

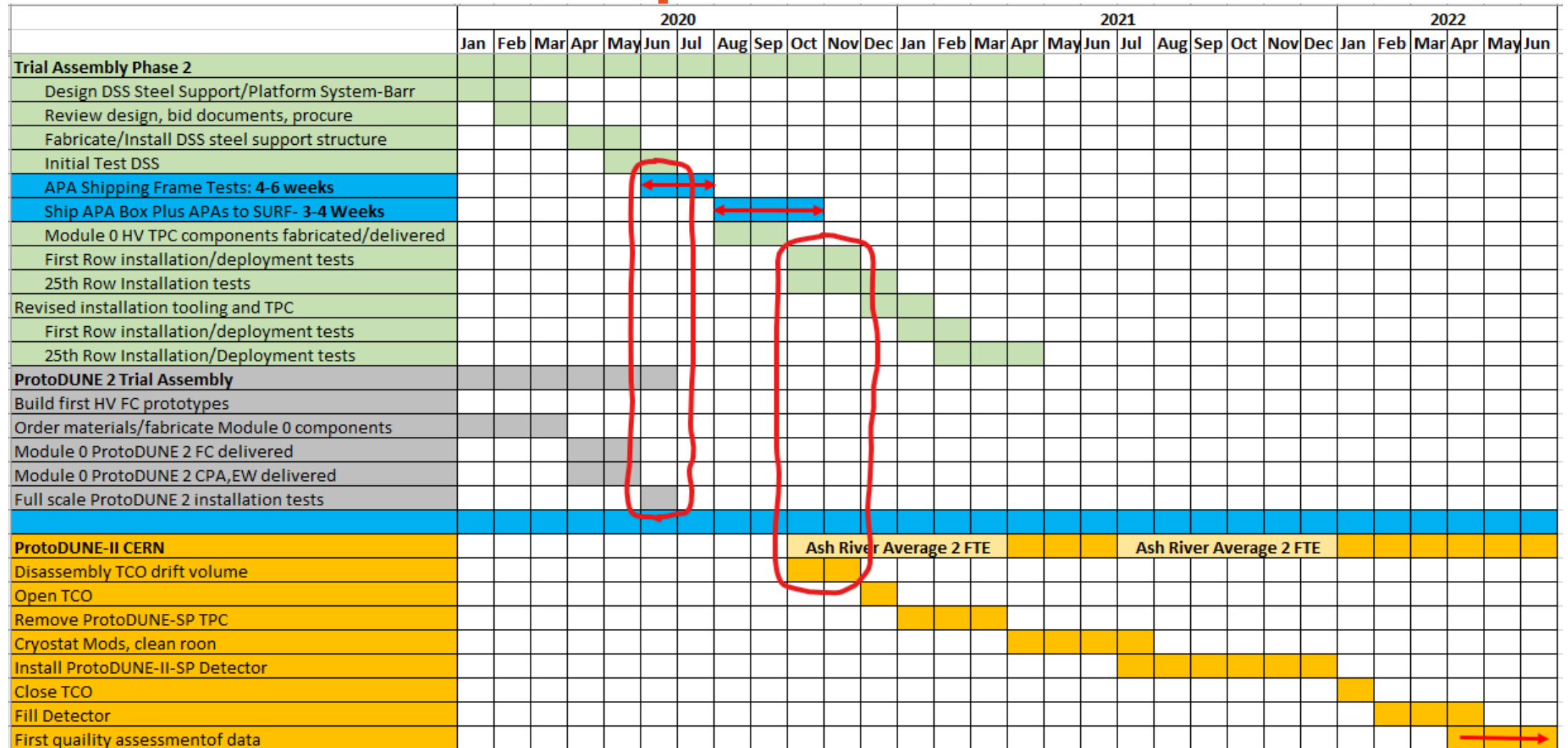


ProtoDUNE-II  
Trial Assembly  
Frame

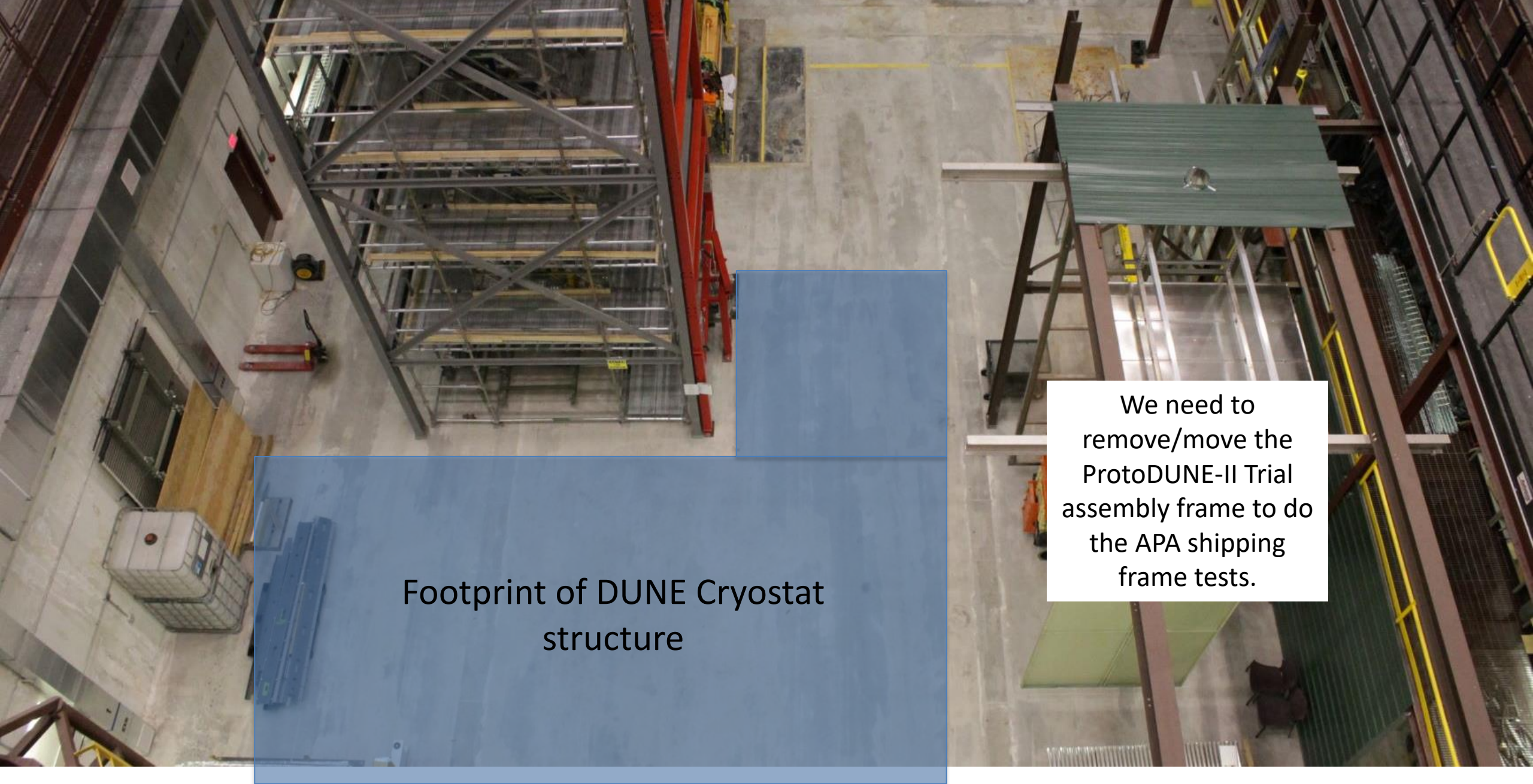
# Ash River Trial Assembly Phase 2

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University of Minnesota

# Updated Schedule is getting compressed with a few potential conflicts-

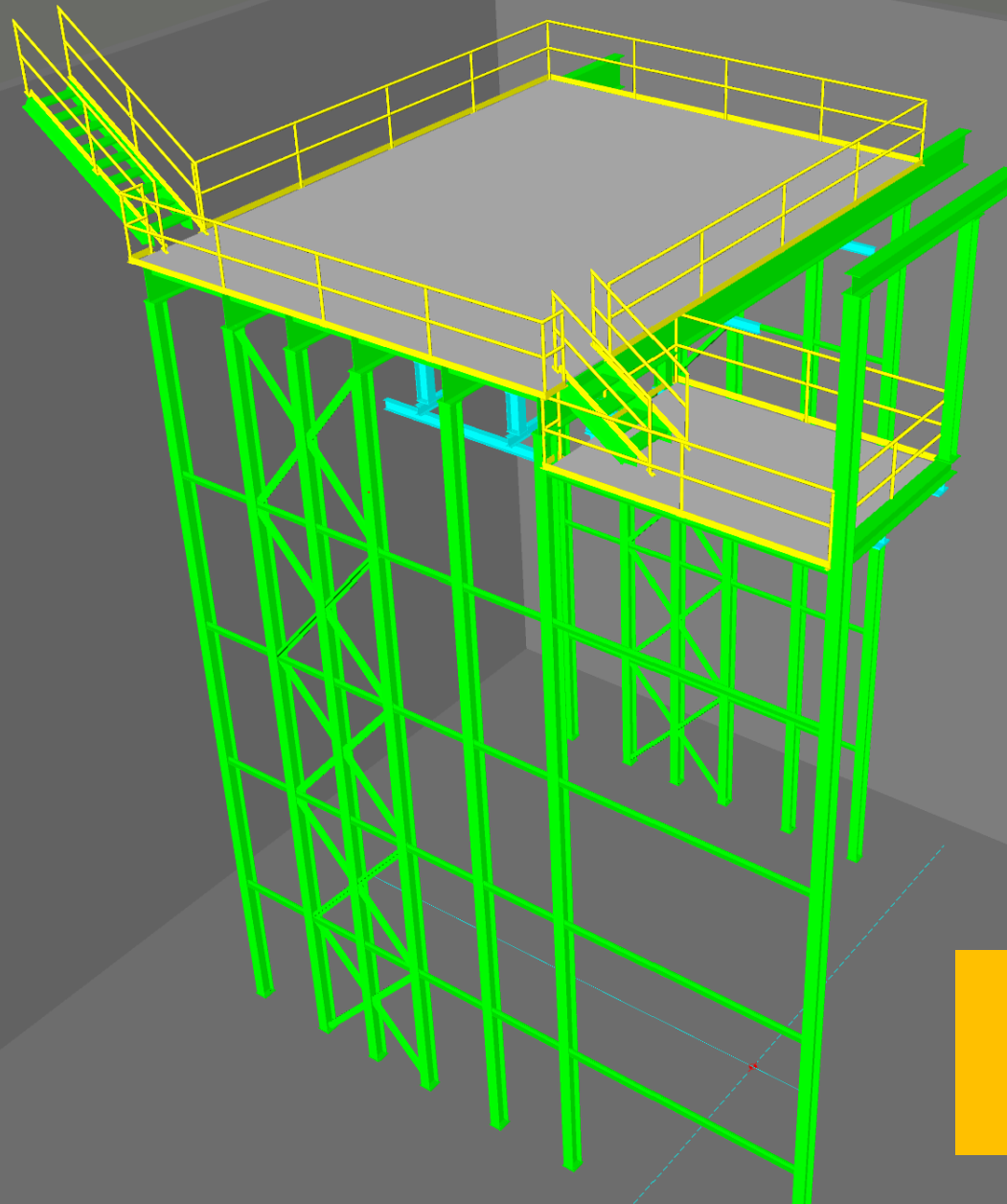






Footprint of DUNE Cryostat  
structure

We need to  
remove/move the  
ProtoDUNE-II Trial  
assembly frame to do  
the APA shipping  
frame tests.



Need to get APA assembly tower, ProtoDUNE Trial assembly, TPC components, false floor, scissor lifts and avatars added to module so we can properly show the installation process

Steel erection needs to be performed off peak in northern Minnesota to contain costs

# Phase 2 Scope

- Draft AR Installation Prototyping requirements document on EDMS [2169069](#)
- This needs to be updated has plans have slightly modified, waiting for good 3-D model to update installation plans
- Document also includes ProtoDUNE-II trial assembly work; it again needs to be updated as better models are available.

## FD-SP Installation Prototyping Goals

- The goals for the DUNE SP-FD installation prototyping program are as follows:
- Test each of the detector installation steps with full scale mechanical mockups based on the detector components final design.
  - Verify the component interfaces are accurate and well understood and that the detector can be assembled.
  - Verify the proposed installation tooling is adequate and re-design where needed.
  - Propose design revisions to the detector components where needed.
- Draft assembly procedure documents for all the installation work.
- Archive a complete set of component documentation for the mockup tests.
- Write full set of Hazard analyses for the installation process and identify points where risk mitigation would be beneficial to reduce the risks.
- Test proposed access equipment (scaffold, scissor lifts, work platforms) and lifting fixtures.
- Perform assembly time and motion studies including labor estimates which will be used to develop the schedule.
- Train the installation crew prior to start of work underground.



# Ash River Prototyping and Milestones

- The Phase 2 schedule has slipped considerably in the last 6 months. Original goal was to build the support structure and do the initial DSS and shuttle beam test before the Directors Review.
- Many of the critical APA doublet, PD and CE cable tests were done during Phase 1 except for the **APA Shipping frame**. This is still an ASAP Prototype test.

**Are there any other critical tests required by the APA or HV consortia before the Phase 2 support structure is in place?**

**ProtoDUNE-II testing has moved into the critical path since this is the first full scale test of the new HV components including latches, APA to Endwall interface, CPA to Endwall interface, Installation and deployment procedures**

- We plan on using the new DUNE APAs which includes and required additional “features” like latches, upside-down APA yoke and cable trays.

