



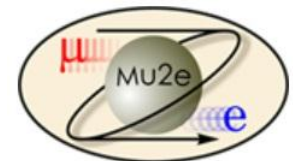
Mu2e Remote Handling Review Overhead Scheme

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Outline:

- A. Motivation for developing the overhead Remote Handling (RH) scheme
- B. Requirements, Assumptions, and Design Constraints
- C. Basic layout of the overhead building and the RH System
- D. Sequence of Operation
- E. Detailed look at the 3 RH modules and how they would work for the Radiation-Cooled (RC) target
- F. Proposed design for a Convection-Cooled (CC) target
- G. How the overhead RH system would accommodate the CC target
- H. Summary

Motivation for Developing the Overhead RH Concept:

1. To develop a RH system that could be adapted to either a RC or a CC target scenario, since:
 - (A) the decision to use a RC target is not final yet
 - (B) even if we do choose RC, we may want the option of using CC in the future
2. To develop a RH system that was more similar to other RH systems that people have experience with at FNAL (APO, Numi/Nova, planned LBNE – all overhead)
3. To develop a RH system that could reach through a cask and pull the window and target straight back into it – minimizing contamination risk
4. To develop a RH system that relied less on robotics / software / electronic motion controls and instead had simpler and fewer motions needed to accomplish the RH task (in general: less complicated = more reliable)
5. To develop a RH system that was less dedicated to the specific task for which it is designed and more accommodating to other tasks we may ask of it in the future

Requirements, Assumptions, and Design Constraints:

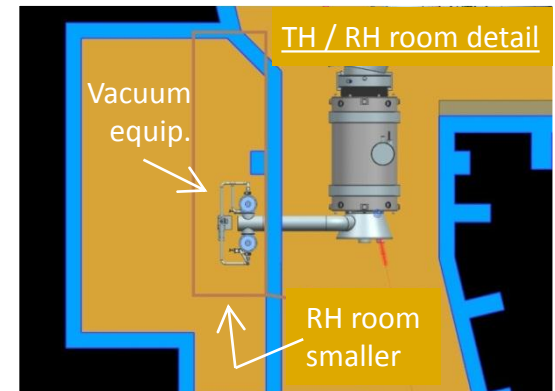
Same as for the horizontal design, except:

1. Entry / exit from the Target Hall (TH) is via overhead gantry crane through a ceiling hatch opening to the inside of a ground-level building – this means:
 - A) RH system has no floor rails
 - B) RH system can be set down onto a structure mounted directly to the PS frame
 - C) This structure would be above the floor, unaffected by floor movements
 - D) Thus: RH system move positions can be preset – no need for machine vision
2. Also means RH system does not need to pass through a narrow doorway. Overhead hatch is 22+ feet long. Thus can place a long module – no need for telescoping motion to reach the target, can just use a long, simple arm with a single in/out motion

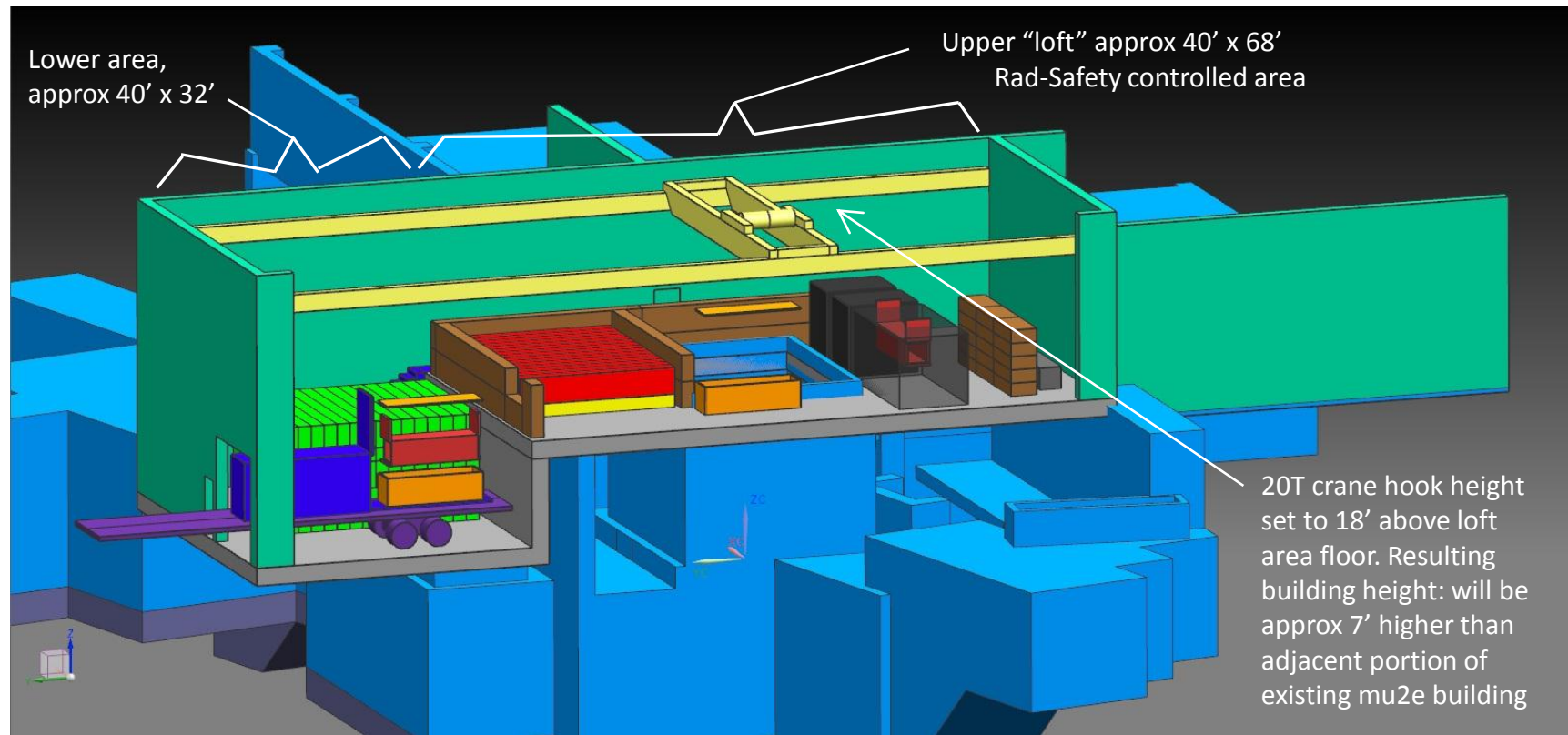
Proposed Overhead Concept: Basic Layout of the Overhead Building and RH System



The basic layout is shown above. The RH system would consist of 3 modules, shown by the 3 dark gray boxes in the picture above. The modules are each lowered in sequence into the TH to perform their specific task and brought back out via crane.



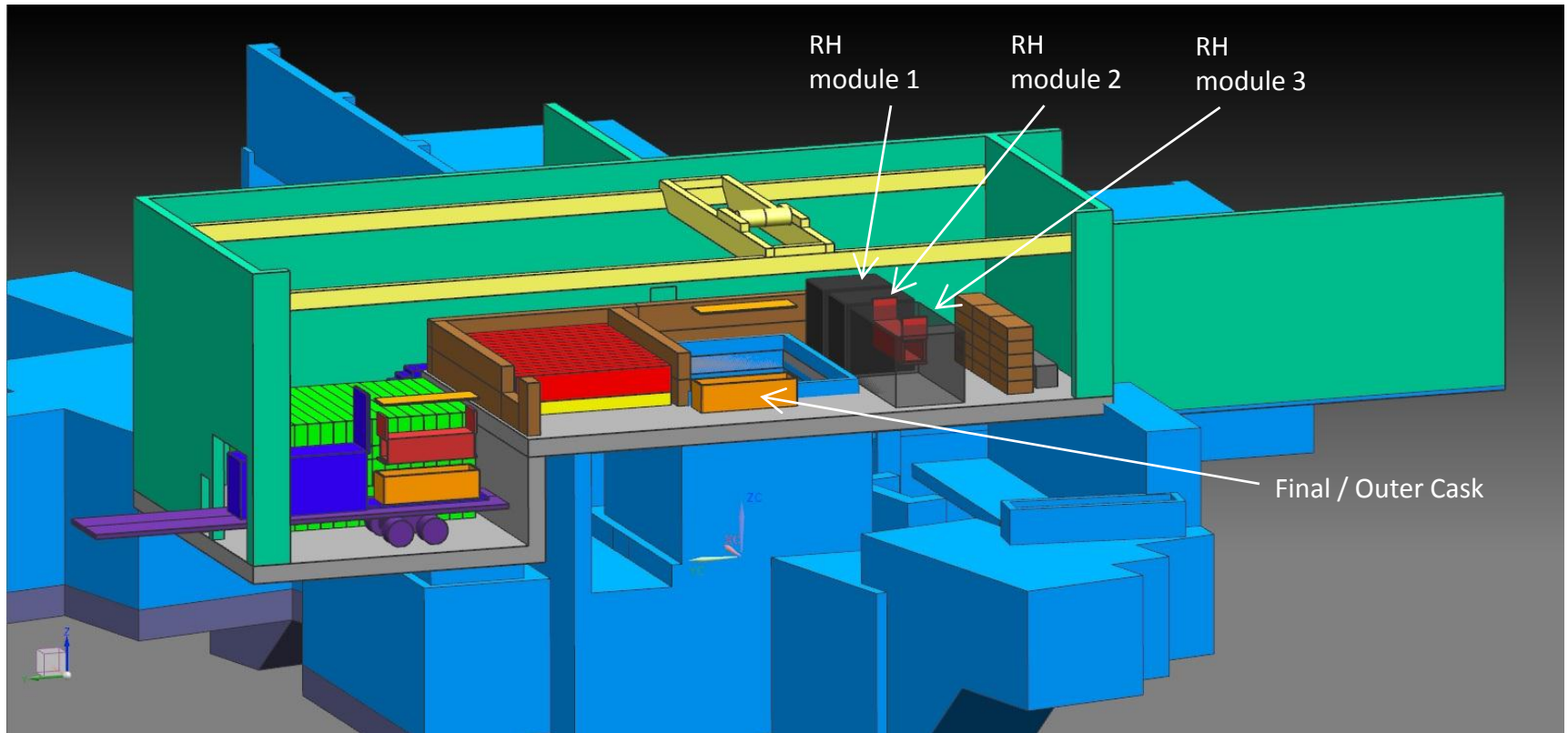
Proposed Overhead Concept: RH System Sequence of Operation



Sequence of Operation . . .

