

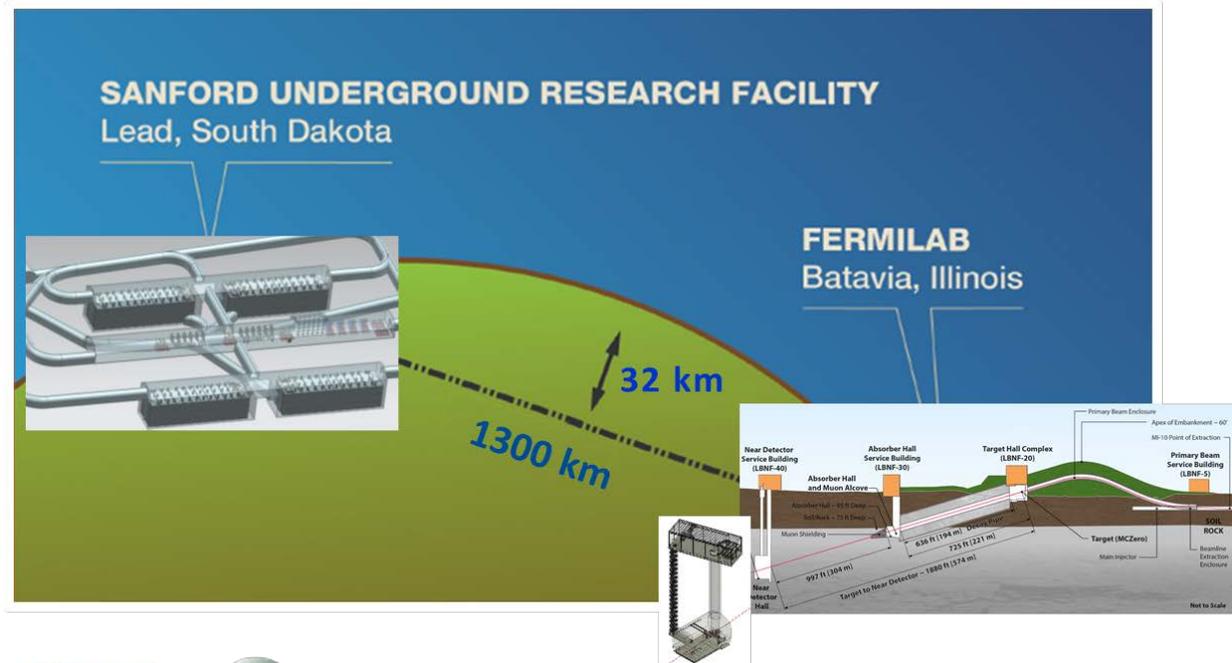


Operated by Fermi Research Alliance, LLC for the U.S. Department of Energy Office of Science

Status and Plans for the LBNF Far Site Project

Chris Mossey,
LBNF Project Director

Report to HEPAP
9 Dec 2015

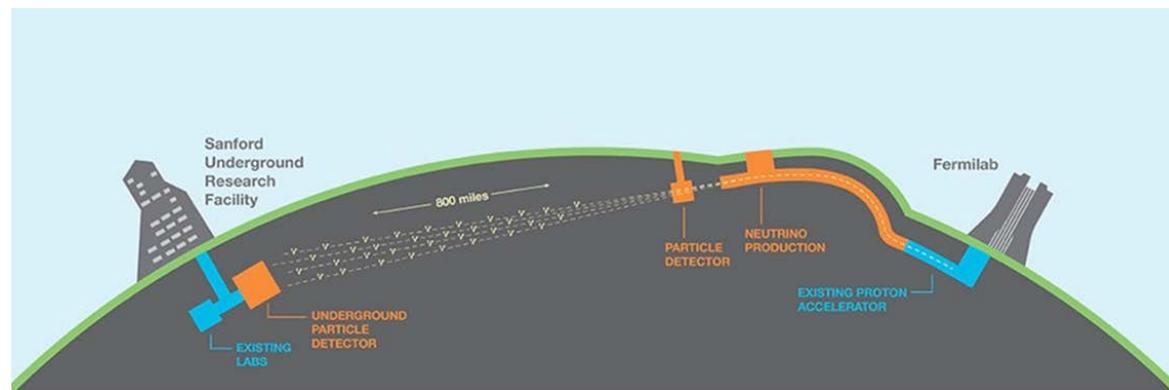


Outline

- Project overview
- DOE Critical Decision Milestone Status
- Far Site Overview and Scope of Work
- Schedule overview and summary
- Governance/Organization/Management
- CD-3A IPR review and next steps

Project Overview: LBNF and DUNE

- **LBNF**: DOE project with support from non-DOE partners. Provides facility infrastructure at two locations to support the experiment:
 - **Near site**: Fermilab, Batavia, IL – facilities to **create neutrino beam**
 - **Far site**: Sanford Underground Research Facility, Lead, SD – facilities to **support DUNE detectors**
- **DUNE**: Deep Underground Neutrino Experiment
 - **Near and far site detectors**: U.S. as **partner** in international project



This project is unique...

“This project will be the first time the U.S. has hosted a truly international mega-science project on U.S. Soil”... SC-2

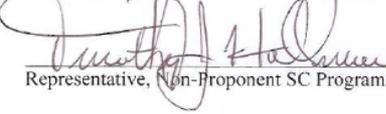
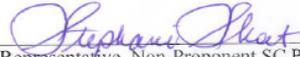
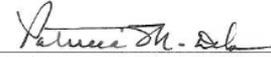
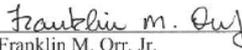
- **We must be a flexible host and a reliable partner to be successful... which means:**
 - **Accounting:** We adopt “core” costing for international partners
 - **Contingency:** No DOE contingency on non-DOE contributions. We trust that our partners will deliver.
 - **Project management:** Earned value system for DOE scope; milestones for partners.

DOE Critical Decision (CD) Milestone Status:

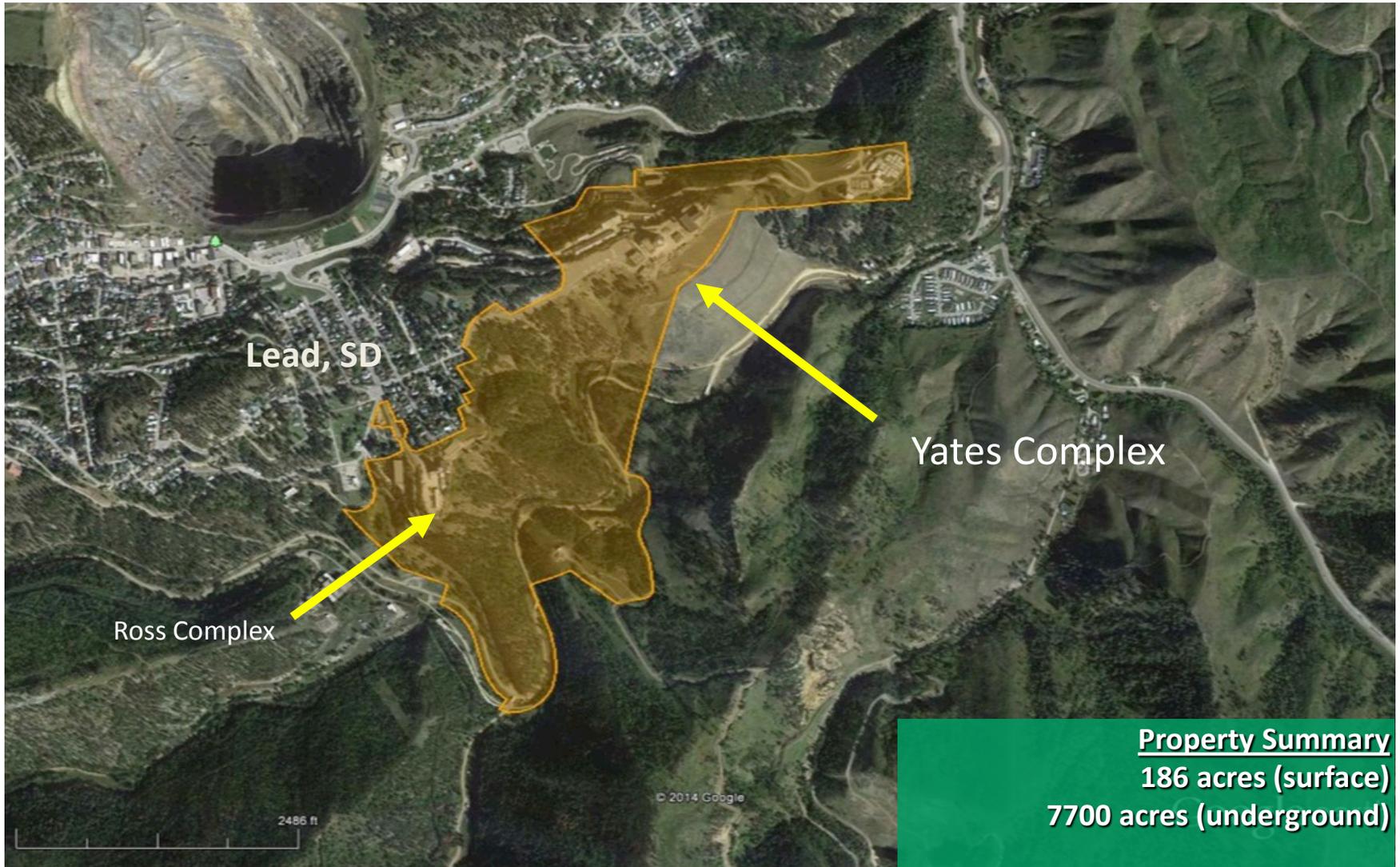
- CD-0 was approved in January 2010
- CD-1R was approved in November 2015 
- DOE IPR conducted December 2nd – 4th 2015 to request approval of milestone CD-3a, **Approve Initial Far Site Construction.**
- Expect CD-3a milestone decision by end of 2nd quarter FY2016

**Critical Decision 1, Approve Alternative Selection and Cost Range
for the LBNF/DUNE Project**

Recommendations:
The undersigned “Do Recommend” (Yes) or “Do Not Recommend” (No) approval of CD-1, Approve Alternative Selection and Cost Range, for the LBNF/DUNE Project at Fermilab and SURF site as noted below.

