OAK RIDGE National Laboratory | SECOND TARGET STATION

# VS/TSS Manufacturing and Fabrication Strategy

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April 22, 2025

U.S. DEPARTMENT OF ENERGY

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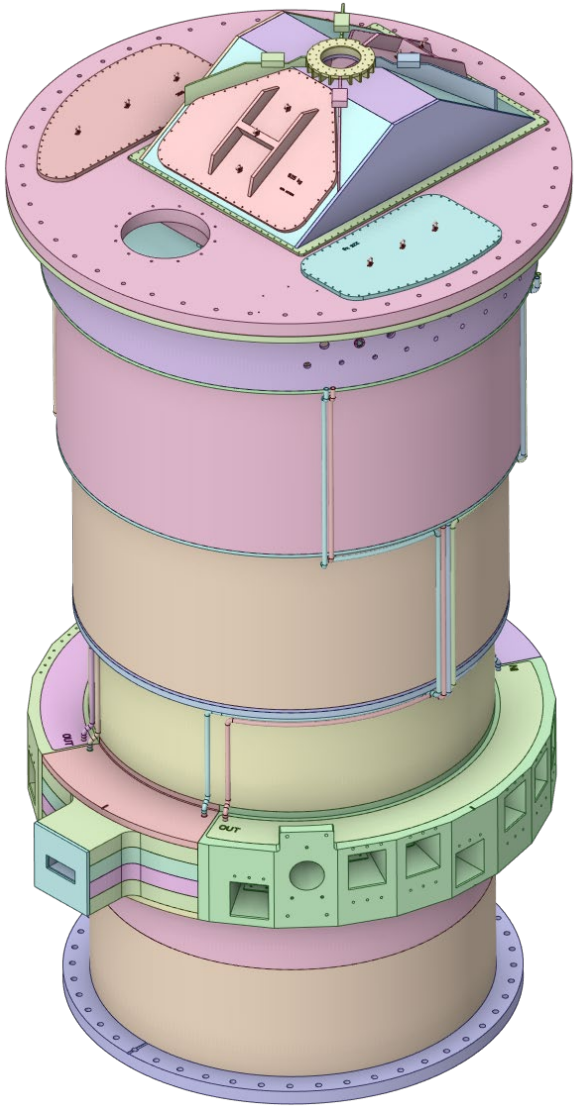
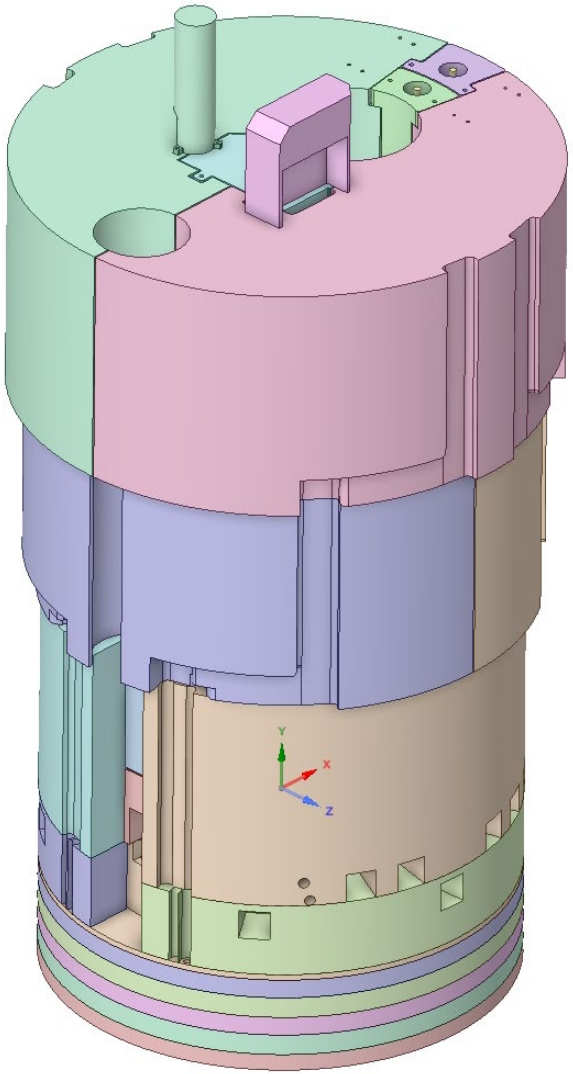
# Vessel Systems Manufacturing

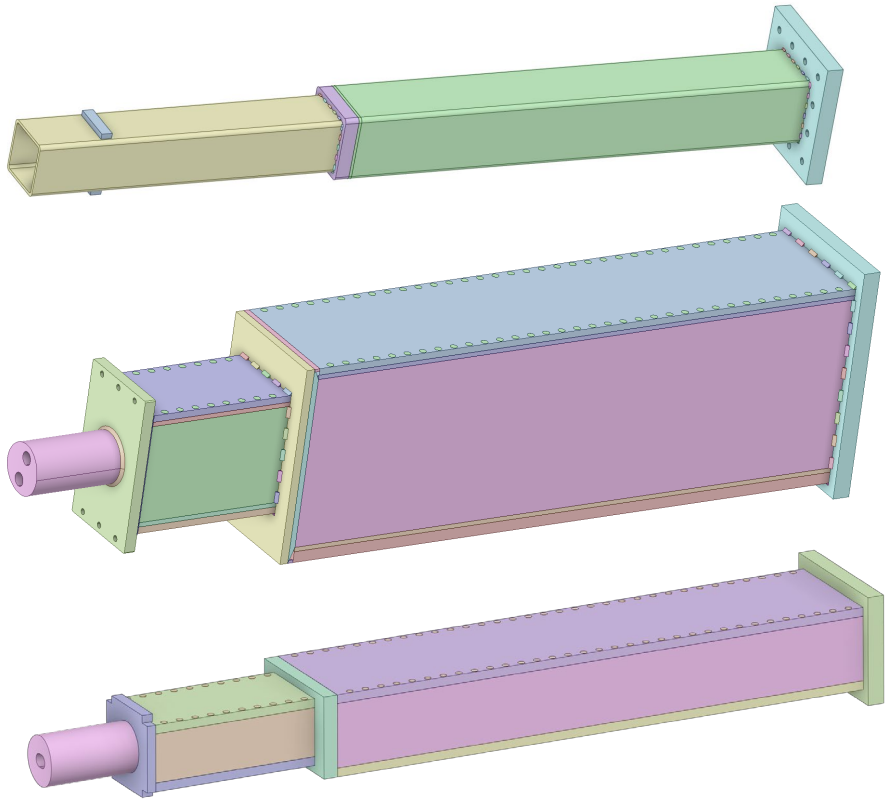
## 1. Core Vessel Assembly



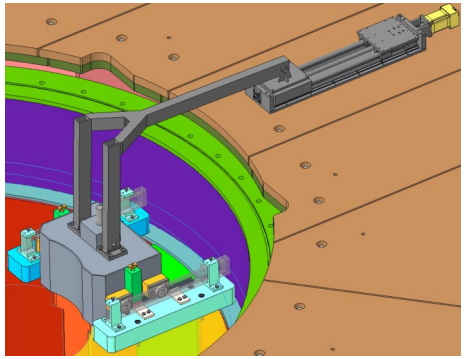
## 2. Core Vessel Shielding



## 3. Nozzle Extensions

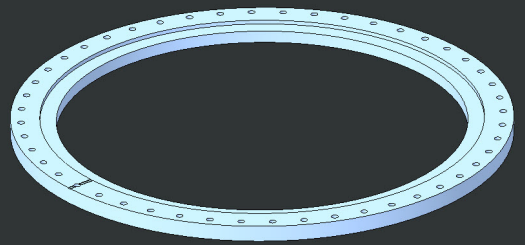


## 4. Gamma Gate

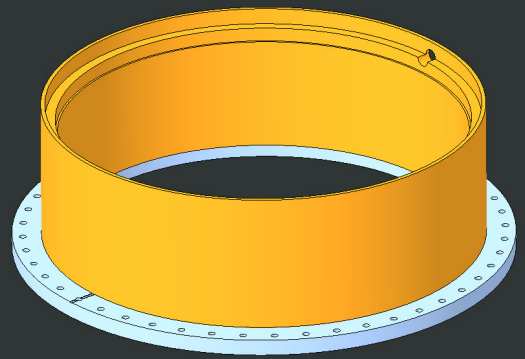


# The CV lower weldment will be built layer by layer with a flange at its base and vertex

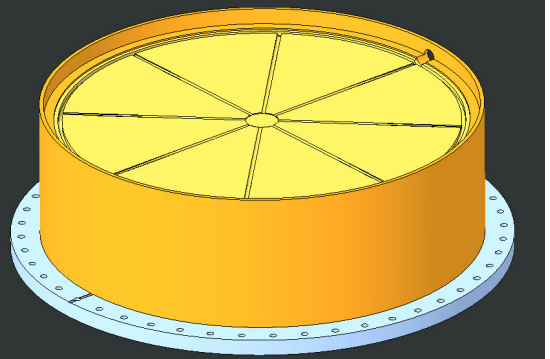
Pre-weld machine



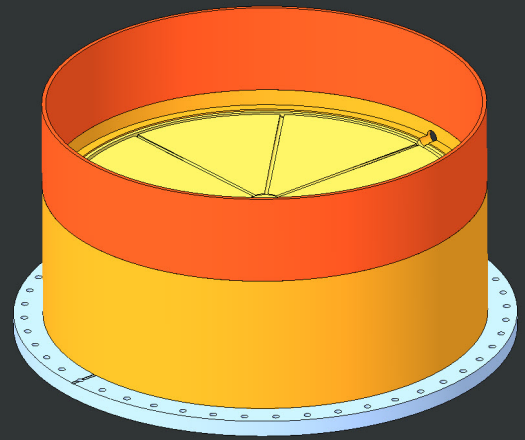
Roll, weld, pre-weld machine



Pre-weld machine, weld

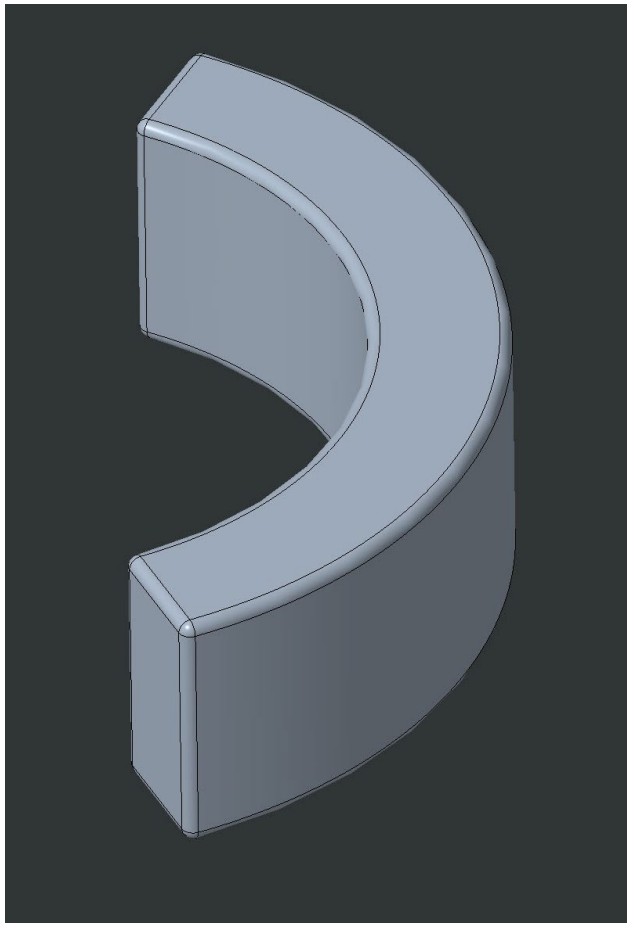


Roll and weld

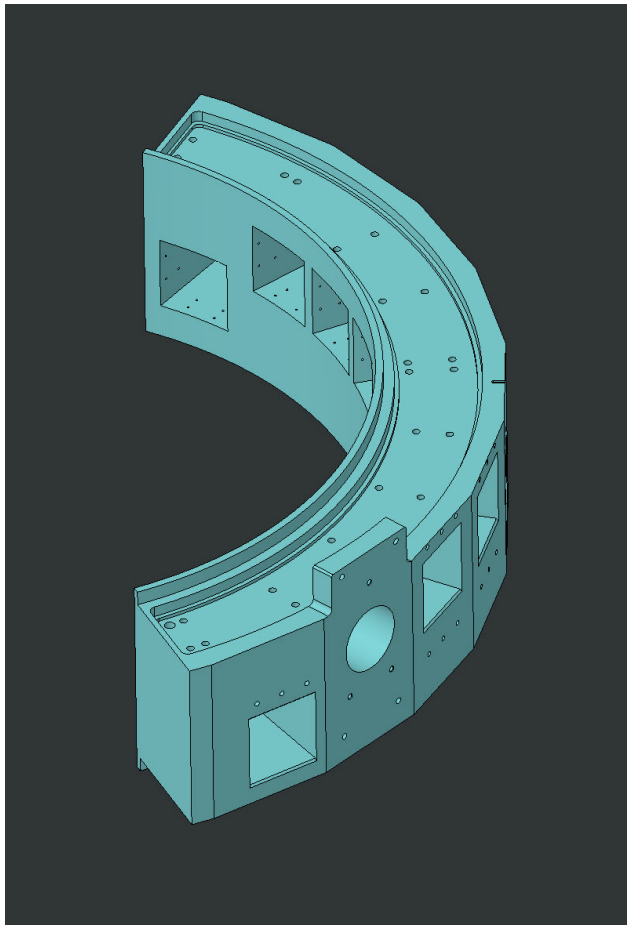


# Forged quadrant machined and welded with plenums

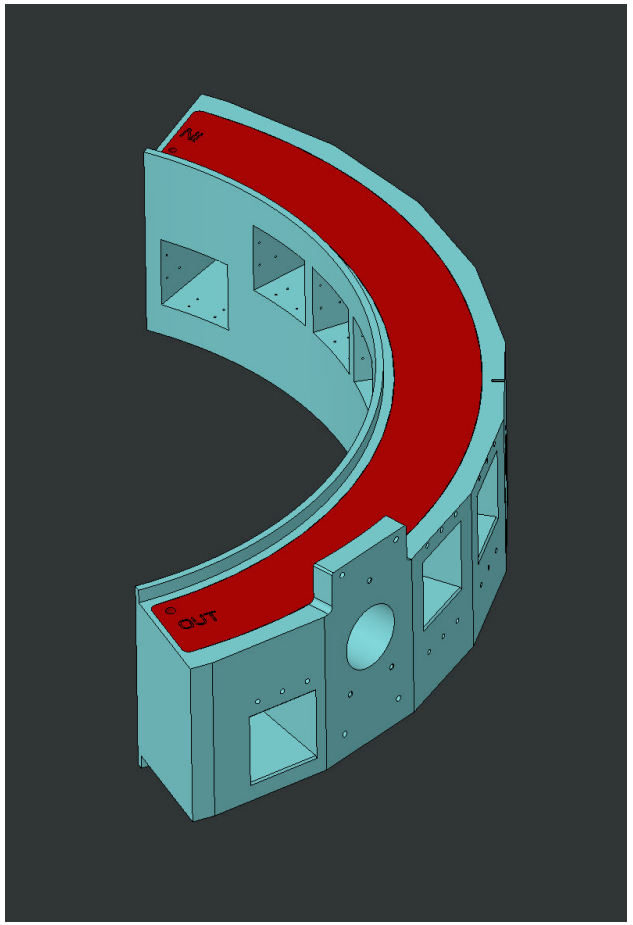
Rough machine forging outer profile



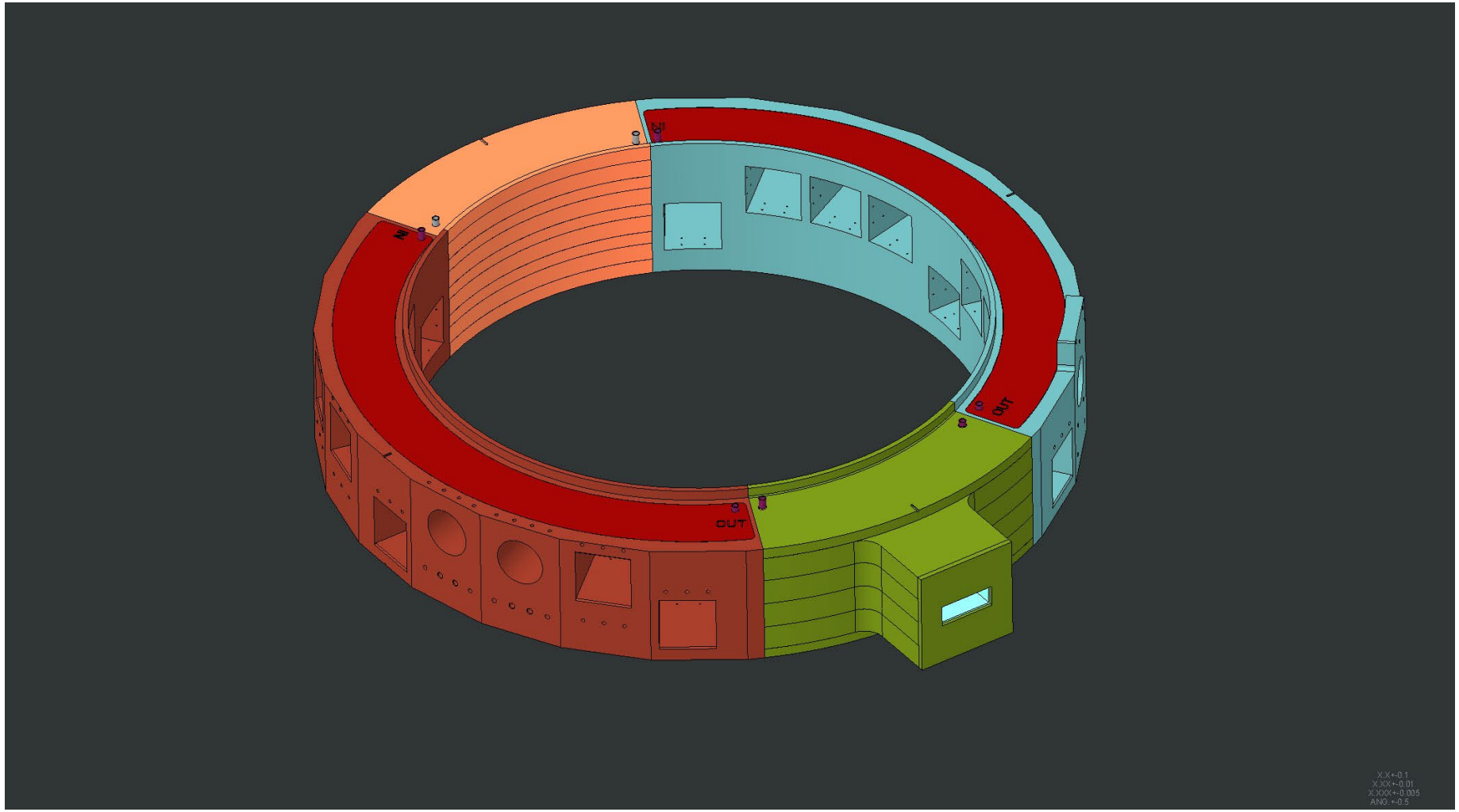
Mill water circuit, rough machine profile



