

LBNE – LAr-FD

Time Projection Chamber detector illustrations

LBNE-doc-2794

Updated Sept. 21, 2012

R. Rucinski, S. Hentschel

LBNE LAr-FD TPC Project Illustrations

- This is a collection of illustrations and slides that are useful for describing the LBNE Liquid Argon TPC detector.
- Generally, the newer recent concepts are first and the obsolete or older illustrations are in the later slides.
- 3D modeling of integrated cryostat, TPC, and cavern by Steve Hentschel, PPD/MD/FNAL.
- Site Plan illustration: Jacobs Associates, Golder
- TPC frame construction illustrations by Bo Yu, Brookhaven National Laboratory.
- Physics reconstruction illustrations by Joshua Spitz, Yale University using ArgoNeuT data.

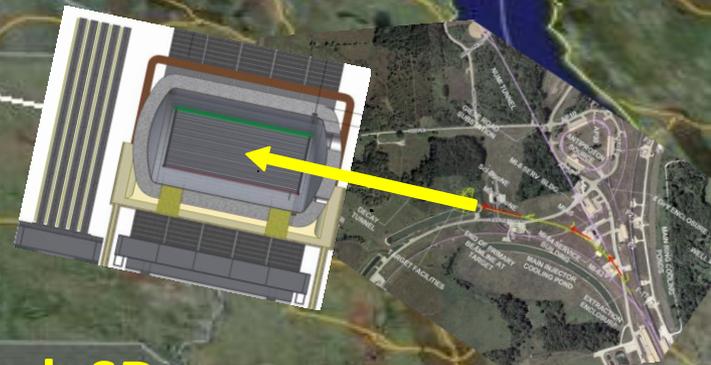
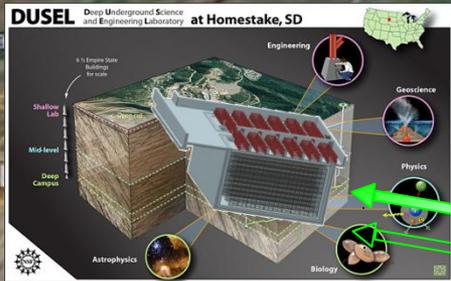
LBNE 10 kton on surface

Sept. 21, 2012

Long Baseline Neutrino Experiment



New Neutrino Beam at Fermilab...
on the Fermilab site



Directed towards a distant detector at the
Sanford Underground Research Facility in Lead, SD

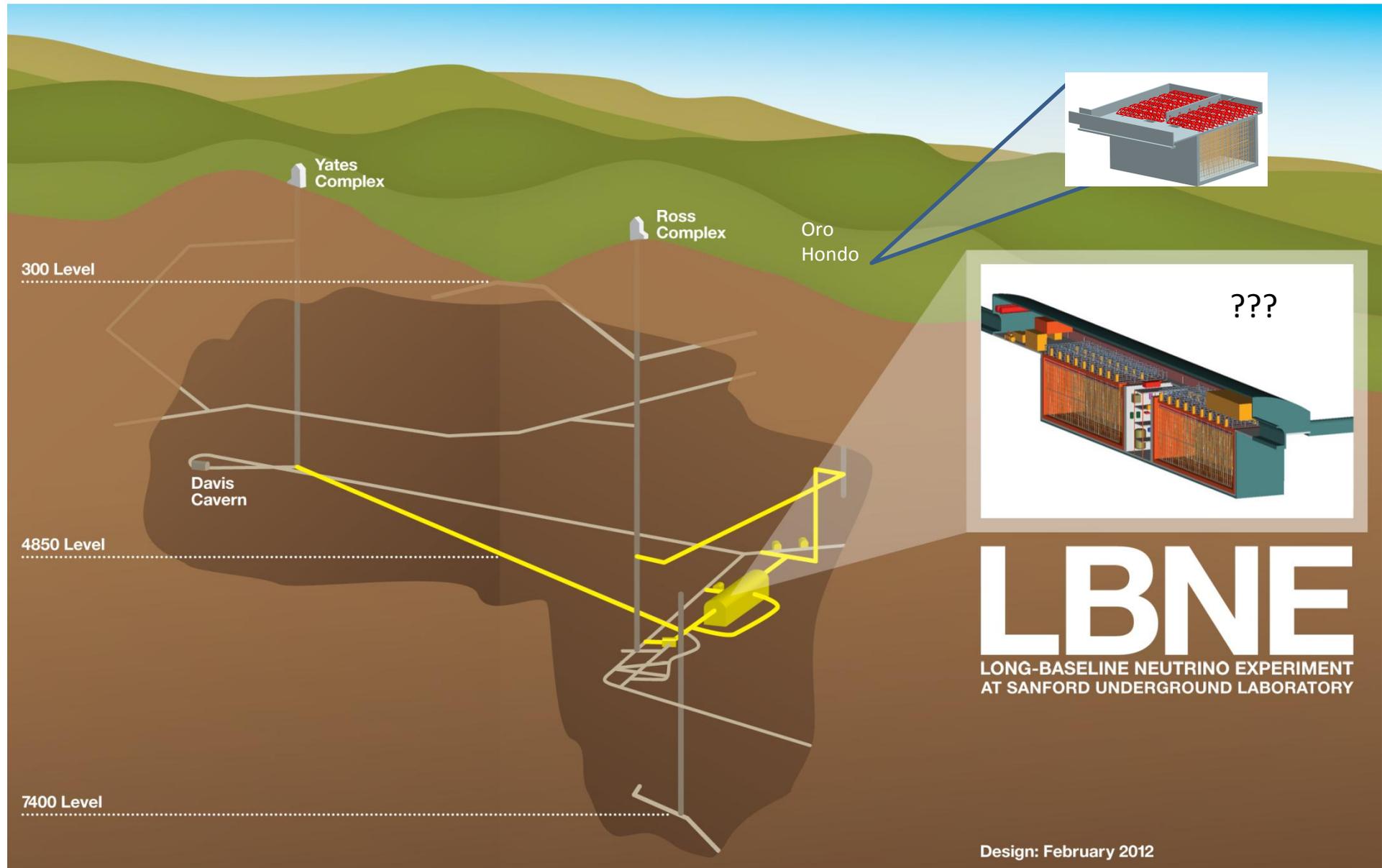
10 kton Liquid Argon TPC Far Detector
just below the surface

Image NASA
© 2008 Tele Atlas
Image © 2008 TerraMetrics
© 2008 Europa Technologies

Google

Pointer 43°03'56.44" N 95°10'42.53" W Streaming 100%

Eye alt 1108.62 km



Yates Complex

Ross Complex

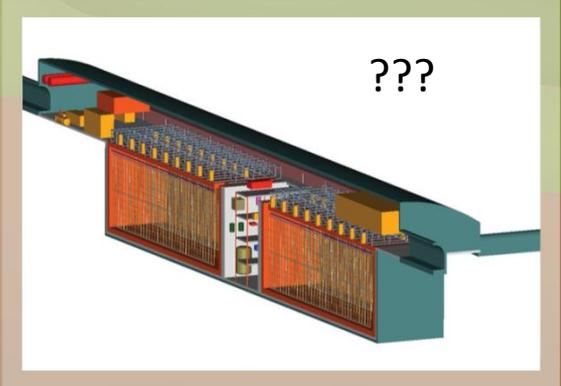
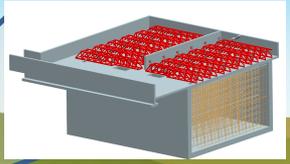
Oro Hondo

