

Overview and Procurement Plan

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Cold Cables Procurement Readiness Review (PRR-Stage1)

13 December 2024



- TPC Electronics Consortium is requesting the Committee to assess our readiness to proceed with the procurement of cold cables for both HD and VD
- Four types of cold cables:

power	data	HV bias
 <p>Low Voltage Power Cable</p>	 <p>Samtec Signal/Clock Cable</p>	 <p>High Voltage SHV</p>
	 <p>MiniSAS Signal/Clock Cable</p>	<p>Note: cable requirements will be covered in Volodya's talk</p>

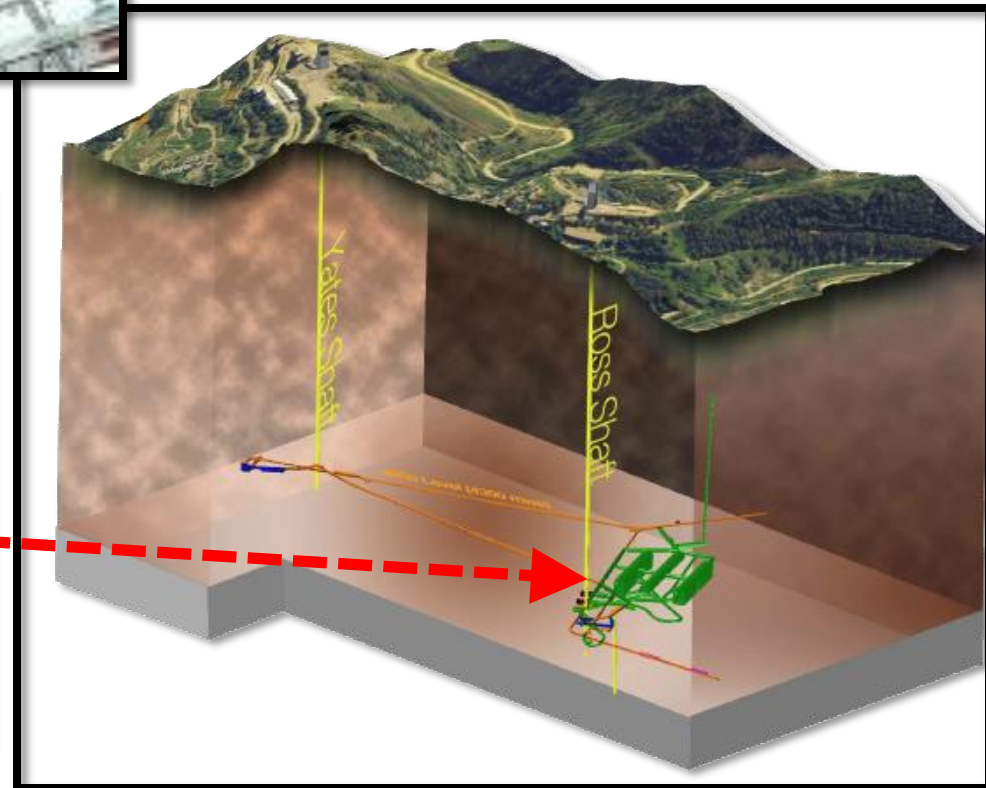
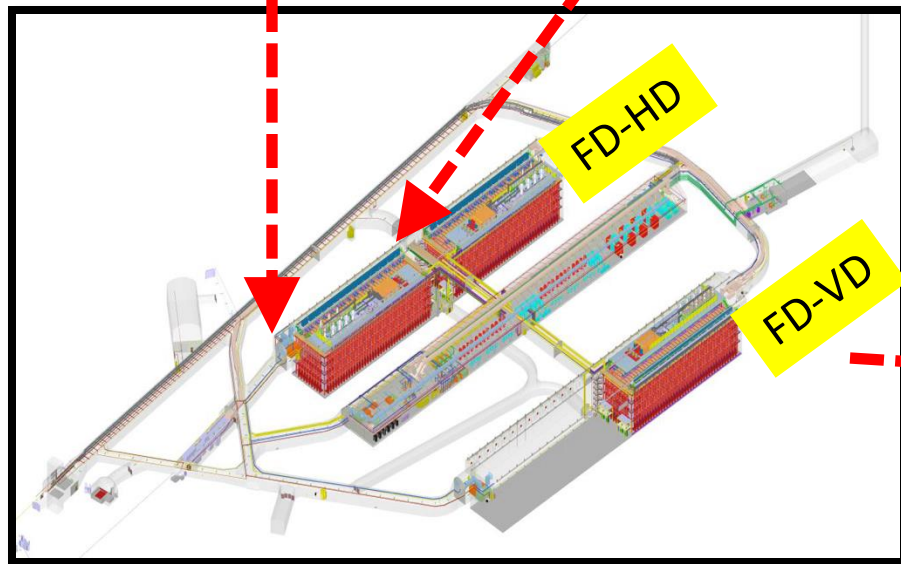
Review Documents

