

# ProtoDUNE-VD Integration Meeting: Bottom Drift Electronics Summary

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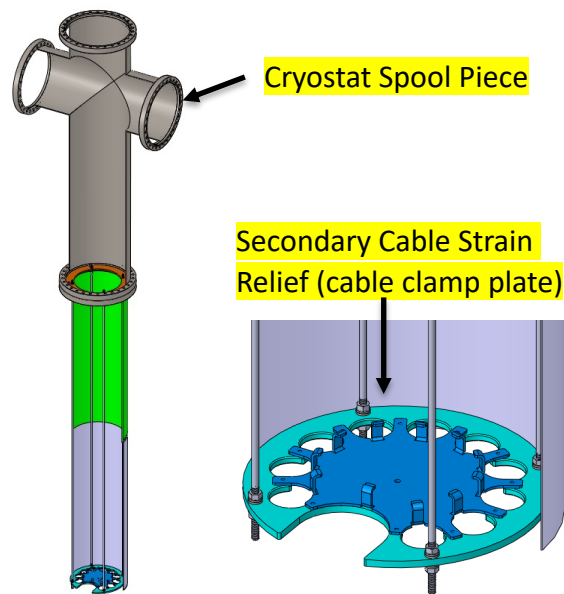
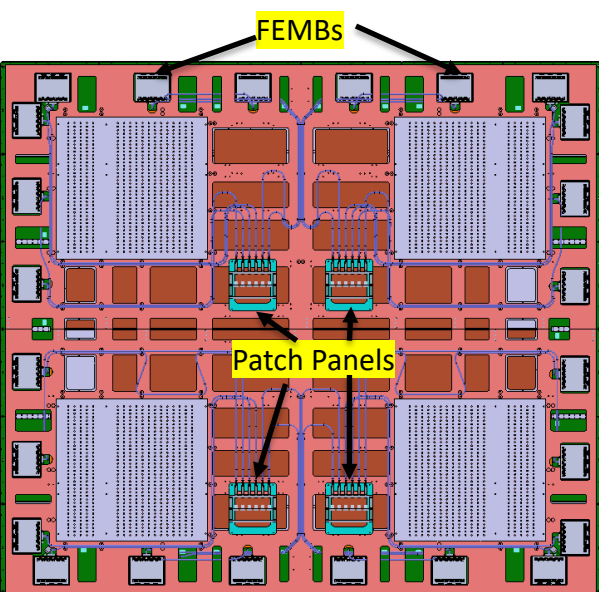
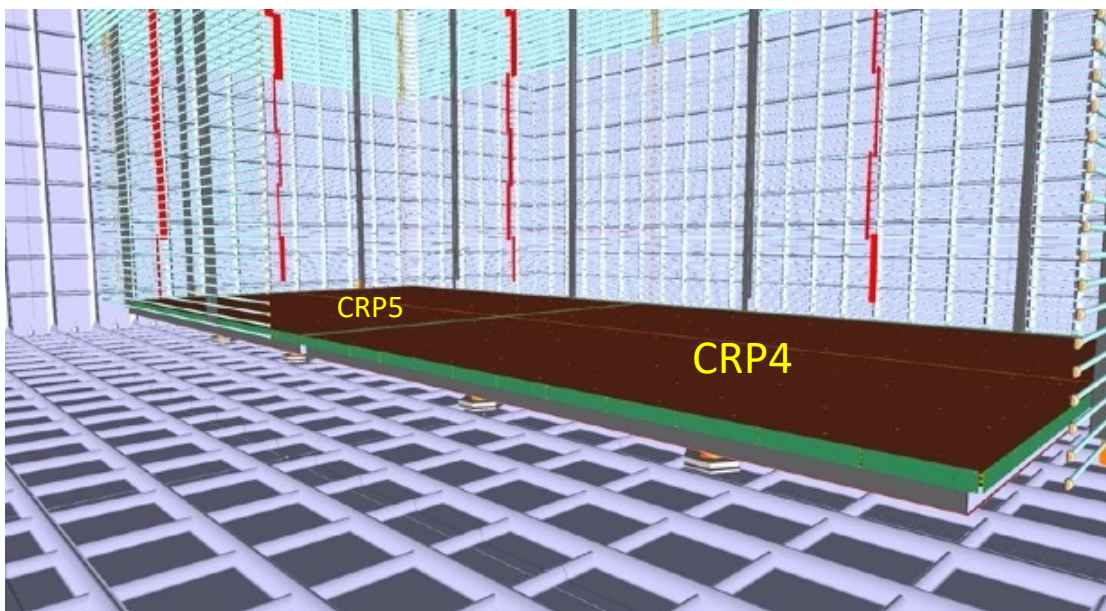
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# Bottom Drift Electronics Deliverables for ProtoDUNE-VD

