DUNE Status and its Implications for DUNE-IT

Sergio Bertolucci

DUNE-IT

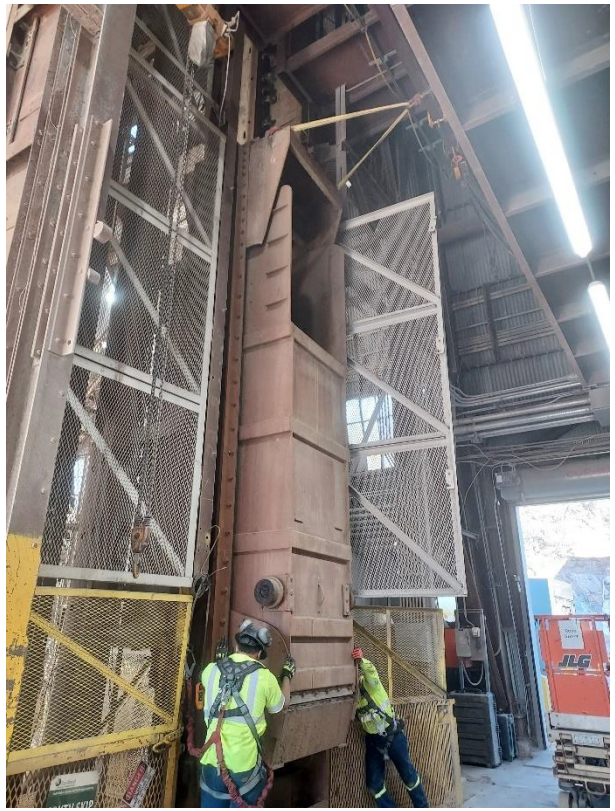
Nov 10, 2025

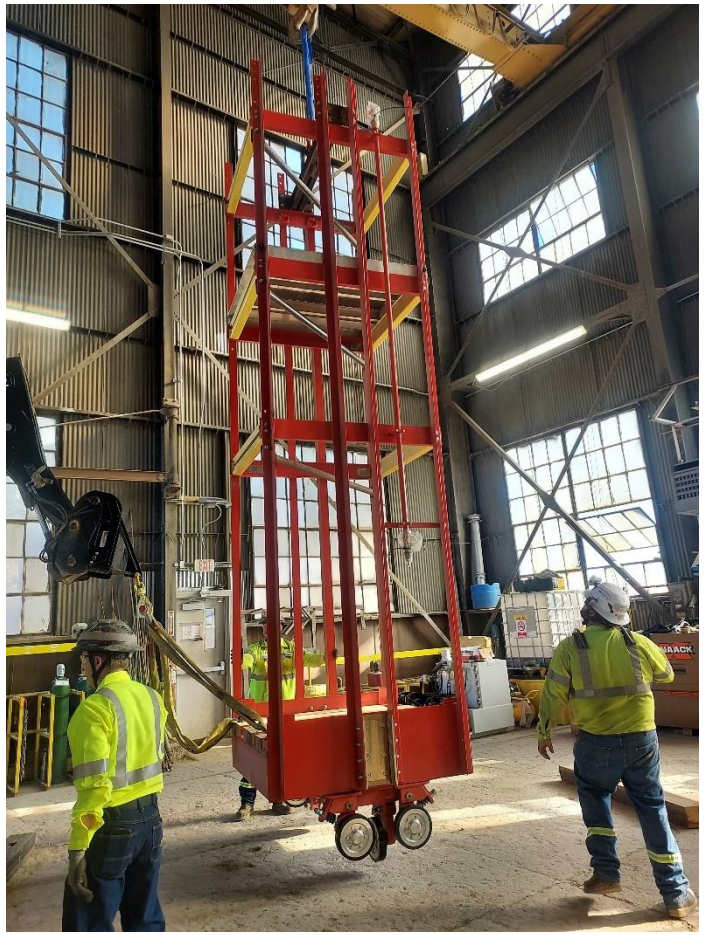
Good News First

Cryostat Installation at SURF Next Year

- All cryostat material delivered to SURF and being prepared for underground transport in January 2026
- Cavern outfitting and final safety checks ongoing
- Cryostat construction anticipated **end of April now → *delayed from mid-March***
- ***FDC I&I workshop held at SURF (Oct. 6-10)*** to continue planning and ensure we meet these key dates to launch construction of the cryostat