- Document spreadsheet link is available on the Review Indico page ([EDMS#3207496](#))
- Some key documents:
 - Technical Design Reports for FD-HD and FD-VD
 - Cable design files
 - Compliance Office reports
 - Procurement and storage plan
 - QC plan
 - Recommendation tracking
- Let us know if there are other information that you need for the review

DUNE Far Detectors

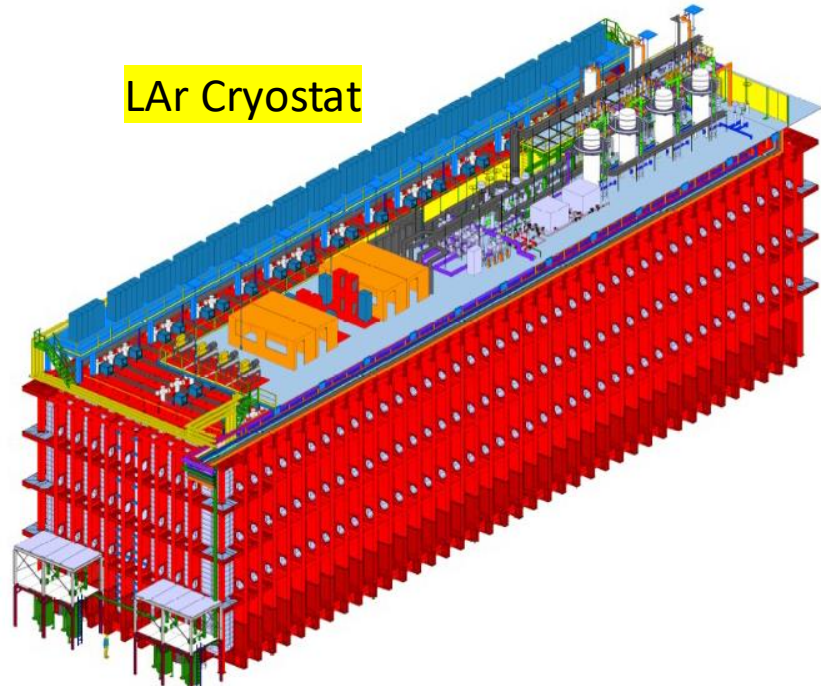
Four 10-kTon (fiducial)
liquid argon detectors

~1500m underground



DUNE Far Detector (HD)

LAr Cryostat

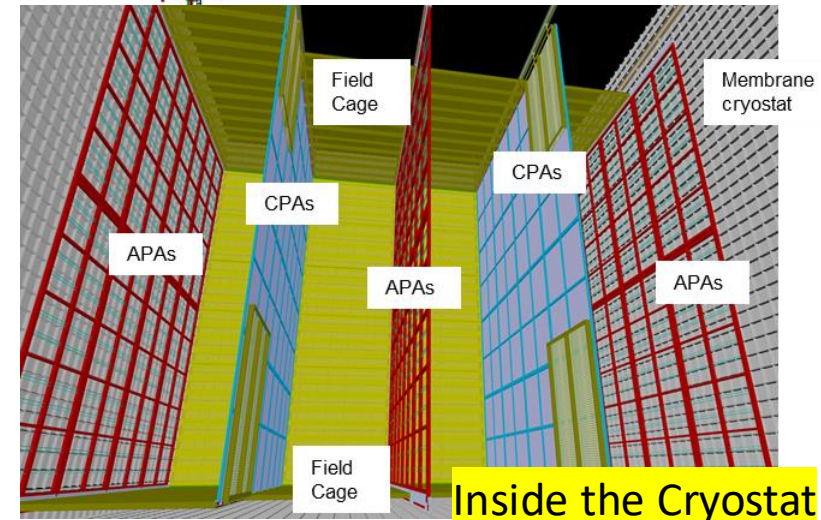


Cryostat dimensions:

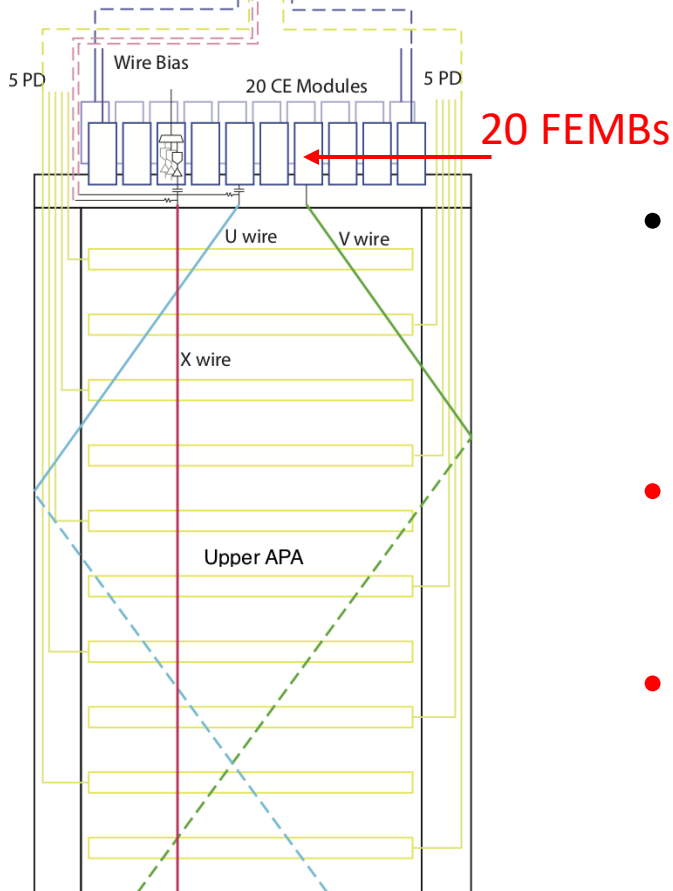
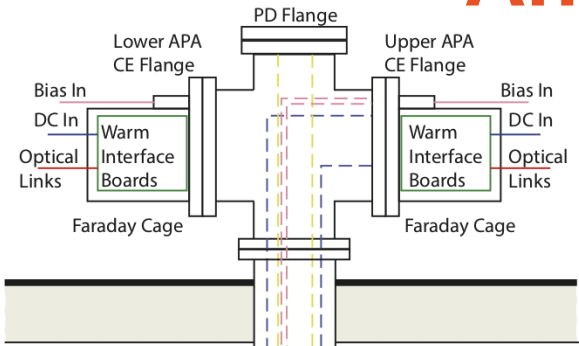
~65m (L) x 19m (W) x 18m (H)

Time Projection Chamber (TPC) Elements:

- Anode Plane Assembly (APA). Sense wires for detecting drift electrons in the TPC
- Cathode Plane Assembly (CPA) at -180kV. Electron drift field of 500V/cm
- Distance between CPA and APA plane = 3.5m (maximum electron drift distance)