**DOCUMENTATION! DOCUMENTATION!**

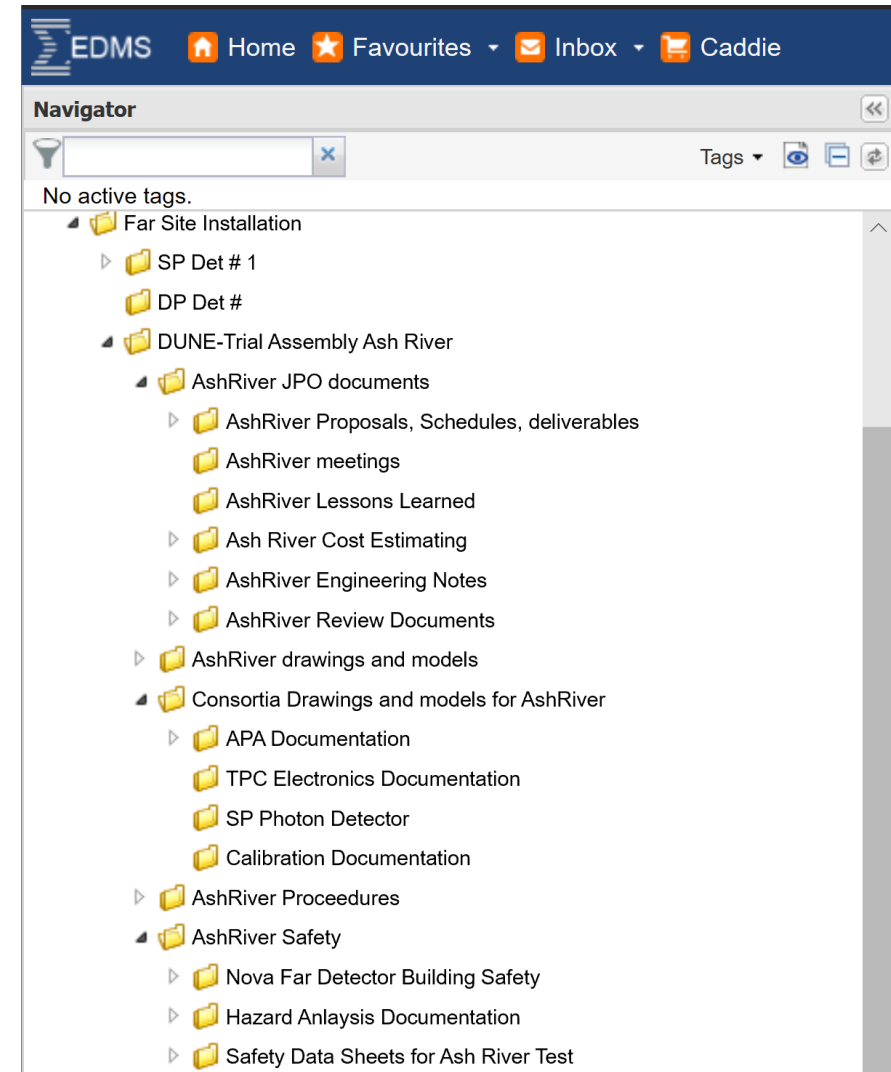
**This will stop us in our tracks  
and we are already behind**

# DOCUMENTATION

**We can't start any of the Phase 2 Trial Assembly work without the proper documentation!**

- Basis of Materials (tracking information for shipments), Assembly drawings, component drawings, 3-D models
- Engineering notes for TPC components
- Installation Procedures
- Hazard Analysis

All this needs to be posted to EDMS and signed off as required.



# Documentation!

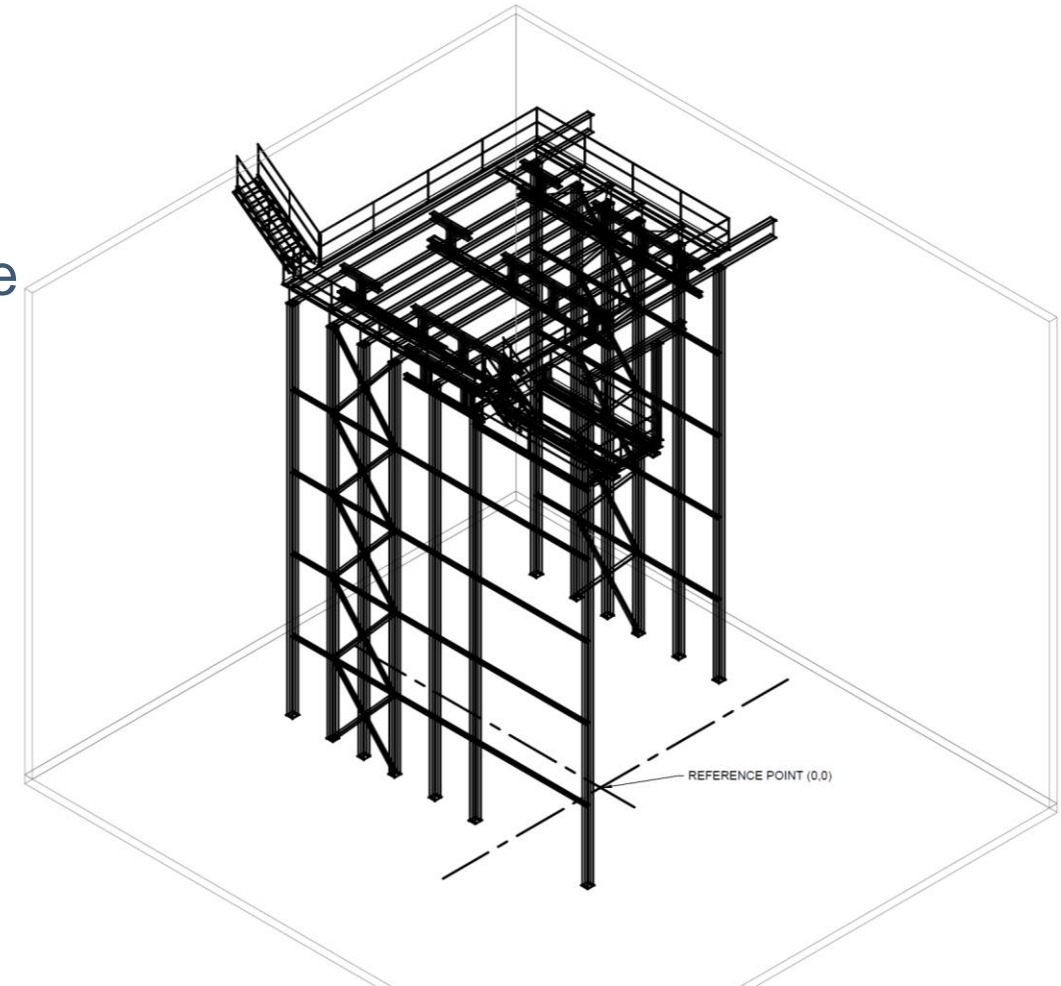
- It needs to mirror what is needed for both ProtoDUNE-II and DUNE. Ash River is not different we can not proceed without the proper documentation in place.
- We can not lift an APA or CPA component until it has been approved by the Compliance Office. For Phase 1 we used a single engineer sign-off on the structure and the components.
- Ash River has the added complication that we also need to have most of the work approved by the University of Minnesota ES&H for installation procedures, hazard analysis by the NOvA Far Detector Lab safety officer and our University ES&H contact Jean Cranston (and other experts if needed)
- In addition we also are required to get building and electrical permits approved by UMN code officials.

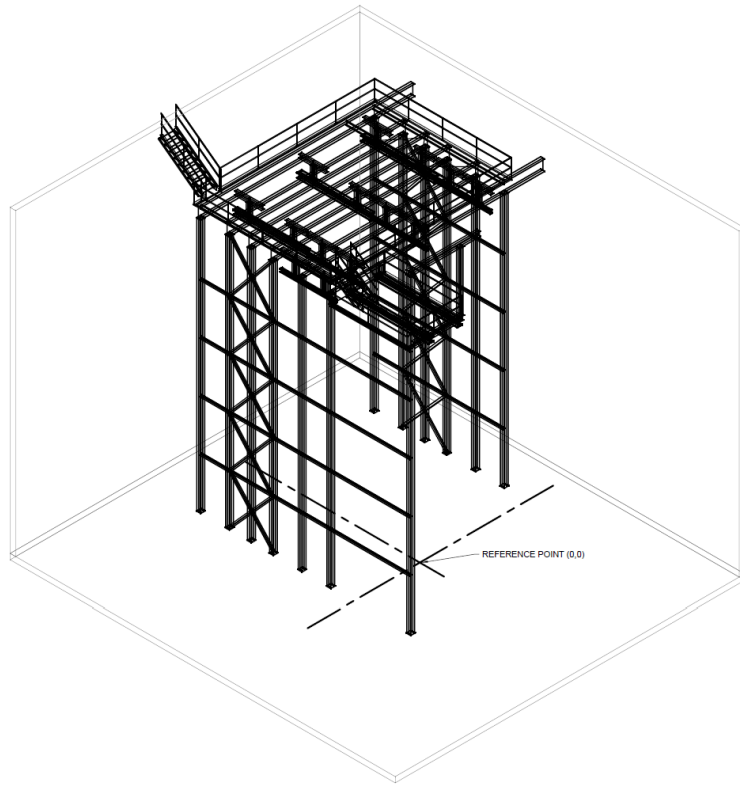
The Compliance Office **defines, leads and implements** the process of assessment, validation and sign-off for the equipment **compliance to mechanical and the electrical standards and regulations.**



# Current Status Trial Assembly @ Ash River

- Added a 6<sup>th</sup> NOvA crew, still plan to add one more over the next 6 months.
- BARR Engineering is working on completing the drawing/bid package for the DUNE Trial Assembly support structure. They still need some information from CERN to complete the design, so it is ready to be reviewed by the University of Minnesota and DUNE.
  - Drawings are at the 50% level now, and a 3-D model has also been supplied.
- Pushing to have completed drawings and bid package on the street by the early March
- Contractor site visit for bids mid-March, bids early by April- DSS will be bid separately





#### DRAWING LIST

S-01	3D VIEW, GENERAL NOTES
S-02	PLAN @ 48'-7 1/4"
S-03	MONORAIL PLAN
S-04	MONORAIL SECTIONS AND DETAILS
S-05	GRATING, STAIRS, AND HANDRAIL PLAN
S-06	SECTIONS LOOKING NORTH
S-07	SECTIONS AND DETAILS
S-08	SECTIONS LOOKING EAST

#### 1.0 GENERAL REQUIREMENTS AND SUBMITTALS

##### A. GENERAL

- THESE NOTES ARE COMPLEMENTARY TO THE SPECIFICATIONS AND DRAWINGS AND REPRESENT MINIMUM REQUIREMENTS. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
- DO NOT SCALE DRAWINGS.
- THE STRUCTURAL DRAWINGS REPRESENT THE FINISHED STRUCTURE AND, EXCEPT WHERE SPECIFICALLY SHOWN, DO NOT INDICATE THE METHOD OR MEANS OF CONSTRUCTION.
- FOLLOW MANUFACTURER'S INSTRUCTIONS FOR PREPARATION AND INSTALLATION OF PURCHASED MATERIALS AND EQUIPMENT.
- TESTS WILL BE PAID FOR BY THE OWNER; HOWEVER, IN THE EVENT THAT WORK IS DEFECTIVE, THE CONTRACTOR WILL PAY FOR THE TESTS AND ANY ADDITIONAL TESTING AND WORK REQUIRED TO CONFIRM THAT THE DEFECTIVE WORK HAS BEEN CORRECTED AND COMPLIES WITH THIS SPECIFICATION.

##### B. GOVERNING CODES

- PERFORM WORK IN COMPLIANCE WITH APPLICABLE FEDERAL, STATE AND LOCAL CODES AND REGULATIONS.
  - 2006 INTERNATIONAL BUILDING CODE AND REFERENCED STANDARDS W/ 2007 MINNESOTA BUILDING CODE AMENDMENTS.

##### C. SUBMITTALS

- PROVIDE SUBMITTALS TO OWNER A MINIMUM OF TWO WEEKS PRIOR TO INCORPORATION INTO THE WORK.
- SUBMIT ONE ELECTRONIC COPY OF EACH SUBMITTAL SPECIFIED TO THE OWNER AT THE FOLLOWING: OWNER COMPANY

ATTN: MR. OR MRS. CLIENT CONTACT [EMAILADDRESS@CLIENT.COM]

- ENGINEER'S ACCEPTANCE MUST BE SECURED FOR ALL STRUCTURAL SUBSTITUTIONS.
- ENGINEER'S REVIEW OF SHOP DRAWINGS ARE FOR GENERAL CONFORMANCE AND COMPLIANCE WITH DESIGN CONCEPTS, STRUCTURAL DRAWINGS AND SPECIFICATIONS. ANY ACTION NOTED DOES NOT WAIVE ANY REQUIREMENTS OF CONTRACT DOCUMENTS; COORDINATION OF TRADES AND SATISFACTORY PERFORMANCE OF THEIR WORK IS THE CONTRACTOR'S COMPLETE RESPONSIBILITY.
- SHOP DRAWINGS WILL BE MARKED AS "NOT APPROVED (RESUBMIT)" IF CONTRACTOR HAS NOT REVIEWED THEM PRIOR TO SUBMITTING.

##### D. SAFETY

- CONTRACTOR IS RESPONSIBLE FOR JOB-SITE CONDITIONS AND SAFETY PROCEDURES AND PROGRAMS. THIS REQUIREMENT APPLIES CONTINUOUSLY AND IS NOT LIMITED TO NORMAL WORKING HOURS.
- MEET ALL FEDERAL, STATE, AND LOCAL RULES AND REGULATIONS PERTAINING TO SAFETY, INCLUDING OSHA AND MNOSHA RULES.
- SECURE THE SITE FOR PUBLIC SAFETY FOR THE DURATION OF THE WORK.

#### 7.0 STRUCTURAL STEEL

##### A. GENERAL

- FABRICATE AND ERECT STRUCTURAL STEEL IN ACCORDANCE WITH THE CODE PROVISIONS OF THE "AISC STEEL CONSTRUCTION MANUAL, 14TH EDITION."

##### B. SUBMITTALS

- STRUCTURAL STEEL FABRICATOR SHOP DRAWINGS.
- STRUCTURAL STEEL ERECTION DRAWINGS.
- CONNECTION DESIGN CERTIFIED BY A PROFESSIONAL ENGINEER.
- MATERIAL CERTIFICATIONS.

##### C. PRODUCTS

- W SHAPES: ASTM A992, FY = 50 KSI.
- M, S, C AND MC SHAPES: ASTM A36, FY = 36 KSI.
- SQUARE AND RECTANGULAR HSS SHAPES: ASTM A500, GRADE B, FY = 46 KSI.
- ROUND HSS SHAPES: ASTM A500, GRADE B, FY = 42 KSI.
- PPES: ASTM A53, GRADE B, SCHEDULE 40, FY = 35 KSI.
- STEEL PLATES AND BARS: ASTM A36, FY = 36 KSI.
- FASTENERS:
  - HIGH STRENGTH BOLTS: ASTM F1552 TWIST-OFF BOLTS OR ASTM A325, TYPE 1
  - NUTS: ASTM A563, HEAVY HEX, GRADE C
  - WASHERS: ASTM F436
  - COMPRESSIBLE-WASHER-TYPE DIRECT TENSION INDICATOR: ASTM F959
  - SHEAR STUD CONNECTORS: ASTM A108
- FILLER MATERIAL FOR WELDED CONNECTIONS: MINIMUM TENSILE STRENGTH OF 70,000 PSI (E70XX ELECTRODES)
- POST-INSTALLED ANCHORS:
  - ADHESIVE ANCHORS: HILTI HIT-RE 500-SD EPOXY ADHESIVE ANCHORING SYSTEM WITH HAS-E THREADED ROD PER ICC ESR-2322.
  - MECHANICAL ANCHORS: HILTI KWIK BOLT-TZ EXPANSION ANCHORS PER ICC ESR-1917.