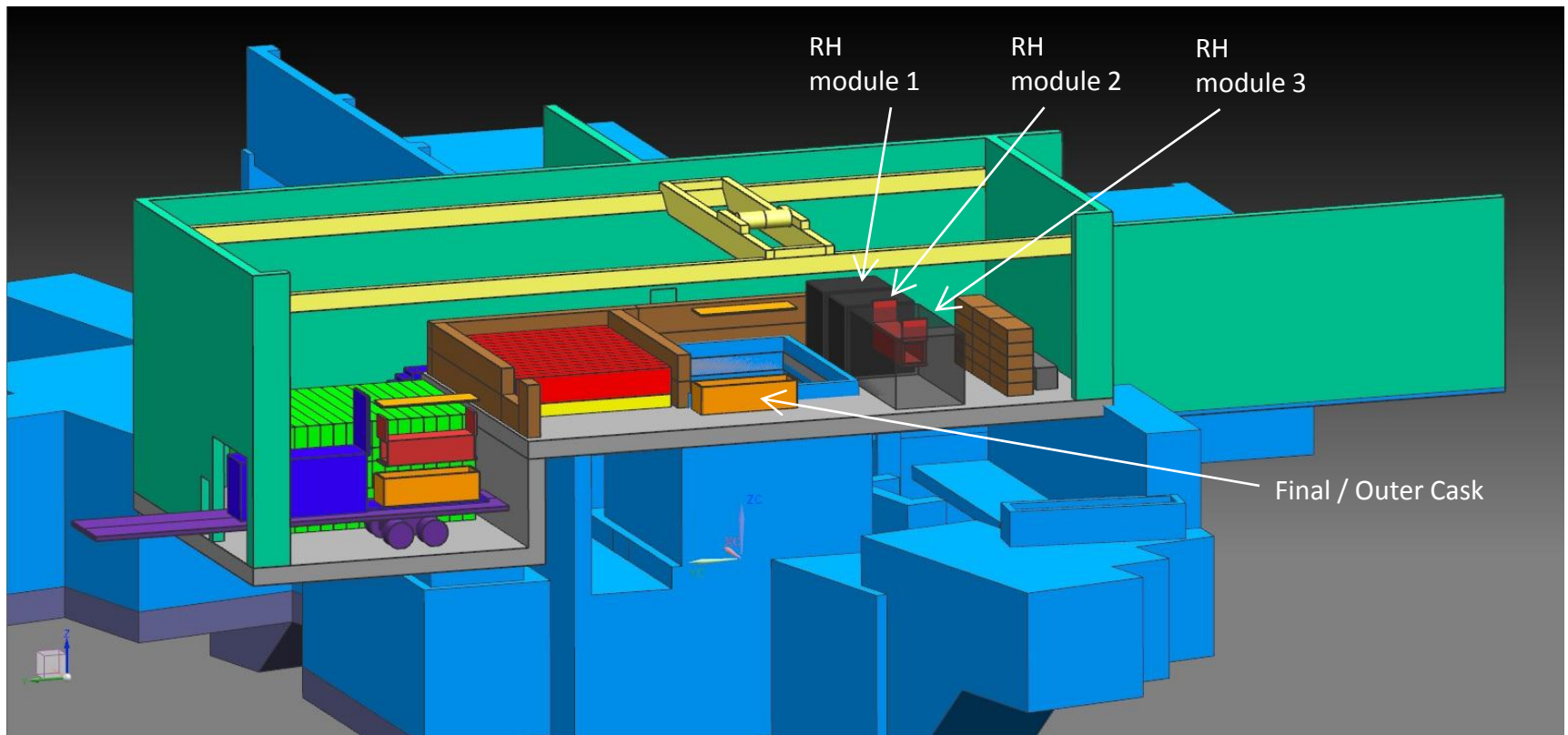
1. Remove hatch shield blocks and stack up as shown in picture above
2. Using crane, lower RH module-1 down into the TH and set in place behind the PS

Proposed Overhead Concept: RH System Sequence of Operation



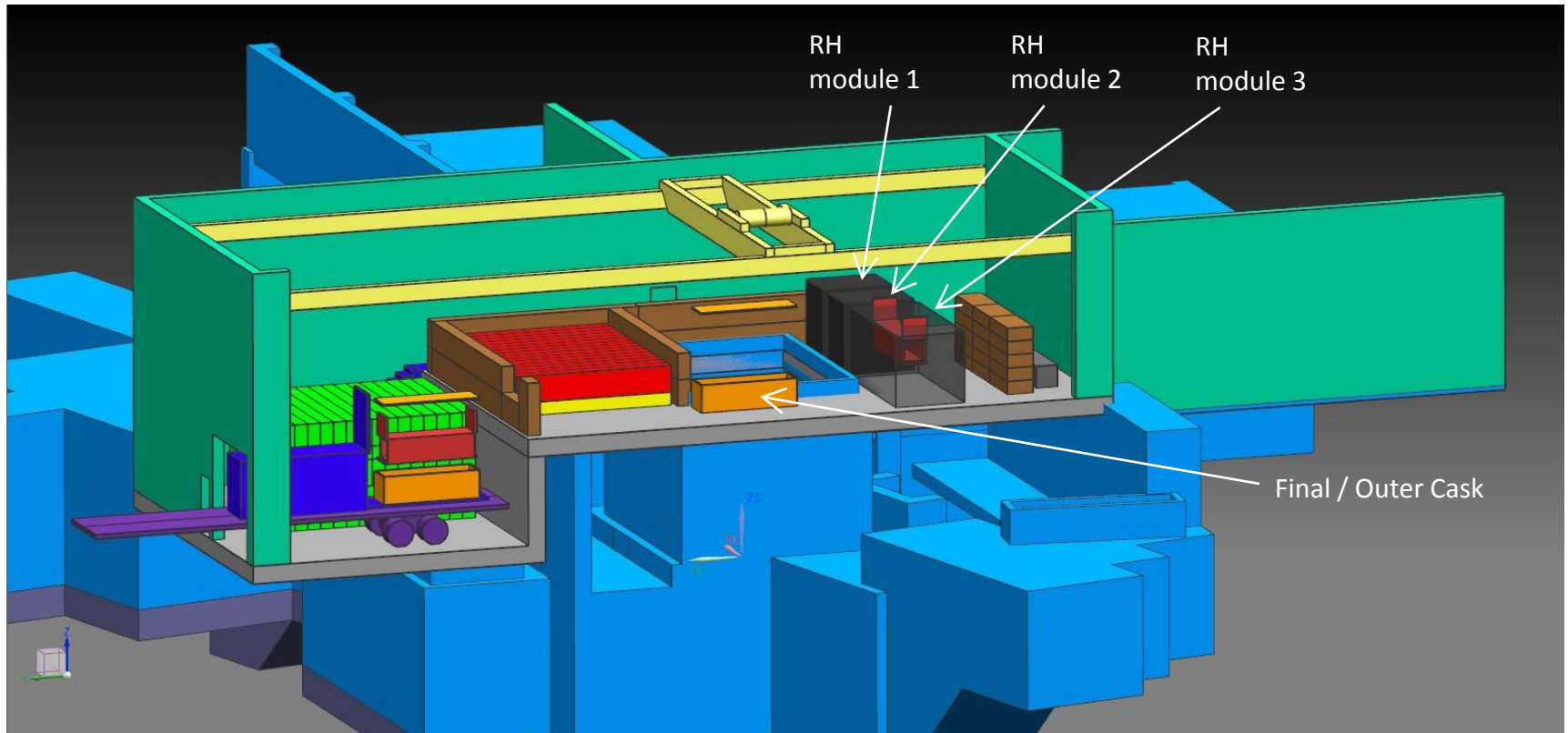
3. RH module-1 removes the 36 bolts around the perimeter of the window
4. Lift RH module-1 back to loft and set down
5. Lower RH module-2 down into the TH and set in place behind the PS. This module includes a cask with 2" steel wall thickness to contain the old window

Proposed Overhead Concept: RH System Sequence of Operation



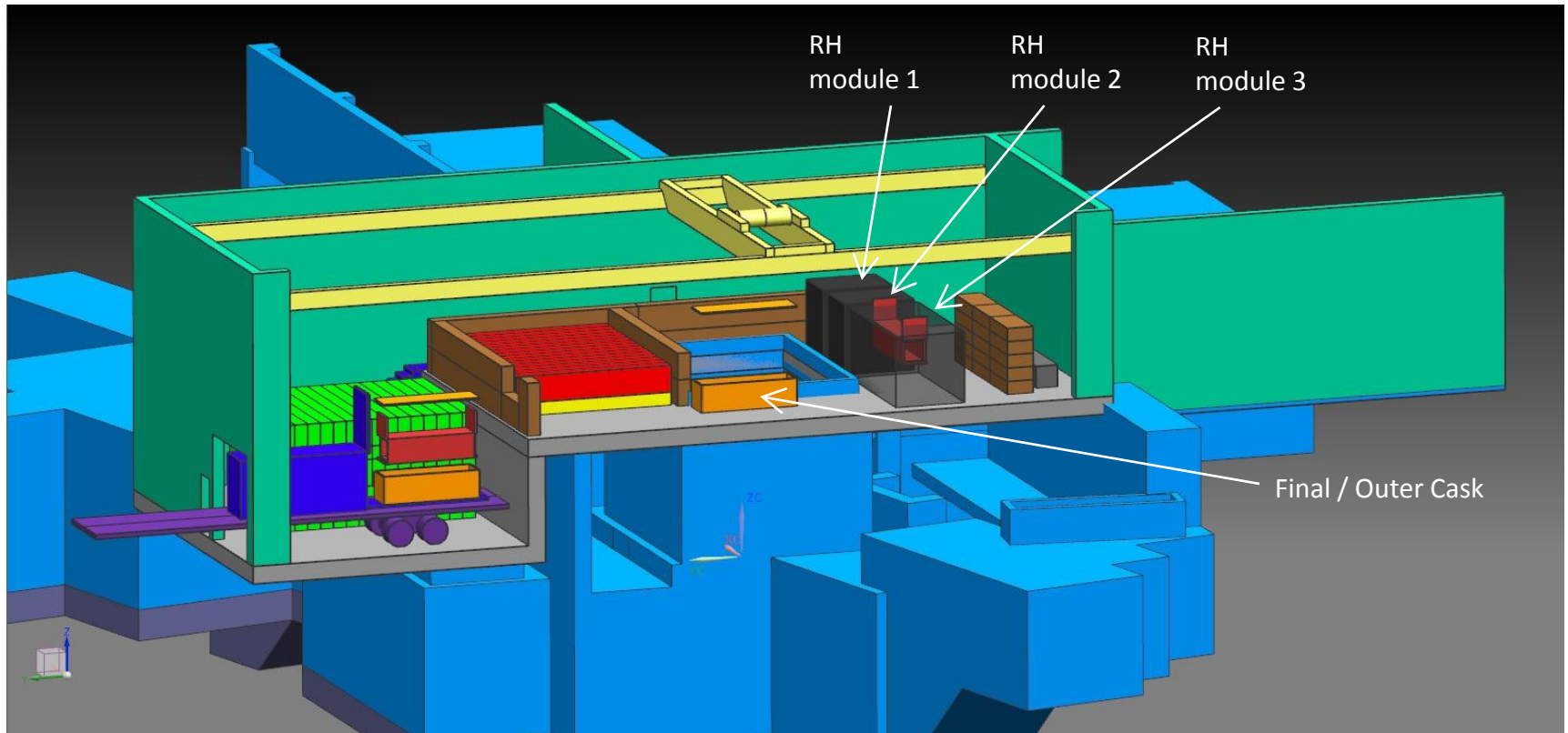
6. RH module-2 removes the window and pulls it straight back into the cask
7. Lift RH module-2 (including its' full cask) back to loft and set down
8. Using the crane, lift the window cask off the module, place into a final / outer cask. This cask can then be placed into a Numi Horn carrier on the truck trailer

