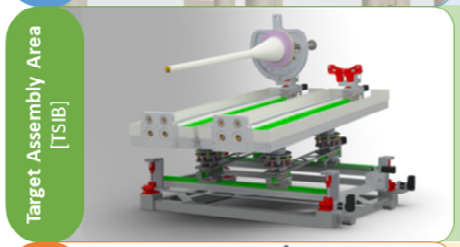
Target docking plate – part of horn

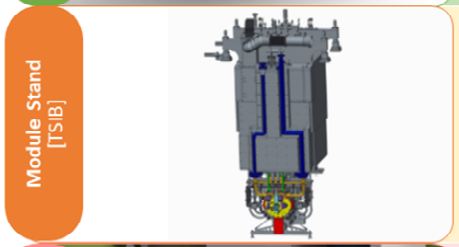
UKRI Sc Te Fa

Targetry Integration Scheme across 5 locations at Fermilab







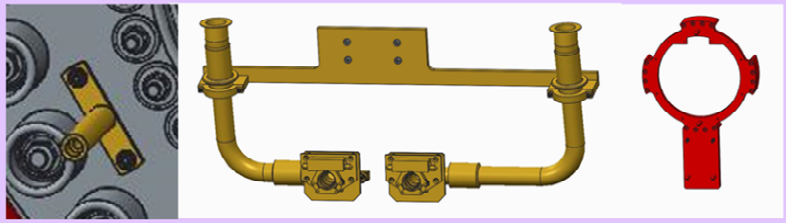


Integrate target supports with prototype horn

Target Supports
- Assemble / align 'red-plate' to horn
- Assemble electrical pin to horn
- Attach He line staging bracket to pull-up block
- Assemble horn-mounted helium pipes

Integrate target supports with production horn

Target Supports
- Assemble / align 'red-plate' to horn
- Assemble electrical pin to horn
- Attach He line staging bracket to pull-up block
- Assemble horn-mounted helium pipes



Prototype Horn electrical test (no target)
- pulse test
- Field mapping
- etc...

Prototype Target

Prototype Horn electrical test with prototype target installed
- Integrate TXS with Horn
- TXS trials with dummy-target
- Install 'real' target into horn
- Horn pulse test (with target)
- Remove target from horn

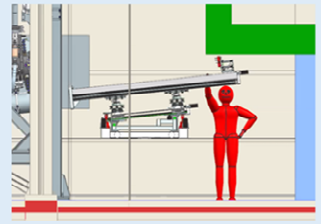
Target/Horn pulse test- on critical path

Production Horn electrical test (no target)
- pulse test
- Field maping
- etc...

Production Target

Production Horn electrical test with production target installed
- Integrate TXS with Horn
- TXS trials with dummy-target
- Install 'real' target into horn
- Horn pulse test (with target)
- Remove target from horn

Target/Horn pulse test- on critical path



TXS

Setup TXS (no horn)
- Commission TXS for manual functional operation

Hylen Device

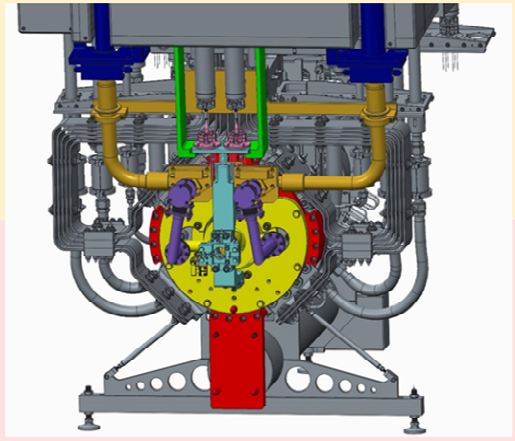
Integrate Hylen Device
- Install Be rods in TPT
- Reference alignment

Manipu-lators

Remote handling practice
- Exchanger lessons learned and fine tuning
- Remote handling trials using motor drives and manipulators

Hylen Device

Integrate Hylen Device
- Install Be rods in TPT
- Reference alignment



Helium Lines

Module Integration
- Helium lines assembled to TUB
- Instrumentation connection bracket attached to TUB
- Remote handling trials using motor drives and manipulators

TIME

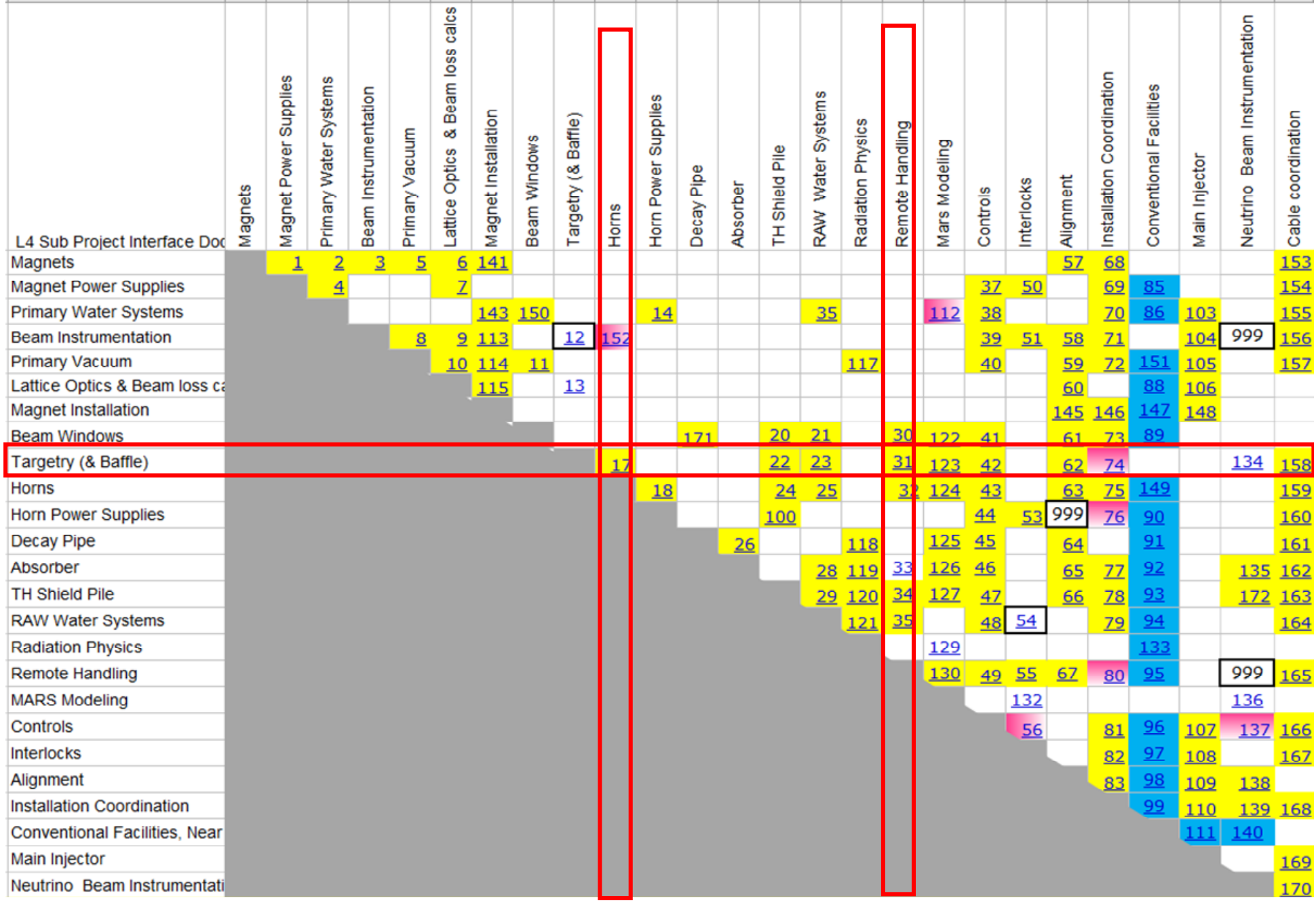
Practice in real workcell - on critical path