Fit and weld top and bottom plenums

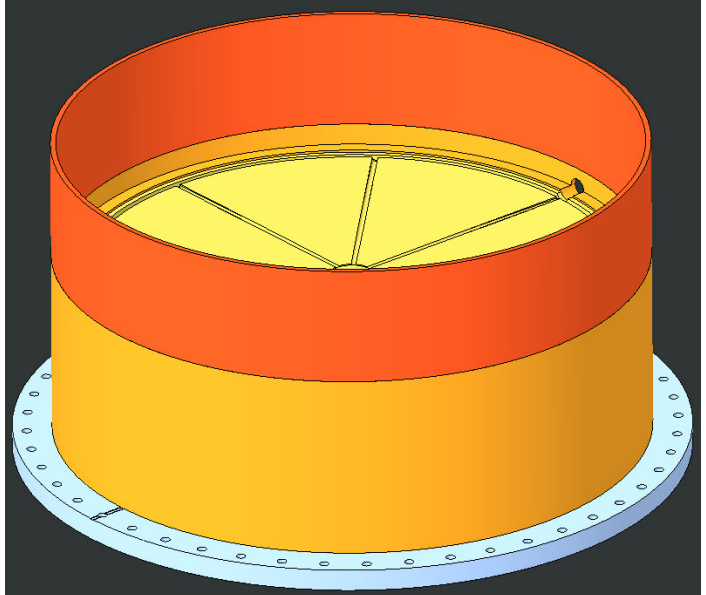


# Fit and weld 4x beltline quadrants to form full beltline

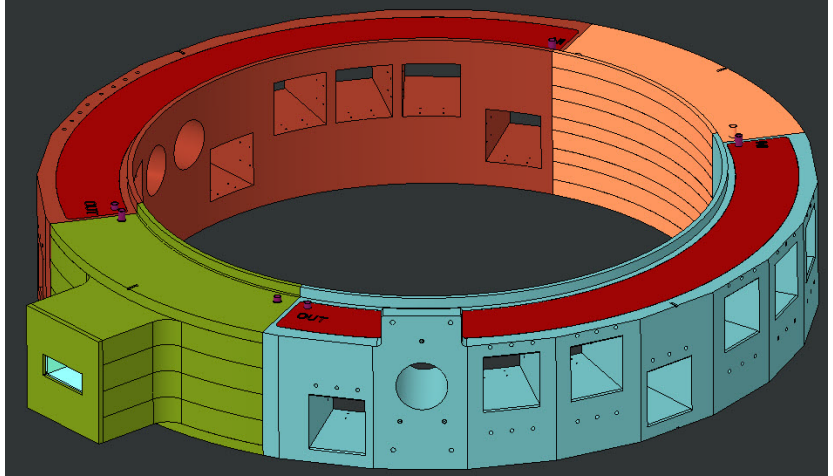


# Welding beltline to lower shell weldment

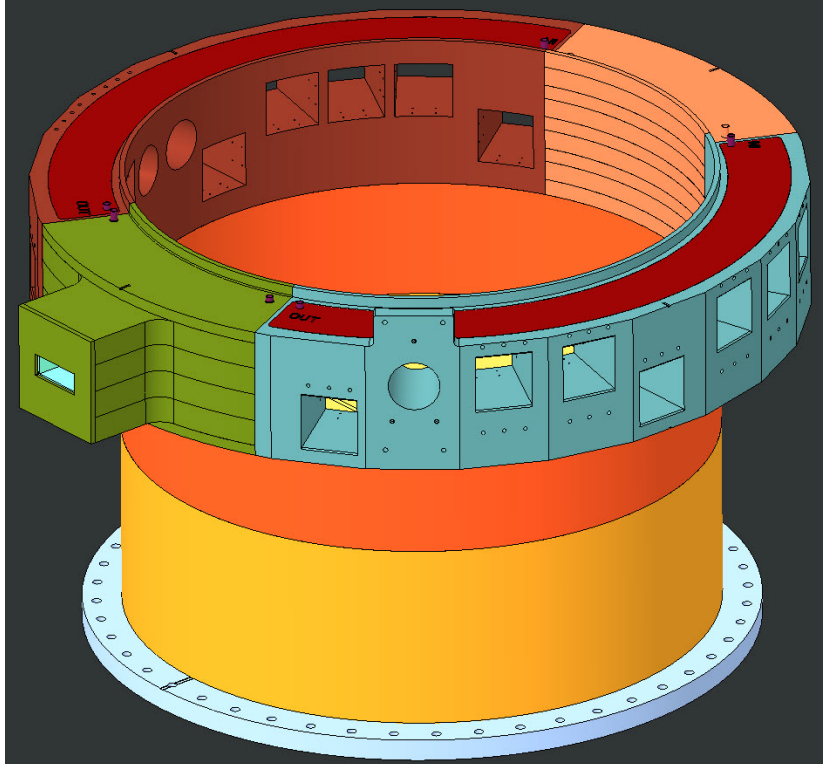
Lower shell weldment



Beltline weldment

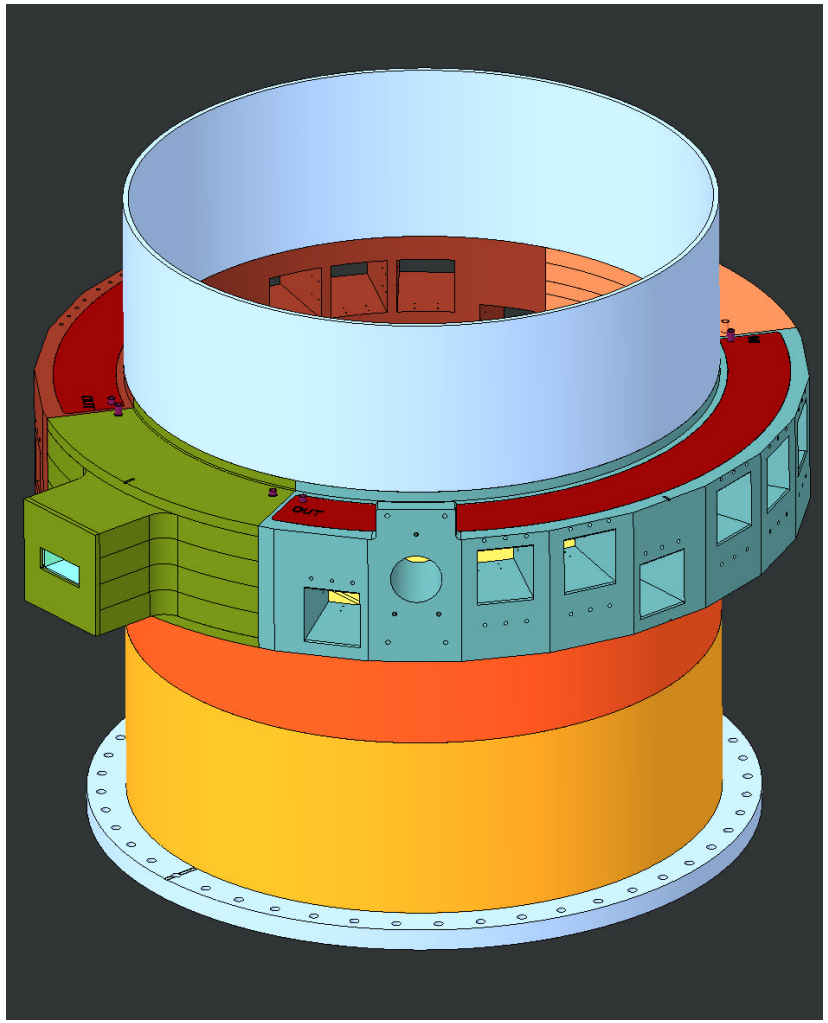



Fit and weld lower shell to beltline

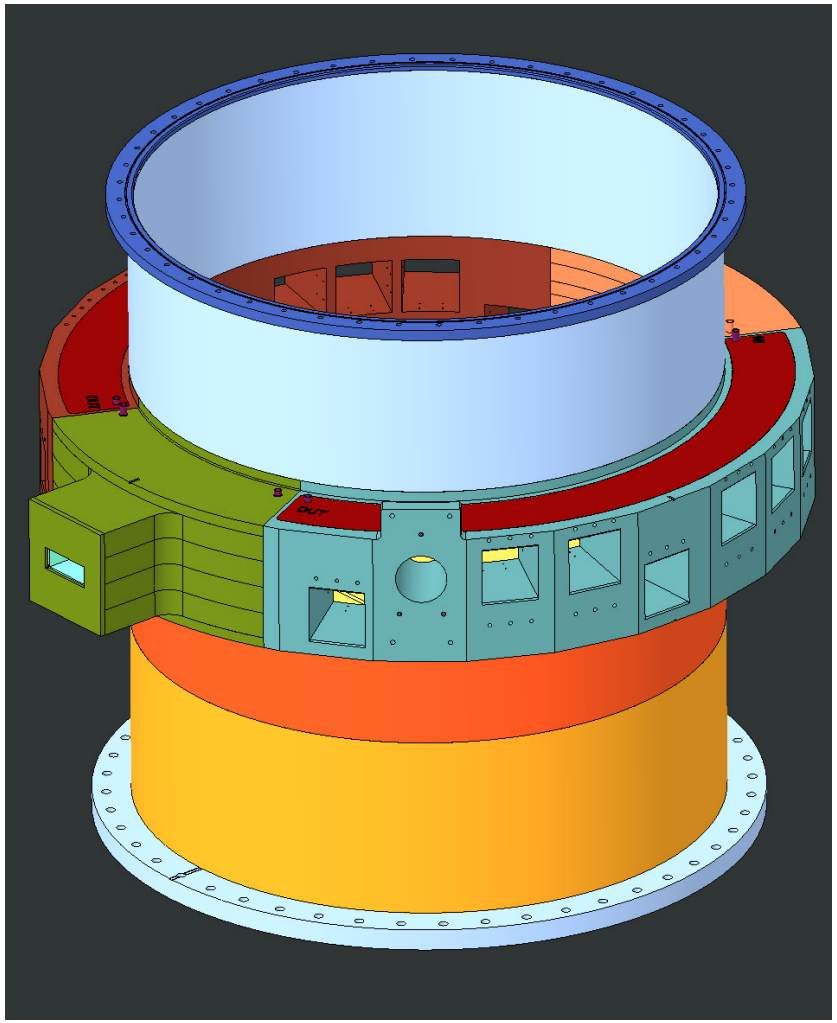


# Once all parts and assemblies are welded together, the flanges and beltline will be machine to ensure precise and accurate features

