Introduction

Sebastien Murphy, Marco Zito

Dual phase far detector meeting

November 30th 2015

Outline

- Where are we in the DUNE structure?
- Overall task of the group
- Work package structure
- Meetings
- Goal of today meeting

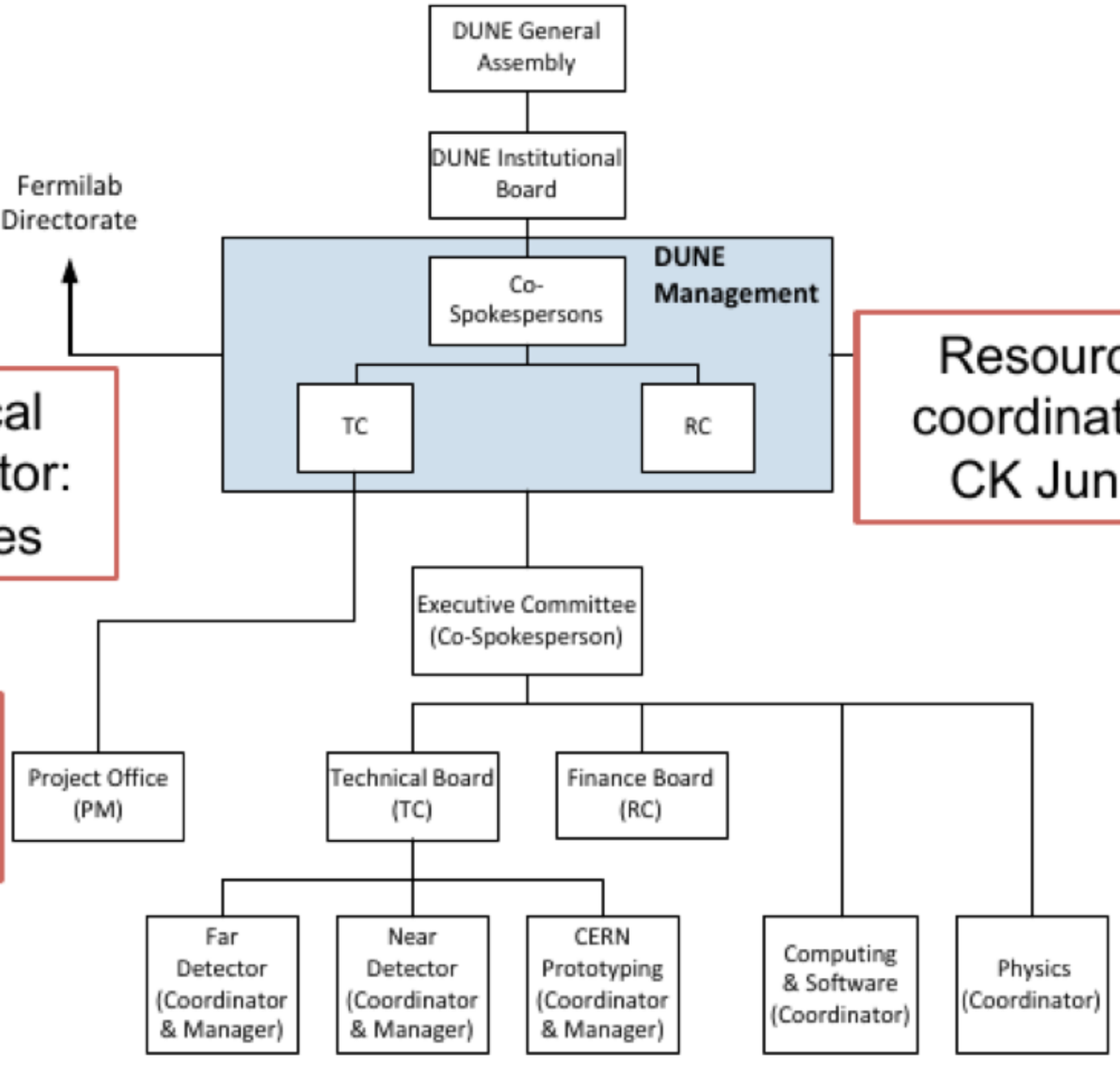
DUNE Management

The top management structure is in place

Technical coordinator: E. James

International project manager: S. Kettell

Resource coordinator: CK Jung

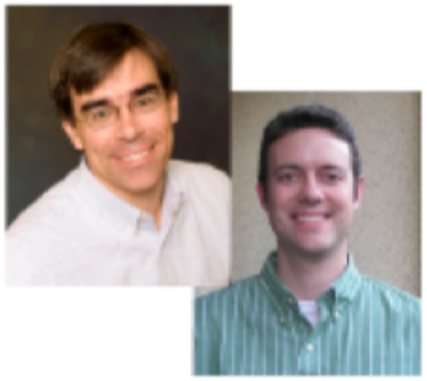


The six high level organisation

Far Detector WG	Near Detector WG	CERN prototyping WG	Accelerator & Beam interface WG	Computing &Software WG	Physics WG







COORDINATORS

T. Bolton	S. Mishra	T. Kutter (interim)	A. Marchionni Dep: Mary Bishai	T. Junk Dep: A. Farbin	J. Urheim Dep: R. Patterson

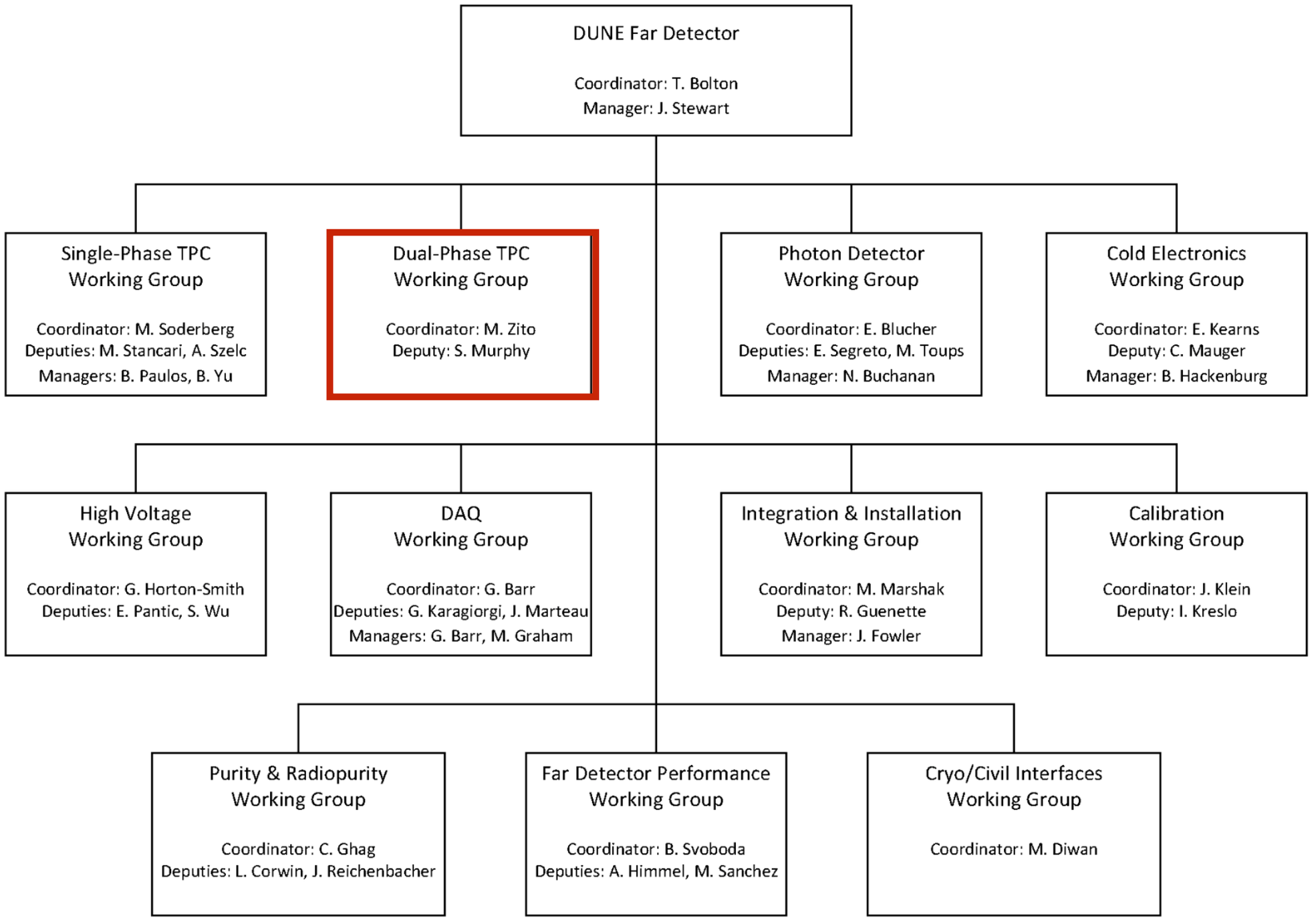
MANAGERS



J. Stewart	tdb	tdb

Goal was to establish coordinators by this meeting: done ✔

FD working group



DAQ, HV, photon detector are in the scope of other working groups

Goal of the Working group

- prove the feasibility of having (at least) o**ne 10kt module with Dual phase technology at SURF.** It will be the only module that can achieve:
  - readout with gain
  - readout with 3 mm pitch
  - decouple from risks that may cripple your signal such as unforeseen noise, lower than expected purity (difficult to predict what the level of noise will be on a 12x60x12 m TPC).
  - guaranteed reach of low energy events.
- worth exploring two different technologies (Dual/Single) each having their own advantages and risks. **Both require proof of operation on the large scale => WA105 & protoDUNE.**

Goals and structure

- The design of the dual phase TPC will be performed **in close contact with the WA105 demonstrator program at CERN**, with important milestones in 2016 (construction and operation of the 3x1x1 m3 detector) and 2017-18, with the installation, commissioning and beam data-taking of the 6x6x6 m3 detector. We would like to take advantage of the lesson learned on these detectors for the DUNE design.
- The dual phase TPC WG will work in **tight coordination with the light readout, the electronics, the HV, and the DAQ WGs**
- Work packages: see later

Work packages

PROPOSAL DUNE dual phase far detector work packages

conveners: Marco Zito, Sebastien Murphy

WP1 Chimneys & Feedthroughs	WP2 CRP mechanical	WP3 CRP sensor	WP4 Drift cage & cathode	WP5 Slow control & calibration	WP6 det. installation and integration
• signal + slow control feedthroughs • all crossing pipes including cryo services • pressure relief devices • tight collab. with the group constructing the tank to ensure adequate placement of chimneys • manholes and accesses • check for sufficient clearance of services inside tank from the drift cage	• mechanical design of 3x3 m^2 CRPs frames. • ensure rigidity and stability in cold according to tolerances • motorised suspension system • extraction grid with sufficient tensioning and minimum dead space between modules • field lines simulations to guide design especially at the junction between CRPs • mounting sequences	• purchase & QA of large amounts of LEMs + anodes • logistics for cleaning, testing and storage of LEM+ anodes • adequate HV connections for all devices (up to 10 kV for extraction grid) • ensure of non sparking for connections in GAr • mounting sequence on 3x3 m2 CRPs	• design and assembly sequence of large drift cage • drift cage suspended to cryostat roof • design of cathode based on field line simulation & ensure mechanical rigidity • spark protection device around cathode • voltage divider chain • connection of cathode to HV feedthrough	• complete list of what we want to monitor and for which purpose • construction and calibration of purity monitors, temperature, pressure,voltages and currents monitoring, level meters, cameras etc.. • includes also low voltage (<= 10 kV) connections in Gar or LAr • cabling and connection to racks near the tank.	• construction the detector taking into account the underground environment and limited shaft space + TCO. • All safety related aspects • Ventilation & accesses • clean room(s) • cavern layout and space for racks and detector/tank services • Insure of non conflicts between subsystems • cavern layout and space for racks and detector/tank services

Webpage

plan to share most of the information on this webpage

https://web.fnal.gov/collaboration/DUNE/SitePages/FD%20Dual-Phase%20TPC%20Working%20Group.aspx

Fermilab

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FD Dual-Phase TPC Working Group

Purpose:

WA105 DUNE DEEP UNDERGROUND NEUTRINO EXPERIMENT

The task of the Dual Phase TPC group is to develop a detailed design of the dual phase Liquid Argon TPC 10 kton fiducial detector for DUNE. This design will be the basis for the DUNE TDR, to be ready for 2019. The starting point design for this detector is contained in the DUNE CDR (Vol 4, chap. 5 released July 2015) . Most of the effort is performed withing the WA105 collaboration where the dual phase technology is been tested and scalled to the very large detectors.