##### D. EXECUTION

##### 1. CONNECTION DESIGN REQUIREMENTS:

- DESIGN, DETAIL, AND FABRICATE ACCORDING TO THE AISC STEEL CONSTRUCTION MANUAL FOR THE INDICATED LOADING SHOWN ON THE DRAWINGS OR THE MINIMUM LOADING INDICATED BELOW.
  - TYPICAL BOLT: 1/4 OR 7/8 INCH DIAMETER, N BEARING-TYPE CONNECTION, WITH STANDARD HOLES, UNLESS NOTED OTHERWISE.
  - MINIMUM GUSSET PLATE SIZE: 3/8 INCH.
  - MINIMUM NUMBER OF BOLTS: TWO, UNLESS NOTED OTHERWISE.
  - WHERE FORCES ARE INDICATED ON DRAWINGS: FORCES CORRESPOND WITH ASD (ALLOWABLE STRENGTH DESIGN) LOAD COMBINATIONS. TENSILE FORCES ARE DESIGNATED AS POSITIVE NUMBERS. COMPRESSIVE FORCES ARE DESIGNATED AS POSITIVE NUMBERS.
  - WHERE FORCES ARE NOT SHOWN ON DRAWINGS:
    - VERTICAL BRACING END CONNECTIONS: AXIAL FORCE: + 24 KIPS MINIMUM.
    - HORIZONTAL END BRACING CONNECTIONS: AXIAL FORCE: + 12 KIPS MINIMUM.
    - STRUTS OR BEAMS ON FRAME LINES: AXIAL FORCE: + 12 KIPS MINIMUM.
    - BEAM SHEAR (END) CONNECTIONS:
      - UNLESS SHEAR LOADS ARE LISTED ON THE DRAWINGS, SELECT END CONNECTIONS TO SUPPORT A VERTICAL SHEAR END REACTION AT EACH END EQUIVALENT TO 50% OF THE MAXIMUM TOTAL UNIFORM LOAD FOR THE GIVEN BEAM AND SPAN (AISC STEEL CONSTRUCTION MANUAL TABLES 3-8 THROUGH 3-9), EXCEPT AS NOTED BELOW. MAXIMUM VERTICAL SHEAR DESIGN VALUE OF 15 KIPS FOR W8, W10, C8, AND C10 BEAM MEMBERS WEIGHING LESS THAN 23 POUNDS PER FOOT.
      - CONNECTION ARRANGEMENT SHOWN IN AISC STEEL CONSTRUCTION MANUAL TABLE 10-2, BOLTED/WELDED DOUBLE-ANGLE CONNECTION, CASE 1, UNLESS NOTED OTHERWISE. MINIMUM WELD SIZE: 1/4 INCH. ALTERNATE CONNECTION ARRANGEMENTS MAY BE CONSIDERED WHERE GEOMETRY OR ERECTION SEQUENCING DOES NOT PERMIT THIS CONFIGURATION.
      - W8 CONNECTION ARRANGEMENT SHOWN IN AISC STEEL CONSTRUCTION MANUAL TABLE 10-11, BOLTED/WELDED SINGLE-ANGLE CONNECTION; MINIMUM WELD SIZE: 1/4 INCH.
- FABRICATE STRUCTURAL STEEL FROM STANDARD ROLLED STRUCTURAL SHAPES, BARS, AND PLATES IN ACCORDANCE WITH AISC 303 AND APPROVED SHOP DRAWINGS.
  - PROVIDE ALL ERECTING TOOLS, HOISTING EQUIPMENT, ERECTION BOLTS, SHIMS, SCAFFOLDING, SUPPORTS, TEMPORARY BRACING, GUYS, BOLTS, AND OTHER ITEMS NEEDED FOR THE COMPLETE ERECTION OF THE STRUCTURAL STEEL.
  - ERECT ACCURATELY TO THE LINES AND LEVELS SHOWN ON THE DRAWINGS. PLUMB ALL COLUMNS AND OTHER VERTICAL MEMBERS. LEVEL HORIZONTAL MEMBERS BEFORE PERMANENT CONNECTIONS ARE MADE. ACCURATELY FIT UP BOLTED FIELD CONNECTIONS BEFORE BOLTS ARE TIGHTENED. DRILL OR REAM ALL UNFAIR HOLES.
  - INSTALL HIGH STRENGTH BOLTS IN ACCORDANCE WITH THE RCSC, SPECIFICATION FOR STRUCTURAL JOINTS USING ASTM A325 BOLTS OR A490 BOLTS.
    - HIGH STRENGTH BOLTED CONNECTIONS: BEARING TYPE.
    - INSTALL HIGH STRENGTH BOLTS IN PROPERLY ALIGNED HOLES AND TIGHTEN BY "TURN OF THE NUT" OR "DIRECT TENSION INDICATOR (DTI)" METHOD TO THE FOLLOWING MINIMUM BOLT TENSIONS: 58 INCH - 19 KIPS, 3/4 INCH - 28 KIPS, 7/8 INCH - 39 KIPS.
    - USE HARDENED WASHERS WITH HIGH STRENGTH BOLTS. USE BEVEL WASHERS AGAINST ALL SLOPING FLANGES.
  - FIELD WELD ON STRUCTURAL MEMBERS ONLY WHERE SHOWN ON THE SHOP DRAWINGS IN ACCORDANCE WITH AWS.
- ##### E. TESTING
- INSPECT HIGH STRENGTH BOLTS IN ACCORDANCE WITH RCSC, SPECIFICATION FOR STRUCTURAL JOINTS USING ASTM A325 OR A490 BOLTS.
  - VISUALLY INSPECT ALL WELDS AND COMPLETE NECESSARY CORRECTION OF ALL DEFICIENCIES IN MATERIALS AND WORKMANSHIP IN ACCORDANCE WITH AWS D1.1.

#### 3.0 COATINGS AND FINISHES

##### A. GENERAL

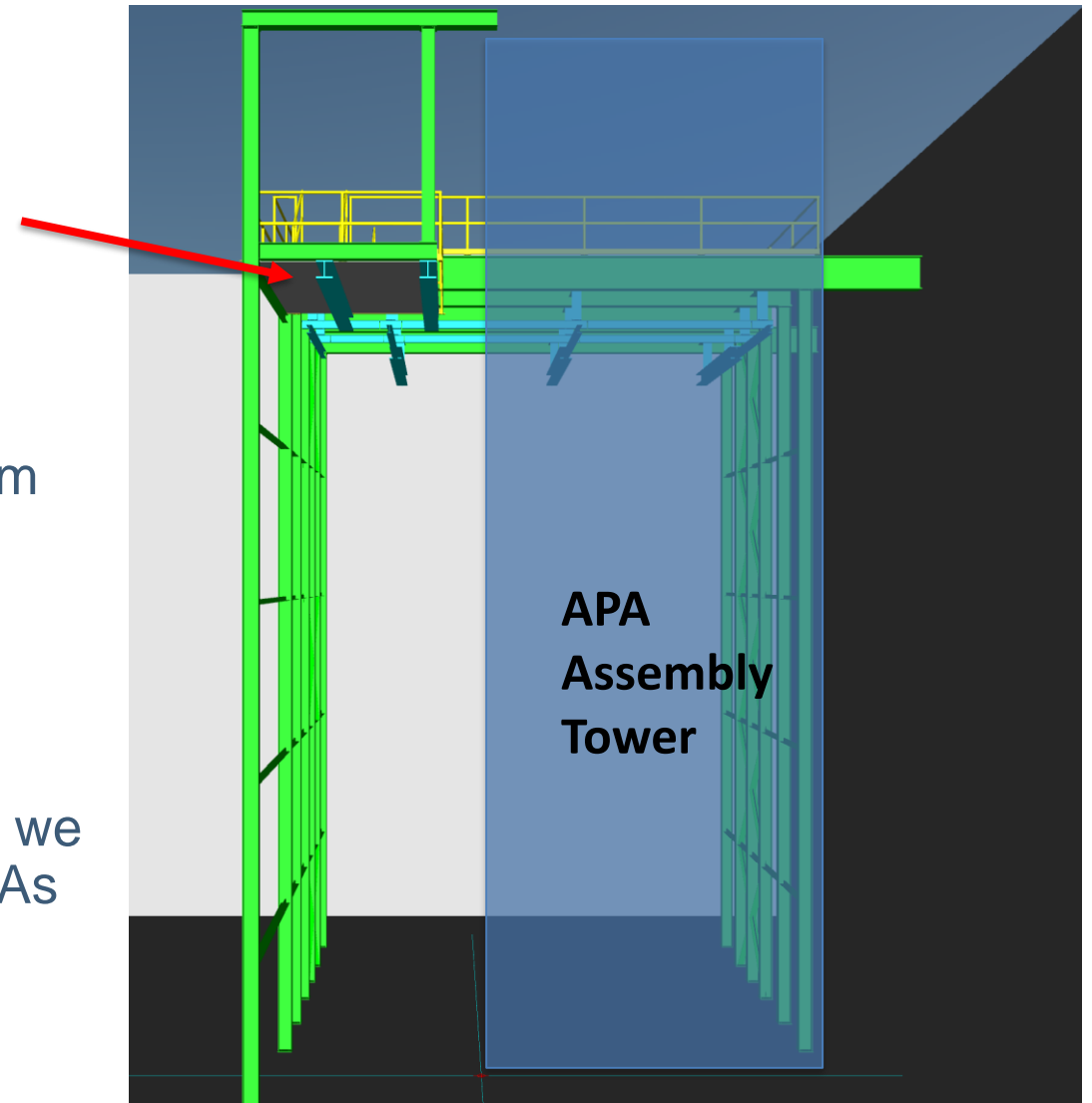
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# DSS support/cryostat structure features

It has several important design features

- TCO opening with both TCO beams (and the warm structure finger)
  - This will allow us to see if it is feasible to bring scissor lifts in and out
  - Test mechanical connection between TCO beam and Shuttle beam
  - This is the planned location to add the top field cages to the completed CPA assembly.
  - The second beam will be used for installing the APA Doublet. This beam is likely the only place we can test the double chain hoist for lifting the APAs out of the shipping frame.
  - We will mock-up the TCO opening size as well