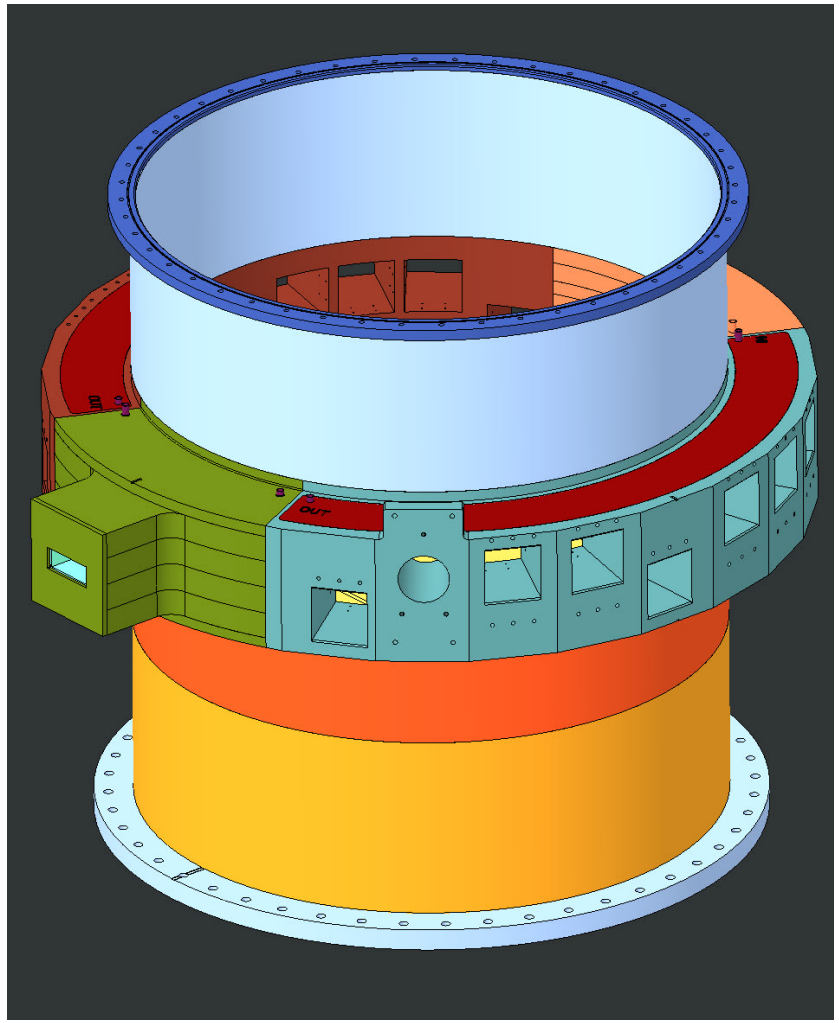
Roll, machine, fit and weld top shell



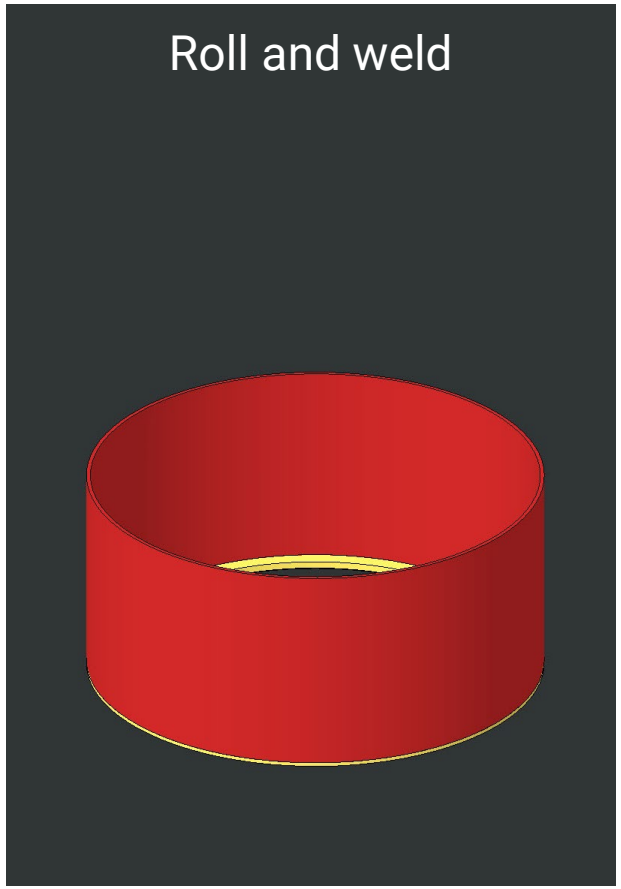
Fit and weld top flange



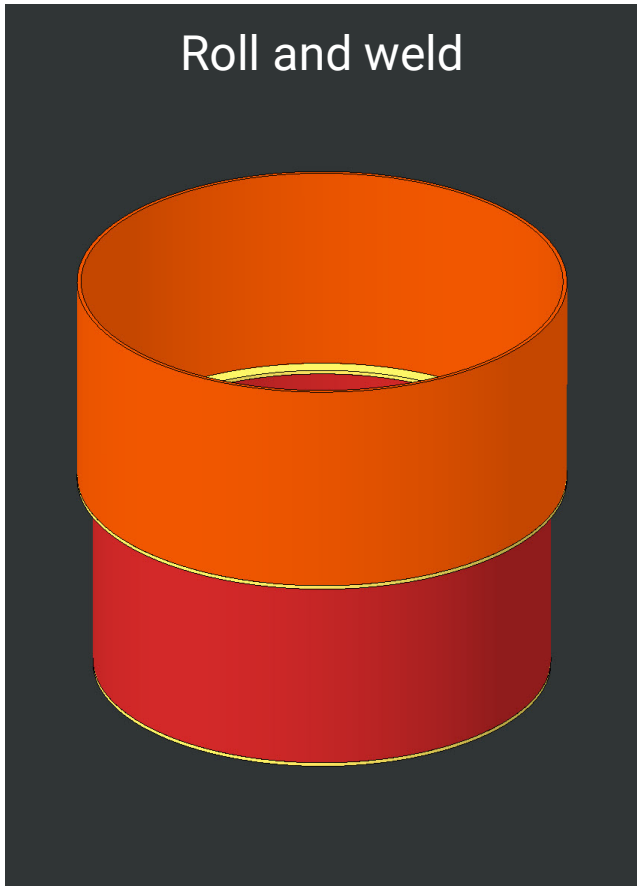
Final machine flanges and beltline



# The Upper CV Shell is similar in construction to the Lower CV Shell. Construction starts with a flange at its base

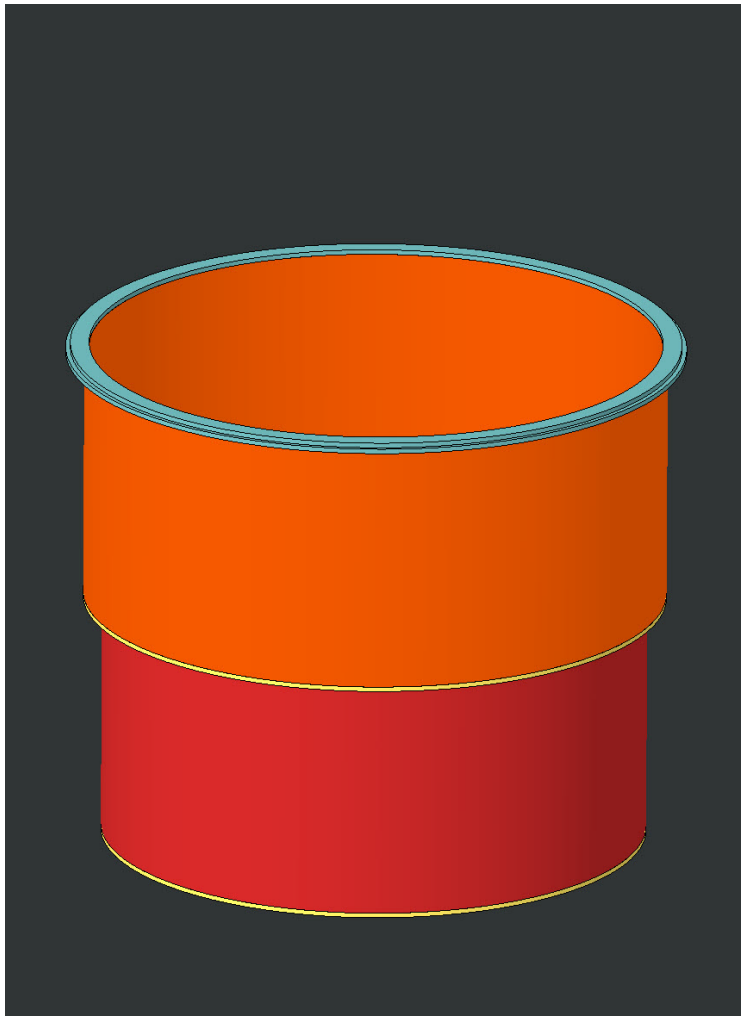





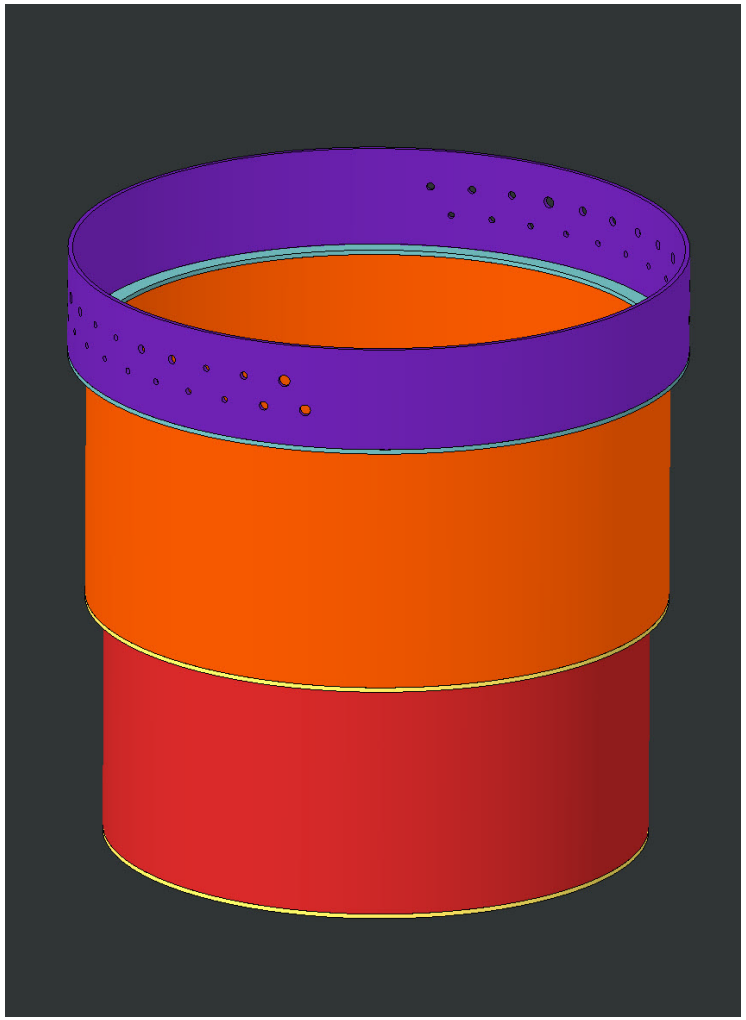


# Rolled sheets and additional flanges are then welded on layer by layer, up to the flange at the top of the weldment

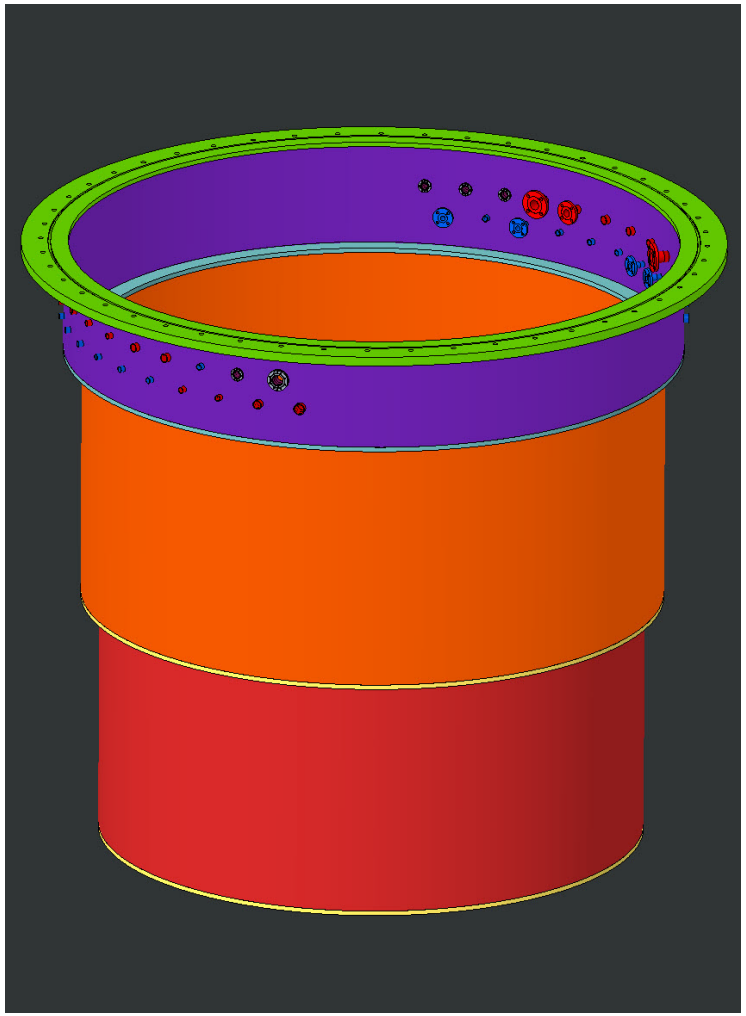
Pre-weld machine, fit and weld



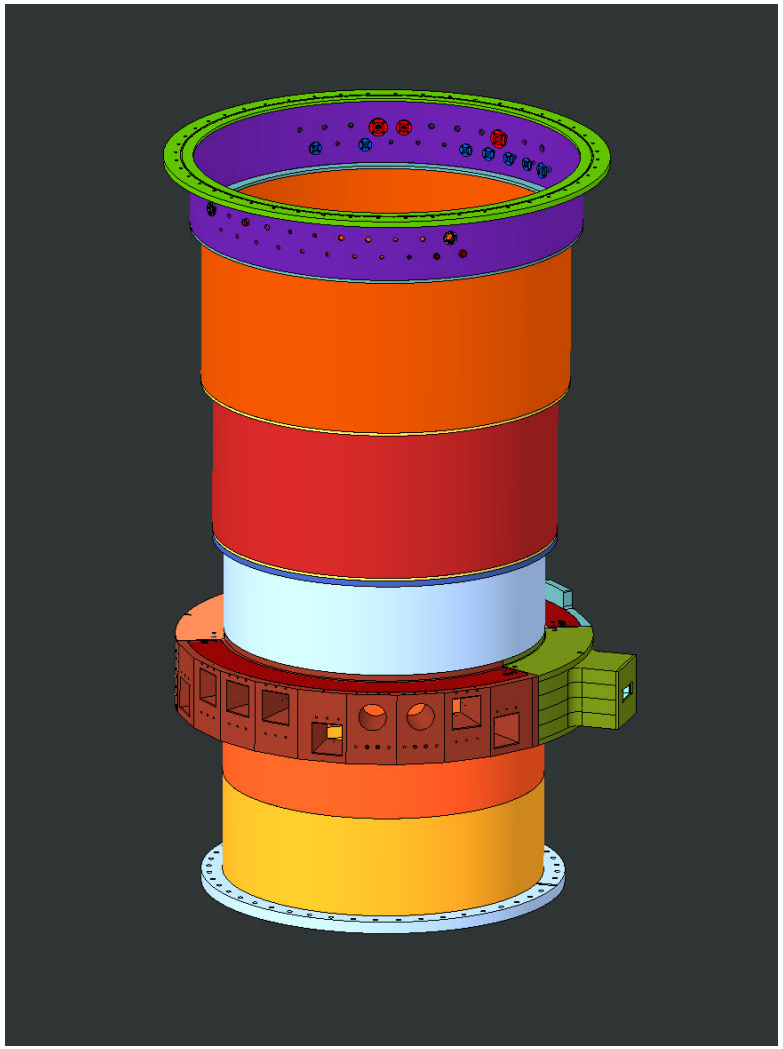
Laser cut, roll and weld

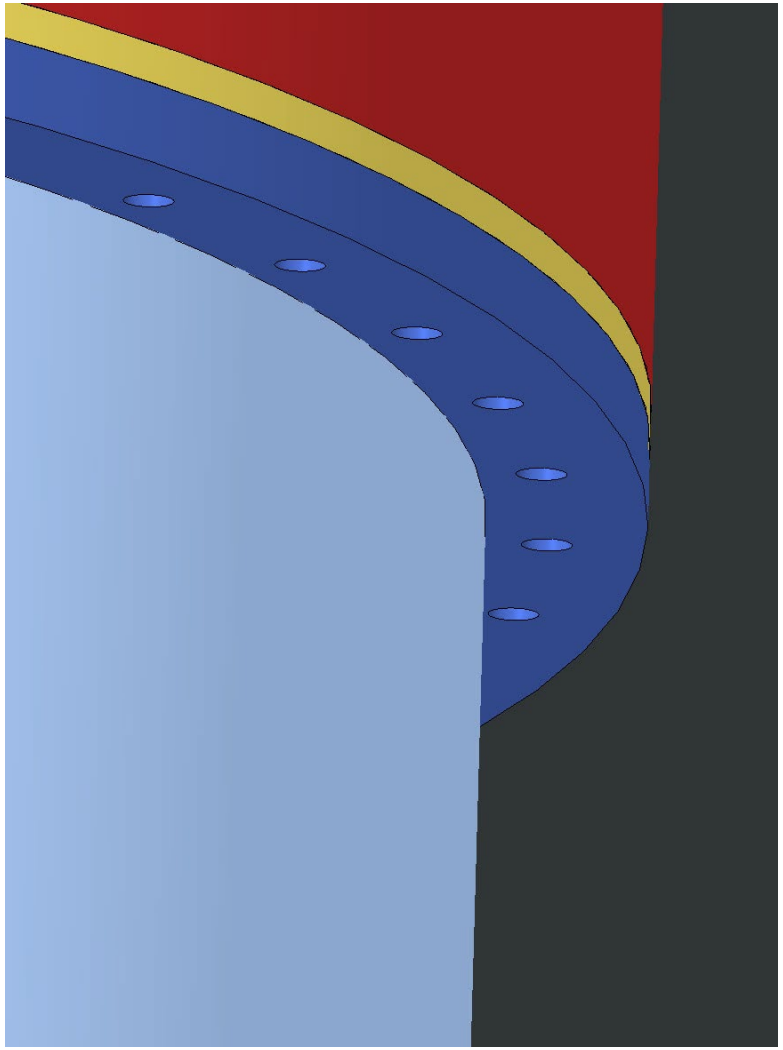


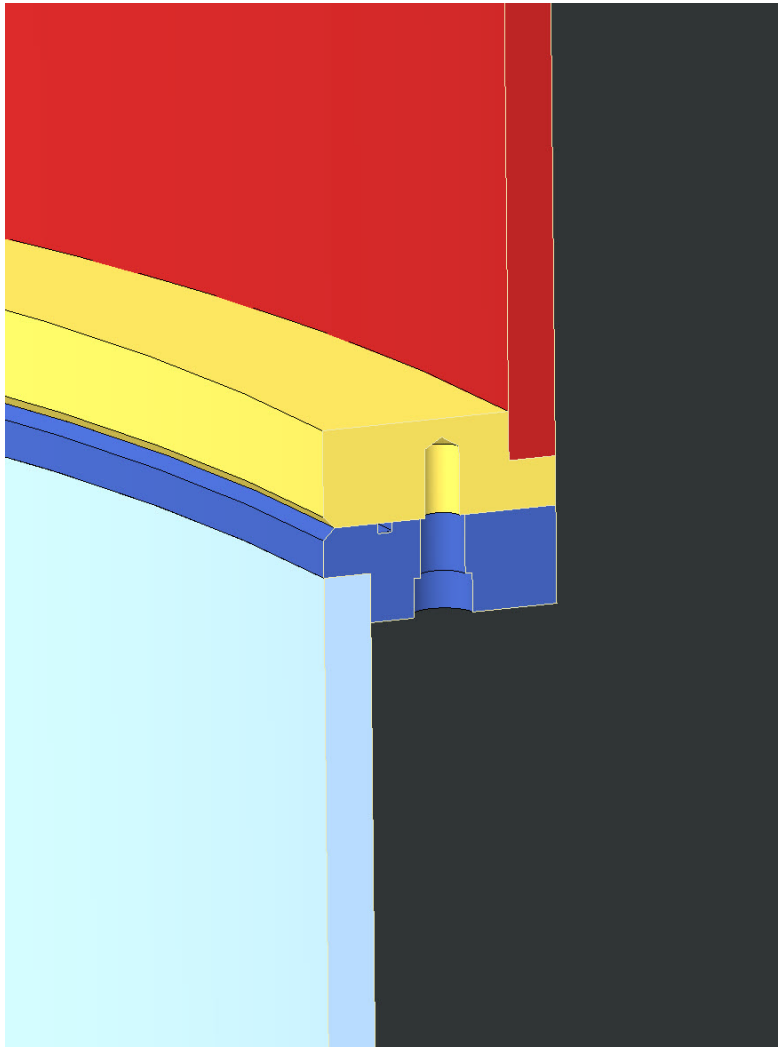
Fit and weld, final machining



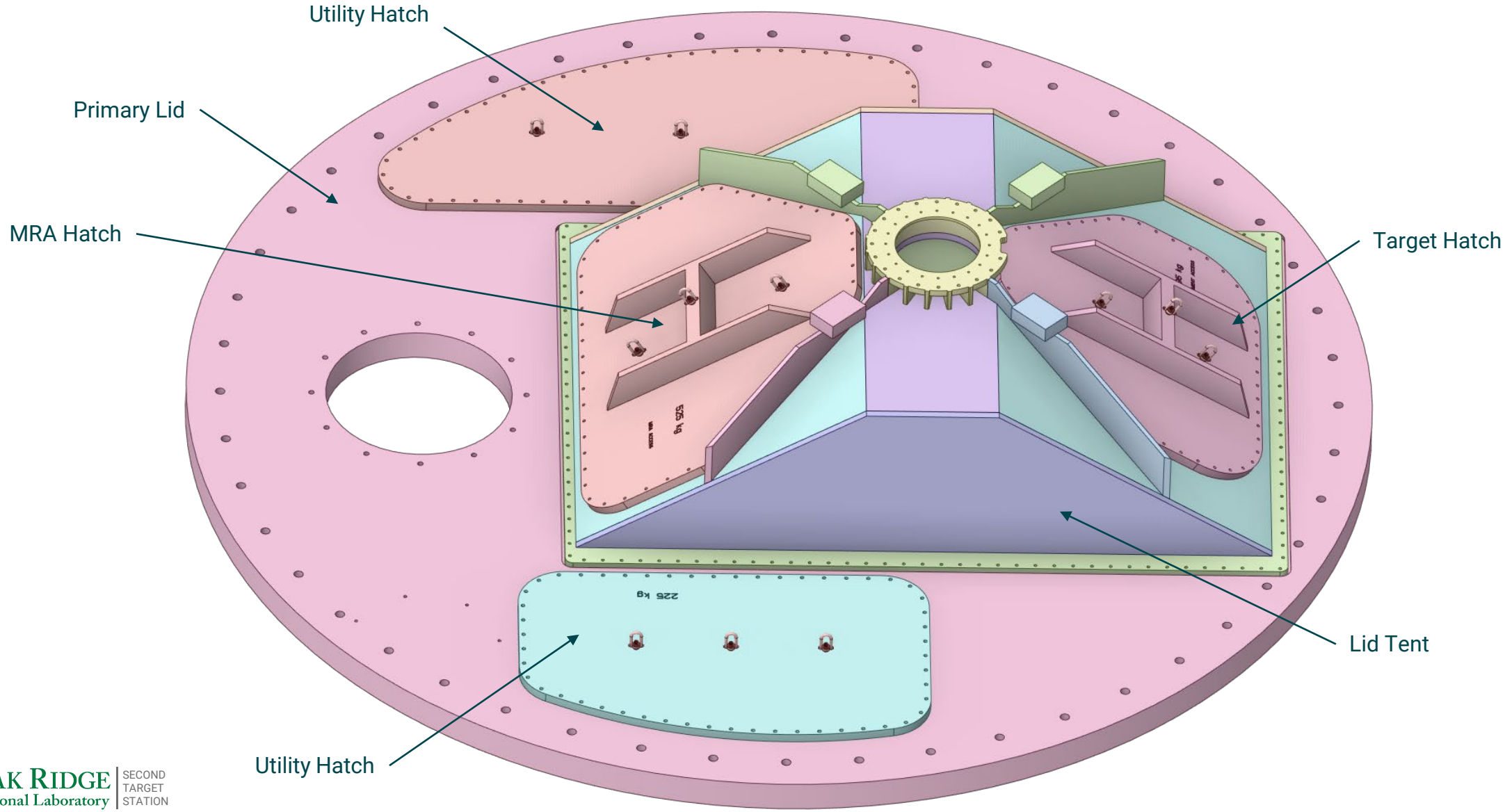
# Upper and lower weldments are bolted together for factory leak testing, and welded together once joined in the monolith



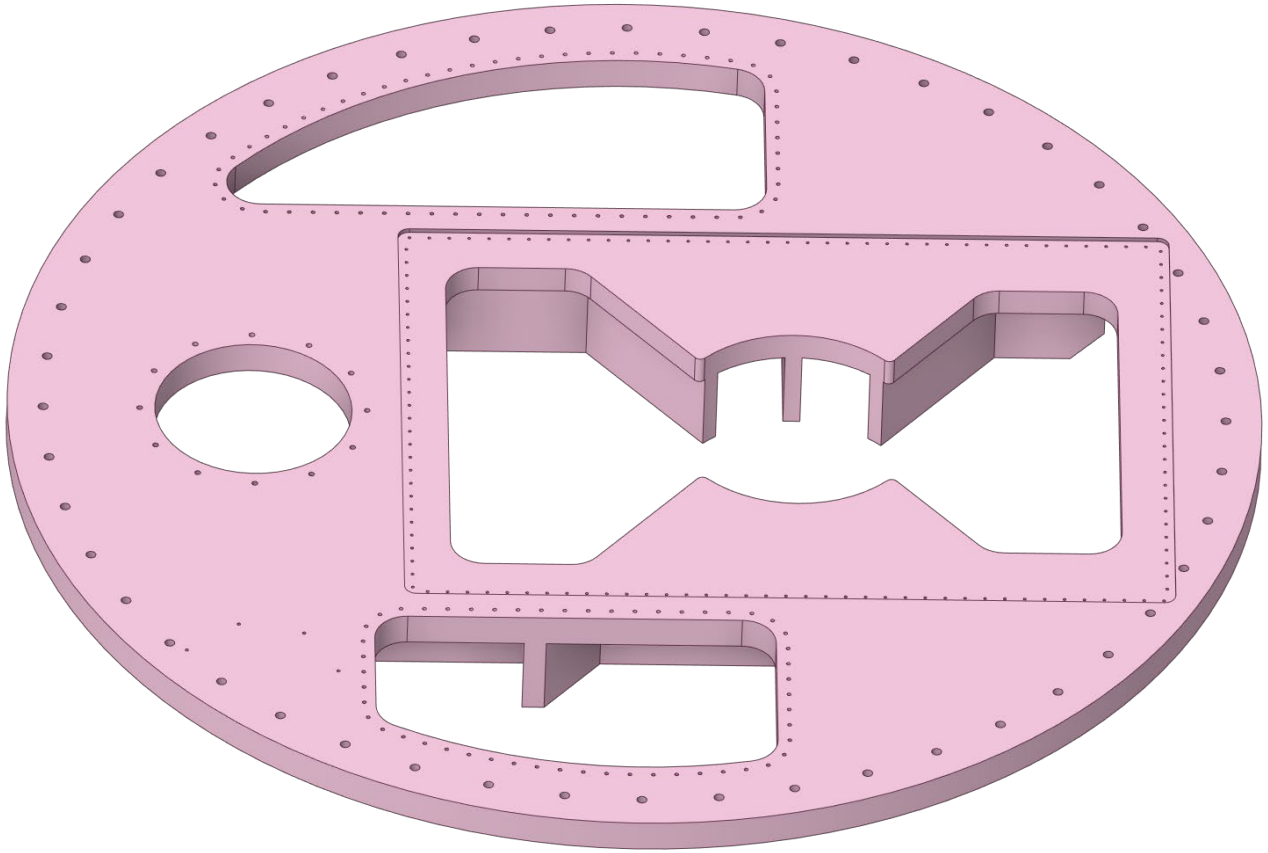


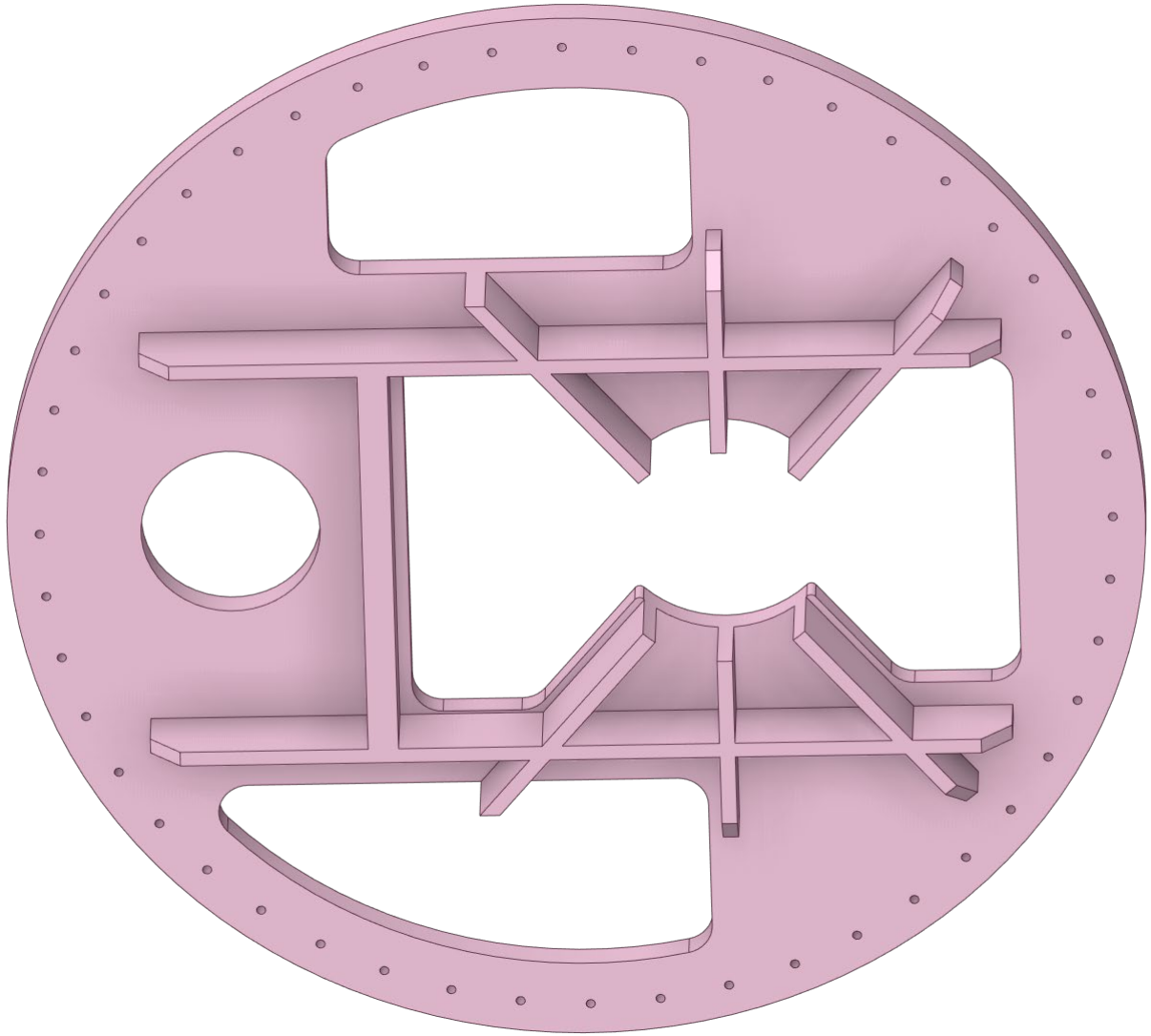


# The Core Vessel lid is comprised the primary lid, tent and four hatches



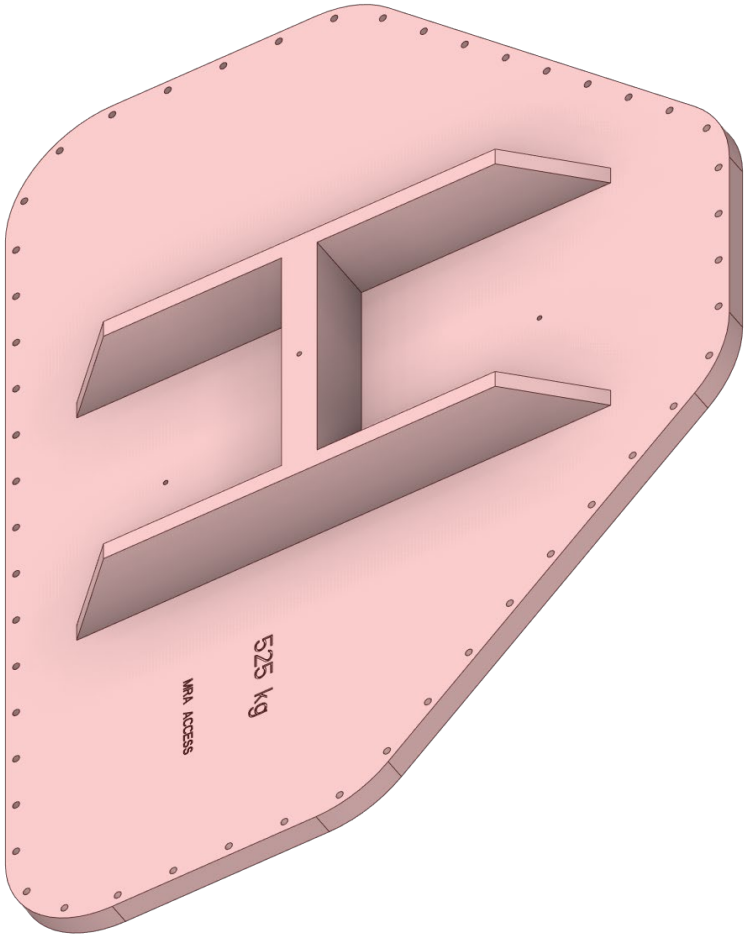
# The Core Vessel primary lid will undergo pre-weld machining, welding of stiffening ribs, followed by final machining



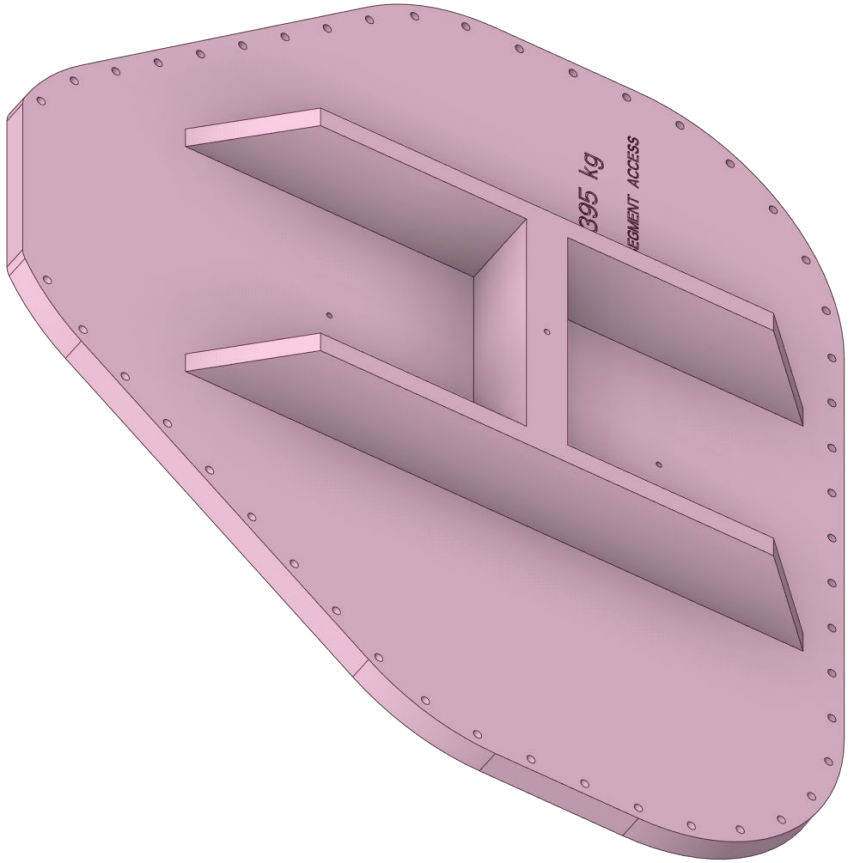


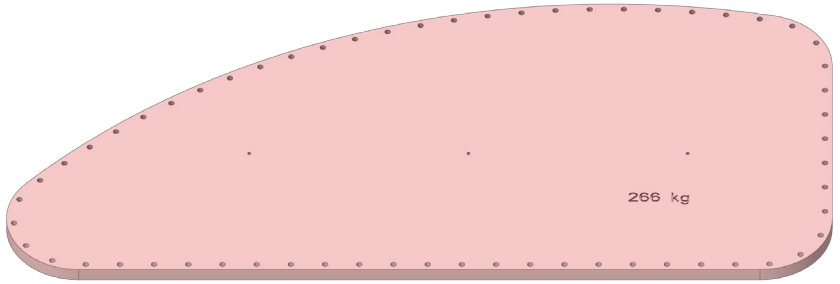
# MRA and Target access hatches include welded stiffening ribs

