

Cable Routing Tests

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Cold Electronics Mechanical Review

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Outline

- Cable routing tests at PSL:
through APA side tube horizontally
- Cable routing tests at Ash River:
through APA side tube vertically
- Planned cable routing tests at BNL:
from upper APA to feedthrough port

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Cable routing test at PSL: through APA side tube horizontally

CE cable routing test at PSL (I)

A double APA side tube setup was built at PSL. PSL originally tried just bundling the wires and pulling with a wire mesh cable grip.



The connectors caught on anything protruding into the tube interior.

Cable routing test at PSL: through APA side tube horizontally

CE cable routing test at PSL (II)

PSL tried covering the connector part of the cable bundle with heat shrink to protect it. Cable volume reduced from 10 CE cables to 9 CE cables.

The connectors still made a bump that caught.
The mesh sleeve was damaged during the pull.



Cable routing test at PSL: through APA side tube horizontally

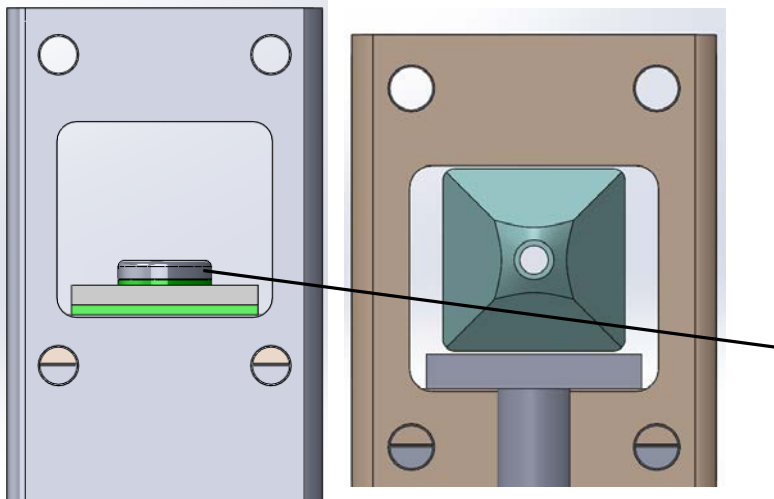
CE cable routing test at PSL (III)

PSL decided to try a rigid cover.



The first ~1.4m cable bundle – where the connectors are, is covered. It's a 2" x 2" tube with a nosepiece to help guide it through the openings.

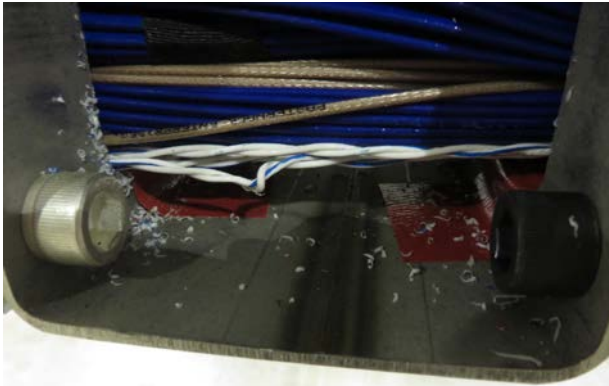
The rope goes through the nosepiece and connects to the cable grip as before.



In order to fit past the link, the screw holding the link had to be made flush with the link surface.

Cable routing test at PSL: through APA side tube horizontally

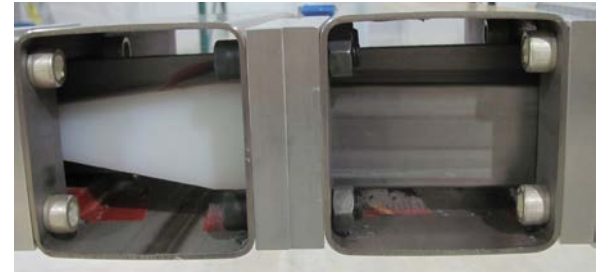
CE cable routing test at PSL (III)



Edges around the opening would scrape off wire insulation. So PSL decided to cover the entire length of the bundle with the woven cover.



