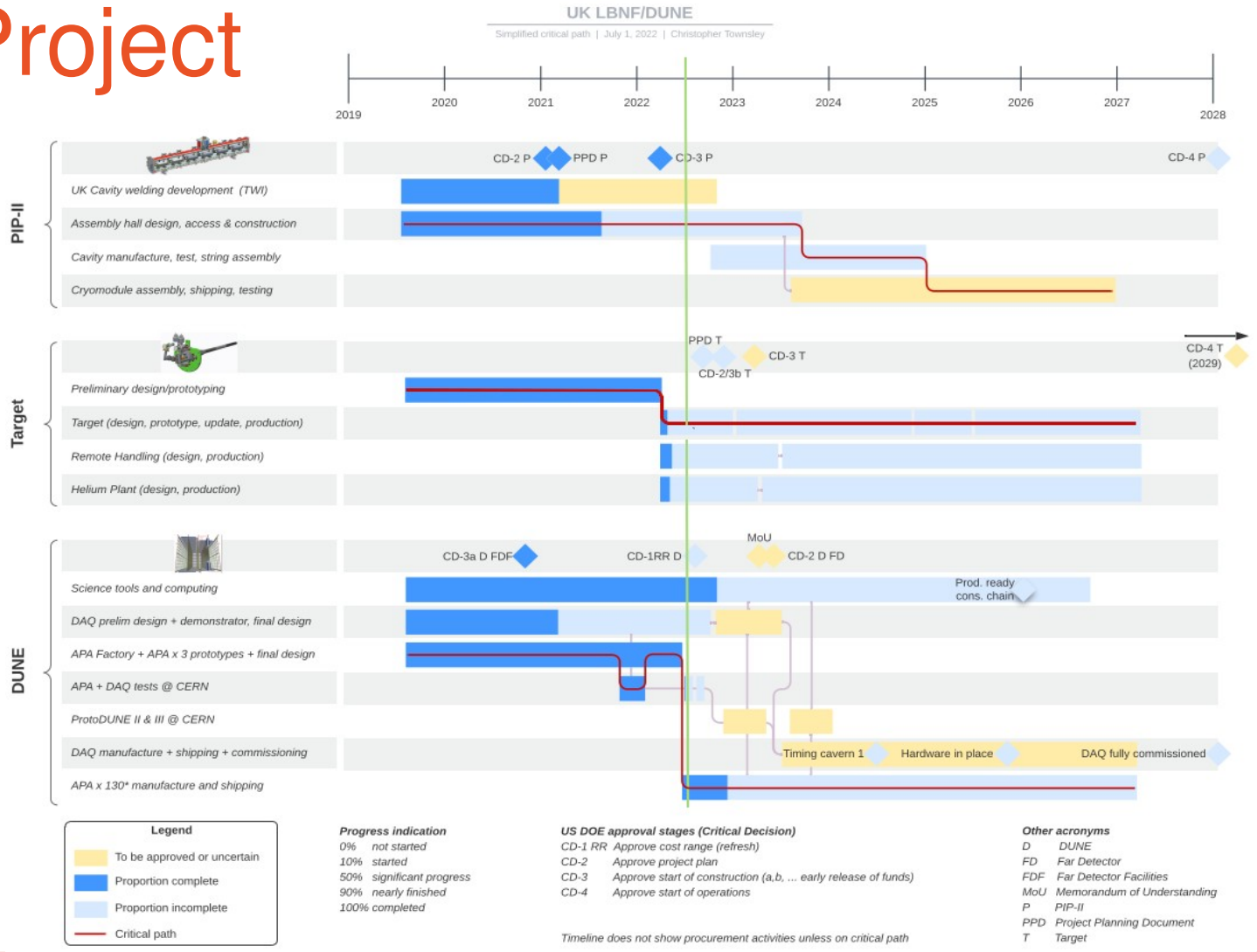
Project Status

Gary Barker

LBNF/DUNE UK Meeting, Lancaster
Jan 2023

UK Project


UK LBNF/DUNE
Simplified critical path | July 1, 2022 | Christopher Townsley
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
PIP-II
CD-2 P
PPD P
CD-3 P
CD-4 P
UK Cavity welding development (TWI)
Assembly hall design, access & construction
Cavity manufacture, test, string assembly
Cryomodule assembly, shipping, testing
Target
PPD T
CD-3 T
CD-2/3b T
CD-4 T (2029)
Preliminary design/prototyping
Target (design, prototype, update, production)
Remote Handling (design, production)
Helium Plant (design, production)
DUNE
MoU
CD-3a D FDF
CD-1RR D
CD-2 D FD
Prod. ready cons. chain
Science tools and computing
DAQ prelim design + demonstrator, final design
APA Factory + APA x 3 prototypes + final design
APA + DAQ tests @ CERN
ProtoDUNE II & III @ CERN
DAQ manufacture + shipping + commissioning
Timing cavern 1
Hardware in place
DAQ fully commissioned
APA x 130* manufacture and shipping
Legend
To be approved or uncertain
Proportion complete
Proportion incomplete
Critical path
Progress indication
0% not started
10% started
50% significant progress
90% nearly finished
100% completed
US DOE approval stages (Critical Decision)
CD-1 RR Approve cost range (refresh)
CD-2 Approve project plan
CD-3 Approve start of construction (a,b, ... early release of funds)
CD-4 Approve start of operations
Timeline does not show procurement activities unless on critical path
Other acronyms
