



August 2026

Target & MRA FDR - Remote Handling Overview

PRESENTED BY

Steve Schrick

STS Target Systems



U.S. DEPARTMENT
of **ENERGY**

ORNL IS MANAGED BY UT-BATTELLE LLC
FOR THE US DEPARTMENT OF ENERGY



Charge Question 2: Has the design been shown to meet the requirements?

Question 5: Is the design sufficiently mature to proceed with finalizing the procurement package?

Objective – Show RH features meet Target requirements

- Pass 
 - Segment shall be capable of replacement within 240 hours
- Fail 
 - The motor assembly shall be capable of replacement within 72 hours
- Fail 
 - Seal or drive bearing shall be capable of replacement with 72 hours
- Pass 
 - All instrumentation shall be capable of replacement within 72 hours

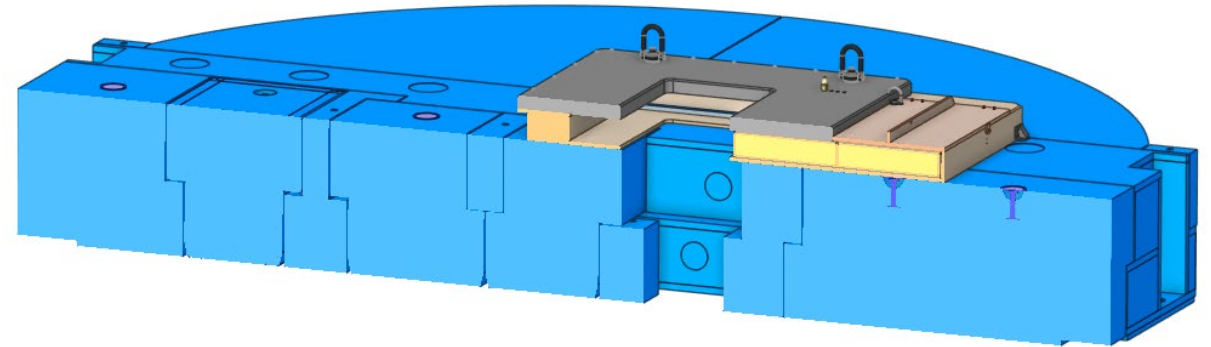
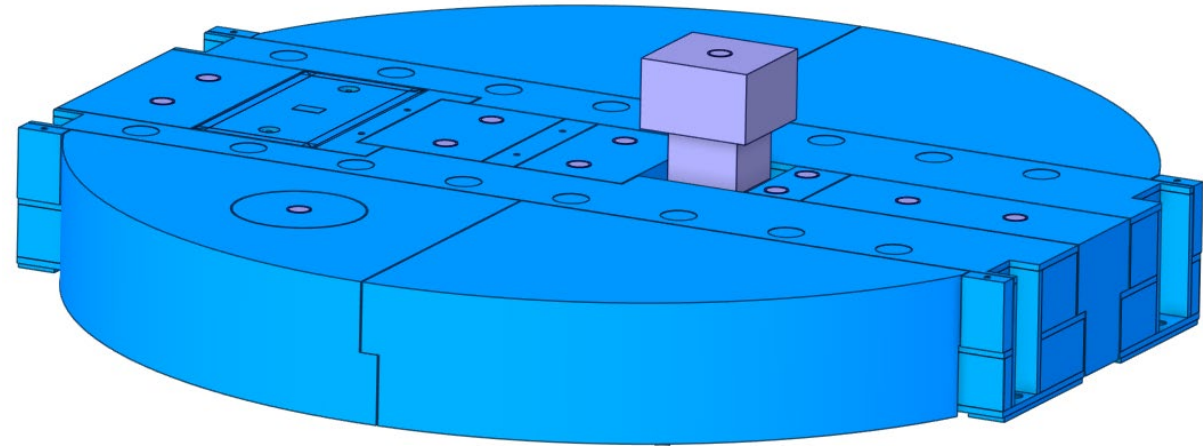
Final Target Maintenance/Removal Procedure

- Target Segment(s)
- Target Drive Assy

Final Target Maintenance/Removal Procedure

Target Segment(s)

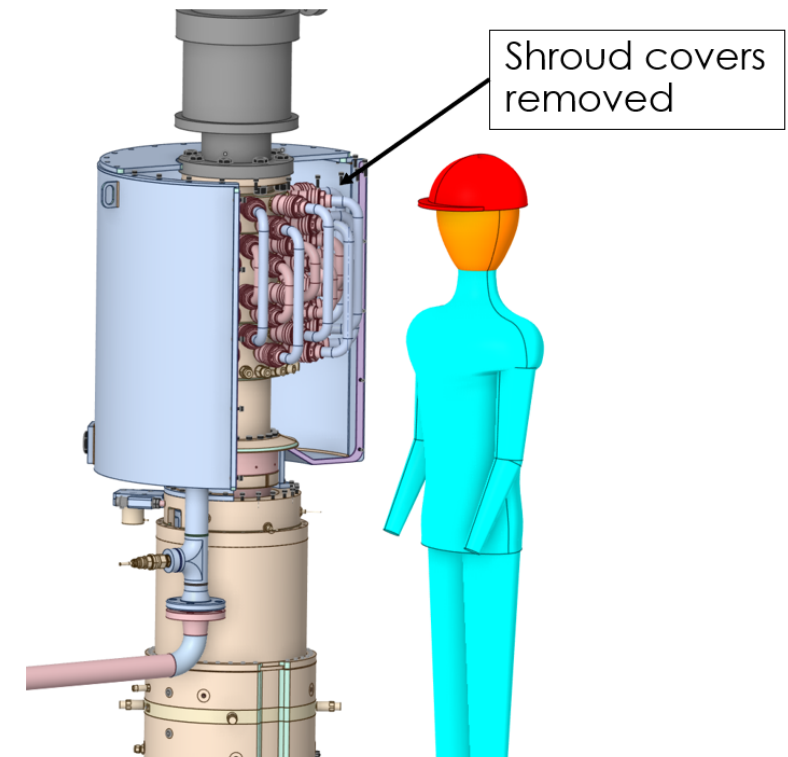
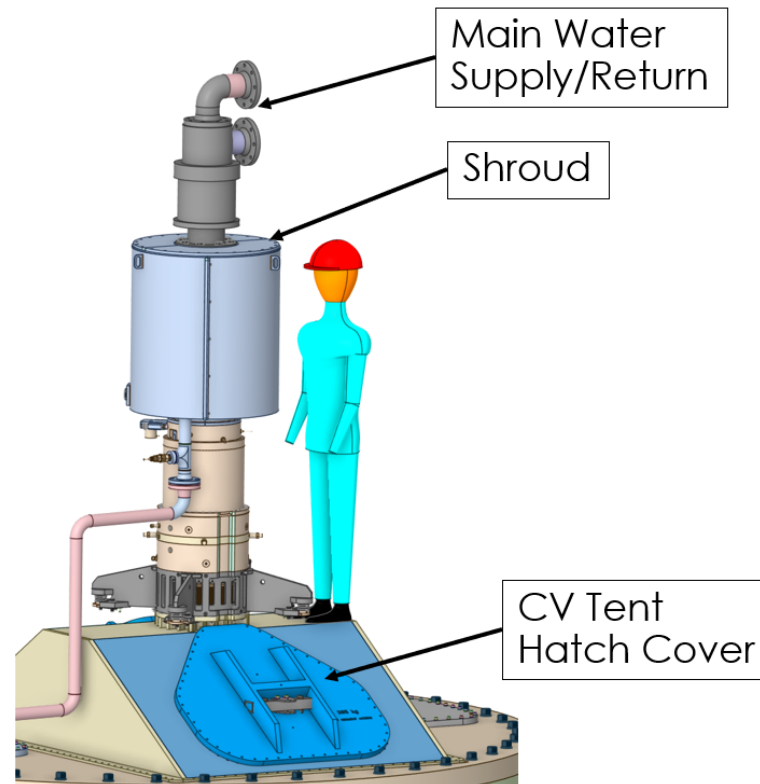
- Beam Off
- *Recommend* 8 hours decay
- Vent CV, remove hydrogen as required
- Perform RAD surveys, A/R
- Prep area with Herculite, A/R
- Remove TDR supplemental shielding and TDR roof hatch
- Install TDR gamma door over hatch opening
- Turn on CV-Target Air Cooling
- Drain and blowdown Loop #1



Final Target Maintenance/Removal Procedure

Target Segment(s)

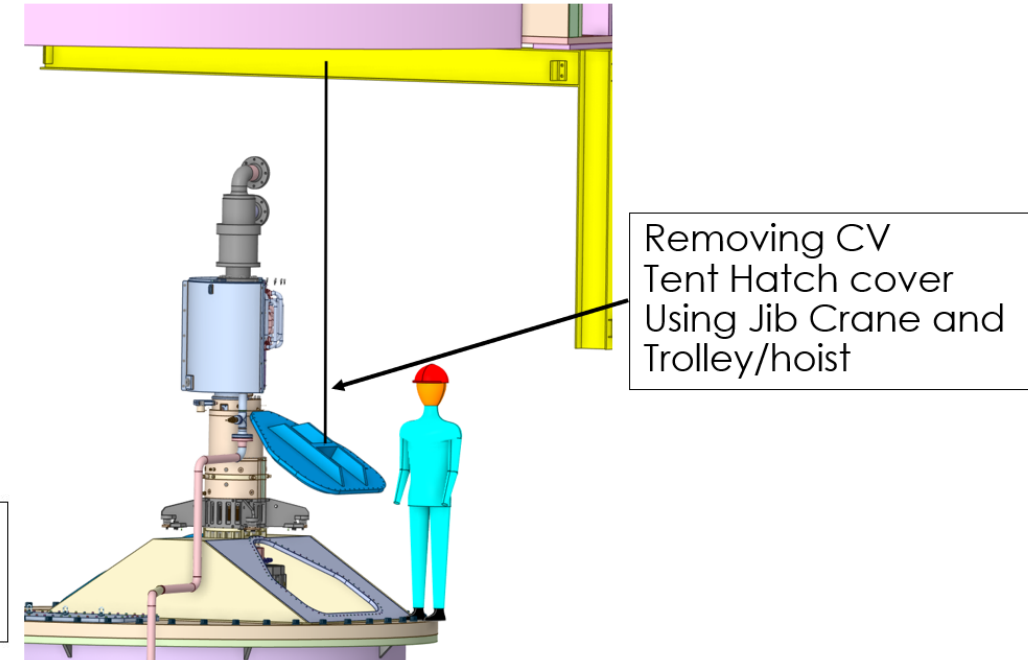
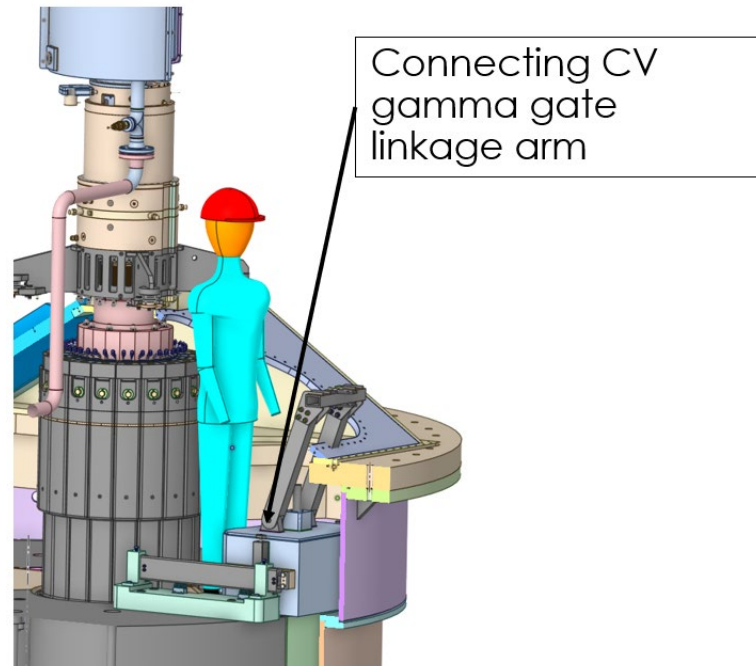
- Unbolt and remove shroud (~30lbs each)



Final Target Maintenance/Removal Procedure

Target Segment(s)

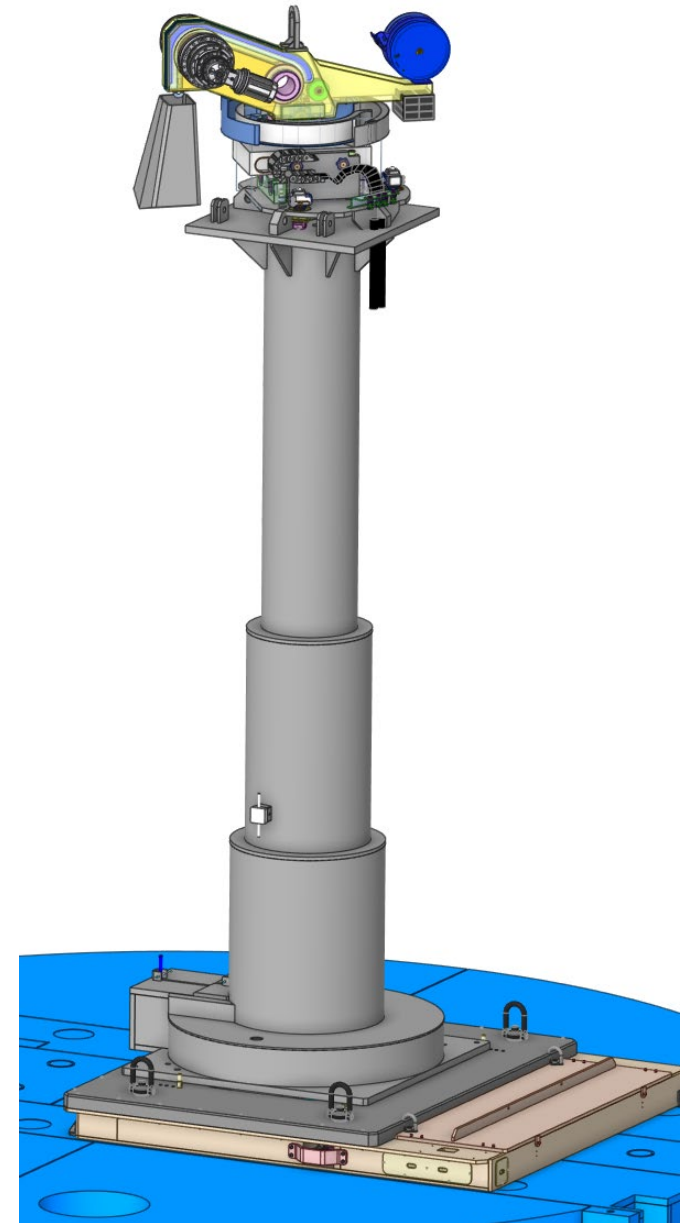
- Unbolt and remove CV tent hatch cover using TDR jib crane
- Connect CV gamma door linkage arm to drive unit
- Setup TDR remote cameras