Cavern Status – Utilities + Cage



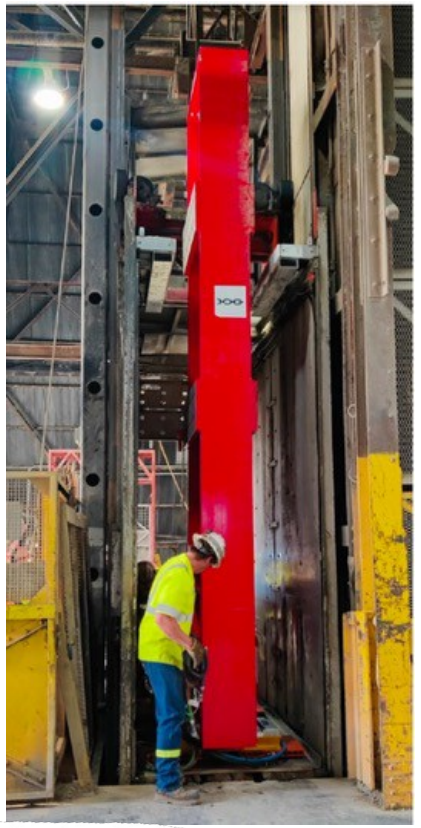


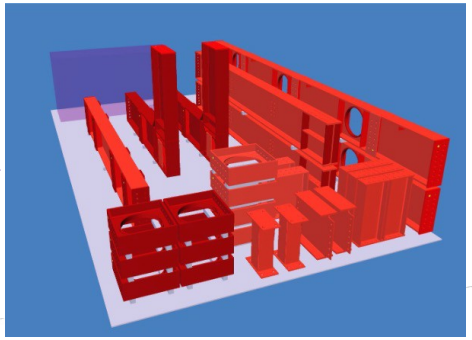
New Skip Cage Installation

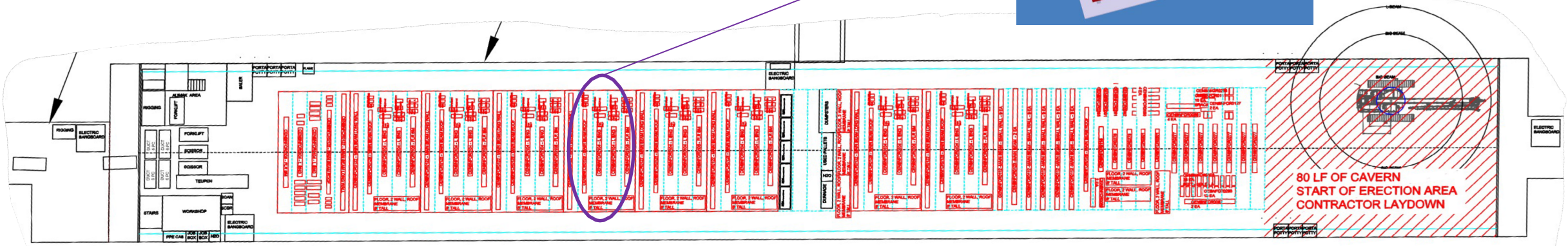
4850-85 & 81 Utility Installation

Cryostat Installation at SURF *(More in J. Macier's talk)*

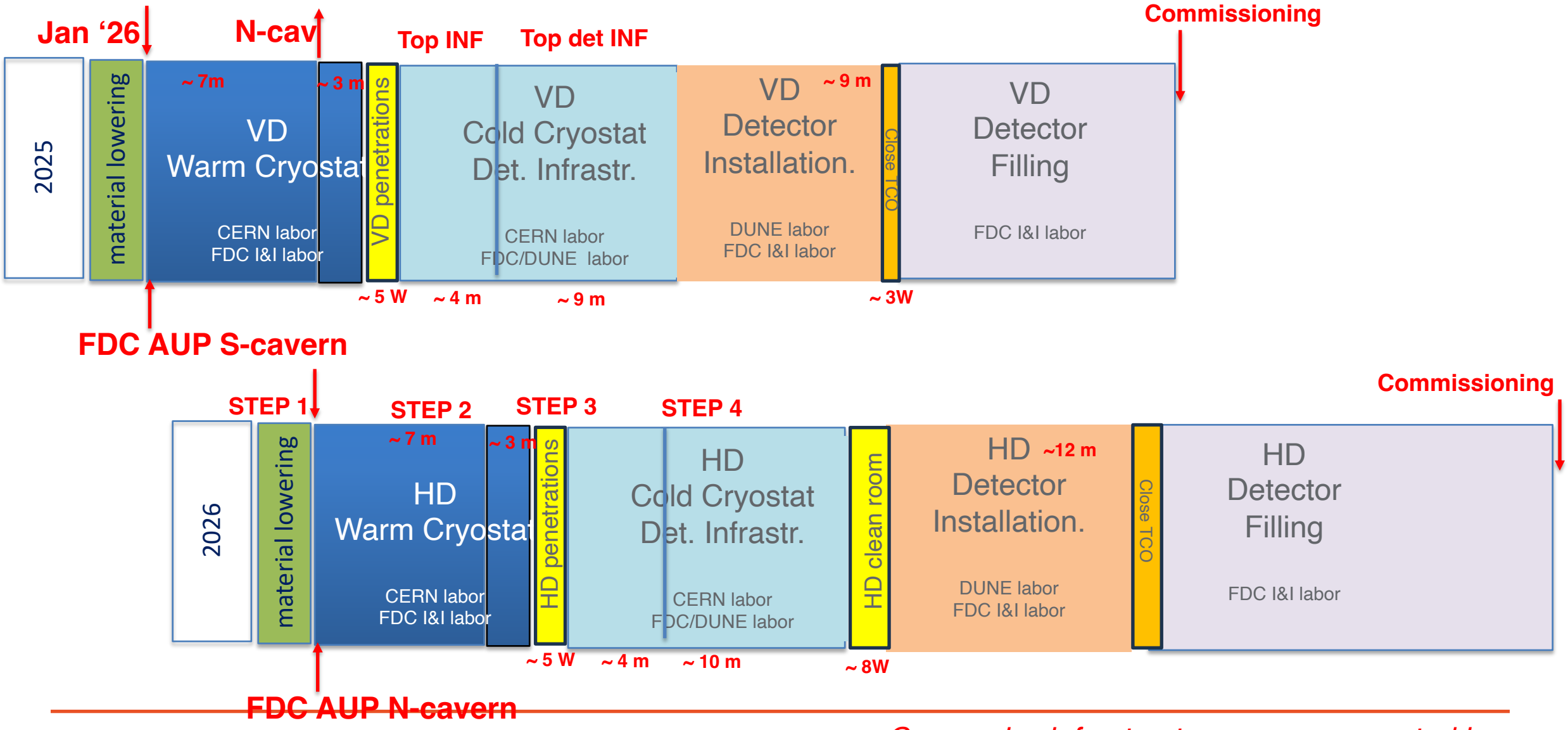
- Need 30% of cryostat material underground as a prerequisite for the CERN contractor to arrive
- 4th May being discussed as a start date for CERN contractor – *need a notice of confirmation several months before.*
- *Any further slip in the FD schedule will make this more challenging*
- Detailed planning underway for material cleaning, lowering and staging cryostat beams underground including testing procedures on the surface





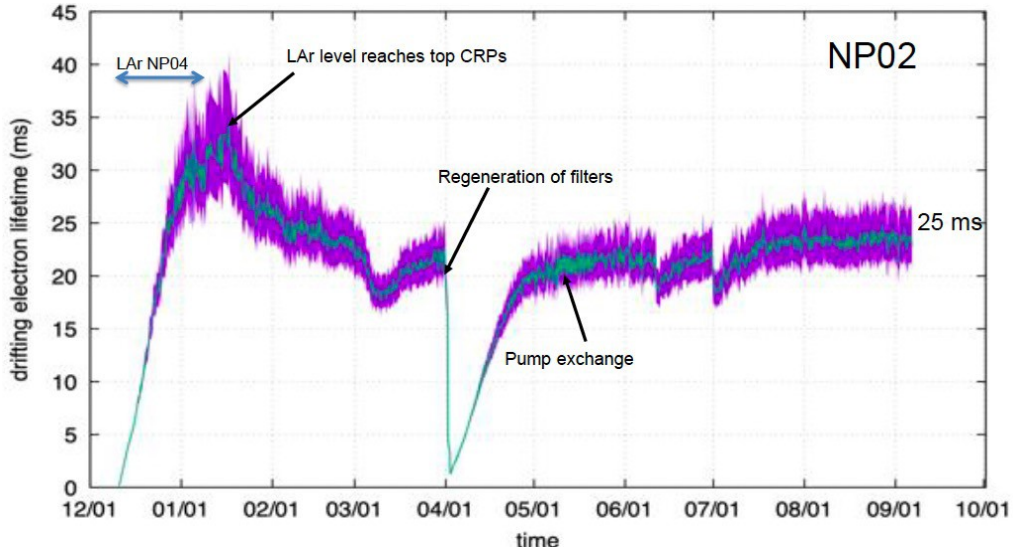


Installation at SURF (a step by step approach)



Cryogenics infrastructure non represented here

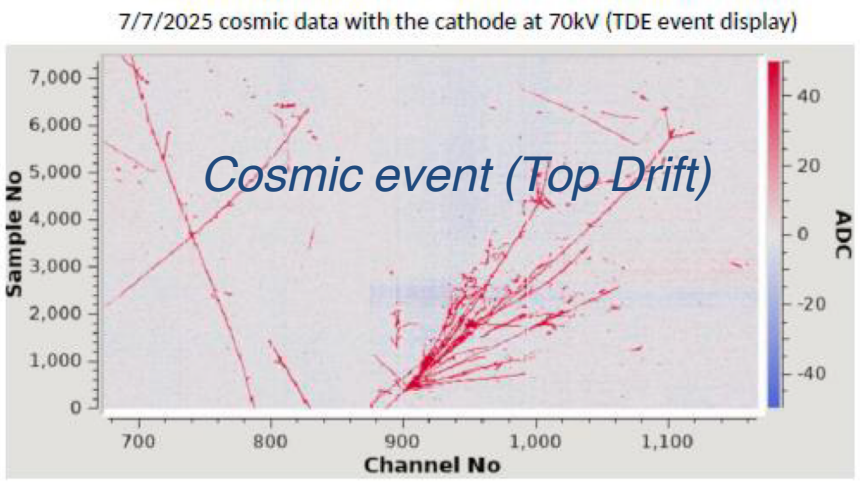
Excellent Operational Performance by ProtoDUNE-VD

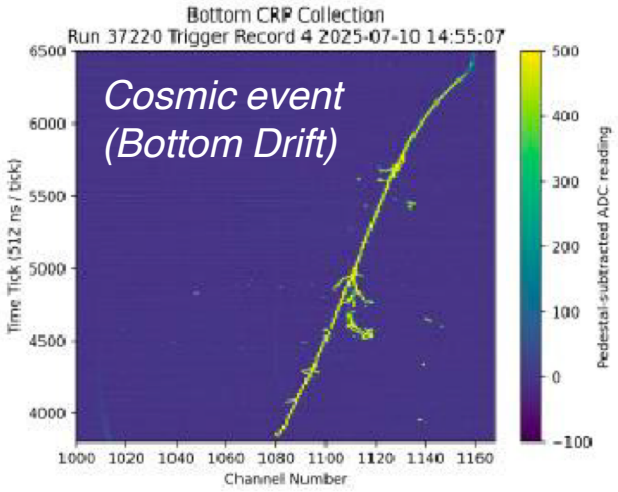


- LAr purity stable at 25 ms far exceeding the design requirement
- High Voltage very stable at nominal value