D DUNE
FD Far Detector
FDF Far Detector Facilities
MoU Memorandum of Understanding
P PIP-II
PPD Project Planning Document
T Target

UK Project Status 1

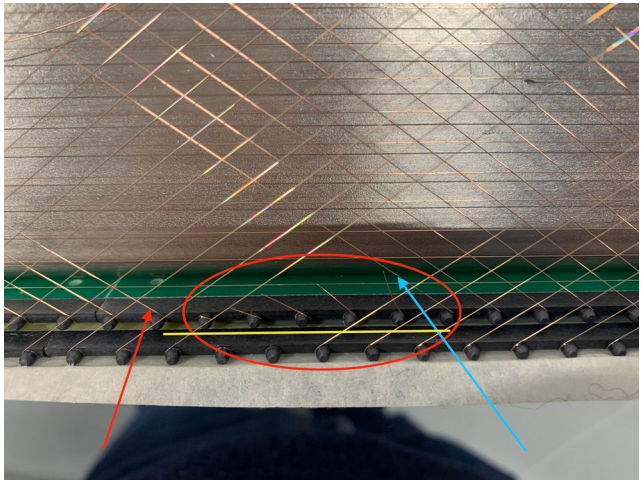
- Entering the period where the sub-projects must pass review to release funding to completion
- Target was organised as separate Phase1 and 2 projects and have already passed through a PPRP review last year releasing full funding for Phase 2 (April'22-March'27)
- PIP-II and DUNE have Mid-Term Reviews scheduled for Feb, these will check progress so far, scrutinise cost/schedule to completion and make recommendations to Project Board
- DUNE required to submit a Phase 2 proposal to PPRP. Review should have happened Oct'22 but will now take place Oct'23 (all documentation submitted by June, bridging funds to take us to a start date of March'24)

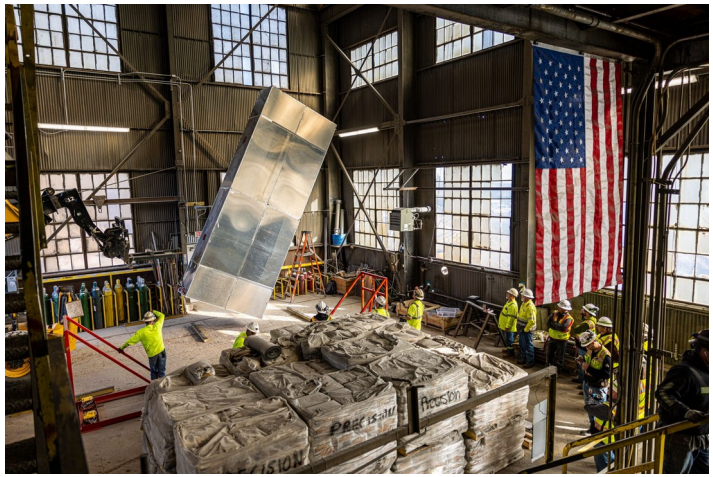
UK Project Status 2

- Project Board meeting in November made clear that strict financial pressures at STFC limits options to handle project underspends
- Delays to the international schedules mean spending profiles have been impossible to realise (for PIP-II and DUNE). Leaves us at risk of scope reduction. We are working to make prompt purchases where the risk to the project is low (e.g. purchasing transport frames for APAs through CERN)
- Delays, COVID, inflation mean we are also asking for significantly more money to completion for PIP-II and DUNE – will make the up-coming reviews particularly challenging