300 Level

Davis Cavern

4850 Level

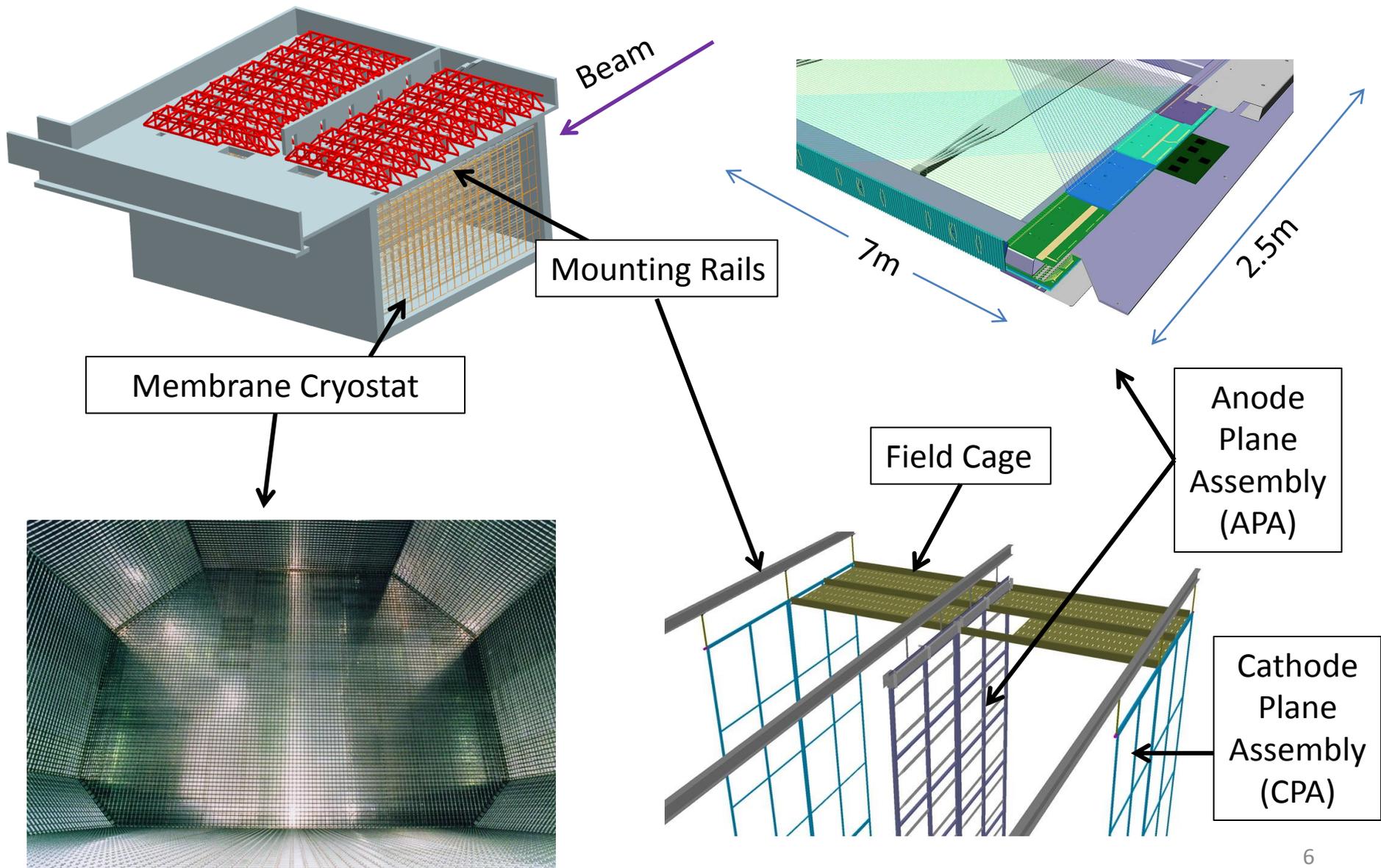
7400 Level

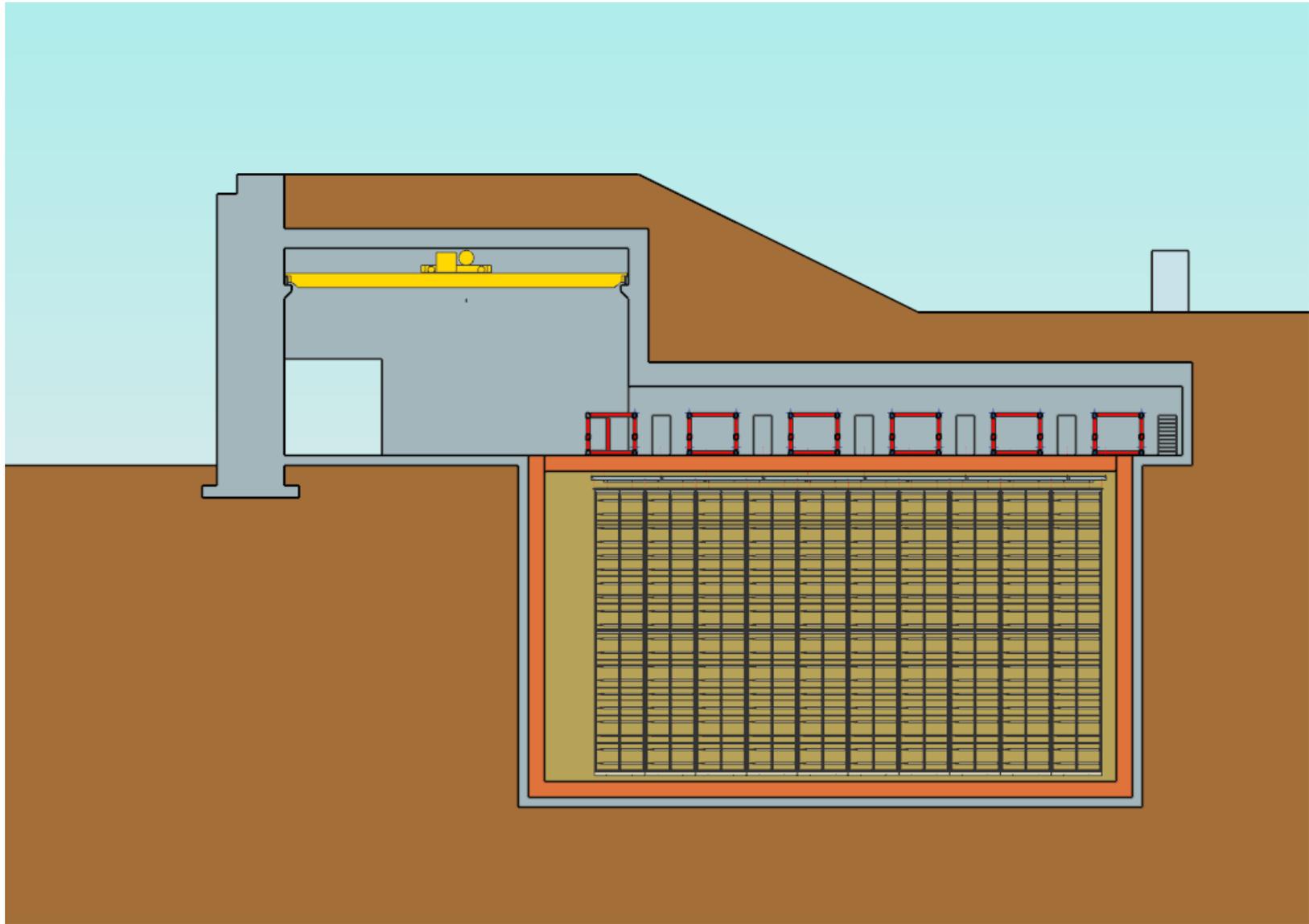


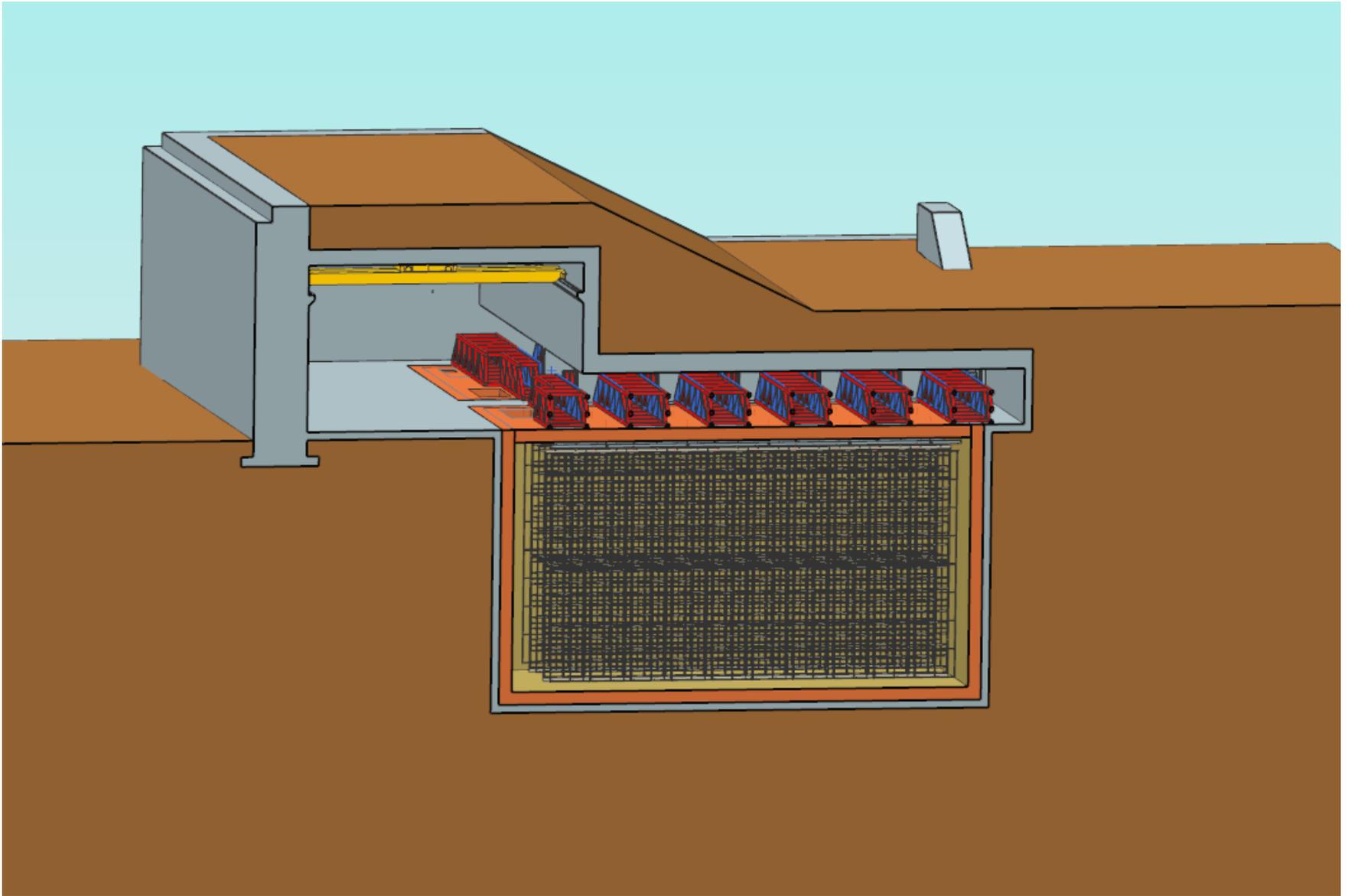
LBNE

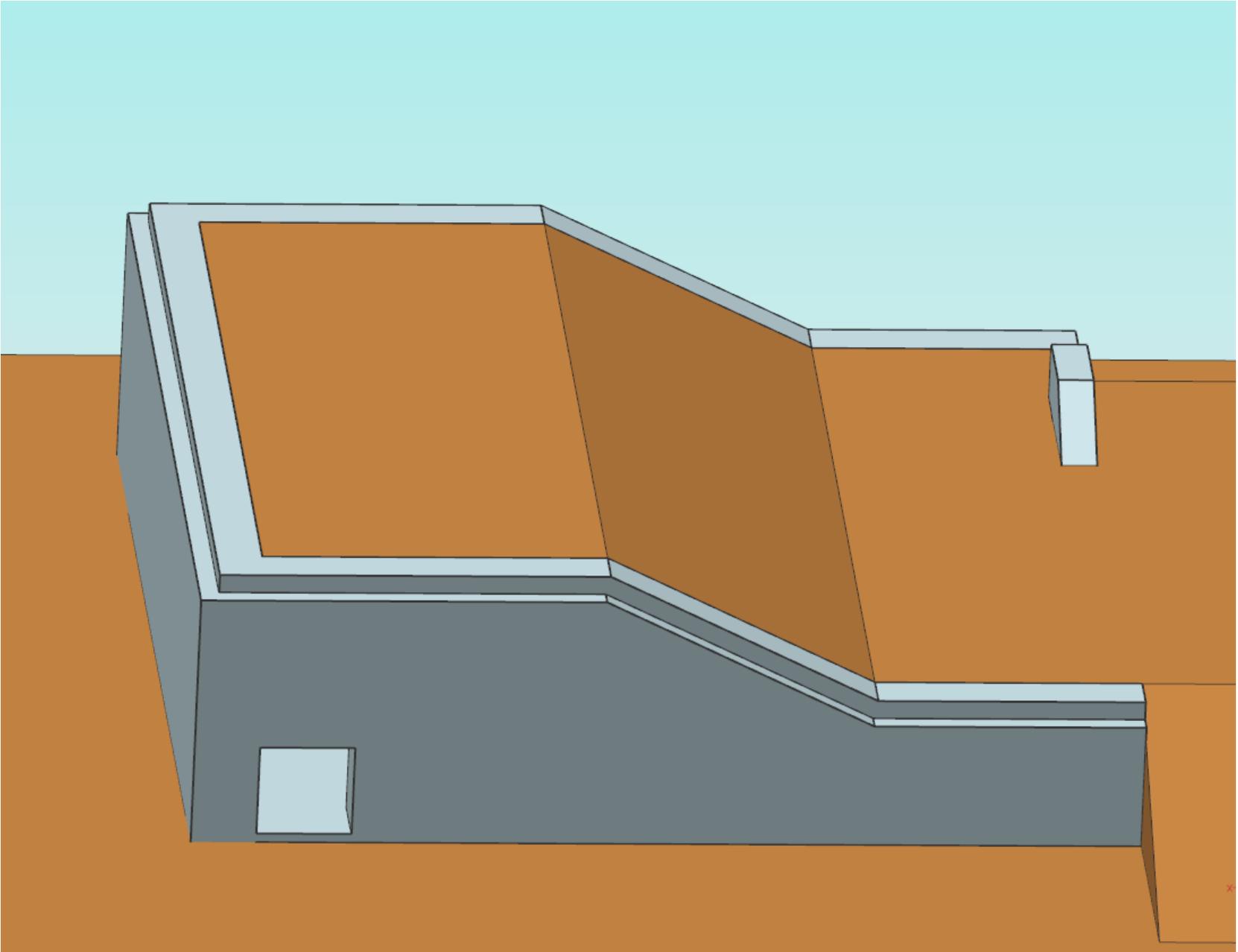
LONG-BASELINE NEUTRINO EXPERIMENT
AT SANFORD UNDERGROUND LABORATORY

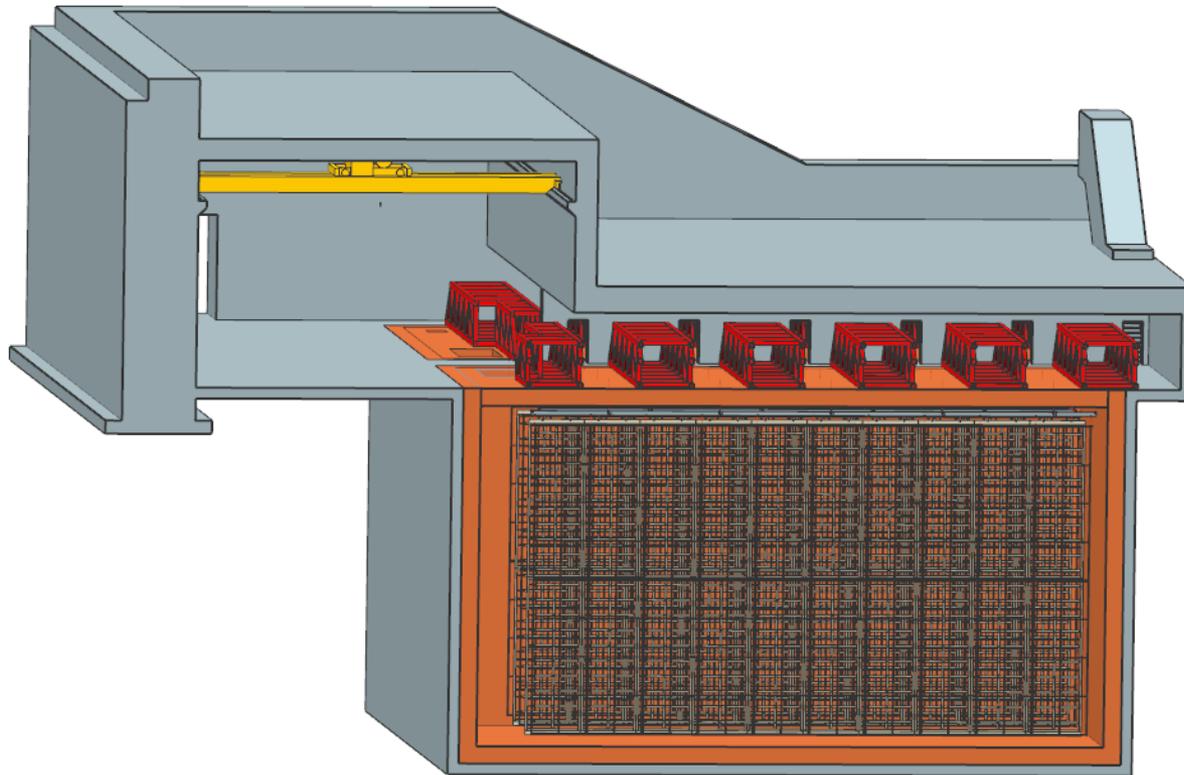
LBNE LAr-FD Detector Overview

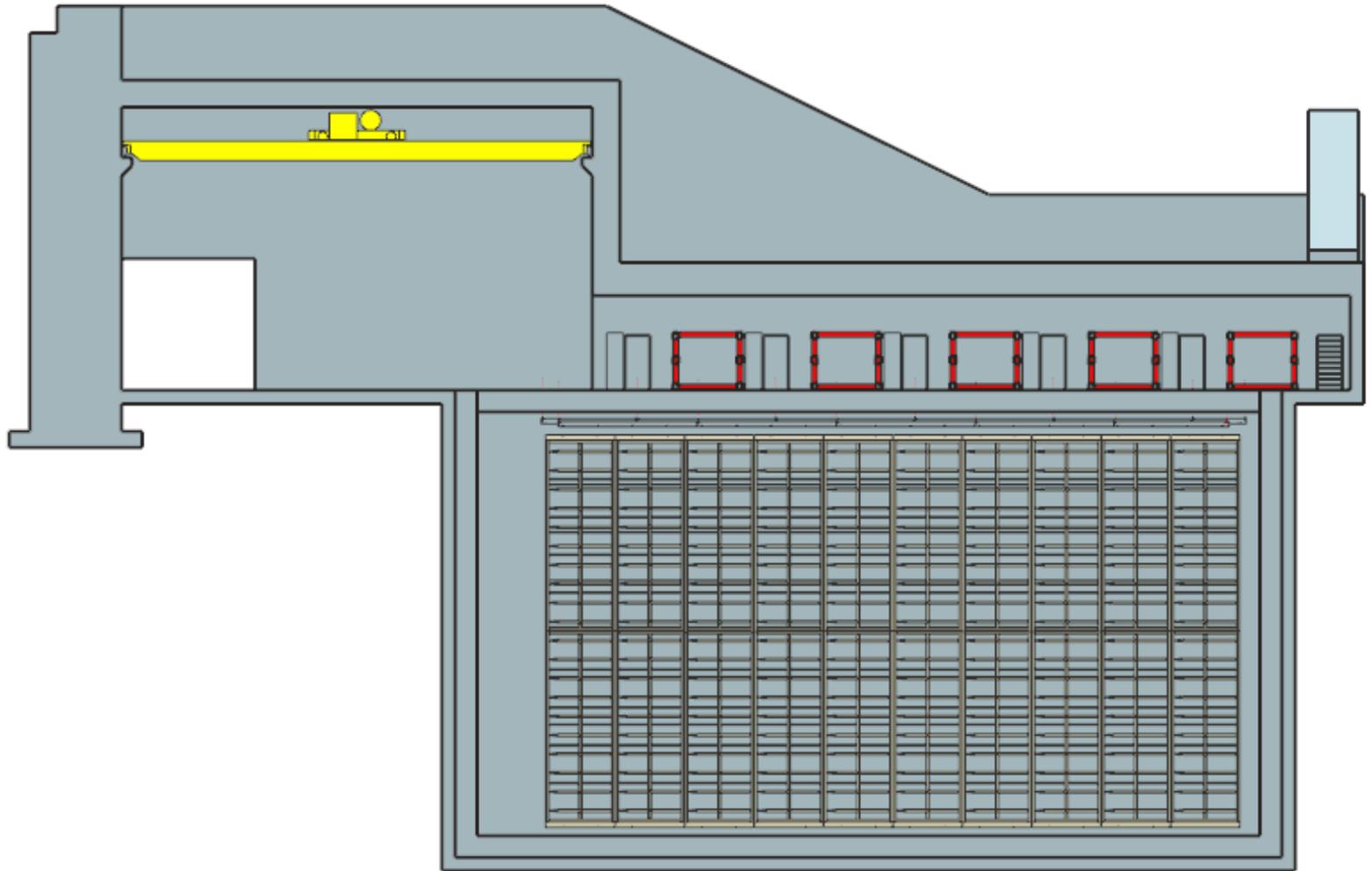




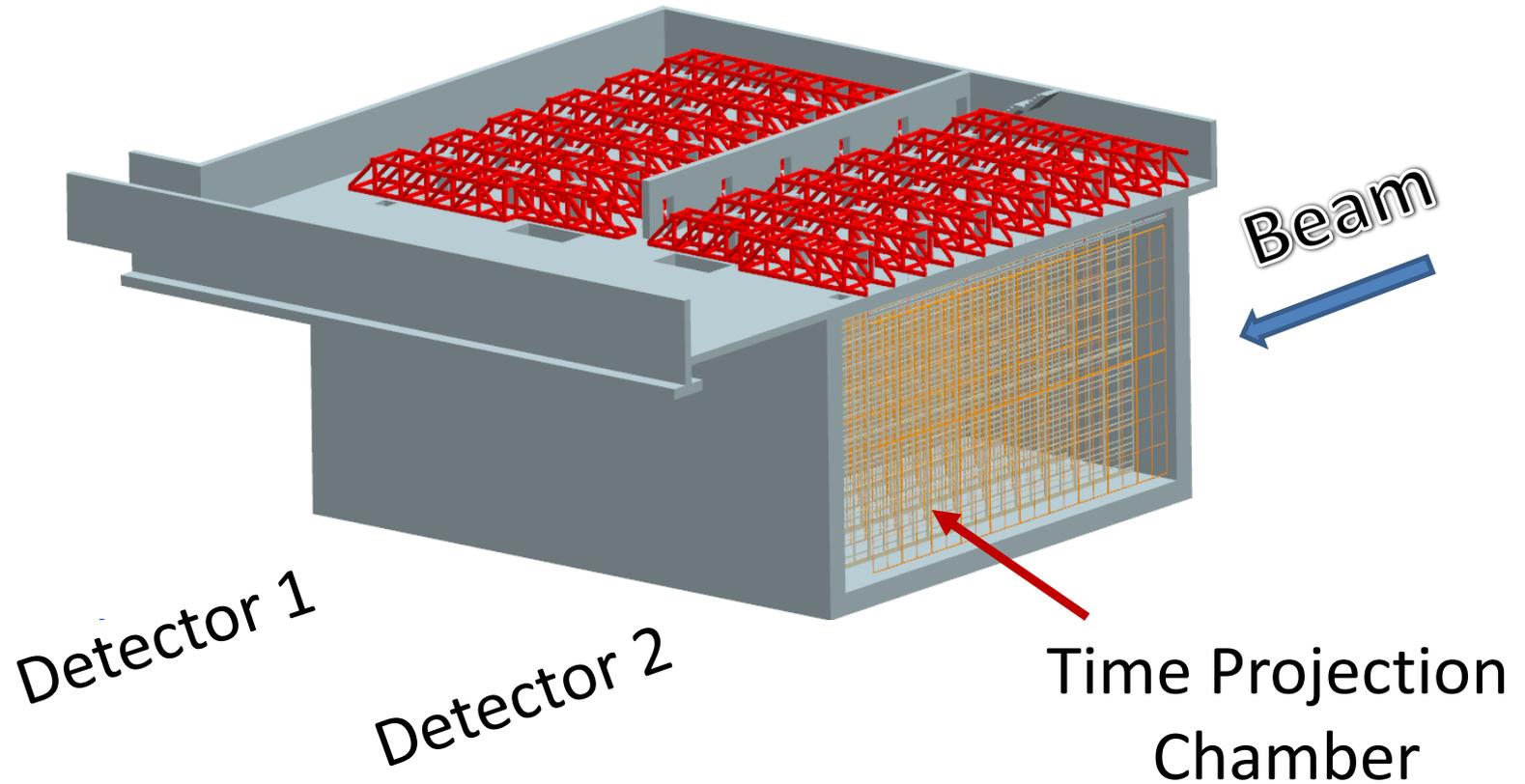


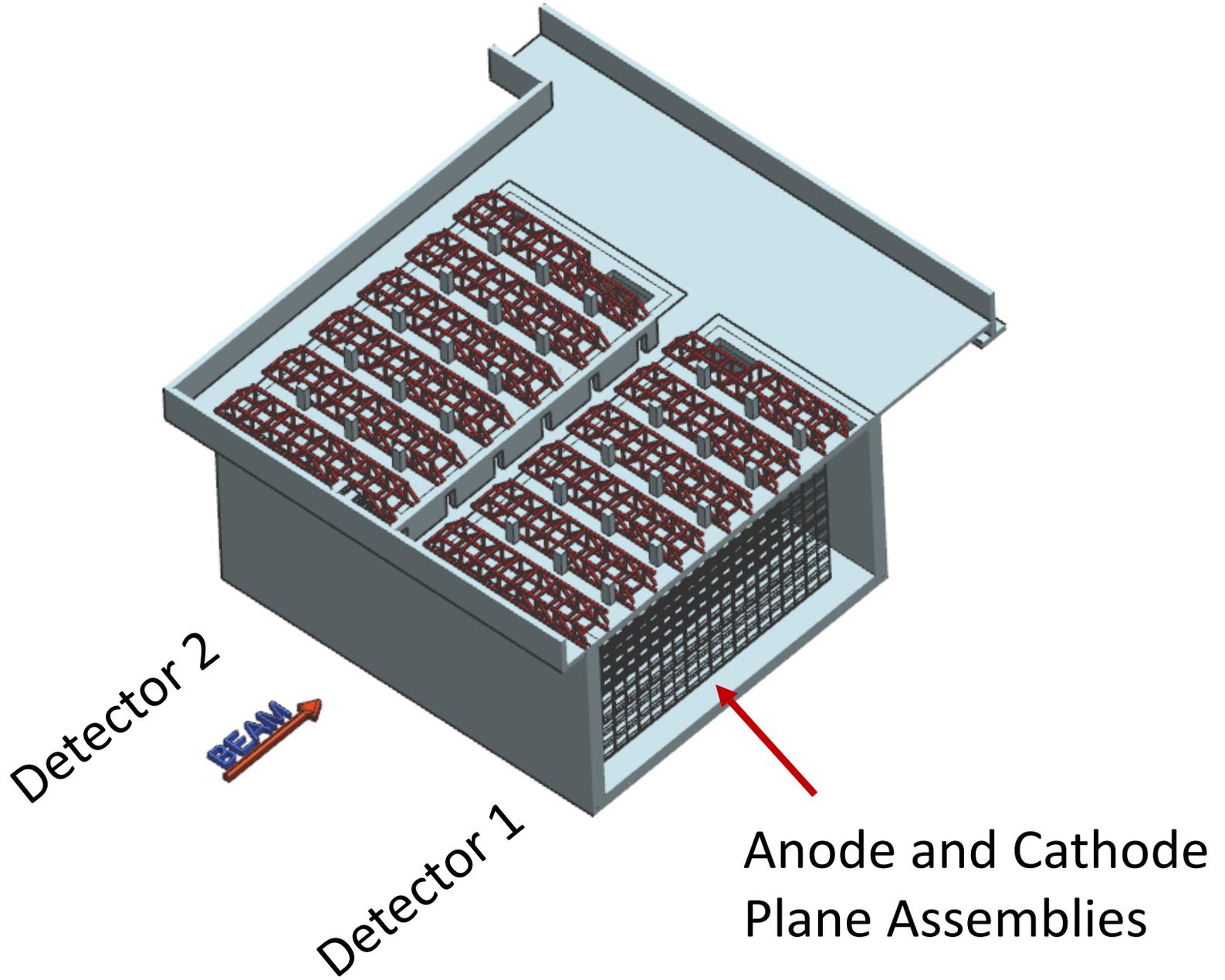


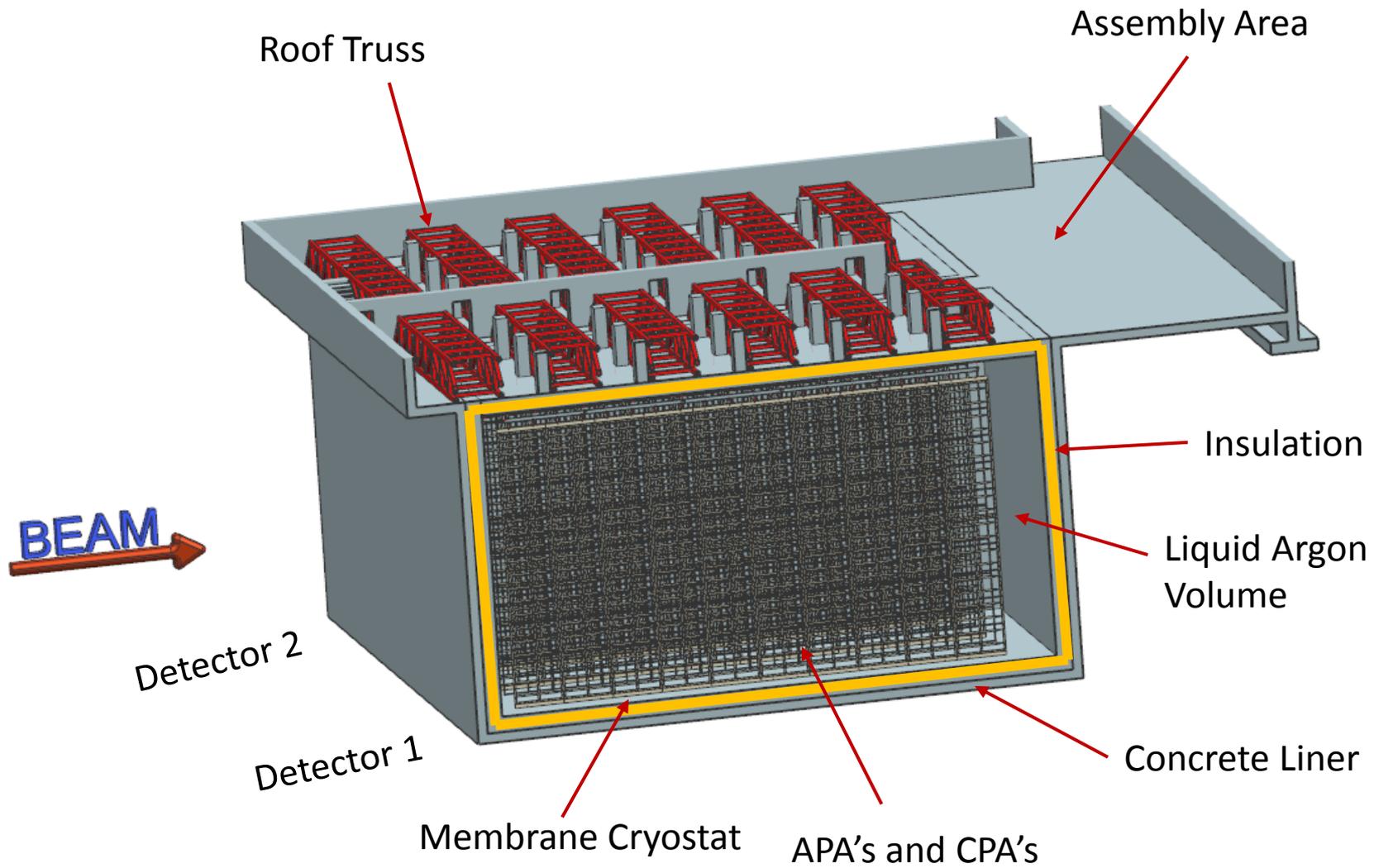


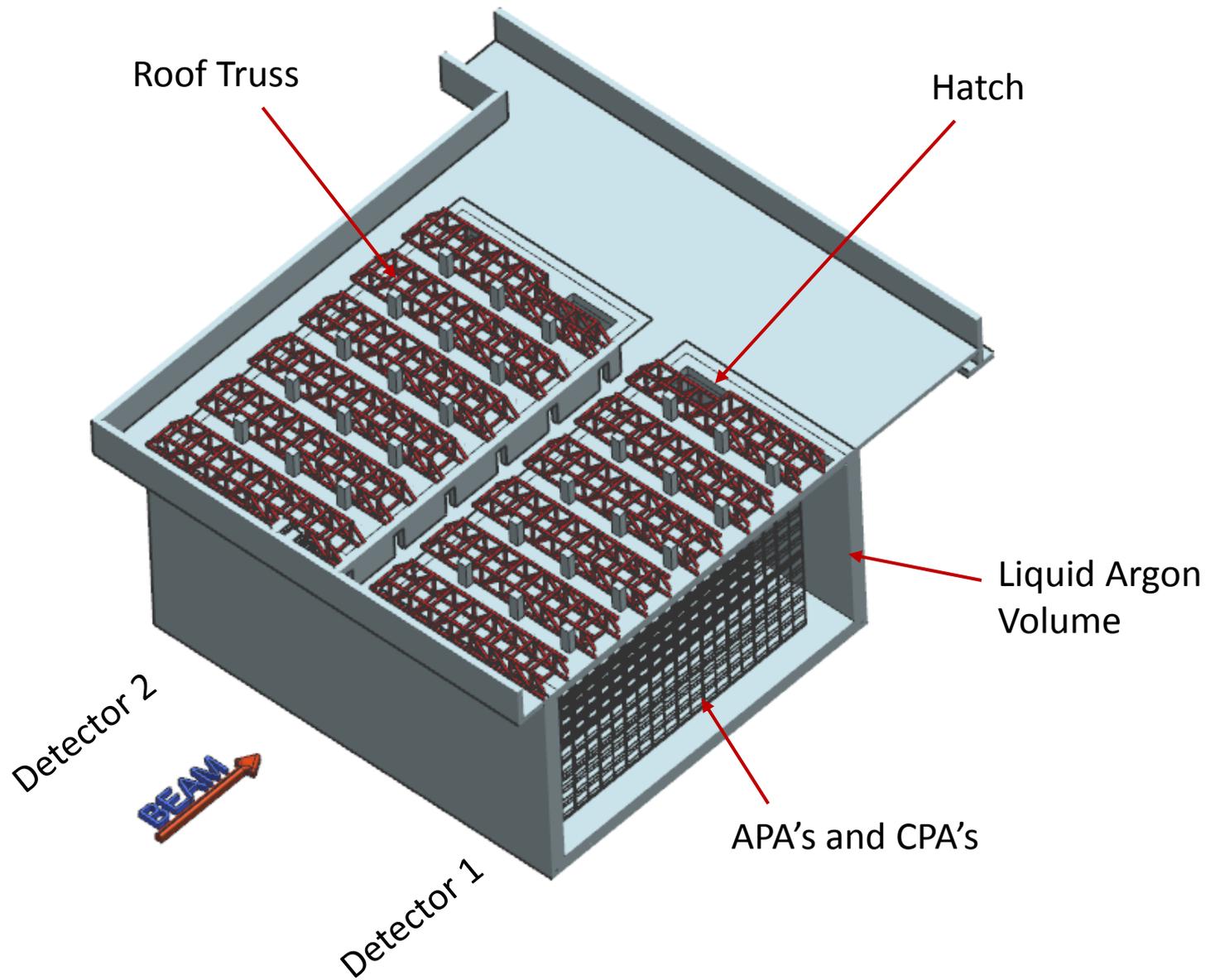


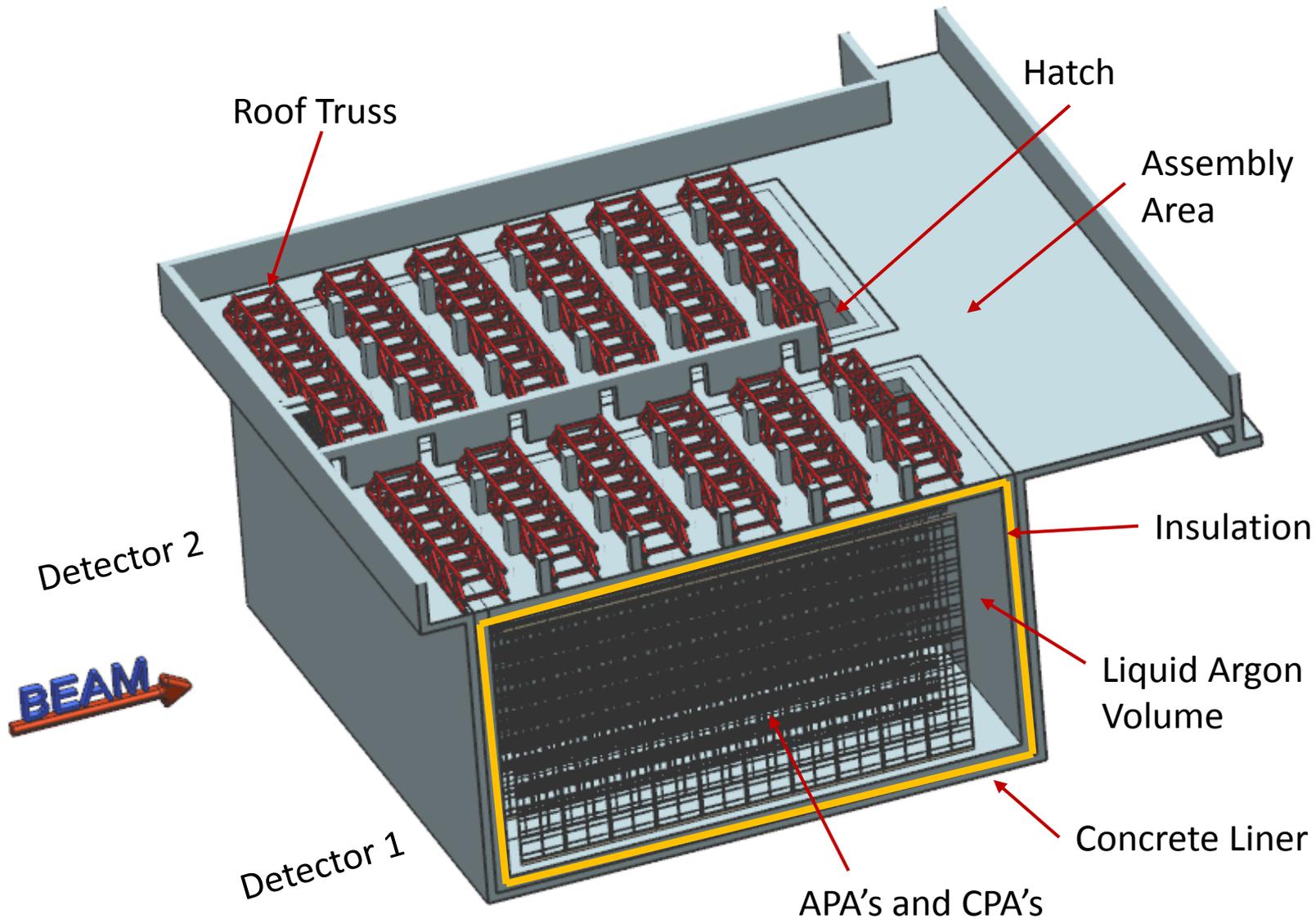
LAr-FD 10 kton detector on the surface. Consists of two 5 kton detectors

