

CERN, 9 November 2016

### **ProtoDUNE - CPA / FC / HV Review**

**In view of the presentations today and available documentation, the review panel proposes a set of questions to the project team to be answered tomorrow in the Q&A session. The goal of these questions is to understand better some identified issues and therefore be able to write a concise report at the end of the review.**

**Mar Capeans, Chair (CERN EP)**  
**Sebastien Murphy (ETHZ)**  
**Fernando Baltasar (CERN HSE)**  
**Wolfgang Klempt (CERN EP)**  
**Filippo Resnati (CERN EP)**  
**B.Baller (Fermilab)**  
**G.Gallo (Fermilab)**  
**R.Preece (STFC)**

- The committee has pointed out several times the concern of unknown field in regions where insulators such as G10/FR4/FRP, that can charge up, are used in the vicinity of high field regions. Can you review and tell us the current knowledge and positive experiences from other experiments, detectors, lab tests? Will this issue be still tested in the 35ton test?
- Present plans for the 35ton test. The committee would like to understand if the foreseen tests and setup can reply on time to the open issues and risks that have been identified in the presentations and discussions.
- Could you make a short summary of the test results of the effect of discharges in the resistive kapton laminated panels? What current do you expect in each plane?
- Have the project discussed alternative designs to the profile caps of the FC Al profiles? The committee believes these parts may pose a significant risk if they degrade.
- The mechanical properties of the proposed FC Aluminum profiles are well defined. Can you show the mechanical requirements (alignment, planarity, etc) when they are together in assembled panels, and when adjacent panels are joined together? Is there a value of how possible deformations after assembly will affect the electric field?
- Currently, the design of the HV feedthrough is mostly in hands of ETHZ. Does the Single-Phase team have a plan to move timely from the current design and validation phases to production?
- A safety factor of 3.75 has been agreed. Minor changes to the design will be made to raise the factor of safety of all components below 3.75 in all loading scenarios. Is it possible to get a table that summarizes and explains uncertainties on which the 3.75 safety factor will apply on top. Have all the components of the design, as known

today, be included in the baseline calculations carried out till today? Has the worst case scenario been considered?

- At which point in time will you include CERN HSE (Safety unit) to validate key aspects of the design and the described assembly and installation scenarios? Their input (to aspects such as co-activity, electrical risks, work on confined spaces, etc) may have a severe impact on the procedures being worked out now.  
Example: It is planned that the construction and assembly of CPA modules, FC modules and installation in the detector will be performed according to a set of Work Planning and Control (WPC) documents. Who validates WPC?
- Can you show a full team organization chart? Are responsibilities well defined for the different phases of the project? How will the project management guarantee that the knowledge acquired by the current team is available during production, assembly and integration? Succession planning?
- Is there already a safety matrix resulting of a global risk analysis and how this will for instance translate in the safety/monitoring interlock strategy for the different systems? What kind of revision/validation are you planning to perform on this global risk analysis? Do you have already a preliminary global risk assessment?
- Can you describe in more detail how is the mass cut from the HV cable into the HV feedthrough made? What's the electrical stress in that specific region?
- Can you clarify the difference between results in Fig59 in Design Doc V25 and Fig50 of V20, where a factor of 20 in terms of displacement appears? How has this number been improved?
- When will you be ready to review the beamplug? This part as it is very innovative and critical, it needs careful revision. Is any test foreseen for validating the design? Would you consider making a full sized test at 1.3 times design voltage in a N<sub>2</sub> atmosphere and with an appropriate beam?
- The assembly/installation procedure is not fully mature, have you considered the implications on schedule and cost if input from the trial assembly at ash river has an impact on parts that are already fabricated at that time?
- Have you studied and documented the implication on detector performance and physics if you are forced to operate at lower HV (space charge may increase and hence the field distortions...)?
- While the design of the different parts seems sound, which is the foreseen validation process for the overall design?