MRA Access Hatch

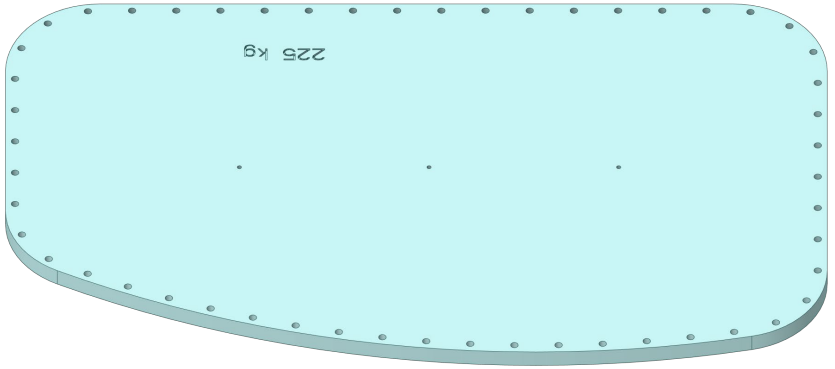



Target Segment Access Hatch

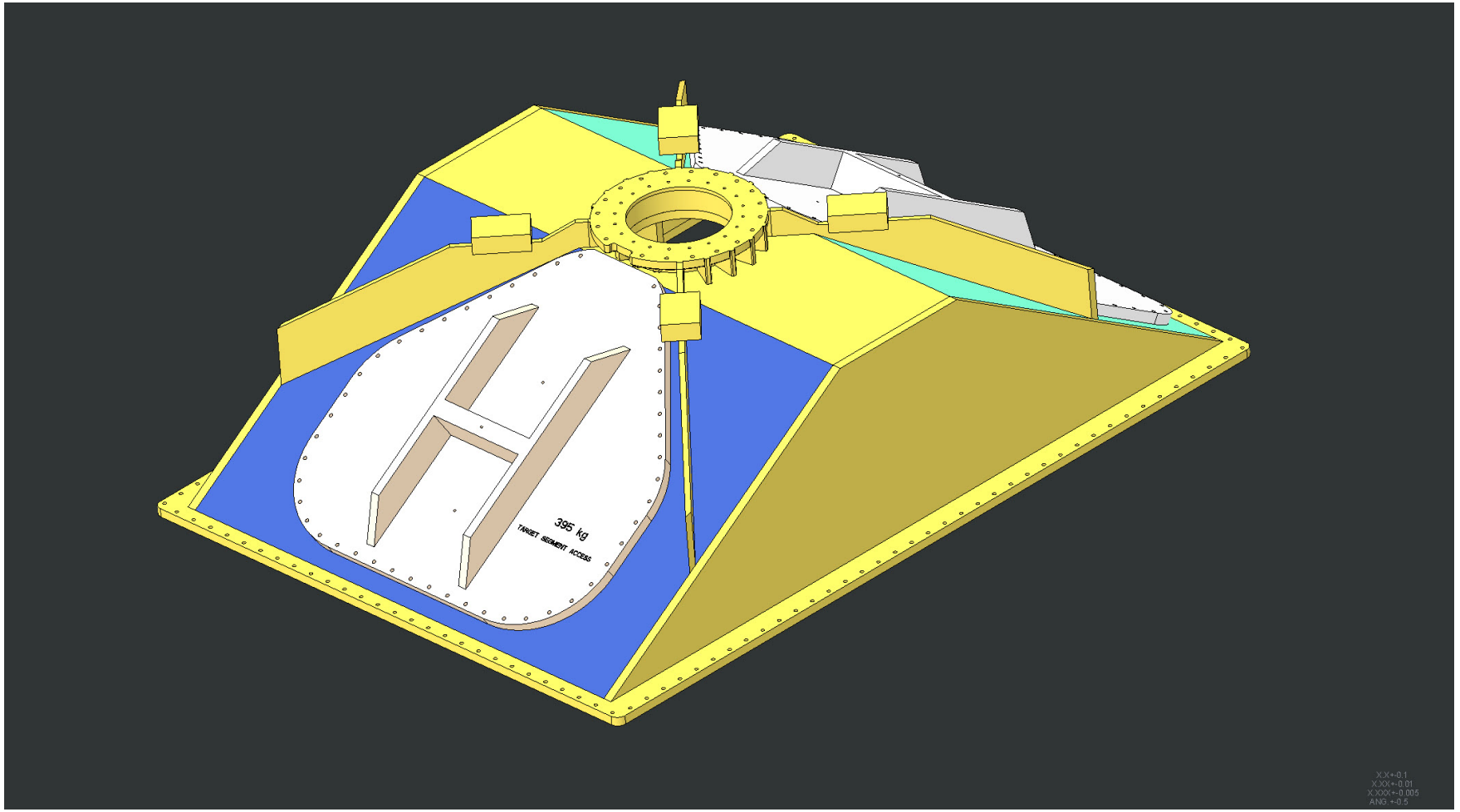


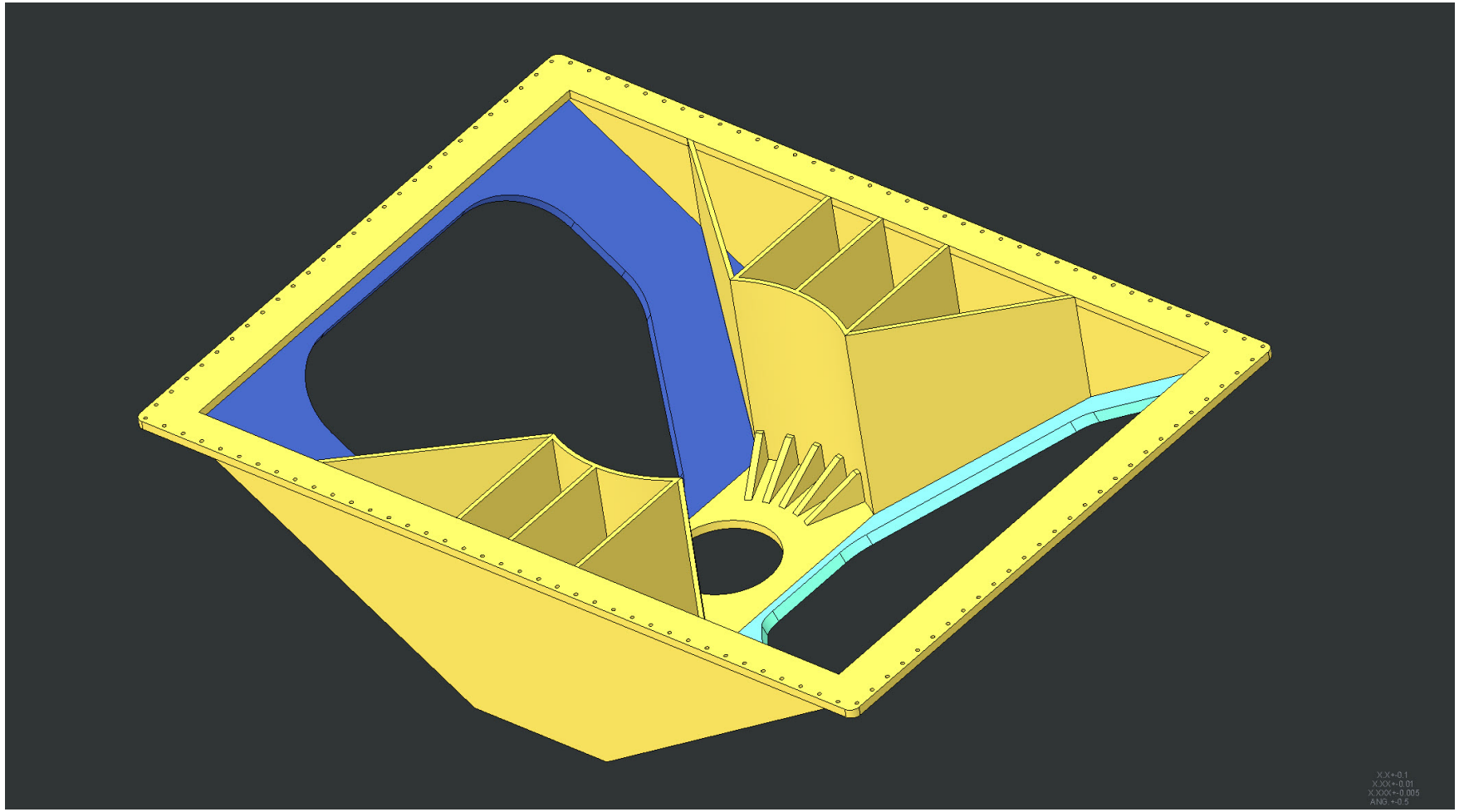

Utility Hatches



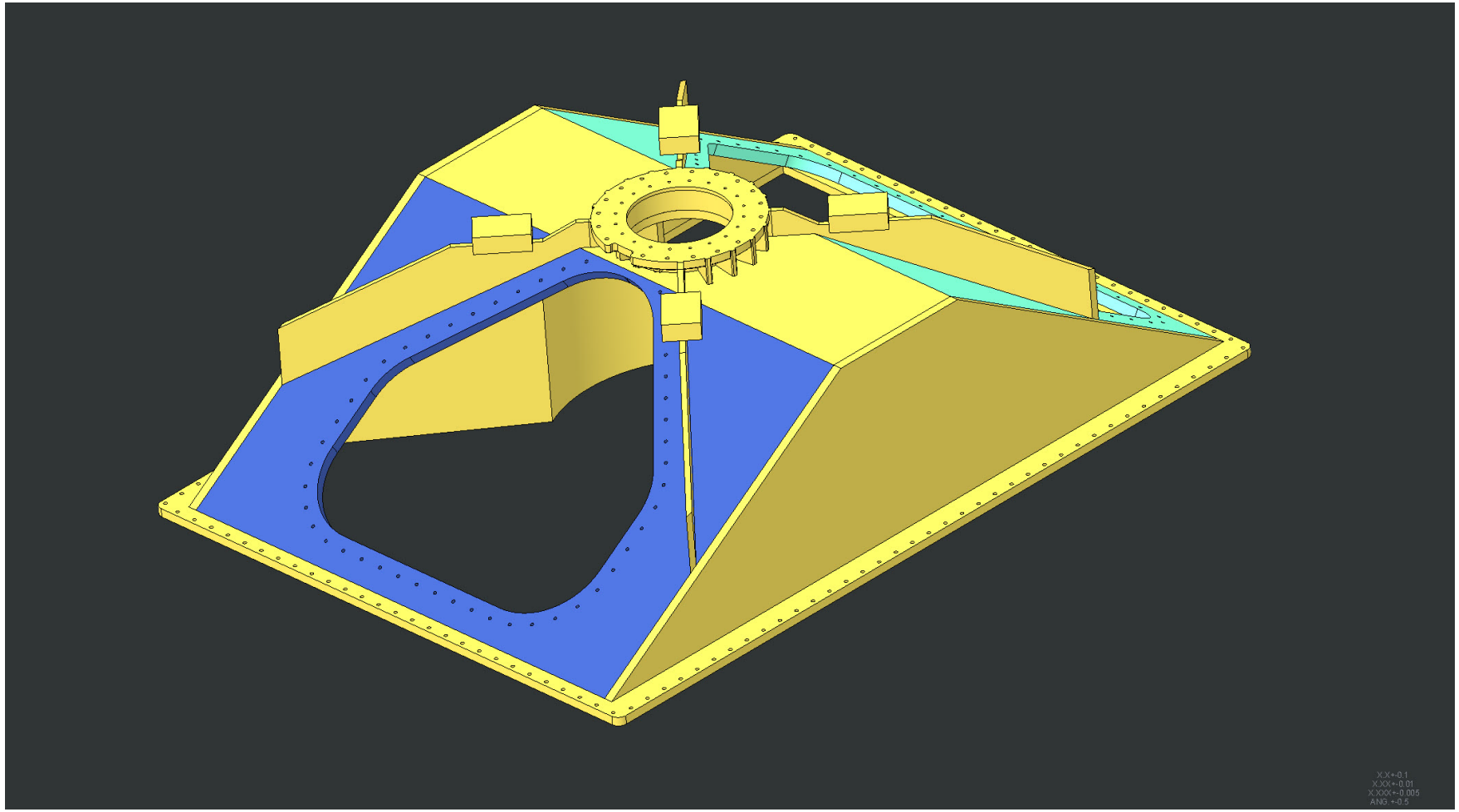
# The tent at the top of the CV is another weldment that requires some relatively simple fabrication followed by finish machining



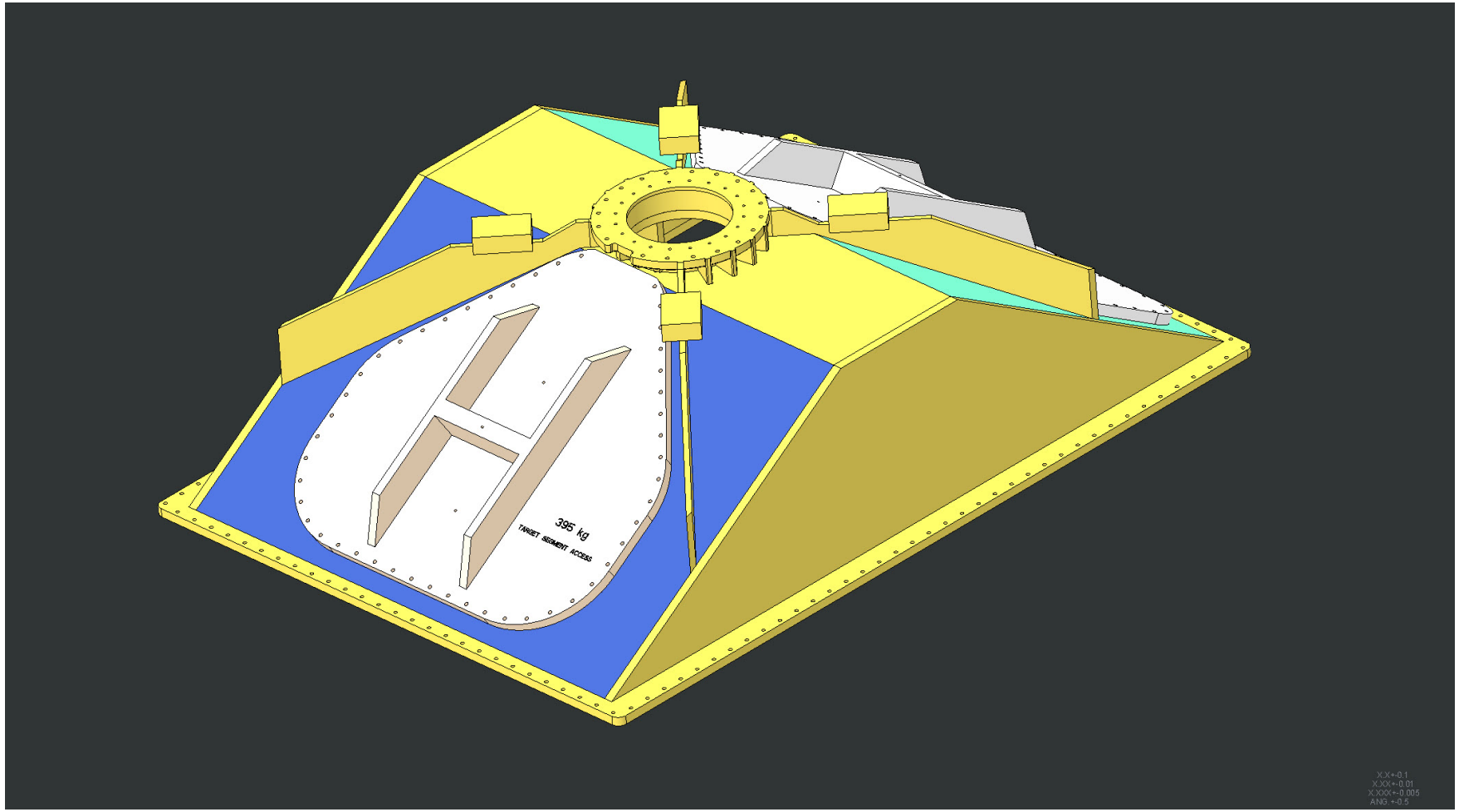
# Construction consists mostly of plates being welded to the base flange with a generous amount of bracing to support the weight of the Target Assembly and prevent deformation under a vacuum load



# The flange weldment for the Target Assembly is welded to the top of the Tent as well as additional bracing

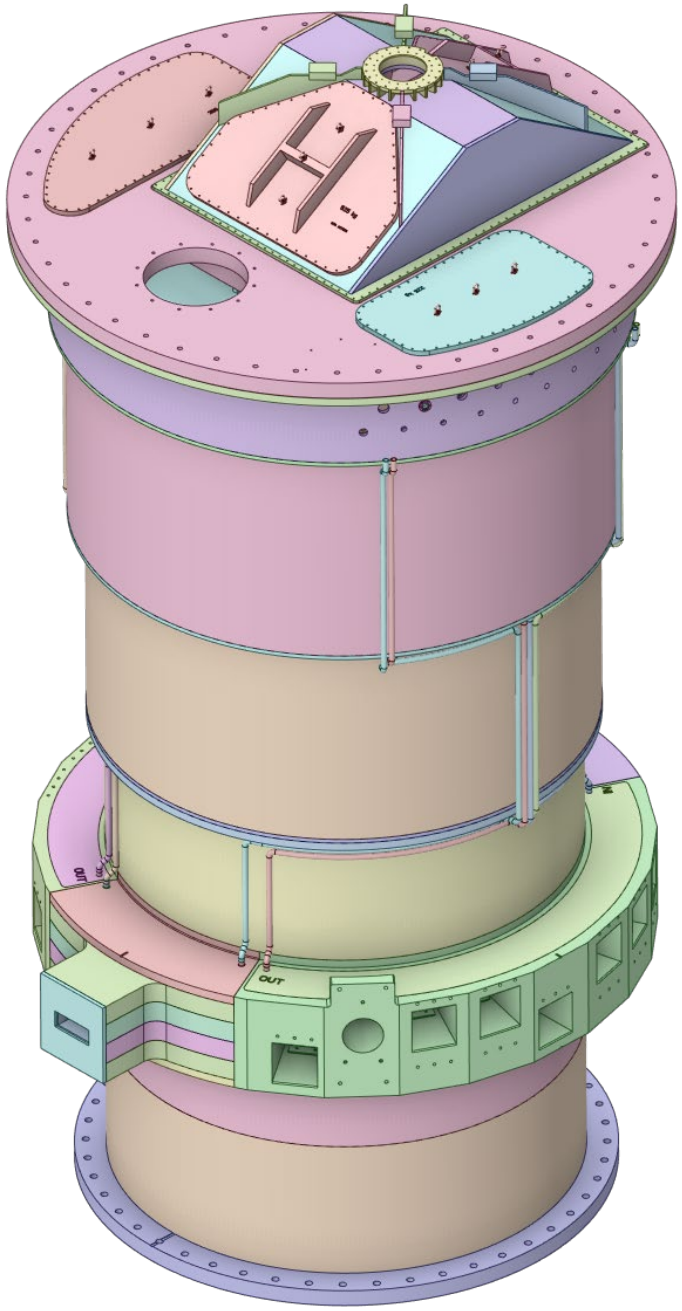


# Post-weld machining of the top and bottom flanges, hatch mating surfaces and target support pads to complete the weldment

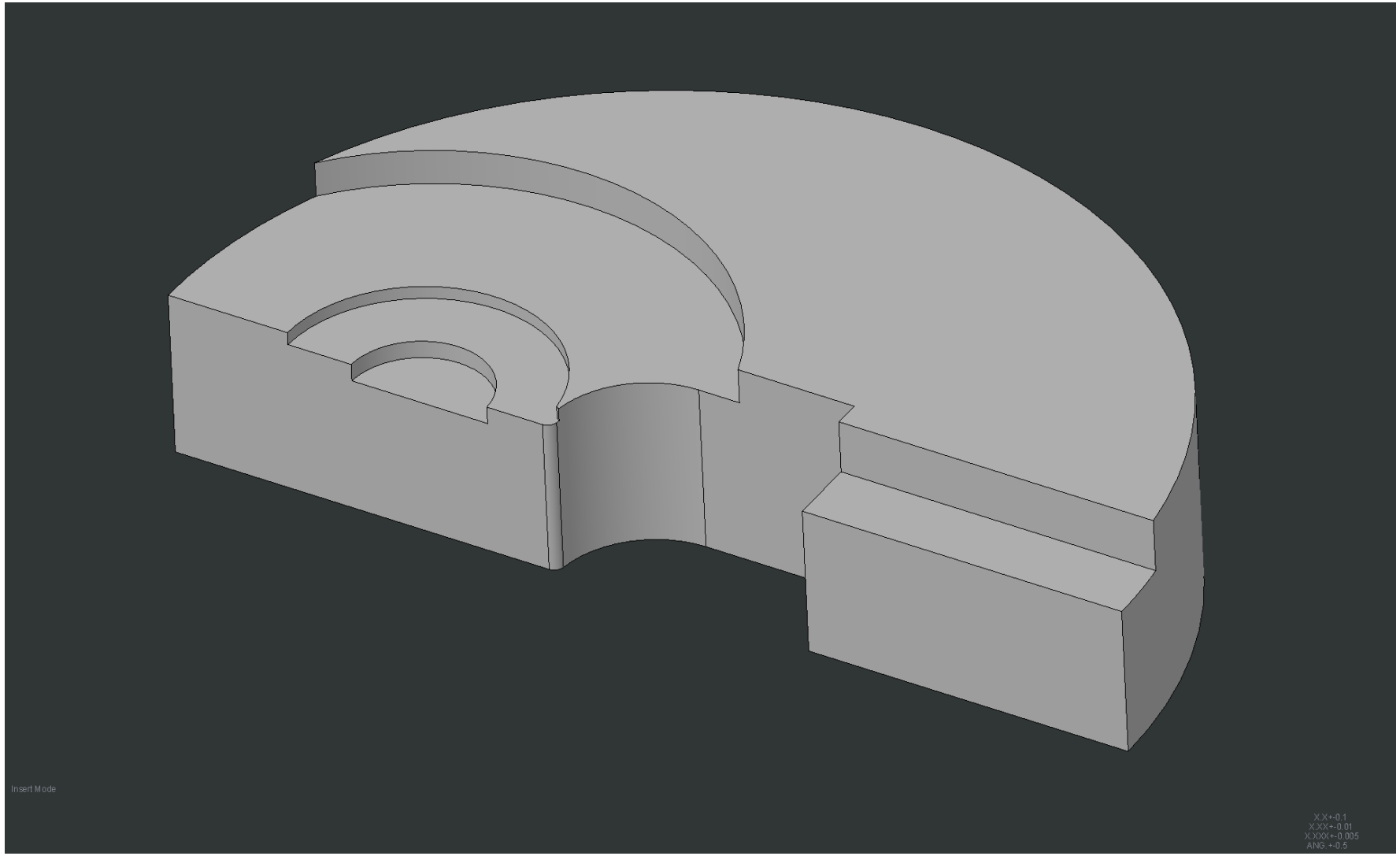


# Core Vessel Assembly Acquisition Strategy

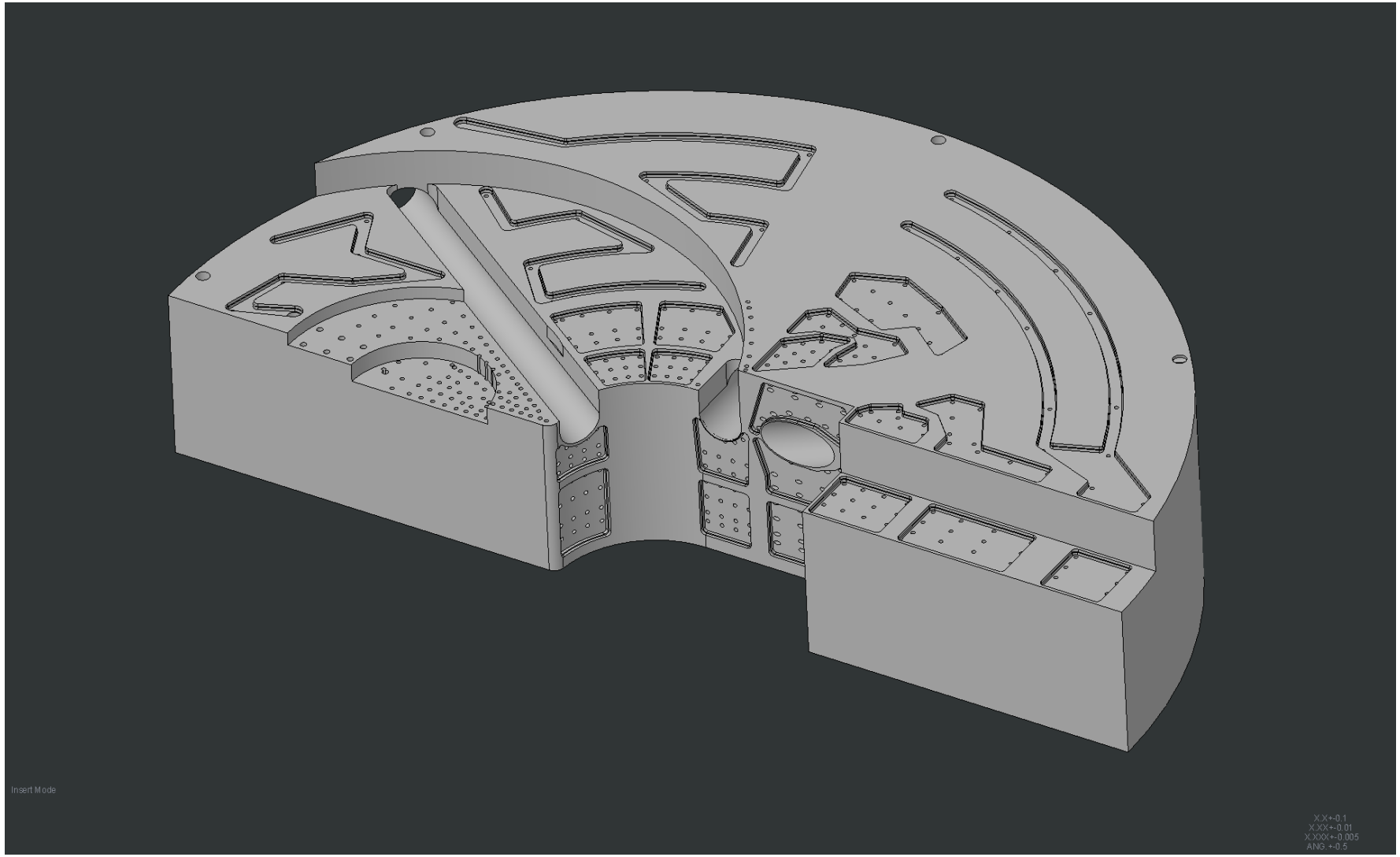
- Procured as a single large manufacturing project
- Manufacturing, temporary assembly and factory testing included
- Relatively small manufacturing pool due to:
  - Large size and weight
  - Complex water-cooled beltline section



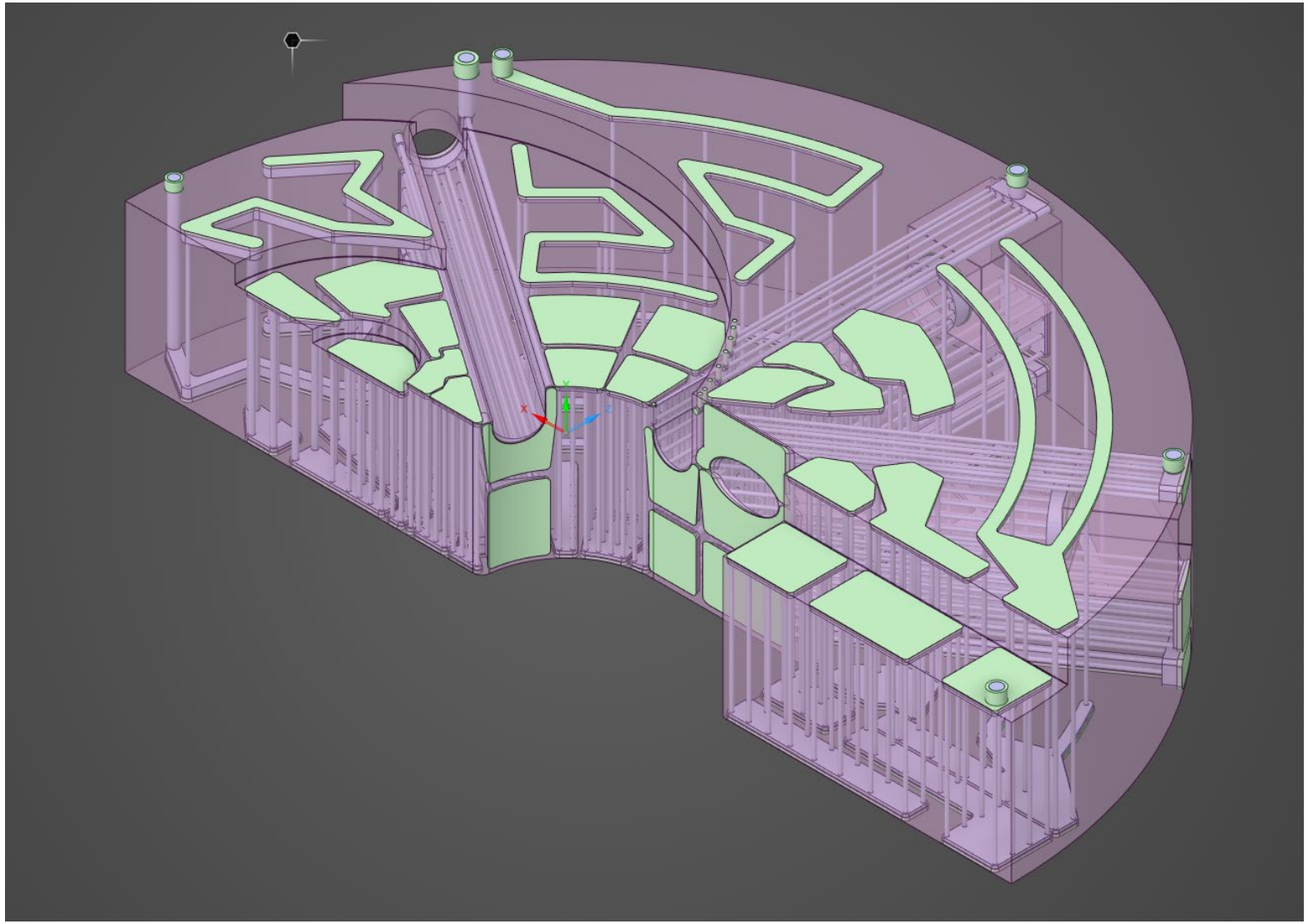
# The cooled shield blocks will start as a large, stainless-steel forgings and will be machined to size



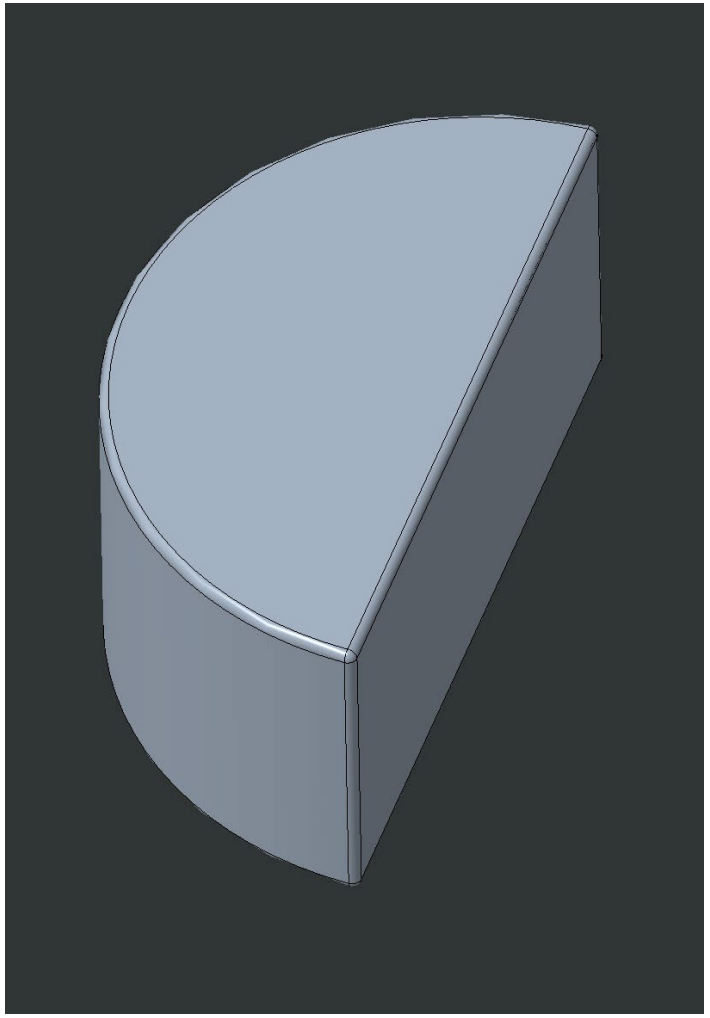
# After machining to size, more milling and drilling operations will follow to create all the necessary cooling channels