Convenor:	Marco Zito
Deputy:	Sebastien Murphy
Email list:	dune-fd-dual-phase-TPC@fnal.gov (archive)

The scope of this group includes the following work-packages:

WP1. Chimneys and feed-throughs (resp. Franco Sergiampietri): The dual phase detector requires specific chimneys for the signal feed-throughs, with the front-end preamplifiers inside the tank insulation. A specific design requirements is also needed for the drift HV feed-throughs. These components are being developed and prototyped in WA105 and will be adapted to the DUNE 10kt. These developments will be addressed in coordination with the FD WG “Cryo interface”.

WP2. The Charge Readout Plane (CRP) mechanical structure (resp. Dominique Duchesneau, Nicolas

Far Detector Working Groups

+ Working Groups

Links:

- DUNE dual phase indico
- WA105 collaboration indico
- WA105 plone - all shared technical material (protected)
- CERN Neutrino platform indico
- published articles by WG members on topic

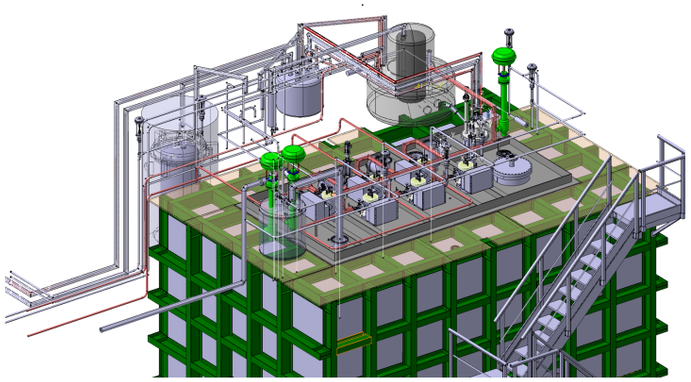
links to meeting and also WA105 information

Phased approach

The final Dual phase module is developed following an incremental approach. Design optimised at each steps