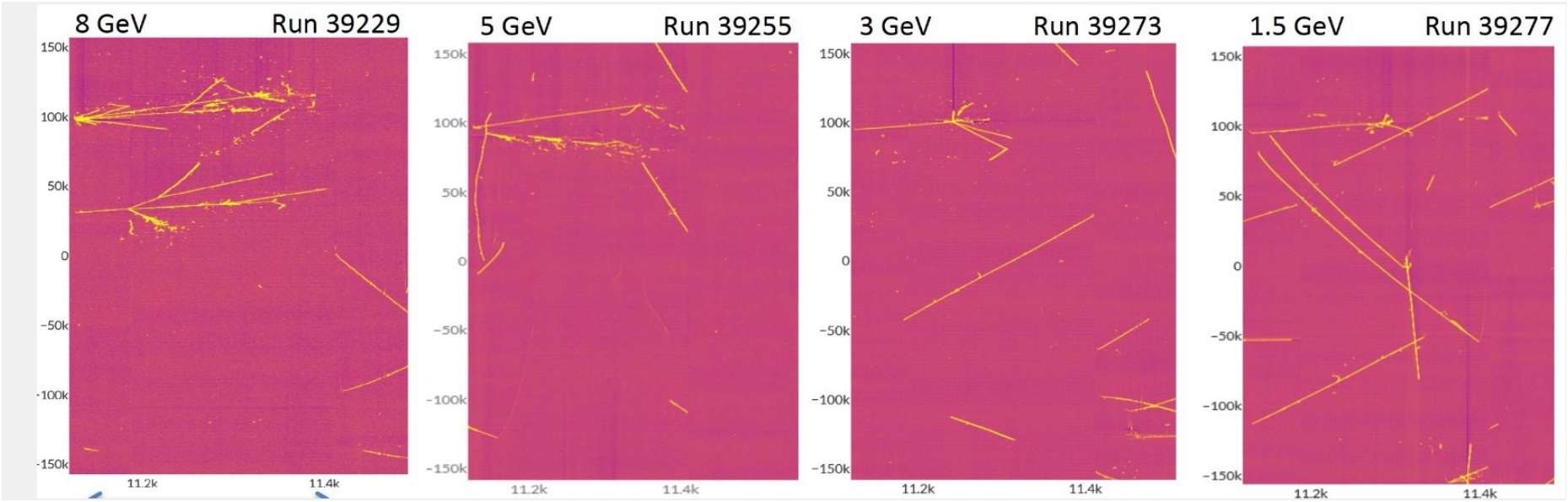
Overall, smooth operations with stable and reliable data taking by ProtoDUNE-VD

Successful Data Taking by ProtoDUNE-VD



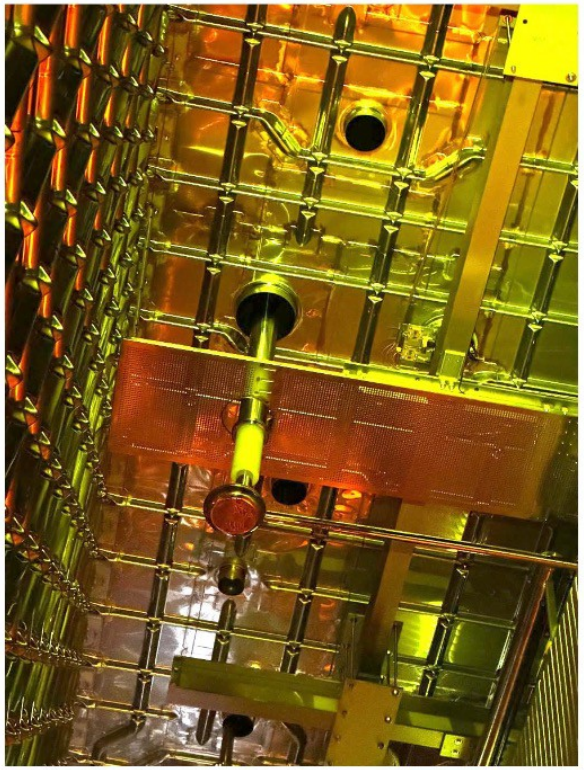


Over 4 million beam events collected in a 2-week beam data taking period



Thanks to the tireless efforts by many collaborators and exceptional support from the CERN Neutrino Platform team!

ProtoDUNE-HD Status



Inspections in and around the TPC ongoing for lessons learned – *plan to install scaffolding to reach top of the detector*

APA testing ongoing in the cold box at CERN – *will likely continue until Sept. 2026*

A total of ***9 technical publications*** planned with ProtoDUNE-HD including the overall detector performance paper – *dedicated effort underway*

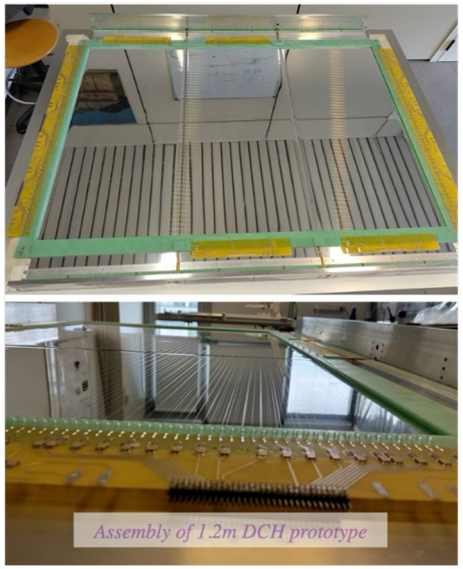
Excerpt from SPSC last year

7.2 NP04

The committee **congratulates** NP04 for the successful operation of the detector with beam and for the completion of the beam program. The SPSC **is looking forward** to the publication of results on detector performance and physics measurements that are relevant for DUNE physics. The SPSC **notes** the effort of the Collaboration to leave the NP04 detector in a state ready for refill, recognizing the long-term value of the NP04 infrastructure.

Near Detector Progressing Well on all Fronts

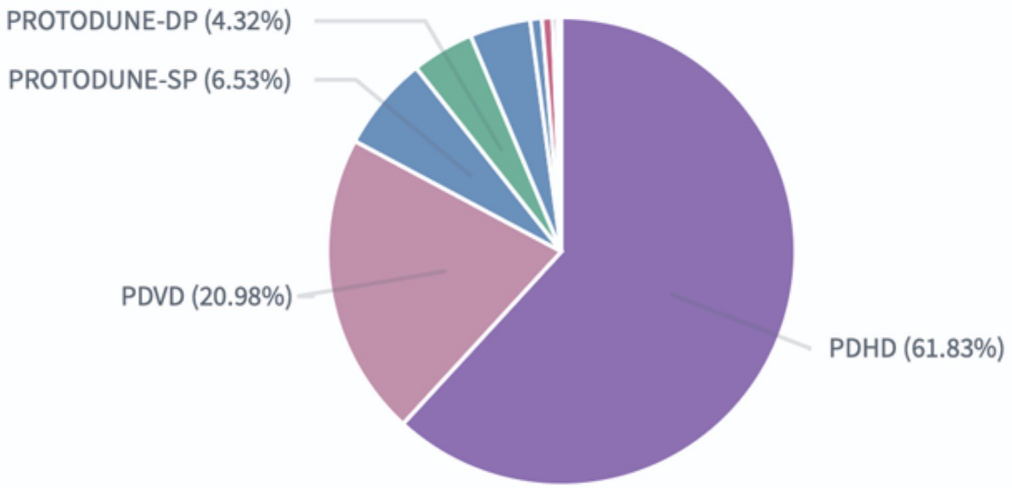
- **ND-LAr** successfully proceeding towards final design review. ND-LAr 2x2 beam-off run successfully started and 2026 beam run approved by FNAL PAC
- **TMS** prototyping well underway. A *TMS task force* evaluated and concluded major design parameters (width, steel stacking, scintillator orientation)
- **PRISM** controls/monitoring and interfaces actively being developed. A *PRISM task force* investigated alternative movement systems and confirmed the current system is needed to meet the physics needs
- **SAND** tracker options (*straw tube tracker and drift chamber*) large scale prototypes tested in beam in July 2025. Decision timeline moved to 2026 to give more time for prototyping and considering renewed funding opportunities in India



US-Near Detector Path Forward

- Following the Director's + DOE Independent Project Review (IPR) on US-ND in April 2025, a list of ND components (US scope) with varying degrees of installation (0 to 100%), cost and physics impact were presented to DOE for guidance on path forward
- Response from DOE in September *removed the $200M cost cap set by CD-1RR* and provides *a clear path for US-ND to deliver fully qualified detectors* for DUNE Phase I – ***a very welcome development!***
- **The plan involves installing ND on operations budget**
- A technically limited schedule is being developed based on this (re)direction
- A ND I&I workshop is planned later this month to discuss next steps
- *ND project decoupled from Near site civil* to mitigate schedule effects and not hamper progress – ***ND detectors proceeding with the nominal plan***