Setup in target station
- Install & commission TXS in real workcell
- Operating target installed

LBNF Operation Phase
- Replace a target
- Replace a horn
- Replace a helium line...

Beamline Interface Matrix Chart

Documents interfaces between the LBNF beamline WBS elements via a numbered Interface Control Document (ICD) for each individual interface



L4 Sub Project Interface Doc	Magnets	Magnet Power Supplies	Primary Water Systems	Beam Instrumentation	Primary Vacuum	Lattice Optics & Beam loss calcs	Magnet Installation	Beam Windows	Targetry (& Baffle)	Horns	Horn Power Supplies	Decay Pipe	Absorber	TH Shield Pile	RAW Water Systems	Radiation Physics	Remote Handling	Mars Modeling	Controls	Interlocks	Alignment	Installation Coordination	Conventional Facilities	Main Injector	Neutrino Beam Instrumentation	Cable coordination
Magnets		1	2	3	5	6	141														57	68				153
Magnet Power Supplies			4			7													37	50		69	85			154
Primary Water Systems							143	150			14				35			112	38			70	86	103		155
Beam Instrumentation					8	9	113		12	152									39	51	58	71		104	999	156
Primary Vacuum						10	114	11								117			40		59	72	151	105		157
Lattice Optics & Beam loss ca							115		13												60		88	106		
Magnet Installation																					145	146	147	148		
Beam Windows												171		20	21		30	122	41		61	73	89			
Targetry (& Baffle)										17				22	23		31	123	42		62	74			134	158
Horns											18			24	25		32	124	43		63	75	149			159
Horn Power Supplies														100					44	53	999	76	90			160
Decay Pipe													26			118		125	45		64		91			161
Absorber															28	119	33	126	46		65	77	92		135	162
TH Shield Pile															29	120	34	127	47		66	78	93		172	163
RAW Water Systems																121	35		48	54		79	94			164
Radiation Physics																		129					133			
Remote Handling																		130	49	55	67	80	95		999	165
MARS Modeling																				132					136	
Controls																				56		81	96	107	137	166
Interlocks																						82	97	108		167
Alignment																						83	98	109	138	
Installation Coordination																							99	110	139	168
Conventional Facilities, Near																								111	140	
Main Injector																										169
Neutrino Beam Instrumentati																										170

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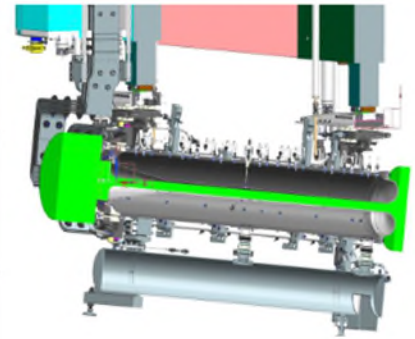
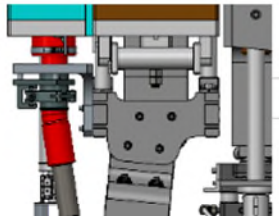
Interface Control Documents ❑ ICD17 between target (RAL) and horns (Fermilab)

Targetry-Horns Interface Table for ICD

Interface Type	Interface Category	Interface Title	Targetry WBS (FNAL) Provides	Targetry WBS (RAL) Provides	Horns WBS Provides	Specification/Parameters	Comments	Integration Model Screenshots
Boundary	Mechanical	CAD Integration - Target / Horn A / TUB / Horn A Module / Target Exchanger	Coordination and maintenance of this CAD interface including establishment of mutually agreed to Design Envelope Volumes (DEVs)	CAD model of target assembly and all associated RAL designed / specified / provided equipment components with agreed to Design Envelope Volumes (DEVs) for undefined design elements	CAD model of Horn A, TUB, and Horn A Module assemblies and all associated Horns designed / specified / provided equipment components with agreed to Design Envelope Volumes (DEVs) for undefined design elements	Master CAD model integrating RAL provided targetry with Horn A and other LBNF beamline systems will be held and maintained at Fermilab. As designs evolve, it is expected that the Design Envelope Volumes collapse to the mutual integrated CAD model geometry	Example screenshot of model with DEV	
Boundary	Mechanical	CAD Integration - Baffle/Carrier <-> Baffle Module	Coordination and maintenance of this CAD interface including establishment of mutually agreed to Design Envelope Volumes (DEVs)	CAD model of baffle/carrier assembly and all associated RAL designed / specified / provided equipment components with agreed to Design Envelope Volumes (DEVs) for undefined design elements	CAD model of Baffle Module assemblies and all associated Horns designed / specified / provided equipment components with agreed to Design Envelope Volumes (DEVs) for undefined design elements	Master CAD model integrating RAL provided targetry with Horn A and other LBNF beamline systems will be held and maintained at Fermilab. As designs evolve, it is expected that the Design Envelope Volumes collapse to the mutual integrated CAD model geometry		
Boundary	Mechanical	Bolted Connection Interfaces	Where ever a bolted connection interface occurs (e.g. target support bracket to Horn A OC flange), the owner of the bolted part provides bolt size, pattern and location specification and bolting hardware. The owner of the mating part provides the tapped holes (or other required mating features) to specification. Interferences will be worked out using the Master CAD model by mutual agreement during design. This also includes Baffle/Carrier <-> Baffle Module Interfaces	Where ever a bolted connection interface occurs (e.g. target support bracket to Horn A OC flange), the owner of the bolted part provides bolt size, pattern and location specification and bolting hardware. The owner of the mating part provides the tapped holes (or other required mating features) to specification. Interferences will be worked out using the Master CAD model by mutual agreement during design. This also includes Baffle/Carrier <-> Baffle Module Interfaces	Where ever a bolted connection interface occurs (e.g. target support bracket to Horn A OC flange), the owner of the bolted part provides bolt size, pattern and location specification and bolting hardware. The owner of the mating part provides the tapped holes (or other required mating features) to specification. Interferences will be worked out using the Master CAD model by mutual agreement during design. This also inclu… Baffle/Carrier <-> Baffle Module Interfac…	Master CAD model integrating RAL provided targetry with Horn A and other	General dependancy/boundary -- Screenshot …et Support "red plate" to OC flange …tion?	
Boundary	M…				…ncluding US Horn A C… …lso provided … …ar alignment to Horn … …shall be capable of … …t tolerance specification.		…shot of Target Support "red plate" to OC …lange connection?	
Requirement	M…				…impact on structural	1. Design Parameters & Specif… WBS1 and WBS2 -- LBNF Be…		
Requirement	E…				…equirements (ie dielectric …ir paths, etc) including …fication	1. Design Parameters & Spec… WBS1 and WBS2 -- LBNF Be… SharePoint		
Boundary	Mec…				…Horn A to accept …	Required features will be documented in …	Could add drawings or specification/description once designed	
		Target Position Thermometer Device	Requirements for Targe Position Thermometer (Be rod size, spacing, etc); Be rods, attached thermo-couples, TC wire, and rad-hard TC end	Target Position Thermometer device and mounting to Target face, not including Be rods and attached thermocouples. Drawings and specifications for Be rods for FNAL	Instrumentation Line sets fo… wires including wire and rad-hard T… connectors. Features on Horn A LE… A, STRIPLINE PULLUP FRONT PL… F10123529 for mounting TC conne…			

