OAK RIDGE National Laboratory | SECOND TARGET STATION

Vessel Systems and Target Station Shielding Requirements, Interfaces and PHAR Cases

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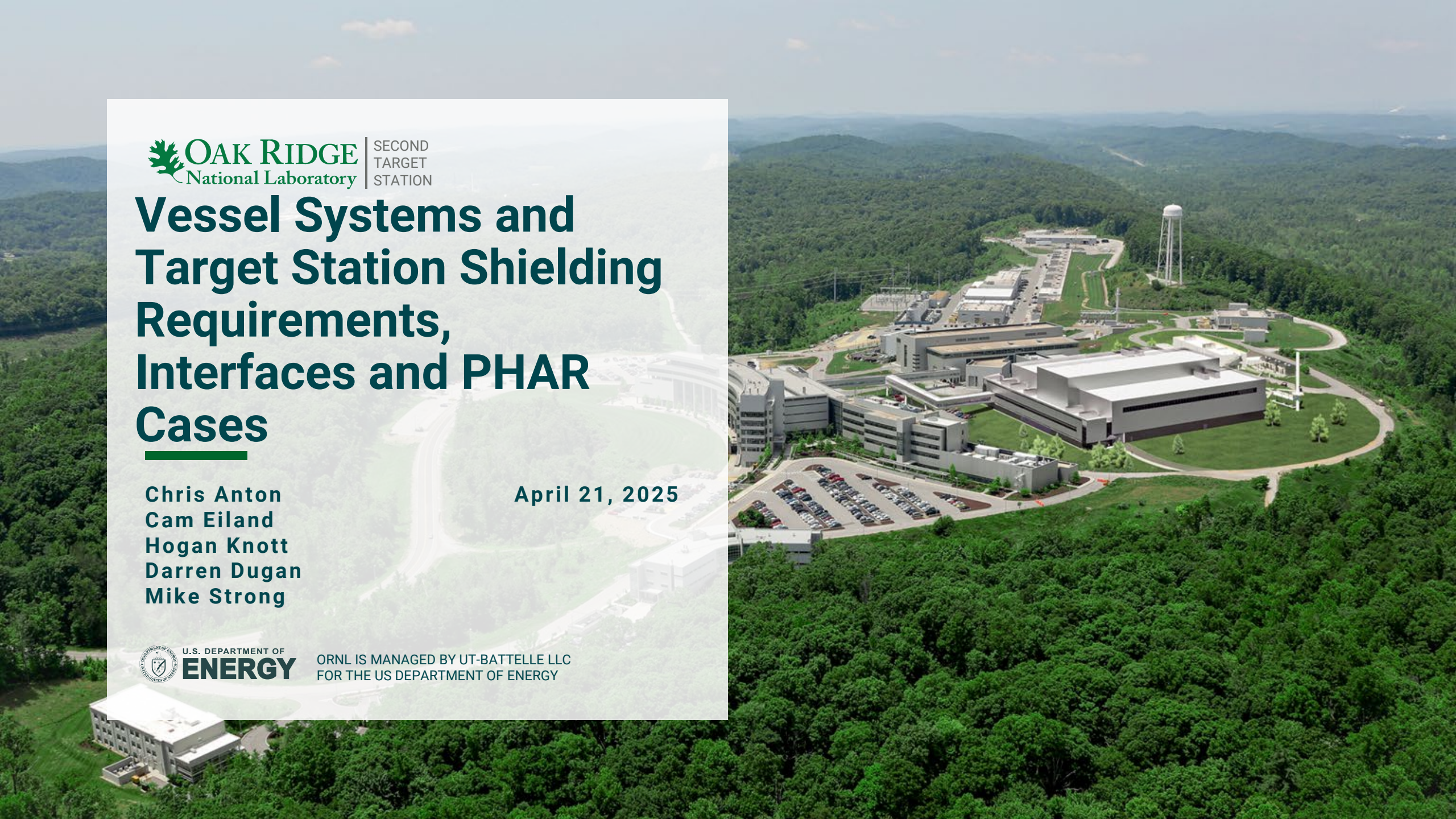

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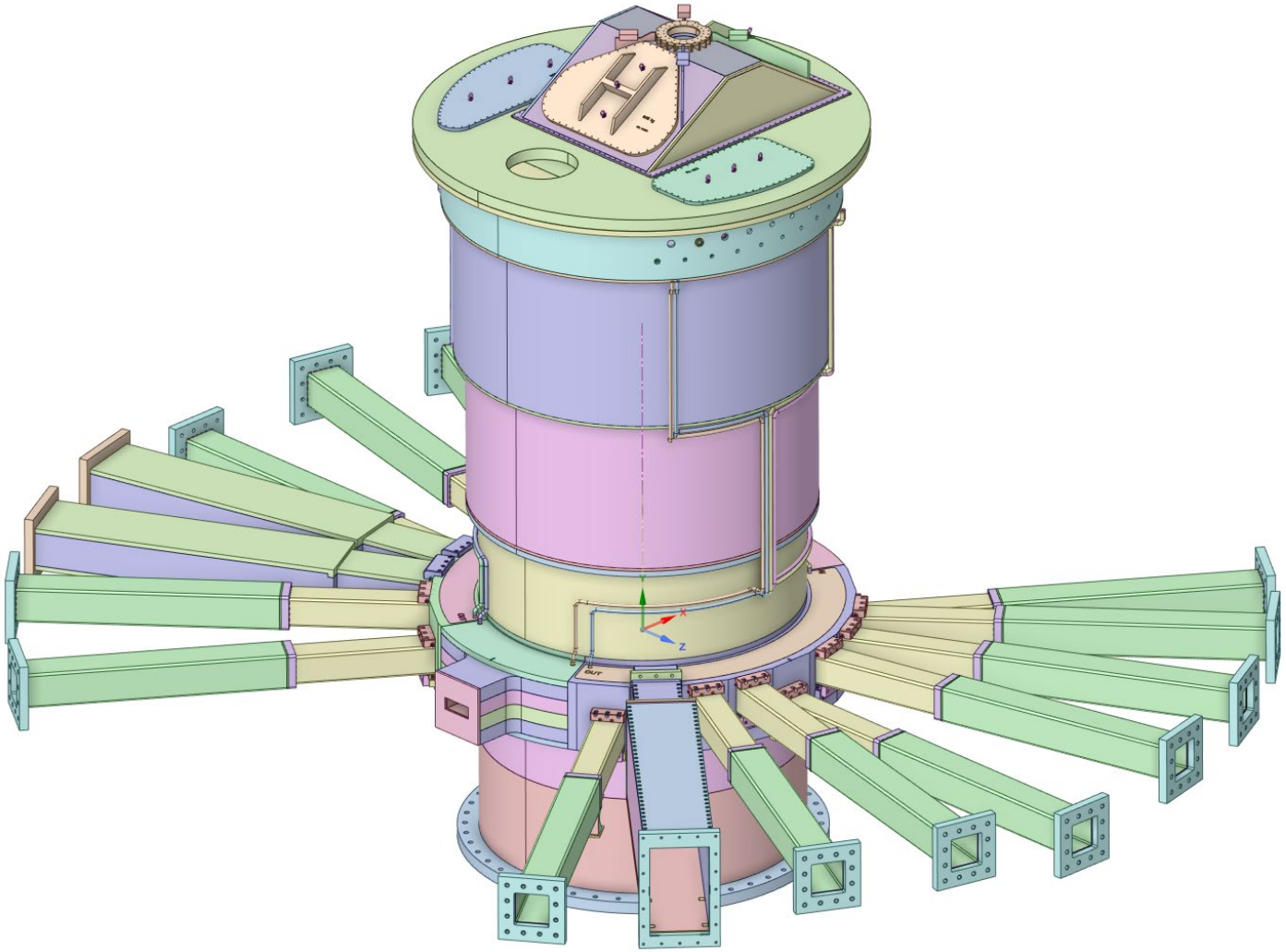
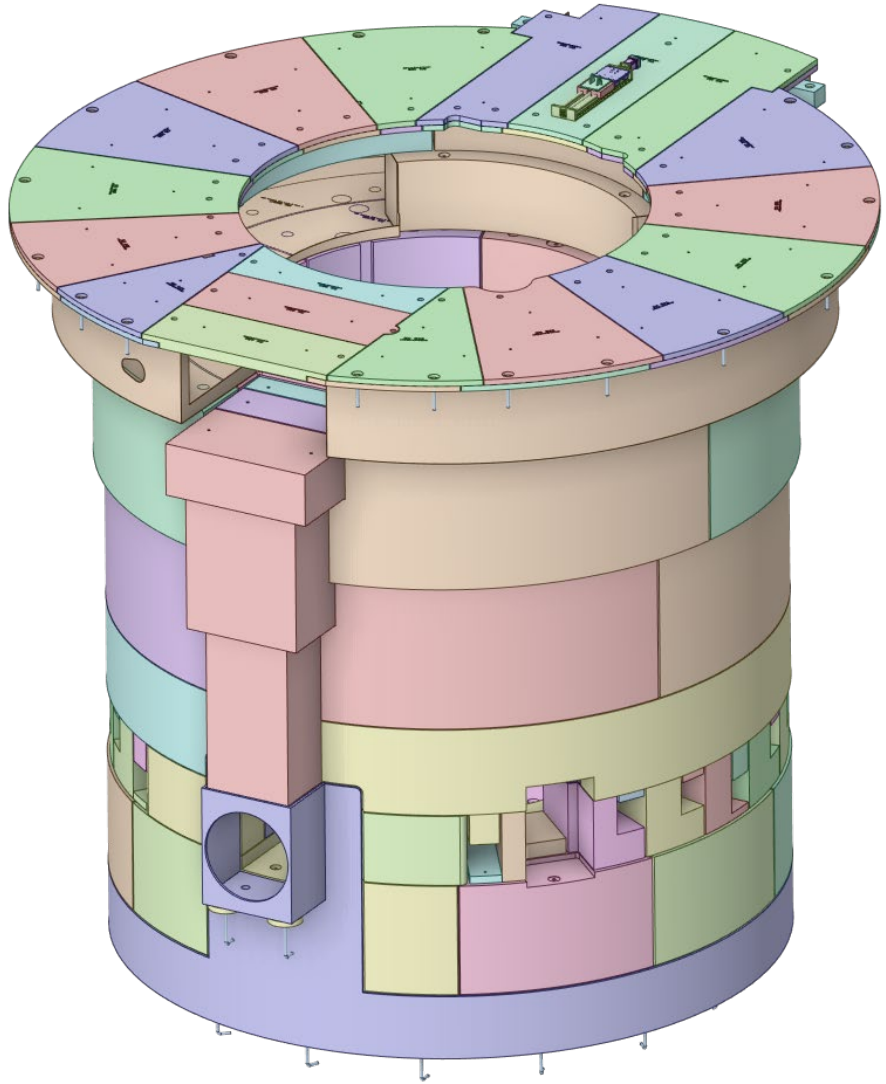
Presentation Overview

Vessel Systems



Target Station Shielding



Vessel Systems Requirements

General Requirement:

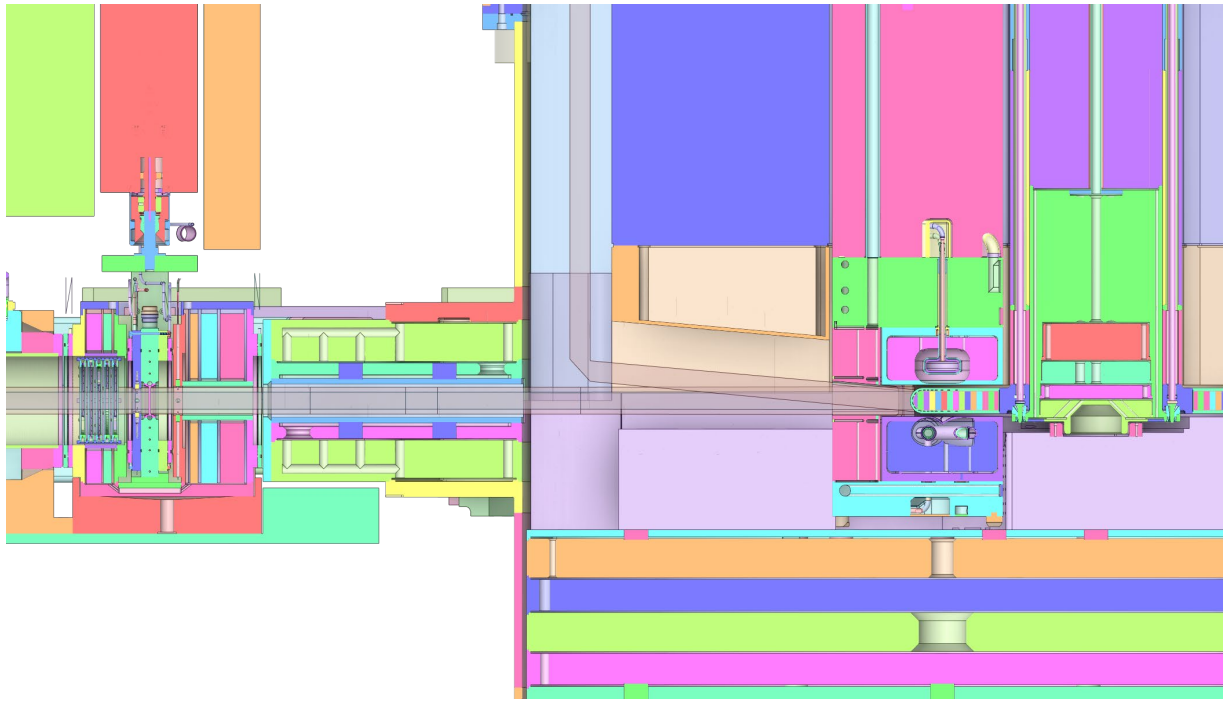
Accept Proton Beam
The Vessel and internal Shielding shall allow greater than 99.9% of the proton beam profile delivered by the Accelerator Systems to reach the Target Assembly unobstructed.

NOTE 1: Beam profile and other characteristics relevant to hardware will depend on beam area and beam position as defined in S01020500-ISXXXXX.

CodeBeamer reference: S.03.06-6121

Upstream References (1)

S.03-1028	Accept Beam from Accelerator



Derived from: Target Systems Requirements

Vessel Systems Requirements

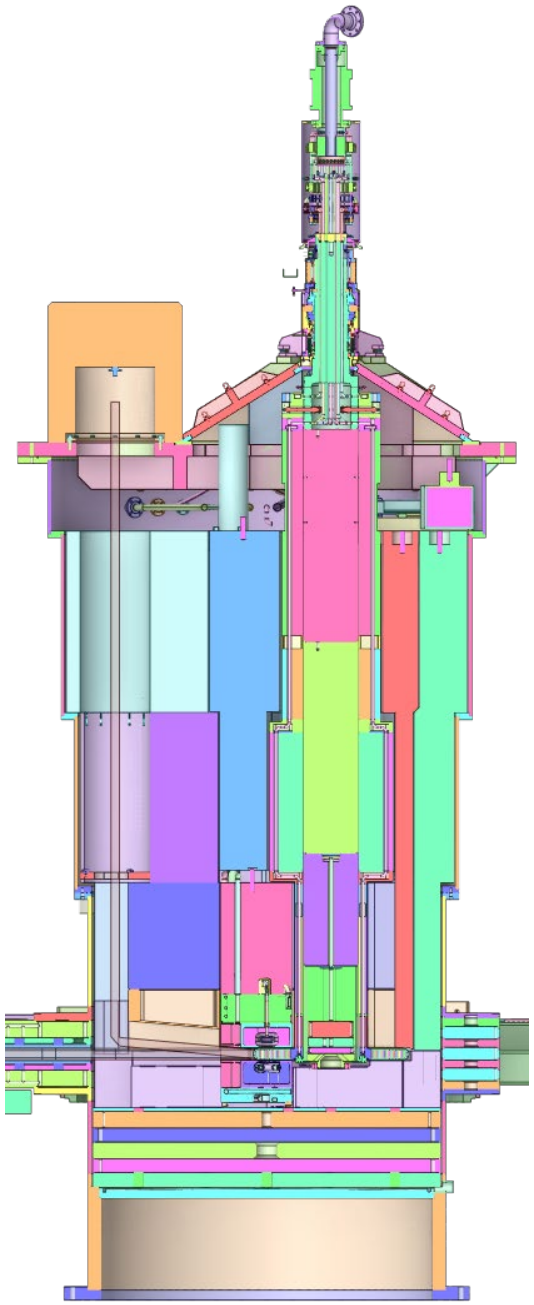
General Requirement:

Radiation Shielding
The Core Vessel and internal shielding shall be capable of limiting radiation exposure in areas accessible to personnel during beam-on and beam-off operations in accordance with the STS Radiation Safety Policy and Plan.

CodeBeamer reference: S.03.06-6130

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation



Derived from: Target Systems Requirements

Vessel Systems Requirements

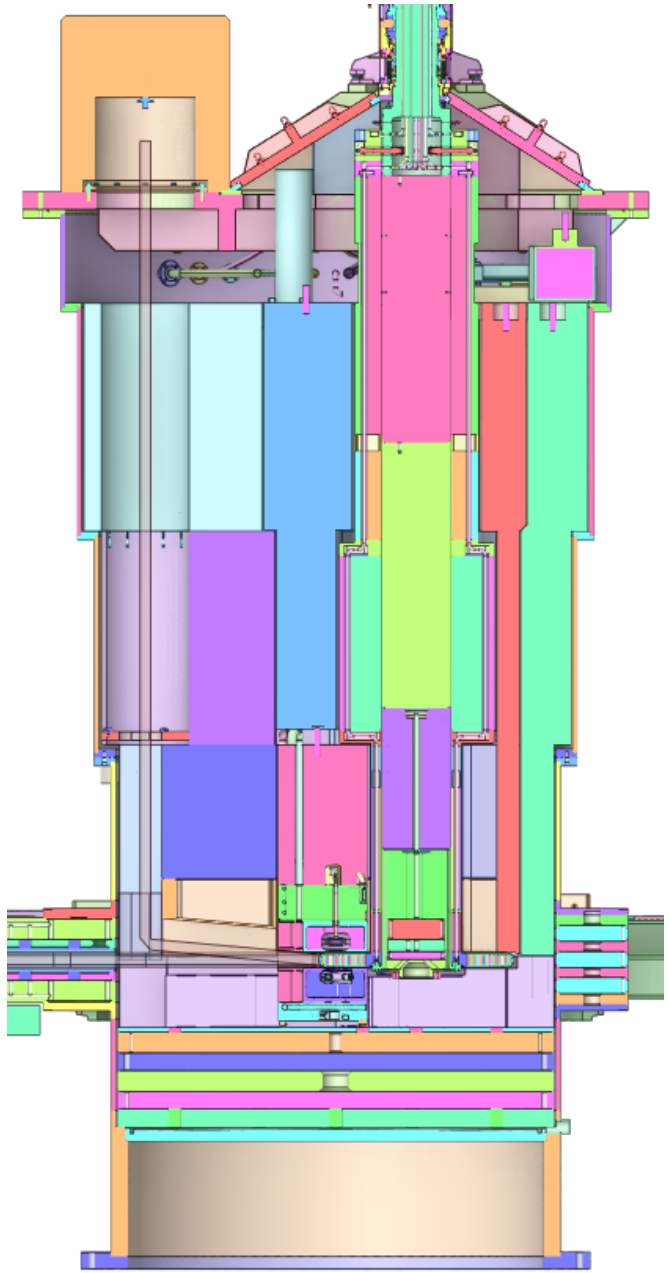
General Requirement:

Stainless Steel Temperature Limit
Vessel Systems stainless steel structures should have a maximum operating temperature of 200 C.

CodeBeamer reference: S.03.06-7181

Upstream References (1)

S.03-3009	Maintenance & Lifetime Criteria



Derived from: Target Systems Requirements

Vessel Systems Requirements

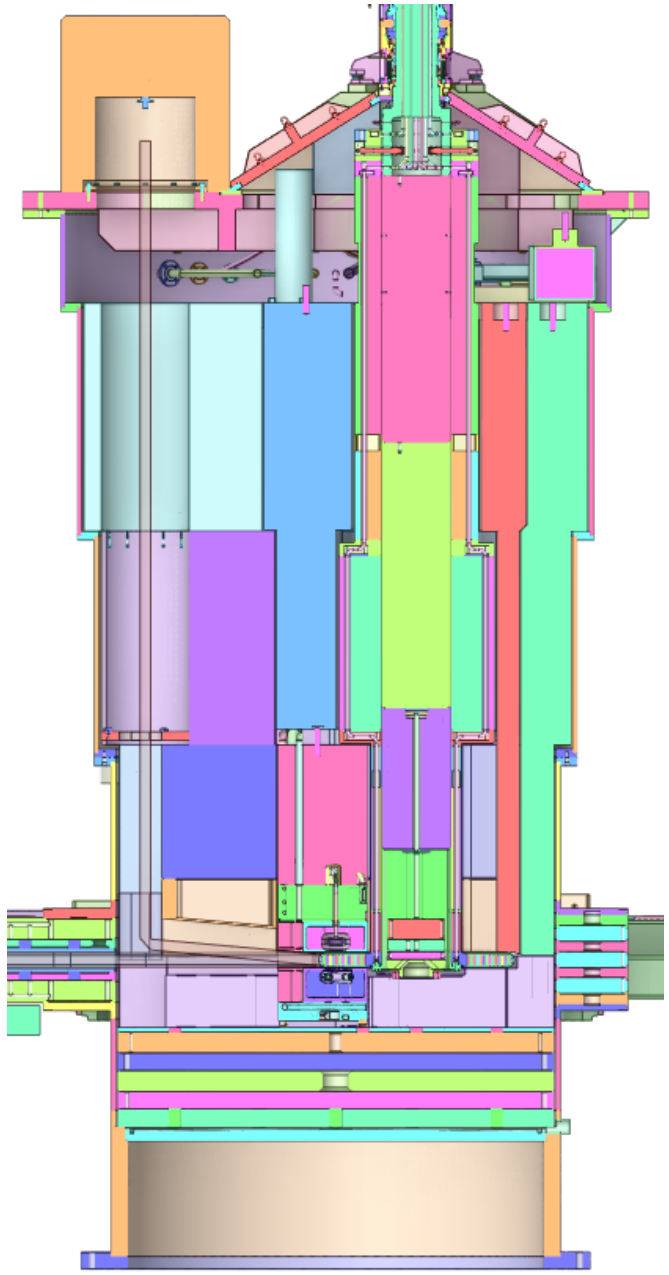
General Requirement:

Carbon Steel Temperature Limit
Vessel Systems nickel plated carbon steel structures should have a maximum operating temperature of 200 C.

CodeBeamer reference: S.03.06-7182

Upstream References (1)

S.03-3009	Maintenance & Lifetime Criteria



Derived from: Target Systems Requirements

Vessel Systems Requirements

General Requirement:

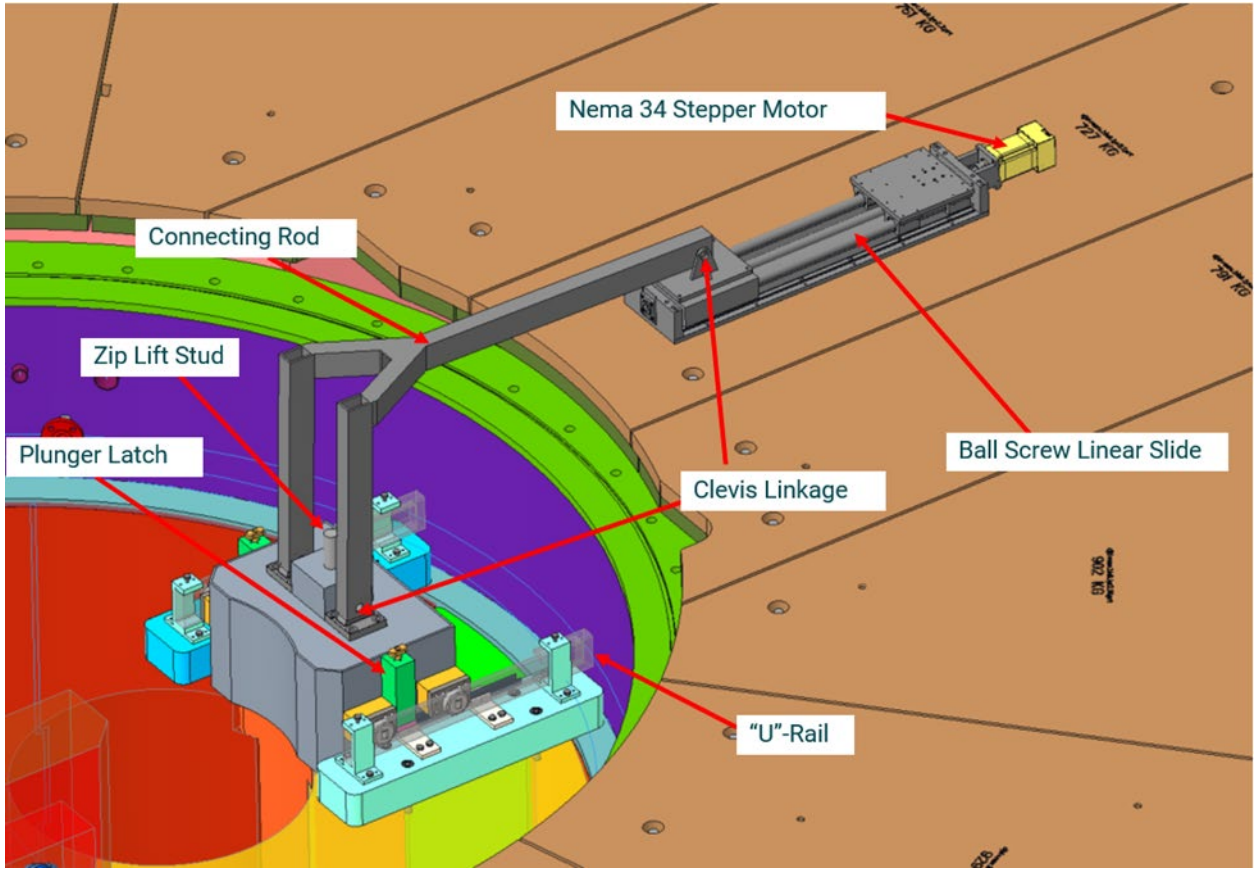
Lifetime
All vessel systems components shall be life of the facility components having a lifetime greater than or equal to 40 years with the following exceptions:
1. Gamma Gate assembly
2. Thermocouples and associated wiring
3. Vacuum and water replaceable seals

Note: Exceptions will be governed by the maintenance and lifetime criteria for perishable components (Requirement 1.9)

CodeBeamer reference: S.03.06-7183

Upstream References (1)

S.03-3009	Maintenance & Lifetime Criteria



Derived from: Target Systems Requirements

Vessel Systems Requirements

General Requirement:

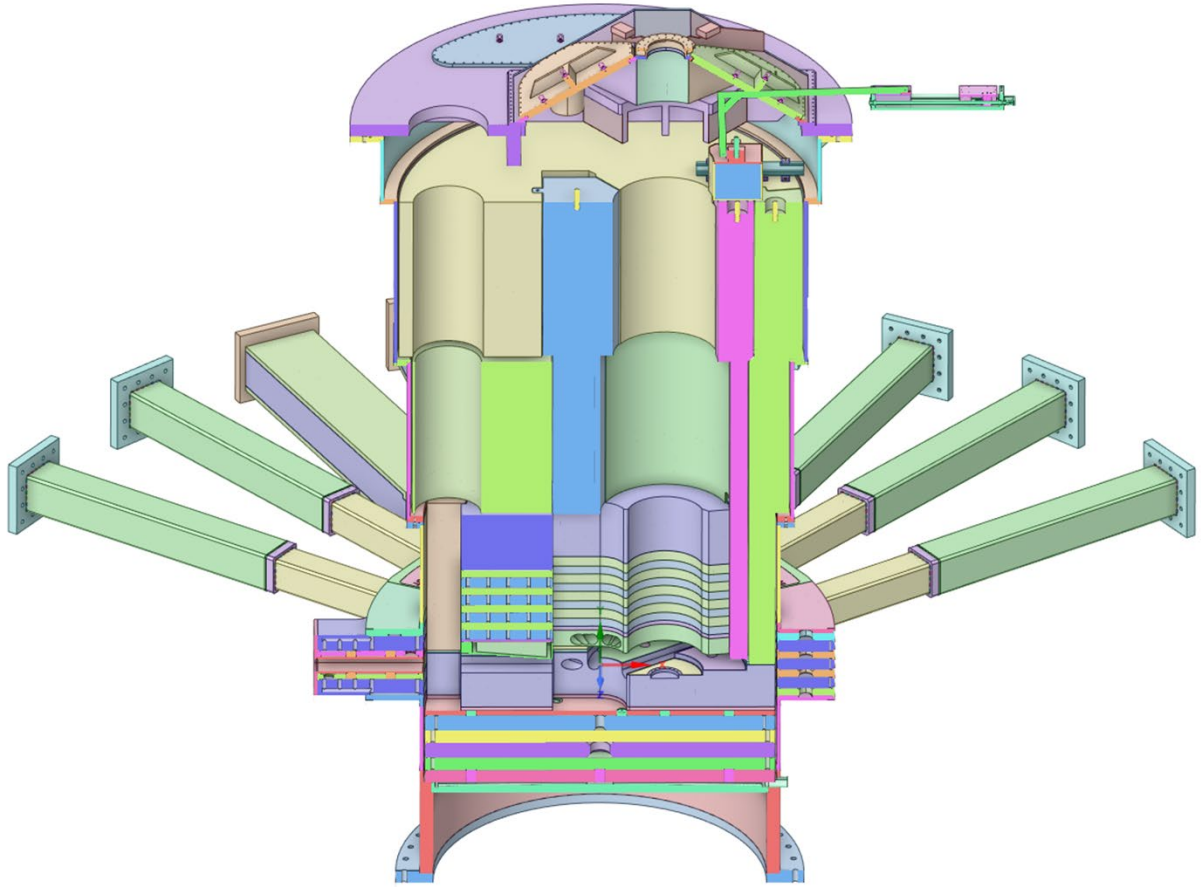
Water Leak Rates
All Vessel Systems water boundaries shall be designed to mitigate water leaks.

Note: Leak testing with water is not practical, leak rates to be verified via helium leak testing with an anticipated acceptance criteria of of 1x10^-6 mbar-l/s or less.

CodeBeamer reference: S.03.06-7184

Upstream References (1)

S.03-1033	Yearly Operating Hours



Derived from: Target Systems Requirements

Vessel Systems Requirements

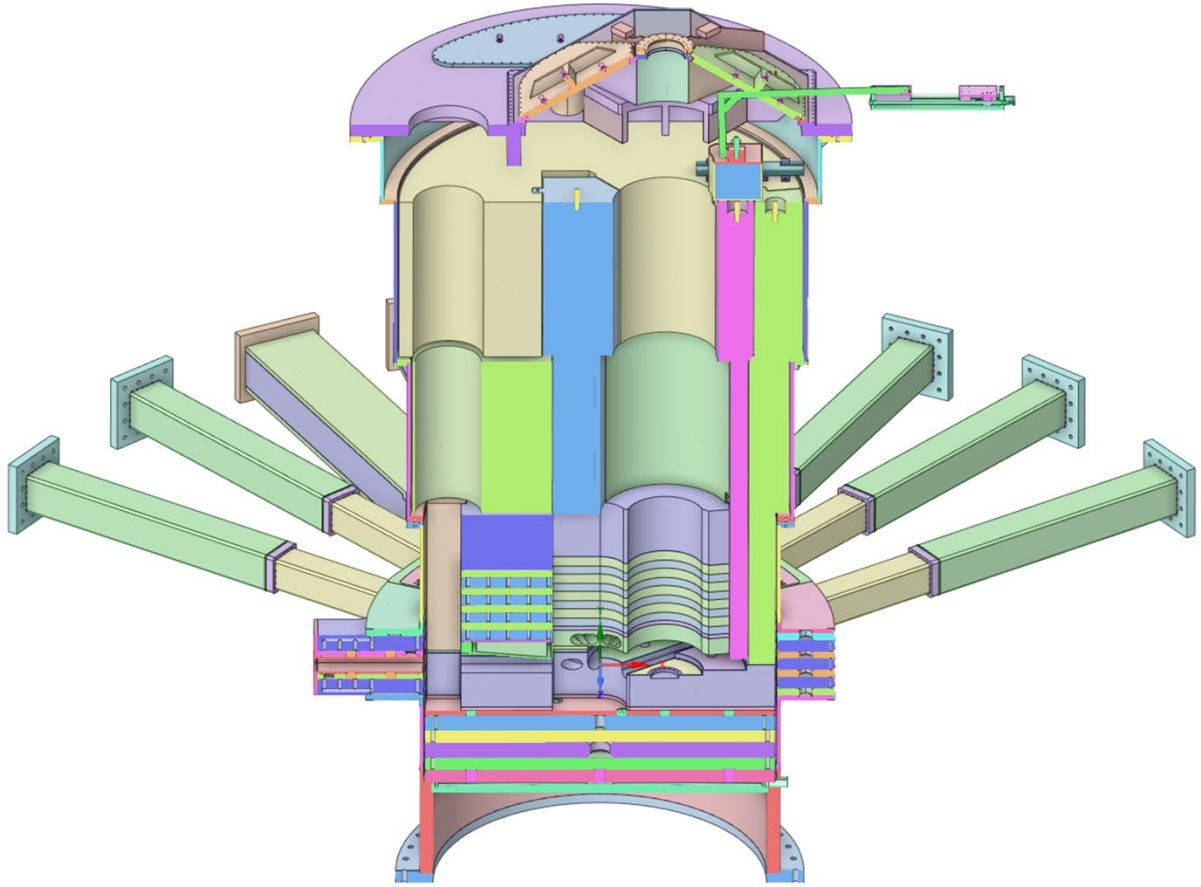
General Requirement:

Pressure Bearing Component Design Criteria
All Vessel Systems water cooled shielding, CV beltline and CV shall be designed per the STS Design and Fabrication of Pressure and Vacuum Systems (S01020000-PC0007).

CodeBeamer reference: S.03.06-7185

Upstream References (1)

S.03-1035	Safe Operation



Derived from: Target Systems Requirements

Vessel Systems Requirements

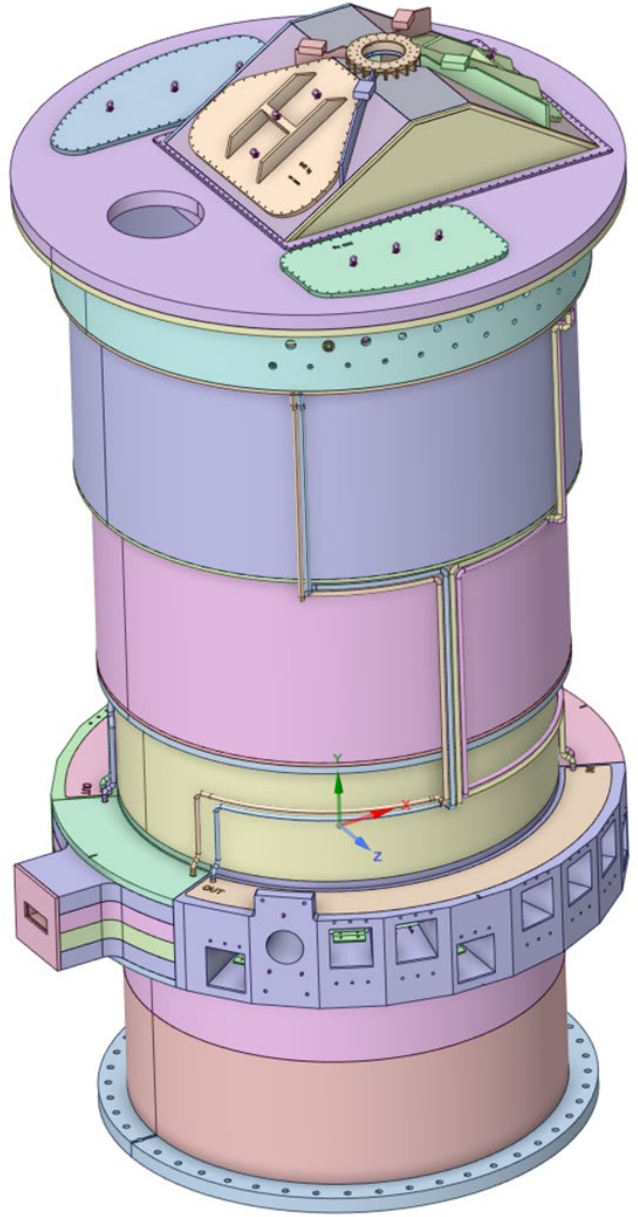
General Requirement:

Piping Design Criteria
All Vessel Systems water piping shall be designed and fabricated to ASME B31.3.

CodeBeamer reference: S.03.06-7186

Upstream References (1)

S.03-1035	Safe Operation



Derived from: Target Systems Requirements

Vessel Systems Requirements

General Requirement:

Maintenance and Lifetime Criteria - Perishable Components

All components shall meet one (or more) of the following criteria:

1. Non-replaceable components shall be designed and constructed with a negligible chance of failure beyond the life of the facility.
2. Components that are designed for the life of the facility but have a chance of failure shall be designed and constructed to permit replacement.
3. Components with expected minimum lifetime of 5000 hours shall be replaceable in 1400 hours or less.
4. Components with expected minimum lifetime of 2500 hours shall be replaceable in 250 hours or less.
5. Components with expected minimum lifetime of 500 hours shall be replaceable in 72 hours or less.
6. Components with expected minimum lifetime of 192 hours shall be replaceable in 16 hours or less.

Note: The criteria above give a high confidence level in meeting the availability requirement

CodeBeamer reference: S.03.06-7674

Upstream References (1)

S.03-3009	Maintenance & Lifetime Criteria

Derived from: Target Systems Requirements

A detailed PHAR review was performed to determine requirements

PHAR Event	Derived Requirement																	
	No requirements derived	The CV shall connect to a burst disc with a rating of less than +15 PSIG	CV shall have an unobscured drain port near the bottom of the vessel that connects to Process Systems drain line of the same diameter	CV shall have a vacuum port that connects to a vacuum systems pipe of the same size	CV shall be designed to operate in a range of -15 psig to +15 psig per ASME BPVC Section VII Div. 2	CV and CV shielding components shall be made of non-flammable materials	Core Vessel shielding shall keep target temperature below 800C under reasonable fire conditions (temperature and duration)	Large amounts of steel shielding within the monolith protect the Target feet and MRA from physical impact damage	Vessel Systems shall not permit shielding within the CV to damage the MRA or cryogenic transfer lines under SDC2 seismic conditions	The CV shall be rigidly anchored to the monolith concrete floor	CV shall maintain an inert environment (rough vacuum or partial pressure helium) under normal operating conditions	CV shall have an exhaust port that provides negative pressure when all CV lid hatches are removed	Vessel Systems hardware is in agreement with Neutronics analysis that verifies the shielding configuration is acceptable	Vessel Systems shall have appropriate features to allow for PPS interlocks confirming all shielding is in place prior to beam operation	All cooled components that are not considered permanent shall have flanged connections that are broken for component removal	Vessel systems hardware shall assist in keeping the target temperature below 800C under loss of cooling event	All vessel systems water cooled components shall have thermocouples that monitor component temperature
Appendix A - Accelerator Interface Components																		
AIC3-3 - Assumptions and Initial Conditions: Core vessel ullage, burst disk designed at nominally 1.5 bar absolute and vent system designed to limit peak core vessel pressure to below 15 psig even with rapid water loss from the target and/or credible hydrogen moderator failures.		X																
AIC3-3 - Assumptions and Initial Conditions: Core vessel operating in inert helium near atmospheric pressure or in vacuum				X	X						X							
AIC3-3 - Assumptions and Initial Conditions: Core vessel leak detection is located in the Core Vessel Drain Downcomer. (See Note 1)			X															
AIC3-3 - Method of Detection: Core vessel pressure change or liquid detection probe CMA Note: liquid detection probe redundant with next method of detection			X	X							X							
AIC3-3 - Method of Detection: Core Vessel Drain Downcomer Liquid Detection			X															
AIC3-3 - Mitigative Features - Attributes: Inert core vessel atmosphere (EC)				X	X						X							
AIC3-3 - Mitigative Features - Attributes: Core Vessel Drain Downcomer Liquid Detection Probe (EC) · Alarm in Control Room on detection of a leak (EC) · MPS trip on High Level in the downcomer (EC) · TPS beam trip on high-high level in the downcomer (EC)			X															
AIC3-3 - Mitigative Features - Attributes: MPS beam trip on high core vessel helium or vacuum pressure during operation. (EC)				X	X						X							
AIC3-3 - Mitigative Features - Attributes: Collection of Water by the Core Vessel; Confinement by Core Vessel, Core Vessel Drain Downcomer, RTST, and neutron beam windows (DF)			X															
AIC3-4 - Assumptions and Initial Conditions: Loop 2 provides cooling water for the PBW: TVP, CMS, and water-cooled shielding. (DF)	X																	
AIC3-4 - Method of Detection: Core Vessel Drain Downcomer Liquid Detection			X															
AIC3-4 - Mitigative Features - Attributes: Inert core vessel atmosphere (EC)				X	X						X							

Vessel Systems Requirements

Safety Requirement:

Core Vessel Pressure Relief
The Core Vessel shall maintain an internal pressure of less than +7.35 PSIG.

Note: A pressure relief system with burst disc shall be designed to ensure that +7.35 PSIG is not exceeded.

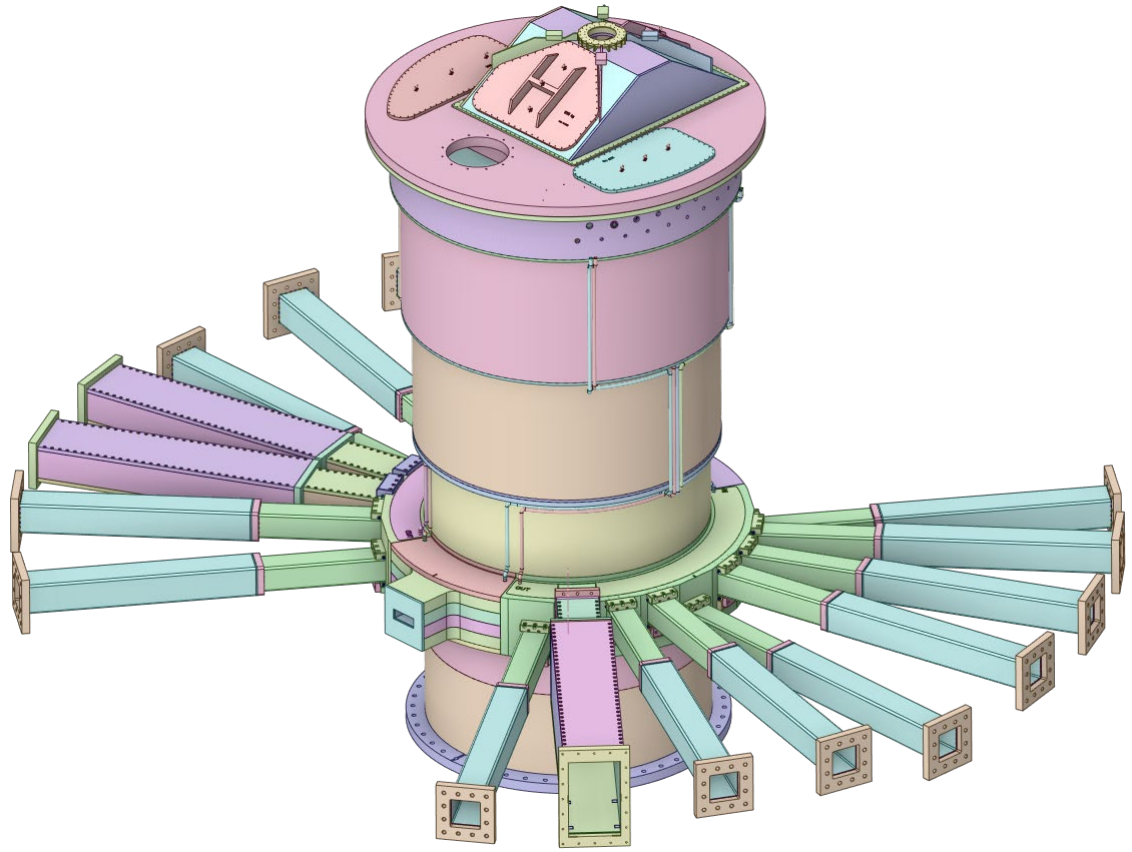
Note: Pressure limit determined by Proton Beam Window per Interface Sheet S01020500-IST10217.