The cover still caught a little



PSL: Although this went through, the cable bundle is right at the maximum size that will fit.

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Cable routing test at Ash River: through APA side tube vertically

The APA side tube cabling setup was shipped to Ash River, and mounted vertically.

December 2018 we did a series of tests with different configurations of the cable bundle as well as some strain relief trials.



Cable routing test at Ash River: through APA side tube vertically

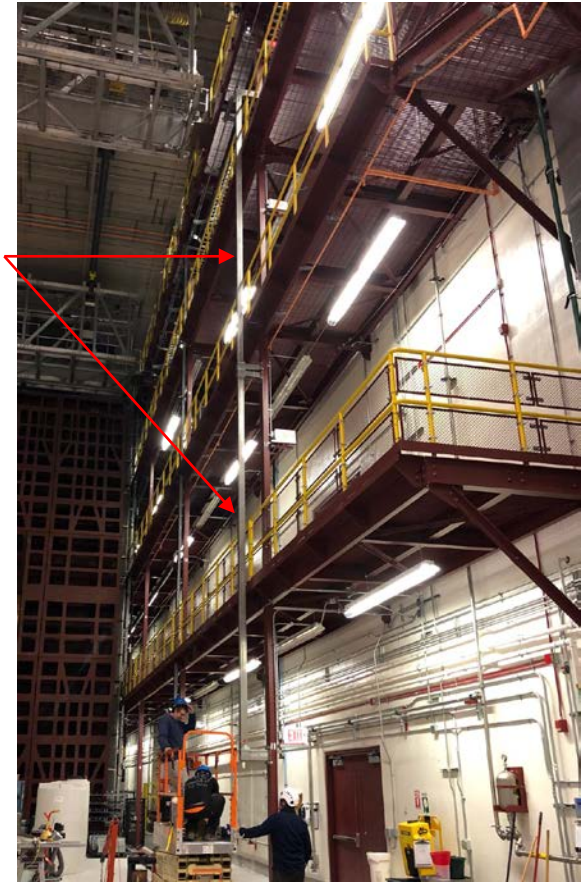
Cabling Setup at Ash River



APA side tubes
(mounted vertically)

Guiding head cone
(removed from the
cable bundle tip)

Guiding rope at
the tip of guiding
head cone



Cable routing test at Ash River: through APA side tube vertically

Cable bundle and cable conduit

Cable bundle
(9 CE signal cables and 9 CE power cables)

Cable
bundle with
sleeve on

Cable grip
slid on the
cable bundle



2.5" OD conduit
resting on APA
head tube



Cable routing test at Ash River: through APA side tube vertically

Feeding head cone into side tube

Feed guiding rope through
the side tubes



Insert guiding head cone into
the side tubes



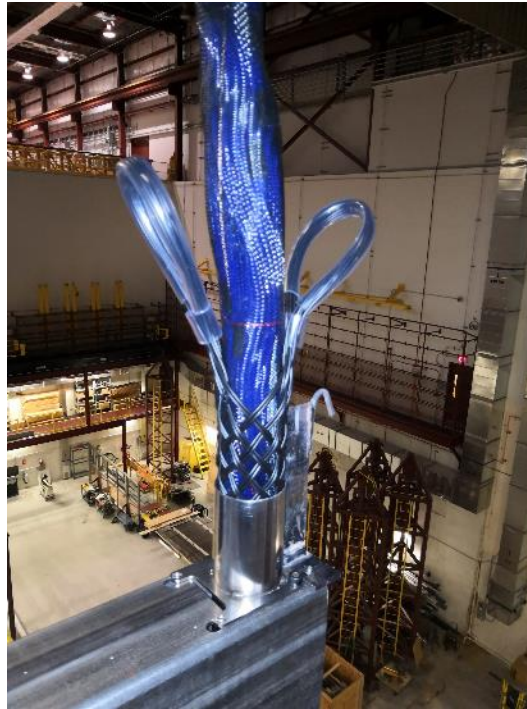
Cable routing test at Ash River: through APA side tube vertically

