

LBNF/DUNE Status

Update to Fermilab Community Advisory Board
18 November 2021

LBNF Project partners:

US/DOE

Brazil/FAPESP-UNICAMP

CERN

India/DAE

Poland/WUST

Switzerland/SERI, and

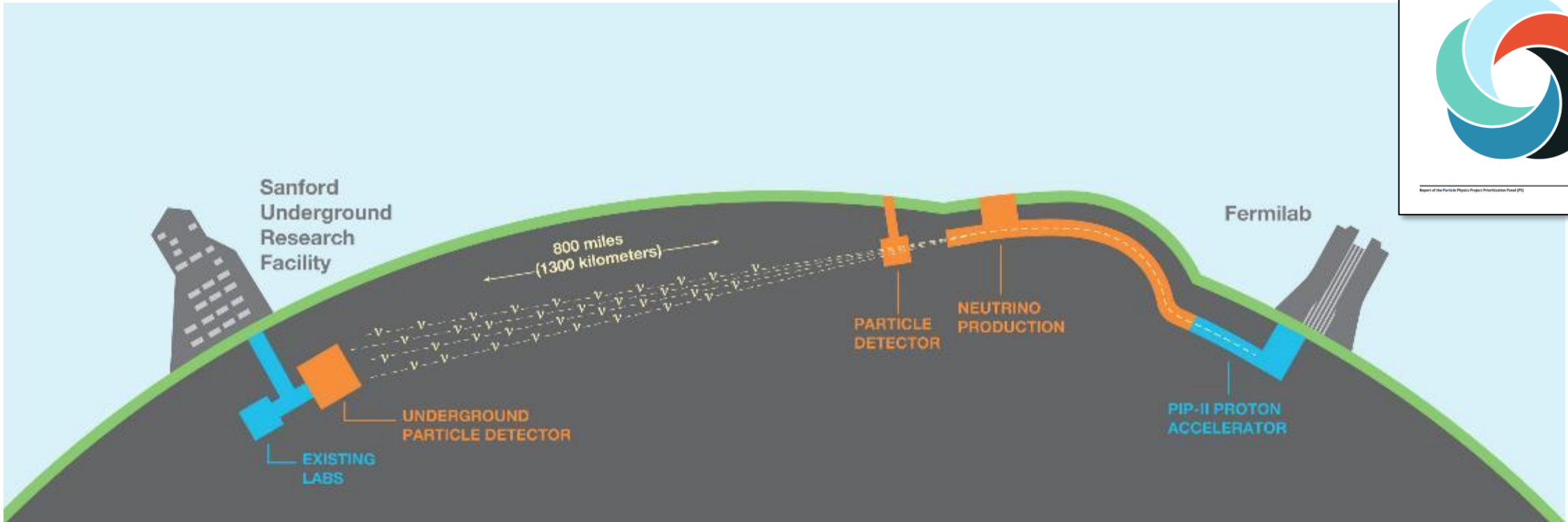
UK/UKRI-STFC



plus the DUNE international
Collaboration and consortia



Implementing the P5 Vision - Deep Underground Neutrino Experiment



Origin of matter. Investigate leptonic CP violation. Are neutrinos the reason the universe is made of matter?



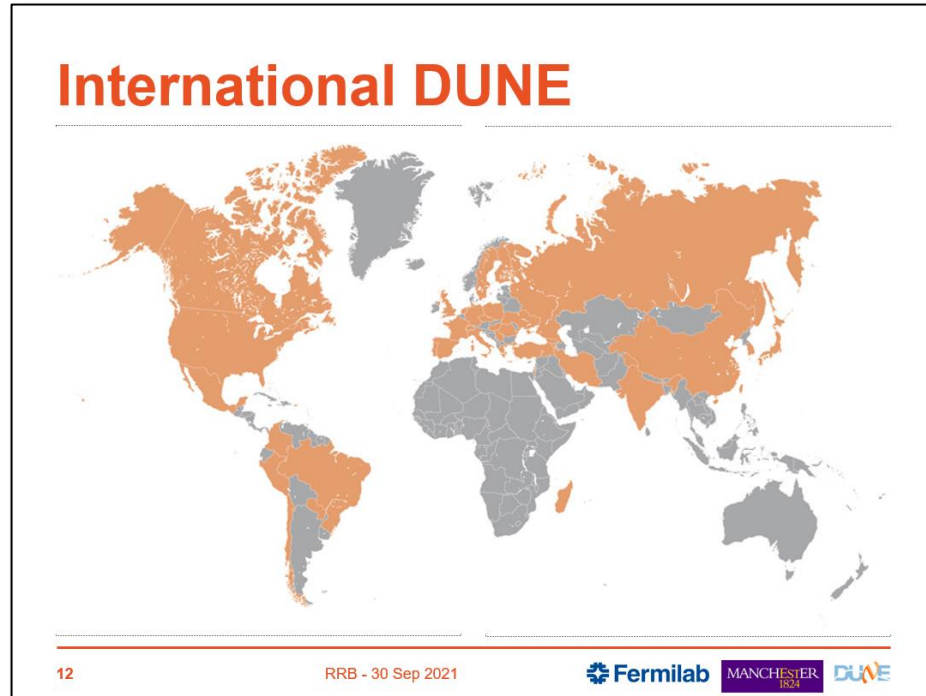
Neutron star and black hole formation. Ability to observe neutrinos from supernovae events and perhaps watch formation of black holes in real time.



Unification of forces. Investigate nucleon decay, advance unified theory of energy and matter.

LBNF and PIP-II will enable the United States to host the global high energy physics community to advance world class discovery science into the fundamental nature of matter

The DUNE experiment is managed by the international DUNE Collaboration



Collaboration statistics

- 1,427 collaborators, 48% U.S./52% non-US
- 218 institutions from 37 countries + CERN



Demographics (not including computing)

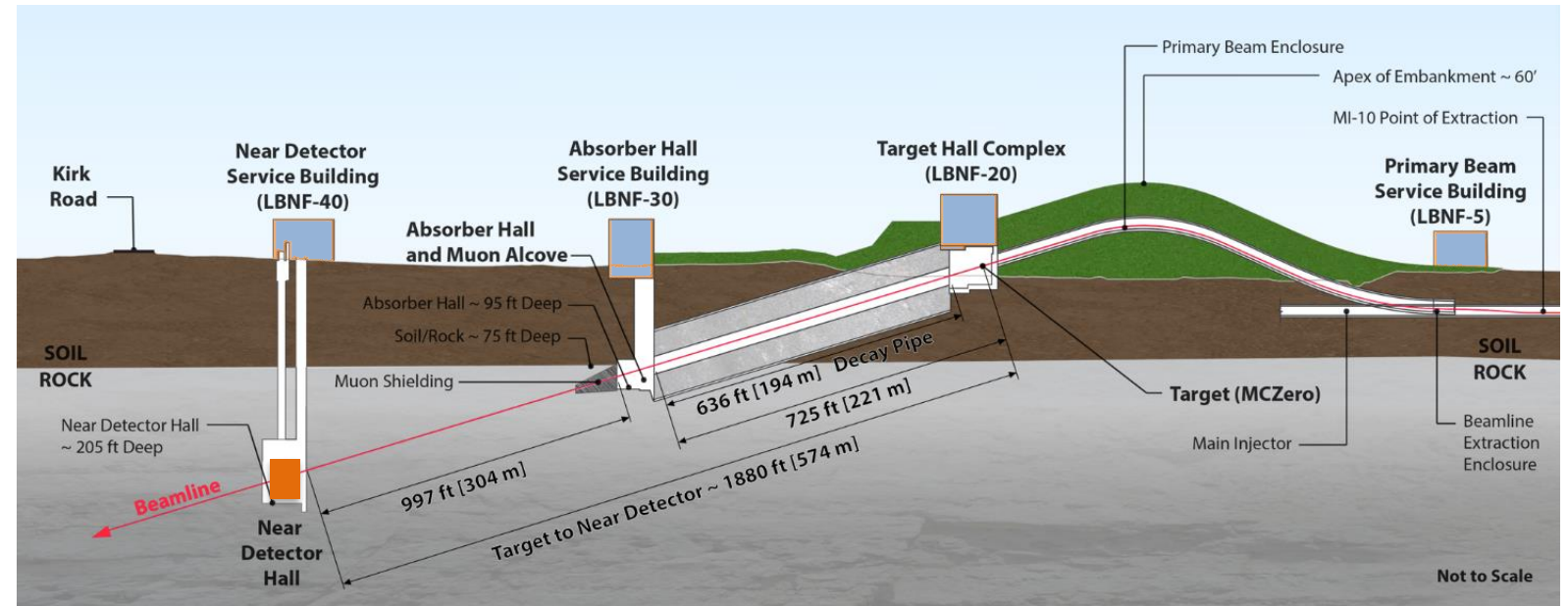
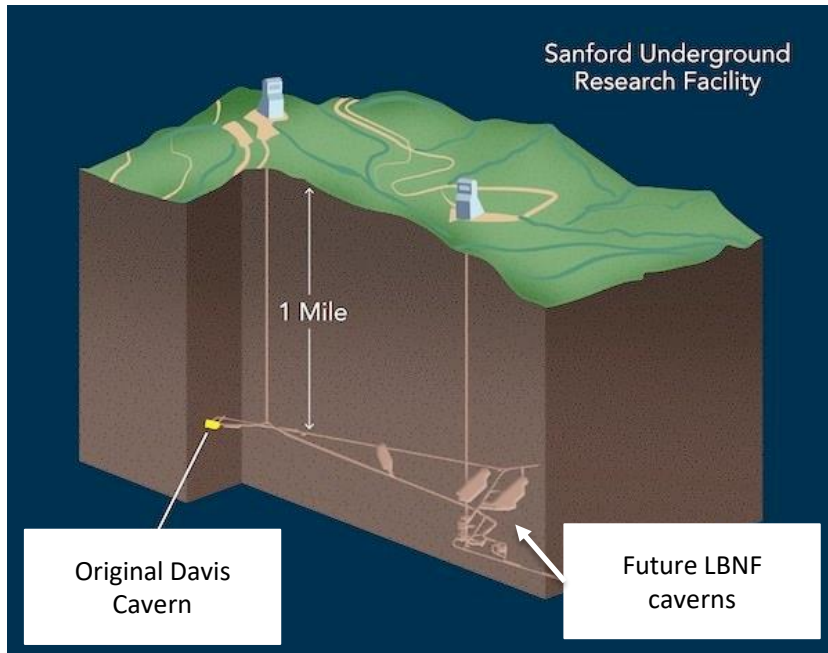
- Facility/Senior staff: 679
- Post Docs: 253
- Grad Students: 326
- Engineers: 159