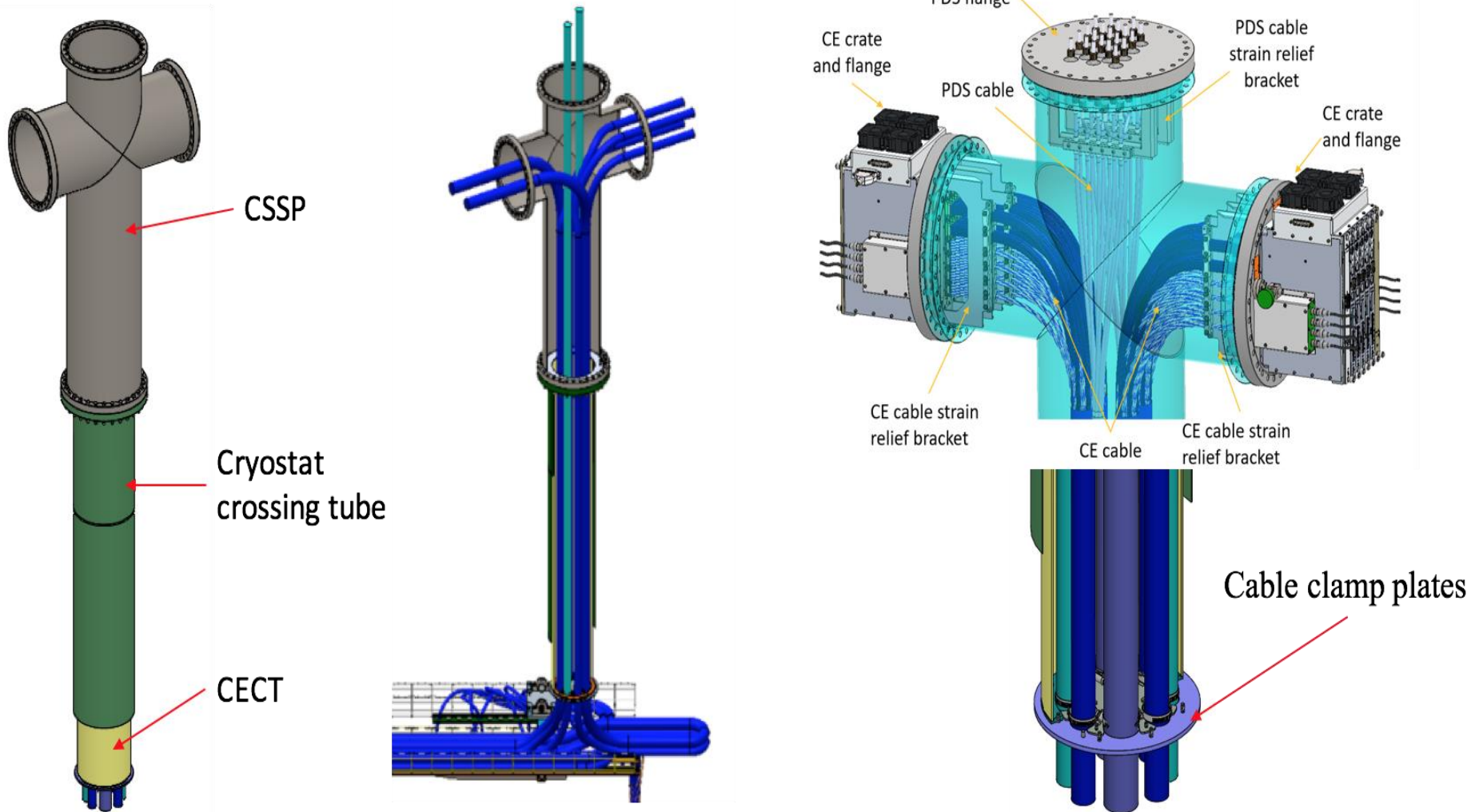


Anode Plane Assembly (APA)