Strain relief (I) with cable grip

Cable grip slides into the conduit



Cable grip hooked on hoist



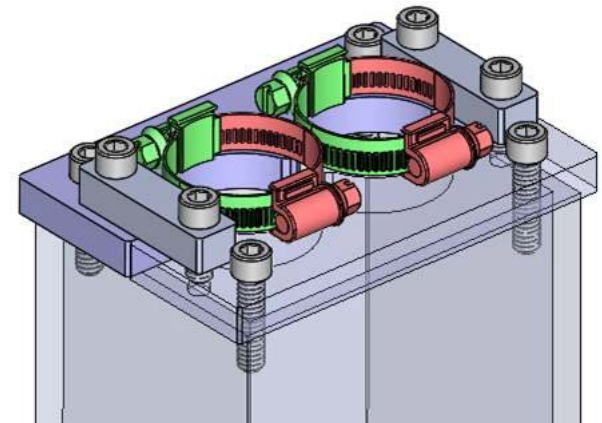
Cable routing test at Ash River: through APA side tube vertically

Strain relief (II) with hose clamps

Alternative strain relief option:

The cable bundle was split into two smaller bundles at the top and clamped with two hose clamps.

In this test, the top end of the mesh was pulled downward into the conduit to allow splitting the cable bundle. But the top end of the mesh wasn't taped onto the cable bundle. When trying to pull the cable bundle out upward, the mesh was slipped over the cable bundle by friction between the mesh and the conduit, and jammed the conduit.



Cable routing test at Ash River: through APA side tube vertically

Cable bundle pull test

Cable pull test was done on every single data and power cable at the bottom.

Strain relief (I) with cable grip

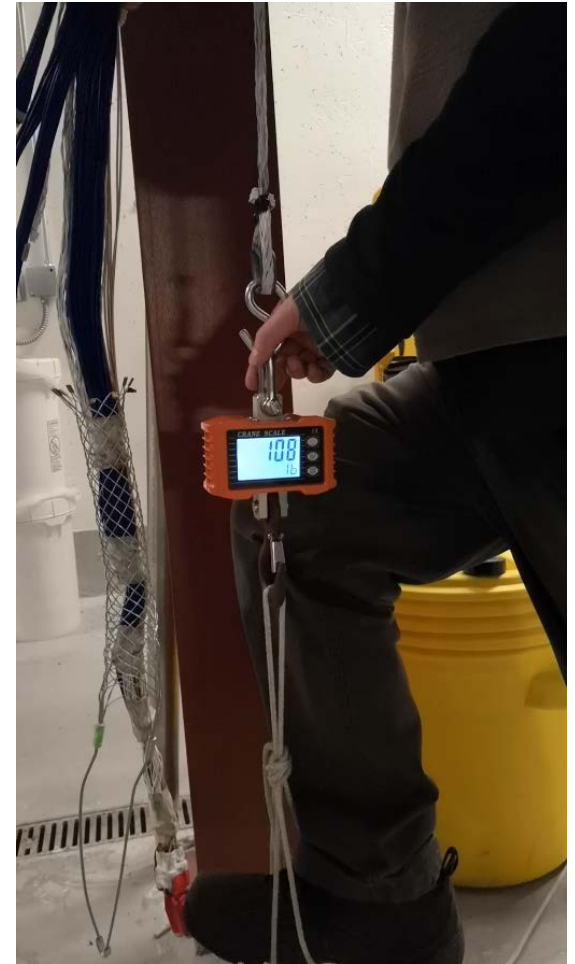
Every single data cable and power cable were further pull tested at 100+ lb. No slipping was observed at the cable grip location at the top.

Strain relief (II) with hose clamps

Max pull force was recorded until cables were observed slipping at the clamping location:

- max pull force is 50 ~ 80 lbs for power cables

- max pull force is 80 ~ 100 lbs for data cables



Cable routing test at Ash River: through APA side tube vertically

Tried feeding 100 mm extra cable length into the conduit

To accommodate cable shrinkage at cold

Cable bundle was pulled up by 10 cm from top.

