



August 11, 2026, Target Assembly FDR

Target Assembly: Interface Overview

Lukas Bearden

Second Target Station



U.S. DEPARTMENT
of **ENERGY**

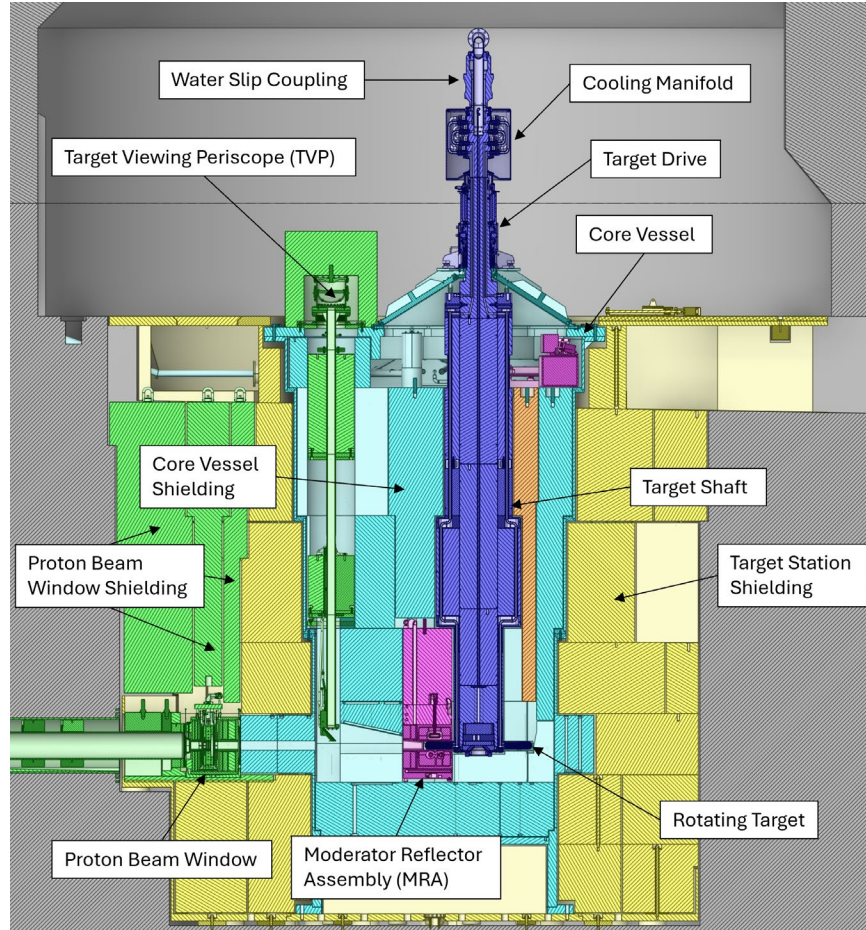
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Charge Question 2: Has the design been shown to meet the requirements?

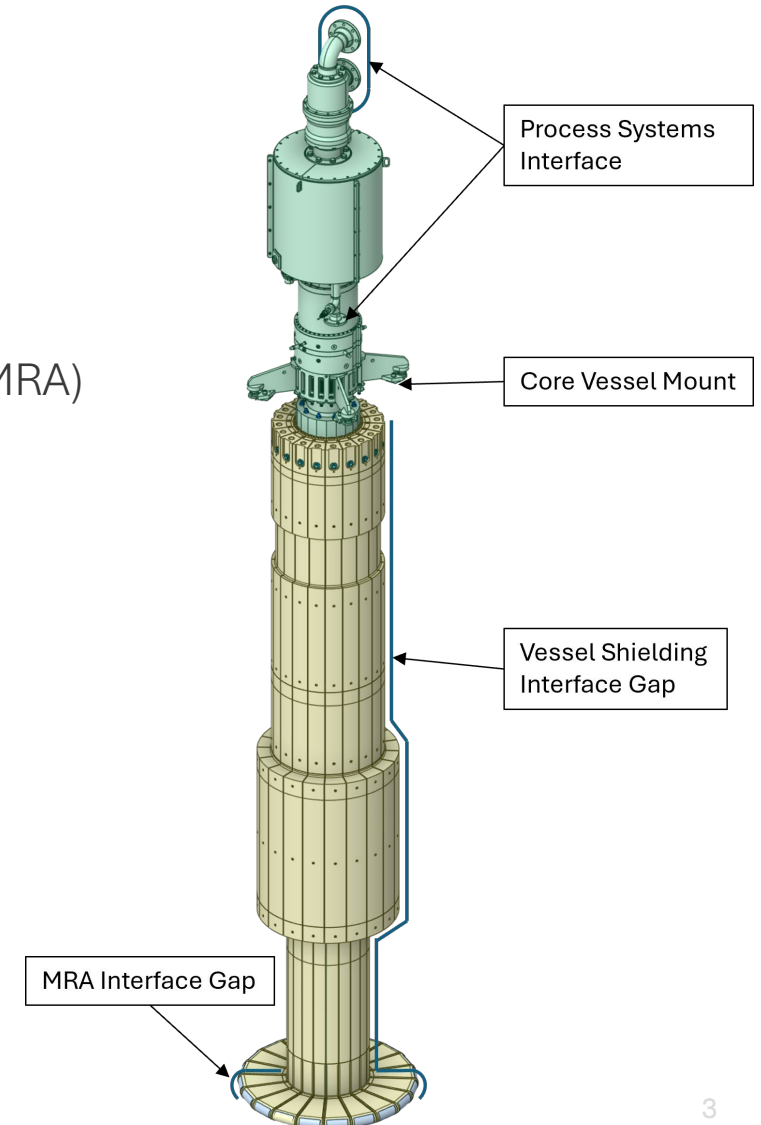
Charge Question 5: Is the design sufficiently mature to proceed with finalizing the procurement package?

The Target Assembly does not exist in a vacuum (actually, 2/3 of it does), therefore it interfaces with many other subsystems



These include:

- 1 Vessel Systems
 - Vacuum Systems
- 2 Moderator Reflector Assembly (MRA)
- 3 Process Systems
- 4 Target Viewing Periscope (TVP)
- 5 Conventional Facilities (CF)
- 6 Control System
- 7 Remote Handling
- 8 Proton Beam



Each interface has an approved interface control sheet that controls technical details and the responsibilities of each WBS

