Mu2e Integration and Refinement of the 3D Integration Model

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Final Review of Summer Internship 2018

September 26 2018

Supervisor

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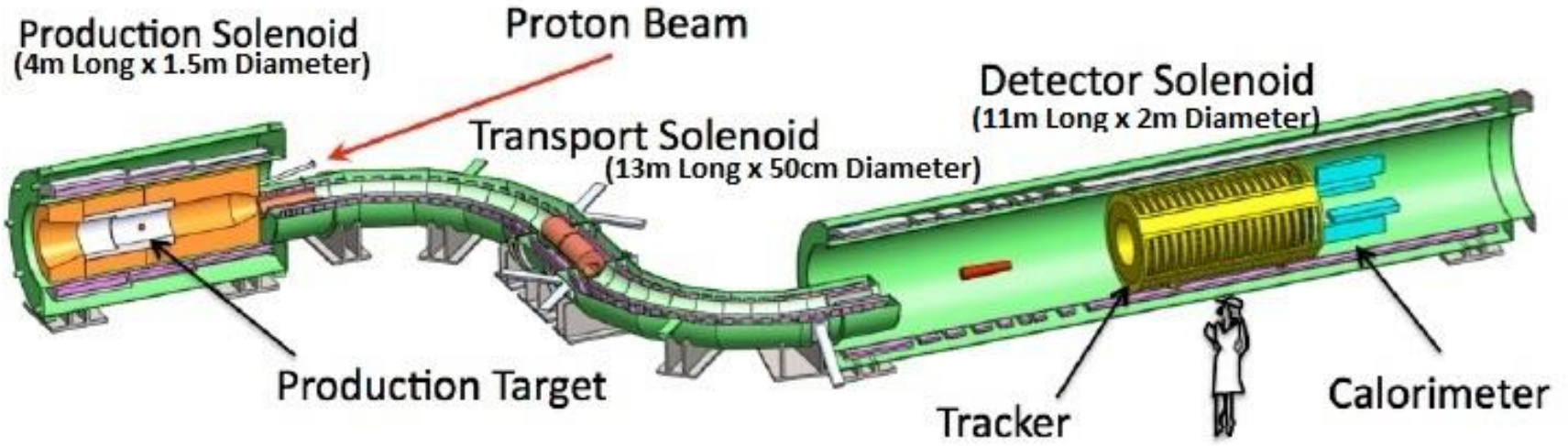
Project Mission



Mu2e proposes to measure the ratio of the rate of the neutrinoless, coherent conversion of muons into electrons in the field of a nucleus, relative to the rate of ordinary muon capture on the nucleus as example of charged lepton flavor violation (CLFV)

$$R_{\mu e} = \frac{\mu^- + A(Z,N) \rightarrow e^- + A(Z,N)}{\mu^- + A(Z,N) \rightarrow \nu_\mu + A(Z-1,N)}.$$

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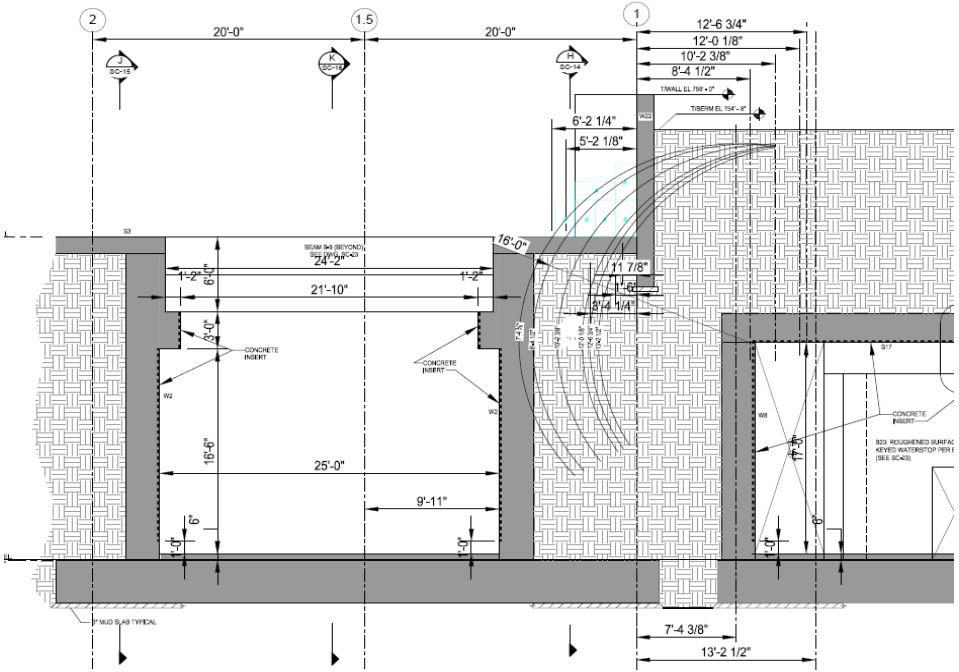
Overview of my Work

- Study of the Mu2e Experiment and 3D Integration Model
- Learn how to use TeamCenter and Nx software
- Become familiar with Mu2e coordinate system
- Check and refine the model of Mu2e Building
- Add new parts to the model, check for and address interferences
- Participating in the Technical Meetings
- Become more familiar with the development and integration of complex projects

Shielding Primary Beamline

Due to proximity of proton beamline to Mu2e building, which transports proton to the production target, need to install 16 foot shielding along the primary beamline in the north west corner of the high bay

- Take measurements in the actual building of the constraints and available spaces and note obstructions
- Use of Civil Drawings to represent the shielding blocks
- Upgrade the Cad model to provide the necessary shielding



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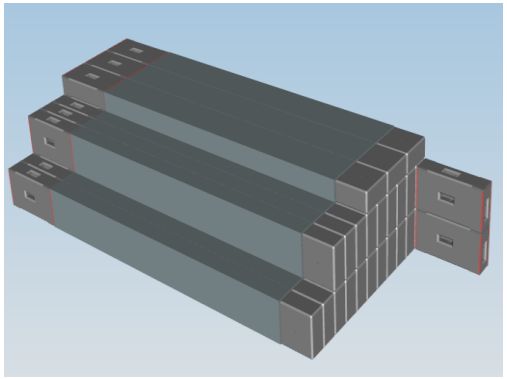
Shielding Primary Beamline



