LBNF Hadron Absorber FDR – Interfaces and Installation

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LBNF Hadron Absorber Final Design Review

18 December 2024

Absorber Interfaces

SharePoint Interfaces List

- Beamline interfaces documented in DUNE-doc-301 (dated copy of official Sharepoint)
- Interface control document with Absorber-specific interfaces and links to relevant controlling docs (e.g., RAW specification and integration models)

Structural Interfaces

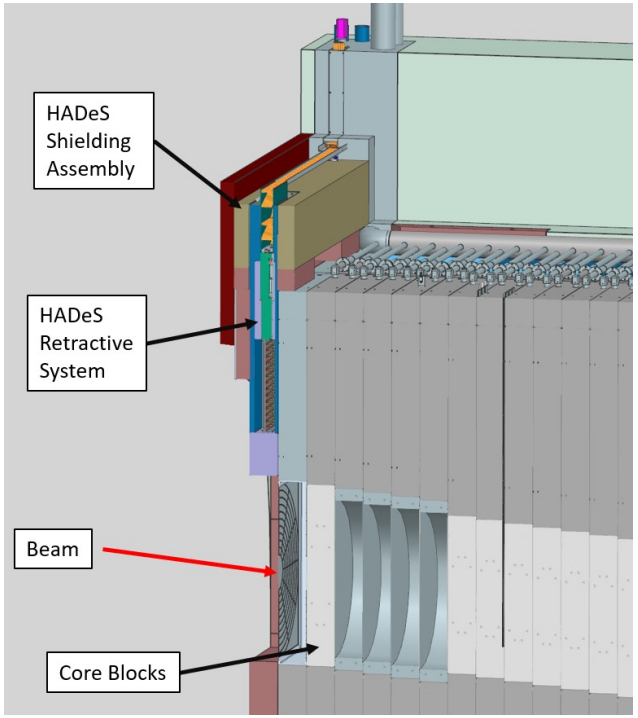
- Air ducting – built by CF
  - CF drawing package consulted to match Absorber air inlet/outlet
- Weld embeds for RAW pan and structural tiebacks – built by CF
- Bunker position in Absorber Hall – set by CF
  - RAW pipes designed to meet this location (flex couplings in RAW scope)
- RAW supply/return pipes – installed during assembly. RAW scope outside of Bunker
- HaDES mounting and commodity routing
  - Coordinate with UT Austin, installed under Absorber scope during assembly
- Embeds/drop-in anchors for safety – anchors added as needed during assembly
- Crane sizing and hook height and hook clearance – specifications given to Integration group for external crane (if extra scope realized in CF bid).
  - Internal crane installed by CF

Instrumentation Interfaces

- Thermocouple outputs
- HADeS signals and commodities – UT Austin in charge of HADeS design. Absorber provides routing paths through shielding for cables and actuator drive
- Share cable tray space and routing with MuMS detectors. Both systems route to Instrumentation Room

HADeS Interface

- Mount and shielding provided at upstream end of Absorber
- Channels in shielding to accommodate drive shafts for retraction mechanism



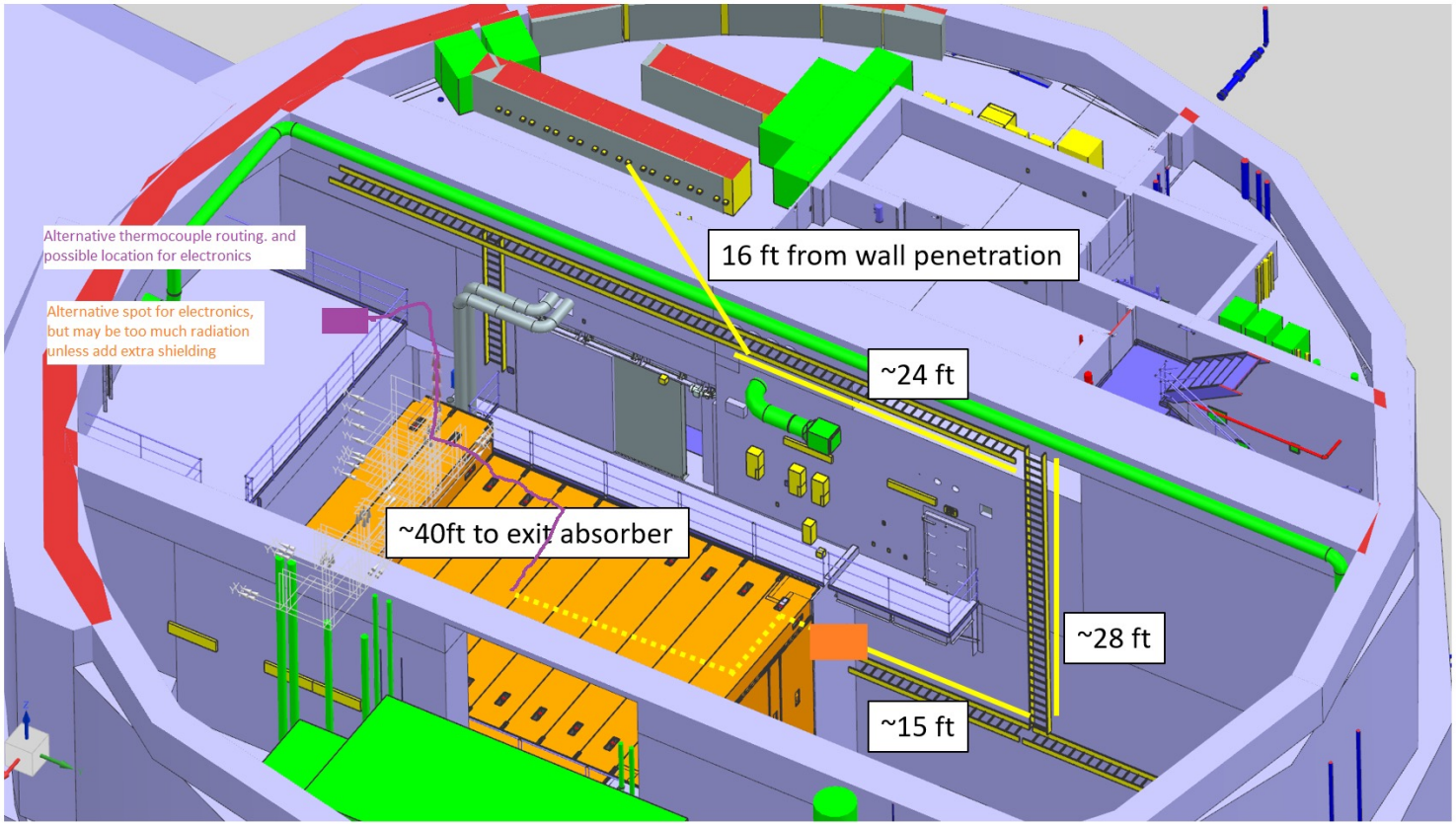
Instrumentation – Core Thermocouple Array

- 228 K-type thermocouples mounted in removable/replaceable bars in the 2nd aluminum core block after the masks
  - Monitor beam intensity and position on a pulse-by-pulse basis
  - Timing/processing requirements have been provided to Controls
    - Signal types, speeds to prevent second accident pulse (see DUNE-doc-32078)
- Controls and Interlocks coordinate separately to process those signals and generate abort signals as required
  - Instrumentation and Controls are testing the PLC and readout modules that will process thermocouple outputs, for example

Instrumentation Cable Routing

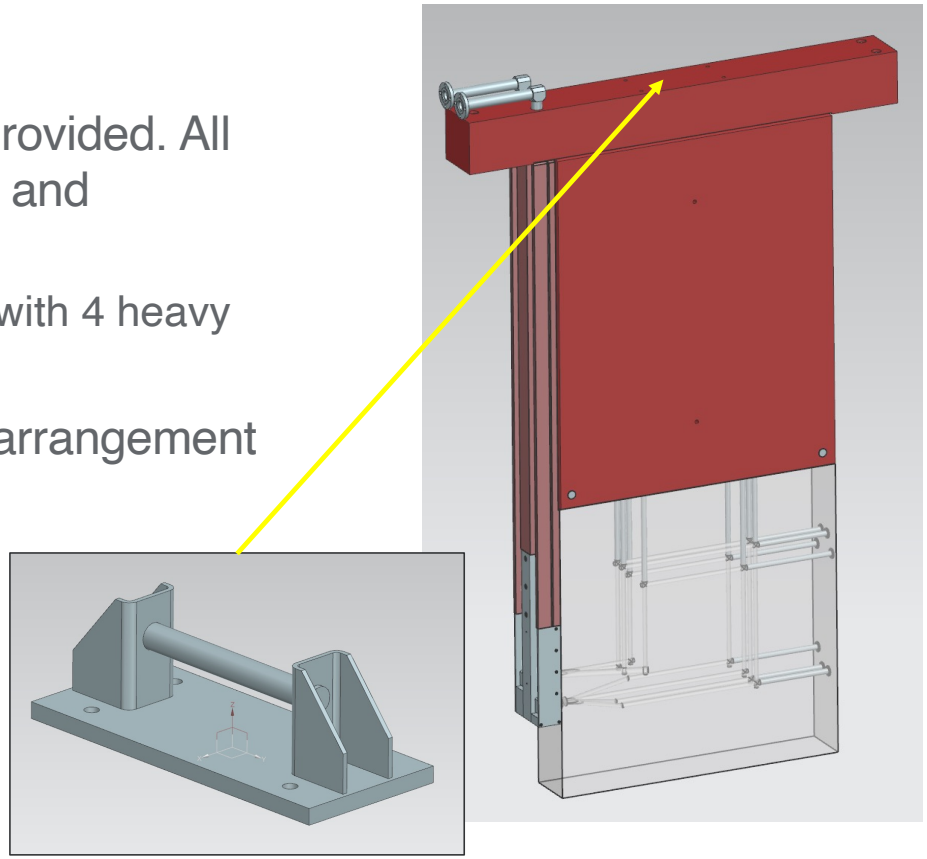
- Absorber scope provides cables (material and installation) out of the bunker and through the Instrumentation Room wall penetration (see next slide)
- 228 channels of K-type thermocouples
  - Kapton-insulated cable to exit the Absorber
  - Patch panel on top of the downstream decay region shielding to switch cable types
  - Normal TC cable to route the rest of the way to the Instrumentation Room
- Not in scope, but need to coordinate pulls: MuMS signal cables
  - Possible that some TC instrumentation could use the same cable trays