Responsible for the readout electronics for the two bottom CRPs (CRP#4, and #5):

- 48 Frontend Motherboards (24 per CRP)
- 8 patch panels (4 per CRP)
- 25-m cold cables: 48 signal (SAMTEC), 48 low voltage power cables, and 6 SHV bias cables
- ~2.5m cold cables: 48 mini-SAS and 48 low voltage power cables
- Warm Interface Electronics Crate (x2)
- 12 Warm Interface Boards (6 per WIEC)
- 2 Power and Timing Card (1 per WIEC)
- Cryostat spool piece (CSSP)
- Secondary cable strain relief system



Status Color Codes:

- Green = in hand
- Orange : ordered (vendor delivery end of January). Have some 22-m SHV cables that could be used as backup
- Blue: fabricating new PTC soon. Plan to use ProtoDUNE-I PTC until new PTC is available
- Red: in production now (expect delivery in middle of Feb)

# ProtoDUNE-VD Integration with Other Consortia

## DCS and Slow Control:

- Plan to use the existing PL506 and HV bias supplies in EHN1
- Expect Neutrino Platform to provide warm cable connections (48V, bias SHV, fan power/RTD cables) to the WIECs
- Provide DCS software control and monitoring plots

## DAQ:

- Expect DAQ Consortium to provide and install the fibers (data, timing, and ethernet) for connections to the WIBs and PTCs

## PDS:

- Routing cables and fibers through the penetration at the same time as the BDE cables

## CRP:

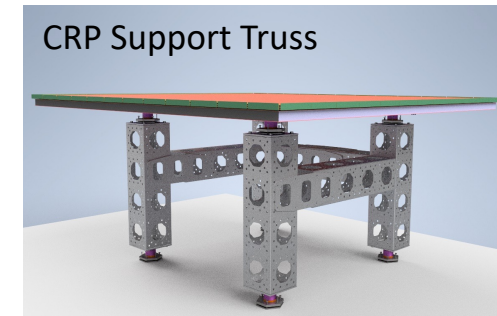
- Expect CRP Consortium to provide the HV bias filter boxes on the CRP
- Expect CRP Consortium to transport the CRPs to inside the NP04 cryostat
- Expect CRP Consortium to provide the temporary support truss for the BDE cable installation

## I&I:

- Expect I&I to provide and install the vertical cable trays
- Expect I&I to provide support to secure BDE cables to the vertical cable trays

## Neutrino Platform:

- Provide logistic support (crane operation, machine shop if needed, minor board rework if needed, etc.)
- May need additional cable trays installed inside NP04. In particular, support long horizontal span on top of the cryostat