Cable bundle was then clamped at bottom.

Released cable bundle from top, but the 10 cm extra length couldn't get into the conduit.



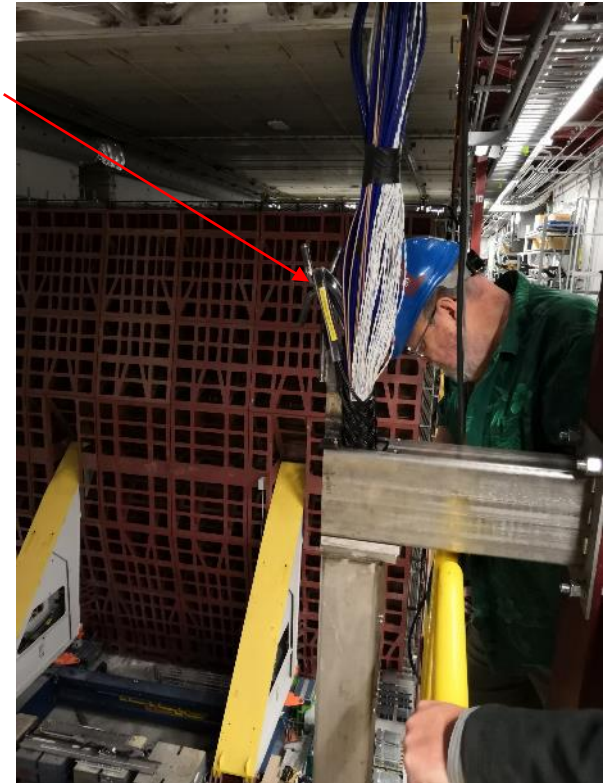
Cable routing test at Ash River: through APA side tube vertically

Cabling test after conduit was removed



A hook welded onto the end T-bracket for supporting the cable grip

Cable bundle was stuck in the side tube several times.



Cable routing test at Ash River: through APA side tube vertically

Damage revealed after cable bundle pulled back out from top

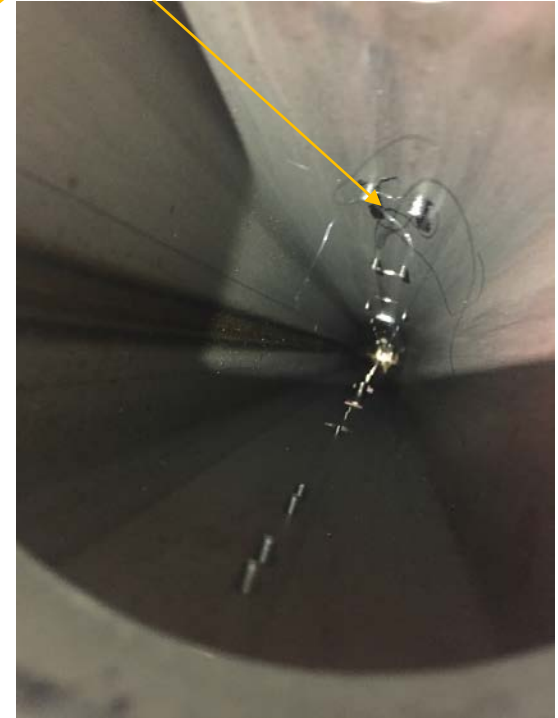
Scratches on
cable grip



Cable grip folded over likely
occurred during pulling
cable bundle upward.



Sleeve was damaged and
fibers caught at screws



Cable routing test at Ash River: through APA side tube vertically

Lessons learned

Both ends of the mesh have to be taped onto the cable bundle.

The conduit tubes shall have rolled ends. Sharp edges cut the cables.

The bottom end of the cable grip shall be taped onto the cable bundle for it to stay in position well, so maintain proper gripping on the cable bundle.