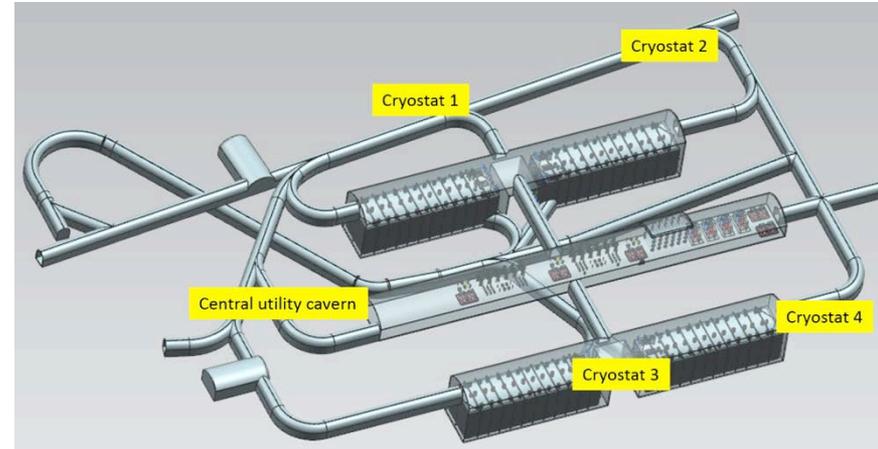
 ESAAB Secretariat, Office of Project Assessment	11/5/15 Date	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
 Representative, Non-Proponent SC Program Office	11/5/15 Date	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
 Representative, Office of Budget	11/5/15 Date	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
 Representative, Non-Proponent SC Program Office	11/5/15 Date	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
 Representative, Office of Project Management Oversight and Assessment	11/5/15 Date	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
 Patricia M. Dehmer Acting Director, Office of Science	11/5/15 Date	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
Approval:		
Based on the information presented in this document and at the ESAAB review, I approve Critical Decision 1, Approve Alternative Selection and Cost Range for the LBNF/DUNE Project.		
 Franklin M. Orr, Jr. Under Secretary for Science and Energy	11/5/15 Date	

Far Site Overview – Sanford Lab in Lead, SD

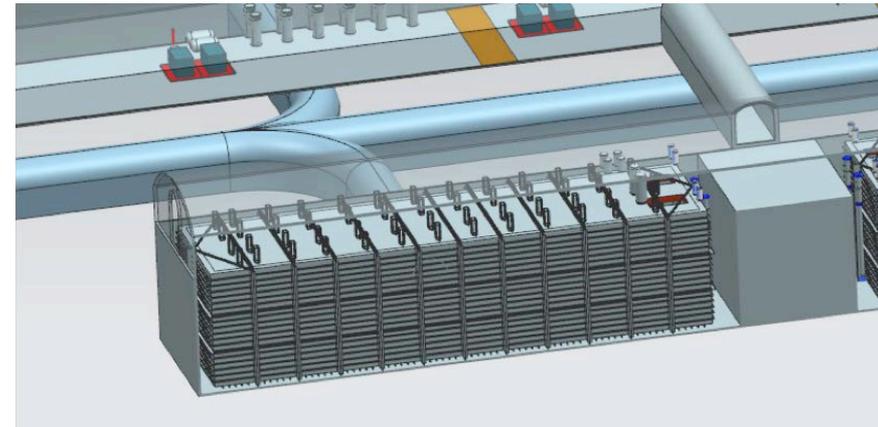


Far Site Scope – Major Components

- **Conventional Facilities:**
 - **Drifts** and two **caverns** for detectors
 - **Central utility cavern** for conventional and cryogenic equipment
 - **Surface** and **shaft** Infrastructure including utilities
- **Cryostats:**
 - Four **membrane** cryostats supported by external steel frames
- **Cryogenic Systems:**
 - **LN2 refrigeration system** for cooling and re-condensing gaseous Argon
 - Systems for **purification** and **recirculation** of LAr
- **Argon: 70kt LAr** (~40kt “fiducial” mass)

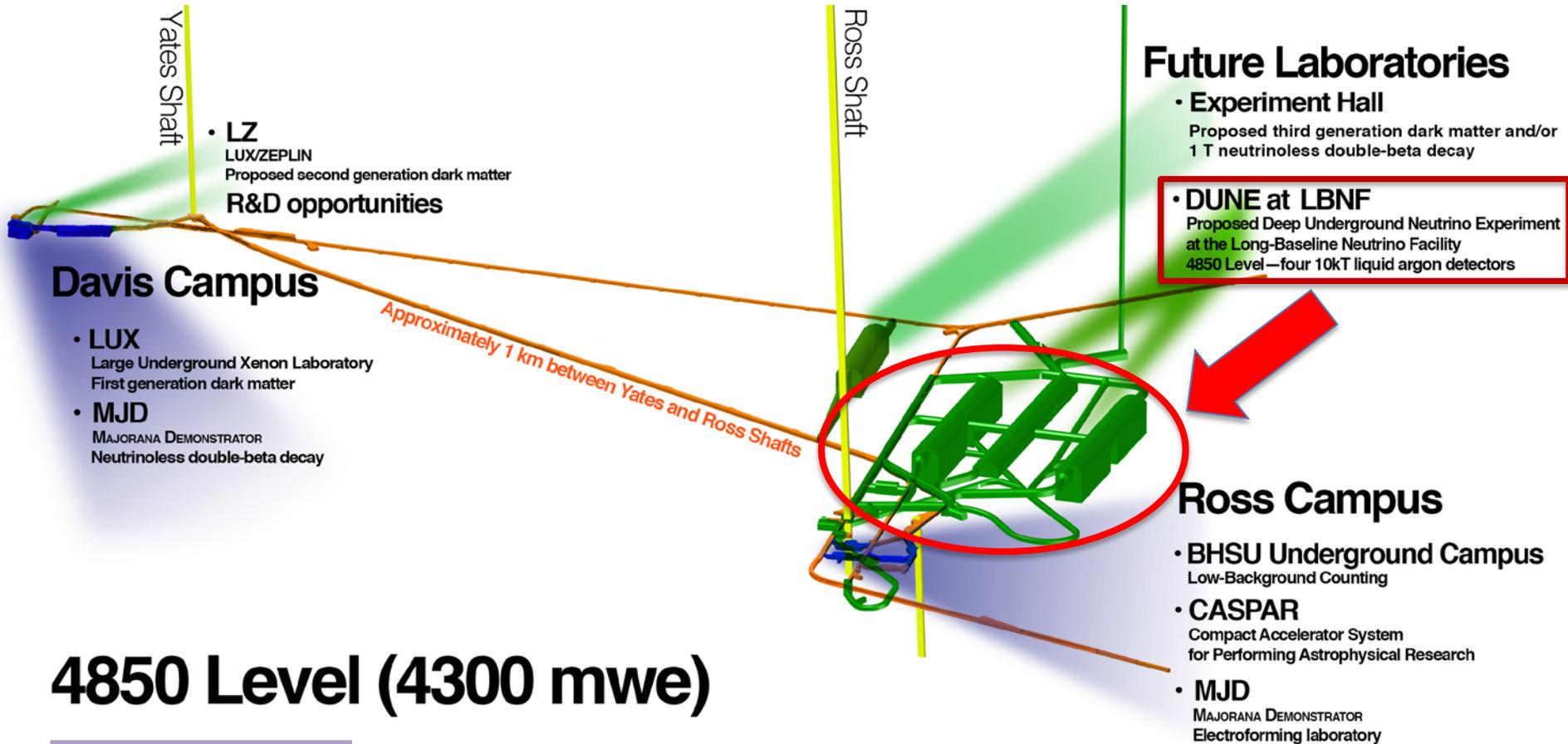


4850L cavern and drift layout



Single cryostat

Far Site Scope Context – *part of an Underground Campus*



4850 Level (4300 mwe)

Existing facilities

Proposed facilities

Far Site Scope – Overview of Phases of Work

1. Sanford Lab Reliability Projects

FY16 – 18

- Ross shaft rehab
- Hoist motor rebuilds, more...

2. Pre-Excavation

FY17 - 20

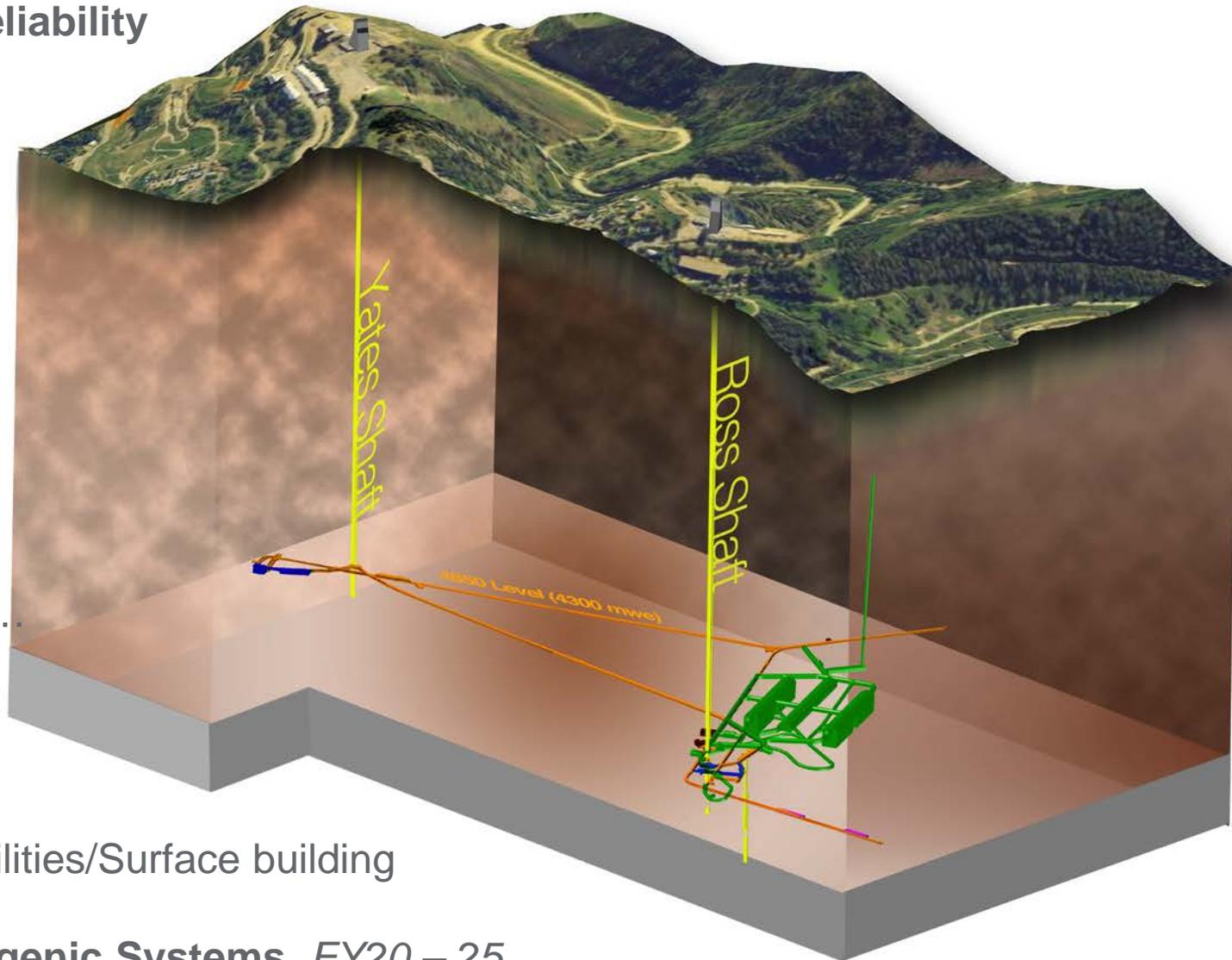
- Rock disposal systems
- Ross brow expansion, more...