Final Target Maintenance/Removal Procedure

Target Segment(s)

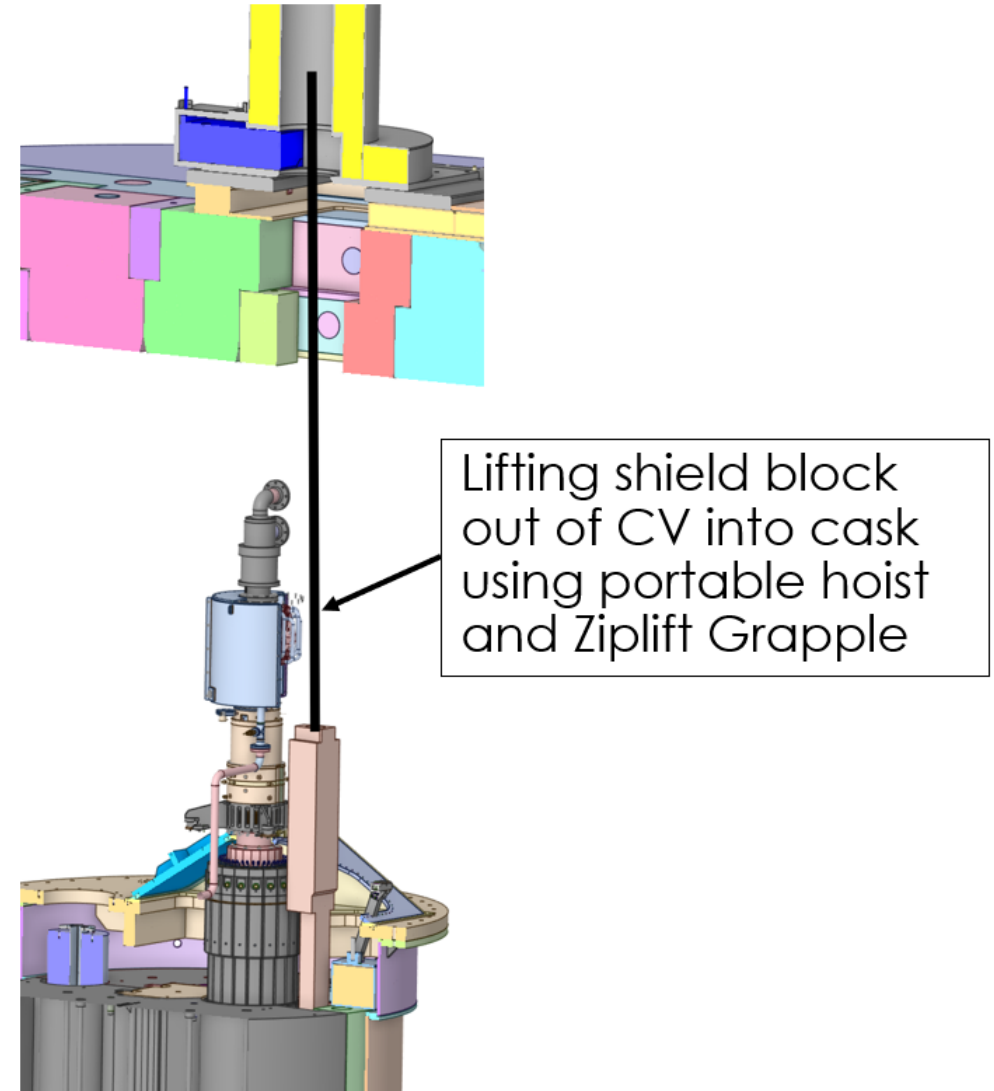
- Rig, transfer and prepare target segment shield block cask.
- Install cask onto TDR gamma door.
- Transfer & install portable hoist onto cask. Perform function check.



Final Target Maintenance/Removal Procedure

Target Segment(s)

- Lower chain from hoist and attach Ziplift grapple to shield block.
- Retract shield block out of core vessel into cask.
- Disconnect Ziplift grapple from hoist onto shield block.
- Remove portable hoist.
- Install cask bottom closure plate.
- Transfer cask to staging area.

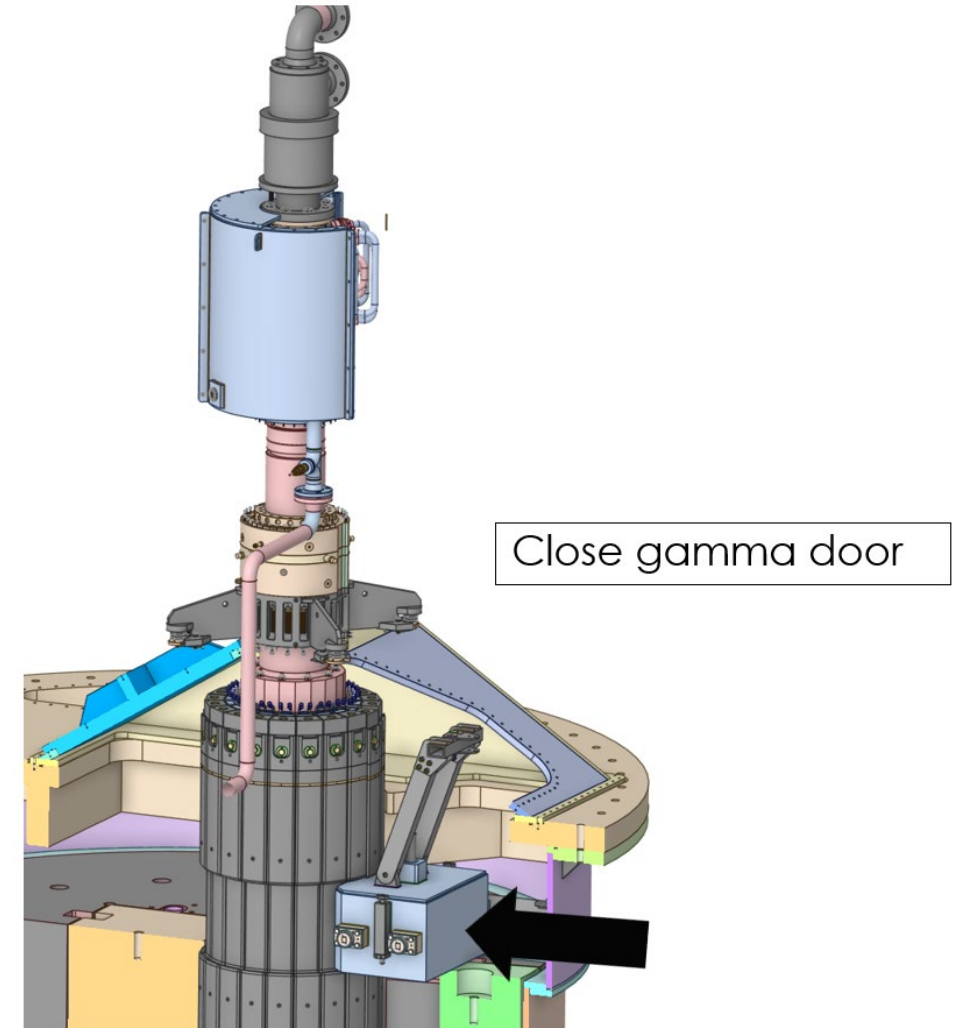


Final Target Maintenance/Removal Procedure

Target Segment(s)

- Remotely close gamma door

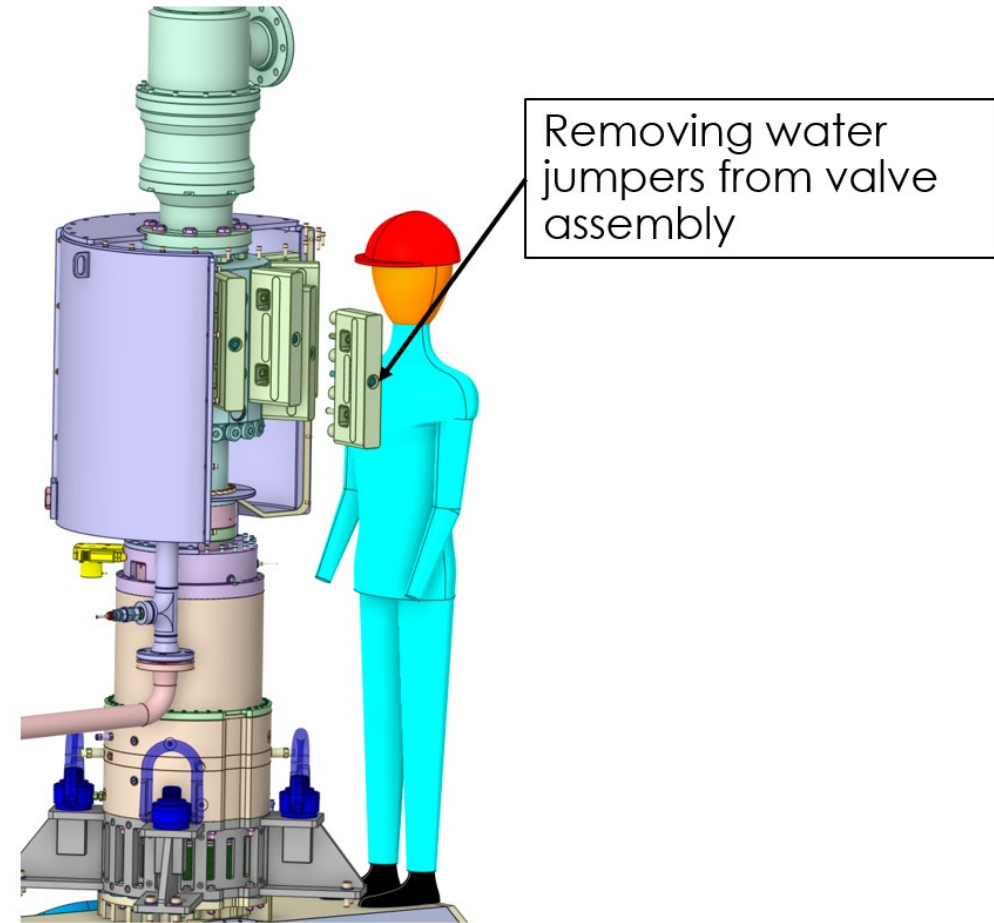
NOTE: CV gamma door drive unit not shown for clarity.



Final Target Maintenance/Removal Procedure

Target Segment(s)

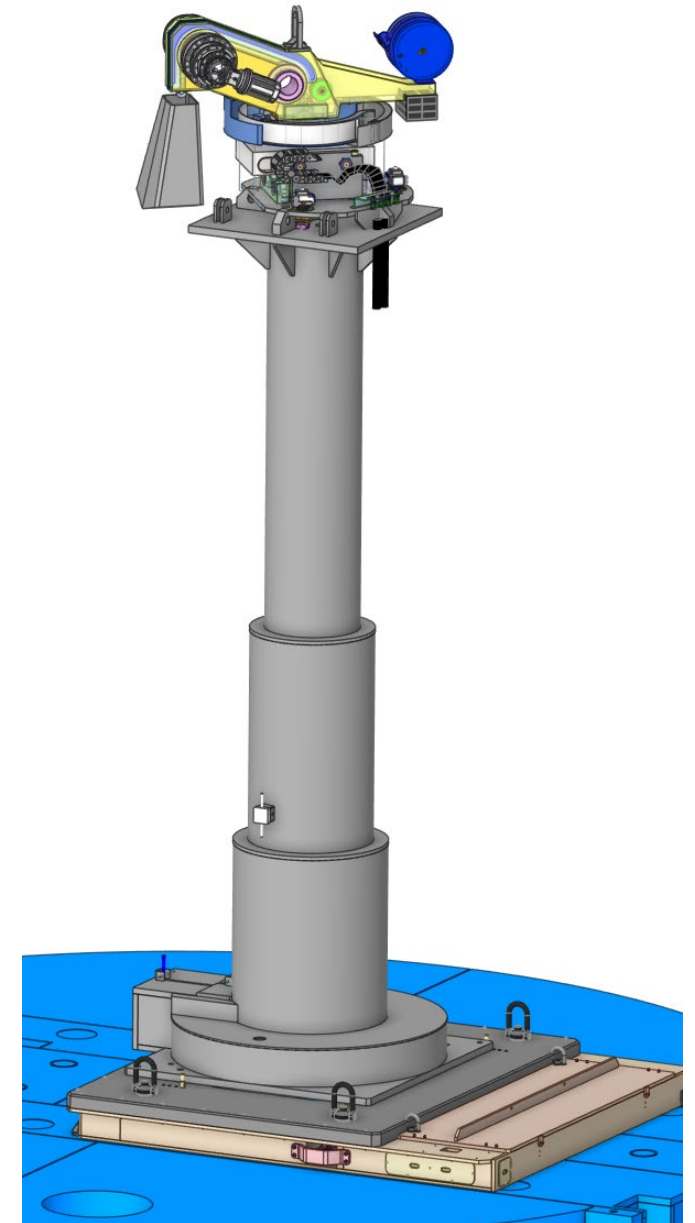
- Disconnect supply and return water jumpers from crown
- Connect air/N2 input line and drain output line
- Perform target segment blowdown procedure