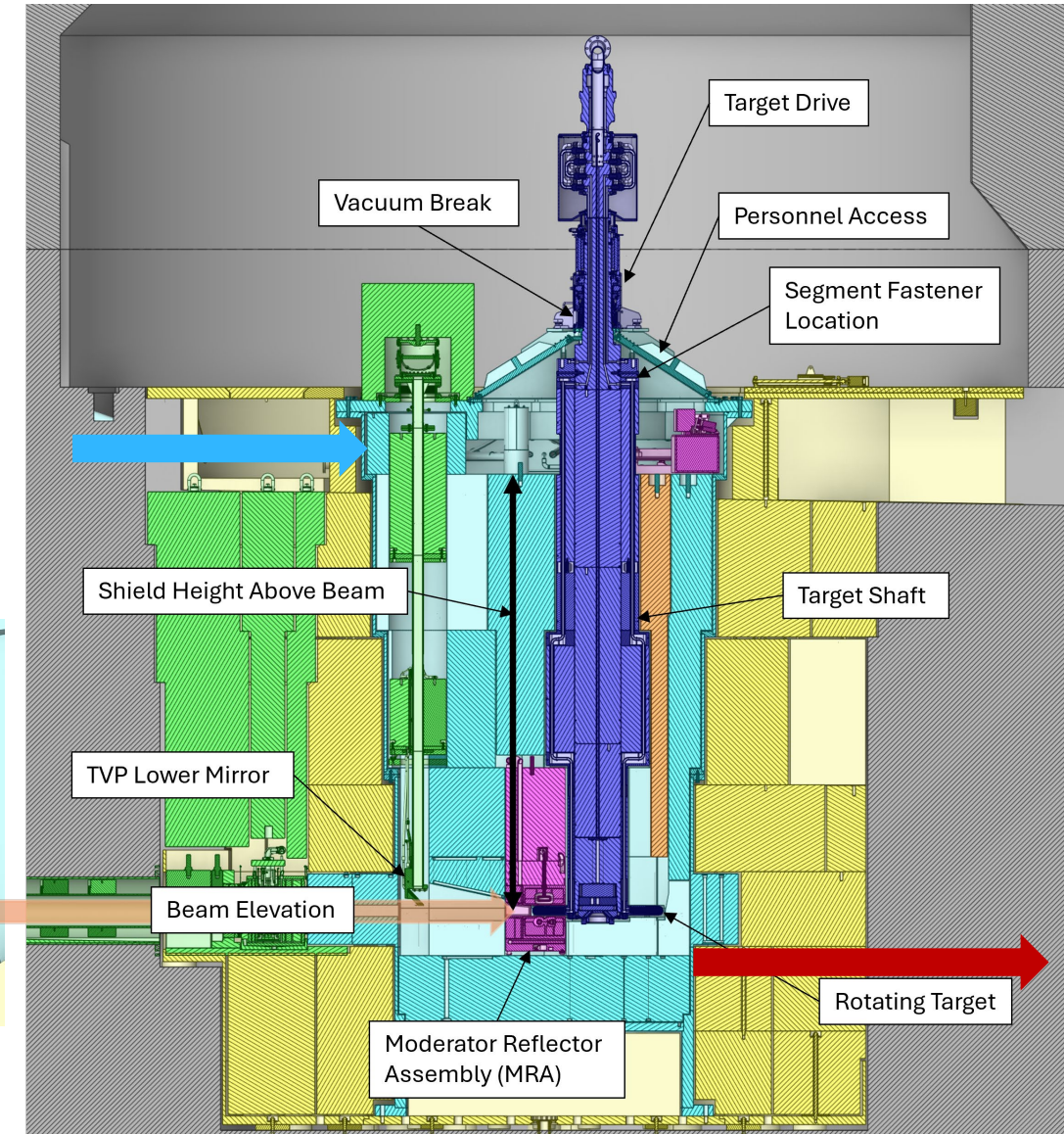
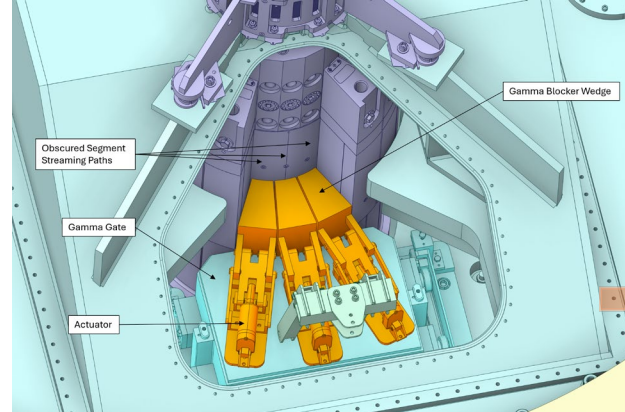
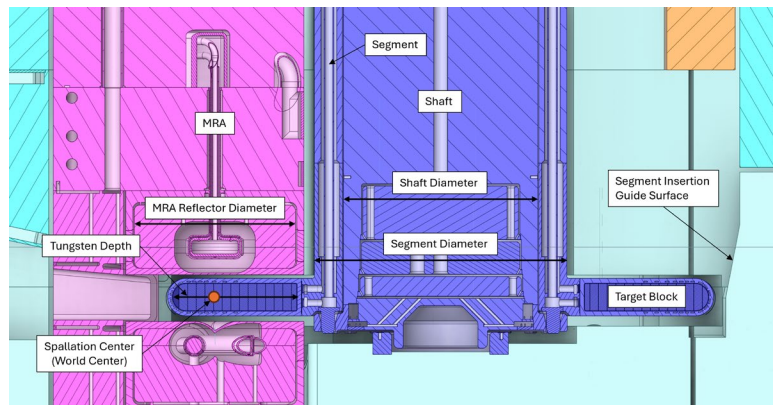
		In Process Draft Complete In Review Backcheck Reccheck Review Complete EDRM Signatures							
Deliverable Title	Document Number								
Target Assembly CAD model	0000004343.asm								
Interface Documents									
Process Systems Interface	S01020500-IST10211	X	X	X	-	-	X	X	
Core Vessel Interface	S01020500-IST10209	X	X	X	-	-	X	X	
TVP Interface	S01020500-IST10212	X	X	X	-	-	X	X	
Controls Interface	S03020000-IST10000	X	X	X	-	-	X	X	
Target Protection Systems Interface	S01020500-IST10104	X	X	X	-	-	X	X	
Remote Handling Interface	S01020500-IST10208	X	X	X	-	-	X	X	
X MRA Interface	S01020500-IST10207	X	X	X	-	-	X	X	
Proton Beam Interface	S01020500-IS0002	X	X	X	-	-	X	X	
Conventional Facilities Interface	S01020500-IST10069	X	X	X	-	-	X	X	
Systems Requirements Document									
Target Assembly Requirements	S03020000-SR0001	X	X	X	-	-	X	X	
Target Drive Requirements	S03020300-SRD10000	X	X	X	-	-	X	X	
Target Shaft Requirements	S03020300-SRD10001	X	X	X	-	-	X	X	
Target Segment Requirements	S03020400-SRD10000	X	X	X	-	-	X	X	
System Design Description									
Design Description Document	S03020000-DES10001	X	X	-	-	-	-		
Configuration Level Determination									
Target Assembly Configuration and Quality Le	S03020100-CMT10000	X	X	X	X	X	X	X	
Design Analysis Calculations									
CALC - Energy Deposition & DPA Report	S00000000-CAC10001	X	X	X	X				
Clearance Budget	S03000000-CAC10000	X	X						
Fatigue Assesment (incl. Offset beams)	S03020400-DAC100000	X	X	X	X	X	X	X	
Material Models	S03020000-DAC100000	X	X	X	X	X	X	X	
Structural Analysis	S03020000-DAC10002	X	X	X					
Neutronics - Beam On doses	S03120100-TPT10017	X	X	X	X	X			

This presentation will walk through key sections of each interface; highlighting the connection with important requirements.