Interface Matrix

Interface Control Document

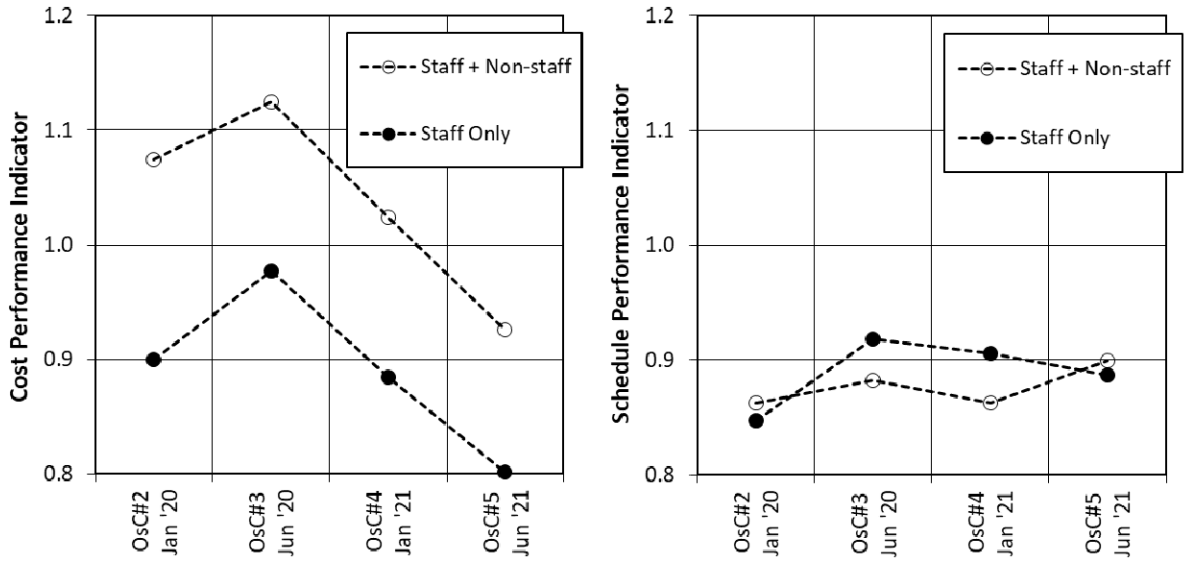
Beamline Parameters and Specifications

LBNF Beamline Requirements

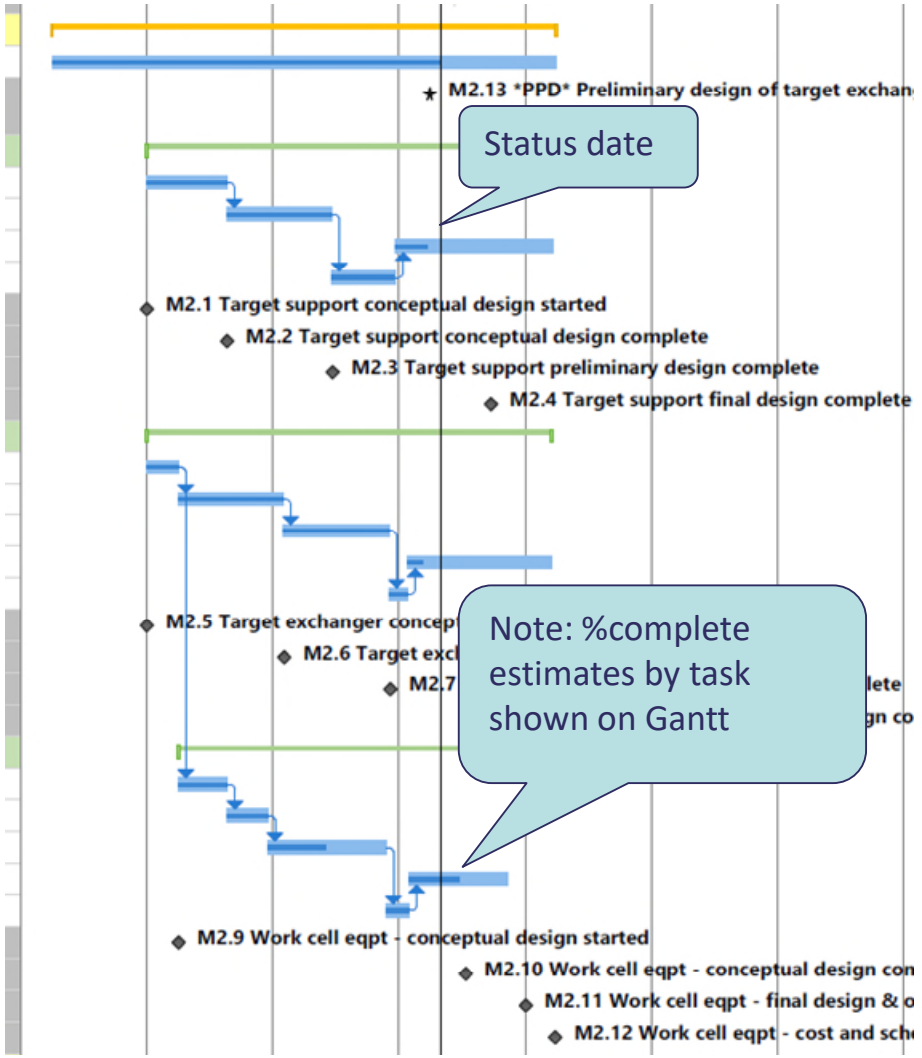
Target Alignment Tolerance Budget

LBNF-UK Target Project - Earned-Value Assessment

- In the Phase-1 (design phase) project we have implemented an earned-value tracking process using a resource-loaded gantt
- Has proved to be a useful project monitoring tool, e.g. to inform on COVID impacts
- Intend to take this forward into phase-2 project