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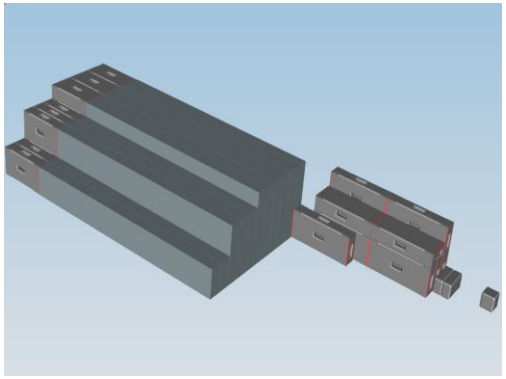

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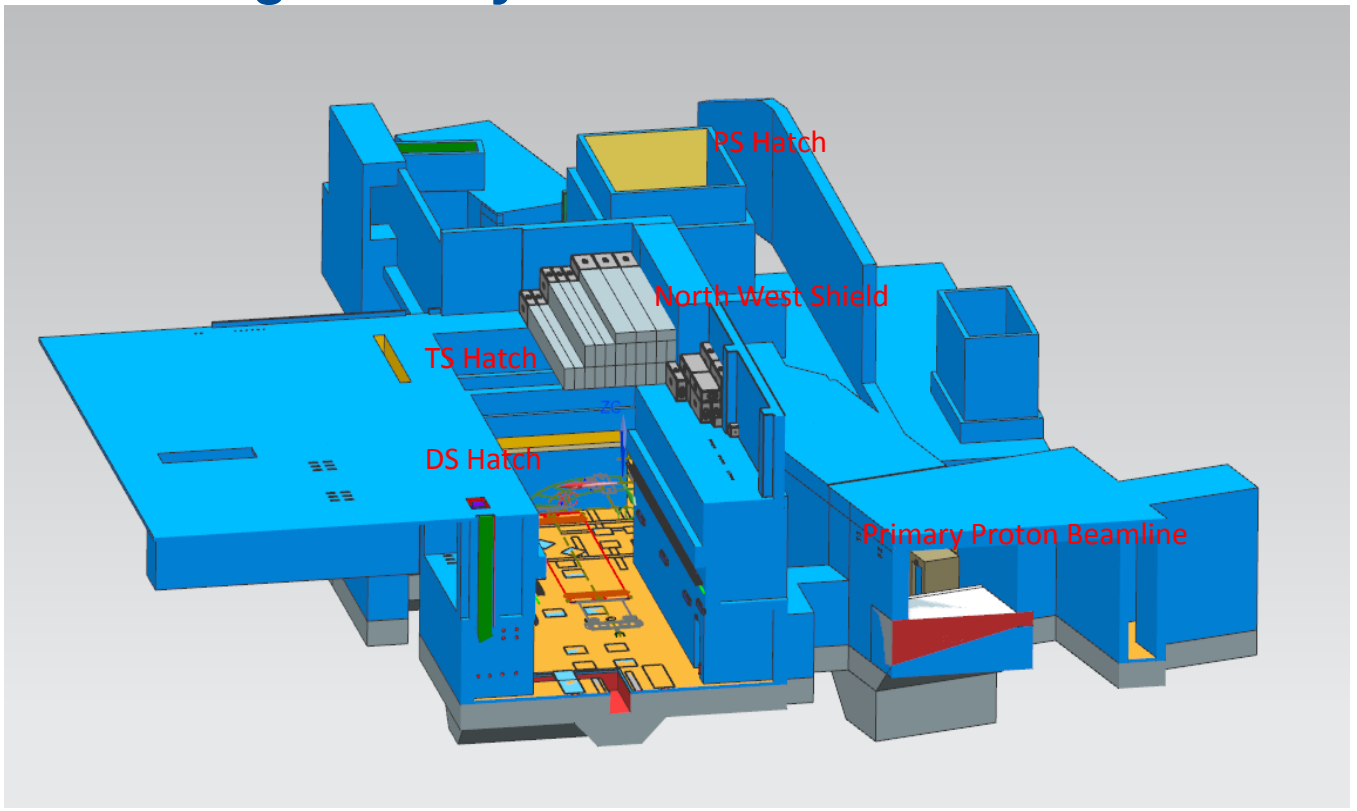

Section of the Building and Block Position

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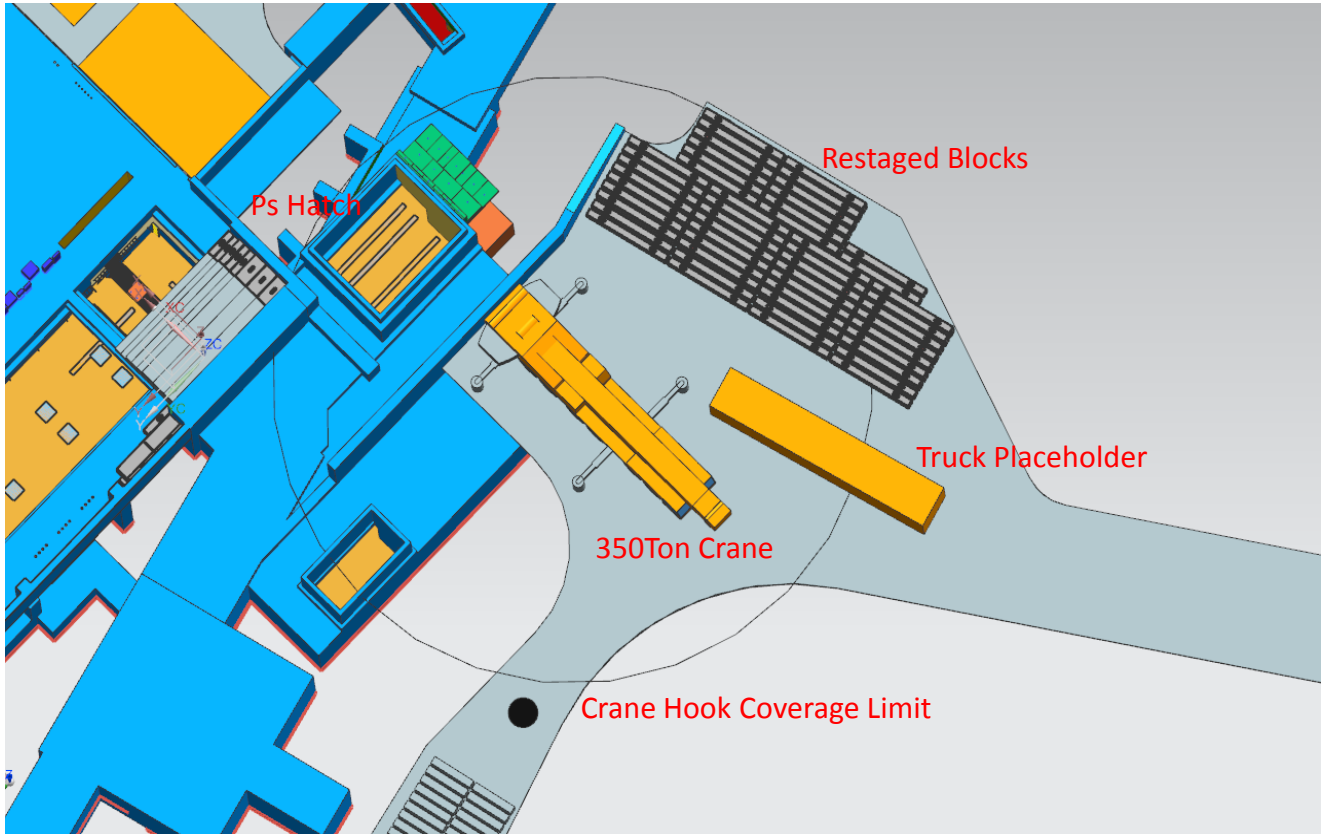
Installation Plan of PS Solenoids