Vessel Systems: Largest Physical Interface

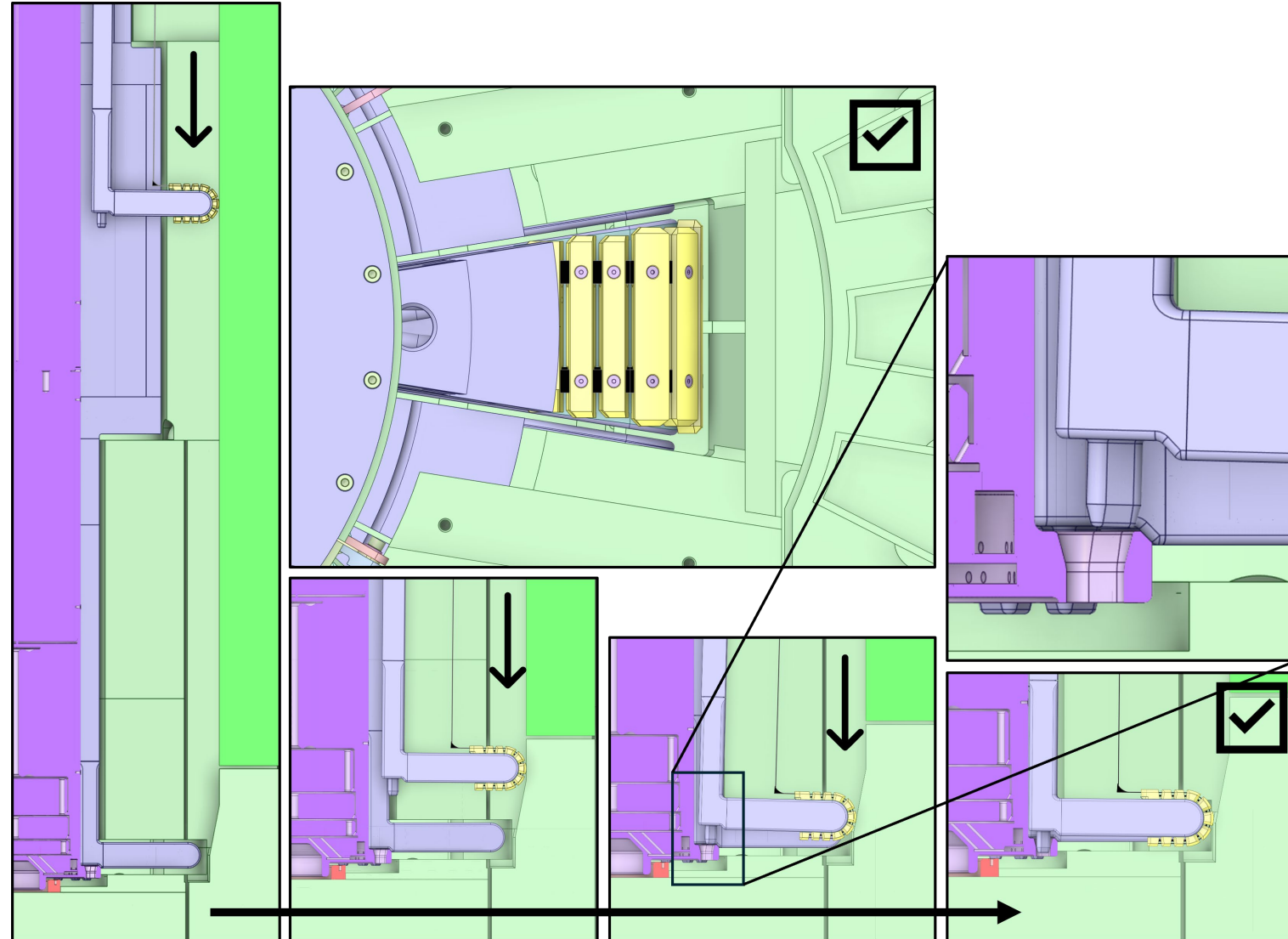
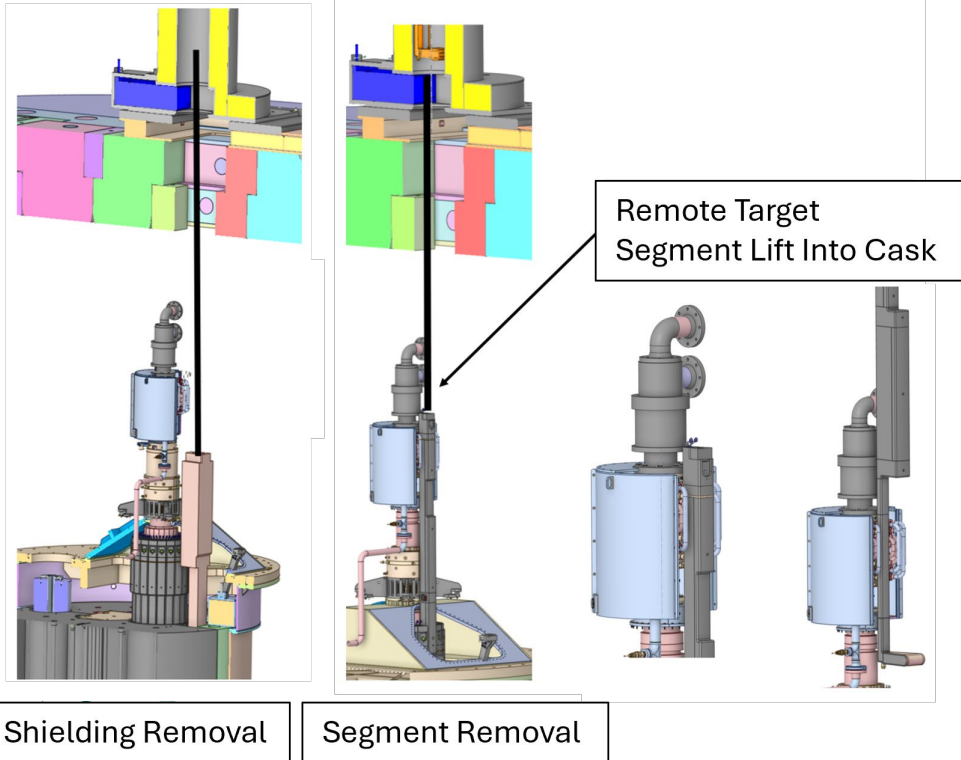
NOTE: Interface with Vacuum Systems is handled through Vessel Systems

- The Core Vessel lid supports the Target Assembly
- Vessel Systems shielding wraps around the Target
- The snubber ring of the Target Assembly mounts to lower shielding
- The Core Vessel provides an inlet and an outlet for external air cooling
- Vessel Systems provides passageways for air to travel around the Target wheel for external air cooling.
- Gamma gate & extensions
- Prevents contact between Target Assembly and MRA



Vessel Systems: Largest Physical Interface

- Permit access to a single segment location for segment exchange.
- Guiding of Segment into place. Utilize shape of Core Vessel shielding, and then guide pin/pocket combo between Segment and flange on shaft.



Vessel Systems: Largest Physical Interface

- Requirements specifically related to the Core Vessel, indicating the key interfaces between Vessel Systems and the Target Assembly


Second Target Station (STS) » Trackers » Target Assembly Requirements » Credited Controls

Hot contact #1566 HEAD / v29 %

Upstream References ● CDF-9948

Description

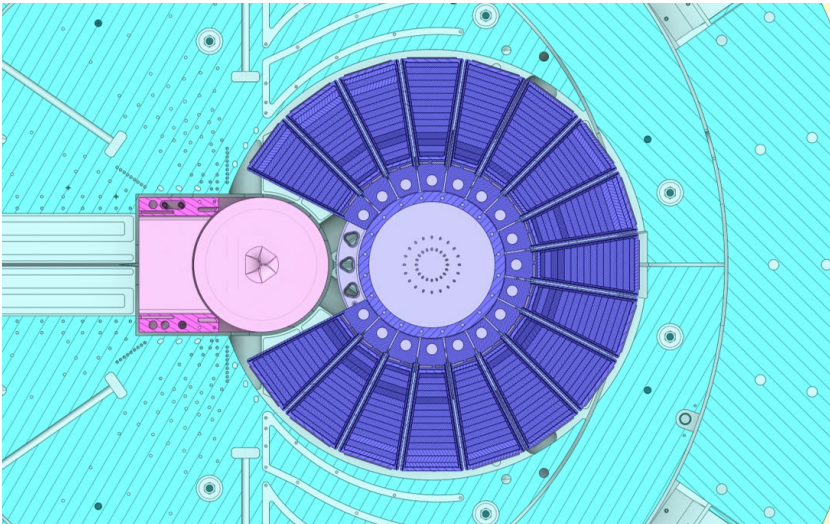
The target shall not contact Moderator components during a loss of cooling event.

Note: This event occurs without rotation

1695	Shaft Outline	The outer boundary shall meet the interface defined in S03000000-M8U-8800-A10001.
1480	Leak Rate	During vacuum operation, the total leakage into the Core Vessel from the Target Assembly shall not exceed 0.1 Torr-L/s. Note: This captures the overall leak rate from ambient into the core vessel during vacuum operation. It is expected that the dominant source will be from a rotary seal, O-rings, and other leak sources. This does not cover "virtual leaks" from outgassing or surface contamination.
1481	Interface Geometry	The target assembly shall mount in the locations indicated within S01020500-IST10209.
1482	Imposed forces	Imposed forces on the core vessel interface shall not exceed those found in IS - Target Assembly - Core Vessel, S01020500-IST10209.
10948	Water Leak rate	Target Assembly water boundaries and seals shall have a leak rate of 1×10^{-5} mbar-l/s or less. Note: This captures the overall leak rate into the core vessel during vacuum operation.

MRA: Highest-Risk Interface

- Credited control specifying no contact between the Target Assembly and the MRA. (Req 1566)
- The MRA wraps around the Target as the Target rotates at 45 RPM – 10 mm vertical gaps
- 3 Target Segments must be removed to create clearance to remove the MRA (Req 10836)



Second Target Station (STS) » Trackers » Target Assembly Requirements » Credited Controls
Hot contact #1566 HEAD / v29 %

Upstream References CDF-8948

Description

The target shall not contact Moderator components during a loss of cooling event.

