

FD2 PDS

ProtoDUNE-VD

Design/Interface Status

18 January 2023
ProtoDUNE-VD Design/Interface Discussions
Ryan Rivera - FD2 PDS L2

Prompt

- Any outstanding ProtoDUNE-VD design issues
- Any differences between FD2 and ProtoDUNE-VD that may be unresolved
- List of deliverables and what you are expecting from others including Neutrino Platform/I&I (we can compare your list of interfaces to Filippo's and look for any missing items)
- Any safety issues or outstanding engineering analyses that may be missing.
- Validation and QC before installation.
- Any requirements from others or issues that may lead to risks to the schedule (<https://indico.cern.ch/event/1227024/contributions/5162365/attachments/2556740/4406044/TB-23Nov2022.pdf>).

Module 0 installation plan (REVISED)	Fillippo	New
Bring in, assemble and lift the field cage support structure	Nov. 28	
Reposition the SGFTs and connect the cables for top CRPs	Dec. 5	
Install the vertical cable trays and the PDs supports on the walls	Dec. 12	
Install two CRP support structures and survey	Dec.12	
Install the first CRP without cathode in the upstream position	Dec. 12	
Cold Box test for PDS without CRP	Dec. 12	
End of the year break from 22nd of December to 4th of January		
CRP-5A delivered to CERN		Jan. 9
CERP 5 Integration and moved to Farady cage		Jan. 16
Cold Box Test for CRP 5		Feb. 2023
Install PD system on the upstream wall	Dec. 19	Feb. 6
Install the cathode on first CRP	Jan. 16	Feb. 13
Connect and test TDE on first CRP	Jan. 23	Feb. 20
Install the PD system on the downstream wall	Jan. 23	Feb. 20
Install the second CRP with cathode in the upstream position	Jan. 30	Feb.. 27
Cold Box test of CRP4 (if needed, or just a Faraday cage test)		Mar. 2022
Connect and test TDE on second CRP	Feb. 6	Mar. 6
Install the field cage except the walls to allow CRP insertion	Feb. 13	Mar. 13
Install the HV extender and the HV feedthrough	Feb. 20	Mar. 20
Install PD and CE penetration connect the cathode and the fibres	Feb. 27	Mar. 27
Remove and clean part of the false floor install first bottom CRP	Mar. 6	Apr. 3
Install and cable the second bottom CRPs	Mar. 13	Apr. 10
Test the BDE	Mar. 20	Apr. 17

20 October 2021

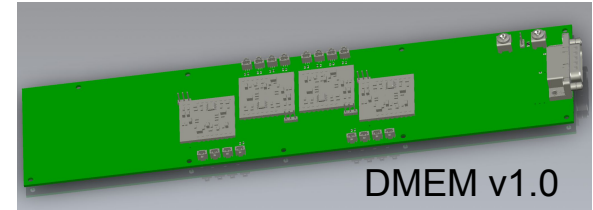
DOE Travel Request

Abbreviated and Complete Component List

- Red/Yellow Highlights show components on critical path for *‘upstream wall Feb 6’*
- Orange Highlights show components on critical path for *‘second cathode Feb 27’*
- Not much slack on others
 - Activities before final shipment still remain, and seem likely to succeed

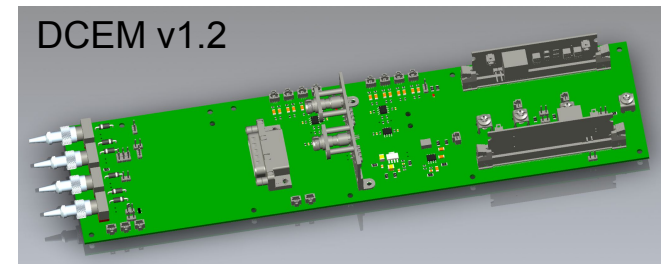
Component
Frame
Flex and SiPMs
Cables from flex to MB
Motherboard
Electronics box
Cold cables
WLS
Filters
Membrane Shielding Mesh
Membrane vertical supports
Response Monitoring System
Penetration
Frame to hold two mem. modules
Cathode fibers
Warm electronics