Final Target Maintenance/Removal Procedure

Target Segment(s)

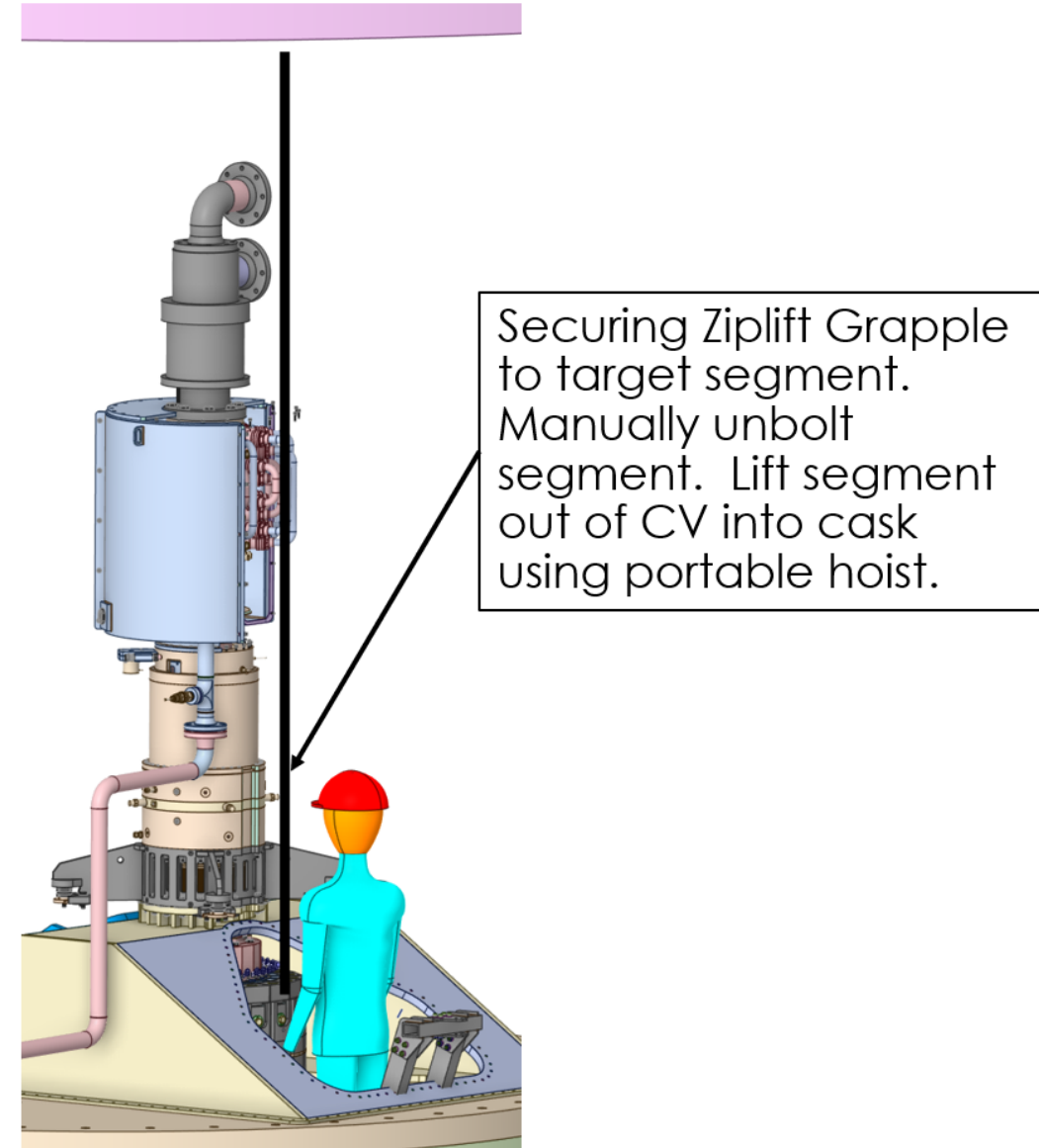
- Rig, transfer and prepare segment cask.
- Install cask onto TDR gamma door
- Transfer & install portable hoist onto cask. Perform function check.



Final Target Maintenance/Removal Procedure

Target Segment(s)

- Lower chain from hoist and attach Ziplit grapple to segment.
- Unbolt segment from drive shaft.

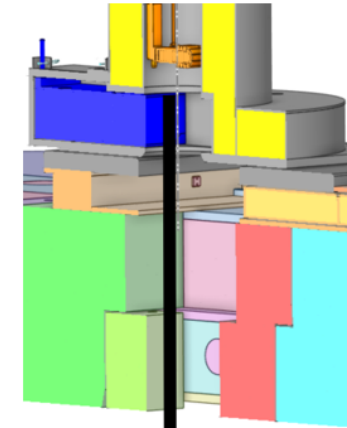
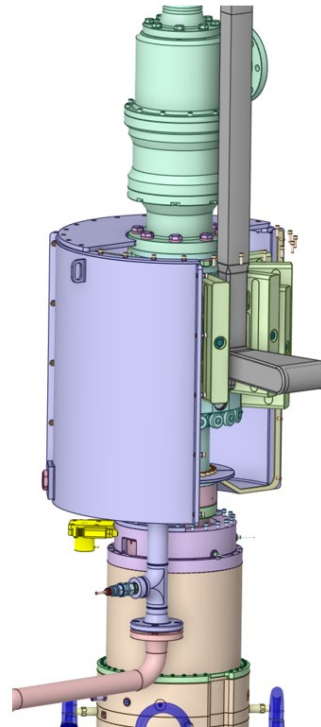
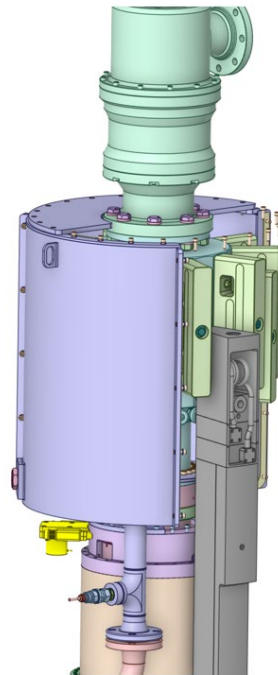


Final Target Maintenance/Removal Procedure

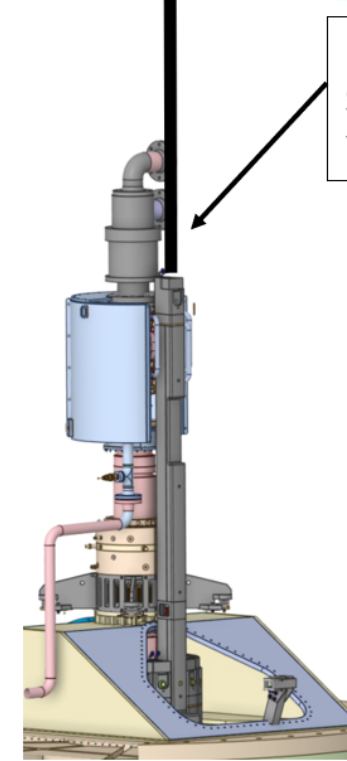
Target Segment(s)

- Remotely open CV gamma door
- Remotely retract target segment from CV up into cask

NOTE: Ziplift grapple & stud omitted for clarity



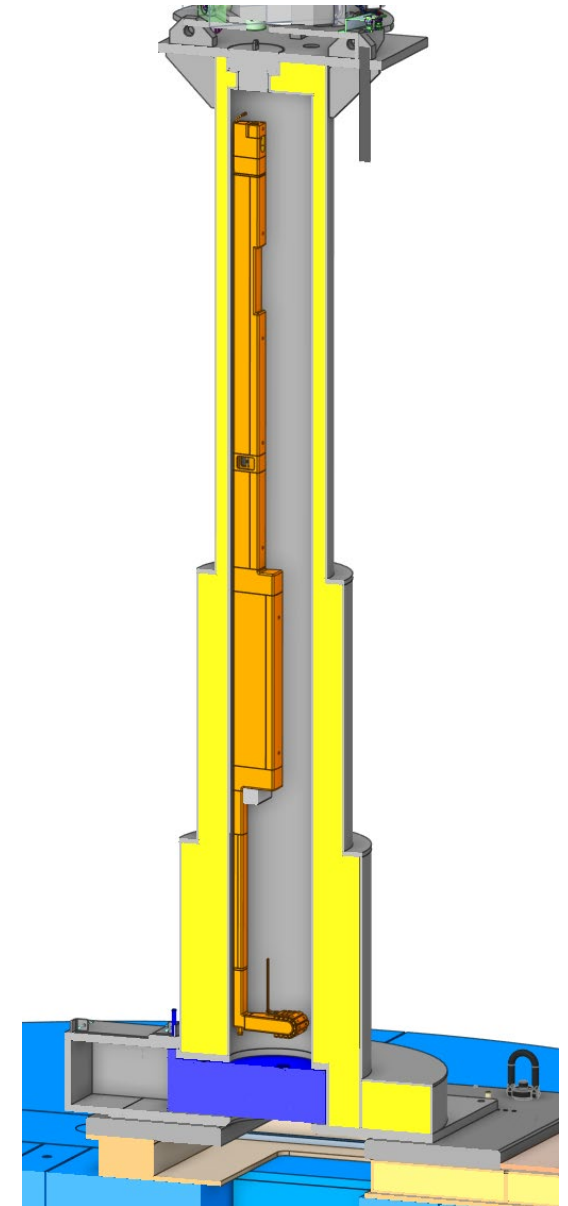
Remotely lift target segment out of core vessel and into cask.



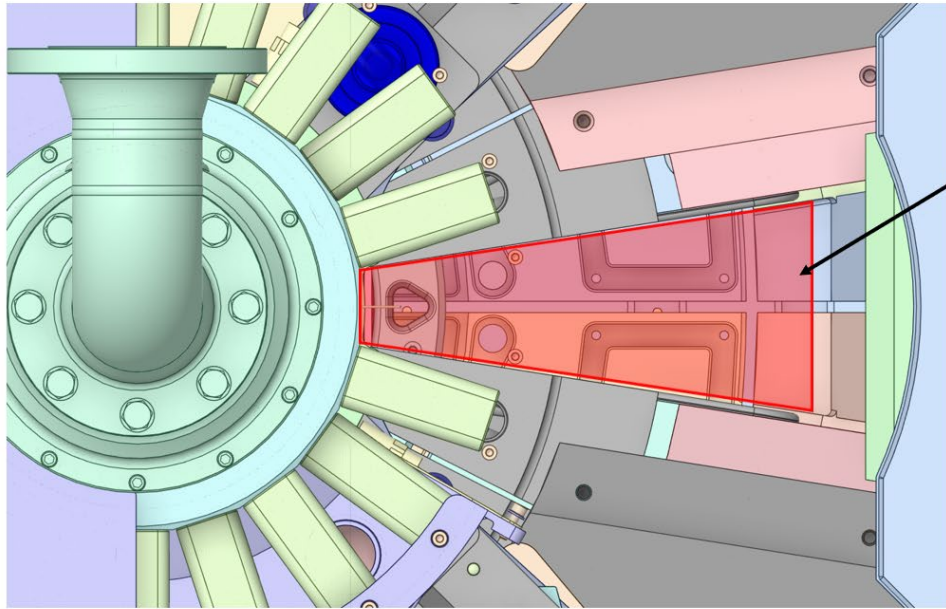
Final Target Maintenance/Removal Procedure

Target Segment(s)

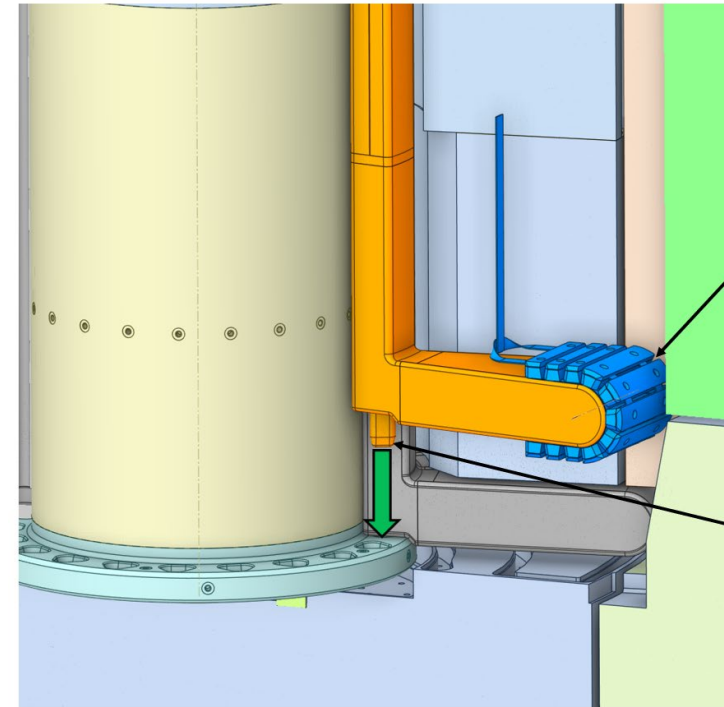
- Remotely close CV gamma door.
- Manually close cask sliding door.
- Engage pins.
- Remove portable hoist.
- Transfer cask to service cell.



Final Target Segment Procedure – Installation



Target Segment
Install Space.



Target Segment
nose protector &
installation fixture.