Note: This event occurs without rotation

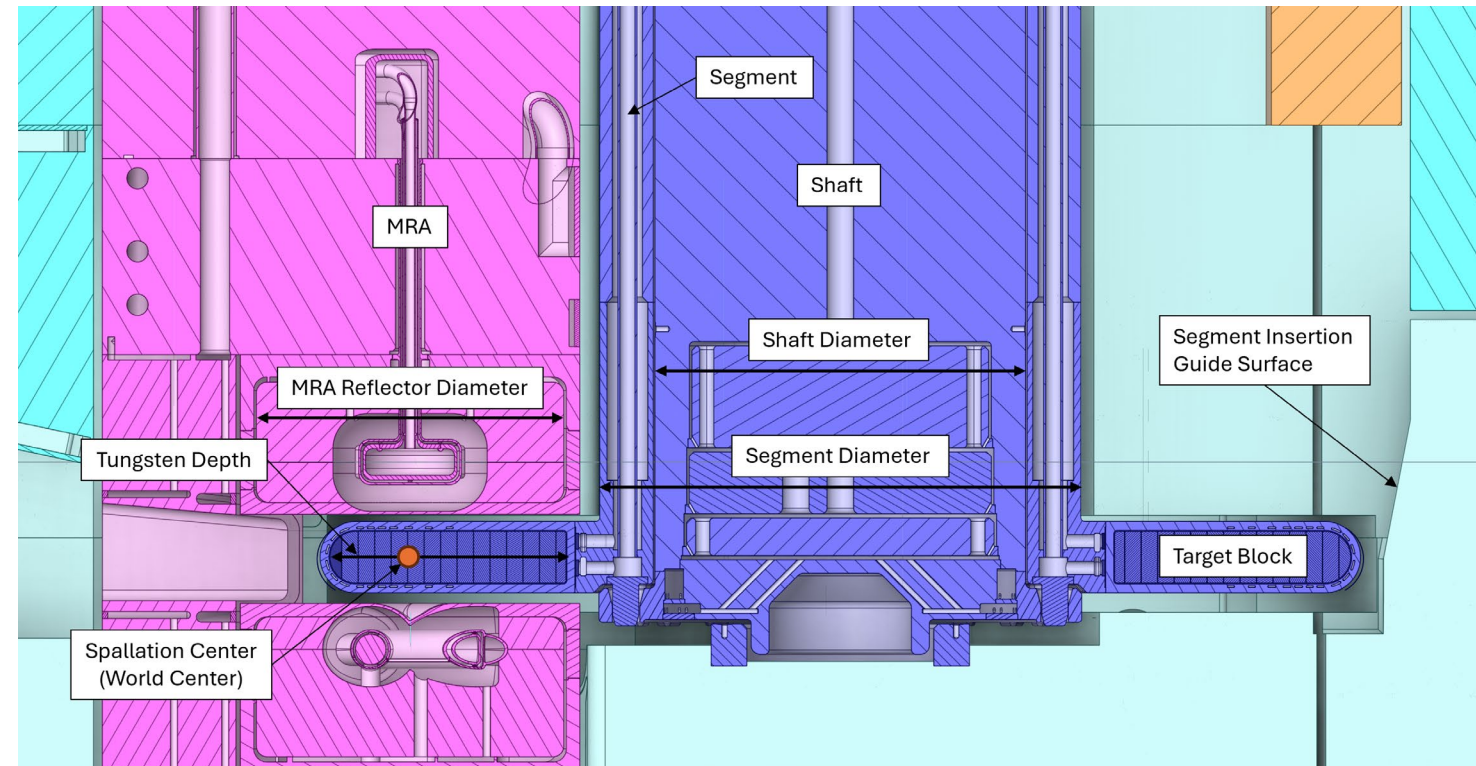
Second Target Station (STS) » Trackers » Target Assembly Requirements » MRA Interface Requirements
Permit MRA Vertical Removal #10836 HEAD / v2 %

No suitable Reference Item found

Description

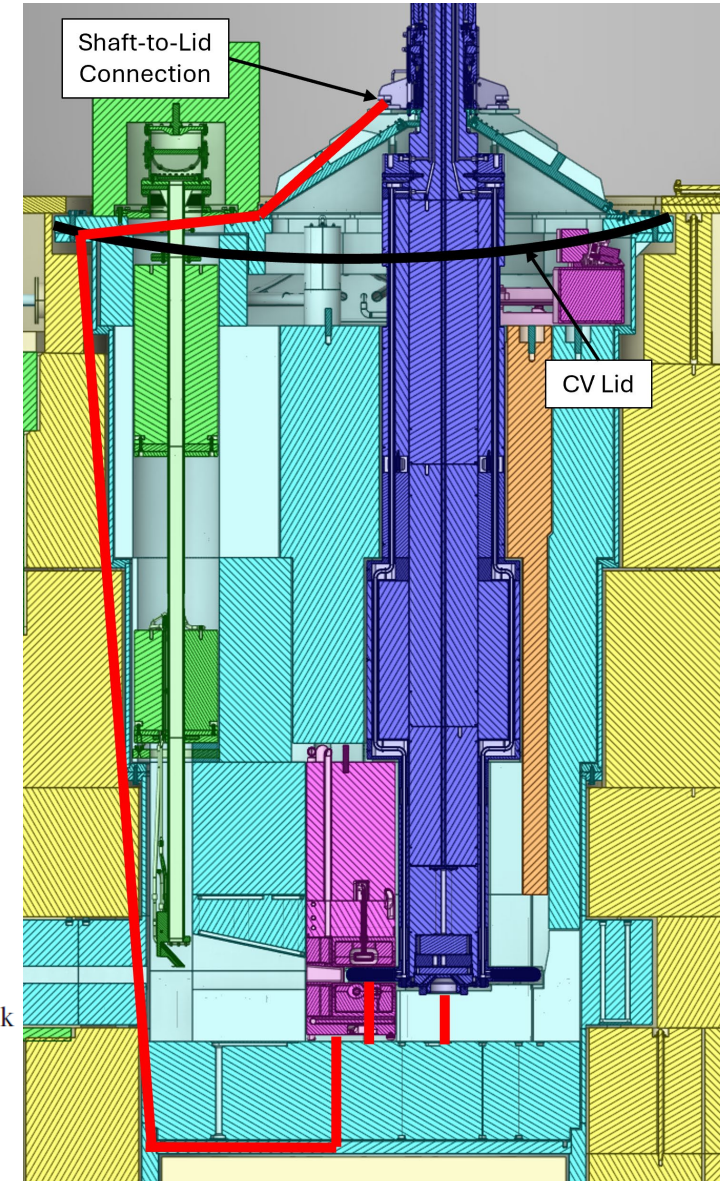
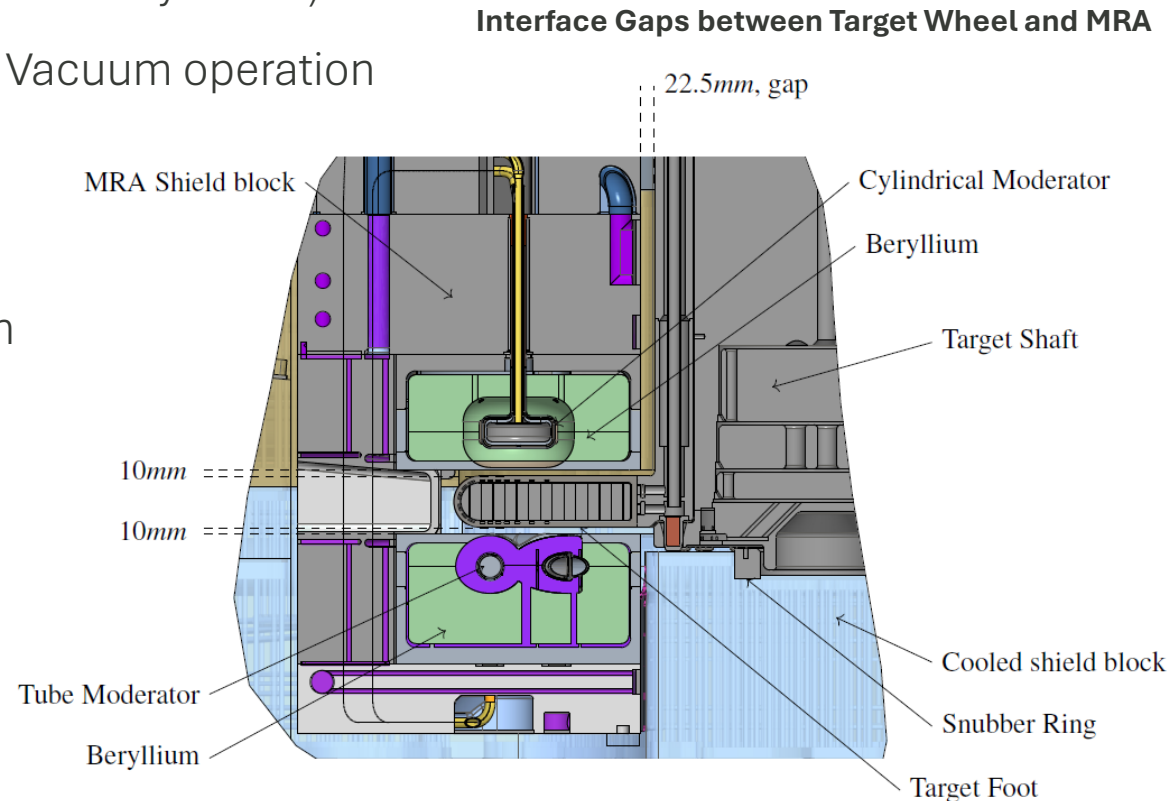
The target assembly shall provide features and capability to permit the MRA to be removed and installed vertically from the core vessel.