Instrumentation Cable Routing



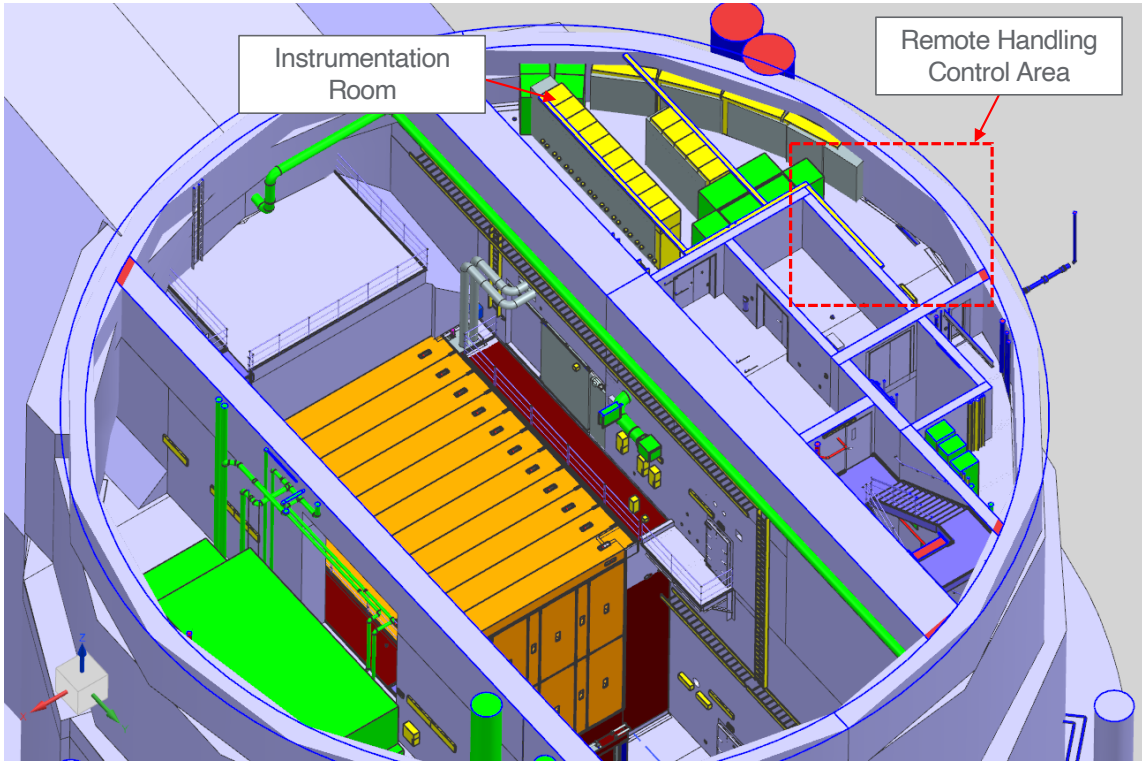
Remote Handling Accommodations

- Fixtures, block stacking plans
- Lifting fixtures for the Core Modules will be provided. All core modules use the same crossbar design and interface to the same below-the-hook fixture
  - The lift point attaches to the top of a module with 4 heavy screws
- G-blocks use the lab-standard lifting pocket arrangement for shielding blocks
- Lifting fixtures have yet to be designed for:
  - TC bar replacement
  - HaDES replacement



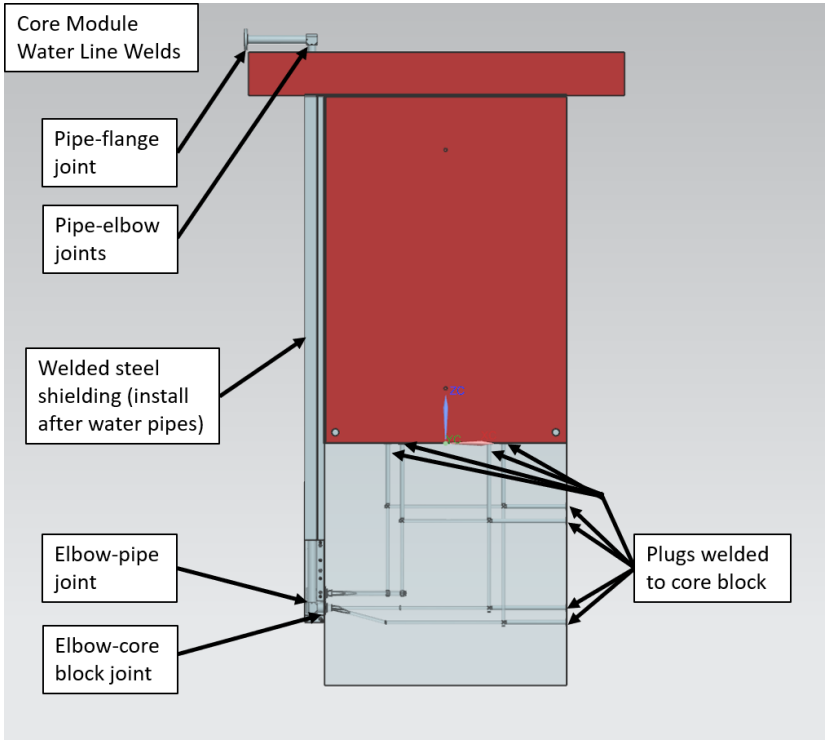
Remote Handling Control Area

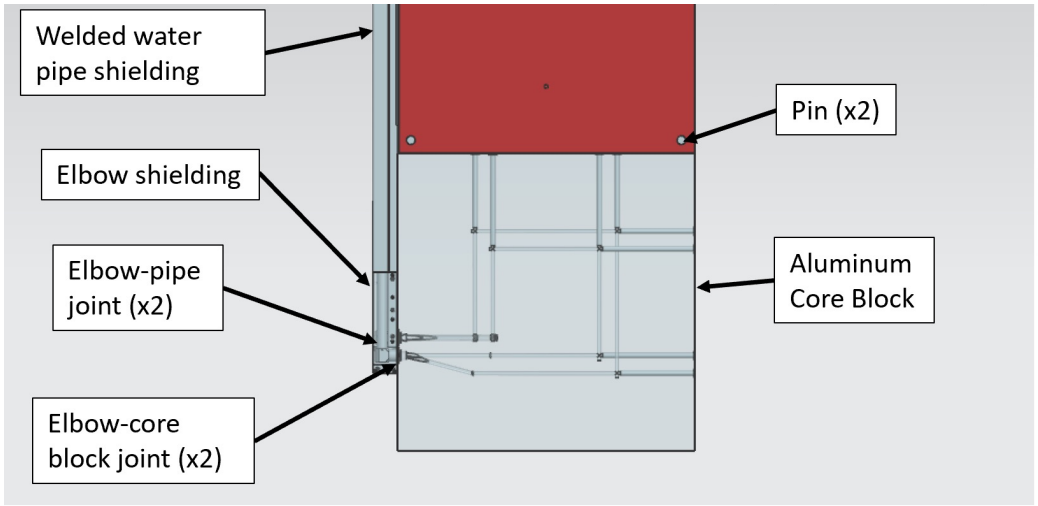
- Back of the Instrumentation Room
  - Has electrical fixtures and data lines to support a remote operations station for the crane, camera feeds from temporary cameras, and other equipment
  - Accessible from elevator/access stairway without entering Absorber Hall
- Remote vision system will be set up in Absorber Hall before accessing the pile
  - Temporary cameras like NuMI