DUNE will be the first internationally conceived and operated mega-science experiment hosted by the Department of Energy in the United States

LBNF: From Illinois to a mile underground in South Dakota

Illinois: →

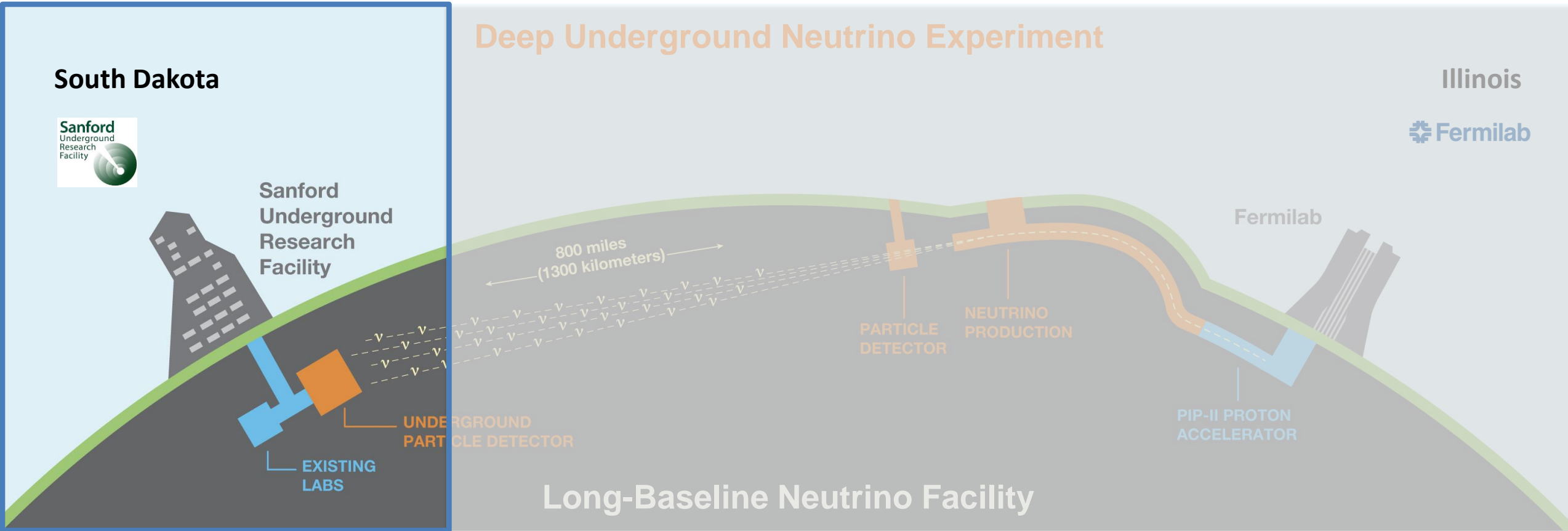
- World's most powerful and advanced neutrino beamline
- DUNE "near" detector



← South Dakota:

- Surface and underground facilities
- Cryostats - Massive membrane cryostats to hold liquid argon
- Cryogenic systems
- DUNE "far" detectors – up to four liquid argon detector modules

LBNF Far Site Update



The “Far Site” in Lead, South Dakota – Former Homestake Gold Mine



Ross shaft headframe

Yates shaft headframe

The far site at Sanford Underground Research Facility (SURF) , Lead, SD

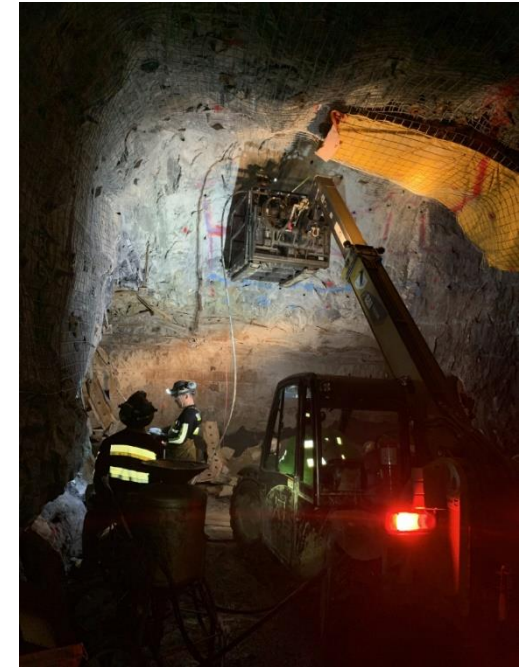
Status - Far Site Conventional Facilities

Conventional Facilities Construction

- ✓ **Reliability Project** upgrades to SURF – complete. Significant infrastructure upgrades, including refurbished shaft and new hoist system.
- ✓ **Pre-excavation phase** – complete. Equipment and systems to move excavated rock from one mile underground to the surface and deposit in the Open Cut.
 - ▶ All work has completed on schedule and with low change order rate (< 6%) despite three-week SURF shutdown due to COVID.
- **Excavation phase** – underway. Construction of three DUNE caverns and new ventilation shaft. Work started in April 2021; plan to finish April 2024. Contractor is performing very well.
- **Infrastructure phase** - ready to start installation of utility systems (HVAC, electrical, etc.) as soon as excavation is completed in 2024.



Depositing rock in Open Cut



Drilling holes for Rock Blast

All Reliability Upgrade Projects were Completed in April 2021



1930-era Control System - Foot Pedals, Analog Gauges, and Hand Levers - replaced with state-of-the-art digital control system