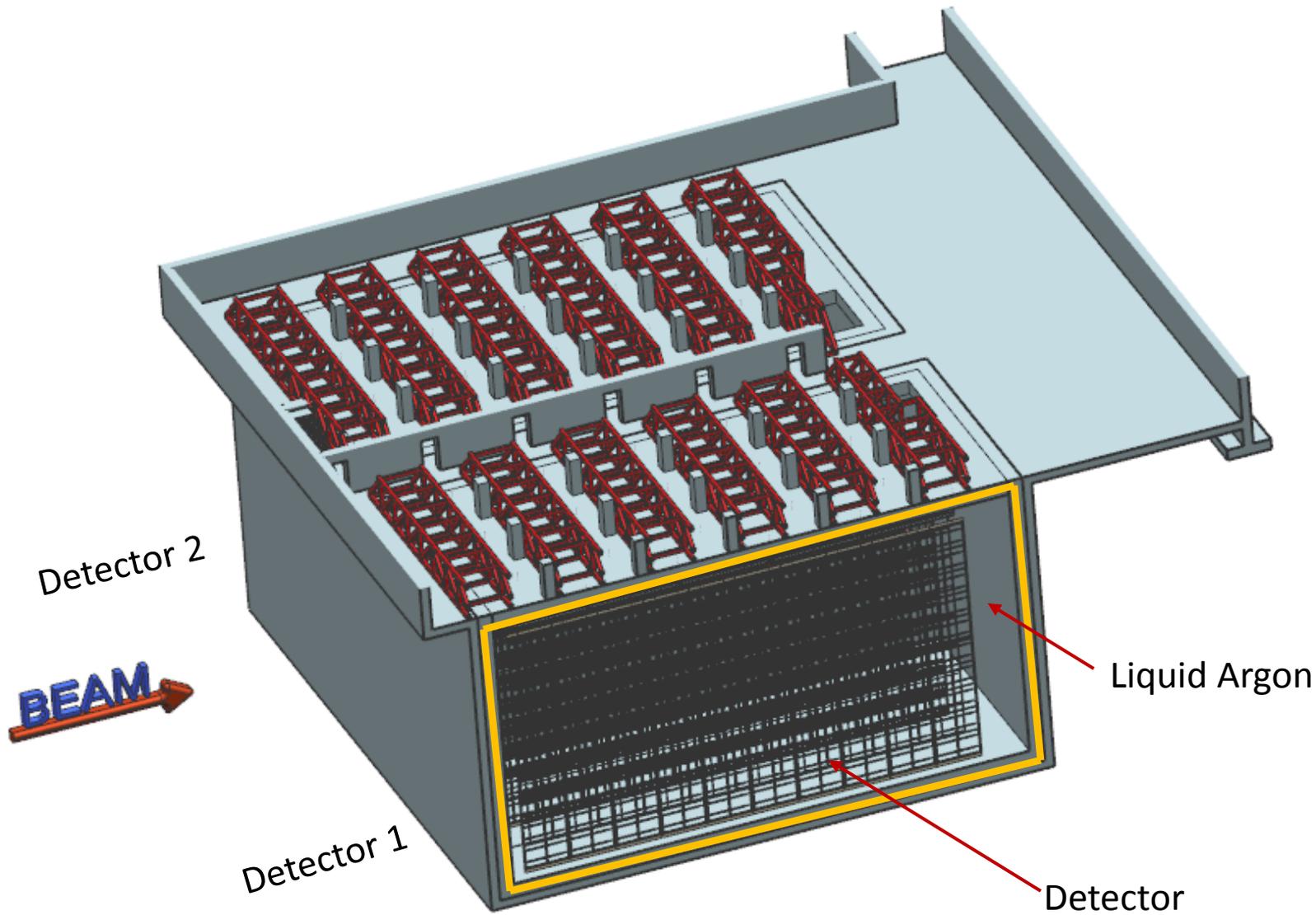




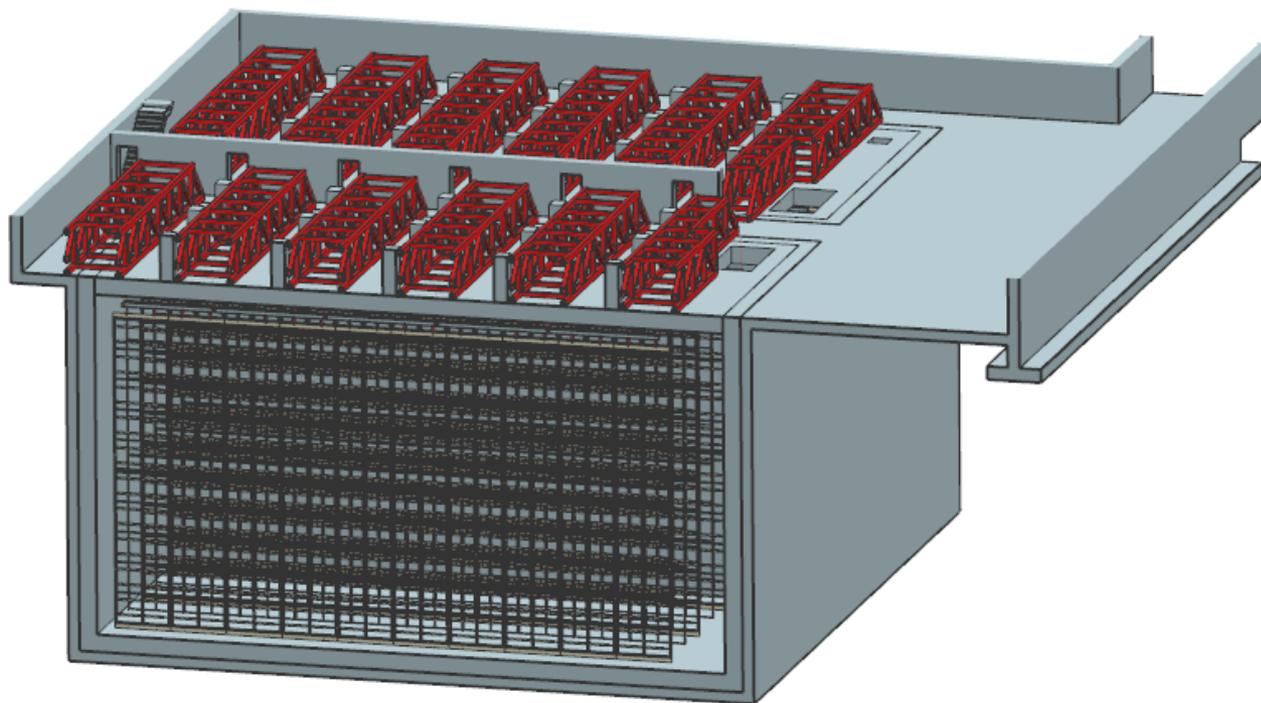




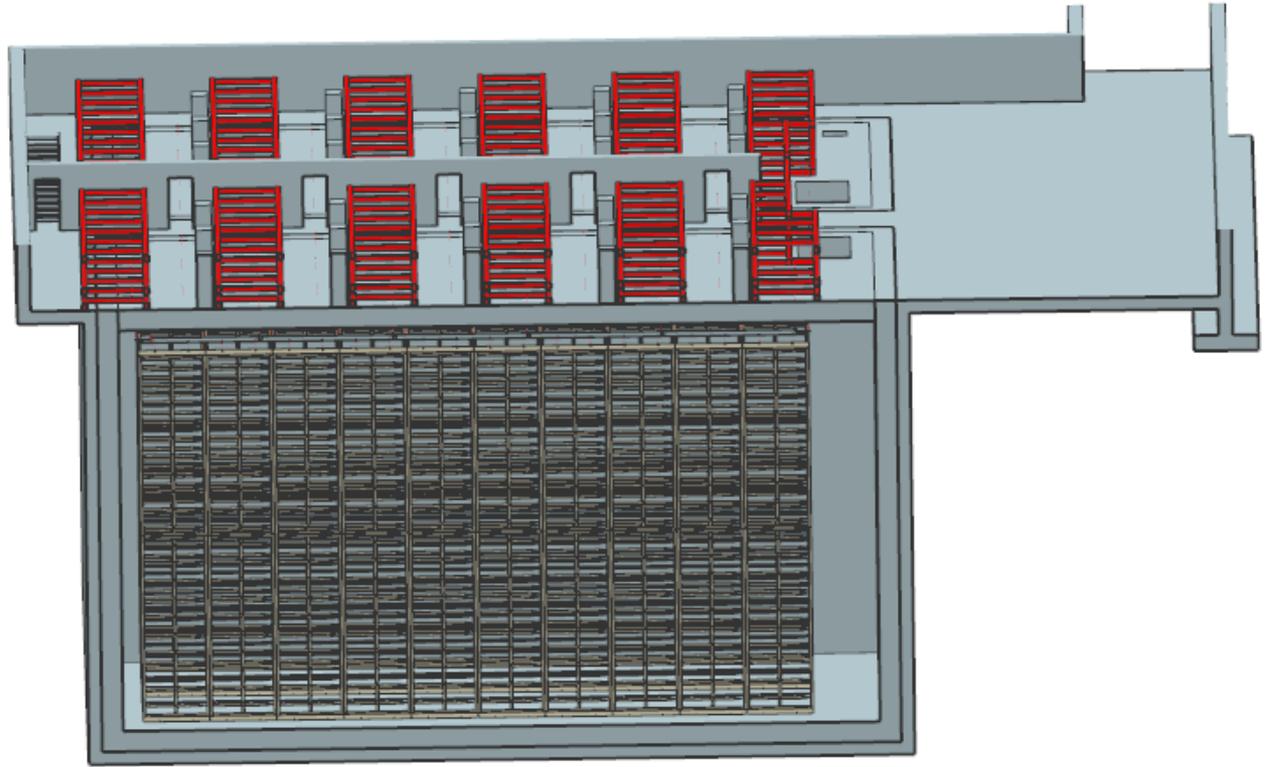


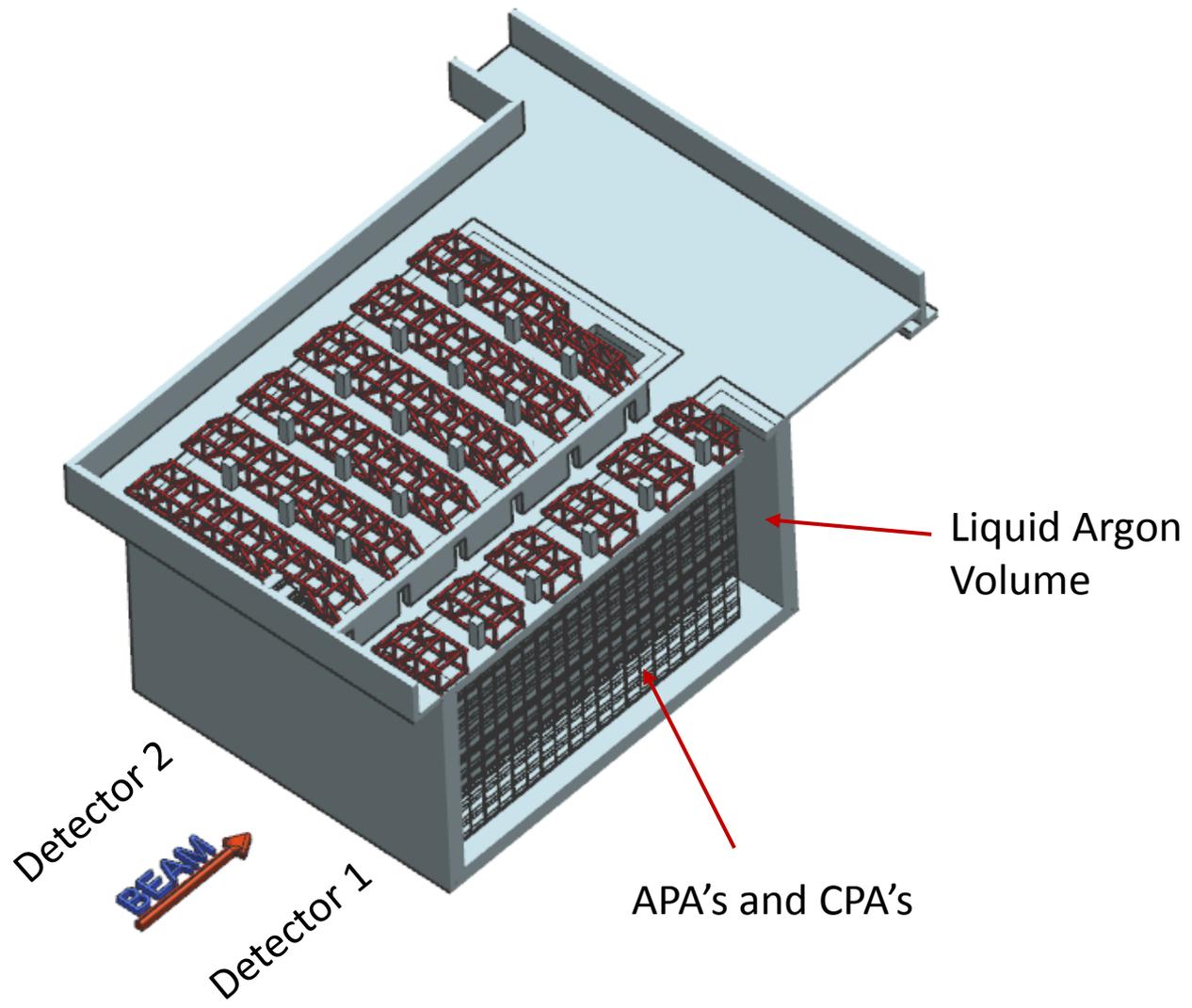


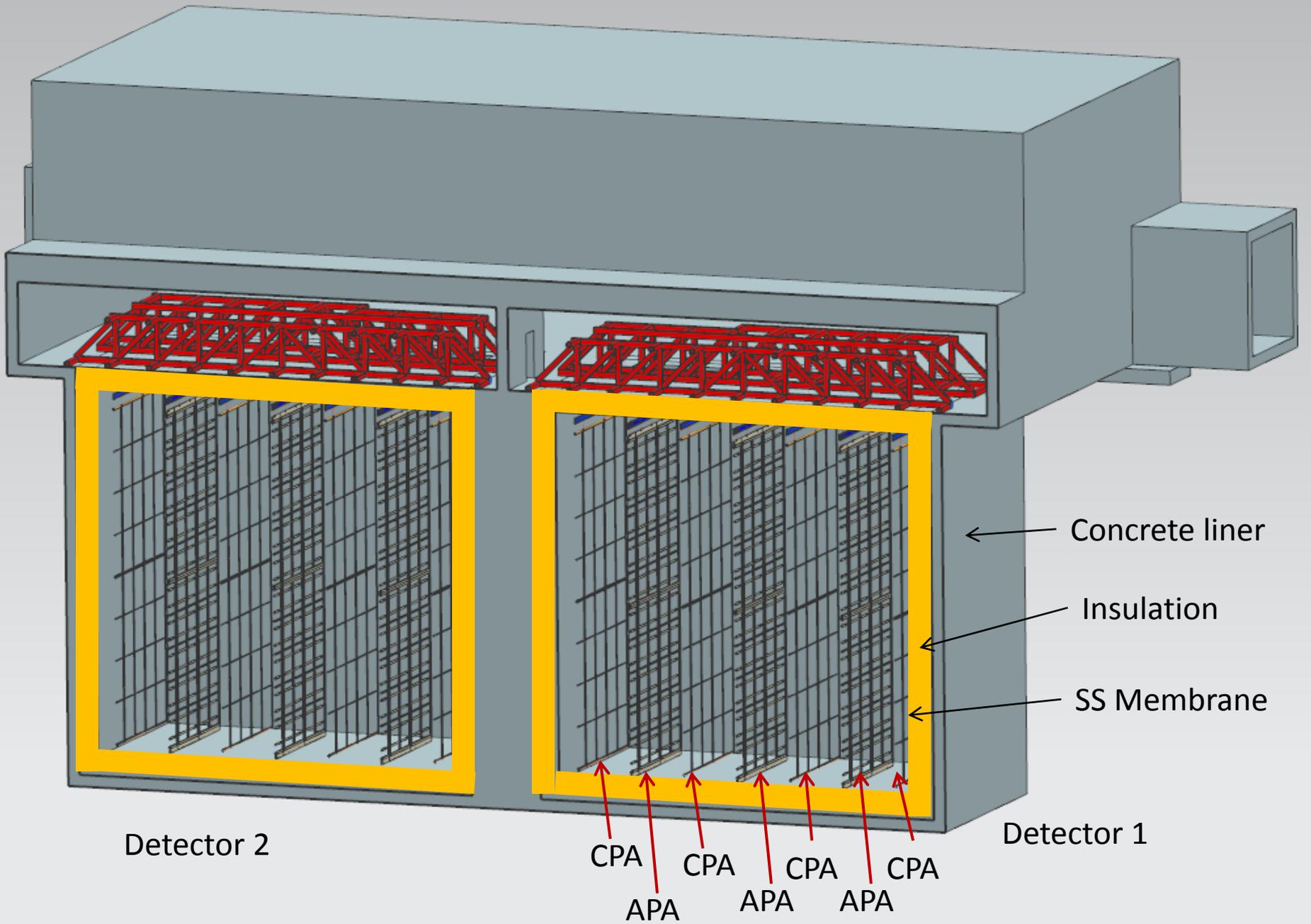
BEAM →

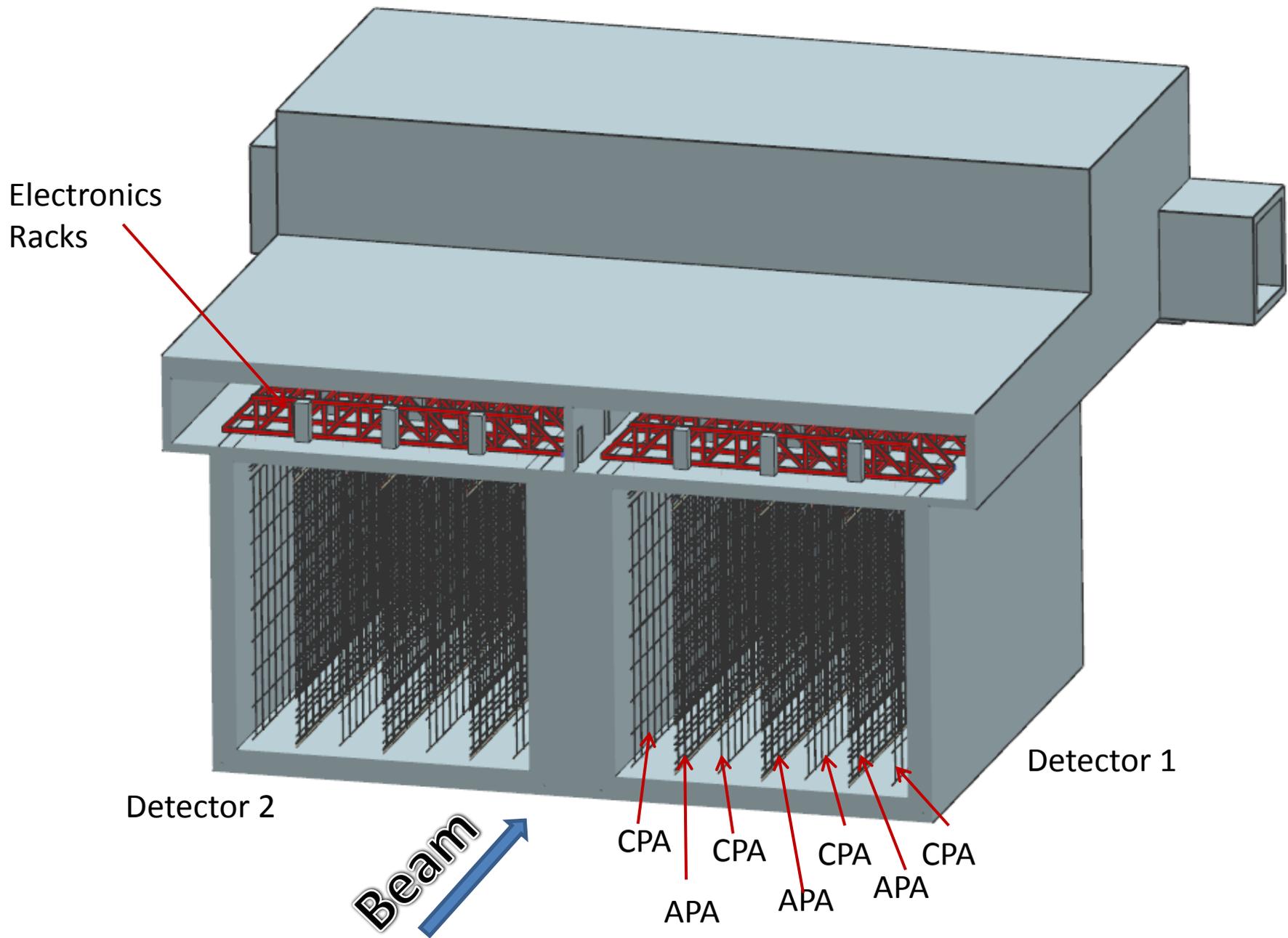


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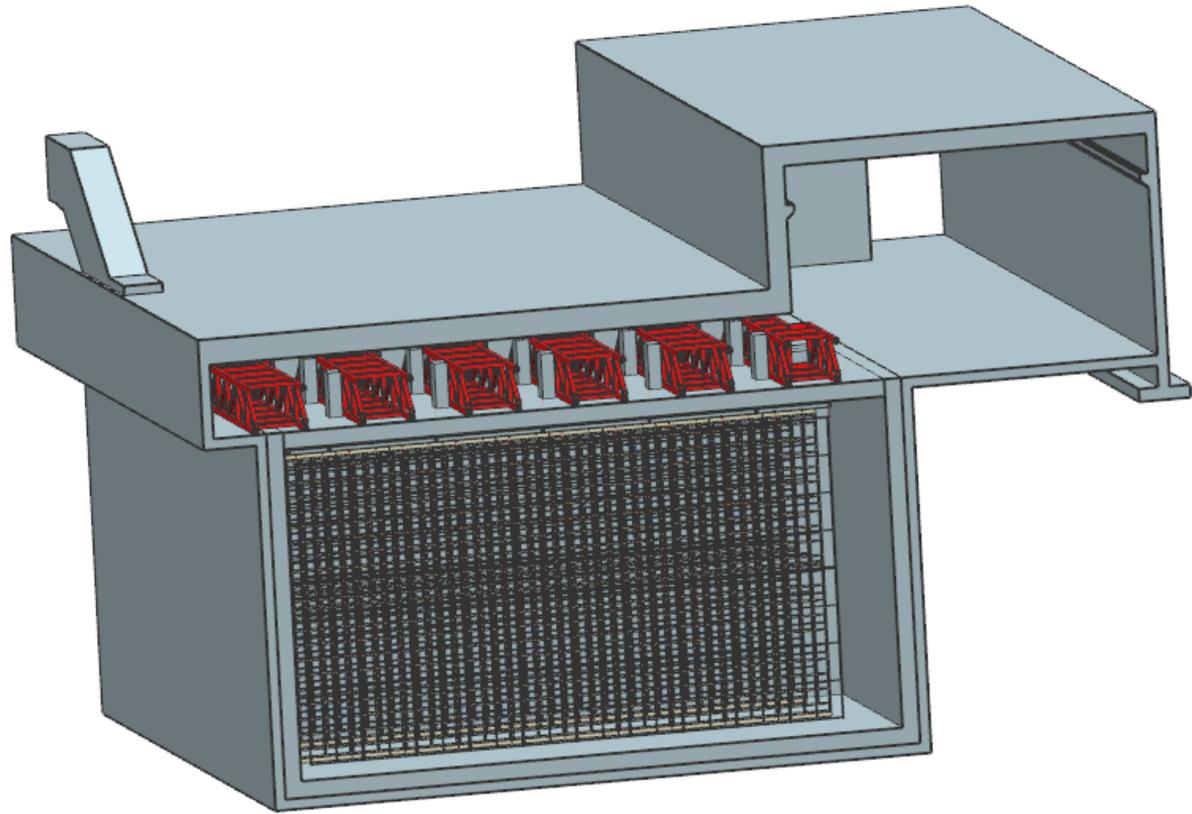