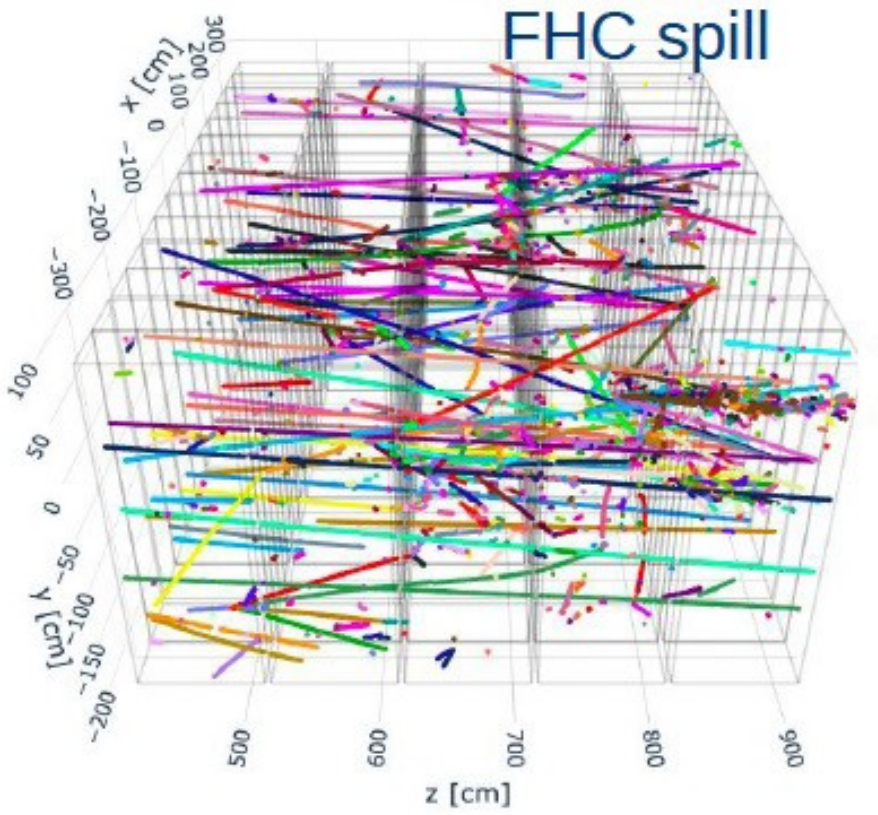
Computing Developments



- Phlex Framework review with external team of experts is complete resulting in a very positive outcome! *(only preliminary report received)*
- CS&C preparing for big transition to Phlex with new software management tools and in coordination with physics/Reco/Sim conveners
- Computing resources meet current needs and continue to grow however more effort (especially from non-US) to support operations is needed
- Coordinating with HEP Software Foundation (HSF) and Indian institutions to begin series of NSF funded software workshops internationally to train collaborators - *next one in India at IIT (Guwahati)*

Simulation/Reconstruction Developments

- A huge effort across ND and FD is underway to produce updated oscillation sensitivities
- An end-to-end workflow for ND is fully operational and analysis files with full ND reconstruction and simulation are now available ➔ *production of larger samples will start soon*
- New high-statistics production samples for HD and VD far detectors are available, development of systematic uncertainties is ongoing
- Oscillation analysis framework is ready to begin integration of new inputs
- Meanwhile, migration and integration into the new Phlex software framework is being actively planned



… and now the Less Good News

Funding, Cost Report and Contingency Status

	Thru FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	Total
DOE CD-1RR ESAAB BA	**1,080**	**180**	**255**	**305**	**305**	**305**	**305**	**290**	**252**	**0**	**0**	**0**	**3,277**
FY25 and beyond $250M (current exercise)	1,080	180	251	251	250	250	250	250	250	250	15	0	**3,277**

Project ended FY2025 with ~$250M in unobligated carryover ➔ solid basis for continuing progress on all fronts. Flat FY2026 Funding is NOT an issue.

FY2027 funding is key but must be viewed in light of whole program

Subproject	Actuals thru Sept 2025	BAC	ETC	EAC	% Complete on EAC	TPC	Contingency $ on ETC	Contingency % on ETC
131.FSCFBSI *	96	208	129	226	43%	211	(15)	-11%
131.FSCFEXC	610	620	21	631	97%	644	13	62%
131.ND	50	184	137	187	27%	200	13	9%
131.BEAM	114	281	176	290	39%	1,103	174	23%
131.NSCF	73	635	567	640	11%			
131.FDC	404	896	497	901	45%	1,119	218	44%
	1,347	**2,823**	**1,528**	**2,874**	**47%**	**3,277**	**403**	**26%**

BSI planning for rebaseline in early 2026, revised TPC approx. $265M.

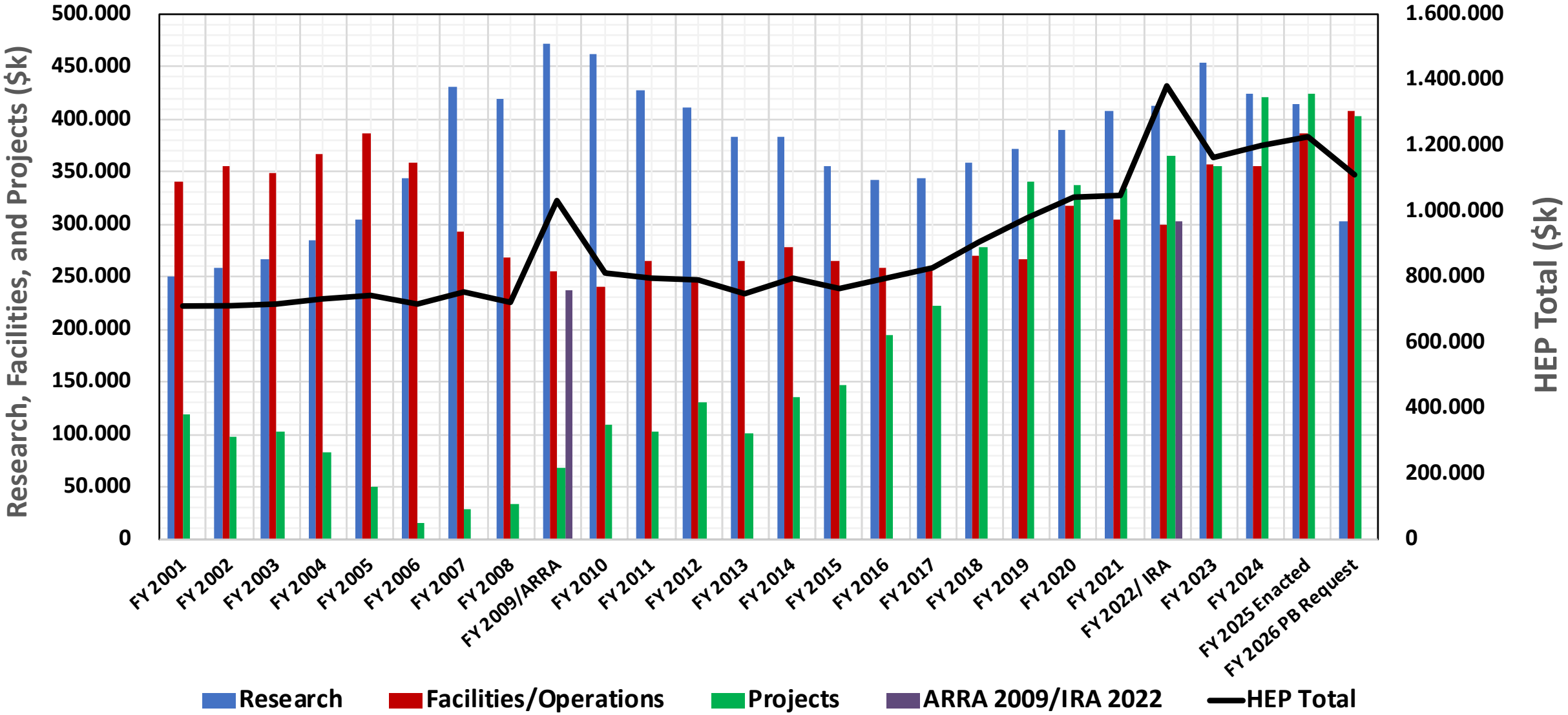
EXC headed for closeout, including ongoing legal actions expected to return $16M - $30M to overall project

ND working to technically driven schedule. $200M cap 'removed', however Threshold KPPs achievable within 200M; installation costs as a future opportunity..

Beamline Technical flowdown of requirements under continued review

NSCF bids well above cost + estimate; reviewing technical and procurement changes

FDC scrubbing complete, under TPC, full CD2/3 in early 2026.