# Differences Between ProtoDUNE-VD and FD2

## Cold Cable Routing:

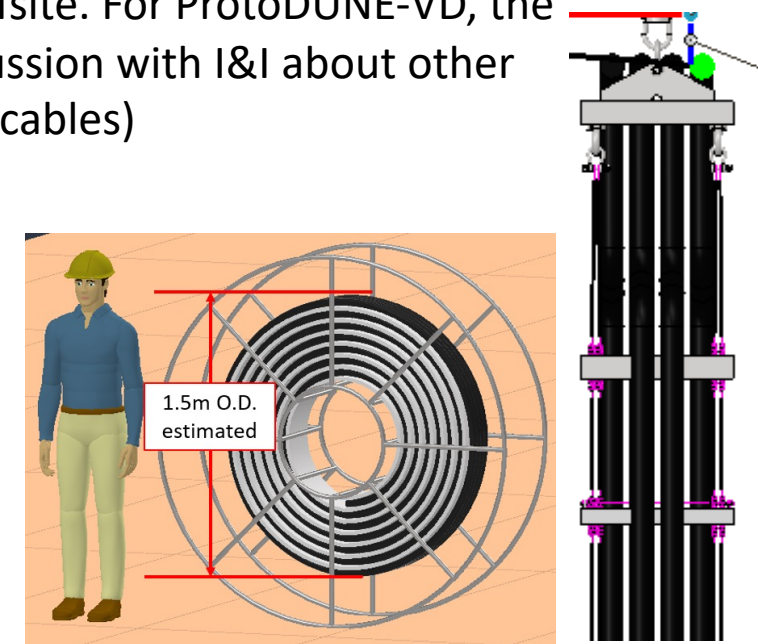
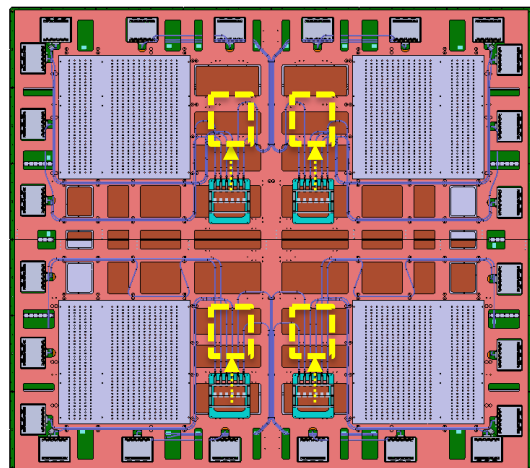
- Using the same 25-m long cables for ProtoDUNE-VD and FD2, but NP02 is only ~half as tall as FD2 cryostat
- Placement of the cryostat penetration relative to the CRPs is different. Have easier access to cryostat penetration in NP02. For FD2, no access to the penetration after the field cage is installed.

## Vertical Cable Tray Assembly:

- Vertical cable tray is only half height
- For FD2 we plan to integrate the BDE cold cables with the the vertical tray offsite. For ProtoDUNE-VD, the nominal plan is to install the BDE cables after the cable tray is installed. Discussion with I&I about other options (e.g. remove the vertical cable tray after trial installation to add BDE cables)

## Placement of Patch Panels:

- For ProtoDUNE-VD, CRP#5 the center patch panels are displaced from the nominal positions to allow access under the cold box roof and avoid interference with metal lifting frame
- For FD2, long cable connections are done from the side facing the TCO