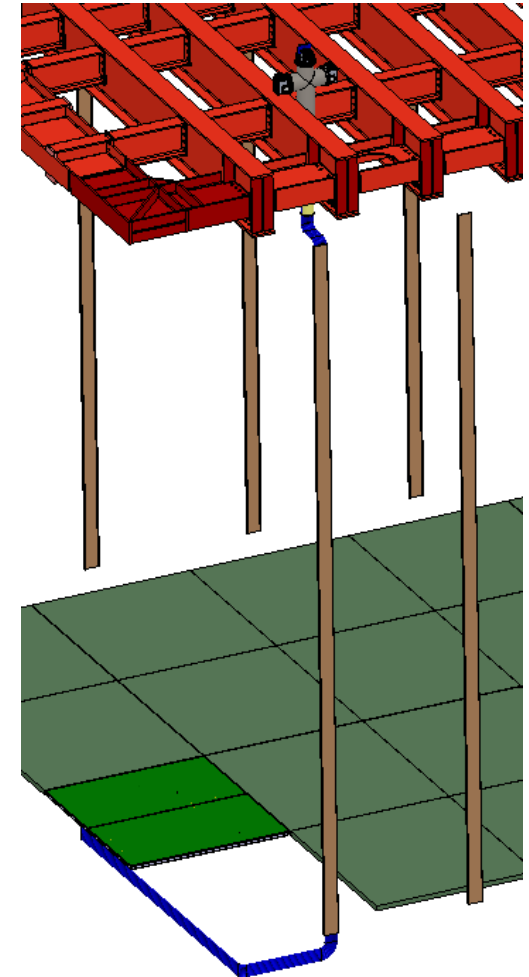
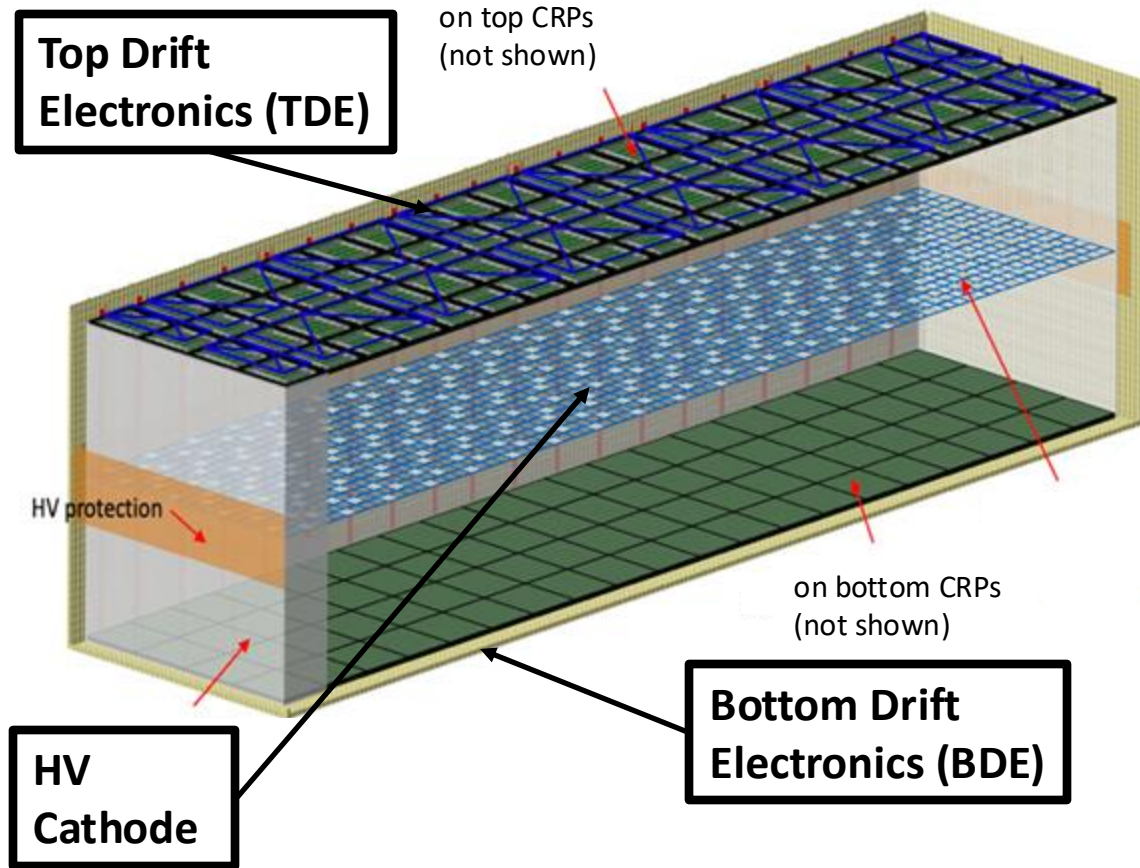
- FD-HD has 150 APAs
- Each APA has four wire planes:
 - 960 grid wires (un-instrumented)
 - 800 U (1st induction wires)
 - 800 V (2nd induction wires)
 - 960 X (collection wires)
- 20 Frontend Motherboards (FEMB) are mounted on the top of each APA and connected to 2560 sense wires
- Cold cables (data, power, bias) are routed from the APAs to the penetration flange
- Some SHV bias cables are routed to the field cage termination boards and ground plane monitors