PHAR References:
AIC3-3, AIC3-5, AIC3-9, AIC3-10, AIC7-1, BG7-8, BG7-9a, BG7-9b, CMS1-1, CMS2-1, CMS2-2a, CMS2-2b, CMS4-1, CMS4-2, CMS4-4, CW3-1d, CW3-3a, CW3-3b, CW3-10, TS3-2, TS3-3, TS3-4, TS3-5, TS3-6, TS3-7, TS3-8, TS3-10, TS3-12, VS1-1, VS2-1a, VS3-2

CodeBeamer reference: S.03.06-7047

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation



Derived from: PHAR

Vessel Systems Requirements

Safety Requirement:

Core Vessel Leak Collection
The Core Vessel shall collect water leaks inside the vessel and route to a drain port near the bottom of the vessel that connects to Process Systems drain line of the same diameter.

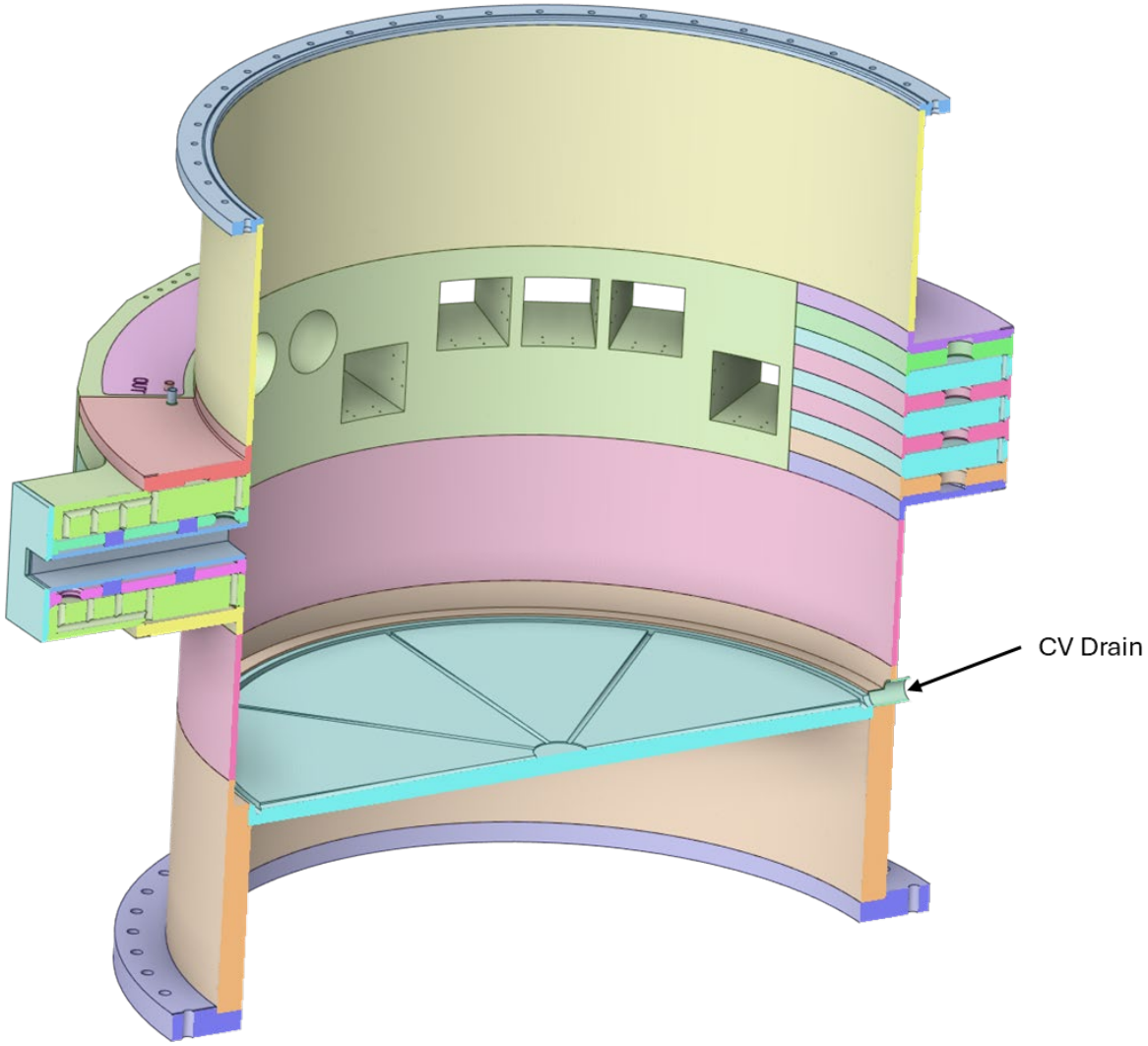
Note: Sizing of the drain line is the responsibility of Process Systems.

PHAR References:
AIC3-3, AIC3-4, AIC3-5, AIC3-7, AIC3-9, AIC3-10, AIC7-1, BG7-8, BG7-9a, BG7-9b, BG7-12, CMS1-1, CMS2-1, CMS2-2a, CMS2-2b, CMS3-4, CMS3-5, CMS4-1, CMS4-2, CMS4-4, CMS7-1, CMS7-3, CMS7-5, CMS7-6, CMS7-7, CW3-1a, CW3-1b, CW3-1d, CW3-2a (Credited), CW3-2b, CW3-3a, CW3-3b, CW3-7a, CW3-7b, CW3-10, GW2-3, HB2-2, HPV3-9, LCS1-1, LCS2-1, LCS3-1, LCS3-2, LCS3-3, LCS4-1, RH3-5, TS3-2 (Credited), TS3-3 (Credited), TS3-4, TS3-5, TS3-7 (Credited), TS3-8, TS3-10, TS3-12 (Credited), VS2-2, VS3-1

CodeBeamer reference: S.03.06-7048

Upstream References (2)

S.03-1035	Safe Operation
S.03-1036	Radiation Safety



Derived from: PHAR

Vessel Systems Requirements

Safety Requirement:

Vacuum Port
The Core Vessel shall have a vacuum port that connects to a vacuum system.

Note: Vacuum nozzle size may be determined in collaboration with other systems to accommodate maintenance ventilation and connection to a Hydrogen-safe release stack.

PHAR References:
AIC3-3, AIC3-4, AIC3-5, AIC3-9, AIC3-10, AS3-2, BG3-2, BG7-8, BG7-9a, BG7-9b, BG7-11, BG7-12, CMS1-1, CMS2-1, CMS2-2a, CMS2-2b (Credited), CMS2-2C, CMS3-4, CMS3-5, CMS3-6, MCS3-7, CMS4-1, CMS4-2, CMS4-4, CMS7-1, CMS7-3, CMS7-5, CMS7-6, CMS7-7, CW3-1a, CW3-1b, CW3-1d, CW3-2a, CW3-2b, CW3-3a, CW3-3b, CW3-7a, CW3-7b, CW3-10, GW3-12, HB2-2, ISB3-1, RH3-11, TS3-2, TS3-3, TS3-4, TS3-5, TS3-6, TS3-7, TS3-8, TS3-9, TS3-10, TS3-12, VS1-1 (Credited), VS1-2, VS2-1a (Credited), VS2-1b, VS2-2, VS3-1, VS3-2

CodeBeamer reference: S.03.06-7049

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation

Derived from: PHAR

Vessel Systems Requirements

Safety Requirement:

Core Vessel Pressure Relief
The Core Vessel shall maintain an internal pressure of less than +7.35 PSIG.

Note: A pressure relief system with burst disc shall be designed to ensure that +7.35 PSIG is not exceeded.

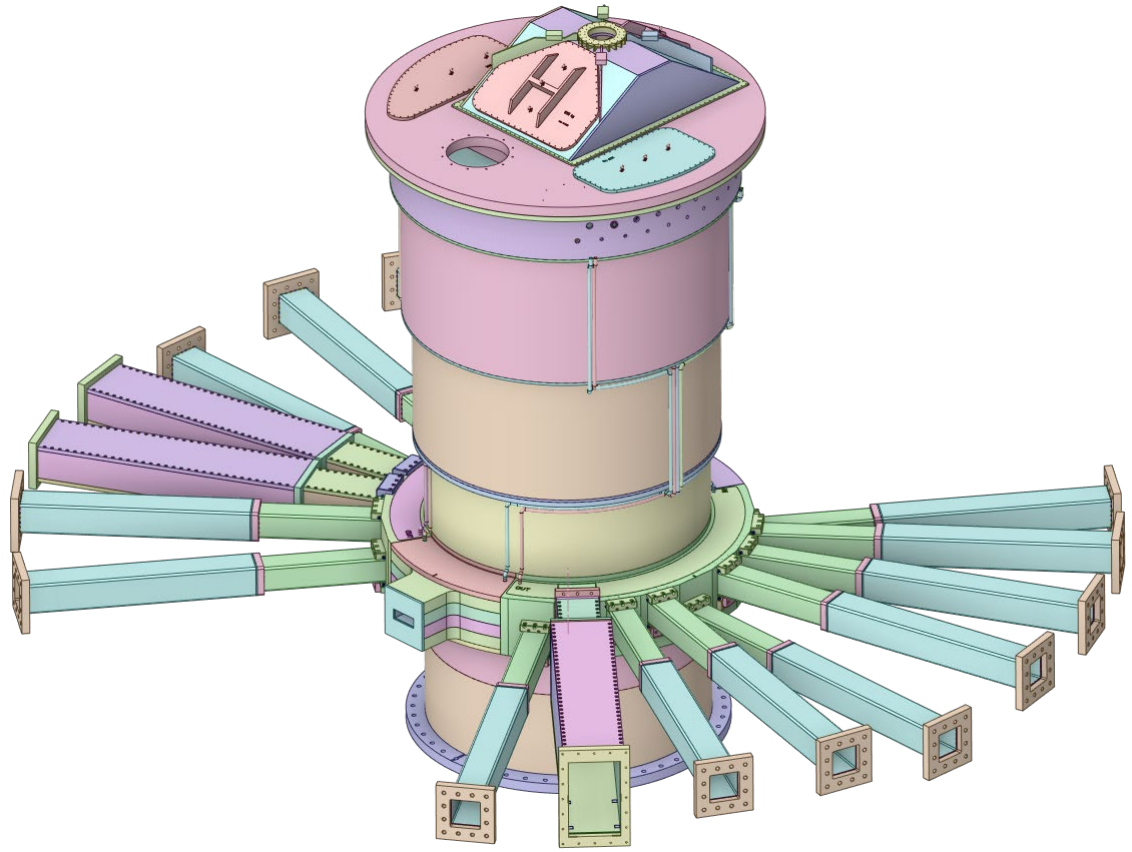
Note: Pressure limit determined by Proton Beam Window per Interface Sheet S01020500-IST10217.

PHAR References:
AIC3-3, AIC3-5, AIC3-9, AIC3-10, AIC7-1, BG7-8, BG7-9a, BG7-9b, CMS1-1, CMS2-1, CMS2-2a, CMS2-2b, CMS4-1, CMS4-2, CMS4-4, CW3-1d, CW3-3a, CW3-3b, CW3-10, TS3-2, TS3-3, TS3-4, TS3-5, TS3-6, TS3-7, TS3-8, TS3-10, TS3-12, VS1-1, VS2-1a, VS3-2

CodeBeamer reference: S.03.06-7047

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation



Derived from: PHAR

Vessel Systems Requirements

Safety Requirement:

Core Vessel Pressure Range
Core Vessel shall be designed to operate in a range of full vacuum to +15 psig per the STS Design and Fabrication of Pressure and Vacuum Systems (S01020000-PC0007).

PHAR References:
AIC3-3, AIC3-4, AIC3-5, AIC3-9, AIC3-10, AS3-2, BG3-2, BG7-8, BG7-9a, BG7-9b, BG7-11, BG7-12, CMS1-1, CMS2-1, CMS2-2a, CMS2-2b (Credited), CMS2-2C, CMS3-4, CMS3-6, MCS3-7, CMS4-1, CMS4-2, CMS4-4, CMS7-6, CW3-1a, CW3-1b, CW3-1d, CW3-2a, CW3-2b, CW3-3a, CW3-3b, CW3-7a, CW3-7b, CW3-10, HB2-2, TS3-2, TS3-3, TS3-4, TS3-5, TS3-6, TS3-7, TS3-8, TS3-9, TS3-12, VS1-1 (Credited), VS2-1a (Credited), VS2-2, VS3-1, VS3-2

CodeBeamer reference: S.03.06-7052

Upstream References (2)

S.03-1035	Safe Operation
S.03-1036	Radiation Safety

Derived from: PHAR

Vessel Systems Requirements

Safety Requirement:

Core Vessel Pressure Relief
The Core Vessel shall maintain an internal pressure of less than +7.35 PSIG.

Note: A pressure relief system with burst disc shall be designed to ensure that +7.35 PSIG is not exceeded.

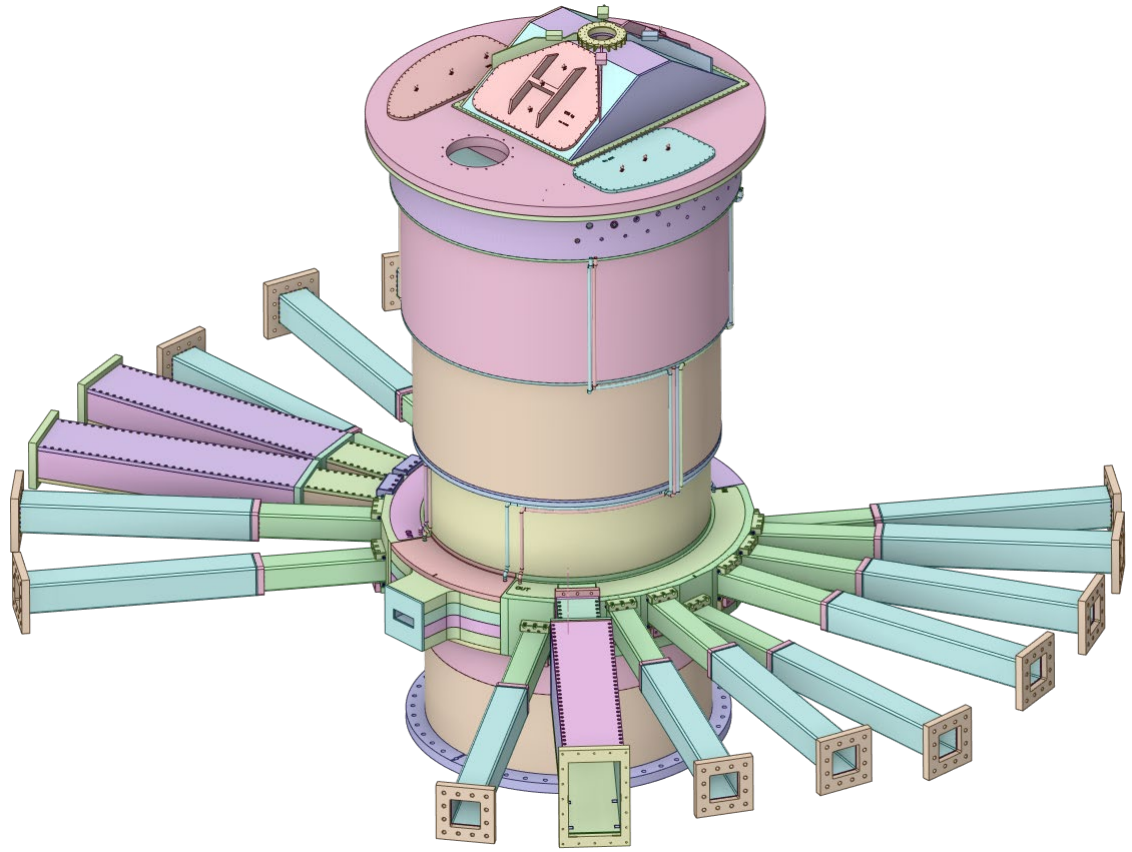
Note: Pressure limit determined by Proton Beam Window per Interface Sheet S01020500-IST10217.

PHAR References:
AIC3-3, AIC3-5, AIC3-9, AIC3-10, AIC7-1, BG7-8, BG7-9a, BG7-9b, CMS1-1, CMS2-1, CMS2-2a, CMS2-2b, CMS4-1, CMS4-2, CMS4-4, CW3-1d, CW3-3a, CW3-3b, CW3-10, TS3-2, TS3-3, TS3-4, TS3-5, TS3-6, TS3-7, TS3-8, TS3-10, TS3-12, VS1-1, VS2-1a, VS3-2

CodeBeamer reference: S.03.06-7047

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation



Derived from: PHAR

Vessel Systems Requirements

Safety Requirement:

Non-flammable Materials
Core Vessel and Core Vessel shielding components shall be made of non-flammable materials where practical.

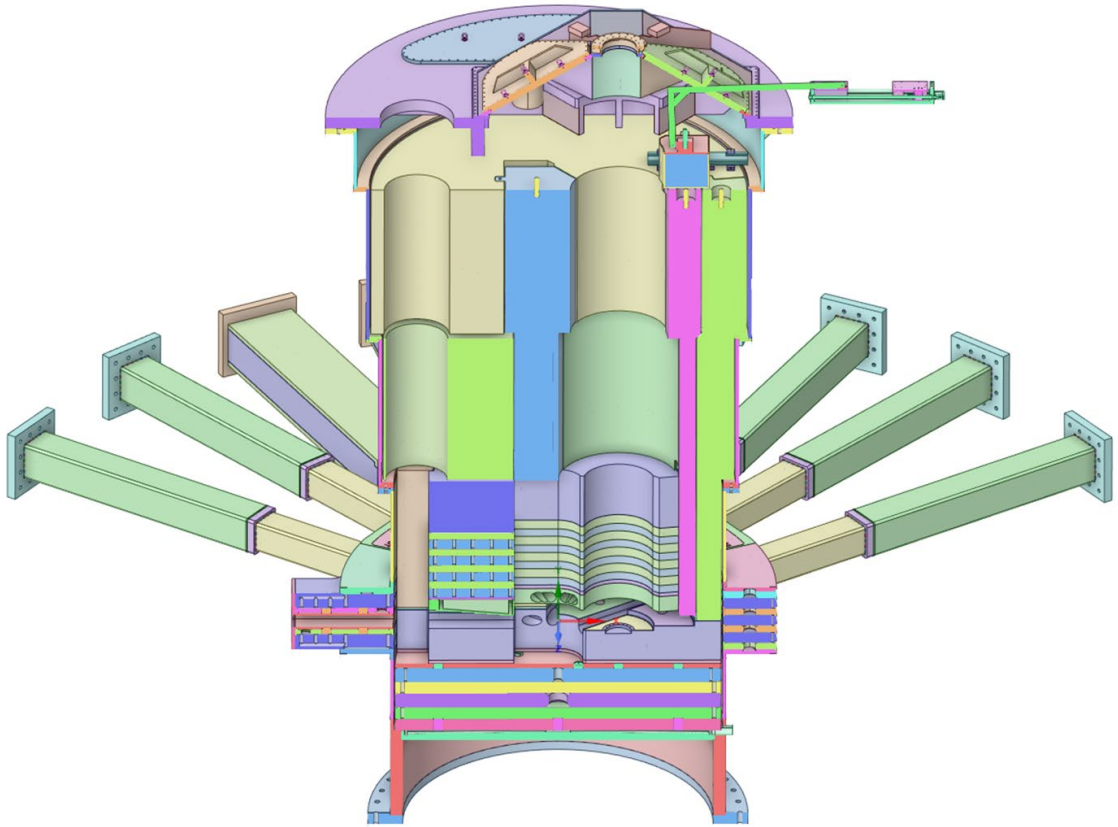
Note: Small volumes (<0.01%) of elastomers will be used for vacuum and water seals within Vessel Systems scope.

PHAR References:
BG1-1, BG6-9 (Credited), BG7-1a, BG7-11, CMS2-2C, CMS7-3, CW3-2a, CW3-2b, VS1-1, VS1-2, VS2-1a, VS2-1b

CodeBeamer reference: S.03.06-7053

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation



Derived from: PHAR

Vessel Systems Requirements

Safety Requirement:

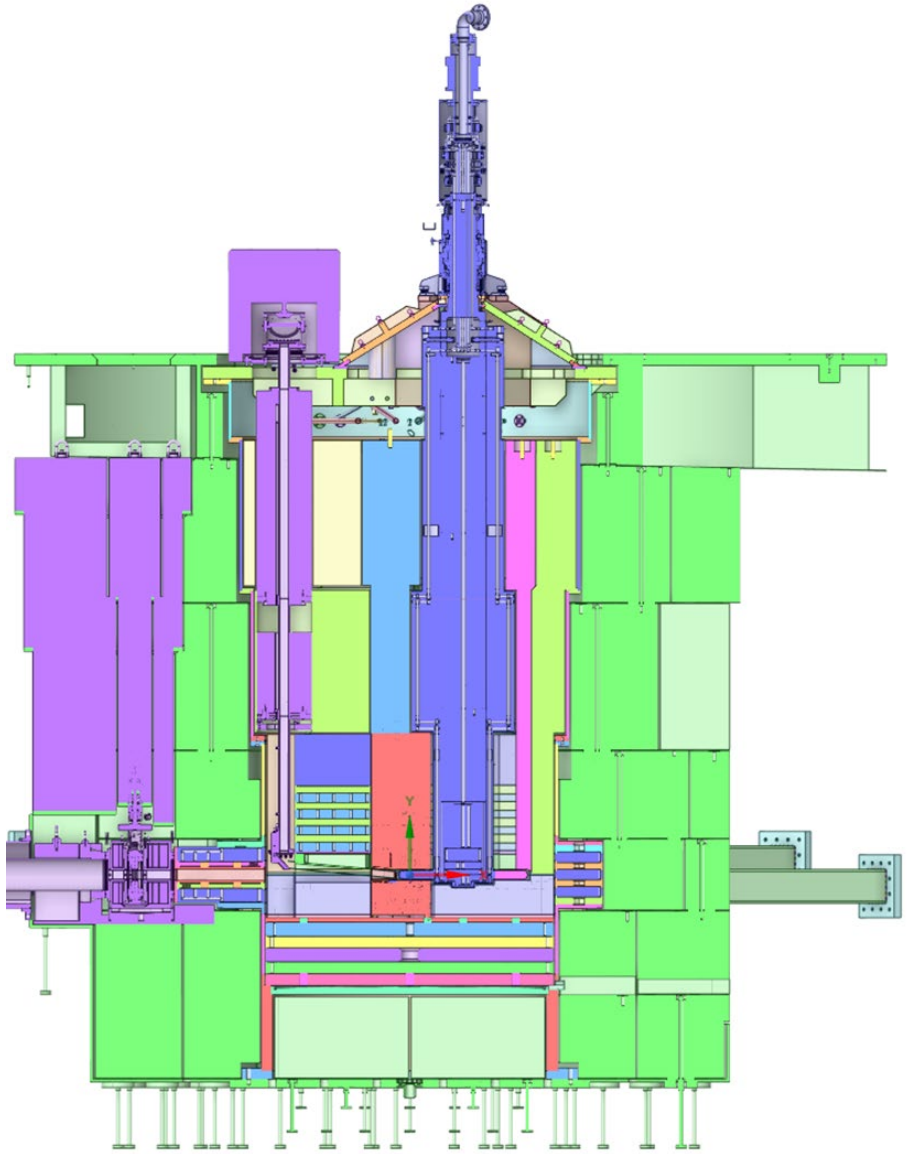
Target Temperature Limit during Facility Fire
Core Vessel shielding shall keep target temperature below 800C under reasonable fire conditions.

PHAR References:
BG1-1, BG6-9 (Credited), BG7-1a, BG7-11, CMS7-3, CMS7-5, CMS7-7 (Credited), CW3-2a, CW3-2b

CodeBeamer reference: S.03.06-7054

Upstream References (2)

S.03-1035	Safe Operation
S.03-1036	Radiation Safety



Derived from: PHAR

Vessel Systems Requirements

Safety Requirement:

Impact Damage Protection
The Monolith steel shielding shall protect the Target feet and Moderator Reflector Assembly from physical impact damage when the Target System is installed and in operational configuration.

Note: Monolith steel shielding does not protect Moderator Reflector Assembly or target feet that have been removed from their home positions within the monolith.

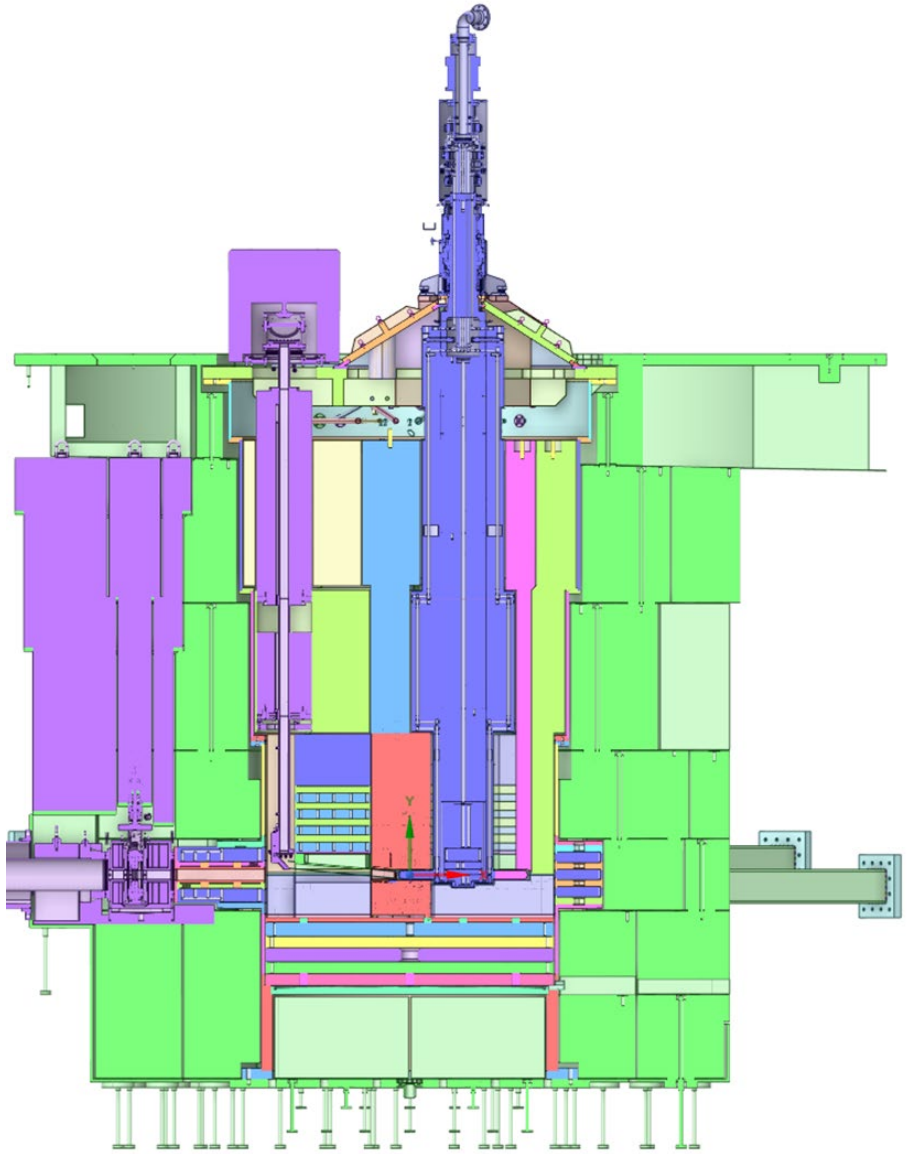
Note: Monolith steel shielding provides less protection when removable shielding is not in place during maintenance activities.

PHAR References:
BG6-6, BG6-7, BG6-9 (Credited), BG6-10, BG7-4, CMS2-5, HB2-2, HB2-3, RH3-1, RH3-2, RH3-5

CodeBeamer reference: S.03.06-7055

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation



Derived from: PHAR

Vessel Systems Requirements

Safety Requirement:

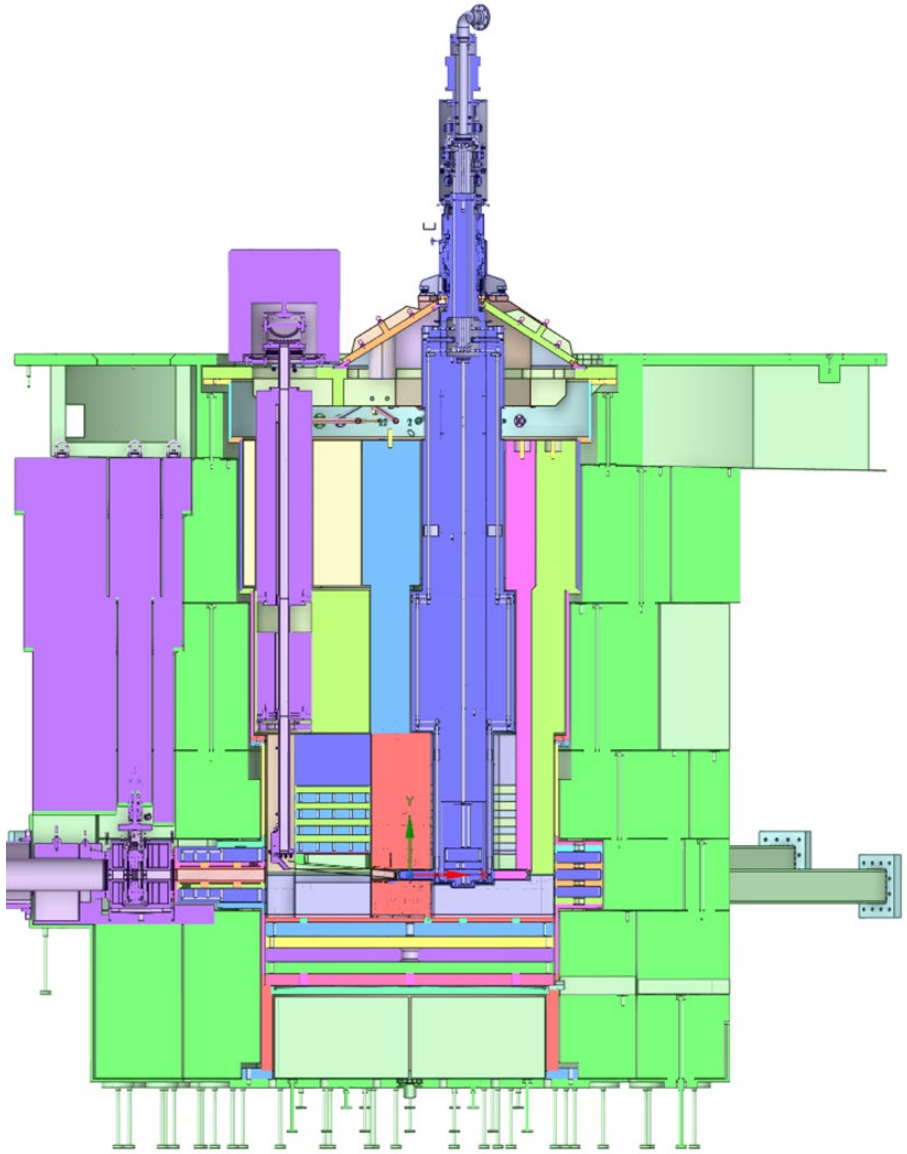
Protect Cryogenic Transfer Lines
Vessel Systems shall not permit the Core Vessel or shielding within the Core Vessel to cause the Moderator Reflector Assembly or cryogenic transfer lines to release Hydrogen under SDC2 seismic conditions.

PHAR References:
BG7-1a (Credited), BG7-2, BG7-11 (Credited), BG7-12, CMS4-2, CMS7-1, CMS7-5 (Credited), CMS7-7 (Credited)

CodeBeamer reference: S.03.06-7056

Upstream References (2)

S.03-1035	Safe Operation
S.03-1036	Radiation Safety



Derived from: PHAR

Vessel Systems Requirements

Safety Requirement:

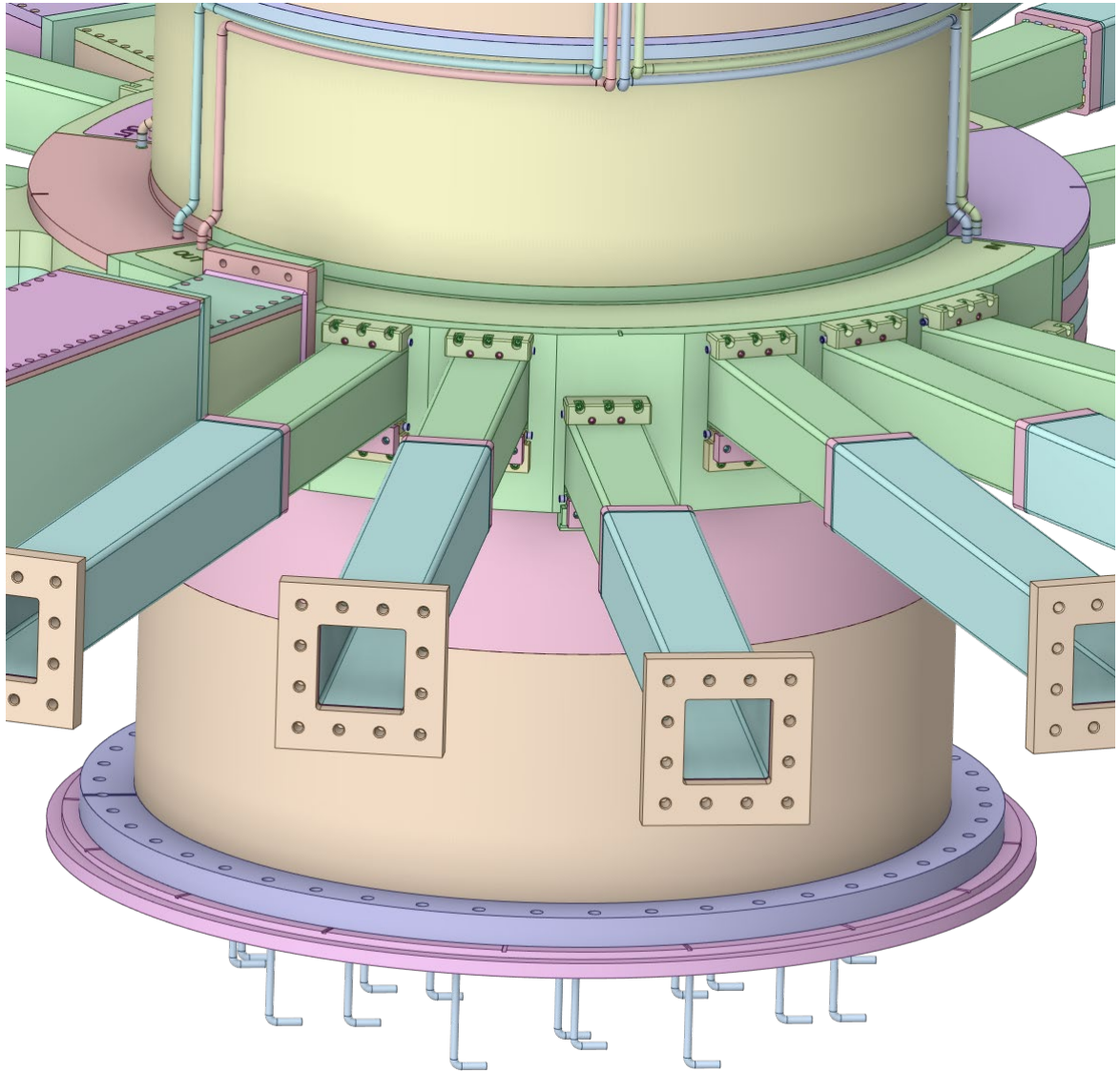
Core Vessel Anchoring
The Core Vessel shall be anchored in such a way to limit motion of the Core Vessel base flange relative to the floor to < 0.1 mm under SDC Level 2 seismic loads.

PHAR References:
BG7-2, BG7-12, CMS7-1, CMS7-3, CMS7-5

CodeBeamer reference: S.03.06-7057

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation



Derived from: PHAR

Vessel Systems Requirements

Safety Requirement:

Core Vessel Environment
Core Vessel shall maintain an inert environment (≤1 torr vacuum or ≤ 700 torr helium) under normal operating conditions

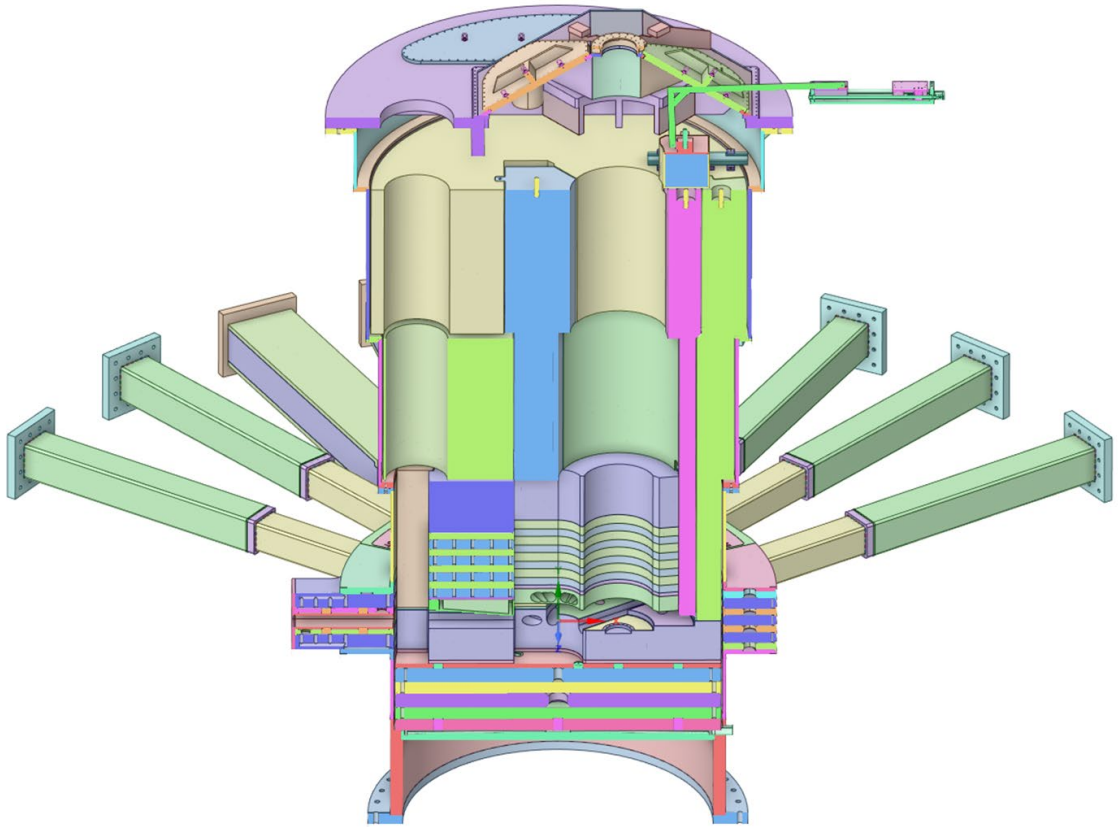
Note: The Core Vessel environment will extend to the Nozzle Extensions accommodating the Instrument Systems Monolith Inserts. Vacuum pumping and instrumentation is in the scope of Target Vacuum Systems, but Vessel Systems and interfacing components that make up the vacuum boundary must be capable of maintaining the required pressure, i.e. to hold leak rates low enough to maintain the required pressure.

PHAR References:
AIC3-3, AIC3-4, AIC3-5, AIC3-9, AIC3-10, AS3-2, BG3-2, BG7-8, BG7-9A, BG7-9B, BG7-11, BG7-12, CMS1-1, CMS2-1, CMS2-2A, CMS2-2b (Credited), CMS2-2C, CMS3-4, CMS3-6, CMS3-7, CMS4-1, CMS4-2, CMS4-4, CMS7-1, CMS7-3, CMS7-5, CMS7-6, CMS7-7, CW3-1A, CW3-1B, CW3-1D, CW3-2A, CW3-2B, CW3-3A, CW3-3B, CW3-7A, CW3-7B, CW3-10, GW3-12, HB2-2, ISB3-1, RH3-11, TS3-2, TS3-3, TS3-4, TS3-5, TS3-6, TS3-7, TS3-8, TS3-9, TS3-10, TS3-12, VS1-1 (Credited), VS1-2, VS2-1A (Credited), VS2-1B, VS2-2, VS3-1, VS3-2

CodeBeamer reference: S.03.06-7058

Upstream References (2)

S.03-1035	Safe Operation
S.03-1036	Radiation Safety



Derived from: PHAR

Vessel Systems Requirements

Safety Requirement:

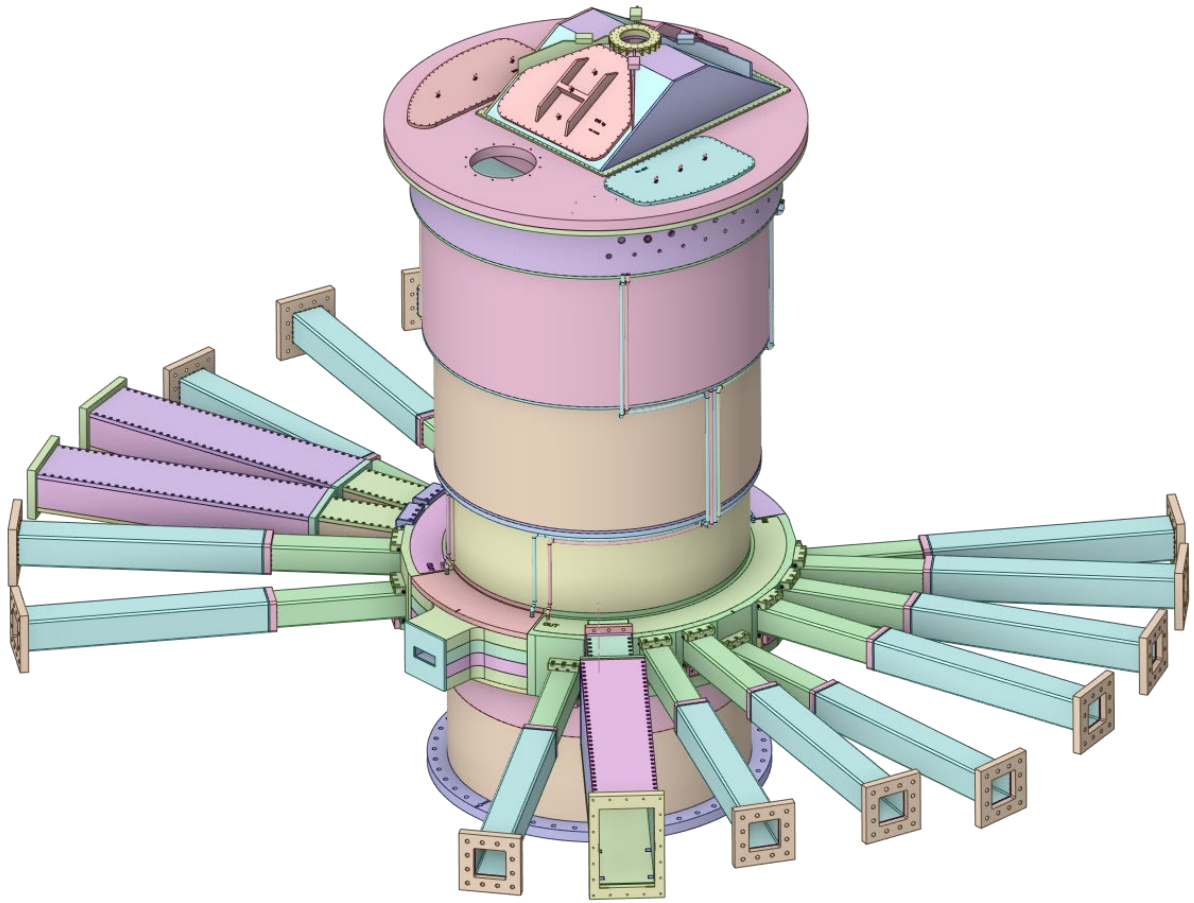
Core Vessel Negative Pressure with Hatches Removed
Core Vessel shall have an exhaust port that provides negative pressure when Core Vessel lid hatches are removed.