Proposed Overhead Concept: RH System Sequence of Operation



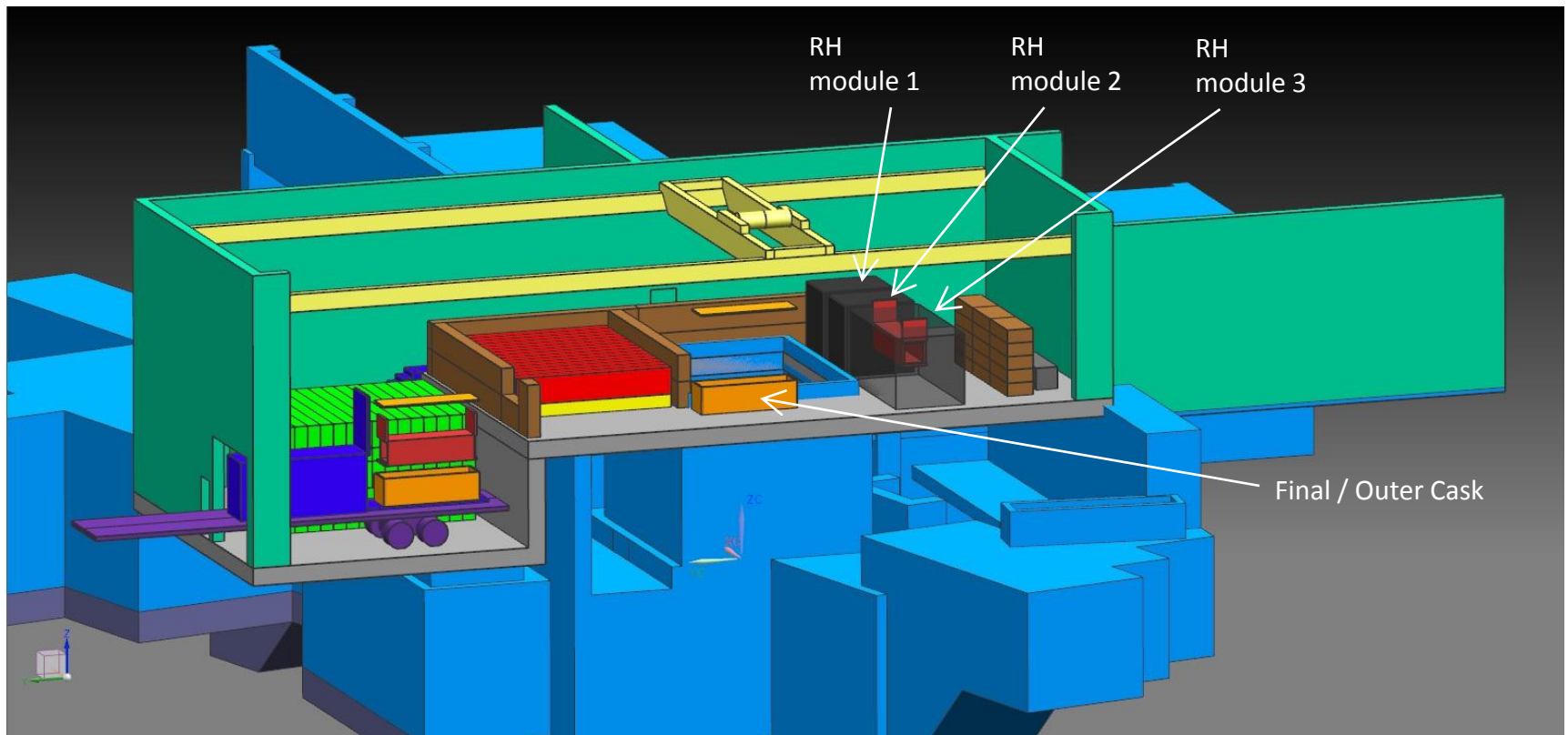
9. Lower RH module-3 down into the TH and set in place behind the PS. This module includes a cask with 2" steel wall thickness to contain the spent target assembly
10. RH module-3 reaches out to retrieve the target and pulls it straight back into the cask
11. Lift RH module-3 (including its' full cask) back to loft and set down

Proposed Overhead Concept: RH System Sequence of Operation



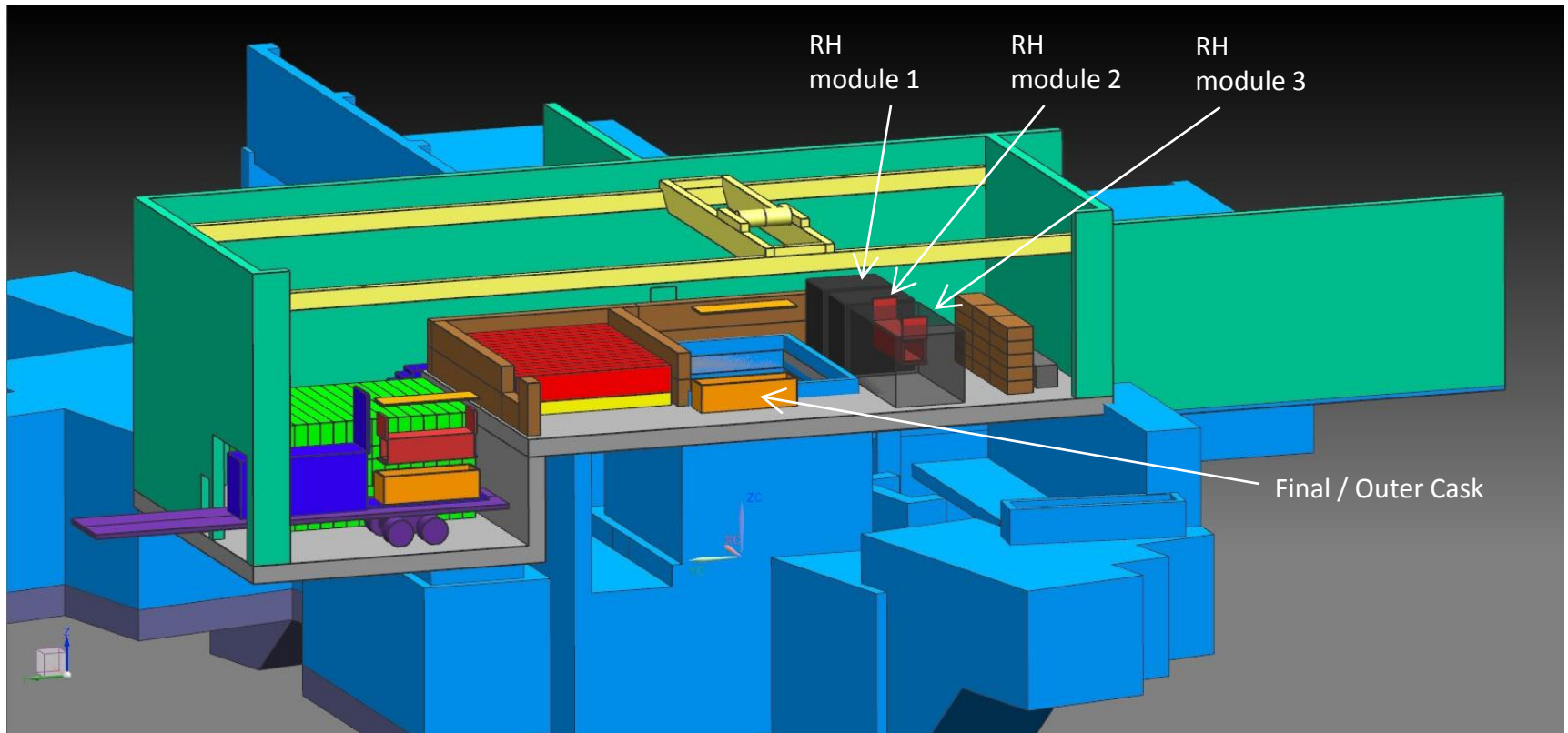
12. Lift the target cask off the module, place into a final / outer cask. This cask can then also be placed into the Numi Horn carrier on the truck trailer. Truck can leave
13. Next, a new target assembly is loaded onto RH module-3, which is then lowered down into the TH and set in place behind the PS

Proposed Overhead Concept: RH System Sequence of Operation



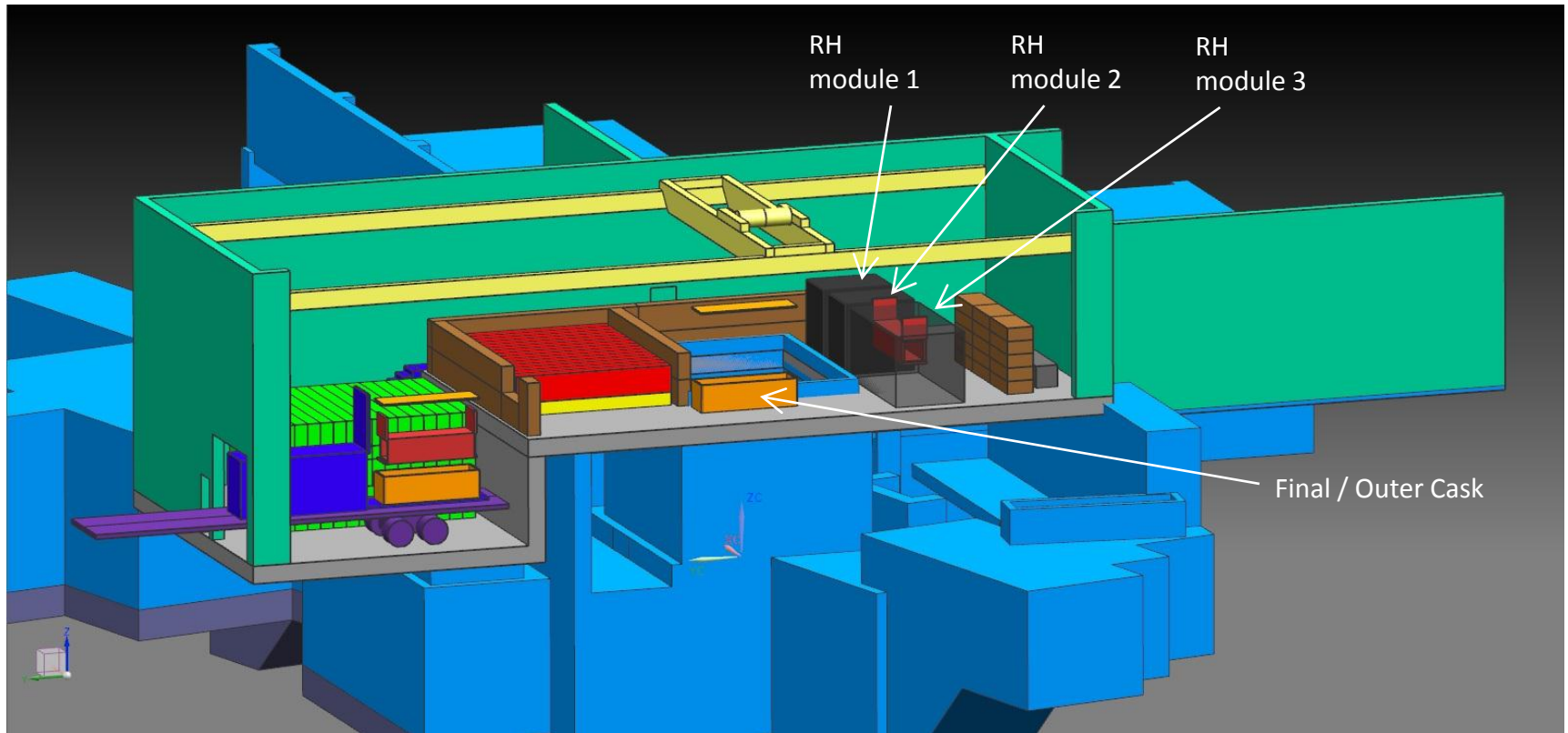
14. RH module-3 then reaches out to place the new target onto its' mounting surface inside the PS. When complete, the module is lifted back to the left and set down
15. A new window is now loaded onto RH module-2, which is then lowered down into the TH and set in place behind the PS