Cold Cable Routing Through Cryostat Penetration



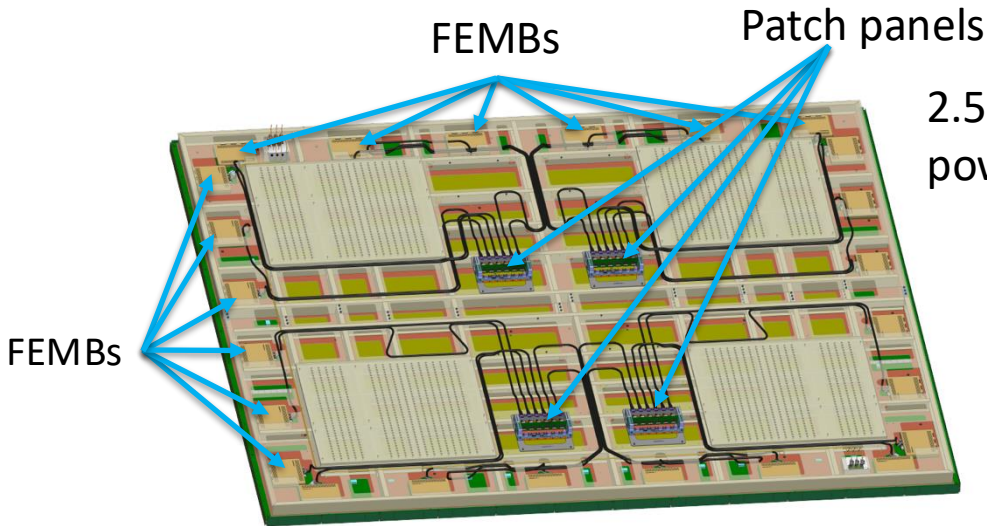
FD-VD cables are routed through the penetration in a similar way

DUNE Far Detector (VD)

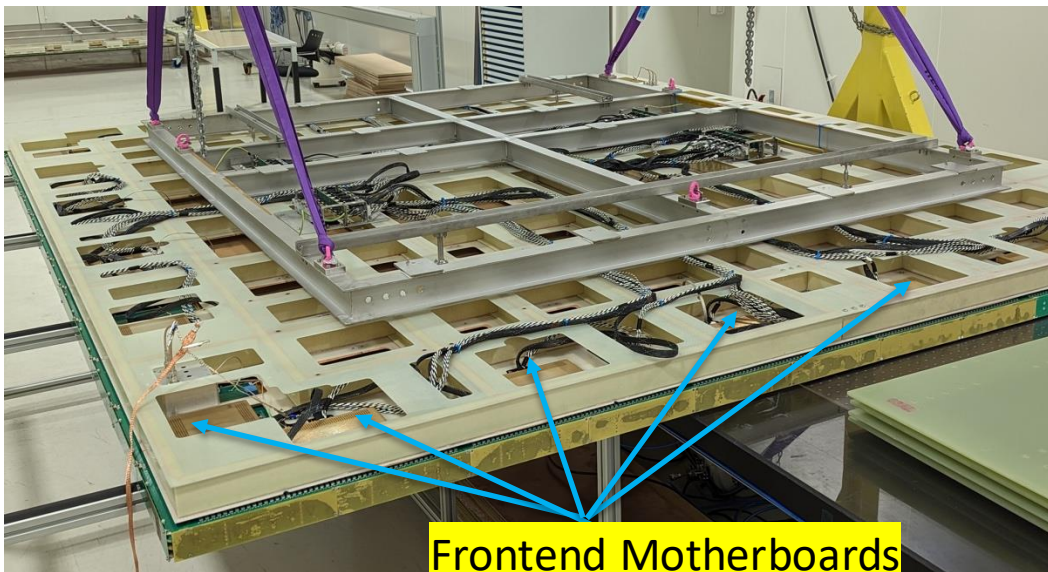


Long 27 m signal, power, and HV bias cables for Bottom Drift Electronics Cables are routed vertically along the cryostat wall