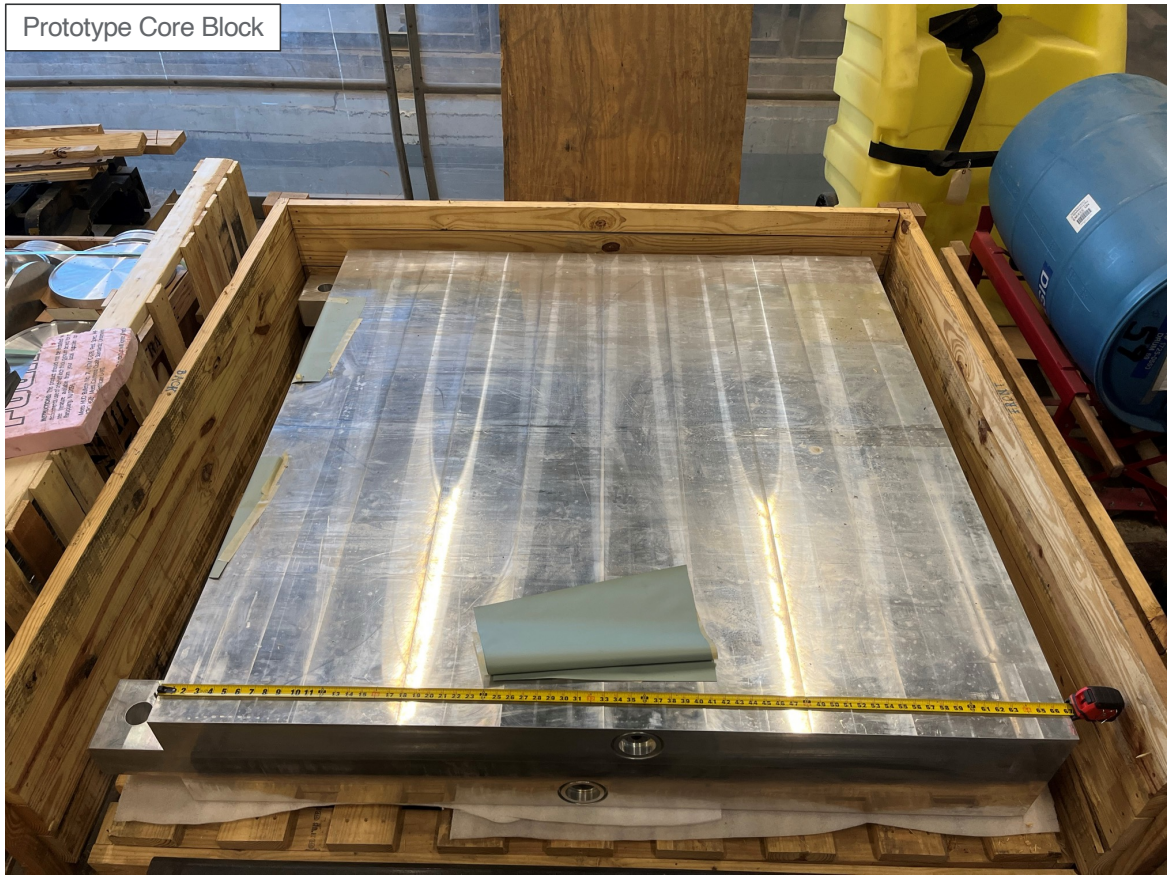
Absorber Installation and Assembly

Core Module Assembly



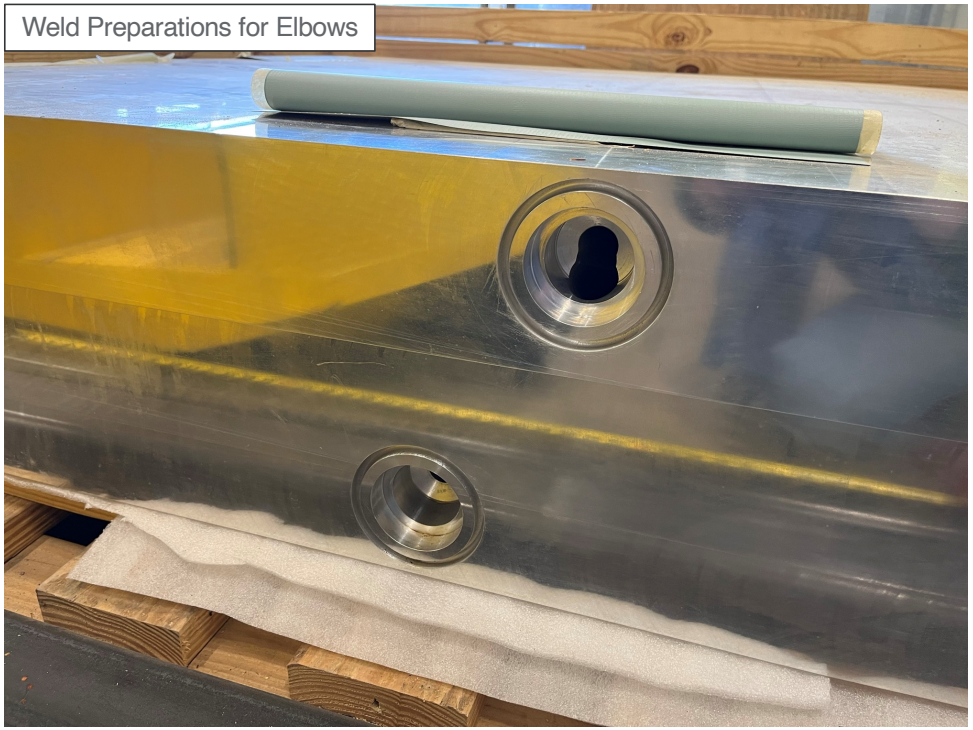


Core Module Assembly

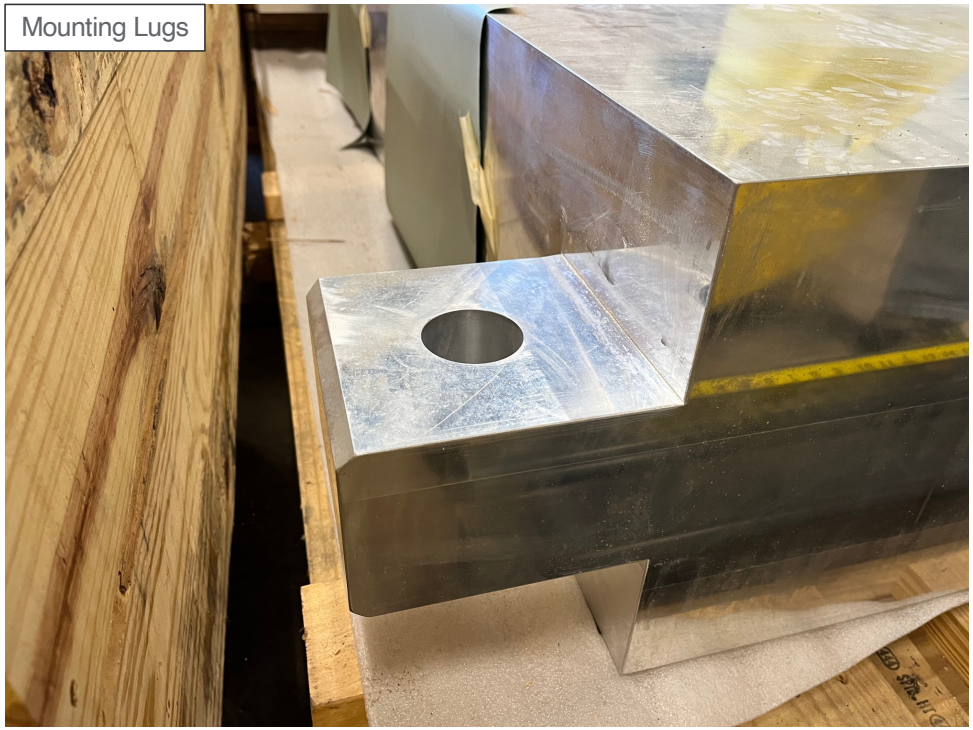


Core Module Assembly

Weld Preparations for Elbows

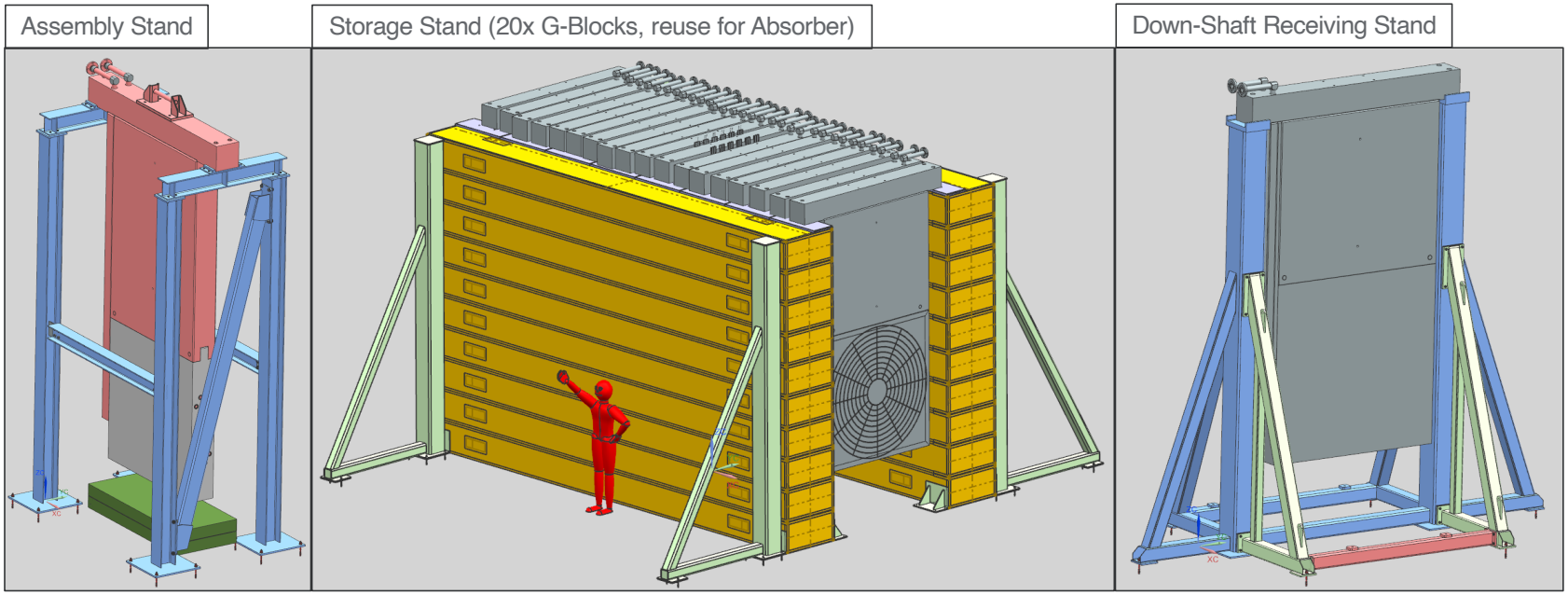


Mounting Lugs



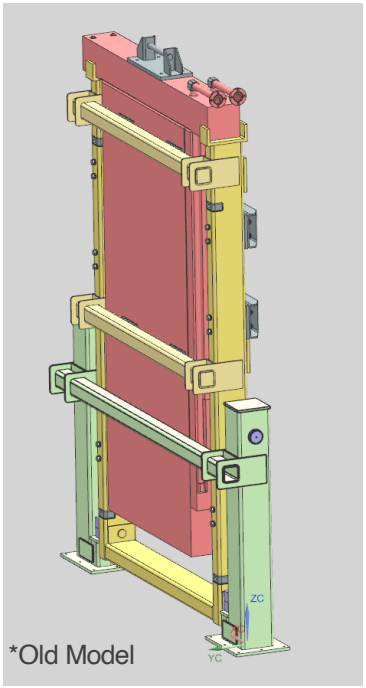
Assembly and Installation Fixtures

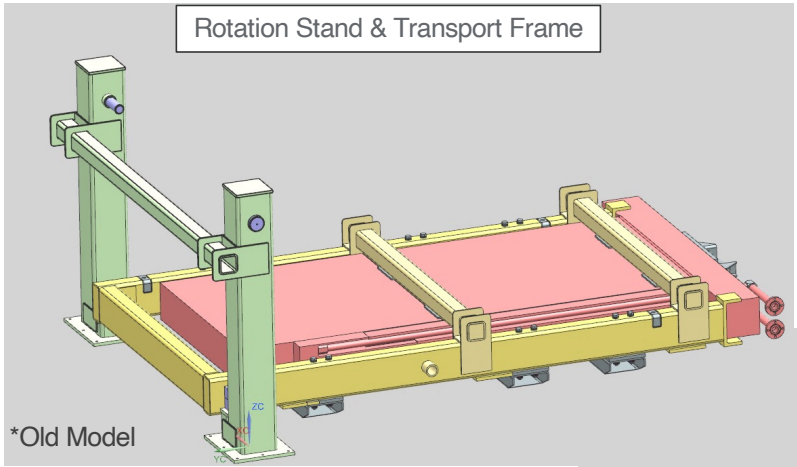
- Assemble completed core block to T-block vertically
- Store modules vertically, then transport to Absorber Hall flat
- Temporary receiving stand installed in Absorber Hall to hand off modules between cranes