- Verify there is room to install the PS Solenoid down the PS Hatch with the PS Hatch blocks also staged on nearby hardstand
- Creation of New parts to represent a 350Ton Crane and a Placeholder for a Flatbed Truck Trailer for the PS
- Restaging of Concrete PS Hatch Blocks in the model to facilitate the PS installation operation
- Positioning and organization of all these elements in the Global Integration Model

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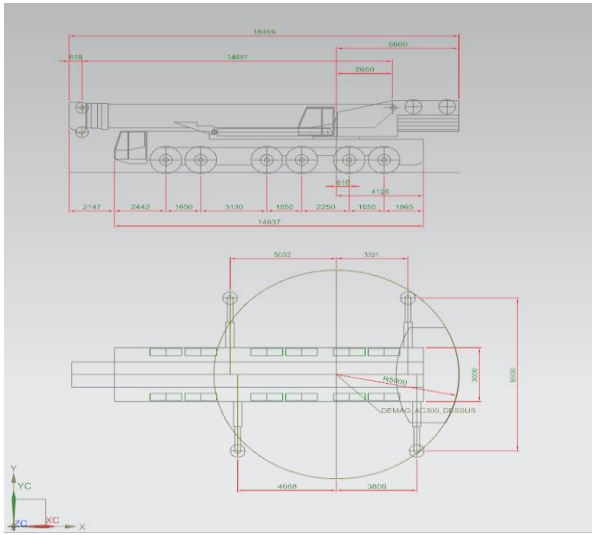
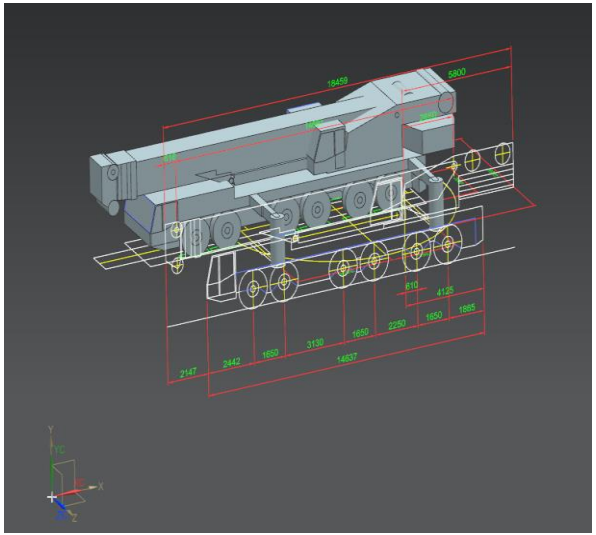
Creation of the 350Ton Crane Model