Cold Cables on Bottom CRP

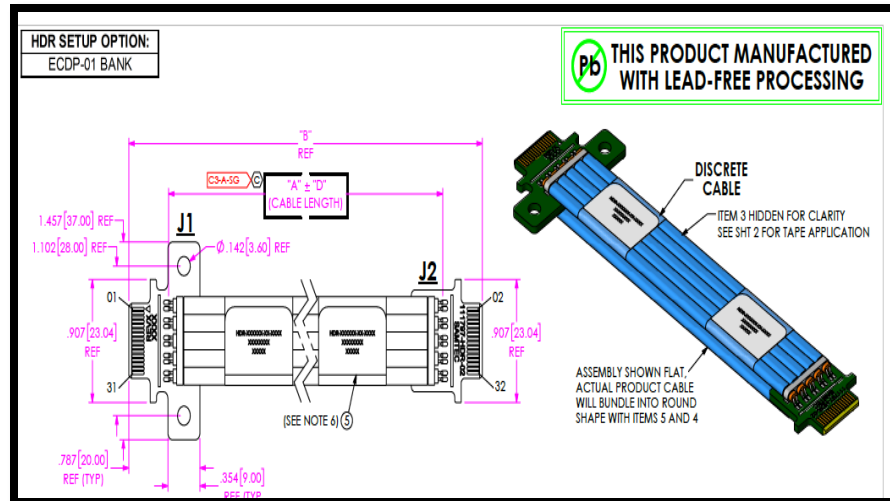


- Frontend Motherboards are mounted at the CRP factories during CRP assembly
- MiniSAS and power cables (2.5 m long) connect between the FEMBs and the patch panels on the CRP



Cold Cable Procurement Plan

- Cold cable procurement plan is discussed in [EDMS#3208023](#)
 - Will discuss the Samtec Signal/Clock cable procurement here.
- Please refer to the Procurement Plan for the other three cables



- Quantities needed:

	FD-HD		FD-VD	
	Required	Spare	Required	Spare
9 m	1500	350	N/A	N/A
22 m	1500	250	N/A	N/A
27 m	N/A	N/A	1920	280

Note: 120 9-m cables in the spare pool will be used for the Cold Box at SURF

Cold Cable Procurement Plan

- Samtec Signal/Clock cable procurement is the most challenging one for us:
 - Total cost exceeds \$5M; Will take ~250 working days to process through BNL's procurement office
 - Samtec plans to phase out the production line. Will accept order until March 31, 2025
 - Need CD-3C ESAAB authorization
- Decision was to procure 9-m Samtec cables through Fermilab and the longer cables (22 and 27 m) through BNL
- BNL procurement should be ready to submit the order in January. Fermilab should be ready to submit the order in March
- If CD-3C ESAAB is not authorized by late January. Will need to request a BCR to move the Samtec signal cable to CD-3B

Cold Cable Procurement Plan

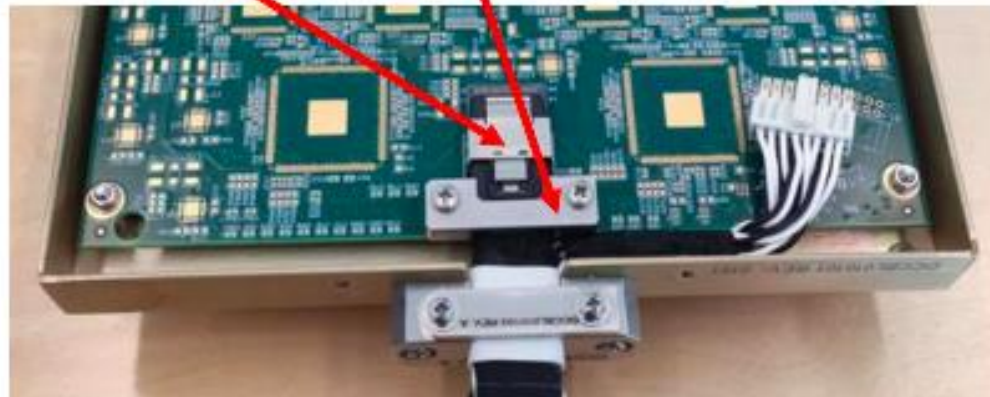
- Delivery schedule will be negotiated with the vendor at the time of PO submission. Based on past experience and lead time, the expected delivery schedule is as follows
 - **27 m cable:** delivery deadline for the first batch is June 2025, with the final delivery in February 2026. Cables delivered in four batches
 - **22 m cable:** delivery deadline for the first batch is April 2026, with the final delivery in April 2027. Cables delivered in five batches
 - **9 m cable:** delivery deadline for the first batch is June 2025, with the final delivery in April 2027. Cables delivered in five batches

Charge Question 2

- Charge question: “Are there any further relevant reviewer comments and recommendations based on design changes implemented since the FDR?”

There have been no changes to the cable design since FDR. However, in one of the CRP cold box tests, we lost communication with one FEMB. Postmortem study revealed that the MiniSAS connection on the FEMB had some “extra degrees of freedom.” The cable strain relief system was modified to improve the MiniSAS connection on the FEMB, and no further issues with that connection have been observed since.