Note: the target assembly and the MRA are "nested" together and make removal of the MRA difficult. The target assembly is responsible for removing obstructions from the removal and installation path.



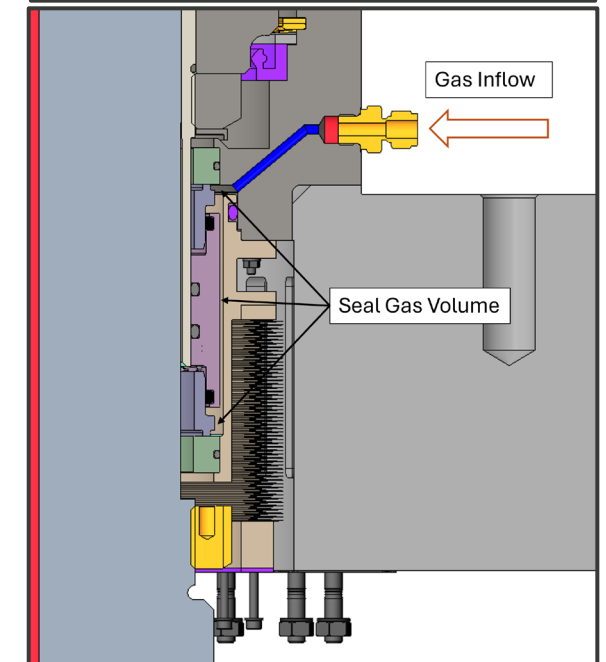
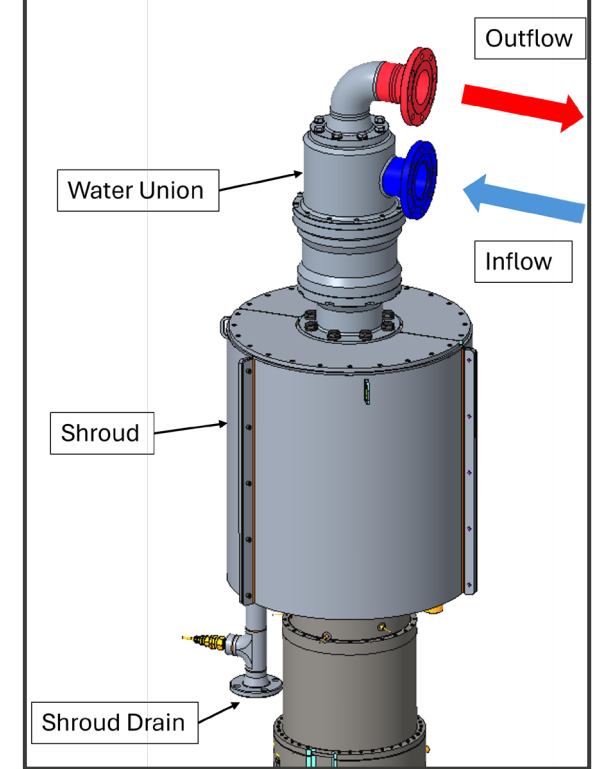
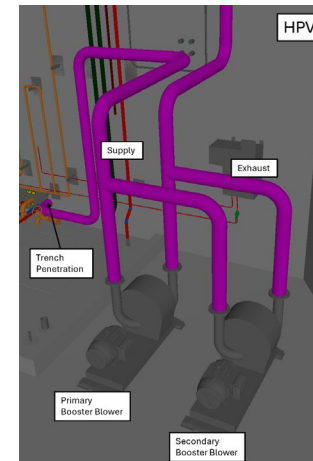
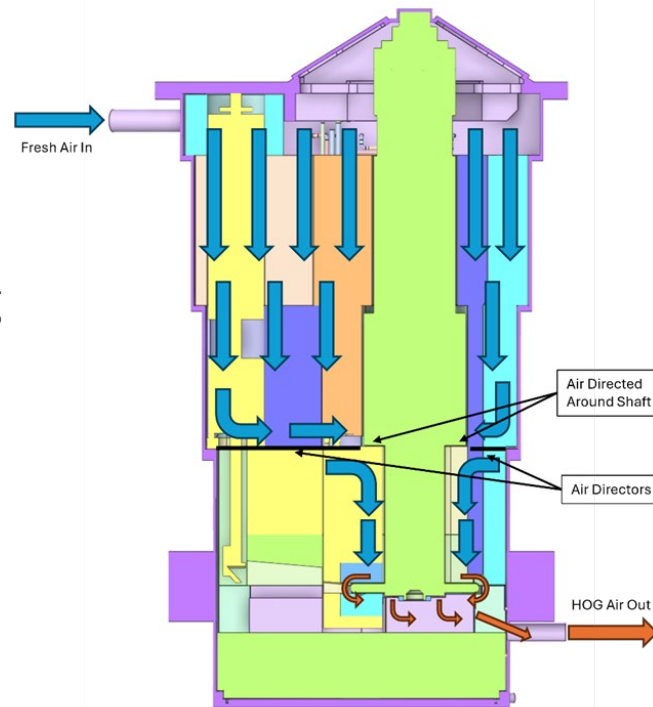
MRA: Highest-Risk Interface – Clearance Allotment is area of greatest interest, requiring multi-faceted evaluation

- Error between Target and MRA positioning result from:
 - Chain between Core Vessel, Target Assembly, MRA (discussed by Aaron)
 - Helium operation vs. Vacuum operation
 - Thermal states
 - Seismic loads
 - Stiffness & Deflection



Process Systems

- Process systems provides the water flow to the Target
 - 158 gpm (7.5 gpm/segment + 7.5 gpm for shaft)
 - 29 psig operating pressure (125 psia MAWP)
- Flange interface specification for inflow and outflow water.
- Vacuum seal cover gas
- Segment/Shaft Purge drain
- Manifold Shroud drain
- Blowers for maintenance air cooling



Process Systems



Second Target Station (STS) » Trackers » Target Assembly Requirements » Process System Interface

Max Pressure drop #1487 HEAD / v14 %

Description

The pressure drop through the target assembly shall not exceed 100 kPa for water circulating in Active Cooling Loop 1.

Reference Note: This requirement is designed to satisfy IS - Target Assembly - Target Process Systems, Windchill # S01020500-IST10211.



Second Target Station (STS) » Trackers » Target Assembly Requirements » Process System Interface

Interface Flanges #1489 HEAD / v13 %

Description

The target assembly shall provide two 4 inch Class 150# flanges in accordance with ANSI B16.47 at the locations indicated in S01020500-IST10211.

Reference Note: This requirement is designed to satisfy IS - Target Assembly - Target Process Systems, S01020500-IST10211.



Second Target Station (STS) » Trackers » Target Assembly Requirements » Process System Interface

MAWP - Target Assembly #10958 HEAD / v3 %

Description

The Target Assembly shall be designed for a Maximum Allowable Working Pressure of 758kPa, with relief devices for overpressure protection.