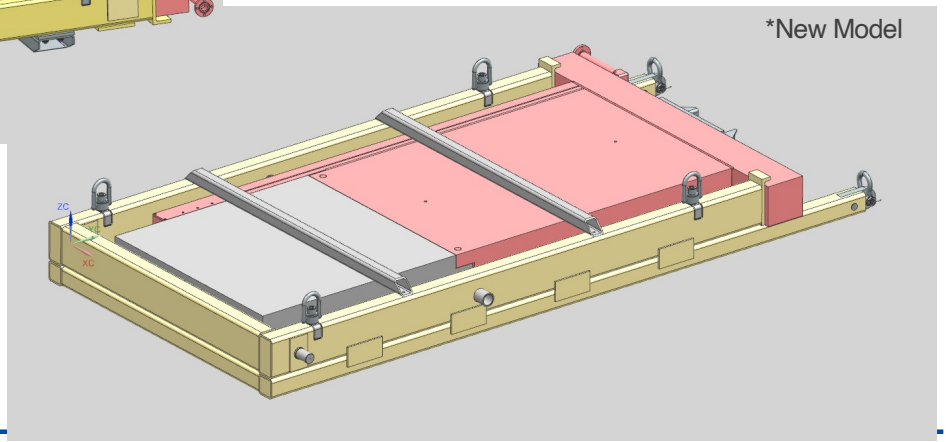


Transport Frame and Rotation Stand

- Rotating strongback/transport cradle
- Rotation fixtures at hatch and storage location (similar concept to NuMI SLB coffin fixtures)

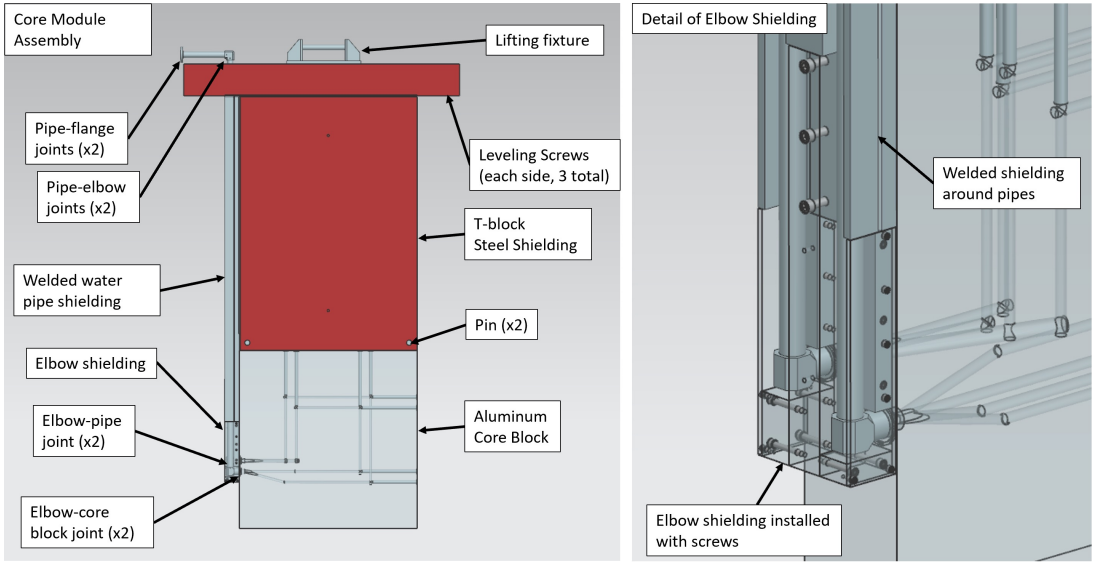






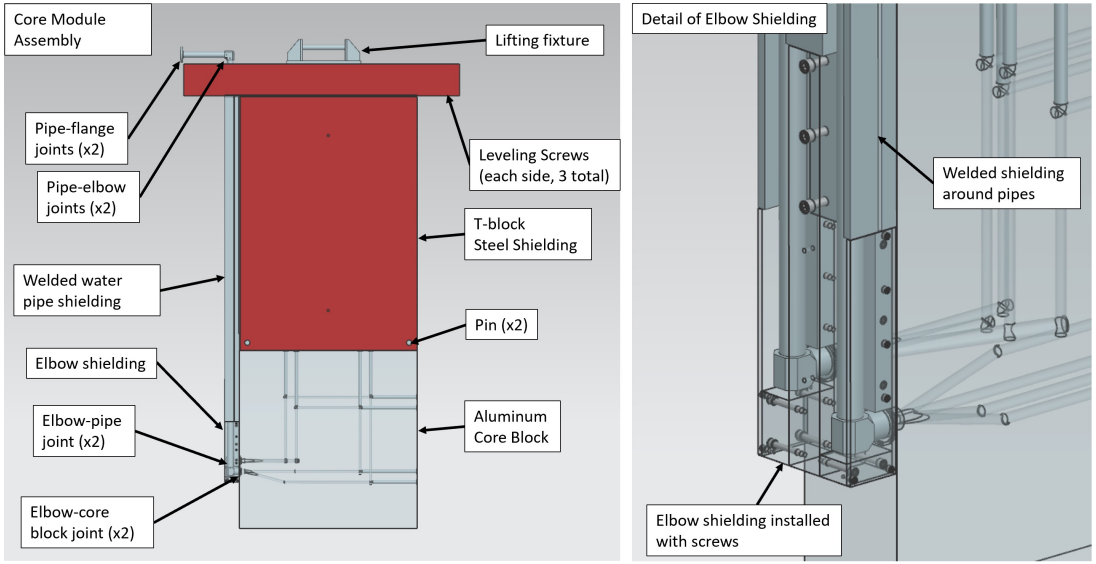
Core Module Assembly Procedure

- Make welds on core block (1G position), plugs and elbows
  - Flip block on side to expose correct face for welding
- Weld steel T-block parts together
- Place core block and T-block on assembly stand, then mate core block and T-block