Proposed Overhead Concept: RH System Sequence of Operation



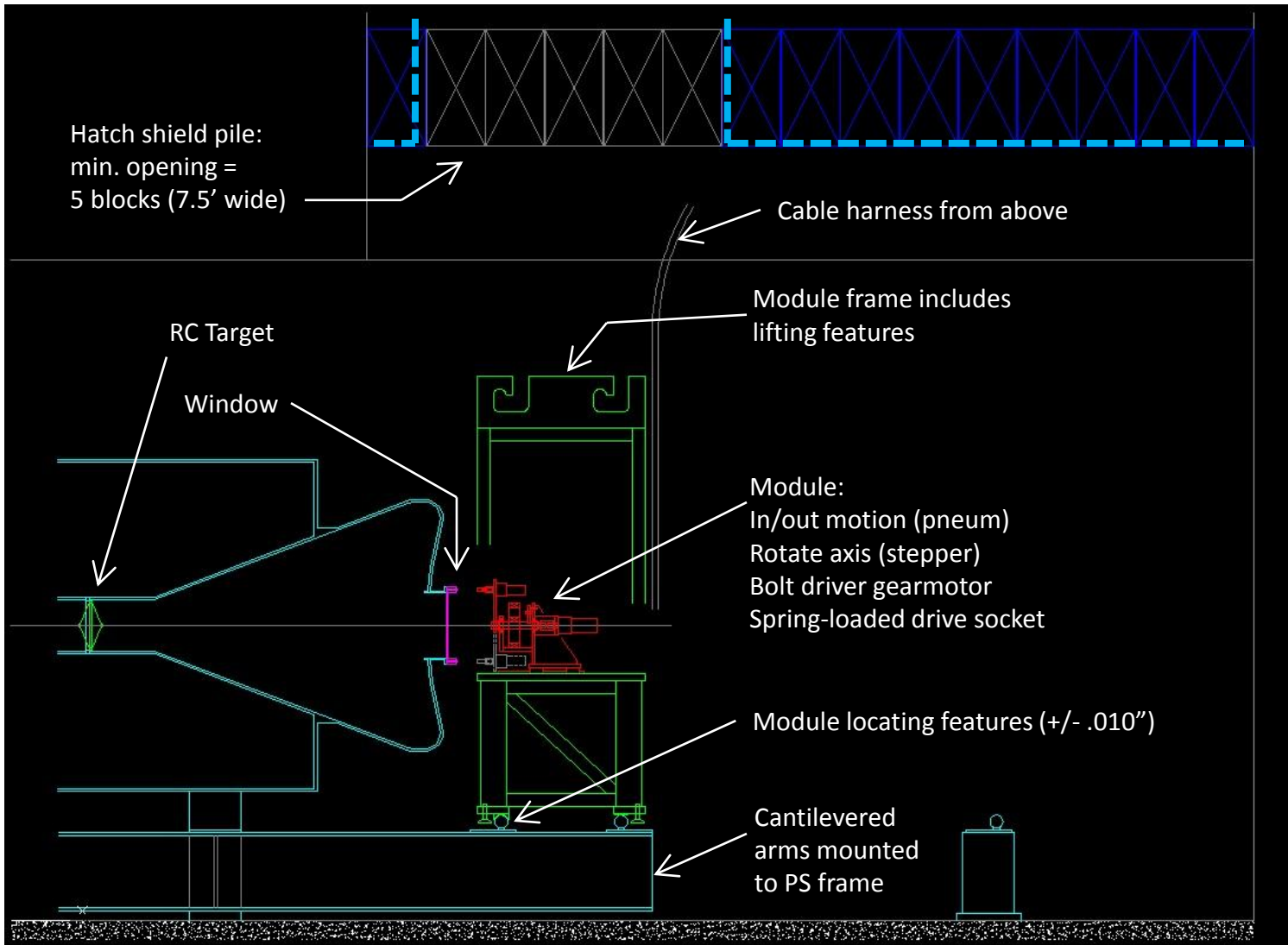
16. RH module-2 reaches out to place the new window onto its' mounting flange on the PS endcap. When complete, the module is lifted back to the loft and set down
17. RH module-1 is then lowered down into the TH and set in place behind the PS. This module proceeds to tighten the 36 bolts around the perimeter of the window. Any desired star pattern tightening sequence can be programmed

Proposed Overhead Concept: RH System Sequence of Operation

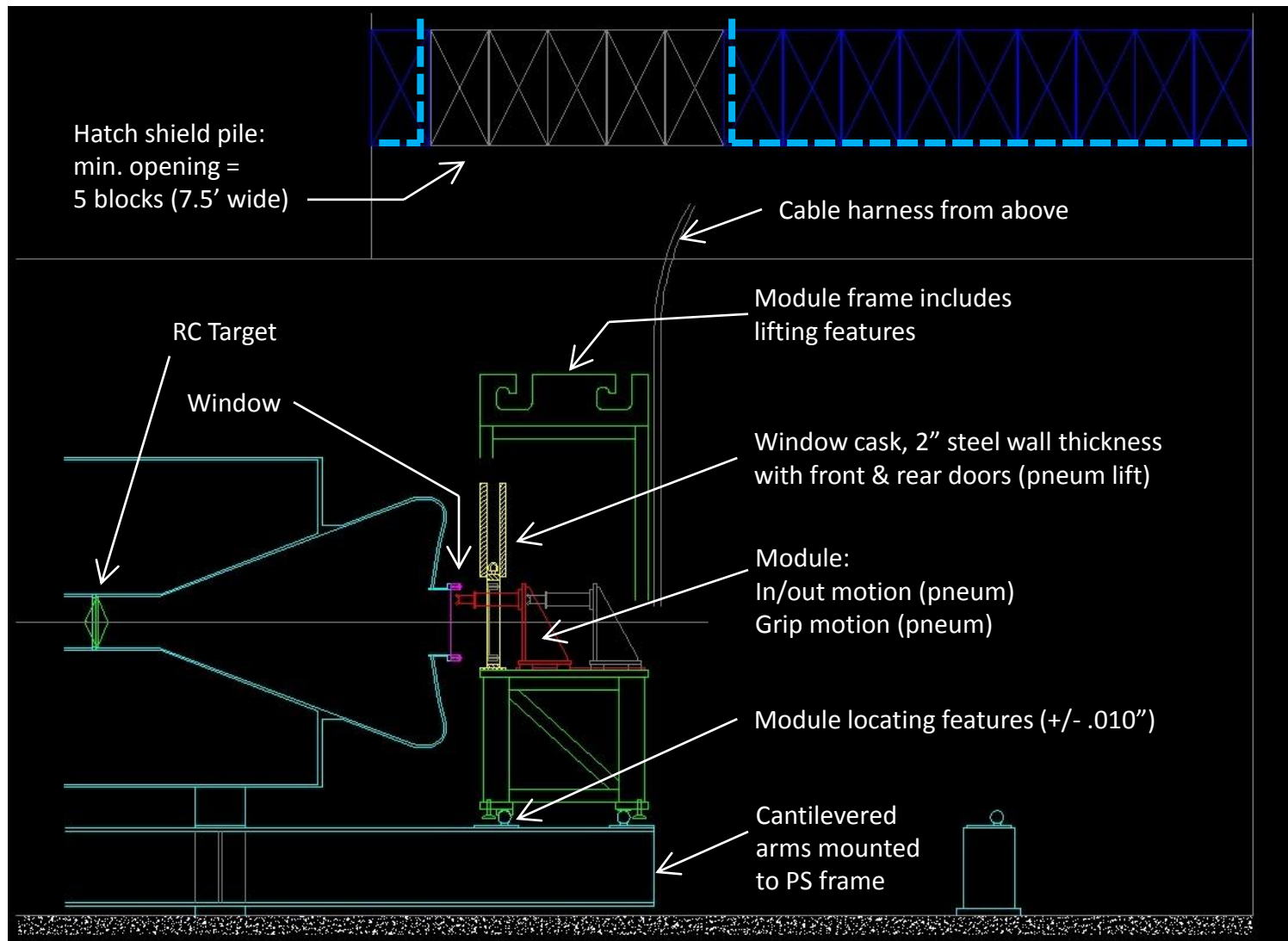


18. Lift RH module-1 back to left and set down
19. Put all shield blocks back into place in the hatch
20. RH target exchange process complete

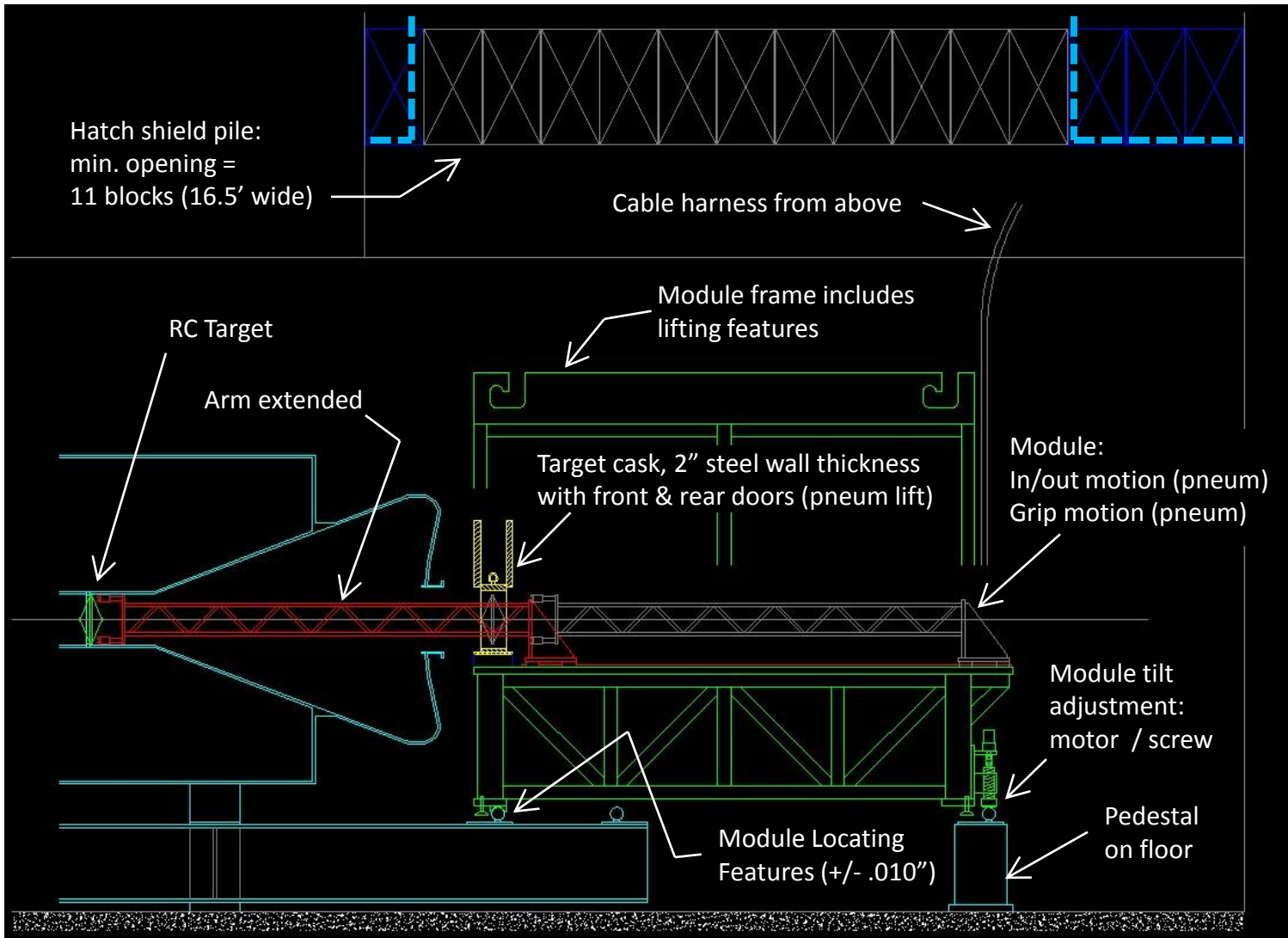
Design Details: RH Module-1 – Bolt Circle