3. Excavation/Construction

FY18 – 22

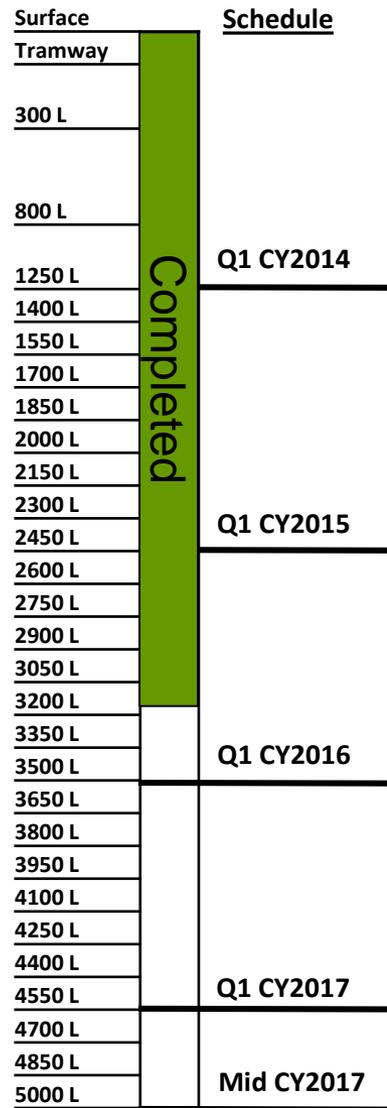
- Caverns/Drifts/Utilities/Surface building

4. Cryostats/Cryogenic Systems *FY20 – 25*



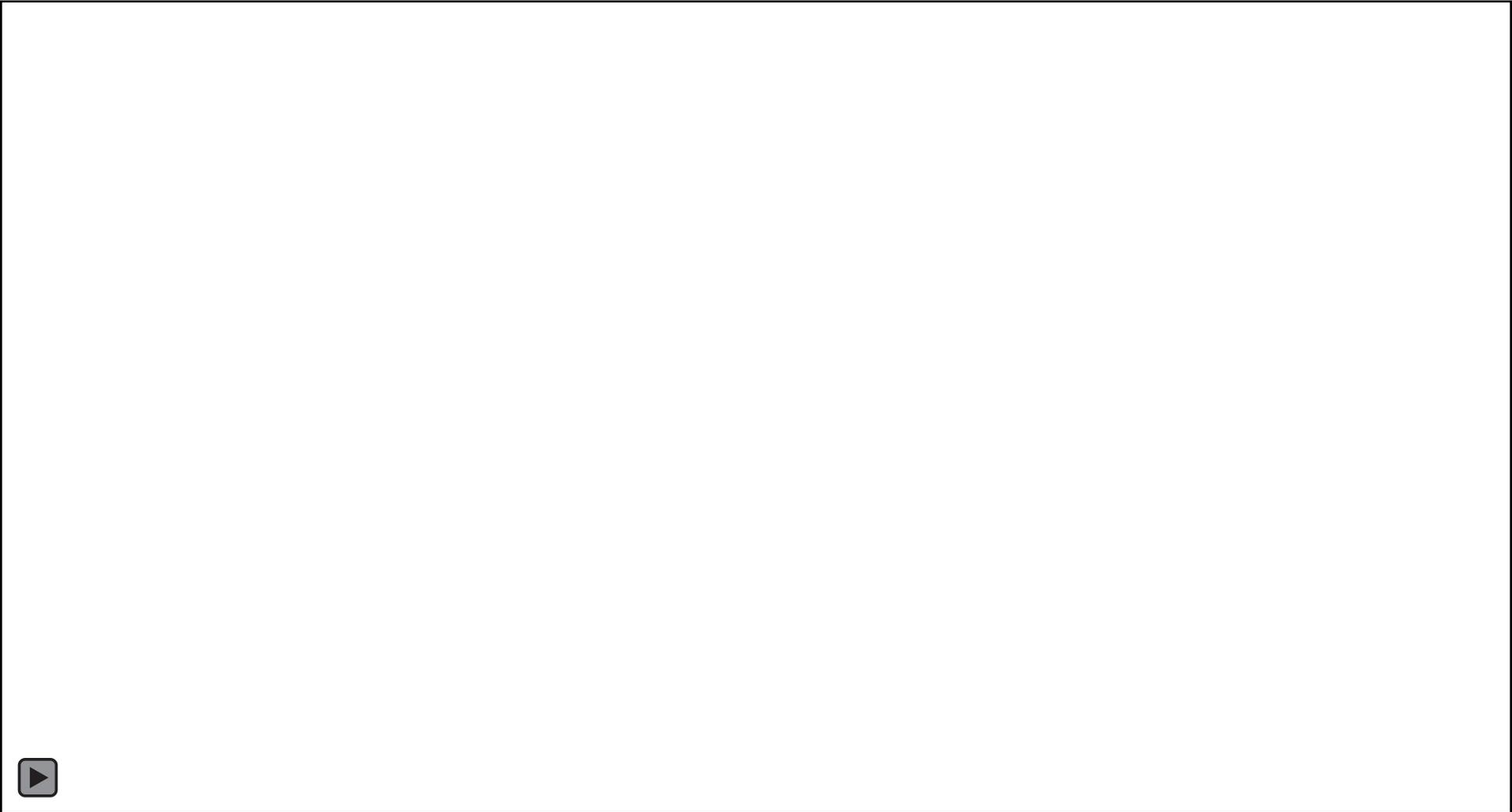
Sanford Lab Reliability Projects - Ross Shaft Refurbishment

3,273' steel installed (64%) completed

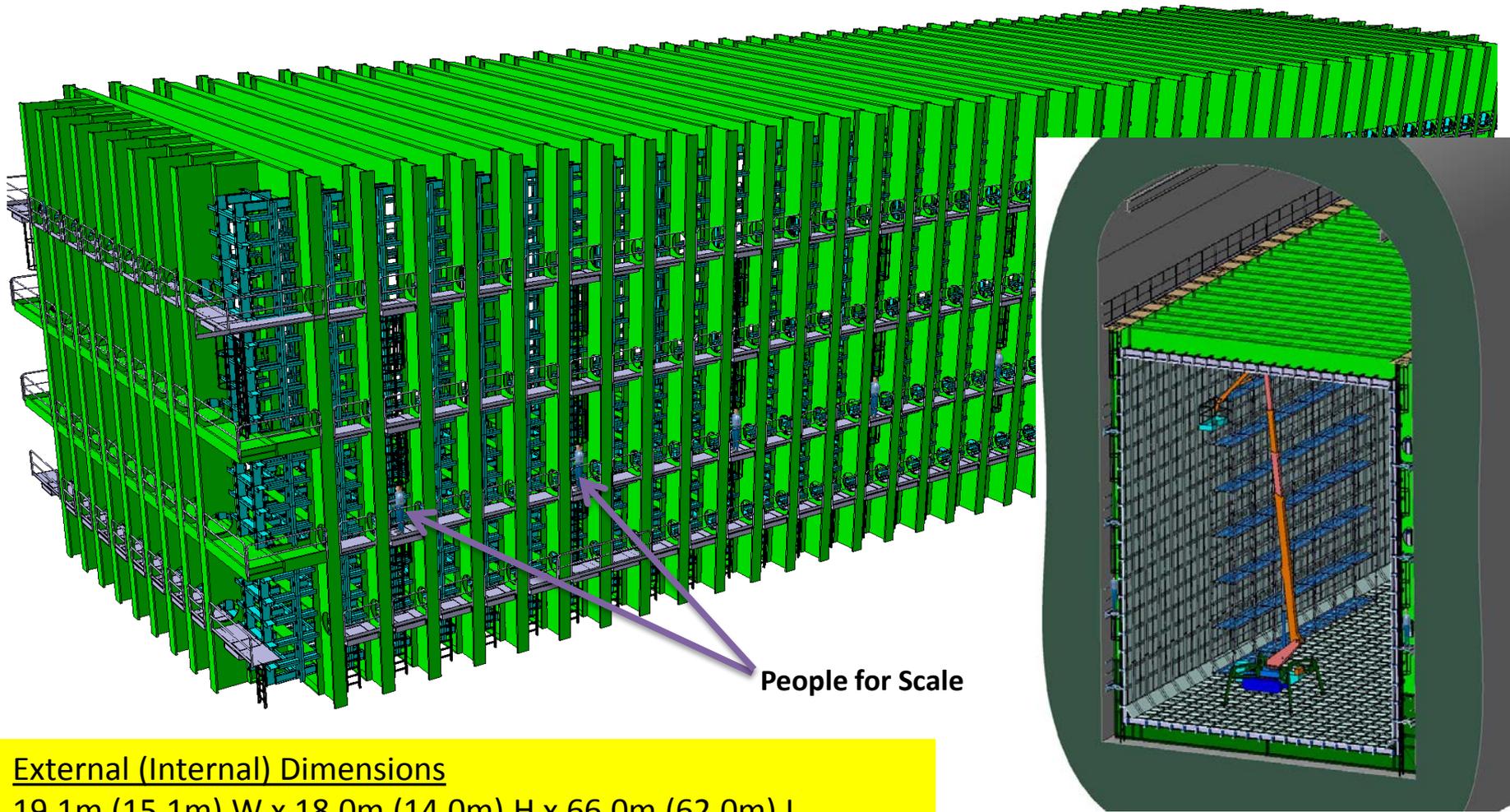


- Both Ross and Yates Shafts constructed in 1930s
- Ross Shaft refurbishment needed to support hoisting of the **~800,000 tons** of excavated rock and transport of personnel and materials for LBNF construction
- Starting in August 2012, SDSTA provided first \$20M (state and private funds) towards refurbishment. SDSTA purchased structural steel for entire project.
- SDSTA self-performing refurbishment.
- Starting January 2016, LBNF will fund remaining shaft refurbishment. Contract is currently in work.
- Project on track to be completed by July 2017