It's impossible to squeeze 100mm extra cables into the conduit.

Damage occurs when feeding cables with conduit removed.

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Mockup of cabling from upper APA to feedthrough port

Goals:

Practice feedthrough installation

Practice CE box installation

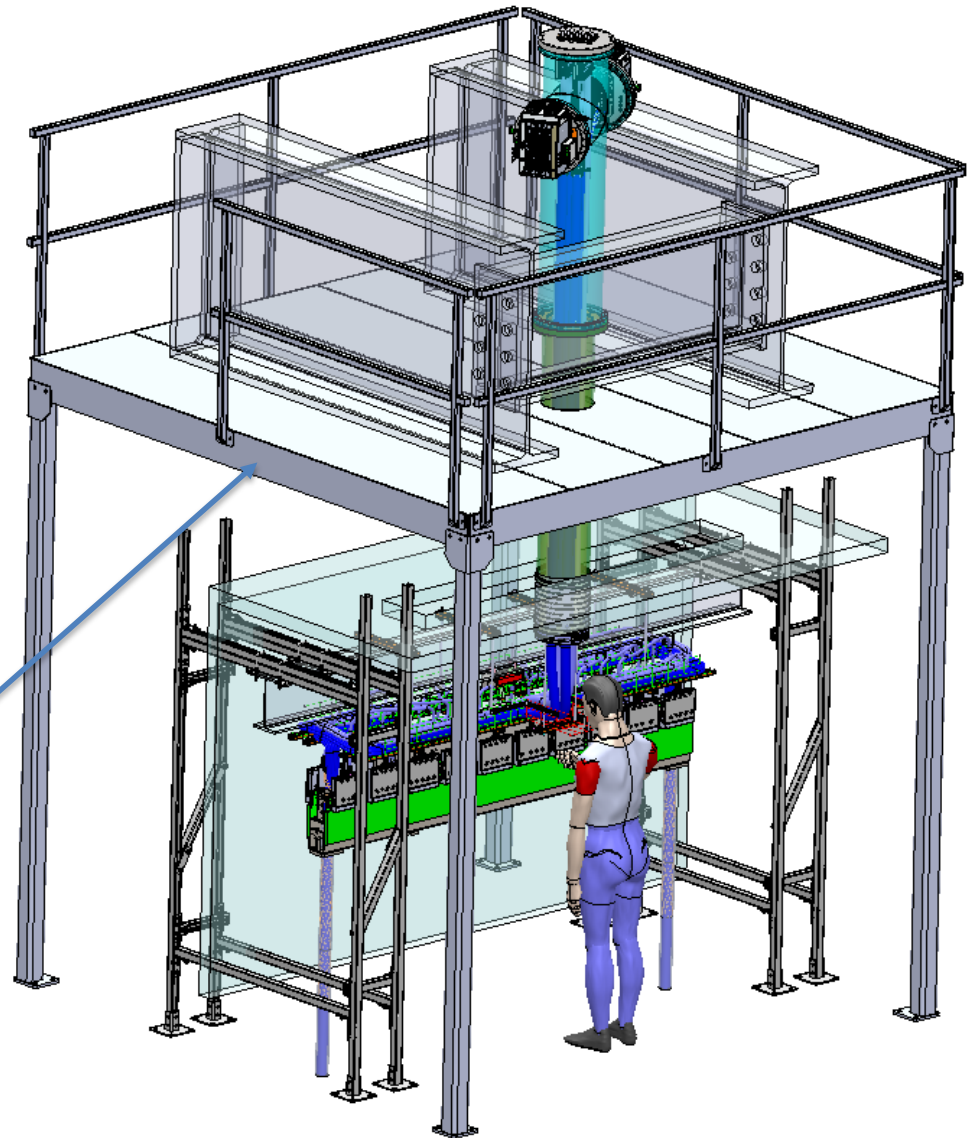
Practice CE crate installation

Practice cable routing

Identify potential interface issues

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Commercial mezzanine
10'x10'x10'
(stairs not shown)



Thank You!