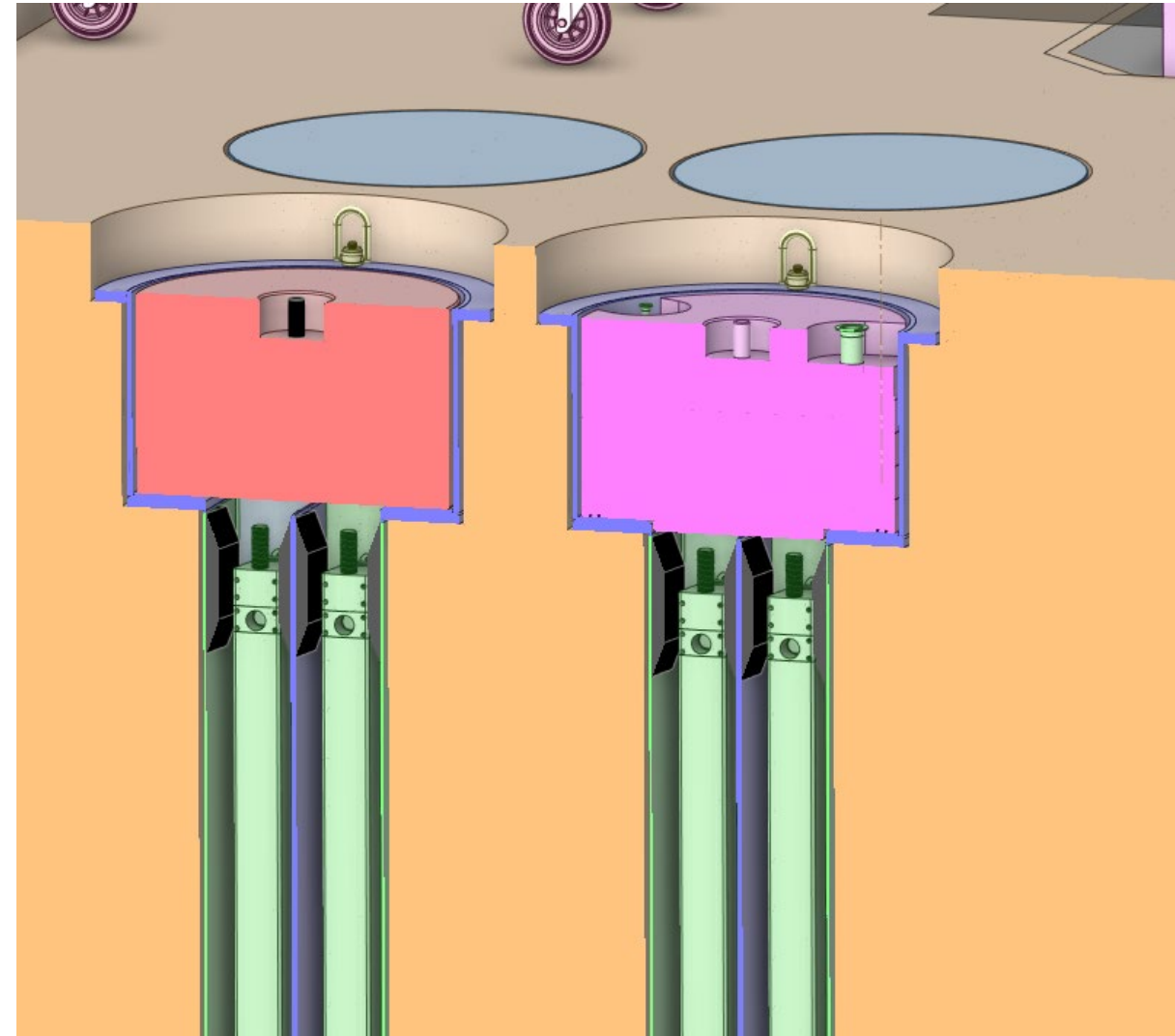
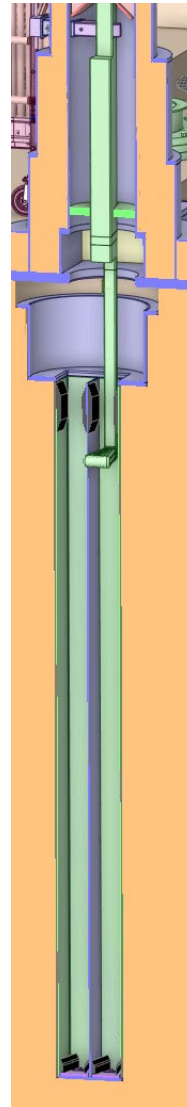
Target Segment
alignment pin.
Mates to hole in
shaft w/ up to
10mm offset.

Final Target Segment Removal and Replacement

- Current estimated cycle time for 1X target segment removal and replacement: <180 hours
 - Maintenance Prep, Remove CV hatch: <42hrs
 - Shield block removal: <20hrs
 - Target Segment blowdown: <8hrs
 - Segment removal: <20hrs
 - Install new segment in CV, leak test: <40hrs
 - Re-install shield block: <20hrs
 - Button up CV: <30hrs

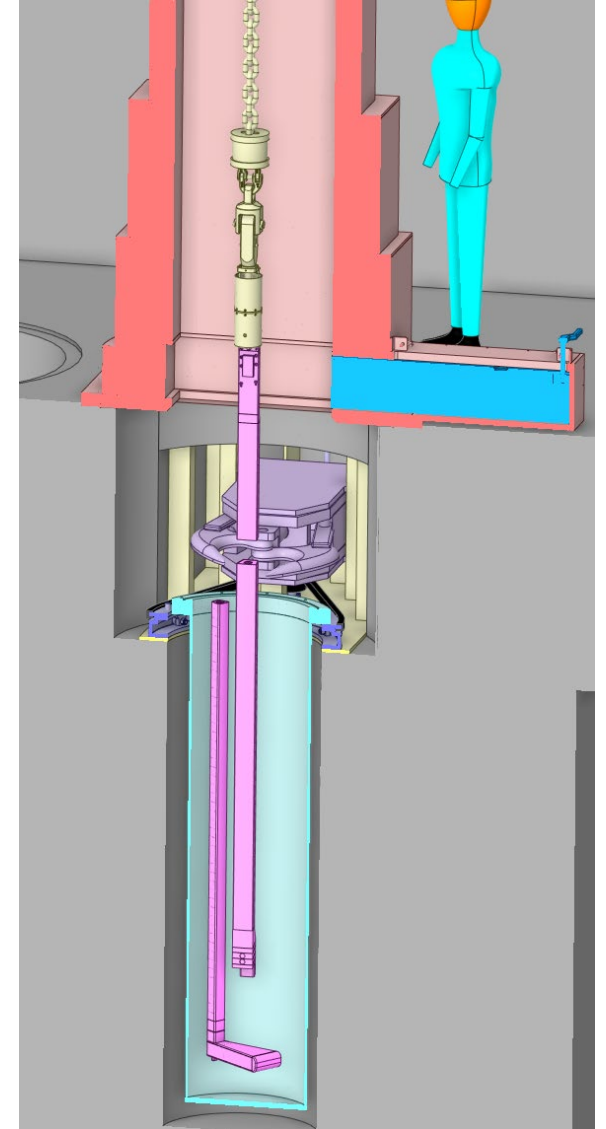
Final Target Segment Disposal Preparation

- Transfer segments from RH cask into storage silo.
- Remotely install vacuum lid
- Perform component drying procedure.
- Replace vacuum lid with storage lid



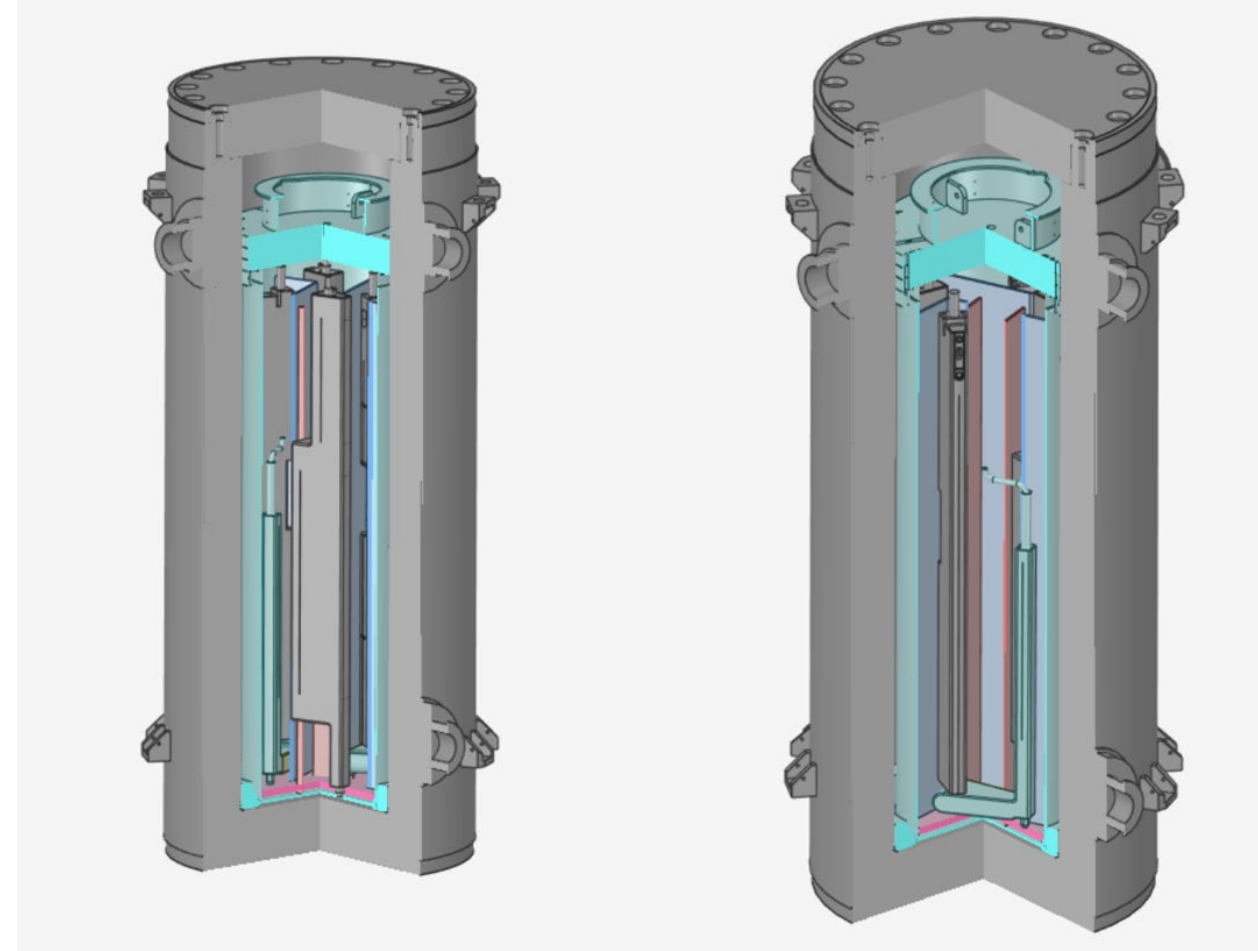
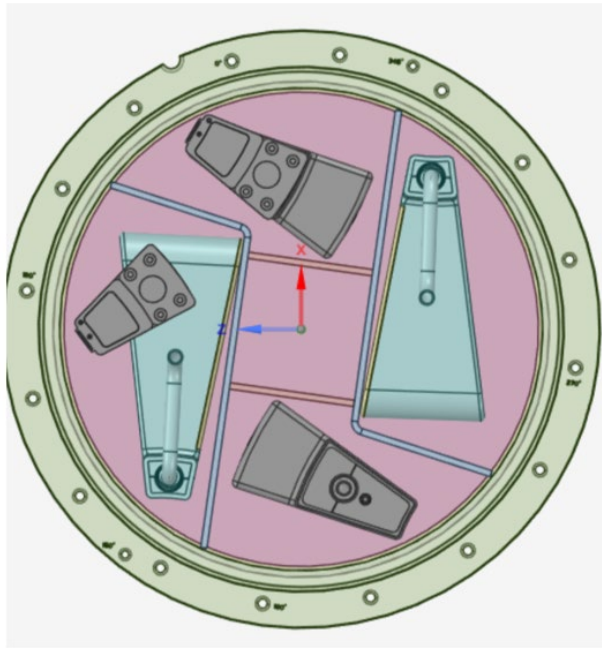
Final Target Segment Disposal Preparation

- Target segment is retrieved from storage silo and transferred to downsizing pit via RH cask
- Using portable hoist mounted on top of cask, lower segment out of cask into main pit liner.
- At predetermined locations perform shearing operation to separate segment into multiple pieces.
- Rotate or otherwise align indexed position in liner with remaining segment.
- Repeat shearing operation, A/R



Final Target Segment Disposal Preparation

- Plan to package 2X spent target segments into a steel liner and then package liner into 3-60B shipping container