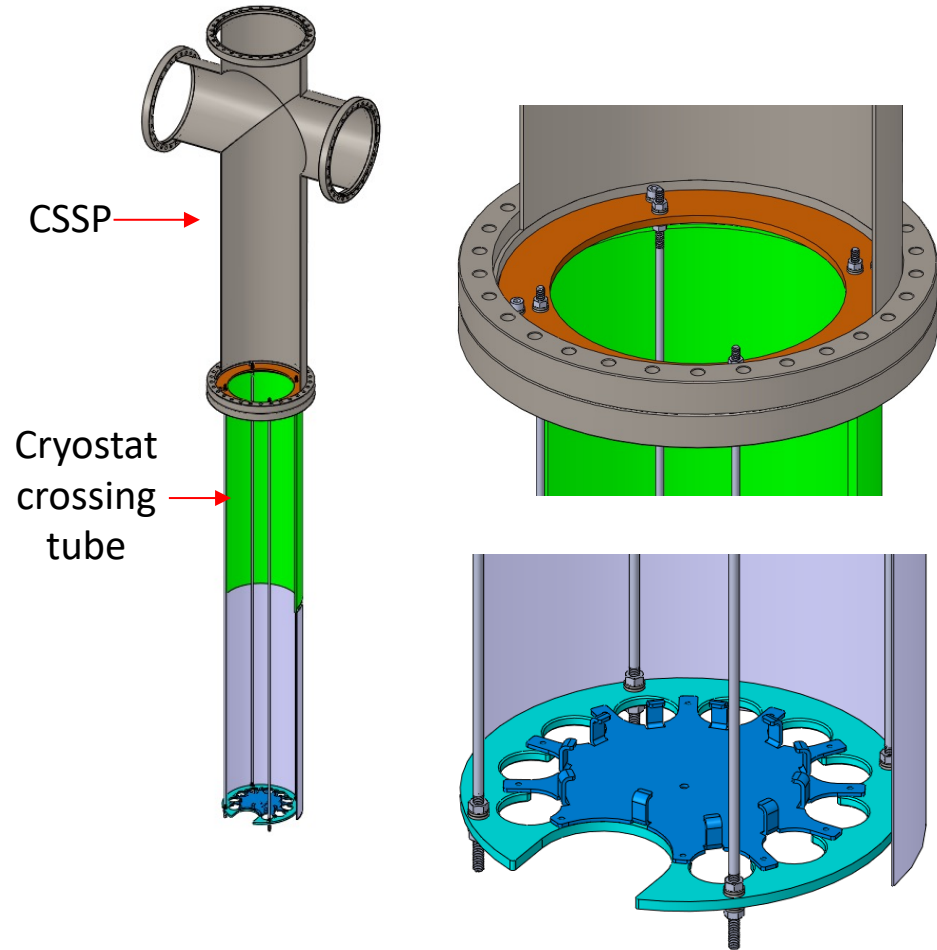


## Expected Changes In Progress:

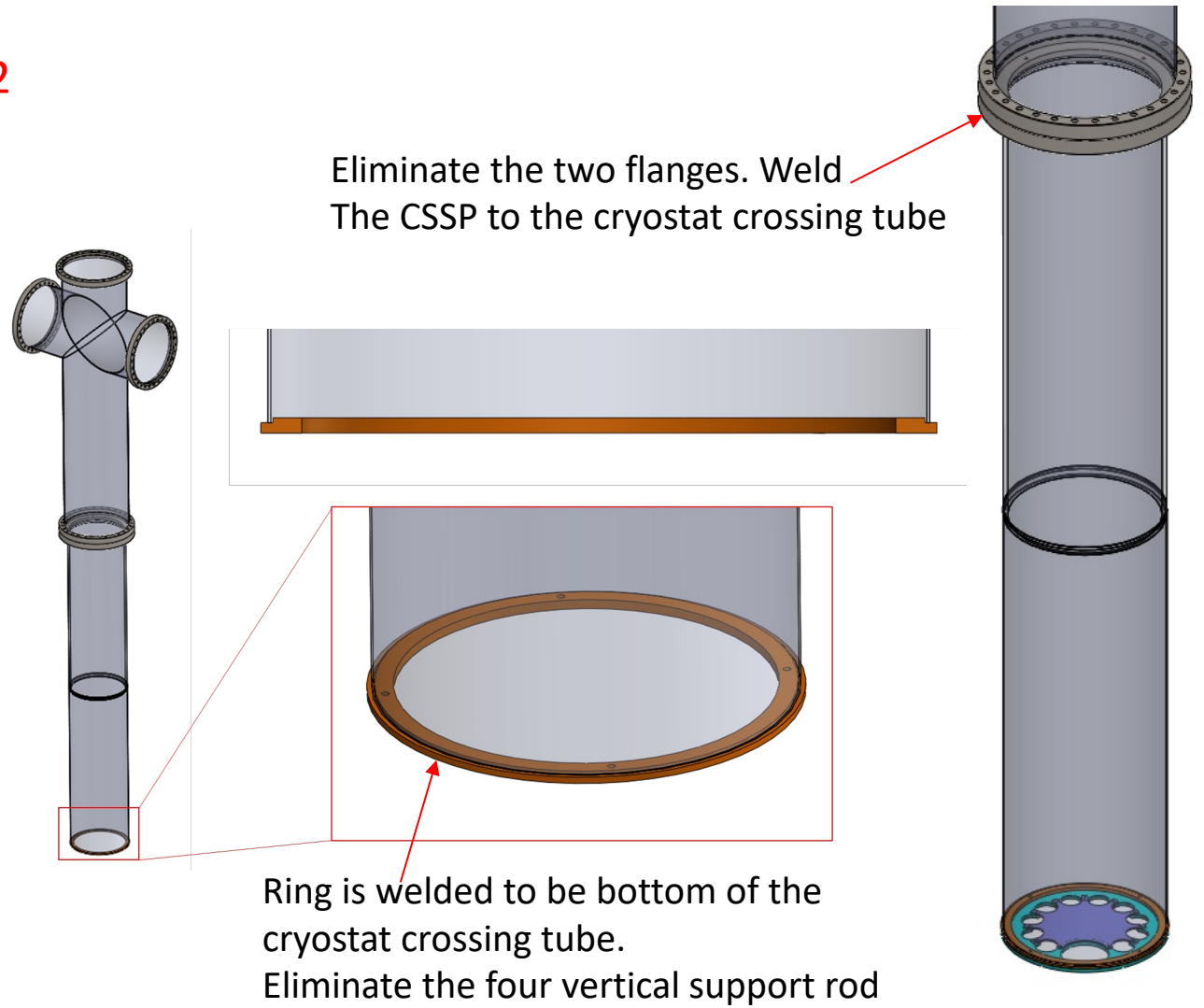
- We are working with DAQ Consortium to migrate from FELIX to ethernet based readout. Will start the integration work on the Vertical Slice Test-stand in the DAQ barrack. Expectation is to transition to ethernet based readout on the time scale of ProtoDUNE-VD run
- Starting the fabrication of the new Power and Timing Card. Expectation is that we will use the new PTC for the ProtoDUNE-VD run
- Will test and integrate the CE Safety Interlock System at ICEBERG in the spring. The plan is to move the setup to NP02 after the system is fully debugged at ICEBERG