Traversing Up the Ross Shaft Video - from old steel into new



Free-Standing Steel Cryostat Design

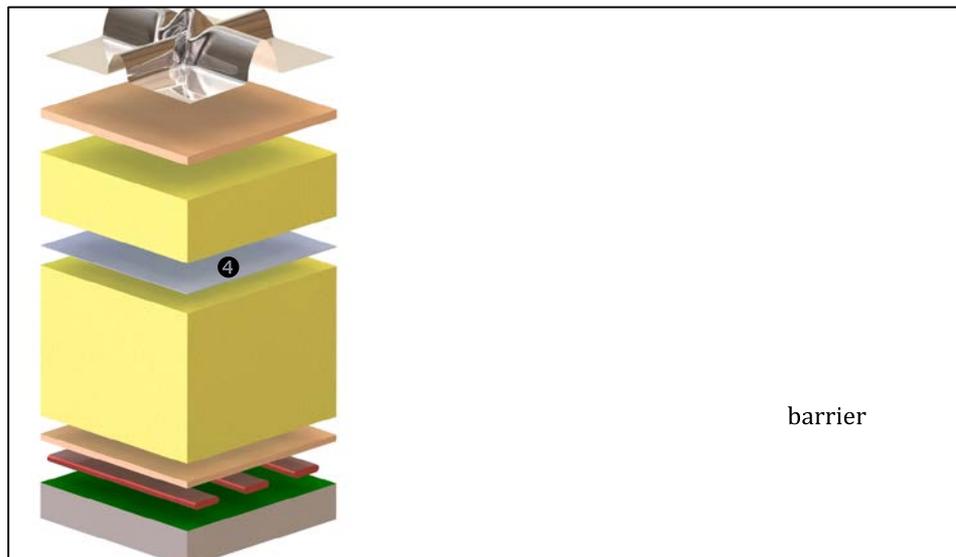
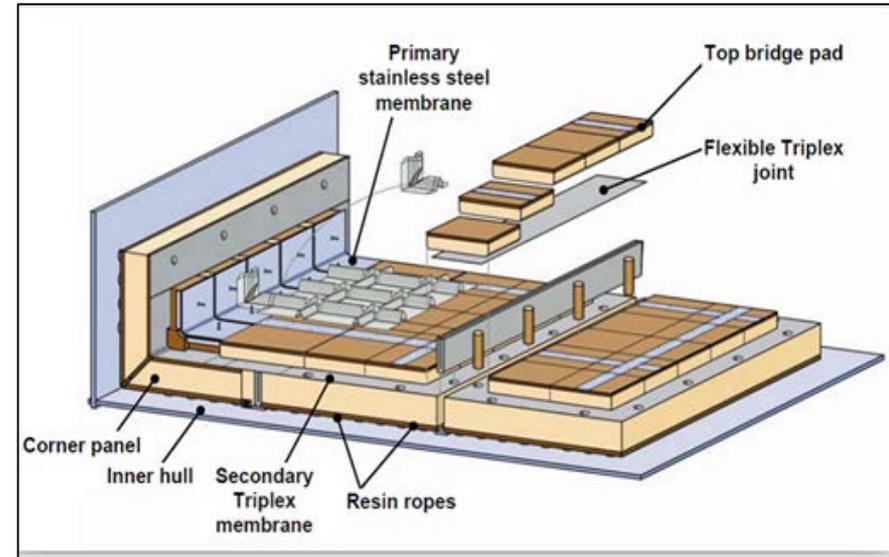


External (Internal) Dimensions

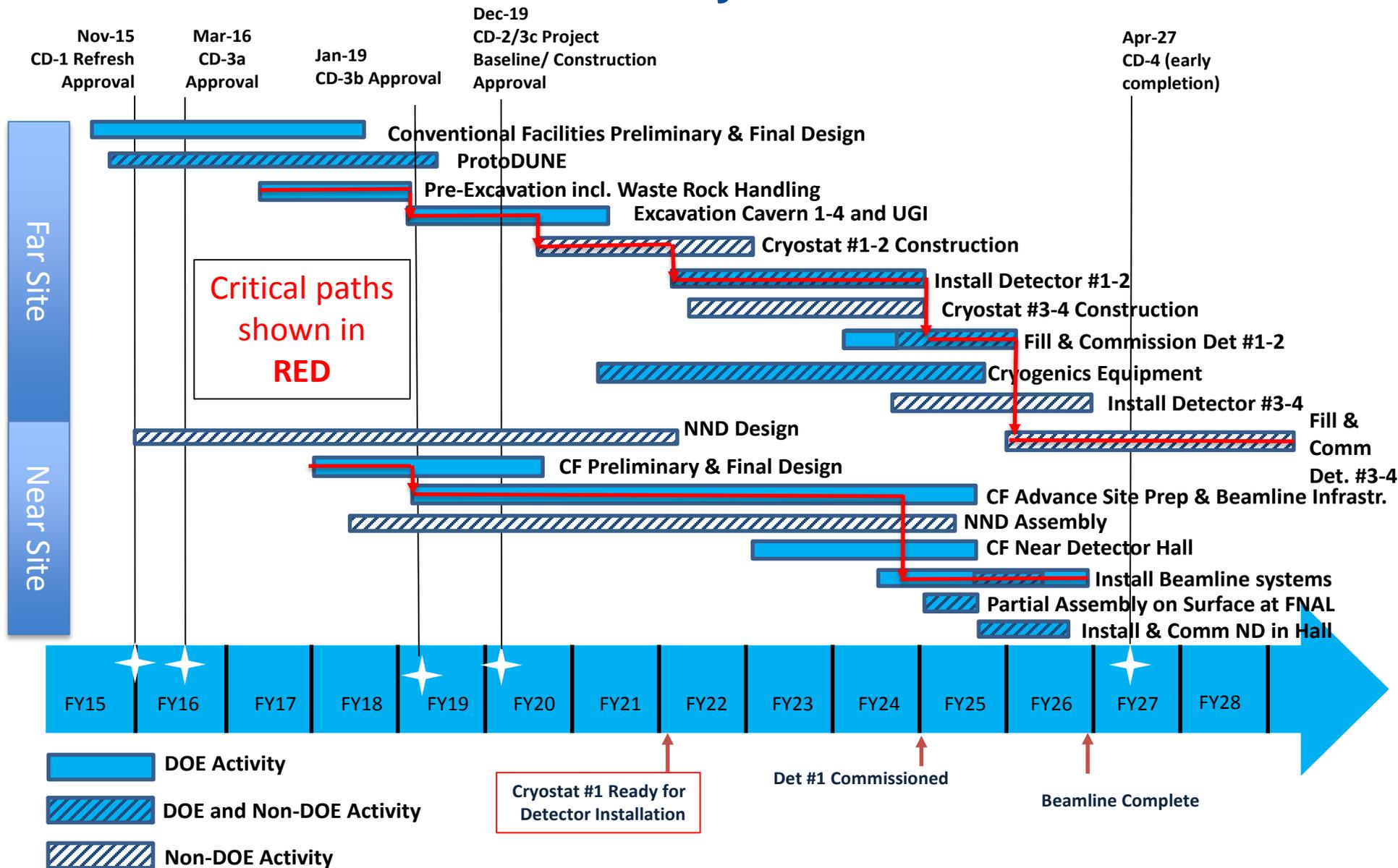
19.1m (15.1m) W x 18.0m (14.0m) H x 66.0m (62.0m) L