Final Target Maintenance/Removal Procedure

Target Drive

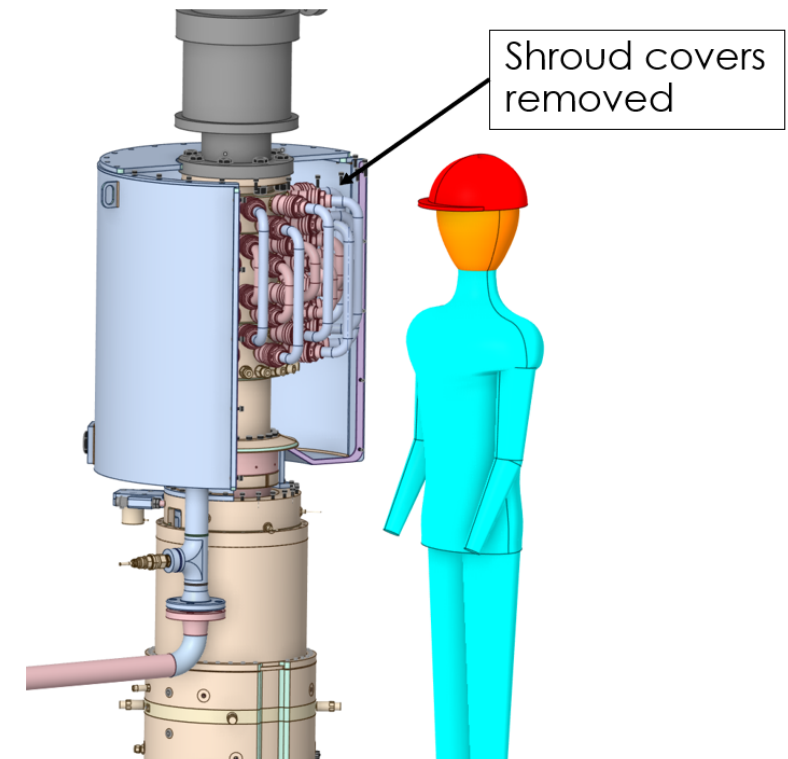
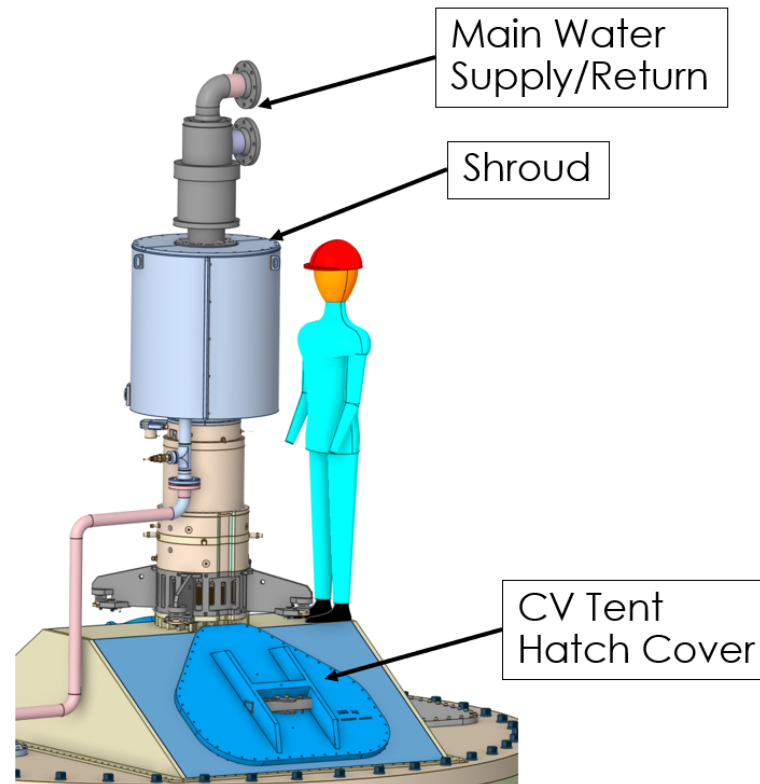
- Beam Off
- *Recommend* 8 hours decay
- Vent CV, remove hydrogen as required
- Perform RAD surveys, A/R
- Prep area with Herculite, A/R
- Turn on CV-Target Air Cooling
- Drain and blowdown Loop #1

NOTE: Only bearing replacement requires removal of TDR roof supplemental shielding and TDR roof hatch plugs.

Final Target Maintenance/Removal Procedure

Target Drive

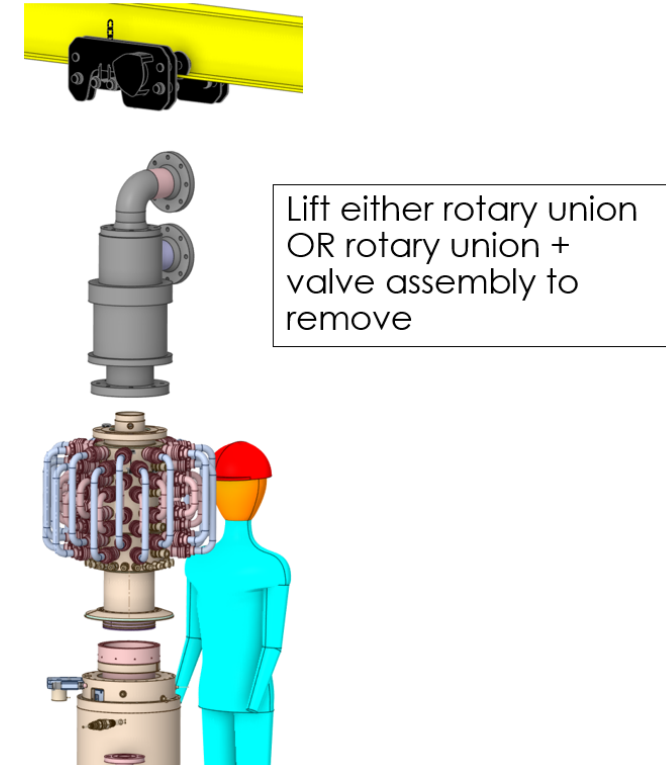
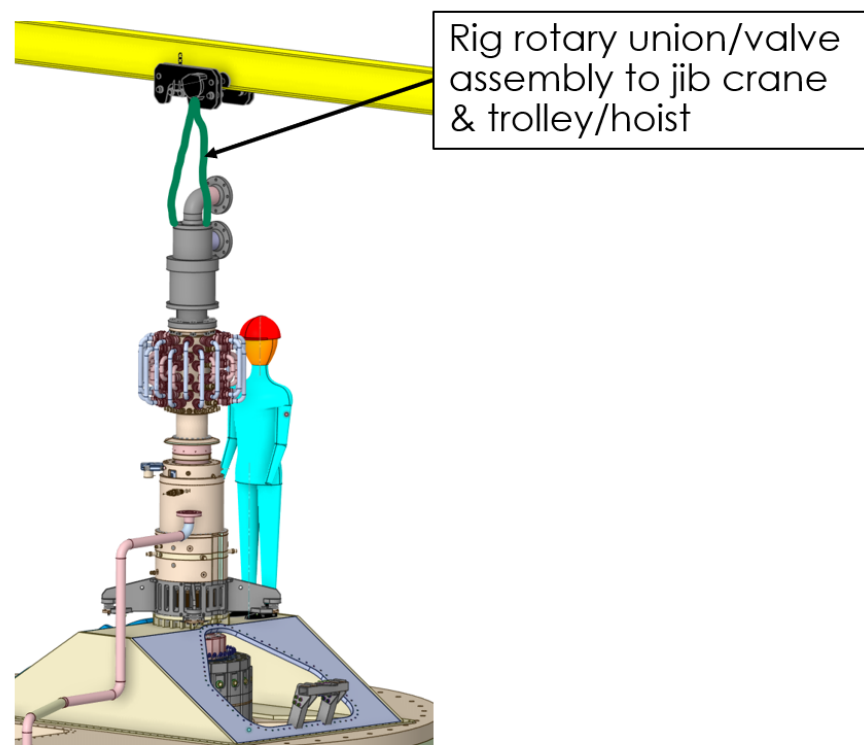
- Unbolt and remove shroud completely (~30lbs each)



Final Target Maintenance/Removal Procedure

Target Drive

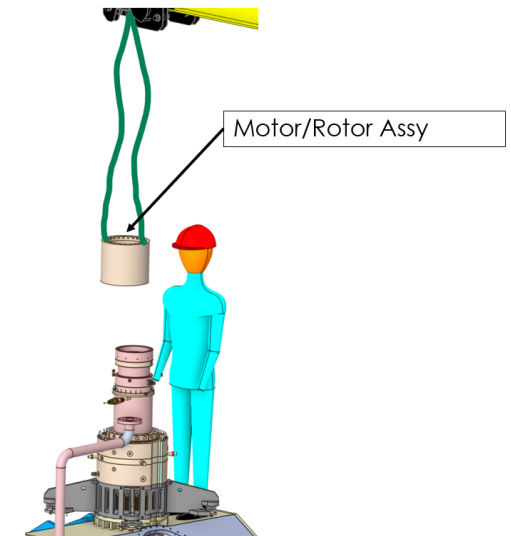
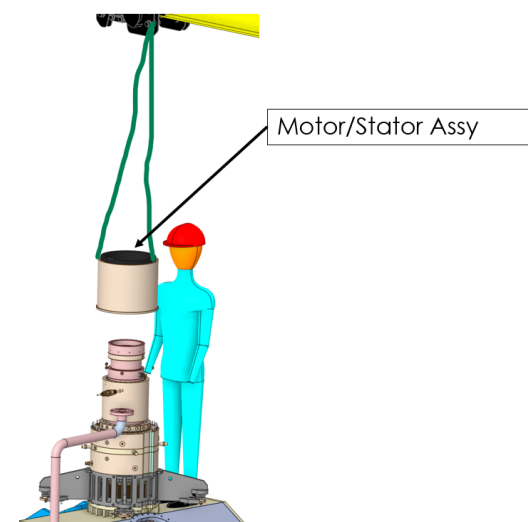
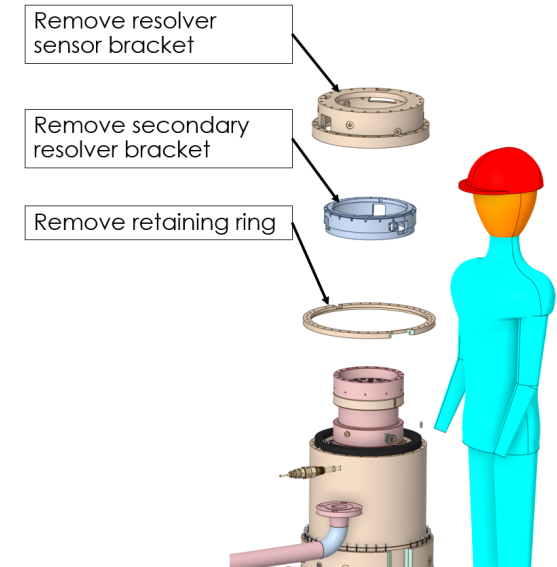
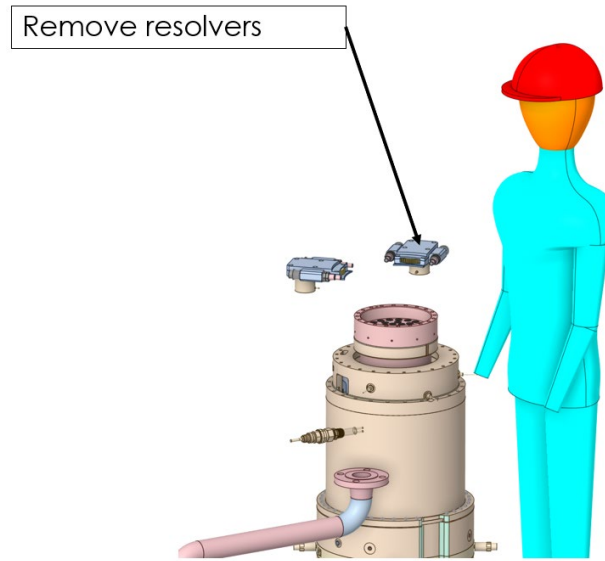
- Rig TDR hoist to rotary union/valve assembly
- Disconnect main water supply & return jumpers from rotary union
- Unbolt either rotary union OR valve assembly
- Lift component & transfer within TDR.



Final Target Maintenance/Removal Procedure

Target Drive

- Disconnect motor electrical connections
- Remove resolvers, sensor mounts, motor retaining ring
- Rig TDR hoist to motor stator assy
- Lift component & transfer within TDR.
- Repeat for motor rotor assy

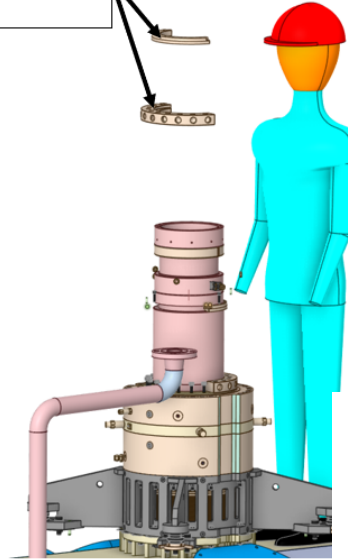


Final Target Maintenance/Removal Procedure

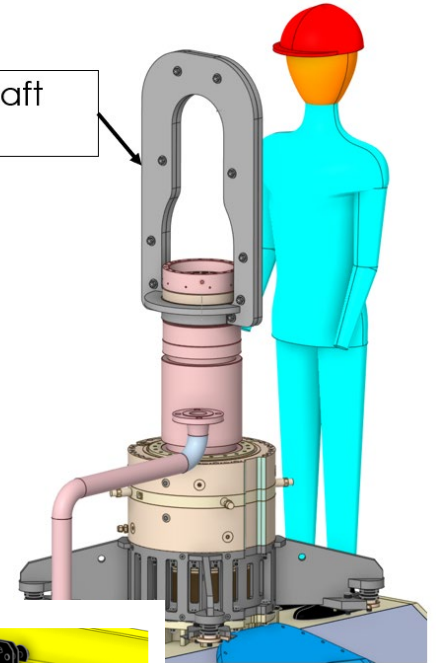
Target Drive

- Unbolt and remove upper split ring
- Rig high bay crane and lifting fixture to drive shaft. Slightly raise shaft.
- Unbolt and remove lower split ring. Lower drive shaft.
- Unbolt bearing assy and bellows.
- Rig TDR hoist to bearing assy.
- Lift component & transfer within TDR.