New Hoist Control System



New Hoist Control Center with Flat Screen Monitors and Joystick Controls

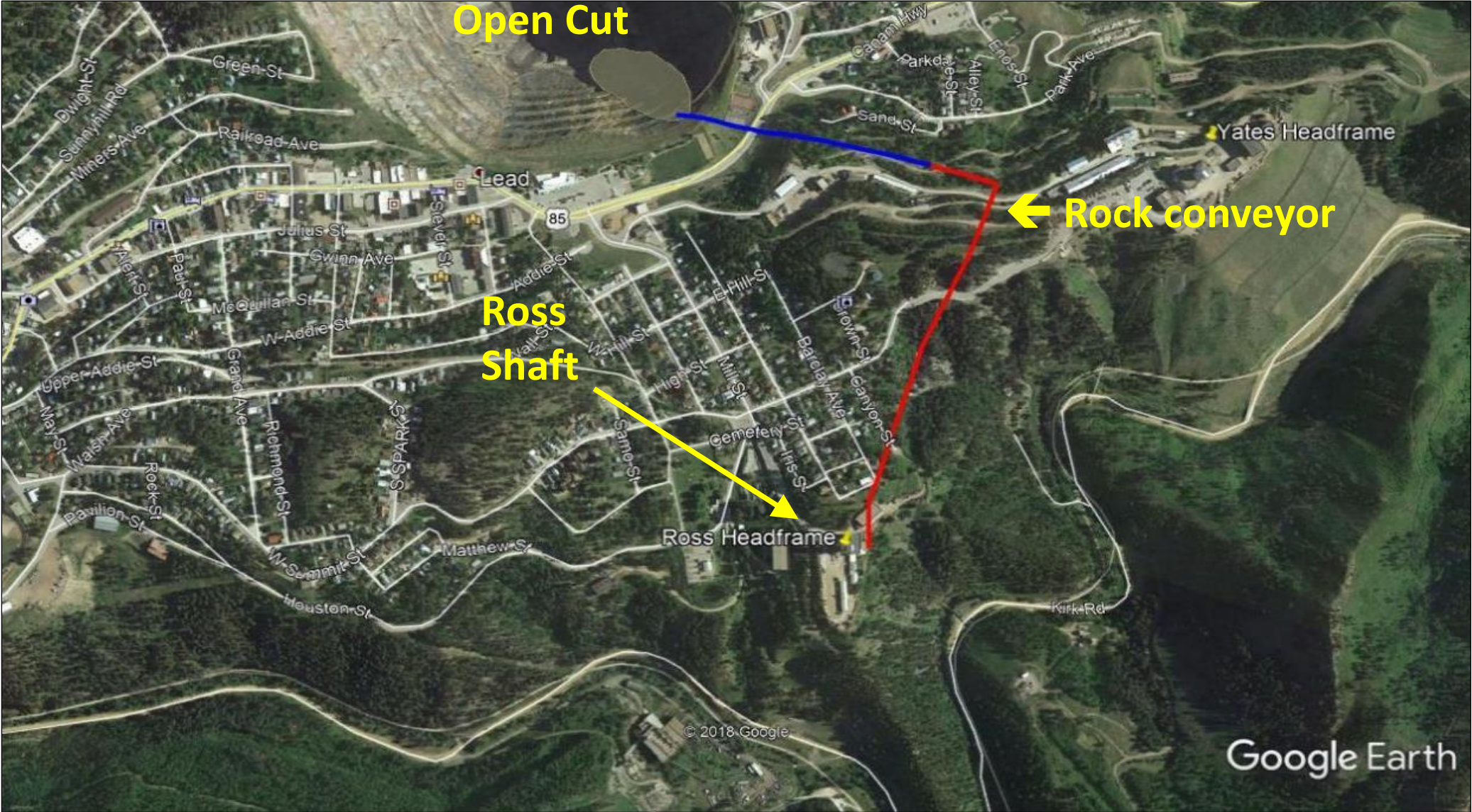


New Hoist Climate Control Cabs for cage and skip systems

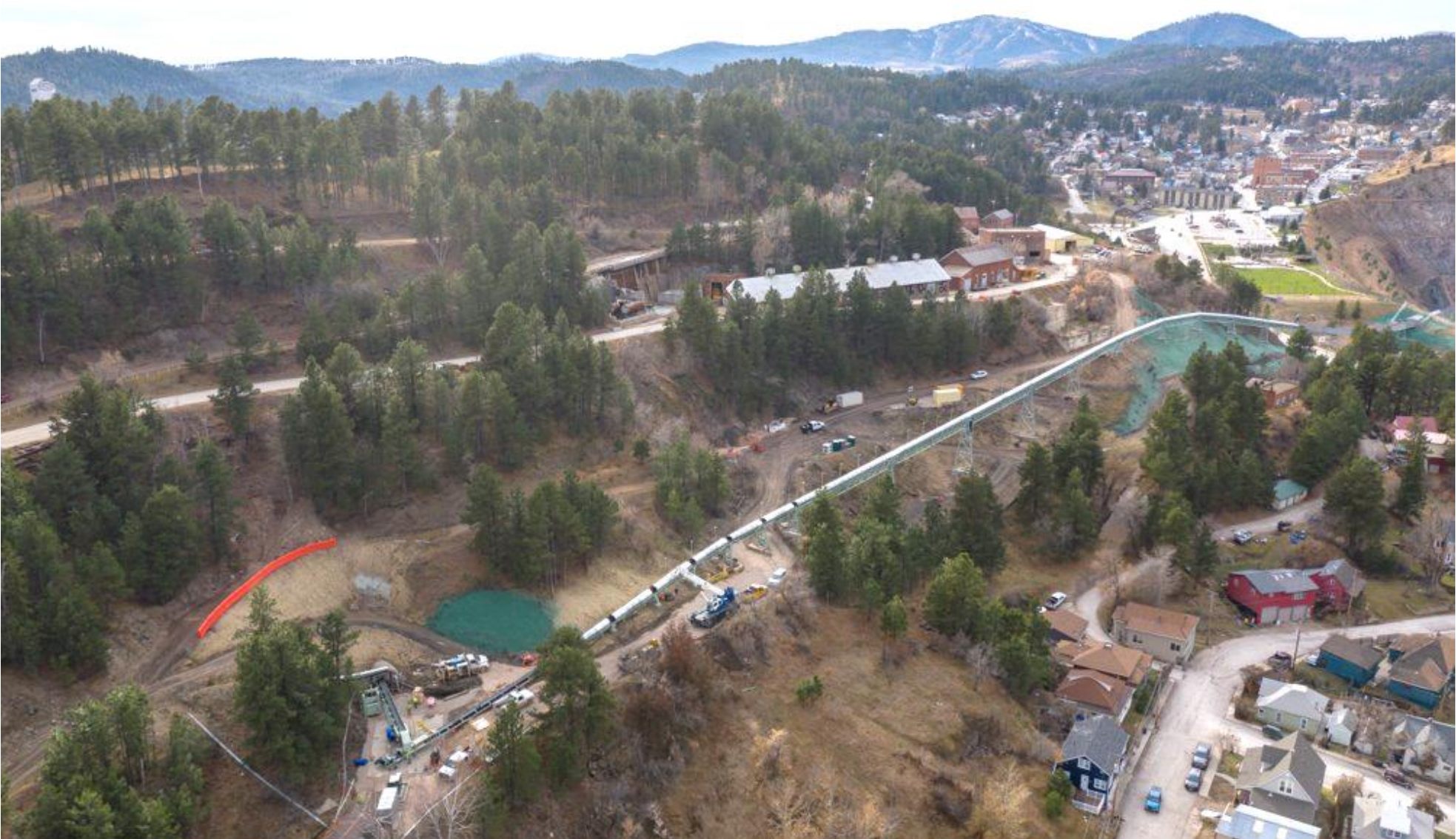
New Hoist Components – Motors and Brake Shoes