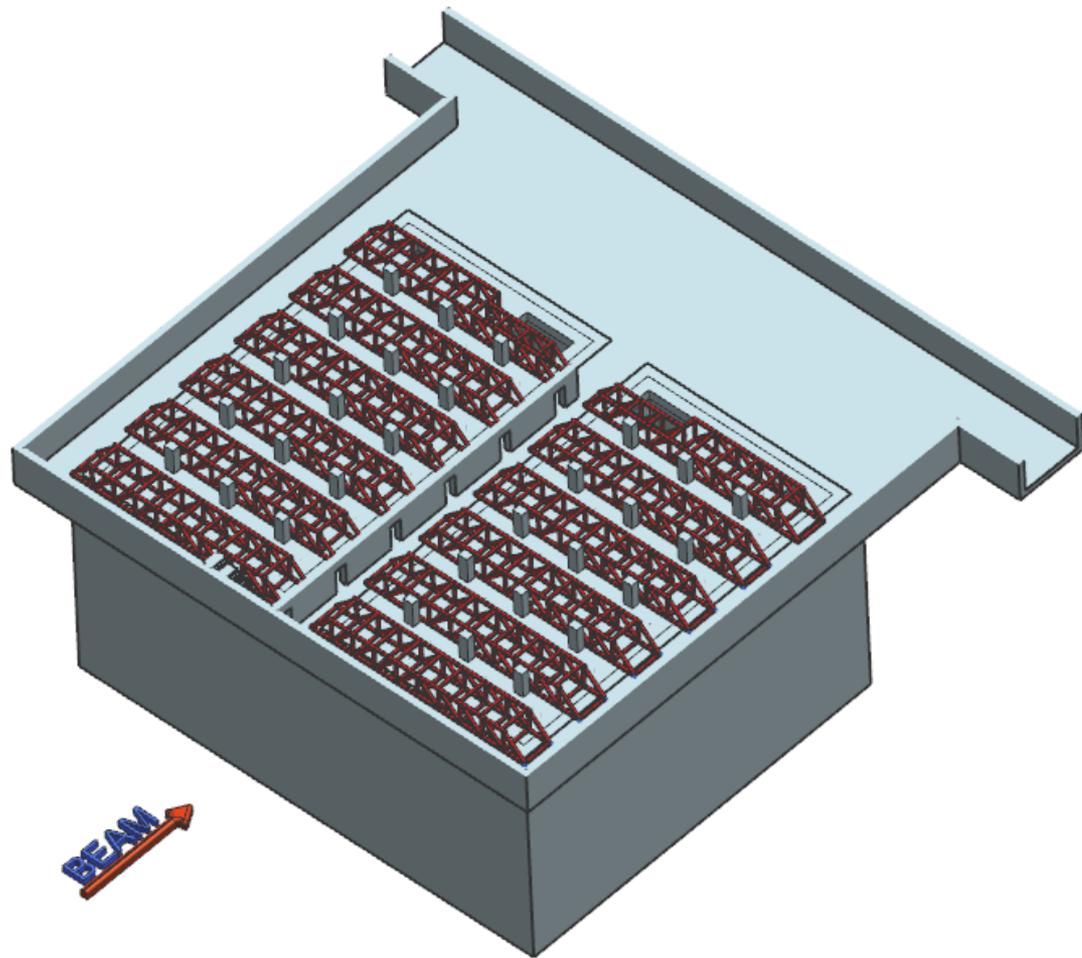




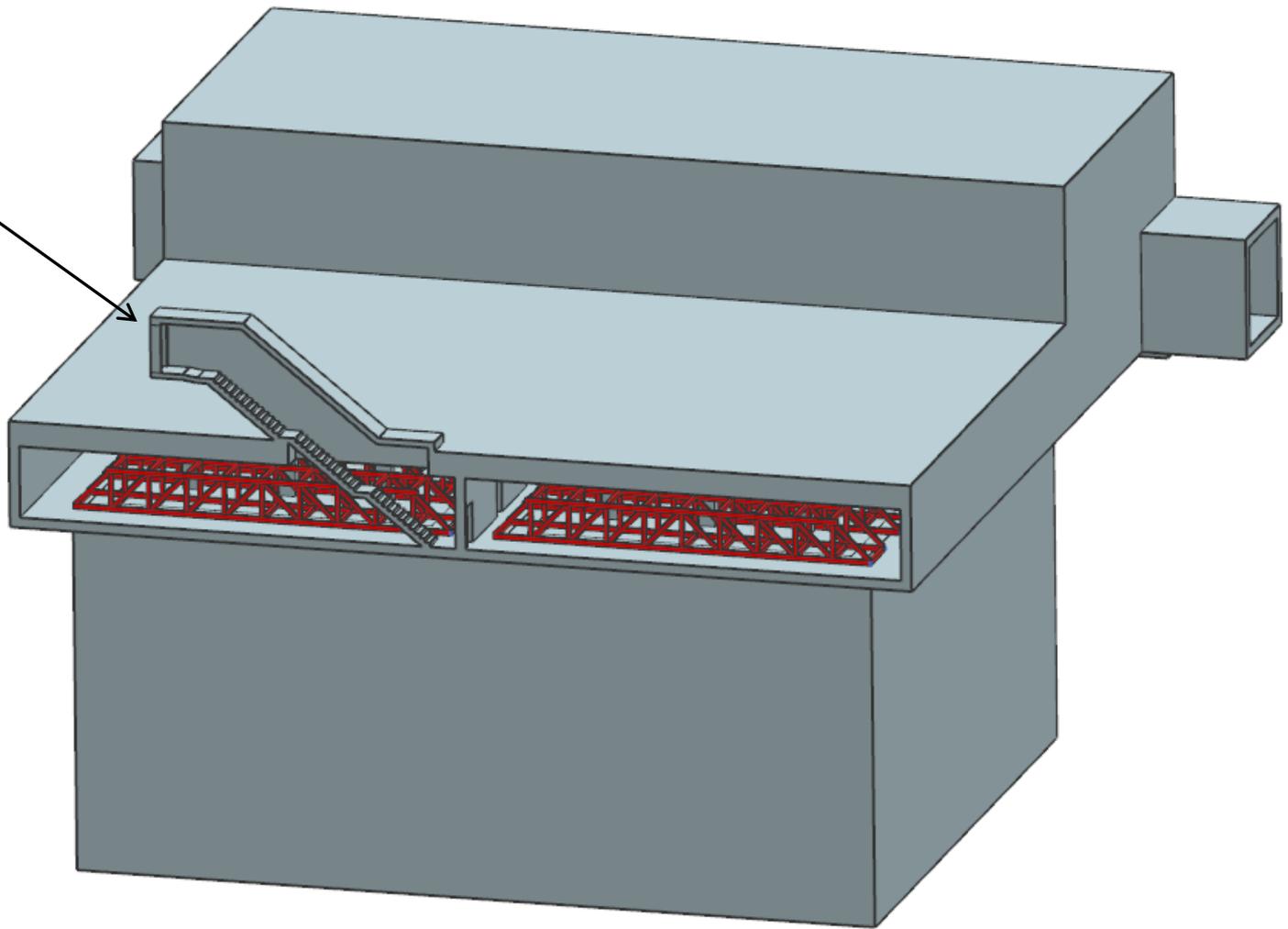


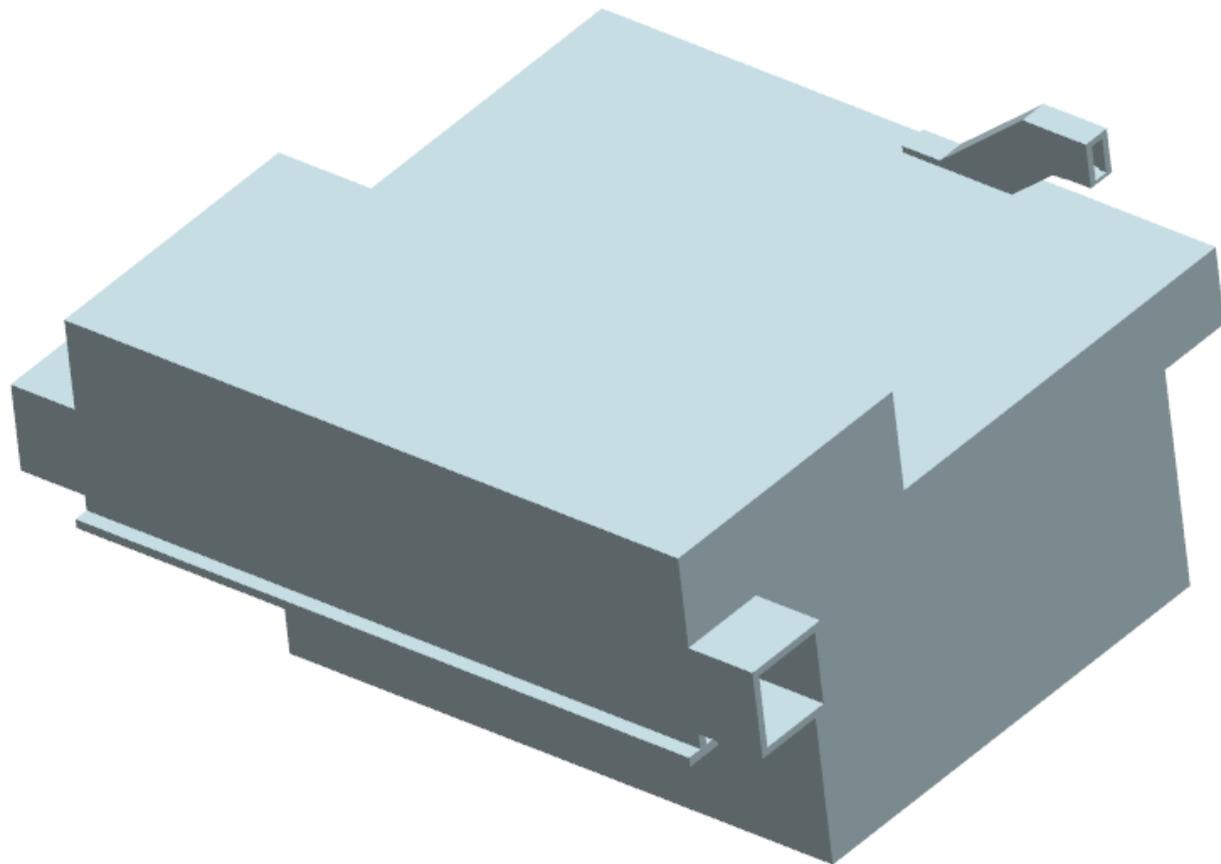
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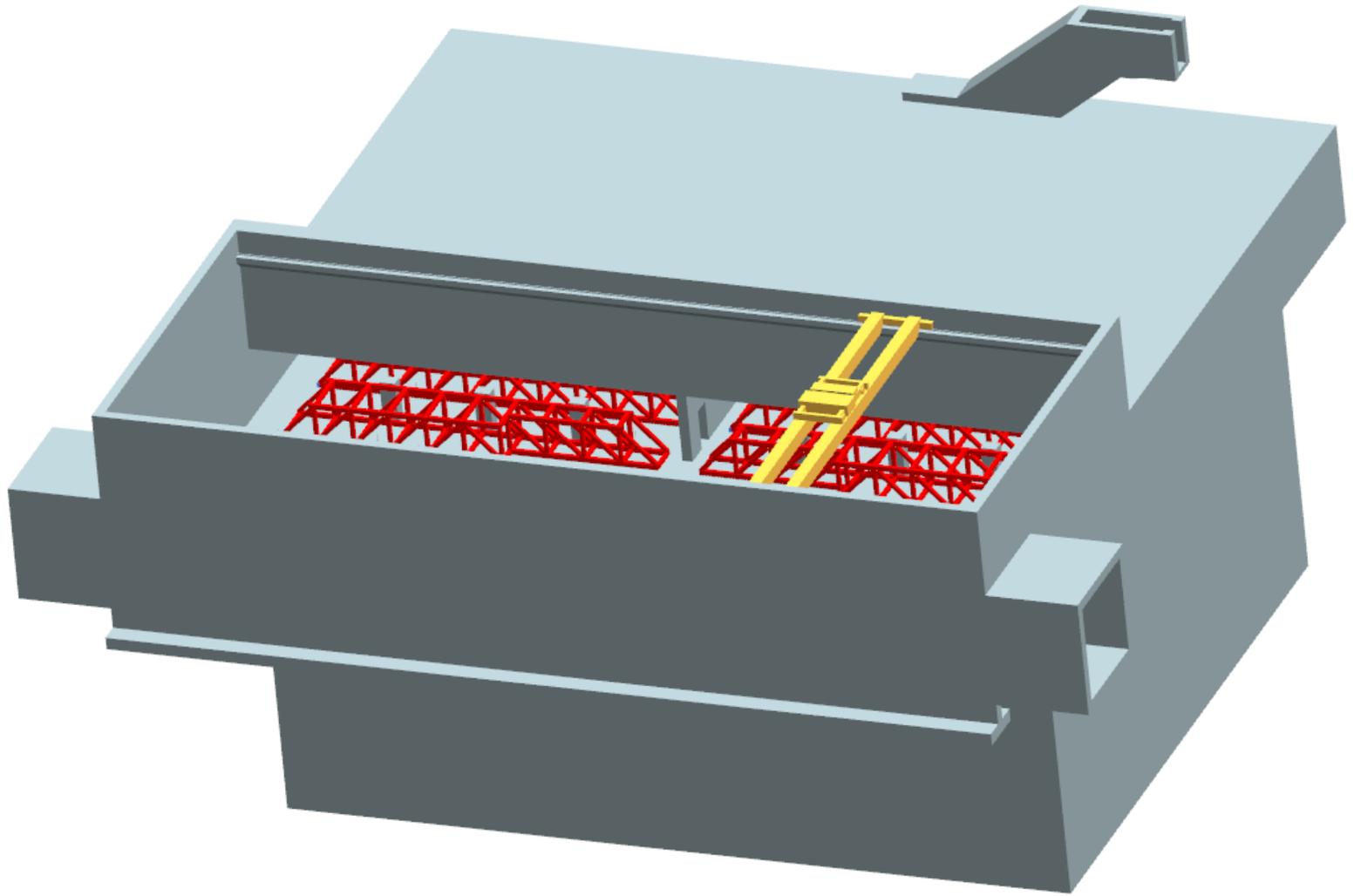