- Any outstanding ProtoDUNE-VD design issues



- The motherboard

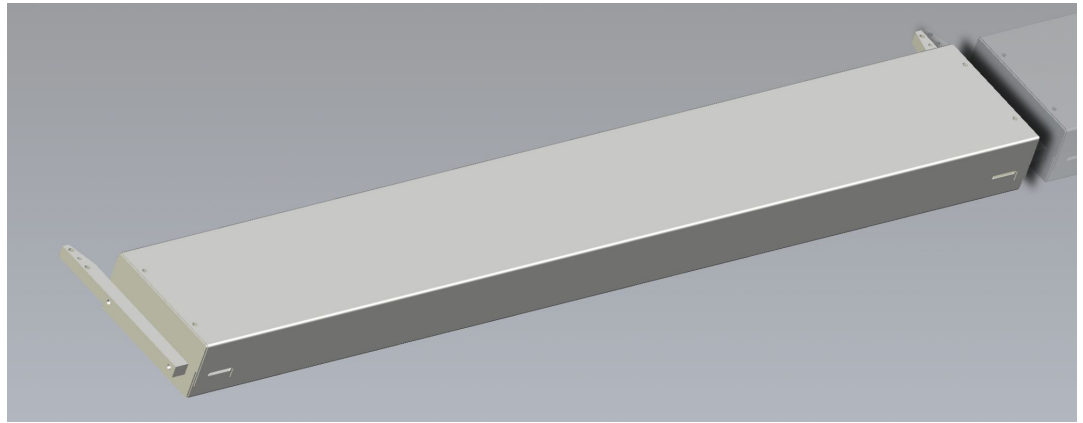
- We have downselected to two motherboards (DCEM v1.2 and DMEM v1.0)
 - (2) DMEM v1.0 {LV, bias, and signal over HD cold cable} at top membrane (for 4 XA)
 - (3) DCEM v1.2 {LV, bias, and signal over HD cold cable} at bottom membrane (for 3 XA)
 - (1) DCEM v1.2 {LV over HD cold cable, bias gen, and SoF} at bottom membrane (for 1 XA)
 - (8) DCEM v1.2 {PoF, bias gen, and SoF} at cathode (for 8 XA)
 - (9) bias gen locations
 - Need a decision on split from Bias breakout meeting
 - Early indications are at least half will be LBL bias
- We saw instability in the December Cold Box.
- The capacitor selection has been a primary focus, Mike Miller has identified 4 bad selections and replacements in the last week.
- Grounding and shielding is an issue
 - Likely requiring board hacks to DB connector



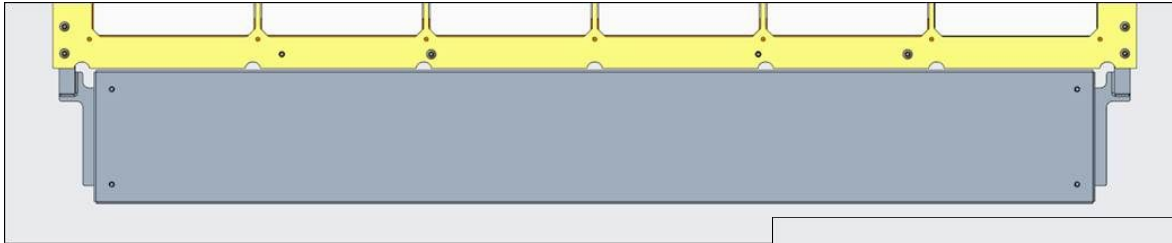
Cold Box must be highest priority

- We must understand what happened with Cold Box now open and demonstrate stability in the February Cold Box in advance of the **Final Design Review (March 21-23)**
- Week of January 23rd the Cold Box will close again
- As of 17-Jan, I have not heard confirmation from CERN that we can blame capacitors!
- In parallel, Mike Miller has already identified issues with the 4.7uF 1206 and 0805, 47uF 1206, and 100uF 1210 we populated and identified replacements:
 - 4.7uF 0805 should be TDK C2012X7R1H475K125AE
 - 4.7uF 1206 should be Murata GRJ31CZ72A475KE01L (cold maintains 92% of capacitance)
 - 100uF 1210 should be AVX 1210ZD107MAT2A
 - 47uF 1206 should be TDK C3216X5R1E476M160AC
- The capacitors affect the DCEM v1.2 and DMEM v1.0