"Pre-Excavation" Work Completed in April

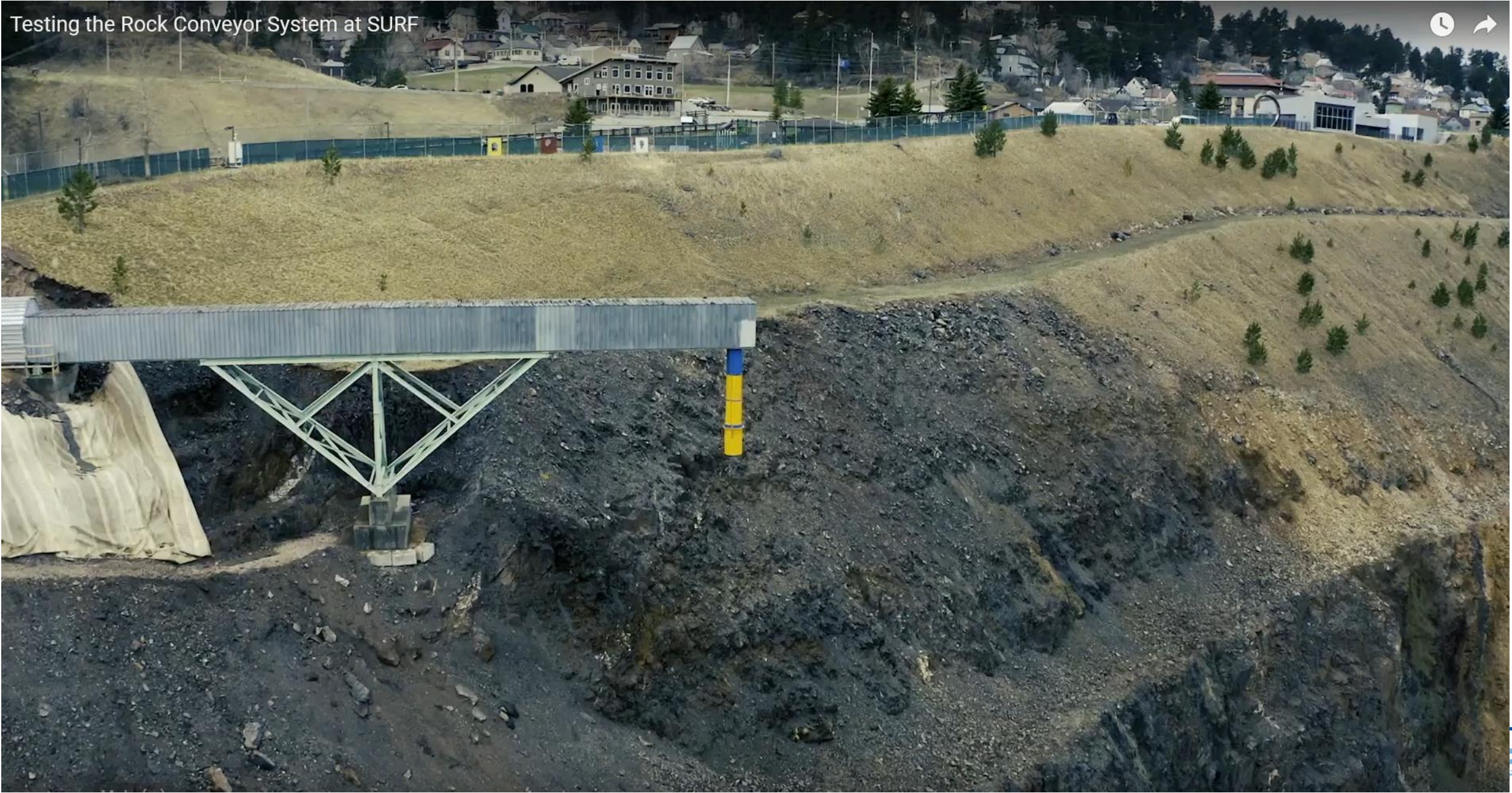


New Rock Conveyor will move 800,000 tons of rock to the Lead SD Open Cut

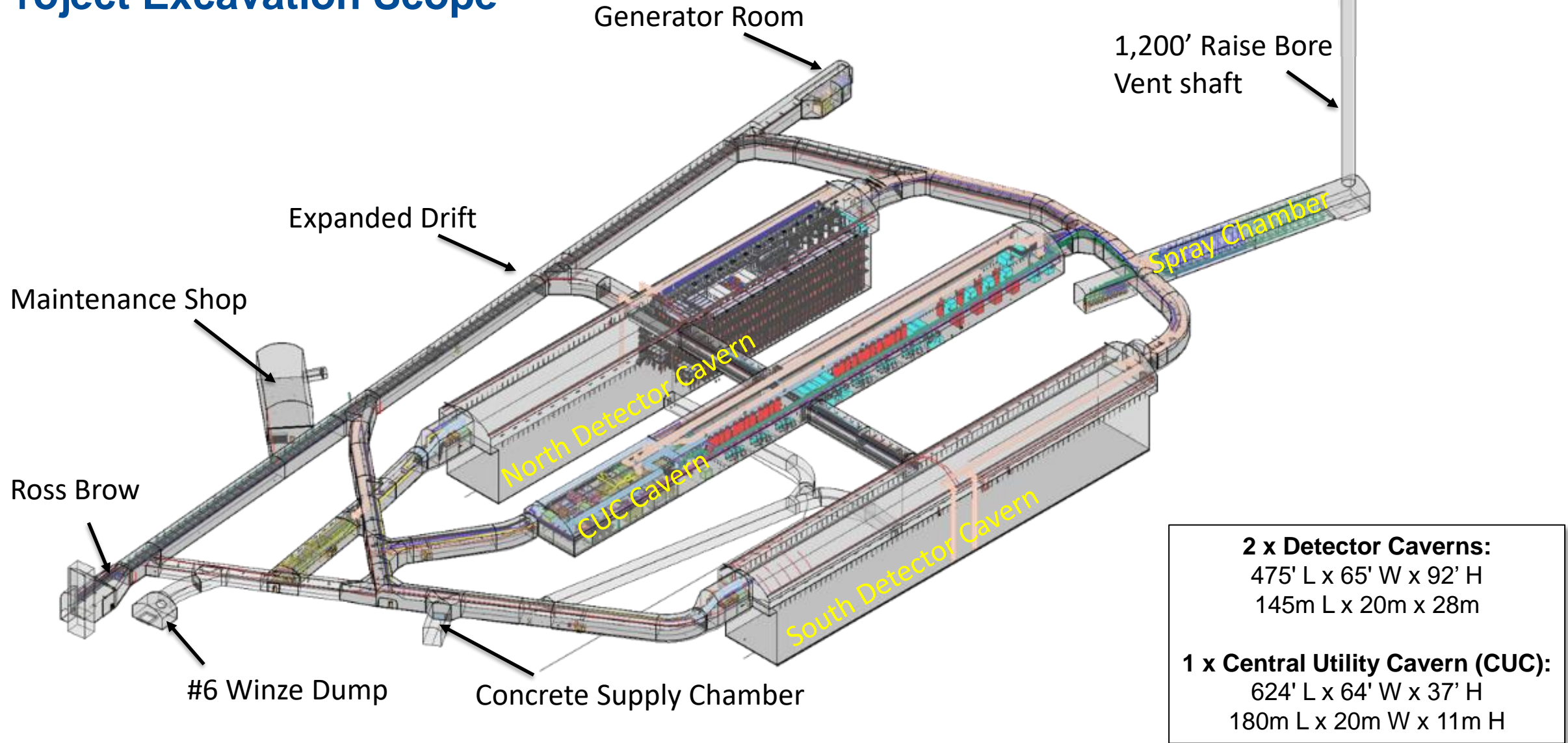


Pre-Excavation Work Completion - First Test of Rock Handling System – May 2021

Testing the Rock Conveyor System at SURF

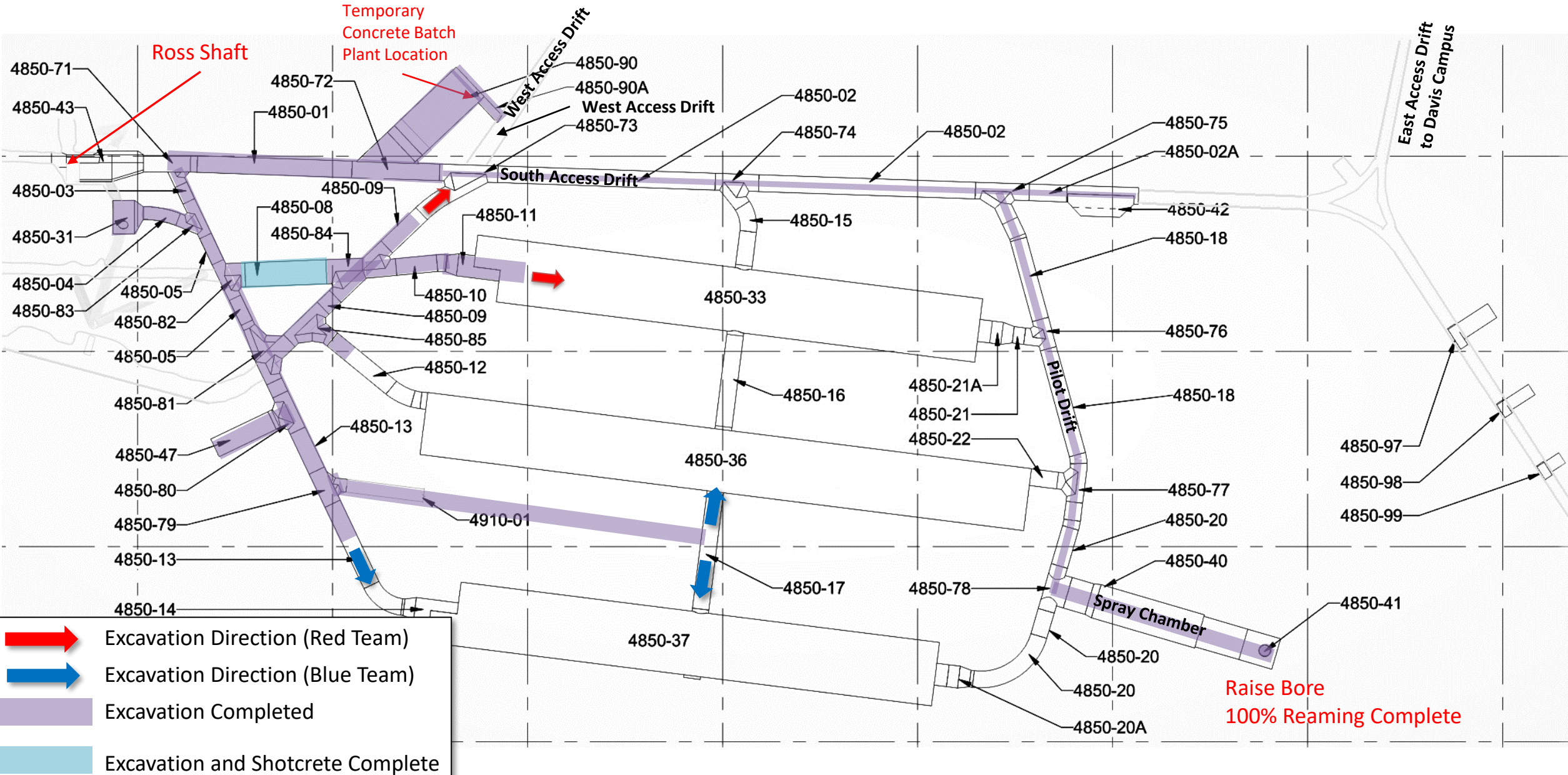


Project Excavation Scope



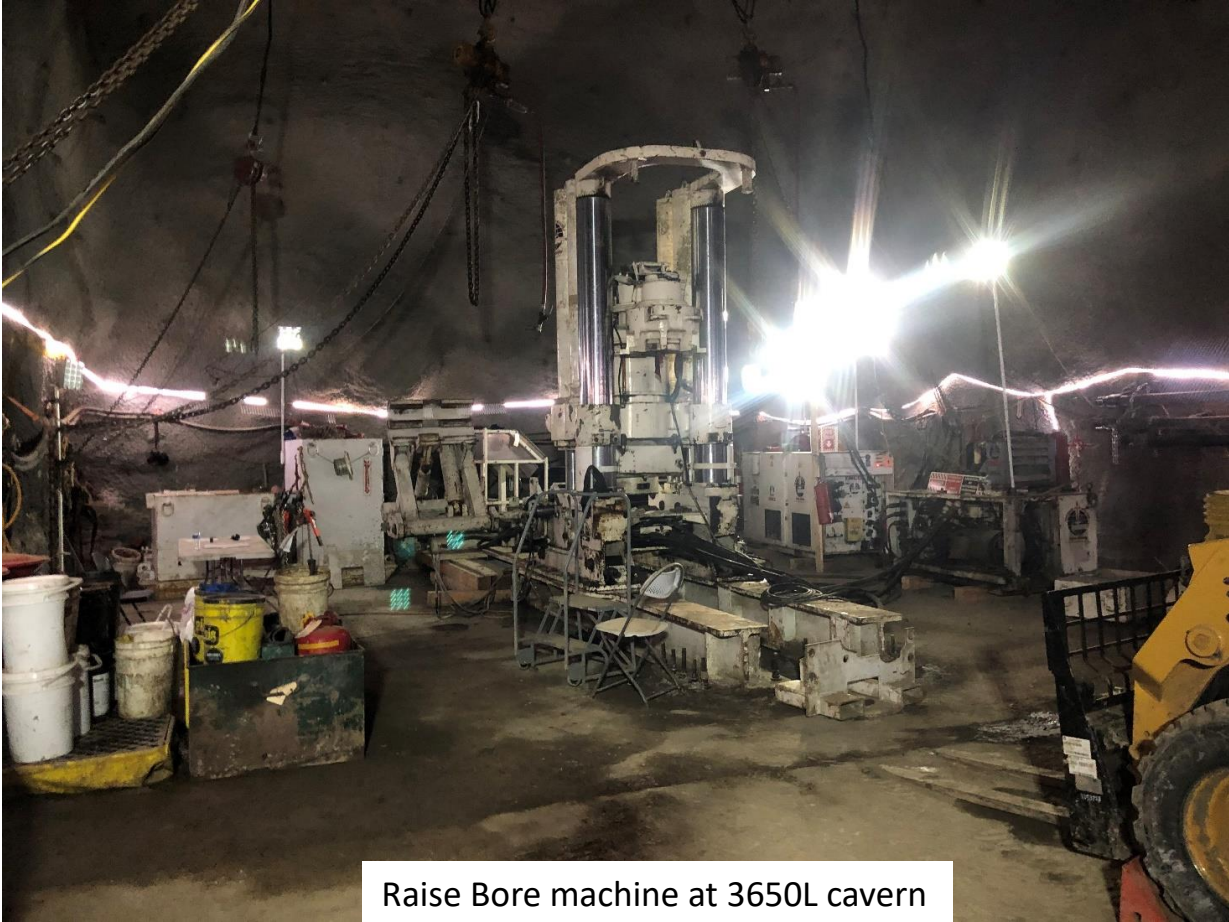