Design Details: RH Module-2 – Window

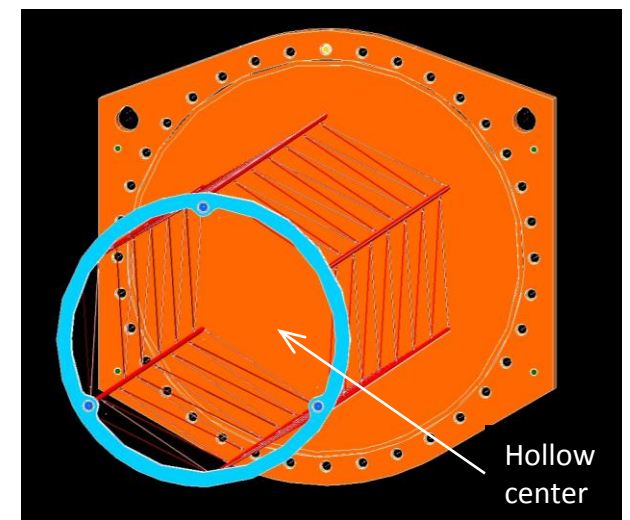
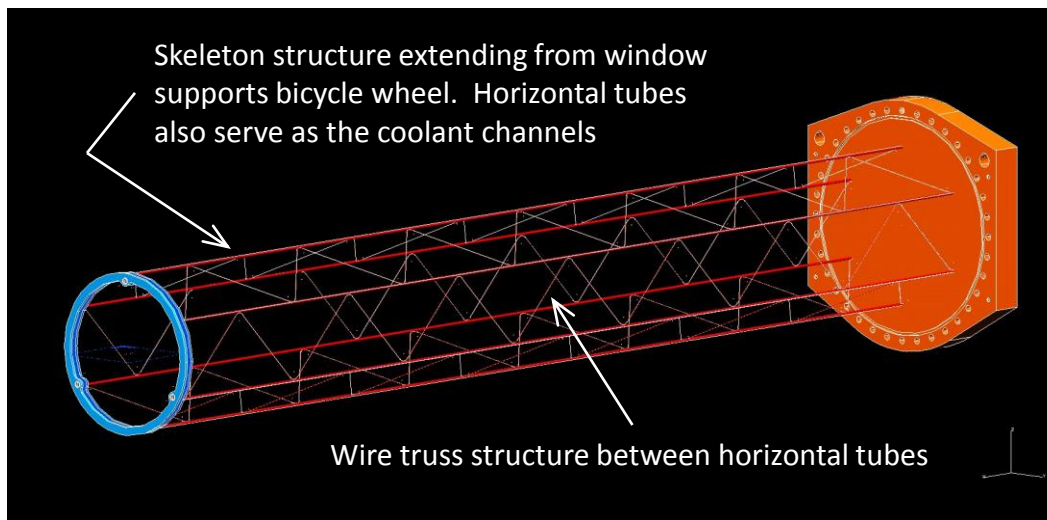
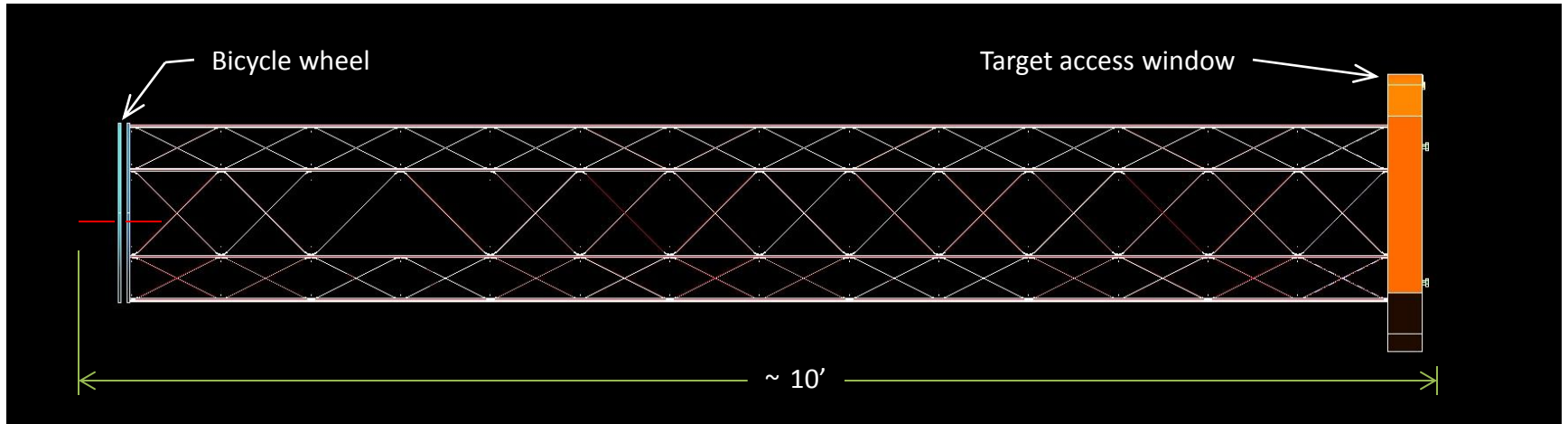


Design Details: RH Module-3 – RC Target

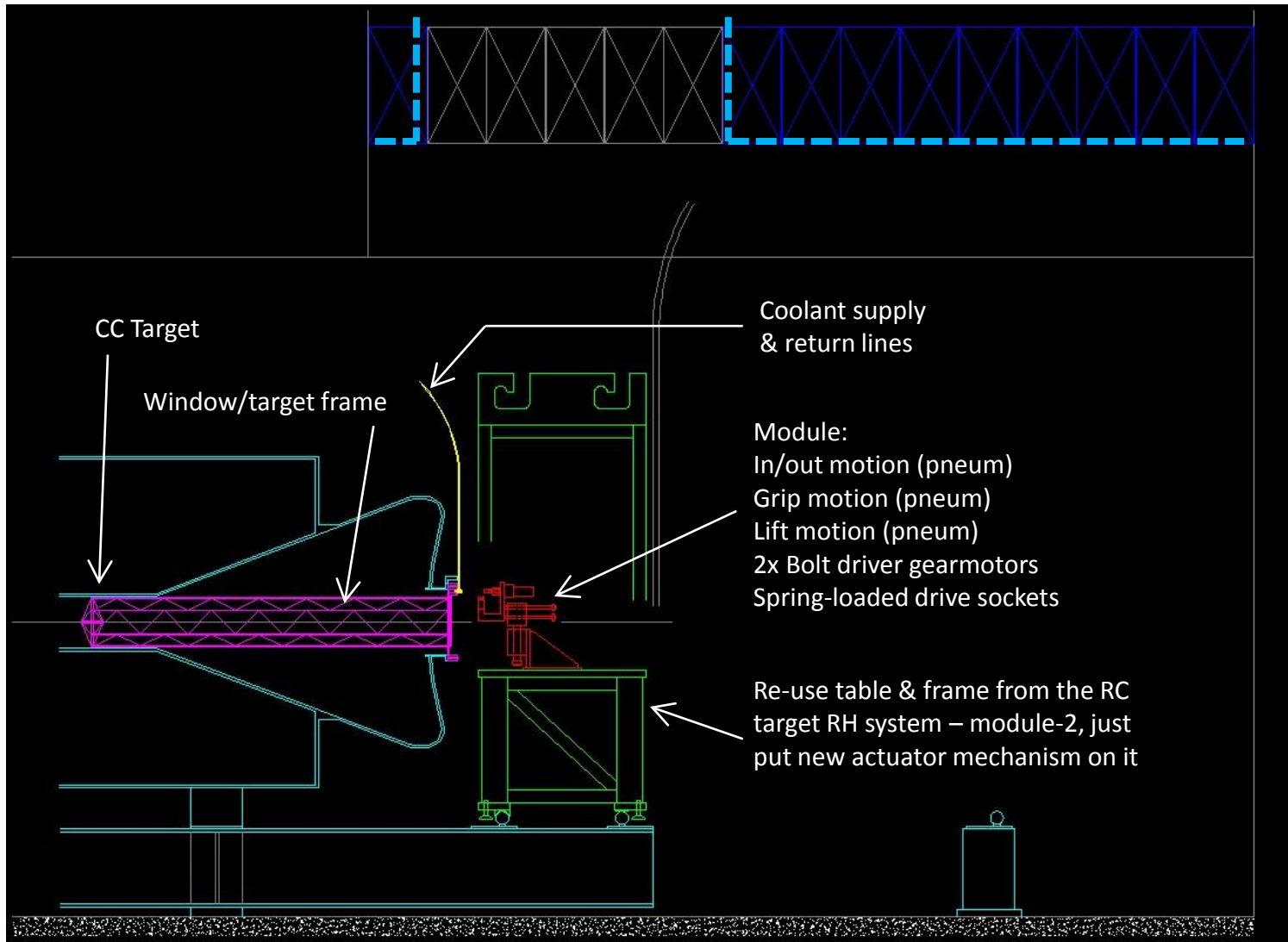


Proposed conceptual design for CC target (version 1)

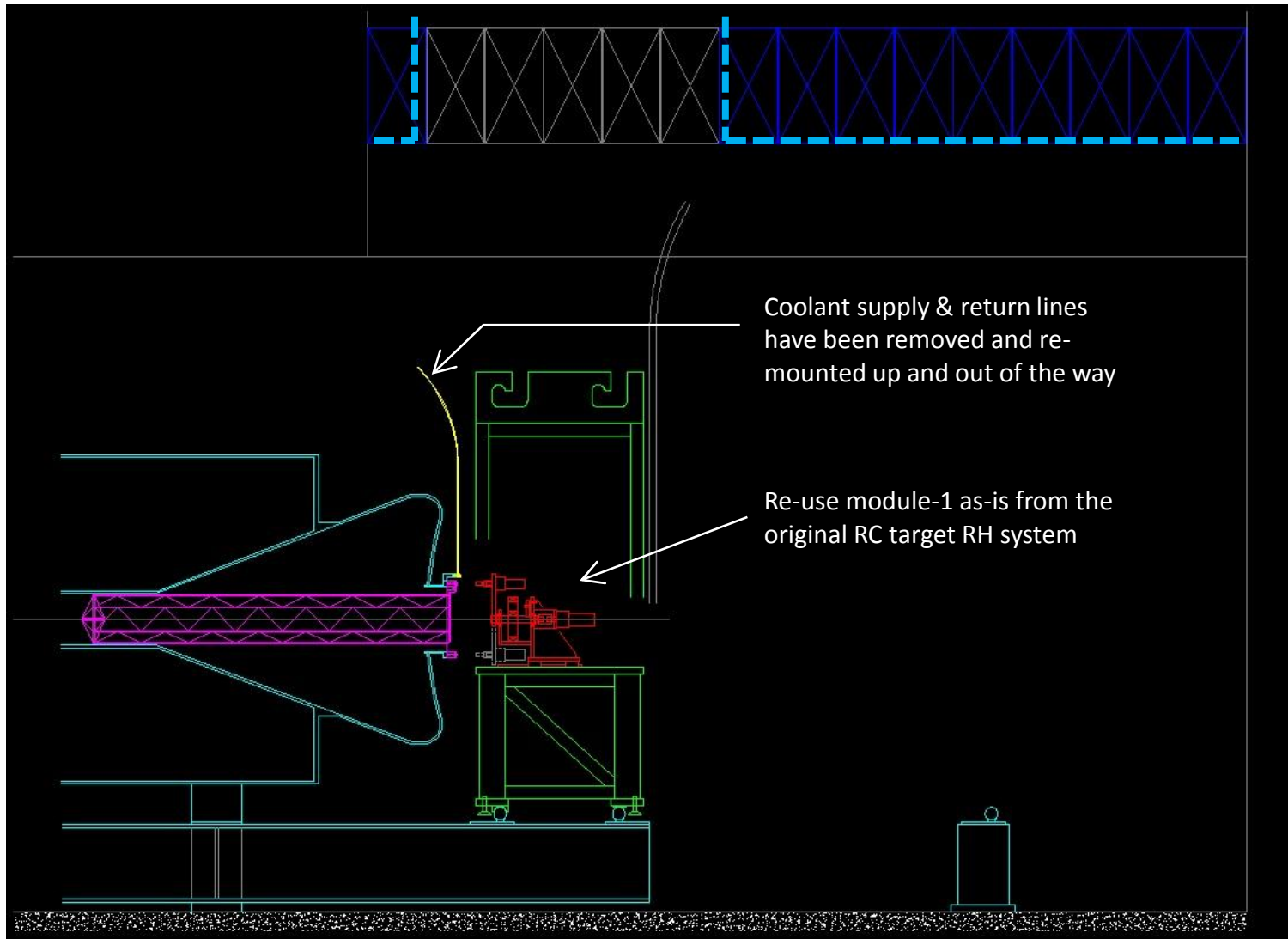
Physics simulation showed no significant loss of muon yield from this structure



