I&I Workshop Sept 16-20

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September 24, 2024

Workshop held at SURF 1/3

- 3 very long days of presentations summarizing current status
  - Monday: Project planning, Cavern status, Plans for cryostat installation, support services, Support for housing in Lead, Cryo installation, new cages
  - Tuesday: Vertical Drift review, cleanroom layout, Anode plane specs & open issues, top electronics status, top CRU assemblies & factories, top CRP installation, bottom CRU assemblies & factories, BDE, overview of bottom CRP installation (much more on this later), cathode construction, cathode installation, PDS including DAPHNE R/O, PDS reviews & production, cable trays inside the cryostat (including new scheme for support from penetrations), electronics racks, field cage elements & installation
  - Wednesday: Horizontal Drift review, APA factory status (UK & US), APA storage in the US (storage near Daresbury planned, 3 options for storage space in the US – FNAL, Madison, Ash River), APA QC, SHV boards (initial discussion of redesign), PDS reviews & production plans, discussion of dichroic filters and pTp substrate fab (better quantum eff w/out dichroic filters; nonetheless dichroic filters will be used for HD),APA assembly (2 high) & cold box testing, field cage installation, temperature sensor installation, DAQ (incl trigger & open issues), hardware database, purity monitors (proposal to include a new type that doesn't use a flash lamp), detector control system (Ignition)

1st three days were a whirlwind recap of current status

2300 MT/Cryostat
1300 components/Cryostat

- Material for 1st cryostat was shipped to Houston earlier this year, but rejected by USDA because wooden pallets were infested with beetles… sent back to Spain.
- Expected delivery is now end of April 2025 at the soonest

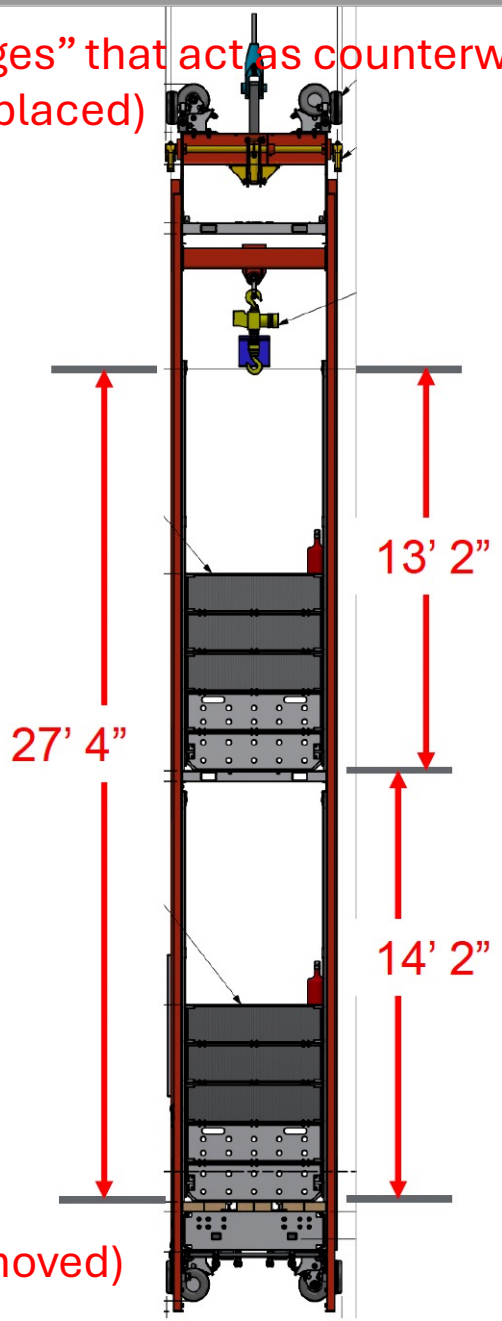
Ross shaft has 3 sections (1 cage w/counterweights & 2 “skip cages” that act as counterweight for one another)
Both the existing passenger cage and the skip cages are being replaced)

Ross Double Deck Cage

Overall Specifications

- Design and Fabrication to by FKC Lakeshore (same as current cage)
- Removeable middle deck with 7,500 lb Payload Capacity
- Distance between bottom and middle deck will allow for personnel to be loaded on the cage at the collar and at the ramp simultaneously with cage chaired at the ramp
- Overall width and length same as current cage
- Slung loads in the cage rather than under the cage

A single big L beam will fit in the new cage (with the upper deck removed)