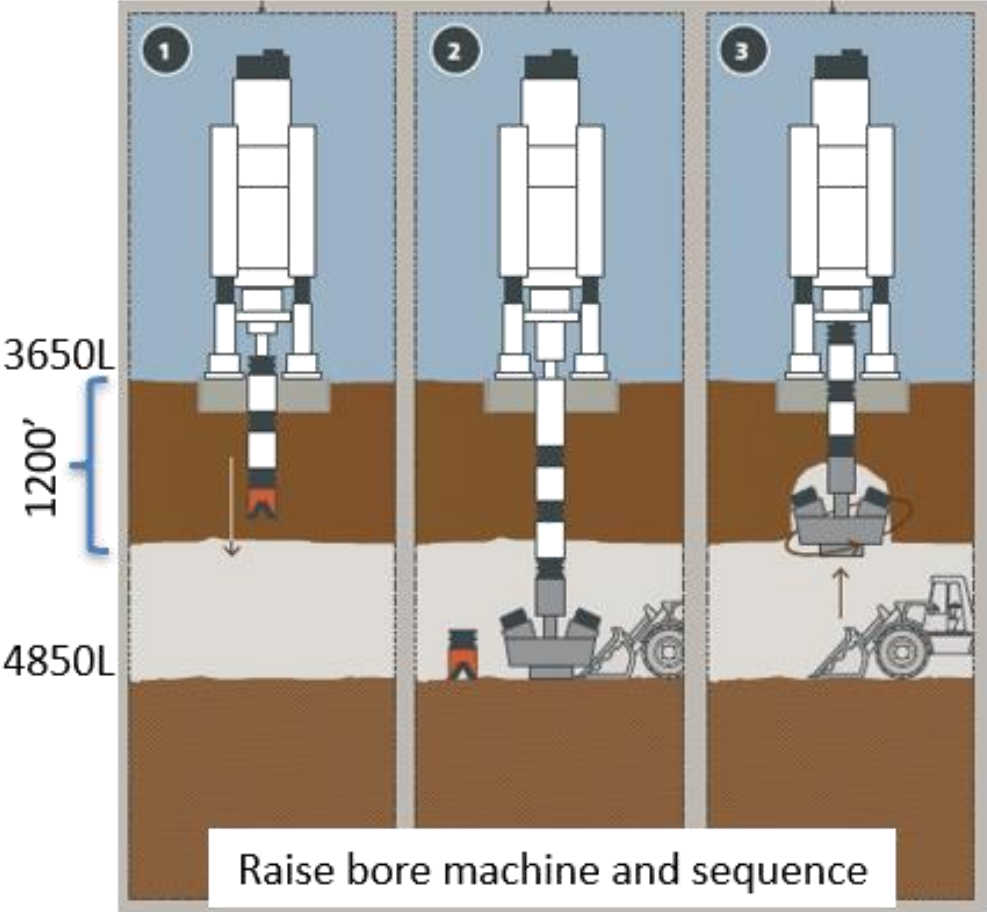
Overall Excavation Status as of 18 November

Total Excavation Complete 10.7%



Far Site “Raise Bore” Ventilation Shaft

- Building a 1200’ ventilation shaft to support the experimental caverns.



Reaming of 1200' Raise Bore Ventilation Shaft was completed on 4 October 2021

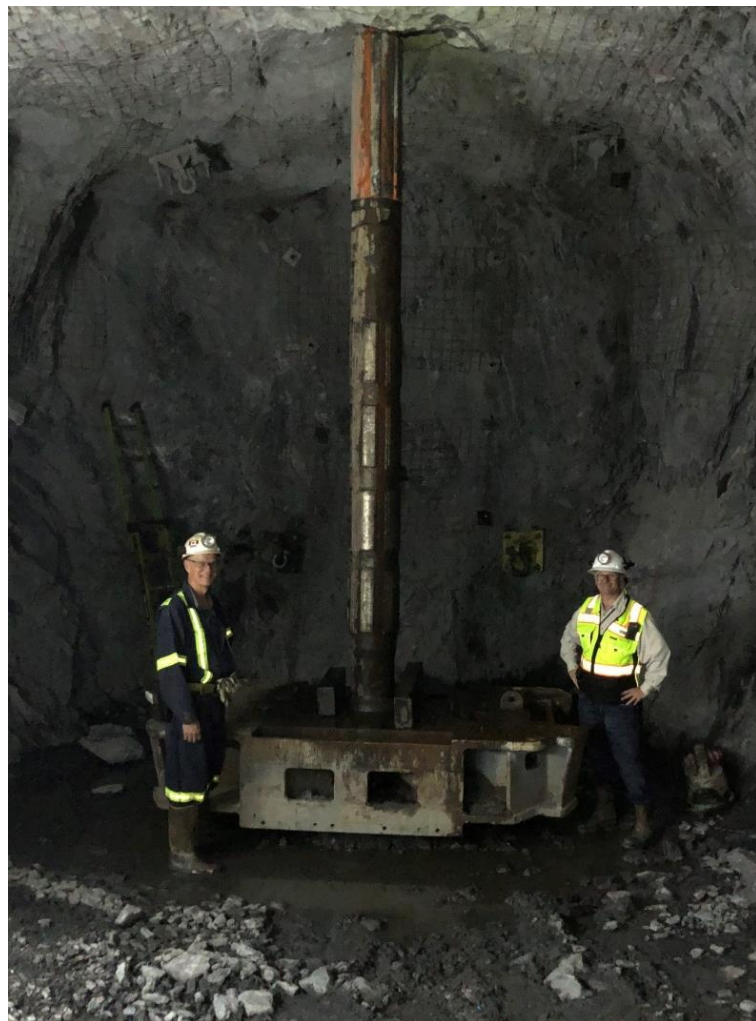
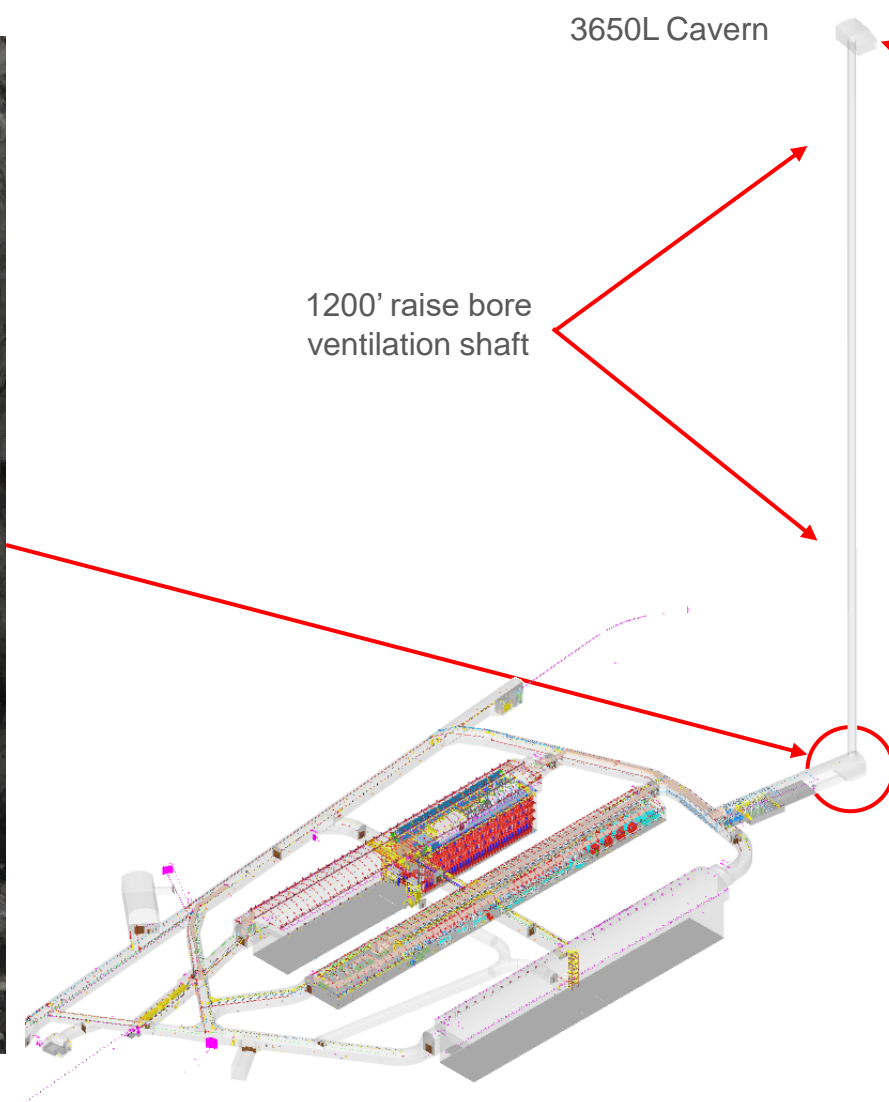