Membrane Cryostat Design

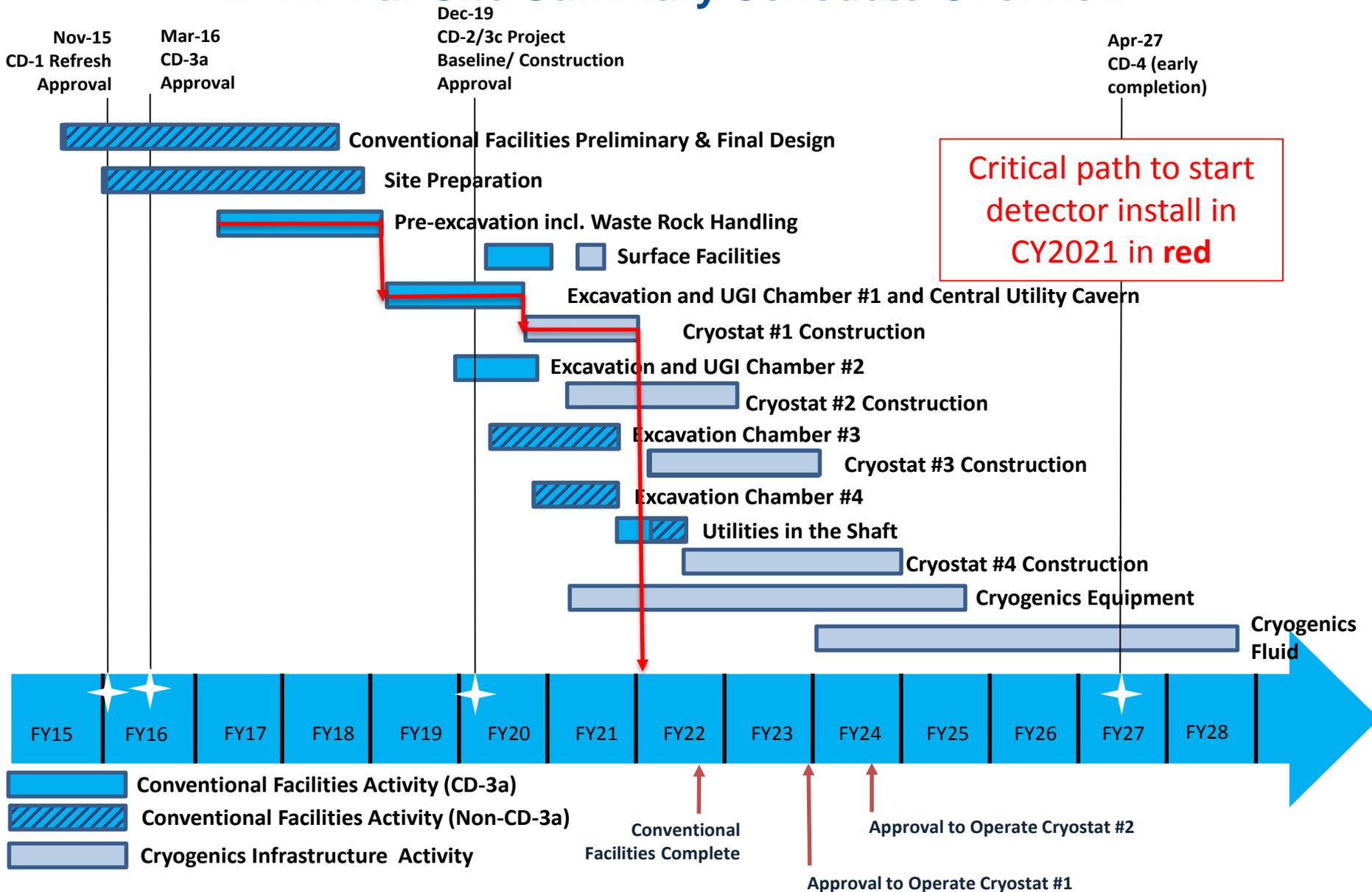
The corrugated stainless steel primary barrier:



LBNF/DUNE – Summary Schedule Overview



LBNF Far Site Summary Schedule Overview



Project Organization and Governance

LBNF/DUNE Governance Chart

IAC: International Advisory Council

RRB: Resources Review Board

LBNC: Long-Baseline Neutrino Committee

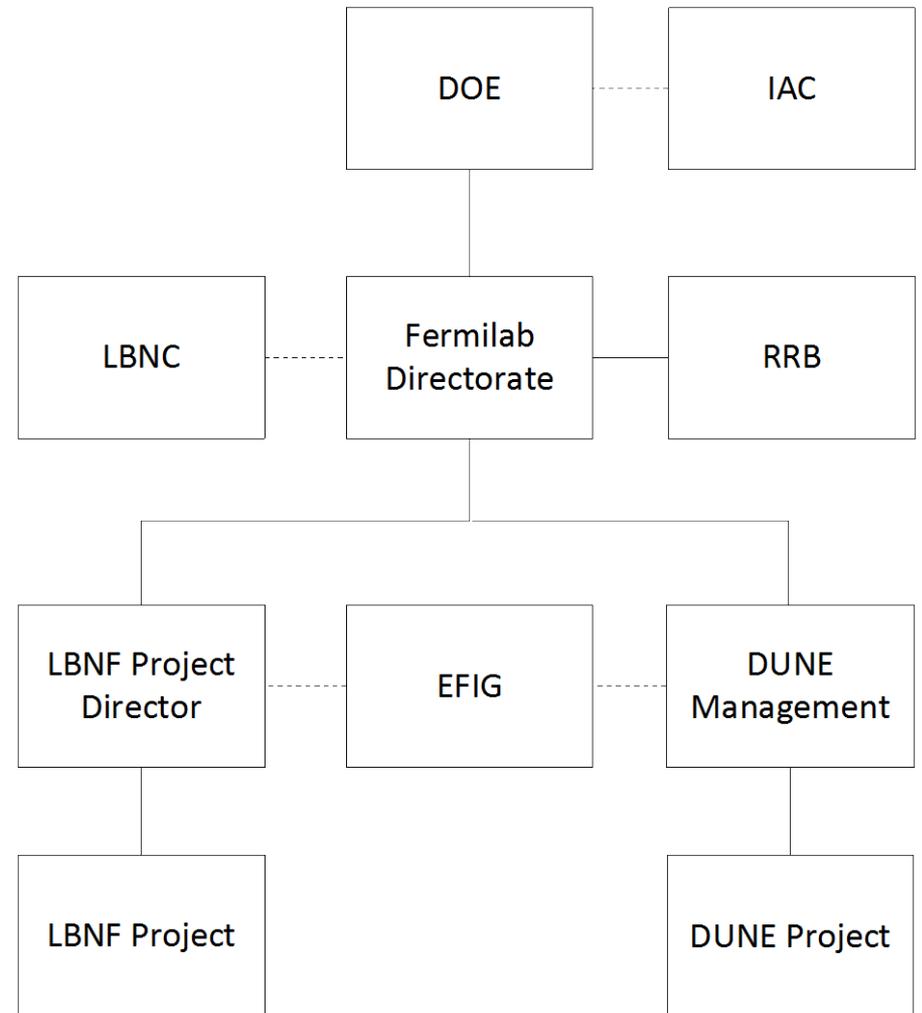
EFIG: Experiment-Facility Interface Group

Fermilab Directorate: The Fermilab Director and the two Deputy Directors

LBNF Project Director/Project

DUNE Management/Project

All councils, boards, and committees are functioning



LBNF/DUNE Governance Chart

IAC: International Advisory Council

RRB: Resources Review Boards

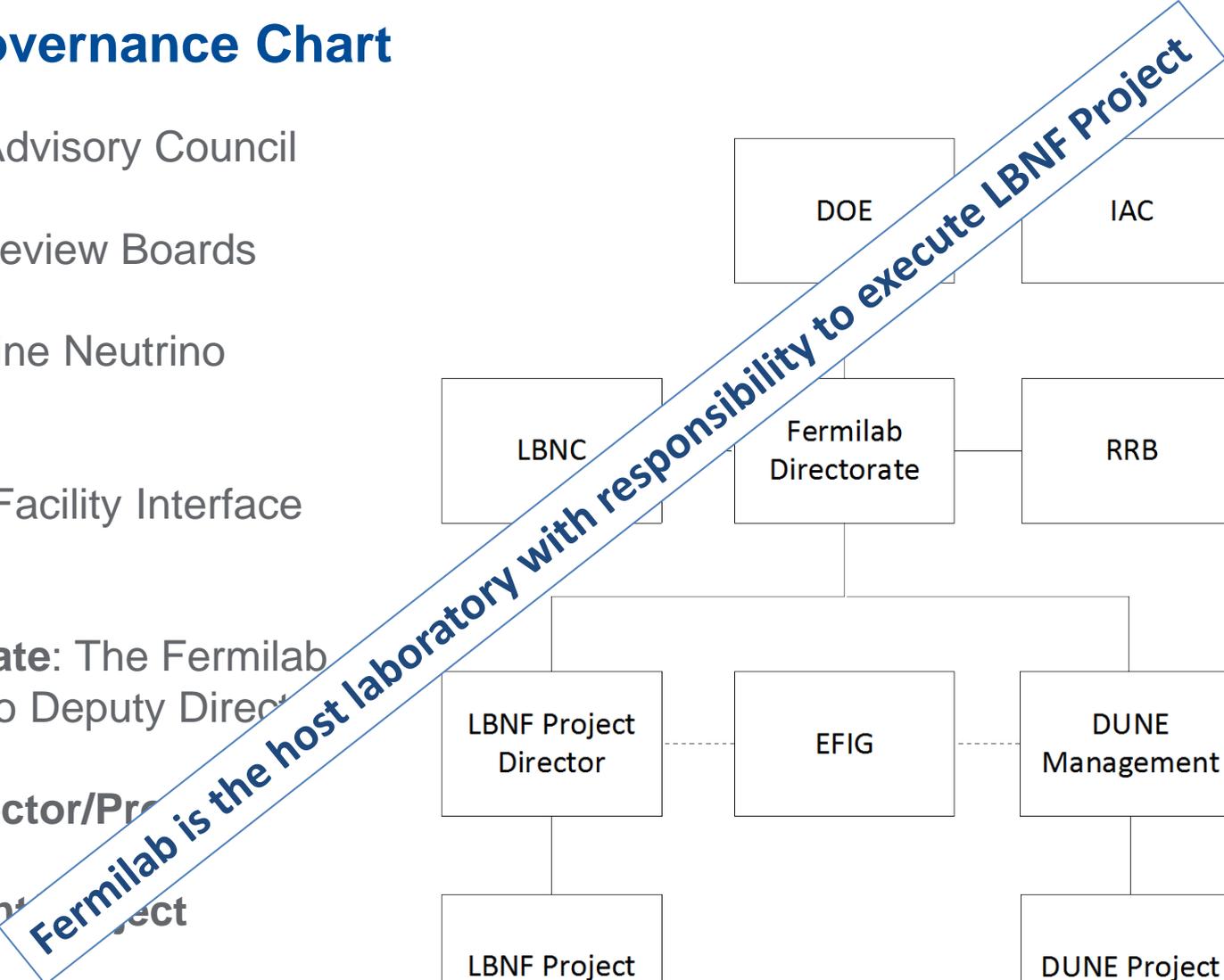
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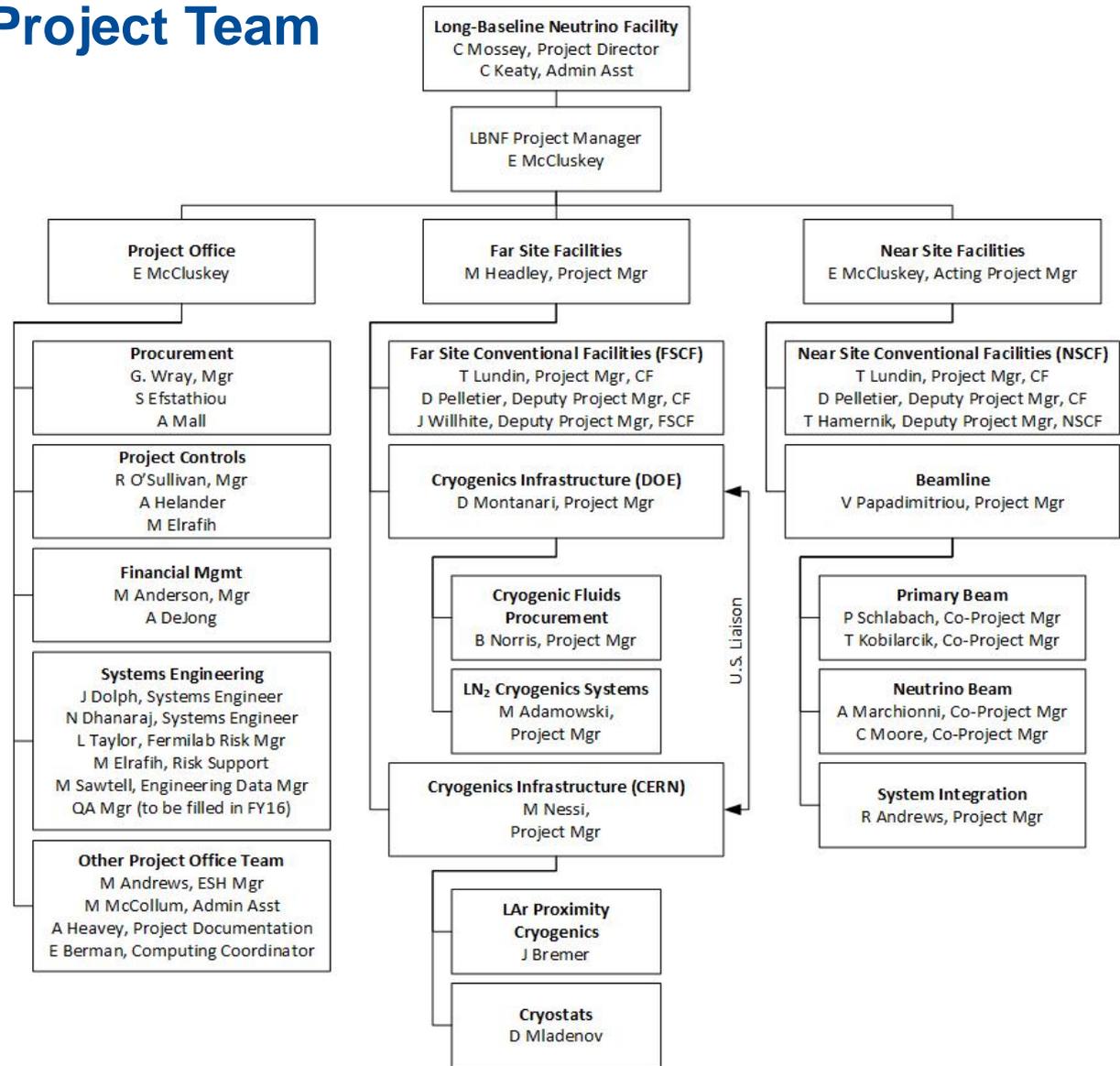
DUNE Management/Project