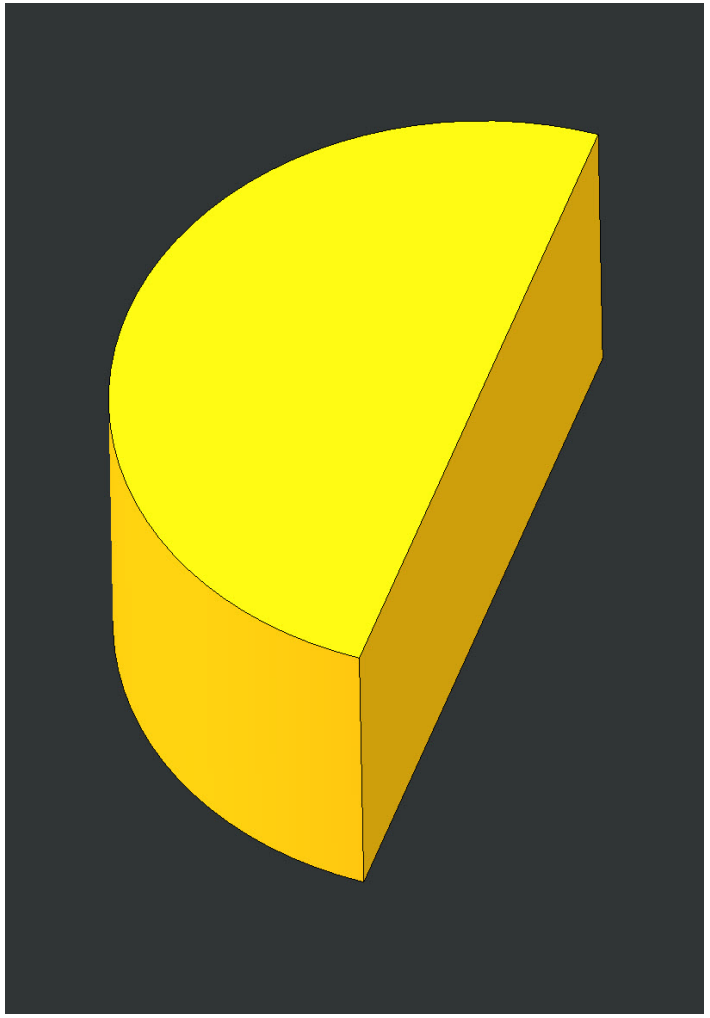


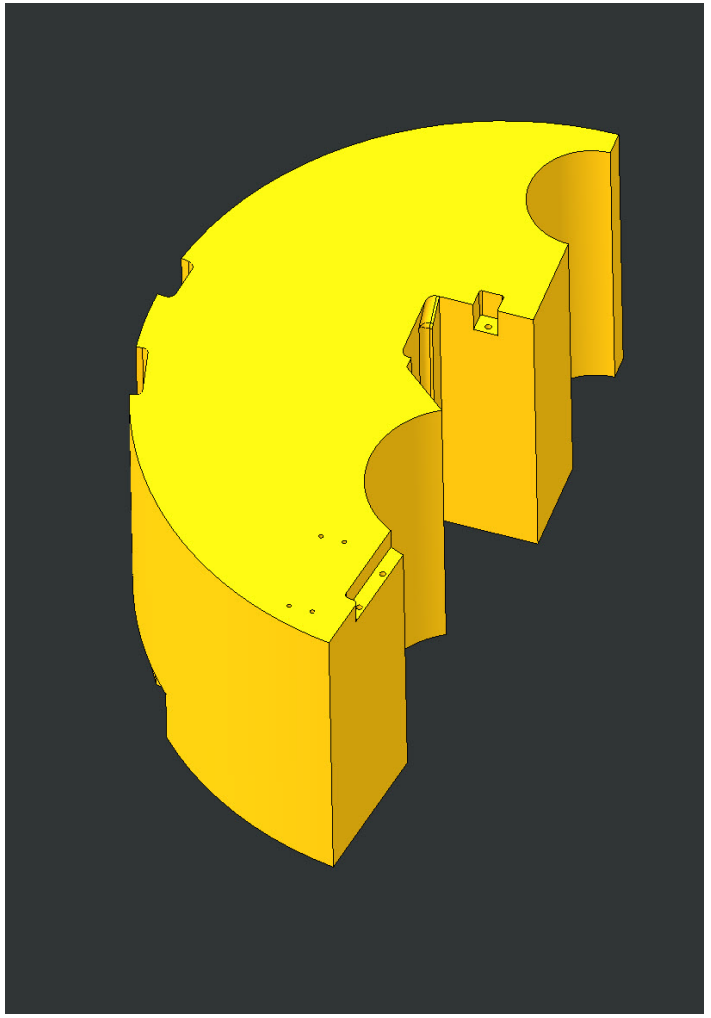
# When machining is completed, plenums will be installed to properly direct coolant flow



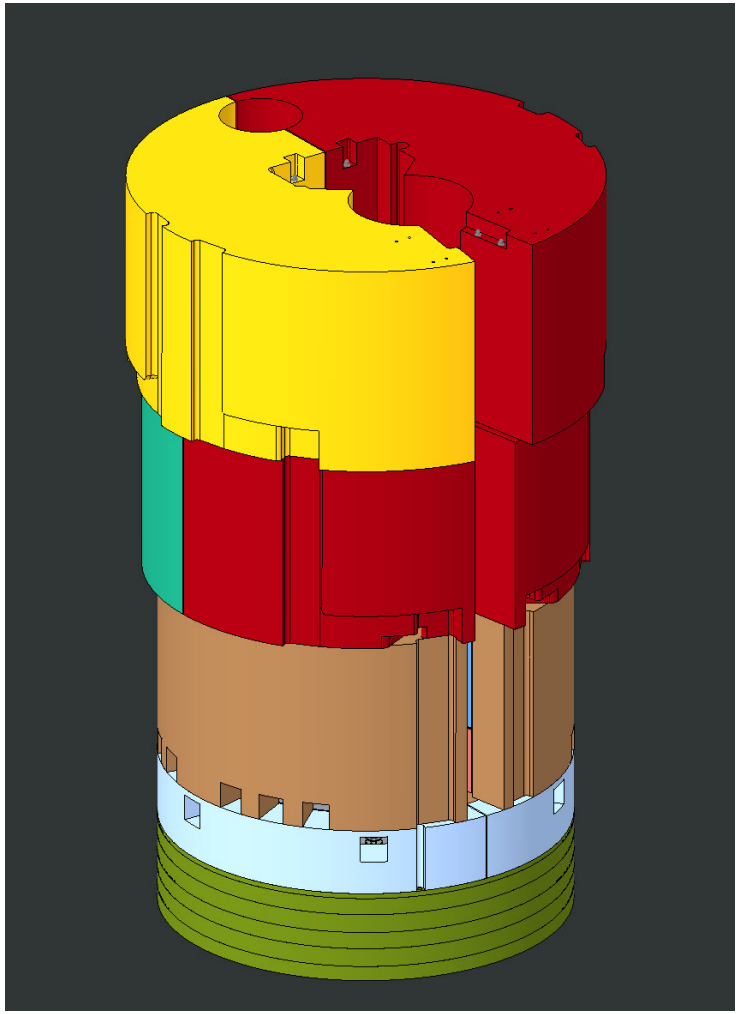
# Uncooled shield block typical manufacturing

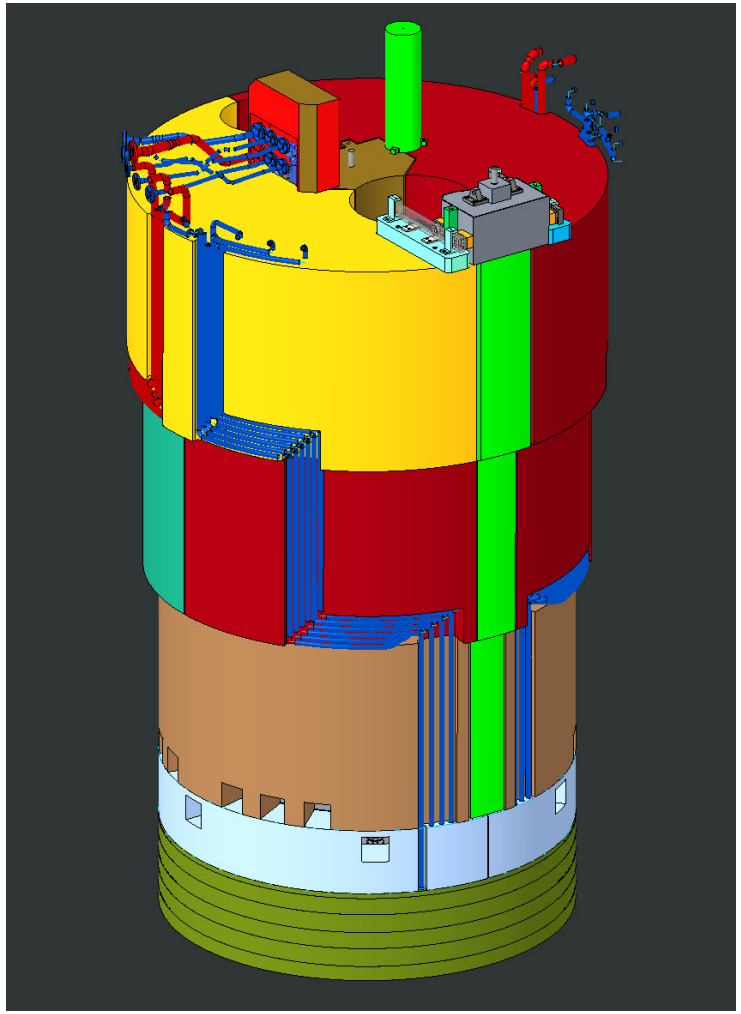






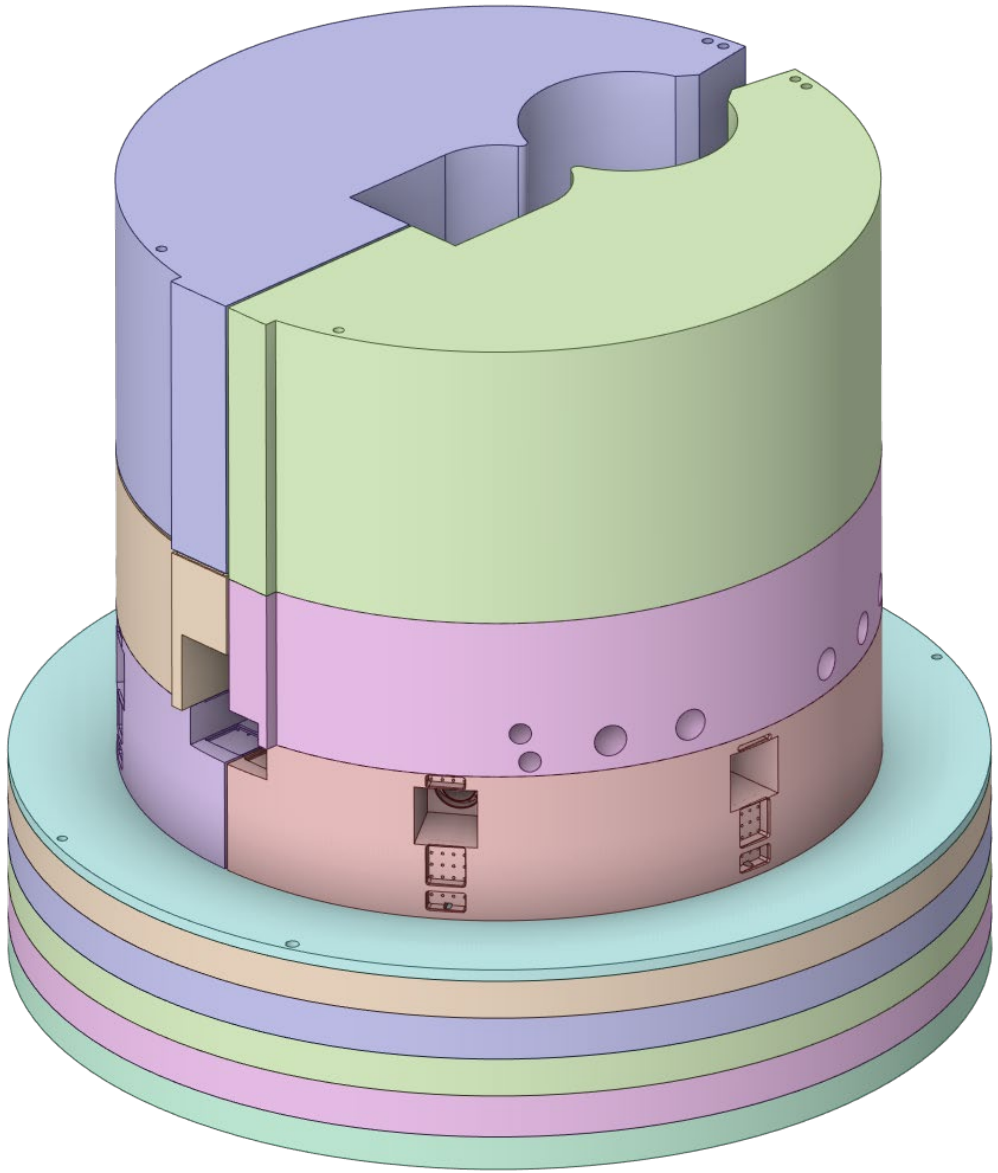
# Fully assembled shield stack without and with piping and removable shielding





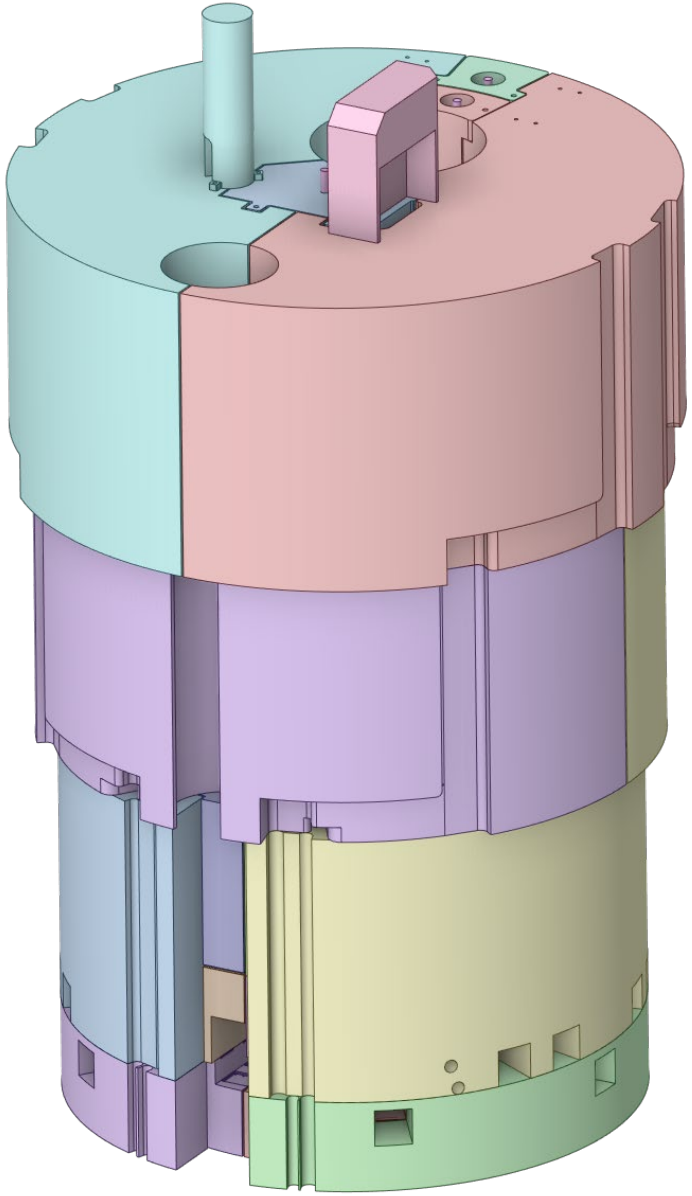
# Core Vessel Cooled Shielding Acquisition Strategy

- Ideally procured as a single large manufacturing project
  - Qty 5 blocks total
  - May split order depending on lead times
- Manufacturing and factory testing included
- Relatively small manufacturing pool due to:
  - Large size and weight
  - Gun drilled water passages
  - Complex geometry of layer 2 and 3 cooled blocks

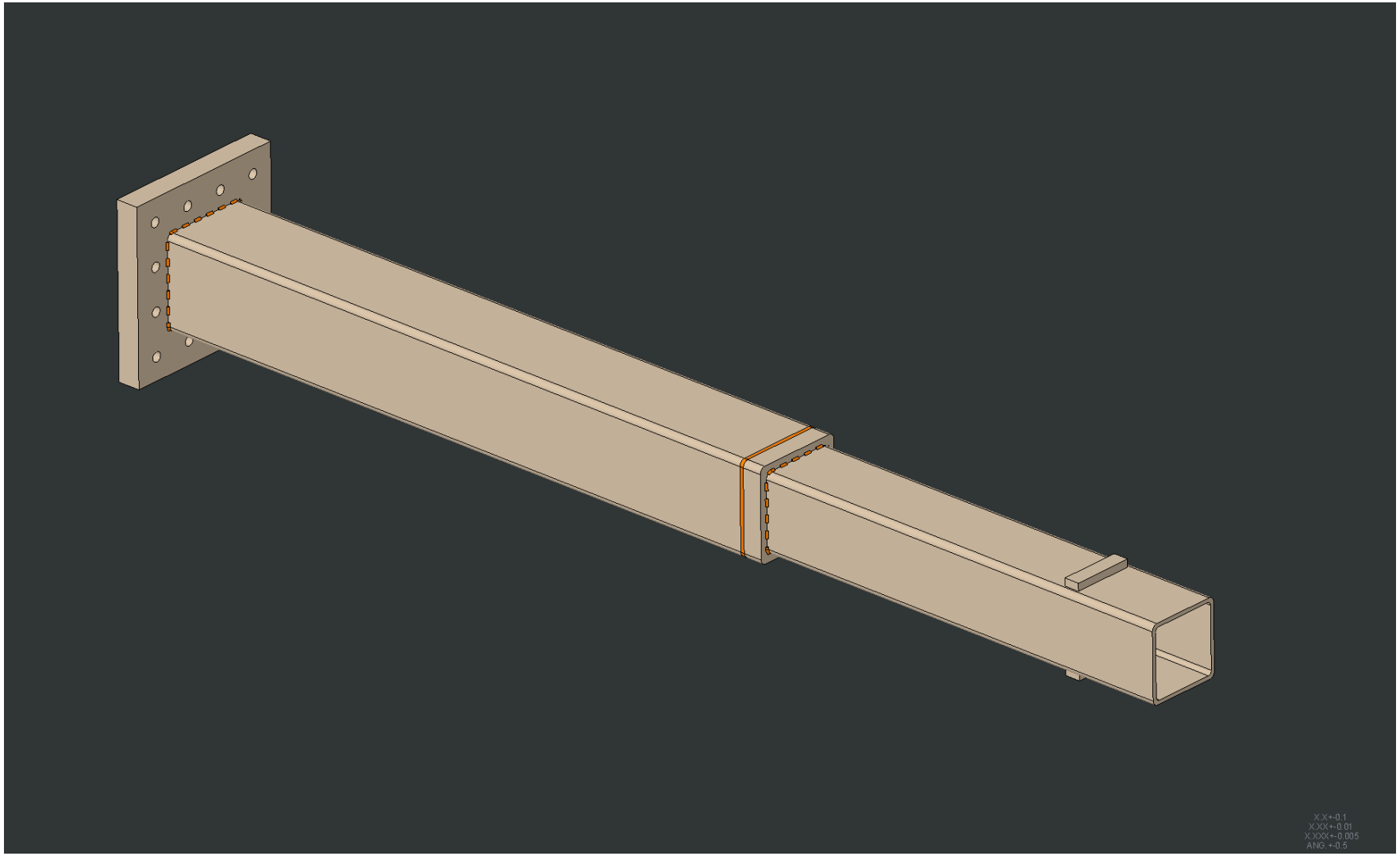


# Core Vessel Uncooled Shielding Acquisition Strategy

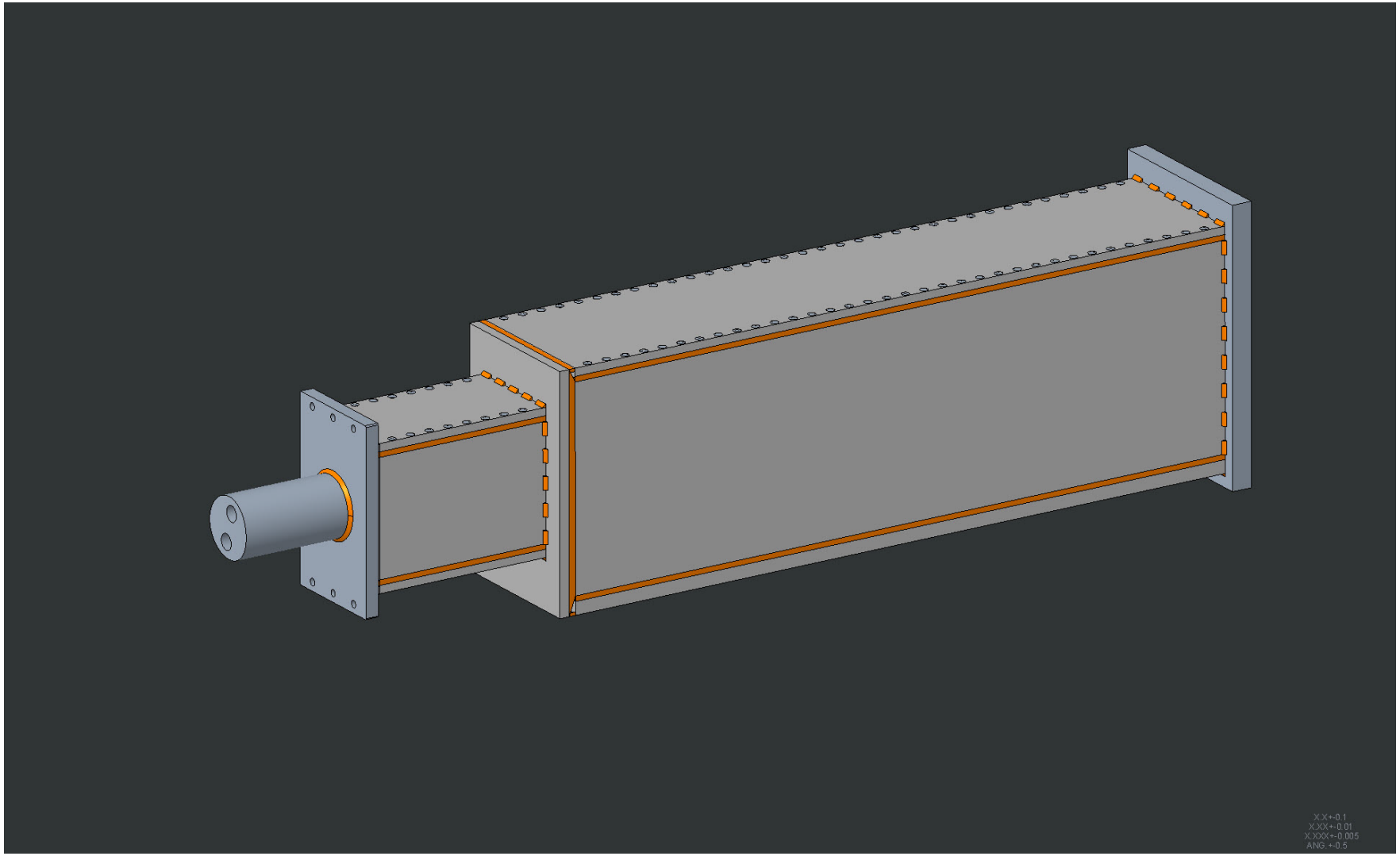
- Ideally procured as a single large manufacturing project
  - Qty 6 permanent blocks
  - Qty 5 removable blocks
- Constructed from low cost secondary steel plate
- Nickel plated for corrosion resistance
- Manufacturing pool is slightly limited by:
  - Large size and weight