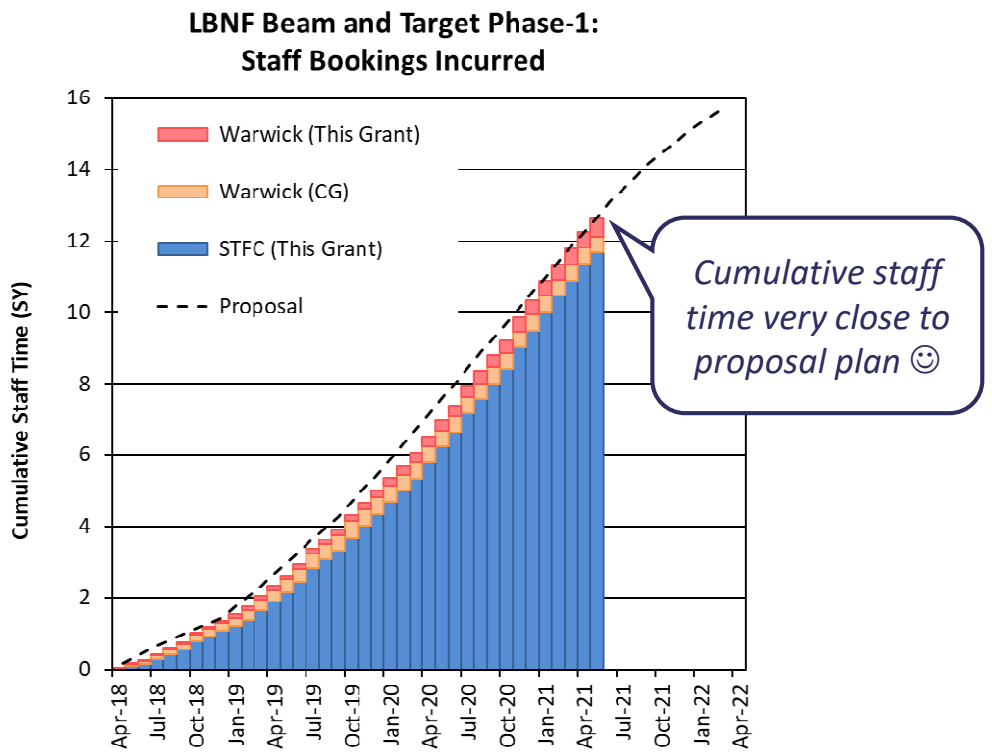
Example earned-value data from phase-1 project

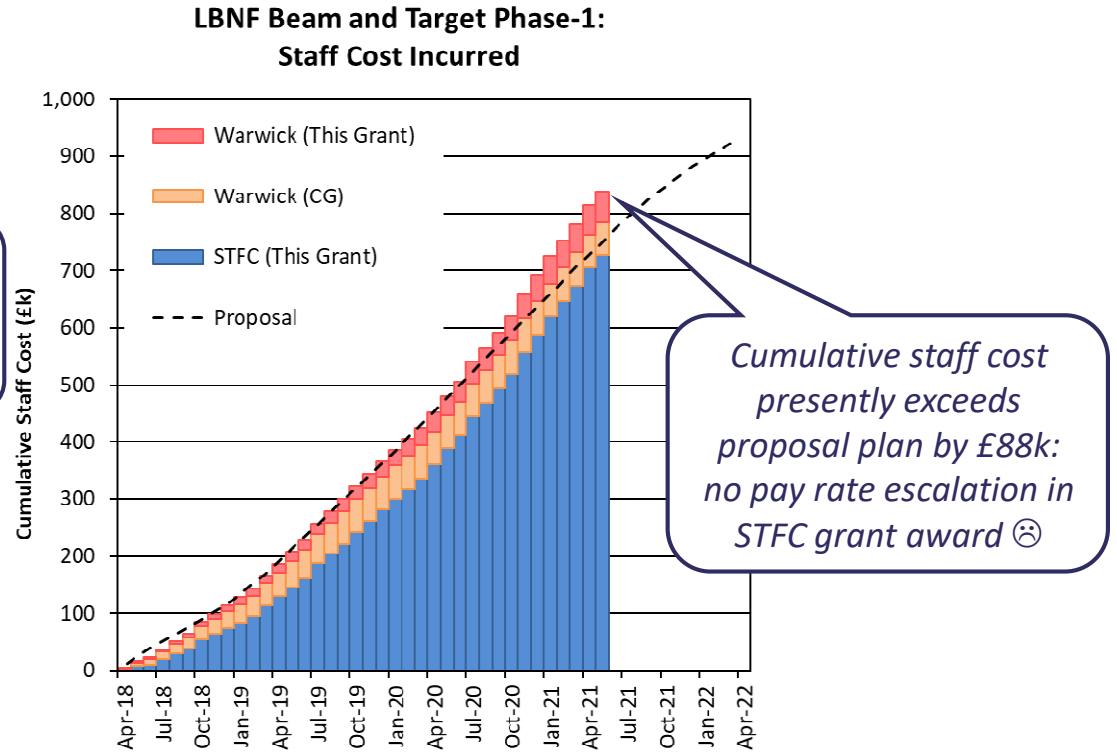


A screenshot from the phase-1 gantt

LBNF Target: Staff Budget and Spend

- Costs in this phase-1 project are dominated by staff resource
- PM tracking monthly staff bookings and staff cost against the funded profile
- We project a staff overspend of £166k at end of March 2022 (but is within approved sum)





Extract from UK LBNF/DUNE Project Board Report

Authored, owned and approved by C. Townsley

Submitted to PB 3rd March 2021, provided to sub-projects 20th April (7 weeks later!)

"For the Targets sub-project an **unfortunate compromise** has been reached for the remainder of phase 1 whereby their PRC will be modified slightly report (with help from the PRC secretary) to be more quantitative. This was deemed a necessary compromise since the sub-project uses the PRC report as their central management tool in-between OsC meetings, rather than the requested issues/risk logs and schedule. **However this near-term management approach will not be adequate for the larger phase 2.** Our request to increase the frequency of catch-ups to fortnightly has been supported by the Oversight Committee.

"The root-cause of these communication problems is that the engineering sub-projects consider themselves to be standalone projects and do not yet fully see the benefit for them in a unified project approach. As a result they sometimes find it difficult to engage with the change control process and centralised management. Overcoming this has sucked a lot of energy from the project which would otherwise lead to beneficial improvements and reduce overall risk.

"We appreciate the help from Programmes Directorate in ensuring that the change control process cannot be bypassed; and in reminding the project participants that the process covers many aspects of project control beyond merely access to working allowance."