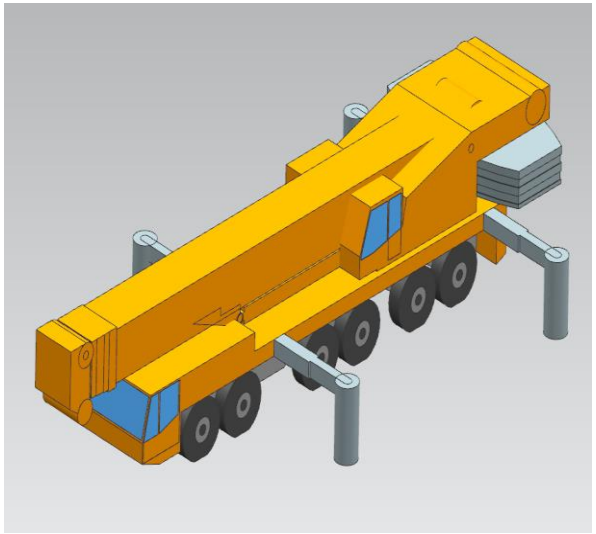
Drawing



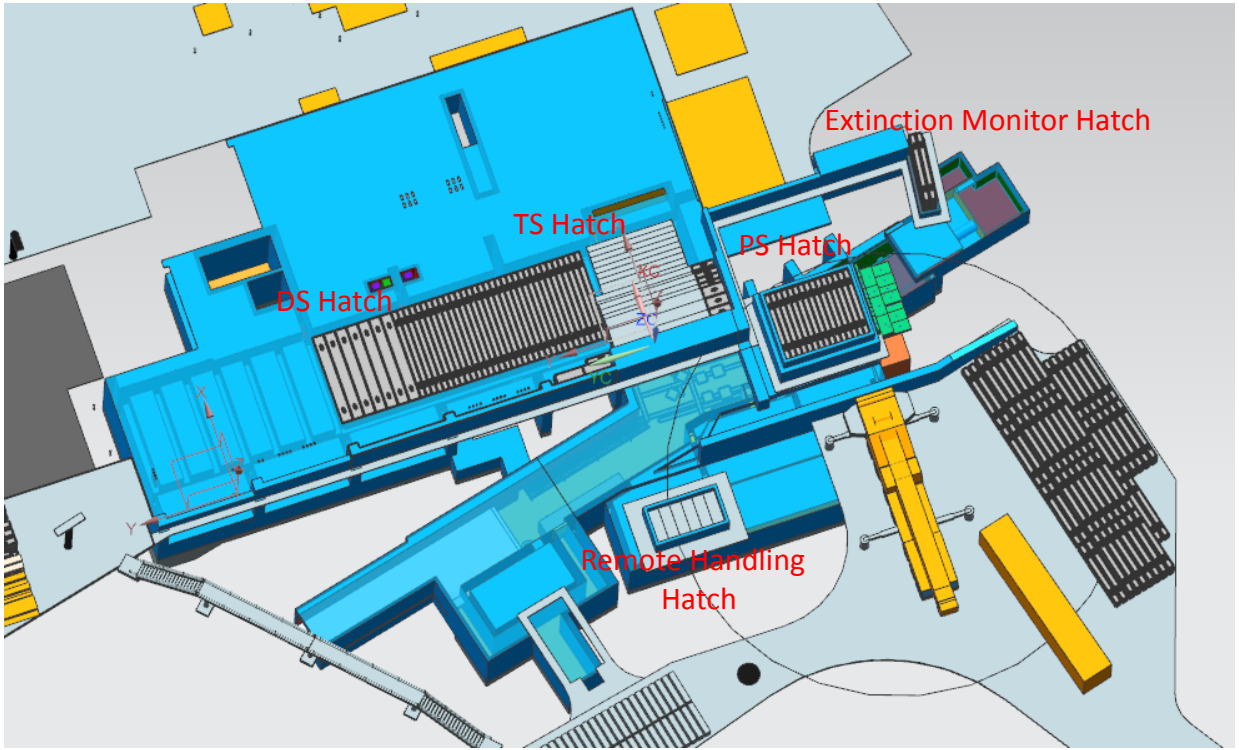
Cad Model



Final Model



Hatch Block Shielding



After the installation of all the experiment elements, according with the radiation simulations, we need the installation of the hatches to seal all the accesses

- Creation and position of the concrete blocks for the 5 hatches, considering the real installation process, taking account for clearance and tolerance using Excel Spreadsheets and keeping in mind the future needs of the experiment maintenance

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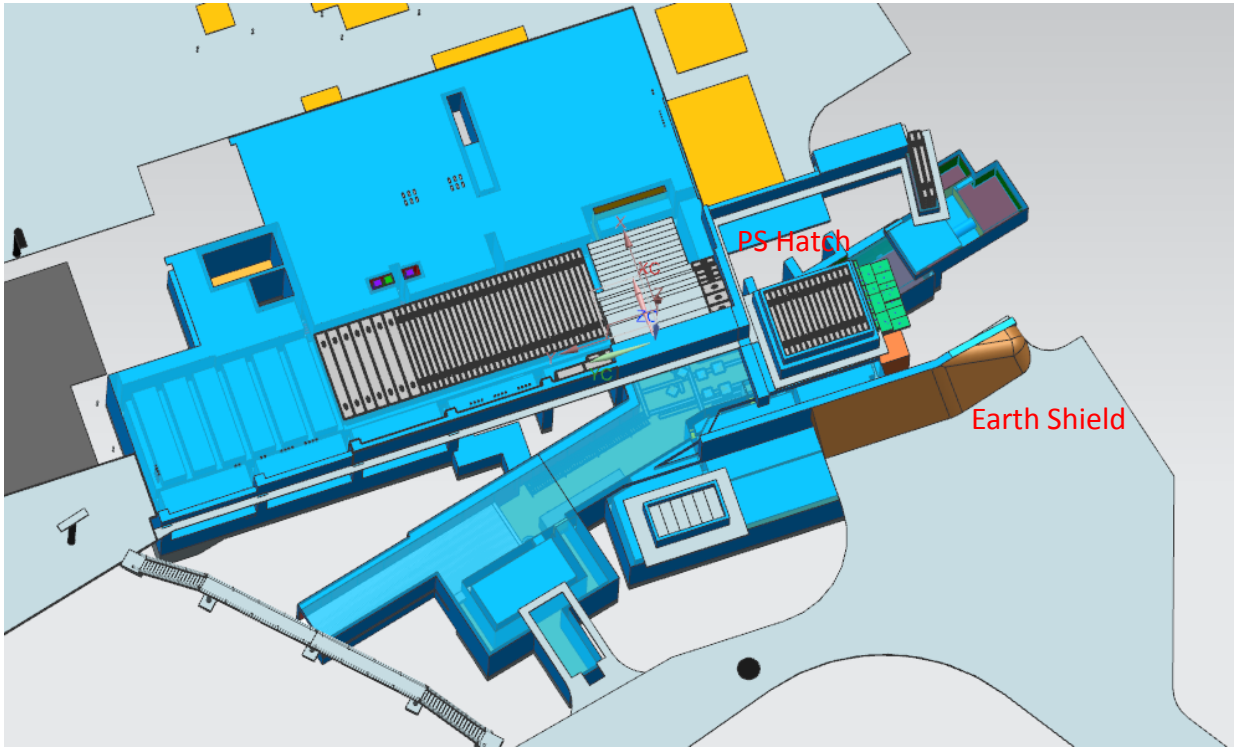
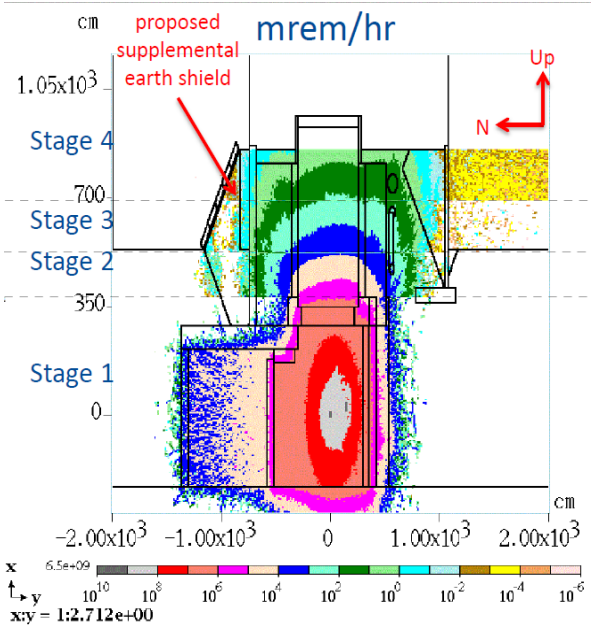
Post Installation Phase



The shield includes the north wall supplemental earth berm and 19' of concrete in the PS drop hatch according to MARS radiation simulation