PHAR References:
CMS2-2C (Credited), RH3-1, RH3-2, RH3-4, RH3-5, RH3-6, RH3-7, RH3-8, RH3-9, RH3-10, RH3-11, RH3-21, RH3-22, RH3-24, RH3-25, RH3-26, RH3-27, VS3-3

CodeBeamer reference: S.03.06-7059

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation



Derived from: PHAR

Vessel Systems Requirements

Safety Requirement:

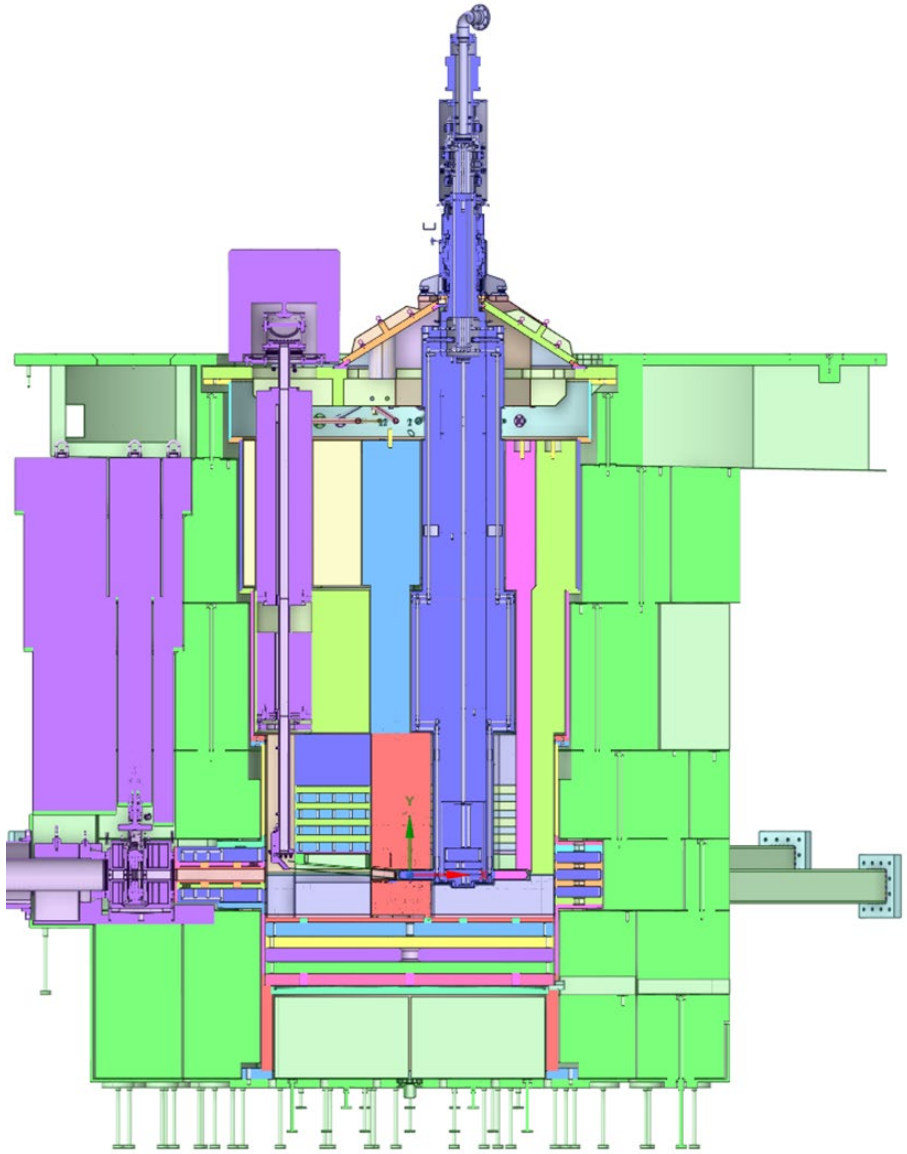
Radiation Shielding Performance
Vessel Systems design, along with the other Target Systems components in the Monolith and Target Drive Room, shall not prevent necessary operations in the high bay due to radiation dose.

PHAR References:
RH4-7 (Credited), RH4-8 (Credited), RH4-9, RH4-10 (Credited), VS4-1 (Credited)

CodeBeamer reference: S.03.06-7060

Upstream References (2)

S.03-1035	Safe Operation
S.03-1036	Radiation Safety



Derived from: PHAR

Vessel Systems Requirements

Safety Requirement:

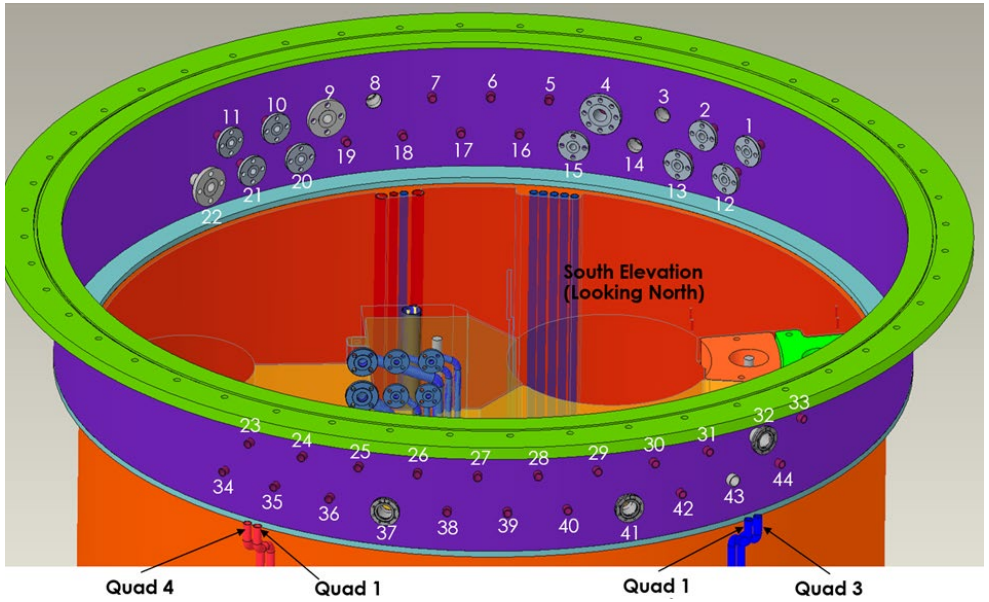
Non-LOF Water-Cooled Component Connections
All water-cooled components that are not considered permanent shall have flanged connections that are broken for component removal.

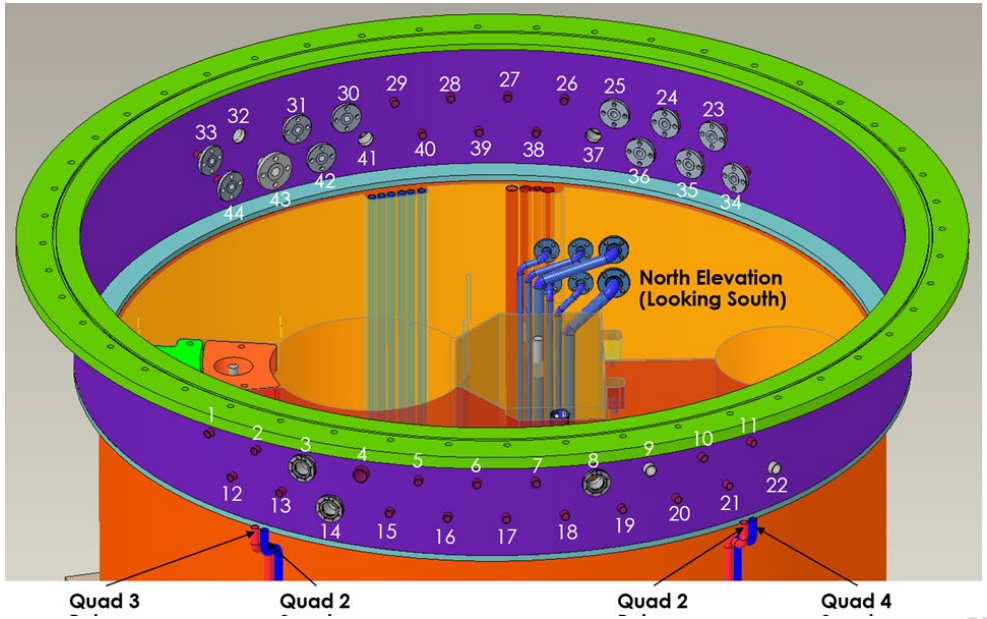
PHAR References:
RH3-17, RH3-18, RH3-20

CodeBeamer reference: S.03.06-7063

Upstream References (2)

S.03-1035	Safe Operation
S.03-3009	Maintenance & Lifetime Criteria





Derived from: PHAR

Vessel Systems Requirements

Safety Requirement:

Target Protection during LOCA
Core Vessel shielding shall assist in maintaining target temperatures below 800 C in a loss of cooling event.

Note: The shielding acts as a thermal sink that helps maintain target temperatures of < 800 C during a loss of cooling event

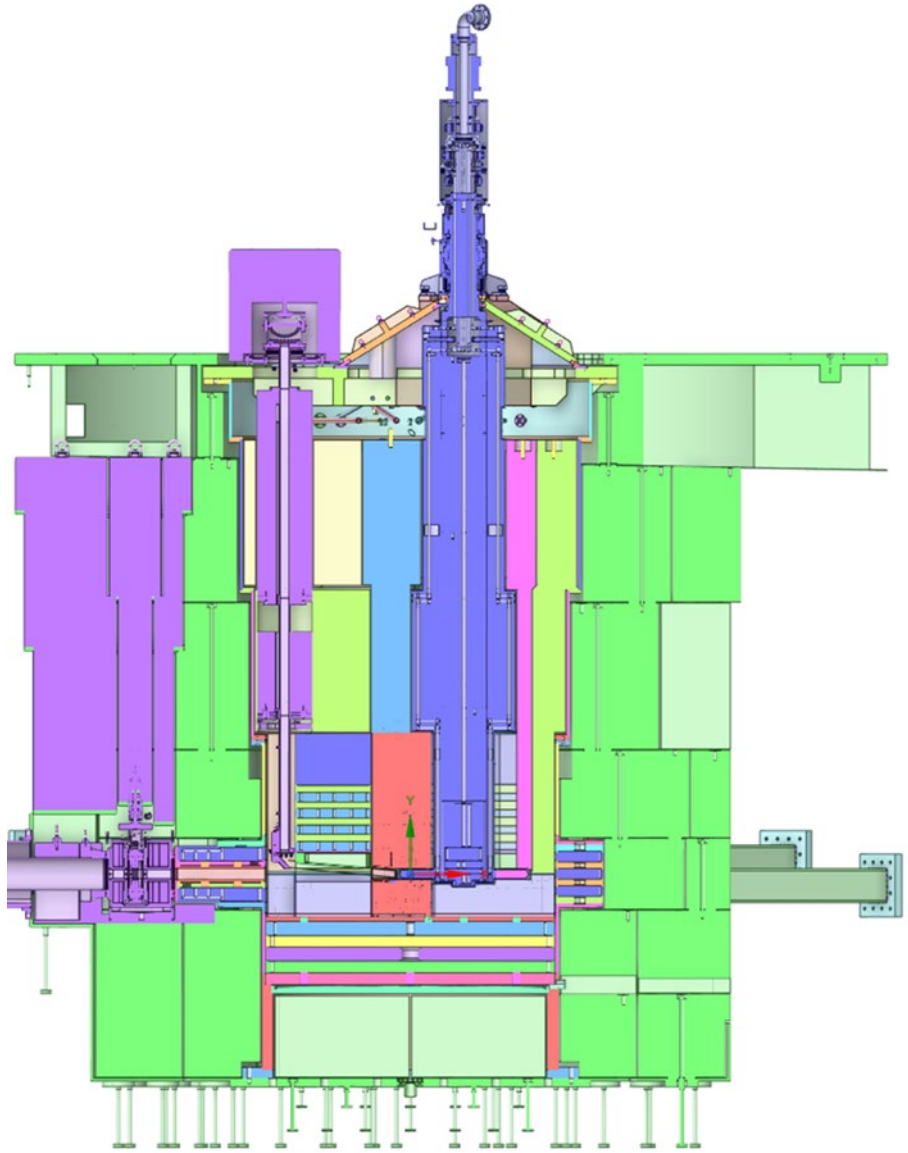
Note: LOCA to be performed by the Target Assembly group with input from Vessel Systems on shielding configuration.

PHAR References:
RG7-8, BG7-9A, BG7-9B, BG7-12, CMS7-1, CMS7-3, CMS7-5 (Credited), CMS7-6, CMS7-7 (Credited), TS3-2, TS3-3, TS3-5, TS3-6, TS3-7

CodeBeamer reference: S.03.06-7064

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation



Derived from: PHAR

Vessel Systems Requirements

Safety Requirement:

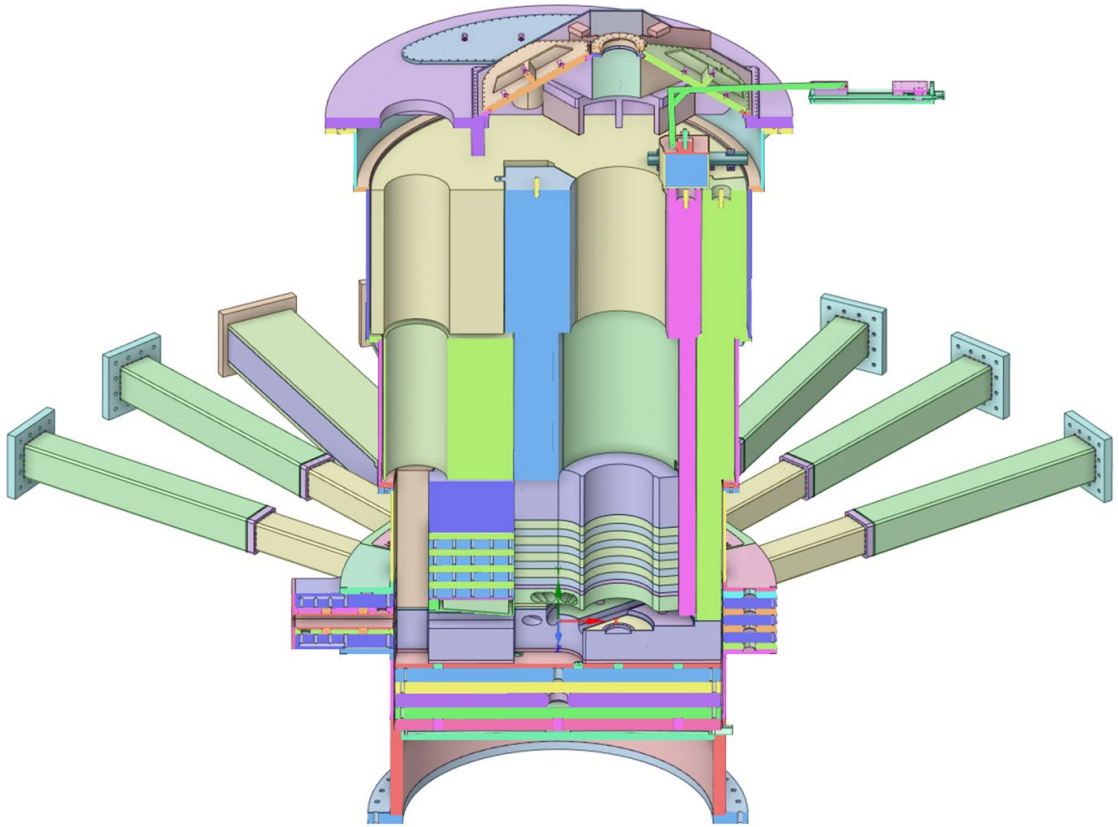
Temperature Monitoring
All vessel systems water cooled components should have thermocouples that monitor component temperature.

PHAR References:
CMS2-2C, CW3-1D, VS1-1, VS1-2, VS1-1A, VS1-1B, VS3-1

CodeBeamer reference: S.03.06-7065

Upstream References (2)

S.03-1035	Safe Operation
S.03-1036	Radiation Safety



Derived from: PHAR

Vessel Systems Requirements

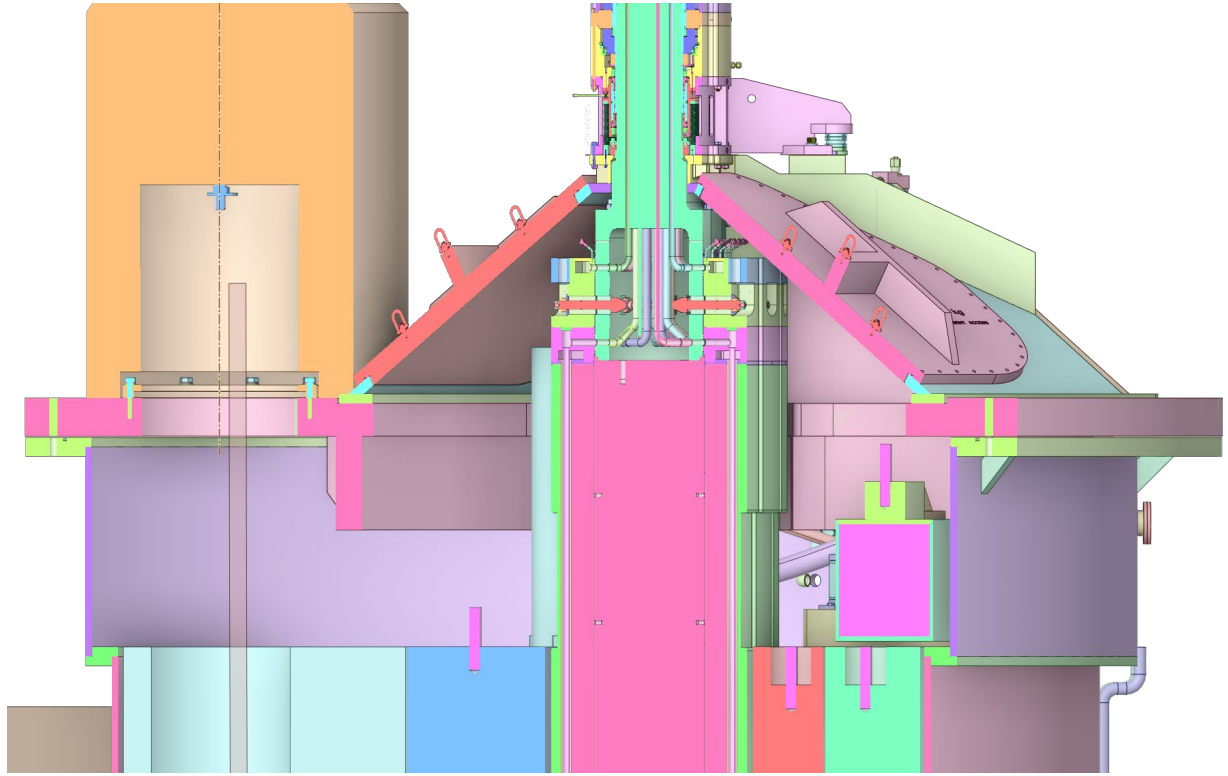
Interface Requirement:

Mechanical Load Support
Vessel Systems shall support the gravitational, imbalance, seismic and segment replacement loads imparted by the target assembly per Interface Sheet S01020500-IST10209 within the deflection limits specified in drawing S03000000-M8U-8800-A10001 at the physical locations specified in drawing S03020000-M8U-8800-A10000.

CodeBeamer reference: S.03.06-7118

Upstream References (1)

S.03.02-1482	Imposed forces



Derived from: S01020500-IST10209 VS-Target Assembly Interface Sheet

Vessel Systems Requirements

Interface Requirement:

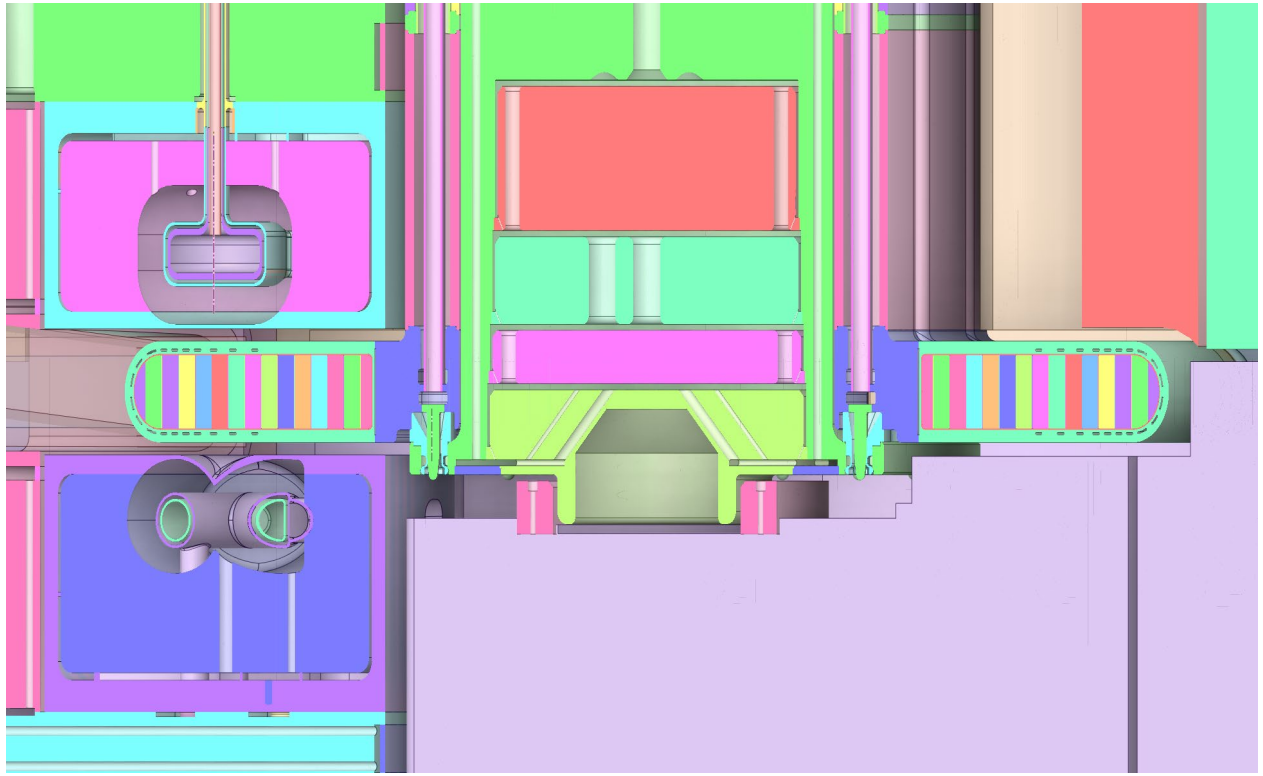
Limiting Ring Integration
Vessel Systems shall provide an interface including a mating face and tapped hole pattern to secure Target Assembly's limiting ring to the Layer 1 Core Vessel shielding. The interfacing dimensions are shown in drawing S0302000-M8U-8800-A10000.

Note: Currently missing from Interface Sheet S01020500-IST10209, will be added during next revision.

CodeBeamer reference: S.03.06-7119

Upstream References (1)

S.03.02-2840	Seismic Deflection



Derived from: S01020500-IST10209 VS-Target Assembly Interface Sheet

Vessel Systems Requirements

Interface Requirement:

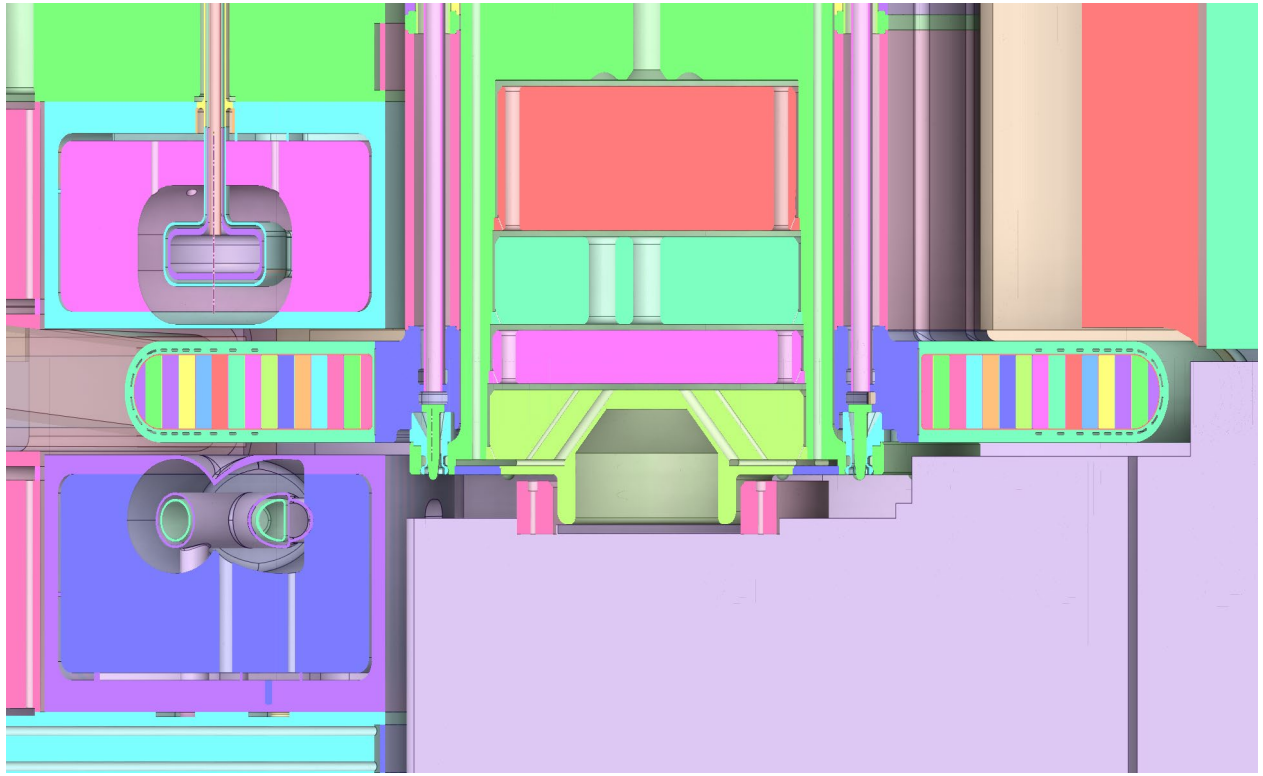
Limiting Ring Mechanical Support
Vessel Systems shall not allow horizontal motion of the portion of the target shaft that contacts the limiting ring in excess of xxxx under a 40 kN seismic side load imparted on the limiting ring by the target shaft.

Note: Currently missing from Interface Sheet S01020500-IST10209, will be added during next revision.

CodeBeamer reference: S.03.06-7120

Upstream References (1)

S.03.02-2840	Seismic Deflection



Derived from: S01020500-IST10209 VS-Target Assembly Interface Sheet

Vessel Systems Requirements

Interface Requirement:

Target Segment Access
Vessel Systems shall allow access to a single target segment within 8 hours per Interface Sheet S01020500-IST10209.

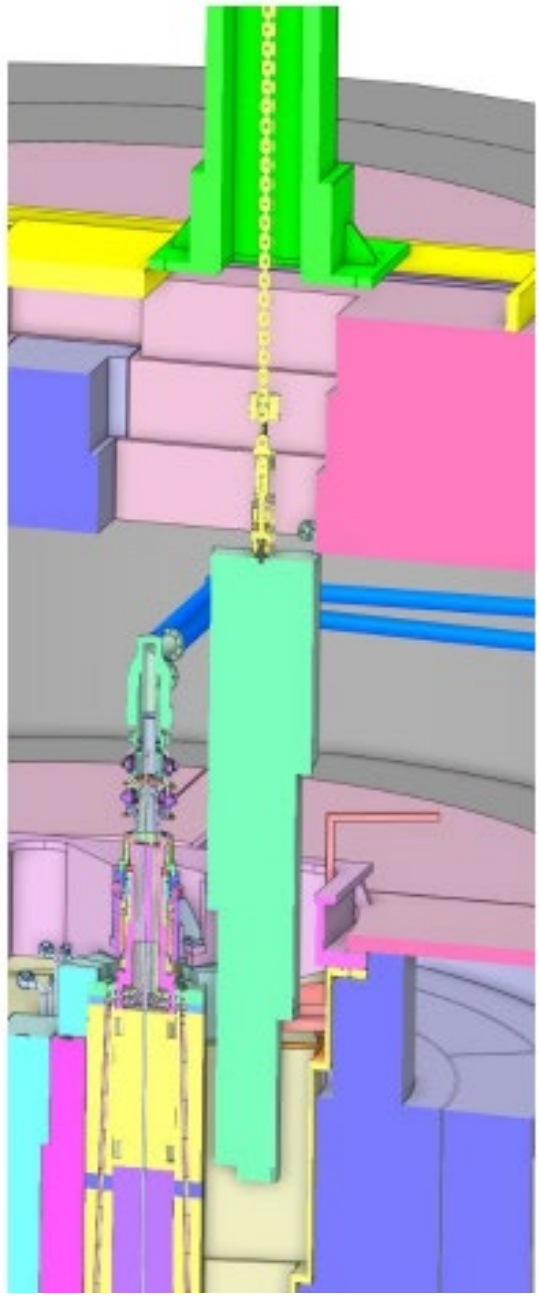
NOTE 1: The clock starts when the Core Vessel is vented and stops when the Target Segment is exposed for removal.

NOTE 2: Driven by Target Segment requirement dictating time allotted for Segment replacement.

CodeBeamer reference: S.03.06-7121

Upstream References (1)

S.03.02.03-1504	Segment Replacement Time



Derived from: S01020500-IST10209 VS-Target Assembly Interface Sheet

Vessel Systems Requirements

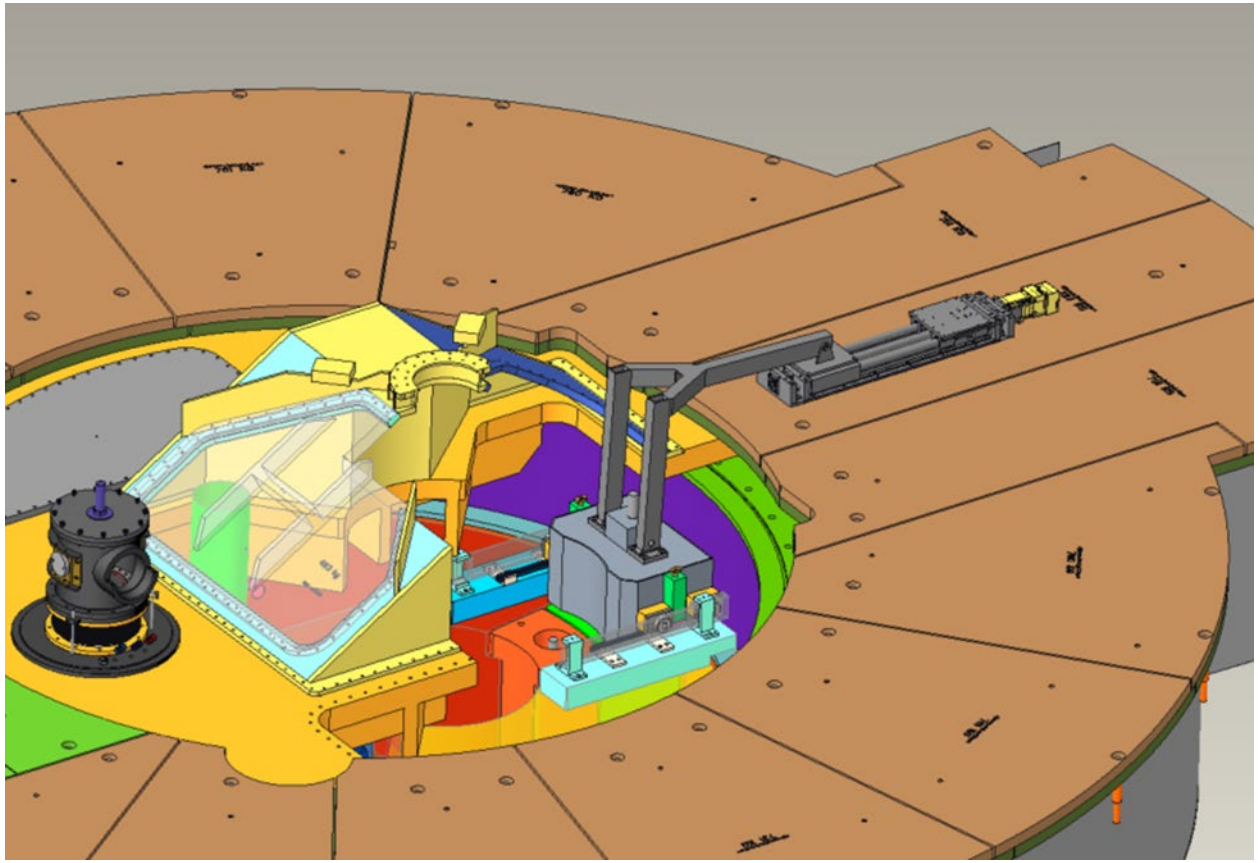
Interface Requirement:

Target Segment Personnel Access
Vessel Systems components shall allow space for personnel and tooling access to the target segment mounting hardware for removal, repair and reinstallation of target segments per Interface Sheet S01020500-IST10209.

CodeBeamer reference: S.03.06-7123

Upstream References (1)

S.03.02.03-1504	Segment Replacement Time



Derived from: S01020500-IST10209 VS-Target Assembly Interface Sheet

Vessel Systems Requirements

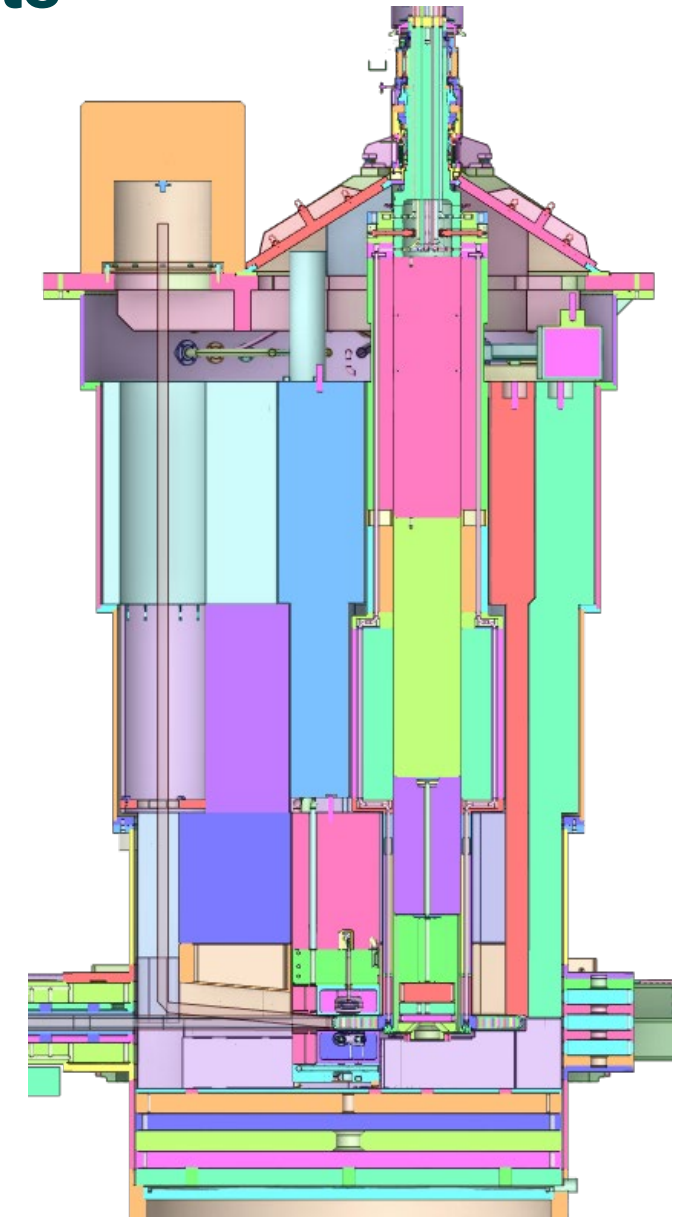
Interface Requirement:

Target Segment Installation Guidance
The Core Vessel Shielding shall provide mechanical boundaries that ensure proper engagement of the target segment to the target shaft when a target segment is installed per Interface Sheet S01020500-IST10209.

CodeBeamer reference: S.03.06-7124

Upstream References (1)

S.03.02.03-1504	Segment Replacement Time



Derived from: S01020500-IST10209 VS-Target Assembly Interface Sheet

Vessel Systems Requirements

Interface Requirement:

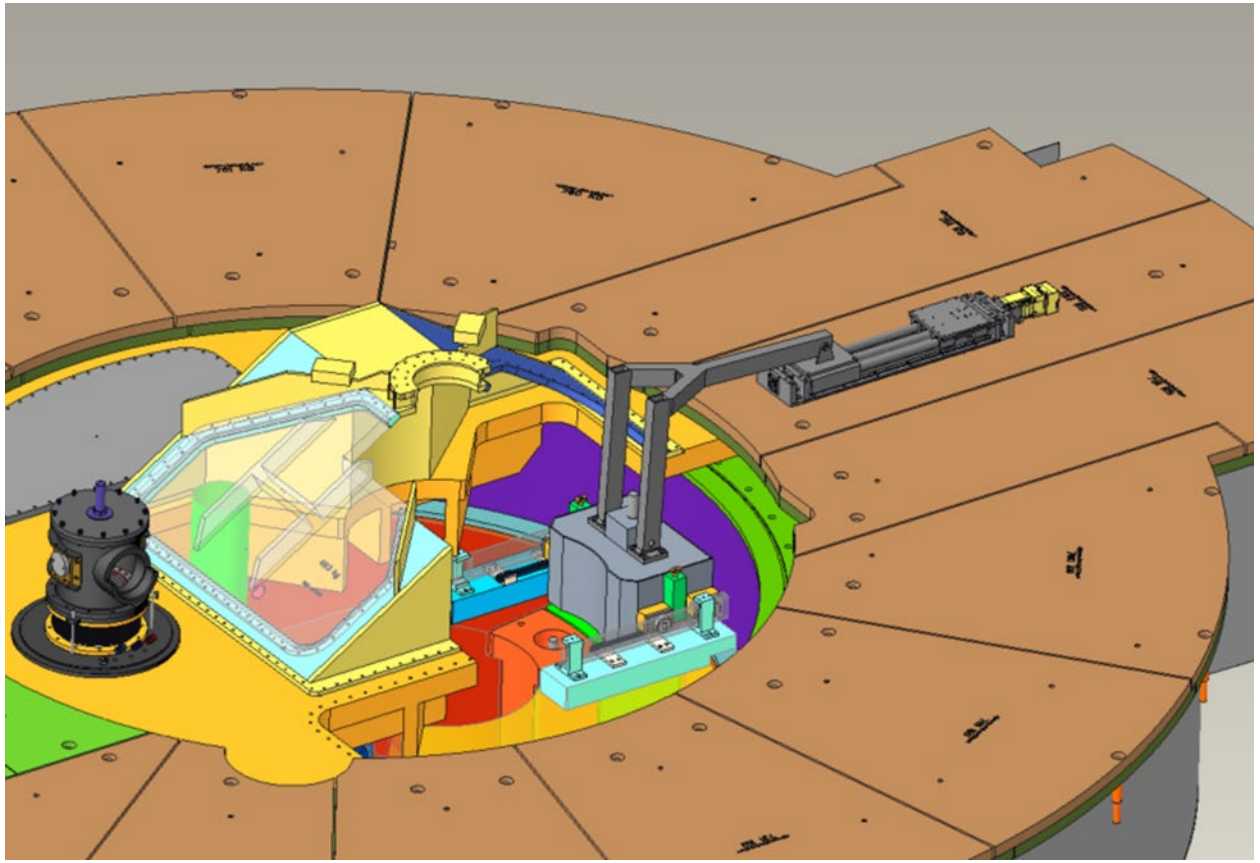
Shielding for Target Segment Removal and Installation
Vessel Systems shall allow for hands-on maintenance at the top of the target segment with the target removable shield block removed.

Note: A gamma gate assembly is moved into place after removable shield block removal to provide radiation protection during hands-on target maintenance.