From Gina Rameika report to the RRB

ARRA 2009 funds supported Research, Facilities, and Projects
IRA 2022 funds supported Projects only

FY26 planning

- Our HEP office has been planning FY26 using as a starting point what is called the "House Mark".
- This is slightly above the President's Budget Request, and therefore may be considered optimistic.
- Never-the-less, it calls for significant cuts to the Laboratory Research Budgets and severe limitations on what we will be able to fund in University grants.
  - Until we have an actual appropriation we will not know the LBNF/DUNE number for FY26
  - We have the PBR at $251M, House Mark at $260M and Senate Mark TBD
- As of November 5, we remain without an FY26 budget appropriation…

From Gina Rameika report to the RRB

Near Site Conventional Facilities *(More in J. Kerby's talk)*

- All contract proposals for the Near Site Civil came significantly higher than expected
  - *currently forms the largest source of schedule and cost uncertainty*
  - *Schedule already anticipated to be delayed by about a year due to this*
- A Beamline working group has been assembled by the LBNF/DUNE-US project
  - *An in-depth value engineering exercise and various physics studies underway (e.g., proton energy, radiation shielding around the decay pipe, location of near detector and distance from the beam, PRISM movement direction etc.)*
- LBNF/DUNE-US project and collaboration working together to address this but exploring possible options requires various other kinds of expertise (e.g., beamline, radiation etc.)
- ***We are working towards solutions to minimize impact on physics reach of DUNE with Phase-I and Phase-II and any further significant delays to schedule***

Near Site Conventional Facilities and Beamline

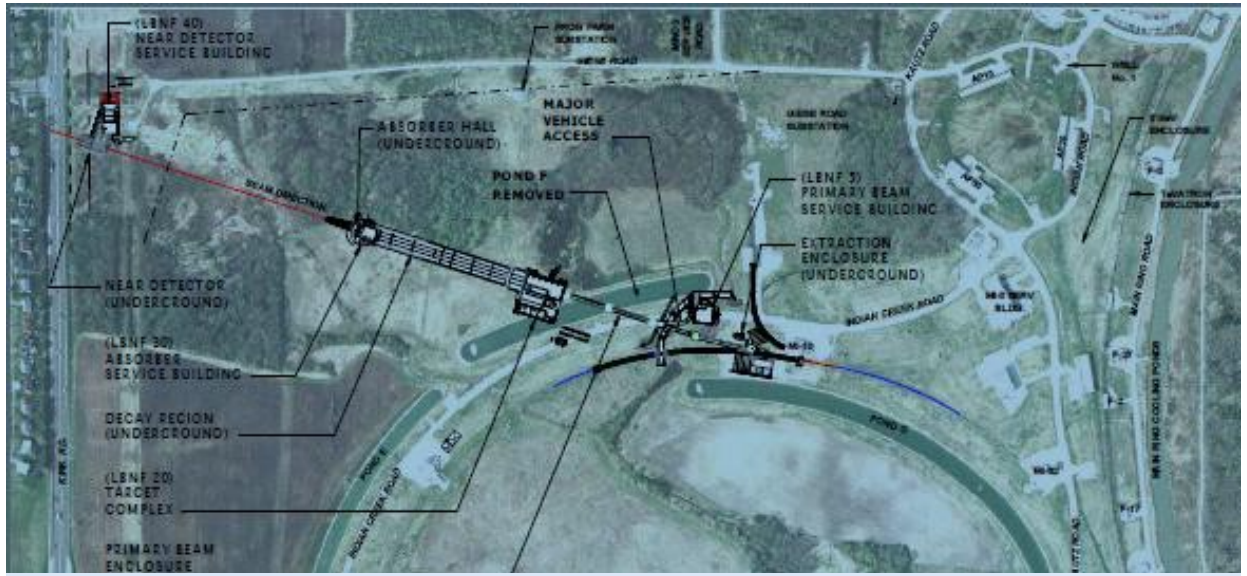
After a long an arduous process the Near Site Civil Construction bids came in noticeably higher than expected.

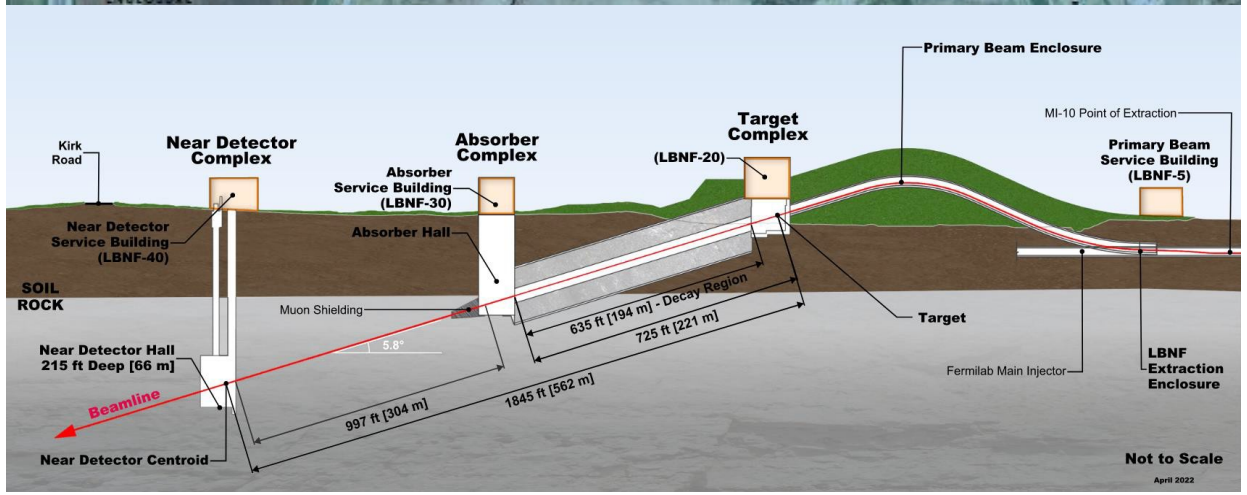
Multiple contributing factors, all being investigated:

- **Contractual:**
  - **Terms and Conditions; Pre-Qualification**
  - **Integrated (w/ DOE) contract review process including Acquisition Strategy**
  - **Economic / Allowable Scaling Factors**
- Technical:
  - Construction Means and Tolerances
  - Radiation Shielding and Tritium Mitigation
  - Beamline Energy, Near Detector Location
- **Timing:**
  - **EA / Wetland Permitting, DOE Independent Cost Estimate, Independent Project Review, and ESAAB timelines**
  - **Overlap with design and shielding assessments.**

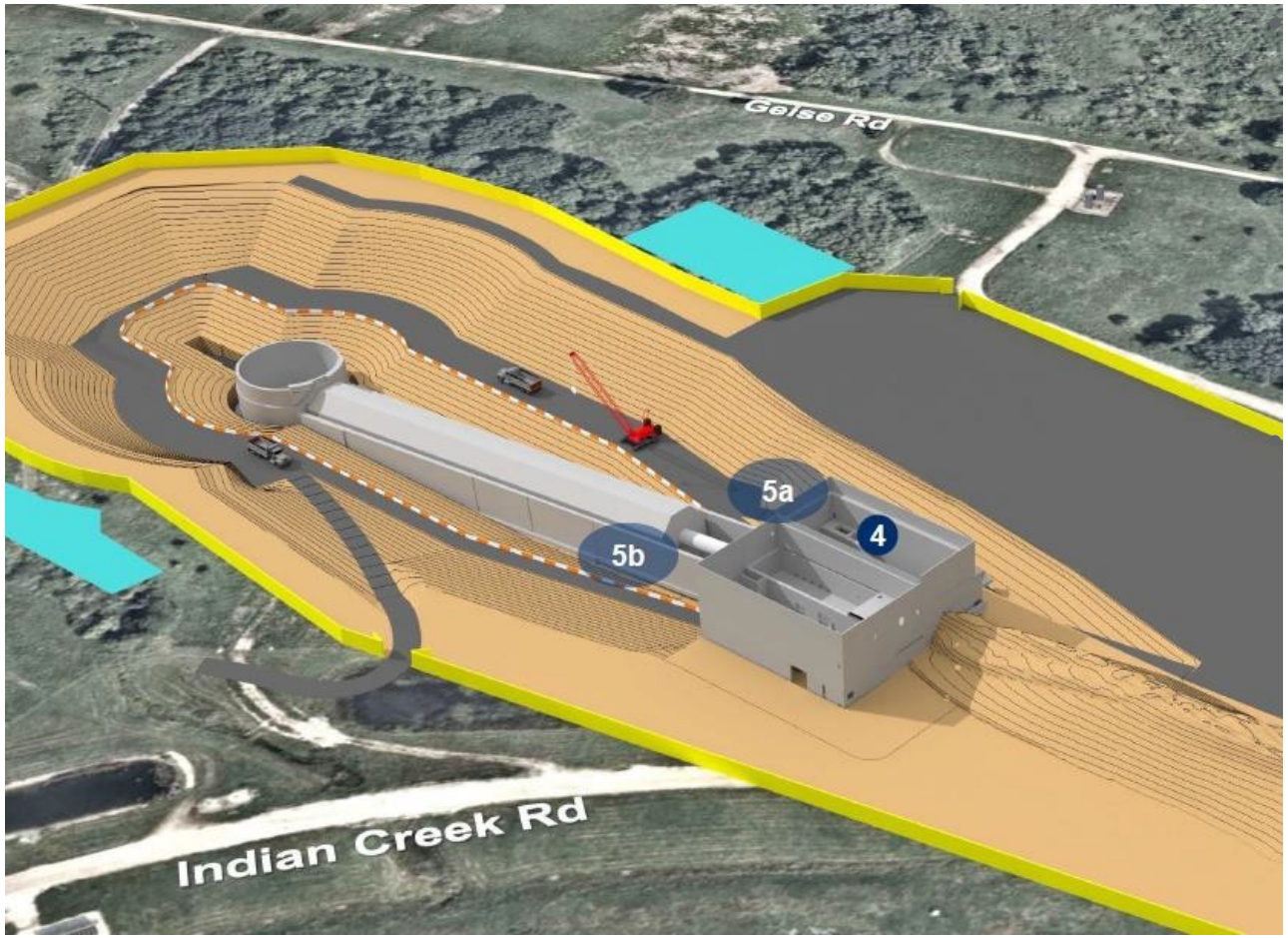
These exercises apply under any scenario. Notionally they will be quicker, but savings is also anticipated to be less.