All councils, boards, and committees are functioning

Experienced LBNF Project Team

- LBNF Project team is in place
 - Organized around **three** L2 managers
 - Organization concept: **location** vs. function
 - CERN team is **tightly** integrated



Coordinated Management at Far Site

- Far Site organizational structure lead by **Mike Headley** ensures **coordination** and **single point of contact** for LBNF work at Sanford Lab:
 - **Shaft usage:** manage and coordinate demand for shaft usage (which is controlled by Sanford Lab) to minimize impacts to existing and planned experiments.
 - **Logistics:** overlapping scopes of work to be executed simultaneously (e.g., excavation + cryostat construction) coordinated through one entity
 - **Interfaces:** FSCF and cryogenic infrastructure tied together with one manager to work with DUNE Far Detector management on interface issues.
 - **Environmental, Safety, Health (ESH):** ESH responsibilities are coordinated through the FSF manager and Sanford Lab director.
- Lease: Creates DOE/FNAL enclave and enables DOE funded construction at state-owned site.

CD-3a Review and Next Steps

DOE CD-3a Review – December 2 – 4, 2015 at Sanford Lab

- Six subcommittees looked at project readiness to begin conventional facilities construction at far site
- Review focus:
 - Science → Requirements → CF design
 - Interfaces: Detectors → Cryostats + cryo systems → Caverns
 - Conventional facilities design maturity
 - Technical risks: Identified and addressed
 - Credible schedule and cost analysis with adequate contingency
 - Environmental, Safety, & Health issues addressed
 - Project organization and management
 - Have previous review recommendations been addressed

DOE CD-3a Review Draft Recommendations

- All sub-committees concluded LBNF/DUNE project is **ready to proceed** to CD-3a milestone
- 25 draft recommendations (including 6 recommendations to proceed) included:
 - Closely manage and work to increase supply of engineering capacity
 - Consider use of schedule margin during creation of CD-3a milestone.
 - Confirm assumptions on staffing for Far Site
 - Request increase in DOE purchasing and subcontracting authority
 - Continue refining and updating project, ESH, and schedule assumptions and plans

LBNF Next Steps...

- **NEPA:** “Finding of No Significant Impact” signed; monitor implementation.
- **Design:** Final Design Plan: start Jan 2016; complete August 2017
- **Project Management Processes:**
 - **Change control:** process is in place and turned “on”
 - **EVMS:** completing training; begin implementation in March 2016
- **Lease:** Under final SDSTA review; expect to be signed this month
- **CM/GC Contract solicitation:** DOE Independent Review Board currently reviewing RFP documents. Plan to award June 2016.

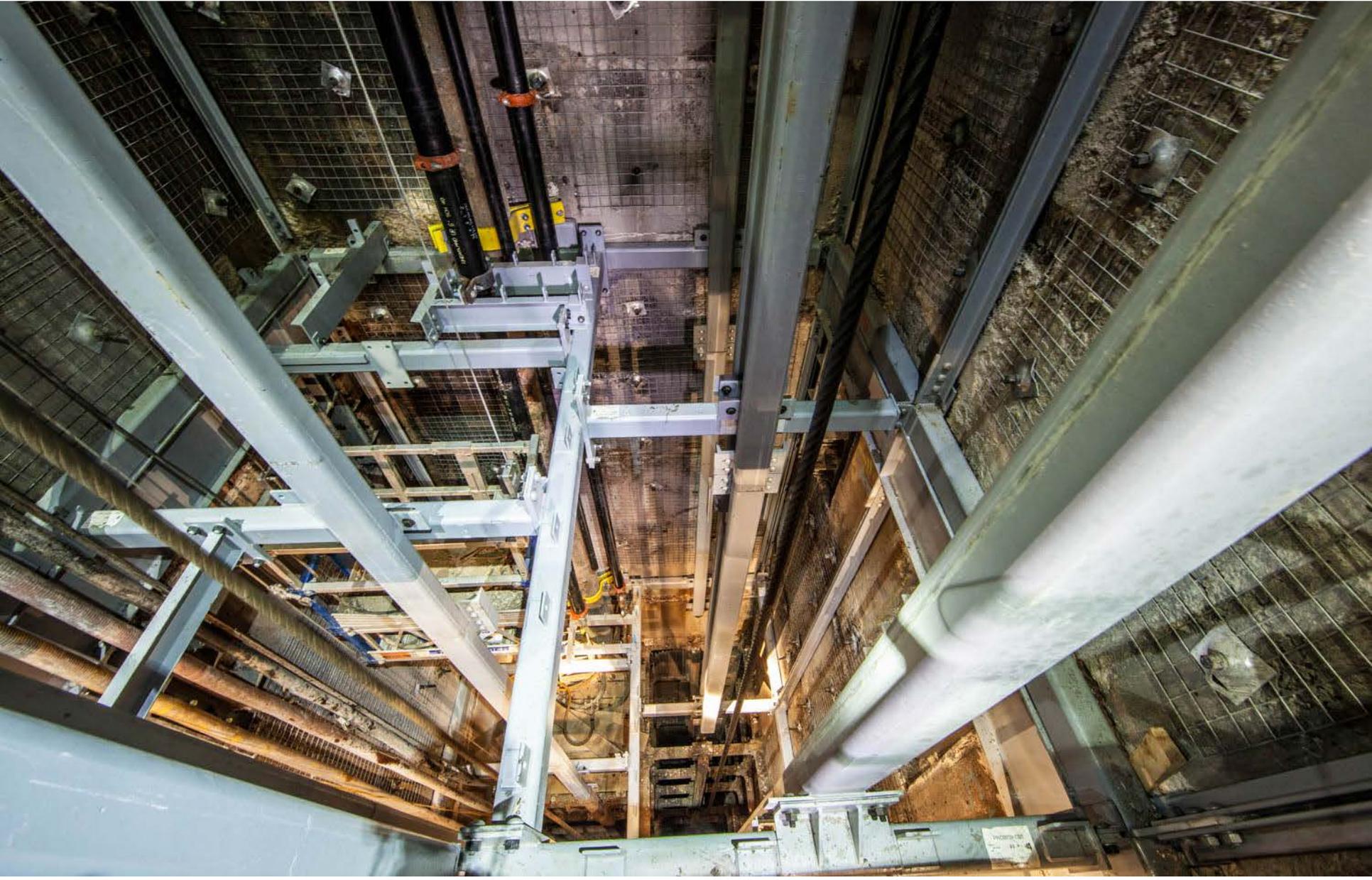
Questions?