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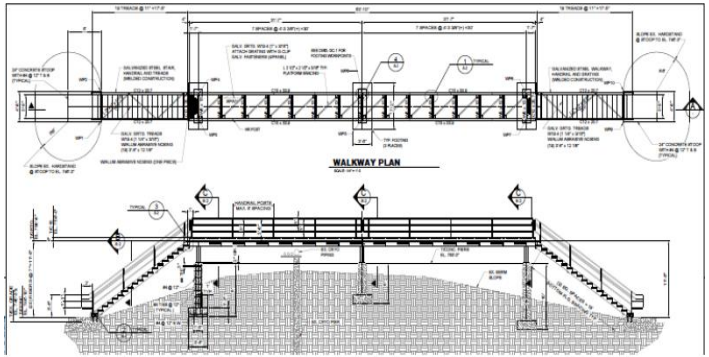
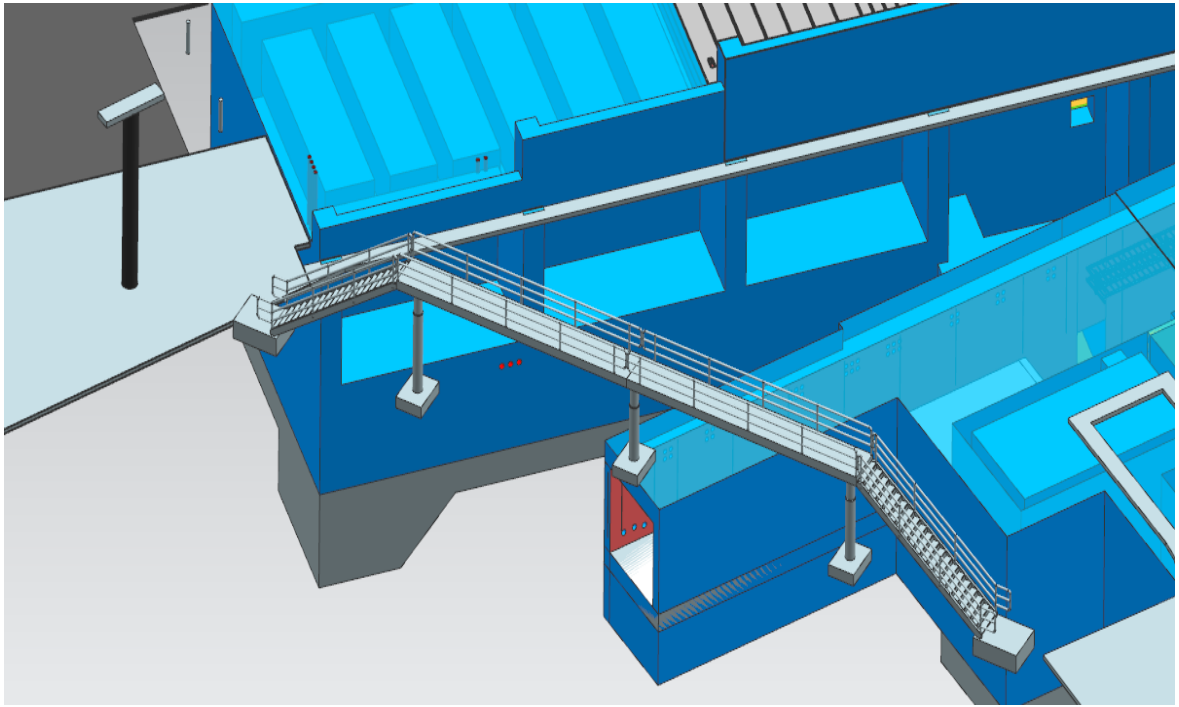
Pedestrian Bridge





- Creation of the model of the Pedestrian Bridge near the Mu2e Building starting from the Civil Drawings

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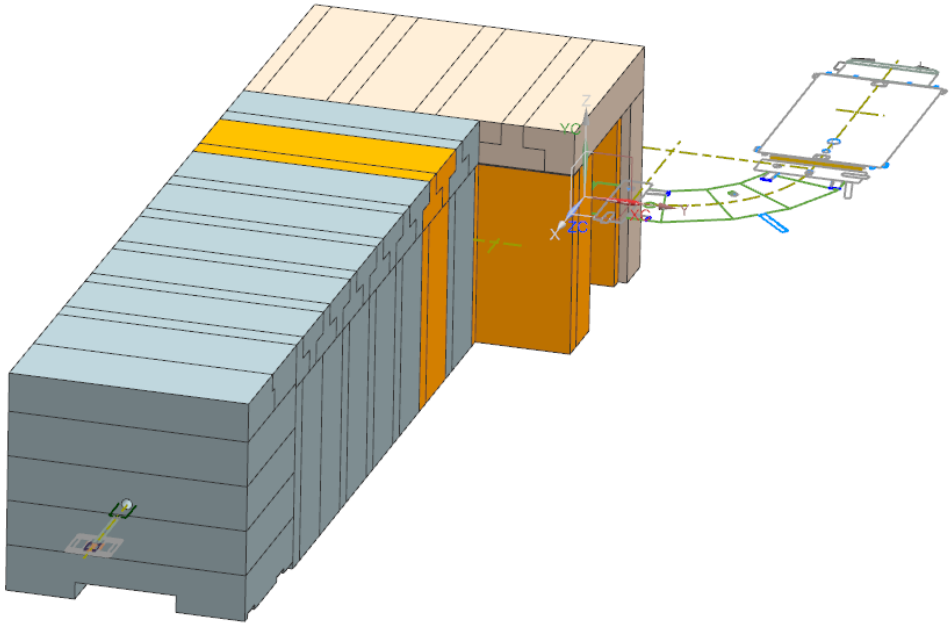
Downstream Muon Beamline Shielding

Downstream Shielding surrounds the downstream end of the Transport and the entire Detector Solenoids with 94 individual blocks, with a total weight of 708 tons, with the main goals of:

- Reducing the neutron and gamma background incident upon Cosmic Ray Veto Counters
- Provide a base for support CRV modules
- Reducing radiation dose rates in the detector hall

Checks and Changes:

- Correction of the various precast concrete Blocks type: Normal Concrete, Boron Loaded Concrete and High Density (Barite) Concrete
- Designation and color of the Blocks to reflect the current project plan
- Adding the material types and density property
- Checks of the measurements and position of the blocks