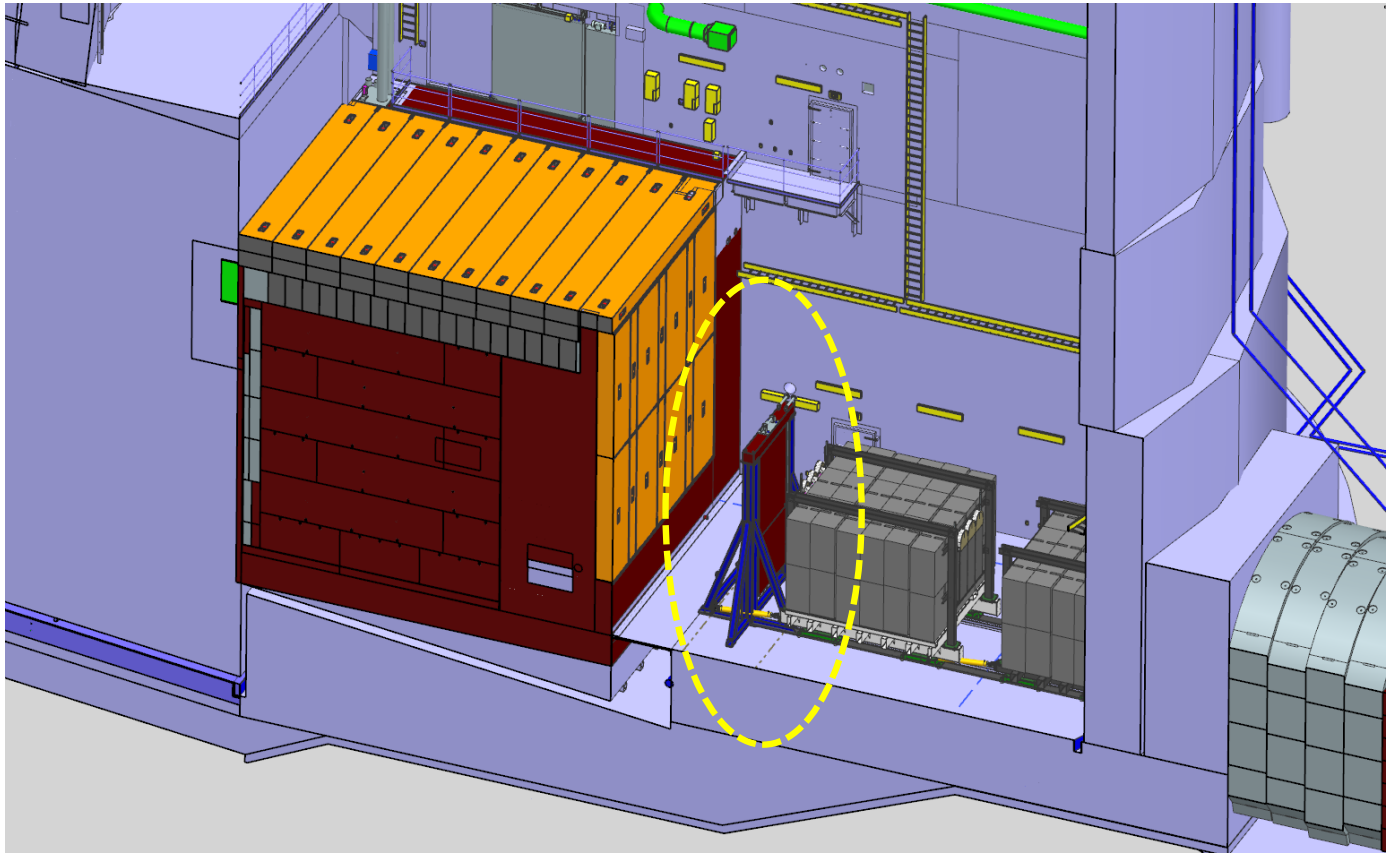


Core Module Assembly Procedure (cont.)

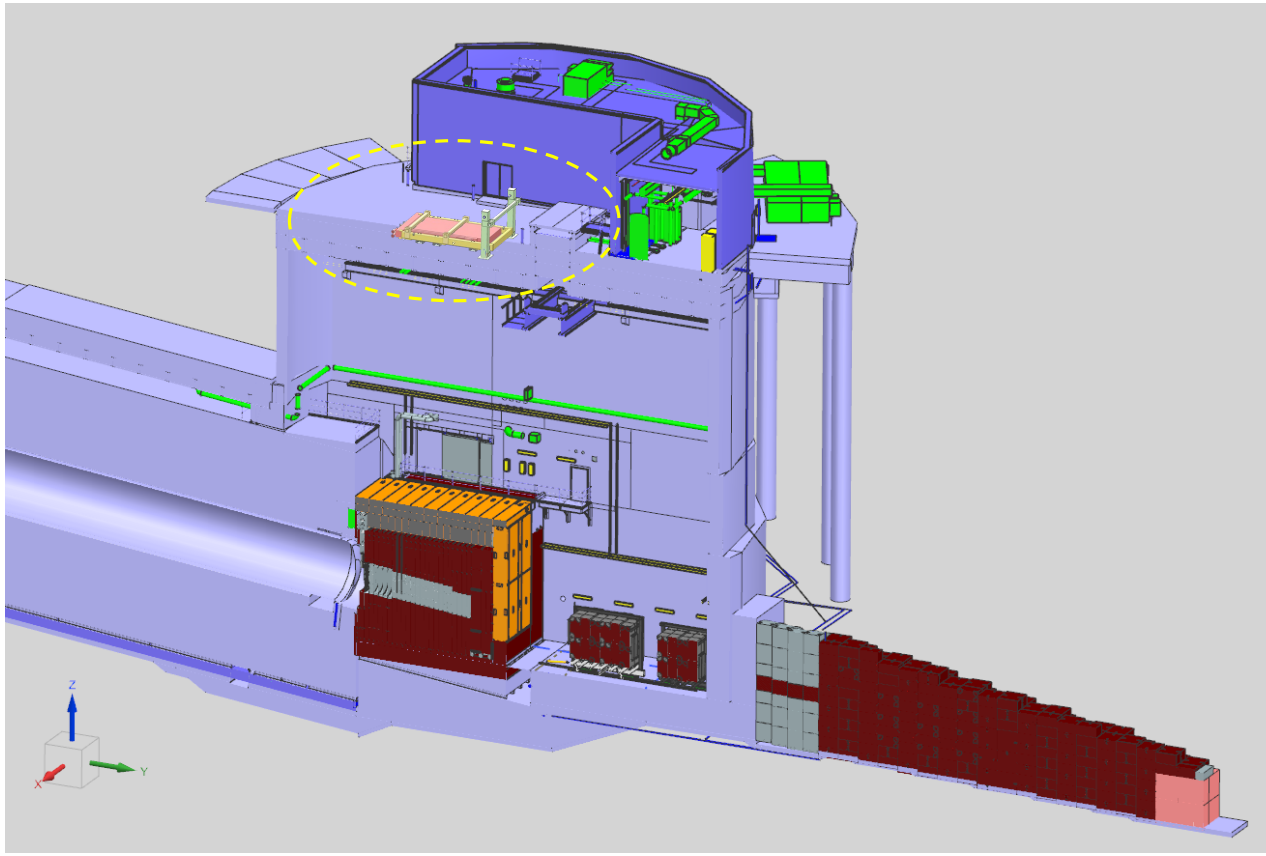
- Separately, weld aluminum water pipe assemblies, then lower into position on module
  - Note, requires inserting through hole in top of T shielding – need hook height above stand
- Make final welds to join supply/return pipes to elbows in 1G position (pipe socket in elbow)
- Add filler shielding, then store core module in storage stand