Feedback from UK OsC received on 3rd March 2021

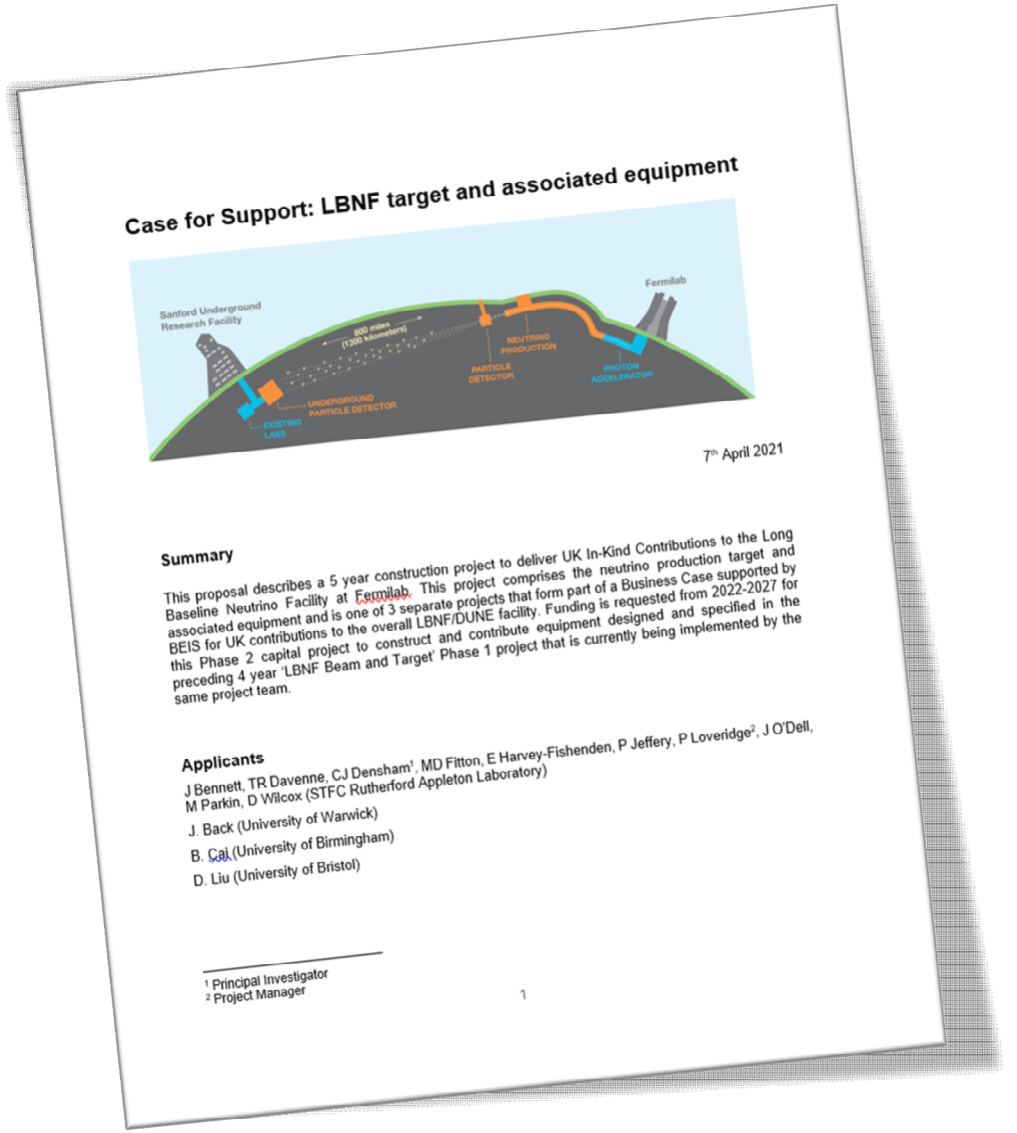
‘The OsC expressed concern that **PPRP would be likely to reject the Phase-II proposal** without clear evidence of additional resource request to increase the project management and reporting activity, particularly given its stronger emphasis on project management in recent years. Consequently, the OsC recommended that the collaboration consider the possibility of delaying the initially proposed April PPRP date to allow time for the above procedures to take place…’

- In our defence:
  - PM & PI effort allocation awarded via PPRP for Phase 1 project (2018 - 2022)
  - We had followed 2015/2016 PPRP instructions to *reduce* requested PI/PM effort from 40% FTE to 15% FTE
    - November 2015: full proposal for ‘LBNF/DUNE Beam and Target System’ submitted, defended, descoped, re-submitted through PPRP & VP and ***draft approval received***
    - October 2018: informed ‘proposal does not fall within the remit or the rules of the scheme’
  - STFC Programmes declined our request for additional PM support for Phase 1 project from £5M resource allocation from BEIS
  - We are managing project according to our PMP approved by the OsC
- We considered invitation to delay (would require 6 months bridge funding)
  - Increased allocations: PI 15% to 40%, PM 10% to 40% and additional 10% project support
  - Deliverables meet approved project scope within £6M budget allocation
  - Submitted Phase 2 proposal to expedited schedule (3 weeks from date of instruction by OsC)

Phase 2 Project Proposal Submission

- PPRP received 5 independent Peer Reviews – all highly supportive
- + Feedback from PPRP ‘Project Management and Delivery Review’ (received 9th June)

‘*The collaboration should be congratulated on this well presented and detailed submission. From the proposal it is clear that the team are in a world leading position in regards to accelerator target design and build, and that providing significant contributions to both LBNF and HyperK reinforces this. The Case for Support provides a comprehensive project management section giving a high degree of confidence in the leadership and management team in WP0.’*



Case for Support: LBNF target and associated equipment

7th April 2021

Summary

This proposal describes a 5 year construction project to deliver UK In-Kind Contributions to the Long Baseline Neutrino Facility at Fermilab. This project comprises the neutrino production target and associated equipment and is one of 3 separate projects that form part of a Business Case supported by BEIS for UK contributions to the overall LBNF/DUNE facility. Funding is requested from 2022-2027 for this Phase 2 capital project to construct and contribute equipment designed and specified in the preceding 4 year ‘LBNF Beam and Target’ Phase 1 project that is currently being implemented by the same project team.