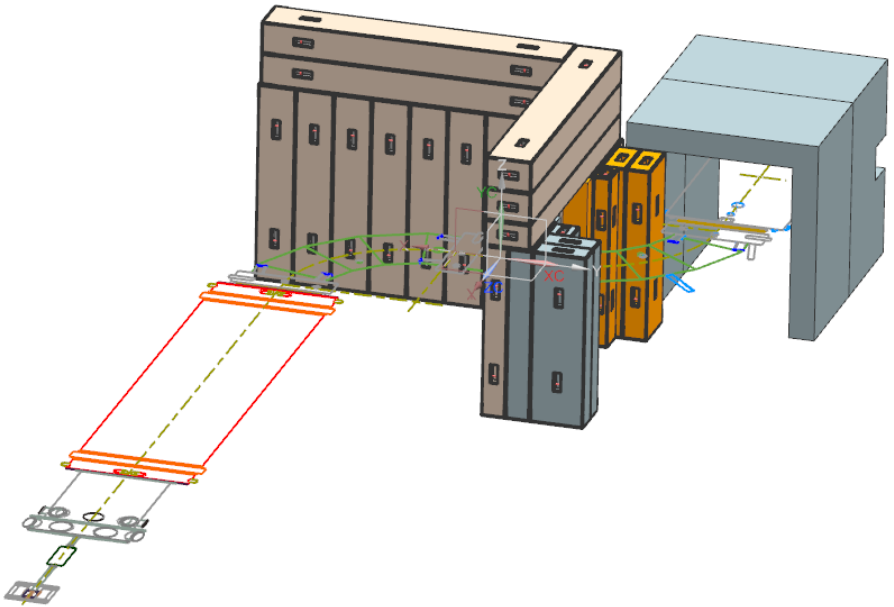
Upstream Muon Beamline Shielding

Upstream Shielding surrounds the Production Solenoid and parts of the Upstream Transport Solenoid, and is composed of 35 blocks for a total weight of 282 tons, with the main goals of:

- Reducing backgrounds in CRV
- Isolate the primary proton beamline from the Downstream muon beamline, dividing the Mu2e Experiment Hall into two different zones to reduce rates in CRV and control flow of activated air

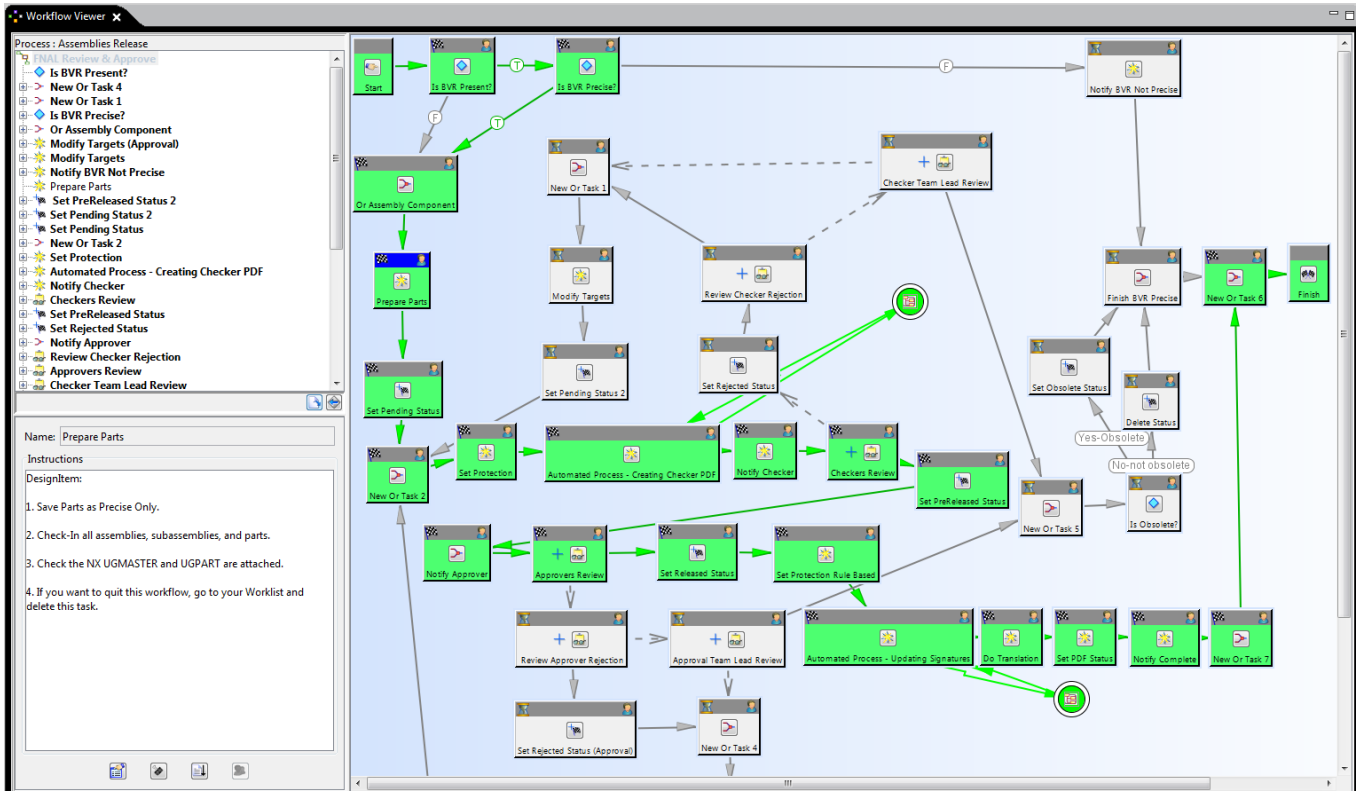
Checks and Changes:

- Reorganization of the subassembly through the creation of new ones
- Correction of the various precast concrete Blocks type
- Changes in the designation and color of the Blocks to reflect the current plan
- Adding the material types and density property so that component weights are properly estimated



Release of The Configuration

- Manage the release of the Downstream and Upstream Muon Beam Shielding configuration to freeze the assembly and then to improve it in the next step



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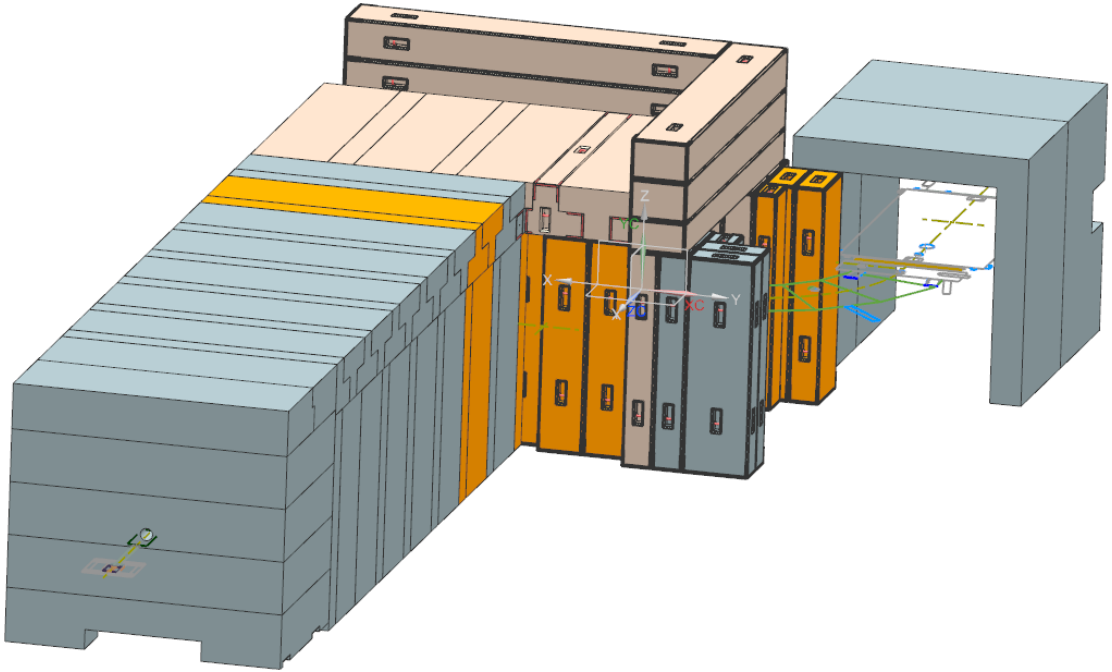
Downstream and Upstream Muon Beamline Shielding