Pressure drop of 15 psi agreed on for system design

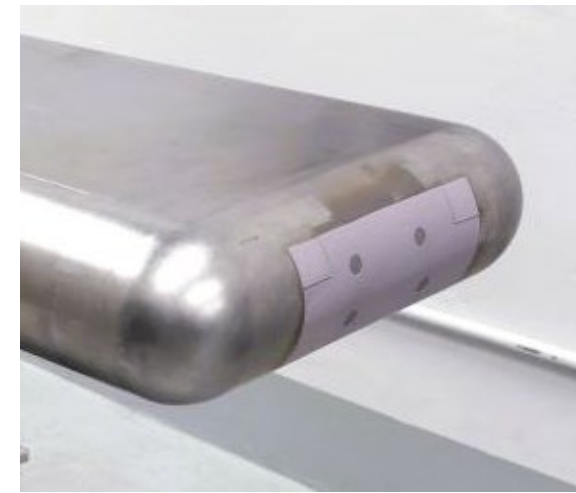
Flange size for piping interface

Max Allowable Working Pressure to ensure piping system sufficiently designed and to coordinate system limits

TVP: A coated target nose for remote viewing

- Imaging temperatures
- Coating Process – Flame Spray
 - Cleaning
 - Temperature
- Substrate material: Inconel 718
- Location
- Segment weight and size

	Target Assembly	Target Viewing Periscope
Target Surface Temperature Operating Range	35-150 °C	
IR Running Temperature Resolution		30 - 100 +/- 5 °C
IR Maintenance Temperature Resolution		100 - 300 +/- 10 °C
Peak Flame Spray Heat Flux		≤ 1 kW for 3 minutes (TBR)
Target Temperature During Coating Process		20 °C - 100 °C
Coating Application	N/A	Specify, Apply & Inspect
Coating Interface	Raw Inconel 718 SA (as machined)	Target Face preparation prior to coating
Fiducials		Specify size(s) and location(s)
Installation Protection	Coordinated by Target Assembly/Remote Handling	
Coating Interface	Width: 140mm Height: 70mm Reference Figure 2	
Configuration at Spray Application	Segment MFG complete, 5.11m (16.78 ft) tall	
Cleanliness Required after Coating	Free of contamination and protected	Free of contamination and protected from impact or abrasion
Weight	550kg	
Procurement	Shared	Shared
Shipping	Custom shipping crate	



<https://www.ornl.gov/news/spallation-neutron-source-achieves-another-major-milestone>

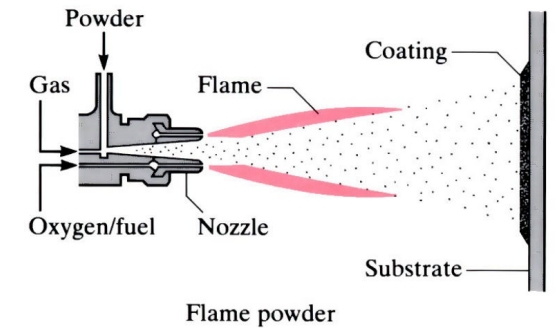
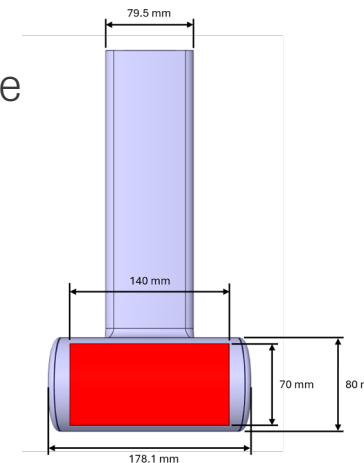


Image: <https://www.open.edu/openlearn/science-maths-technology/engineering-technology/manupedia/thermal-spraying-hardfacing>

Second Target Station (STS) » Trackers » Target Assembly Requirements » Target Viewing Periscope Interface
Coating Interface #1493 HEAD / v21

Upstream References S.03-1041 Level 1 GRD-1008

Description

The target assembly shall provide a surface interface for coating in accordance with IS - Target Assembly - Target Viewing Periscope, S01020500-IST10212.
 Reference Note: This requirement is designed to satisfy IS - Target Assembly - Target Viewing Periscope, Windchill # S01020500-IST10212.

Conventional Facilities

- Assembly weight for crane – 18 Tons
- Component weights
- Component elevations
- Target Drive Room coverage needs (jib crane)
- Nitrogen and dry air needs (provided to TDR)
- Spares storage (Used Segments)

Component	Dimensions (mm)	Mass (kg)	Pick Point Height Above Beamline (mm)	Vertical Travel Required (mm)	Estimated Frequency
Upper Pipe Spool (Return)	L: 2527.3 W: 927.1 H: 228.6	62.56	7774	NA	< 1/yr
Lower Pipe Spool (Supply)	L: 2527.3 W: 622.3 H: 228.6	57.63	7499	NA	< 1/yr
Rotary Water Coupling ^a	L: 386.41 W: 318 H: 895.25	190.42	7888.25	100	< 1/yr
Motor (with stator housing) ^a	L: 400 W: 400 H: 341.36	240.75	6071	565	every 6 yr
Drive Bearing Unit ^a	L: 570 W: 570 H: 485	241.03	5735	1043	every 6 yr
Valve Assembly ^a	L: 685 W: 685 H: 793	363.97	7001	45	every 6 yr

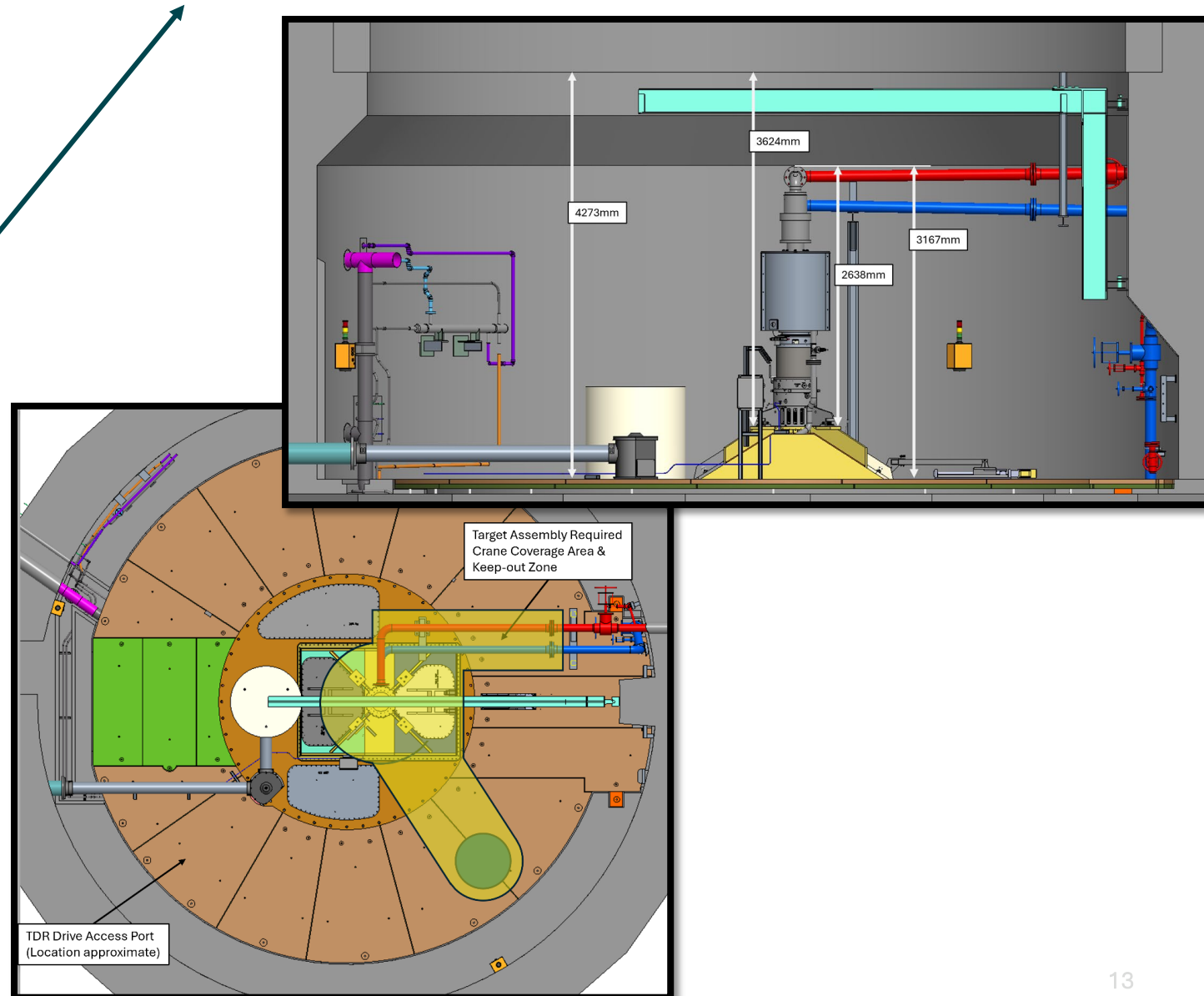


Second Target Station (STS) > Trackers > Target Assembly Requirements > Conveyance Interface Requirements
Blowdown Capability #1565 **HEAD / v24** %