Applicants

J Bennett, TR Davenne, CJ Densham[1], MD Fitton, E Harvey-Fishenden, P Jeffery, P Loveridge[2], J O'Dell, M Parkin, D Wilcox (STFC Rutherford Appleton Laboratory)

J. Back (University of Warwick)

B. Cai (University of Birmingham)

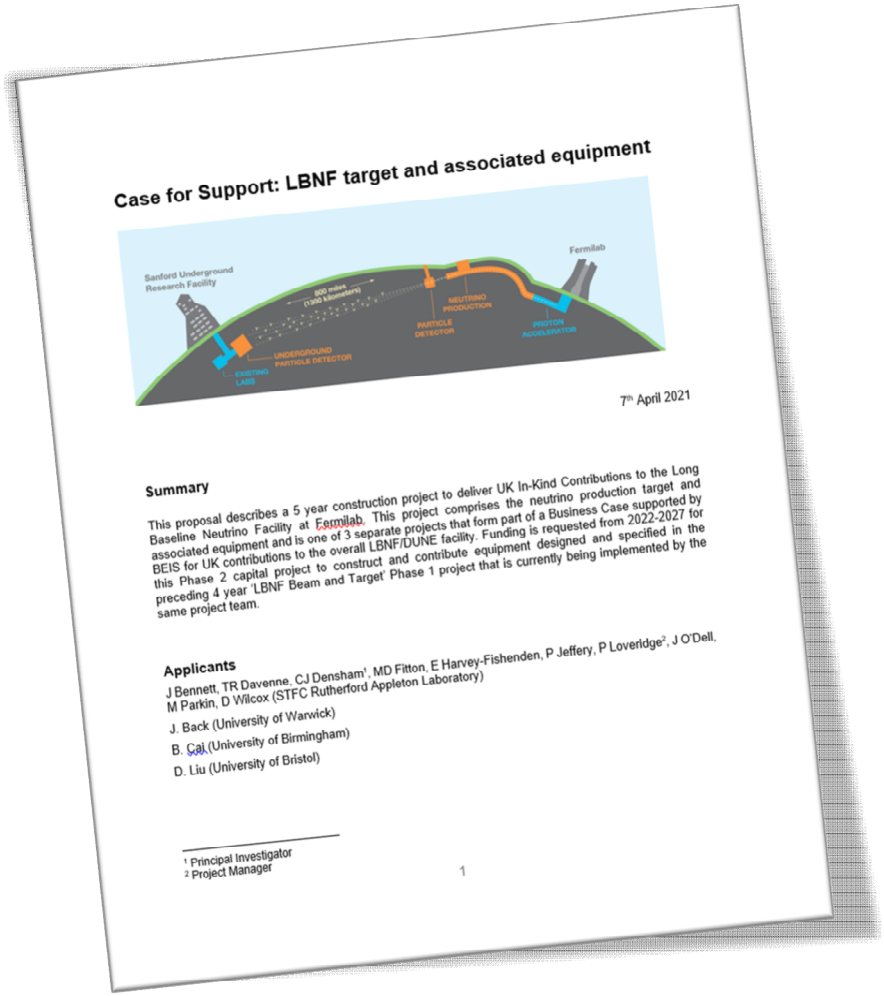
D. Liu (University of Bristol)

[1] Principal Investigator
[2] Project Manager

1

Phase 2 Project Proposal Timeline

- 24th March: pre-submitted to LBNF/DUNE PI and PM as required by OsC (with 3 weeks notice)
- 7th April: submitted to PPRP via Je-S
- 8th July: PI + PM presentation to PPRP
- 12th August: feedback received from PPRP
  - **20 questions to answer by project team**
- **14th October: Visiting Panel**
- **Late October?: Science Board**



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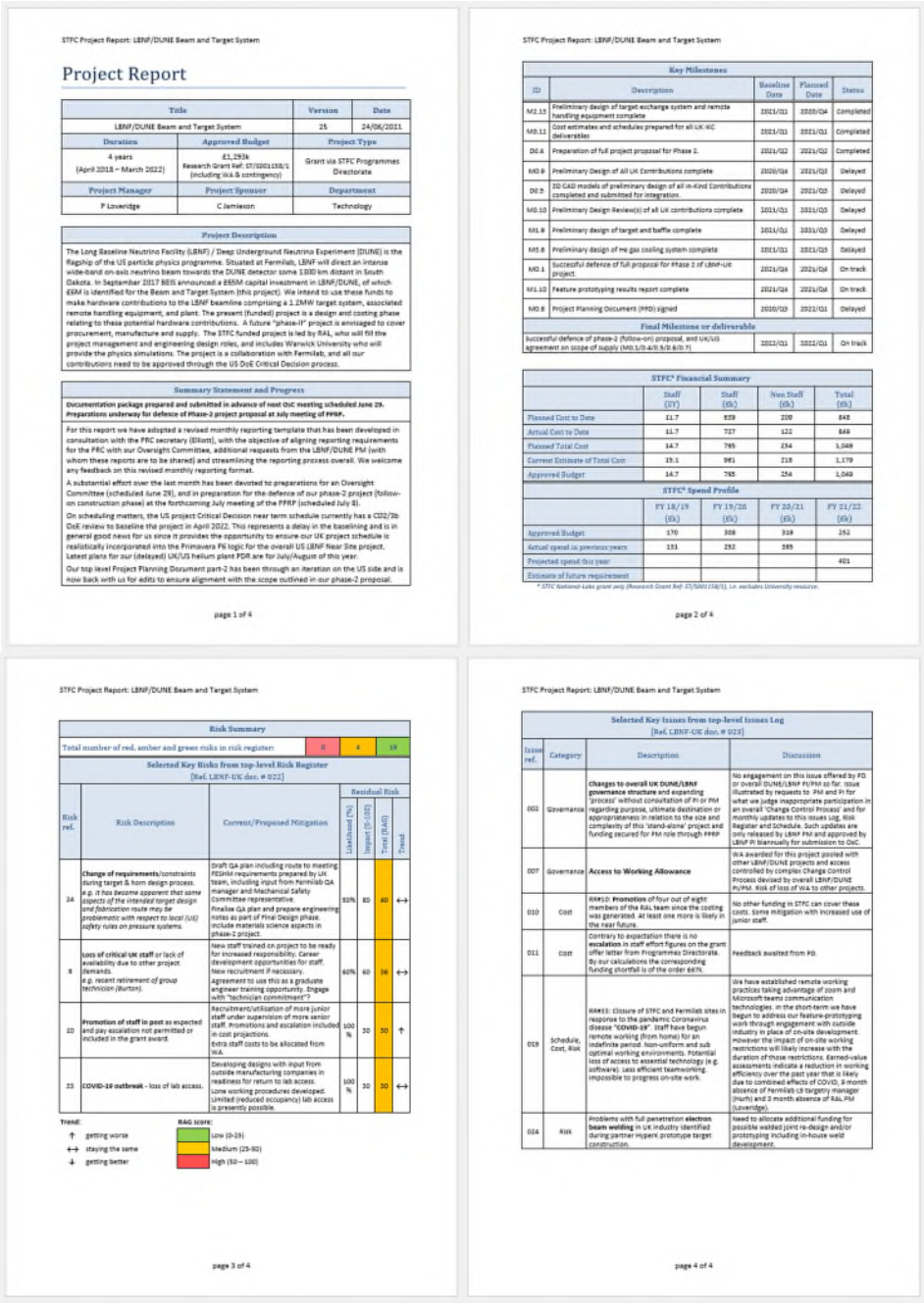
Questions?