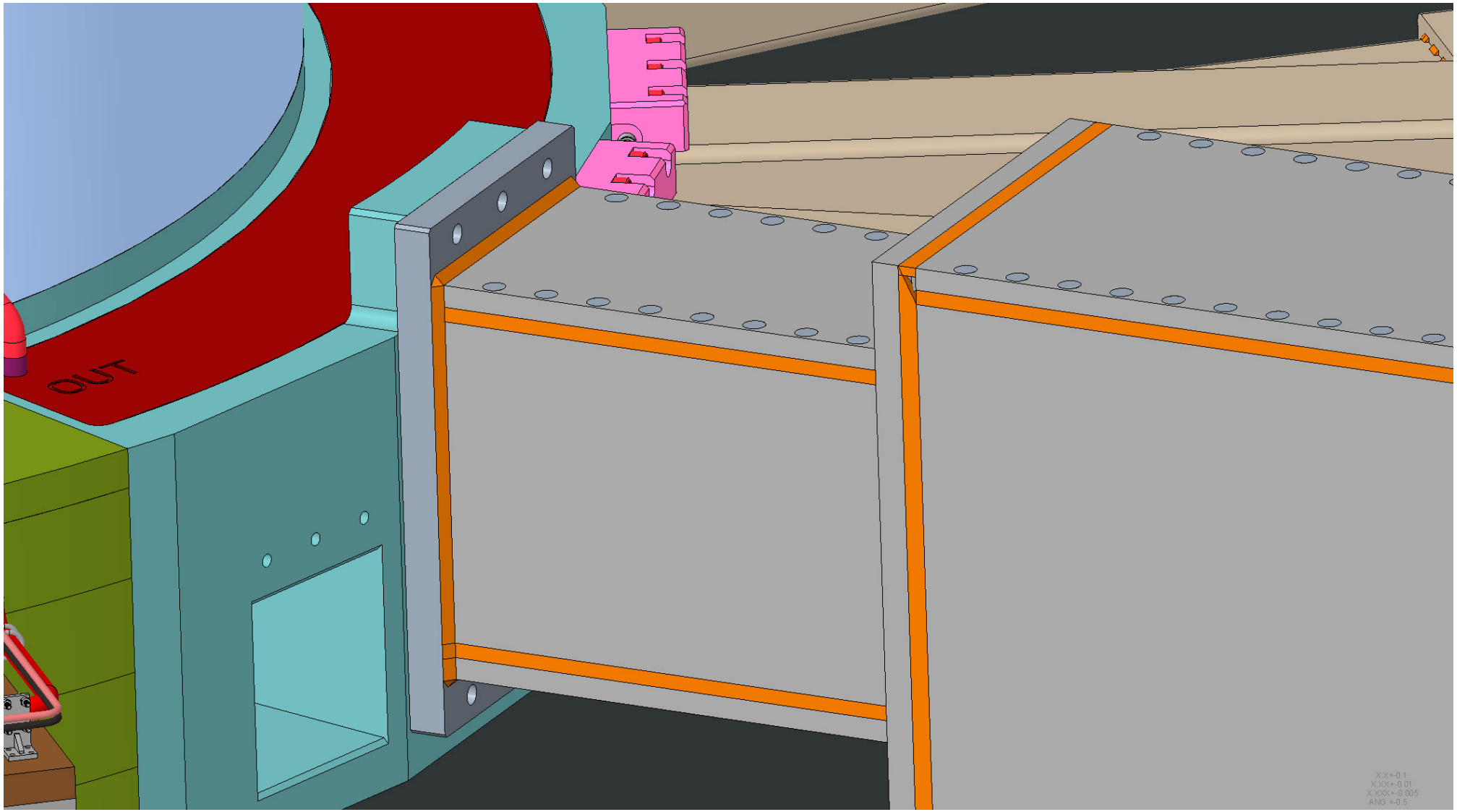
# The standard beam nozzles will be constructed of square steel tubing that is welded together with a transition flange



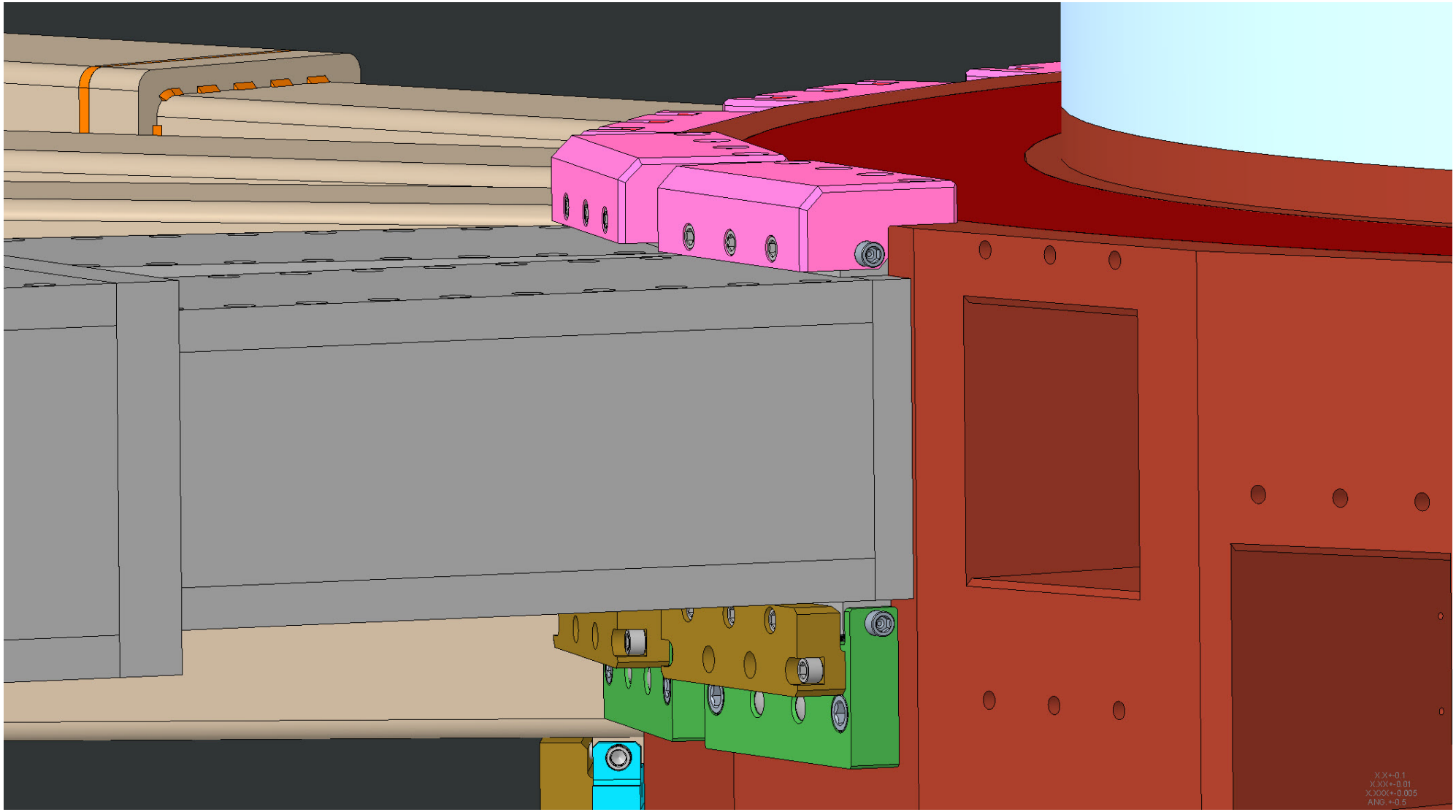
# QIKR and the Dual Beam Nozzle shields will be construct of machined plate that is bolted and welded together.



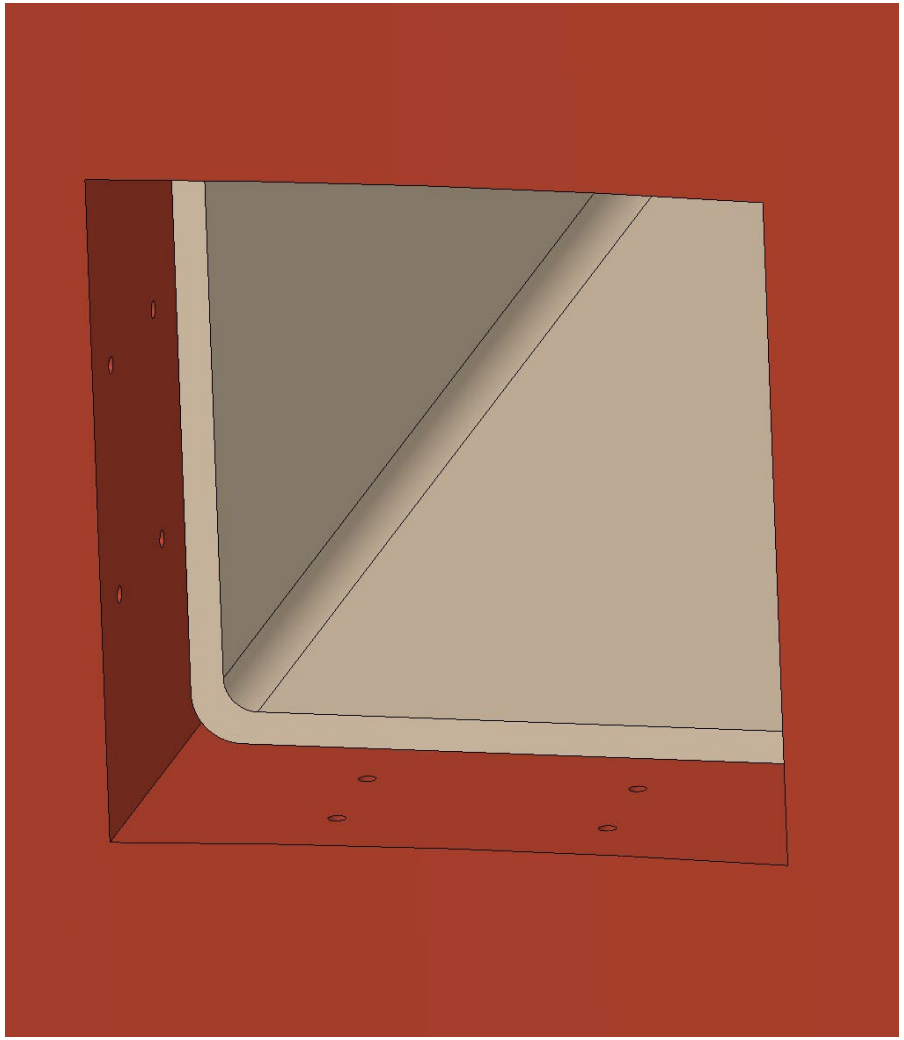
# QIKR Installation

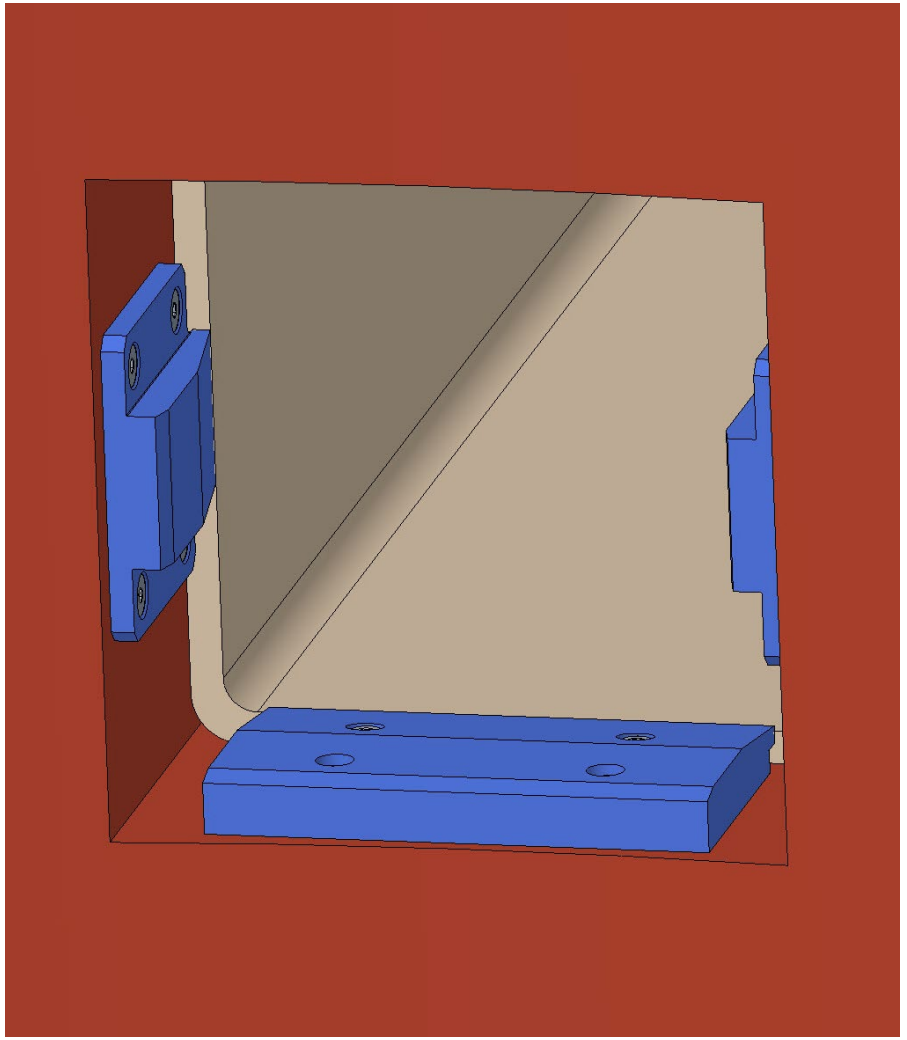


# Dual Nozzle and Standard Nozzle Installation



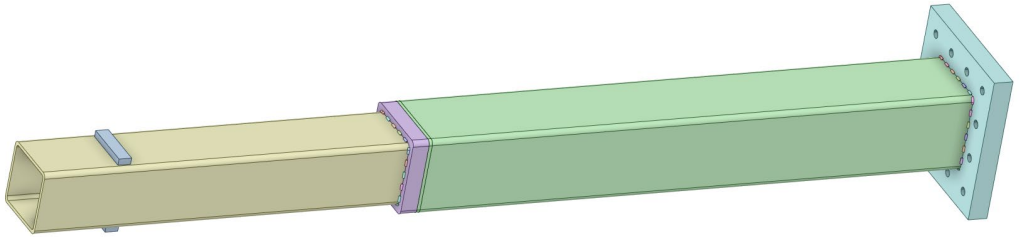
# Interior view of the landing pads

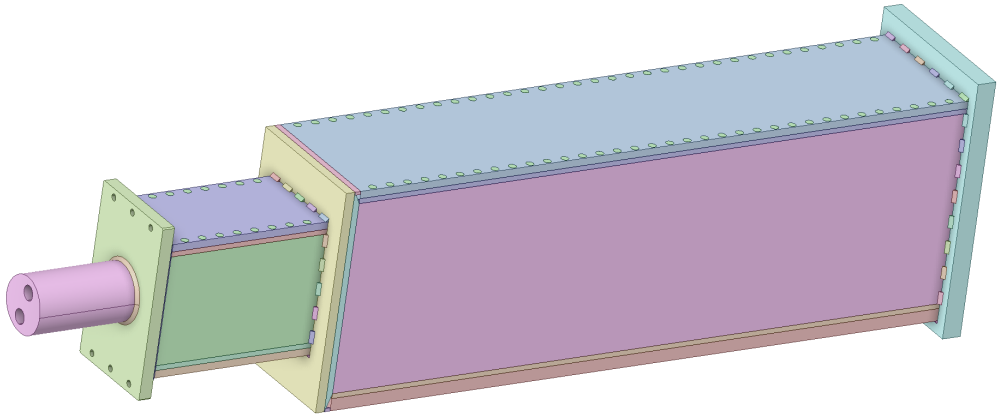


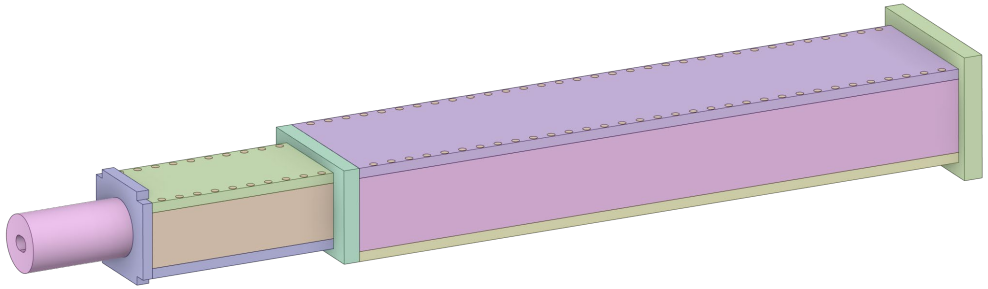


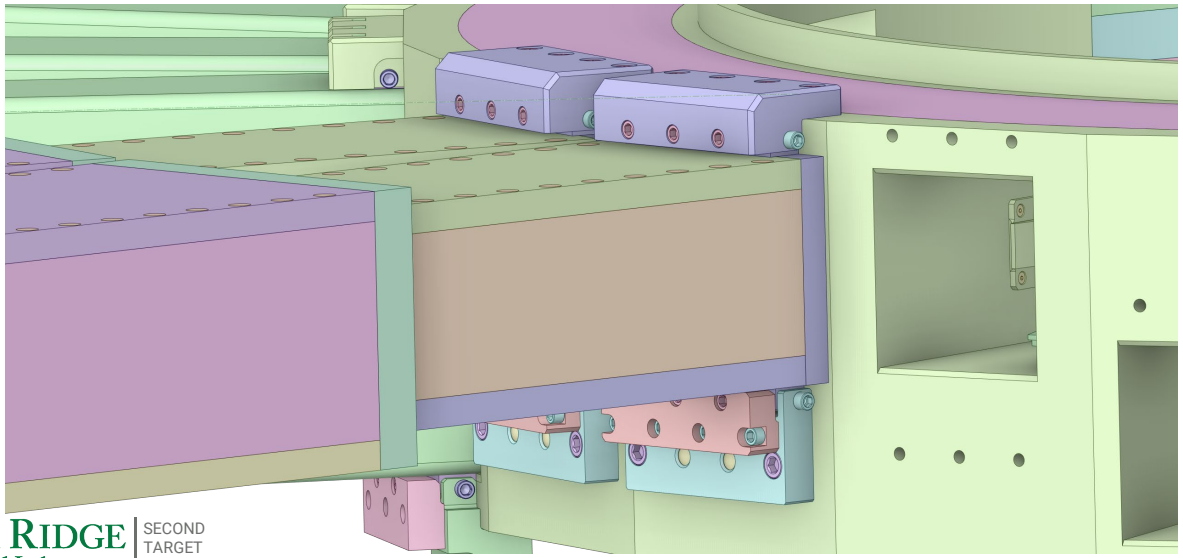
# Nozzle Extension Acquisition Strategy

- Ideally procured as a single large manufacturing project
  - Qty 15 standard nozzle extensions
  - Qty 2 dual channel nozzle extensions
  - Qty 1 QIKR nozzle extension
  - Custom brackets included
- Manufacturing pool is slightly limited by:
  - Large size
  - Tight interior profile tolerances
  - Careful management of weld distortion