# Cryostat Penetration Design

## Nominal Design for ProtoDUNE-VD and FD2

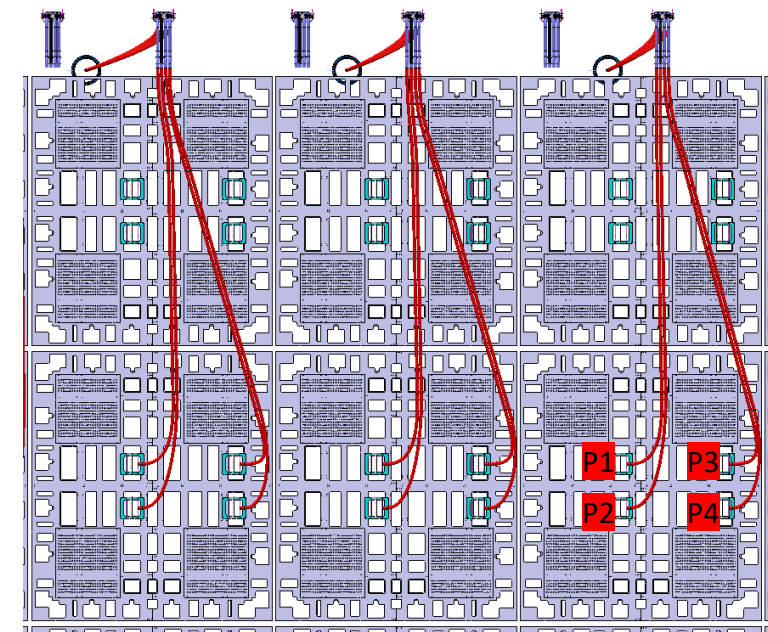
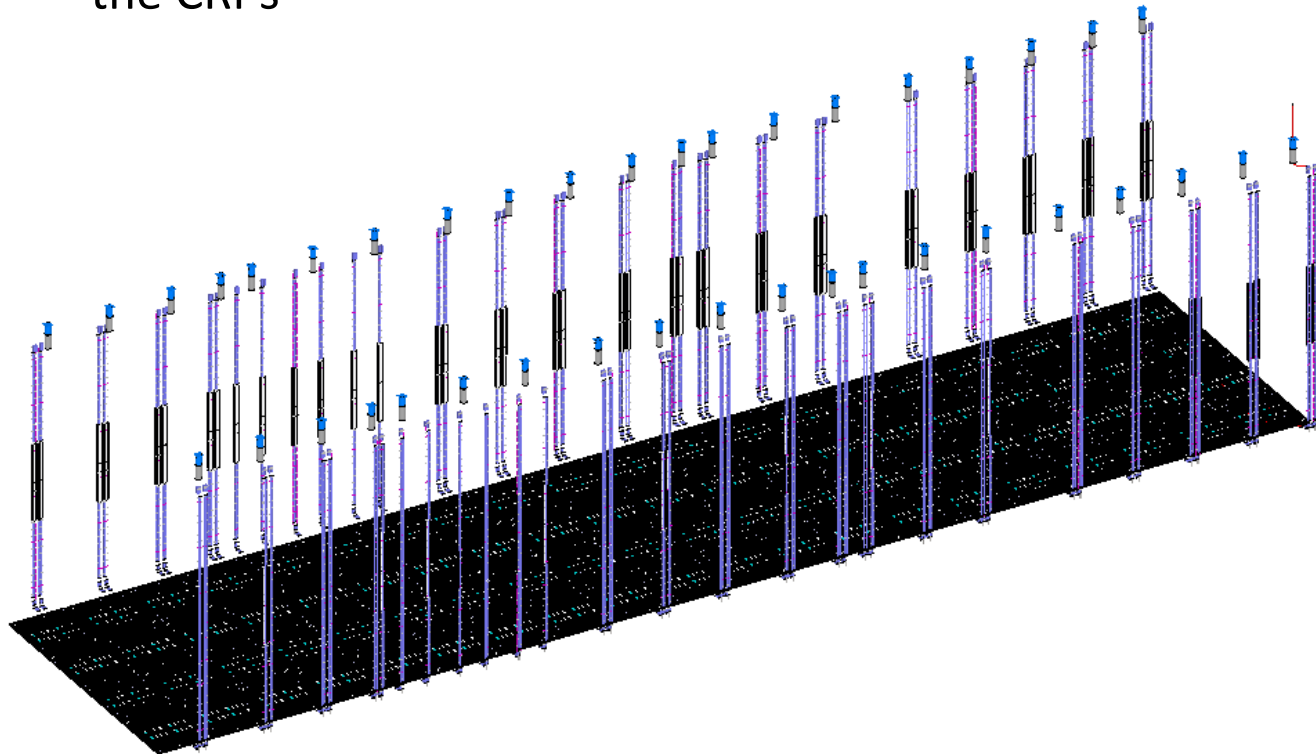