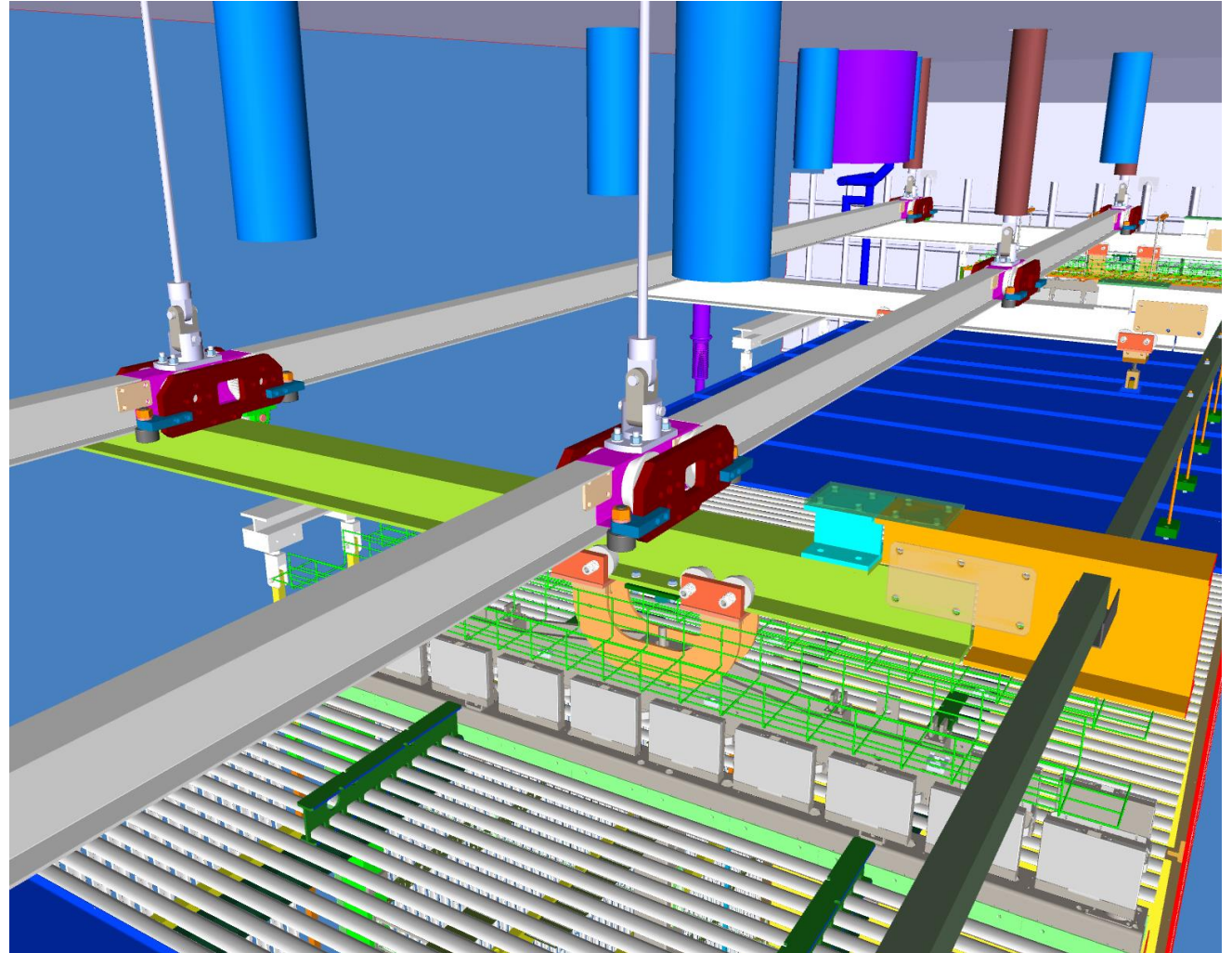




# DSS support/cryostat structure features

DSS and shuttle beam system

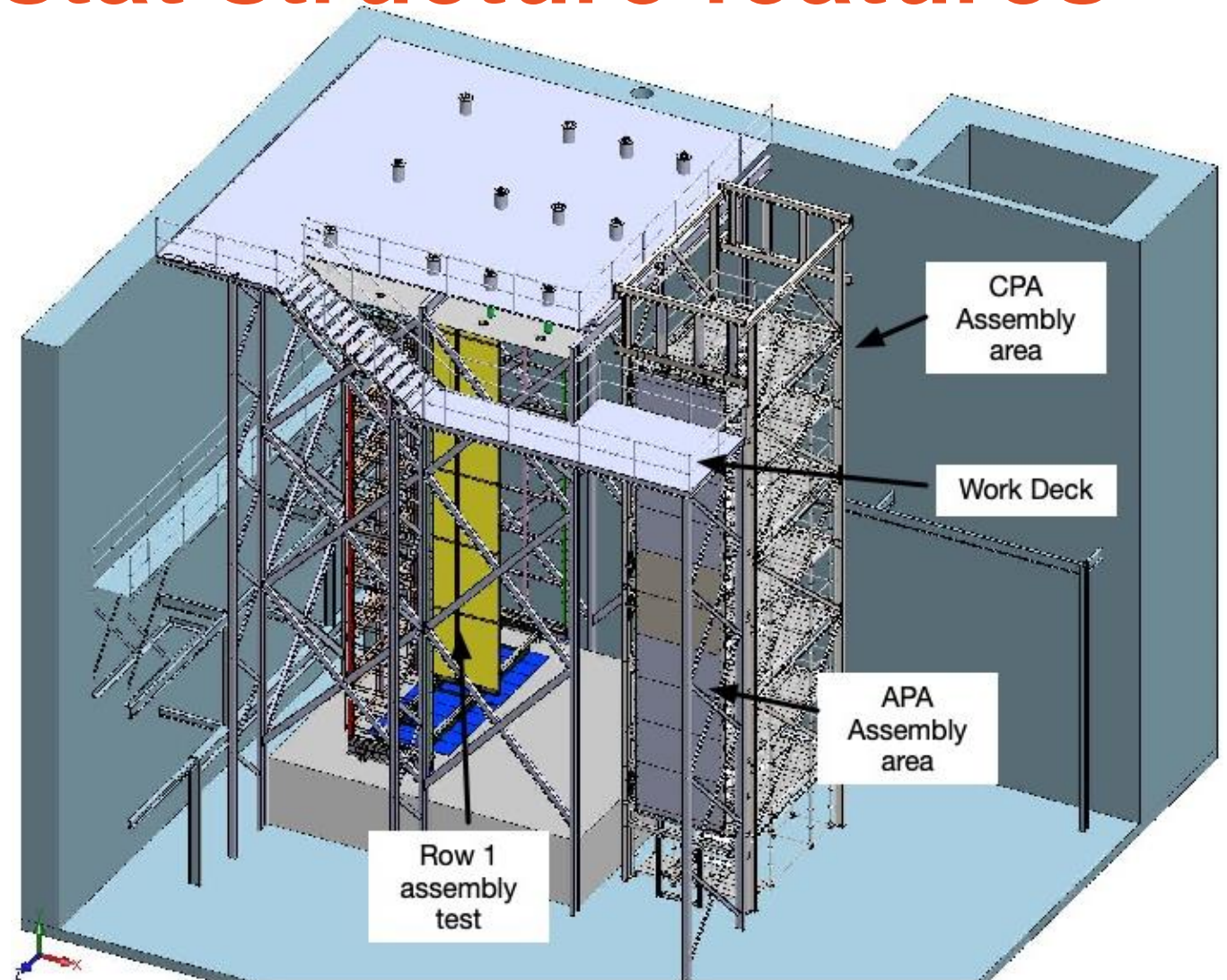
- Including trolleys, and removable runway beams identical to DUNE
- **DSS steel come from CERN?** It is made in Switzerland,
- **Current plan is to put the stainless steel and trolleys on a separate bid package since details are not completed yet.**



# DSS support/cryostat structure features

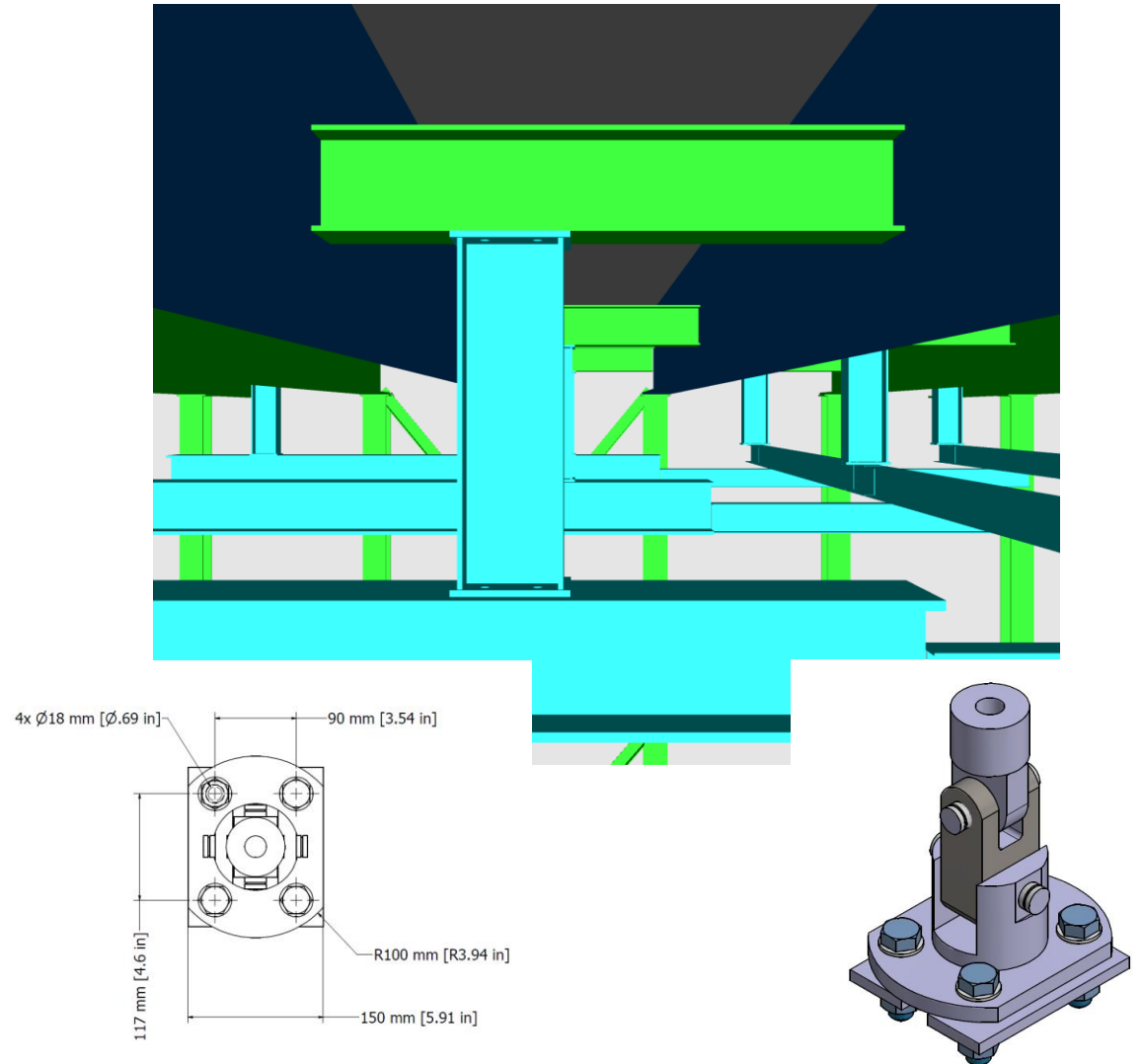
I have not been able to get models combined yet, so this is original concept snapshot

- This will allow us to build row 1 and row 25 the most difficult one
- The dimensions are identical to the inside of the cryostat, we will mock-up cryostat walls, cryogenic plumbing everything that will be in our way!
- We will build the false floor and test how it works including driving scissor lifts on it.



# DSS support/cryostat structure features

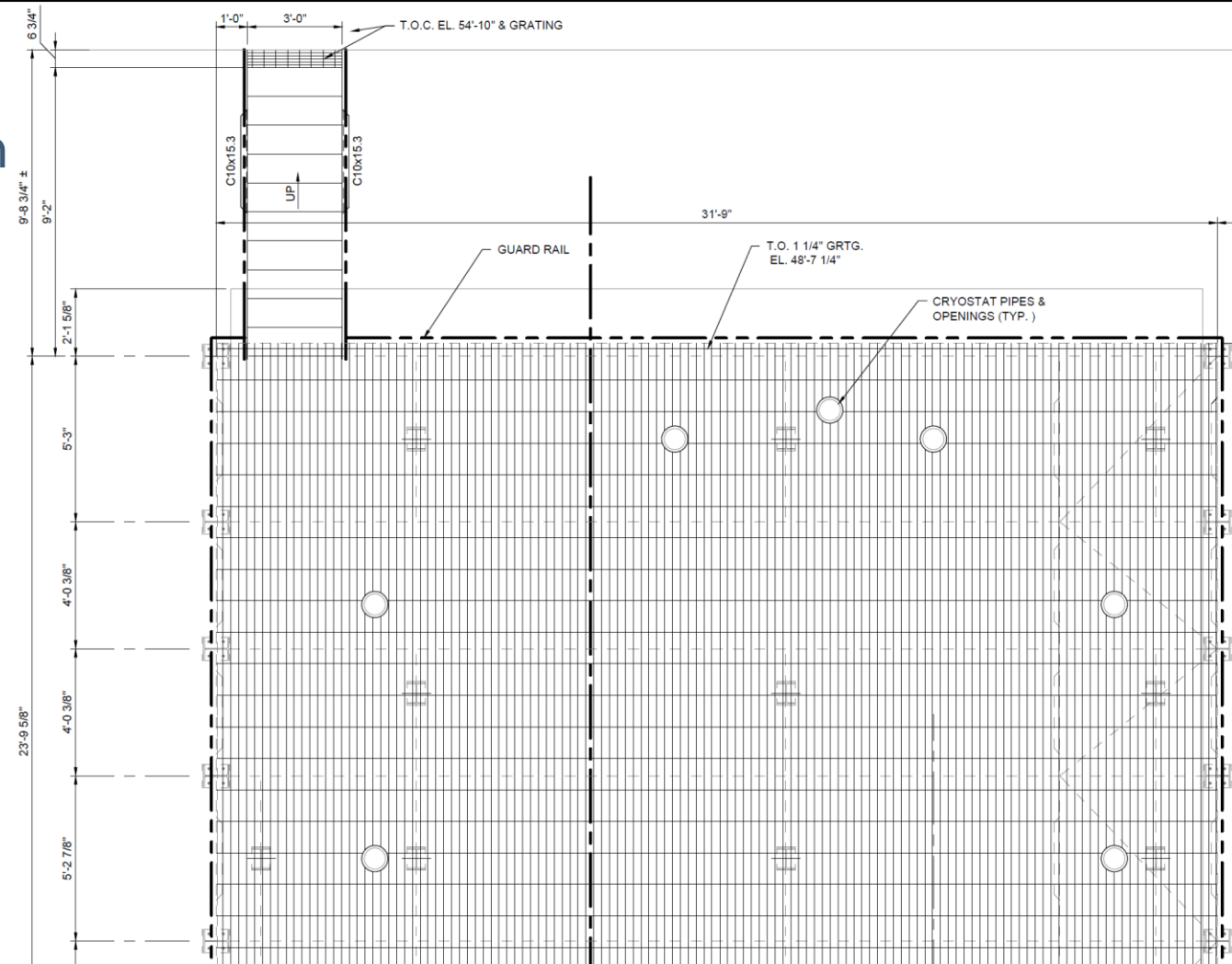
- Design of DSS support is such if it is decided a full feed-thru needs to be tested the green horizontal beam and the short vertical column can be removed
- Appropriate support can be added to allow new support for DSS feed-thru and flange can be added
- The hole pattern on the top of the Stainless Steel DSS beams matches the proposed hole pattern on the DSS support
- This would include Dual Phase if needed





# DSS support/cryostat structure features

- The layout of the support columns and beams has been done to ensure that ANY feed-thru penetration at DUNE can be added when needed.
- We plan on installing a mock-up of all cryogenic plumbing or monitoring equipment that will be in our way from the bottom side.
- We will also add sections of cryostat walls and ceilings where appropriate to again make access more realistic
- If/when we do a phase 3, we will add the appropriate cable feed thru's



# Continued progress with Phase 1 tests



**Test new bottom APA installation concept using slings and spreader bar and trolleys**



**New handrails – better access to APA**

**Week of 30 Sept. APA doublet workshop at Ash River**

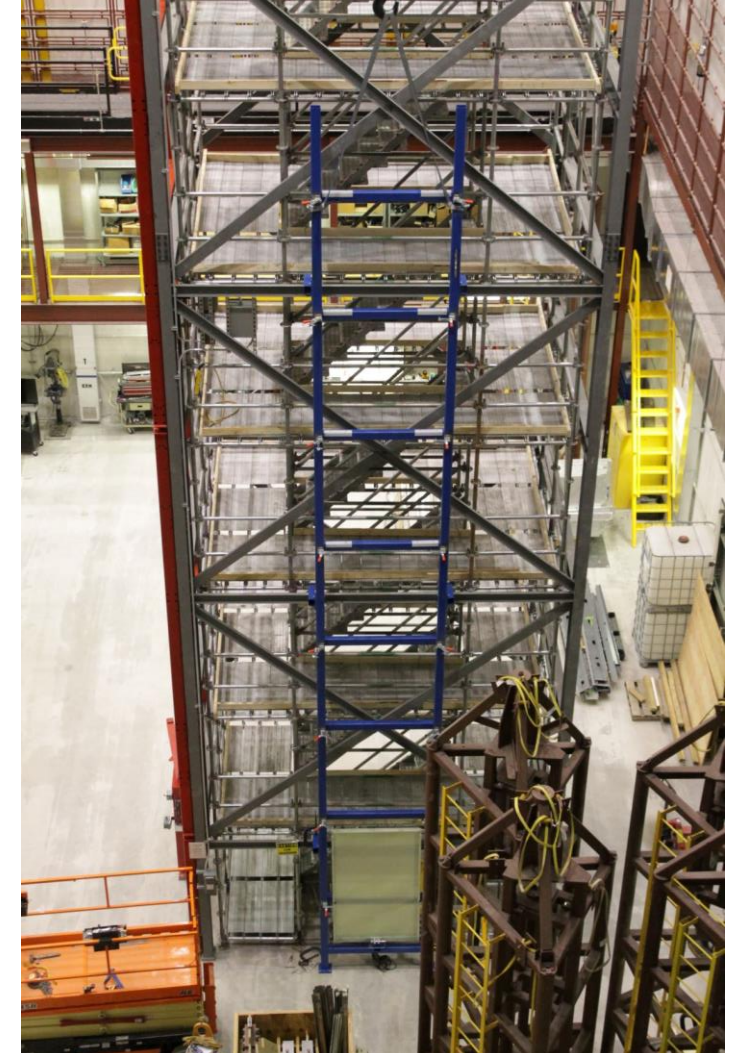
Demonstrate procedures to DUNE ES&H, UMD ES&H and QA teams, review documentation