Down Shaft Receiving Stand Location



Rotation Stand at LBNF-30 Hatch

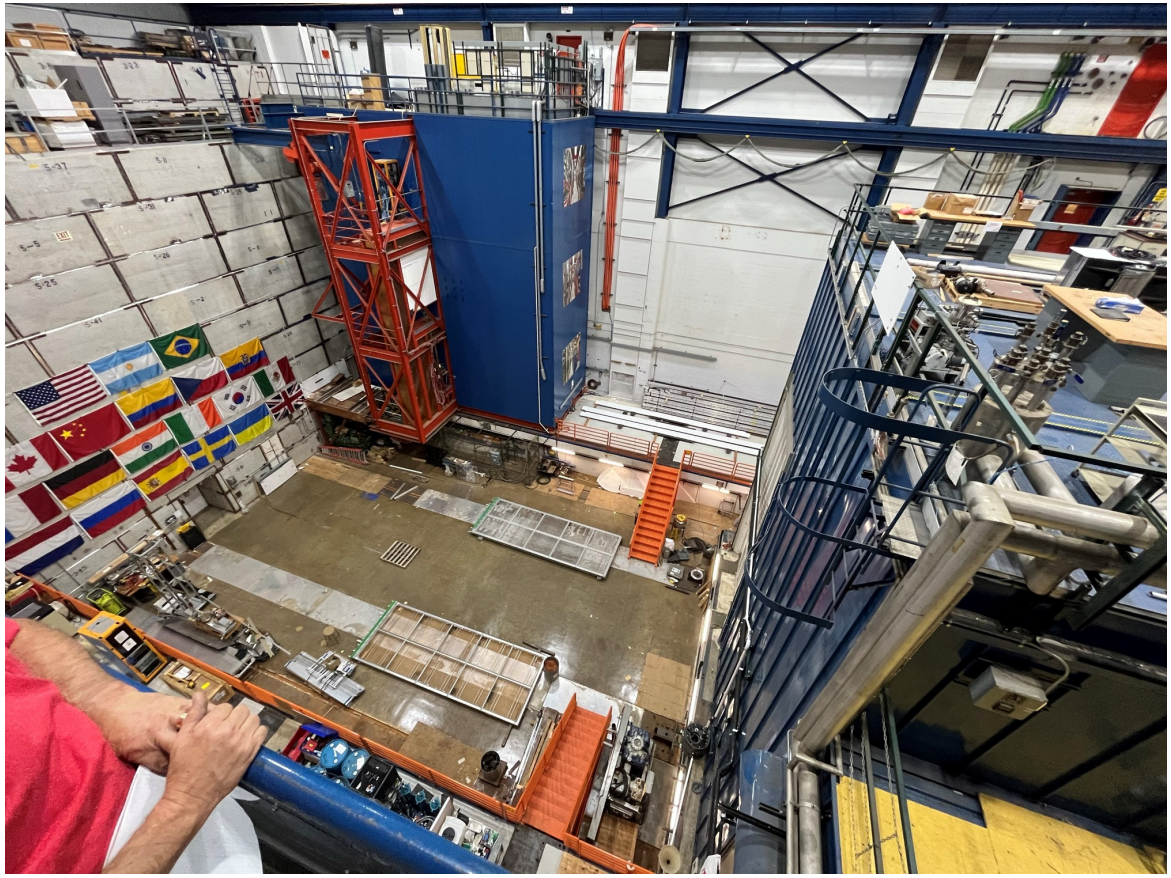


Assembly Workshop at DAB

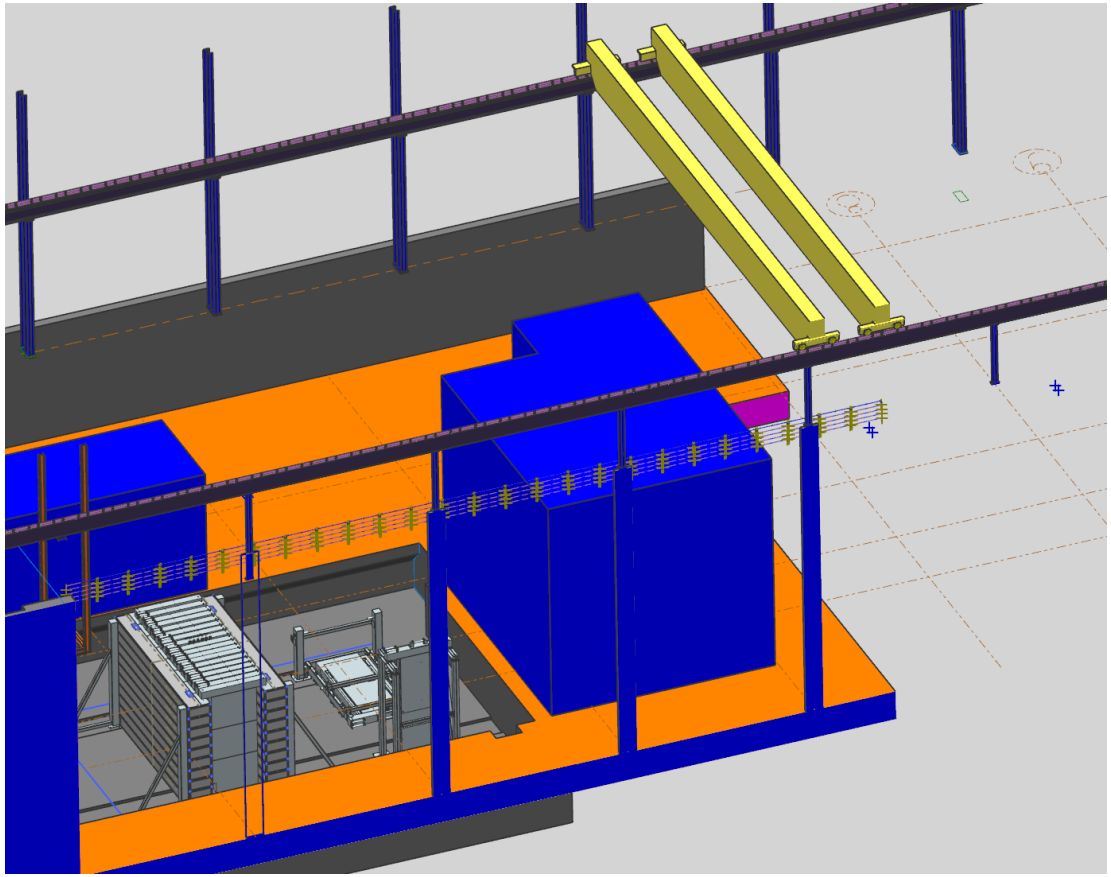
- Use shop space at DZERO Assembly Building
- Steel T-Block welding can be done upstairs, and the fixtures and stands can go in the pit
- Only available crane with enough capacity (30+ ton), hook height to lift full-height modules, and availability
- Coordinating to ensure space is reserved in 2028-2029 for module assembly and storage

Building	Crane capacity(ton)	Hook to Floor(ft)	Door HT(ft)	Door Width(ft)	Door faces	Comment
DAB	50/10	21	18	19	South	2 hooks, one trolley
Minos	15	18	16	16	South	Not Shaft crane
Minos (Shaft)	15	350	16	16	South	Prox. Limiters
PB7(2 cranes)	15	40' 7"	14	14" 10"	North	18' CL to CL
PC4	10	13.5	13' 8"	13	n/a	Travel limited
Lab 6	5	12.5	15' 10"	13' 4"	West	Electric lines outside
LArTF	5	14' 3"	16	17' 6"	South	Travels Pit
Meson Center	20	23' 4"	16	16' 3"	North	Coexists w Meson East
CDF	50/10	18' 6"	16	16	East & West	2 hooks, one trolley
PAB (2 cranes)	10	15' 3"	14	14	North	underslung trolley
MAB 1	20	16	16	16	North	Travel limited to North Half.
MAB 2	10	16	14	14	E/W	East/West Doors
Minos Hall	15	23' 1-1/2"	n/a	Blast 14' 3"	n/a	Travel over Detectors
Lab A	20	31	19	24	East	Round Bridge Travel
Meson East	30	16	12	16	East	Coexists w Meson Central
Lab G	20	12(dock)	11' 6"	14	East	Hook 16' 6" floor
Lab B	5	21' 8"	16	12	South	Pit depth
Lab F -1	12.5	21' 6"	13' 10"	18	South	15' 6" dock floor to hook
Lab F -2	7.5	19	n/a	n/a	n/a	Over Clean Room
NM4	25	18	16	16	North	CL hook to: south wall= 7'
						North wall= 10'
						West wall 4'
Mu2e	30 (2)		16	14	South	
Mc1	30		14	12	North	
Lab 7	3 ton	8	14	16		11 feet wide on west side of Lab
Lab 7 JIB	5 ton	10	14	16		10 foot long
Lab 5	2 ton	9	14	16		

DAB Lower Level (Pit)



DAB Lower Level CAD Mockup (F10215415)



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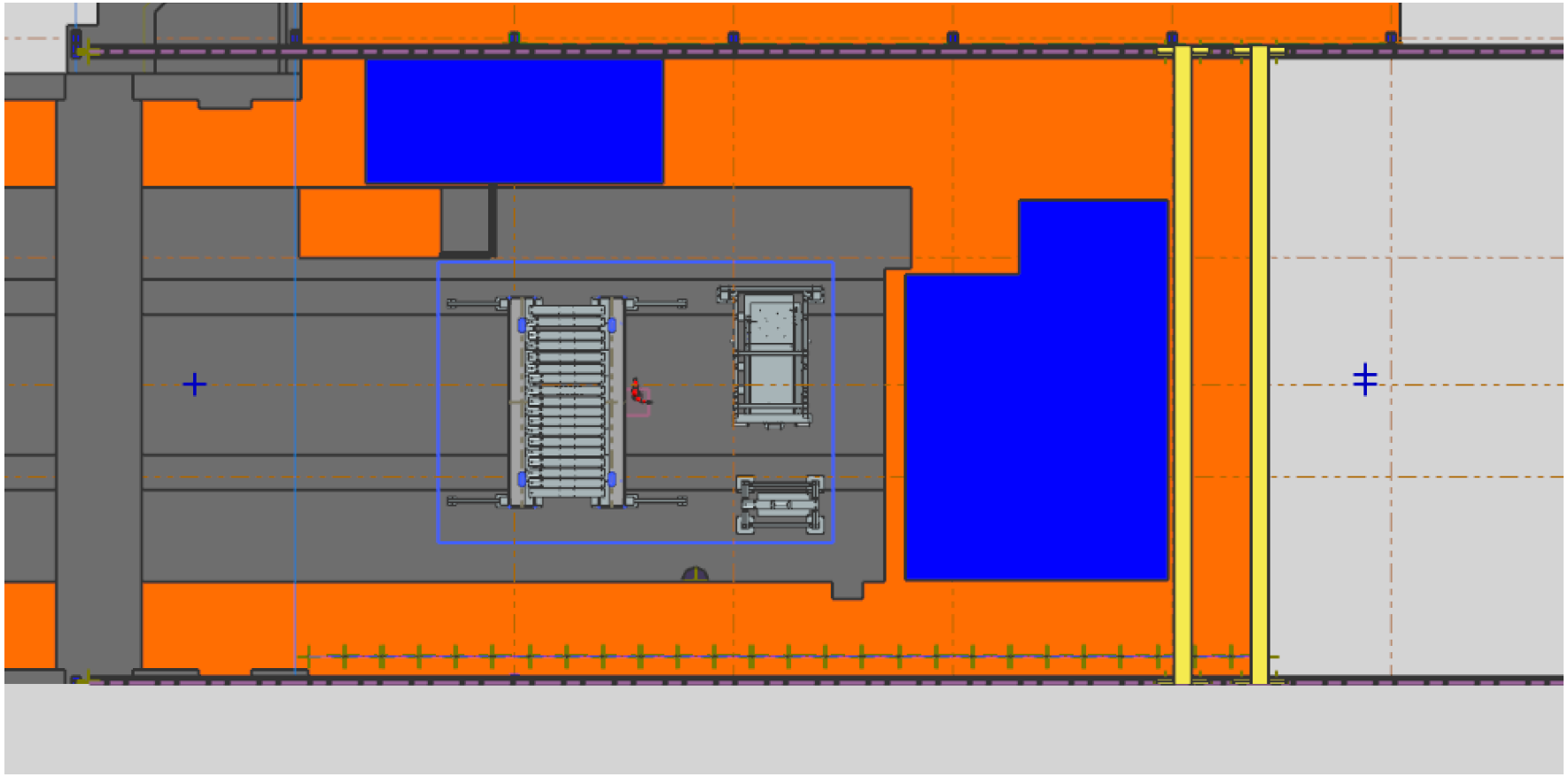


Installation Overview

- DUNE-doc-30781 – Installation Documentation
  - Process/sequence is not final
  - Stability calcs have been reviewed (informally)
- Factors driving installation sequence:
  - Size of components
  - Worker access to weld points
    - In-process QA accessibility, machinery positioning
  - Access to install shims
    - E.g., Blue Block shimming
  - Worker access to bunker at various stages
    - Fall protection/prevention
    - “staircase” install sequence where possible