CodeBeamer reference: S.03.06-7125

Upstream References (1)

S.03.02.03-1504	Segment Replacement Time



Derived from: S01020500-IST10209 VS-Target Assembly Interface Sheet

Vessel Systems Requirements

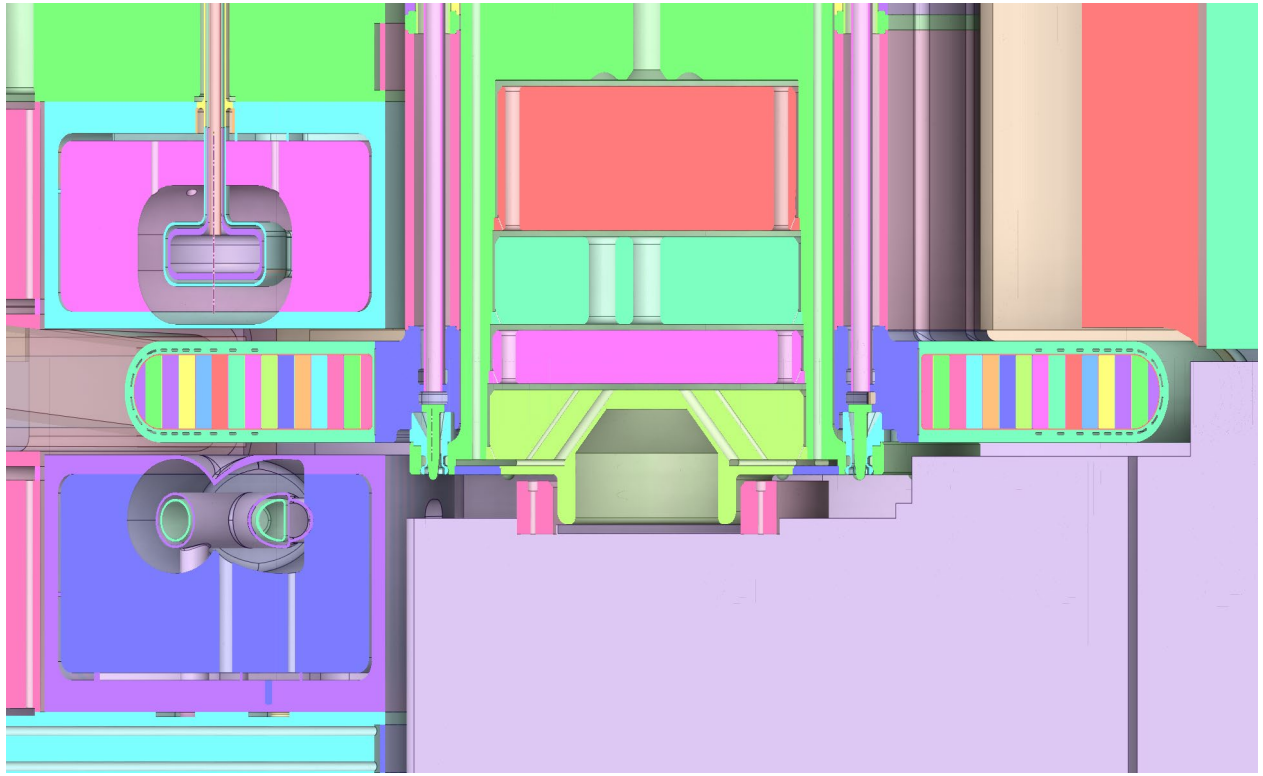
Interface Requirement:

Target Shaft Bottom Support
Vessel Systems shall allow for the full 16,000 kg mass of the target assembly to rest on the bottom Core Vessel shield block without contacting the Moderator Reflector Assembly per Interface Sheet S01020500-IST10209.

CodeBeamer reference: S.03.06-7127

Upstream References (1)

S.03.02.02-1611	Shaft Maintenance Support



Derived from: S01020500-IST10209 VS-Target Assembly Interface Sheet

Vessel Systems Requirements

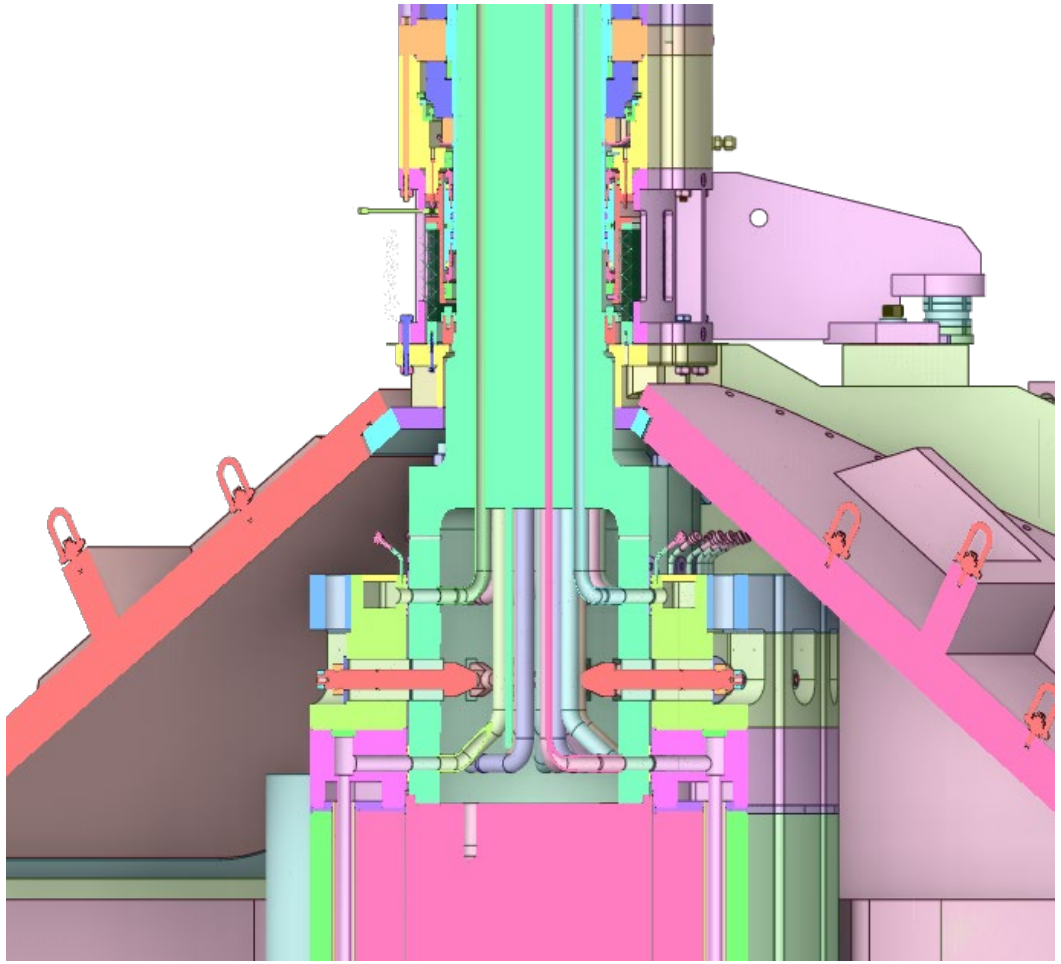
Interface Requirement:

Target Assembly Seal
Vessel Systems shall provide a seal interface for the Target Assembly per Interface Sheet S01020500-IST10209 and drawing S03020000_G8U-8800-A10000.

CodeBeamer reference: S.03.06-7128

Upstream References (1)

S.03.02-1480	Leak Rate



Derived from: S01020500-IST10209 VS-Target Assembly Interface Sheet

Vessel Systems Requirements

Interface Requirement:

Hydrogen Transfer Line Nozzle
Vessel Systems shall provide a nozzle in the side wall of the CV for the hydrogen transfer line per interface sheet S03000000-IST10010.

CodeBeamer reference: S.03.06-7136

Upstream References (1)

S.03.03.01-6102	Hydrogen Transfer Line Routing Requirement - Credited

Derived from: S03000000-IST10010 VS-CMS Interface Sheet

Vessel Systems Requirements

Interface Requirement:

Hydrogen Transfer Line Clearance
Vessel Systems shall provide ≥ 25mm of clearance between Vessel Systems hardware and the transfer line per interface sheet S03000000-IST10010.

CodeBeamer reference: S.03.06-8048

Upstream References (1)

S.03.03.01-6102	Hydrogen Transfer Line Routing Requirement - Credited

Derived from: S03000000-IST10010 VS-CMS Interface Sheet

Vessel Systems Requirements

Interface Requirement:

Hydrogen Transfer Line Support
Vessel Systems shall provide features in the top of the core vessel shielding stack to accommodate hydrogen transfer line supports designed and provided by CMS per Interface Sheet S03000000-IST10010.

CodeBeamer reference: S.03.06-8049

Upstream References (1)

S.03.03.01-6102	Hydrogen Transfer Line Routing Requirement - Credited

Derived from: S03000000-IST10010 VS-CMS Interface Sheet

Vessel Systems Requirements

Interface Requirement:

Hydrogen Transfer Line Welding Access
Vessel Systems shall provide appropriate welding access to the hydrogen transfer lines during MRA installation via removable hatches in the CV lid and removable shielding above the transfer lines per Interface Sheet S0300000-IST10010.

CodeBeamer reference: S.03.06-8050

Upstream References (1)

S.03.03.01-2397	Hydrogen Transfer Line Construction Requirement

Derived from: S03000000-IST10010 VS-CMS Interface Sheet

Vessel Systems Requirements

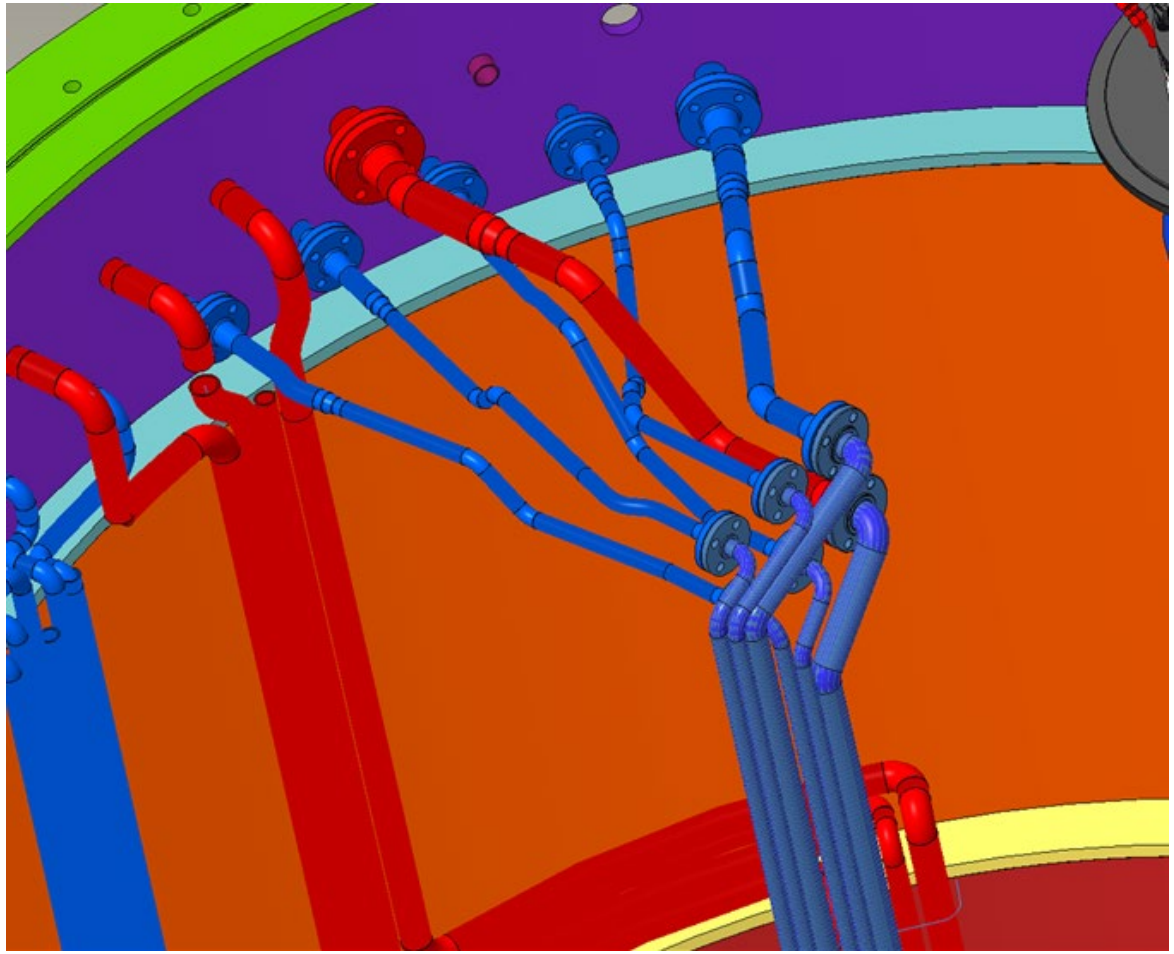
Interface Requirement:

MRA Cooling Water Connections
Vessel Systems shall provide water supply and return lines that connect the Moderator Reflector Assembly water inlet and outlet flanges to the appropriate nozzles in the Core Vessel side wall per Interface Sheet S03000000-IST10009.

CodeBeamer reference: S.03.06-7137

Upstream References (1)

S.03.04-2347	MRA Replacement Requirement



Derived from: S03000000-IST10009 VS-MRA Interface Sheet

Vessel Systems Requirements

Interface Requirement:

MRA Cooling Water Line Tie-Downs
Vessel Systems will provide mounting features to accommodate Moderator Reflector Assembly water line tie-downs per Interface Sheet S03000000-IST10009.

CodeBeamer reference: S.03.06-7138

Upstream References (1)

S.03.04-2994	MRA Deflections Requirement

Derived from: S03000000-IST10009 VS-MRA Interface Sheet

Vessel Systems Requirements

Interface Requirement:

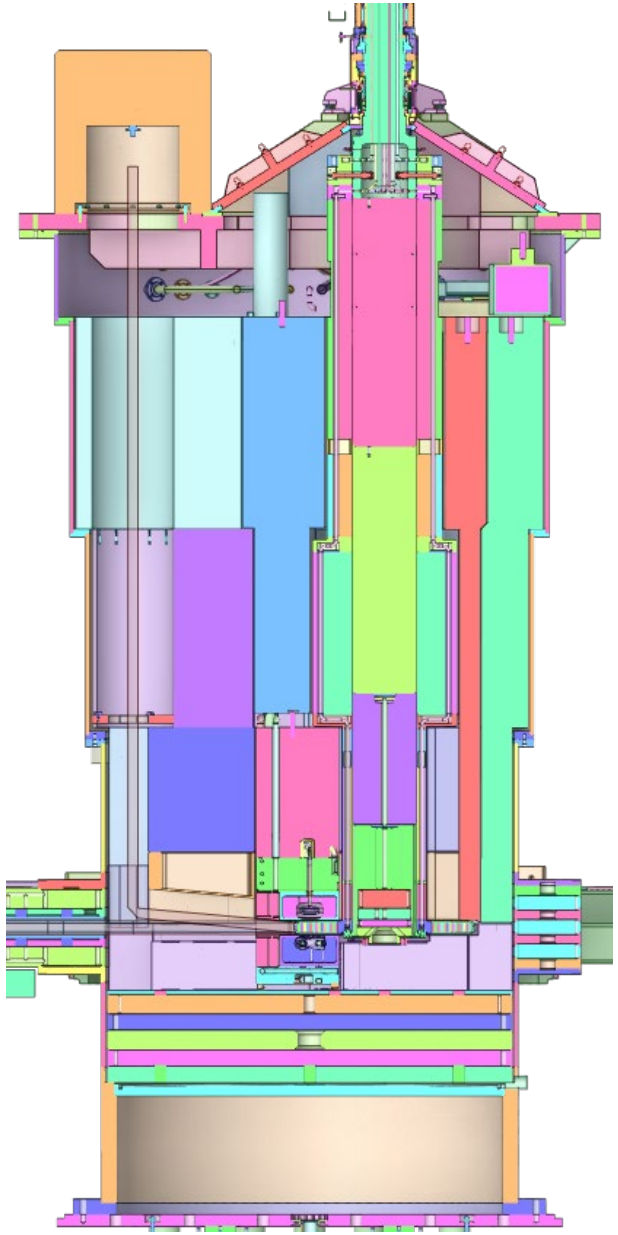
MRA Access
Vessel Systems shall allow access to the Moderator Reflector Assembly within 8 hours per Interface Sheet S03000000-IST10009.

Note: The clock starts when the removal of the Moderator Reflector Assembly access hatch in the Core Vessel lid begins and stops when the Moderator Reflector Assembly is exposed for removal.

CodeBeamer reference: S.03.06-7139

Upstream References (3)

S.03.04-2347	MRA Replacement Requirement
S.03.04-3590	MRA Installation Requirement
S.03.04-3589	MRA Removal Requirement



Derived from: S03000000-IST10009 VS-MRA Interface Sheet

Vessel Systems Requirements

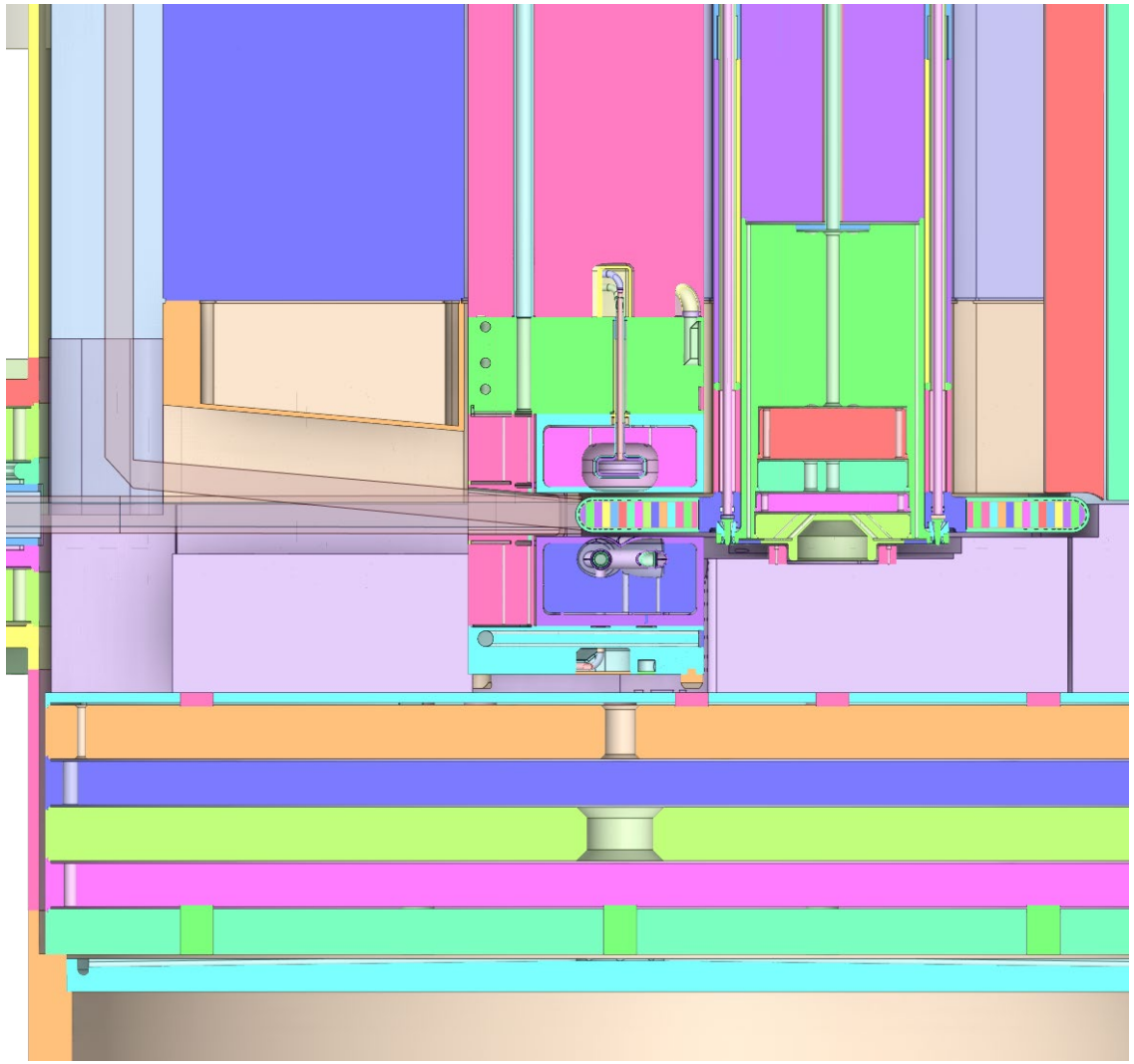
Interface Requirement:

MRA Alignment Features
Vessel Systems shall provide mounting features in the Core Vessel shielding for mounting of the Moderator Reflector Assembly canoe sphere alignment system as described in Interface Sheet S03000000-IST10009.

CodeBeamer reference: S.03.06-7404

Upstream References (1)

S.03.04-2374	MRA Boundary Requirement



Derived from: S03000000-IST10009 VS-MRA Interface Sheet

Vessel Systems Requirements

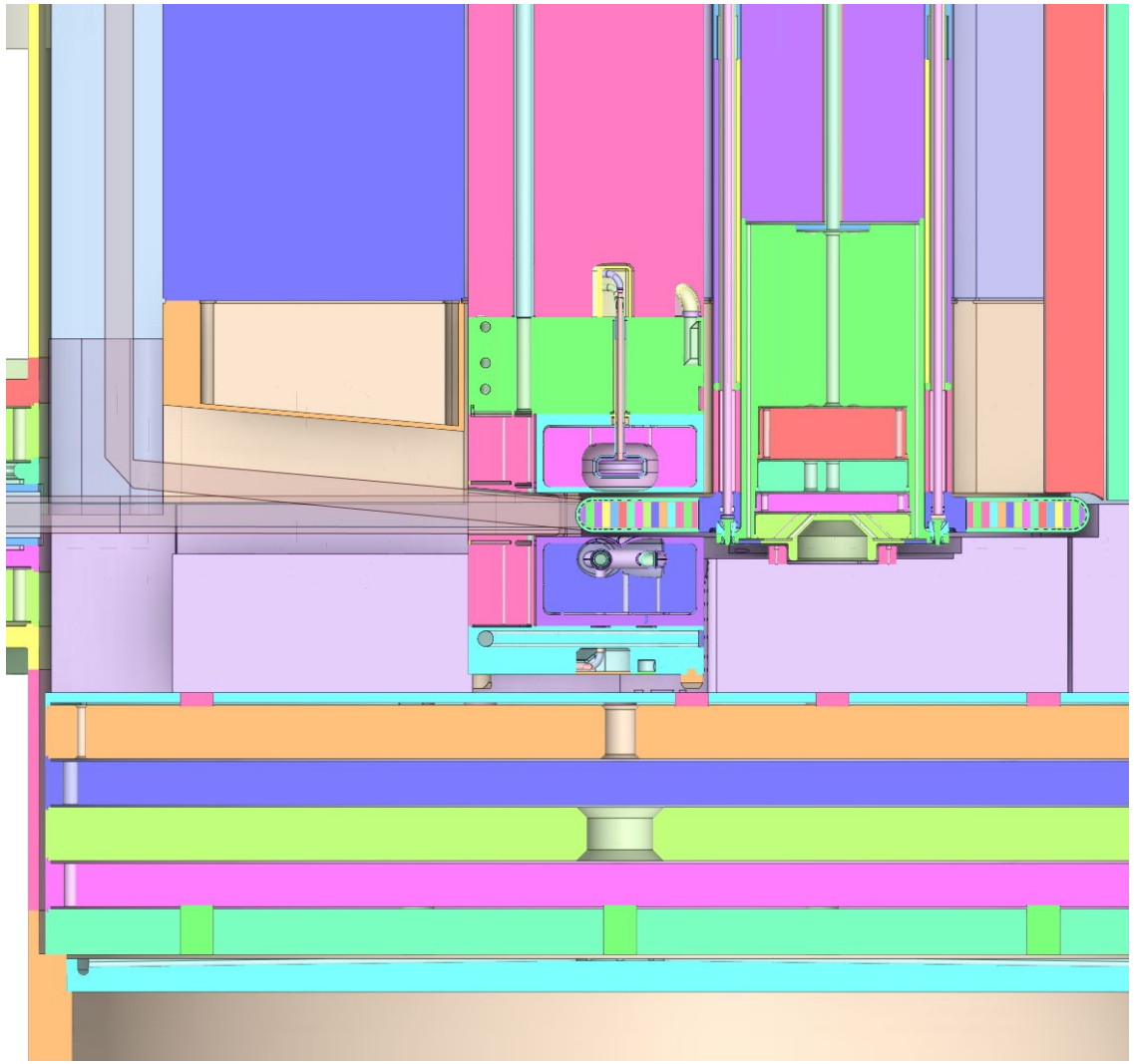
Interface Requirement:

MRA Support
Vessel Systems shall support the loads imparted by the Moderator Reflector Assembly while maintaining the alignment tolerances specified in Interface Sheet S03000000-IST10009.

CodeBeamer reference: S.03.06-7405

Upstream References (1)

S.03.04-2994	MRA Deflections Requirement



Derived from: S03000000-IST10009 VS-MRA Interface Sheet

Vessel Systems Requirements

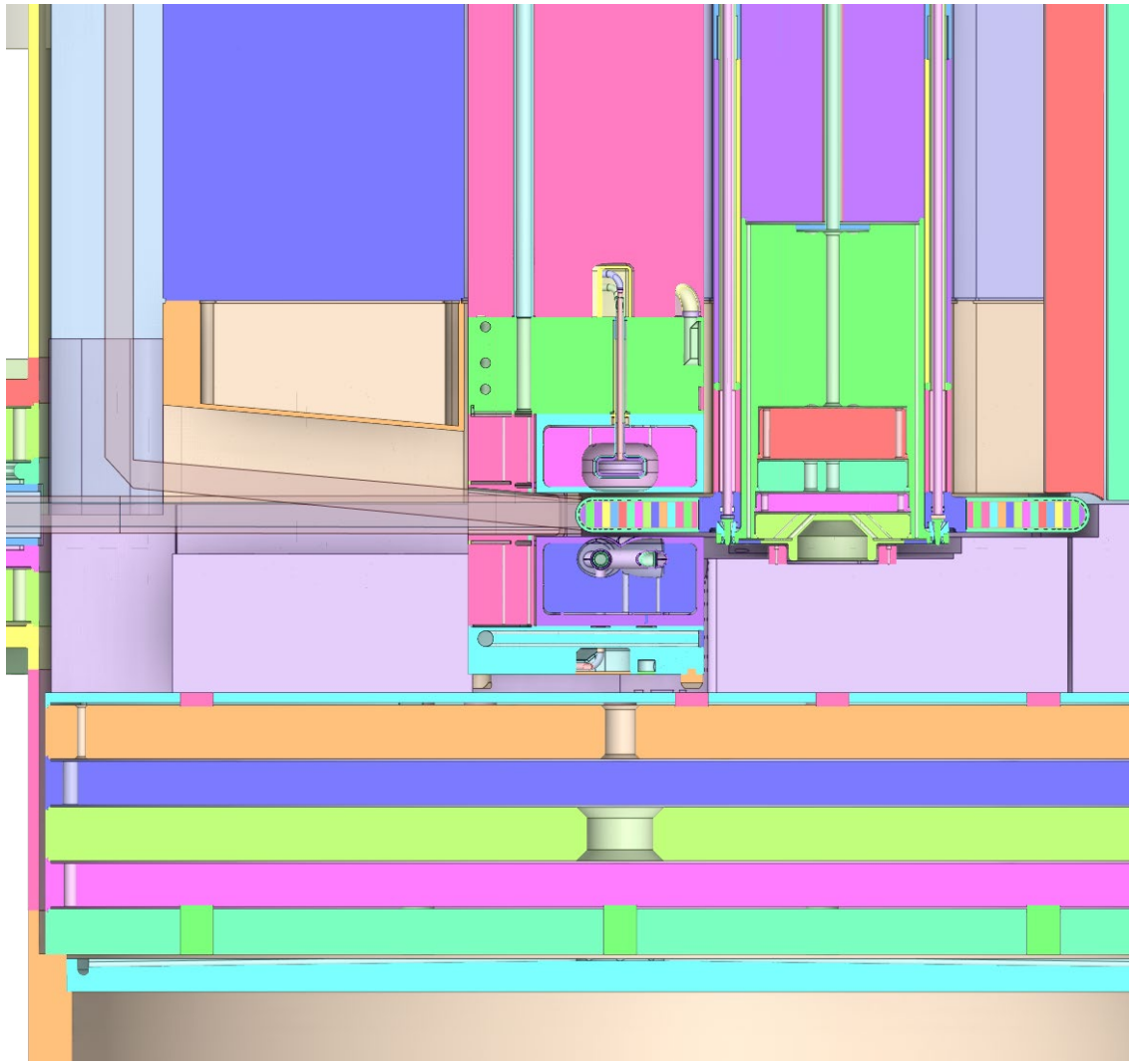
Interface Requirement:

Position and gaps
Vessel Systems shall ensure that all hardware adjacent to the Target and Moderator Reflector Assembly conforms to the positions and gaps outlined in Interface Sheet S01020500-IST10205.

CodeBeamer reference: S.03.06-7407

Upstream References (2)

S.03-1035	Safe Operation
S.03-1478	Hydrogen Boundary interactions



Derived from: S01020500-IST10205 VS-MRA-Target Interface Sheet

Vessel Systems Requirements

Interface Requirement:

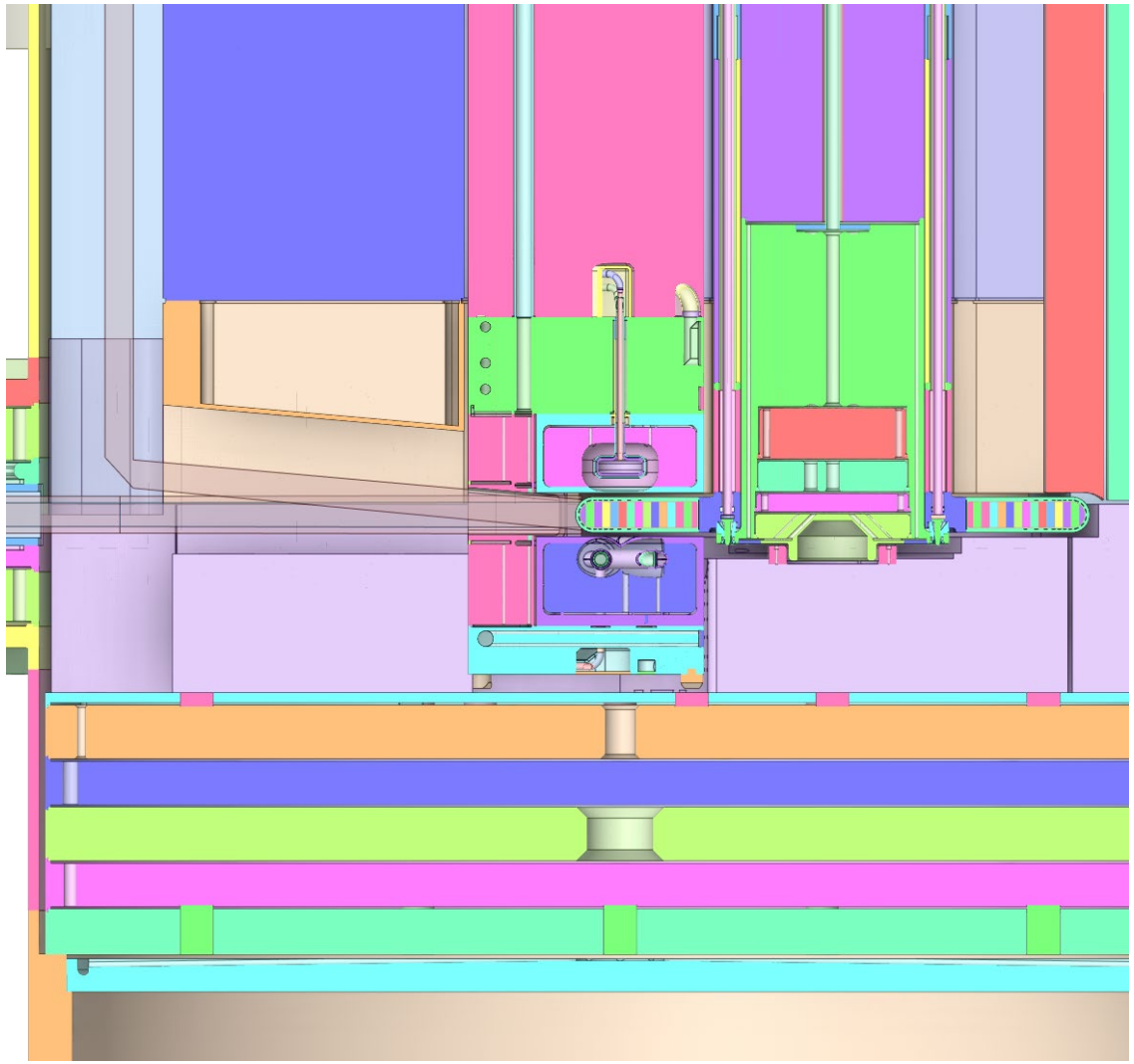
Positional deviations
Vessel Systems shall ensure that all hardware adjacent to the Target and Moderator Reflector Assembly does not deviate beyond the Vessel Systems tolerance allotment per Interface Sheet S01020500-IST10205.

Note: Anticipated deviations include manufacturing, alignment, seismic, thermal and pressure induced.

CodeBeamer reference: S.03.06-7408

Upstream References (2)

S.03-1478	Hydrogen Boundary interactions
S.03-1035	Safe Operation



Derived from: S01020500-IST10205 VS-MRA-Target Interface Sheet

Vessel Systems Requirements

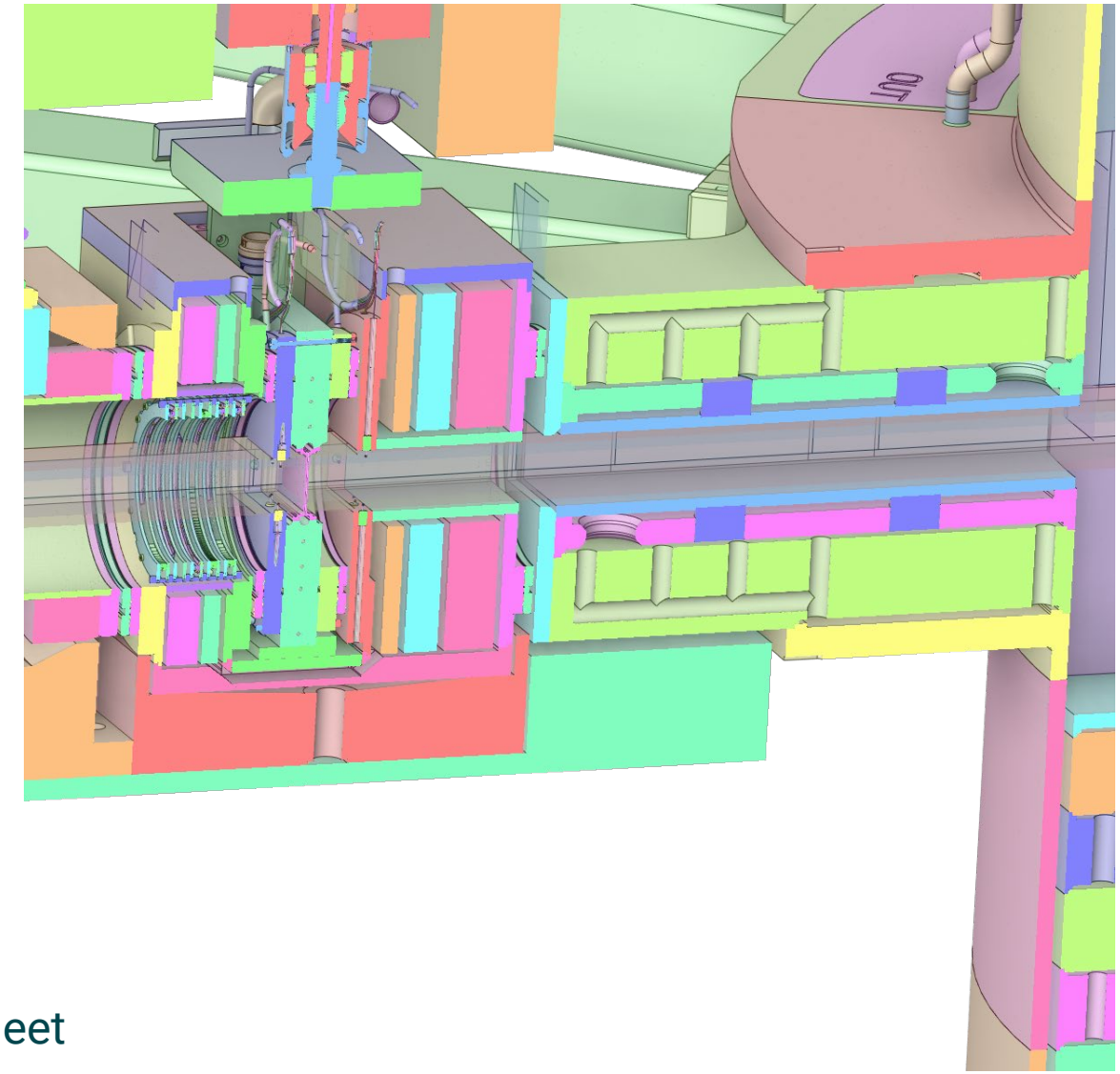
Interface Requirement:

Proton Beam Window Shielding Sealing Interface
Vessel Systems shall provide a sealing surface for the proton beam window shielding that is capable of achieving a <10^-4 Torr l/s leak rate.

CodeBeamer reference: S.03.06-7141

Upstream References (1)

S.03.05.02-7858	PBW Core Vessel Environment



Derived from: S01020500-IST10217 VS-AIC Interface Sheet

Vessel Systems Requirements

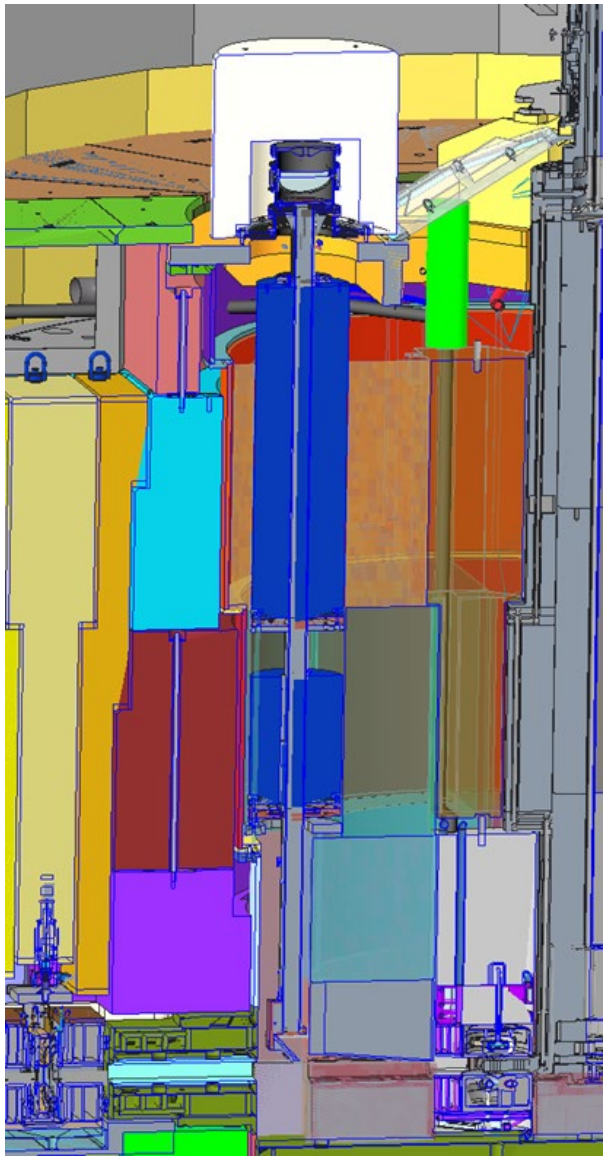
Interface Requirement:

Target Viewing Periscope Alignment Holes
Vessel Systems shall provide mounting holes in the Core Vessel Shielding for mounting of the Target Viewing Periscope canoe sphere alignment system in the locations described in Interface Sheet S01020500-IST10217.

CodeBeamer reference: S.03.06-7144

Upstream References (1)

S.03.05-5732	AIC Measure Beam on Target



Derived from: S01020500-IST10217 VS-AIC Interface Sheet

Vessel Systems Requirements

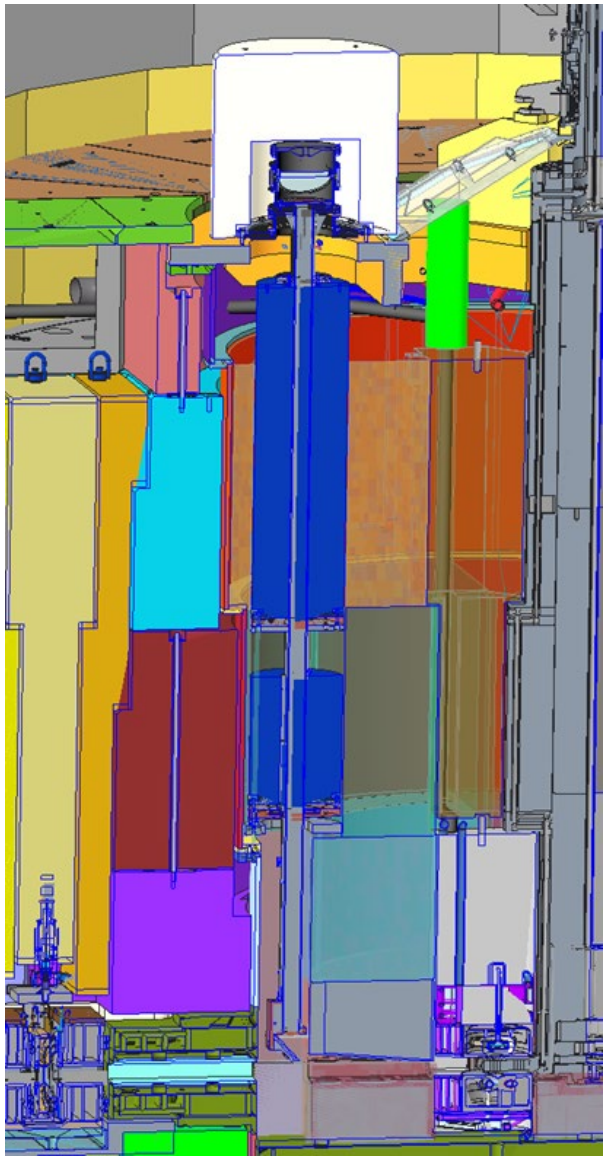
Interface Requirement:

Target Viewing Periscope Support
Vessel Systems shall support the loads imparted by the Target Viewing Periscope assembly while maintaining the alignment tolerances specified in Interface Sheet S01020500-IST10217.

CodeBeamer reference: S.03.06-7145

Upstream References (1)

S.03.05-5732	AIC Measure Beam on Target



Derived from: S01020500-IST10217 VS-AIC Interface Sheet

Vessel Systems Requirements

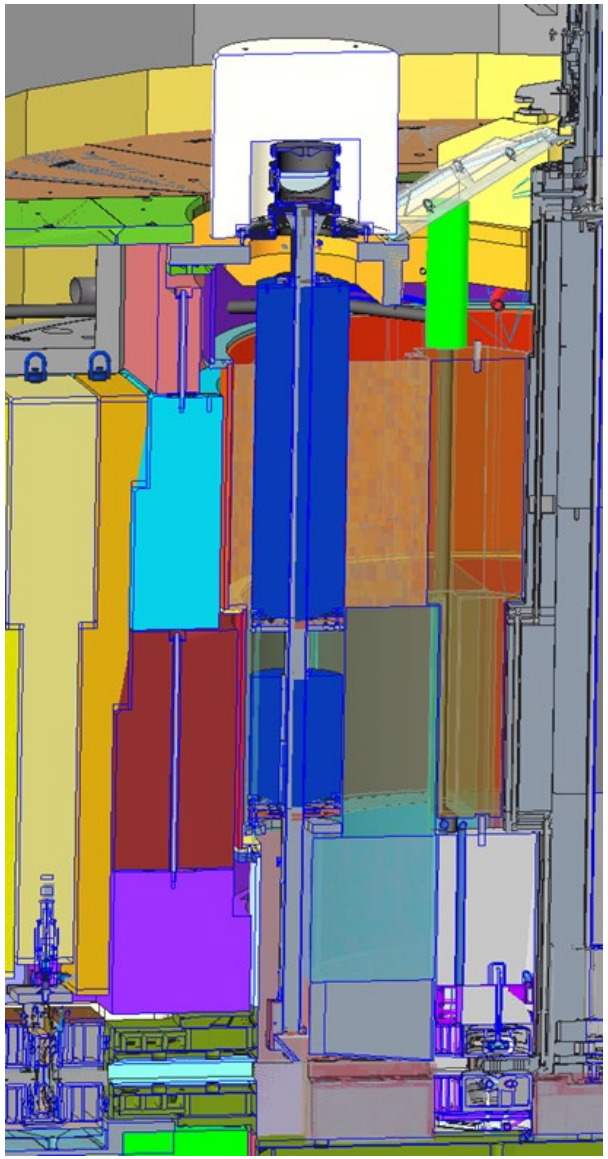
Interface Requirement:

Target Viewing Periscope Vacuum Flange
Vessel Systems will provide a flange seal mounting interface in the Core Vessel Lid as specified in Interface Sheet S01020500-IST10217.