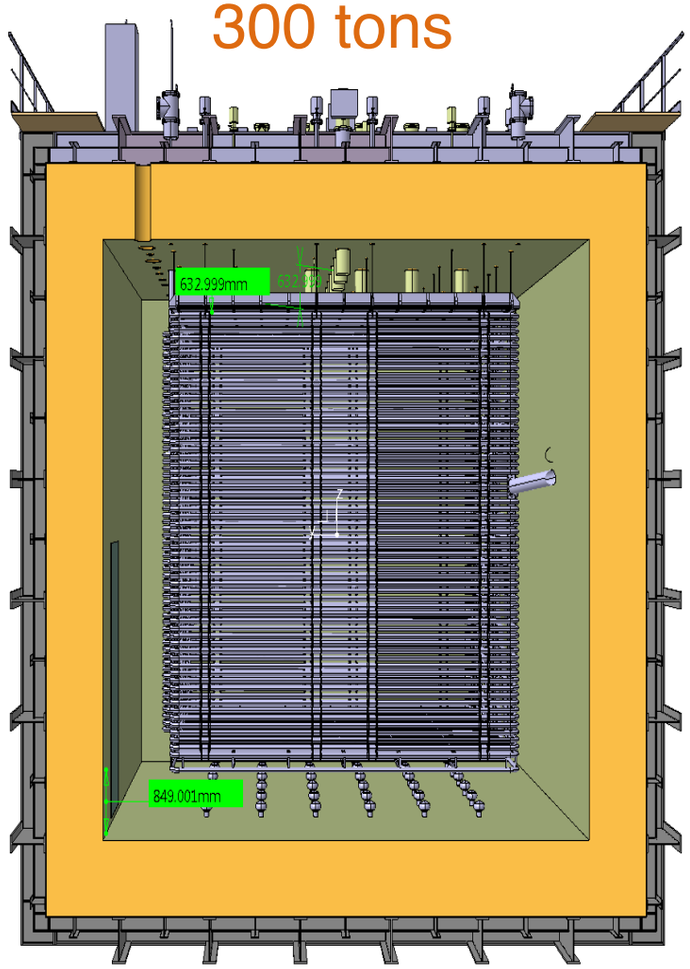
2016-2017

WA105 3x1x1 m^3
5 tons



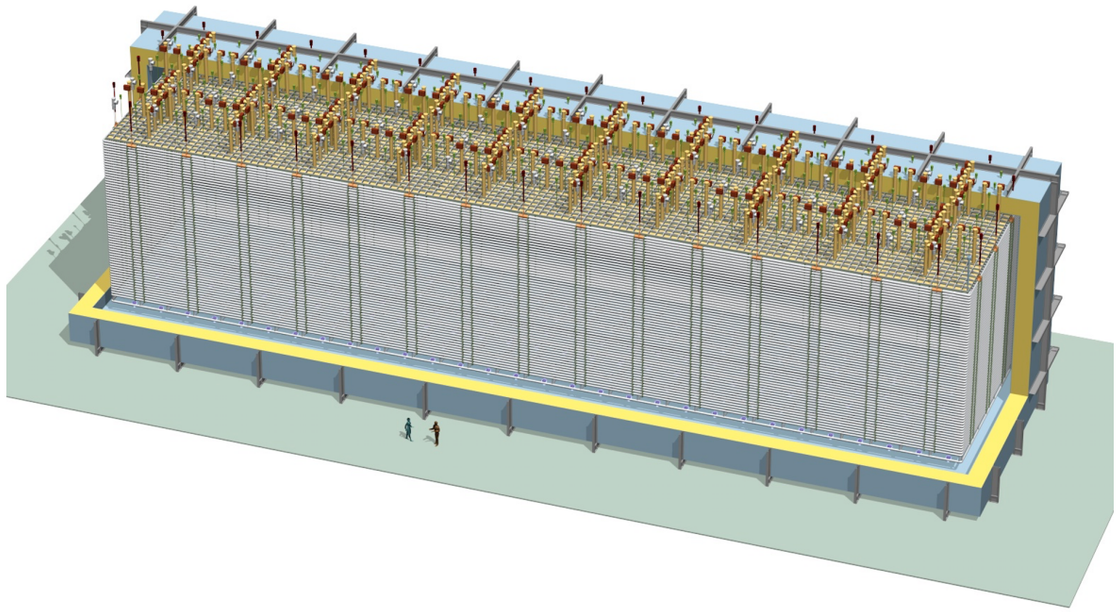
2018-2019

WA105 6x6x6 m^3
300 tons



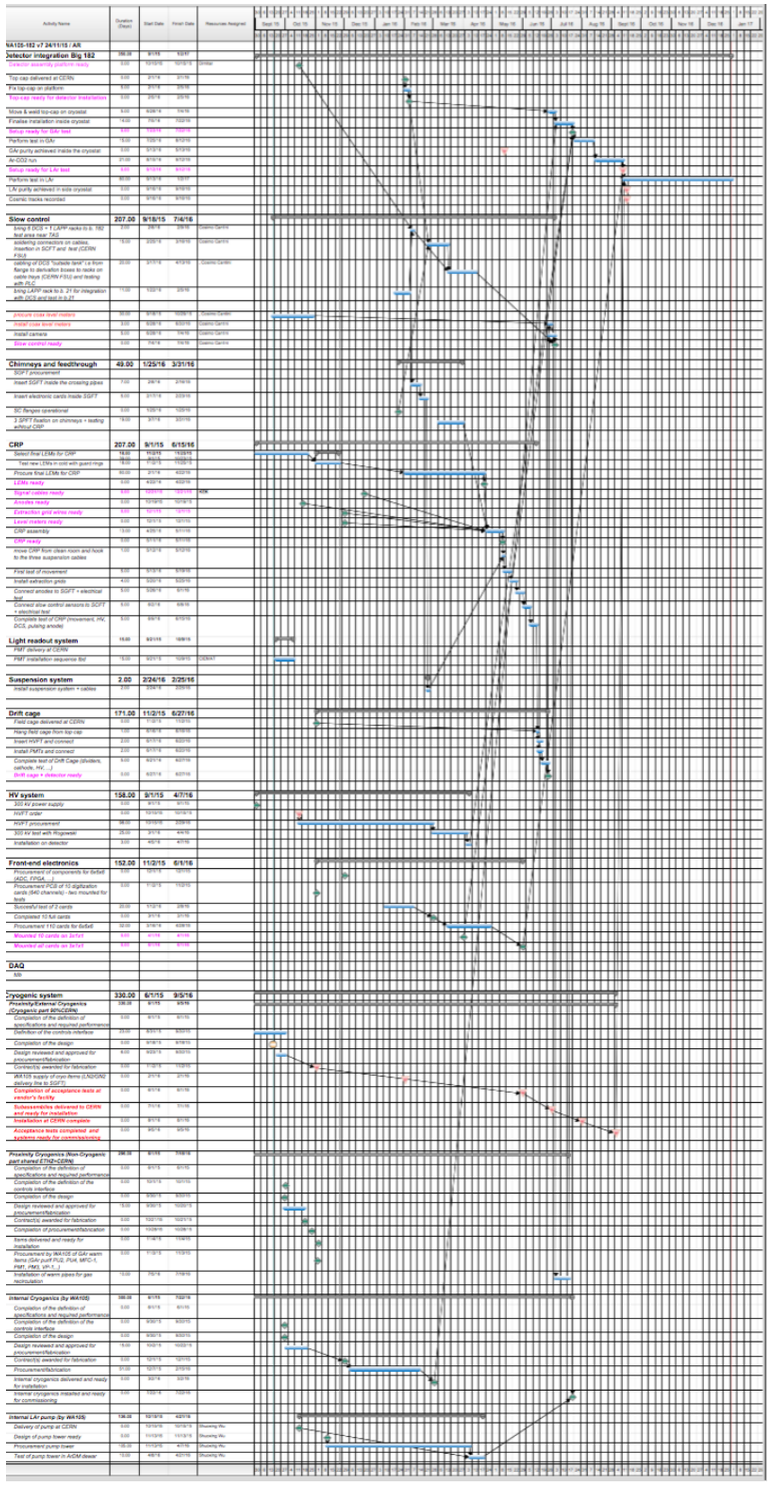
2020+

DUNE 12x60x12 m^3
10’000 tons

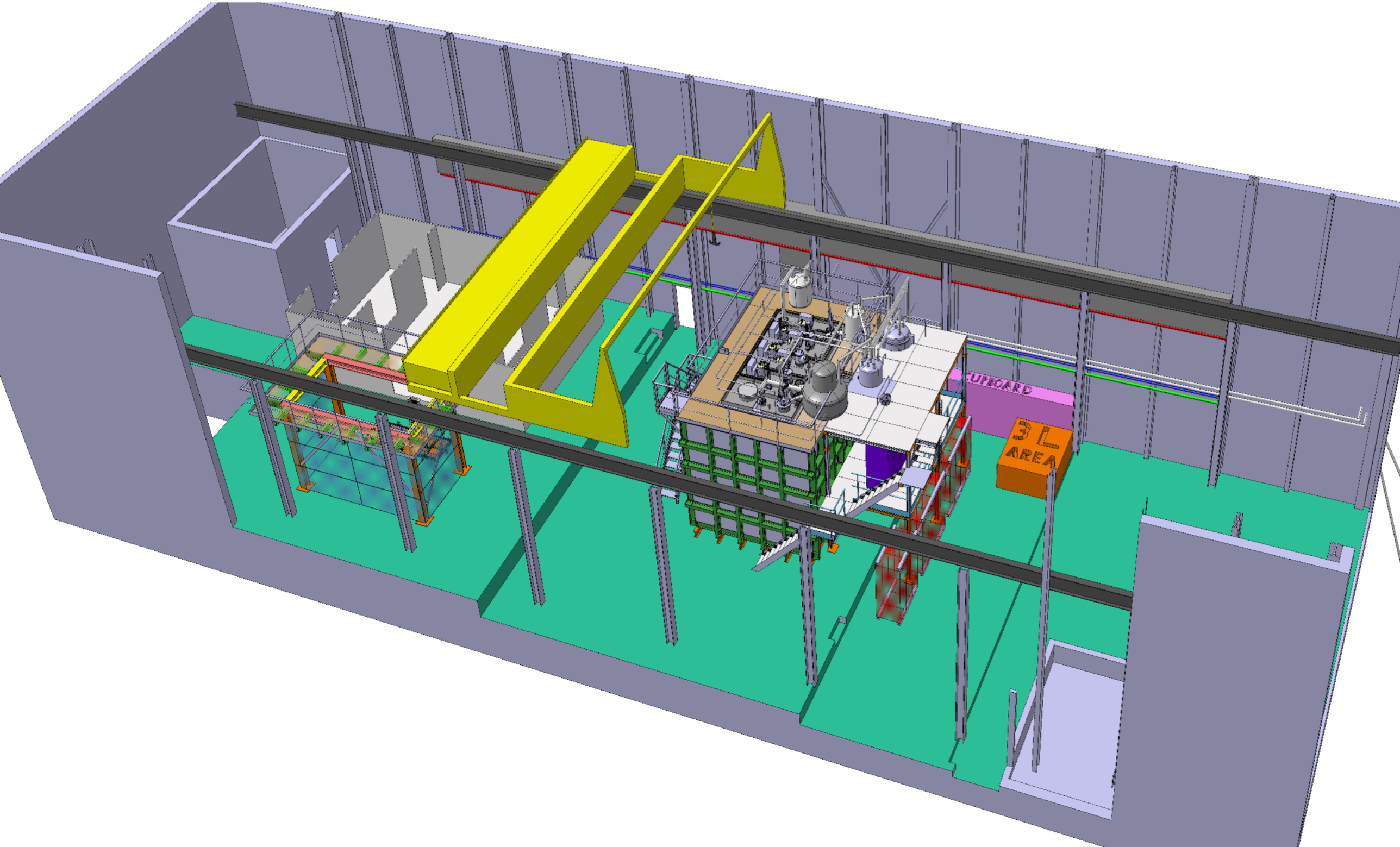


Milestones 3x1x1

- December: assembly structure ready
- February: top-cap delivered.
- March-April-May: detector installation and cabling in assembly structure + testing.
- June: move top-cap with detector to cryostat and install internal cryo-piping.
- July: setup ready for GAr test
- Aug 1st. cryo-installation complete.
- Sept: setup ready for LAr test

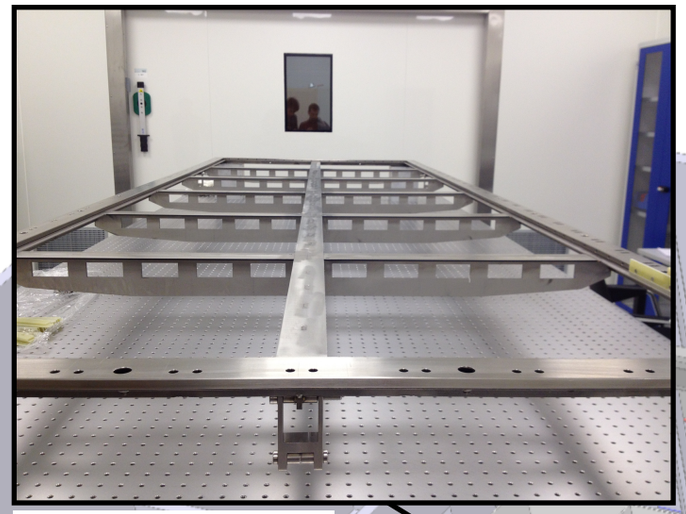


3x1x1 layout b.182

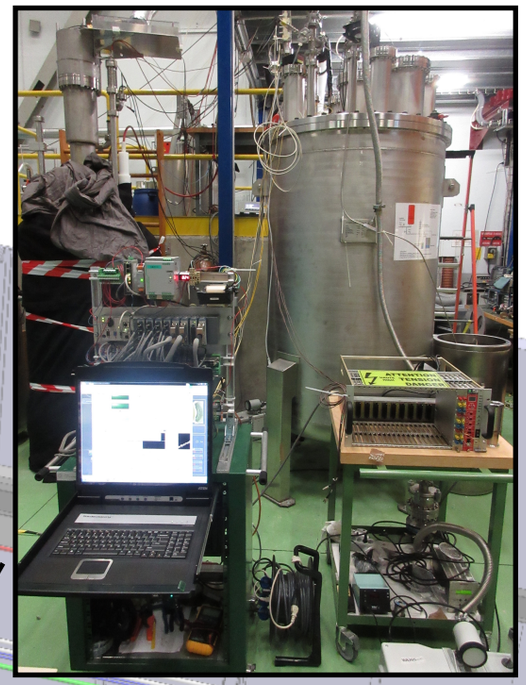


3x1x1 layout b. 182

membrane cryostat



clean room

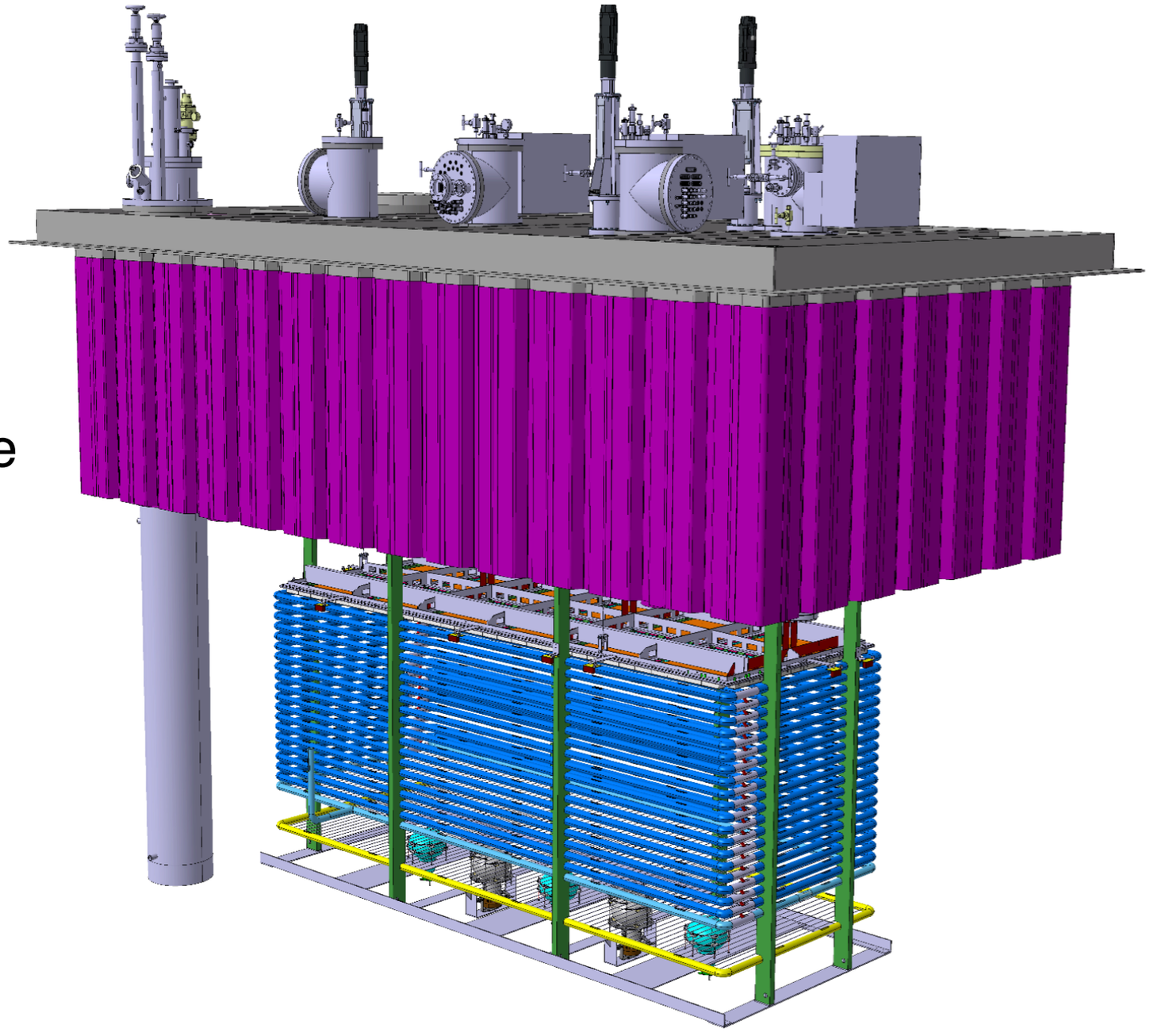


area for multipurpose testing

assembly structure

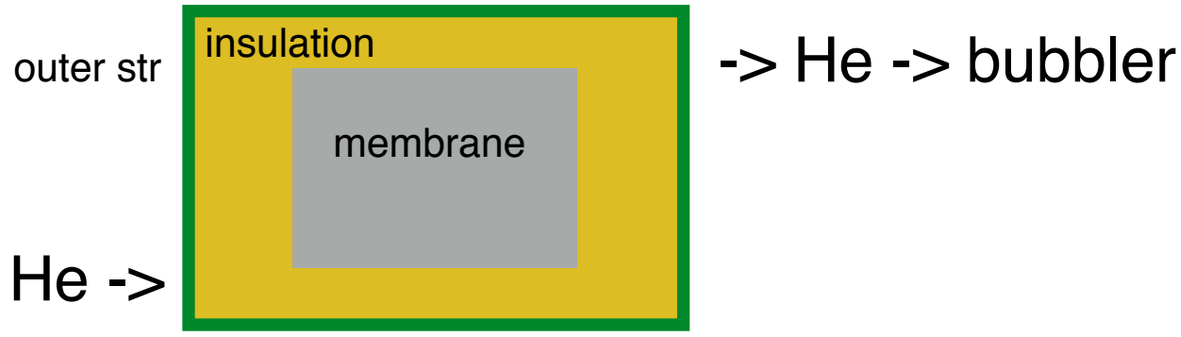
Detector

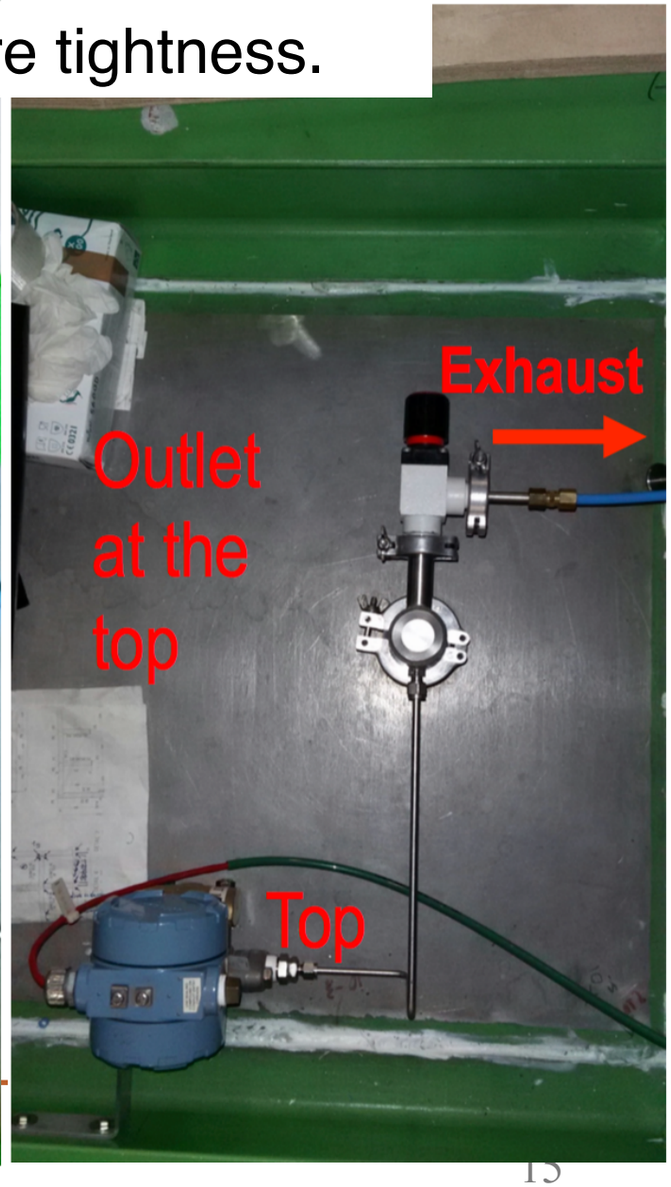
- Drift cage ready.
- CRP: mechanical frame ready.
- PMTs ready.
- Feedthroughs:
- HV arrives in December- testing beg. of next year.
- Signal: one proto delivered since spring. Remaining 5 arrive in December
- Slow control: delivered
- suspension: ready
- racks for slow control: last ones been cabled. Almost ready.
- cable routing being finalised.
- **Detector assembly begins February. Lots of work ahead!**