*More discussion on this and worker safety in next talk

Installation Overview

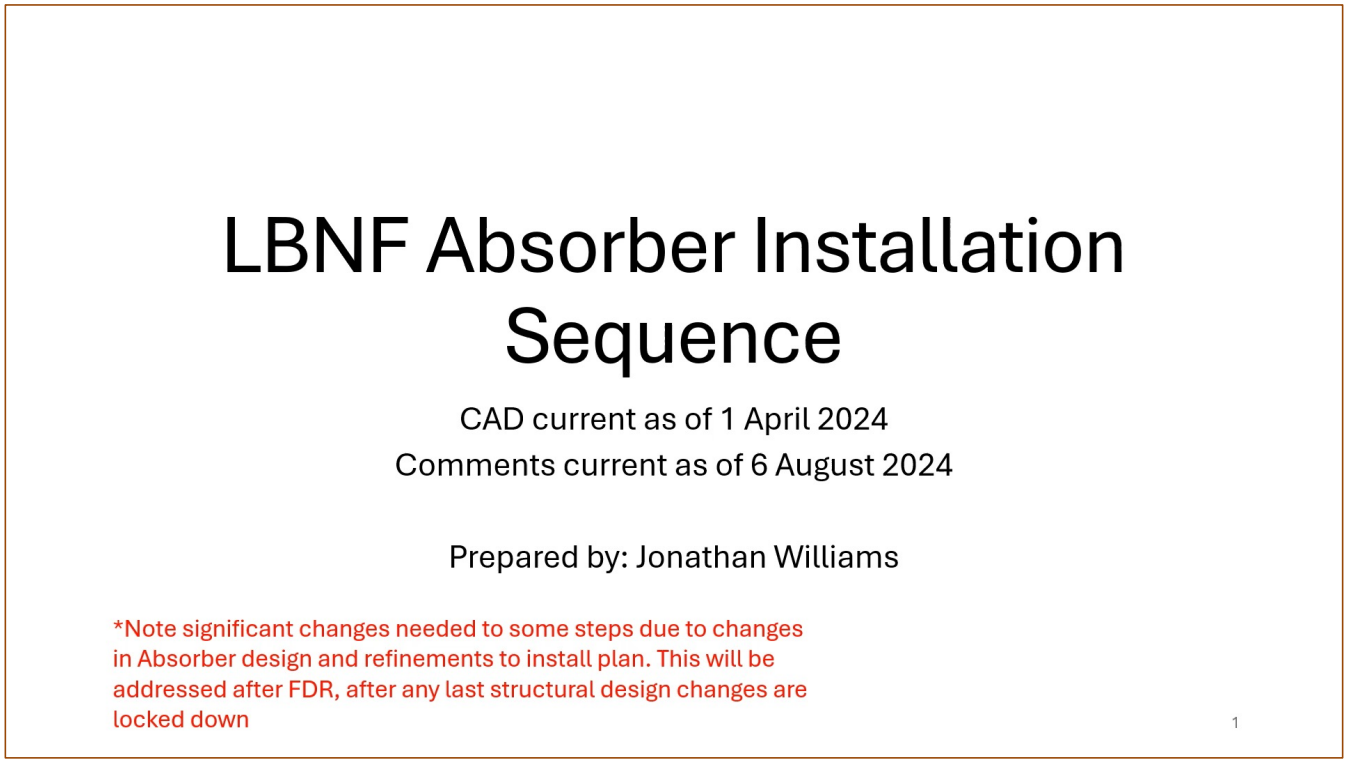
- Tipping loads
  - Blue Blocks
  - Steel slabs
  - Crane swing impulses
  - Pressure loads on downstream wall
- Weld sizing per AISC Spec. for Structural Steel Buildings
  - See weld plan in DUNE-doc-30781

Installation Note Highlights

- Engineering Notes for assembly fixtures have been reviewed, final edits are in-work
  - Not on Teamcenter yet
- Stability notes will be formally reviewed when assembly plan is to be finalized
  - Tipping modes analyzed depend on specifics of install steps
  - Weld plan will need an update (upstream steel shielding has been simplified since writing)
- Many “Critical Lifts” as defined by FESHM 10200 (see backup slide for specific definitions)
  - High-value components
  - Unique components
  - Close confines and nonstandard rigging (e.g., rotation fixture for core modules)
  - Heavy steel components >75% capacity of 30-ton crane

Installation Sequence - Animation

- See DUNE-doc-30781 for installation plan and detailed assembly steps



FESHM 10200 - Critical Lifts

*More ES&H considerations discussed in next talk

Critical Lift –
A lift that meets any of the following:

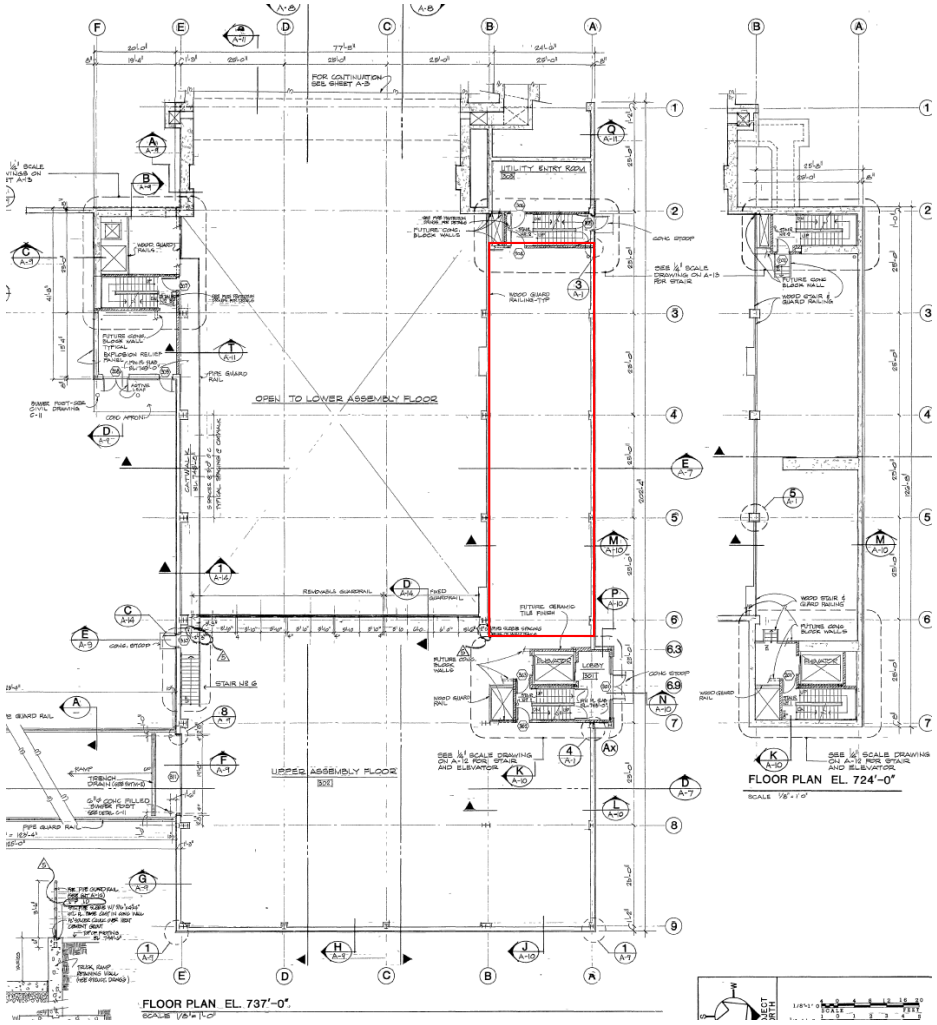
- Loss of control of the item being lifted would likely result in the declaration of an emergency.
- The load or item is unique and, if damaged, would be irreplaceable or not repairable and is vital to a system, facility or project operation.
- The cost to replace or repair the load item damaged would have a negative impact on facility, organizational, or DOE budgets to the extent that it would affect program commitments.
- Lifts made with more than one crane/forklift.
  - *Exception: a tandem lift with synchronized overhead cranes that utilize one controller, as long as the item being lifted does not meet any other critical lift criteria.*
- Lifts made near electrical, ground or overhead utilities.
- Lift involves non-routine or technically difficult rigging arrangement.
- Lifts over items that are considered critical to the lab.
- For steel erection, a lift shall be designated as a critical lift if:
  - The lift exceeds 75% of the rated capacity of the crane, or
  - The lift requires the use of more than one crane.

Installation Schedule & Logistics

- Approximately 8 months of continuous install operations (excluding wind days, holidays, etc.)
  - All core modules to be built, tested, and stored prior to Absorber install
  - Once Absorber is ready for modules, truck modules from DAB to LBNF-30 with transport frames
- DUNE-doc-28487
  - Labor effort included in budget estimate
  - Component cost estimates, with quotes when possible

Questions?

Backup



Upper level:

- Truck access
- Approx. 21' 9.5" usable hook height, 50t crane
- Counting House track outlined in red