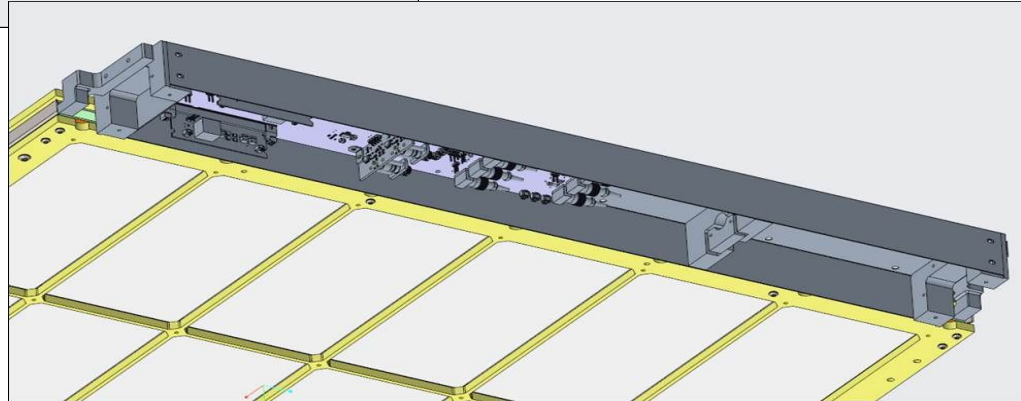
- **Any outstanding ProtoDUNE-VD design issues**
- The Membrane electronics box (for HV discharge protection)
 - Paul at Iowa finishing the drawing 12-Jan, model posted 13-Jan. Targeting shipping 18-Jan. Need update from Iowa.
 - Needed to hold date 'upstream wall Feb 6'



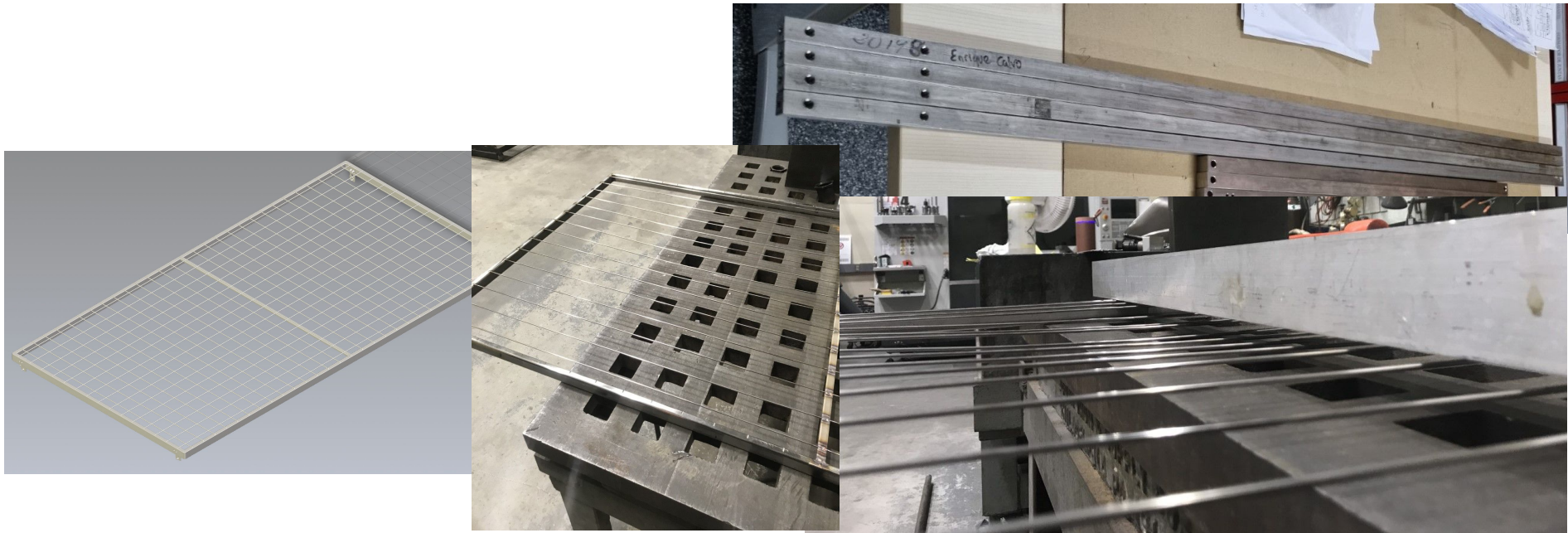
- Any outstanding ProtoDUNE-VD design issues
- The Cathode electronics box (for HV discharge and light leakage protection)
 - Christian at Iowa finished the design 13-Jan, expects to have all parts received 18-Jan. Targeting Peter carrying 22-Jan.