**Received Occupational Readiness Clearance from UMN**



# CPA Assembly Frame is installed

- The CPA assembly Frame has been installed and is basically ready for use
- We need to write update the installation documents, HA's and include all the engineering notes on the CPAs and post on EDMS in the Trial Assembly area
- Current plan is to use module 0 CPA panels (full field shaping strips) so we can fully test both installation and QA/QC using the inventory system being developed at the University of Minnesota





# Second PD cable installation tests

- Dave Warner(CSU) and Kyle Keug(PSL) visited Ash River December 18<sup>th</sup>-19<sup>th</sup> to test the improved version of the bulkhead connection and cable routing
- A more compact connector layout with an additional cable for temperature sensors was added.
- Kyle installed a new version of the APA alignment pins to insure we have the proper alignment as the two APAs come together.
- Both were very successful



# Lessons learned from Phase 1

This is list of comments and suggestions from the September workshop:

- Need to order another set of slotted tubes to do PD installation tests in ~April, should confirm they are lower ones with drawing sets.
- Need to update design of strain relief on top APA, test first at BNL during tests there and confirm at Ash River this summer
- Dan made minor modifications to actuator to help stabilize it, could use a few more tweaks
- **Completed new PD cable tests and alignment pins**
- Need to improve design of protection panels for APA. Particularly the heavy C-Channels are difficult to install. These were left over's from ProtoDUNE and not designed for the new APAs. Needs further testing
- **Ordered cable reel roller and successfully tested**
- Need to try  $\frac{3}{4}$ " and 1" cable mesh on bundle when split into two bundles, this will be tested at BNL
- The bolt for the latch cannot be installed or removed after the unistrut cable tray support is installed. It will be investigated if the nut on the latch pin can be eliminated-BNL

# Lessons learned from Phase 1

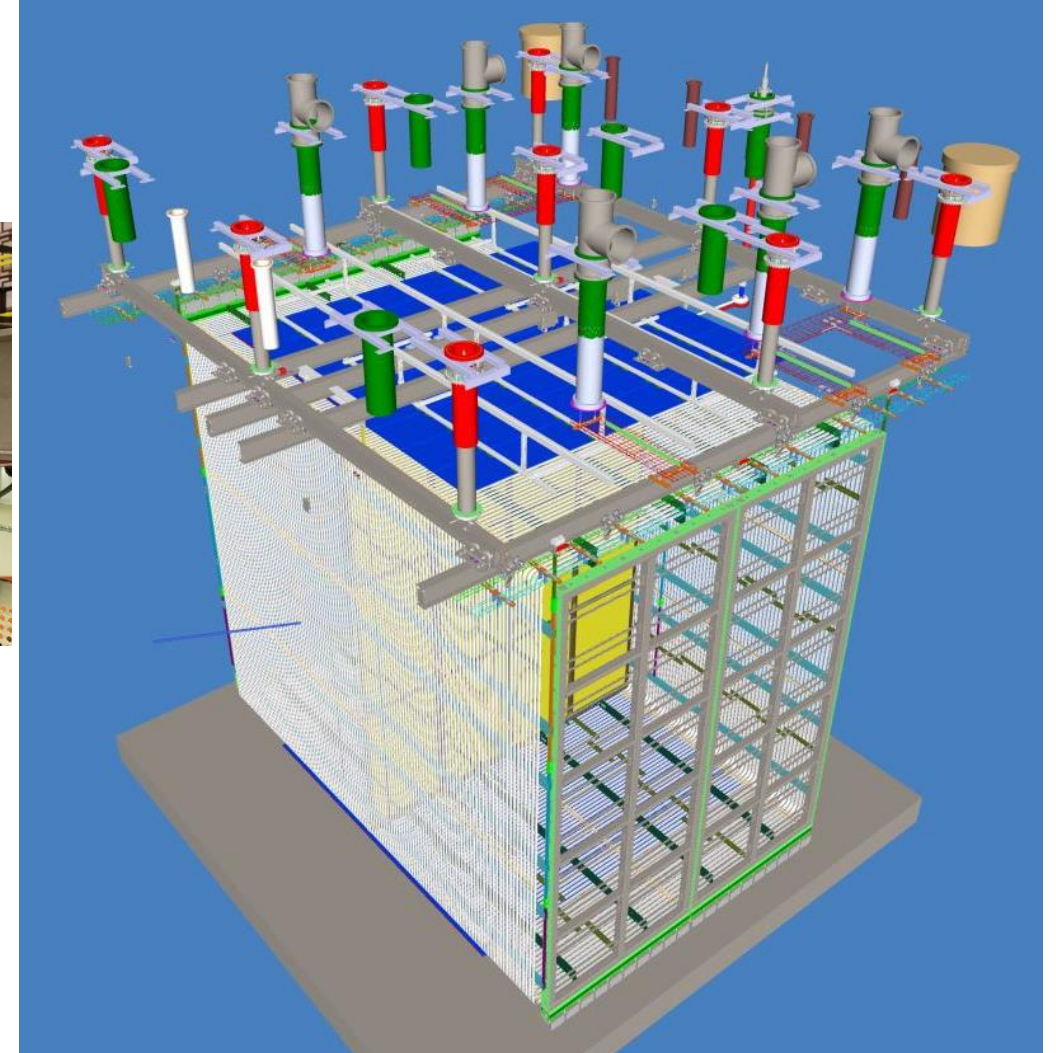
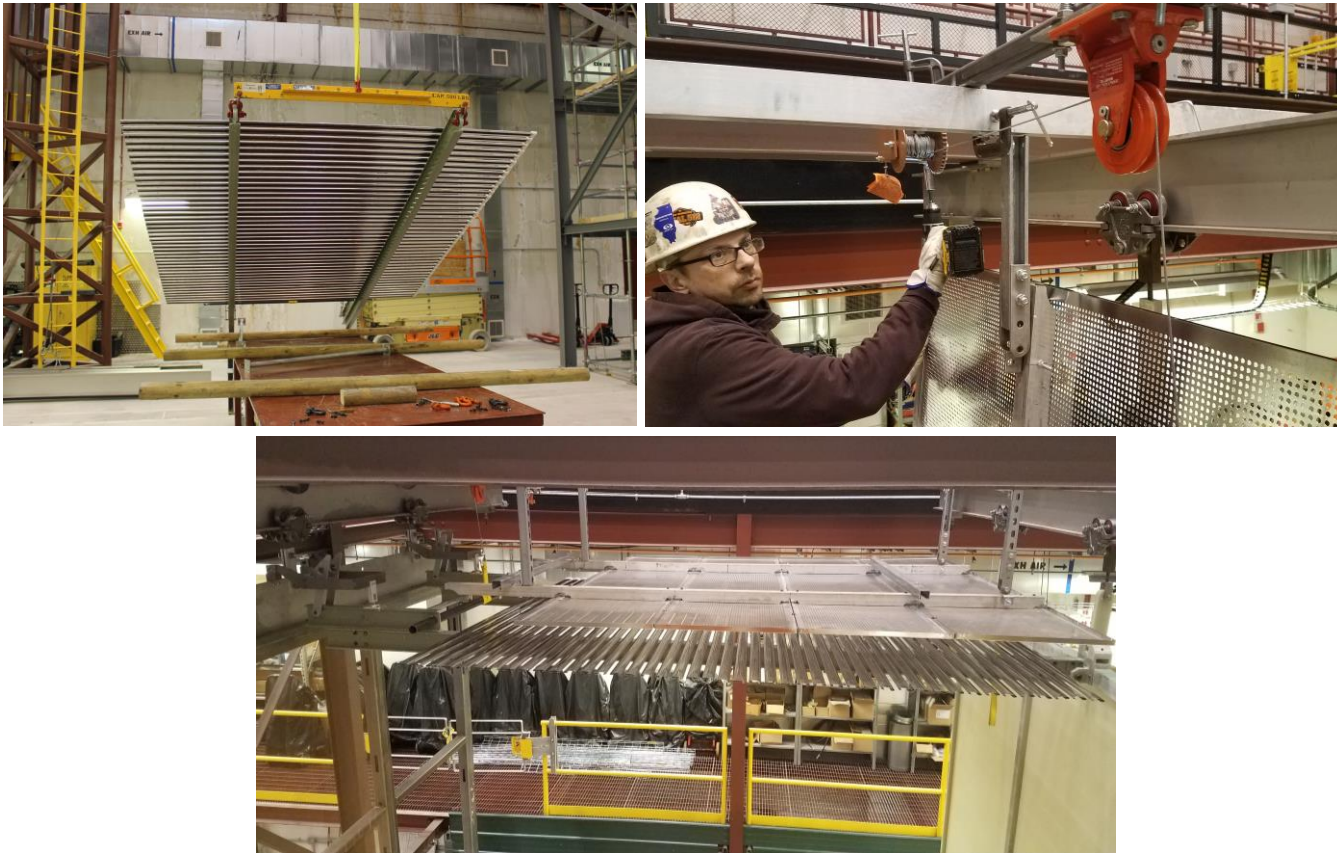
- The new lower APA cable assembly was fed through the conduit. The new assembly has a break in the mesh where the extra length is collected. This needs protected as it goes over the sheave. A strap should be integrated in the cable assembly to support the loose cable section during installation.
- GOOD Radio headsets should be tested for better communication.
- **We added 4" steel tube to the top of the tower to minimize movement of the segmented beam.**
- **Tested lifting lower APA with straps to eliminate the use of a second hoist on the tower. Basically worked well but a turn buckle adjustment needs to be added**
- Modify the existing lifting beam to lift allow for a doublet to be transported. This needs a new engineer note from PSL to allow us to complete this task. Hardware is on hand.
- Modifications to the trolley design were completed by Argonne and a new set sent to BNL. Since that time CERN has designed a new trolley which needs tested at Ash River



# ProtoDUNE-II Trial Assembly

# ProtoDUNE-II Trial Assembly

- We have already been testing the model -1 version of the FC and ground plane at Ash River for ~6 months





# ProtoDUNE-II Trial Assembly- What to do?

- Using the top and bottom APA we have at Ash River we could build  $\frac{1}{2}$  of the ProtoDUNE detector
  - HV will have two end walls and 2 pairs of top and bottom field cages
- BUT this will require a new lifting fixture/yoke/connection for the bottom APA to be rolled onto the trial assembly structure. BUT this is an important test to see how the new latches work.
- We can do the top APA right away and wait on the bottom one if the new yoke is not available.



**ProtoDUNE Trial Assembly**



# ProtoDUNE-II Trial Assembly

**There are a lot of new components needed, most of the HV ones will be made with used extrusions but new frames**

## **We need to define the scope**

**What needs to be tested:**

New HV components including a minimum of:

- One pair Top and Bottom Ground Plane
- One end wall
- One upside down APA

With the it includes all new:

- Lifting fixtures and deployment tools
- New FC latches
- New yoke/trolley system for upside down APA
- New cable trays going to new feed-thru locations, new cables
- New interface brackets between End Wall and APA and End Wall and CPA
- ???

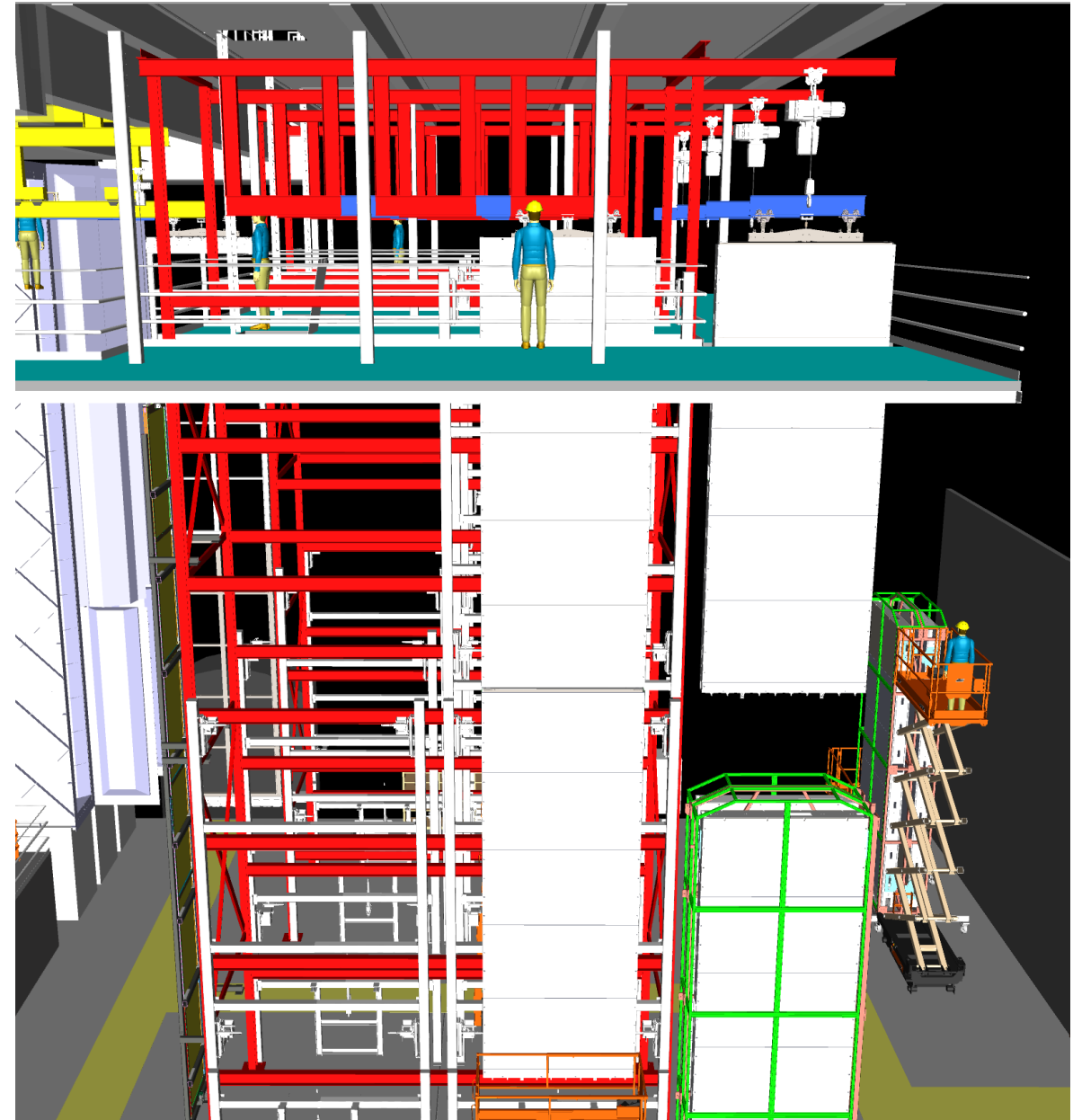
# Action Items and Backup Slides

# ID-81934

## Rigging Hours

**All rigging** done in both the cleanroom and cryostat will be done by trained I&I core technicians-Not the rigger operators that bring equipment into the cavern.