Description

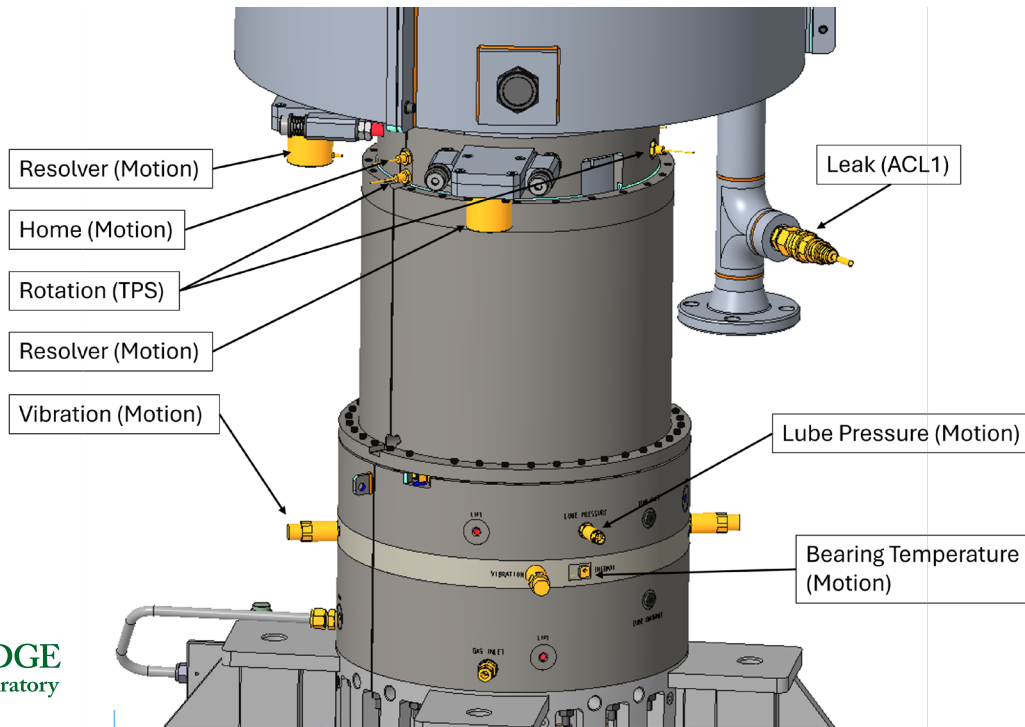
Water-cooled components shall have the ability to remove bulk water (so as not to spill when tipped 30 degrees during lift) to individual segments while in the core vessel.

Reference Note: This requirement is designed to satisfy IS - Target Assembly - Remote Handling, Windchill # S01020500-IST10208.



Control System

- Target Protection System (TPS)
- Motion Controls (ICS)
- **TA:** select devices; procure motor, resolvers, and sensors; provide functionality input
- **ICS:** device selection assistance, electrical design, controller procurement, programming



Second Target Station (STS) » Trackers » Target Assembly Requirements » Control System Interface
Homing Position #3599 **HEAD / v4**

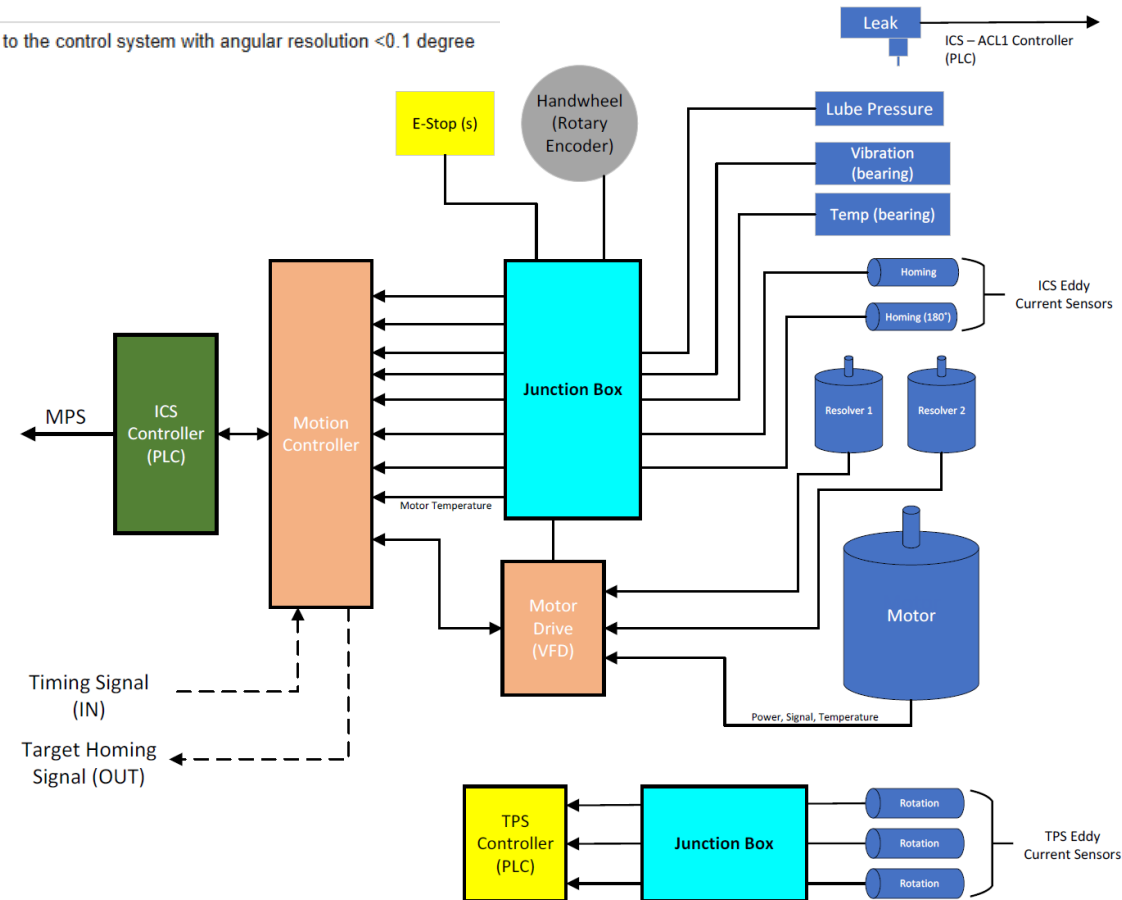
Description

The target assembly shall provide a sensor with connection to the control system at a repeatable and unique location in the target rotation.

Second Target Station (STS) » Trackers » Target Assembly Requirements » Control System Interface
Angular Resolution #3598 **HEAD / v5**

Description

The target assembly shall provide redundant sensors with connection to the control system with angular resolution <0.1 degree