UK Project Status 3

- **Target** – Phase 2 construction project in full swing
- **PIP-II**: fast cool down testing promising/tender process for cavity producer completed/ termination of TWI UK cavity production development
- **DUNE** – further resource sharing changes with US APA project/DAQ readout baseline solution converging and change in UK leadership/impressive progress in software reconstruction/computing. Many challenges but also successes:





LBNF/DUNE International Project

	Subproj Abbrev	Subproject Title	Subproject Scope	Design Maturity	Proposed CD-2 IPR
FAR SITE	FSCF-EXC	Far Site Conventional Facilities - Excavation	All Far Site (FS) conventional facilities (CF) reliability, pre-excavation, and excavation including all detector caverns	**100%**	✓ Completed 12 Jan 2022
FAR SITE	FSCF-BSI	Far Site Conventional Facilities – Building & Site Infrastructure	All Far Site (FS) conventional facilities (CF) support infrastructure	**100%**	Scheduled 15 – 17 Nov 2022
FAR SITE	FDC	Far Detector 1, Far Detector 2 + Cryogenics	Far Detector 1 (FD1), Far Detector 2 (FD2), including integration/installation, and all cryogenic infrastructure (C) and LAr fluids.	83% (FD1) 71% (FD2) 63% (C)	Planned early 2023
NEAR SITE	NSCF+B	Near Site Conventional Facilities + Beamline	All Near Site (NS) conventional facilities (CF) including beamline facilities, detector cavern and support infrastructure; primary and neutrino beamline (B)	**100%** (CF) 65% (BL)	Planned late 2023
NEAR SITE	ND	Near Detector	Near Detector (ND) including integration/installation and cryogenic systems	30%	TBD 2023 to 2025

LBNF/DUNE

DUNE

International Funding Profile

- Successful CD-1RR held in July'22 which supported an increased point estimate and an accelerated funding profile

	Prior	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	Total
Reference Profile	772	180	180	200	225	250	250	250	250	250	250	74	**3,131**
CD-1RR Profile	772	184	180	255	305	305	305	305	275	245	0	0	**3,131**
Difference	0	4	0	55	80	55	55	55	25	-5	-250	-74	**0**

- Important to allow far-site excavation and infrastructure to proceed
- Next milestone is the baselining (CD-2) review for the Far Detectors and Cryogenics in spring'23

Memorandum of Understanding

- The CD-2 baselining process for the Far Detectors demands MOUs to be in place
- The MOU for FD-1 has been stuck with DOE for some time while the question of Russian institute involvement is addressed (INR Moscow have now been suspended but individuals can attach to other institutes e.g. JINR)
- Recent re-draft of both the FD-1 and FD-2 MOUs to make more explicit the international contributions

Common Fund

- Reserves to fund items/services not covered by MOU agreements in the Consortia
- Often set-up in large collaborations but has proven very difficult to establish for DUNE (many collaborators with weak funding support, participation of US institutes etc)
- New push to get this established (white paper):
  - PhD collaborator per-head charge
  - possibility of in-kind contributions
- Proposal will be made to RRB meeting in March with plan to start invoicing for payment in October
- Hoping for a net saving to the UK project

New DUNE Co-Spokesperson

- The Spokesperson election process ran in December to find a replacement for Gina Rameika (to join Sergio Bertolucci)
- Mary Bishai and Josh Klein were selected to stand for election

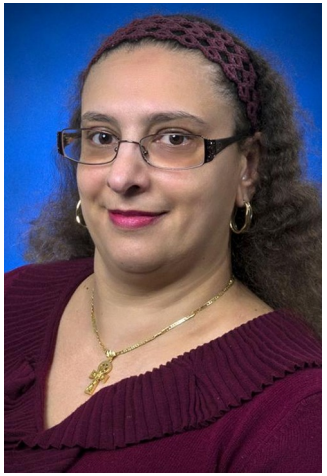
- Mary has been elected:

  -Senior Scientist at BNL

  -Involved with DUNE from the early days of LBNE

  -Instrumental in widening the physics programme e.g. nu_tau appearance and the implications for LBNF beam design

  -Has strong views on how to guide us through Phase 1 CD2/3 processes and into Phase 2