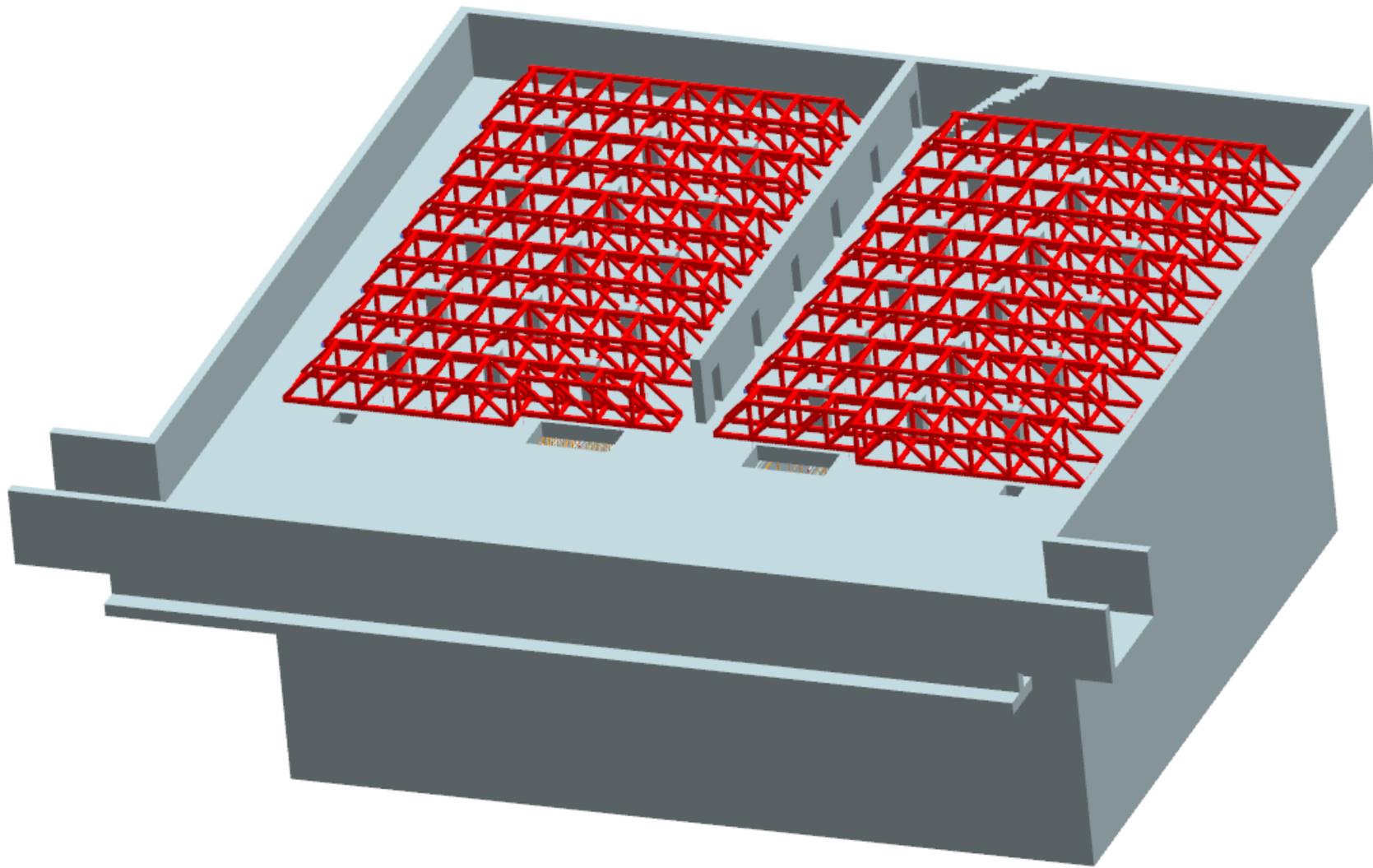


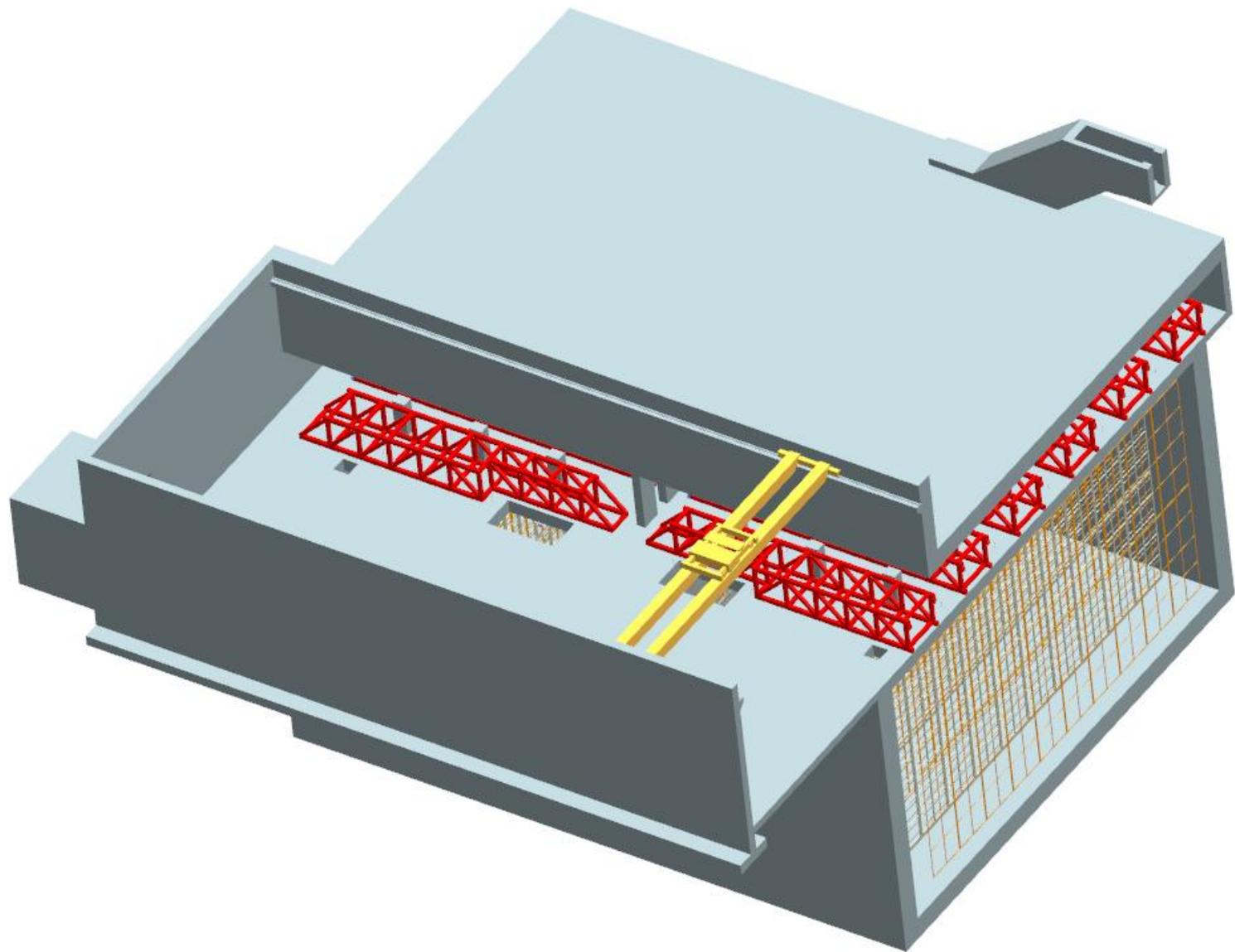
Egress
stairway

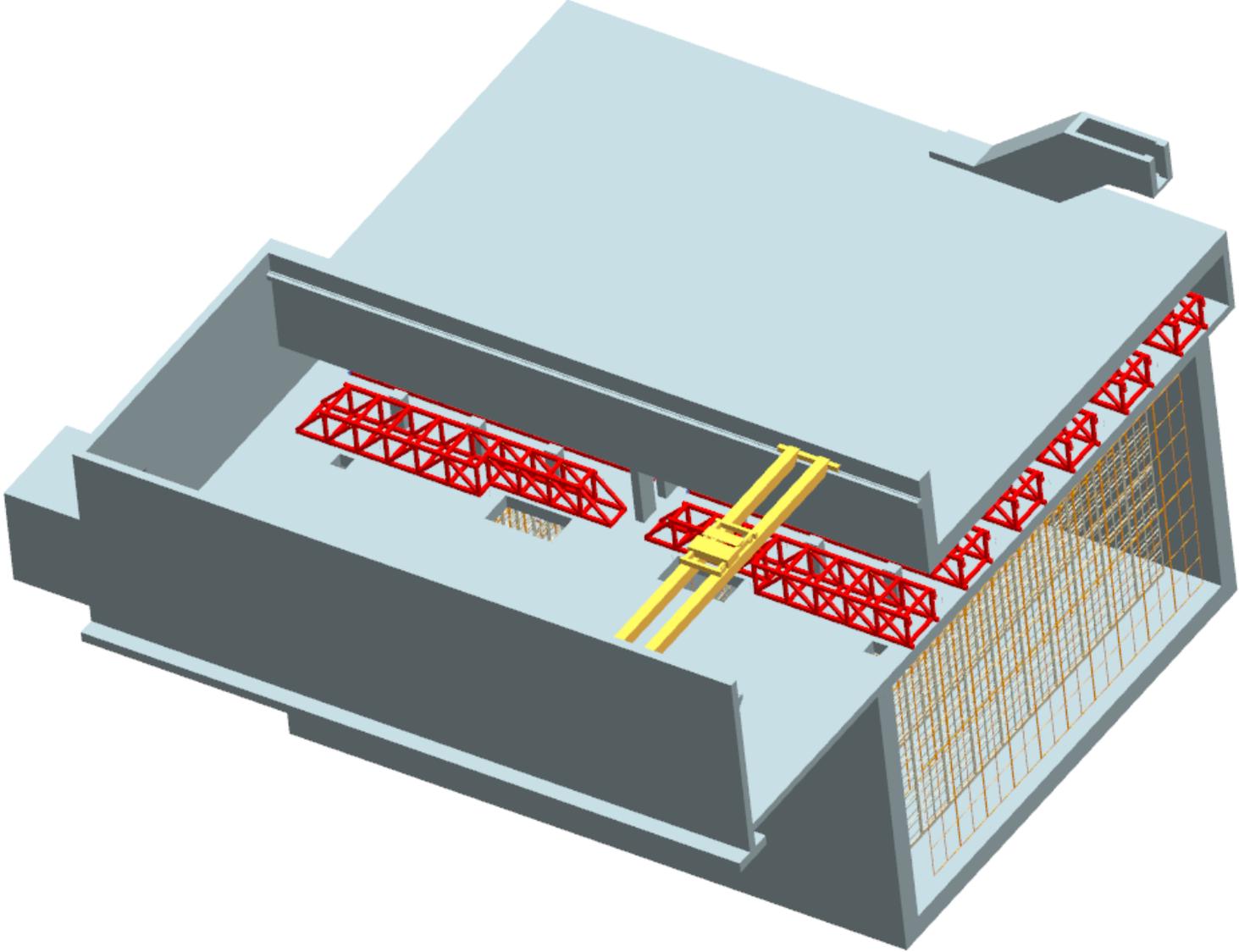


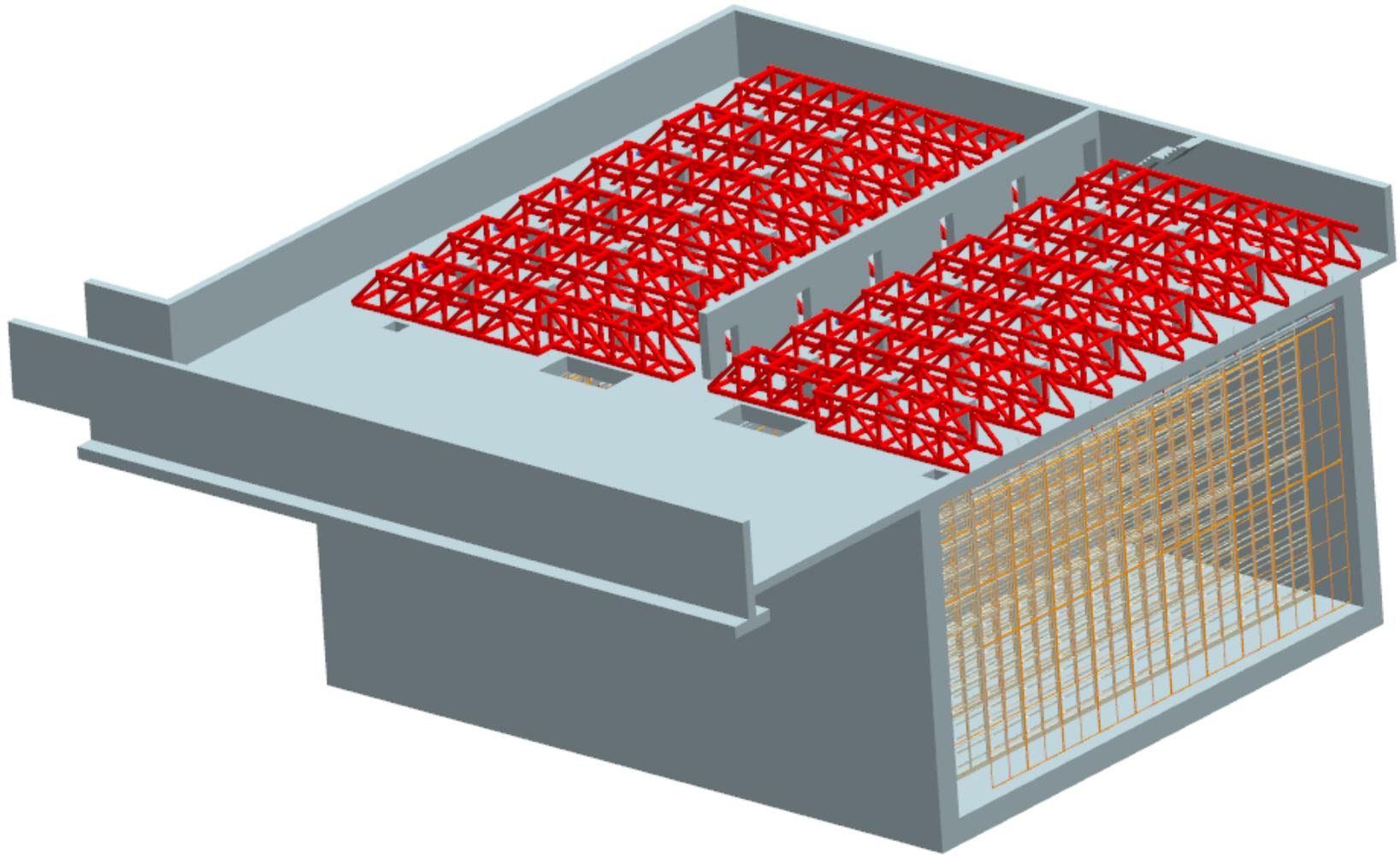


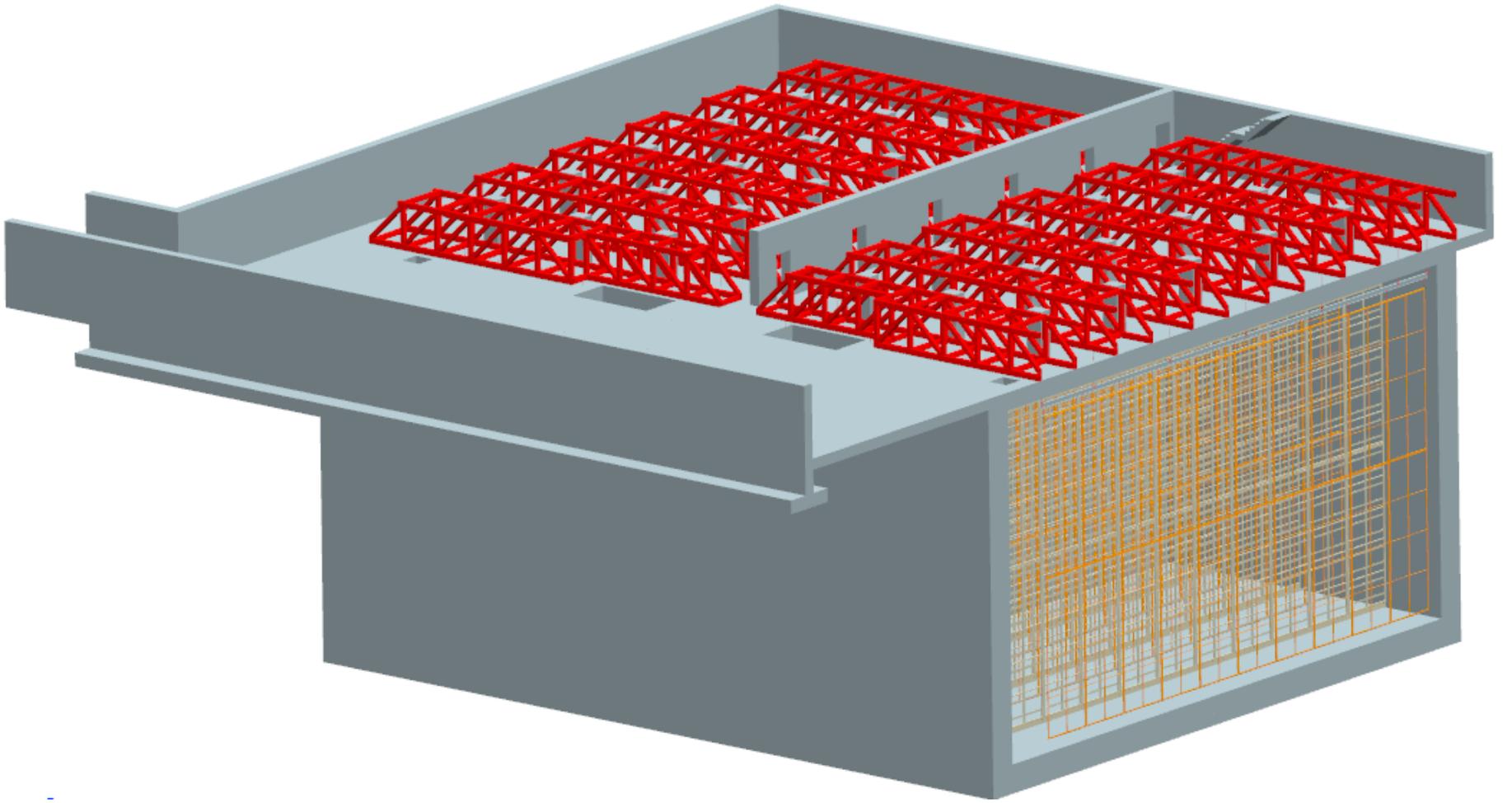


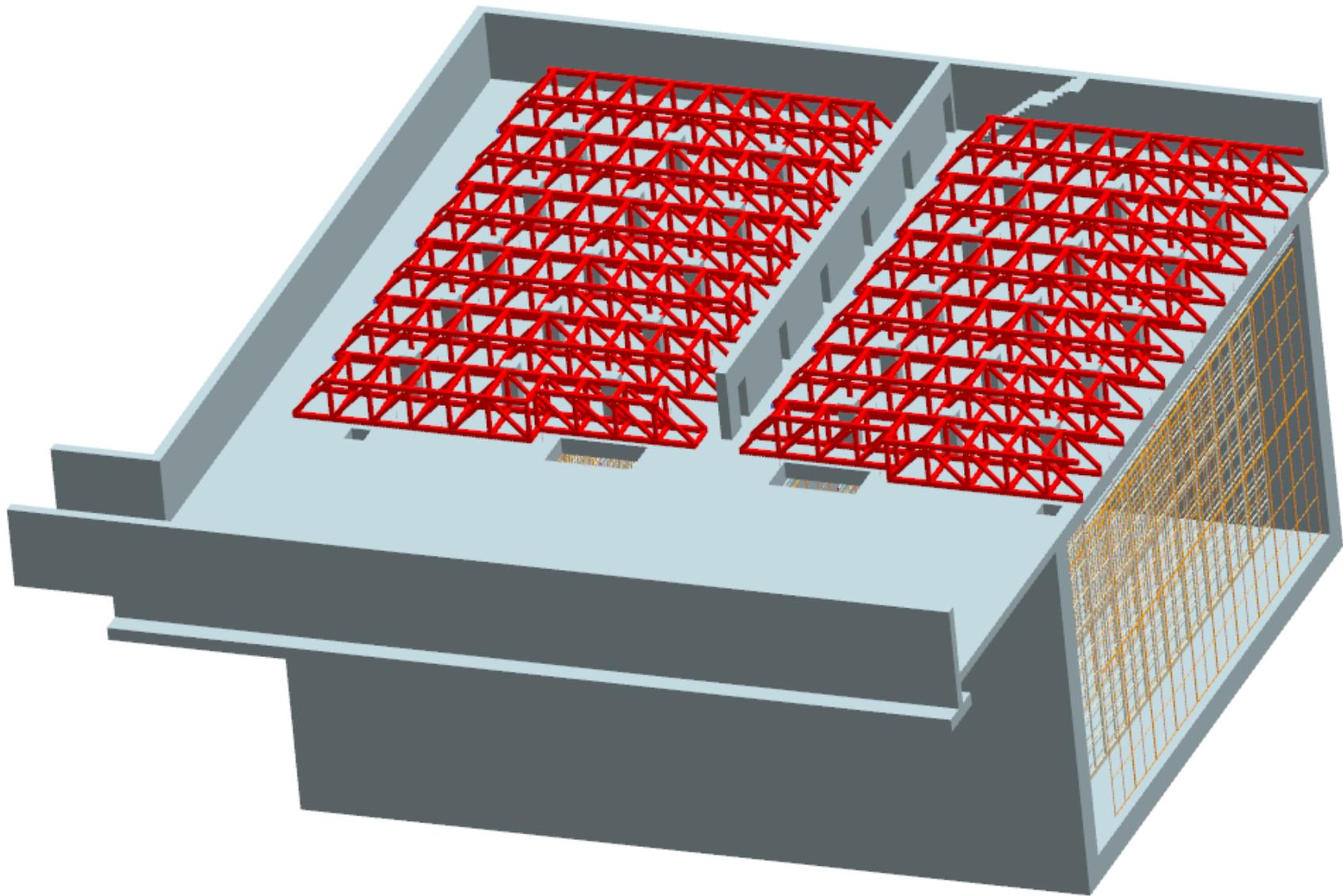


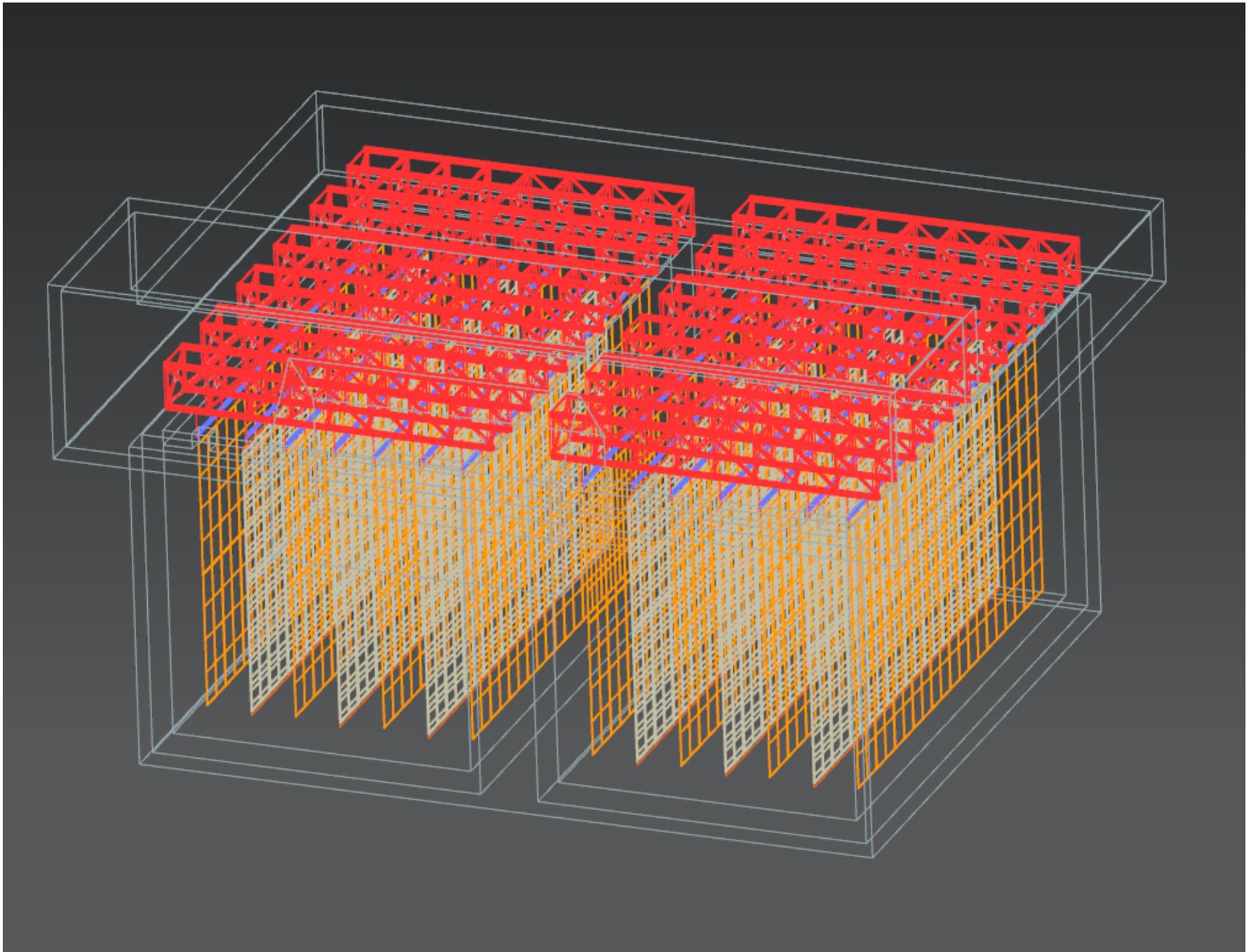




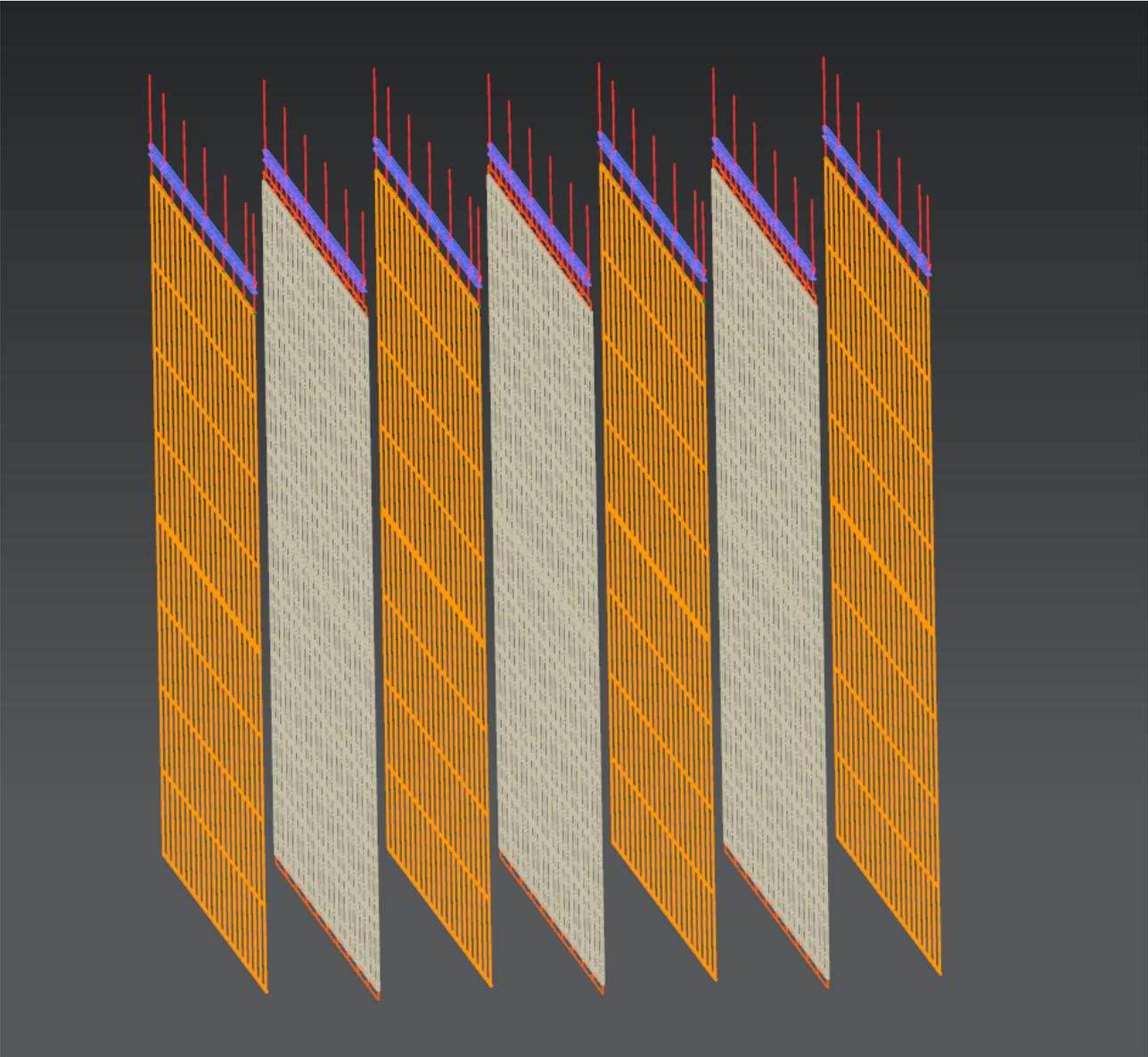




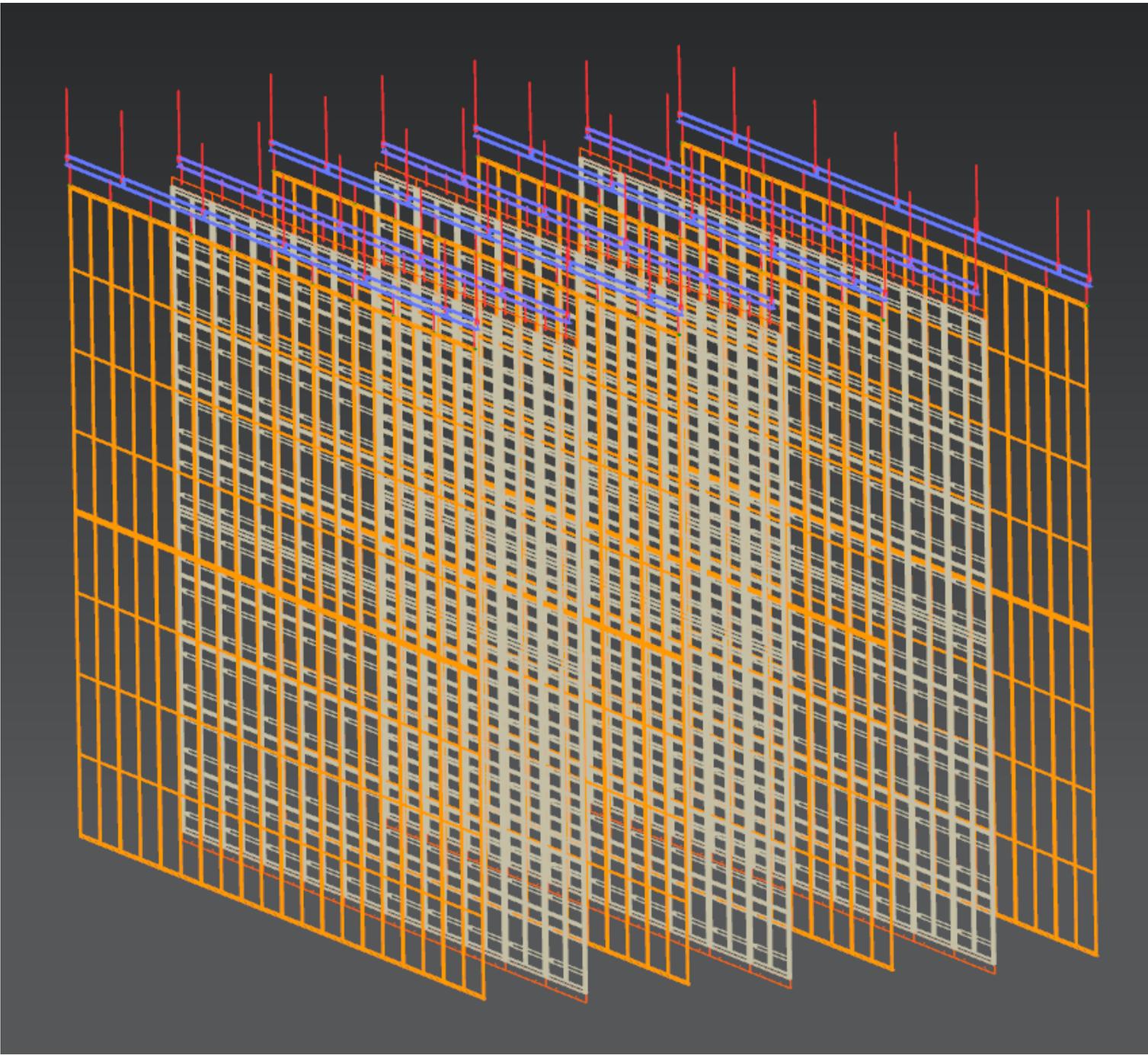




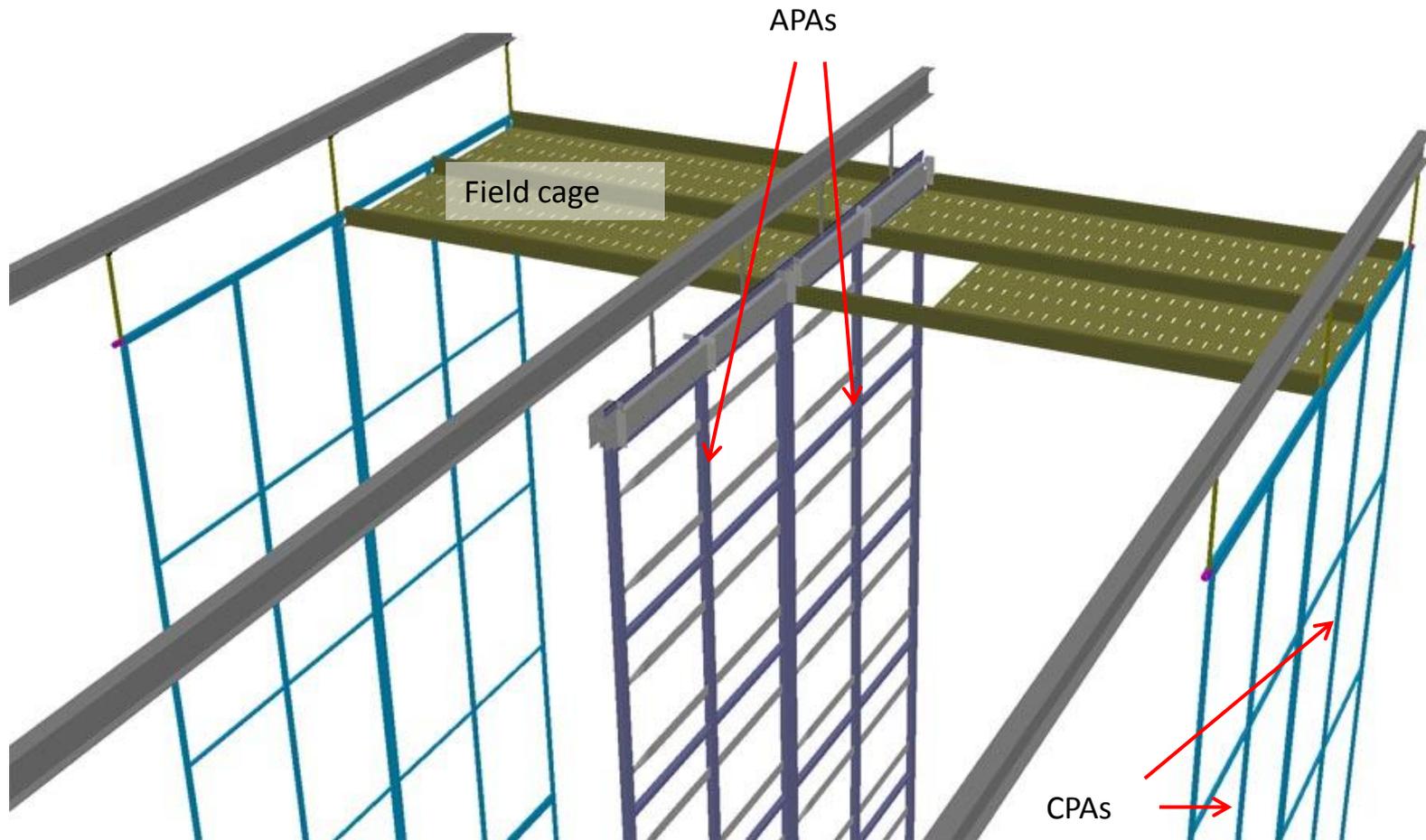
LBNE 10 kton surface detector, June 21,2012



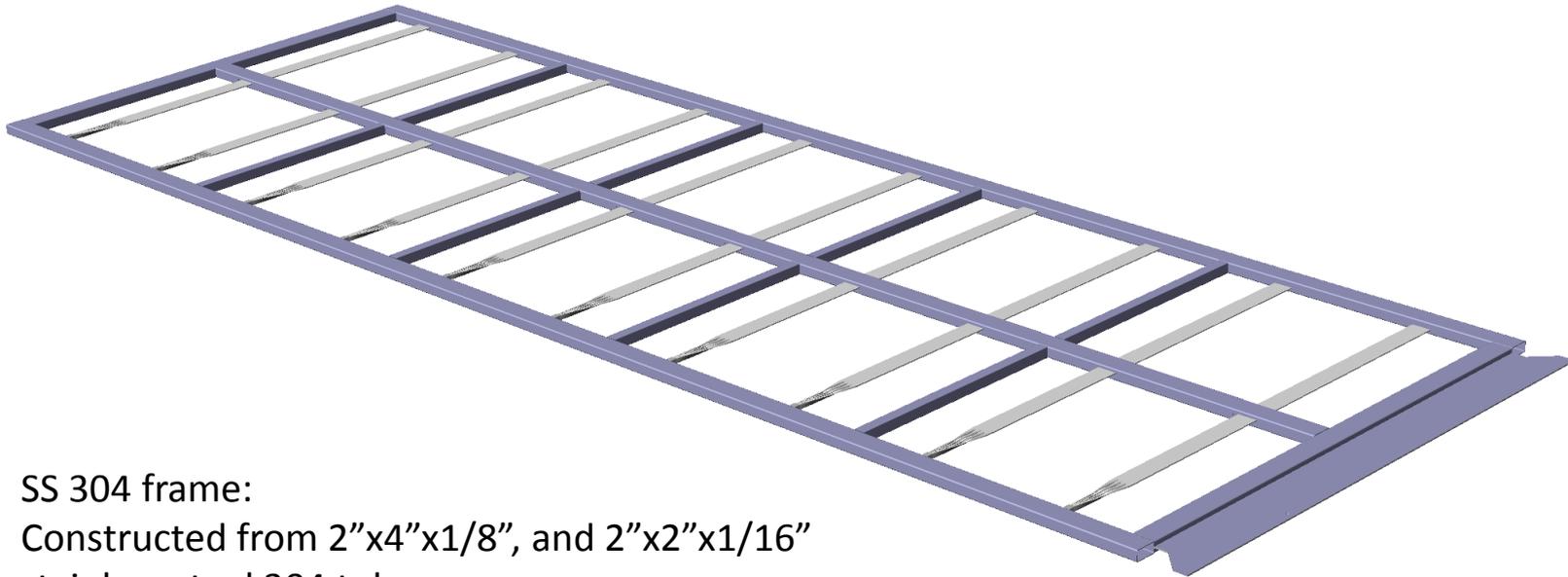
LBNE 10 kton surface detector, June 21, 2012



LAr-FD TPC System Overview

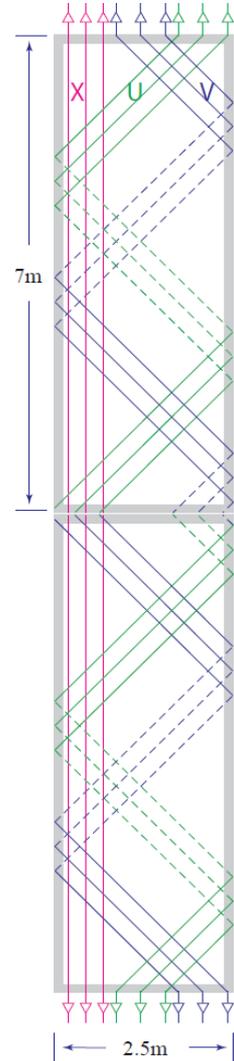


Anode Plane Assemblies (APA)



SS 304 frame:
Constructed from 2"x4"x1/8", and 2"x2"x1/16"
stainless steel 304 tube
Weight ~ 250kg

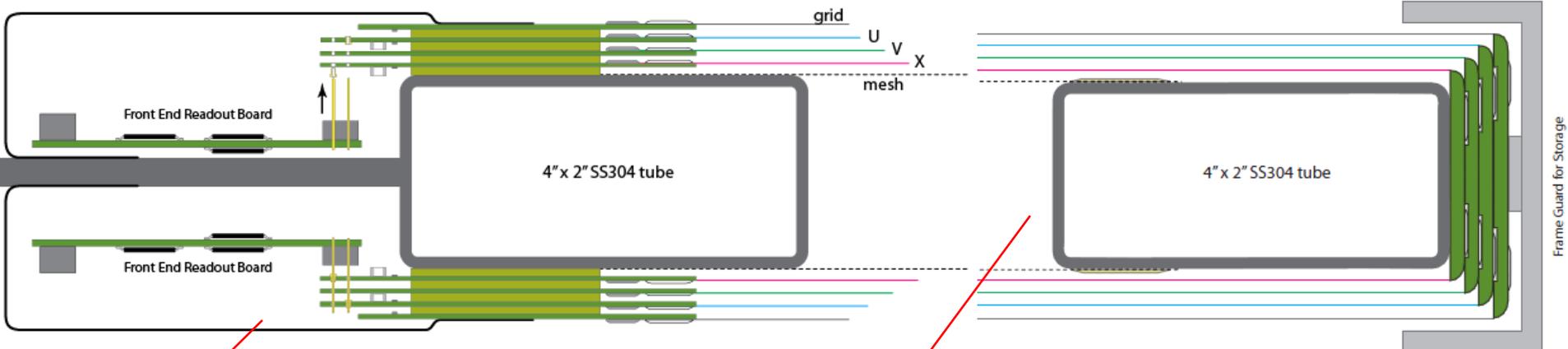
7m x 2.5m active area
4 planes of wires @ 4.5mm pitch
2560 sense wires, 3680 wires total
Electronics on one end of the frame