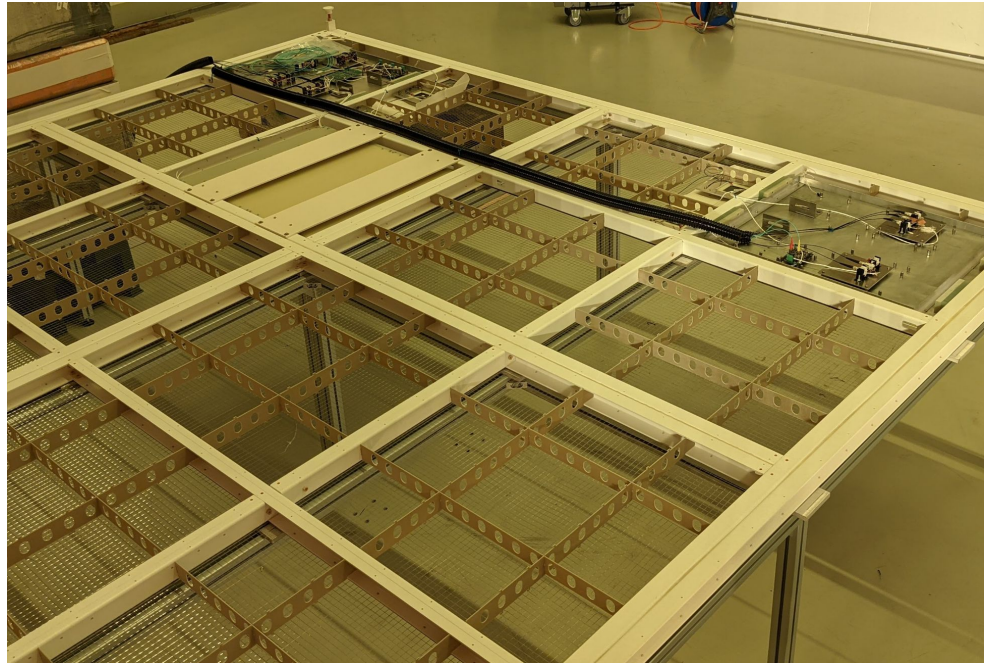
- Concept is shielding box with motherboard is installed in cathode, then cathode moved into cryostat, then fibers routed to motherboard, then fibers potted, then box lid closed, then cathode mesh closed.
- Still developing plan for potting fiber termination to minimize light leakage



- Any outstanding ProtoDUNE-VD design issues
- The membrane shielding mesh
 - Jim at Stony Brook working to solve wire sag issue, plans to ship 18-Jan
 - Enrique at CIEMAT working to solve counterweight issue, plans to ship 18-Jan



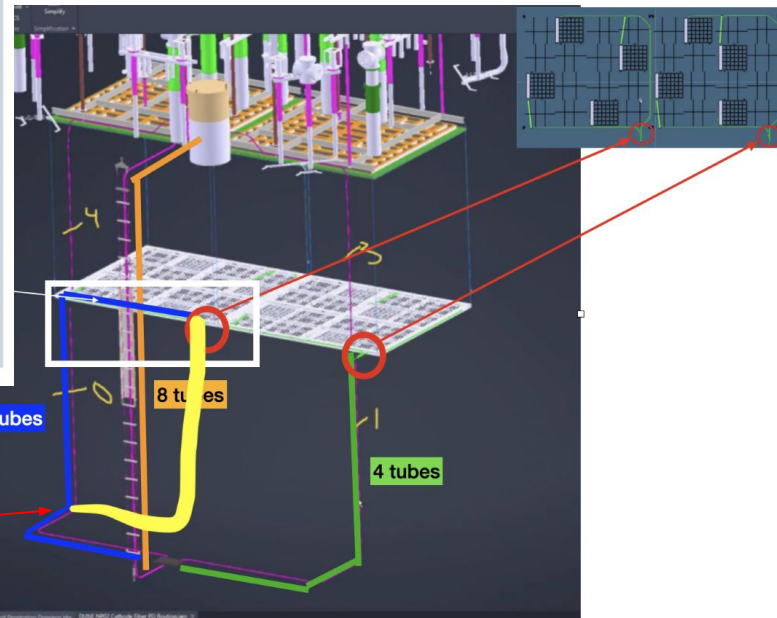
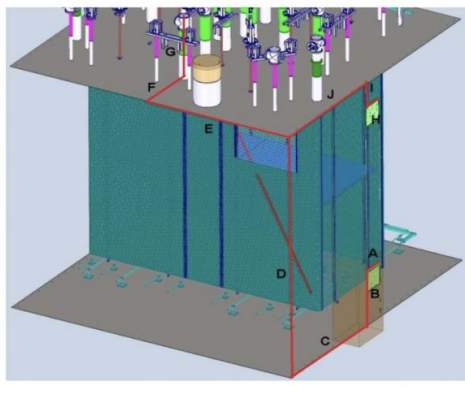
- Any outstanding ProtoDUNE-VD design issues
- The cathode mesh supports
 - Paul at Iowa knows Philippe is waiting for a model as of 13-Jan.
 - Waiting on update from Iowa