LBNF/DUNE: Two Phases

- DUNE Phase I (International Partners+LBNF/DUNE-US +PIP-II)
  - Two far detectors : 1 HD + 1 VD
  - Near detector = NDLAr + TMS + SAND + PRISM movement
  - 1.2 MW beam power
- DUNE Phase II
  - Additional mass at Far Detector (module 3 + 4)
  - A More Capable Near Detector e.g ND-GAr could replaceTMS
  - Increased beam power (up to 2.4 MW) provided by Booster replacement and upgrade to current complex

DUNE and Snowmass

- Series of meetings/process to define the scope of US particle physics – updated every ~10 years
- Makes recommendations to Particle Physics Project Prioritisation Panel (P5) which ranks projects for the Dept. of Energy and National Science Foundation
- Strong endorsement from the 2014 P5 was the start of the LBNF/DUNE programme and the start of the international collaboration with FNAL as host lab

Snowmass Recommendations

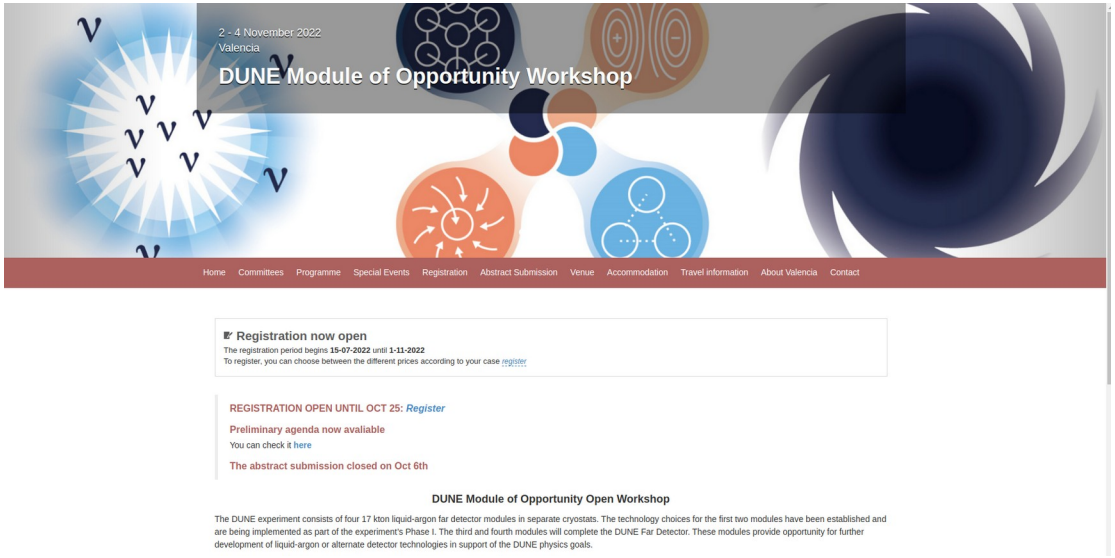
From, Neutrino Frontier Report Executive Summary:

There has been tremendous progress on oscillation physics with the current experiments and the DUNE/LBNF program since the last P5. However, the primary questions about the three-flavor paradigm remain unanswered, and the motivations for answering them, and probing new physics beyond the three-flavor paradigm, are undiminished. **Completion of existing experiments and execution of DUNE in its full scope are critical for addressing the NF science drivers**. Both Phase I and Phase II are part of the original DUNE design endorsed by the last P5. DUNE Phase I will be built in the current decade and DUNE Phase II (2 additional FD modules, more capable ND, and use of the 2.4 MW beam power from the FNAL accelerator upgrade) is the priority for the 2030s.

Existing technologies enable the original DUNE physics program for both Phase I and Phase II. However each piece of DUNE Phase II offers broader physics opportunities than originally envisioned. **To exploit these new opportunities, directed R&D needs to be supported.** These opportunities for DUNE Phase II should be explored with a process inclusive of the community at large.