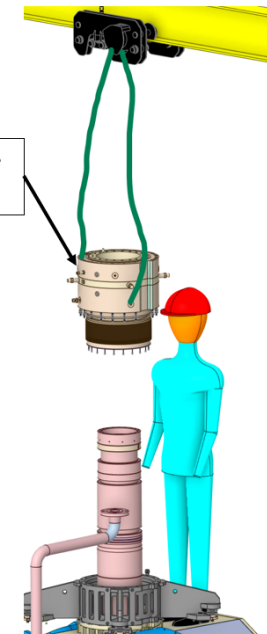
Remove upper and lower split rings



Target Drive Shaft lifting fixture



Unbolt and remove bearing assembly



Final Target Drive Removal and Replacement

- Current estimated cycle time for target drive rotary union and/or valve assembly removal and replacement: <50 hours
 - Including any sensors/instrumentation located on the outer shroud housing
- Current estimated cycle time for motor assembly removal and replacement: <90 hours
 - Including any sensors/instrumentation located on the motor and/or resolver assemblies
- Current estimated cycle time for bearing assembly removal and replacement: <145 hours
 - Including any sensors located on the main drive housing below the CV lid

Conclusion – Target Assembly

- Overall development of remote handling tooling and processes seems reasonable to support target assembly maintenance.
- RH requirements are not completely satisfied, but deemed acceptable to move forward into Final Design.
- Additional planning, development, and testing will occur to support RH operations and improve cycle time efficiency.

Objective – Show RH features meet MRA requirements

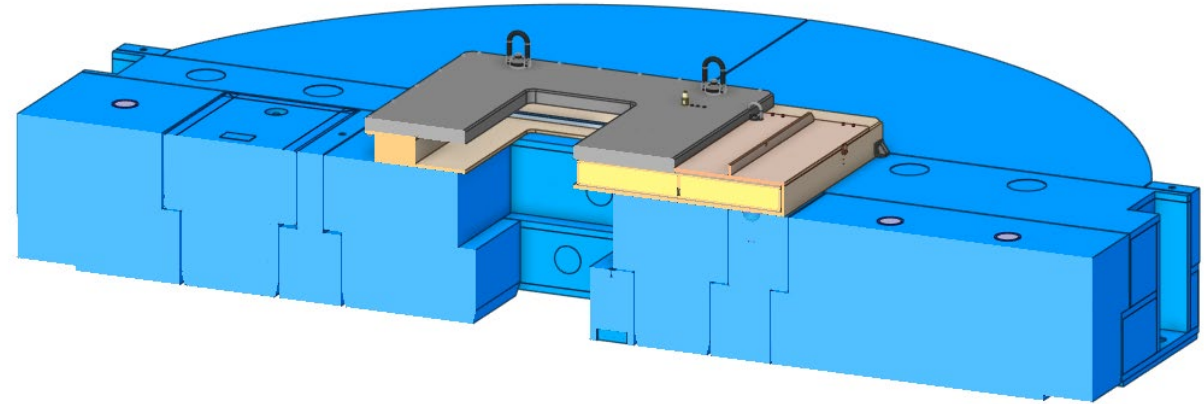
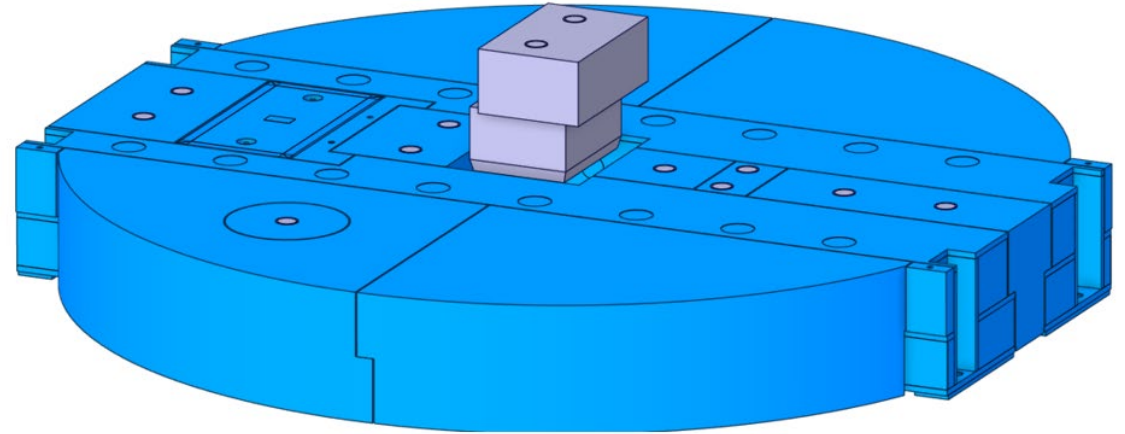
- Pass 
 - MRA shall be designed to be replaced in a 1400-hour outage
- Pass 
 - MRA piping shall be designed for cutting above upper shield block
- Pass 
 - MRA shall be capable of vertical removal & installation after removal of 3 target segments
- Pass 
 - MRA shall fit within a liner designed to fit in the TN-RAM shipping container after removal of piping & mass shall be less than 2400kg.

Final MRA Maintenance/Removal Procedure

- MRA

Final MRA Maintenance/Removal Procedure

- Beam Off
- *Recommend* 8 hours decay
- Vent CV, remove hydrogen as required
- Perform RAD surveys, A/R
- Prep area with Herculite, A/R
- Remove TDR supplemental shielding and TDR roof hatch
- Install TDR gamma door over hatch opening
- Turn on CV-Target Air Cooling
- Drain and blowdown Loops #1 & #2

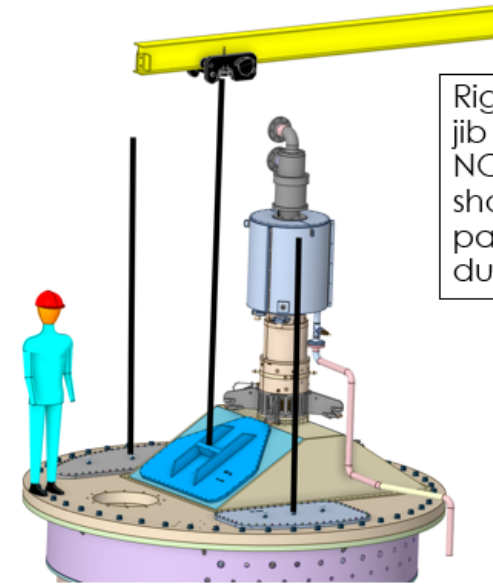


Final MRA Maintenance/Removal Procedure

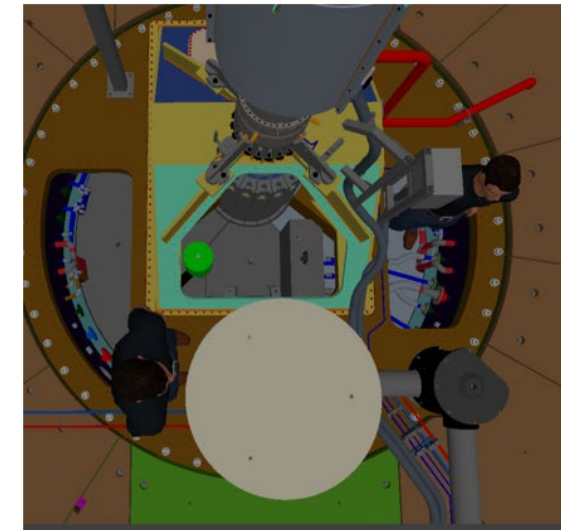
- For MRA removal, 3 segments must be removed and all transferred to service cell.
- Target drive shaft shall be rotated to align the gap with the MRA to facilitate vertical removal and installation of MRA

Final MRA Maintenance/Removal Procedure

- Unbolt and remove shroud pieces completely
- Unbolt and remove CV tent hatch covers and alternate access covers using TDR jib crane
- Setup TDR remote cameras



Rig CV hatch covers to jib crane & trolley/hoist.
NOTE: TVP doghouse not shown for clarity. Actual part will be in position during operations.

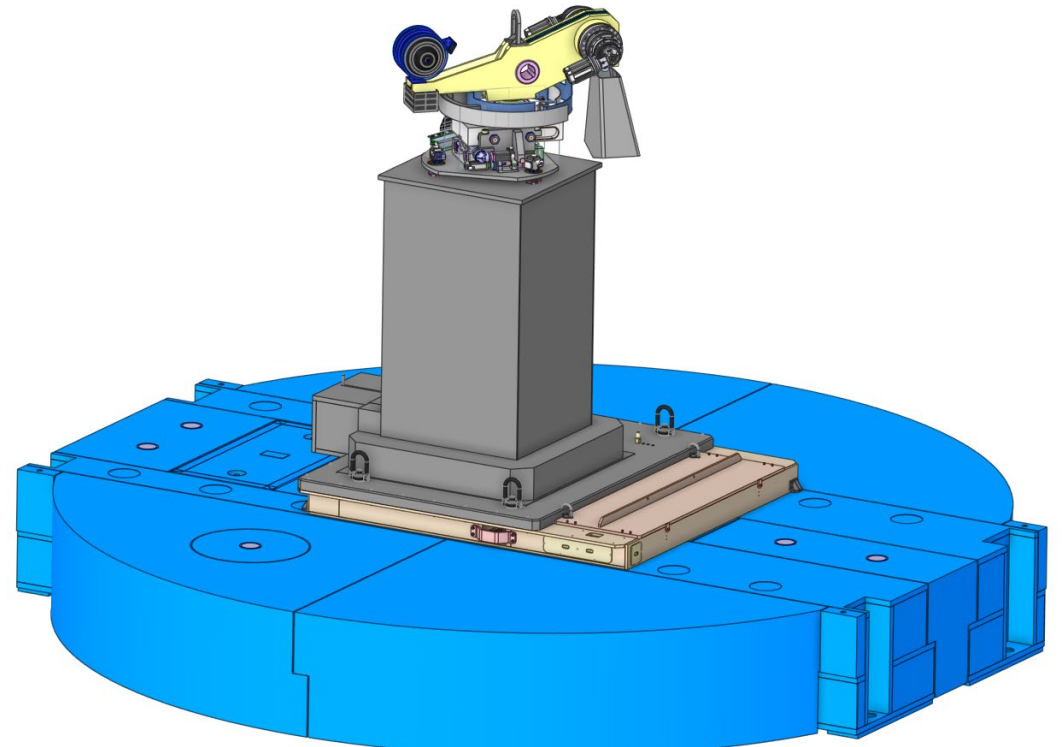


Final MRA Maintenance/Removal Procedure

- Unbolt and remove MRA pipe chase supplemental shield blocks and seismic restraints
- Manually disconnect water joint flanges below CV lid
- Cut hydrogen transfer line below CV lid
- Attach lifting straps/lanyards to MRA water pipes and transfer line

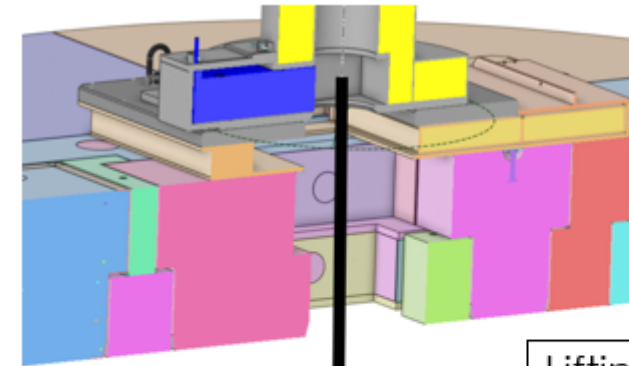
Final MRA Maintenance/Removal Procedure

- Rig, transfer and prepare MRA shield block cask.
- Install cask onto TDR gamma door.
- Transfer & install portable hoist onto cask. Perform function check.

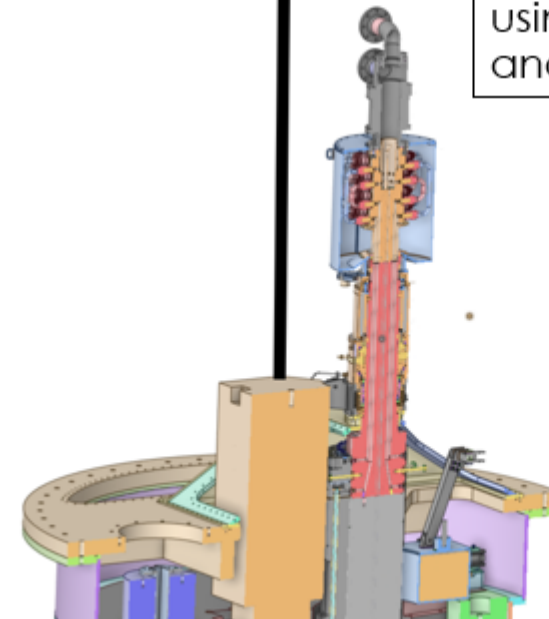


Final MRA Maintenance/Removal Procedure

- Lower chain from hoist and attach Ziplift grapple to shield block.
- Retract shield block out of core vessel into cask.
- Disconnect Ziplift grapple from hoist onto shield block.
- Remove portable hoist.
- Install cask bottom closure plate.
- Transfer cask to staging area.