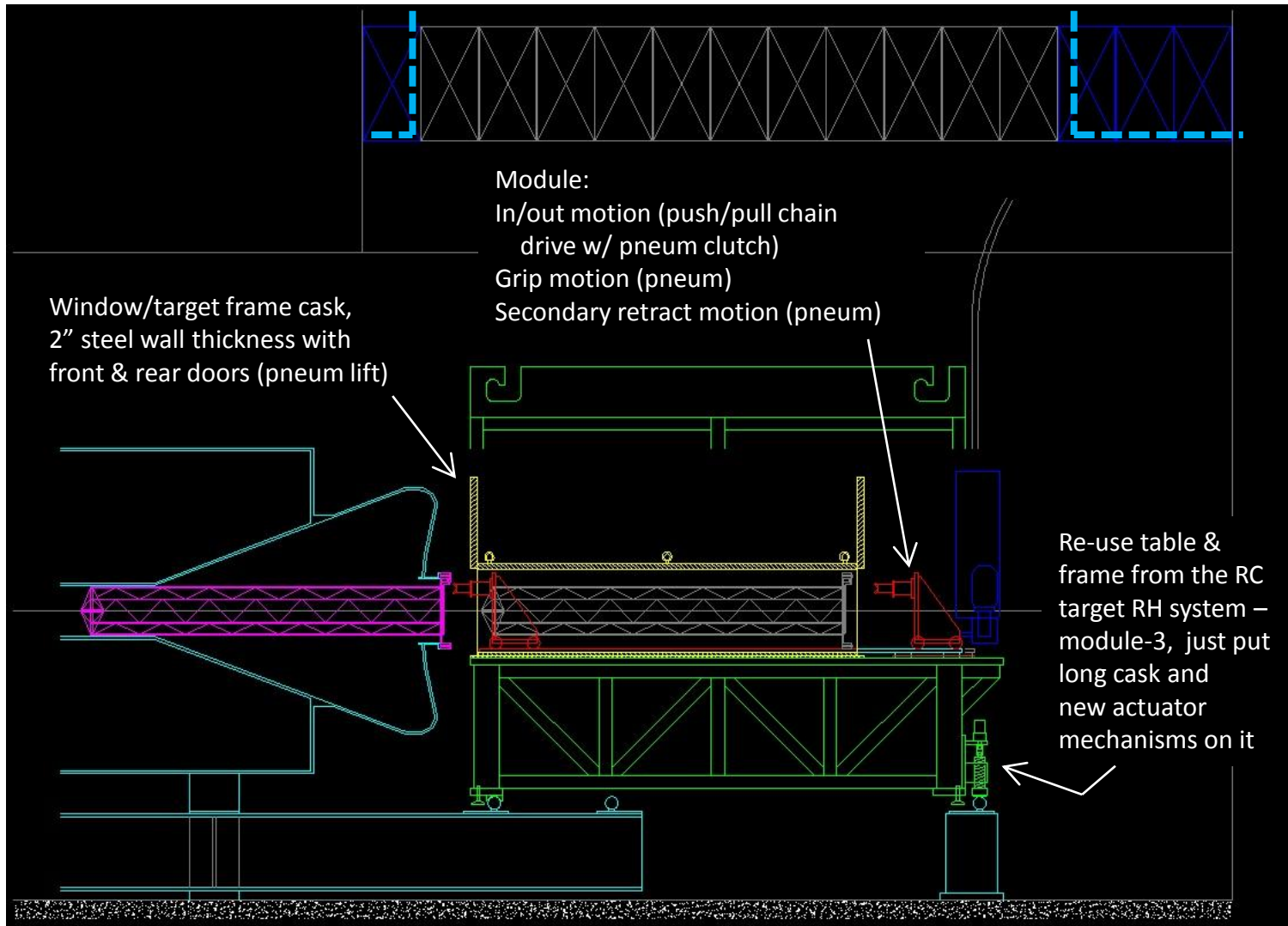
Design Details: RH Module-1 for CC Target – Remove Coolant Lines



Design Details: RH Module-2 for CC Target – Bolt Circle



Design Details: RH Module-3 for CC Target – Remove Window/Target Frame



Summary:

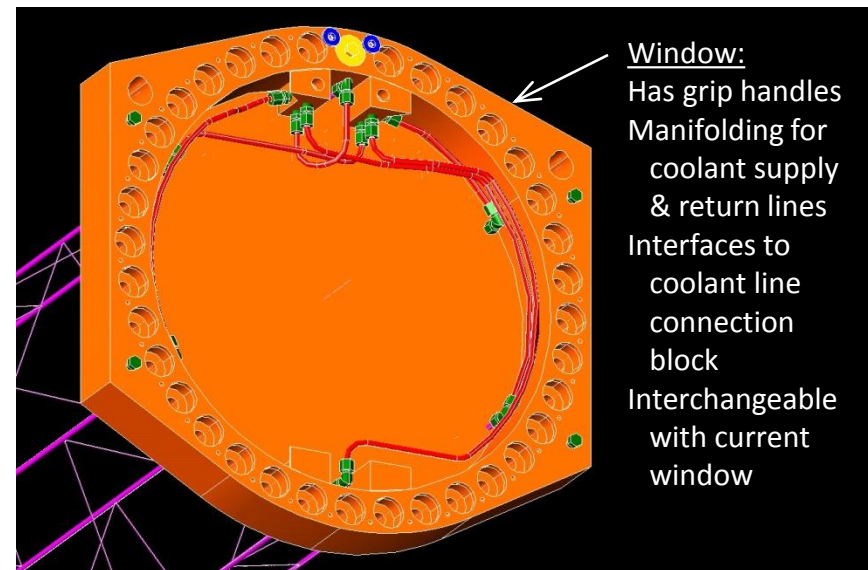
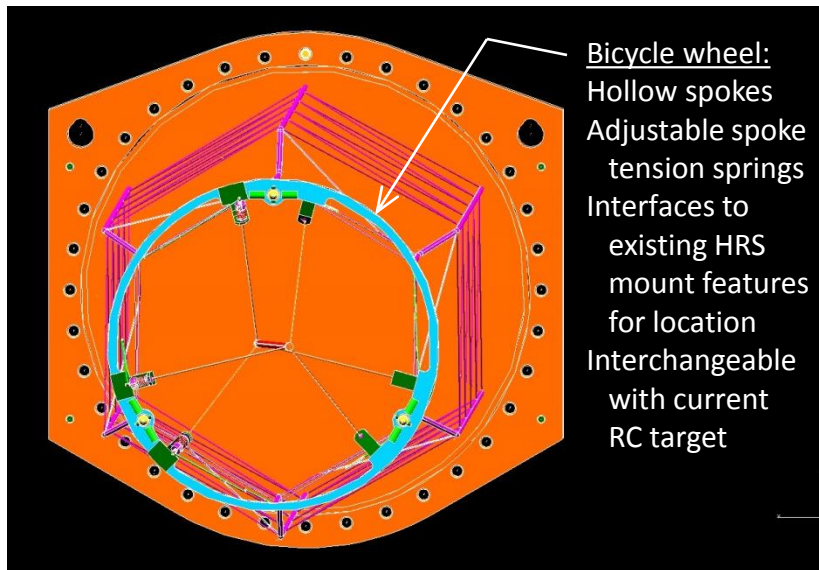
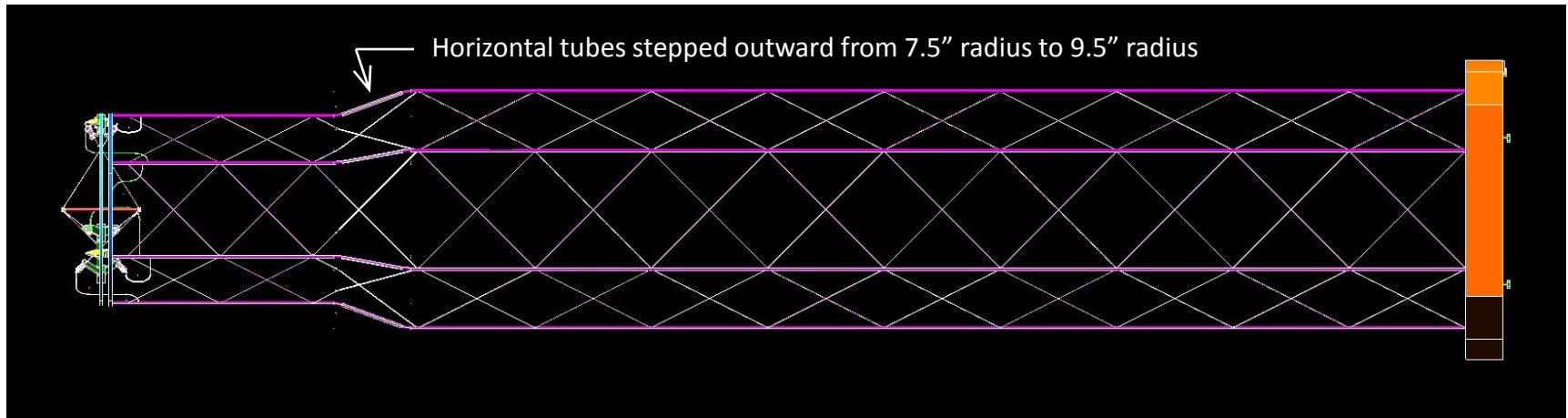
The Overhead RH Scheme:

1. Facilitates either the RC or CC target – now or later
2. Would re-use much of the RH system if a RC --> CC change was made
 - > building layout, 1 complete module, 2 other module bases, control system
 - > proposed CC target design uses same mount as RC (thus interchangeable)
3. Utilizes an overhead gantry crane, similar to other RH systems at FNAL
4. Utilizes 3 modules, each with simple motions – thus should have good reliability
5. Locates on a structure tied directly to the PS, above the floor
6. Utilizes a non-telescoping arm to reach the RC target with a single in/out motion
7. Minimizes contamination risk by pulling straight back into the casks
8. Provides future flexibility - can add new module(s) as needed for whatever task
 - > proton beam exit window, extinction monitor window, other tasks TBD ?

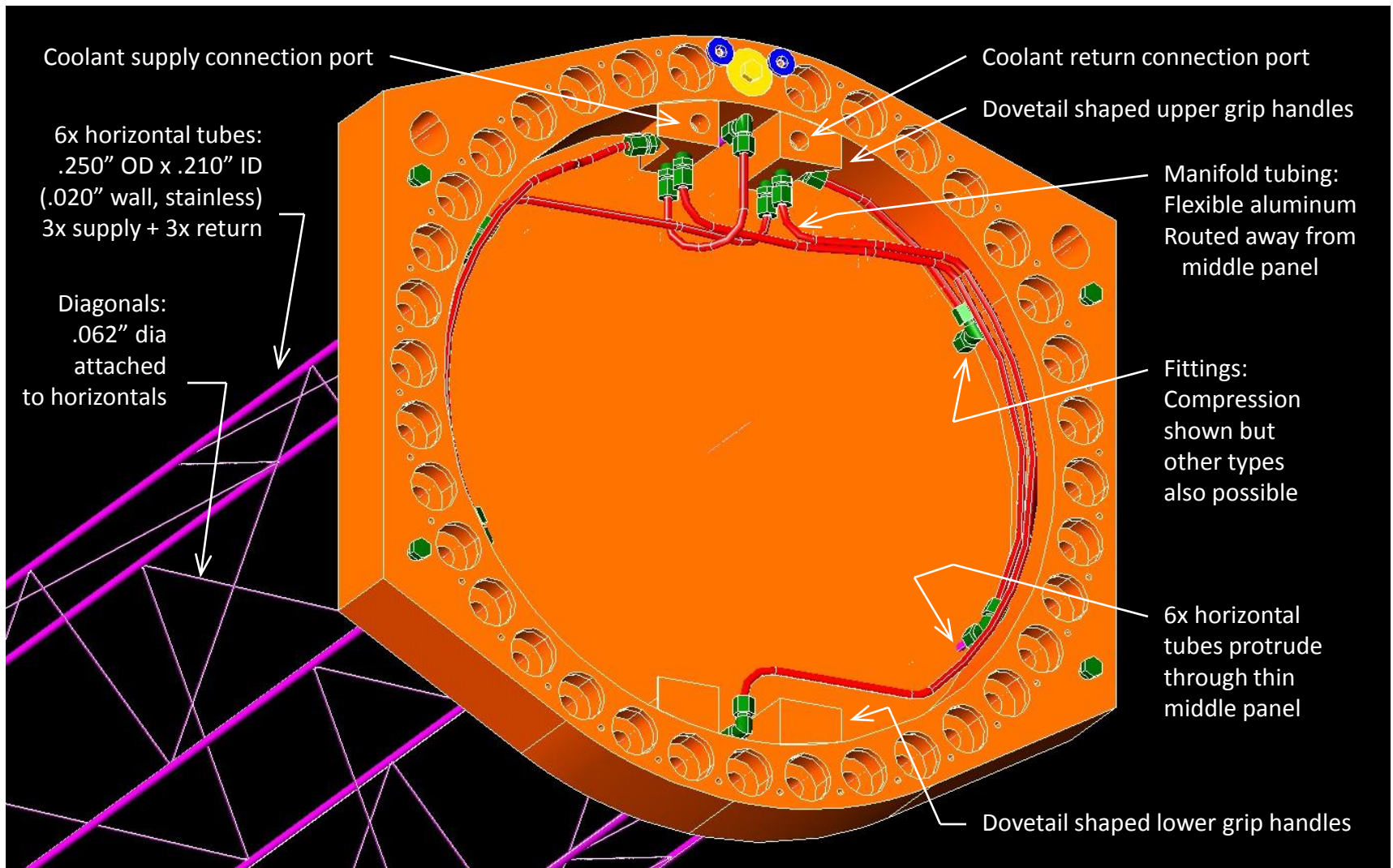
End of Main Presentation

Back-up Slides Following . . .