SPECIFICATIONS:

MAX. CAGE-HOIST PAYLOAD:
6 METRIC TON (13,225 LBS)

CAGE WEIGHT (LB)
12466

MAX. UPPER DECK MATERIAL PAYLOAD: 7,500 LBS

MAX. CONVEYANCE MATERIAL PAYLOAD: 13,500 LBS

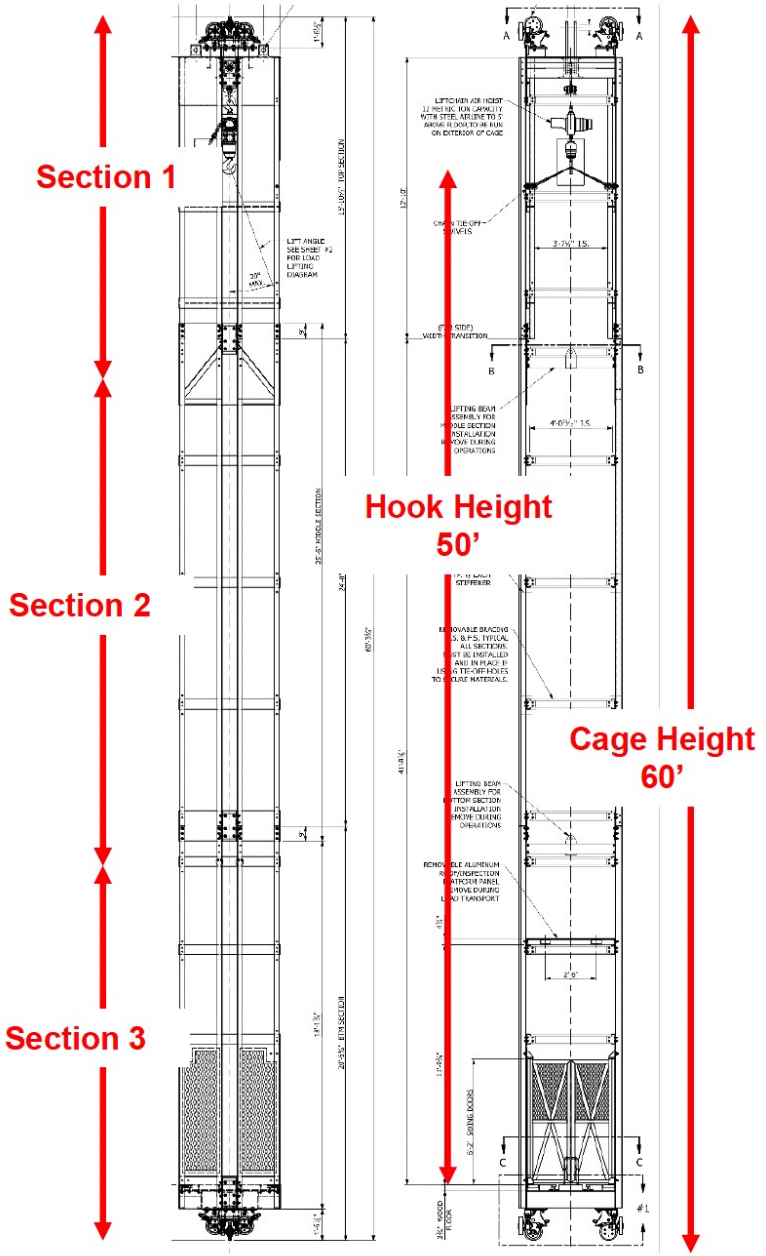
MAX. CONVEYANCE PERSONNEL PER DECK: 16
TOTAL : 32