- Any outstanding ProtoDUNE-VD design issues
- Exact path, strain relief, dressing of cables and fiber route not defined.
Concept defined:

ProtoDUNE-VD-PDm Cables length

	Cable length Bottom	Cable length Top	
A		650	
B		1700	
C		3800	
D		7900	
E		4200	4200
F		1600	1600
G		2100	2100
H		650	
I		750	
J		3800	
Length (mm)	21950	13100	



Yellow path for 4 tubes is correct,
Not blue path leaving floor.

- **Any differences between FD2 and ProtoDUNE-VD that may be unresolved**
- Response Monitoring System installation plan has not been defined for FD2
 - For ProtoDUNE-VD there is space to resolve installation after field-cage goes up; not true for FD2
- Cathode fiber installation plan is the same for FD2
 - Unless revisiting of splicing, pulling up, or connectors

- List of deliverables and what you are expecting from others including Neutrino Platform/I&I
- Two scissor lifts for installation of each membrane XA
 - Is there any information for training that can be shared? We have some on team already trained at CERN.
- Shared cable tray with BDE cables? Cable and fiber path to penetration?
 - We could use some help with details here. Spanish team arrives 23-Jan.
- Warm-side electronics rack
 - PoF and digitizers. Where do we locate?
- HV discharge events
 - Is there a plan for discharging on purpose?



- **Any safety issues or outstanding engineering analyses that may be missing.**
- We have approval on 04-Oct-22 from James Devine and CERN HSE team for
 - 330m of black PTFE 3/8" ID 1/2" OD tubing
 - 2000m of black ETFE 1.5mm OD optical fiber
 - There is a specific exemption in the CERN SSI-FS-2-1 safety rule (https://edms.cern.ch/ui/file/2669584/LAST_RELEASED/SSI-FS-2-1_EN.pdf) for optical fibres in cryogenic applications, so no derogation is necessary.
- **Power-over-Fiber verification and operation**
 - Re-evaluation for EHN1 test stand: Laser Safety document drafted by Peter Shanahan and shared with Filippo. Next steps?
 - Same concepts and components apply for ProtoDUNE2, but larger scale and more interfaces
 - We need clear documented procedure which is required before turn-on
 - We will want to turn on to check fiber continuity after each cathode install
- **Items we plan to discuss with the compliance office:**
 - Understand the cable loading on the flange
 - Better study the cable load on the trays, and motion in the LAr thermal flow
 - Confirm that the HV shielding we are building meets needs
 - Understand the impact of the extra mass on the membrane supports

- Validation and QC before installation.
- Each X-ARAPUCA will be cold tested at EHN1 test stand before installation

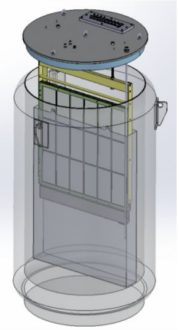


Figure 3. Left and middle: the dewar with inner dimensions 70 cm diameter and 120 cm height. Right: 3D model of the entire dewar setup