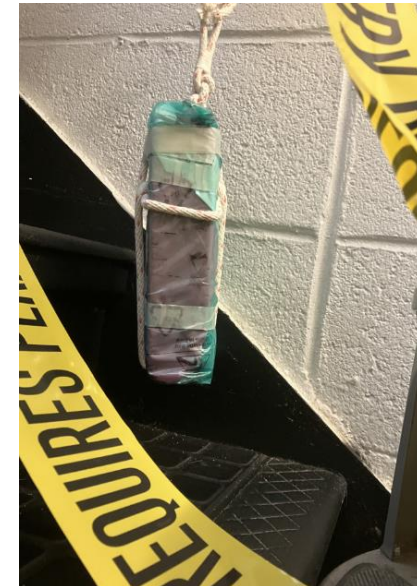
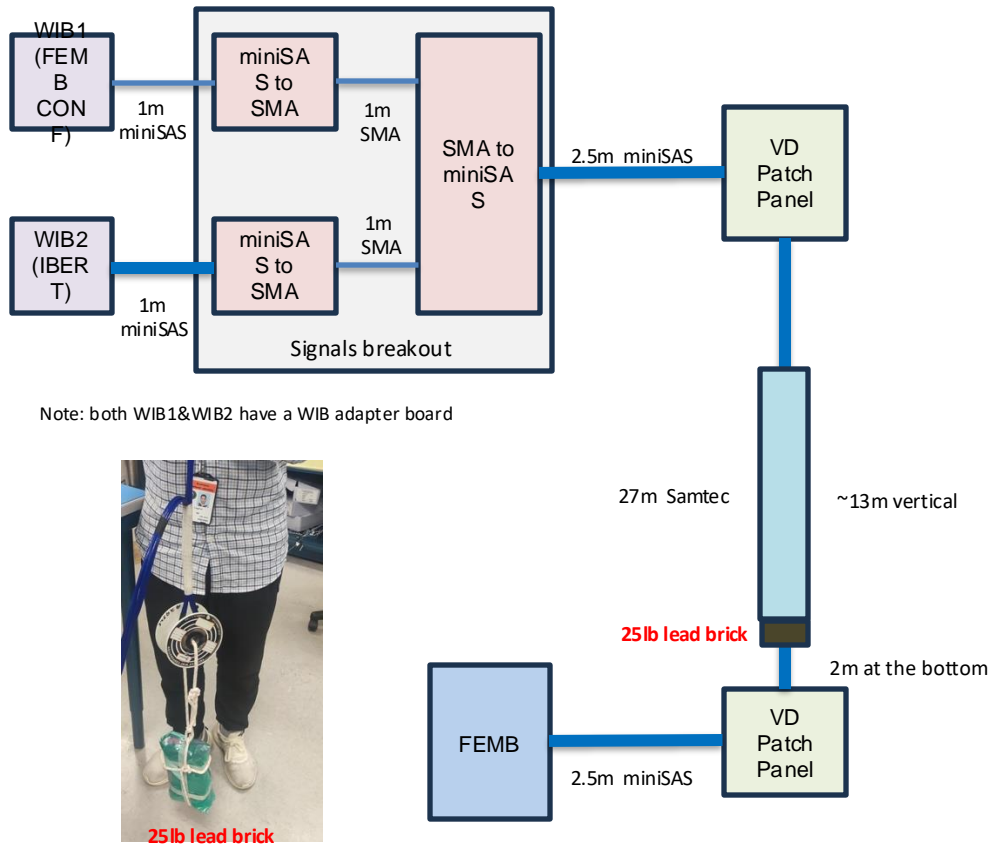
- Move **miniSAS connector** and add **cable clamp** on board for better strain relief



Past Recommendation

- Recommendation: “Follow through with plans to do bit error rate testing of cables under mechanical stress”
- Our initial plan was to perform the cable stress test at the end of NP04 operation. However, access to NP04 is not available until spring 2025. We decided to perform the cable stress test at BNL so we can have the results ready for the PRR
- See “ColdCable_BER_Test.pdf” in [EDMS#2086113](#) for details
- Test was successfully completed the week of 10 Dec 2024. Not bit error detected → BER was $< E-15$ with cables under mechanical stress

Setup with cables hanged and extra load



BER result (0 error, BER < 8.8E-15)