- Most operations are simple, raise APA with a hoist, use a power pallet jack, small forklift, moving TPC components from APA tower to cold box or cryostat, winches for FC deployment.
- All core technicians will be training and certified in the specific equipment
- Typically these “rigging” tasks take 10’s of minutes and would use crews of 2-3 FTE depending on the task. But they assist in the prep work, cover removal, removal of shipping containers, etc.



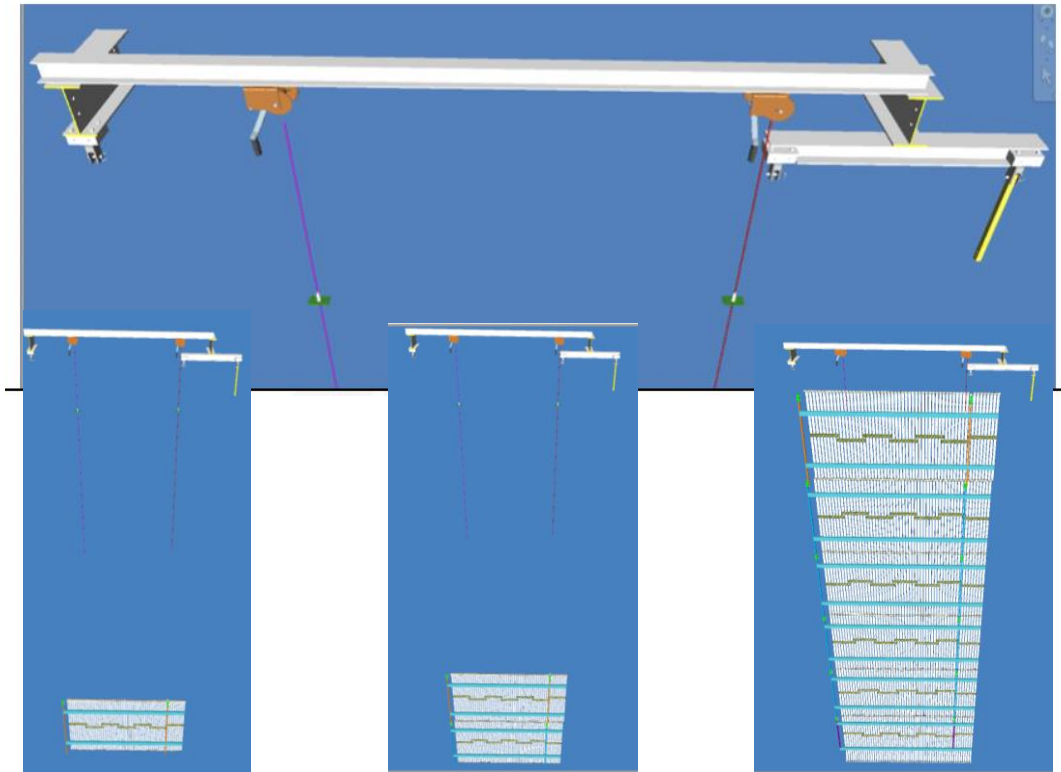


									Week 1															
									Day 1				Day 2				Day 3				Day 4			
Labor Force									Shift 1		Shift 2		Shift 1		Shift 2		Shift 1		Shift 2		Shift 1		Shift 2	
Task									6:00	11:00	17:00	22:00	6:00	11:00	17:00	22:00	6:00	11:00	17:00	22:00	6:00	11:00	17:00	22:00
		APA	CE	PD	HV	Surv		Location																
Line # 1																								
1	Move APA Bottom and top to APA Assembly frame	2						line#1	2															
							3		3															
2	Connect PD Cables, test, connect linkage test and form APA doublet	2						line#1		2														
							3			3														
3	APA wire tension, Install CR Boards, install bias voltage Hareness	4						line#1			4	4	4	4										
4	Install CE FEBMs top and bottom APA		4					line#1							4	4	4	4						
5	Move APA Doublet to cabling station and install cable trays		4																4					
6	Install top and bottom CE cables		4					line#1												4				
7	CE Cable management/PD Cable		4					line#1													4			
8	Test electronics warm +Bias test/PD test		4					line#1													4	4		
9	Remove Protective panels move to front of Cold Box	3						line#1															3	
							3																3	
10	Photogrammetry/survey	1						line#1	1	1														
							2		2	2														
11	Move to cold box and cable		2					Cold Box #1			2	2												
							2				2	2												
12	Warm check APA and close box		2					Cold Box #1					2	2	2	2								
13	Cool down Cold Box		2					Cold Box #1									2	2	2	2				
14	Cold test Cold Box		2					Cold Box #1													2	2	2	2
15	Warm up Cold Box		2					Cold Box #1																
16	Move out of cold box and uncable, move to switchyard		2					Cold Box #1	2	2														
							2		2	2														

# ID-81939

## Procedures-End Wall

- These procedures will be confirmed during the Ash River Trial Assembly for both ProtoDUNE-II and DUNE
- First End Wall section was constructed at LSU 2 weeks ago
- Basic concept is the same for ProtoDUNE, the top section is lifted, and the next section is bolted on
- Major difference is that End Walls are constructed underground, starting ~2 months before the cleanroom infrastructure is completed
- The more difficult EW is the last one where workspace is greatly reduced.



# ID-81922 - Cleaning the Cryostat

- We are assuming that we start with a clean cryostat and an installed floor
- Once a row of APAs is in place we can no longer to the side walls.
- Our plan is to clean an area of the walls BEFORE the APAs go into place. This process will be repeated before each new row is started.
- During the deployment stage of the detector installation as the floor is removed it is HEPA vacuumed and alcohol wiped while access is available

## For this to work:

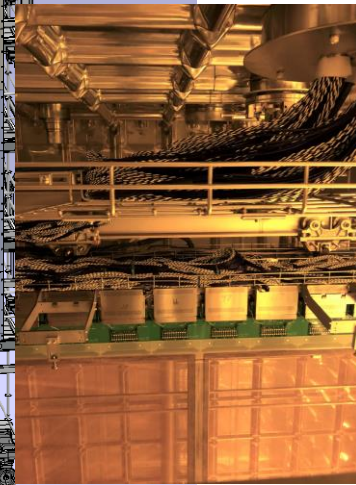
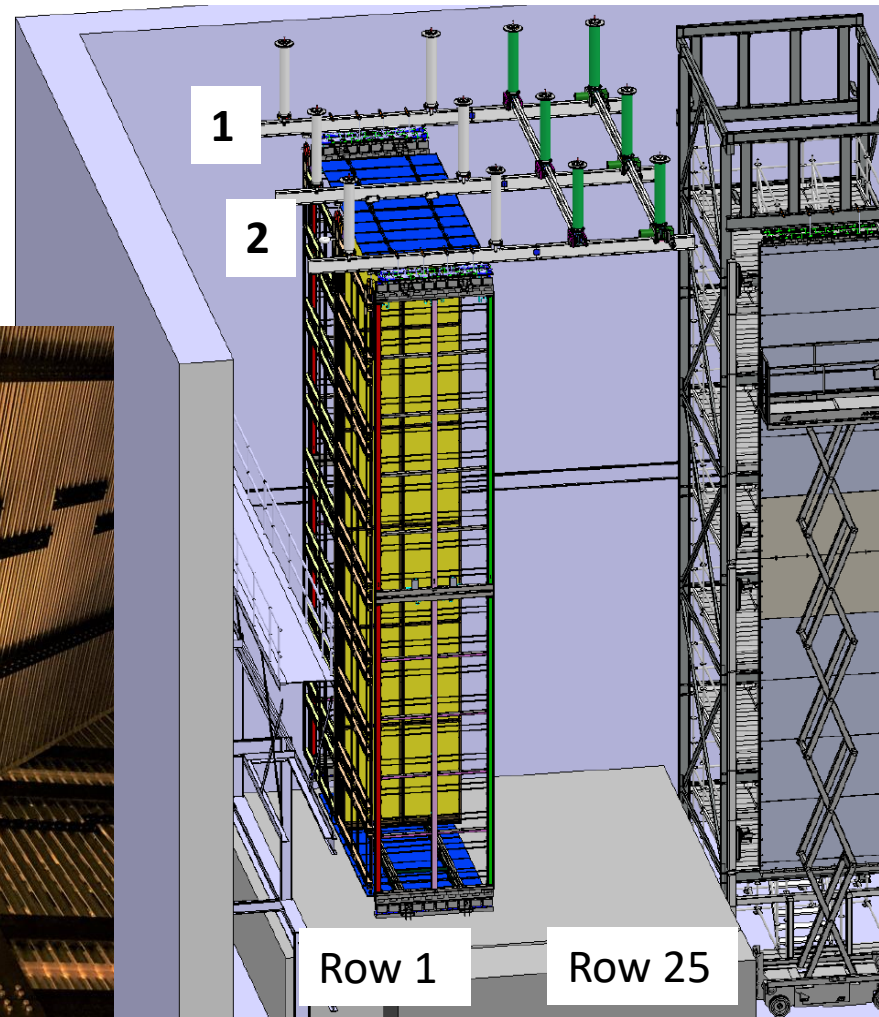
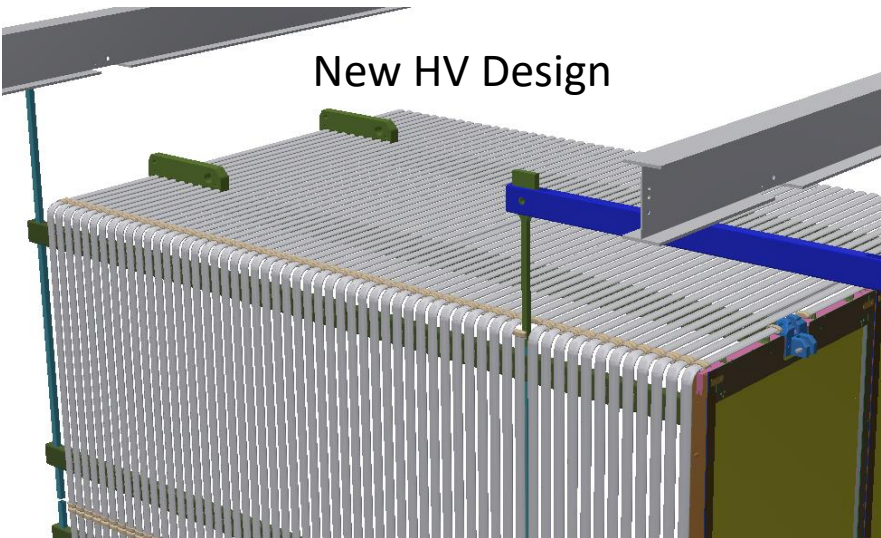
- It is critical that the ventilation system for the cryostat is designed properly, clean air flows thru the cryostat into the cleanroom
- Stand-alone HEPA recirculation system will reduce the partial count in both the cryostat and cleanroom to get it down to ISO-8 standards.
- ALL staff and equipment entering the cleanroom will required to follow the procedures in place to minimize the contamination



# Phase 2 TPC Component Deliverables

- End Walls, Field cages, ground plane designs have all changed and require full testing if possible