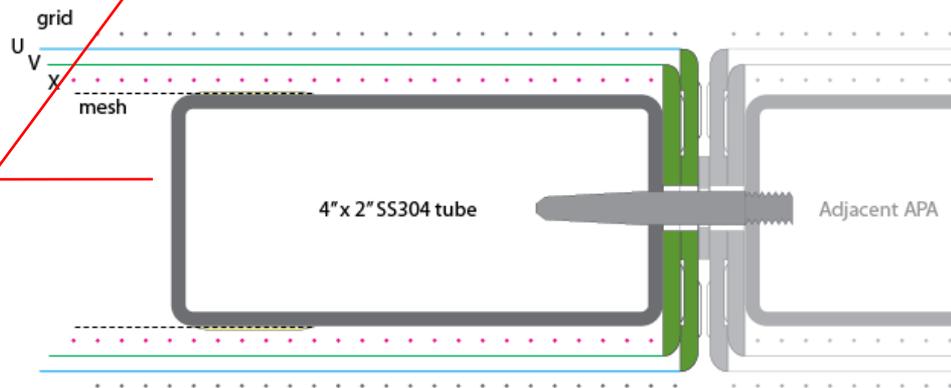
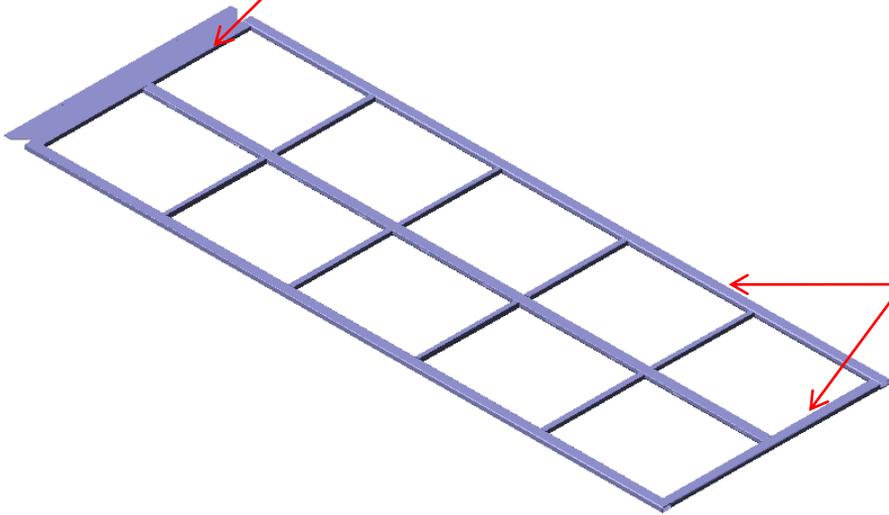
APA Cross Section Views

Cross section of the readout end of the APA

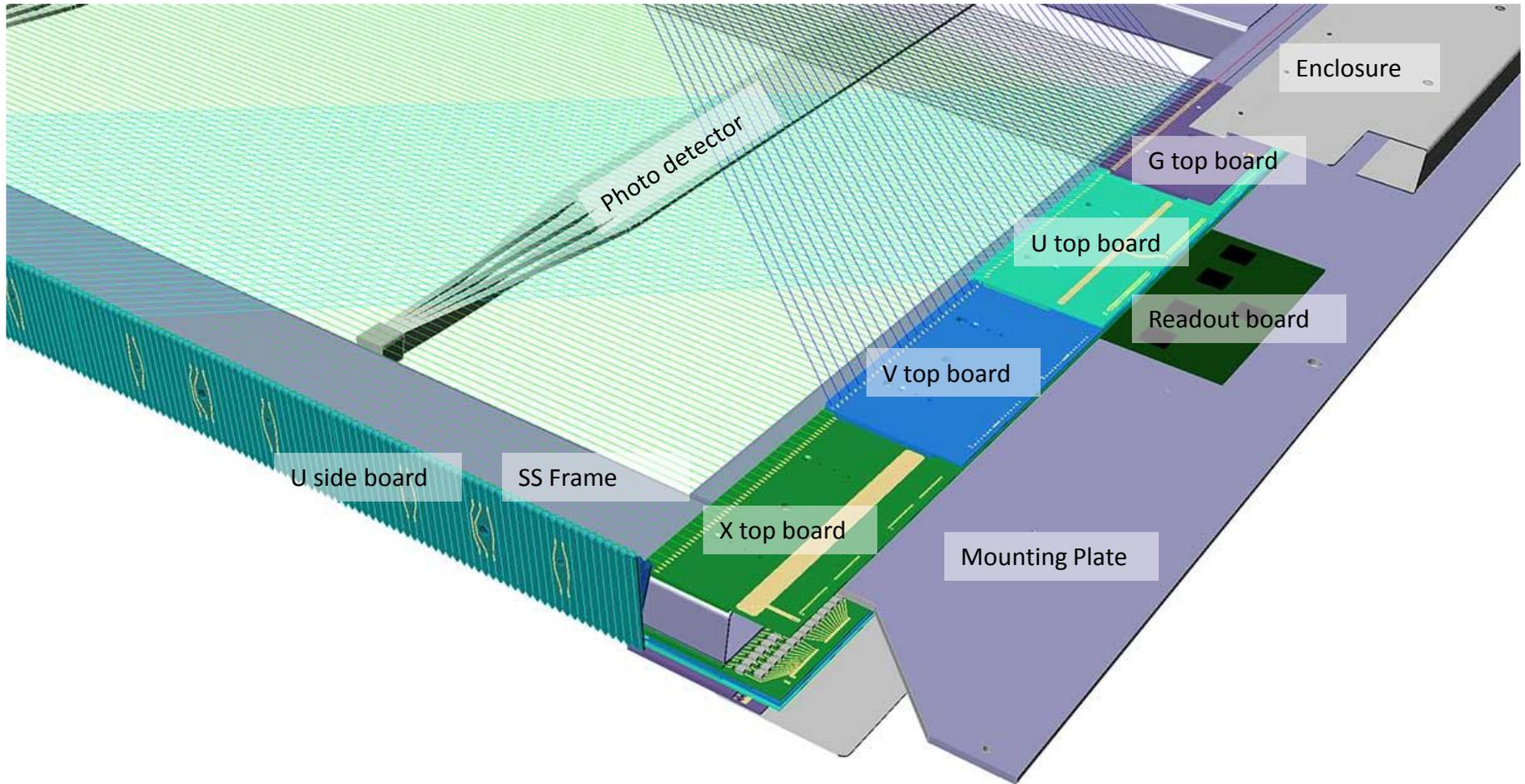
Cross section of the non-readout short end of the APA



Cross section of a long end of the APA

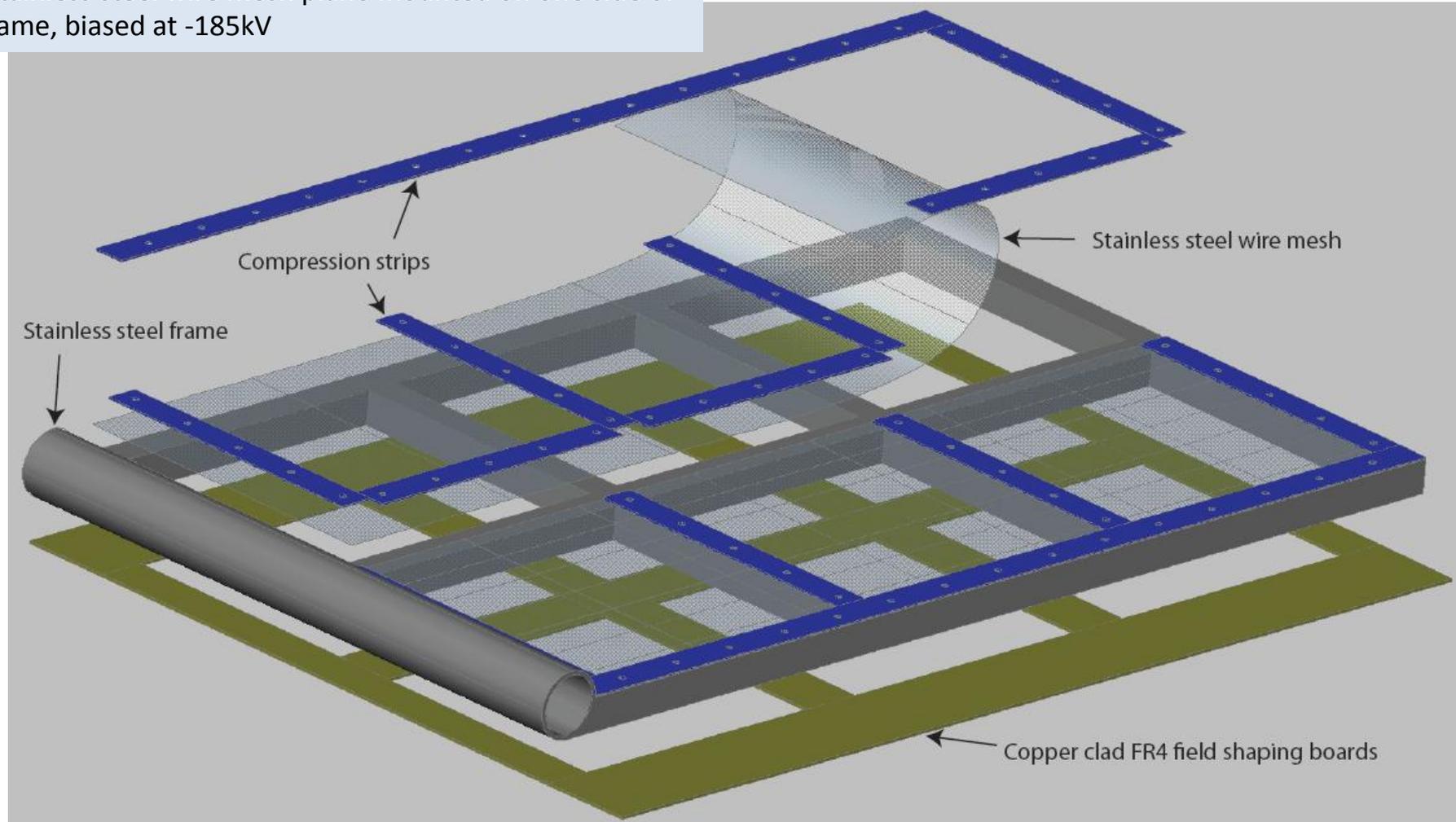


APA Close-up View



Cathode Plane Assembly (CPA)

One stainless steel wire mesh plane mounted on one side of the frame, biased at -185kV

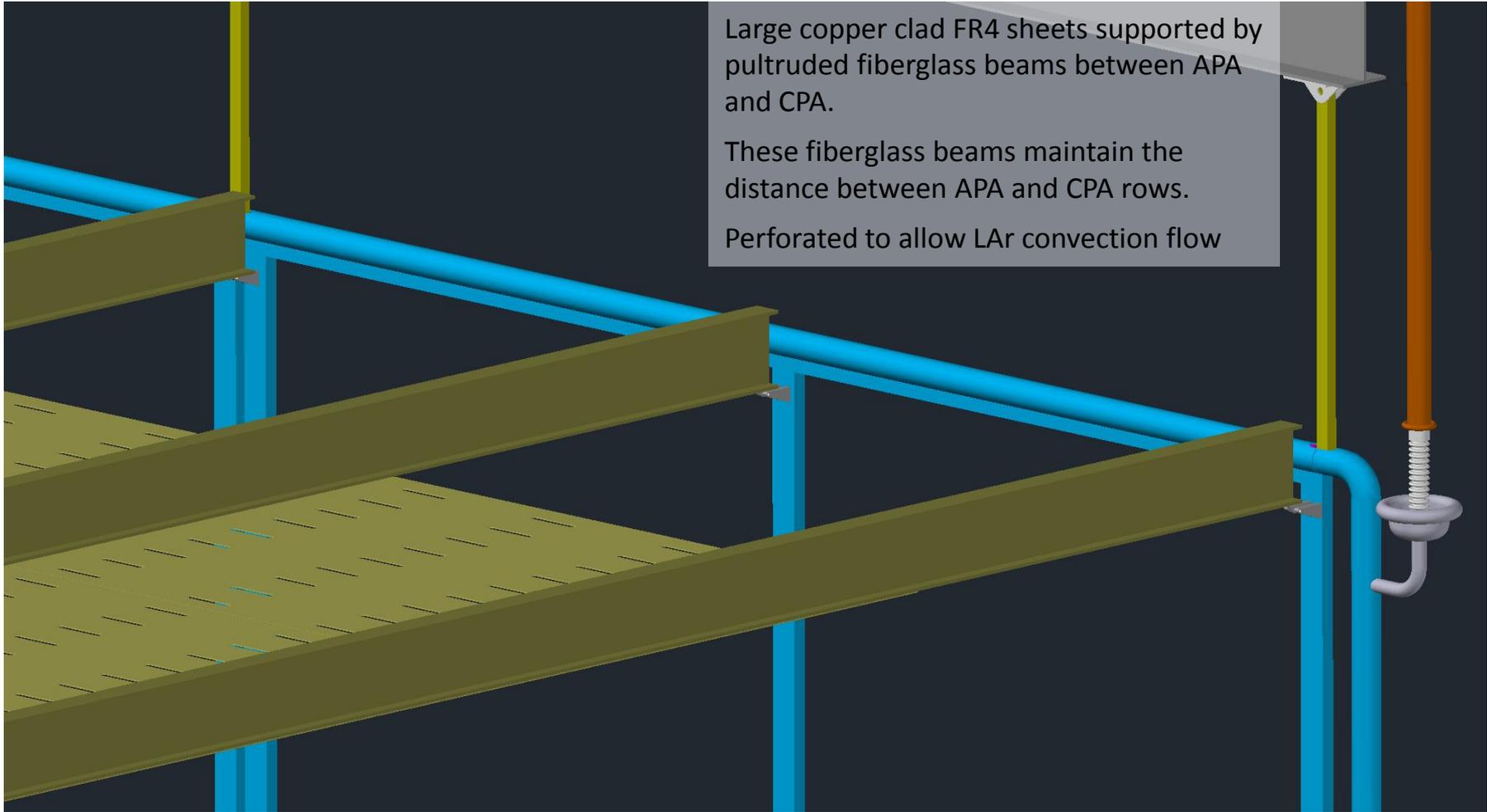


Field Cage

Large copper clad FR4 sheets supported by pultruded fiberglass beams between APA and CPA.

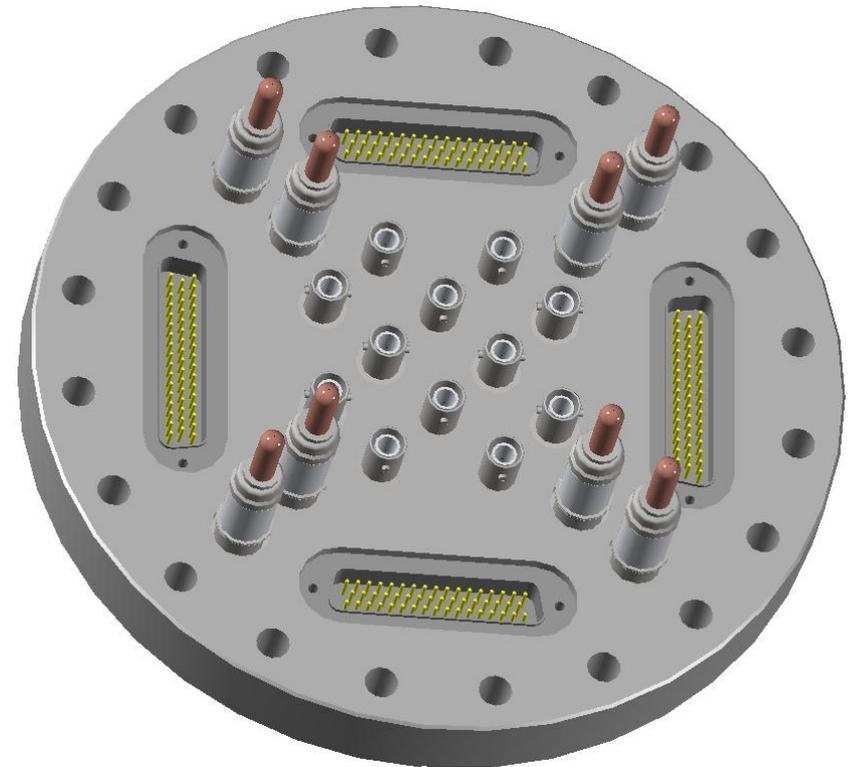
These fiberglass beams maintain the distance between APA and CPA rows.

Perforated to allow LAr convection flow



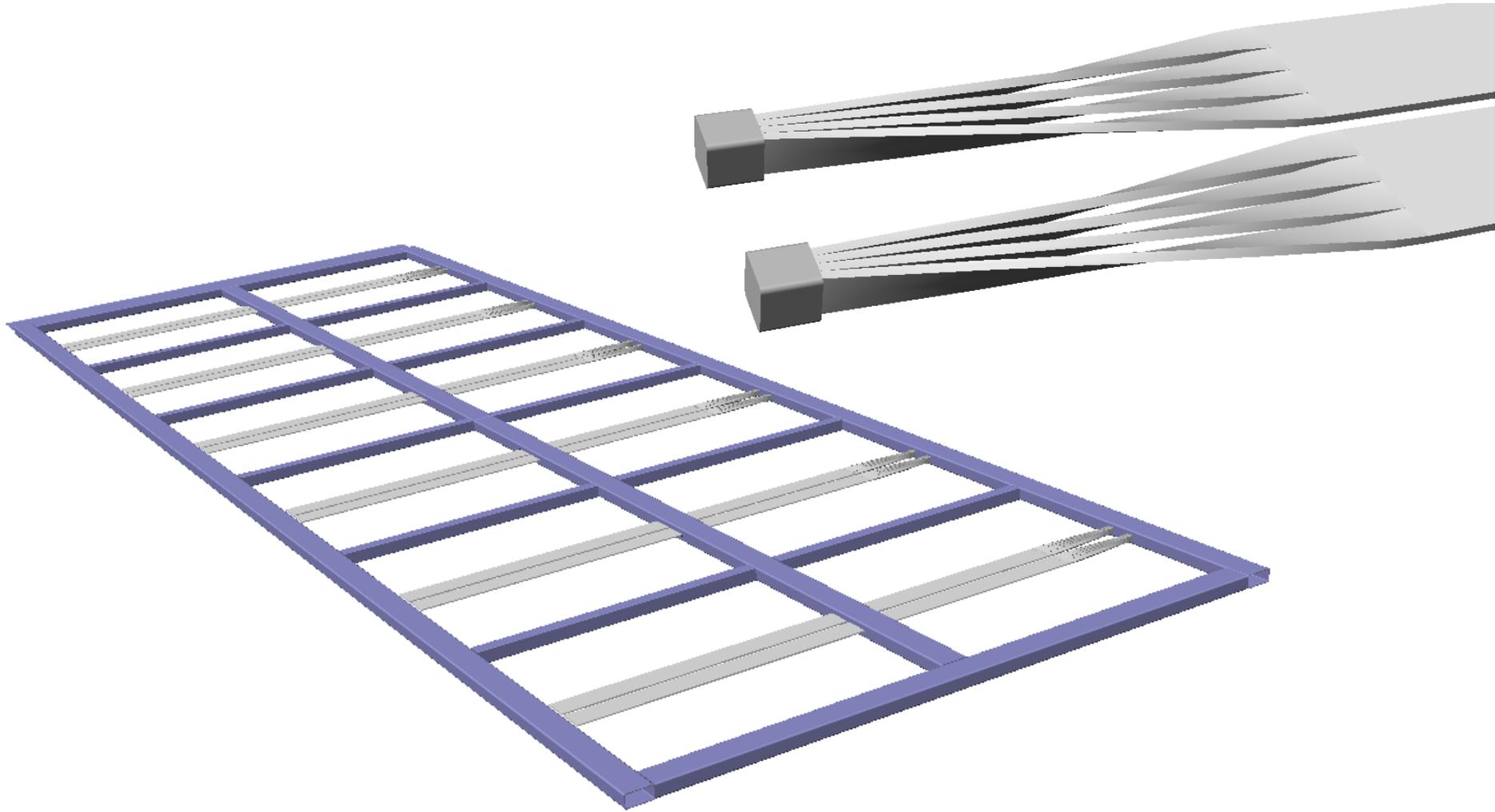
Signal/Power feedthrough

Roof nozzle penetration



Each feedthrough serves 4 APAs
Power to the digital ASICs through the
multi-pin connector

APA with Integrated Photo Detectors



LAr-FD Cryostat



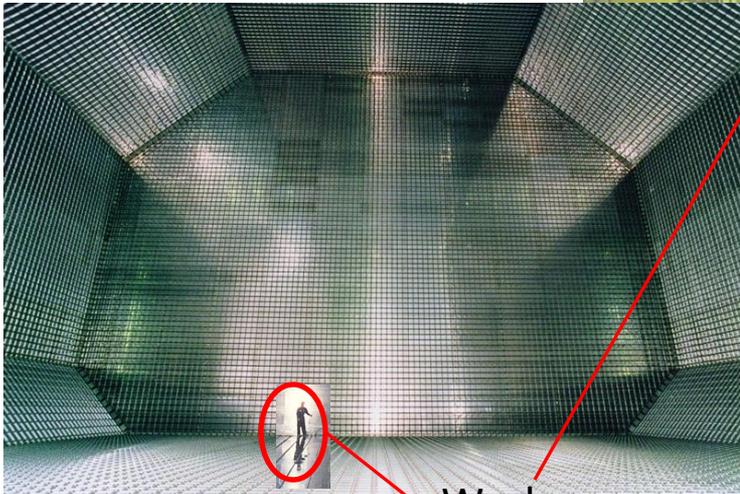
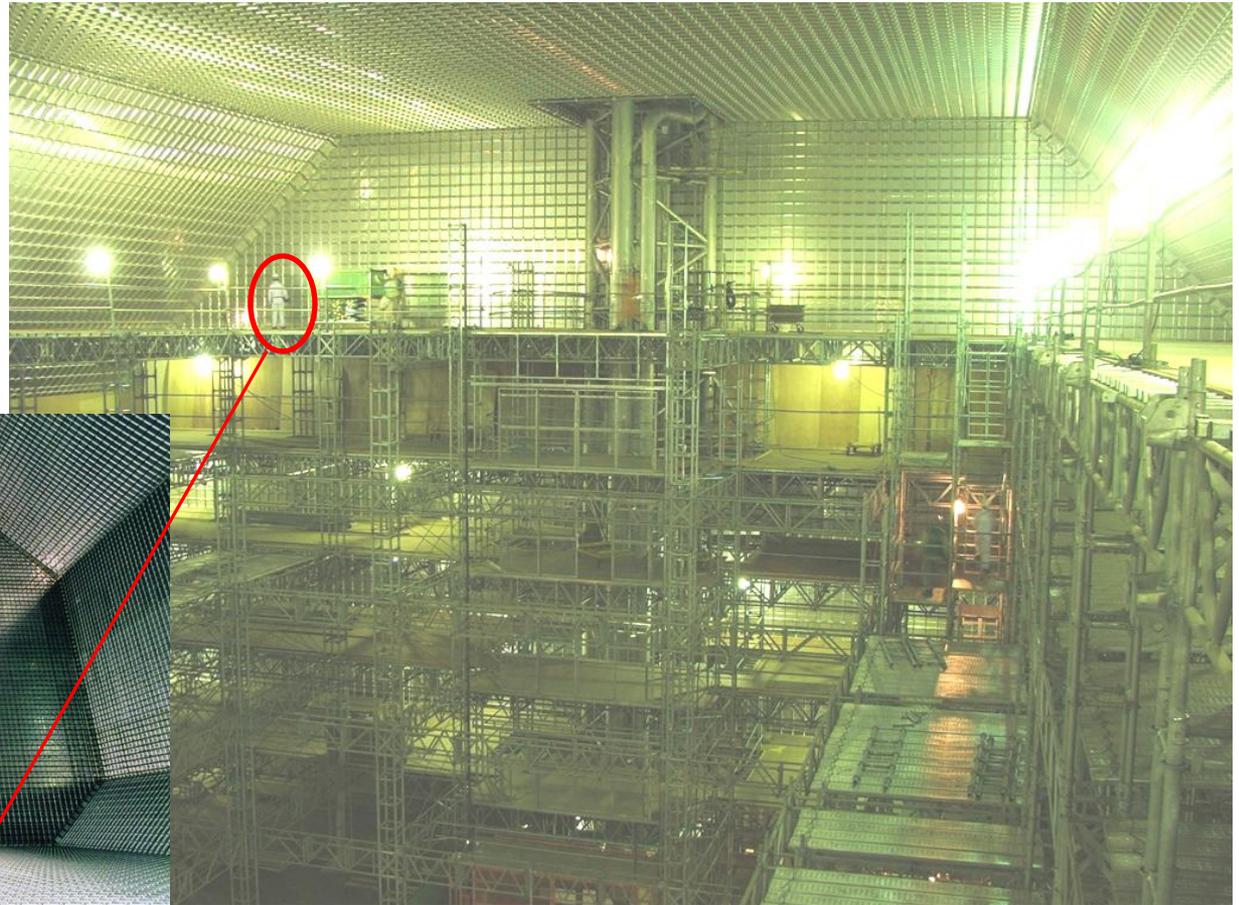
Roof nozzle penetration

REFERENCE DESIGN:
Membrane Cryostat



Interior hull of a LNG ship tanker. A typical tank is made of four 40,000 m³ compartments, 35 m high by 45 m wide. The interior grid-like corrugations are on 0.34 m pitch. The above tank scales to 24 m high by 35 m wide.

Impressive Pictures of Commercial membrane tanks



Worker



MV Mesaimmer LNG Tanker at Canaport LNG Receiving Facility in New Brunswick Canada, December 2009.

The light blue boxes represent the inside dimensions of a 5k cryostat.