Back up slides and alternate graphics

Sanford Lab Reliability Projects - Ross Refurbishment - *before*

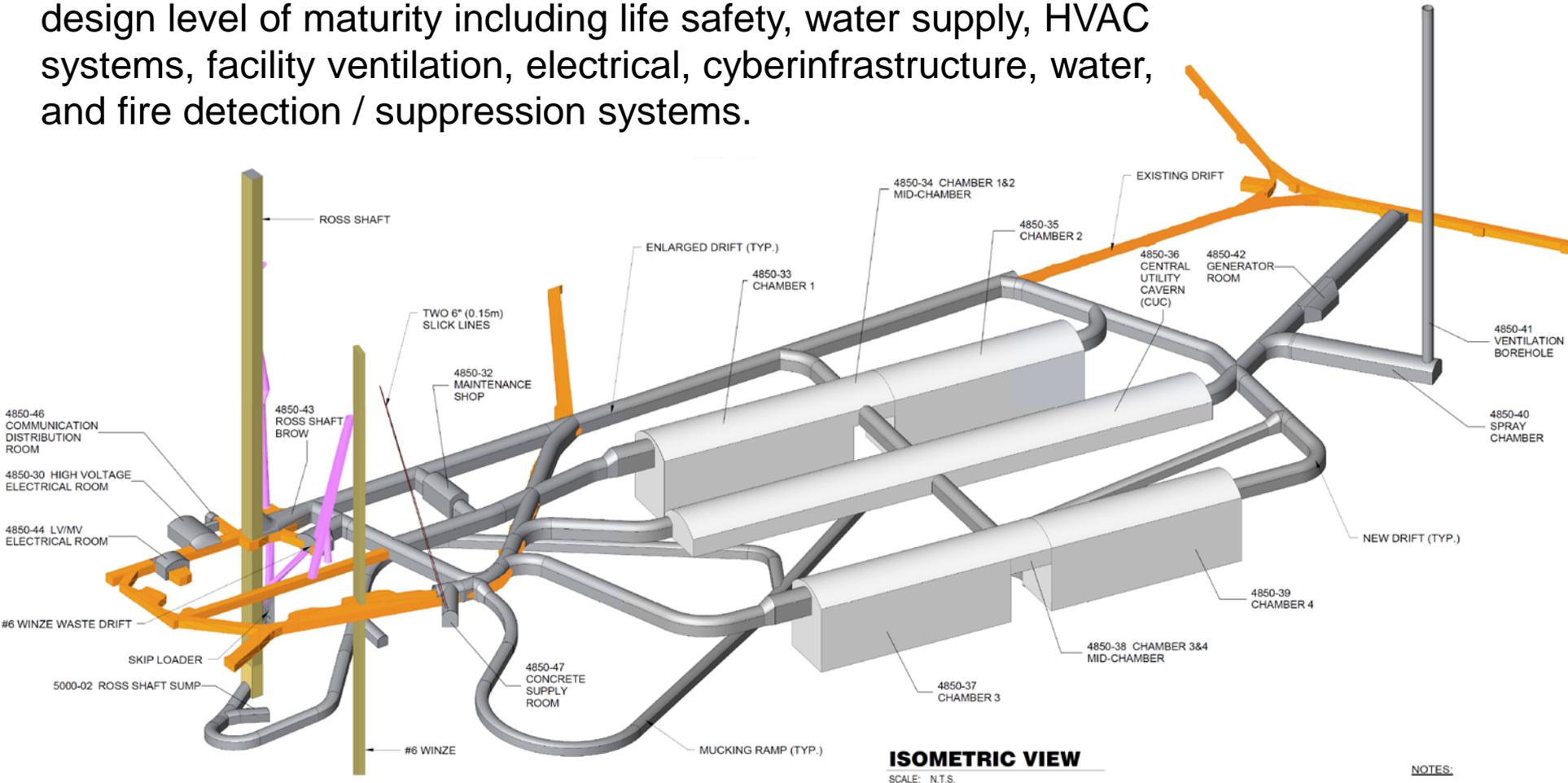


Sanford Lab Reliability Projects - Ross Refurbishment - after



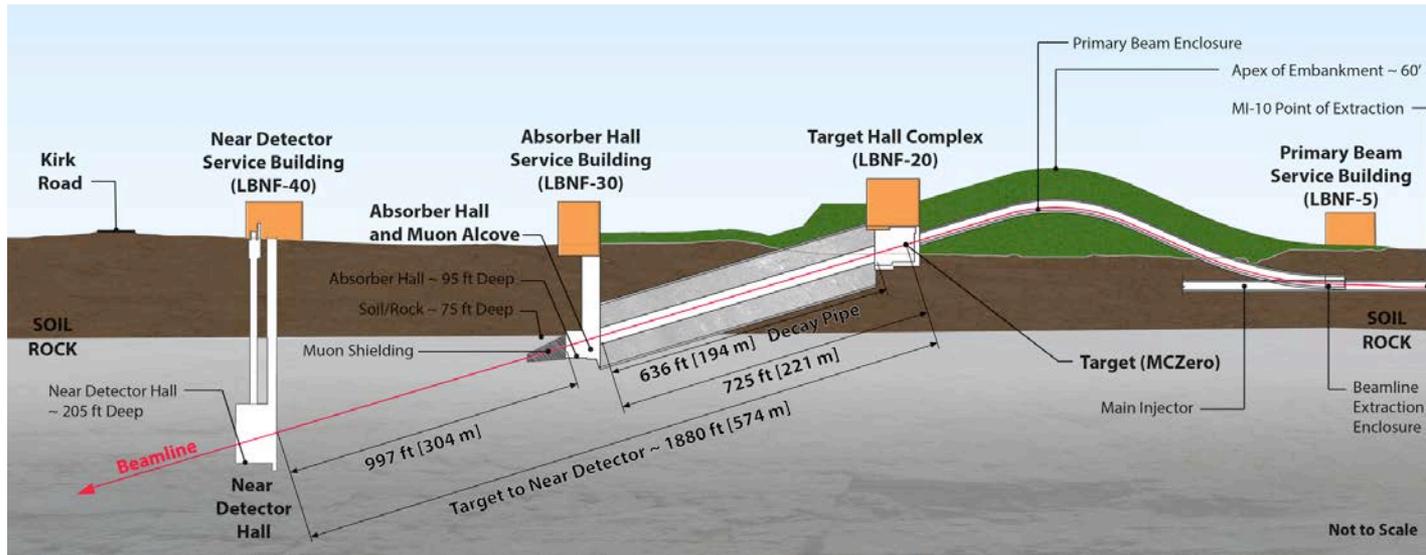
4850L LBNF Excavation Design

Major elements have been addressed to a 100% preliminary design level of maturity including life safety, water supply, HVAC systems, facility ventilation, electrical, cyberinfrastructure, water, and fire detection / suppression systems.



~800,000 tons of excavated material to be removed

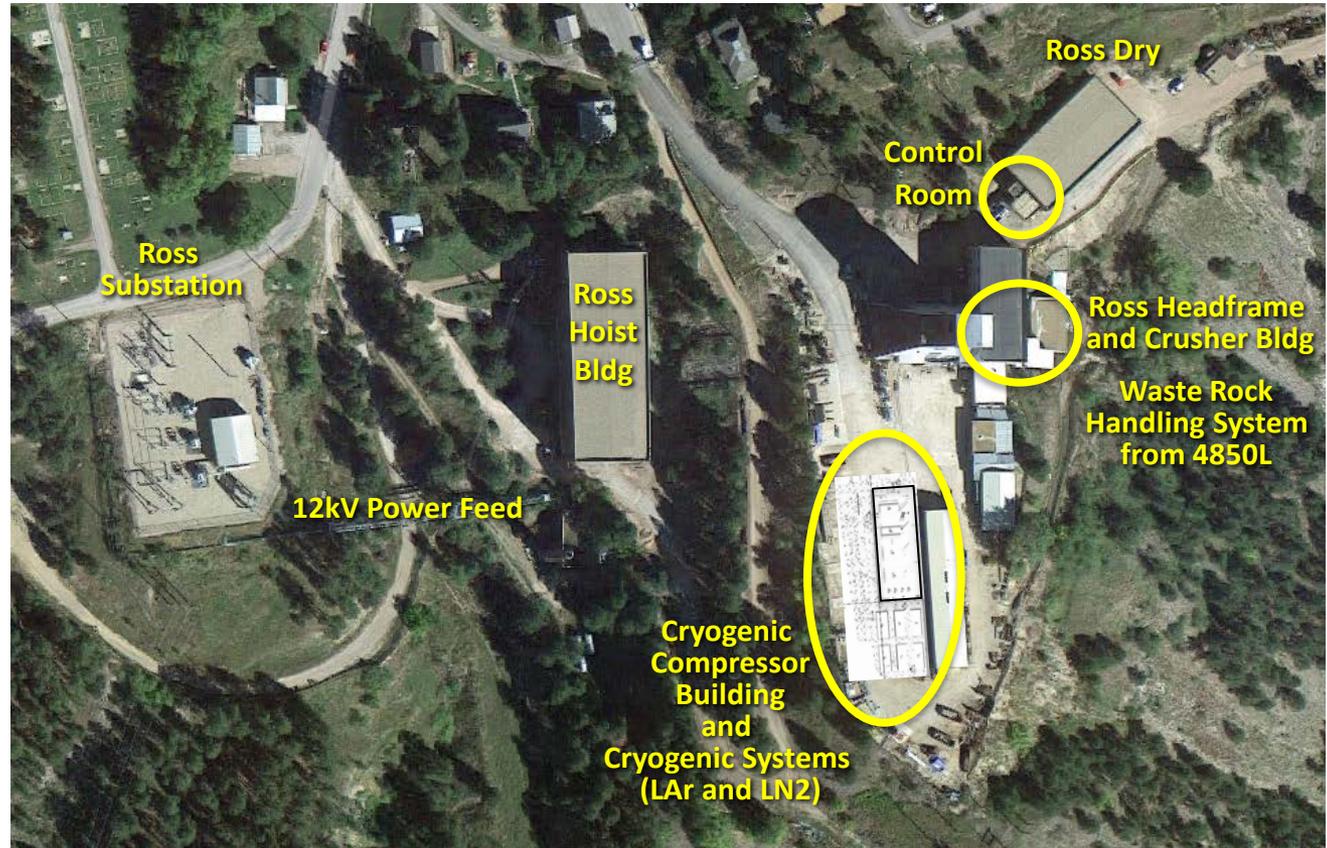
Overview - “Near Site” – LBNF at Fermilab, Batavia, IL



- Primary proton beam @ 60-120GeV extracted from Main Injector
- Initial 1.2 MW beam power, upgradable to 2.4 MW
- Embankment allows target complex to be at grade and neutrino beam to be aimed to Lead, SD
- Decay region followed by absorber
- Four surface support buildings
- Near Detector facility