CodeBeamer reference: S.03.06-7146

Upstream References (1)

S.03.05.03-3800	TVP Vacuum Leak Rate



Derived from: S01020500-IST10217 VS-AIC Interface Sheet

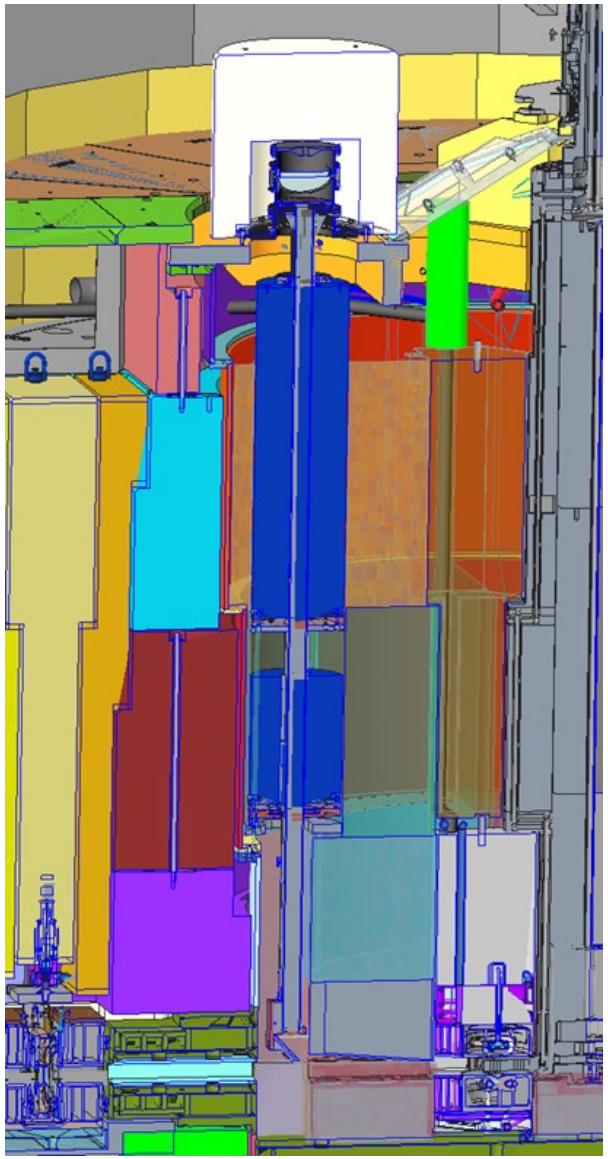
Vessel Systems Requirements

Interface Requirement:

Target Viewing Periscope Keep-Out Zones
Vessel Systems shall provide openings in the Core Vessel Shielding per Interface Sheet S01020500-IST10217

NOTE: Decomposes from TVP requirement 5445 to ensure that the Target Viewing Periscope can view the Target Segment without obstruction.

CodeBeamer reference: S.03.06-7147



Derived from: S01020500-IST10217 VS-AIC Interface Sheet

Vessel Systems Requirements

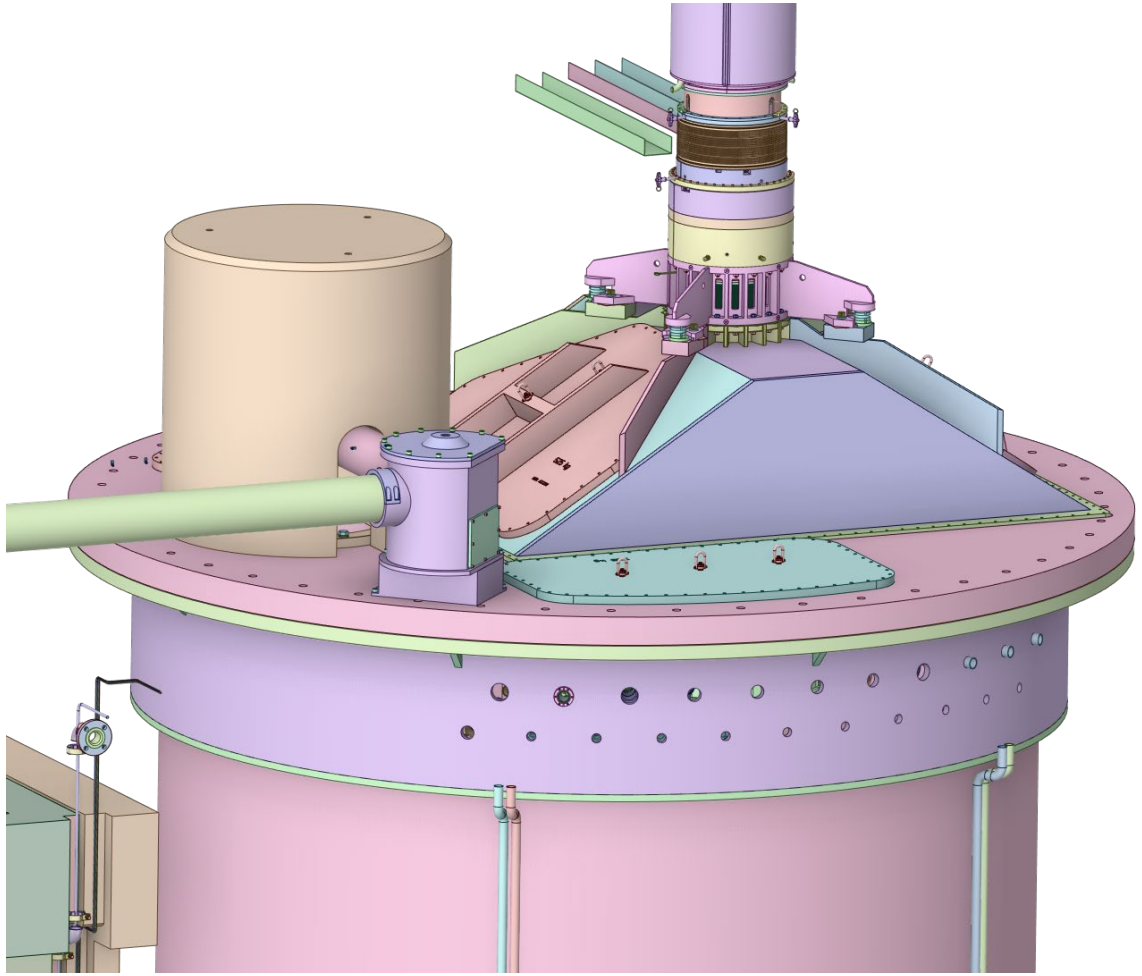
Interface Requirement:

Target Viewing Periscope Doghouse Mounting
Vessel Systems shall provide features in the Core Vessel lid for mounting of the Target Viewing Periscope doghouse per Interface Sheet S01020500-IST10217.

CodeBeamer reference: S.03.06-7149

Upstream References (1)

S.03.05.03-7412	TVP Limit Radiation Exposure - High Bay



Derived from: S01020500-IST10217 VS-AIC Interface Sheet

Vessel Systems Requirements

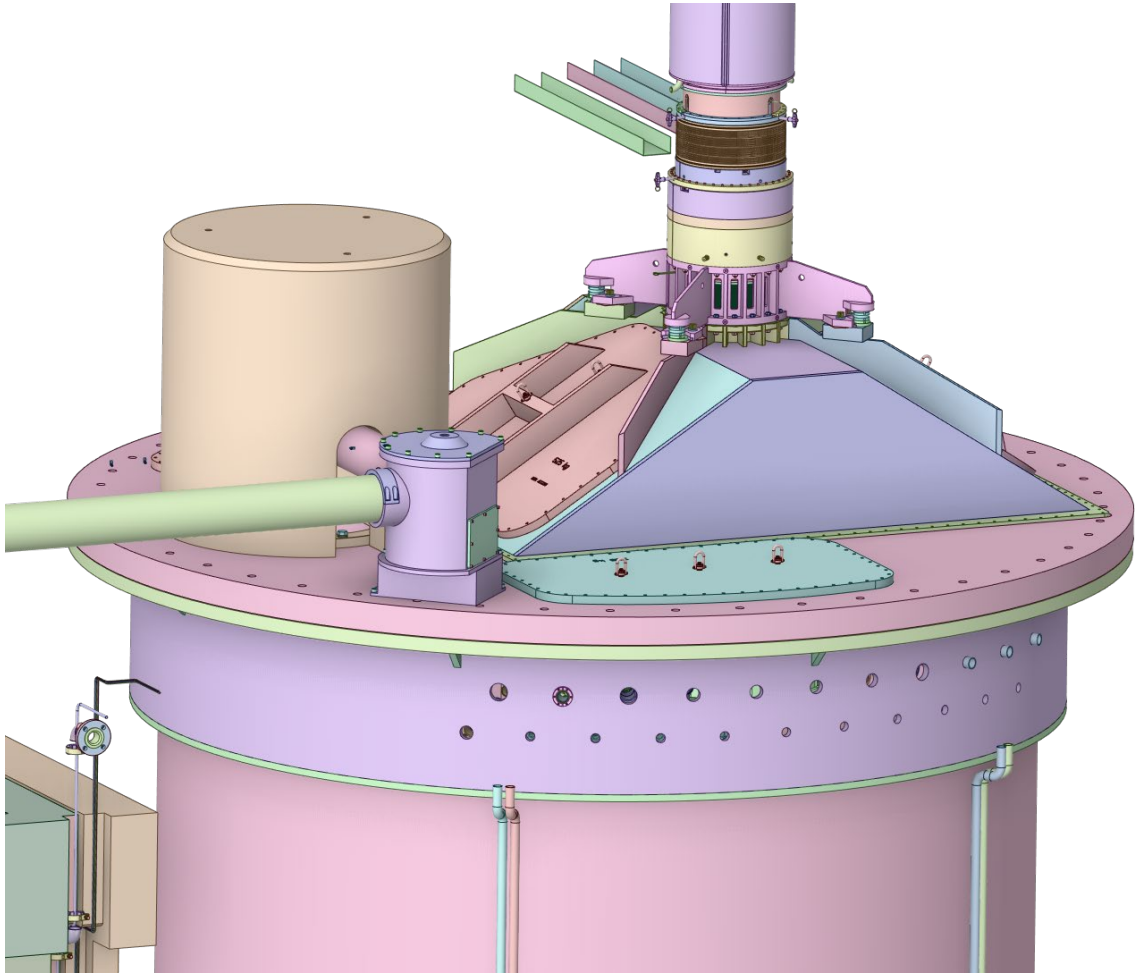
Interface Requirement:

Target Viewing Periscope 3rd Mirror Mounting
Vessel Systems shall provide features in the Core Vessel lid for mounting of the Target Viewing Periscope 3rd mirror assembly per Interface Sheet S01020500-IST10217.

CodeBeamer reference: S.03.06-7151

Upstream References (1)

S.03.05-5732	AIC Measure Beam on Target



Derived from: S01020500-IST10217 VS-AIC Interface Sheet

Vessel Systems Requirements

Interface Requirement:

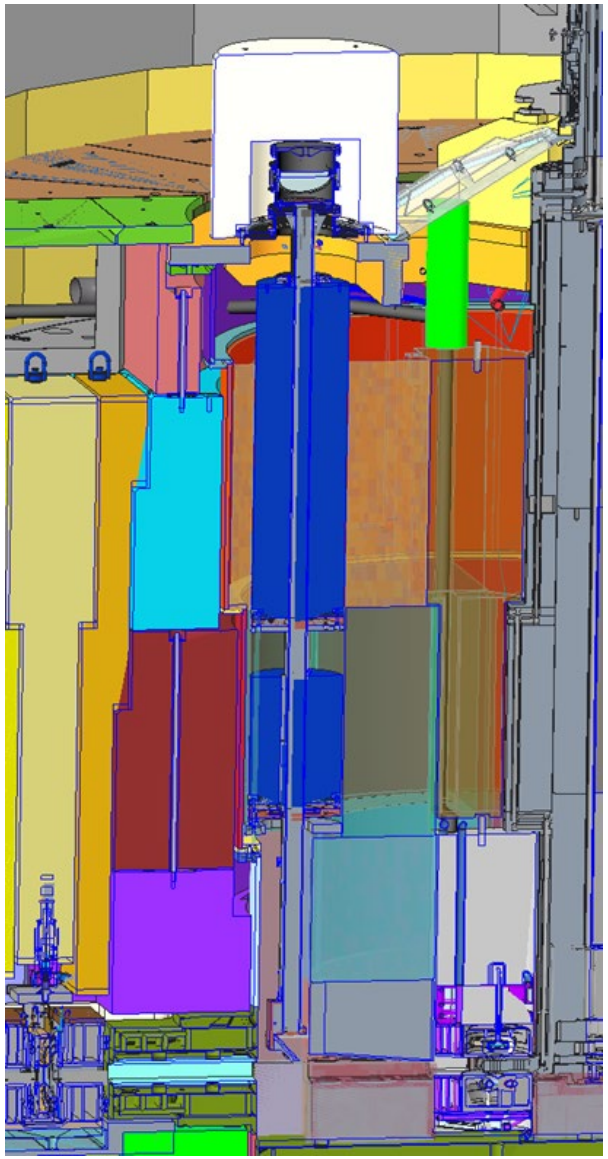
Target Viewing Periscope Position and Gaps
Vessel Systems shall ensure that all hardware adjacent to the Target Viewing Periscope conforms to the positions and gaps outlined in Interface Sheet S01020500-IST10217.

Note: Currently missing from Interface Sheet S01020500-IST10217, will be added during next revision.

CodeBeamer reference: S.03.06-7685

Upstream References (1)

S.03.05.03-7412	TVP Limit Radiation Exposure - High Bay



Derived from: S01020500-IST10217 VS-AIC Interface Sheet

Vessel Systems Requirements

Interface Requirement:

Positional Deviations
Vessel Systems shall ensure that all hardware adjacent to the Target Viewing Periscope does not deviate beyond the Vessel Systems tolerance allotment per Interface Sheet S01020500-IST10217

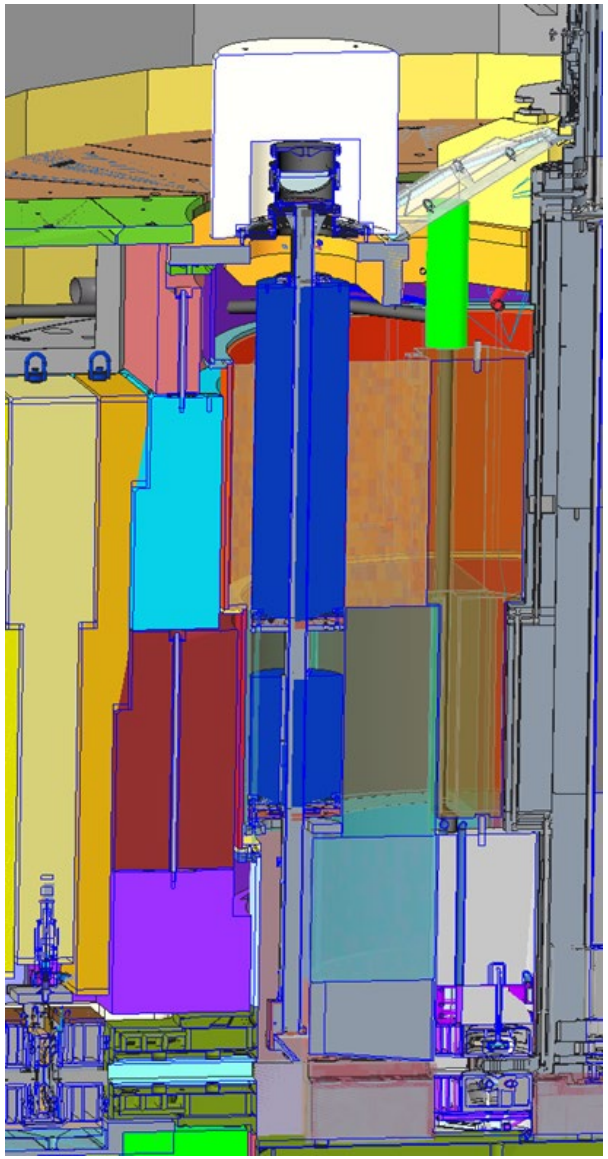
Note: Anticipated deviations include manufacturing, alignment, seismic, thermal and pressure induced.

Note: Currently missing from Interface Sheet S01020500-IST10217, will be added during next revision.

CodeBeamer reference: S.03.06-7686

Upstream References (1)

S.03.05-5732	AIC Measure Beam on Target



Derived from: S01020500-IST10217 VS-AIC Interface Sheet

Vessel Systems Requirements

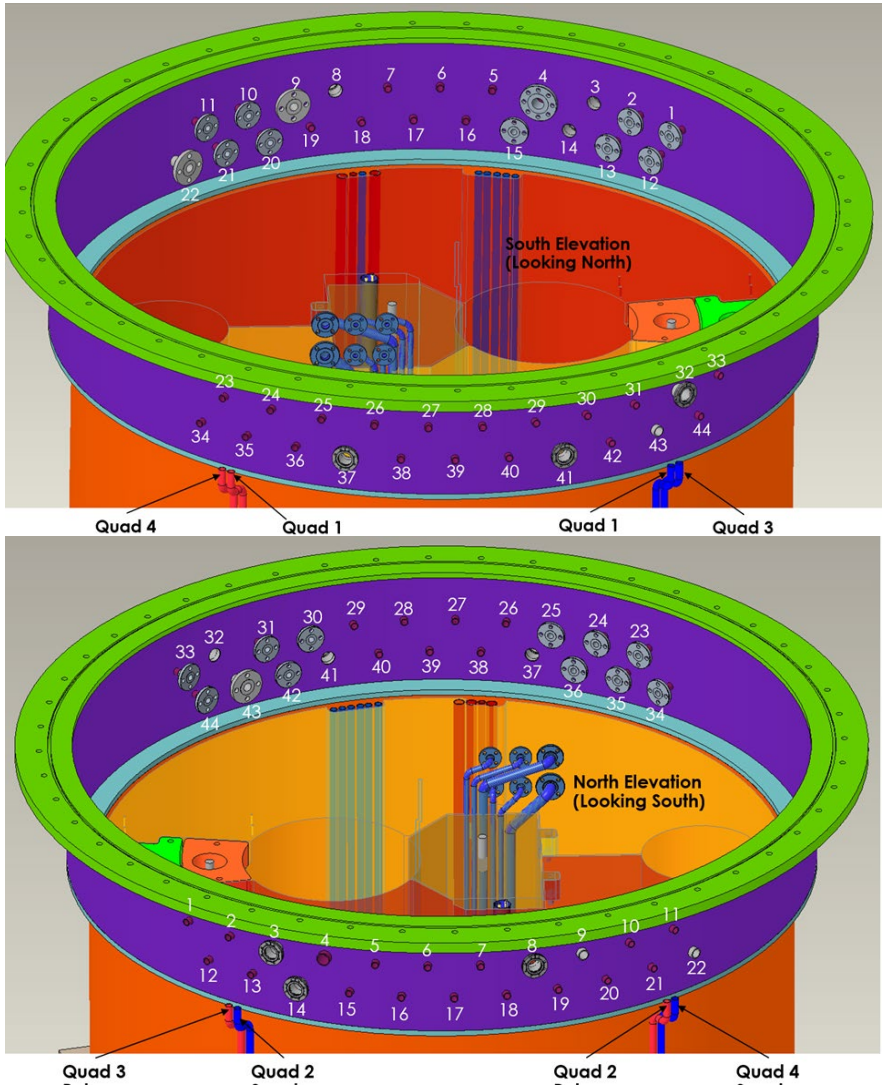
Interface Requirement:

Utility Nozzle Connections
Vessel Systems shall provide utility nozzles in the sidewall of the Core Vessel that allow cooling water and helium gas provided by Process Systems to enter the Core Vessel. Vessel Systems shall provide the interfacing locations of all Core Vessel beltline utility waterlines. The sizes and locations of all utility nozzles and water connections are specified in Interface Sheet S03000000-IST10004.

CodeBeamer reference: S.03.06-7155

Upstream References (1)

S.03.09-6115	Cooling Services



Derived from: S03000000-IST10004 VS-Process Systems Interface Sheet

Vessel Systems Requirements

Interface Requirement:

Cooling Water Requirements
Vessel Systems will provide the required cooling water specifications for all water cooled components within Vessel Systems scope to Process Systems per Interface Sheet S03000000-IST10004.

CodeBeamer reference: S.03.06-7156

Upstream References (1)

S.03.09-6115	Cooling Services

Derived from: S03000000-IST10004 VS-Process Systems Interface Sheet

Vessel Systems Requirements

Interface Requirement:

Target Water Line Support
Vessel Systems will support target water line support assemblies on top of the Core Vessel lid per Interface Sheet S03000000-IST10004.

CodeBeamer reference: S.03.06-7159

Upstream References (1)

S.03.09-6115	Cooling Services

Derived from: S03000000-IST10004 VS-Process Systems Interface Sheet

Vessel Systems Requirements

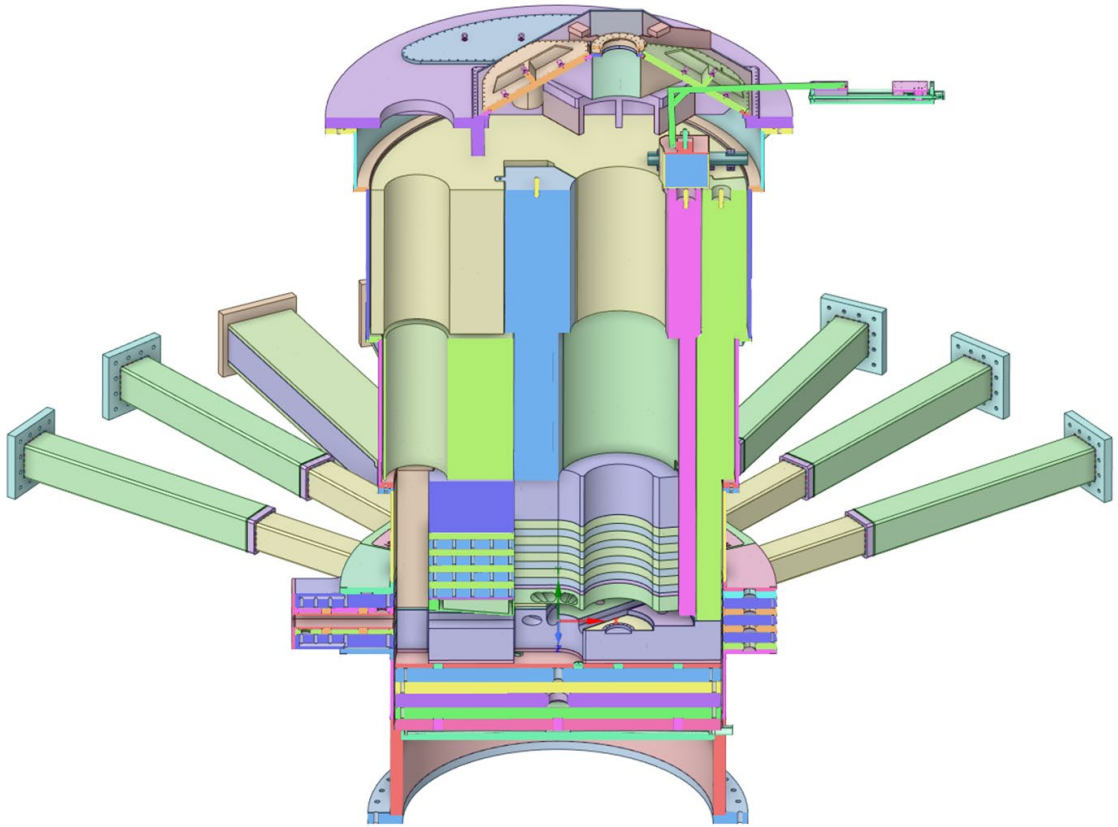
Interface Requirement:

Pressure Drop
Vessel Systems water cooled components should have pressure drops less than 103.4 kPa (15 PSI) at 30.3 L/min (8 gpm) per cooling line.

CodeBeamer reference: S.03.06-7187

Upstream References (1)

S.03.09-6115	Cooling Services



Derived from: S03000000-IST10004 VS-Process Systems Interface Sheet

Vessel Systems Requirements

Interface Requirement:

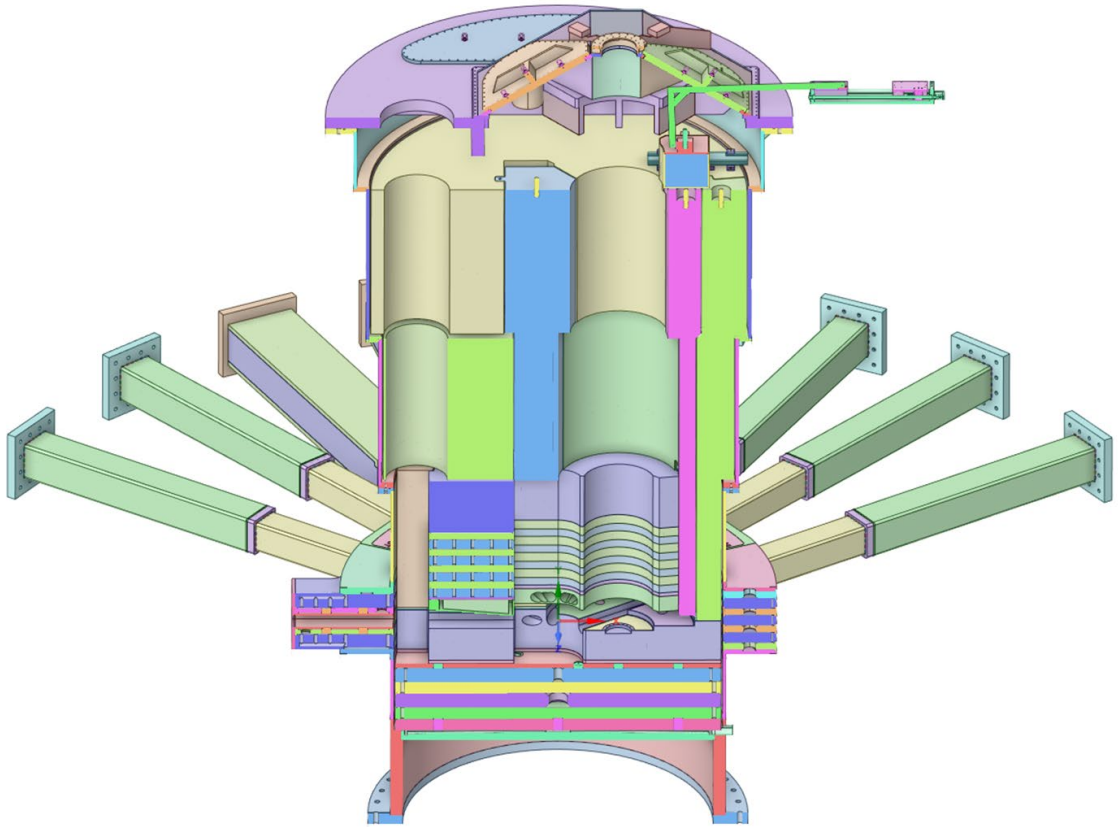
Water Boundary Pressure
Vessel Systems water cooled components shall have a MAWP of 500 kPa.

Note: Pressure relief devices will be specified to ensure that the MAWP is not exceeded at the shield block locations.

CodeBeamer reference: S.03.06-7188

Upstream References (1)

S.03.09-6115	Cooling Services



Derived from: S03000000-IST10004 VS-Process Systems Interface Sheet

Vessel Systems Requirements

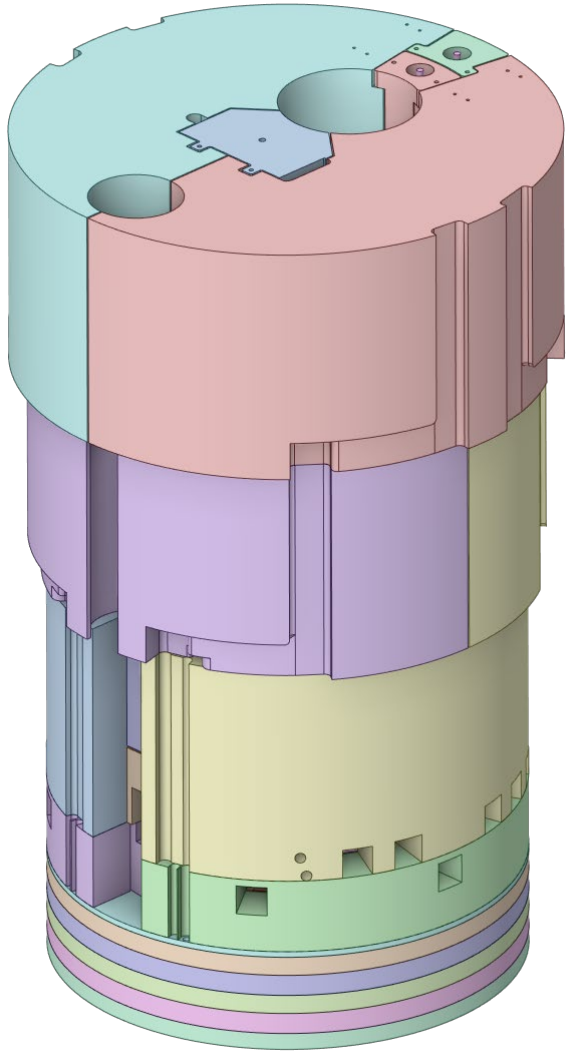
Interface Requirement:

Removable Component Lifting Interfaces
Vessel Systems shall provide lifting interfaces for all removable Vessel Systems components per Interface Sheet S03000000-IST10006.

CodeBeamer reference: S.03.06-7162

Upstream References (1)

S.03-3009	Maintenance & Lifetime Criteria



Derived from: S03000000-IST10006 VS-Remote Handling Interface Sheet

Vessel Systems Requirements

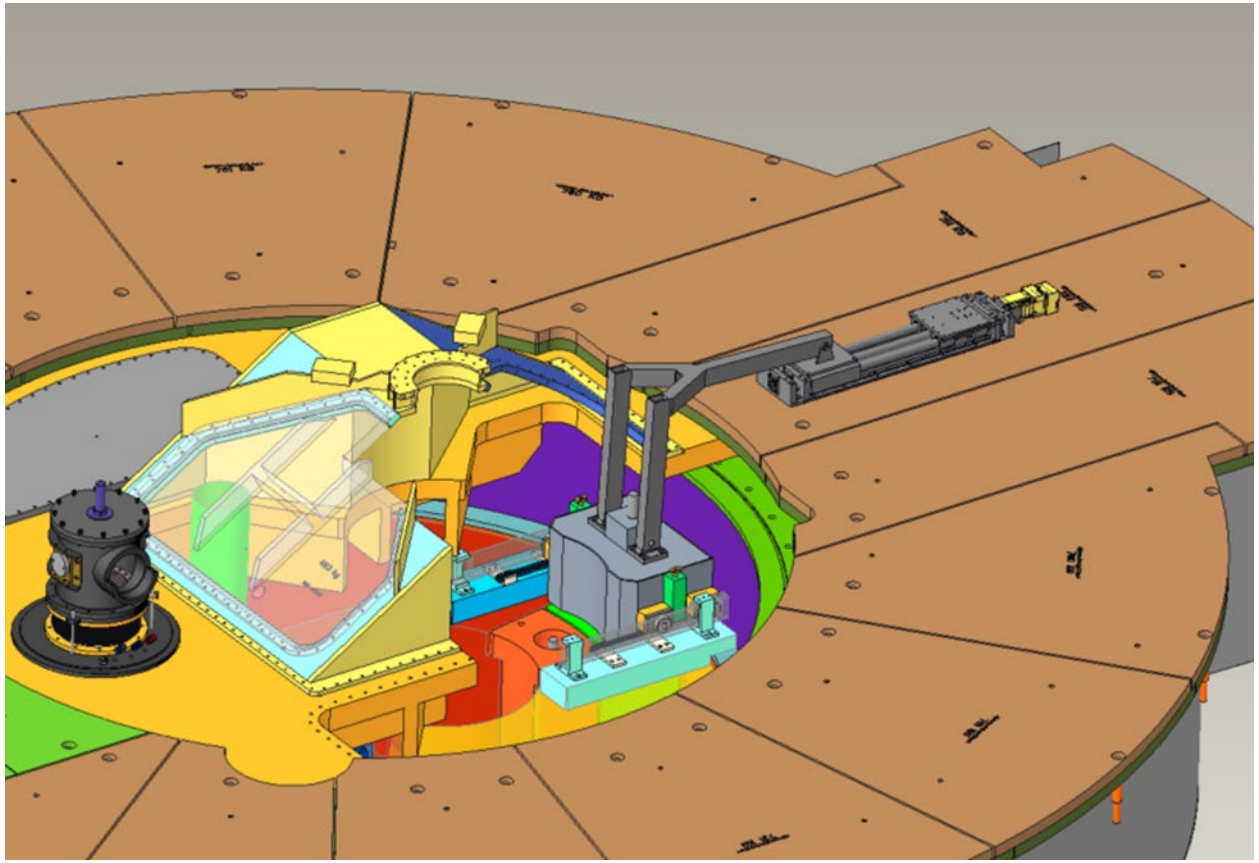
Interface Requirement:

Gamma Gate Control
Vessel Systems shall provide power and control requirements for the gamma gate linear actuator to Remote Handling per Interface Sheet S03000000-IST10006.

CodeBeamer reference: S.03.06-7163

Upstream References (1)

S.03-1035	Safe Operation



Derived from: S03000000-IST10006 VS-Remote Handling Interface Sheet

Vessel Systems Requirements

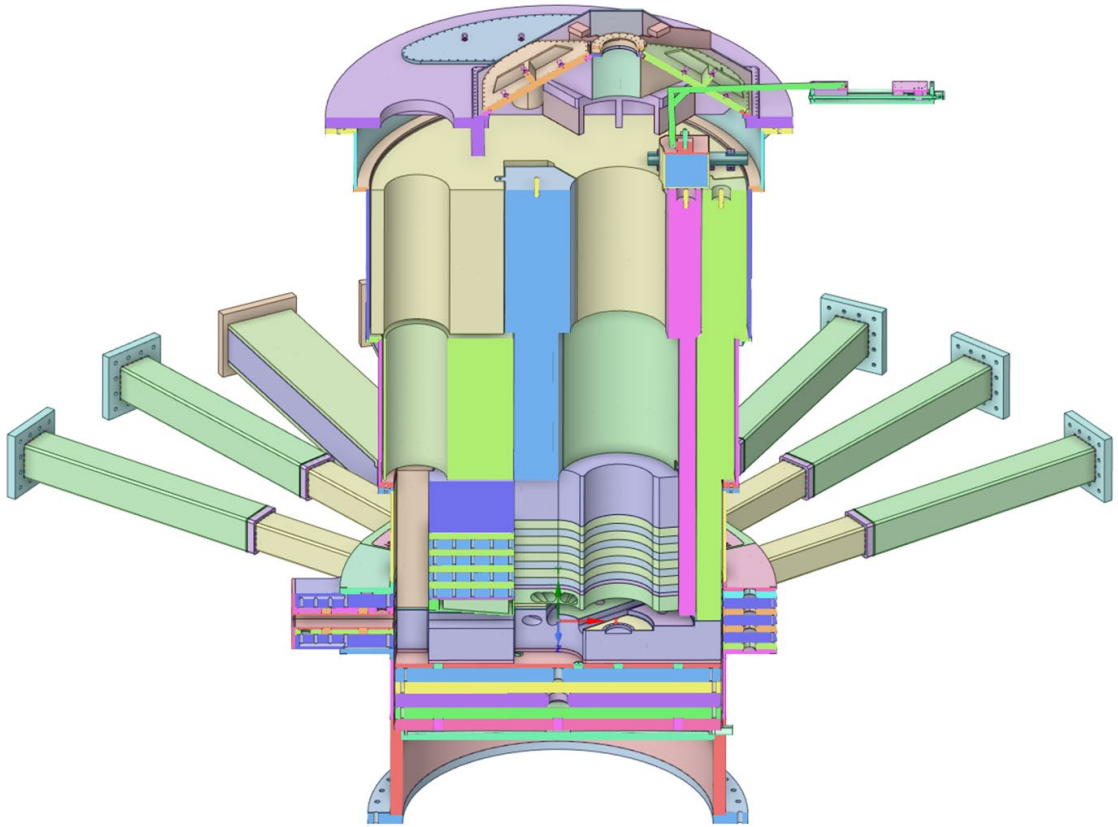
Interface Requirement:

Vacuum Pumping Performance
The Core Vessel shall be capable of maintaining an operating pressure of ≤1 torr.

CodeBeamer reference: S.03.06-7615

Upstream References (1)

S.03-3009	Maintenance & Lifetime Criteria



Derived from: S03000000-IST10008 VS-Vacuum Systems Interface Sheet

Vessel Systems Requirements

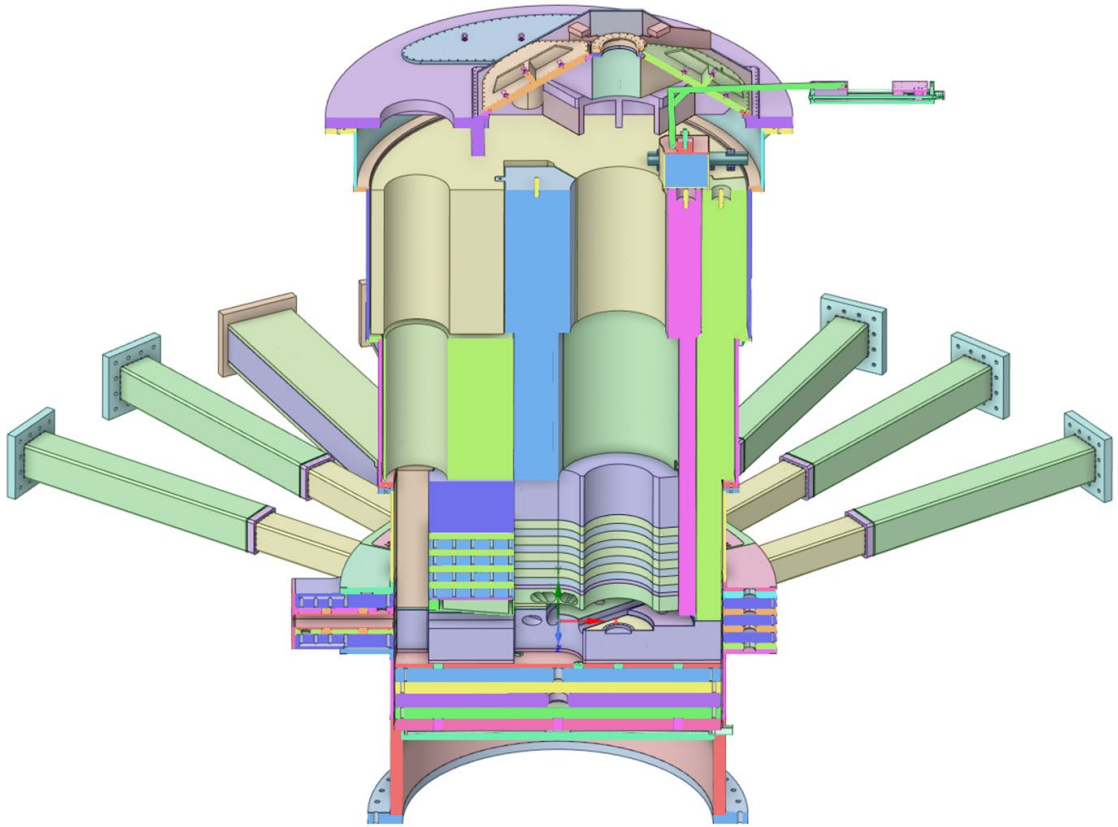
Interface Requirement:

Operability with Water Leaks
Vacuum Systems shall be able to operate with a small internal water leak per Interface Sheet S03000000-IST10008.

CodeBeamer reference: S.03.06-7617

Upstream References (1)

S.03-1033	Yearly Operating Hours



Derived from: S03000000-IST10008 VS-Vacuum Systems Interface Sheet

Vessel Systems Requirements

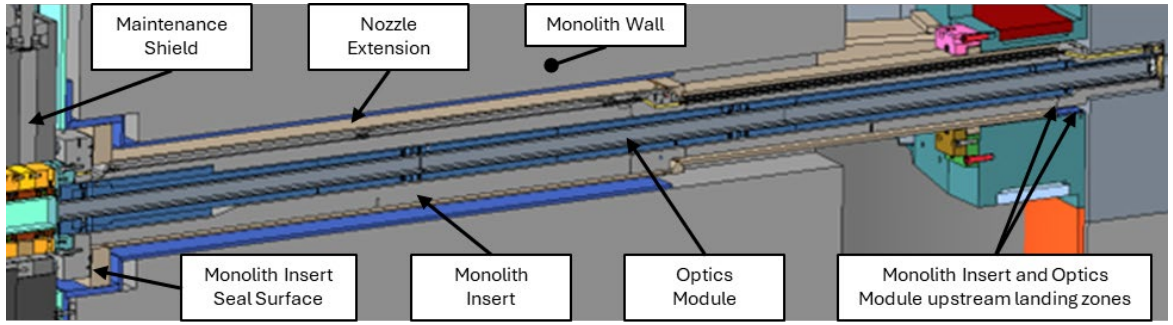
Interface Requirement:

Monolith Insert Clearance
Vessel Systems shall provide gaps between the monolith inserts and the Core Vessel technical components (nozzle extensions, Core Vessel beltline and Core Vessel internal shielding) per Interface Sheet S01020500-IST10025.

CodeBeamer reference: S.03.06-7165

Upstream References (1)

S.03-1030	Number of Beamlines



Derived from: S01020500-IST10025 VS-Instrument Systems Interface Sheet

Vessel Systems Requirements

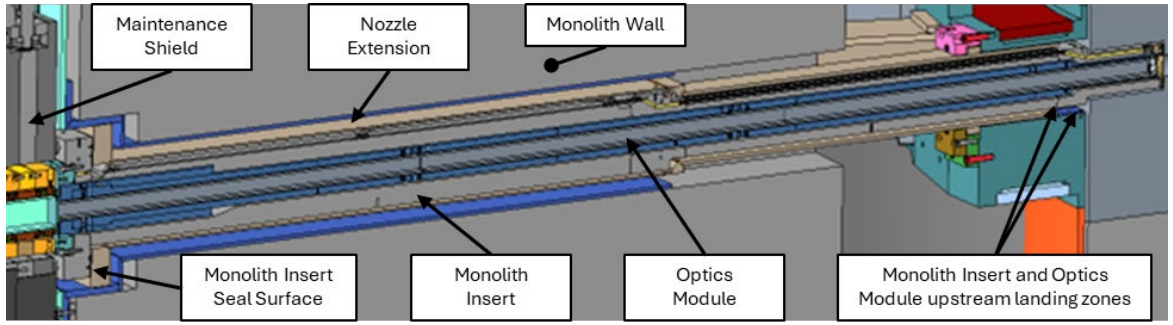
Interface Requirement:

Monolith Insert Interfacing Component Tolerances
Vessel Systems shall maintain dimensional tolerances of monolith insert interfacing components (nozzle extensions, Core Vessel beltline and Core Vessel internal shielding) per Interface Sheet S01020500-IST10025.