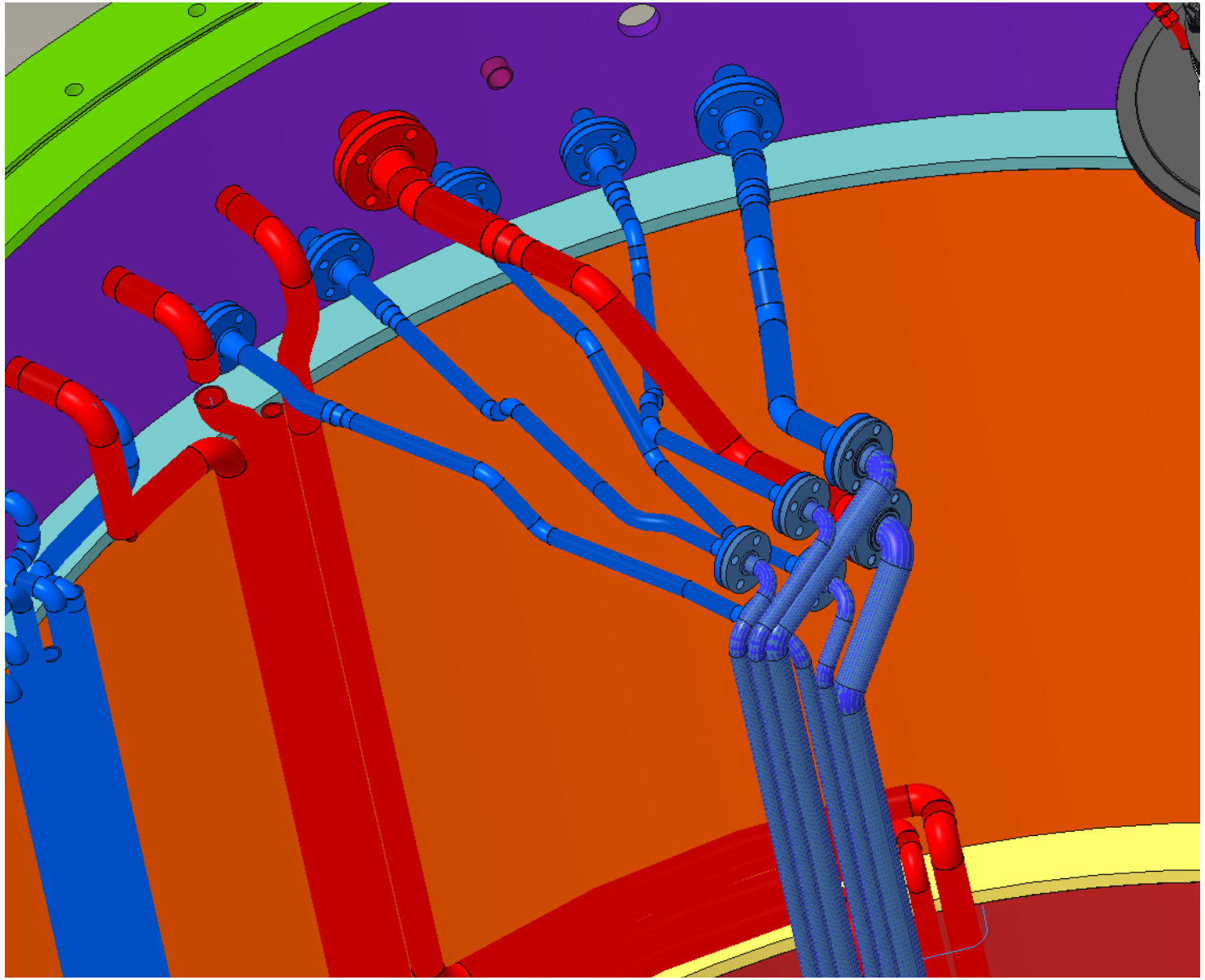




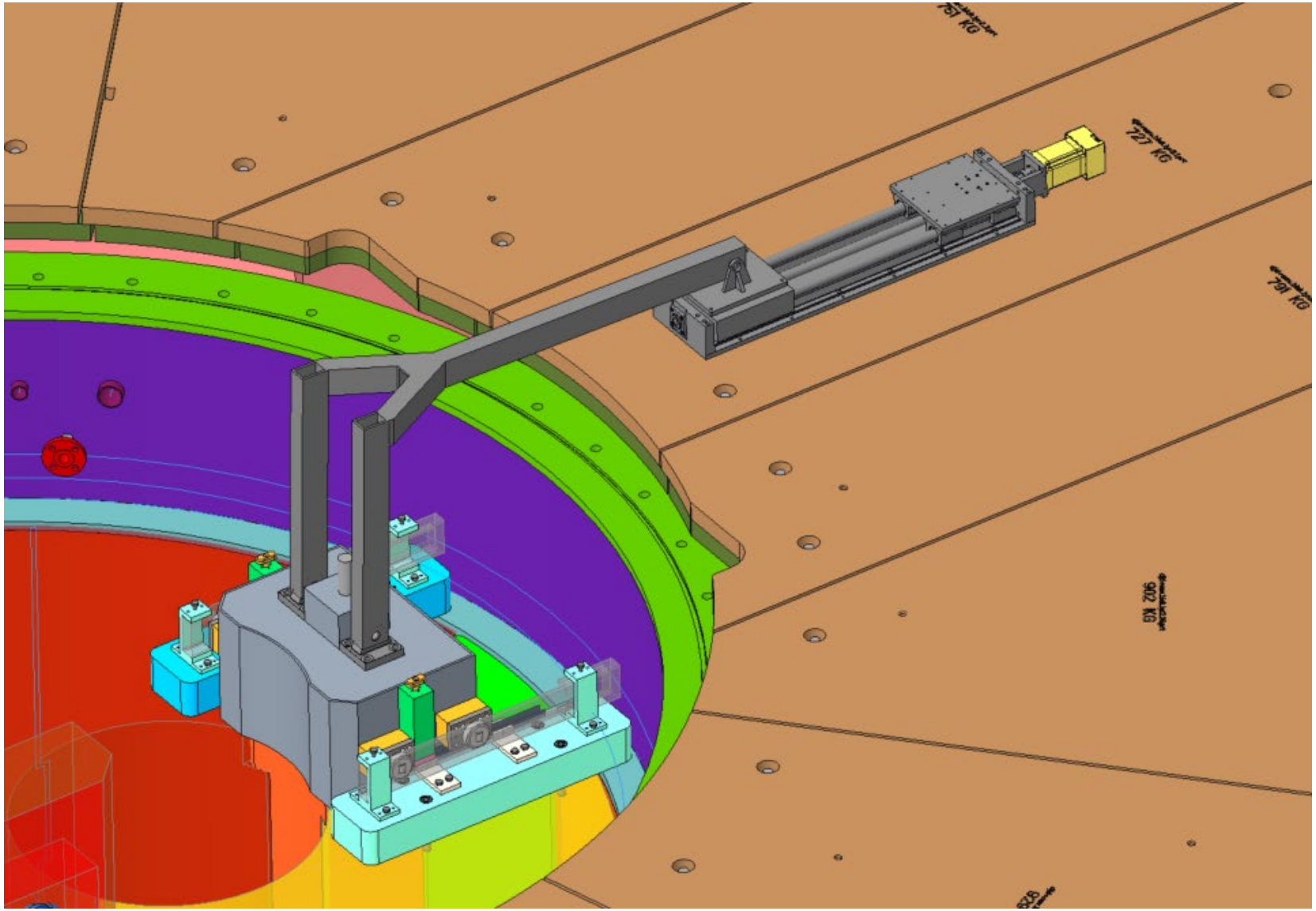




# MRA Utility Jumpers each include a flexible portion of line

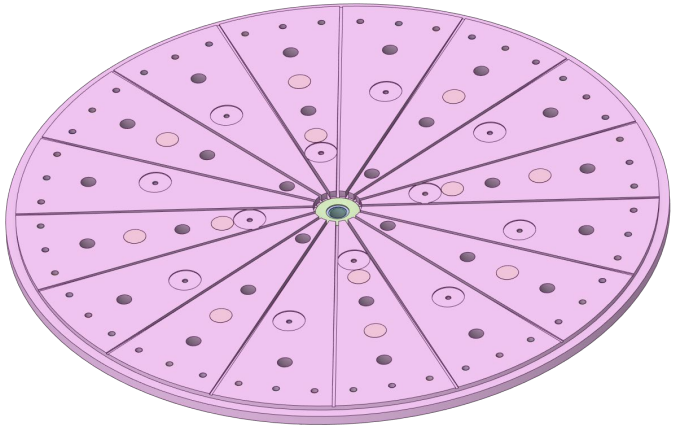


# The gamma gate assembly is a mix of COTS and custom components

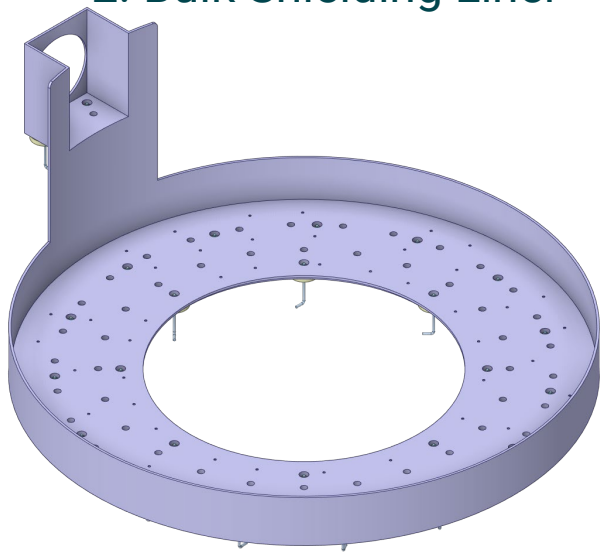


# Target Station Shielding Manufacturing

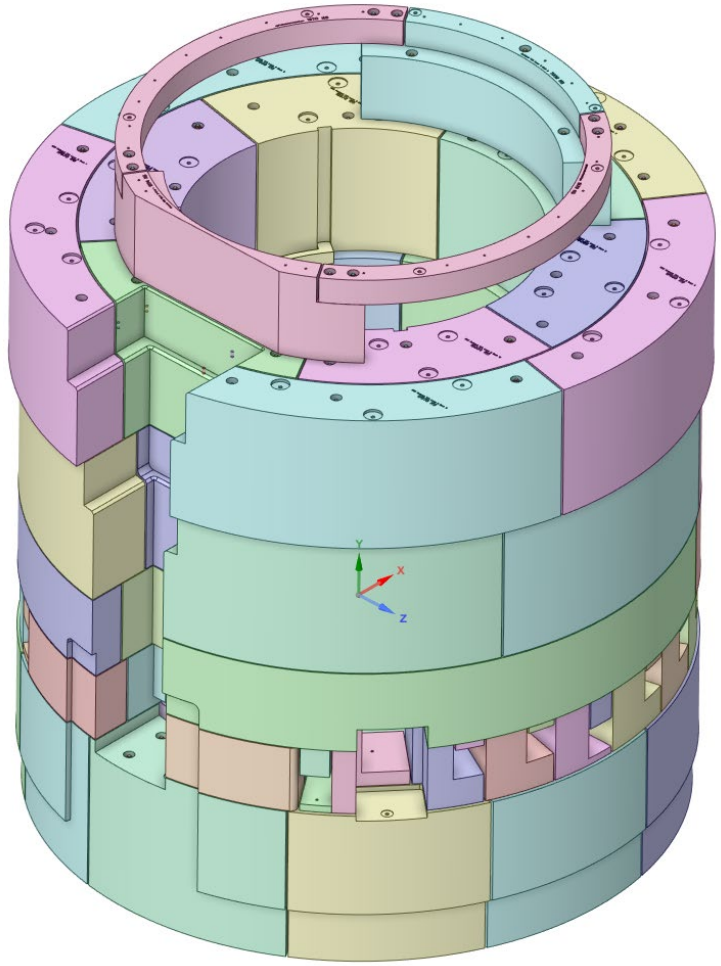
1. CV Baseplate



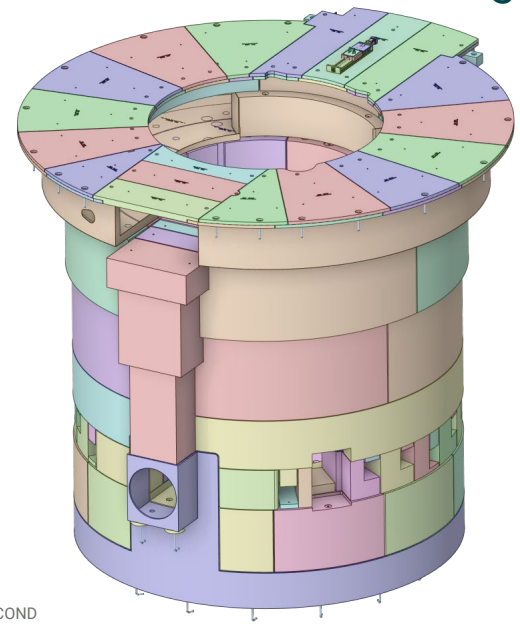
2. Bulk Shielding Liner



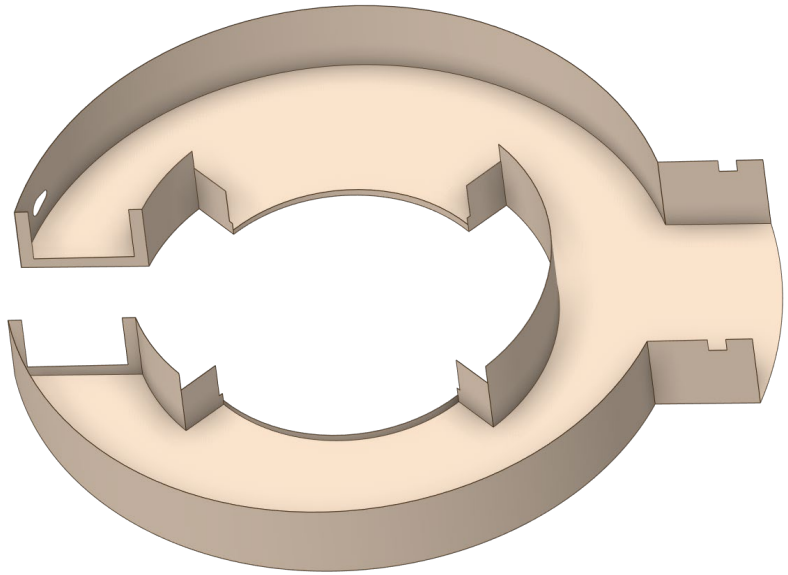
3. Bulk Shielding



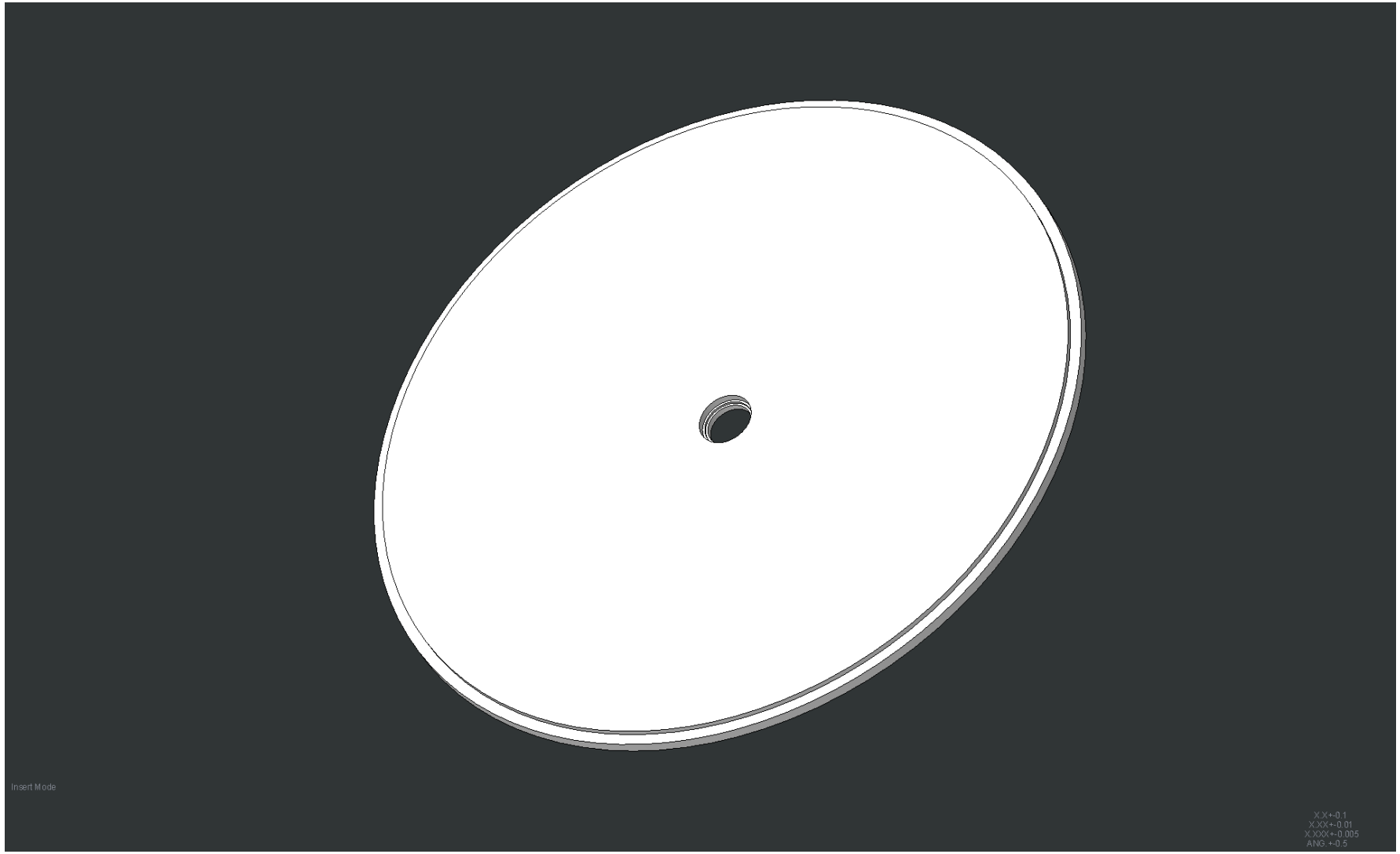
4. Removable Shielding



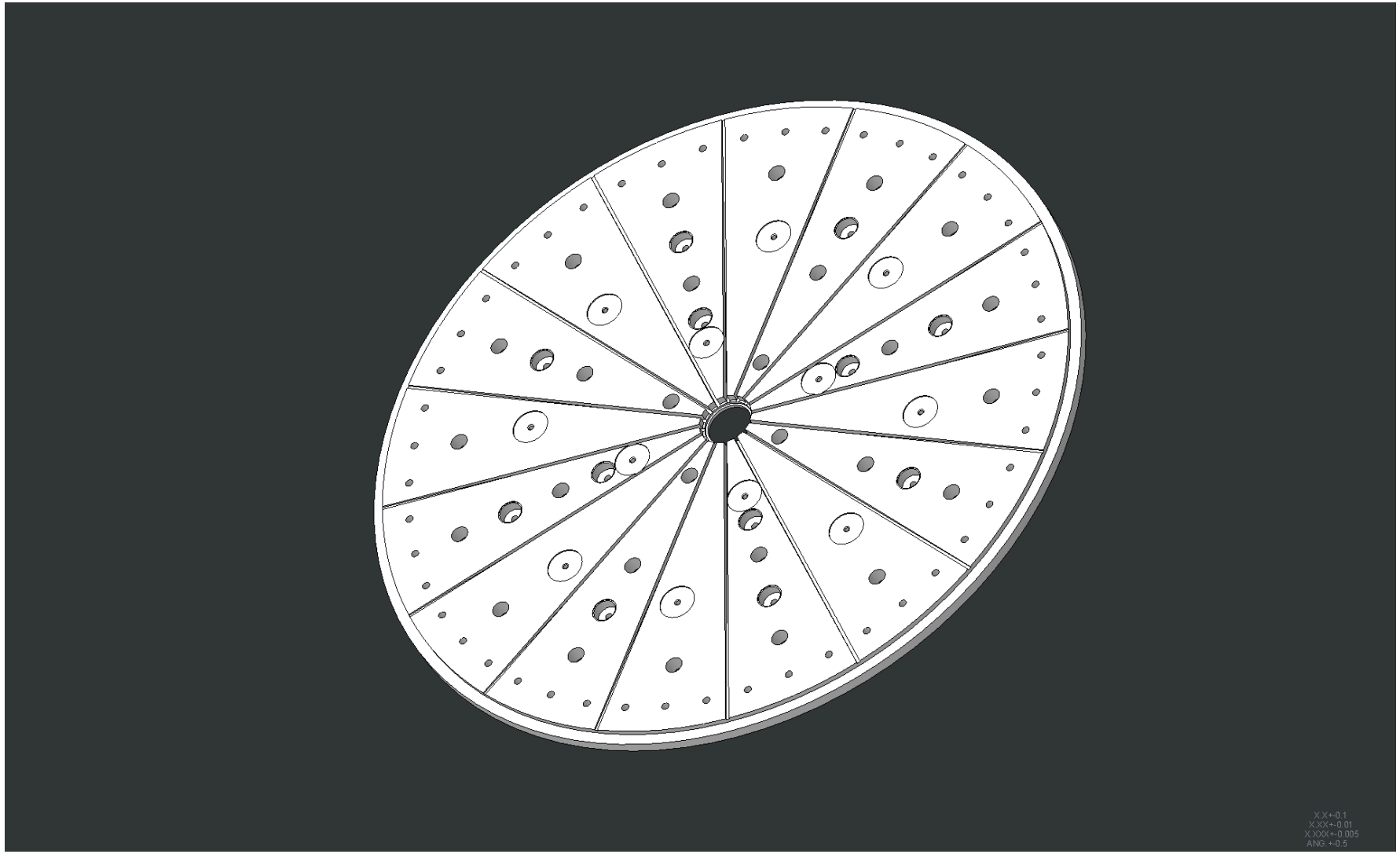
5. Pipe Pans



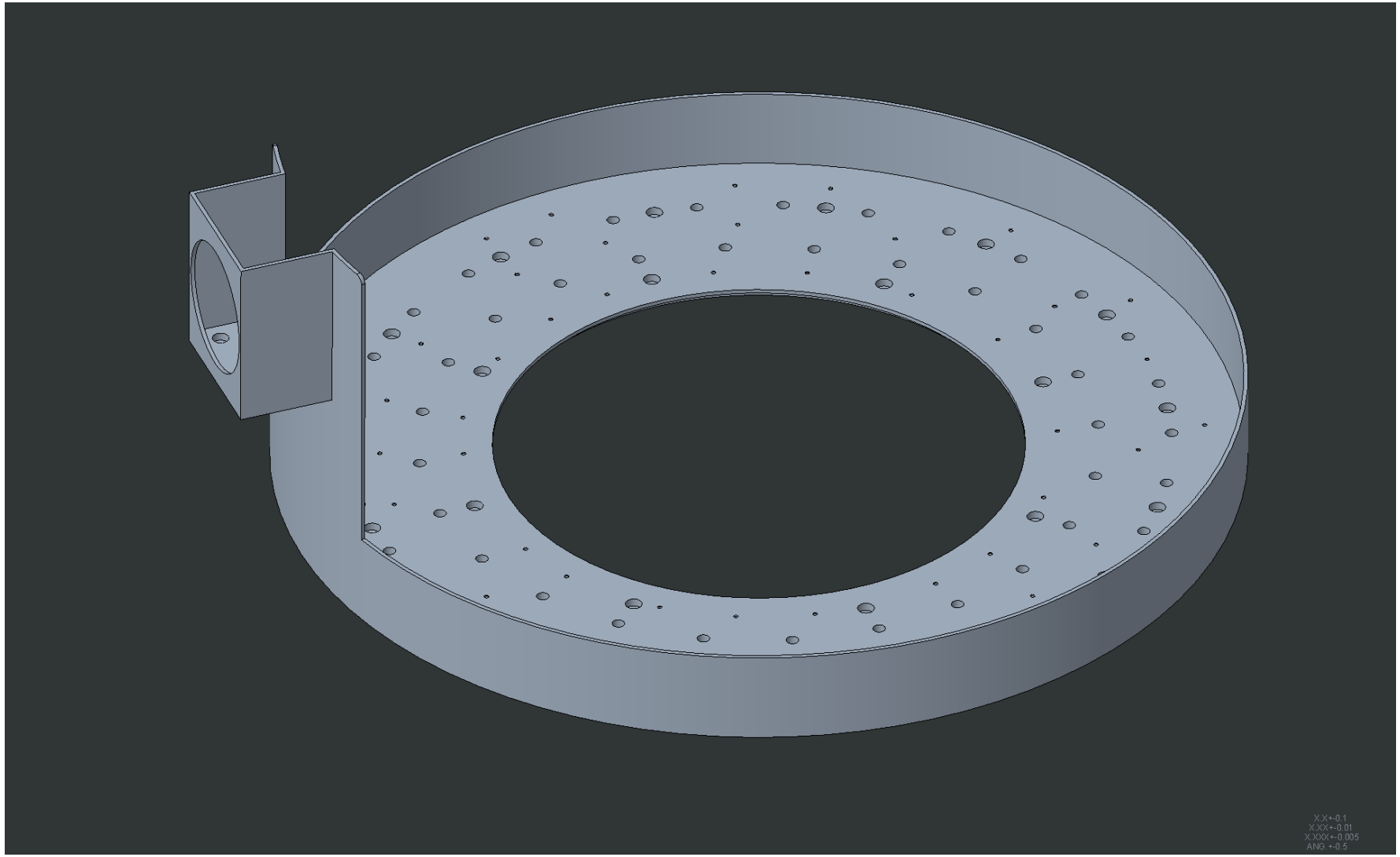
# The baseplate that serves as the base for the CV will start as a round plate and will initially be turned to size



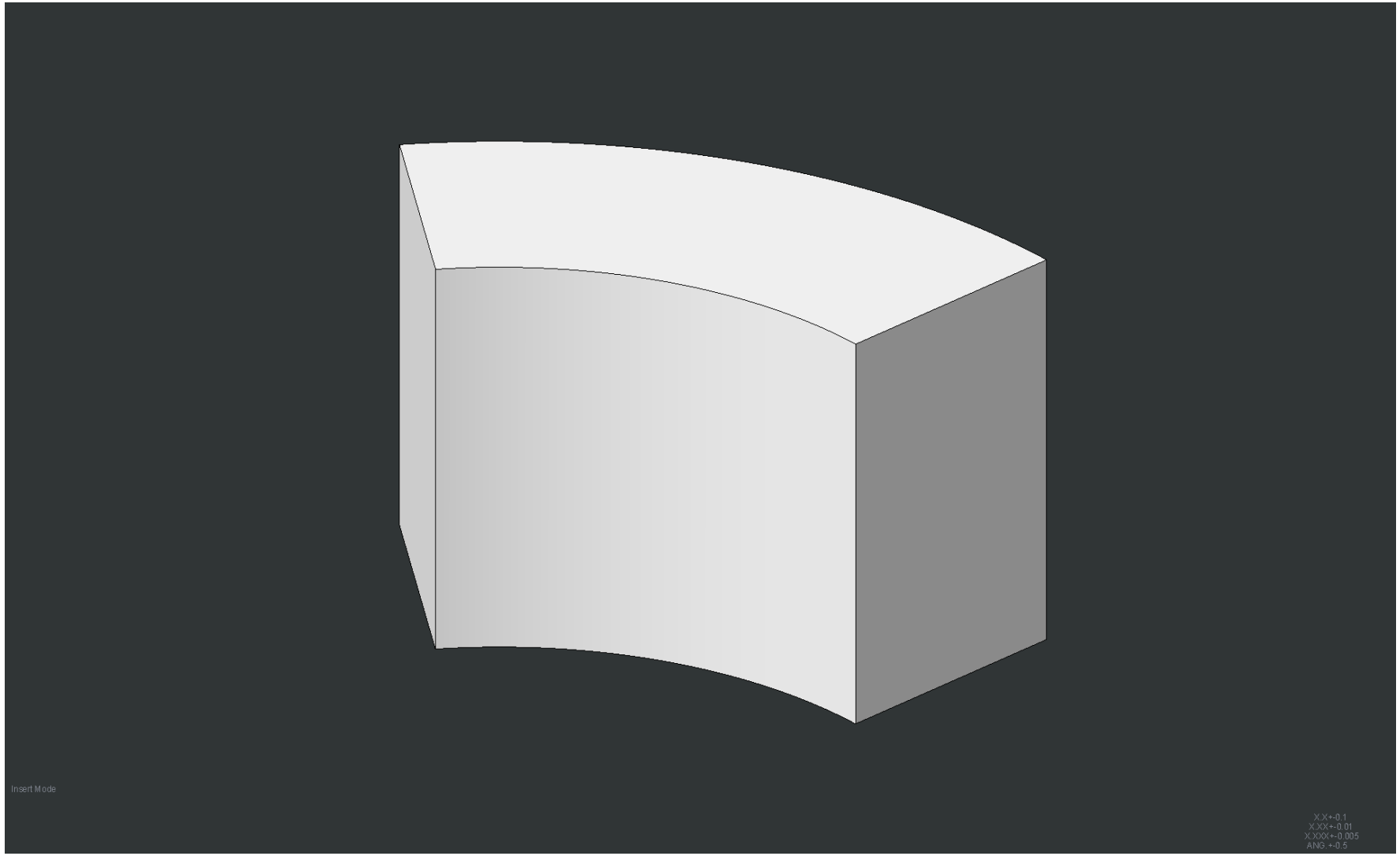
# Additional milling operations will then need to be performed to machine the remaining features on the baseplate