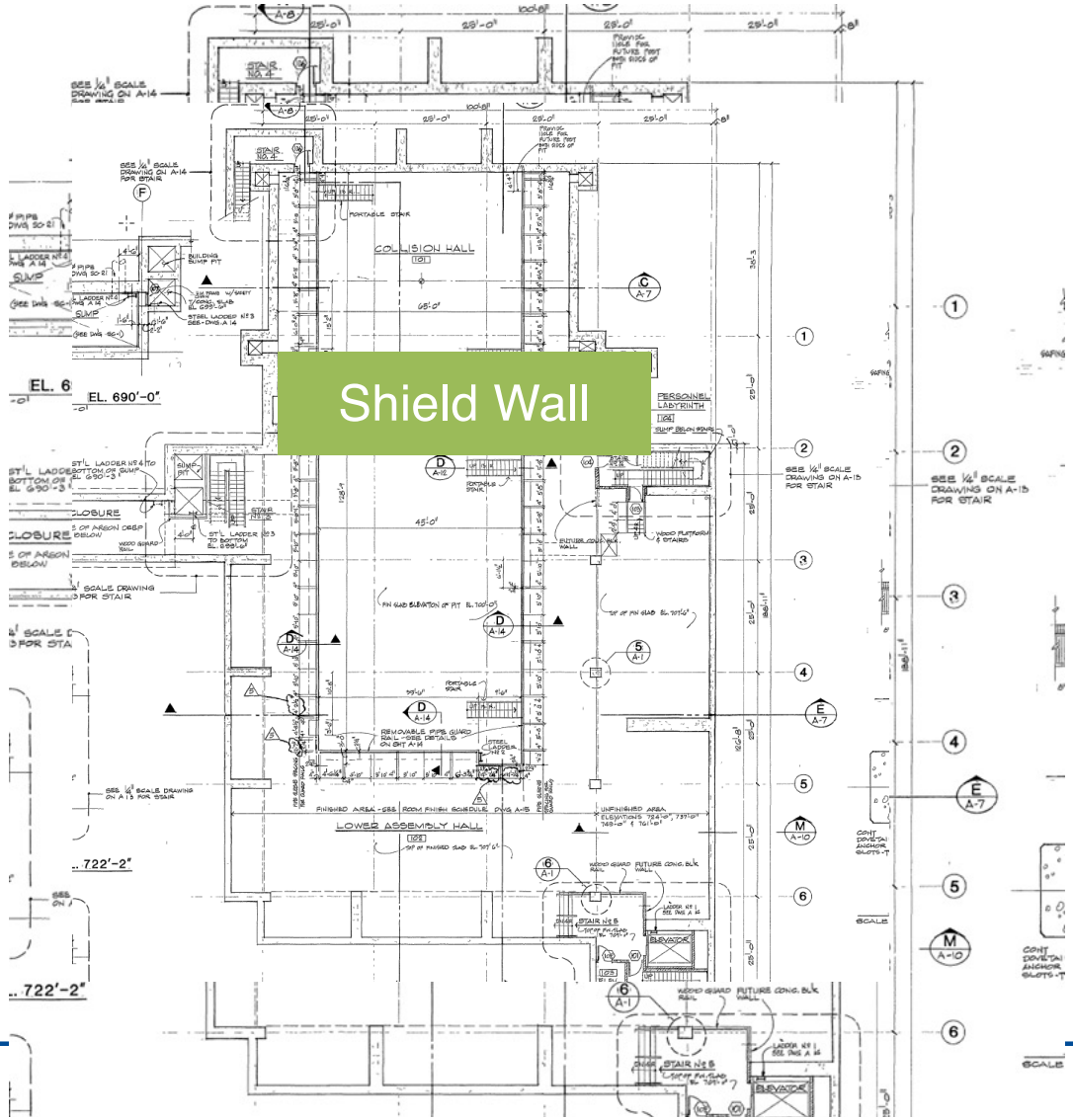
REV	DATE	DESCRIPTIONS
	9-71-XX	GUARD RAIL DIMENSION REVISION
1	3-29-85	PIPE GUARD RAIL, DIMENSIONS & MISC. CORRECTIONS
		REVISIONS

DESIGNED	R SACHTSCHALE	6/7/85
DRAWN	J W BANKS, A TUBINAS	6/7/85
CHECKED		6/7/85
APPROVED		6/7/85
SUBMITTED		6/7/85

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

D-O EXPERIMENTAL AREA
PLAN EL. 707'-6"/709'-6"

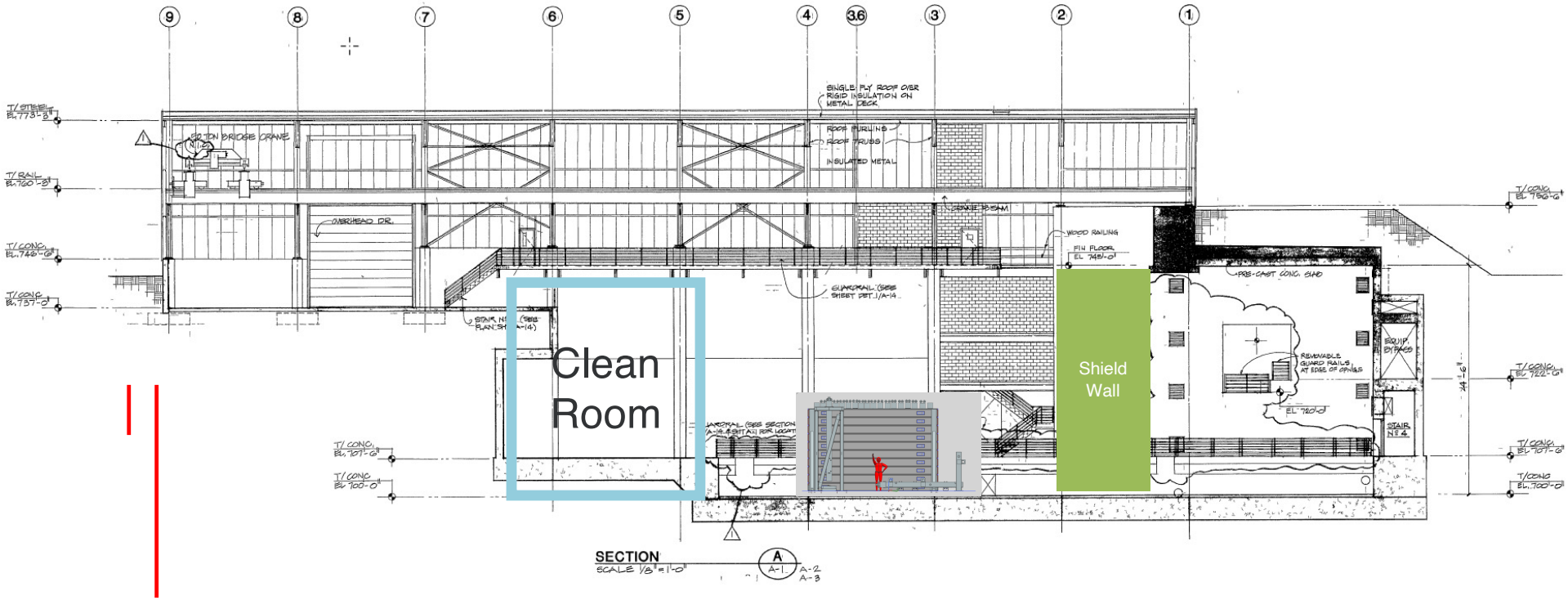
DRAWING NO 6-3-3 A-1 REV 5

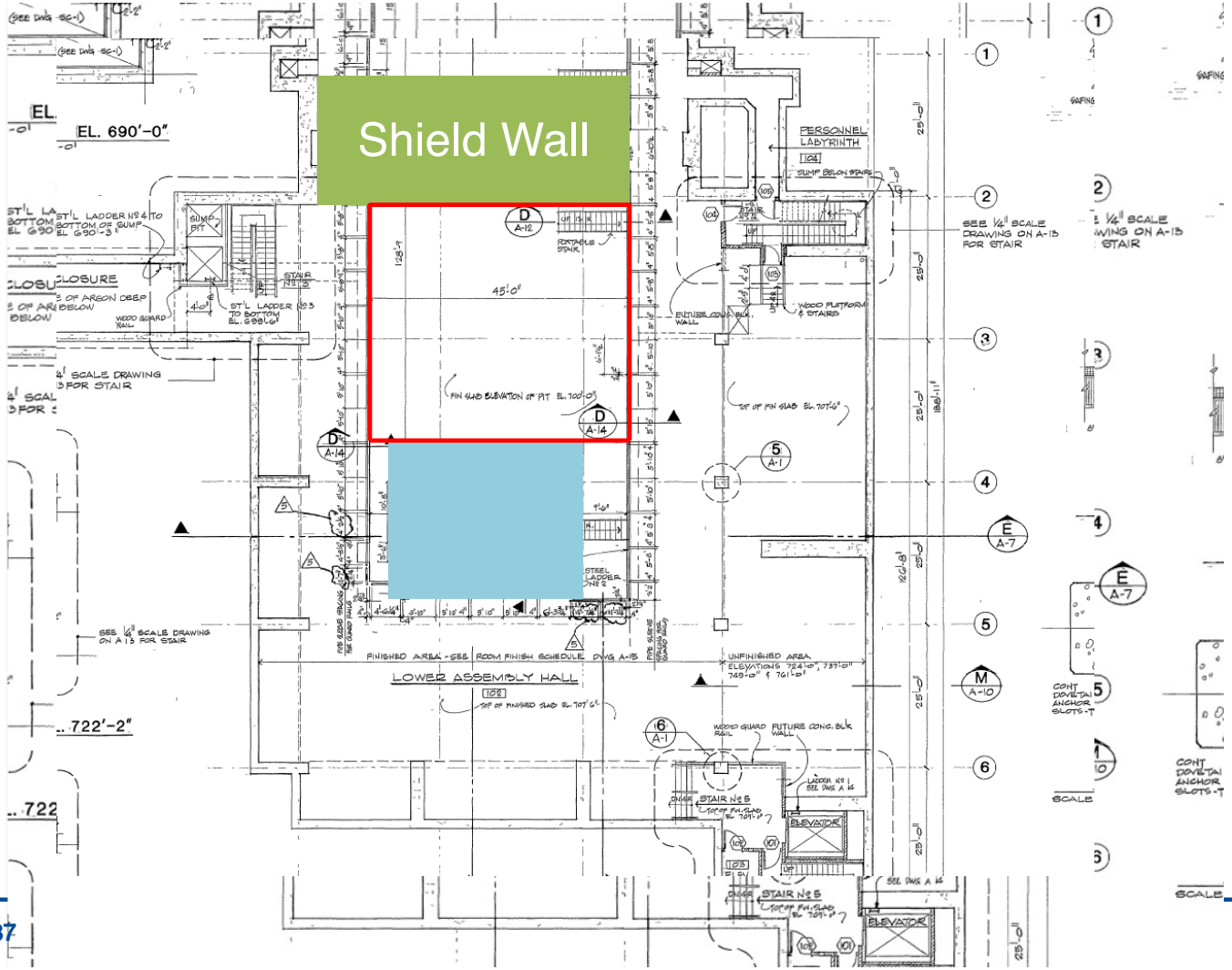


Lower Level:

- Heavy slab floor
- 37' hook height, about 58' total

LBNF/DUNE


Clean Room
Shield Wall
SECTION
SCALE 1/8" = 1'-0"



Lower Level:

- Heavy slab floor
- 37' hook height, about 58' total height
- about 45' across, rough estimate of 32' deep in front of clean room

LBNF/DUNE