CodeBeamer reference: S.03.06-7166

Upstream References (1)

S.03-1029	Peak Brightness



Derived from: S01020500-IST10025 VS-Instrument Systems Interface Sheet

Vessel Systems Requirements

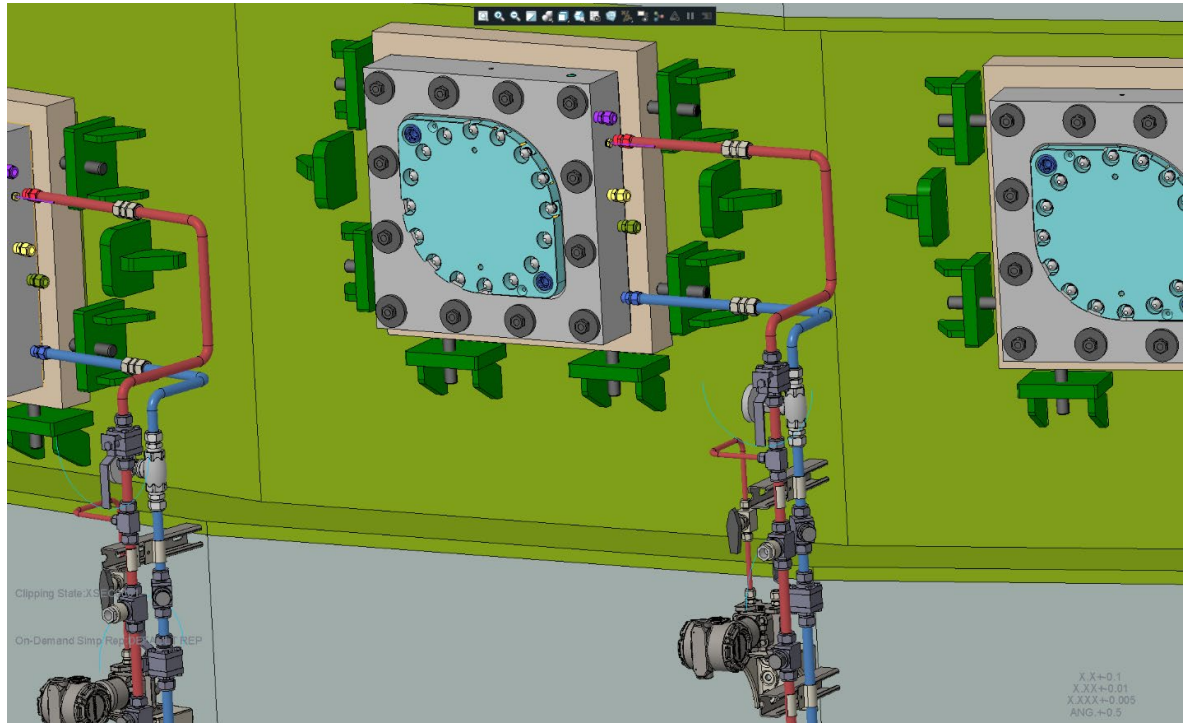
Interface Requirement:

Monolith Insert Sealing
Vessel Systems shall provide a flanged sealing interface at the rear of each nozzle extension that corresponds to the Monolith Insert geometry per Interface Sheet S01020500-IST10025.

CodeBeamer reference: S.03.06-7167

Upstream References (1)

S.03-1029	Peak Brightness



Derived from: S01020500-IST10025 VS-Instrument Systems Interface Sheet

Vessel Systems Requirements

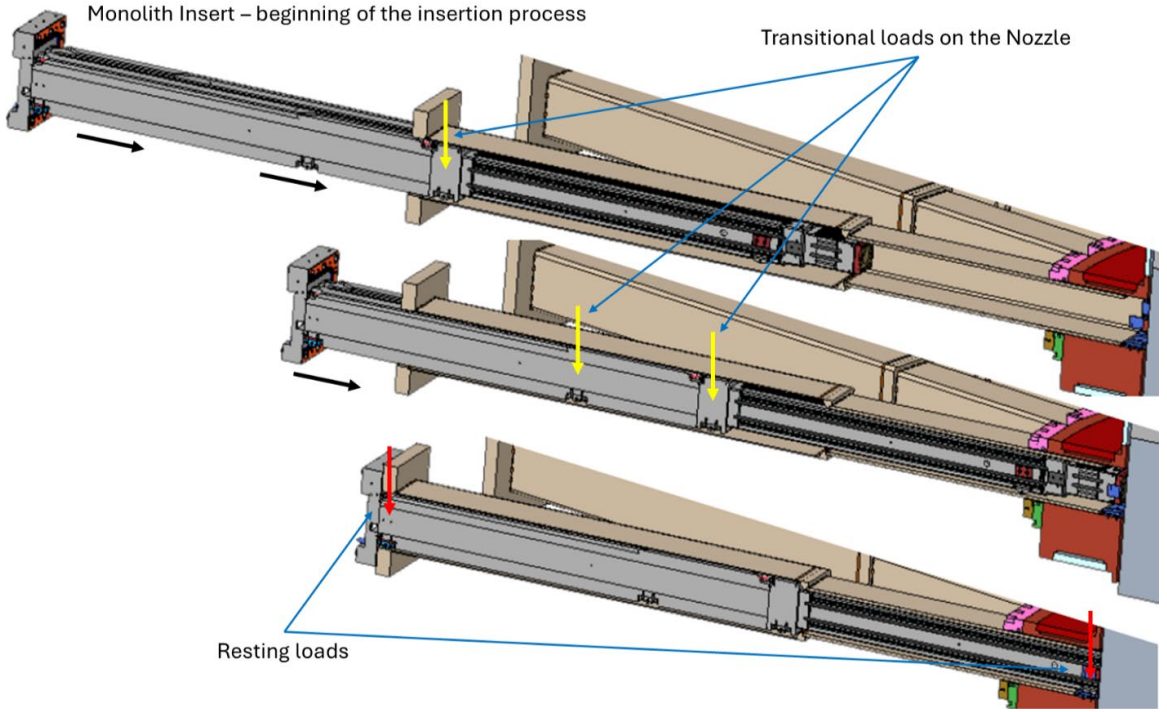
Interface Requirement:

Monolith Insert Support
Vessel Systems shall mechanically support the monolith inserts while maintaining the tolerances described in Interface Sheet S01020500-IST10025.

CodeBeamer reference: S.03.06-7168

Upstream References (1)

S.03-1029	Peak Brightness



Derived from: S01020500-IST10025 VS-Instrument Systems Interface Sheet

Vessel Systems Requirements

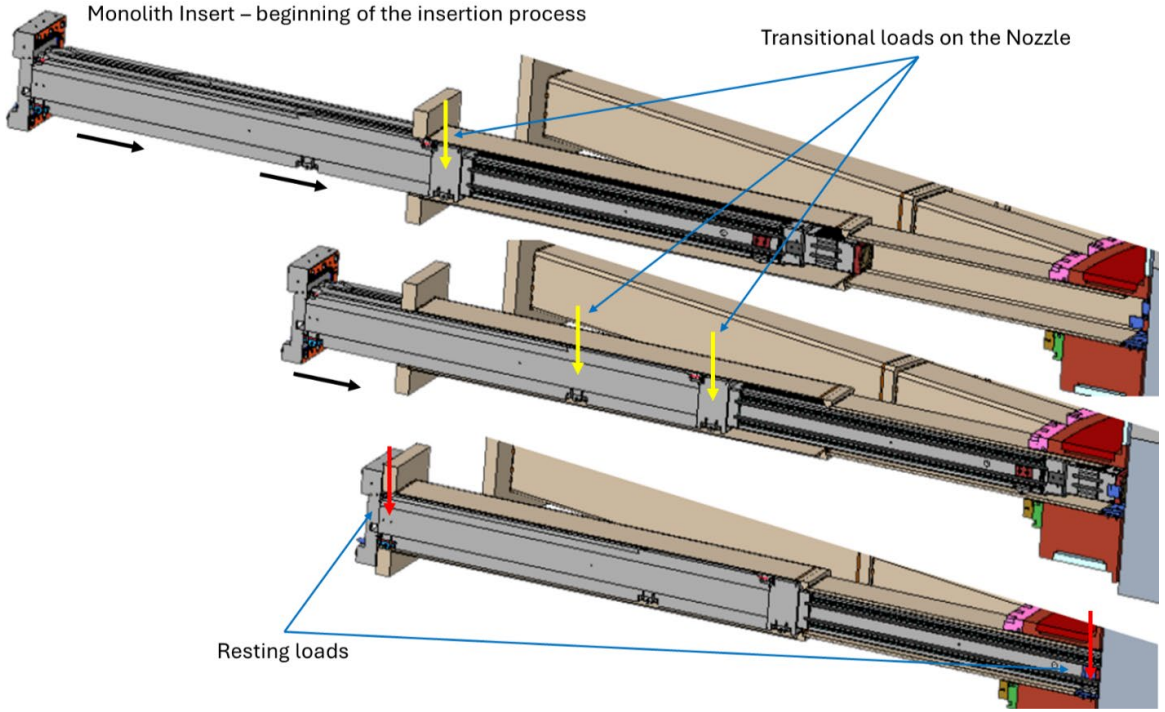
Interface Requirement:

Monolith Insert Installation Support
Vessel Systems shall support the Monolith Inserts during the installation process without plastic deformation per Interface Sheet S01020500-IST10025.

CodeBeamer reference: S.03.06-7169

Upstream References (1)

S.03-1029	Peak Brightness



Derived from: S01020500-IST10025 VS-Instrument Systems Interface Sheet

Vessel Systems Requirements

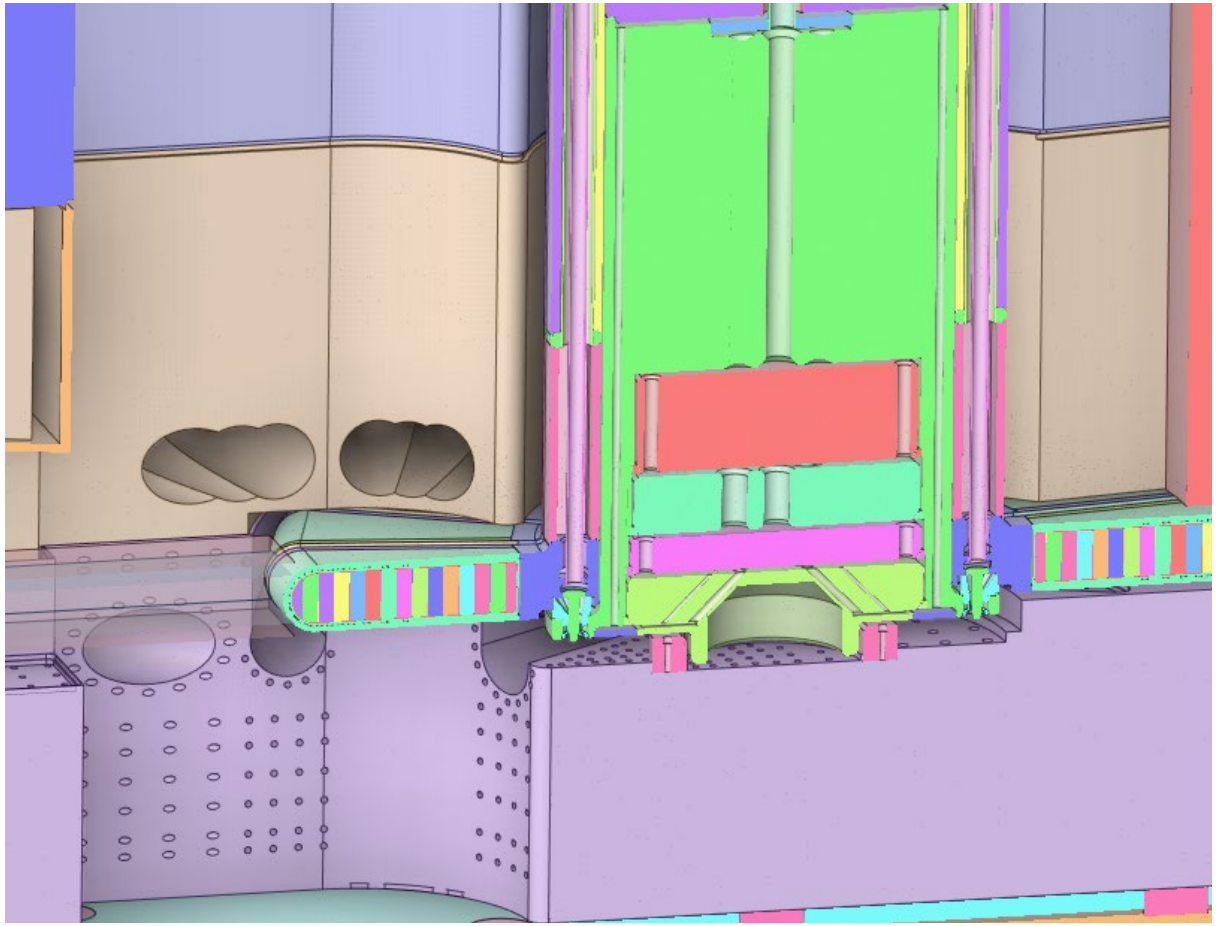
Interface Requirement:

Neutron Flight Path to Monolith Inserts
Vessel Systems shall provide clearance within the Core Vessel Shielding to ensure an unobstructed path between the monolith insert windows and the moderator per Interface Sheet S01020500-IST10025.

CodeBeamer reference: S.03.06-7170

Upstream References (1)

S.03-1029	Peak Brightness



Derived from: S01020500-IST10025 VS-Instrument Systems Interface Sheet

Vessel Systems Requirements

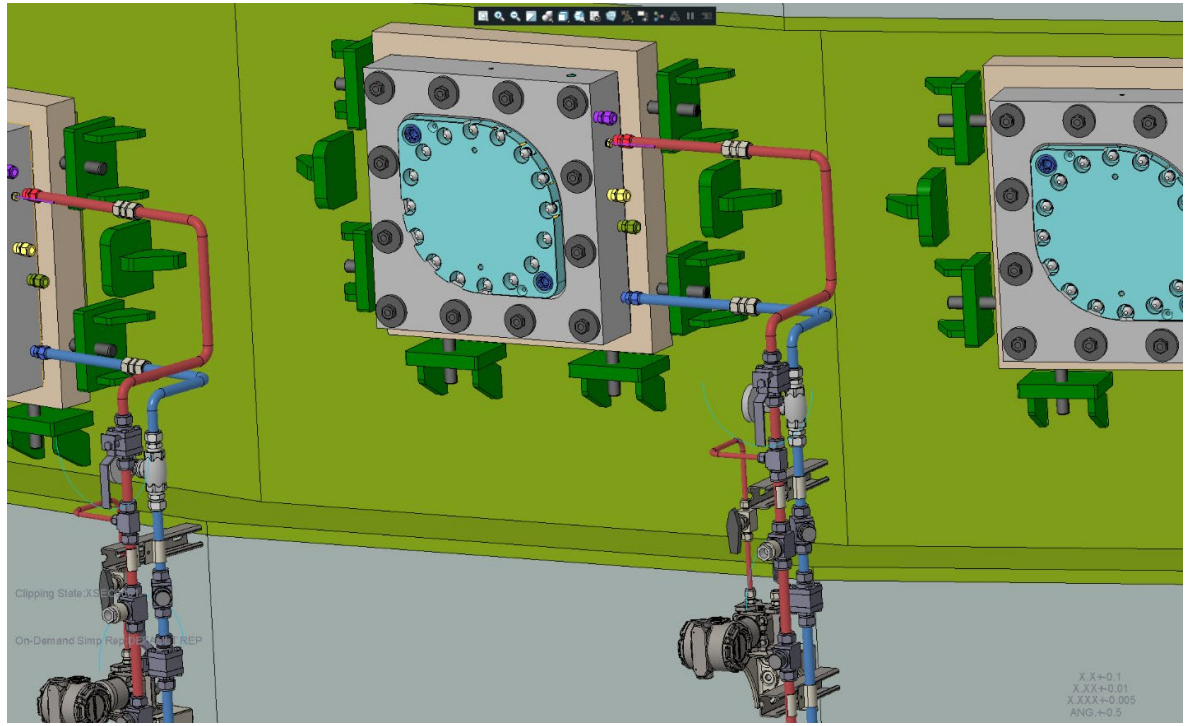
Interface Requirement:

Monolith Insert Seal Leak Rate
Vessel Systems shall accommodate the monolith insert rear seal leak rates specified in Interface Sheet S01020500-IST10025.

CodeBeamer reference: S.03.06-7171

Upstream References (1)

S.03-1029	Peak Brightness



Derived from: S01020500-IST10025 VS-Instrument Systems Interface Sheet

Vessel Systems Requirements

Interface Requirement:

Monolith Insert Over Pressurization Protection
Vessel Systems shall ensure that the monolith inserts are not subjected to a positive pressure greater than 7.35 PSI per Interface Sheet S01020500-IST10025.

Note: This is not currently captured in the interface sheet, but I suggested to Pete that he add it.

CodeBeamer reference: S.03.06-7172

Upstream References (1)

S.03-1033	Yearly Operating Hours

Derived from: S01020500-IST10025 VS-Instrument Systems Interface Sheet

Vessel Systems Requirements

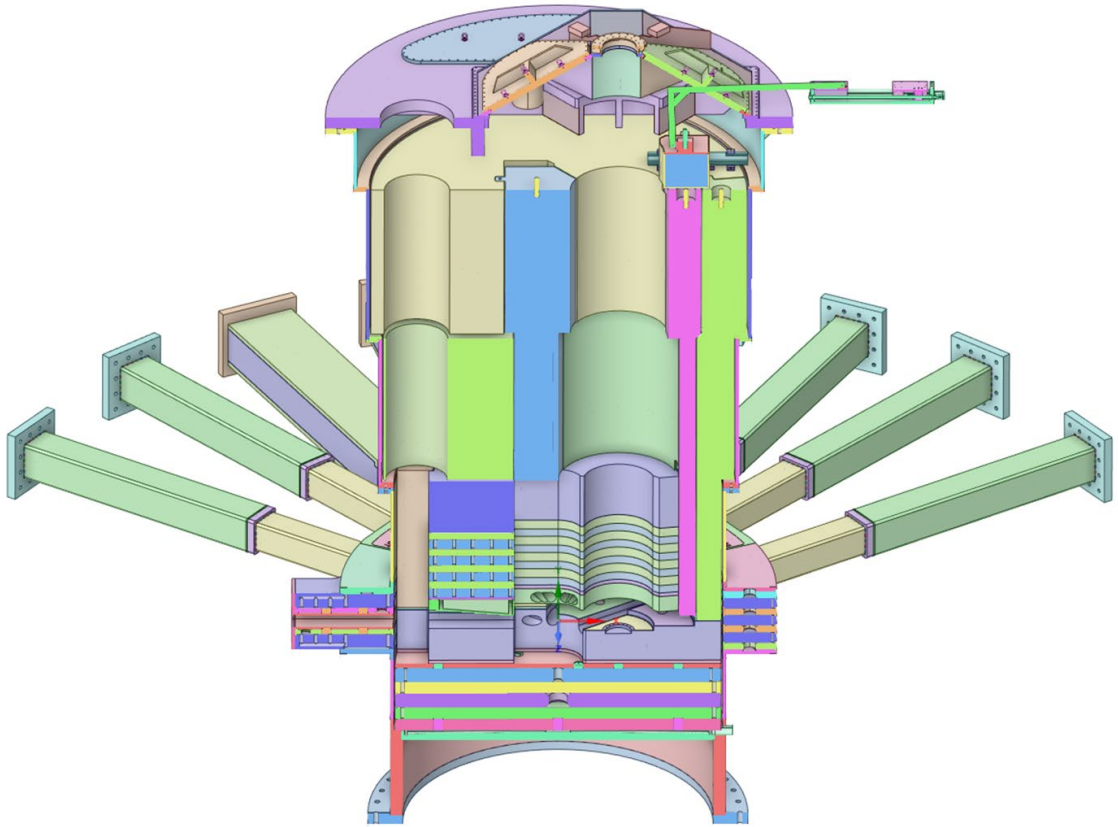
Interface Requirement:

Vessel Systems Temperature Monitoring
Vessel Systems should include devices for monitoring the temperature of all cooled shield blocks as well as the cooled Core Vessel beltline per Interface Sheet S01020500-IST10128.

CodeBeamer reference: S.03.06-7178

Upstream References (1)

S.03-1035	Safe Operation



Derived from: S01020500-IST10128 VS-Integrated Controls Interface Sheet

Vessel Systems Requirements

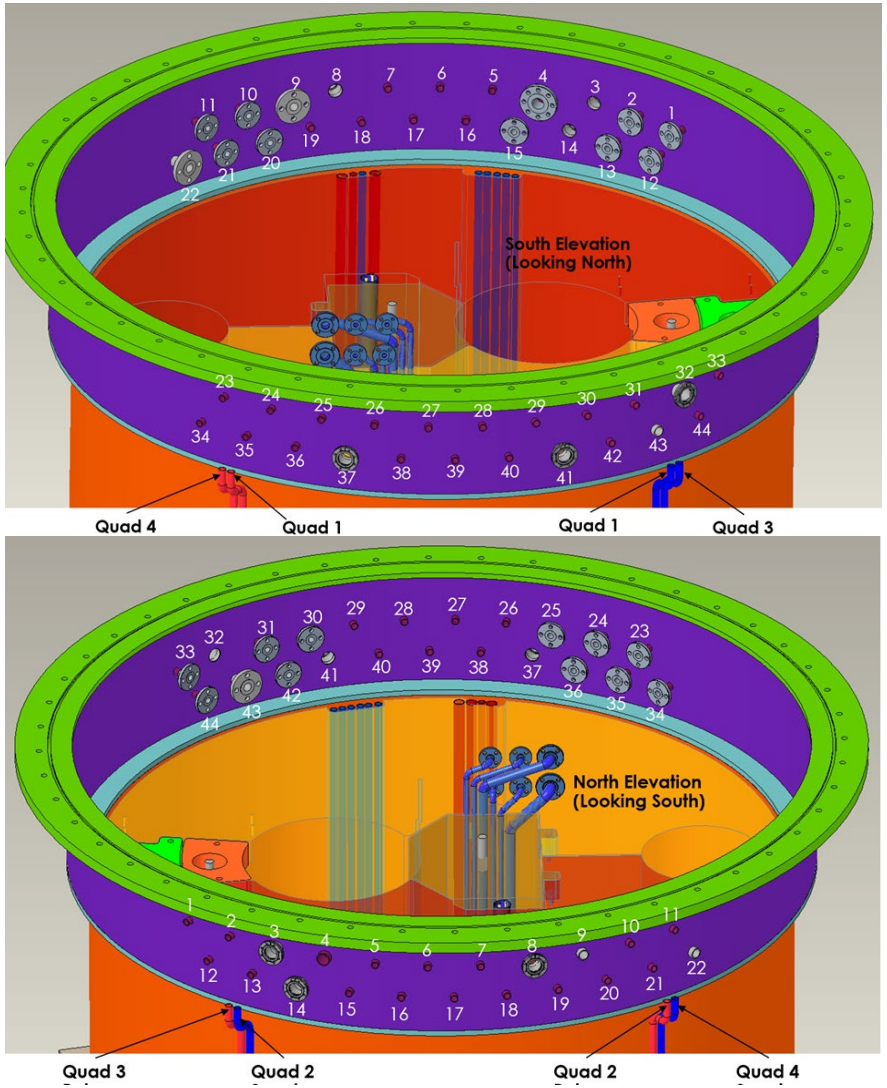
Interface Requirement:

Thermocouple Wiring
Vessel Systems shall provide pin-out IDs for all temperature monitoring device connections to the hermetic feedthroughs per Interface Sheet S01020500-IST10128.

CodeBeamer reference: S.03.06-7179

Upstream References (1)

S.03-1035	Safe Operation



Derived from: S01020500-IST10128 VS-Integrated Controls Interface Sheet

Vessel Systems Requirements

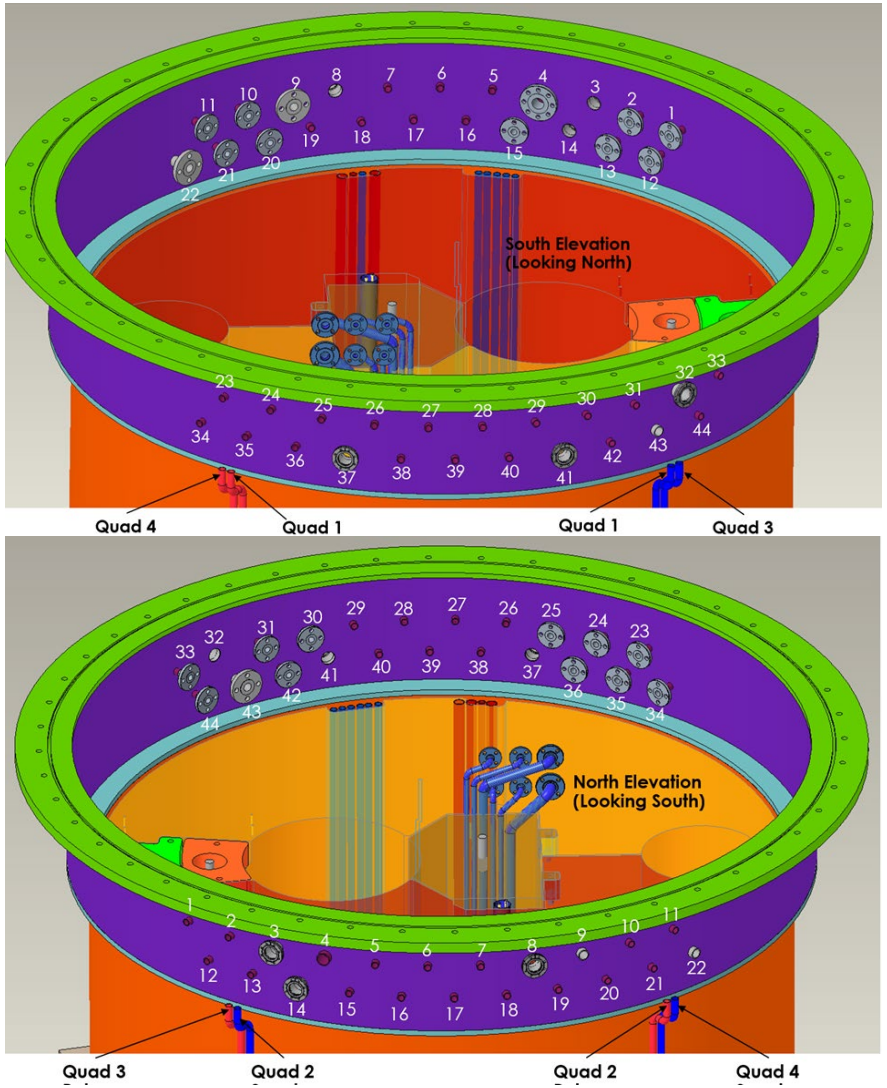
Interface Requirement:

Hermetic Electrical Feedthroughs
Vessel Systems shall provide and install hermetic feedthroughs allowing thermocouple signal transfer out of the Core Vessel per Interface Sheet S01020500-IST10128.

CodeBeamer reference: S.03.06-7180

Upstream References (1)

S.03-1035	Safe Operation



Derived from: S01020500-IST10128 VS-Integrated Controls Interface Sheet

Target Station Shielding Requirements

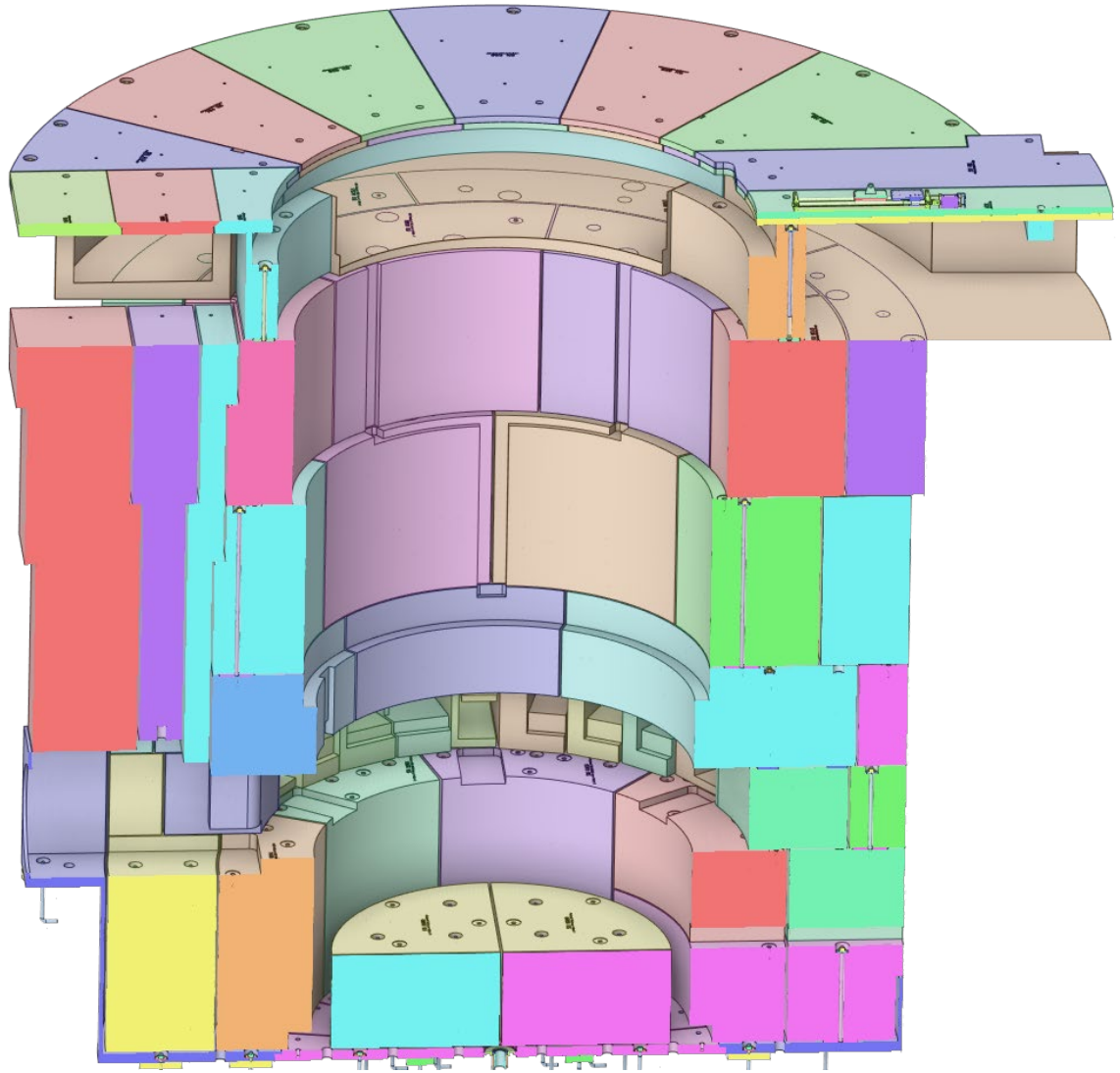
General Requirement:

Carbon Steel Temperature Limit
Target Station Shielding carbon steel structures should have a maximum operating temperature of 200 C.

CodeBeamer reference: S.03.07-6138

Upstream References (1)

S.03-3009	Maintenance & Lifetime Criteria



Derived from: Level 2 Target Systems Requirements

A detailed PHAR review was performed to determine requirements

PHAR Event	Derived Requirement										
	No Requirement Derived	Target Station Shielding components shall be made of non-flammable materials	Monolith shielding shall keep target temperature below 800C under reasonable fire conditions (temperature and duration)	Large amounts of steel shielding within the monolith protect the Target feet and MRA from physical impact damage	Target Station Shielding shall not permit shielding to damage the cryogenic transfer lines under SDC2 seismic conditions	The Target Station Shielding shall be rigidly anchored to the monolith concrete floor	Bulk shielding liner shall be water tight and connected to a leak collection system	Target Station Shielding shall have appropriate features to allow for PPS interlocks confirming all shielding is in place prior to beam operation	Pipe Pans shall be water tight and have a drainage path to the leak collection system	Target Station Shielding hardware is in agreement with Neutronics analysis that verifies the shielding configuration is acceptable	Target Station Shielding hardware shall assist in keeping the target temperature below 800C under loss of cooling event
Appendix A - Accelerator Interface Components											
AIC4-2 - Preventive Features - Attributes: PPS interlocked shielding (e.g., with trapped keys or other positive means of controlling shielding placement). (EC) CREDITED CONTROL								X			
AIC7-1 - Mitigative Features - Attributes: Monolith external structure designed to maintain monolith iron shielding in place. (DF)					X	X					
Appendix C - Building General											
BG1-1 - Assumptions and Initial Conditions: Excessive heating of the target by facility fire is prevented by mass of surrounding core vessel and monolith shielding		X	X								
BG6-9 - Assumptions and Initial Conditions: Reinforced concrete shielding and large amounts of steel shielding on the instrument floor and in the monolith would protect significant inventories of radioactive materials against damage associated with aircraft impact. These were taken into account in the SNS aircraft impact risk study (Aircraft Impact Risk for the Spallation Neutron Source Target Facility, WSMS-OR-00-0015, August 2000) and found to reduce the risk of general aviation damage to an actual target to less than 10-6/year.				X							
BG6-9 - Assumptions and Initial Conditions: Similarly, fire temperatures are not high enough to cause significant releases from the tantalum clad tungsten target because it is located within the massive steel and concrete monolith structure.		X	X								
BG6-9 - Mitigative Features - Attributes: The monolith shielding protects the core vessel and the shielding inside the core vessel, in turn, protects the target (DF) CREDITED CONTROL		X	X	X	X						
BG6-10 - Assumptions and Initial Conditions: Reinforced concrete shielding and large amounts of steel shielding on the instrument floor and in the monolith would protect significant inventories of radioactive materials against damage associated with a vehicle impact.				X							

Target Station Shielding Requirements

Safety Requirement:

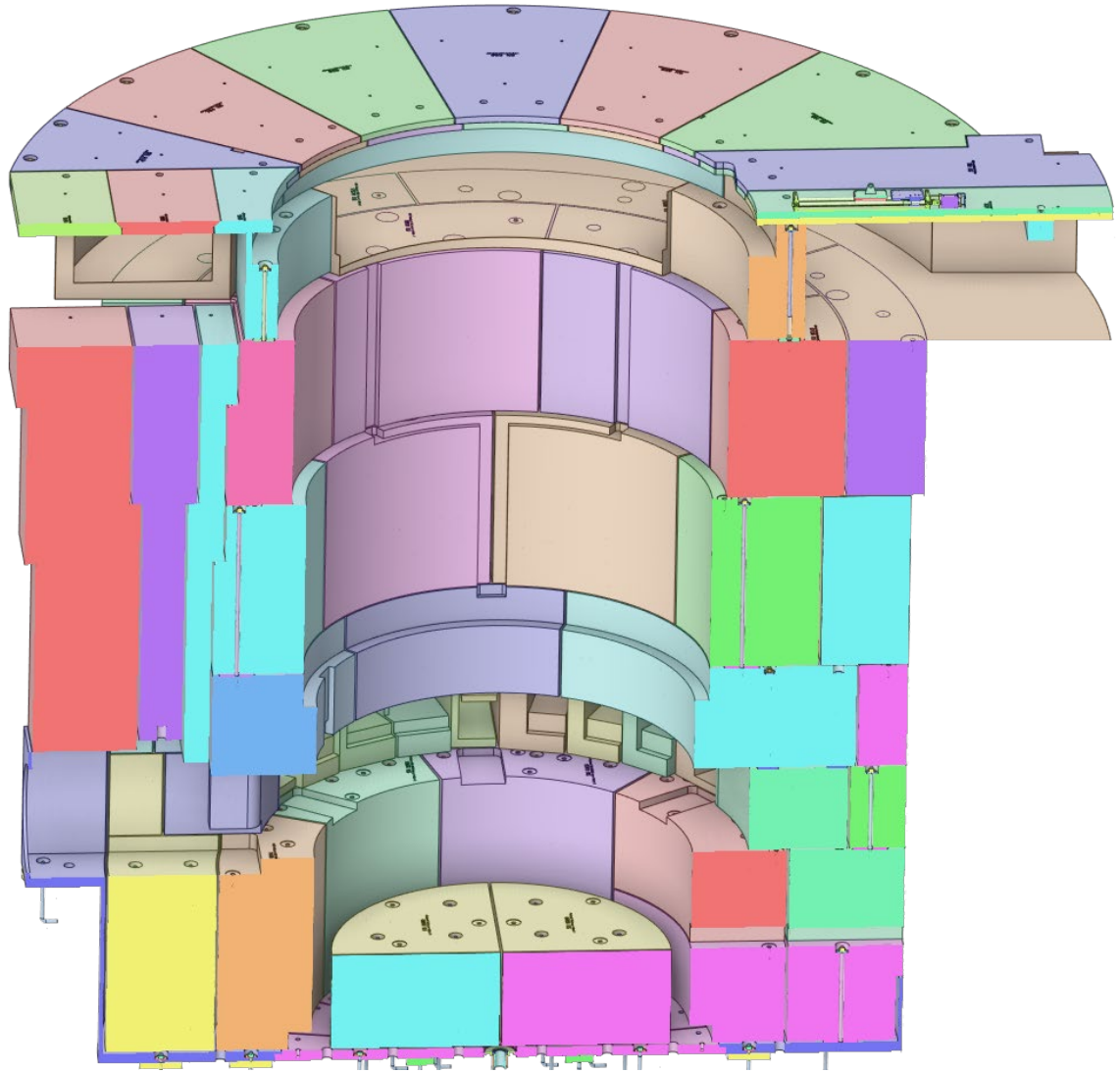
Non-Flammable Shielding
Target Station Shielding components shall be made of non-flammable materials.

PHAR References:
BG1-1, BG6-9, BG6-9 (Credited), BG7-1A, BG7-11

CodeBeamer reference: S.03.07-6982

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation



Derived from: PHAR

Target Station Shielding Requirements

Safety Requirement:

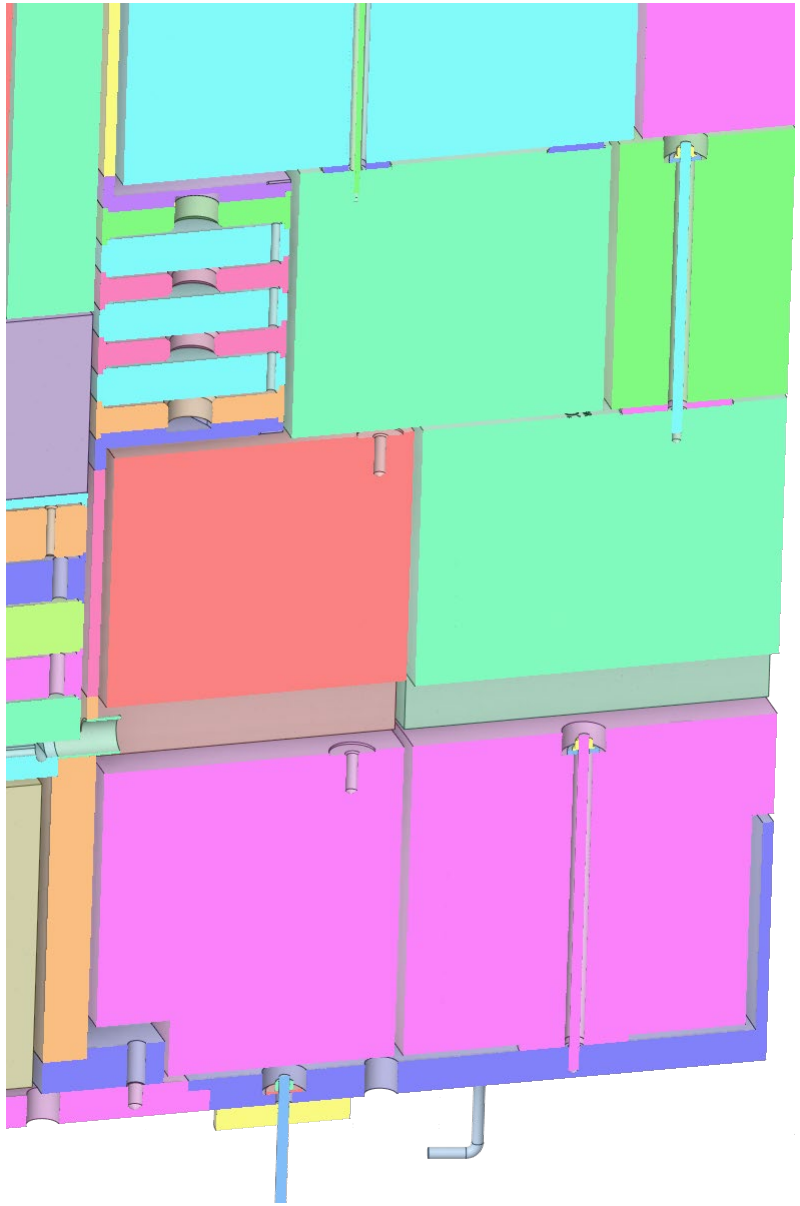
Protect Cryogenic Transfer Lines
Target Station Shielding shall not permit motion of the shielding to cause the cryogenic transfer lines to release Hydrogen under SDC2 seismic conditions.

PHAR References:
AIC7-1, BG6-9 (Credited), BG7-1A (Credited), BG7-2, BG7-11, BG7-12, CMS7-1, CMS7-5

CodeBeamer reference: S.03.07-6983

Upstream References (2)

S.03-1035	Safe Operation
S.03-1036	Radiation Safety



Derived from: PHAR

Target Station Shielding Requirements

Safety Requirement:

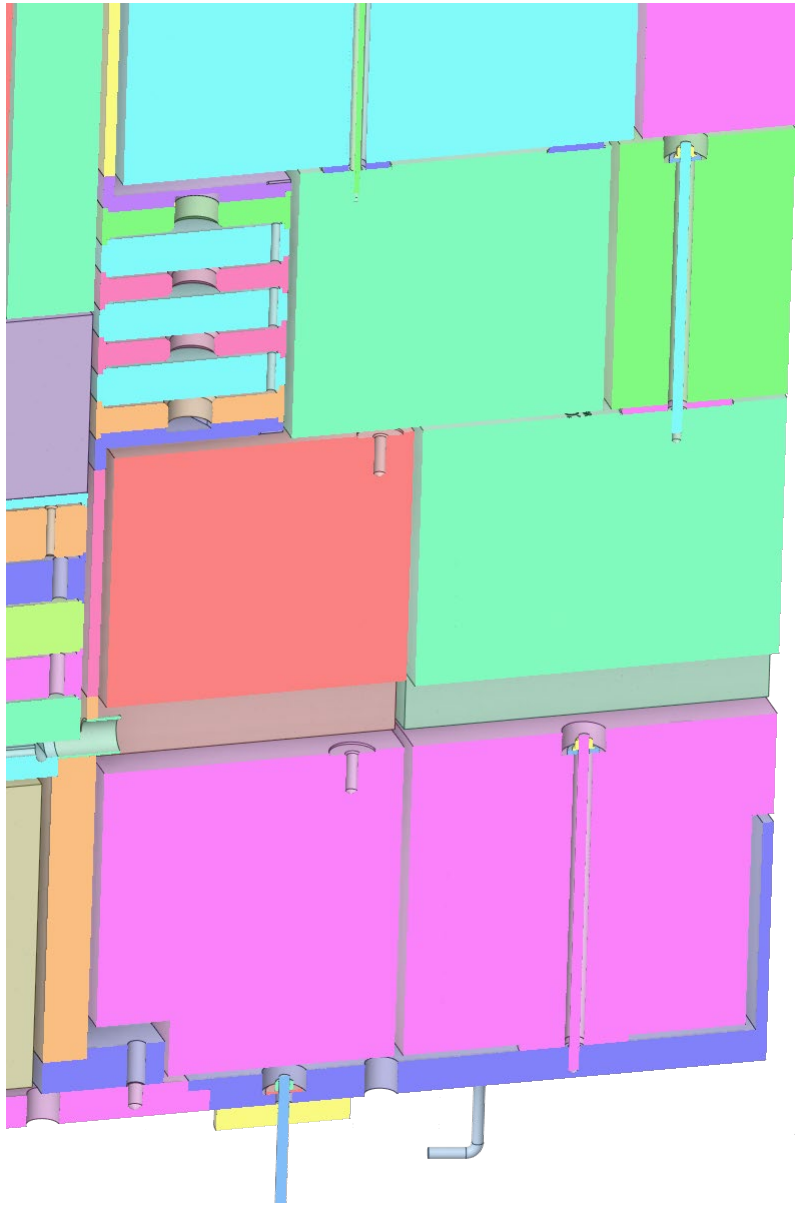
Shielding Anchoring
The Target Station Shielding shall be anchored in such a way to limit motion of the bulk shielding relative to the monolith floor or relative to different shielding layers to < 0.1 mm under SDC Level 2 seismic loads.