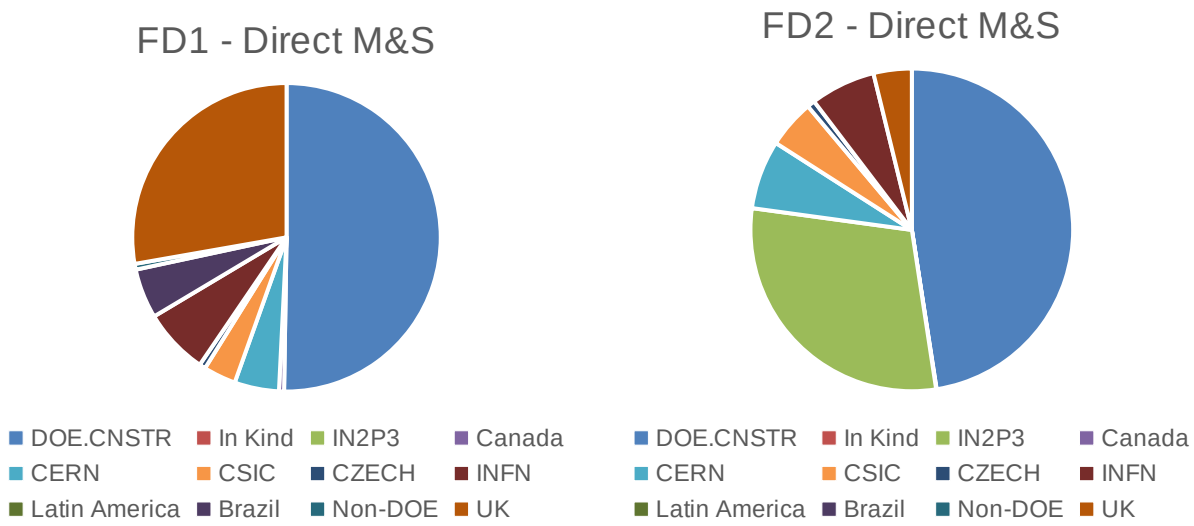
Towards Phase 2

- Creation of new DUNE Phase-II working group coordinated by Stefan Soldner-Rembold (with Michel Sorel as deputy)
- Will coordinate the assessment of the baseline Phase-II detectors, the physics reach and review the R&D needed – owned by DUNE but open to the community
- The recent Valencia workshop has kept the momentum up and had quite some UK interest/participation



Institute Activity Update 2022

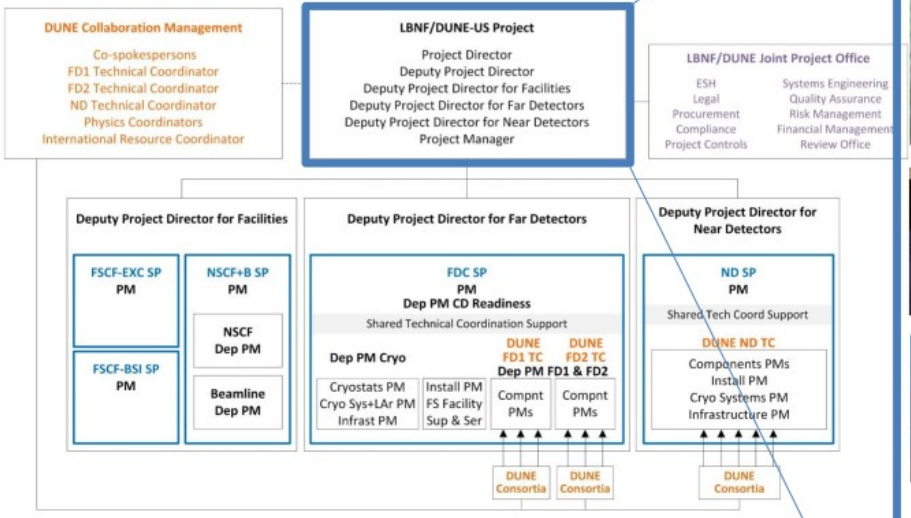
- The annual update period of the DUNE DB is about to open (Jan-March)
- IB-Reps are responsible but everyone should check that their contributions are being accurately recorded



Conclusions

- Significant challenges ahead of us
- We must continue to make progress towards delivering this project as close as we can to our nominal budget
- De-scoping of our main deliverables e.g. target, PIP-II cryomodules, APAs, DAQ, is not an option
- Impressive progress is being made as we will hear in this meeting
- Important to also cement our role in the collaboration so let's take advantage of publicising our contributions at the CERN collaboration meeting in 2 weeks