Monthly Reporting

- An updated (improved?) monthly reporting format has been developed with the objective of aligning reporting requirements for the PRC with this Oversight Committee, additional requests from the LBNF/DUNE PM and streamlining the reporting process overall.
- Next report presently in draft (right)
  - Narrative on progress since last report
  - Key milestones with dates
  - Financial summary (data from ORACLE OBI)
  - Key risks from top-level RR (amber or red)
  - Narrative on key issues from top-level issues log



STFC Project Report: LBNF/DUNE Beam and Target System

Project Report

Title	Version	Date
LBNF/DUNE Beam and Target System	25	24/06/2021

Duration	Approved Budget	Project Type
4 years (April 2018 – March 2022)	£1,293k Research Grant Ref: ST/S001158/1 (including VAT & contingency)	Grant via STFC Programmes Directorate

Project Manager	Project Sponsor	Department
P Loveridge	C Jamieson	Technology

Project Description

The Long Baseline Neutrino Facility (LBNF) / Deep Underground Neutrino Experiment (DUNE) is the flagship of the US particle physics programme. Situated at Fermilab, LBNF will direct an intense wide-band on-axis neutrino beam towards the DUNE detector some 1300 km distant in South Dakota. In September 2017 BEIS announced a £65M capital investment in LBNF/DUNE, of which £6M is identified for the Beam and Target System (this project). We intend to use these funds to make hardware contributions to the LBNF beamline comprising a 1.2MW target system, associated remote handling equipment, and plant. The present (funded) project is a design and costing phase relating to these potential hardware contributions. A future "phase-II" project is envisaged to cover procurement, manufacture and supply. The STFC funded project is led by RAL, who will fill the project management and engineering design roles, and includes Warwick University who will provide the physics simulations. The project is a collaboration with Fermilab, and all our contributions need to be approved through the US DoE Critical Decision process.

Summary Statement and Progress

Documentation package prepared and submitted in advance of next OsC meeting scheduled June 29. Preparations underway for defence of Phase-2 project proposal at July meeting of PPRP.

For this report we have adopted a revised monthly reporting template that has been developed in consultation with the PRC secretary (Elliott), with the objective of aligning reporting requirements for the PRC with our Oversight Committee, additional requests from the LBNF/DUNE PM (with whom these reports are to be shared) and streamlining the reporting process overall. We welcome any feedback on this revised monthly reporting format.

A substantial effort over the last month has been devoted to preparations for an Oversight Committee (scheduled June 29), and in preparation for the defence of our phase-2 project (follow-on construction phase) at the forthcoming July meeting of the PPRP (scheduled July 6).

On scheduling matters, the US project Critical Decision near term schedule currently has a CD2/3b DoE review to baseline the project in April 2022. This represents a delay in the baselining and is in general good news for us since it provides the opportunity to ensure our UK project schedule is realistically incorporated into the Primavera P6 logic for the overall US LBNF Near Site project. Latest plans for our (delayed) UK/US helium plant PDR are for July/August of this year.

Our top level Project Planning Document part-2 has been through an iteration on the US side and is now back with us for edits to ensure alignment with the scope outlined in our phase-2 proposal.

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STFC Project Report: LBNF/DUNE Beam and Target System

Key Milestones

ID	Description	Baseline Date	Planned Date	Status
M2.15	Preliminary design of target exchange system and remote handling equipment complete	2021/Q1	2020/Q4	Completed
M3.11	Cost estimates and schedules prepared for all UK-IKC deliverables	2021/Q1	2021/Q1	Completed
D2.6	Preparation of full project proposal for Phase 2.	2021/Q2	2021/Q2	Completed
M3.9	Preliminary Design of All UK Contributions complete	2020/Q4	2021/Q3	Delayed
D2.5	2D CAD models of preliminary design of all in-Kind Contributions completed and submitted for integration.	2020/Q4	2021/Q3	Delayed
M2.10	Preliminary Design Review(s) of all UK contributions complete	2021/Q1	2021/Q3	Delayed
M1.8	Preliminary design of target and baffle complete	2021/Q1	2021/Q3	Delayed
M5.8	Preliminary design of He gas cooling system complete	2021/Q1	2021/Q3	Delayed
M3.1	Successful defence of full proposal for Phase 2 of LBNF-UK project.	2021/Q4	2021/Q4	On track
M1.10	Feature prototyping results report complete	2021/Q4	2021/Q4	On track
M3.8	Project Planning Document (PPD) signed	2020/Q3	2022/Q1	Delayed

Final Milestone or deliverable

Successful defence of phase-2 (follow-on) proposal, and UK/US agreement on scope of supply (M3.1/3-4/5.9/8.7)	2022/Q1	2022/Q1	On track

STFC* Financial Summary

	Staff (£Y)	Staff (£k)	Non Staff (£k)	Total (£k)
Planned Cost to Date	11.7	629	209	848
Actual Cost to Date	11.7	727	122	849
Planned Total Cost	14.7	795	254	1,049
Current Estimate of Total Cost	15.1	961	218	1,179
Approved Budget	14.7	795	254	1,049

STFC* Spend Profile

	FY 18/19 (£k)	FY 19/20 (£k)	FY 20/21 (£k)	FY 21/22 (£k)
Approved Budget	170	308	319	252
Actual spend in previous years	151	252	385	
Projected spend this year				401
Estimate of future requirement				

* STFC National rolex grant only (Research Grant Ref: ST/S001158/1), i.e. excludes University resource.

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Risk Summary

Total number of red, amber and green risks in risk register	0	4	10

Selected Key Risks from top-level Risk Register
[Ref. LBNF-UK doc. # 922]

Risk ref.	Risk Description	Current/Proposed Mitigation	Residual Risk: Likelihood (%)	Impact (0-100)	Total (0-100)	Trend
24	**Change of requirements**/constraints during target & horn design process. *e.g. it has become apparent that some aspects of the intended target design and fabrication route may be problematic with respect to local (US) safety rules on pressure systems.*	Draft QA plan including route to meeting FESHM requirements prepared by UK team, including input from Fermilab QA manager and Mechanical Safety Committee representative. Finalise QA plan and prepare engineering notes as part of Final Design phase. Include materials science aspects in phase-2 project.	80%	80	40	↔
8	**Loss of critical UK staff** or lack of availability due to other project demands. *e.g. recent retirement of group technician (Burton).*	New staff trained on project to be ready for increased responsibility. Career development opportunities for staff. New recruitment if necessary. Agreement to use this as a graduate engineer training opportunity. Engage with "technician commitment"?	60%	60	36	↔
10	**Promotion of staff in post** as expected and pay escalation not permitted or included in the grant award.	Recruitment/utilisation of more junior staff under supervision of more senior staff. Promotions and escalation included in cost projections. Extra staff costs to be allocated from WA.	100 %	50	50	↑
33	**COVID-19 outbreak** - loss of lab access.	Developing designs with input from outside manufacturing companies in readiness for return to lab access. Some working procedures developed. Limited (reduced occupancy) lab access is presently possible.	100 %	50	50	↔