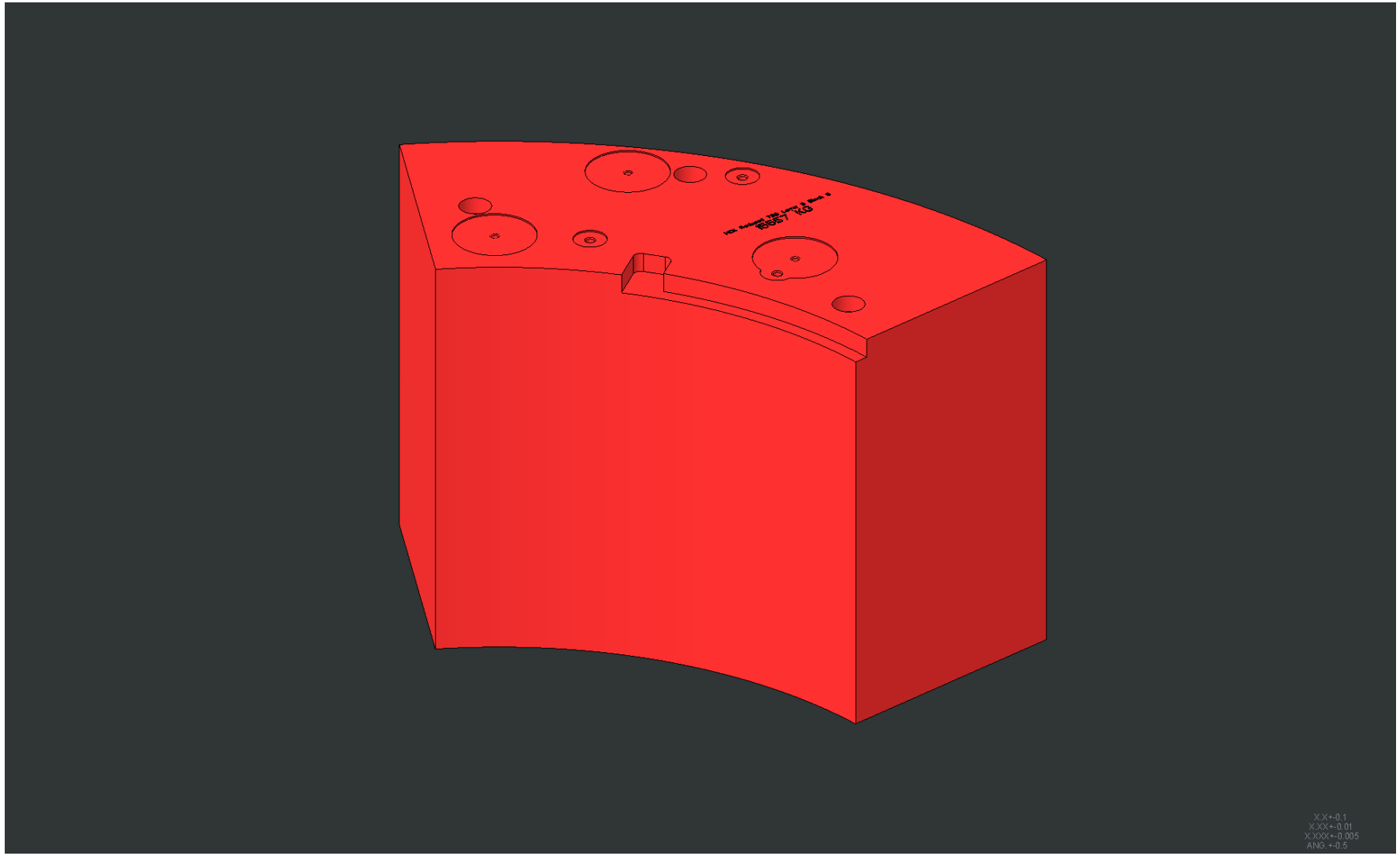
# Due to its size, we expect we'll need to fabricate the liner out of multiple parts in place and utilize mag drills to create the necessary features



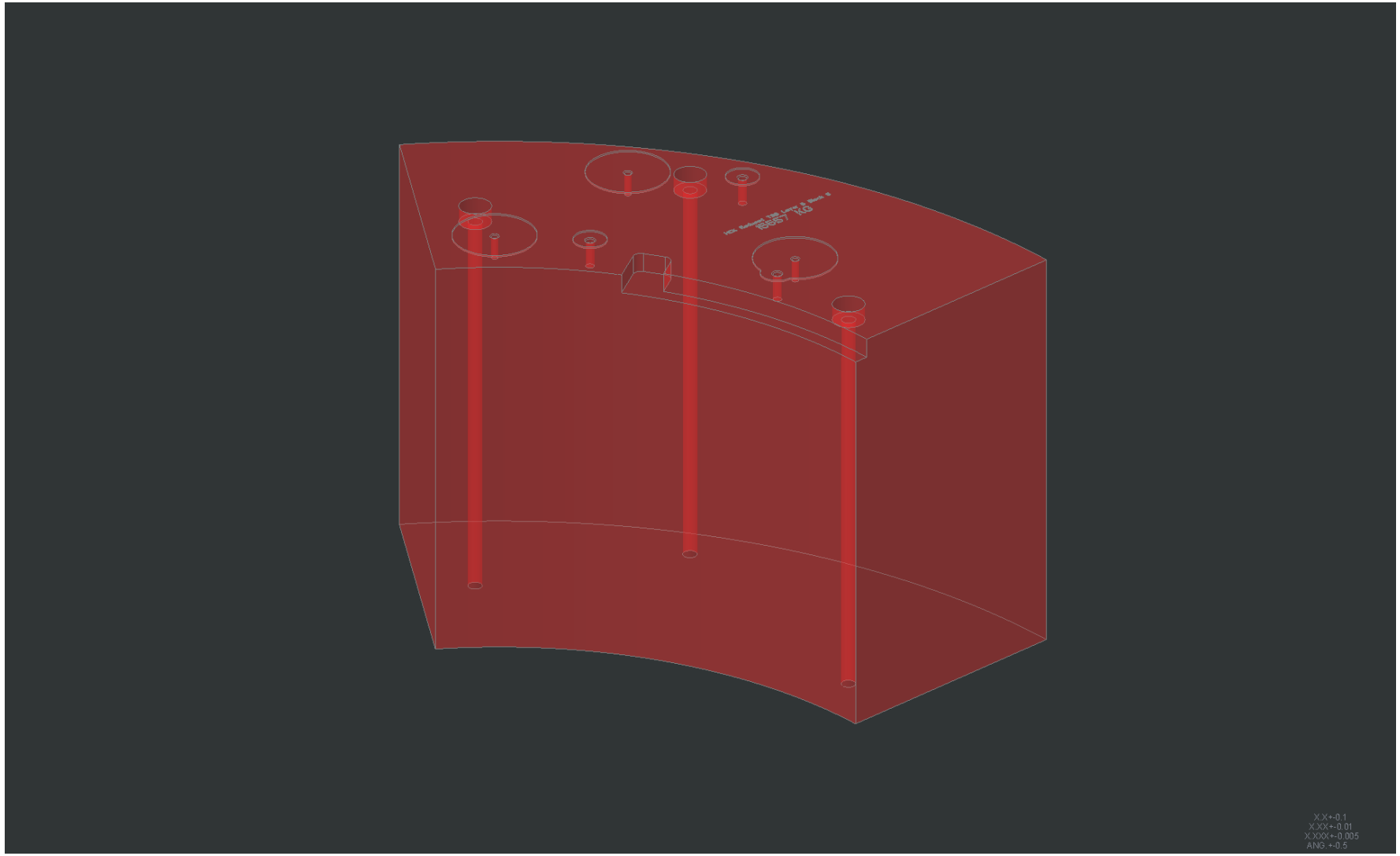
# The large, stationary shield blocks that make up the majority of the TSS will start as a rough casting and be machined to size



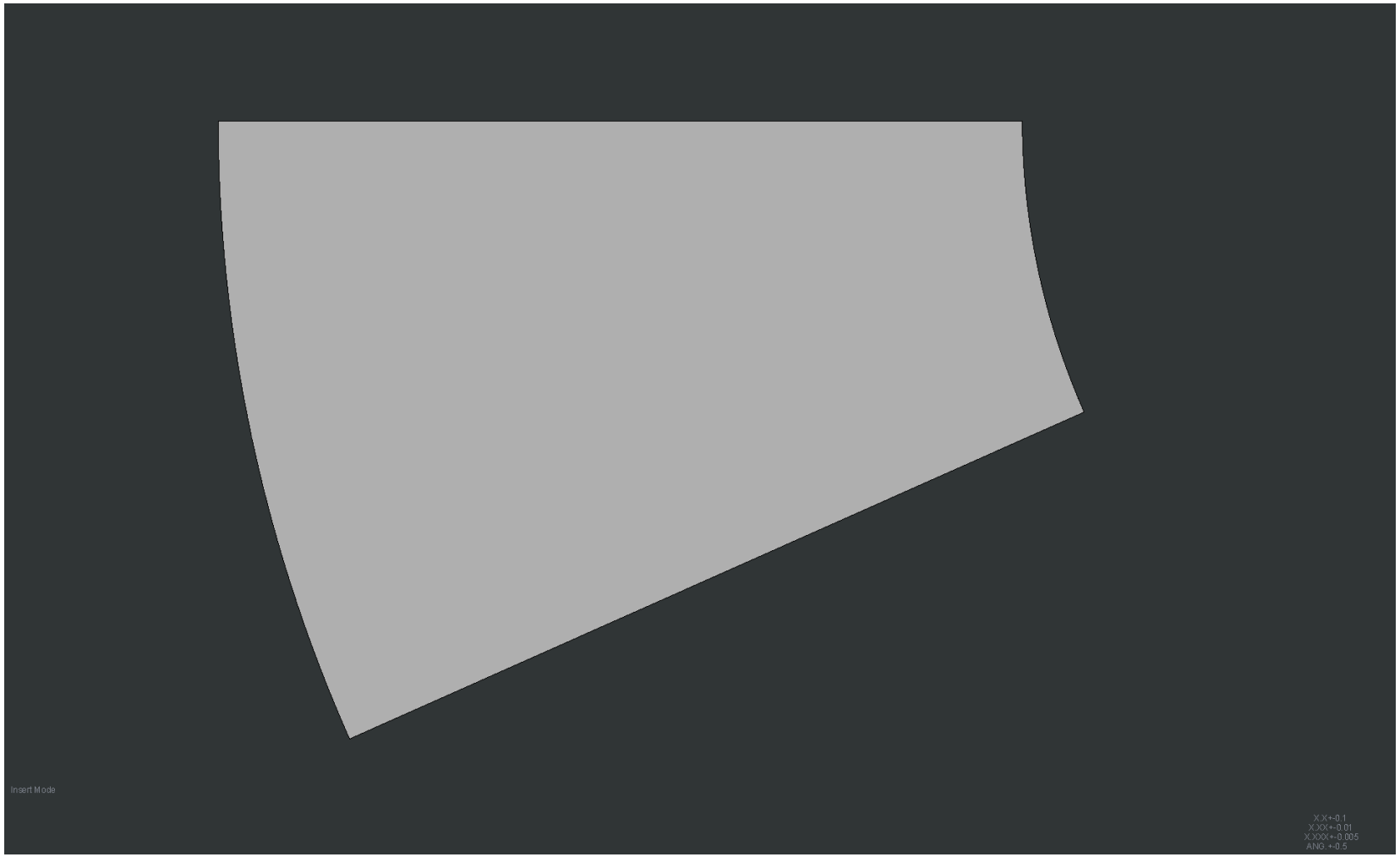
# Once the profile is complete, most blocks will require one or two more operations to machine the remaining features



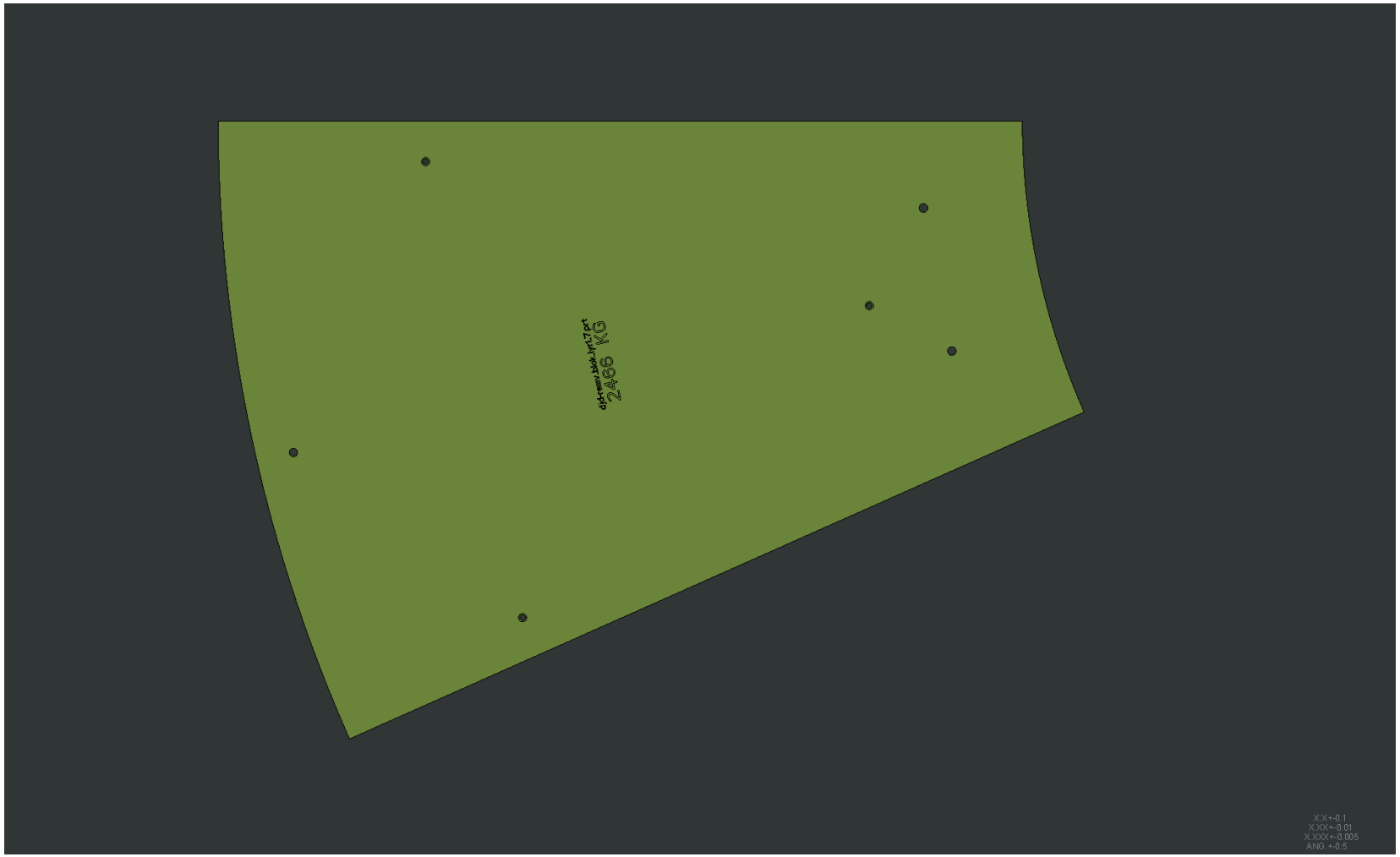
# Note that all blocks will require drilling all the way through the block to allow for anchoring to the shielding below



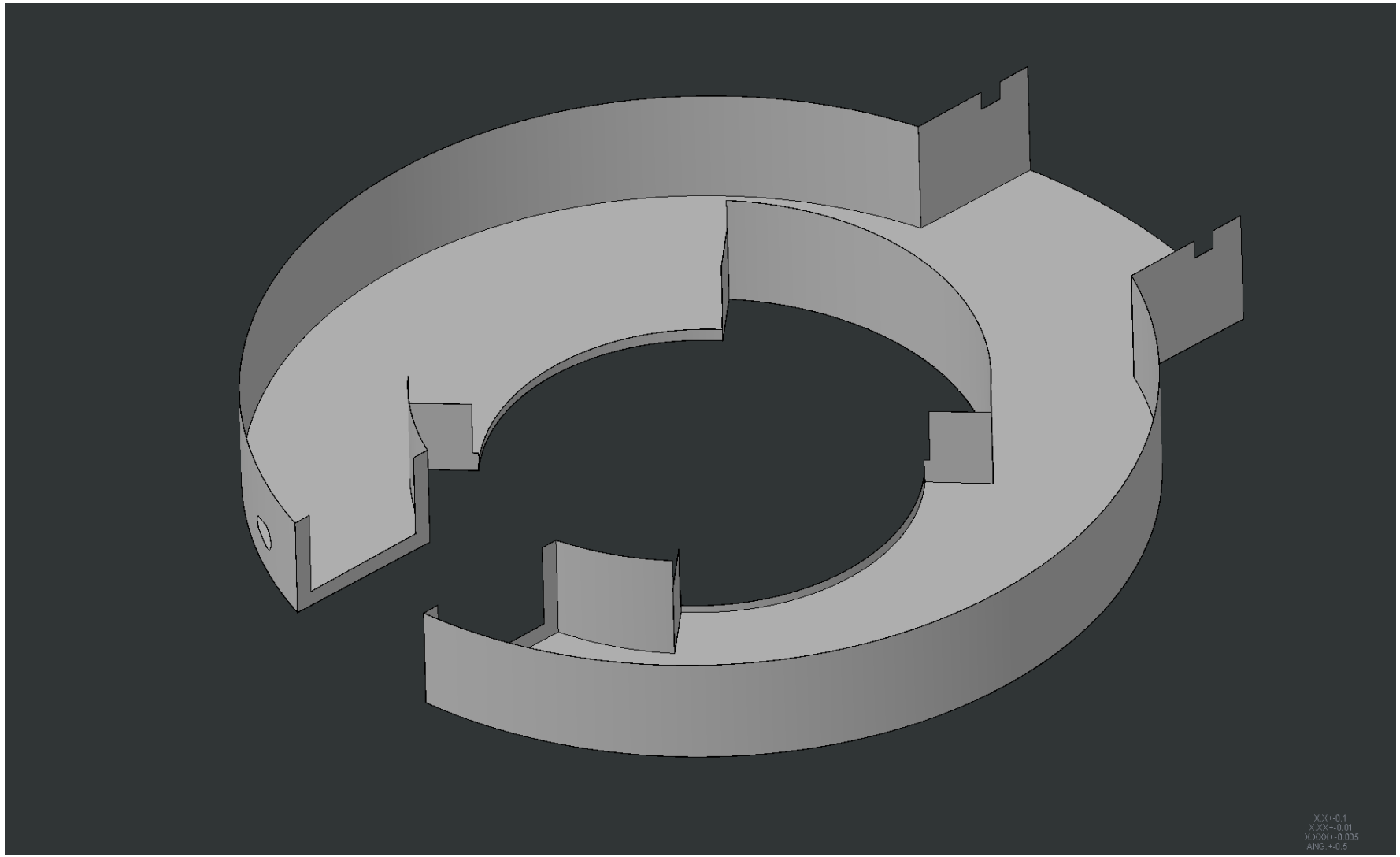
# Fabrication of the removable shield plates will begin with a 50mm steel plate being cut to shape on a waterjet



# All features may then be machined in one operation, followed by the coating process

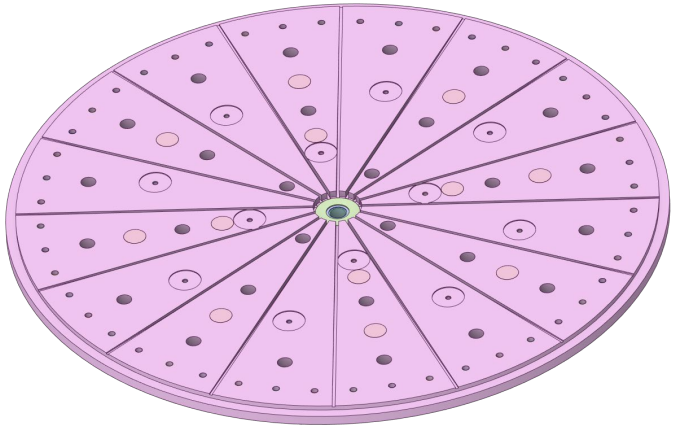


# The pipe pan will be fabricated from multiple flat and rolled sheets of stainless steel

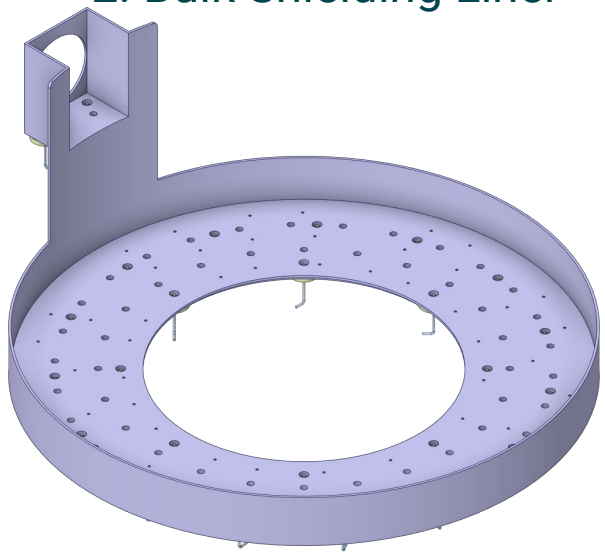


# Target Station Shielding Acquisition Strategy

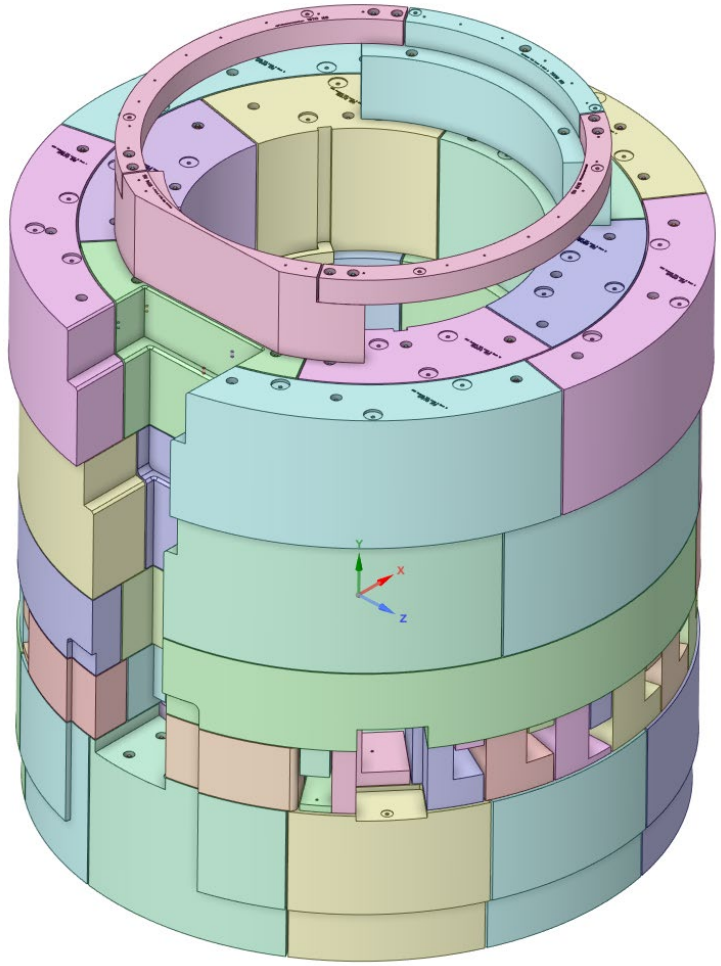
1. CV Baseplate



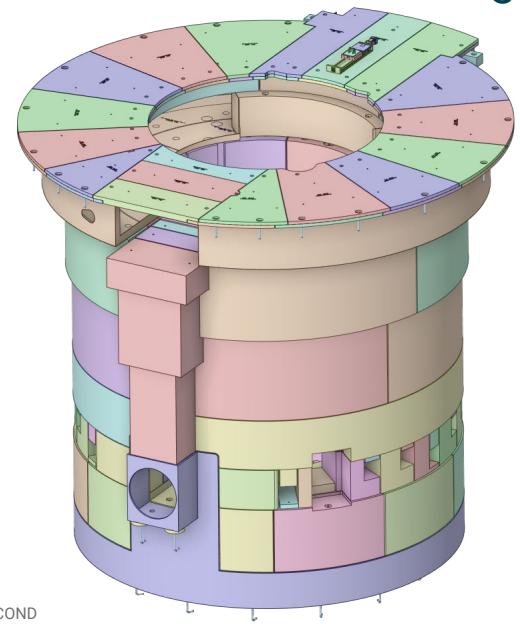
2. Bulk Shielding Liner



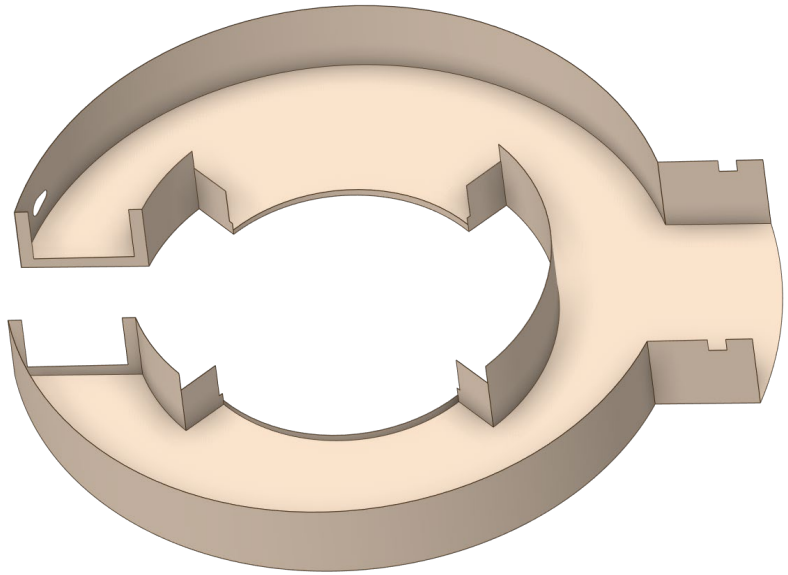
3. Bulk Shielding



4. Removable Shielding



5. Pipe Pans



# Manufacturing R&D Efforts included CV and Nozzle Extension manufacturing study and Nozzle Extension prototype fabrication