LBNF/DUNE Management Tree



LBNF/DUNE-US Deputy Project Director – **Ron Ray**

Leader of Mu2e project since inception

NOvA Deputy Project Manager through CD-2

Deputy Project Director for Facilities – **Mary Convery**

Deputy Head/Associate Head of Accelerator Division 2015-2021

Oversaw construction of Fermilab Muon Campus 2011-2019

Deputy Project Director for Far Detectors – **Marzio Nessi**

Technical Coordinator for ATLAS construction and initial run

Chair of CERN Neutrino Platform

Deputy Project Director for Near Detectors – **Sam Zeller**

Co-spokesperson for MicroBooNE and Deputy of FNAL Neutrino Division

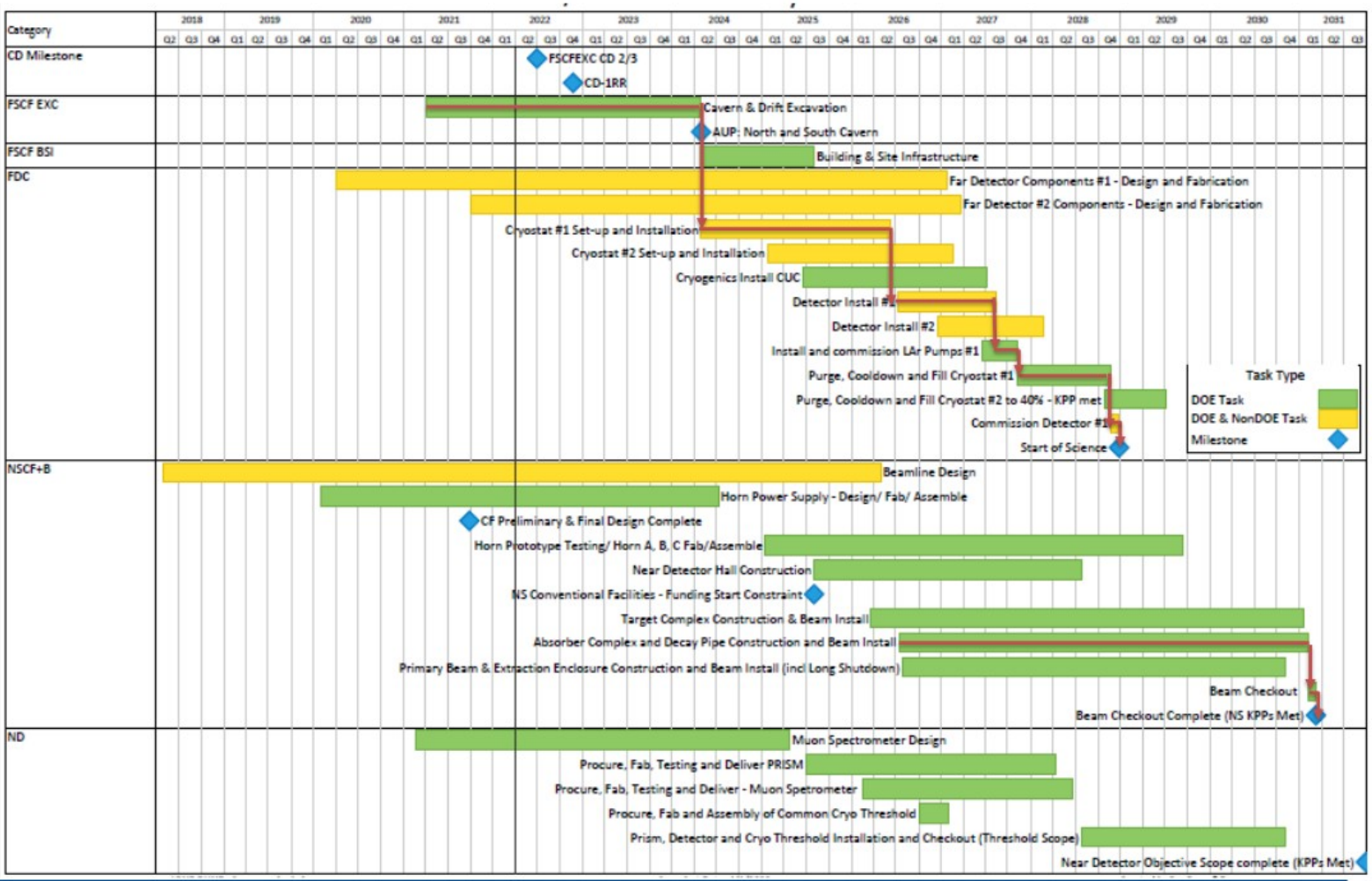
Previous DUNE roles include LBL Physics Co-Convener, FD TDR Co-Editor, JPO Review Office

LBNF/DUNE-US Project Manager – **Kurt Vetter**

US ITER Deputy Project Manager and Interim Project Manager

Project Manager – LSST Science Raft; PM Photon Science Division, BNL

International Schedule



UK Project organisation