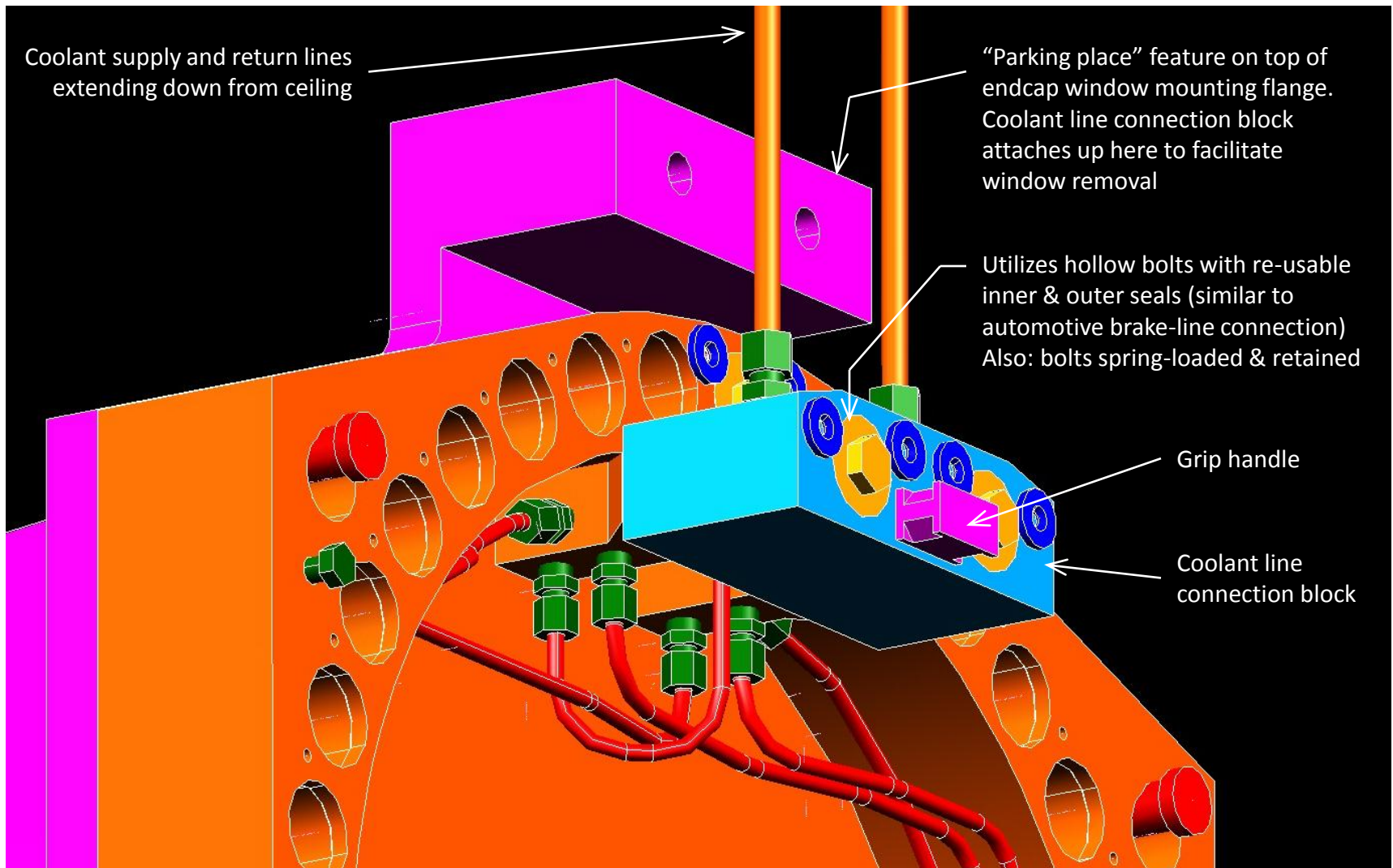
Proposed Design Details for CC target : Overview



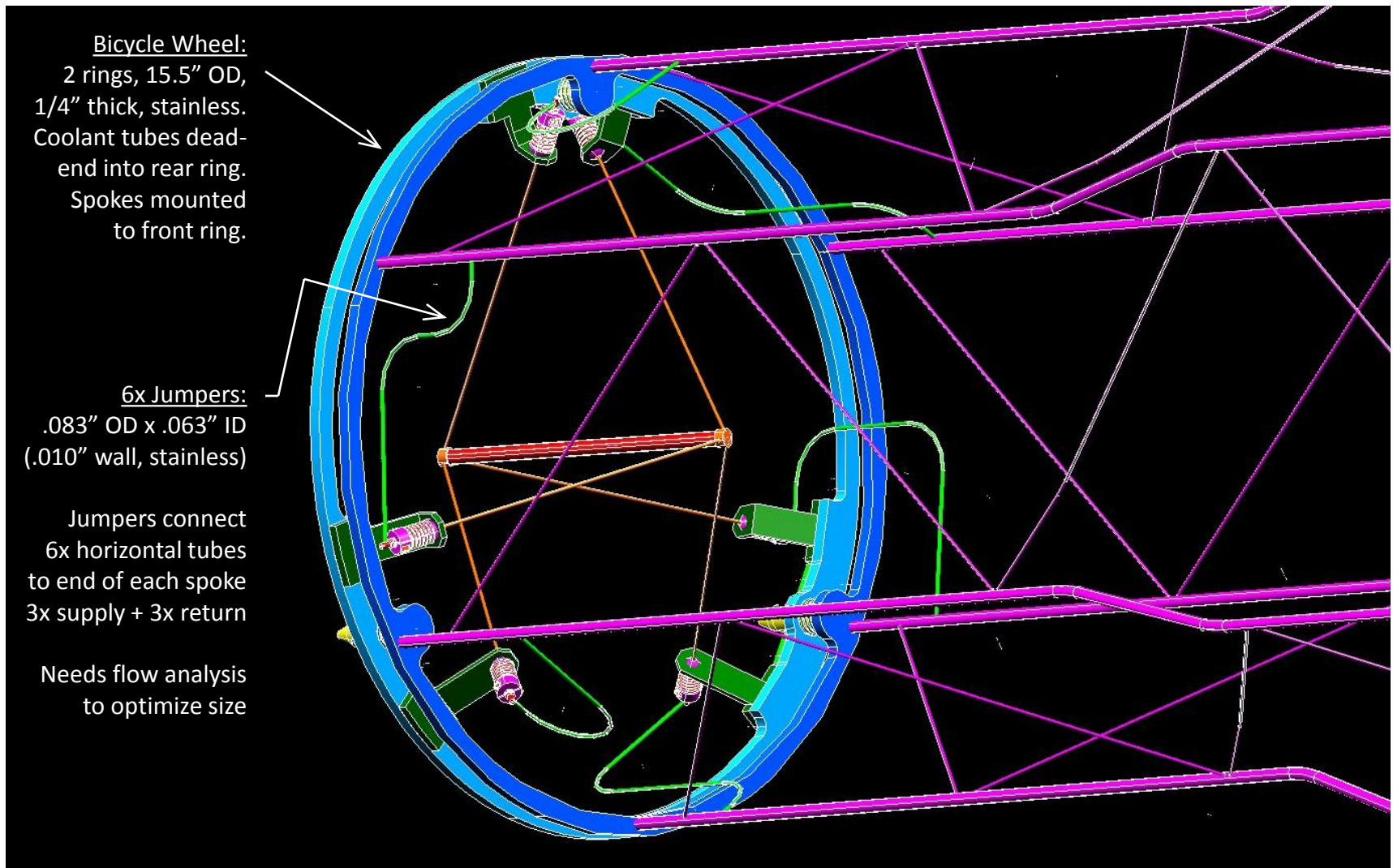
Proposed Design Details for CC target : Window and skeleton frame



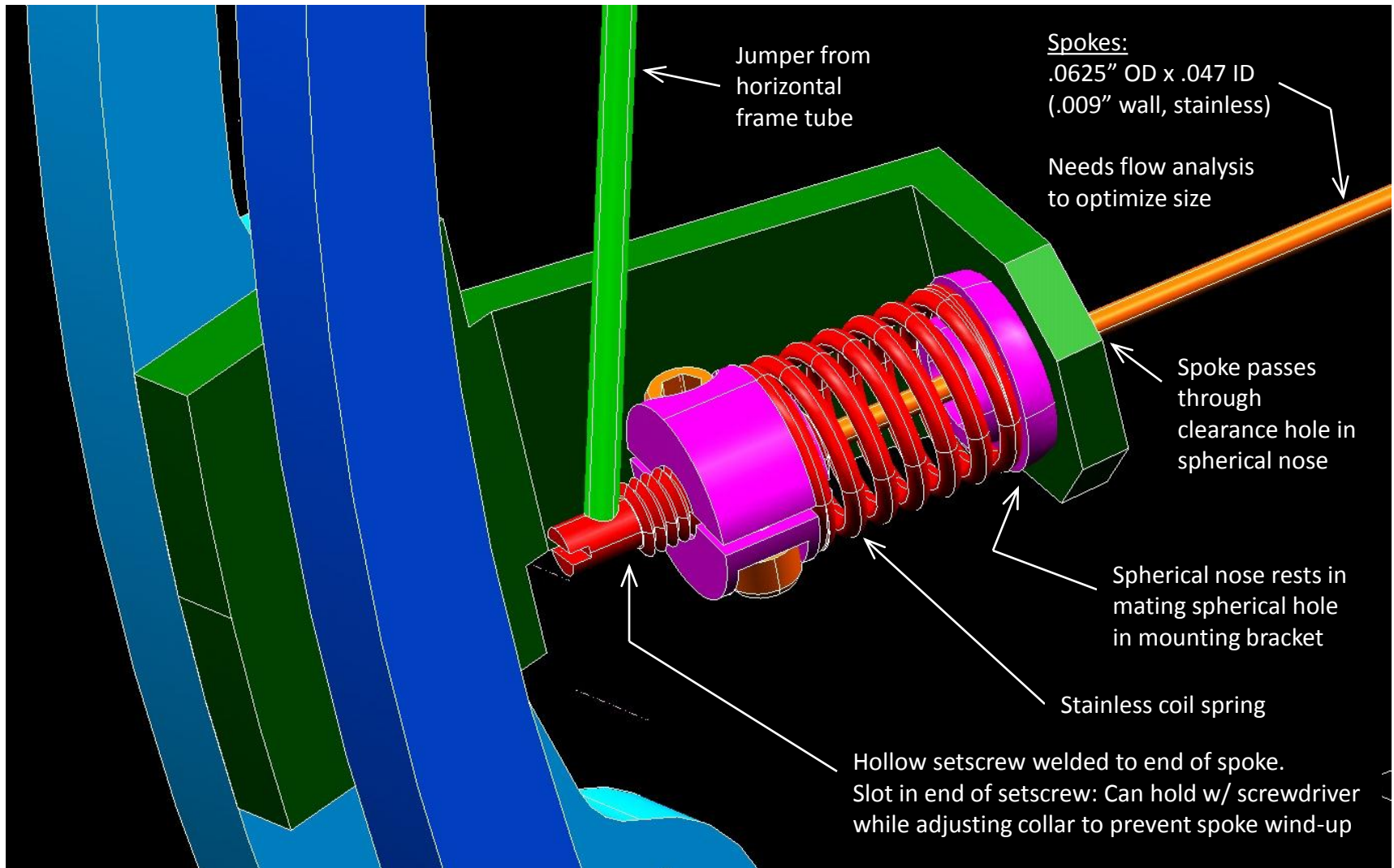
Proposed Design Details for CC target : Coolant line connection block