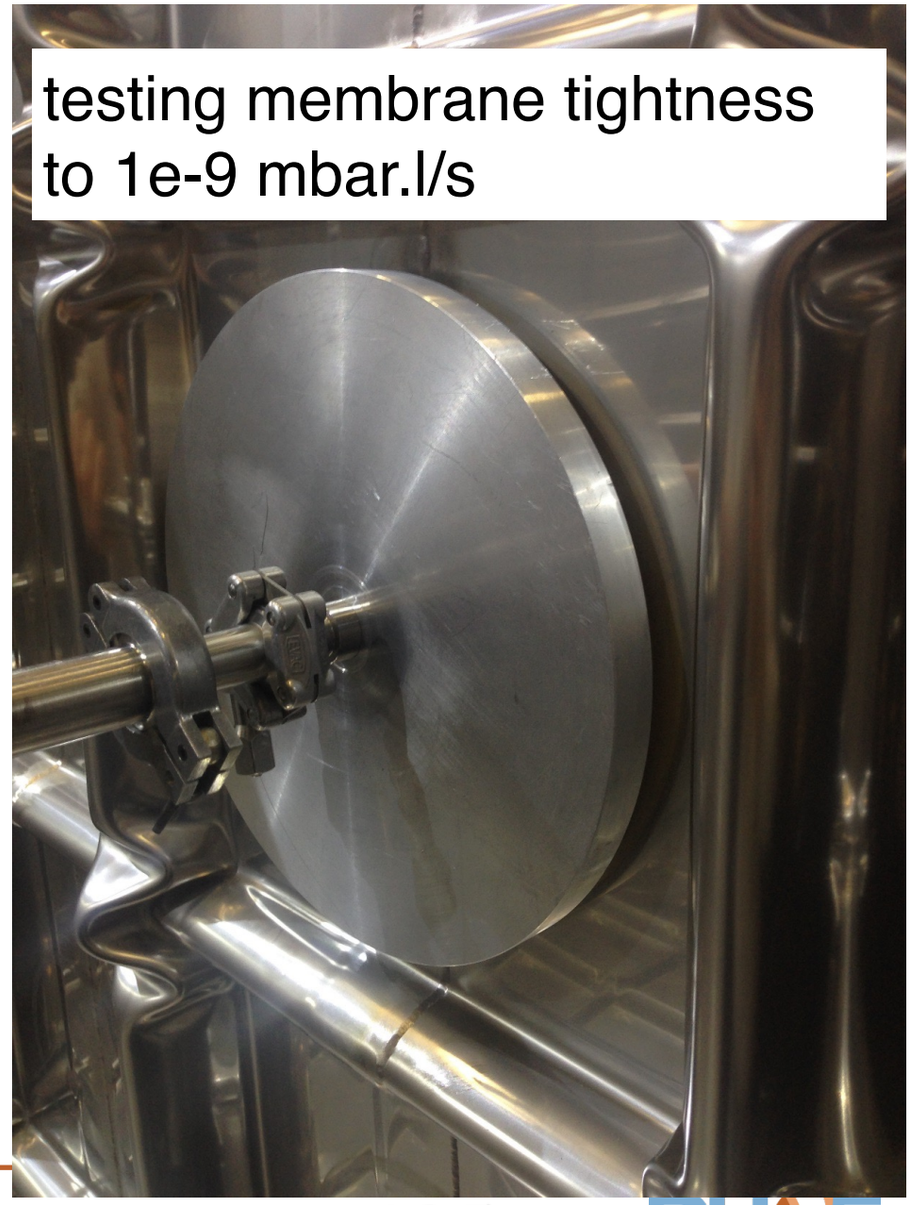


Cryostat

lots of progress and ongoing work on measuring the tightness of the membrane (local test) and the outer structure (accumulation test).
=> of primary importance for DUNE cryostats (common dual/single)







Cryogenics

Tendering document is been sent out to companies. Expect replies in January.
Request ready for cryo operation in September.

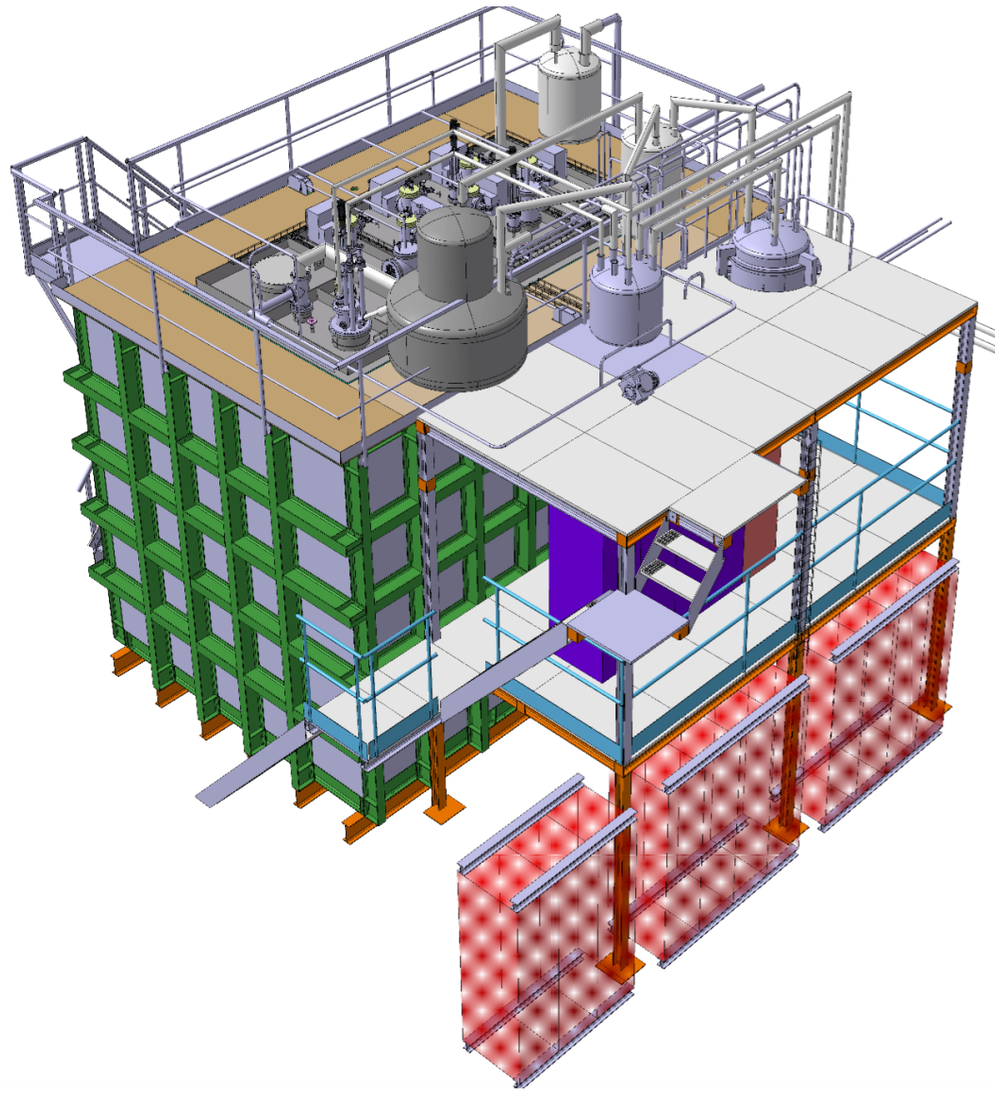
European Organization for Nuclear Research
Organisation européenne pour la recherche nucléaire

-EDMS No.: 1549445
Document Ref.: **NE.WA.10.00-TS-001**

Group Code: DG-DI/DI

Invitation to Tender

Technical Specification
Design, supply and installation of a cryogenic system for the WA105 prototype



Milestones 6x6x6

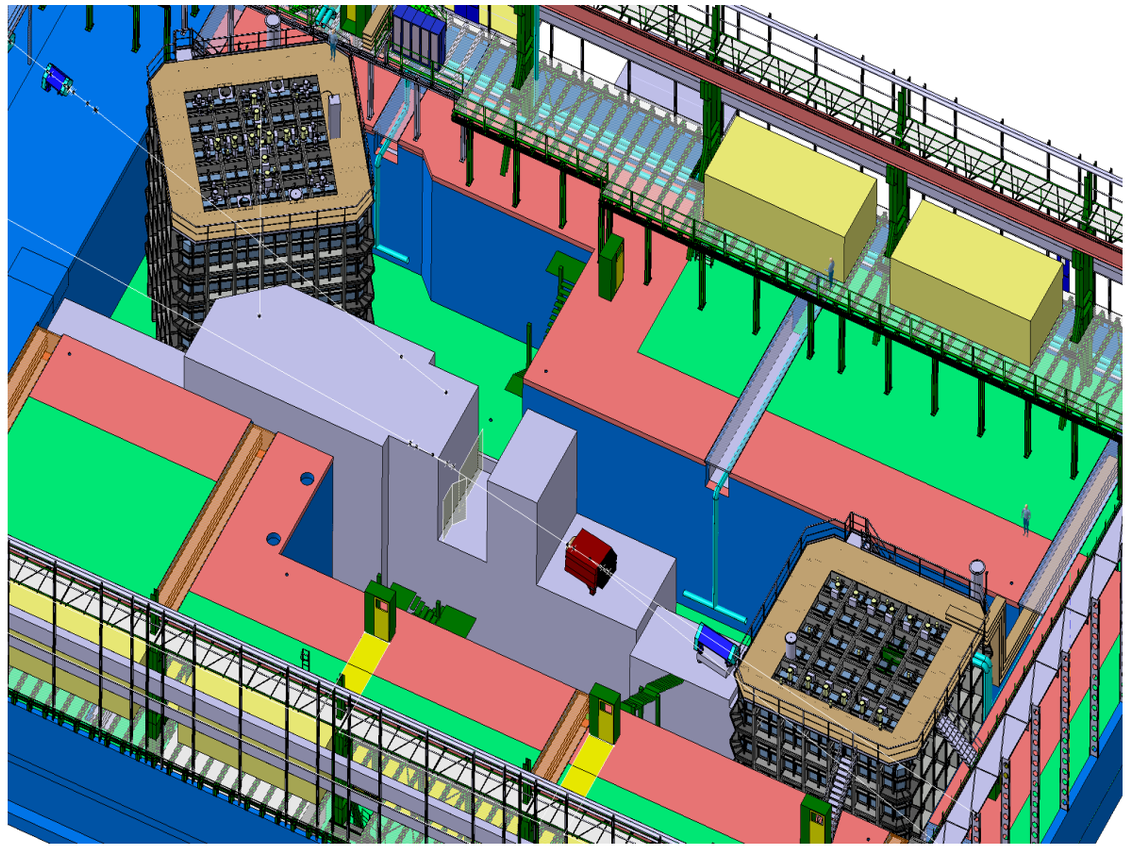
Based on the experience gained with the 3x1x1m3 master schedule
->includes feedback from real experience on building the 3x1x1