## Alternative FD2 Design

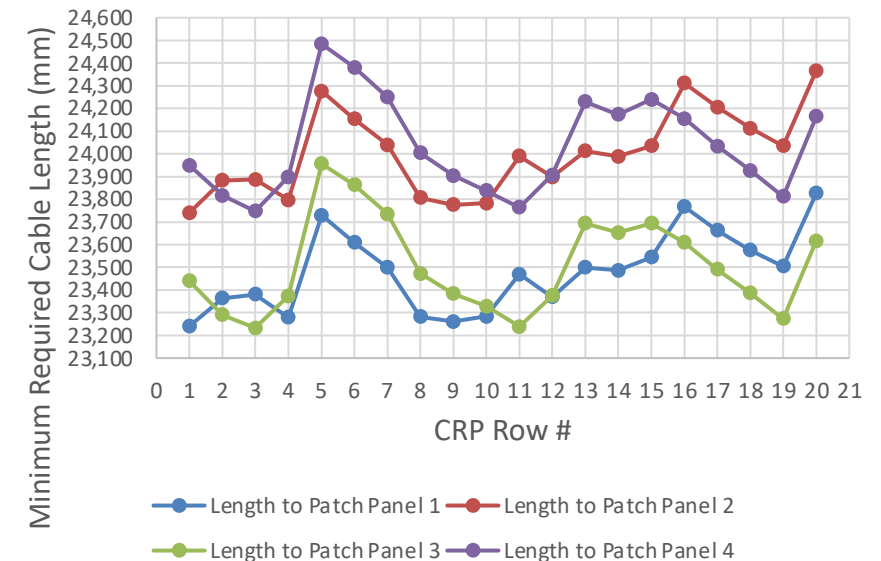


# FD2 Cable Routing and Cable Length

- ~10m of excess cable for ProtoDUNE-VD
- For FD2, a few CRPs have a minimum required cable length close to 25-m
- Exploring various solutions to increase the cable slack for some of the CRPs



Minimum Required Cable Length from Penetrations to Central Bottom CRPs



# Quality Control of ProtoDUNE-VD Components

- All components are tested at various levels before installation at CERN
- Cold tested most of the ASICs in LN2
- Cold test individual FEMBs in LN2
- WIBs tested at benchtop before shipping to CERN
- WIBs are currently in the Vertical Slice Test-stand for DAQ integration test
- Penetration flanges leak checked
- Continuity tests for the cables by the vendors and also at BNL
- All cold cables checked (or will be) in LN2 cold box
- Cold electronics on CRP5 will be tested in the CERN cold box before installation
- Cold electronics on CRP4 will be tested in LN2 cold box at Yale before shipping to CERN. Will warm test CRP4 in the faraday cage at CERN and possibly also in the cold box as well
- During installation of the CRP in NP02:
  - Readout using DAQ to verify all FEMB channels are working while on the supporting truss
  - After the CRPs are lowered to the final position on the cryostat floor, will monitor the noise data at regular intervals



# Backup

# Warm Crate Assembly

1 PTC and 6 WIBs per WIEC