Example technical scenarios follow….





One (larger) Redesign Option: Do not backfill open cut

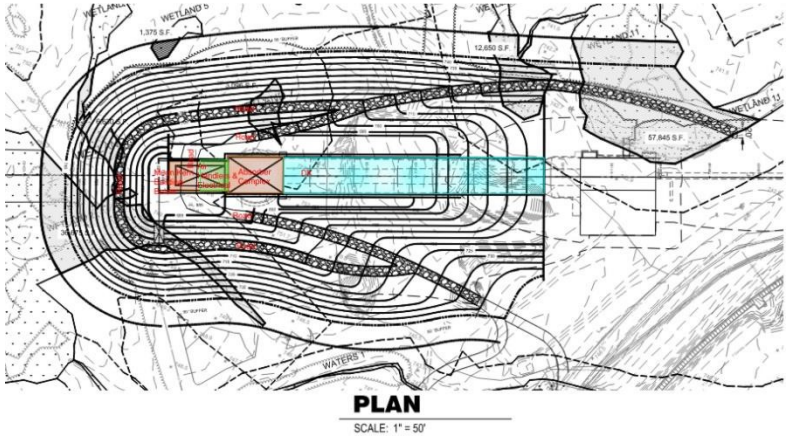


Details & benefits:

- Eliminate “outer box” – permits direct inspection and repair of shielding concrete
- Eliminate massive circular absorber complex structure
- Service building at depth
- Eliminate multi-layer waterproofing around muon kern
- Eliminate muon kern de-scaling system

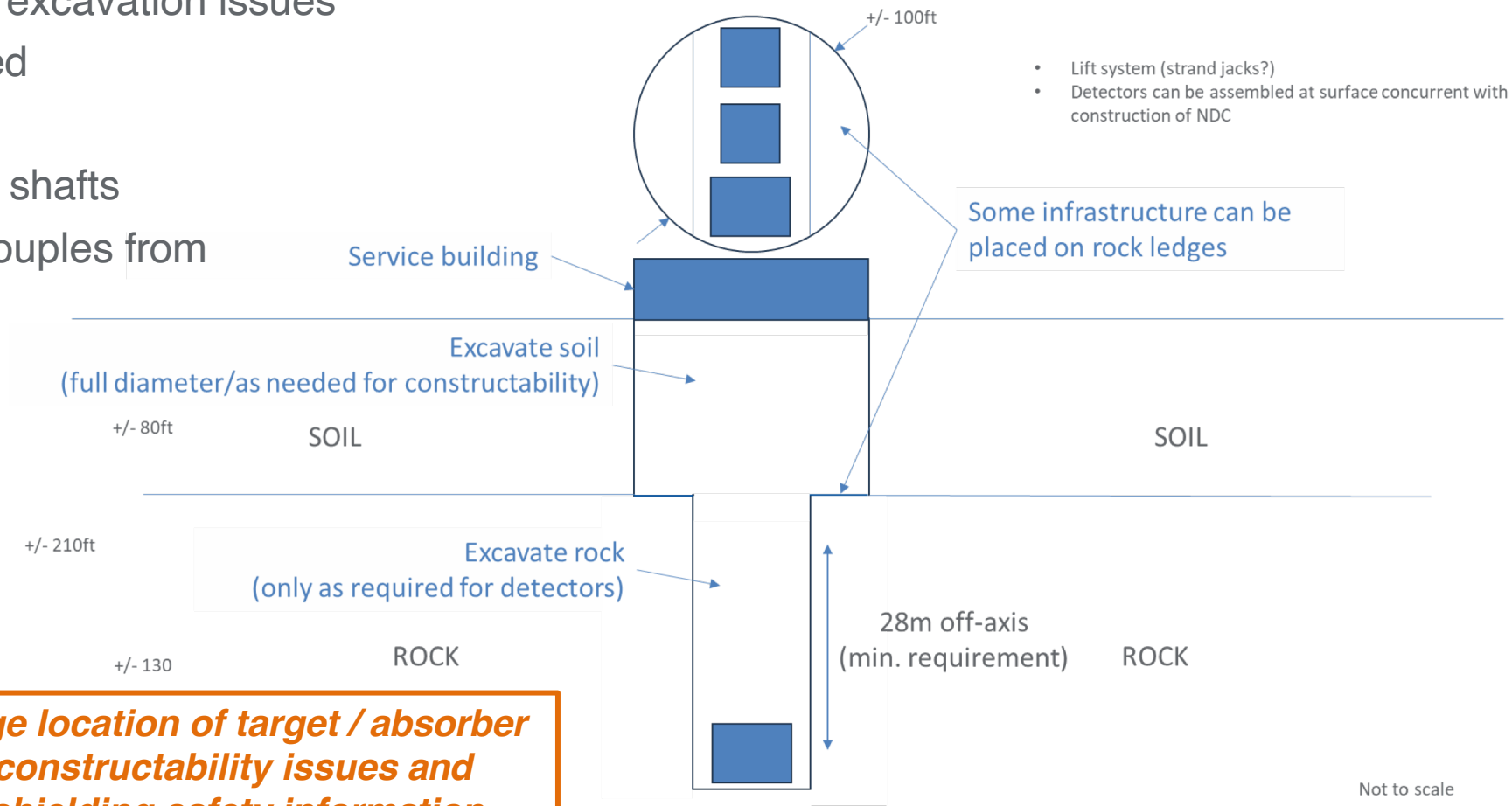
Risks:

- Tritium management
- Flooding
- Weather (snow/ice, temperature swings)
- Wetlands impacts?



ND Hall Option – Shaft with vertical off-axis

- Details & benefits:
  - Addresses construction / excavation issues
  - Diameter can vary to need
  - Possible vertical motion
  - Possible multiple smaller shafts
  - Different technique / decouples from beamlines
- Risks:
  - Possible vertical motion
  - Space constraints