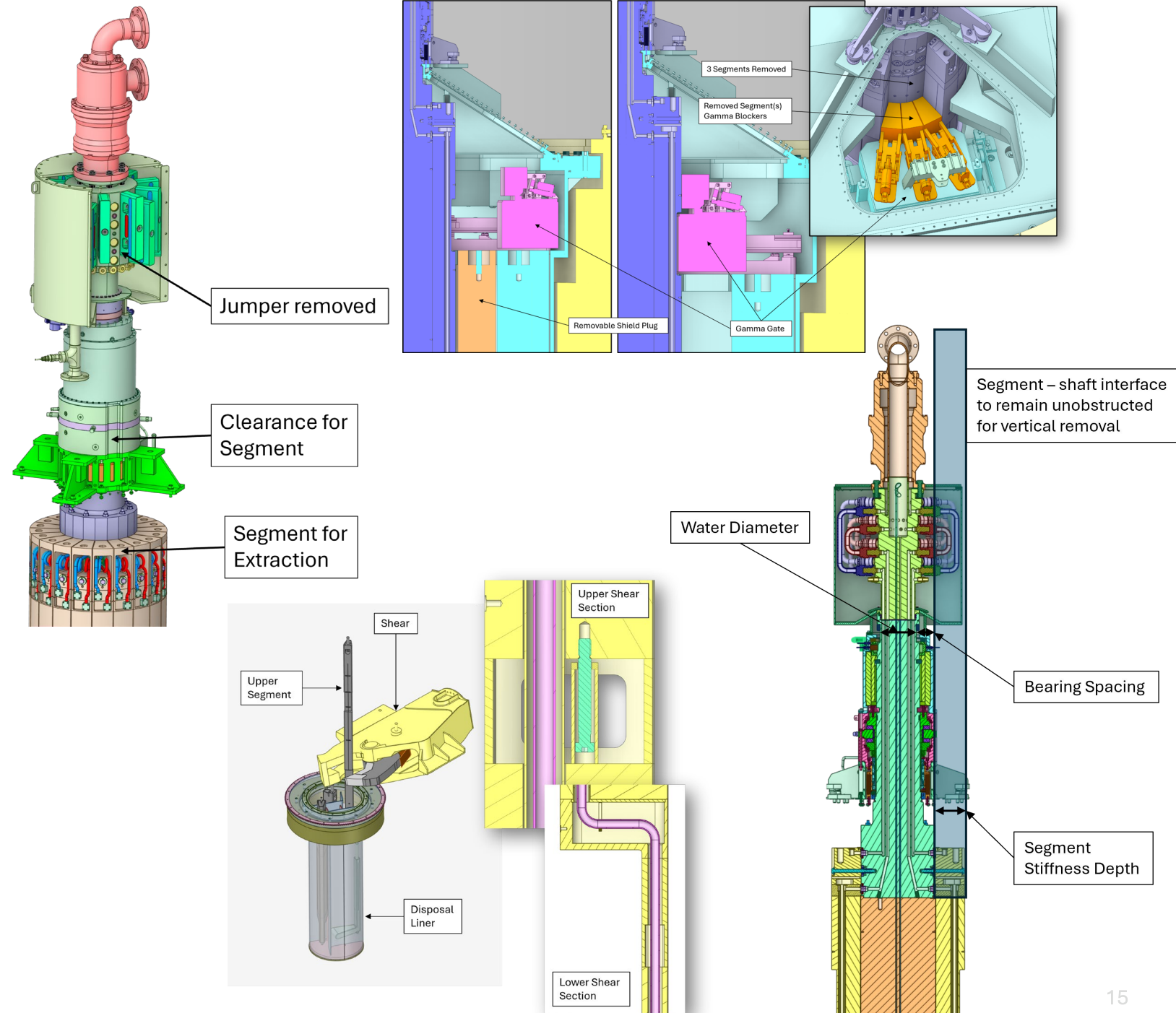


2 homing sensors and 2 resolvers for control system (motion)

3 eddy current sensors for TPS rotation verification.

Remote Handling

- Lifting & lowering Target Segment
- Shield blocks
- Drives clearance of other components
 - Manifold jumpers
 - Drove drive design and clearances for segment extraction vertically
- Prepare for transport to disposal site
 - Dry
 - Cool-down
 - Downsize
 - Package



Remote Handling

Contain feature to interface with zip-lift for specific components (Segment)

Water 3 cm or more below interface before component servicing

Remove sufficient bulk water before transporting within facility

Perishable components to be transported in approved container



Second Target Station (STS) » Trackers » Target Assembly Requirements » Conveyance Interface Requirements
Remote Handling Interface #1490 HEAD / v36 %

Description

Items with a mass >16kg and a radiation source term >100mrem/hr shall provide a remote-handling interface consisting of either:

- 1.5"-8UN threaded male stud with a length of 50.8 mm or
- 1.5"-8UN threaded female hole compatible with a 1.5"-8UN threaded male stud

This interface shall be located on a top-facing surface and shall have unobstructed access from above, including a minimum clear cylindrical tool envelope of diameter 140mm centered on the stud or hole axis, to allow tool engagement and disengagement.

Reference Note: This requirement is designed to satisfy lifting with a "Zip-stud" tool and to meet IS - Target Assembly - Remote Handling, Windchill # S01020500-IST10208.



Second Target Station (STS) » Trackers » Target Assembly Requirements » Conveyance Interface Requirements
Assembly Blow Down Level #10953 HEAD / v6 %

Description

The water level in the system shall be >3cm below any water boundary to be disrupted for maintenance.

Note: The water level must be below the crown and valve assembly as well as the segment sealing interface before personnel can gain hands-on access.



Second Target Station (STS) » Trackers » Target Assembly Requirements » Conveyance Interface Requirements
Blowdown Capability #1565 HEAD / v24 %

Description

Water-cooled components shall have the ability to remove bulk water (so as not to spill when tipped 30 degrees during lift) to individual segments while in the core vessel.

Reference Note: This requirement is designed to satisfy IS - Target Assembly - Remote Handling, Windchill # S01020500-IST10208.



Second Target Station (STS) » Trackers » Target Assembly Requirements » Conveyance Interface Requirements
Disposal Preparation & Transportation #10213 HEAD / v10 %

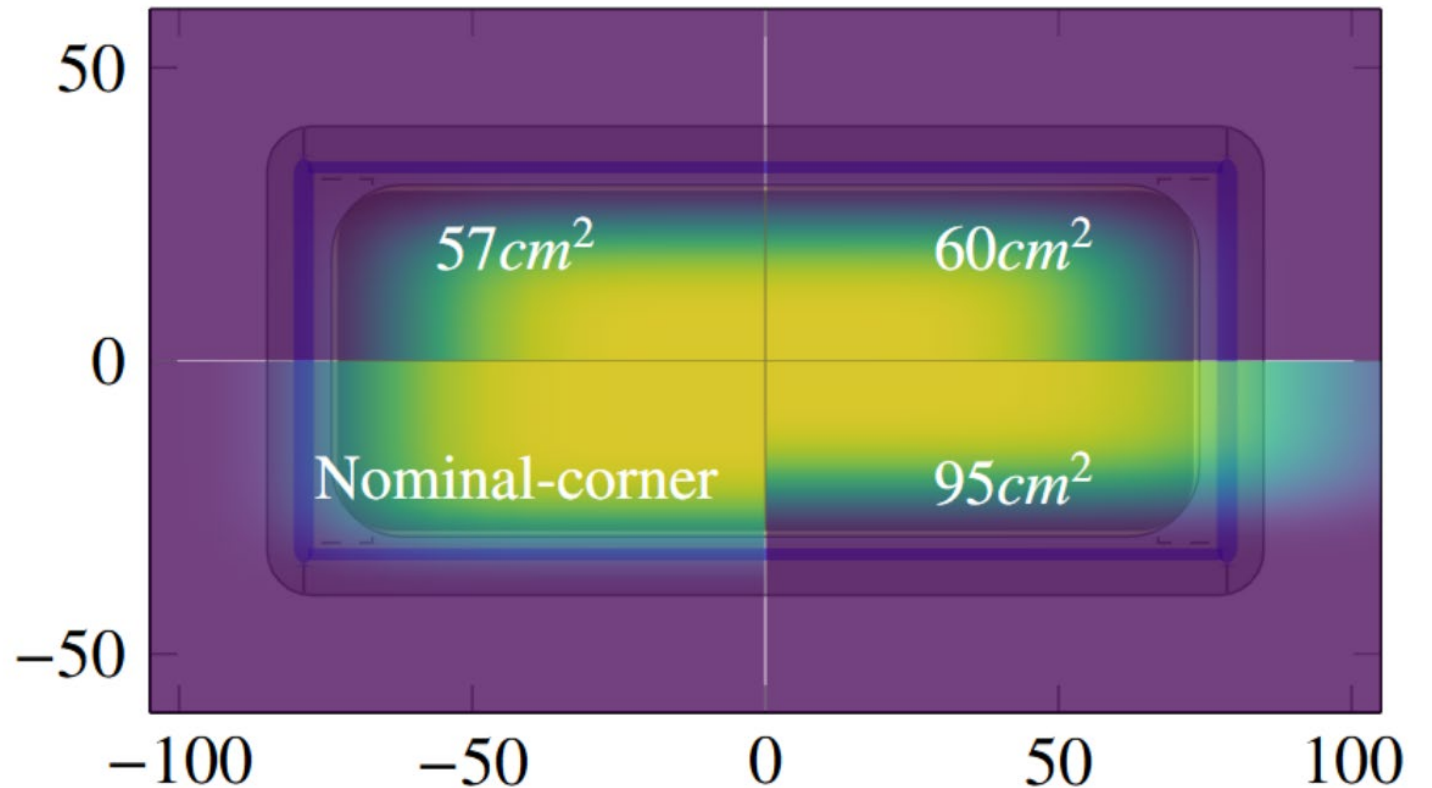
Description

All perishable components shall be capable of transportation with a certified Type B container which has been approved by the DOE for consignment of radioactive material.

NOTE: The STS Project has selected the Energy Solutions 3-60B as the basis of design for target assembly/component waste disposal & transportation.

Proton Beam

- Covered in Target Assembly Segment Design presentation by Aaron Jacques



Conclusion

- Interfaces have been matured post PDR
- Continue to mature the Controls Interface as the Controls WBS progresses through its scope.
- Interfaces such as Remote Handling and Process System may continue to develop as development on these systems progresses.



OAK RIDGE

National Laboratory



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