Photo of start of reaming at 4850L – 13 July 2021



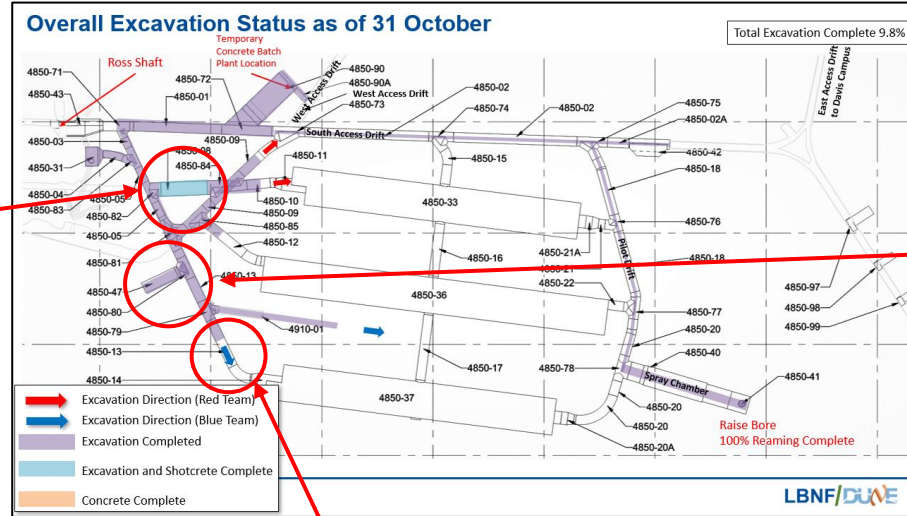
12' reamer head at breakthrough at 3650L Cavern – 4 Oct 2021

Completion of excavation for the raise bore retires most significant excavation risk

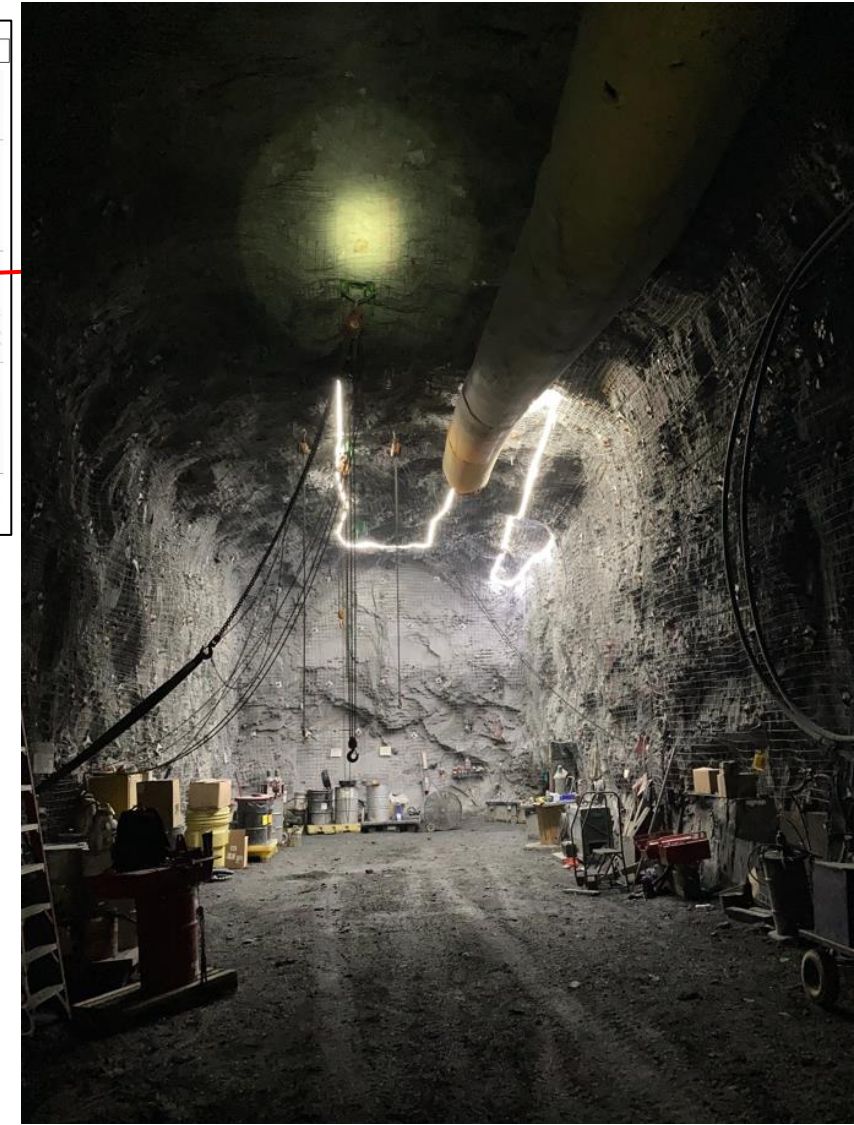
Excavation Status Photos



Setting Up the Robotic Shotcrete Machine

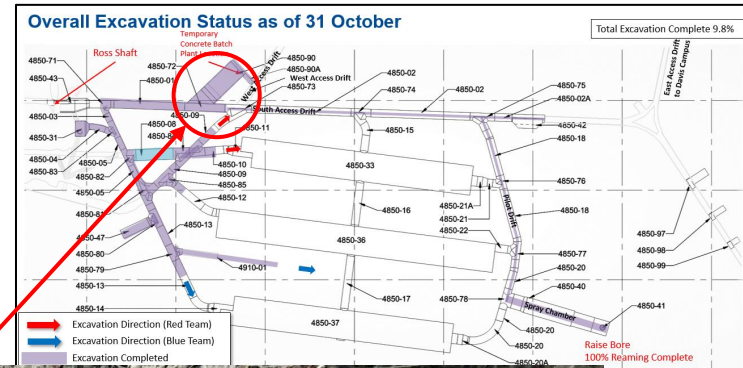


Surveyor mapping the 4850-13S Heading



Permanent Concrete Batch Plant (4850-47)

Completion of Maintenance Chamber allows Larger Equipment for Main Cavern Excavation to Begin Movement Underground



Sandvik 422i Jumbo on surface



Sandvik 422i Jumbo being reassembled at 4850L in new maintenance cavern

Far Site Excavation Process



Setting out the Blasting Pattern



Drilling Charge Holes in the 4850-81 Face

Far Site Excavation Process



Moving “muck” to the ore bin, to be loaded in skip and moved to surface, crushed, and conveyed to the Open Cut



Installing rock bolts and welded-wire fabric for ground control

DUNE Far Detectors Status

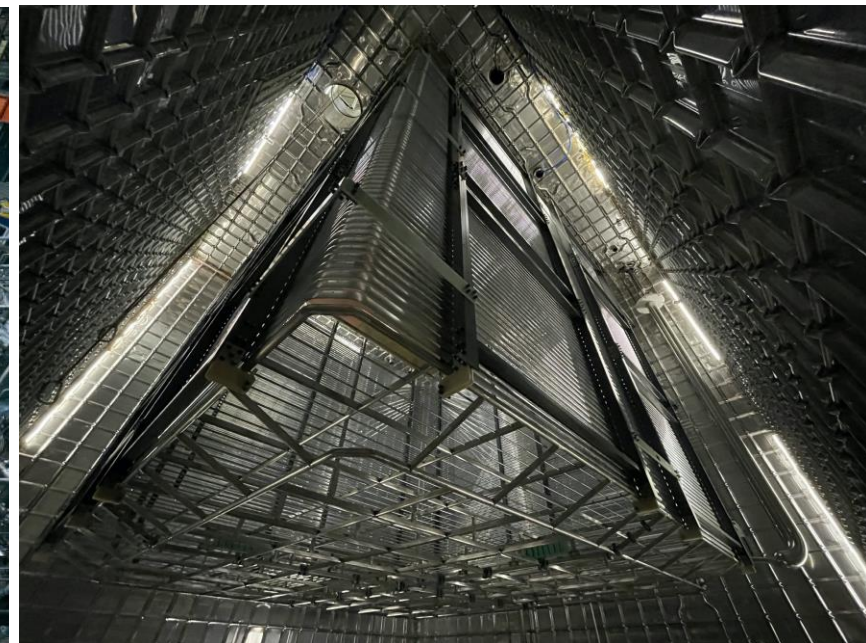
- 1st far detector module to be based on Anode Plane Assembly (APA) technology with horizontal drift
- 2nd far detector module to be based on Charge Readout Plane (CRP) technology with vertical drift
- CERN Neutrino Platform has operated two 8m x 8m x 8m prototypes to mature and prove technology



APAs for Module 0 ProtoDUNE being tested at Daresbury Laboratory, UK. One 2.3m x 6.3m APA is shown; UK to provide 130 APAs.