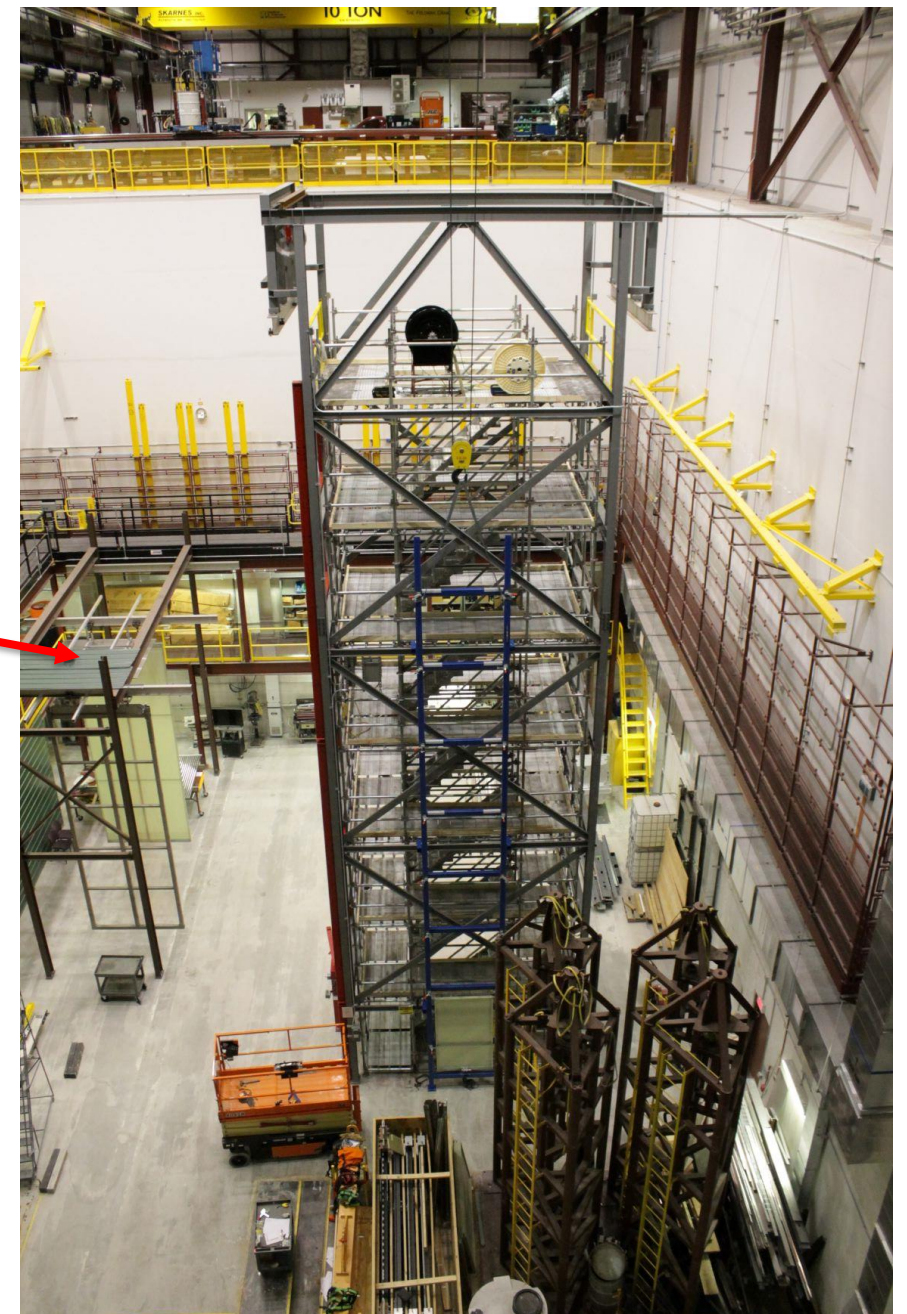
New HV Design





# Ash River-University of MN

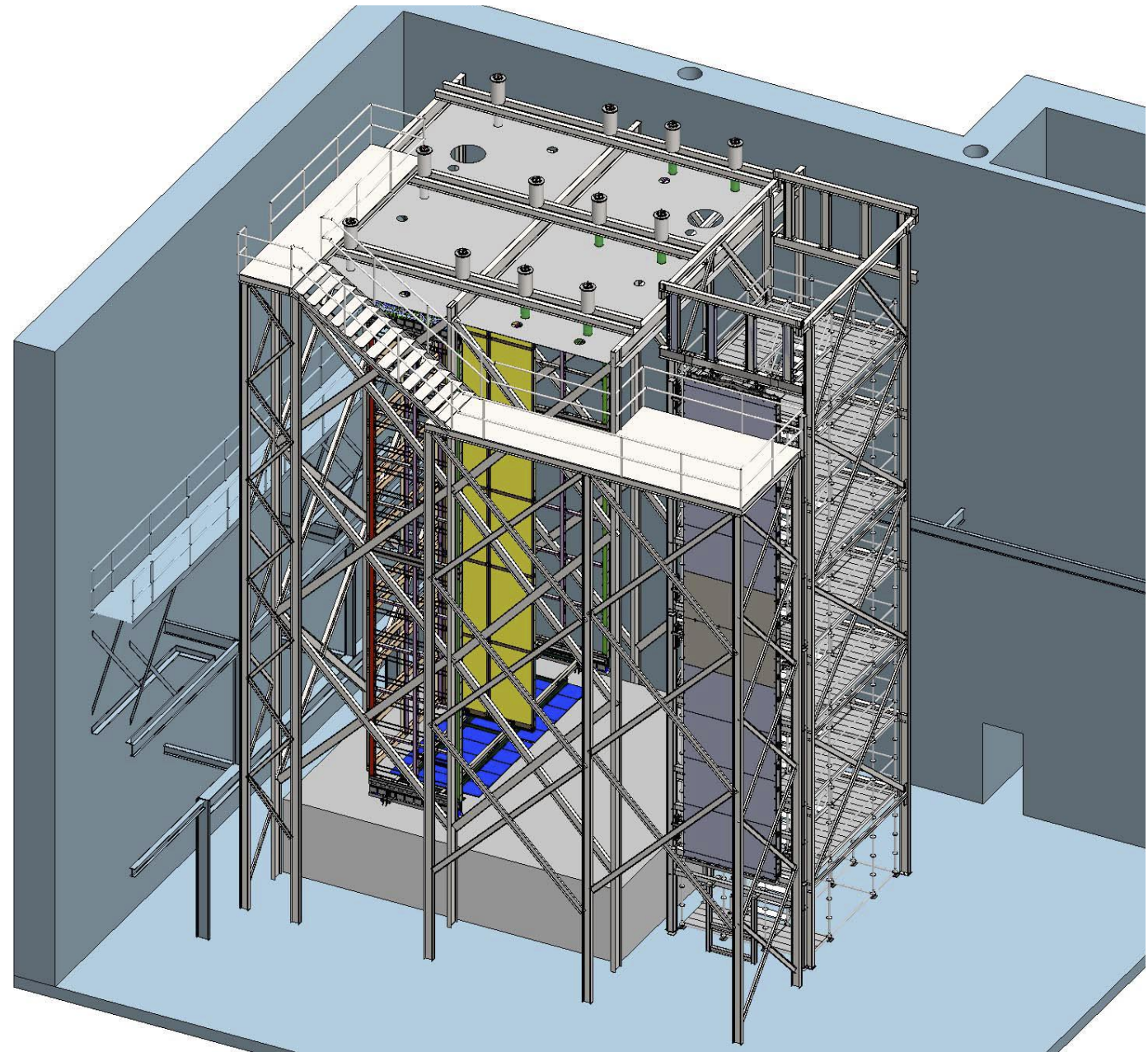
- What we have now:
- Long winters but a nice place to work!
- Constructed APA and CPA Assembly tower
- ProtoDUNE Trial Assembly structure
- Two 10-ton cranes
- Access equipment-40 & 26 ft scissor lifts, 60 ft boom lift, numerous size work platforms and ladders
- Forklift, motorized pallet jack, pallet jacks
- Machine shop, hand tools, welders, and people that know how to use them
- Loading dock area for deliveries
- Office and meeting space for small work shops



# Ash River

## What we need :

- Completed Cryostat and APA Assembly work platform
- Documentation and approvals for new structure from DUNE and UMN-This is a large job
- Updated Installation procedures and HA documents for phase 2- This is also a very large job

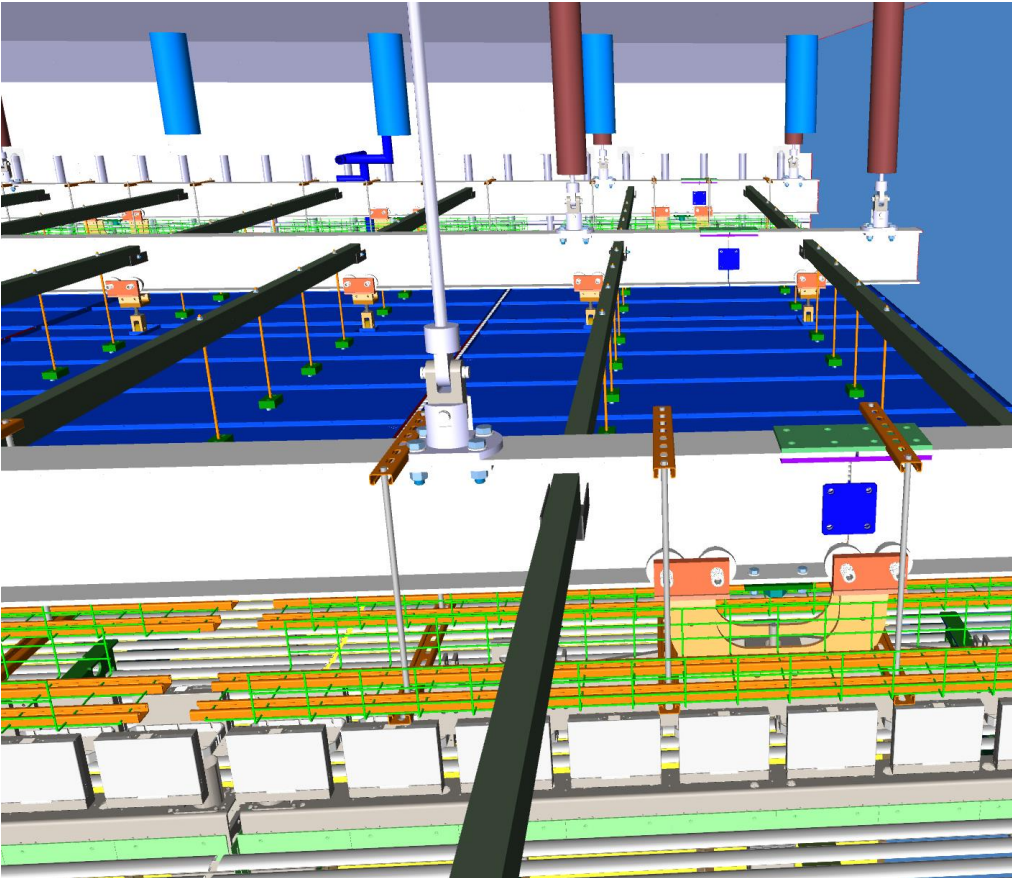




# Deliverables DSS - CERN

## What we have now:

- 3-D drawings



## What we need:

- Model of Shuttle beam trolleys so they can be added to our model
  - Drawings, specifications, engineer reports, etc. so they can be built
- Model of APA trolleys so they can be added to our model
  - Drawings, specifications, engineer reports, etc. so they can be built
- New DSS and shuttle beam design so they can be put out for bids.
- Design of the Ground Plane support

# Deliverables APA Consortia

What we have now:

- Operational APA Assembly frame and actuator
- Two APA frames
- Two upper slot conduits
- Yoke and hardware
- APA linkage
- Single APA lifting fixture



# Deliverables APA Consortia

## What we need :

- Design and engineering report for lower APA lifting fixture
- New engineering report and update drawing for APA Doublet lifting fixture (we will do a new load test)
- 2 additional slotted conduits
- APA hanger support
- New C-Channel and APA Protection panels for both top and bottom APA
- APA shipping Frame with ALL the features discussed. Including outside protection panels, and all required documentation and approval to use it
- **Can we use two APAs from ProtoDUNE to make the second Doublet for the tests at Ash River? Use the new shipping frame to send them from CERN to Sanford Lab, ride underground and then back to Ash River.**



# Deliverables PD Consortia

## What we have now:

- Some PD rails and misc. hardware

## What we need:

- New set of cables and bulkhead to be installed between APA including ones that go from the Top APA to feed-thru
- Some small number of dummy PDs to practice the installation process
- New cables so QC test can happen during the installation process.
- Installation tooling required to put them in place

# Deliverables HV Consortia

## What we have now:

- Operational CPA assembly tower
- Some number of extrusions left over from ProtoDUNE. I do not know if this is enough for both ProtoDUNE-II and DUNE trial assembly
- Some HV equipment that will be left over from ProtoDUNE-II trial assembly, not clear what can be used in DUNE.

**The HV consortia has taken over the design of many of the critical interface features that align and support the TPC:**

**FC latches on top and bottom APA, mechanical connection between End Wall and APA, End Wall and CPA, End Wall hangers, CPA hangers (?) Ground plane and DSS (may go to DSS)**

## What we need:

- Two pairs of module 0 top and bottom FCs with latches, lift points and hinges to connect to CPA panel. This includes the installation frame for assembling the FC components.
- Module 0 End Wall two full end wall sections including so we can test “dual deployment” to End Wall hanger.
- Including End Wall assembly frame/table
- CPA panels including the field shaping strips. They would not have to have resistive panels unless we wanted to do full QA/QC tests.

# Deliverables HV Consortia

## What we need:

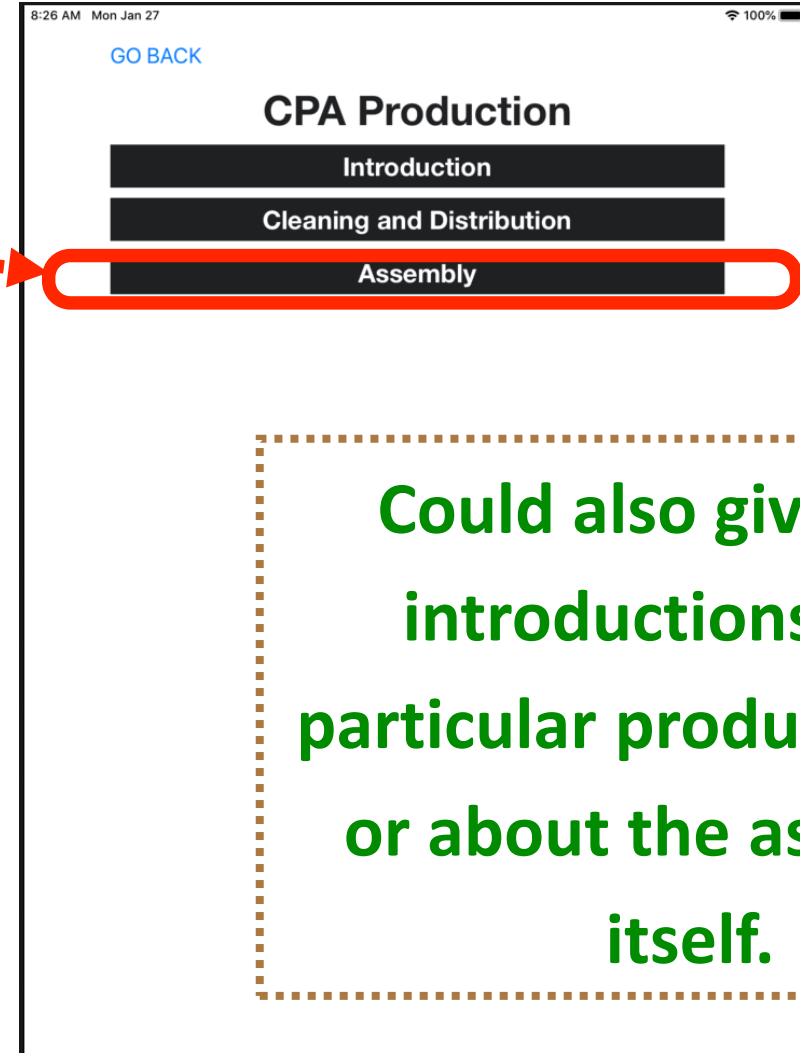
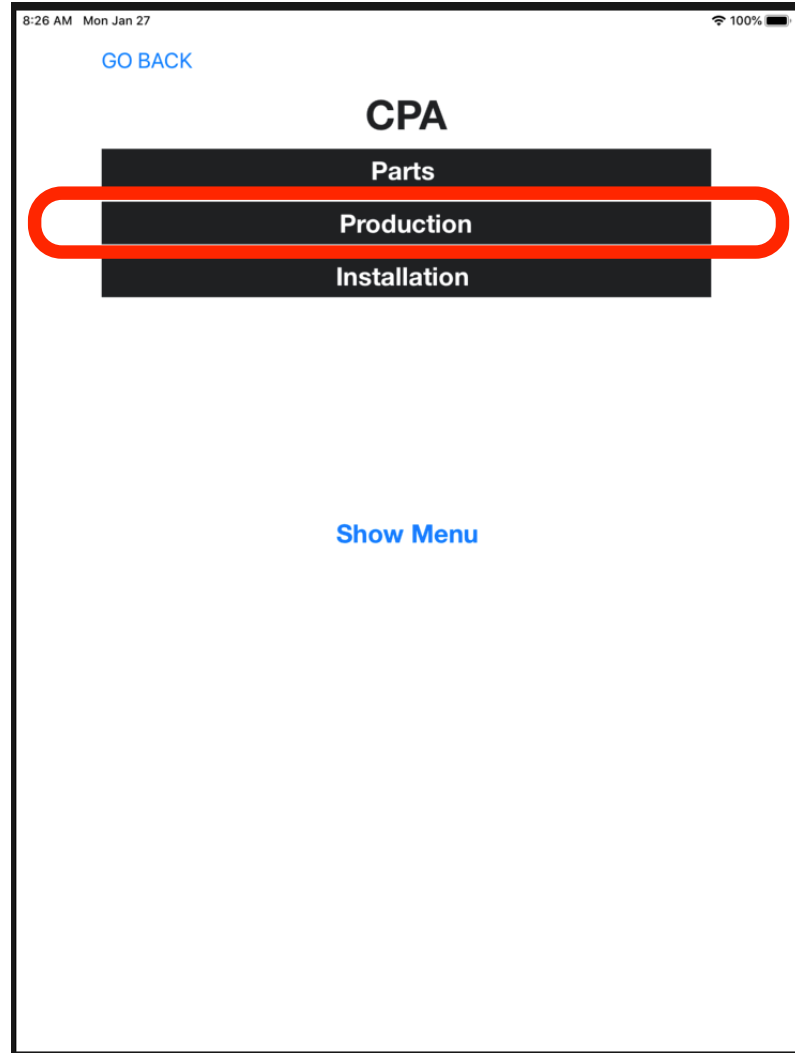
- Lifting fixtures for all components with engineering notes, They can be load tested at Ash River if needed.
- Field Cage deployment hardware including documentation
- Do we include electrical connections and tests? It would be helpful for time and motion studies.
- End Wall hangers
- Tie-rods to hold/adjust alignment of bottom APA and bottom FC