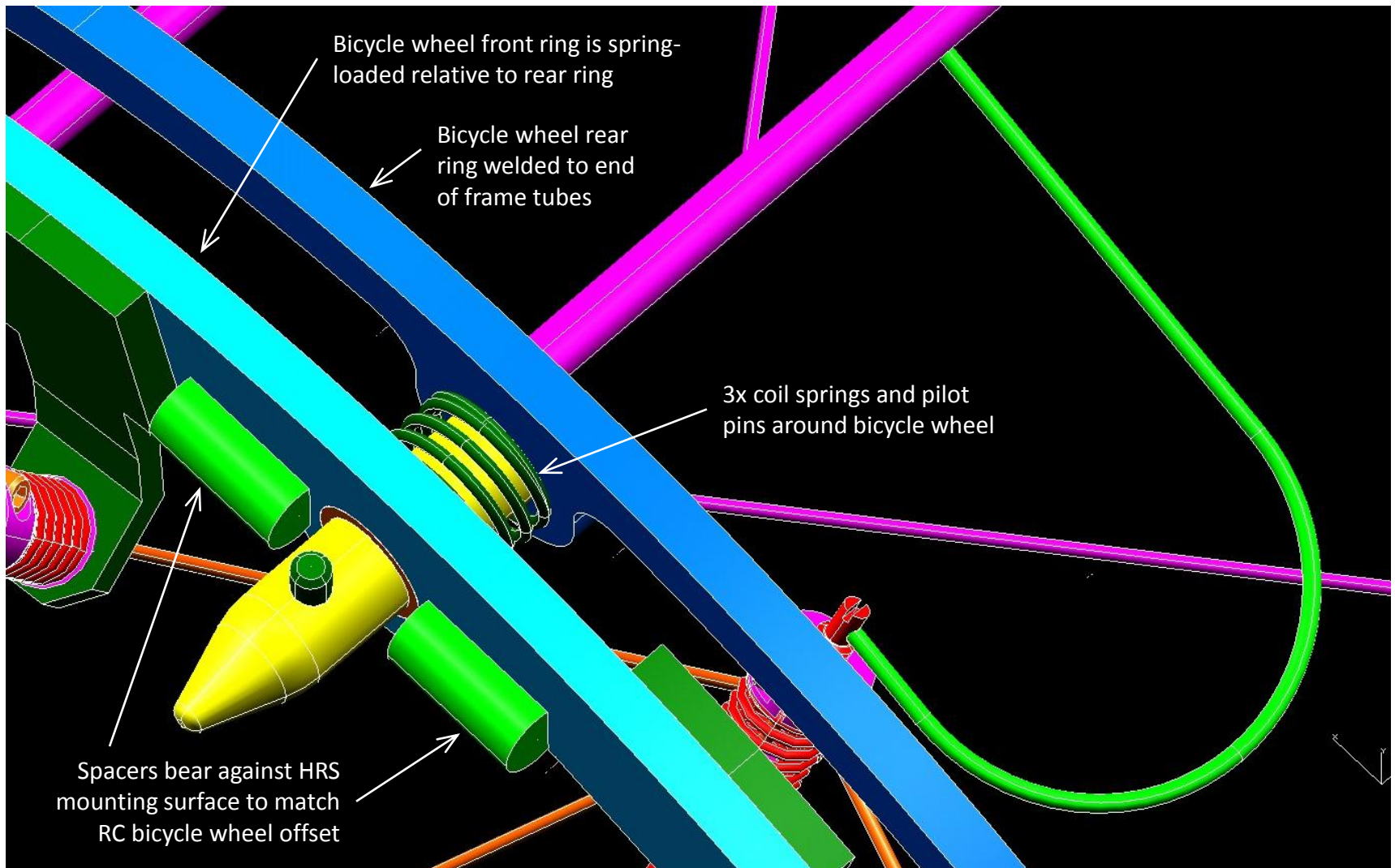
Proposed Design Details for CC target : Bicycle wheel and coolant routing to spokes



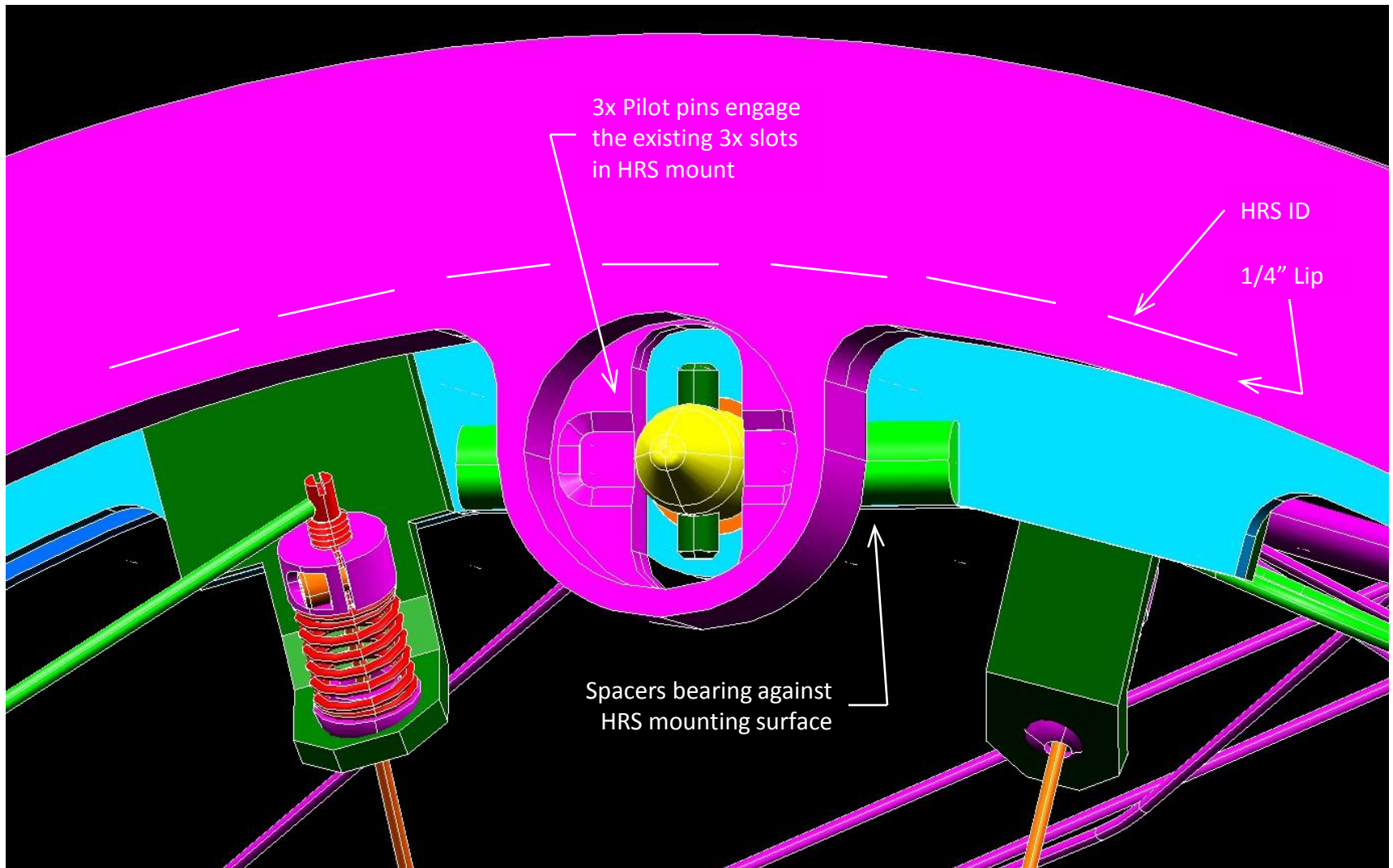
Proposed Design Details for CC target : Adjustable spoke tensioning



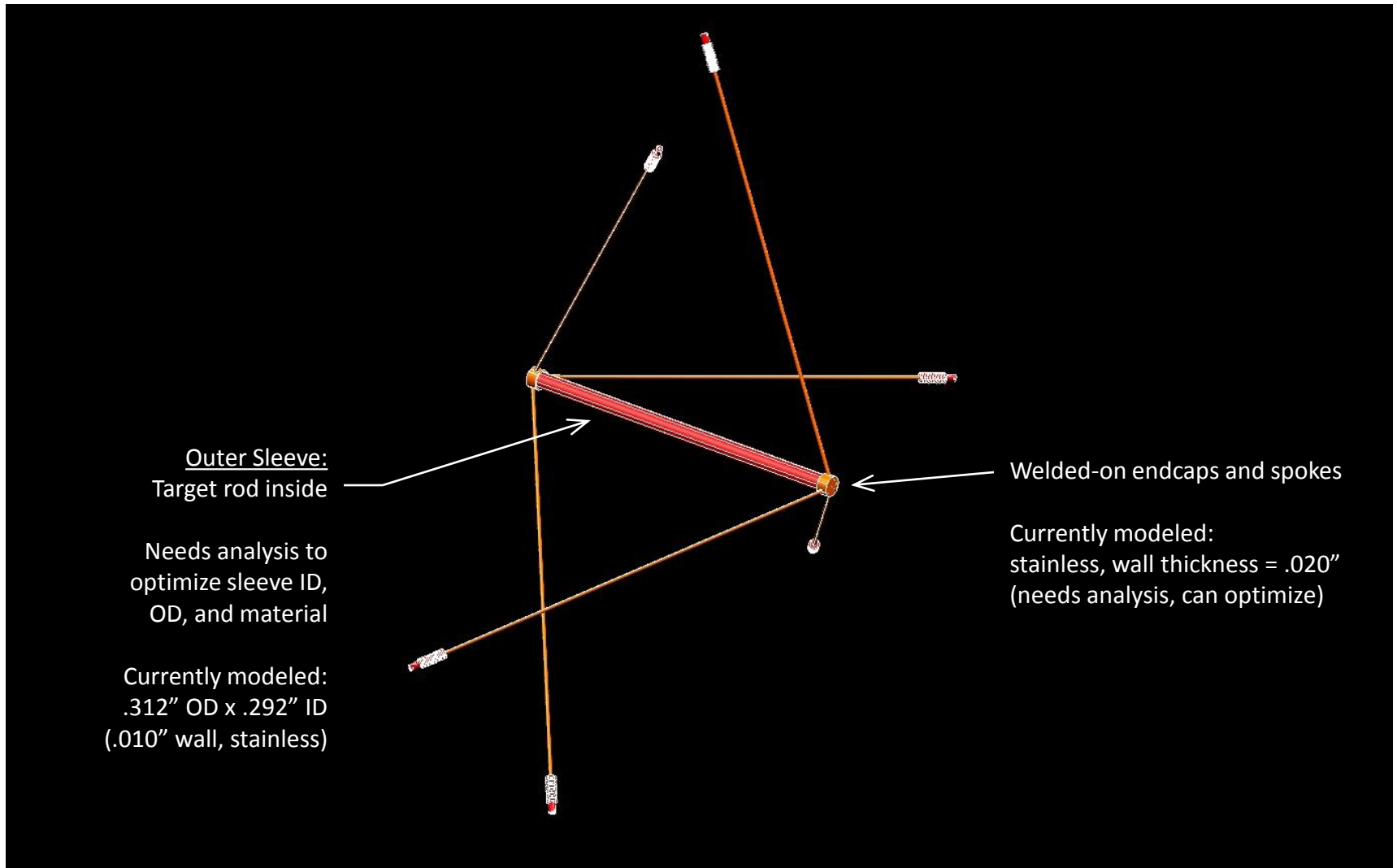
Proposed Design Details for CC target : Interface to existing HRS mounting features



Proposed Design Details for CC target : Interface to existing HRS mounting features



Proposed Design Details for CC target : Target, sleeve, and spokes detail



Proposed Design Details for CC target : Important symmetries maintained for target/spoke