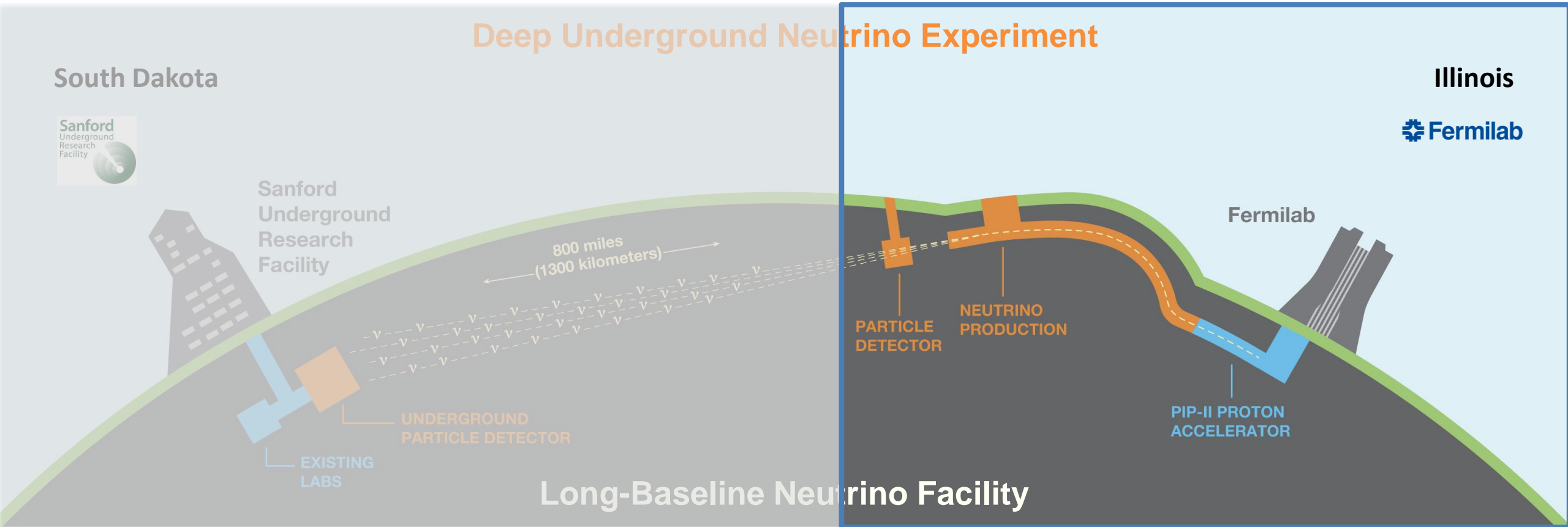


NP-02 and NP-04 ProtoDUNE 8m x 8m x 8m detector prototypes at CERN.

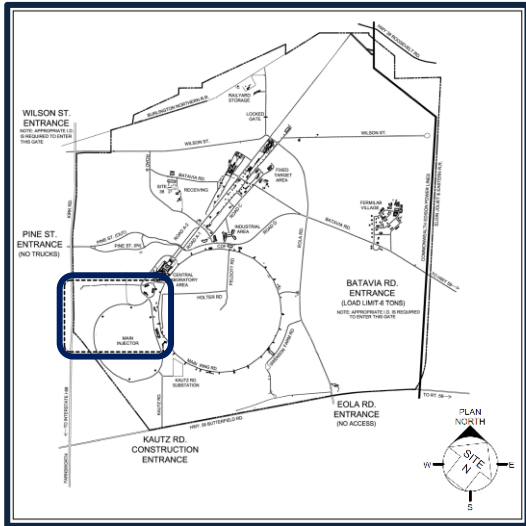


NP-02 ProtoDUNE 8m x 8m x 8m cryostat at CERN has demonstrated 300 kV across field cage for CRP detector technology

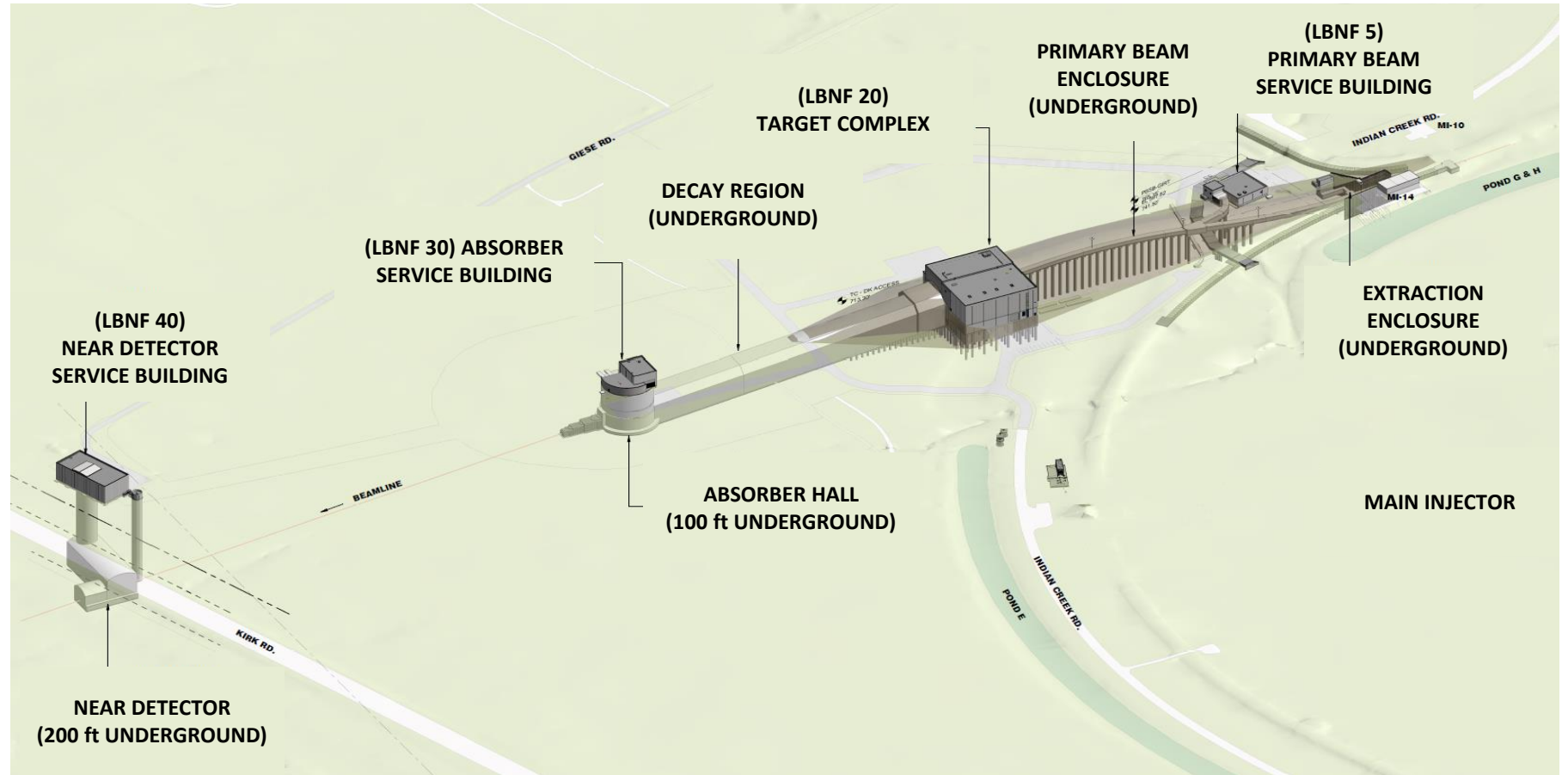
LBNF Near Site Update



LBNF Near Site Conventional Facilities – at Fermilab



LBNF project area located in SW corner of Fermilab site near Kirk Rd



100% final design and design reviews completed on 28 September for the Beamline Complex and Near Detector Complex.