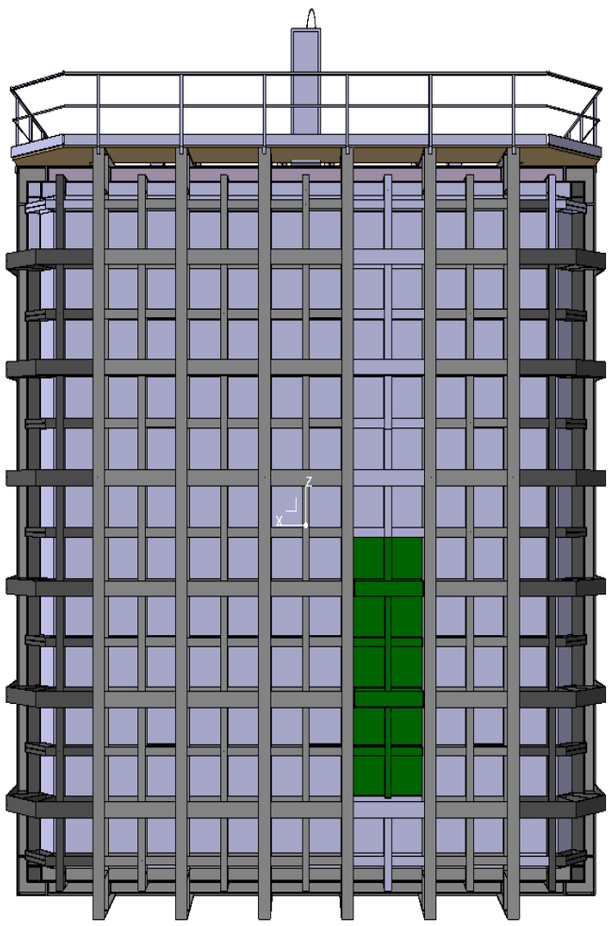
- September 2016: start cryostat construction
- April 2017: start detector installation
- December 2017: seal TCO & cryostat
- January 2018: start cryogenic operation

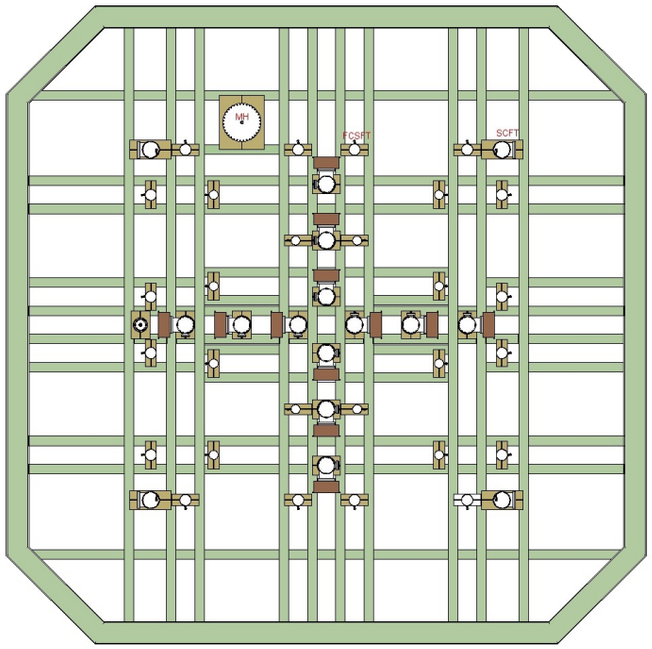
  (cooldown+filling)
- March 2018: ready to collect beam

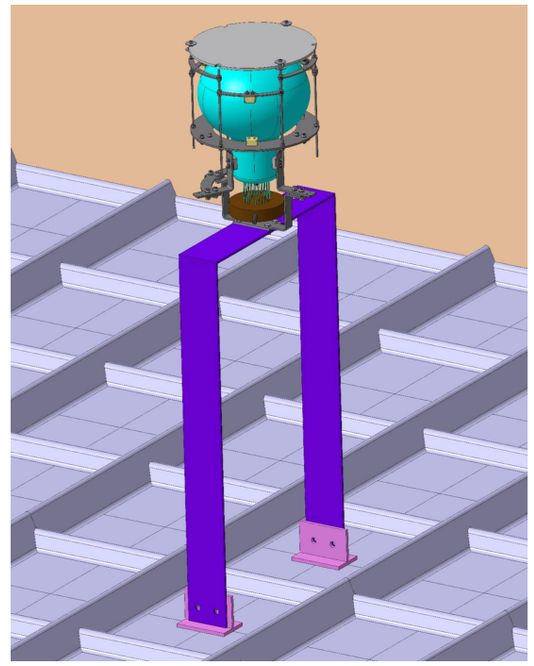
Recent progress on the 6x6x6

Lots of recent progress on finalising the detector aspects linked to the cryostat design (chimney layout, PMT fixation, TCO, …).
Lots of progress also on the beam steering and reduction of the muon background.







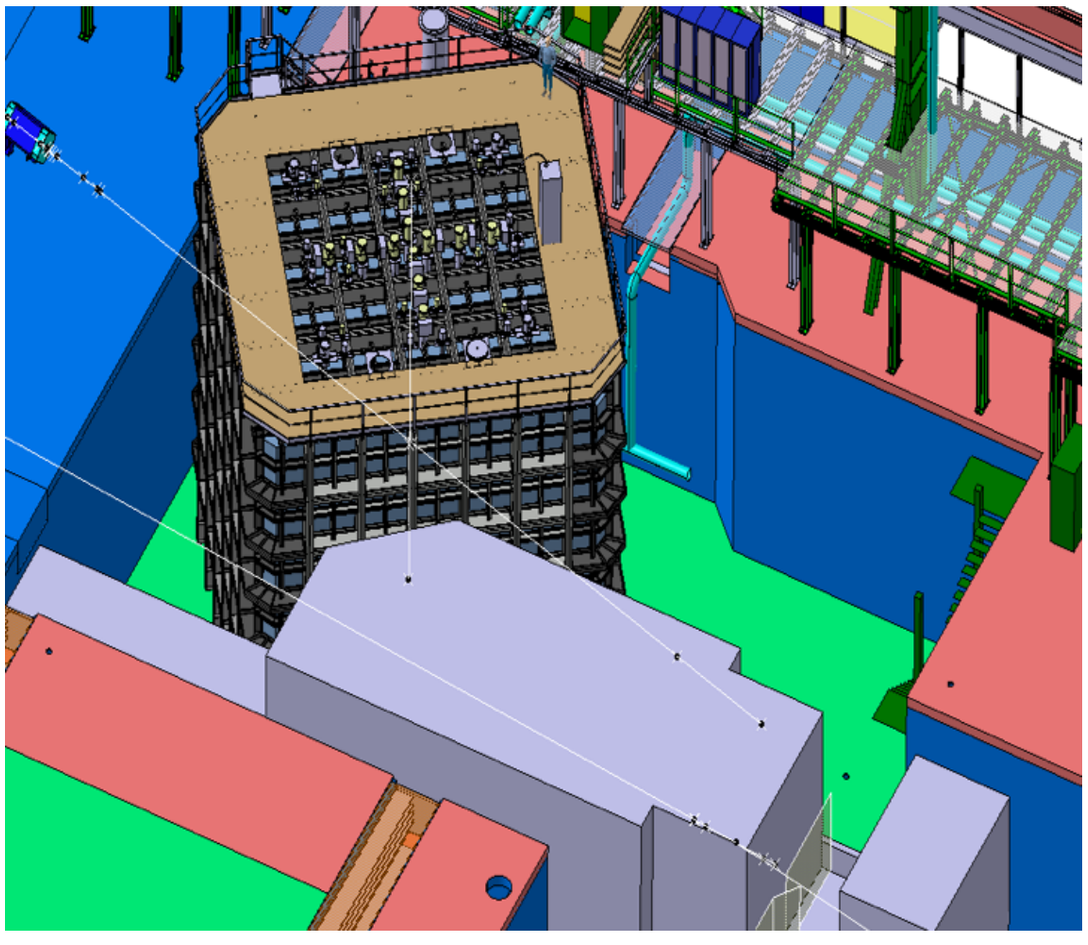


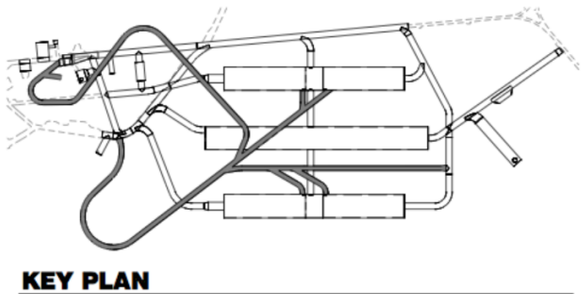
Recent progress on the 6x6x6

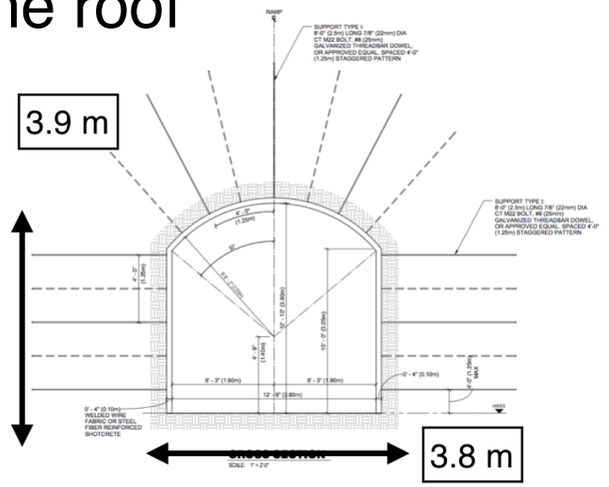
The 6x6x6 is also of primary importance for testing the DUNE dual phase integration scheme. Both detectors have exact same modularity (3x3 m2 CRPs). They will be installed with the same procedure.

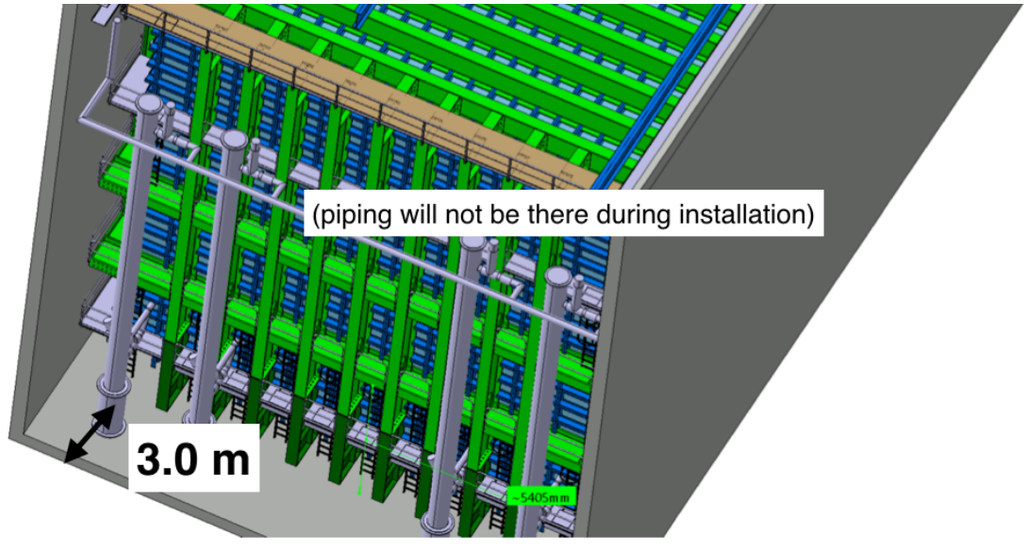
Common to WA105 & DUNE

CRP box: 3100x3100x500 that contains the CRP fully assembled.
The box enters the TCO located in the pit through the roof