In the continuous process of improving of the configuration, we update the model to take account of the installation process, the tolerance of the blocks and to reduce the overall costs

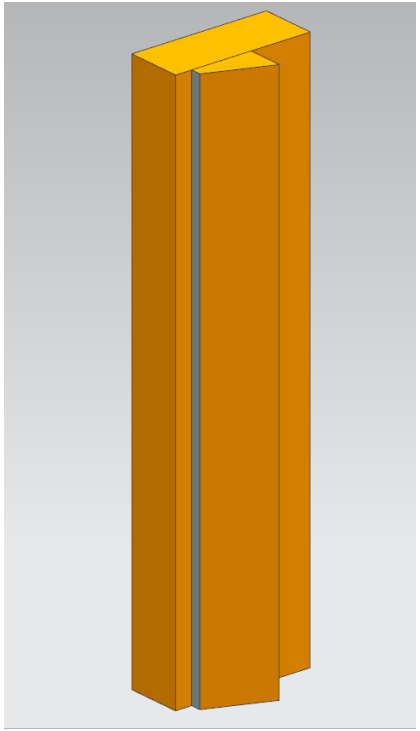
- Reposition of the Blocks with appropriate clearance between each other
- Change of the shape of some blocks to reduce the number of types of blocks
- Add lifting features to improve the integration process
- Check for interference of the new configuration with the other elements in the model: Solenoids, Cryo system and Building



Blocks Integration

Example of Block Integration:

- Robust configuration
- Less Pieces
- Add lifting features
- Add reinforcement features



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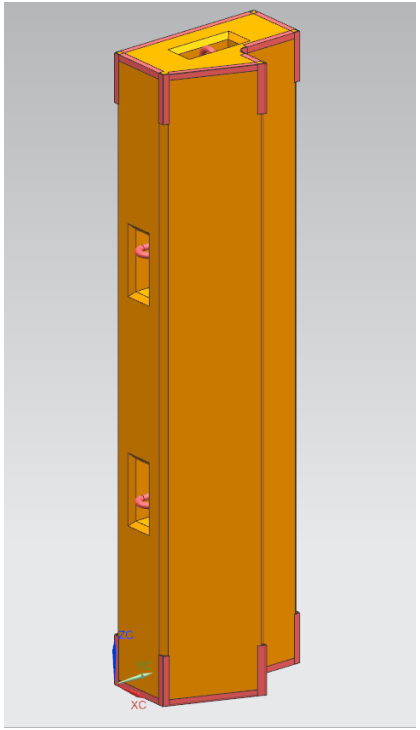