PHAR References:
AIC7-11, BG7-2, BG7-12, CMS7-1, CMS7-3, HPV3-4B

CodeBeamer reference: S.03.07-6984

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation



Derived from: PHAR

Target Station Shielding Requirements

Safety Requirement:

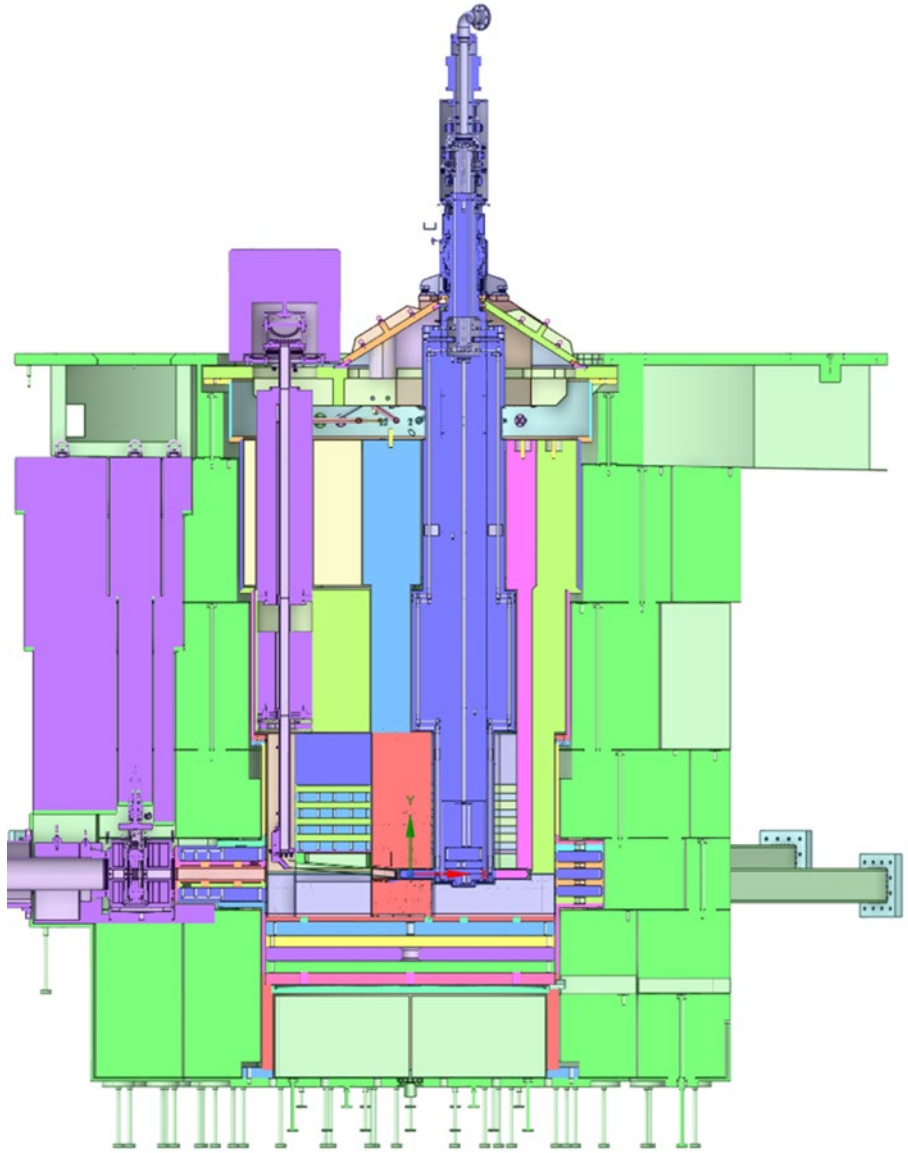
Radiation Shielding Performance
Target Station Shielding, along with the other Target Systems components in the Monolith and Target Drive Room, shall not prevent necessary operations in the high bay due to radiation dose.

PHAR References:
VS4-1 (Credited)

CodeBeamer reference: S.03.07-6986

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation



Derived from: PHAR

Target Station Shielding Requirements

Safety Requirement:

Target Protection during LOCA
Target Station Shielding hardware shall assist in keeping the target temperature below 800C under loss of cooling event.

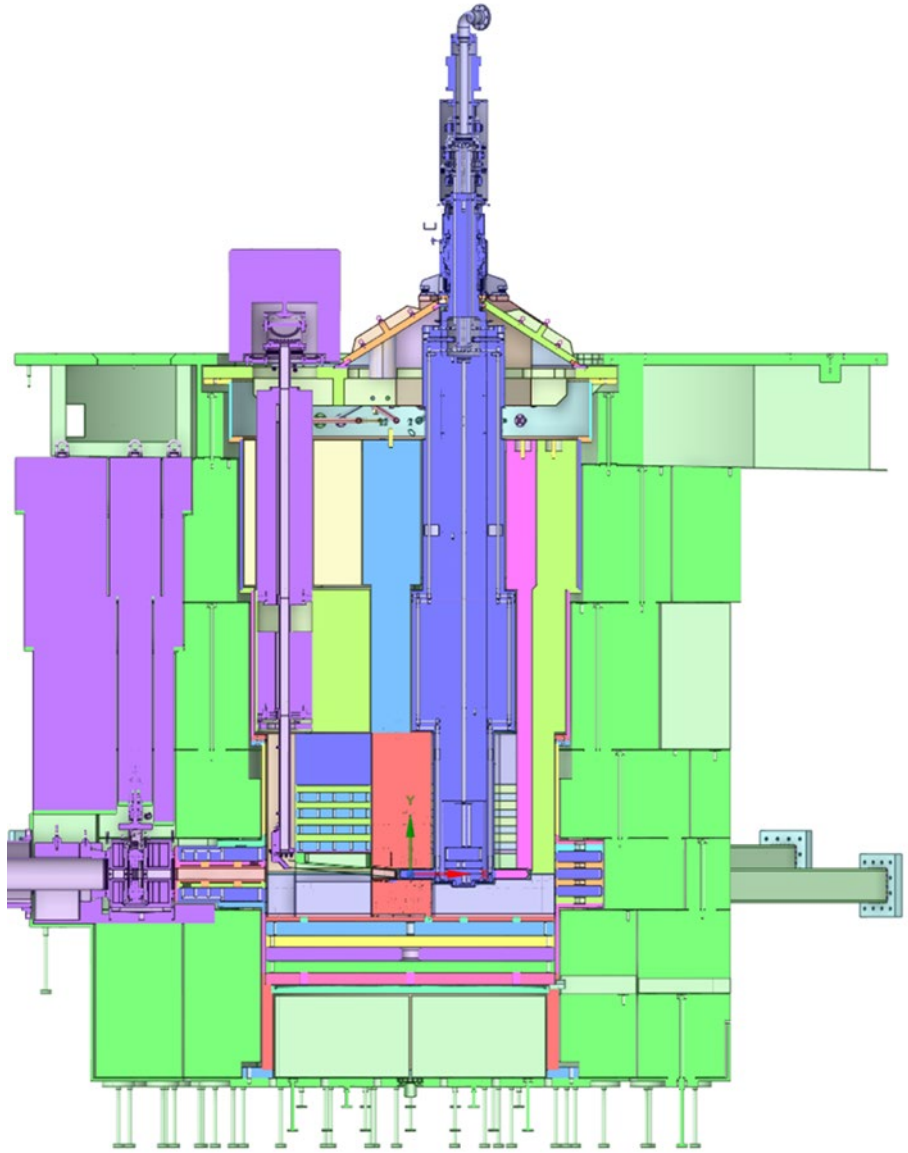
Note: The shielding acts as a thermal sink that helps maintain target temperatures of < 800 C during a loss of cooling event.

PHAR References:
BG7-8, BG7-9A, BG7-12, CMS7-1, CMS7-3, CMS7-5, TS3-2, TS3-3, TS3-5, TS3-6, TS3-7

CodeBeamer reference: S.03.07-6987

Upstream References (2)

S.03-1035	Safe Operation
S.03-1036	Radiation Safety



Derived from: PHAR

Target Station Shielding Requirements

Safety Requirement:

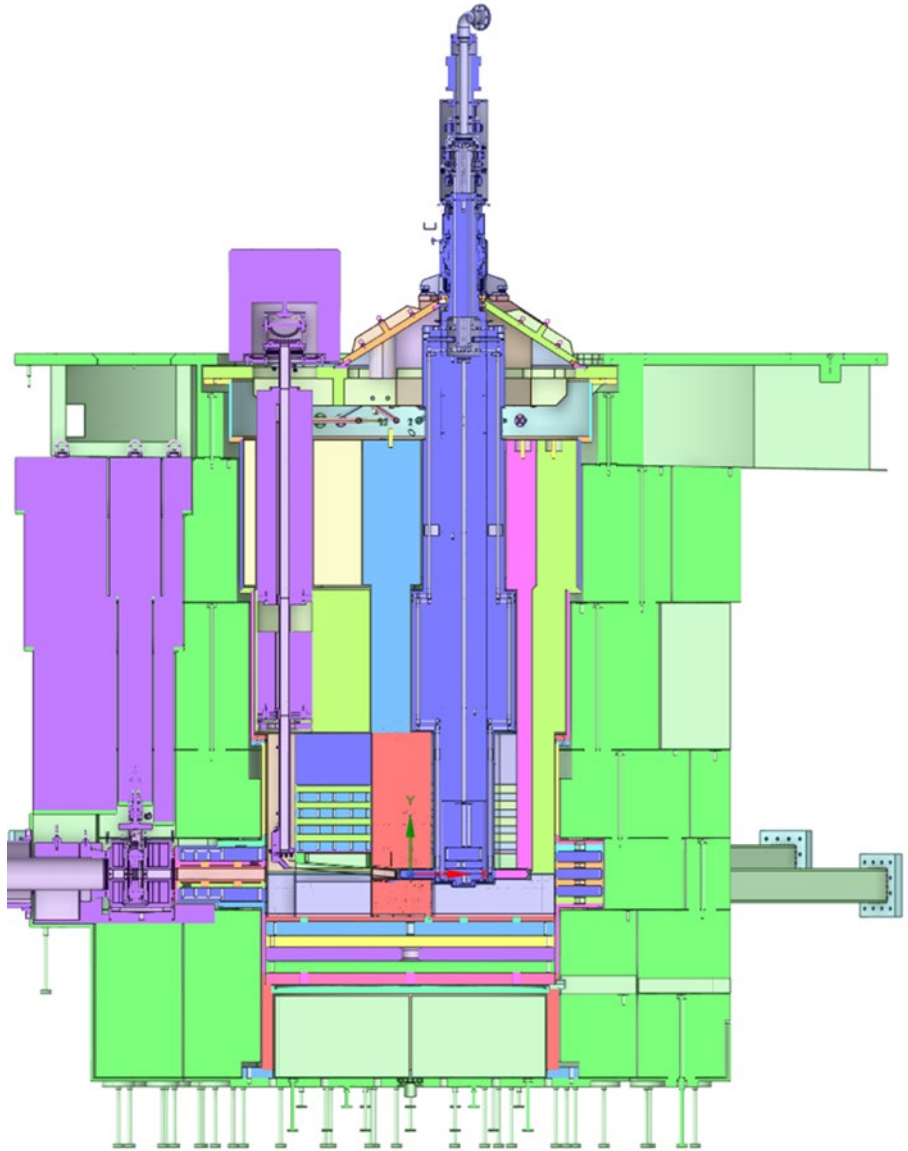
Target Temperature Limit During Facility Fire
Monolith shielding shall assist in keeping target temperature below 800C under reasonable fire conditions.

PHAR References:
BG1-1, BG6-9 (Credited), BG7-1A, BG7-11, CMS7-3, CMS7-5

CodeBeamer reference: S.03.07-6977

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation



Derived from: PHAR

Target Station Shielding Requirements

Safety Requirement:

Impact Damage Protection
The Monolith steel shielding shall protect the Target Feet and Moderator Reflector Assembly from physical impact damage when installed and in the operational configuration.

Note: Target Station Shielding does not protect Moderator Reflector Assembly or Target feet that have been removed from their home positions within the monolith.

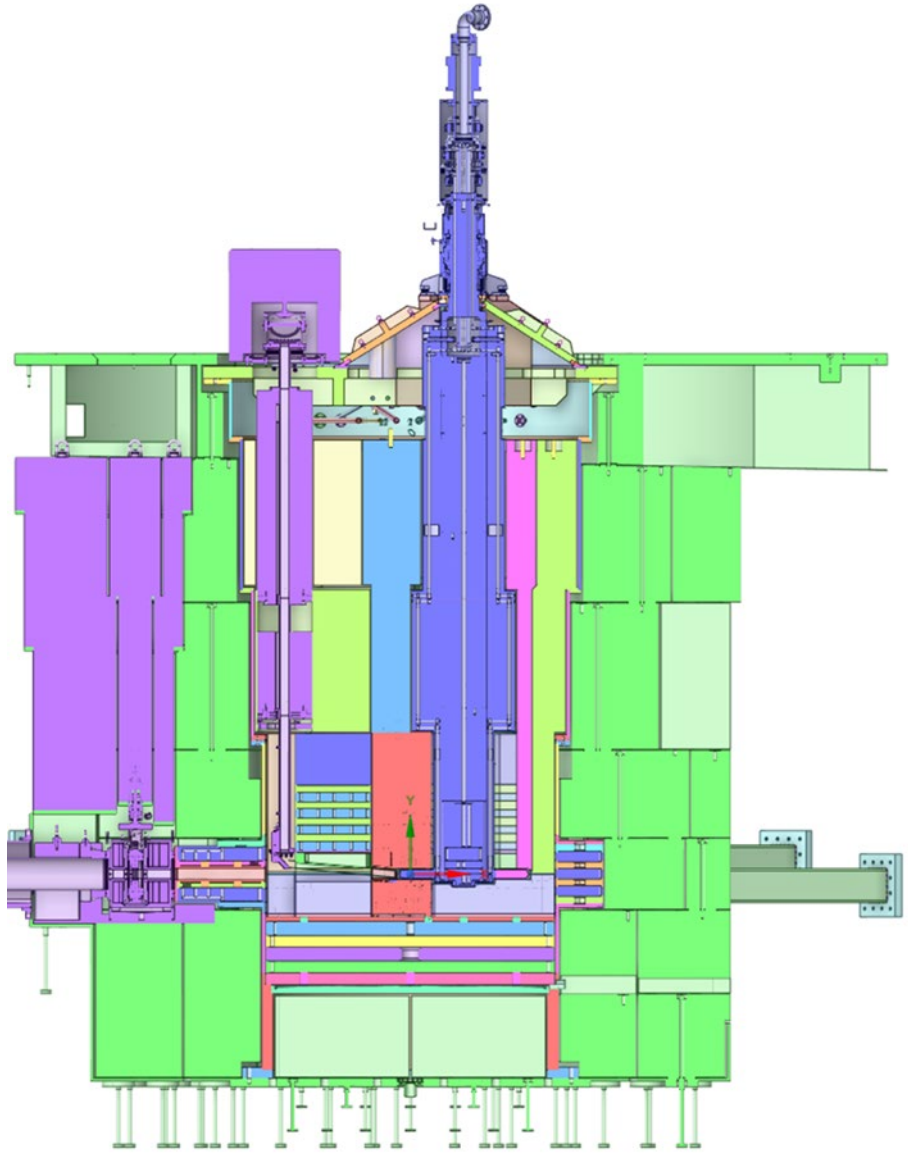
Note: Target station shielding provides less protection when removable shielding is not in place during maintenance activities.

PHAR References:
BG6-9 (Credited), BG6-10, BG7-4, CMS2-5

CodeBeamer reference: S.03.07-6978

Upstream References (2)

S.03-1035	Safe Operation
S.03-1036	Radiation Safety



Derived from: PHAR

Target Station Shielding Requirements

Safety Requirement:

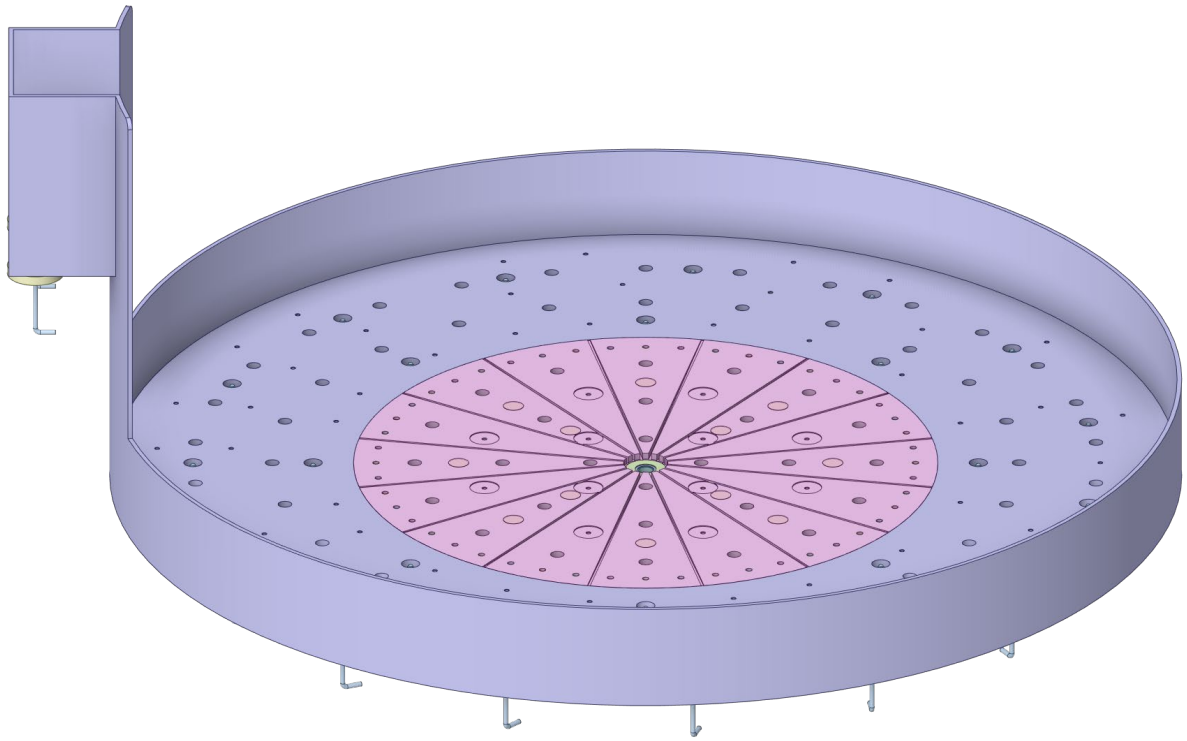
Bulk Shielding Liner Leak Collection
A bulk shielding liner shall capture water leaks at the bottom of the Monolith and drain to a connected leak collection system.

PHAR References:
CMS1-4, CMS2-5, LCS1-1, LCS2-1, LCS3-1, LCS3-2, LCS3-3, LCS4-1, VS3-1

CodeBeamer reference: S.03.07-6979

Upstream References (4)

S.03.05.02-3795	PBW Cooling
S.03.05.06-3786	PBW Shielding Cooling
S.03-1036	Radiation Safety
S.03-1035	Safe Operation



Derived from: PHAR

Target Station Shielding Requirements

Safety Requirement:

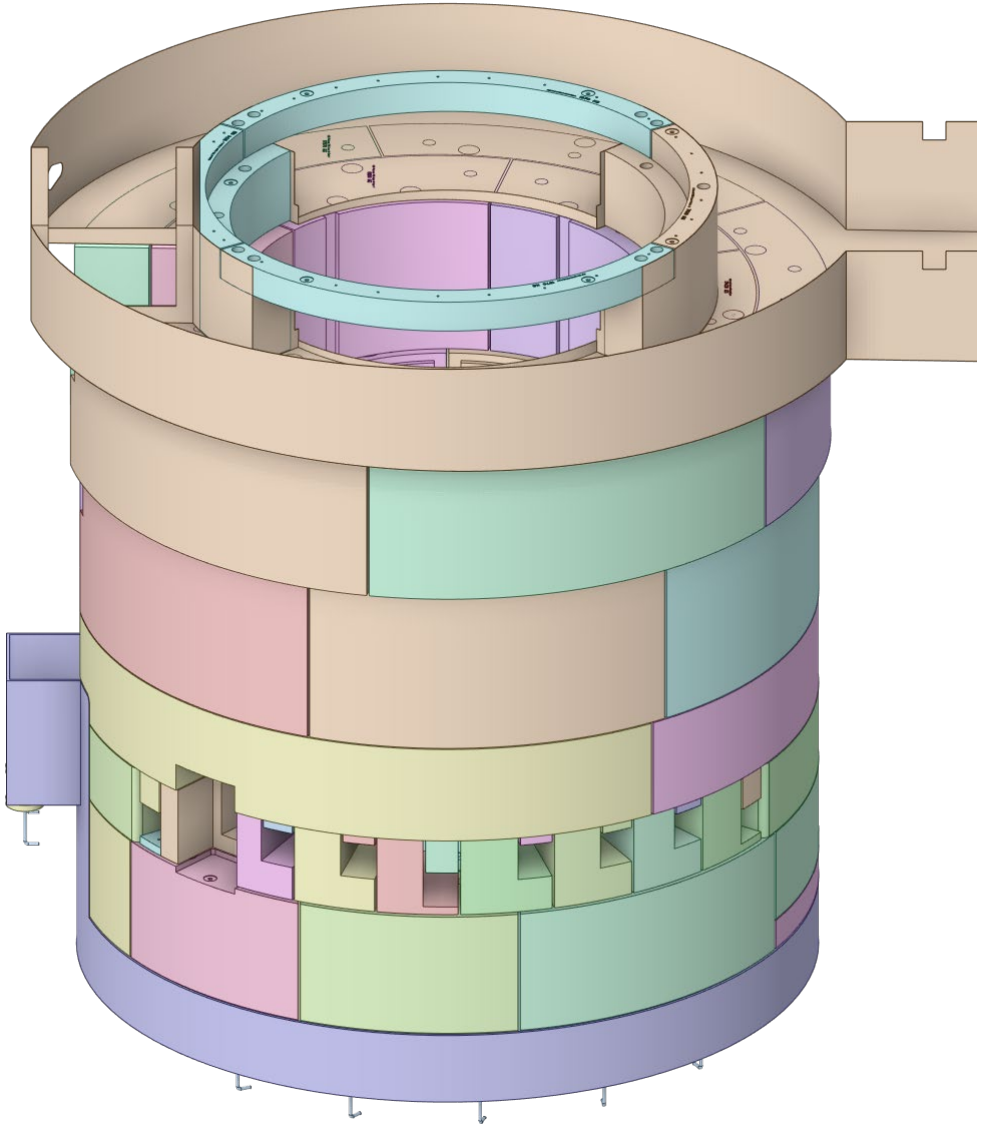
Pipe Pan Drain
Pipe Pans shall capture water leaks in the Target Drive Room and drain to a connected leak collection system.

PHAR References:
CMS1-4, CMS2-5, LCS1-1, LCS2-1, LCS3-1, LCS3-2, LCS3-3, LCS4-1, VS3-1

CodeBeamer reference: S.03.07-6980

Upstream References (2)

S.03-1035	Safe Operation
S.03-1036	Radiation Safety



Derived from: PHAR

Target Station Shielding Requirements

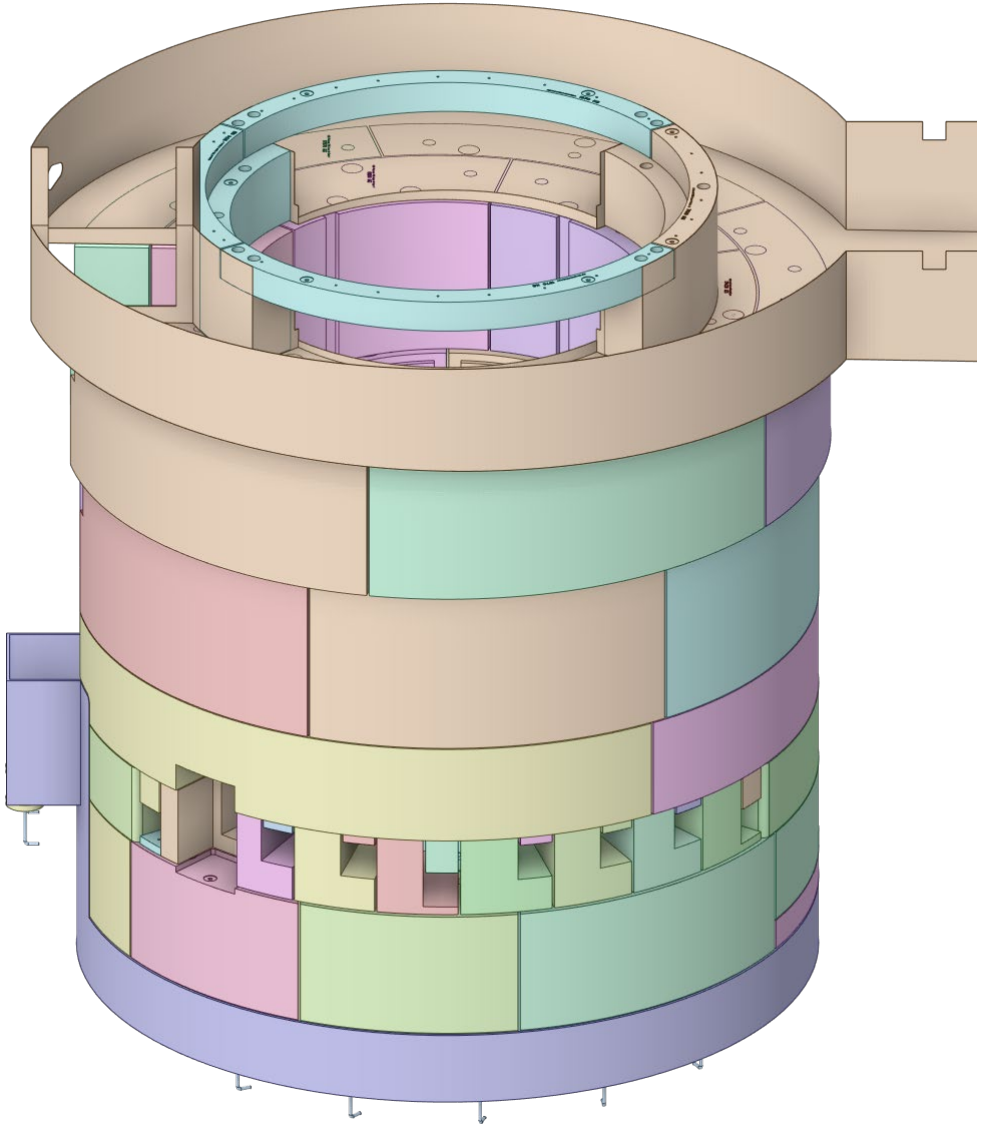
Interface Requirement:

Transfer line Clearance
Target Station Shielding shall provide an unobstructed path through the pipe pan for the hydrogen transfer line per Interface Sheet S03000000-IST10011.

CodeBeamer reference: S.03.07-7201

Upstream References (1)

S.03.03.01-6102	Hydrogen Transfer Line Routing Requirement - Credited



Derived from: S03000000-IST10011 TSS-CMS Interface Sheet

Target Station Shielding Requirements

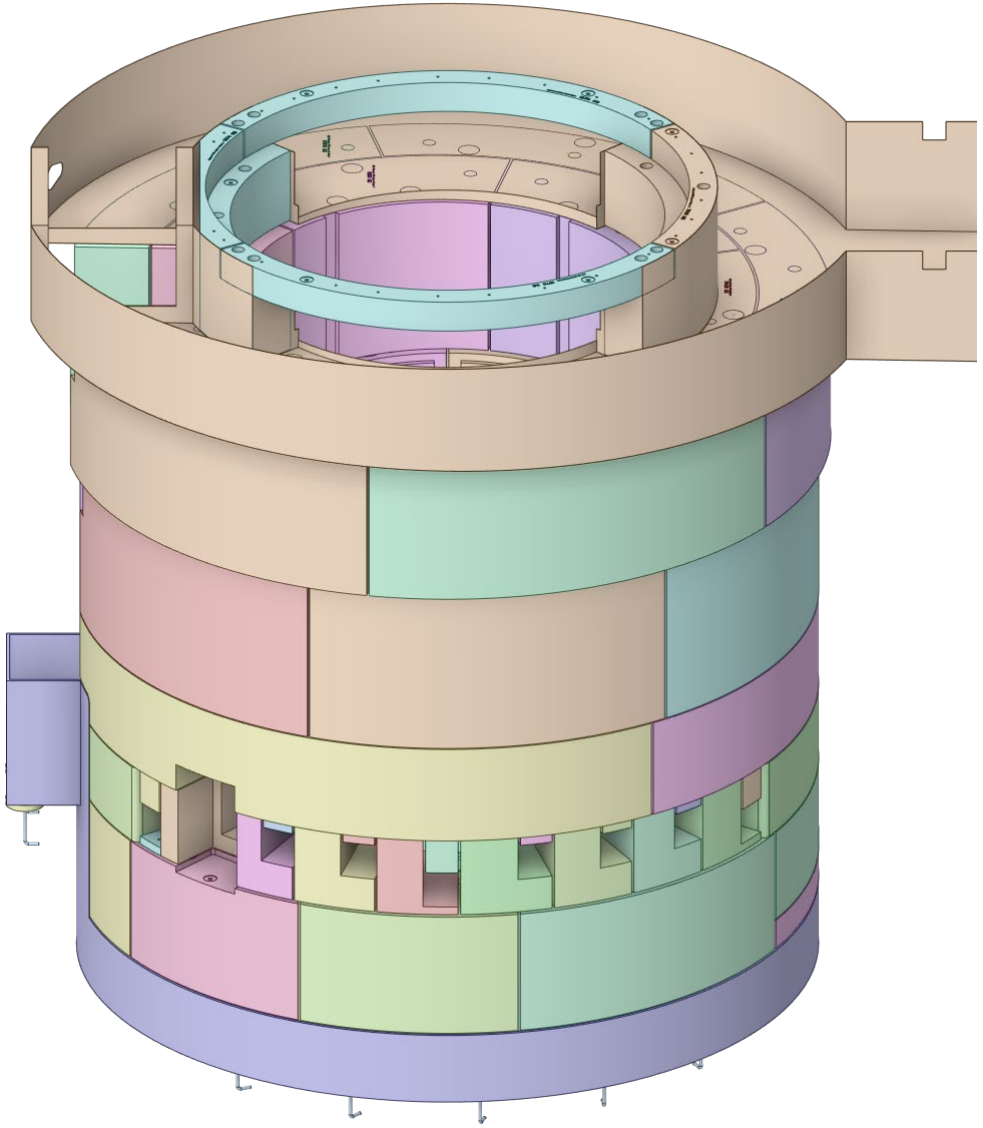
Interface Requirement:

Transfer Line Seismic Protection
Target Station Shielding shall prohibit the pipe pan from damaging the hydrogen transfer line during a seismic event per Interface Sheet S03000000-IST10011.

CodeBeamer reference: S.03.07-7202

Upstream References (1)

S.03.03.01-6102	Hydrogen Transfer Line Routing Requirement - Credited



Derived from: S03000000-IST10011 TSS-CMS Interface Sheet

Target Station Shielding Requirements

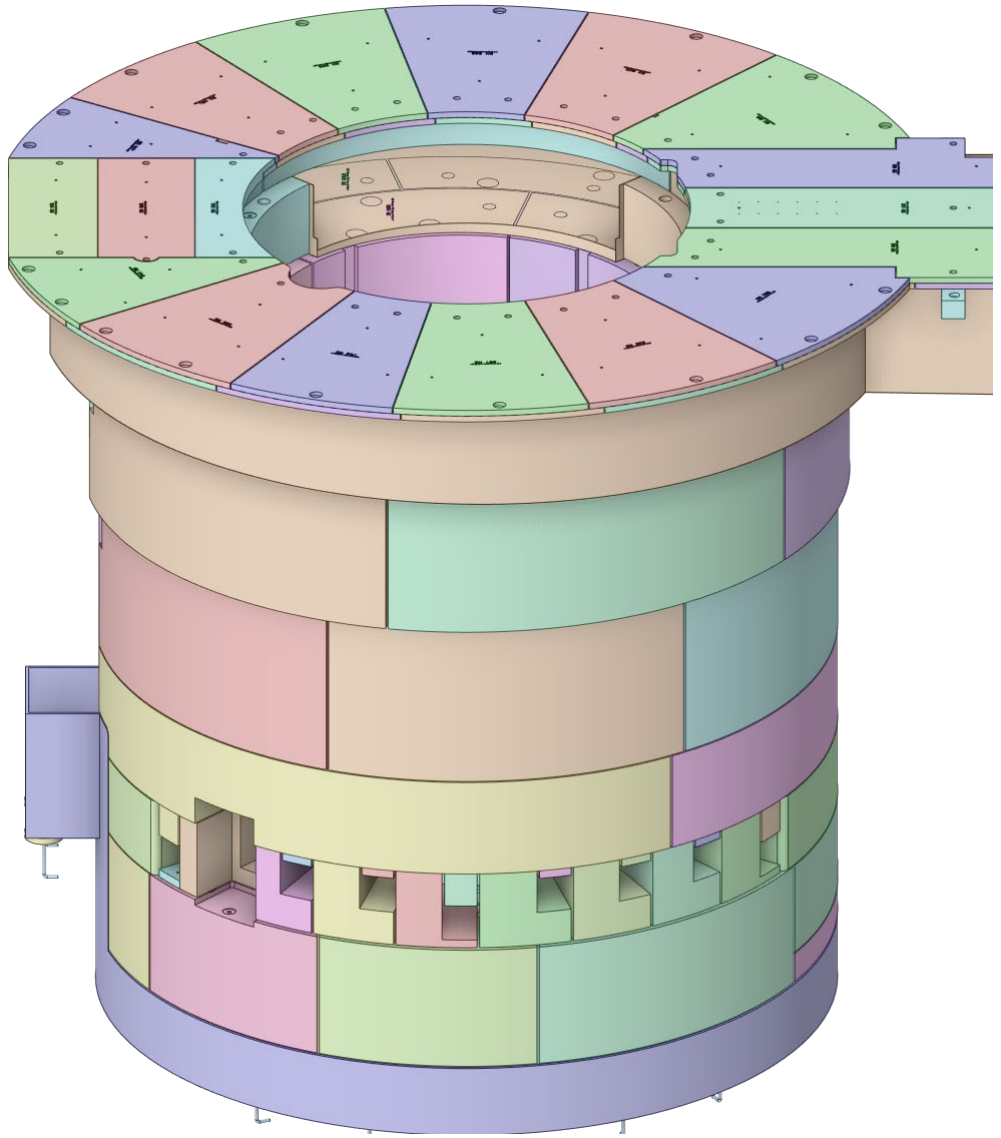
Interface Requirement:

Transfer Line Drop Damage Protection
Target Station Shielding shall provide removable covers above the hydrogen transfer line to protect it from damage due to falling objects within the target drive room per Interface Sheet S03000000-IST10011.

CodeBeamer reference: S.03.07-7203

Upstream References (1)

S.03.03.01-6102	Hydrogen Transfer Line Routing Requirement - Credited



Derived from: S03000000-IST10011 TSS-CMS Interface Sheet

Target Station Shielding Requirements

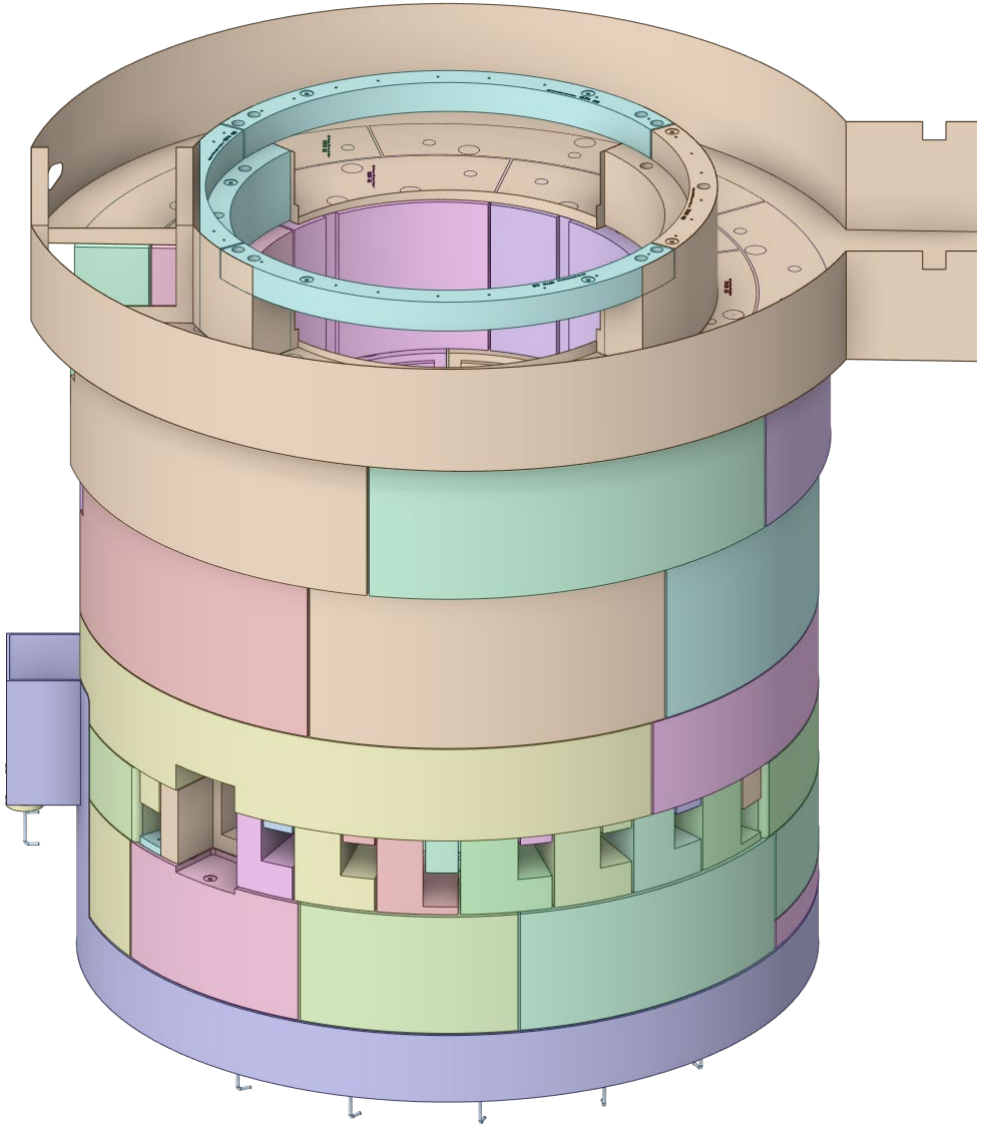
Interface Requirement:

Transfer Line Support Features
Target Station Shielding shall provide features in the pipe pan for mounting of transfer line supports per Interface Sheet S03000000-IST10011.

CodeBeamer reference: S.03.07-7204

Upstream References (1)

S.03.03.01-6102	Hydrogen Transfer Line Routing Requirement - Credited



Derived from: S03000000-IST10011 TSS-CMS Interface Sheet

Target Station Shielding Requirements

Interface Requirement:

Hydrogen Transfer Line Welding Access
Target Station Shielding shall provide access for welding of the hydrogen transfer line during facility construction per Interface Sheet S03000000-IST10011.

CodeBeamer reference: S.03.07-8052

Upstream References (1)

S.03.03.01-2397	Hydrogen Transfer Line Construction Requirement

Derived from: S03000000-IST10011 TSS-CMS Interface Sheet

Target Station Shielding Requirements

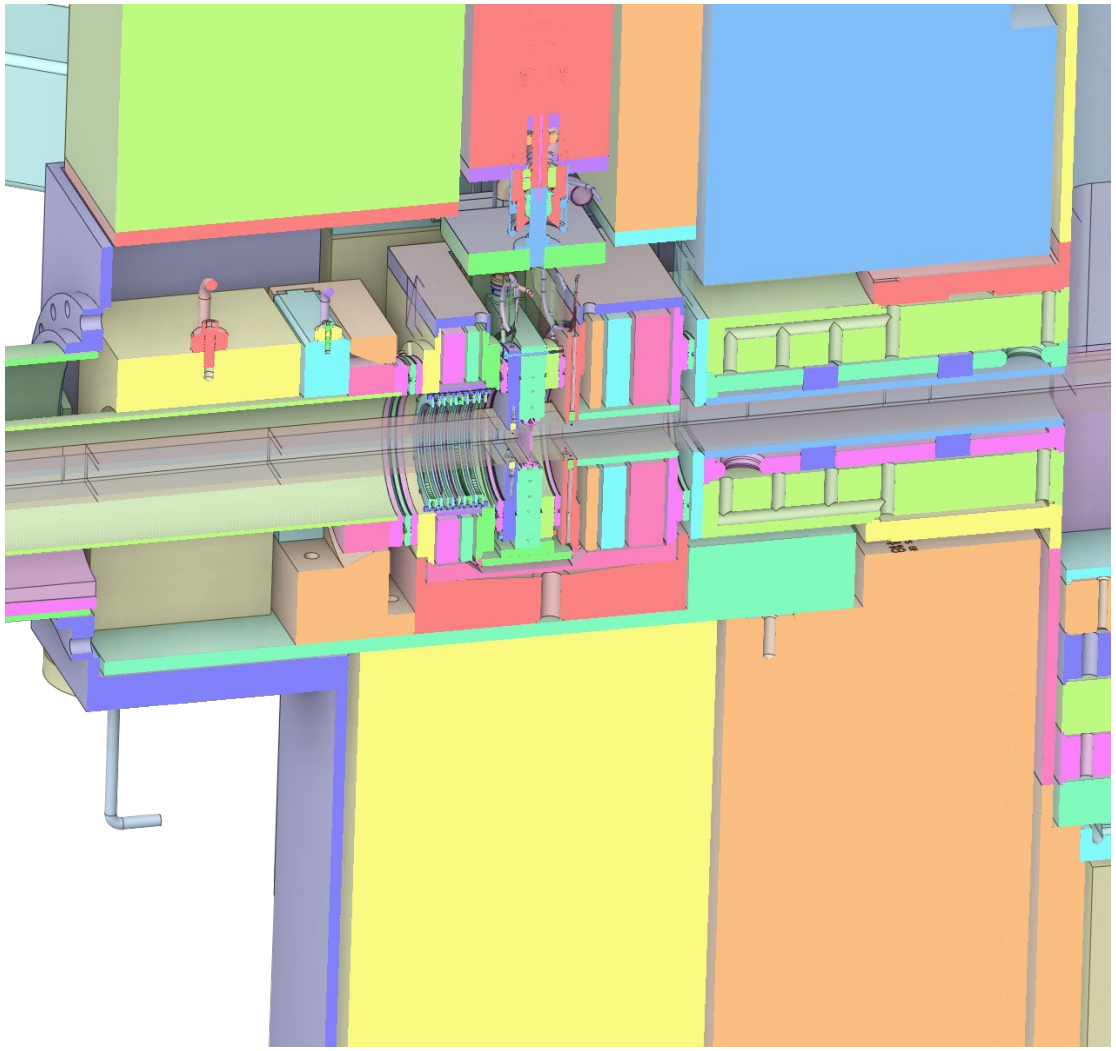
Interface Requirement:

AIC Support
Target Station Shielding shall align and support the baseplate that the Proton Beam Window, Proton Beam Window Shielding and Proton Beam Tube Assembly remote clamp are mounted to. Gravitational and seismic loads will be supported while maintaining the alignment tolerances specified in Interface Sheet S01020500-IST10217.