## What we need:

- We have no clips for old AI extrusions
- Proper size ground plane panels and connection to DSS support system
- QC documentation is in good shape with Steve working with Hajime on software. We should try and use the inventory system-See next few pages

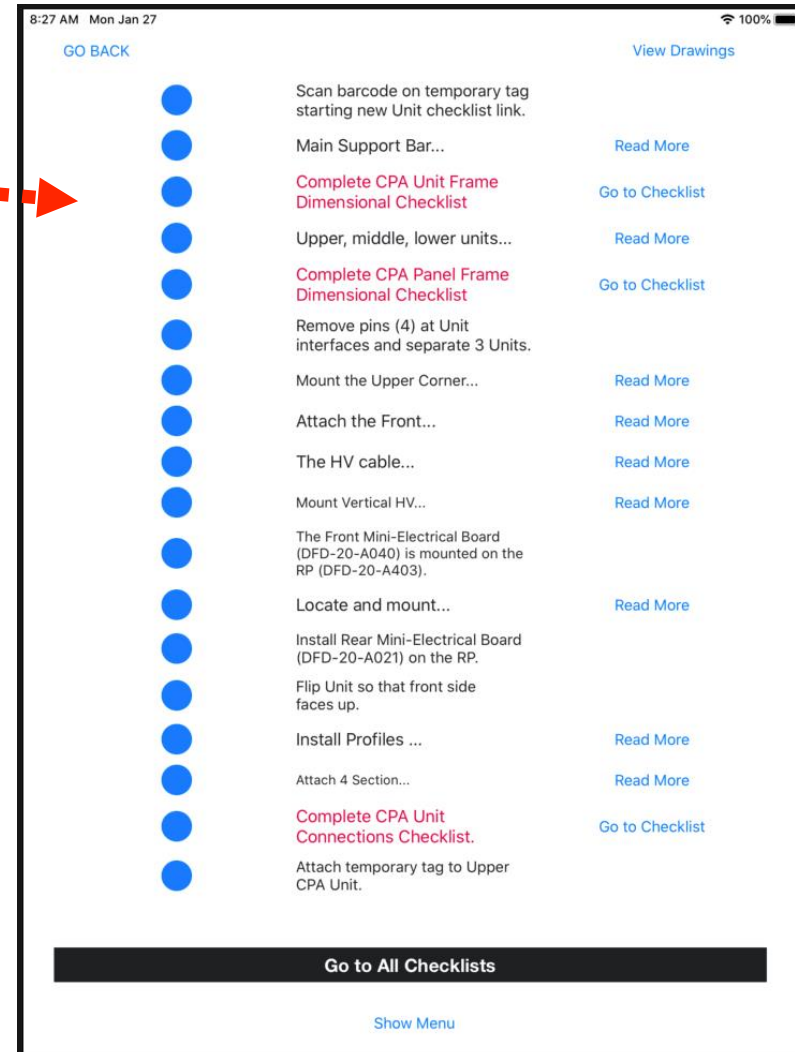
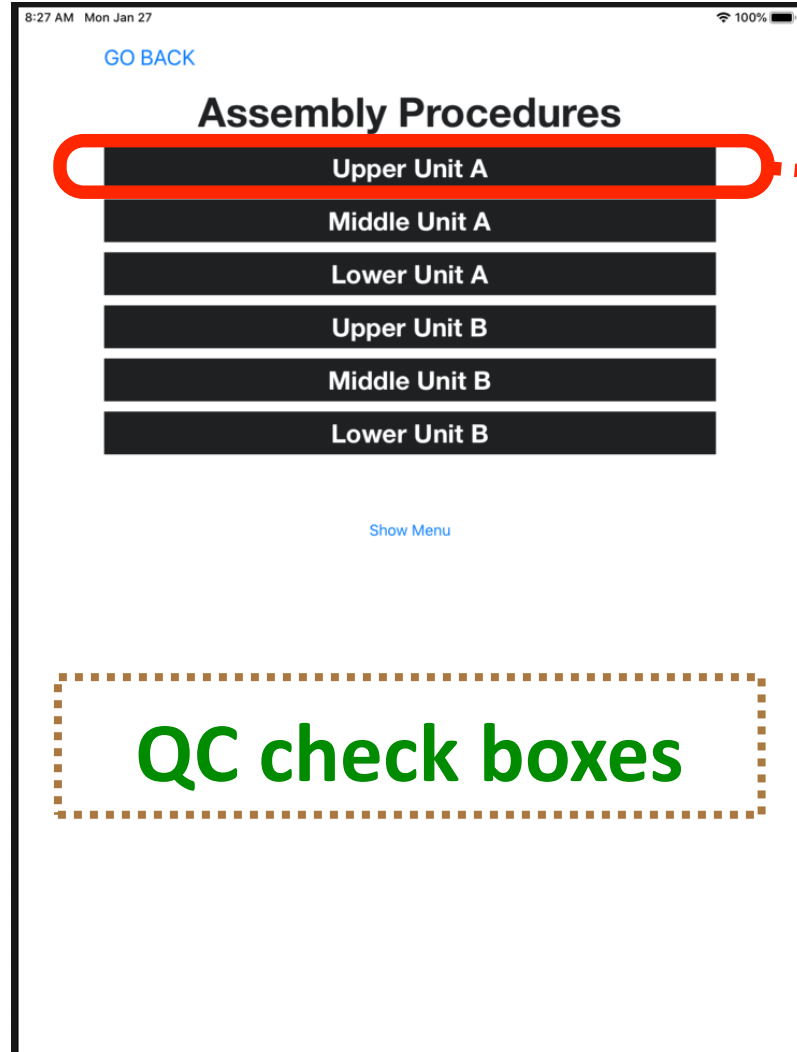


# QA/QC and inventory for HV system



Could also give brief introductions for a particular production site or about the assembly itself.

# QA/QC and inventory for HV system



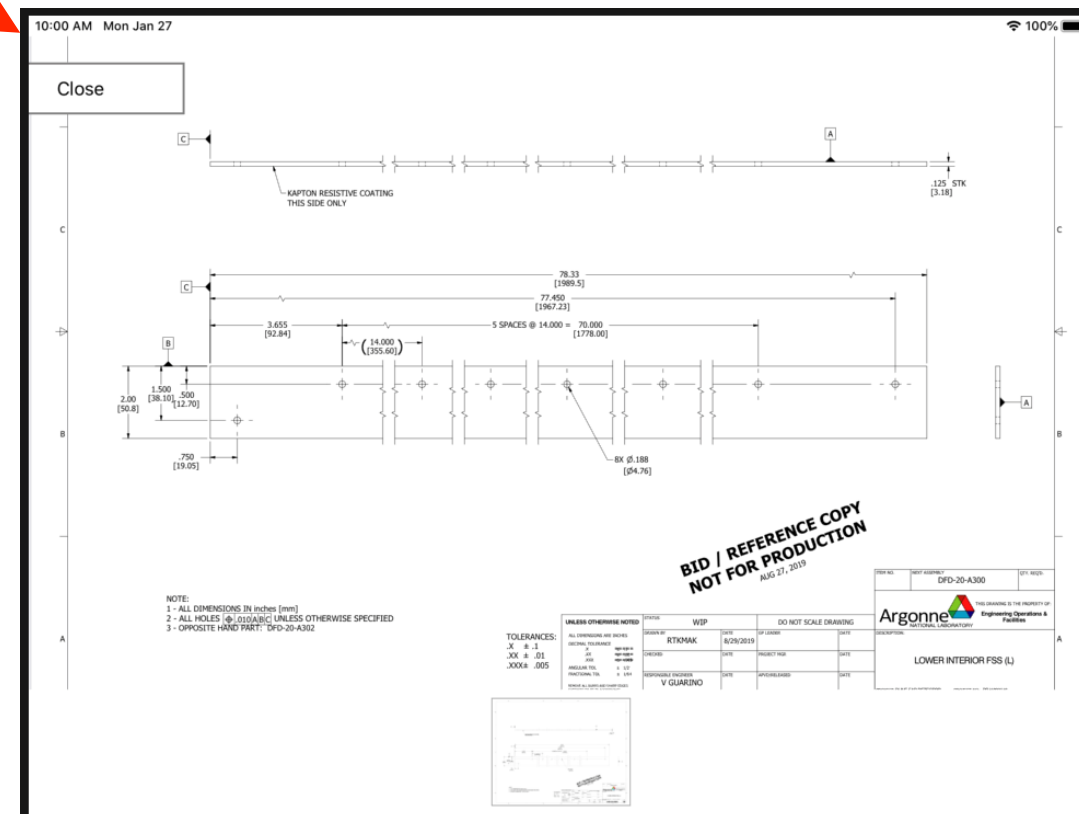
Attach temporary tag to Upper.

[Read More](#)

(DFD-20-A402), Upper Side Bars (DFD-20-A404, DFD-20-406A) and Intermediate Bar (DFD-20-A405) of the top module are arranged with the RP (DFD-20-A403) in the slot and are bolted together as shown in drawing DFD-20-A100. Then, on

[Go to Checklist](#)

# QA/QC and inventory for HV system



**The corresponding pinch-able drawing(s) can pop up.**



# QA/QC and inventory for HV system

8:27 AM Mon Jan 27 100%

GO BACK View Drawings

- Scan barcode on temporary tag starting new Unit checklist link.
- Main Support Bar... [Read More](#)
- Complete CPA Unit Frame Dimensional Checklist** [Go to Checklist](#)
- Upper, middle, lower units... [Read More](#)
- Complete CPA Panel Frame Dimensional Checklist** [Go to Checklist](#)
- Remove pins (4) at Unit interfaces and separate 3 Units.
- Mount the Upper Corner... [Read More](#)
- Attach the Front... [Read More](#)
- The HV cable... [Read More](#)
- Mount Vertical HV... [Read More](#)
- The Front Mini-Electrical Board (DFD-20-A040) is mounted on the RP (DFD-20-A403).
- Locate and mount... [Read More](#)
- Install Rear Mini-Electrical Board (DFD-20-A021) on the RP.
- Flip Unit so that front side faces up.
- Install Profiles ... [Read More](#)
- Attach 4 Section... [Read More](#)
- Complete CPA Unit Connections Checklist.** [Go to Checklist](#)
- Attach temporary tag to Upper CPA Unit.

[Go to All Checklists](#)

[Show Menu](#)

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Cancel

### CPA Unit Connections Checklist

CPA Panel Type (A, B, C):

CPA Unit Type (UM, MM, ML):

Name:

Date:

[Enter](#)

[Show Menu](#)

8:36 AM Mon Jan 27 100%

Done < > AA dbweb5.fnal.gov

**DUNE** protoDune Hardware Database

Home Permission Mgr Admin Mgr Log out

Permission can\_insert on bars for user None denied

Forgot username  
Forgot password  
Request access

Username:

Password:

Login

This is DEVELOPMENT version of Single Phase PDUNE Hardware Database.

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Cancel

Name	Drawing #	Connections designati...	Continuity	Resistance(MOhms)
Bus				
Input place to Top (A)/RH (C) Tab (UM)	DFD-20-	✓	✓	--
Input wire to Top LH (B)	DFD-20-	✓	✓	--
LH Tab to Top RH (UM)	DFD-20-	✓	✓	--
LH Tab to Top RH (UM)	DFD-20-	✓	✗	--
module Tab to tom module Tab (MM,ML)	DFD-20-	✓	✓	--
LH Tab to Bottom Tab - Bottom (MM,ML)	DFD-20-	✓	✓	--
tom LH Tab to tom RH Tab (ML)	DFD-20-	✗	✓	--
Profiles				
to vertical LH, RH	DFD-20-	✓	✓	--
tical to vertical RH	DFD-20-	✓	✓	--
Vertical to horiz. RH	DFD-20-	✓	✓	--
Vertical to horiz. RH	DFD-20-	✓	✓	--
Resistor Boards				
Front (A,B,C)(UM)	DFD-20-040	✓	✓	✓
Rear (A,B,C)(UM)	DFD-20-021	✓	✓	✓
tom Front (A,B,C)	DFD-20-040	✓	✓	✓
tom Rear (A,B,C)(ML)	DFD-20-021	✓	✓	✓
RP (UM,MM,ML)	DFD-20-(A,B,C)100	✓	✓	✓

wing # - add Panel type to drawing # (A, B, or C).

Bus - using digital meter, check connection continuity.

Profile - using digital meter, measure connection continuity of FSS-FSS and FSS-Profile.

Resistor Boards - using Megger, measure resistance of boards on CPA.

RP Continuity - using digital meter, measure connection continuity between resistive panels.

[Show Menu](#)

The final QC check list to be uploaded to the hardware DB.

# Schedule & NOvA Resources Conflicts

- We can't do the APA Shipping Box test with the ProtoDUNE-II support structure in place, while we will not get rid of it would take a ~week to take down and put back up. It would be much more efficient to complete at least the first pass set of tests.
- If the installation of the DUNE Trail Assembly structure slips a ~month it would be adventitious to have that additional floor space for laydown area. I plan to put in the bid documents that the contractor could remove it and put it back up.
- Most of any future ProtoDUNE-II could be done on the DUNE Trial Assembly structure
- Delays in the Phase 2 work may cause conflicts with the available NOvA staff for ProtoDUNE-II if we are attempting to do both at the same time.
- Future work shops at Ash River
  - Remember that Ash River is a tourist area and local housing becomes more problematic during the summer. Larger workshops (10-20 people) should be scheduled in late September/October or late April/May when housing and restaurants are easily available.