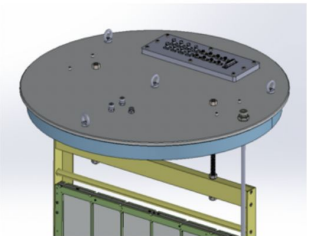
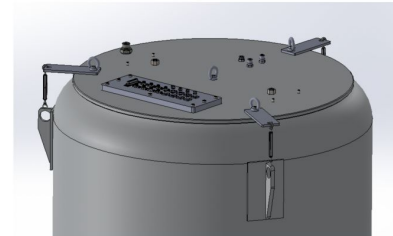
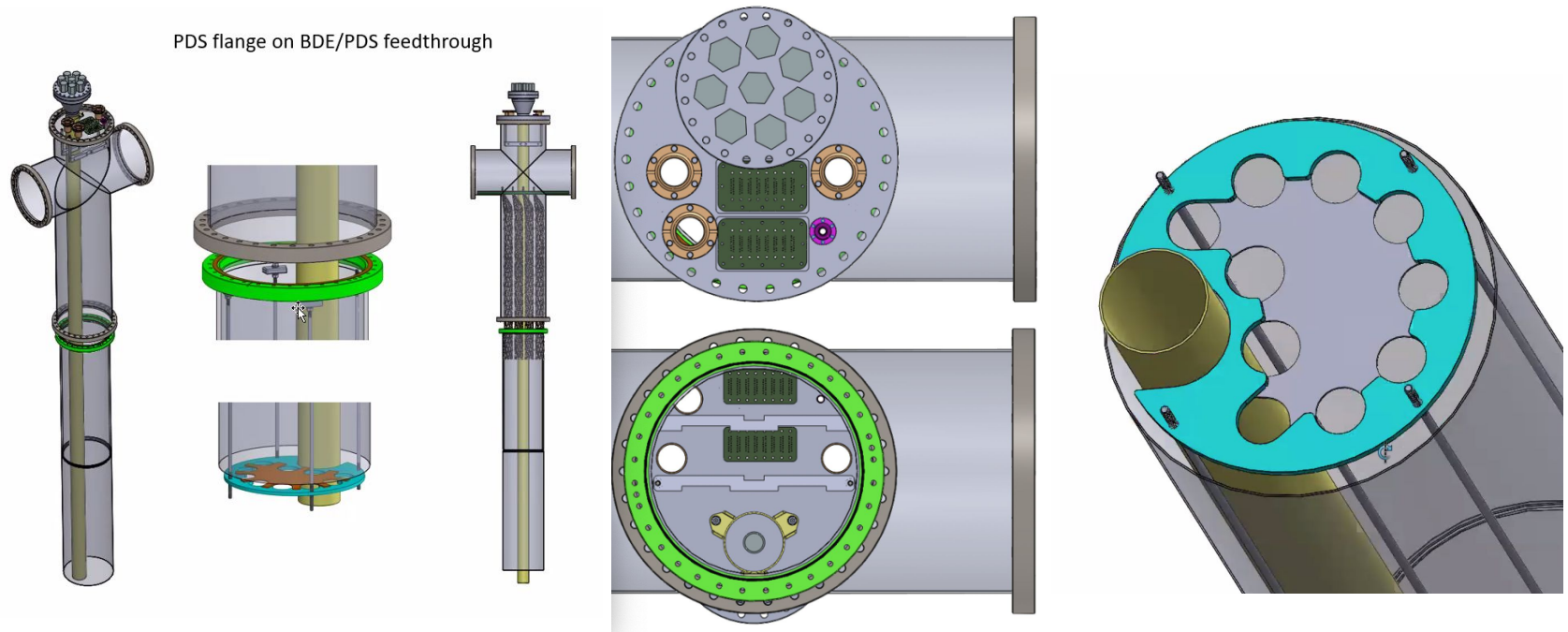


Figure 4. 3D model of the dewar lid

- Any requirements from others or issues that may lead to risks to the schedule
- The activities on the penetration shared between BDE+PDS will have to be coordinated well



- Any requirements from others or issues that may lead to risks to the schedule
- The activities on the penetration shared between BDE+PDS will have to be coordinated well
- When will we verify cathode XA installation - turn on PoF and see SoF returned for each XA to test cathode XA installation?
 - Is it only after the penetration is established in this line:

Install PD and CE penetration connect the cathode and the fibres	Feb. 27	Mar. 27
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- At this point, will we still have access to the cathode XA from below if an issue is identified?
- Or do we need a temporary topology for the power- and signal-over-fiber test?