NOTE: FINAL WEIGHTS & LOADS MAY VARY

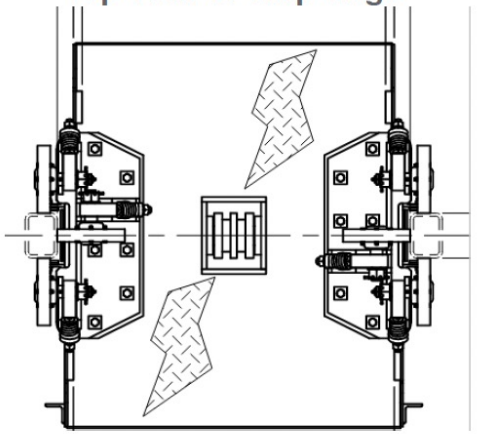
Ross Skip Cage

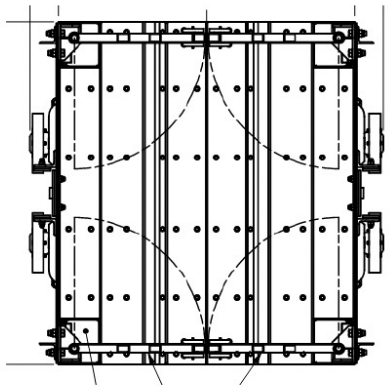
Design Status & Schedule

- Skip cage is the highest priority
- Design and Fabrication Contractor – FKC Lakeshore – same company who designed and fabricated existing single deck cage
- 30% Design is complete. Review completed.
- Structural Design Report completed
- 90% design in progress. Expected completion end of October
- Shop Drawings complete end of November
- Fabrication complete and delivered to site Feb 1, 2025
- SDSTA outfitting with lights and safeties – Feb 15
- Installed in shaft and commissioned – Feb 28

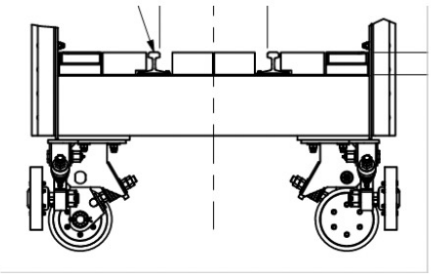


Top view of Skip Cage





Floor view of Skip Cage



Workshop held at SURF 2/3

- Thursday: First FDC Construction Executive Board (FDC EB) meeting.
  - Cheng-Ju will be our representative on this board; I will continue to represent our consortium on the DUNE EB.

- Also on Thursday:
  - Underground visit for ~20 of us (including me)
  - 3 parallel engineering meetings (including 1 on the VD installation test facility at building 185, that Cheng-Ju attended)
  - Discussion on DAQ facilities available during installation & commissioning

At the Ross shaft ready to go!

At the 4850 level after a 10 minute ride down. The roof of the area at the bottom of the shaft has been raised so that the 45 ft. long cryostat beams can be removed from the skip cages. The ceiling hasn't yet been raised at the surface level.

All of the passageways are much taller than normal mine tunnels. The floor is nicely finished. The walls are secured with rock bolts, covered with screen wire, and shockcrete.

Overall everything was much cleaner than I imagined it would be.

The long caverns are really long! This is the central utility cavern seen from one end.

It’s hard to appreciate the scale of the two detector caverns from a picture. You can get some sense of scale from the stairs and telelifter at the far end of the cavern.

Here’s an identical 120’ telelifter in the CUC

Workshop held at SURF 3/3

- Friday:
  - Underground visit for the FDC EB members & maybe a few others
- Also on Friday:
  - Three parallel engineering meetings
    - Bottom CRU Installation (both Cheng-Ju & I attended)
    - PDS Open Issues
    - “Work Permission Process”

I will summarize the Bottom CRU Installation meeting

Bottom CRP Installation

- The TDR says that bottom CRPs will be supported by 4 feet (1 fixed, 3 sliding in the horizontal plane). The details have been changed somewhat, but until recently it was planned that the installation will include these steps:
  - Move CRUs (half CRPs) into cryostat (anode side down)
  - Assemble 2 CRUs into a CRP (pins into slots) & electrically join CRU ground planes
  - Attach support feet
  - Flip CRU so that anode side is up (electronics down) & place on an installation truss
  - Attach cables to patch panels & test electronics
  - Remove installation truss (supporting with telelifter)
  - Lower CRP to floor & fine tune level; check fit with neighboring CRPs

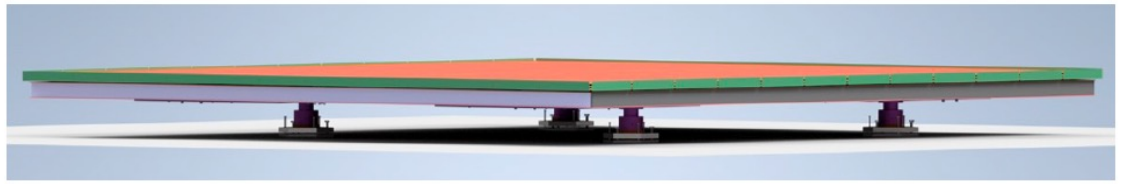


Figure 3.21: Illustration of a bottom CRP supported about 160 mm above the membrane flat surface by four posts.