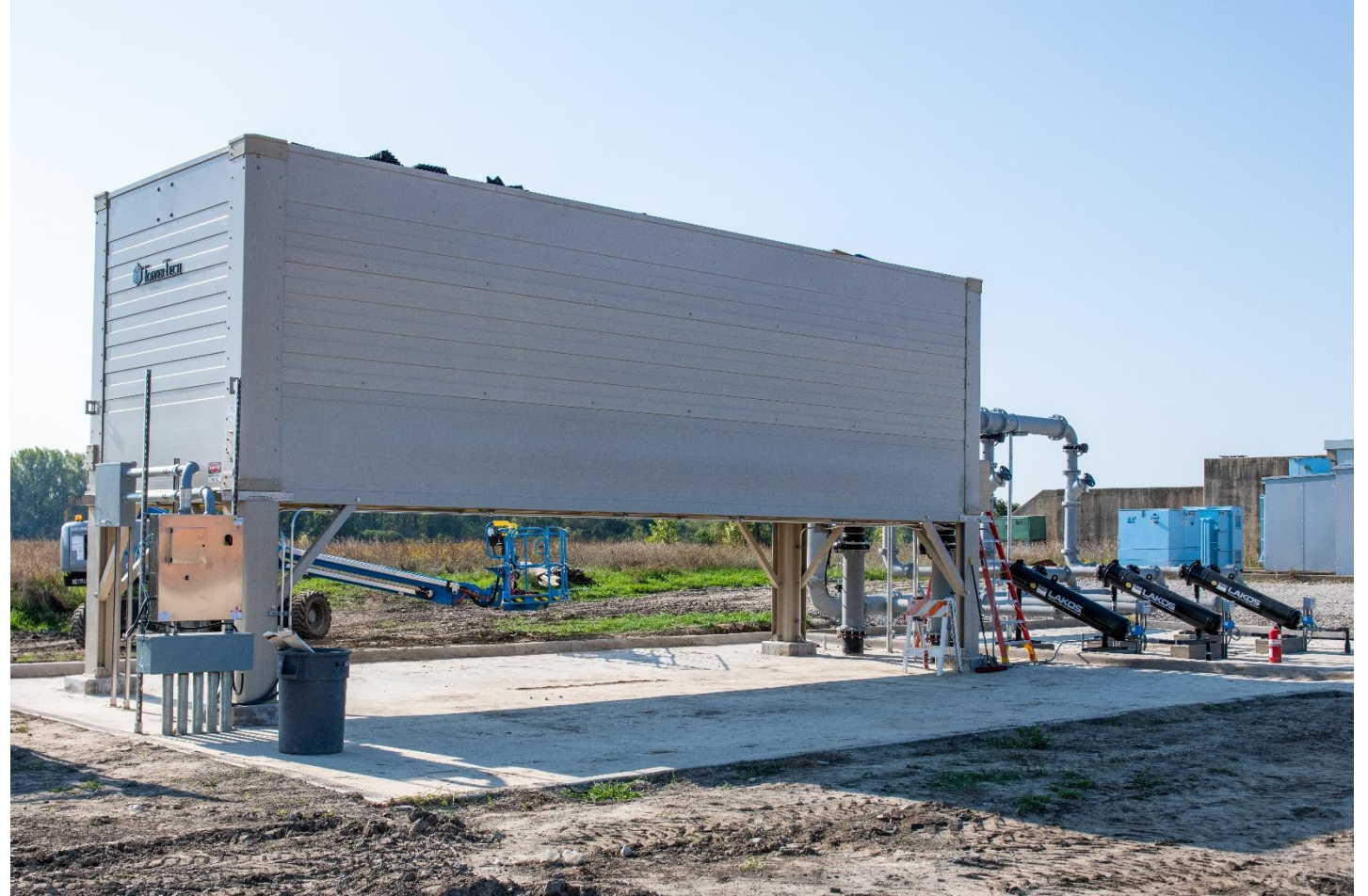
Batavia: Site Preparation Work Status – completed last October

- \$15M scope of work completed to prepare site for LBNF beamline facilities
 - Reroute Indian Creek, relocate utilities, backfill a Fermilab cooling pond
- Completed on schedule



Rerouting Indian Creek with a new 450+ foot long culvert system with fish channel – now completed

Batavia: Backfilling Main Injector Cooling Pond and Installing New Cooling Tower



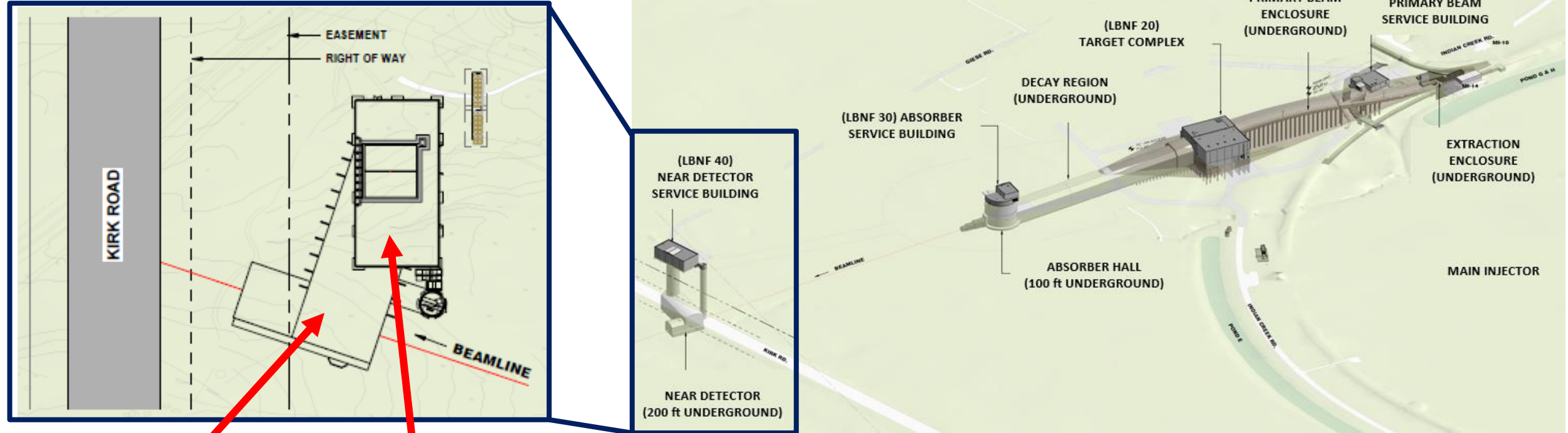
Filling in “Pond F” to create site for LBNF Facilities; replacing cooling capacity with new cooling tower – now completed

Batavia: Rerouting Power Distribution



Utilities relocation to support LBNF Facilities – now completed

Batavia: Main LBNF Construction at Fermilab Scheduled to Begin 2026

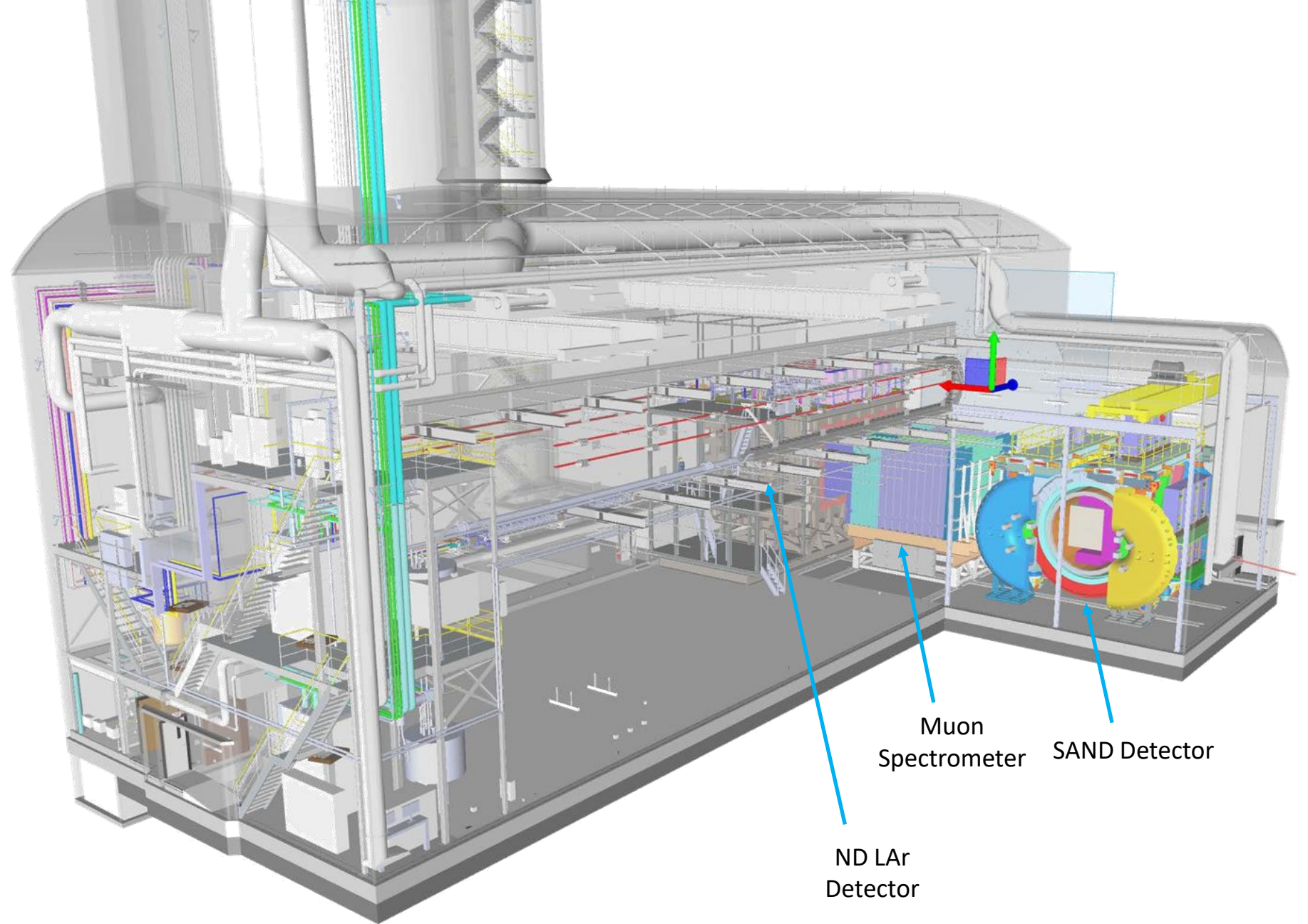


Near Detector Cavern will be 200 ft underground

Near Detector Service Building (10k SF) located within Fermilab site will be visible from Kirk road (see slide 30)

The Near Detector Complex will be most visible part of the main LBNF construction to the surrounding community.

Near Detector Hall



ND LAr
Detector

Muon
Spectrometer

SAND Detector

Near Site Conventional Facilities are positioned to start construction upon funding availability and approval

Batavia: Near Detector Service Building



View from inside Fermilab (looking west)



View from Kirk Road (looking east)

Looking ahead

- Due to funding limitations, don't expect construction work to start at Fermilab until 2026.
- If additional funds are made available, we could start construction in 1.5 to 2 years.
- Thanks for your ongoing support of this exciting project!

Thank you. Questions?