The MV Mesaimmer is a mid-sized Q-Flex ship with a capacity of $216,000 \text{ m}^3$ in 5 GTT membrane tanks. The ship also contain onboard BOG reliquefaction using nitrogen refrigeration (compressors, expanders and coldbox). The reliquefaction system is capable of reliquefying 6 metric tons per hour of LNG BOG which is about 350 kW, cooling power. The ship is 315 m long and 50 m wide.

The Canaport concrete tanks, each hold $160,000 \text{ m}^3$ and stand 40 m tall at the wall.

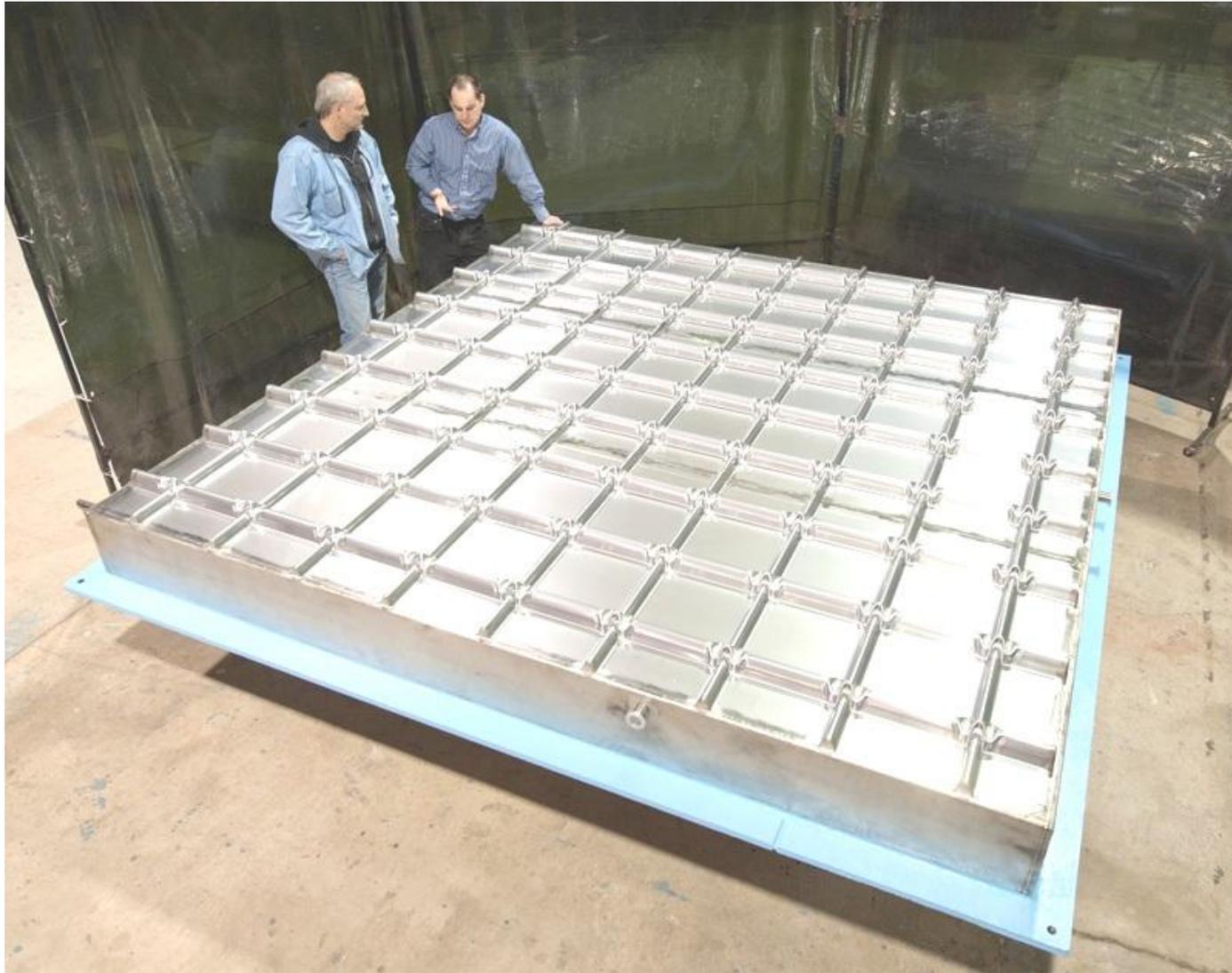
Picture Credit: Canaport LNG Photo Gallery, <http://www.canaportlng.com/highresphotos.php> (Retrieved 07/26/12)

"Shipboard Reliquefaction for Large LNG Carriers", Proceedings of the 1st Annual Gas Processing Symposium, Elsevier, 2009.
MV Mesaimmer, Super Tanker Data, <http://www.aukevisser.nl/supertankers/gas/id462.htm> (Retrieved 07/25/12)

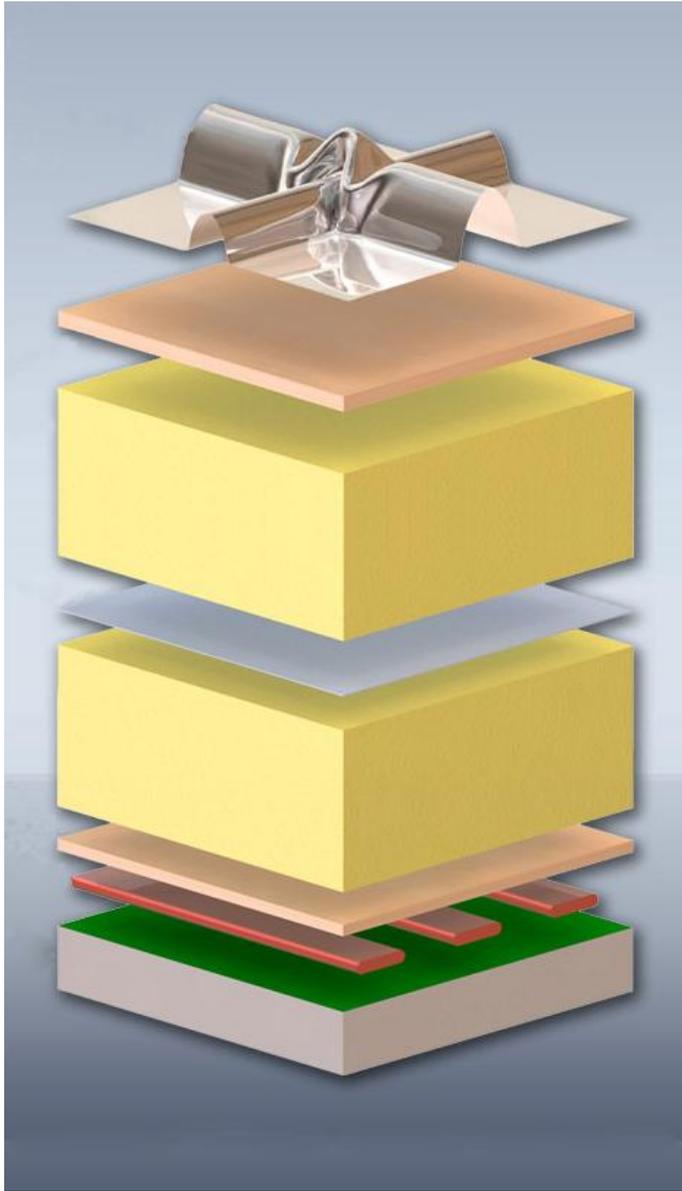
MV Mesaimmer LNG Tanker at Canaport LNG Receiving Facility
in New Brunswick Canada, December 2009

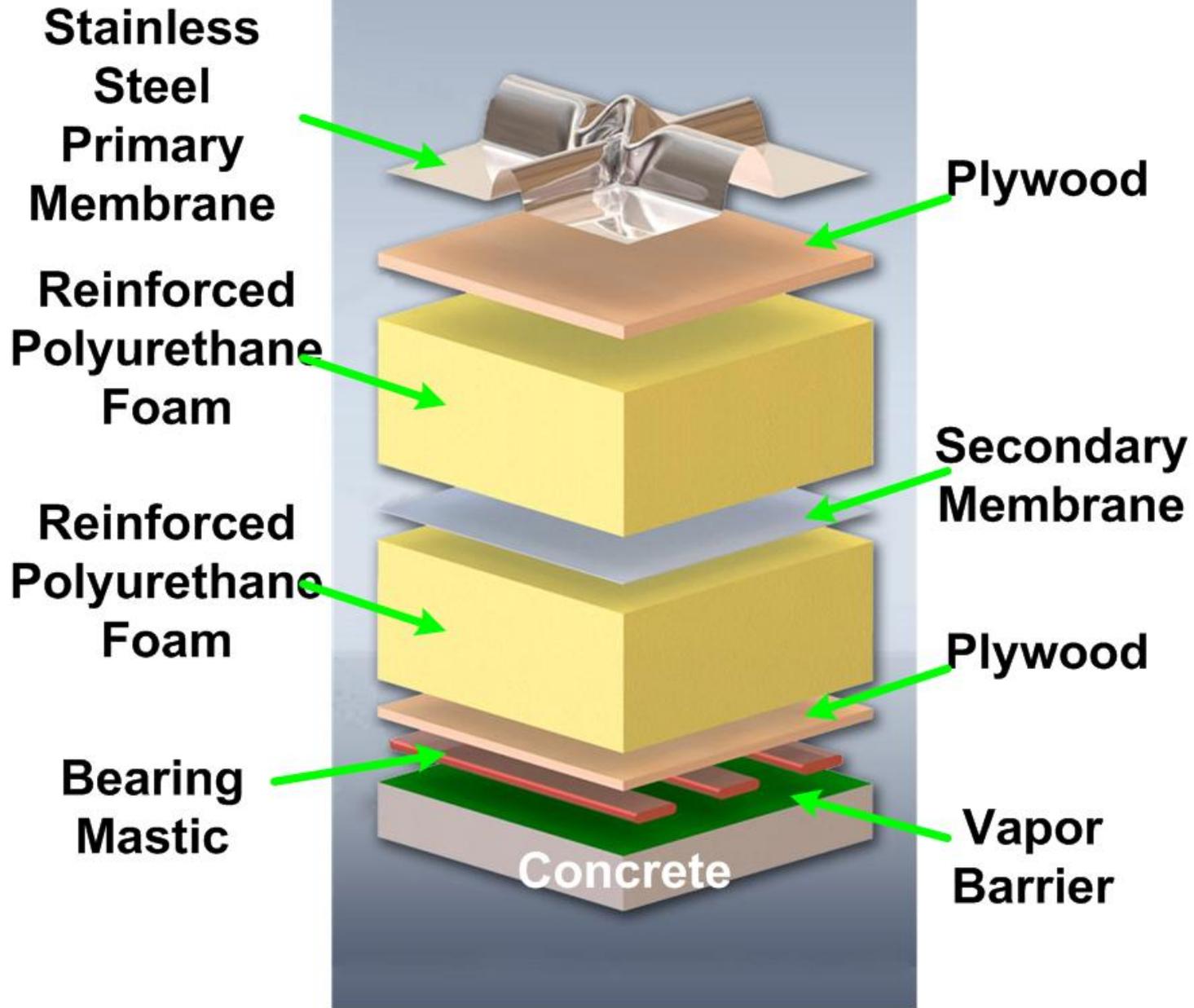


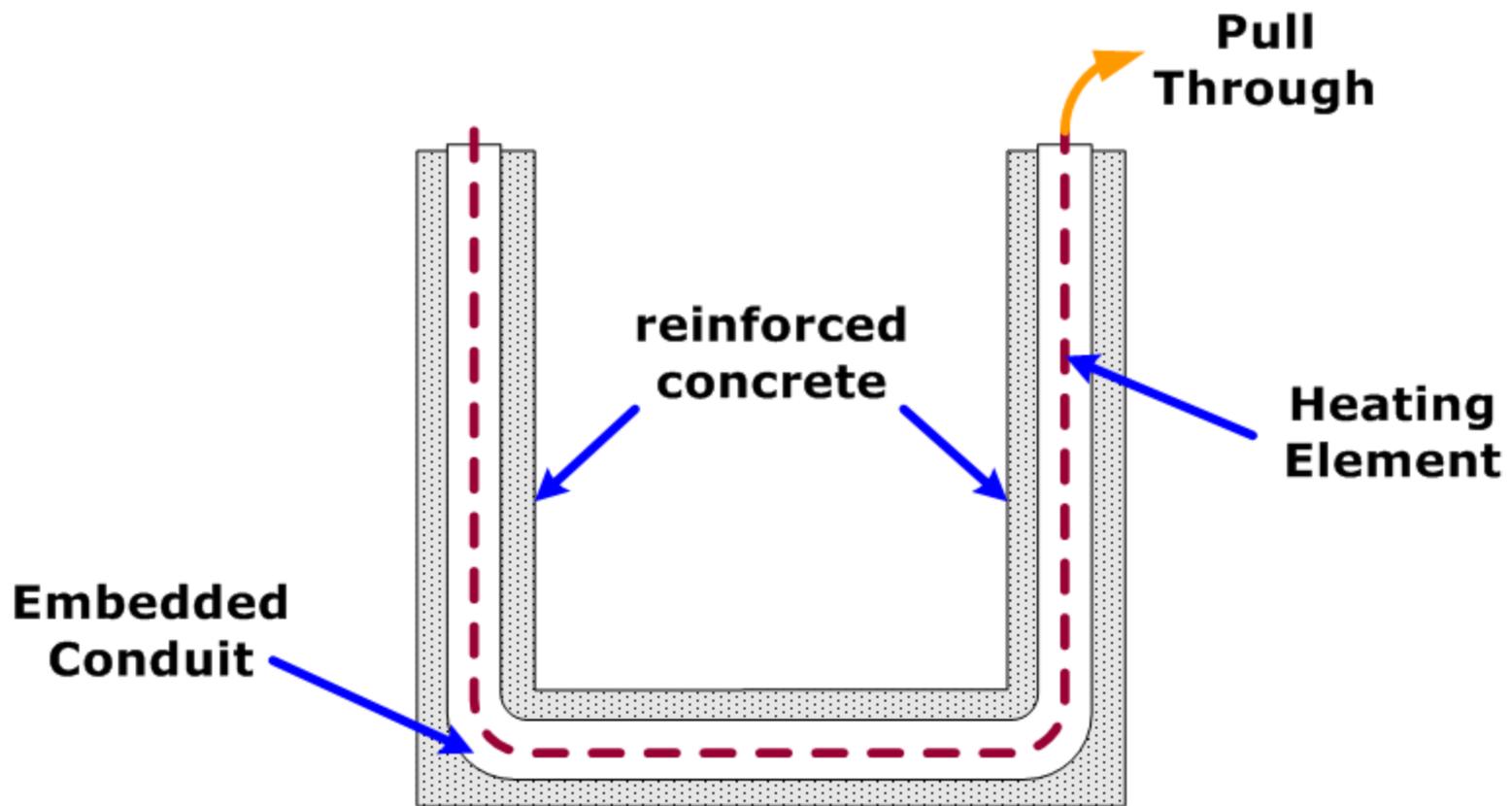
Membrane Cryostat wall section prototype - 3 m x 3 m, GTT



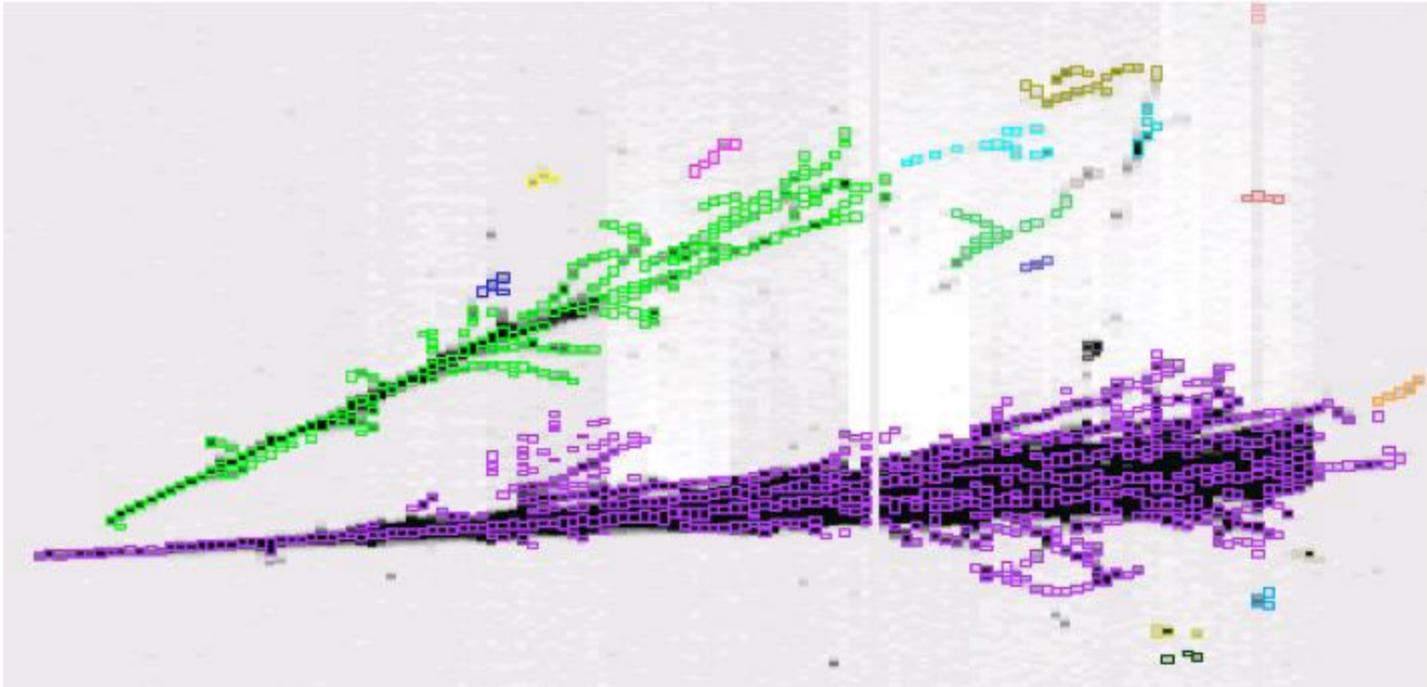
Pictured: Welder Mike Cooper and Engineer Russ Rucinski,
Photo taken May 2011 by Reidar Hahn, FNAL VMS. Neg # 11-0121-02D.jpg





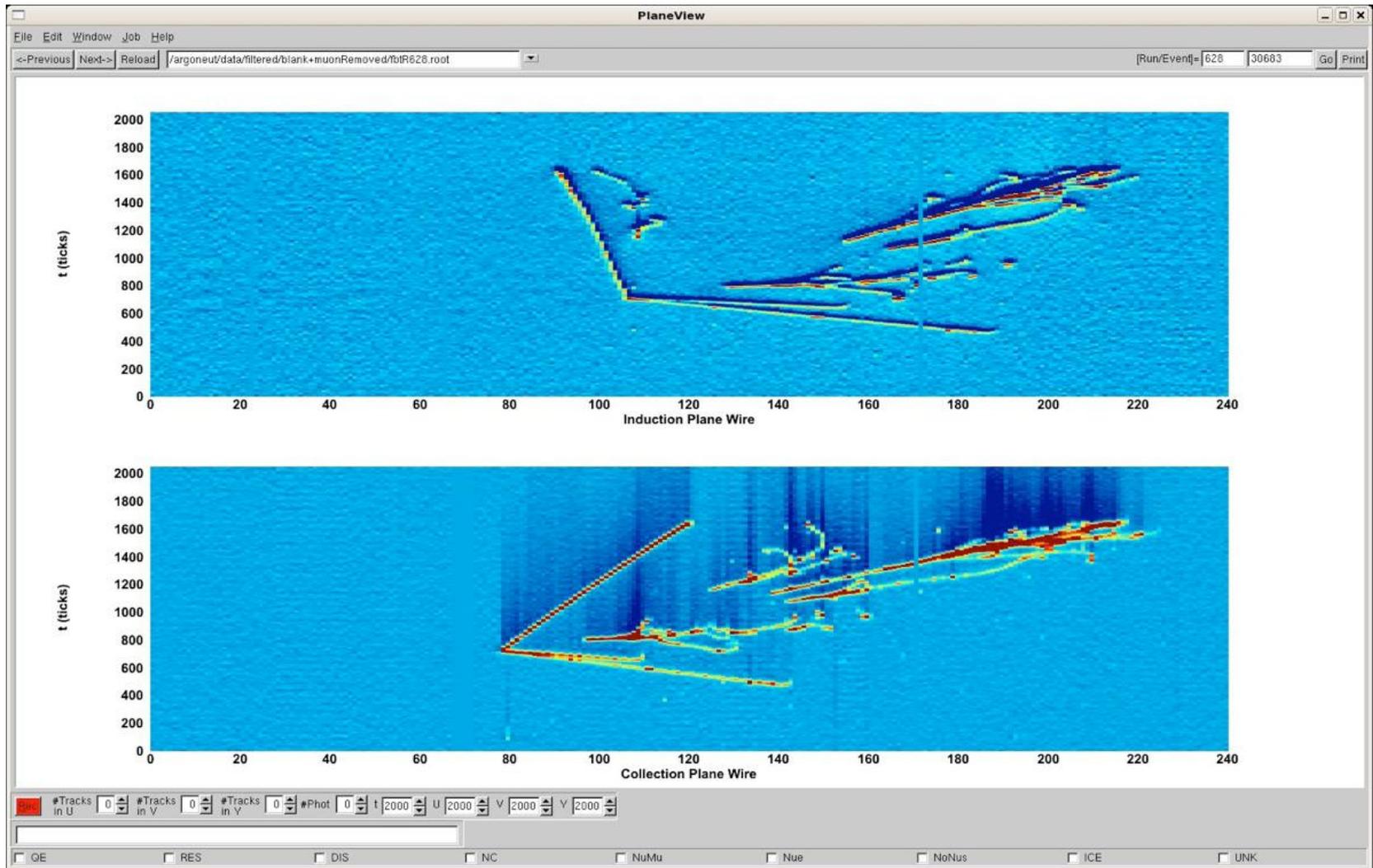


Hit finding + density-based clustering.



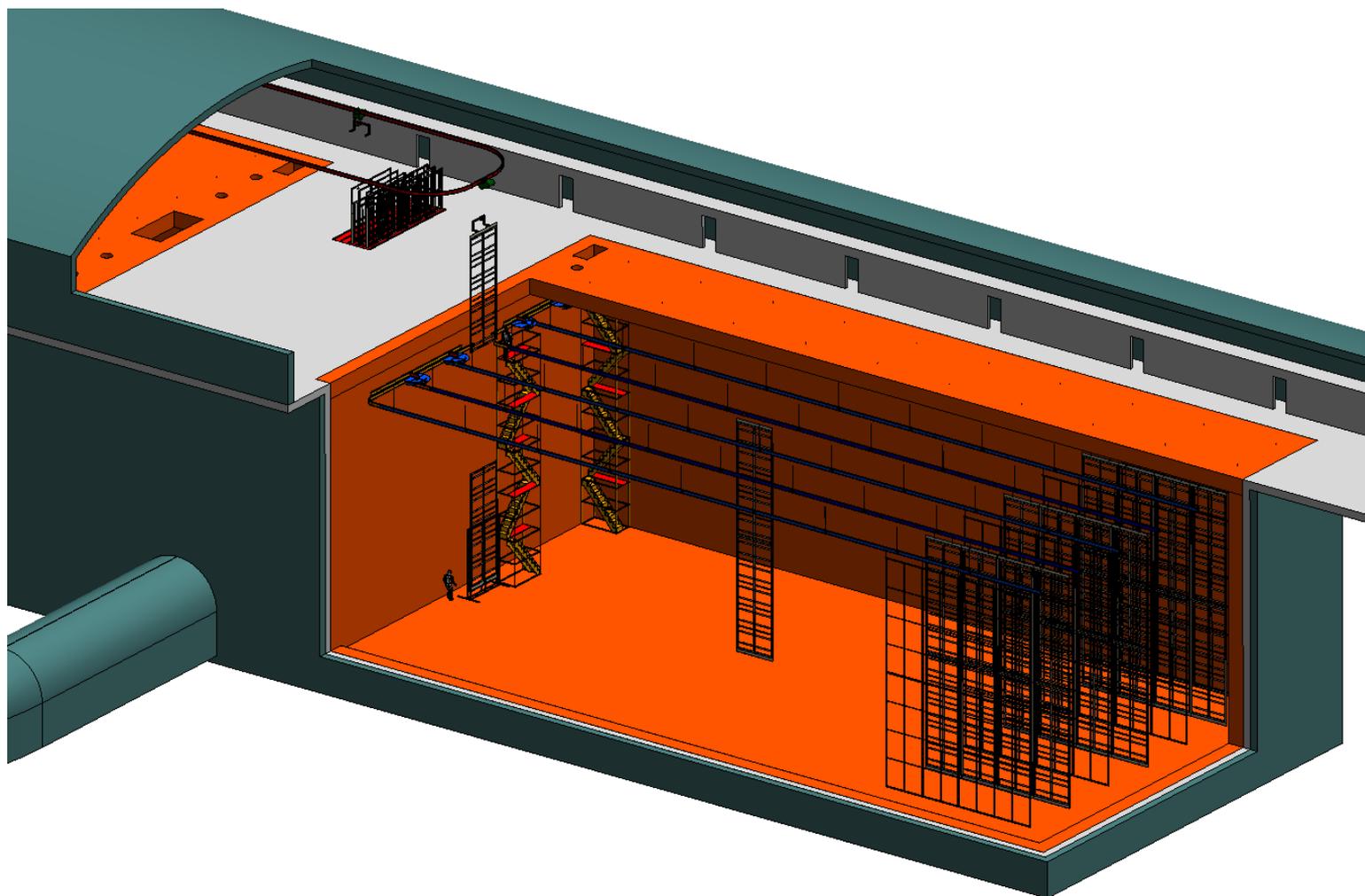
Source: Joshua Spitz, Yale University
DocDB # 2693