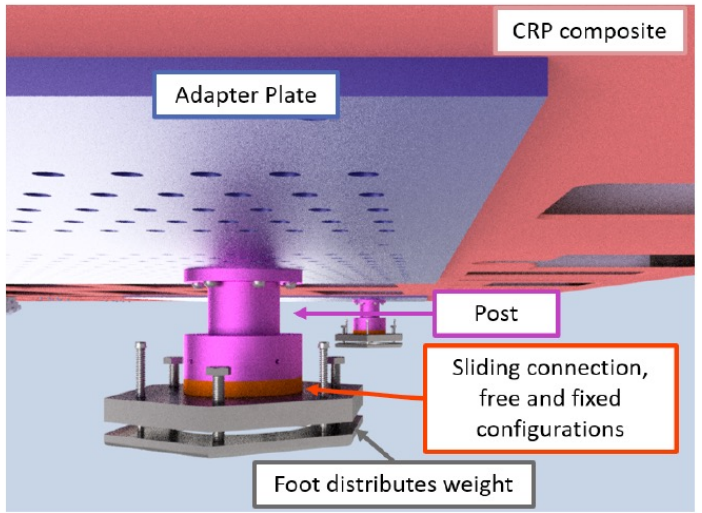


Figure 3.22: The bottom support design consists of four components: the adapter plate out of G10/FR-4, and aluminum post, a low-friction plastic sliding connection, and a type 316 stainless steel foot.

Recent events (before last week)

- Top CRP support design requires that the top CRPs be lowered so that they are ~20 mm closer to the cathode.
  - This implies that the bottom CRPs should be raised an equal amount
  - This relaxes constraints on the bottom CRP support design & could allow a simpler structure.
- The plan to have us working under the CRPs with only a temporary structure supporting the CRP poses a risk that may not be acceptable.
- The installation of the last row of CRPs probably cannot be done in the same way as the rest of the CRPs because of space constraints… the last row probably needs to be installed as CRUs.
  - These considerations led to the proposal that all CRPs be installed CRU by CRU and installed without the temporary truss (the patch panels would be placed so that we wouldn't need to work under the CRUs to connect cables)
  - Details of how small the gap between CRUs could be (now 1mm gap with pin/slot engagement of CRUs) and how the ground planes will be electrically connected not yet fully worked out – a session was scheduled for Friday to discuss these and other issues.

The truss is assembled on the membrane floor out of bolt-together components and uses fixed support feet for CRP-like load transfer to floor. The CRP is placed on top of installation 1.22 m above the membrane floor.

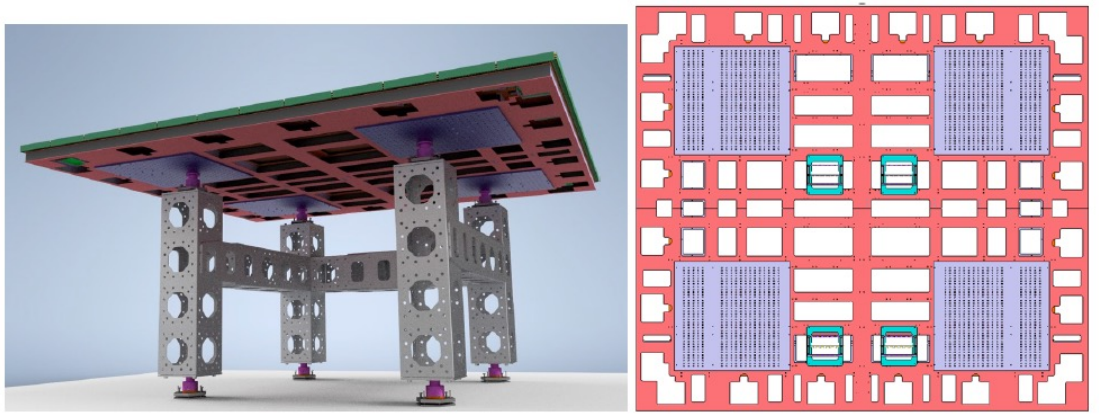


Figure 3.30: Left: Truss system with a bottom CRP sitting on it for cabling of the CE to the CRP patch panels. Right: Bottom view of the CRP showing the position of the four patch panels in blue.