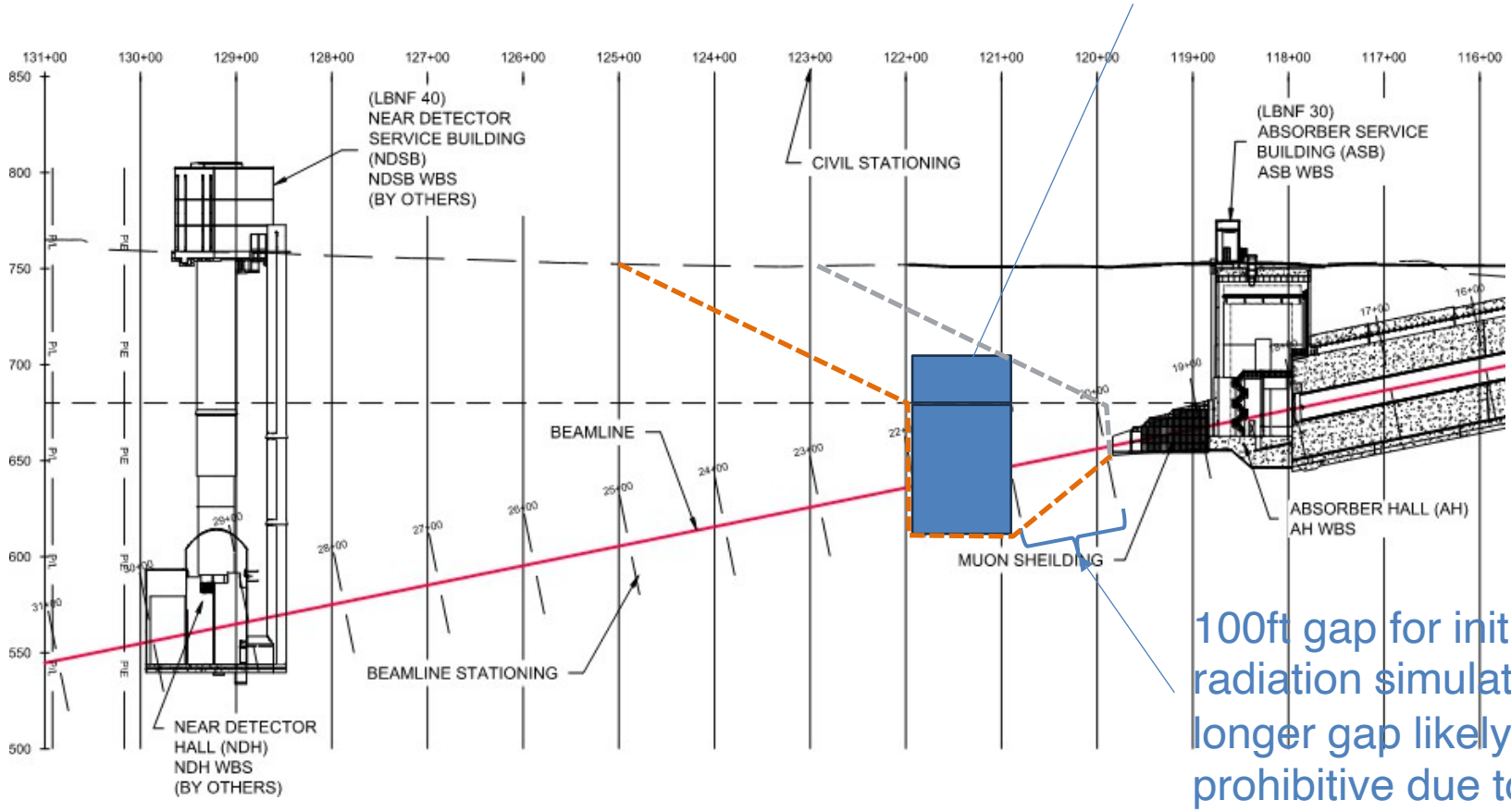
These 2 examples do not change location of target / absorber / near detector, but do address constructability issues and potential changes with refined shielding safety information

"Upstream ND" – Move vertical shaft closer to the Muon shielding

How close to the AC can we build the NDC if we eliminate Rock Muons (use air gap)?

Simulations being run with the start of ND hall located ~100 ft from the end of the muon kern as a starting point.

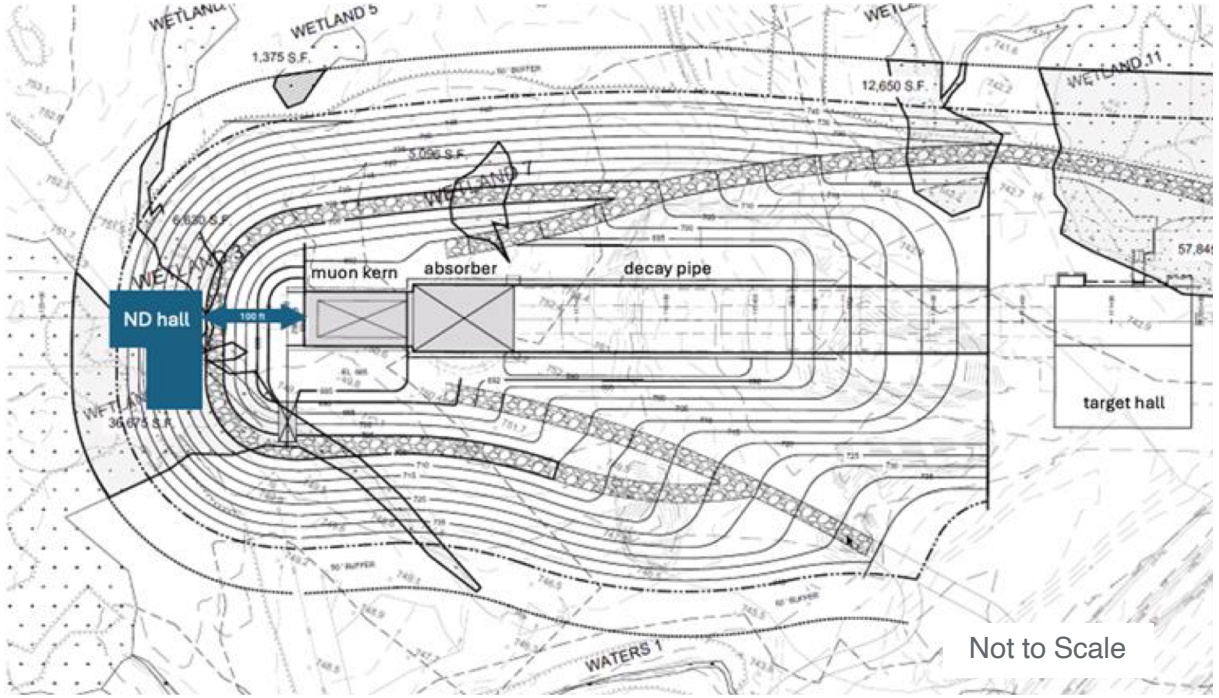
Consider constructing NDC in open cut to shallower depth



100ft gap for initial radiation simulations; longer gap likely cost prohibitive due to increase in soil/rock excavation

"Upstream ND" – No Backfill

- Must extend the open cut downstream
- Requires all rock between the muon kern and the detector hall to be excavated.
- Additional soil and rock excavation laterally needed for off-axis measurements.
- Similar in scale (and therefore cost?) to Absorber Complex?



These 2 examples do not change location of target / absorber but obviously DO for the near detector and are under evaluation for science impact. There IS a longer term impact but that trade is part of the evaluation.

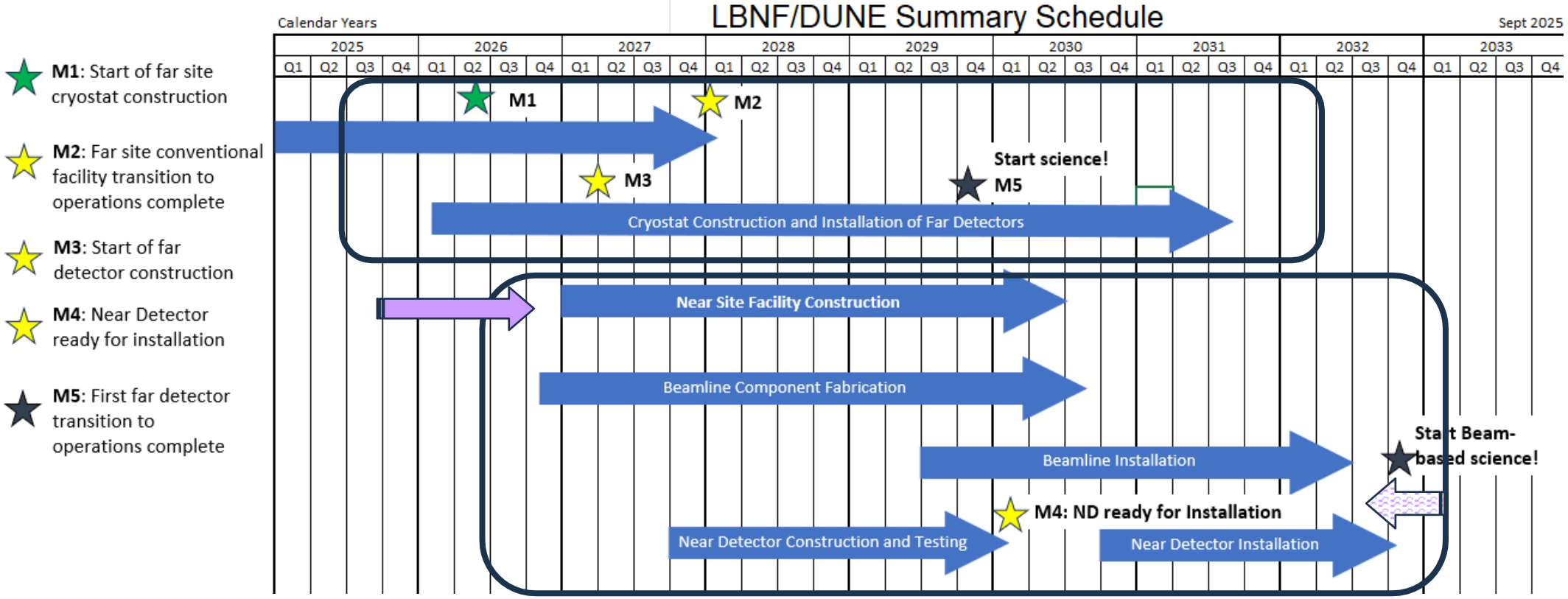
FY27 and Beyond

From Gina Rameika report to the RRB

- Very early planning for FY27, with no public information available
- We do know that LBNF/DUNE will need significant funding to move forward, particularly for the NSCF
- Listening to the options from the project for various profile scenarios
  - **We will need to request an increase in the Total Project Cost**
- Need to elevate discussions to Office of Science leadership now that we have an appointee as Undersecretary (Dr. Dario Gil)
  - General HEP Overview briefing scheduled for 11/20
  - Will not likely go into LBNF-DUNE issues
- Conclusion : LBNF/DUNE is a very challenging project
- Cost increases are not easily accommodated in the budget planning process