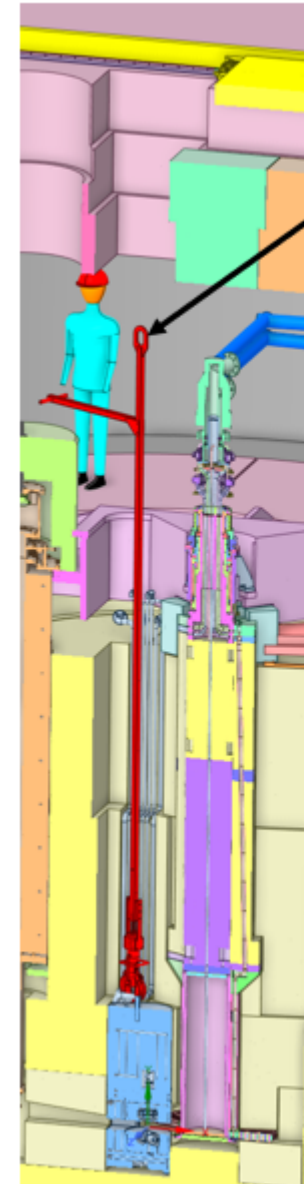
Lifting shield block out of CV into cask using portable hoist and Ziplift Grapple



Final MRA Maintenance/Removal Procedure

- Rig, transfer and function check long reach hydraulic pipe cutter

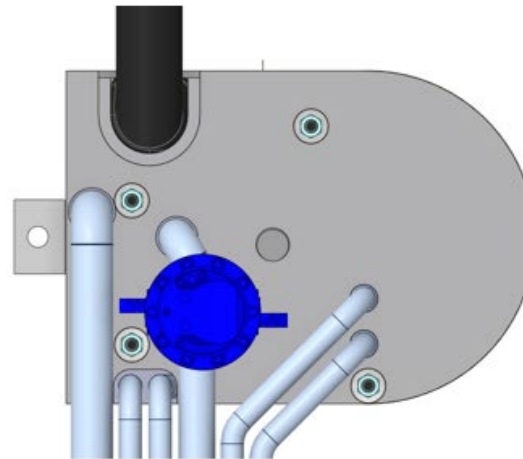
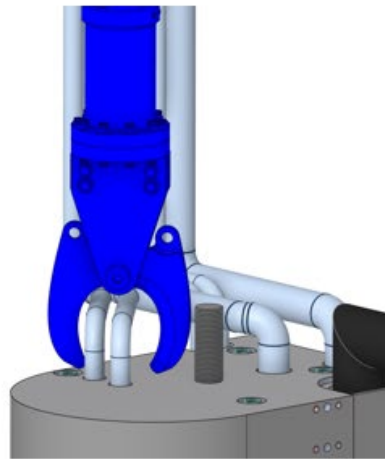
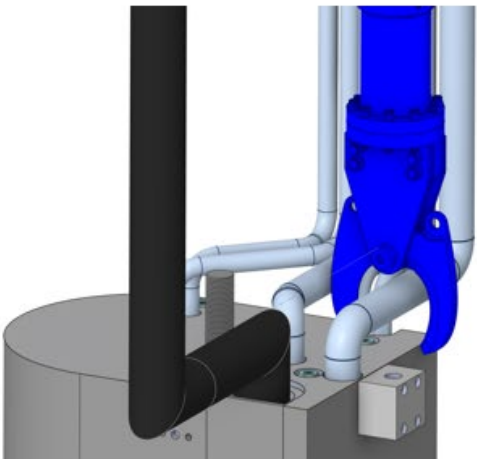
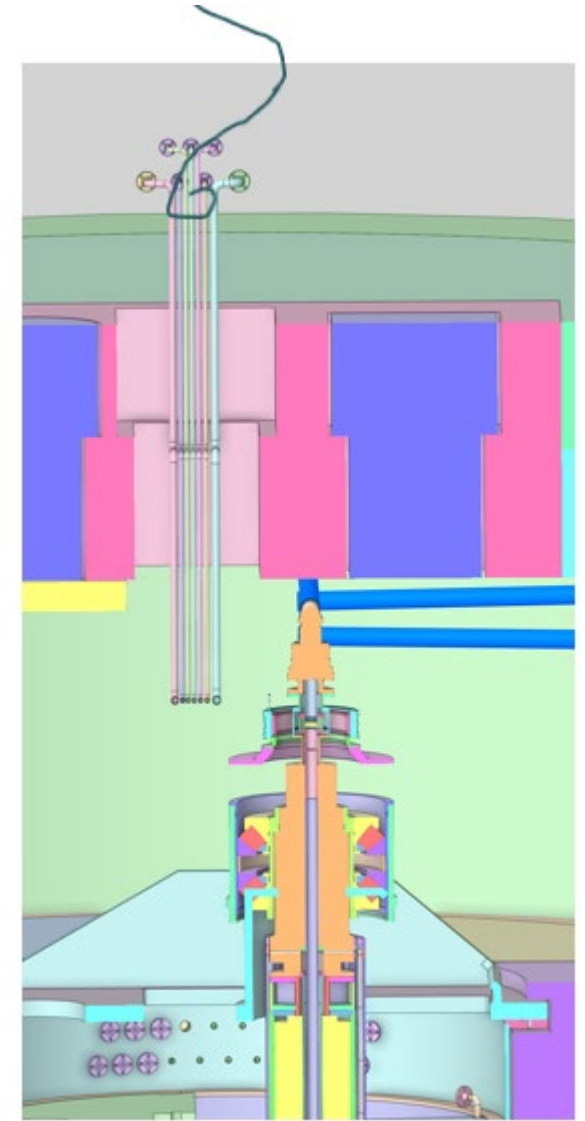
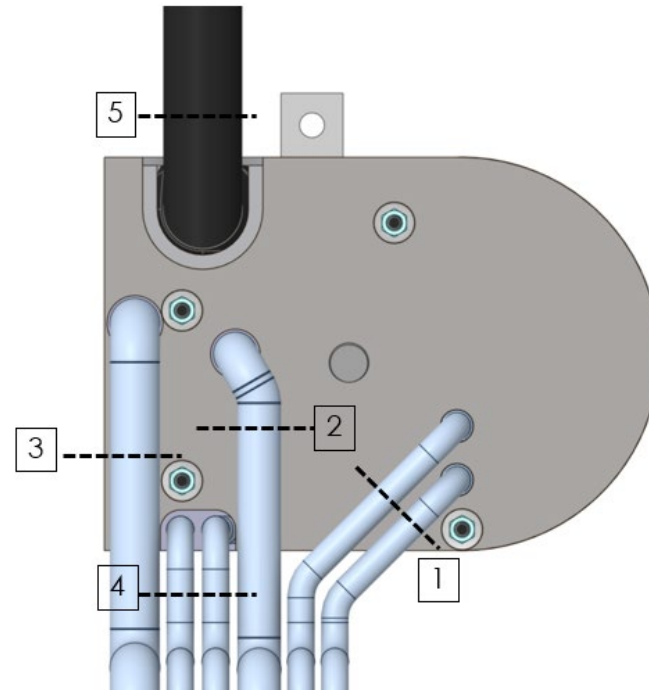
NOTE: Hydraulic Power Unit (HPU) staged in high bay.
Manual selector switched staged in TDR.
Hydraulic lines routed from HPU to selector to cutter



Long reach pipe cutter tooling. Rigging to high bay crane (not shown)

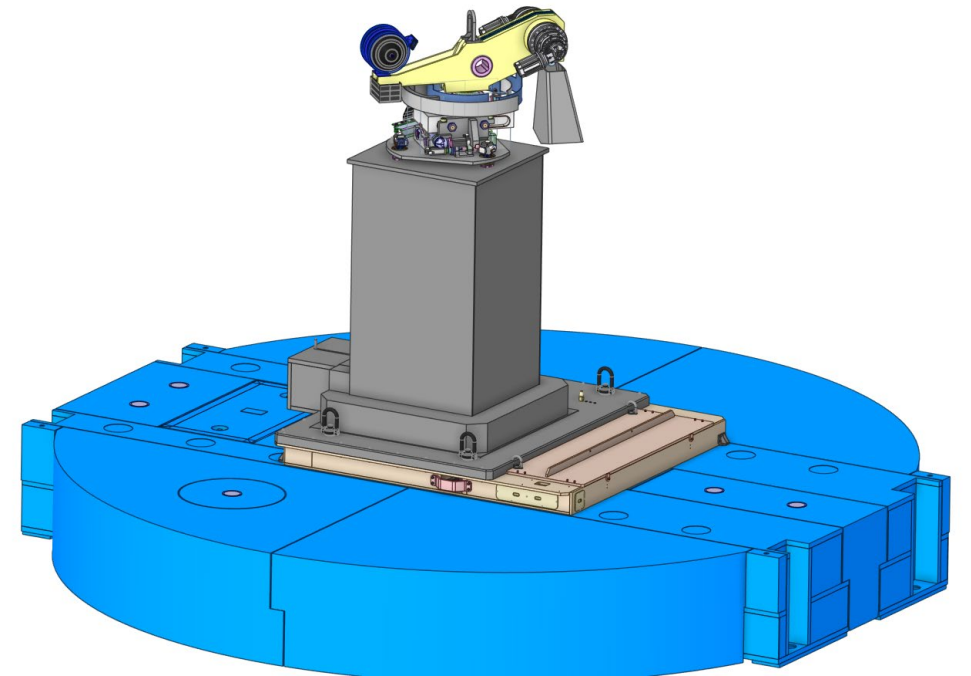
Final MRA Maintenance/Removal Procedure

- Perform cutting of transfer line and water pipes and extract individually from CV



Final MRA Maintenance/Removal Procedure

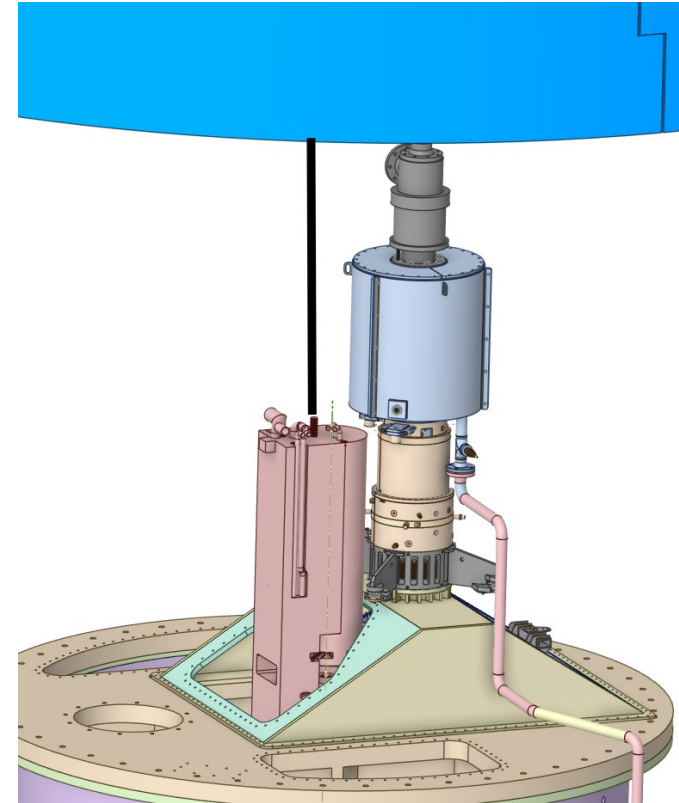
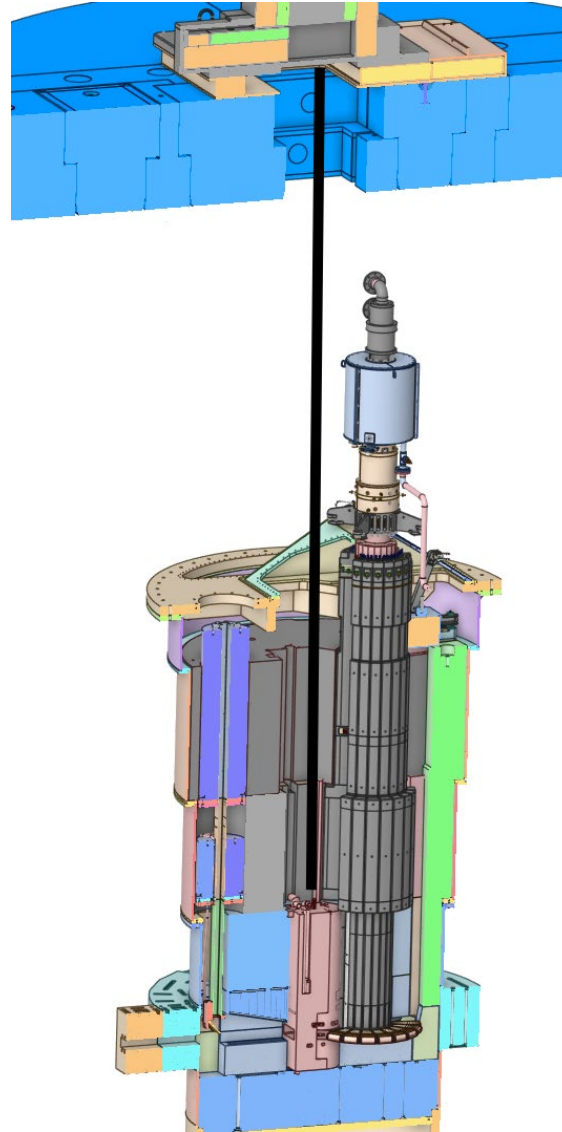
- Rotate target drive shaft to position 3X segment void under MRA
- Rig, transfer and prepare MRA cask.
- Install cask onto TDR gamma door.
- Transfer & install portable hoist onto cask. Perform function check.