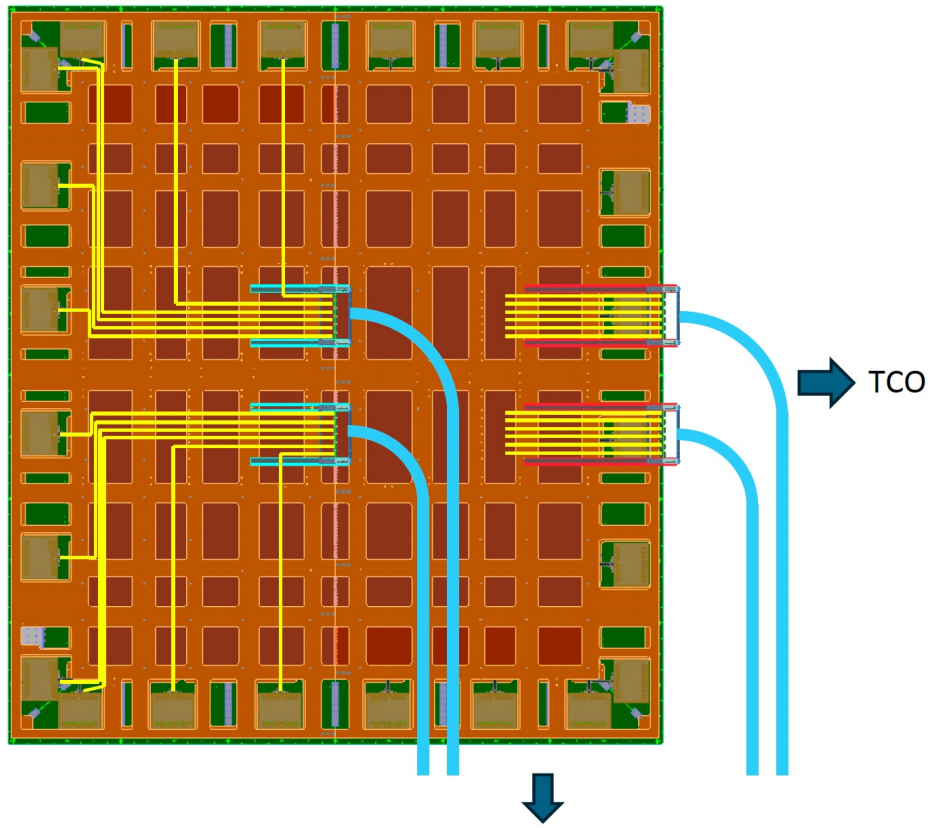
Summary of Friday's Discussion

- Presentation of plan for CRU-by-CRU installation included:
  - No intimate connection between CRUs (no way to use pins & slots without being able to move CRUs horizontally while supported above the floor); gap increased to 4mm
  - No obvious way to make the ground connection between CRUs (especially for the last CRUs in a row)
    - We have evidence that we haven't yet been able to achieve a monolithic ground plane on any of the CRPs built to date ("cross talk" from large positive-going pulses does not cross CRU boundaries on CRPs in NP02)
    - Maybe we don't need the ground planes connected at all.
- Dimitar interrupted the description of how the feet will be adjusted to level the CRU by saying that this was pointless.
  - The thin membrane floor will move vertically because of hydrostatic loading when the cryostat is filled with liquid argon.
  - This will occur because the membrane will not be in close contact with the rest of the insulating and structural material (foam, plywood, steel plate) before the cryostat is filled.
  - The vertical motion will be relatively large (1–10 mm) and nonuniform.
  - This fact was not known to the PSI engineers who devised the proposed support system.
- Near the end of the session we talked about CRU orientation & patch panel location on the CRUs (see next slide)
- The PSI engineers will go back to the drawing board, guided by a new set of requirements (see next slide). There will be regular meetings between the PSI engineers and the CRP group organized by Matt W. & Dominique D.

New Requirements for Bottom CRP Installation

- Install CRUs instead of CRPs
- Increase height of bottom CRP by 20mm
- CRU will be installed in symmetric orientation (see next slide)
  - Edge cards opposite to TCO or inverse?
- Grounding may not be necessary between 2 CRUs
- Preference is to ground the feet to the membrane
- Foot should always be in contact with the membrane
- 1 foot fixed & 3 sliding (1 is guided)
- Distribute the gap or look at the optimal for dead spaces
- Orientation: edge cards away from the TCO is preferred
- Each gap should be controlled at warm

Preferred CRU Orientation



My preferred orientation is  rather than