Neutrino event

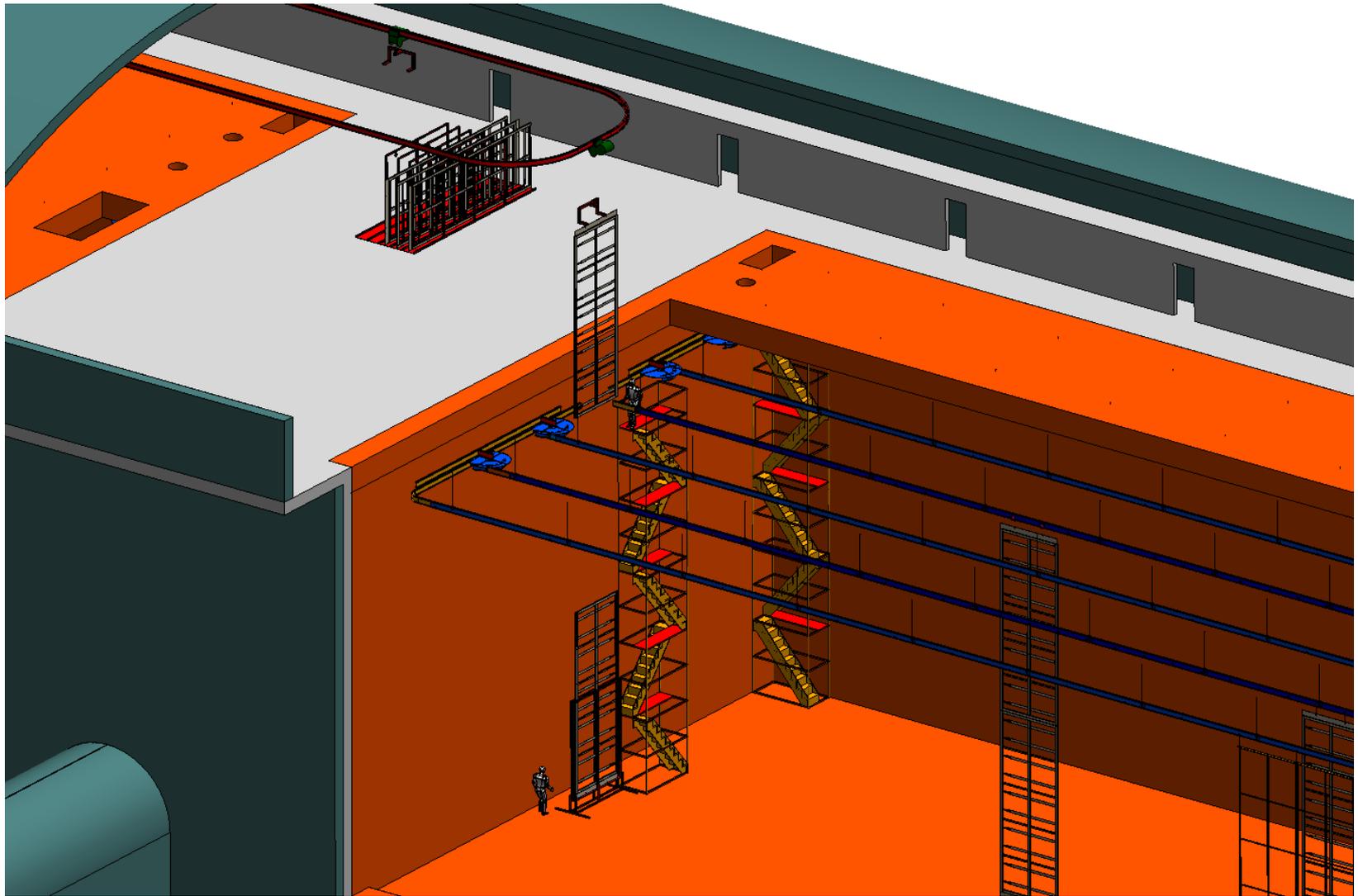


Source: Joshua Spitz, Yale University
DocDB # 2693

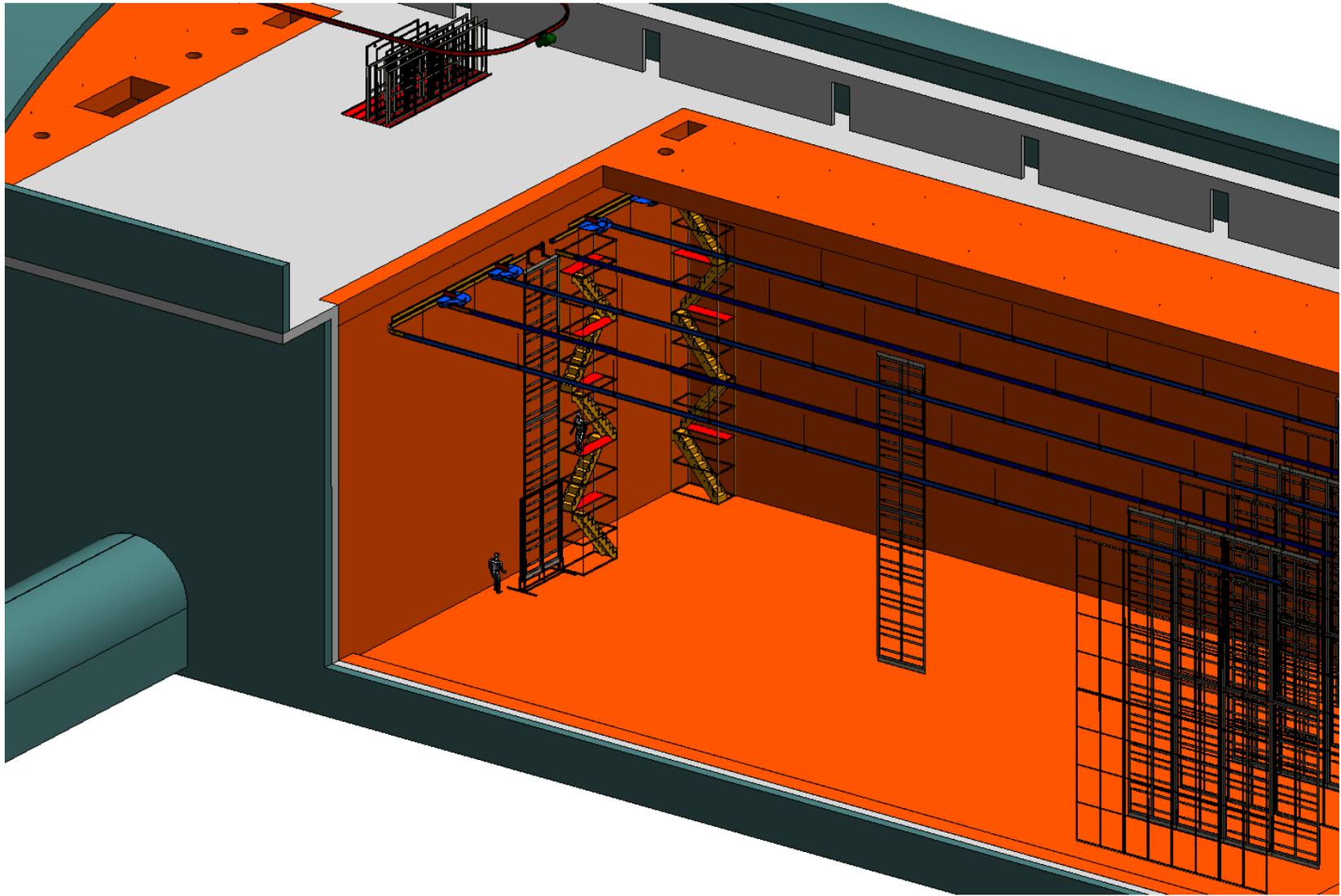
LAr-FD 33 kton fiducial mass at 4850', February 3, 2012 – TPC installation



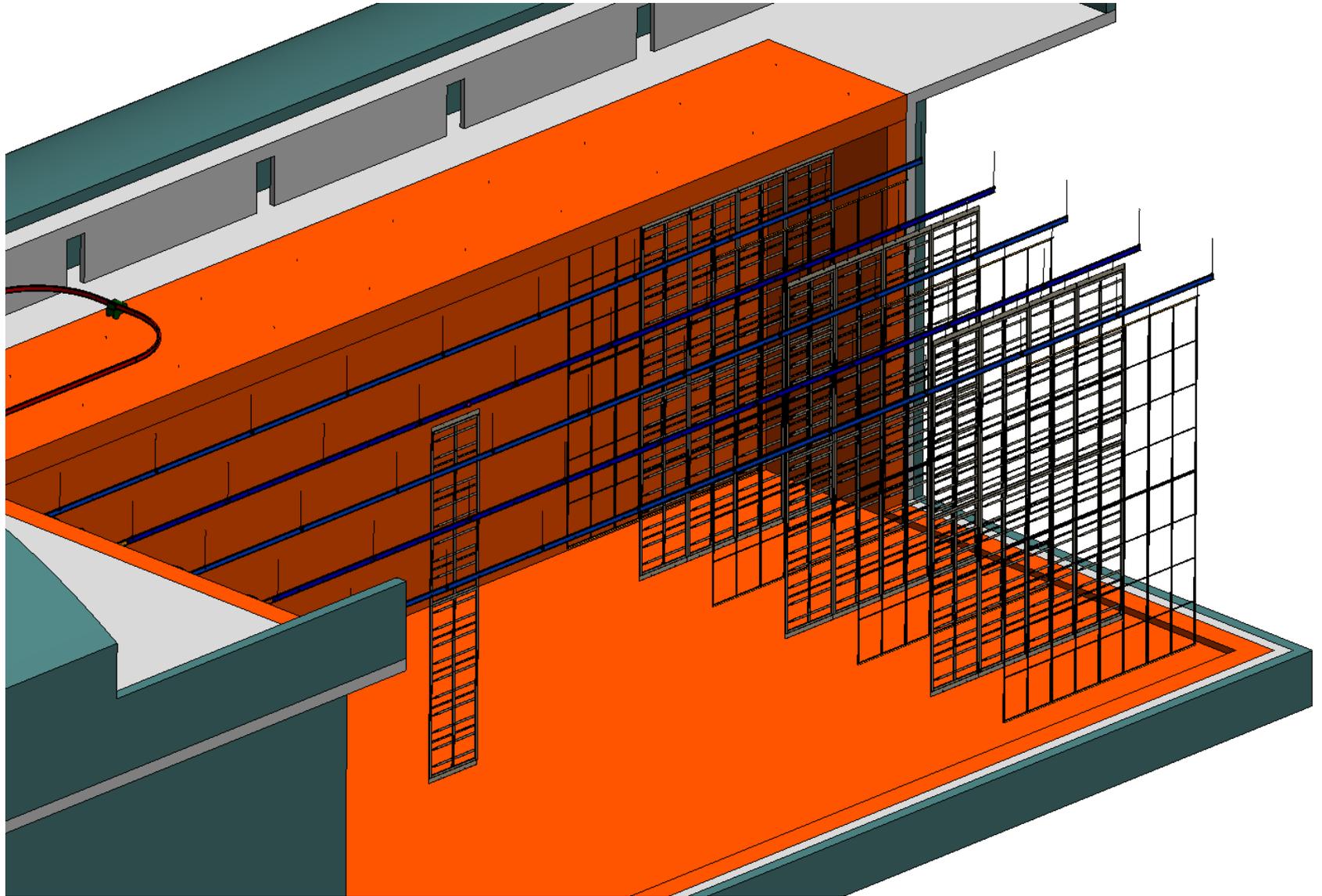
LAr-FD 33 kton fiducial mass at 4850', February 3, 2012 – TPC Installation



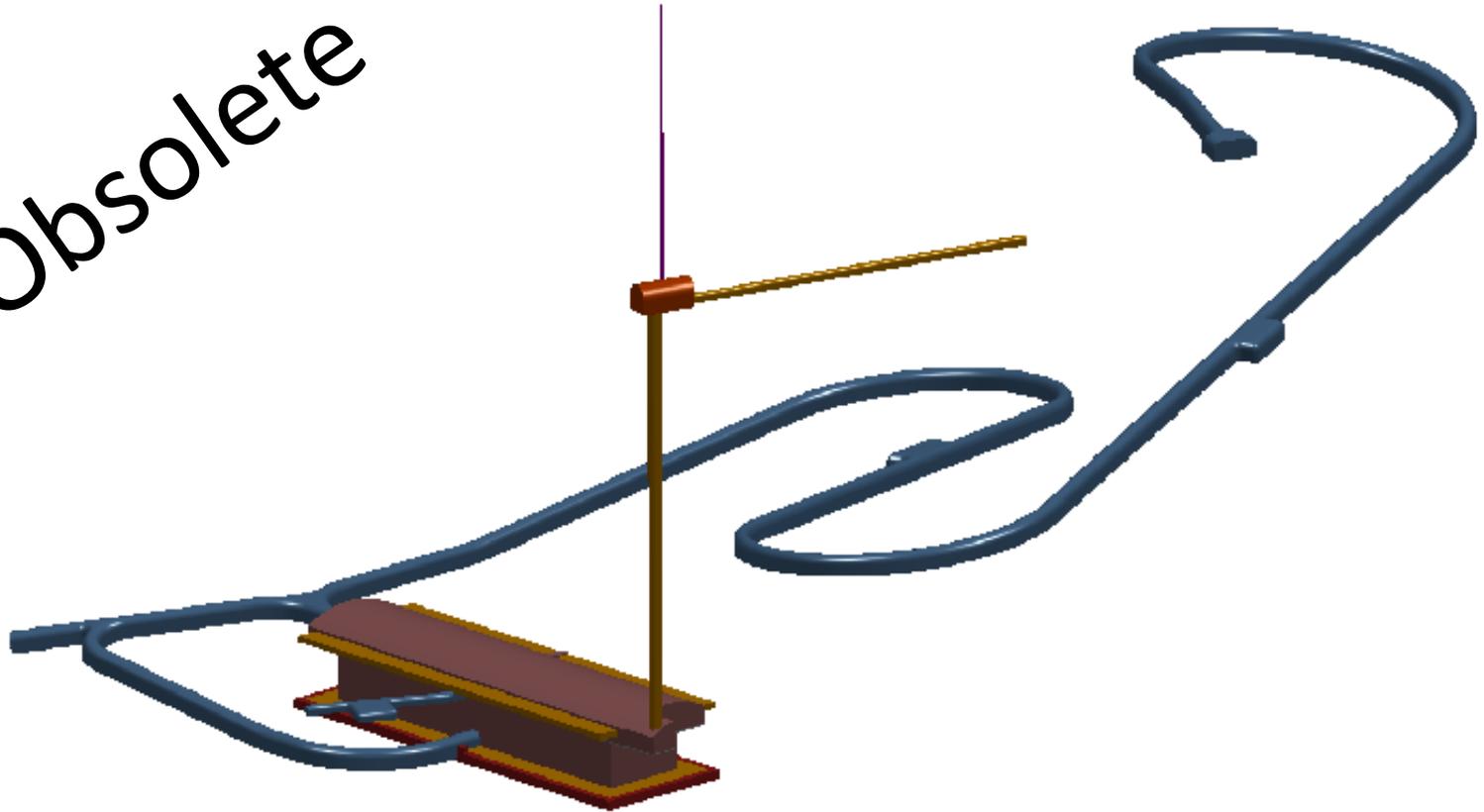
LAr-FD 33 kton fiducial mass at 4850', February 3, 2012 – TPC installation



LAr-FD 33 kton fiducial mass at 4850', February 3, 2012 – TPC installation



Obsolete

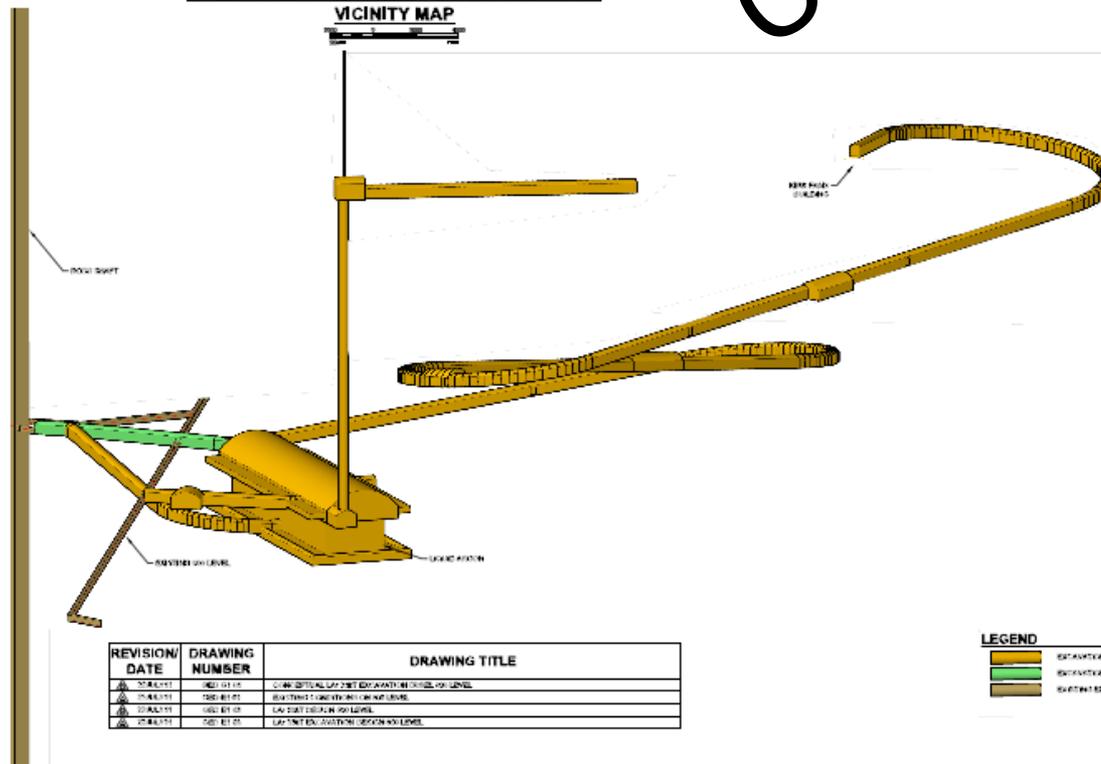


**LBNE FAR SITE DETECTOR
SANFORD UNDERGROUND LABORATORY
LEAD, SOUTH DAKOTA - 33KT LIQUID ARGON DETECTOR**



VICINITY MAP

Obsolete



REVISION	DATE	DRAWING NUMBER	DRAWING TITLE
1	02/01/11	046-001-001-001	CONCEPTUAL EXCAVATION DESIGN OF LEVEL
2	02/01/11	046-001-001-002	CONCEPTUAL EXCAVATION DESIGN OF LEVEL
3	02/01/11	046-001-001-003	CONCEPTUAL EXCAVATION DESIGN OF LEVEL
4	02/01/11	046-001-001-004	CONCEPTUAL EXCAVATION DESIGN OF LEVEL

LEGEND

	EXCAVATIONS REQUIRED FOR DECONTAMINATION
	EXCAVATIONS REQUIRED FOR CONSTRUCTION
	EXISTING EXCAVATIONS

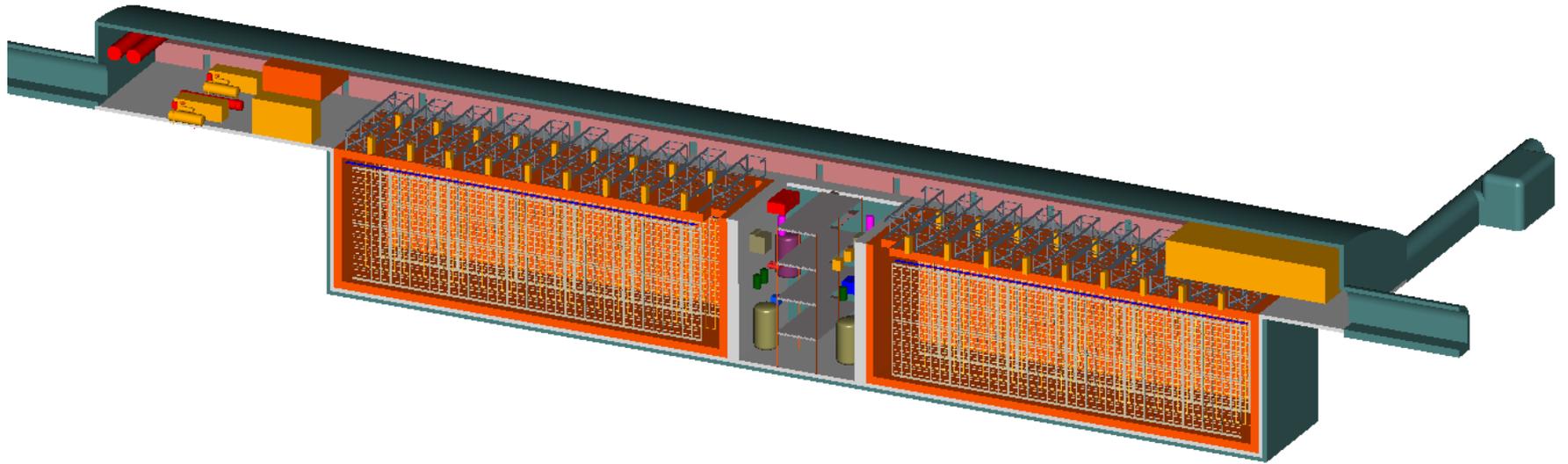
DESIGNED BY	DATE	SCALE	PROJECT NO.	REV. NO.
DRAWN BY	DATE	SCALE	PROJECT NO.	REV. NO.
CHECKED BY	DATE	SCALE	PROJECT NO.	REV. NO.
APPROVED BY	DATE	SCALE	PROJECT NO.	REV. NO.

LBNE FAR SITE CONCEPTUAL EXCAVATION DESIGN
LEAD, LAWRENCE COUNTY, SOUTH DAKOTA

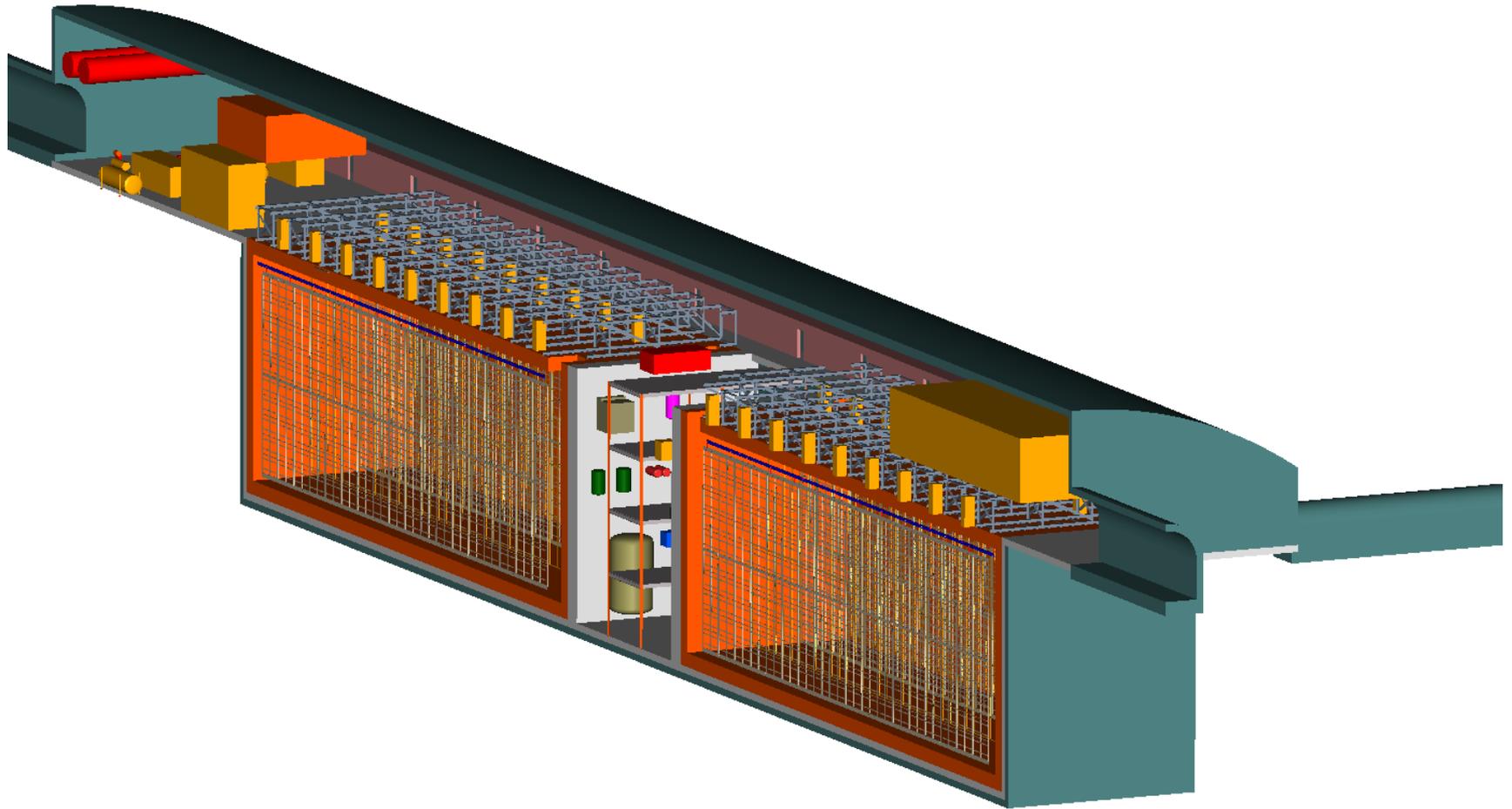
**CONCEPTUAL LAr 33KT EXCAVATION
DUSEL 800 LEVEL**

PROJECT NO. 10-000-001 | SCALE AS SHOWN | REV. A
 DRAWN BY: J. J. JENSEN | CHECKED BY: J. J. JENSEN
 DATE: 02/01/11 | PROJECT: LBNE FAR SITE
GED-G1-01

LAr-FD at 4850', February 6, 2012



LAr-FD at 4850', February 6, 2012



LAr-FD at 4850', January 12, 2012

