Cold Electronics Mechanical Review Introduction

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Cold Electronics Mechanical Review

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Glossary, Numbers (i)

- The DUNE single phase TPC contains 150 Anode Plane Assemblies (APAs) that are installed in 25 rows of 6 APAs each
  - Each APA covers an area that is approximately 6 x 2.3 m^2
- Each detector row contains 4 drift volumes in the configuration APA-CPA-APA-CPA-APA (CPA: cathode plane assemblies)
  - To reach the 12 m height two APAs are stacked vertically
- The wires of each APA are read out via Front-End Motherboards (FEMBs) that contain FE amplifiers, ADCs, and serializers
  - We are considering two solution for the FEMB
    - 3 ASIC solution: LArASIC + ColdADC + COLDATA (8+8+2 ASICs)
    - Single ASIC solution: CRYO (2 ASICs)
- FEMBs are housed in Cold Electronics (CE) boxes that provide support / shielding (Faraday cage), serve as

Glossary, Numbers (ii)

- The cables from each APA pair (both Cold Electronics [CE] and Photon Detector System [PDS]) are routed to one of 25 cryostat penetrations
  - Connection to room temperature electronics
  - Warm Interface Boards (WIBs) + Power/Timing/Control Boards (PTCs) housed in Warm Interface Electronics Crates (WIECs)
    - Further data multiplexing, optical data transmission to DAQ backend
- Other detector services on top of the cryostat

Scope of today's review

- Today we are reviewing the mechanical aspects of the Cold Electronics part of the DUNE Single Phase TPC project
- Connection of FEMBs and to the CE boxes to the APA
- Connection of the FEMBs to the cold cables
- Cable plant in the liquid argon, including the cable trays required to support the cables (we are not discussing the electrical details of the cables, but we are discussing connectors)
- Cable routing

One or two more reviews of CE in May/June: a) ASICs and FEMBs, b) system aspects, WIEC/WIB/PTC, al the rest….

Charge (i)

The committee is requested to review the DUNE Single Phase TPC Cold Electronics (CE) design and determine if it meets the requirements of the preliminary design as outlined in the DUNE Far Detector Design Review Plan (DocDB-9564 [certificate link]). This review of the CE design is focused on the mechanical aspects of the project, including the dimensions of the cold cable bundles, cable routing inside the cryostat including the cable support system inside the cryostat and the cable mounting to the CE box and APA, cold cable strain relief, cryostat penetrations up to and including the flanges separating the cold volume from the top of the cryostat, the mechanism to route the cables through the cryostat penetrations, the signal feedthrough assembly (flange and flange board) and services on top of the cryostat (the warm interface crate is excluded from this review). This review includes the photon detector ~~flange and~~ cold cables.

Charge (ii)

1. Have design choices been fully identified and do they meet detector requirements?
2. Are the specifications and drawings for standard and custom components substantially complete and available in EDMS? Are they of sufficient maturity to proceed to final design?
3. Have interfaces with other detector components been addressed and documented? Do risks of design changes in other systems have appropriate mitigation strategies?
4. Are engineering analyses sufficient to ensure the design is safe during all phases, and have applicable design codes and standards been satisfied?
5. Does the design support a reasonable procurement strategy and manufacturing plan?
6. Are quality assurance and testing plans sufficiently developed to proceed to final design?
7. Have lessons learned from ProtoDUNE been implemented? Are the issues with the connectors on the FEMBs understood?
8. Are plans for additional prototyping reasonable and sufficient?
9. Have appropriate cost estimates and schedule been determined? Are plans for required technical and scientific resources consistent with scope of remaining work?

Agenda (i)

Go to day

Monday, 11 February 2019

08:00 - 08:30	Committee executive session (restricted) *30'* Speakers: Jennifer Raaf (Fermilab), Dr. Alberto Marchionni (Fermilab), Terry Tope (Fermilab), Steve Kettell, Steve Kettell (BNL), Dr. Eric James (Fermi National Accelerator Lab), Jonathan Lewis (Fermilab), Mr. Dan Wenman (University of Wisconsin - Madison), Farshid Feyzi, Farshid Feyzi (Universtiy of Wisconsin-Madiosn)
08:30 - 08:40	Introduction *10'* Speaker: Marco Verzocchi (Fermilab)
08:45 - 09:05	CE Integration and Installation Plan *20'* Speaker: Marco Verzocchi (Fermilab) Material: Slides
09:15 - 09:45	Lessons Learned from ProtoDUNE *30'* Speaker: Matthew Worcester
10:00 - 10:15	Status of Interface Documents *15'* Speaker: Marco Verzocchi (Fermilab) Material: Slides
10:25 - 10:45	Coffee break *20'*
10:45 - 11:10	Changes to the CE box design and to the FEMB/CE and CE box/APA interfaces *25'* Speaker: Manhong Zhao (BNL)
11:20 - 11:35	Reduction of the CE cable plant *15'* Speaker: Marco Verzocchi (Fermilab) Material: Slides
11:40 - 12:05	Review of cable routing tests *25'* Speaker: Manhong Zhao (BNL)
12:20 - 13:30	Lunch *1h10'*

Agenda (ii)

12:20 - 13:30	Lunch *1h10'*	
13:30 - 14:00	Cable trays inside the cryostat *30'* Speaker: Manhong Zhao (BNL)	
14:15 - 14:45	Cryostat penetrations and CE flanges *30'* Speakers: Bo Yu (Brookhaven National Lab), Manhong Zhao (BNL)	
15:00 - 15:20	Cost and schedule *20'* Speaker: Marco Verzocchi (Fermilab)	
15:30 - 15:45	Coffee break *15'*	
15:45 - 17:00	Committee executive session *1h15'*	
17:00 - 17:45	Joint session (committee/CE consortium) *45'*	
18:30 - 20:30	Dinner *2h0'*	

Tuesday, 12 February 2019

08:00 - 08:30	Committee executive session *30'*	
08:30 - 09:30	Joint session (committee/CE consortium) *1h0'*	
09:30 - 12:00	Committee writing session *2h30'*	
12:00 - 12:30	Closeout *30'*	
12:30 - 13:30	Lunch *1h0'*	
13:30 - 14:00	Reserve *30'*	

Apologies

In hindsight scheduling this review very close to the Collaboration Meeting and the TDR submission date was a mistake

Documentation has been made available at the last minute, and it is not complete as it should be

This review is the first 60% design review, the first review where engineering notes are required, the first review where there is a requirement to store drawings in EDMS

I want to thank the reviewers for their patience, let's try to use these two days in the best possible way

The CE management has certainly learned a lot in the preparation of this review, and we will avoid the same mistakes the next time