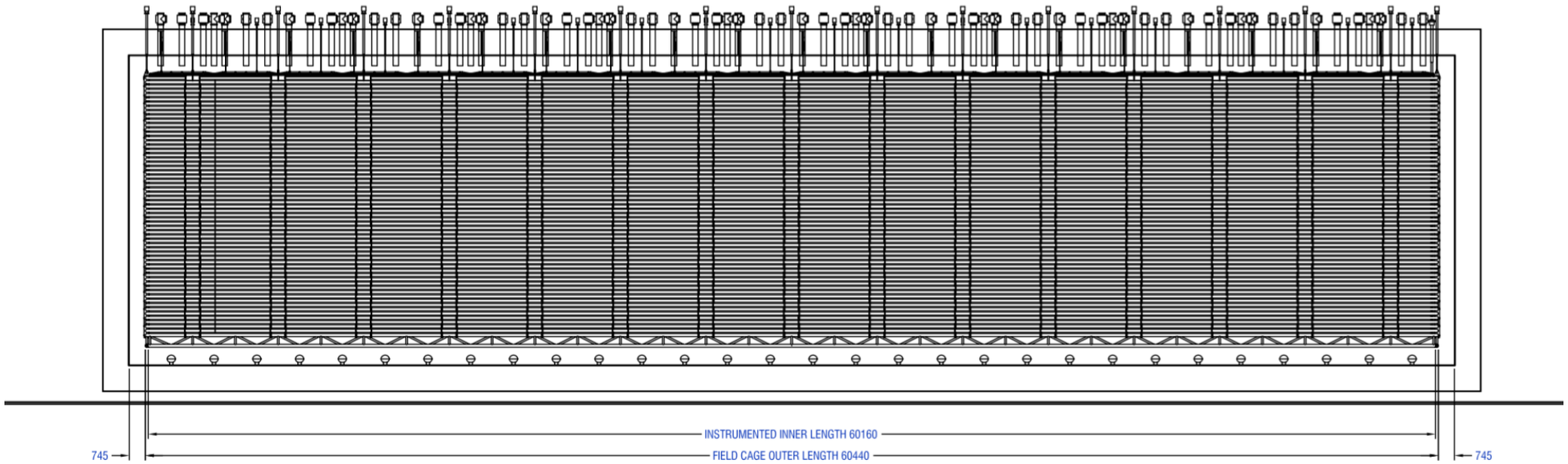


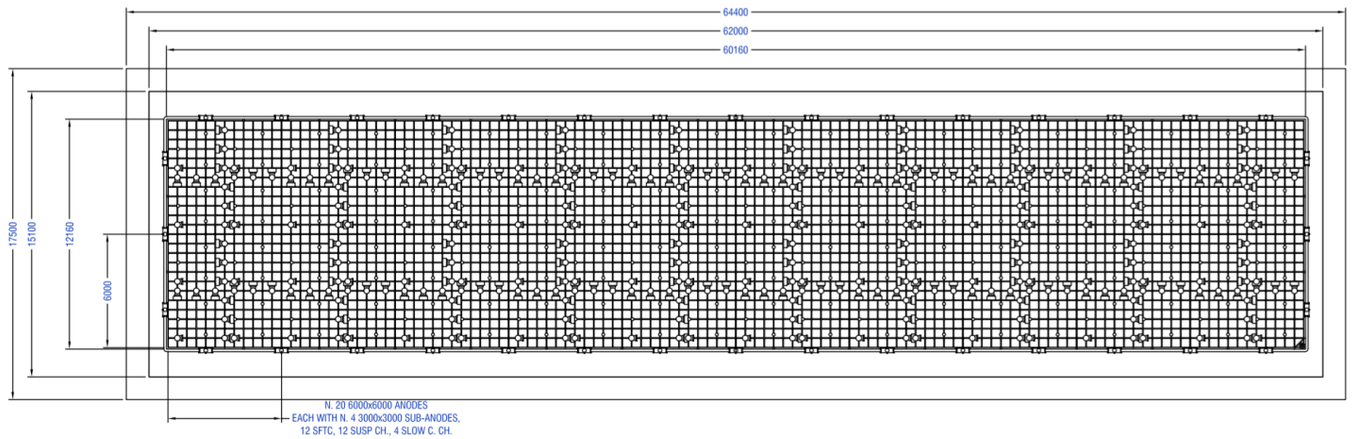


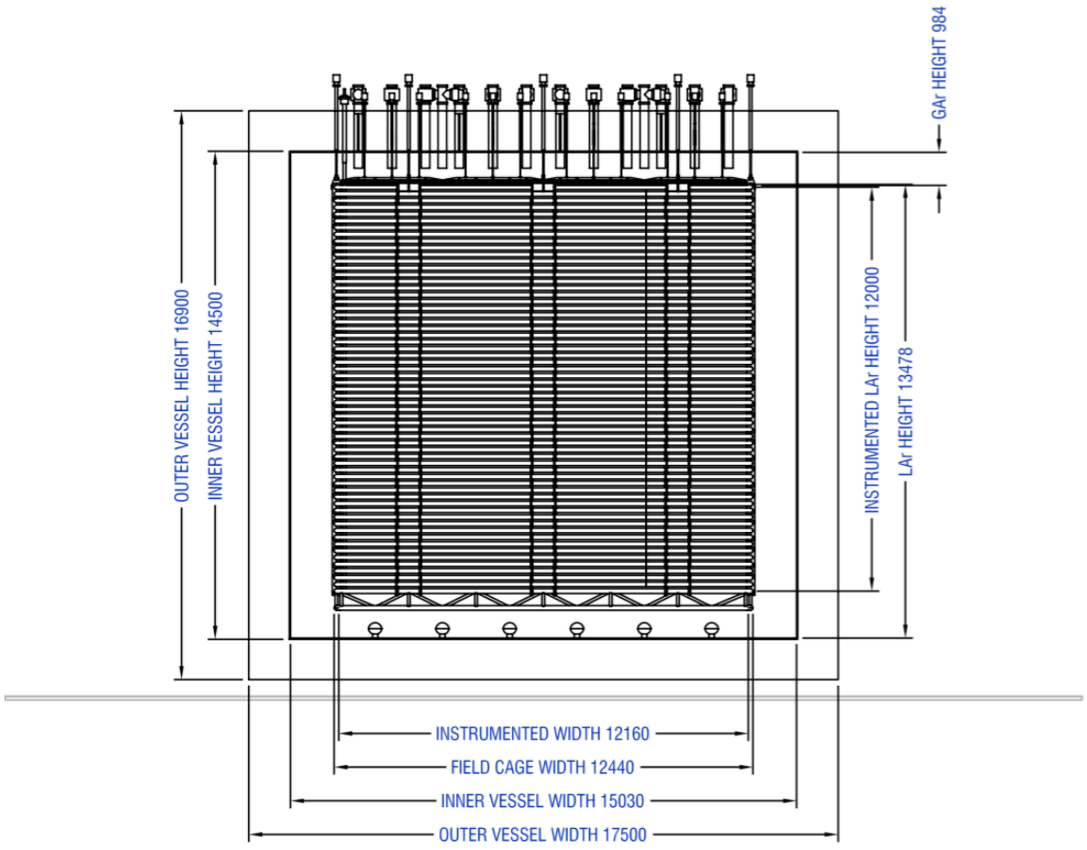
many email exchanges, thank you for all the feedback. Work is ongoing (but no dedicated presentations today).

Latest detector drawing

Same chimney layout as the for 6x6x6 modules.

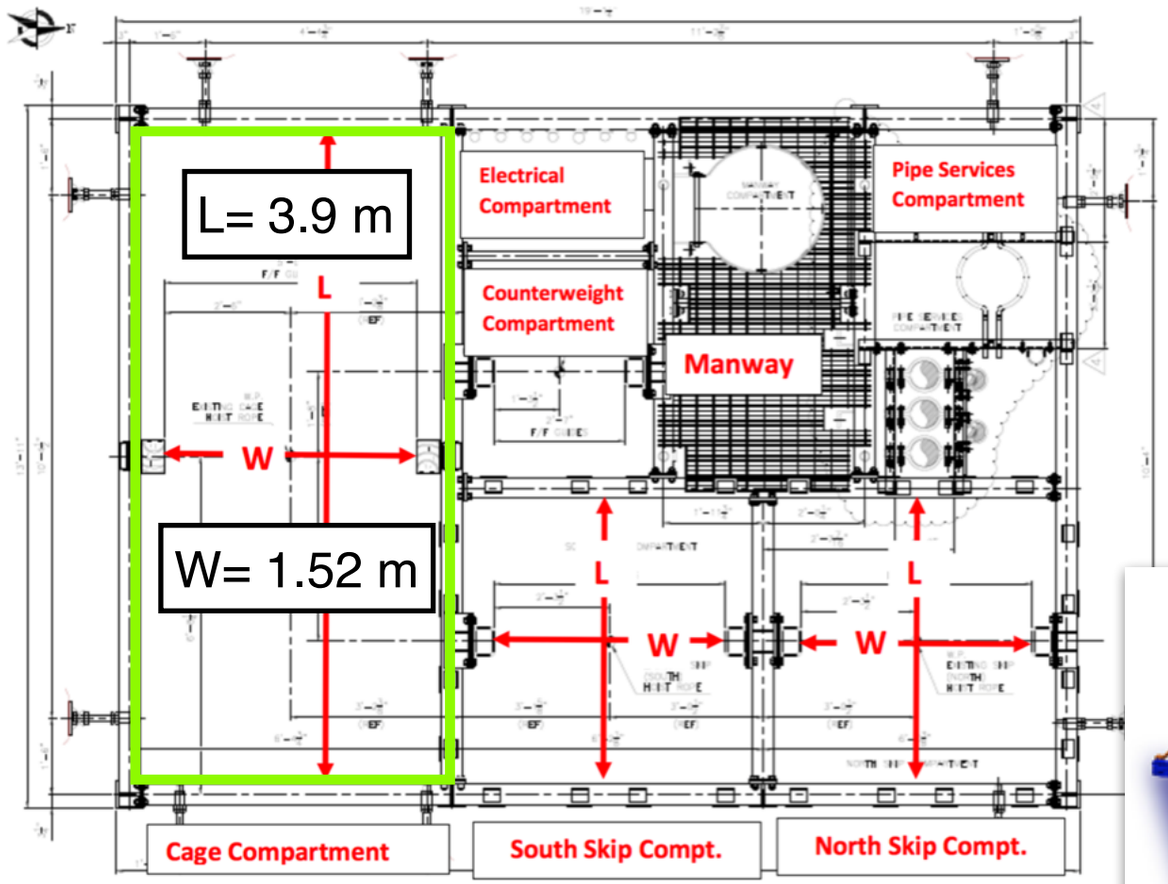






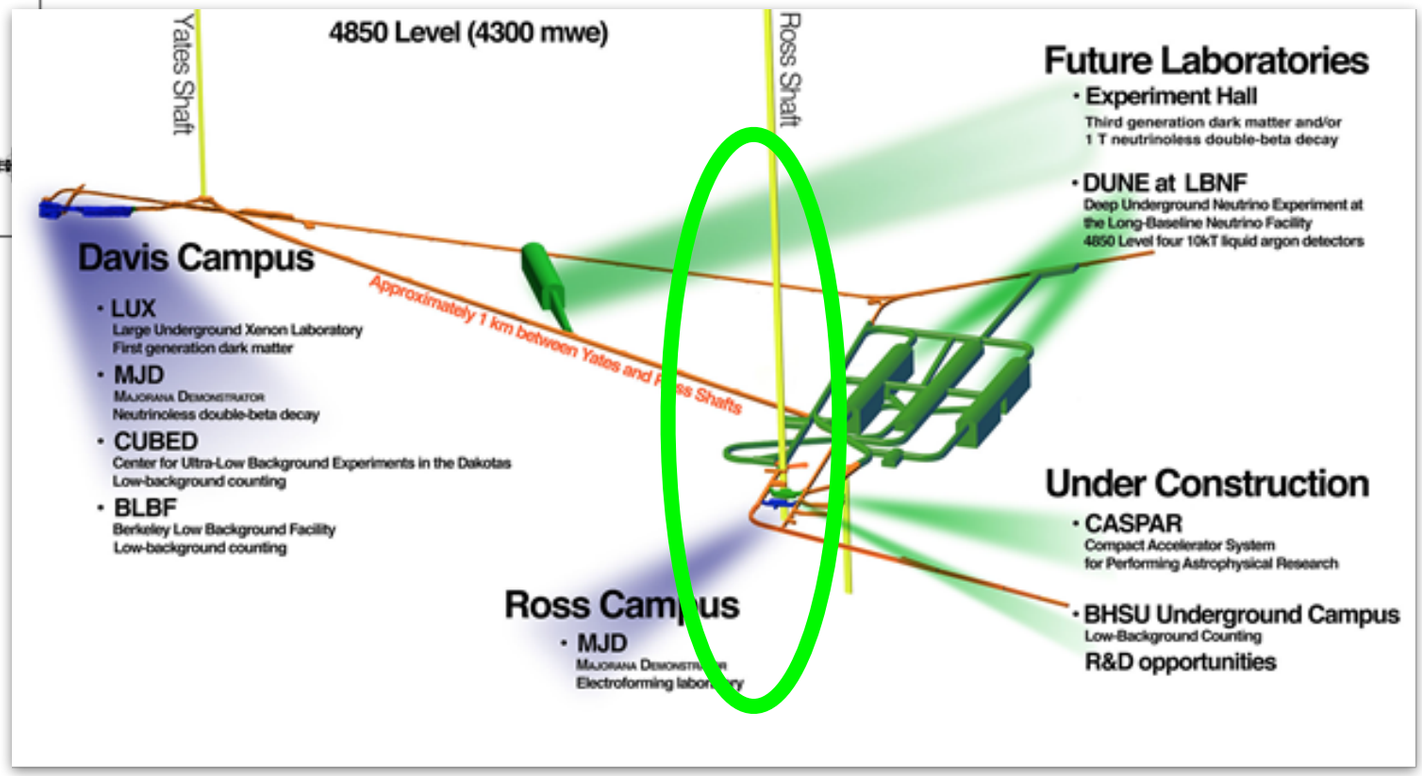
Integration & shaft

Ross



	Length 'L' (ft.)	Width 'W' (ft.)
Cage Compartment	12' 10 ½"	5'
South Skip Compt.	5' 7 ¼"	4' 7"
North Skip Compt.	5' 7 ¼"	4' 7"

We are investigating how many CRPs we can fit in the cage and how fast it can be lowered.
3 per cage would obviously make installation quicker. Anyhow main message is that at least one is possible.
Also investigating the CAD of the tunnels.