Trend: ↑ getting worse; ↔ staying the same; ↓ getting better

RAG score: Low (0-25); Medium (25-50); High (50 – 100)

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Selected Key Issues from top-level Issues Log
[Ref. LBNF-UK doc. # 923]

Issue ref.	Category	Description	Discussion
002	Governance	**Changes to overall UK DUNE/LBNF governance structure** and expanding "process" without consultation of PI or PM regarding purpose, ultimate destination or appropriateness in relation to the size and complexity of this 'stand-alone' project and funding secured for PM role through PPRP	No engagement on this issue offered by PD or overall DUNE/LBNF PI/PM so far. Issue illustrated by requests to PM and PI for what we judge inappropriate participation in an overall "Change Control Process" and for monthly updates to this issues Log, Risk Register and Schedule. Such updates are only released by LBNF PM and approved by LBNF PI biannually for submission to OsC.
007	Governance	**Access to Working Allowance**	WA awarded for this project pooled with other LBNF/DUNE projects and access controlled by complex Change Control Process devised by overall LBNF/DUNE PI/PM. Risk of loss of WA to other projects.
010	Cost	RR#10: **Promotion** of four out of eight members of the RAL team since the costing was generated. At least one more is likely in the near future.	No other funding in STFC can cover these costs. Some mitigation with increased use of junior staff.
011	Cost	Contrary to expectation there is no **escalation** in staff effort figures on the grant offer letter from Programmes Directorate. By our calculations the corresponding funding shortfall is of the order £67k.	Feedback awaited from PD.
019	Schedule, Cost, Risk	RR#13: Closure of STFC and Fermilab sites in response to the pandemic Coronavirus disease "COVID-19". Staff have begun remote working (from home) for an indefinite period. Non-uniform and sub optimal working environments. Potential loss of access to essential technology (e.g. software). Less efficient teamworking. Impossible to progress on-site work.	We have established remote working practices taking advantage of Zoom and Microsoft teams communication technologies. In the short-term we have begun to address our feature-prototyping work through engagement with outside industry in place of on-site development. However the impact of on-site working restrictions will likely increase with the duration of those restrictions. Earned-value assessments indicate a reduction in working efficiency over the past year that is likely due to combined effects of COVID, 9 month absence of Fermilab LB targetry manager (Hurh) and 3 month absence of RAL PM (Loveridge).
024	Risk	Problems with full penetration **electron beam welding** in UK industry identified during partner inspect prototype target construction.	Need to allocate additional funding for possible welded joint re-design and/or prototyping including in-house weld development.

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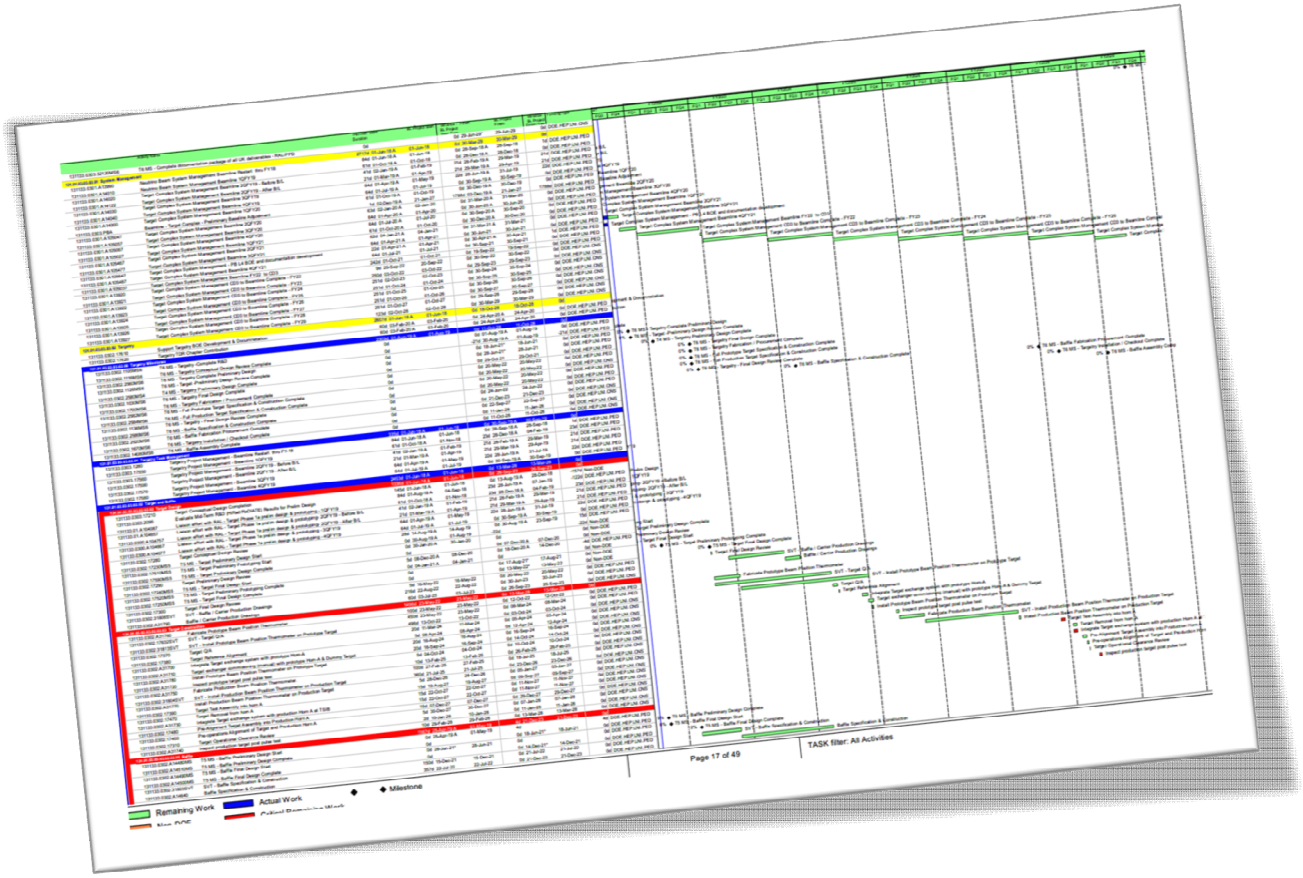
UK/US Schedule Integration

- Schedule revisions underway so that each major UK deliverable, milestone and task including duration is correctly integrated into the Primavera P6 logic for the US project.
- US funding approved for a Target Station Integration Building (TSIB) on Fermilab site.
  - will enable us to integrate our UK hardware contributions with the US supplied components and infrastructure before beneficial occupancy of the Target Station becomes available after the conclusion of the UK Phase 2 project
- Targetry hardware integration plans adjusted accordingly



LBNF Beamline Full Project Schedule Update (P6) screenshot (Updated monthly at DUNE doc-db-964)

…49 pages of gantt (tiny font!) in .pdf….