Cold Electronics Integration and Installation Plans

Marco Verzocchi
Fermilab

Cold Electronics Mechanical Review

11 February 2019

Integration & Installation

- Today we are discussing integration and installation of
  - Cold boxes containing FEMBs
  - Cold cables and cable trays
  - Cryostat penetrations
- All have different timelines (discussed more in detail in Cost and Schedule presentation at the end of the review)

- We DO NOT have a detailed plan for integration, because it is not clear where this will happen
- However the sequence of activities is clear

Integration & Installation

- Today we are discussing integration and installation of
  - Cold boxes containing FEMBs
  - Cold cables and cable trays
  - Cryostat penetrations
- All have different timelines (discussed more in detail in Cost and Schedule presentation at the end of the review)

- We DO NOT have a detailed plan for integration, because it is not clear where this will happen
- However the sequence of activities is clear

Integration on APAs

Discuss the integration of FEMBs+CE boxes on the APA first at the ITF, then the addition of the final cold cables at SURF

At a certain point we also install the cryostat penetrations on top of the cryostat

Then we move the APAs inside the cryostat, route the cables through the cryostat penetrations, change the support point for cable trays, test ……

Installing the FEMBs on the APAs (i)

- The installation of the FEMBs on the APAs (including the installation of the CE boxes) takes place at the Integration and Test Facility
  - Manhong's presentation on the "Changes to the CE box design and to the FEMB/CE and CE box/APA interfaces" gives the details of the design changes made to the CE box and the FEMB to address some of the issues found during the Integration of ProtoDUNE
  - With new design of CE box the appropriate sequence could be
    - Mount adapter card on the CE box (can have stack of CE boxes with adapter cards attached, before we even start putting these on the APA)
    - Mount CE box+adapter card on the APA
    - Insert FEMB inside the CE box, connect to the adapter card and fix in place with screws

Installing the FEMBs on the APAs (ii)

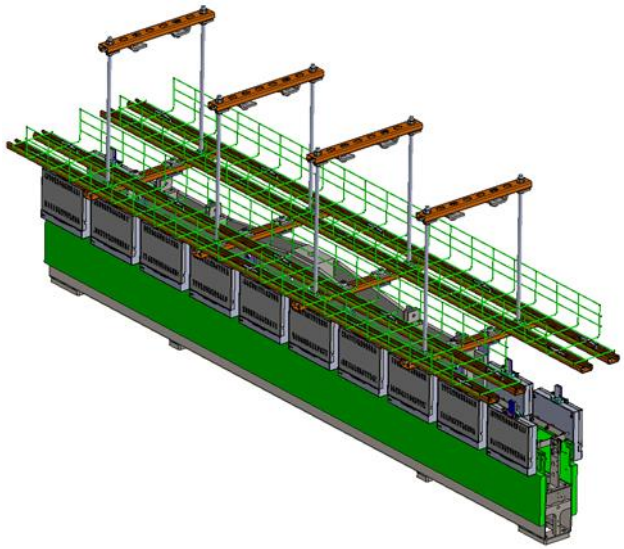
- At the ITF we are no longer performing cold tests on all the APAs
  - Only 10% of APAs (plus all initial ones at pre-ITF facility) will undergo cold tests
- If we are performing cold tests on this APA:
  - Attach “long” cables to the FEMB, connect 2nd end of long cable to portable WIB, perform quick test to demonstrate that the FEMB is connected properly and sees all the wires
  - Move on to next FEMB
- If we are not performing cold tests on this APA:
  - Attach “pigtails” to the FEMB that connect to a portable WIB, perform quick test, remove “pigtail”
  - Tests performed on set of 4 FEMBs, then move to next set of 4 FEMBs

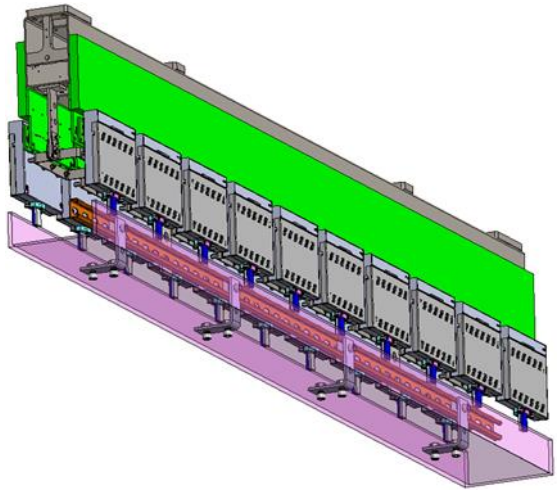
Installing the FEMBs on the APAs (iii)

- If we are performing cold tests on this APA:
  - Move the APA into the cold box
  - Connect the “long” cables to a patch panel inside the cold box that has 2nd set of fixed cables that are connected to the cold box cryostat penetration and from there to the WIEC
  - Perform warm readout check
  - Close cold box, cool down, perform cold tests, warm up
  - Remove APA from the cold box
  - Disconnect the cables from the APAs
- For all the APAs
  - Prepare the APA for shipment to SURF

At SURF in the clean room (i)

- After the top+bottom APAs have been mechanically coupled they are moved to a work station inside the clean room outside the cryostat at SURF
- Sequence of (CE) activities
  - Install two cable trays on top of the APA pair, connected to the APA yoke, install channel beam attached to the bottom APA





At SURF in the clean room (ii)

- Route the two bundles of cables for the bottom APA through the APA frames (from the top):
  - first bundle of 10 FEMB control/clock+data readout cables, 10 FEMB power cables and 8 bias voltage cable on one side of the APA
  - second bundle (without bias voltage cables) on the other side of the APA
  - connect the cables to the CE boxes, perform quick check with portable WIB system on 4 FEMBs at a time, install the strain relief
  - repeat for 20 APAs total
  - connect the bias voltage cables to the SHV board
  - fix the cables to the channel-beam and install the protective cover at the bottom of the APA

At SURF in the clean room (iii)

- Arrange the cables on the cable trays on the top of the APA pair
- Install the cables for the 20 FEMBs connected to the top APA, including the corresponding SHV cables, including performing tests with portable WIB system
- Move APA pair into the cold box, connect the cables to patch panel, cool down, perform tests, warm up
- If everything is fine, arrange cables in the cable trays
- Move APA into final position inside the cryostat
- Route cables through cryostat penetration, connect to WIEC, perform readout tests with final DAQ system

- Many more details in Manhong's presentation(s)

Cryostat Penetrations

- Discussed in Manhong's presentation
- Need to be ready and installed before we install the detector support structure (can start installing as soon as the internal membrane in a part of the cryostat is complete, welded and leak checked)
- Needed to completely seal the cryostat, clean air flows only from the manholes to the TCO opening
- Will be reopened when routing the CE and PDS cables through the penetration (build a tent over the cryostat penetration to minimize dirt going into the cryostat)

APAs move into the cryostat

- Once an APA is successfully tested inside the cold box it moves with all its cables into final position inside the cryostat
- At this points cables are routed through the cryostat penetration, connected to the WIEC and the entire readout of the APA is tested with the final DAQ backend
- Routing of cables, change of support point for cable trays are discussed in Manhong's presentation

- This completes the timeline for integration and installation that is relevant for this review