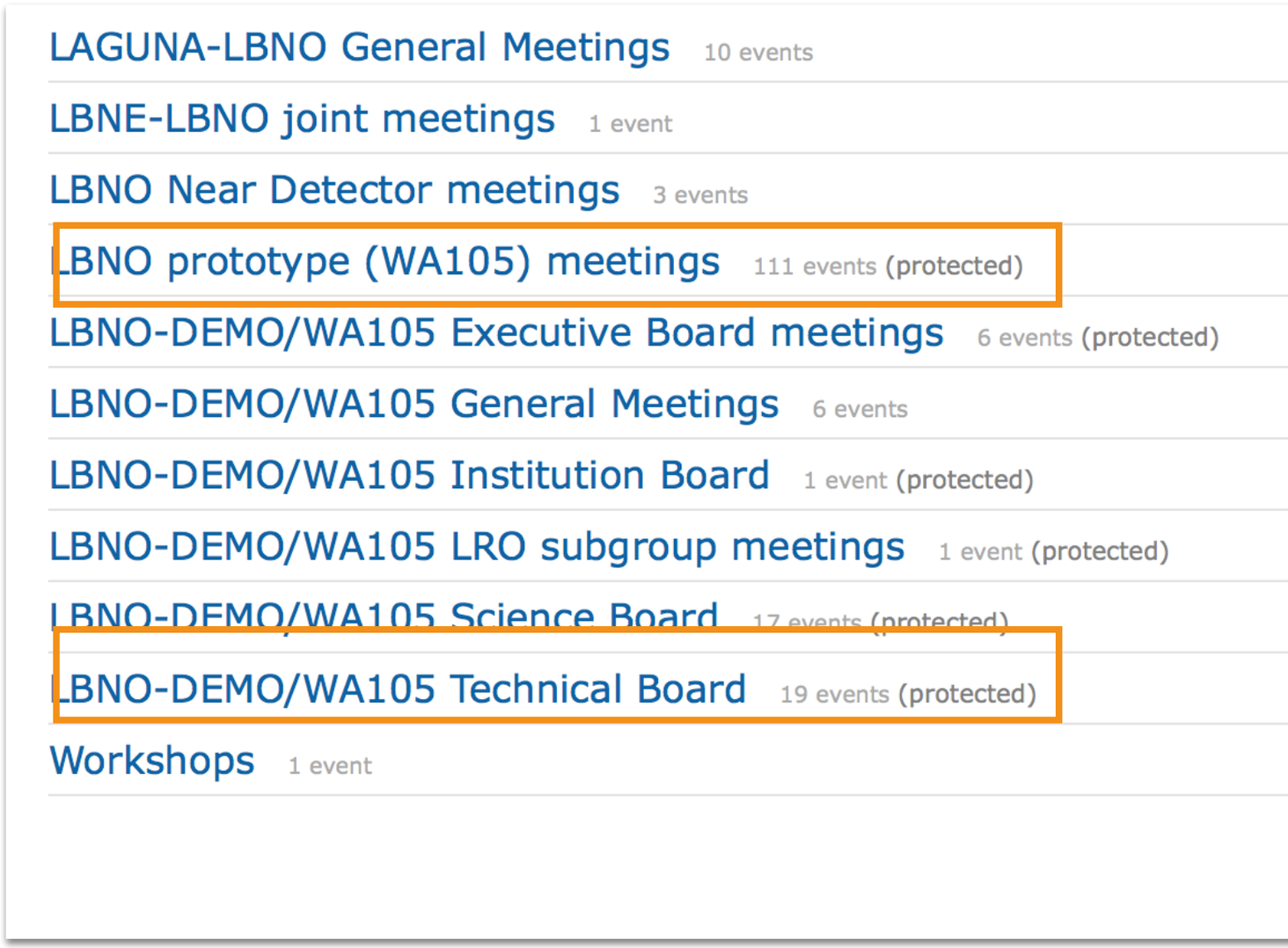
Ongoing work

- Most of the team is already in place since LAGUNA, LAGUNA-LBNO and WA105 projects
- The core of the activity is the WA105 preparation, construction and tests.
- However we will also make progress in parallel with the DUNE FD that has a longer timescale. **A large part (most) of the engineering for the DUNE-DPFD is now been tested in the 3x1x1 and even more so in the 6x6x6 that has the same modularity and integration scheme.**

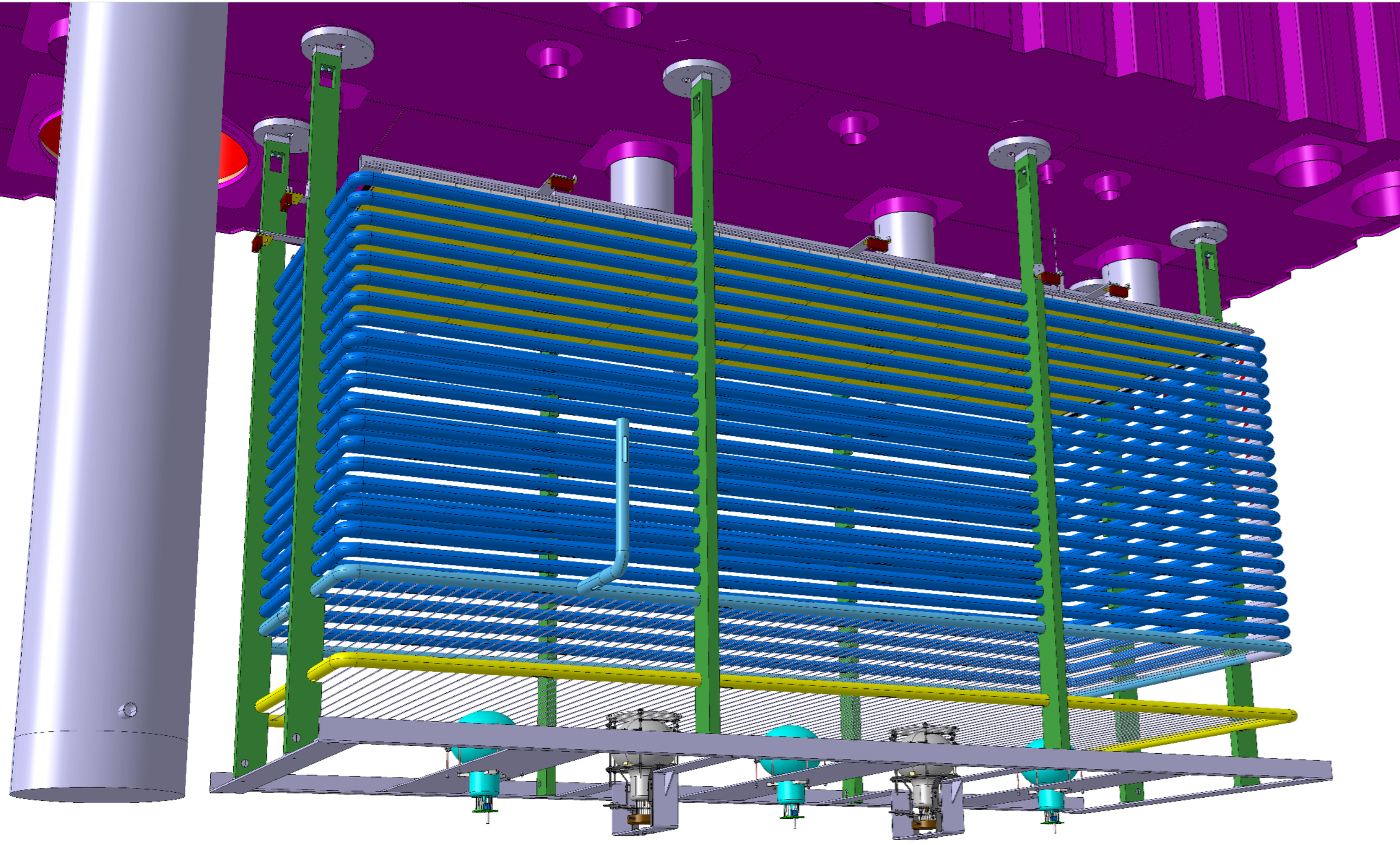
- We have therefore decided to limit the number of meetings to 1-2 in between DUNE CM.

6x6x6: bi weekly meetings on Wednesdays.

3x1x1: bi weekly meeting on Thursdays



extra slides

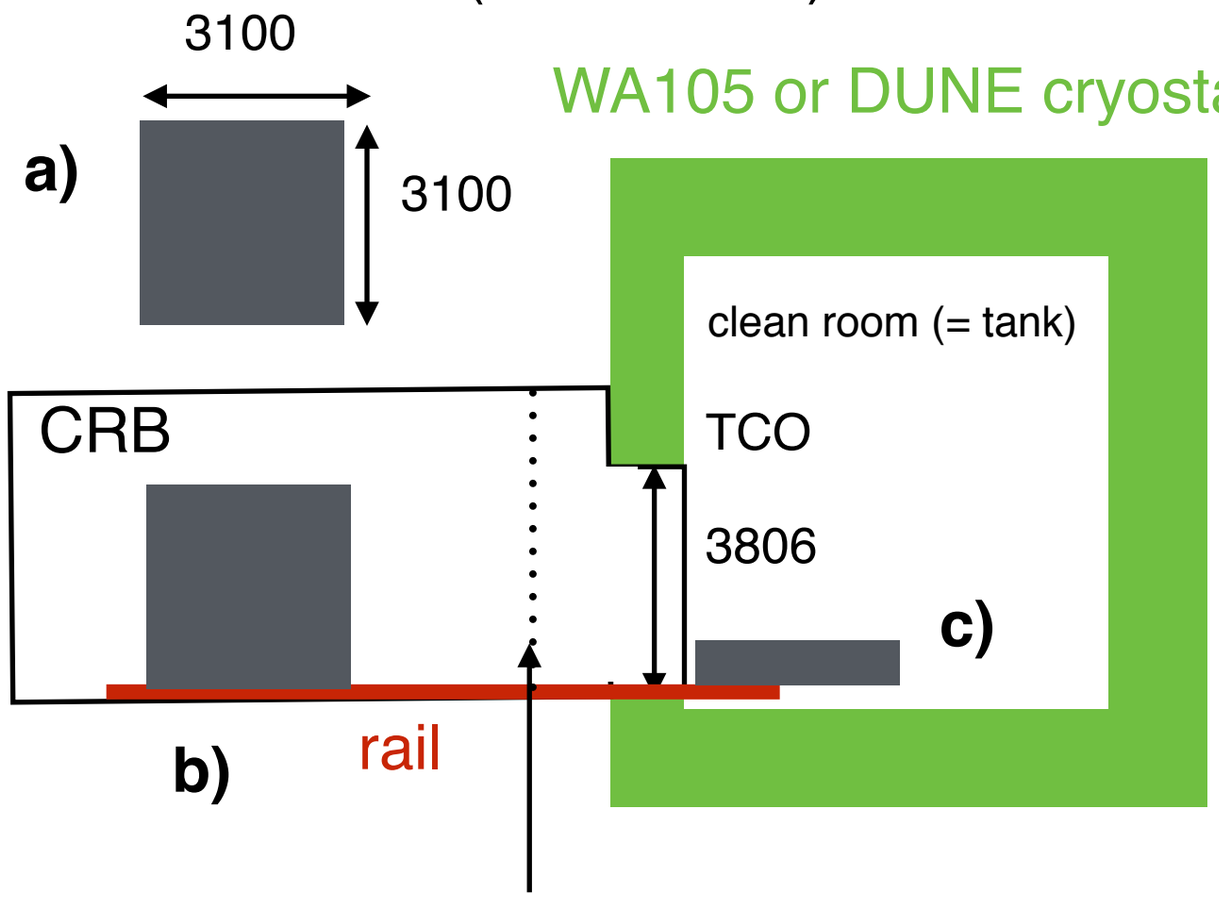


CRP installation

Common to WA105 & DUNE

CRP box: 3100x3100x500 that contains the CRP fully assembled.
The box enters the CRB located in the pit through the roof