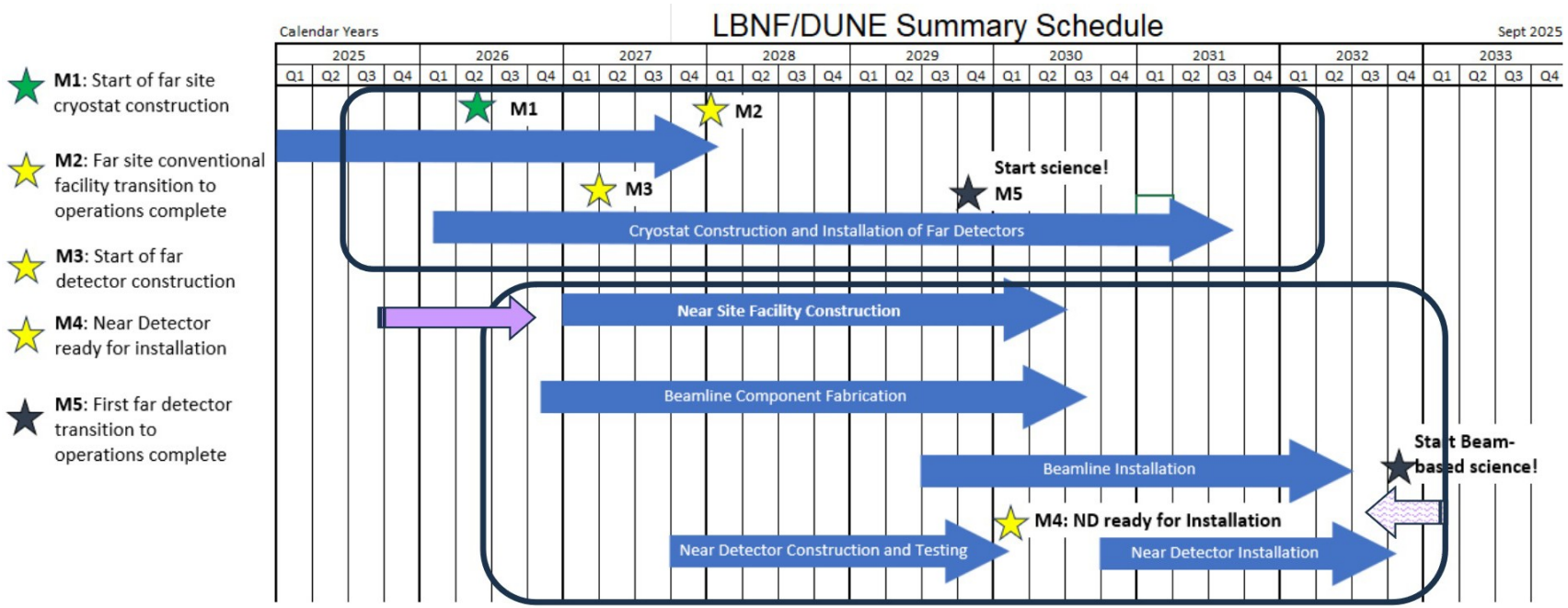
LBNF/DUNE Construction Timeline

- The far site and detector are our first priority! Good progress there...
- Near Detector will advance independent of Near Site Civil – also good news
- Start of Near Site Construction and Beamline delayed ➔ heavy value engineering effort ongoing ➔ working on all facets. Well supported by program.

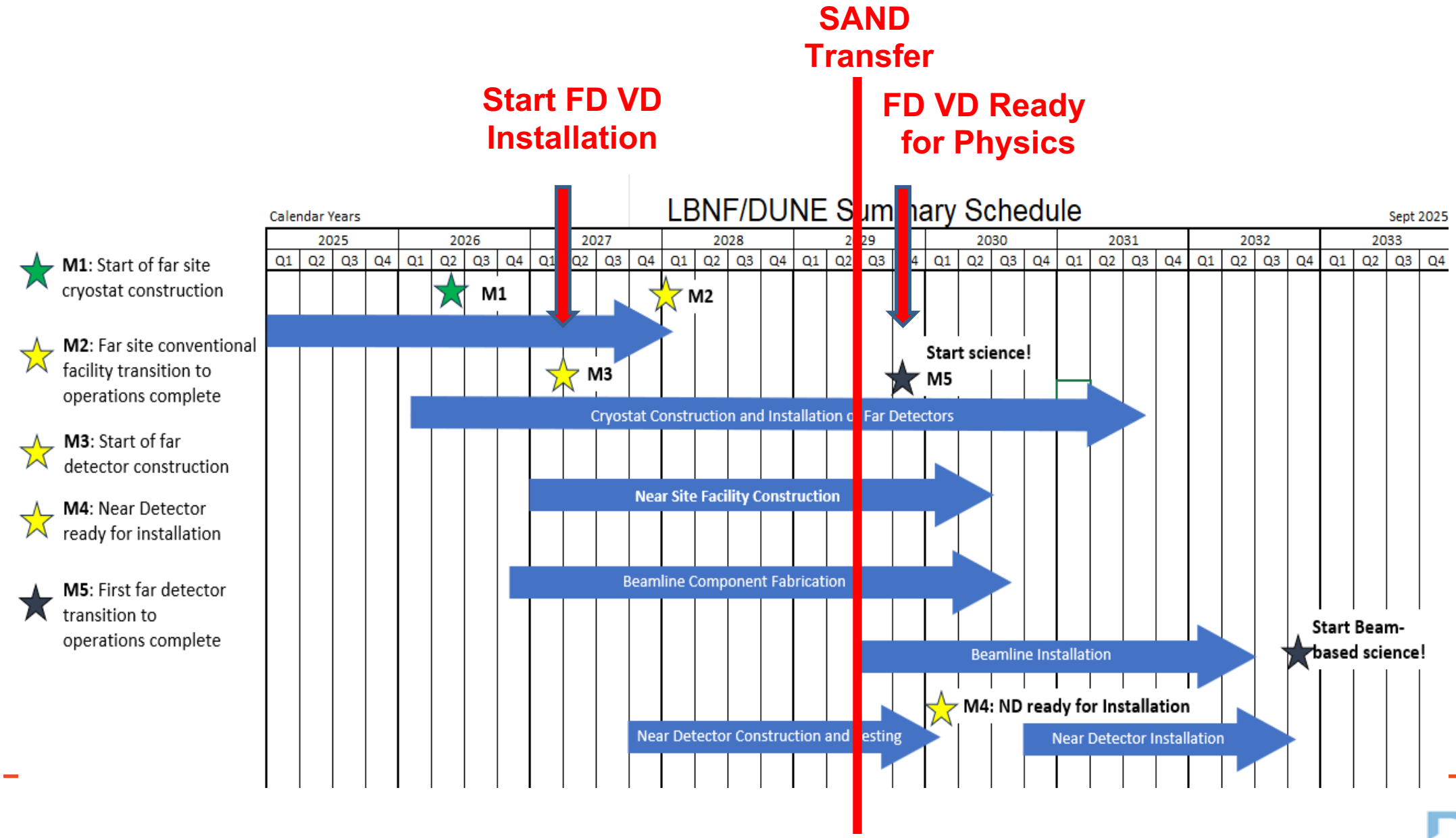


Timing is Key

- **DUNE is not in a vacuum** – *we are challenged by a strong international competition*
- ***Being on schedule is paramount for DUNE to stay relevant and competitive*** – current funding uncertainties and schedule slips due to site infrastructure/civil are increasing the risk to Phase-I physics goals *(we have a narrow window to MO discovery)*
- Both Phase-I and Phase-II are needed for DUNE to achieve its full physics potential



What Does All That Imply for DUNE-IT?



Our Priorities

- **Keep building our deliverables for the FD -VD** ***(Top Priority)***
- ***Prepare for the beginning of the FD-VD installation in 2027 (Top Priority)***
- **Align the milestones of SAND components for a transfer to FNAL in Summer 2029** ***(Top Priority)***

A final communication

I am stepping down from the position of DUNE-IT National Responsible in CSN1

I propose that Francesco Terranova joins Laura Patrizii in this position.

THANKS

Questions?