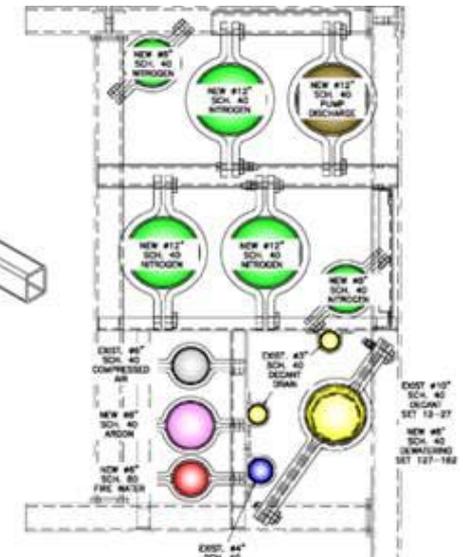
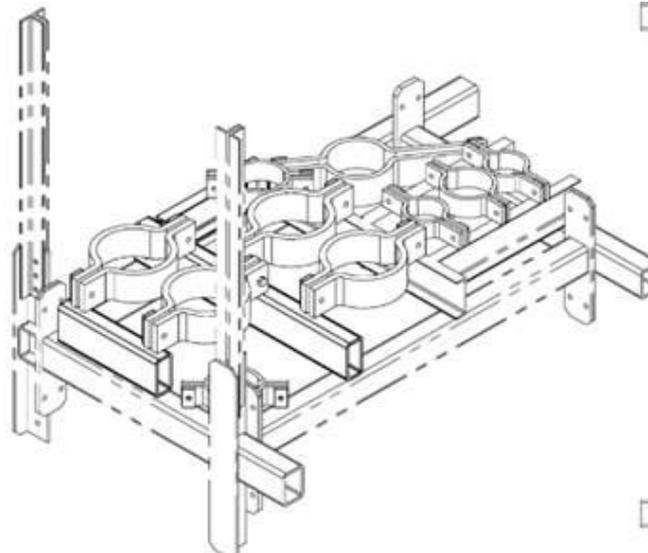
Far Site Surface Facilities

- Power upgrade
- Cryo systems and compressor building
- Ross Hoist upgrades
- Control room
- Waste rock handling system

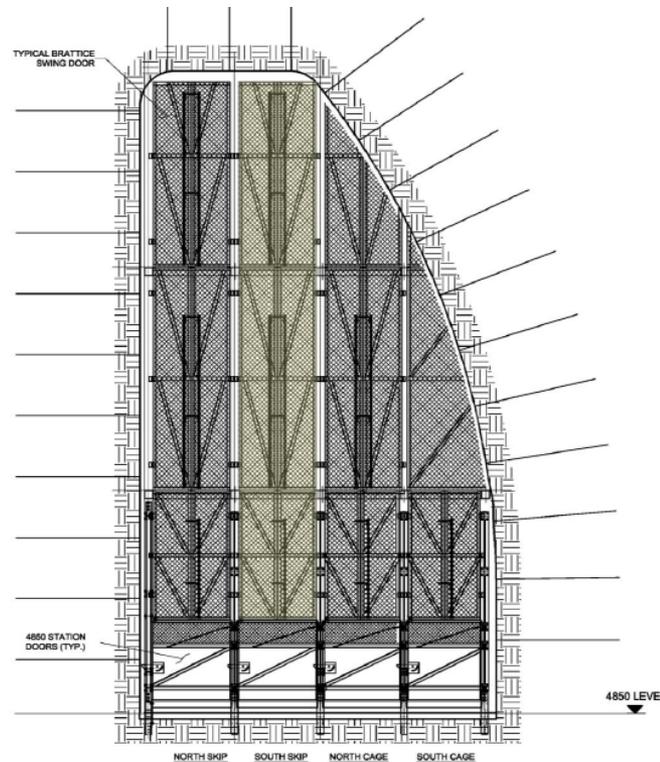
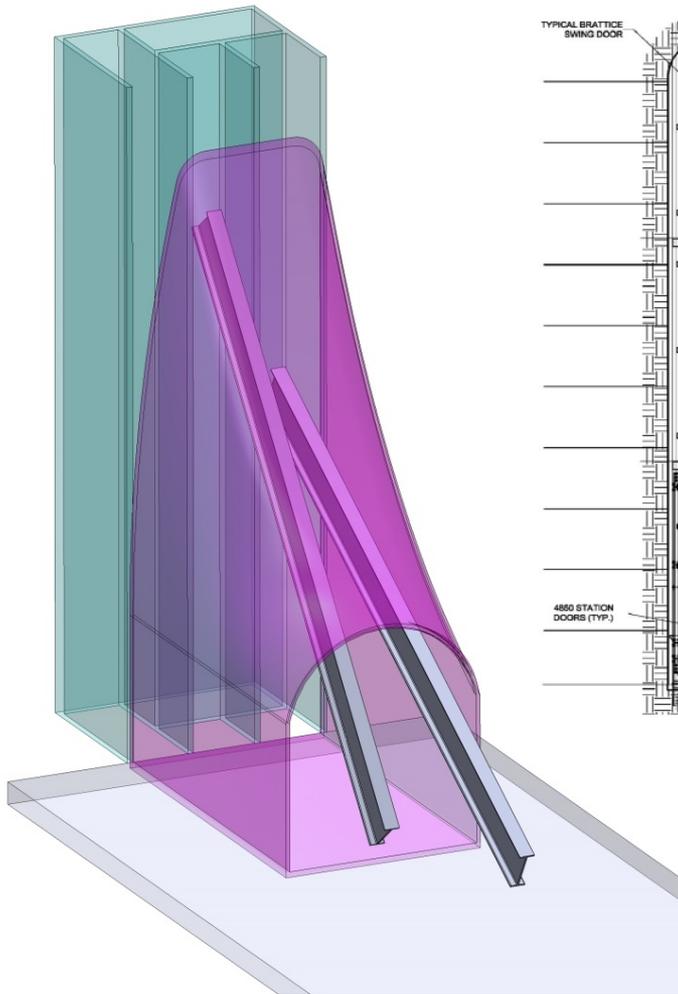


Far Site Ross Shaft

- Completion of Ross Shaft rehabilitation, cage and skips, loading pocket
- Expansion of shaft brow on 4850L
- Utilities in the Ross Shaft
 - Electrical power
 - Fiber optics for experiment data & control and fire alarm
 - Gas pipes in Ross Shaft for N₂ and Ar
 - Fire water pipe from 4100L sump to 4850L
 - Concrete slick line for construction



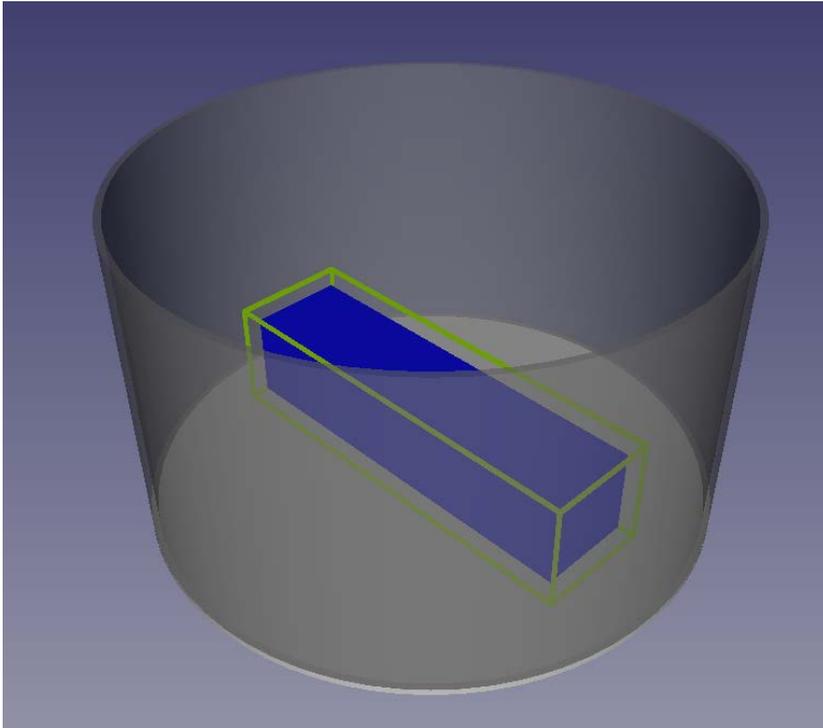
Far Site Ross Shaft - *Expansion*



Shaft Brow Modifications at 4850 L Station

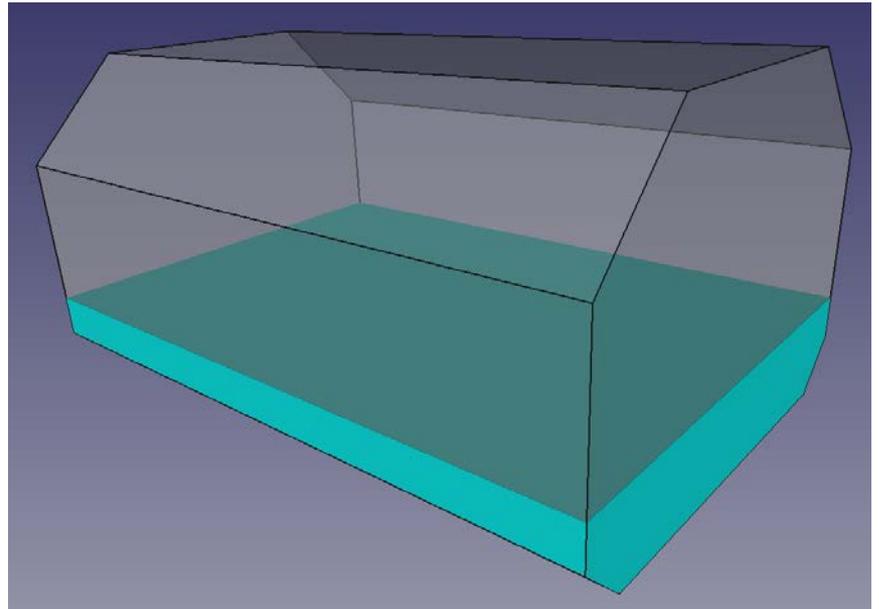
- Excavation required for long load deliveries
- Special swing out gates required to allow for long load slinging
- Special bracing required for shaft sets where brow opens up

LBNF Cryostat size relative to LNG Industry



On Land:

- Whole 10kt Cryostat fits inside 200,000 m³ LNG storage tank



On ships:

- LAr for one cryostat fills about 25% of a Q-MAX membrane chamber

LBNF Cryostat size relative to LNG Industry – Another View