(not to scale)

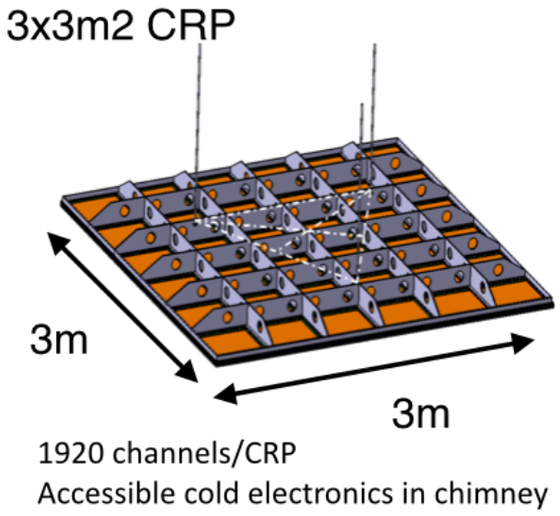


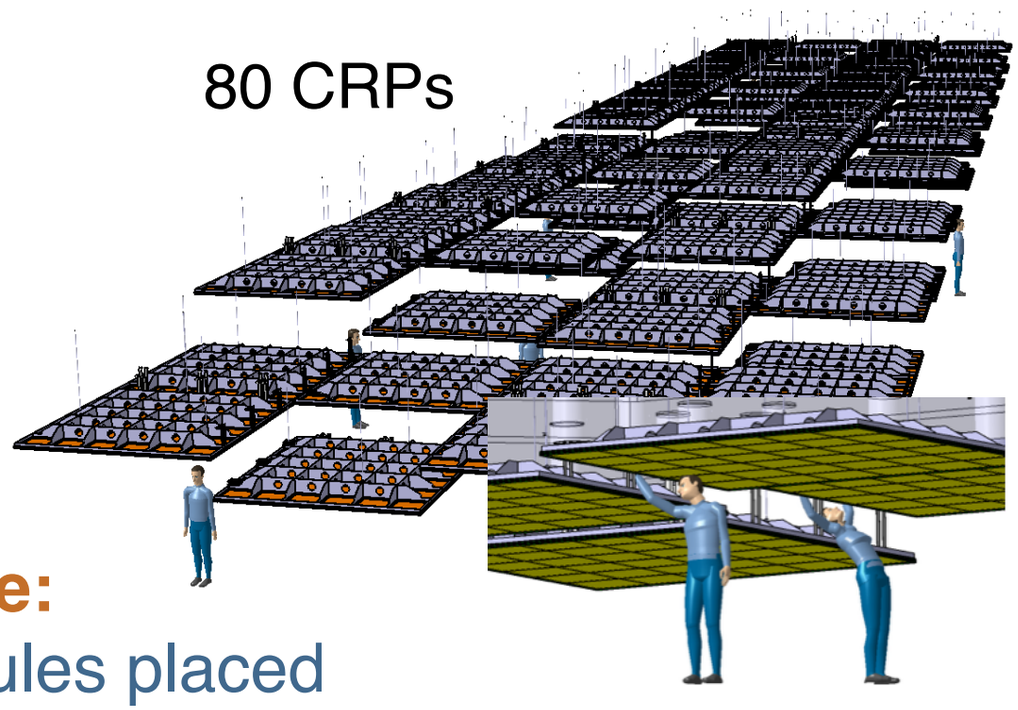
a) insert CRP box into clean room buffer (CRB)
b) fix on rails in CRB and slide into the clean room via the TCO.
c) once inside the tank need a tool to rotate and lay flat to unpack (requires that the rails extend into the tank and a platform inside tank too)

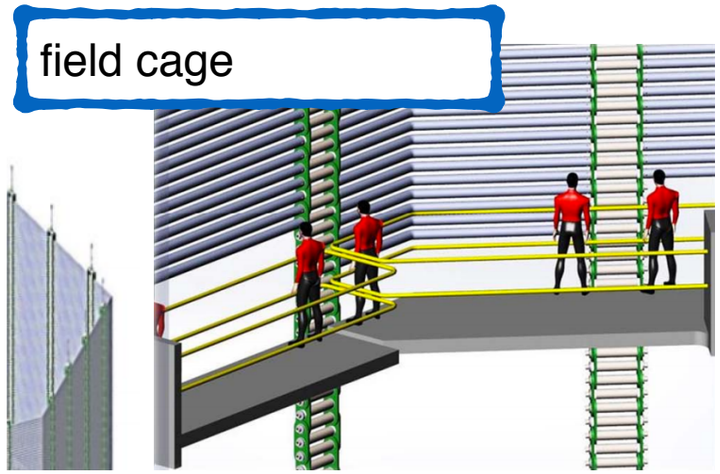
similar process for 6x6x6 and DUNE-DP

Double phase TPC layout

Underground installation studied in details during LAGUNA, we are just translating it to the DUNE environment. Same remark for the field cage.



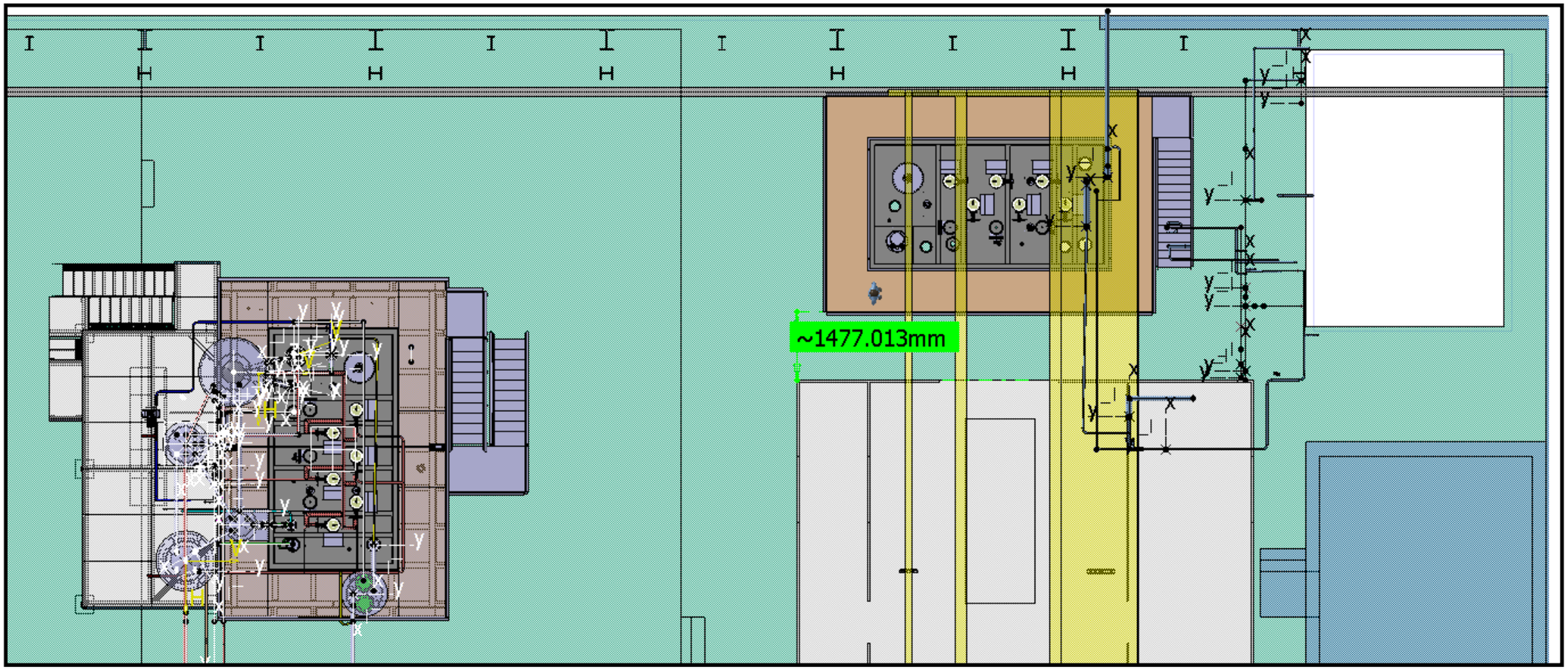


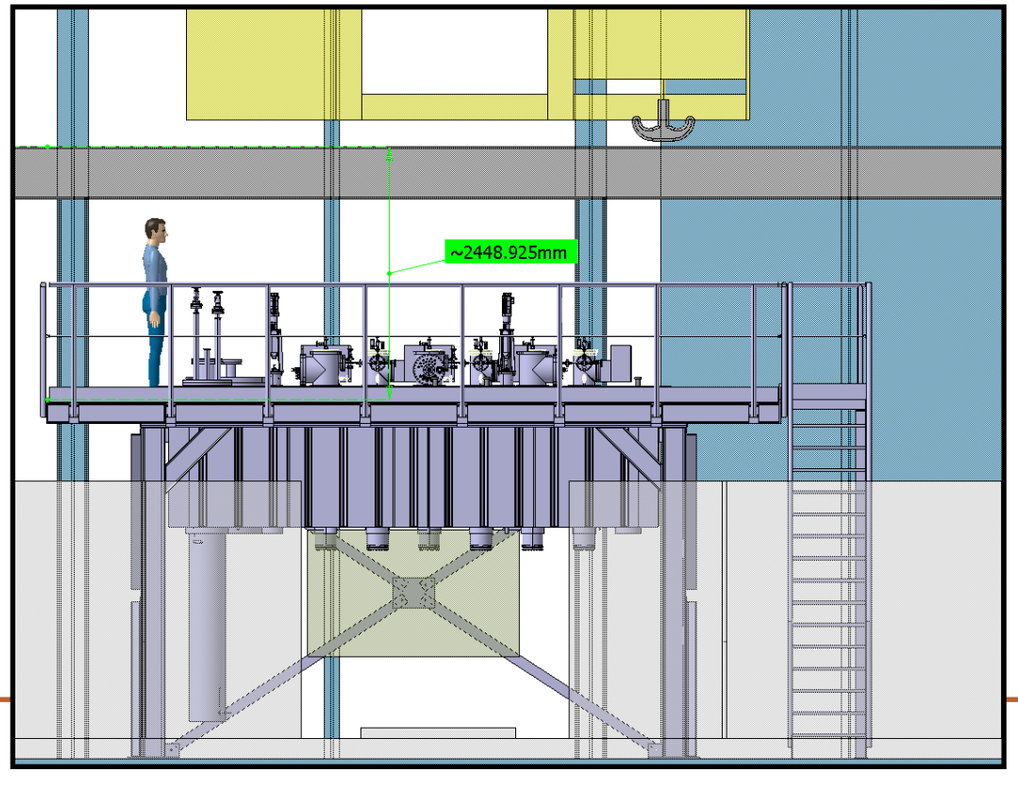


One 10 kt FD module:

- 3x3m2 CRP modules placed at the gas-liquid interface
- 2 perpendicular “collection” views, 3mm readout pitch
- 80 CRPs / 10 kton
- 153,600 ionisation readout channels
- Accessible cold electronics
- Hanging field cage and cathode@600 kV for 0.5 kV/cm
- Decoupled PD system (w/ no. 720 8” PMT)
- Active mass 12’096 tons (10’643 fiducial) for 12m drift

external assembly structure





if everybody agrees with this position we go ahead (~2 weeks from now)

Membrane