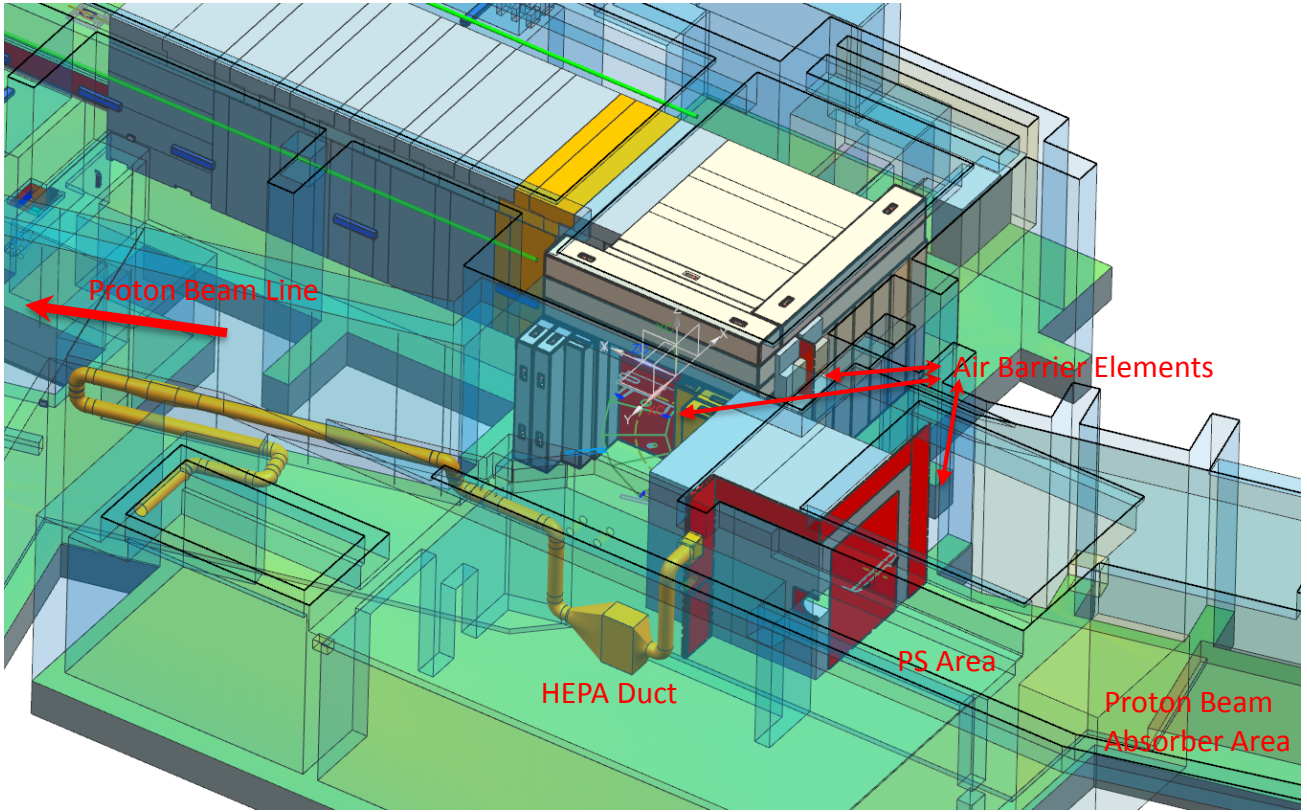
Updated Version

Activated Air Barrier

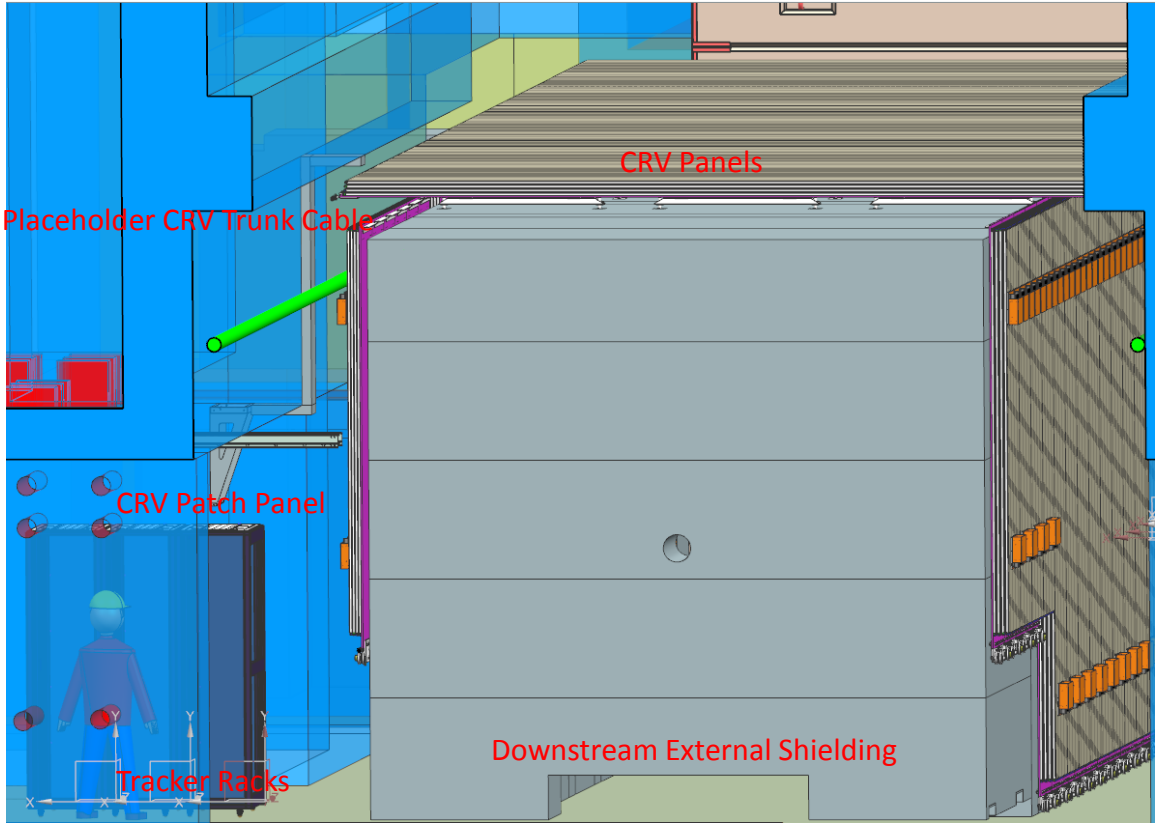
One of the most serious potential sources of radioactive particulates is the activation of the air between the PS and the Proton Beam Absorber.
To minimize this risk:

- PS area should have a negative pressure relative to surrounding area
- The air should pass through the HEPA filter and then to the Proton Beam Line, it will arrive out from the building after an appropriate decay time

To manage all of that, we propose a first solution to seal the affected zone



CRV Team Support



The Cosmic Ray Veto consists in four layers of long extruded scintillator strips, with aluminum absorbers between each layers to suppress the potential background due to the cosmic ray muons.

- Creation and position of a CRV Patch Panel
- Generate Placeholders for the cable routing
- Add supports blocks for CRV-U panels

In the same way, in the optic of improve the integration process between the various division:

- Reposition of the racks for the Tracker team

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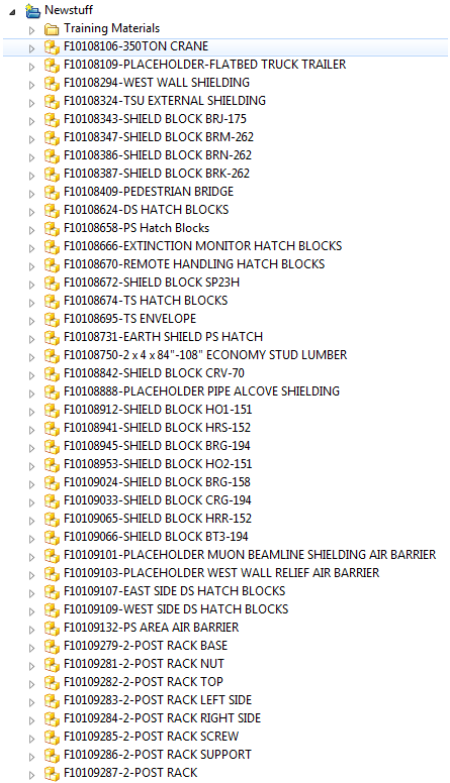
Summary

- Project Overview
- Shielding Primary Beamline
- Installation Plan of PS Solenoids
  - Installation: 350 Ton Crane, Flatbed Truck
  - Hatch Block Shielding
  - Earth Shield
- Pedestrian Bridge
- Downstream and Upstream External Shielding
  - Update of the Nominal Version
  - Release of the Nominal Version
  - New Version with Clearance
  - Implementing of lifting features and corners reinforcements in progress
- Activated Air Barrier
- CRV Team Support
- Other Stuff (as placeholders, checks, measures, etc.)



NewStuff

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Results

- The net result is an improvement in the fidelity of the representation of the current Mu2e plan, facilitating Mu2e integration activities, reducing the potential for interferences or misunderstandings

- I have participated in the Technical Meetings and Discussion, having a taste of the participation in a big project, divided in groups with a common goal and that work hard to achieve it.

Thank you for the Opportunity