Final MRA Maintenance/Removal Procedure

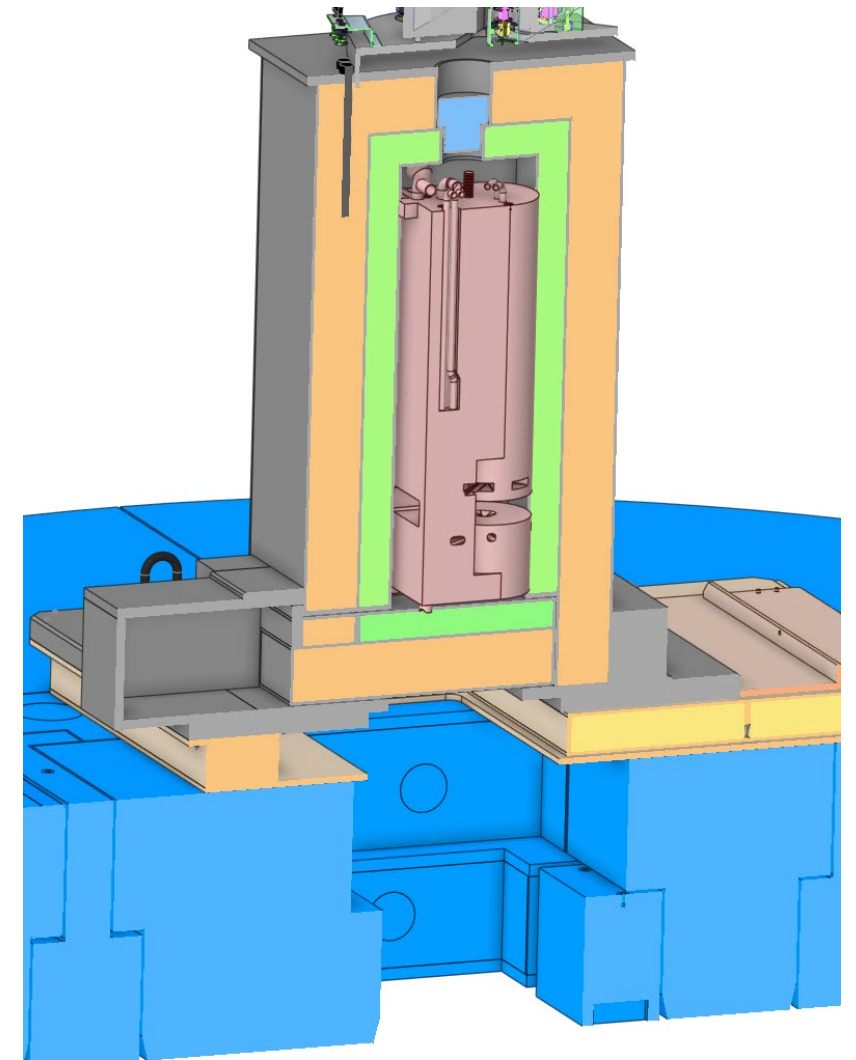
- Lower chain from hoist and attach Ziplift grapple to MRA.
- Retract MRA out of core vessel into cask.

NOTE: Shroud on target drive crown will be removed during this operation to facilitate vertical removal/install of MRA.

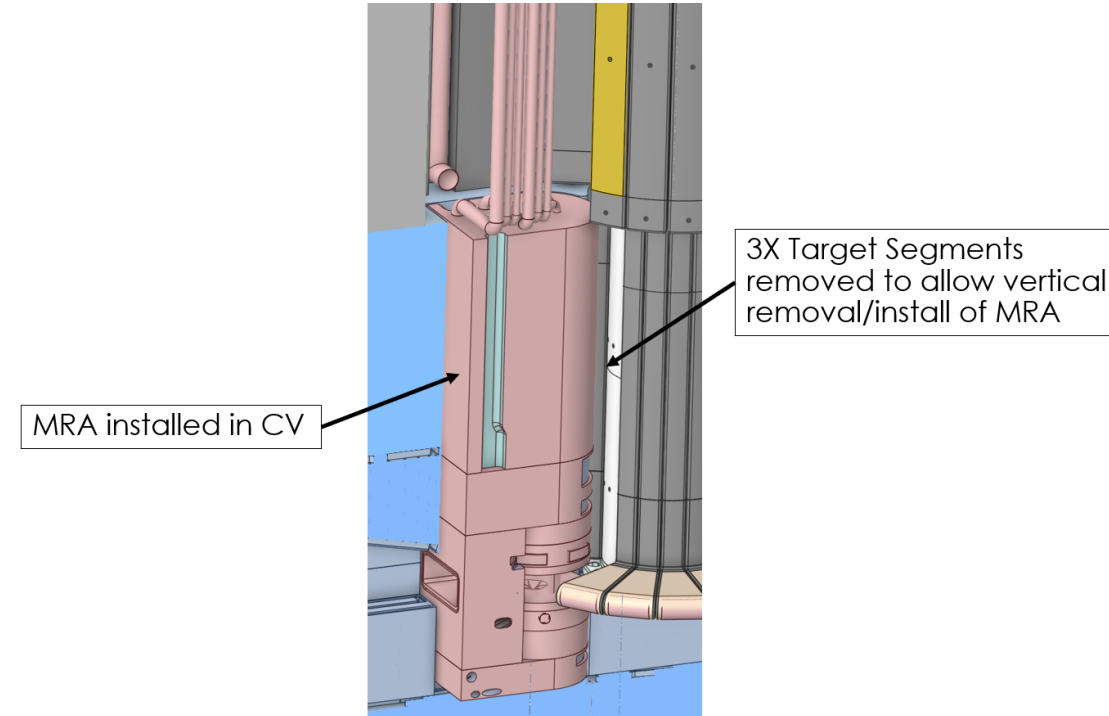
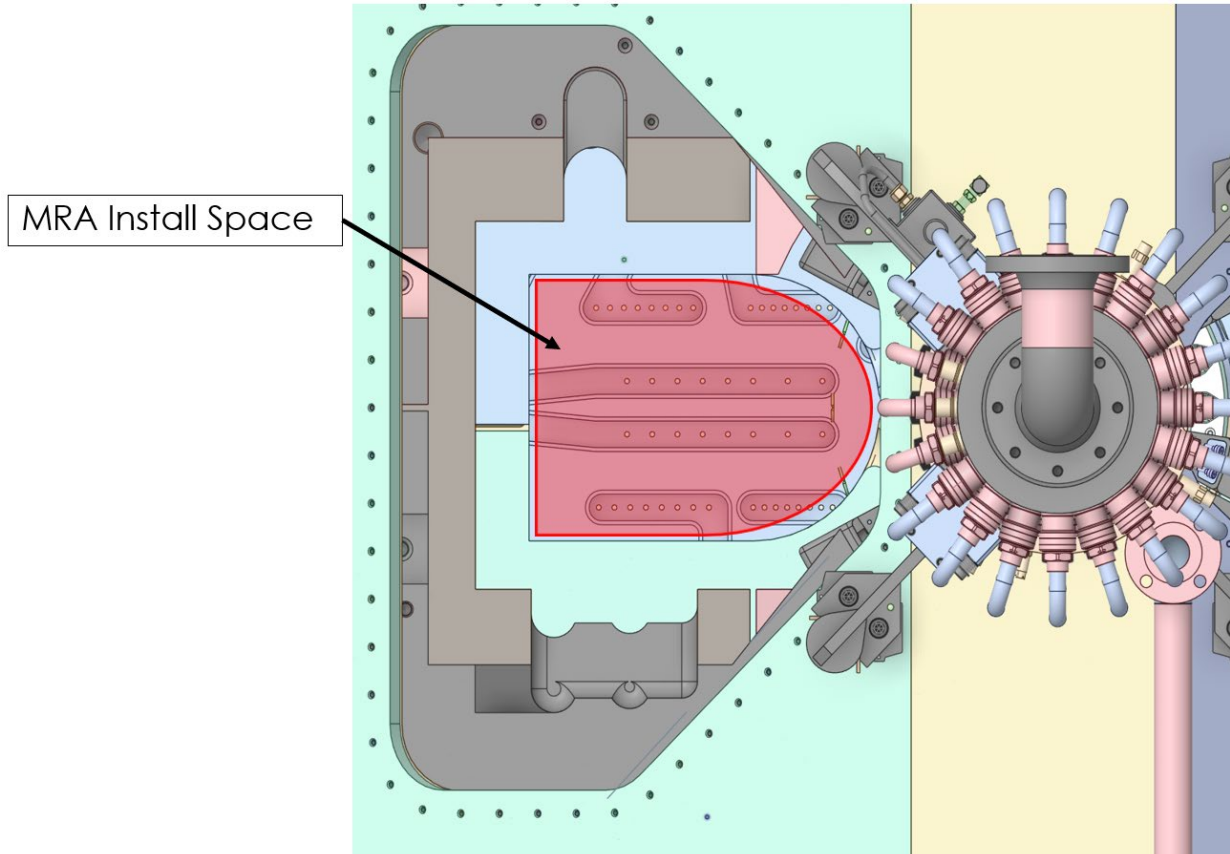


Final MRA Maintenance/Removal Procedure

- Manually close cask sliding door.
Lower MRA onto door.
- Disconnect Ziplift grapple from MRA.
- Remove portable hoist.
- Transfer cask to service cell.



Final MRA Procedure – Installation

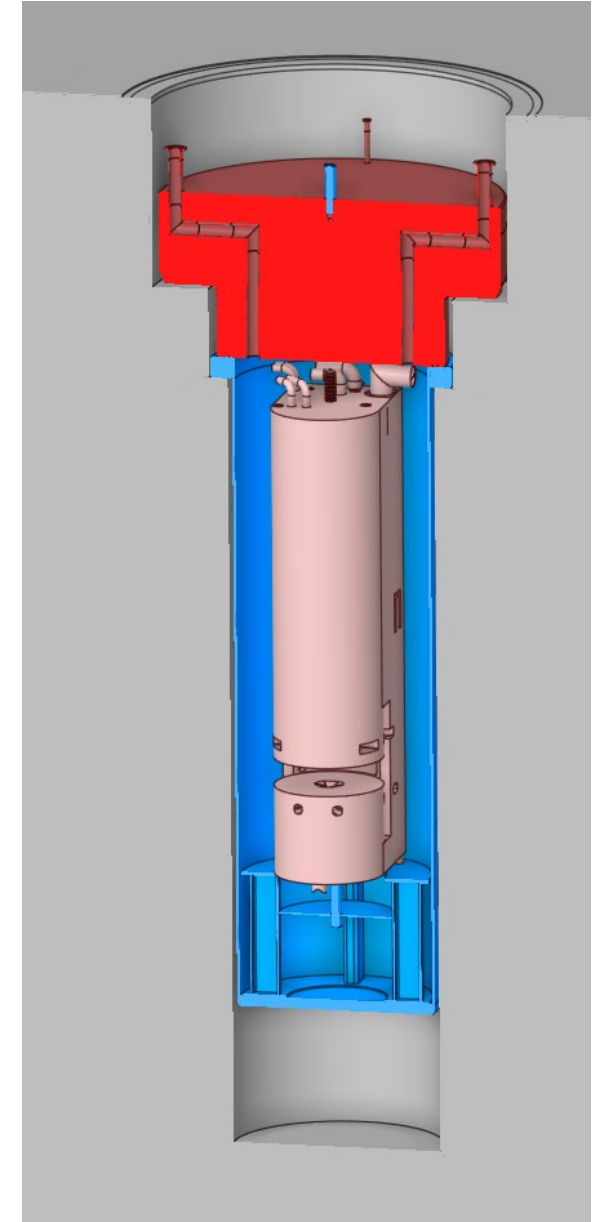


Final MRA Removal and Replacement

- Current estimated cycle time for MRA removal and replacement: <550 hours
 - 3X Target Segment Removal: <160hrs
 - Maintenance Prep, Remove CV hatch: <42hrs
 - Shield block removal: <20hrs
 - MRA pipe cutting: <30hrs
 - MRA removal: <20hrs
- Install new MRA in CV: <30hrs
- Re-install shield block: <16hrs
- Weld, Bolt, & Leak Test all joints: <50hrs
- Finish 3X Target Segment Install: <90hrs
- Button up CV: <80hrs

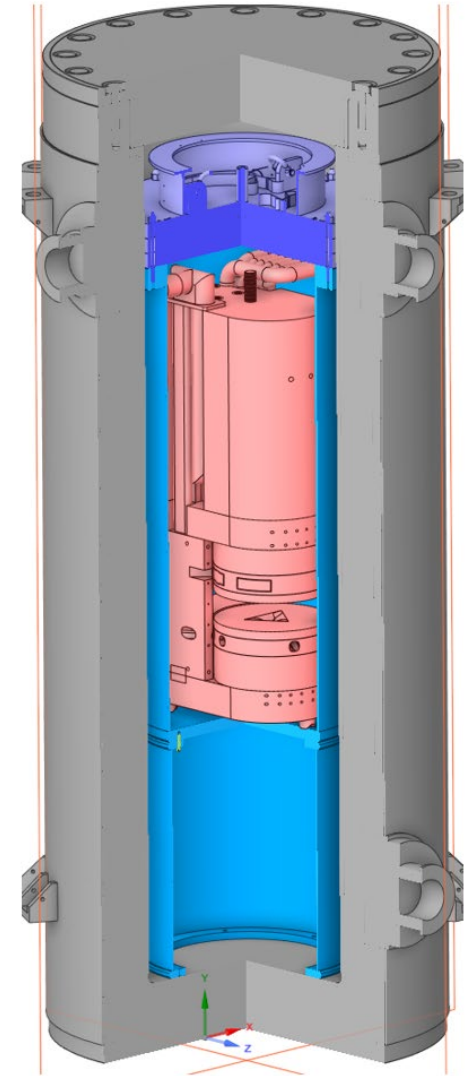
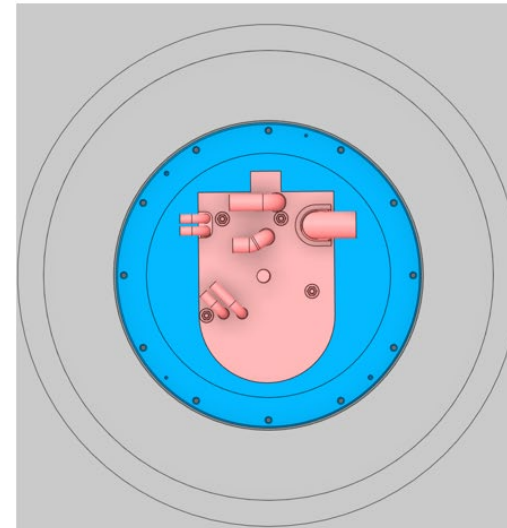
Final MRA Disposal Preparation

- Transfer MRA from RH cask into decay storage pit containing removable disposal liner.
- Remotely install vacuum lid.
- Perform component drying procedure.
- Replace vacuum lid with storage lid.



Final MRA Disposal Preparation

- Plan to package a single MRA into a steel liner and then package liner into TN-RAM shipping container



Conclusion – MRA

- Overall development of remote handling tooling and processes seems reasonable to support MRA maintenance.
- All RH requirements are satisfied.
- Additional planning, development, and testing will occur to support RH operations and improve cycle time efficiency.