CodeBeamer reference: S.03.07-7207

Upstream References (2)

S.03-1040	Isolated Environments
S.03.05.02-4780	PBW Structural Integrity



Derived from: S01020500-IST10217 TSS-AIC Interface Sheet

Target Station Shielding Requirements

Interface Requirement:

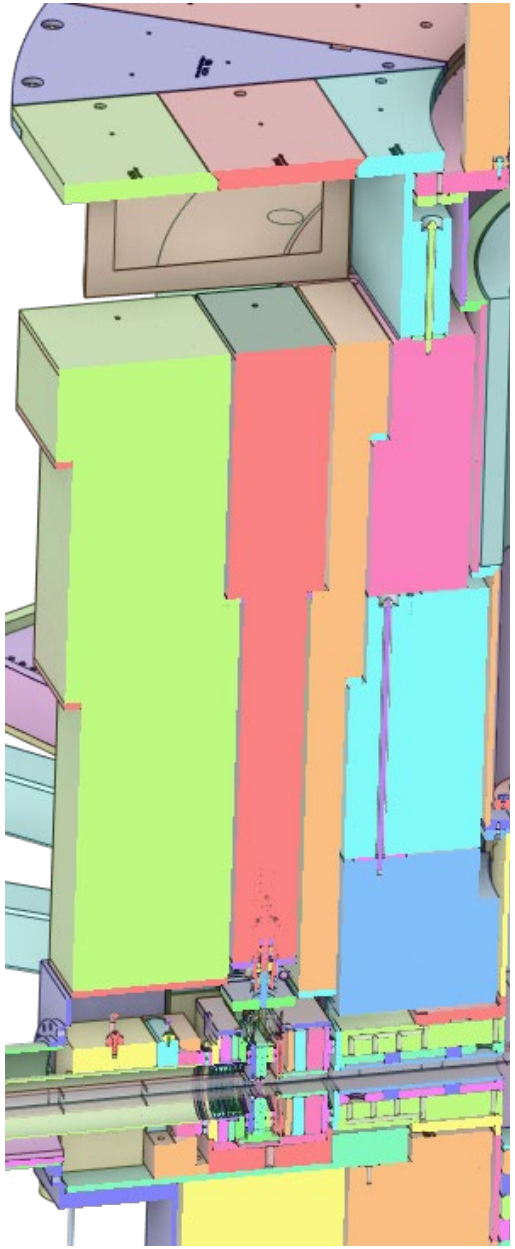
Proton Beam Window Access
Target Station Shielding shall allow access to the Proton Beam Window within 8 hours per Interface Sheet S01020500-IST10217.

Note: The clock starts when the removable shielding removal above the PBW begins

CodeBeamer reference: S.03.07-7211

Upstream References (2)

S.03.05.02-3792	PBW Replacement and Disposal
S.03.05.02-3210	PBW Maintenance & Lifetime Criteria



Derived from: S01020500-IST10217 TSS-AIC Interface Sheet

Target Station Shielding Requirements

Interface Requirement:

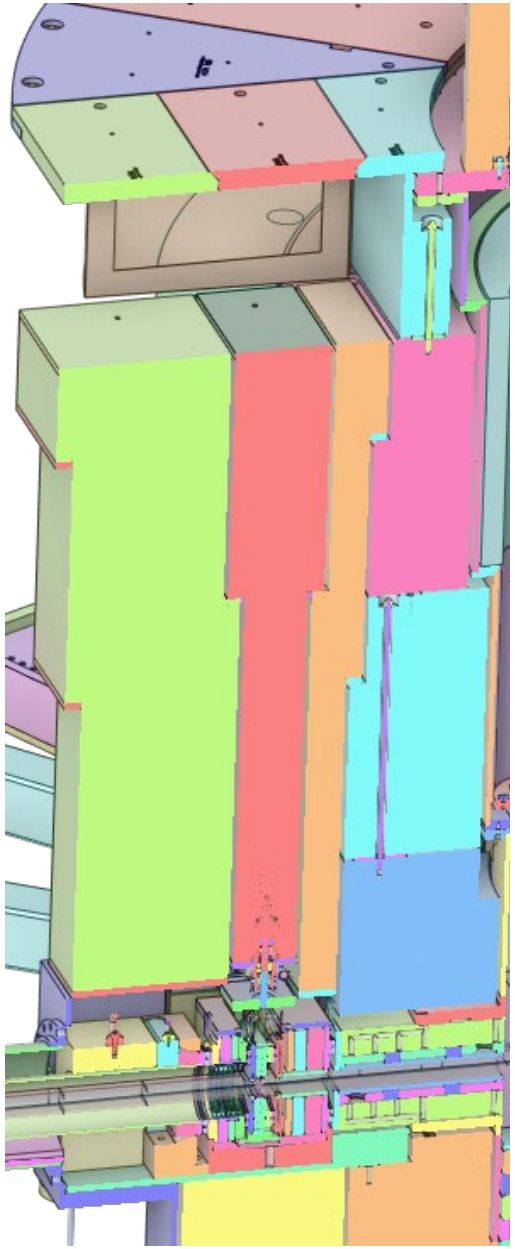
Proton Beam Window Shielding Access
Target Station Shielding shall allow access to the Proton Beam Window Shielding Assembly within 24 hours per Interface Sheet S01020500-IST10217.

Note: The clock starts when the removable shielding removal above the PBW Shielding assembly begins.

CodeBeamer reference: S.03.07-7212

Upstream References (2)

S.03.05.02-3792	PBW Replacement and Disposal
S.03.05.02-3210	PBW Maintenance & Lifetime Criteria



Derived from: S01020500-IST10217 TSS-AIC Interface Sheet

Target Station Shielding Requirements

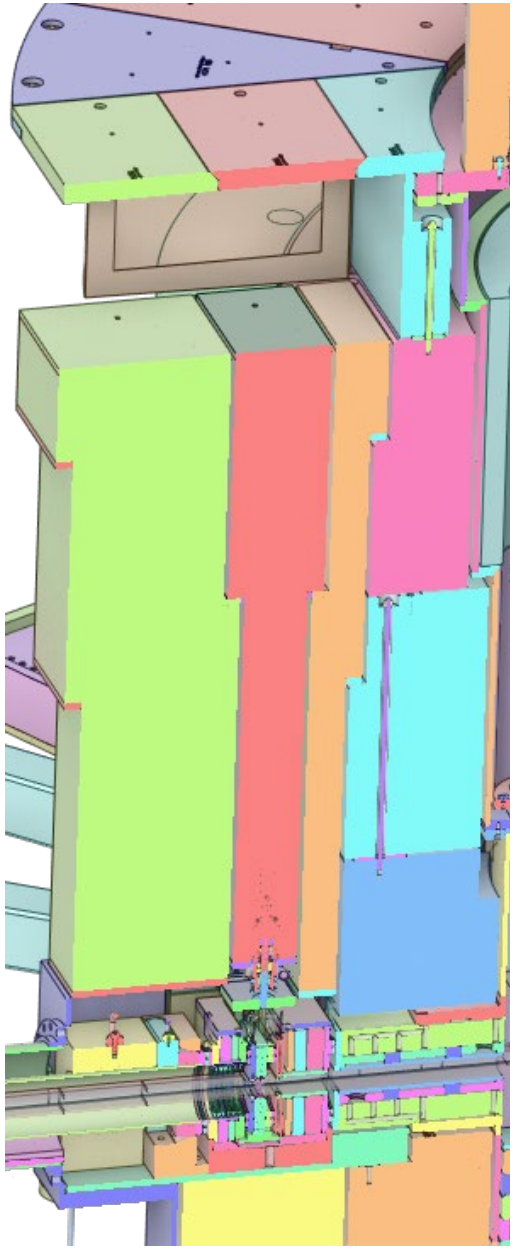
Interface Requirement:

Utility Line Clearance
Target Station Shielding shall provide clearance for the Proton Beam Window and Proton Beam Window Shielding utility lines per Interface Sheet S01020500-IST10217.

CodeBeamer reference: S.03.07-7213

Upstream References (1)

S.03.05.02-3795	PBW Cooling



Derived from: S01020500-IST10217 TSS-AIC Interface Sheet

Target Station Shielding Requirements

Interface Requirement:

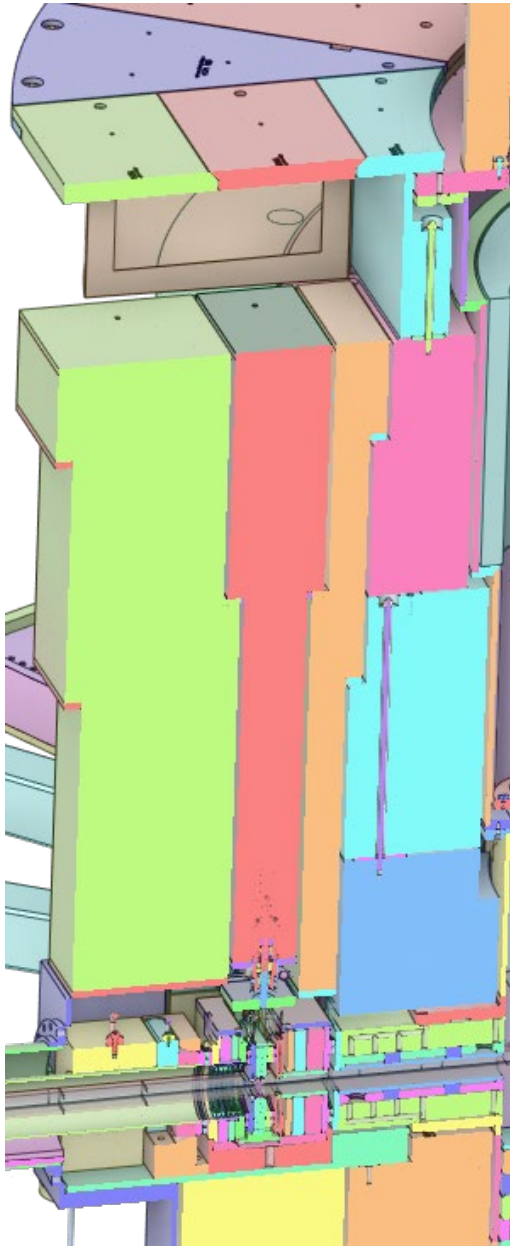
Proton Beam Tube Assembly Remote Clamp Access
Target Station Shielding shall allow access to the Proton Beam Tube Assembly remote clamp within 24 hours per Interface Sheet S01020500-IST10217.

Note: The clock starts when the removable shielding removal above the Proton Beam Tube Assembly begins.

CodeBeamer reference: S.03.07-7214

Upstream References (1)

S.03.05.05-3780	PBTA Replacement and Disposal



Derived from: S01020500-IST10217 TSS-AIC Interface Sheet

Target Station Shielding Requirements

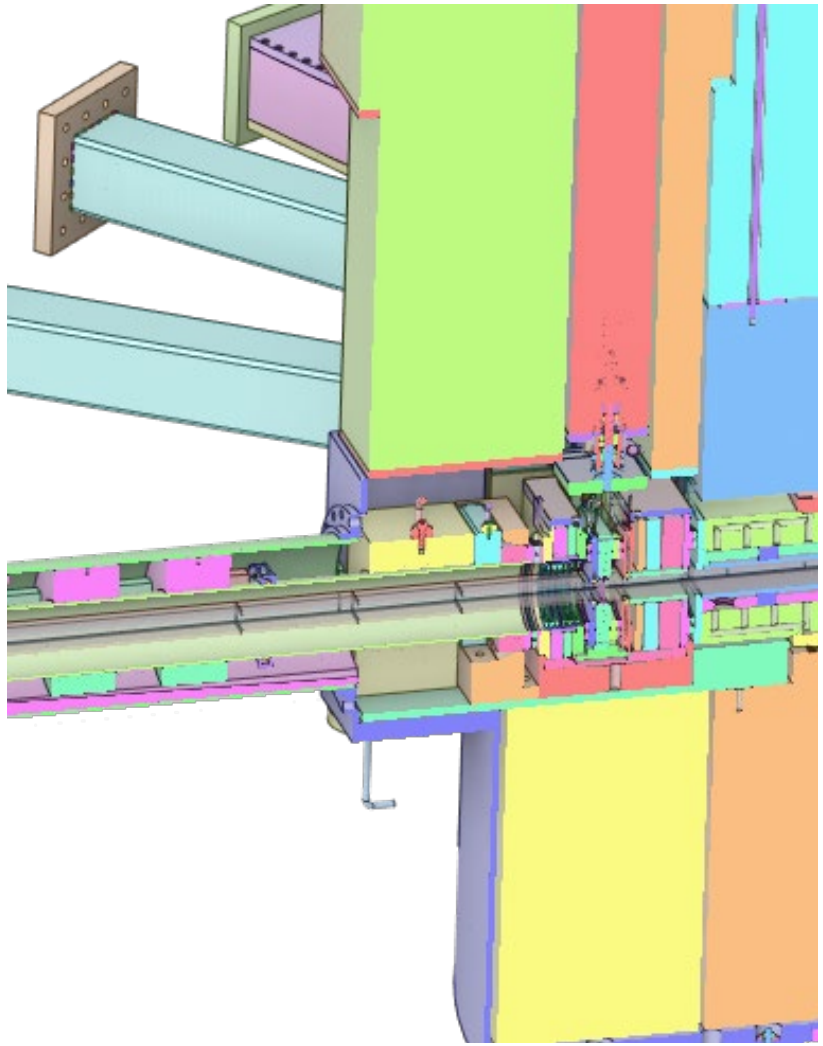
Interface Requirement:

Proton Beam Tube Assembly Clearance
Target Station Shielding shall provide clearance in the bulk shielding liner for the Proton Beam Tube Assembly per Interface Sheet S01020500-IST10217.

CodeBeamer reference: S.03.07-7215

Upstream References (1)

S.03.05.05-3780	PBTA Replacement and Disposal



Derived from: S01020500-IST10217 TSS-AIC Interface Sheet

Target Station Shielding Requirements

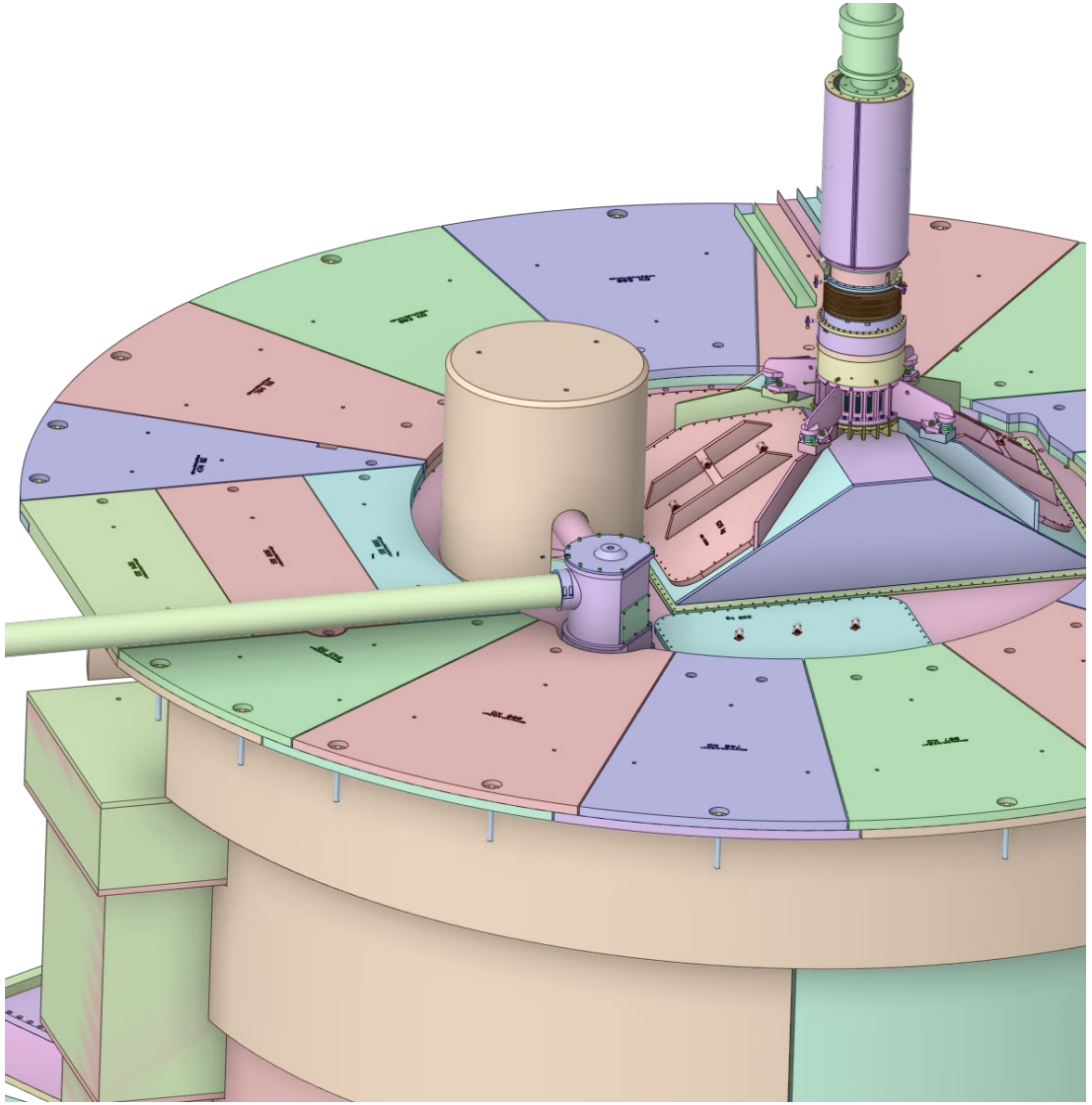
Interface Requirement:

Target Viewing Periscope Clearance
Target Station Shielding shall provide appropriate clearance around the Target Viewing Periscope assembly per Interface Sheet S01020500-IST10217.

CodeBeamer reference: S.03.07-7813

Upstream References (1)

S.03.05.03-5746	TVP Beam Position Measurement



Derived from: S01020500-IST10217 TSS-AIC Interface Sheet

Target Station Shielding Requirements

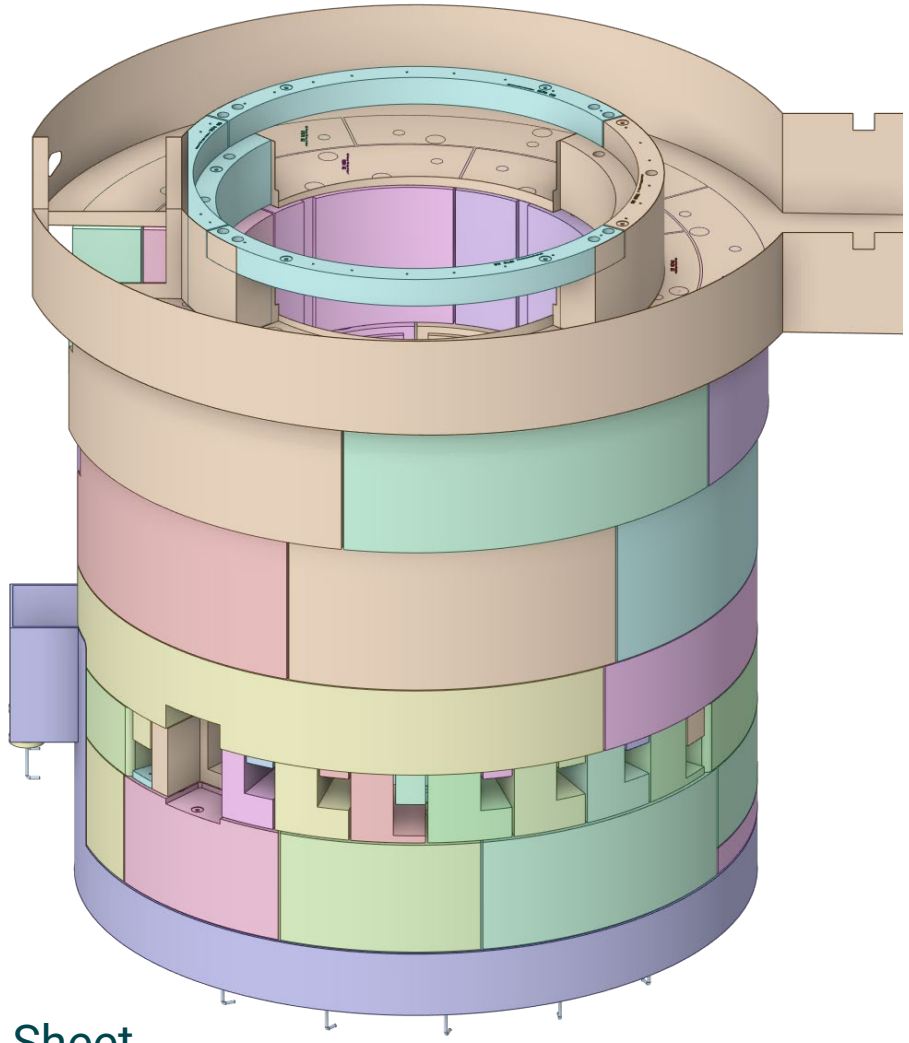
Interface Requirement:

Utility Pipe Clearance
Target Station Shielding shall supply sufficient clearance for utility piping inside the pipe pan per Interface Sheet S03000000-IST10005.

CodeBeamer reference: S.03.07-7217

Upstream References (1)

S.03.09.02-6448	Piping Design



Derived from: S03000000-IST10005 TSS-Process Systems Interface Sheet

Target Station Shielding Requirements

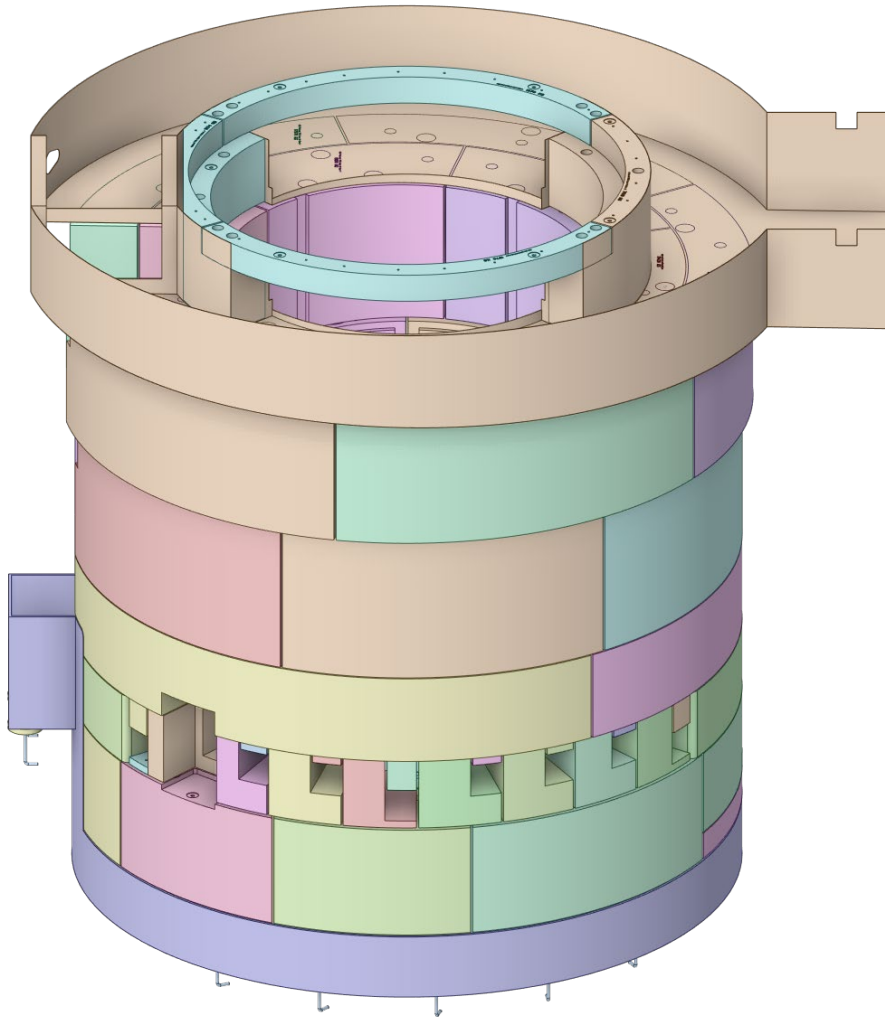
Interface Requirement:

Pipe Pan Drainage
Target Station Shielding shall slope the bottom of the pipe pan a minimum of 1 degree downward slope towards the hot process vault and provide an interfacing feature for water routing to the leak collection system per Interface Sheet S03000000-IST10005.

CodeBeamer reference: S.03.07-7218

Upstream References (1)

S.03.09-6118	Leak Collection



Derived from: S03000000-IST10005 TSS-Process Systems Interface Sheet

Target Station Shielding Requirements

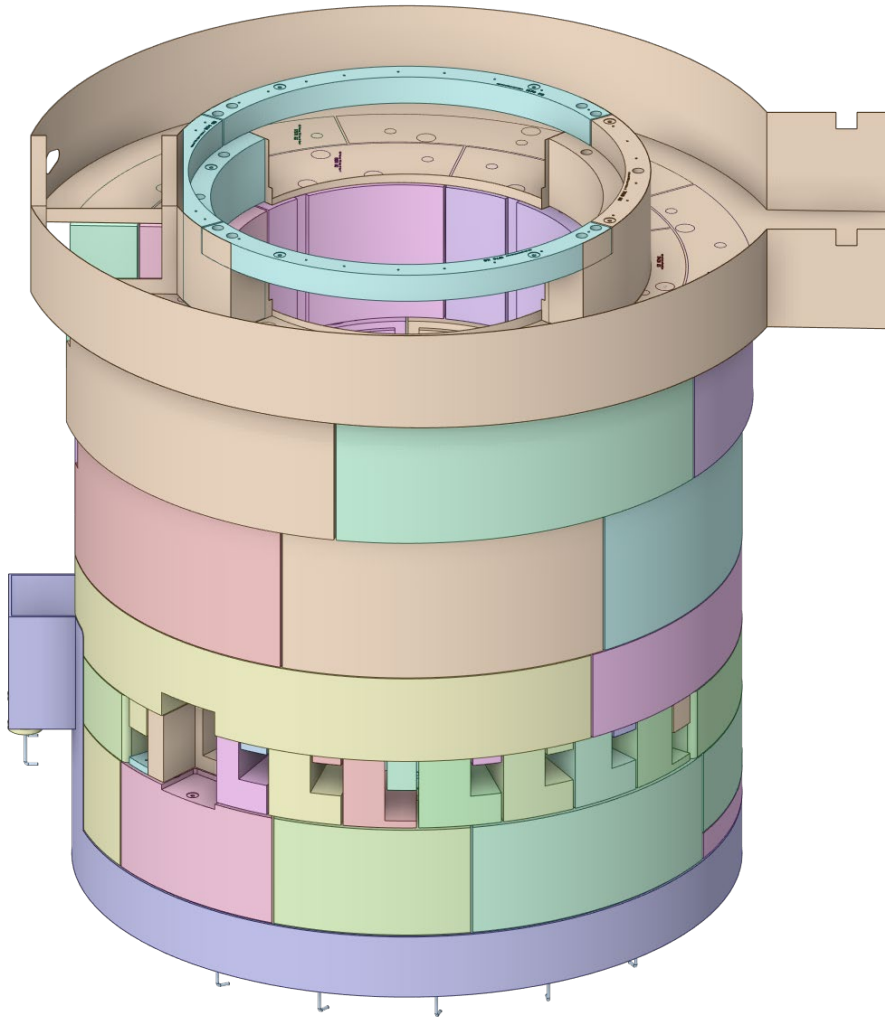
Interface Requirement:

Pipe Pan Pipe Supports
Target Station Shielding shall provide features within the pipe pan for mounting of pipe supports designed and provided by Process Systems per Interface Sheet S03000000-IST10005.

CodeBeamer reference: S.03.07-7219

Upstream References (1)

S.03.09.02-6448	Piping Design



Derived from: S03000000-IST10005 TSS-Process Systems Interface Sheet

Target Station Shielding Requirements

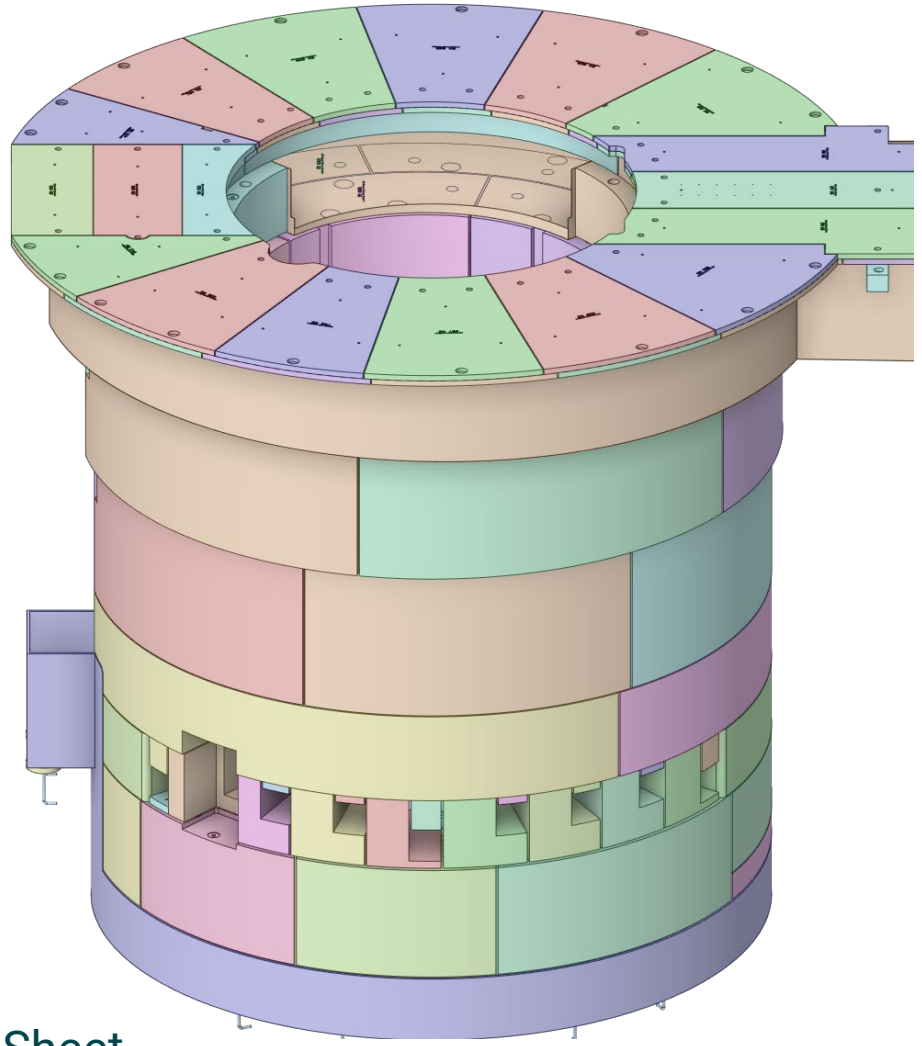
Interface Requirement:

Utility Pipe Access
Target Station Shielding shall allow for access to the utility pipes contained within the pipe pan per Interface Sheet S03000000-IST10005.

CodeBeamer reference: S.03.07-7220

Upstream References (1)

S.03-3009	Maintenance & Lifetime Criteria



Derived from: S03000000-IST10005 TSS-Process Systems Interface Sheet

Target Station Shielding Requirements

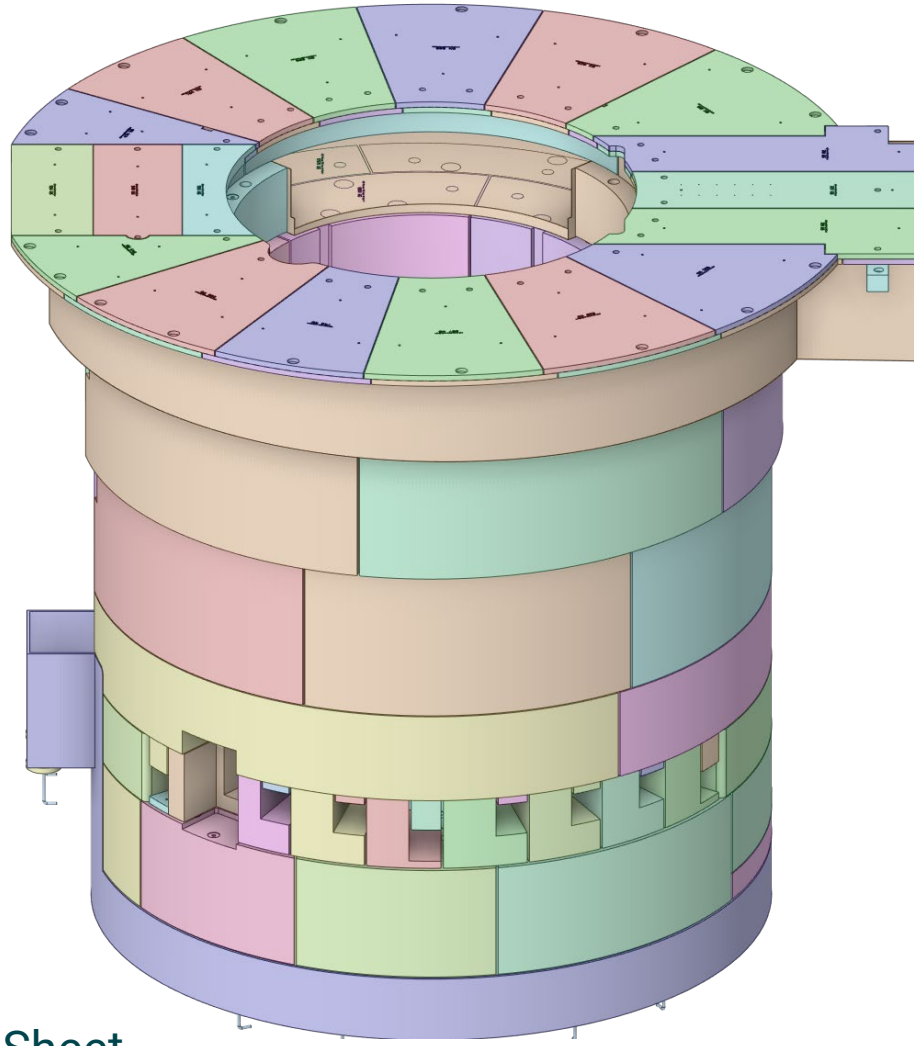
Interface Requirement:

Utility Pipe Clearance
Target Station Shielding shall allow for utility pipes to pass through the pipe pan covers into the target drive room per Interface Sheet S03000000-IST10005.

CodeBeamer reference: S.03.07-7221

Upstream References (1)

S.03.09.02-6448	Piping Design



Derived from: S03000000-IST10005 TSS-Process Systems Interface Sheet

Target Station Shielding Requirements

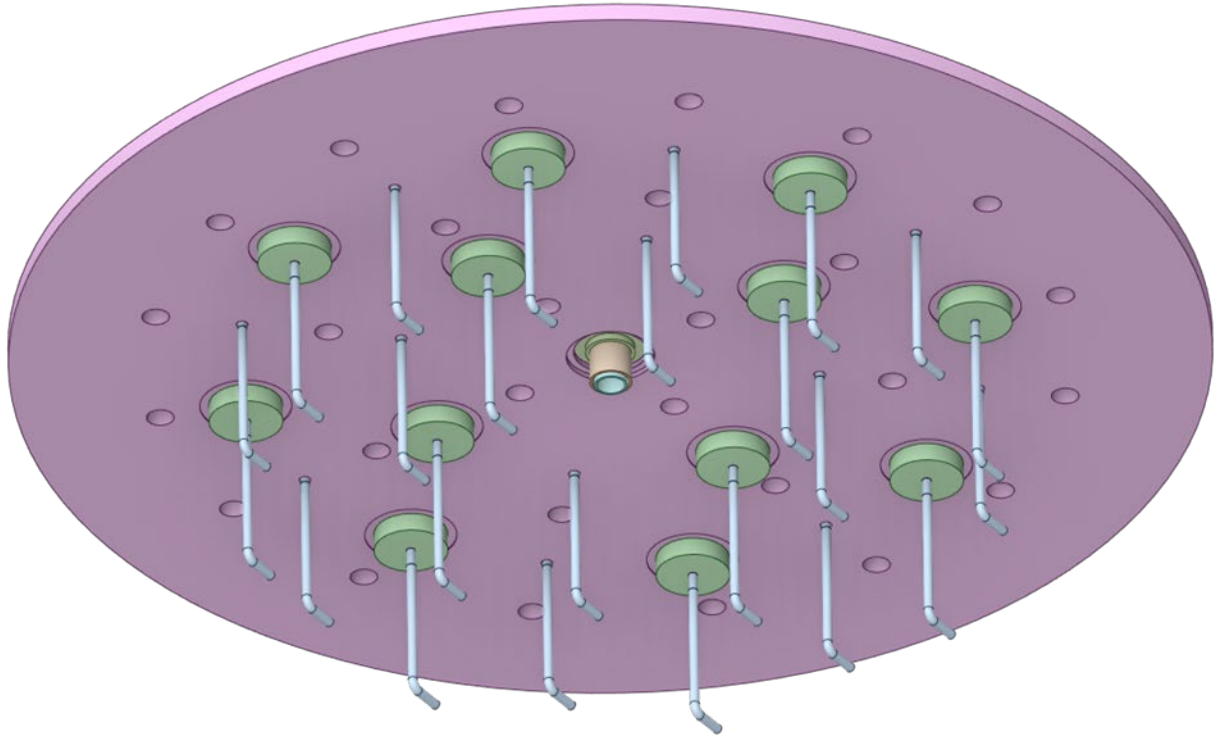
Interface Requirement:

Bulk Shielding Liner Drain
Target Station Shielding shall provide a connection pipe to the bulk shielding liner drain per Interface Sheet S03000000-IST10005.

CodeBeamer reference: S.03.07-7222

Upstream References (1)

S.03.09-6118	Leak Collection



Derived from: S03000000-IST10005 TSS-Process Systems Interface Sheet

Target Station Shielding Requirements

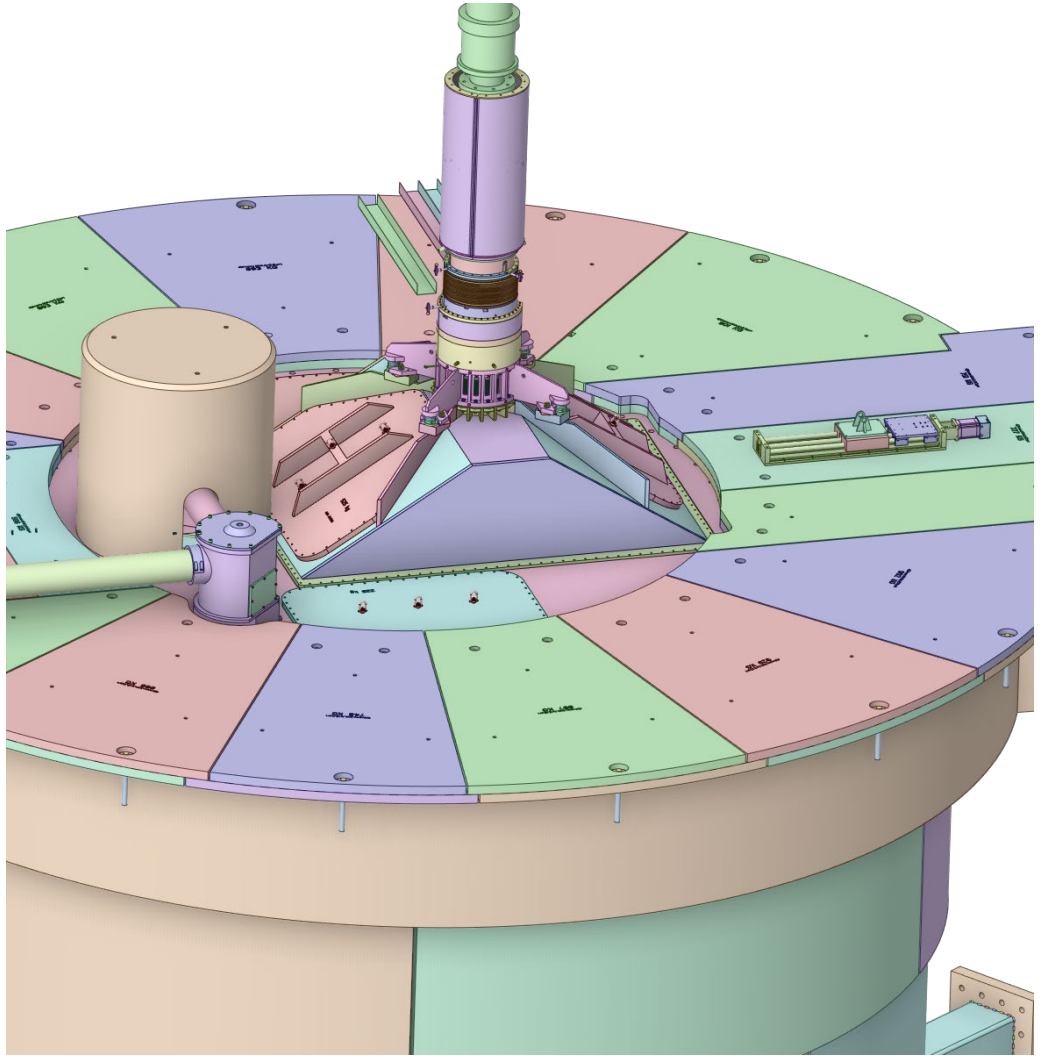
Interface Requirement:

Target Water Line Support
Target Station Shielding shall support target water line support assemblies per Interface Sheet S03000000-IST10005.

CodeBeamer reference: S.03.07-7223

Upstream References (1)

S.03.09.02-6425	Target Assembly Cooling



Derived from: S03000000-IST10005 TSS-Process Systems Interface Sheet

Target Station Shielding Requirements

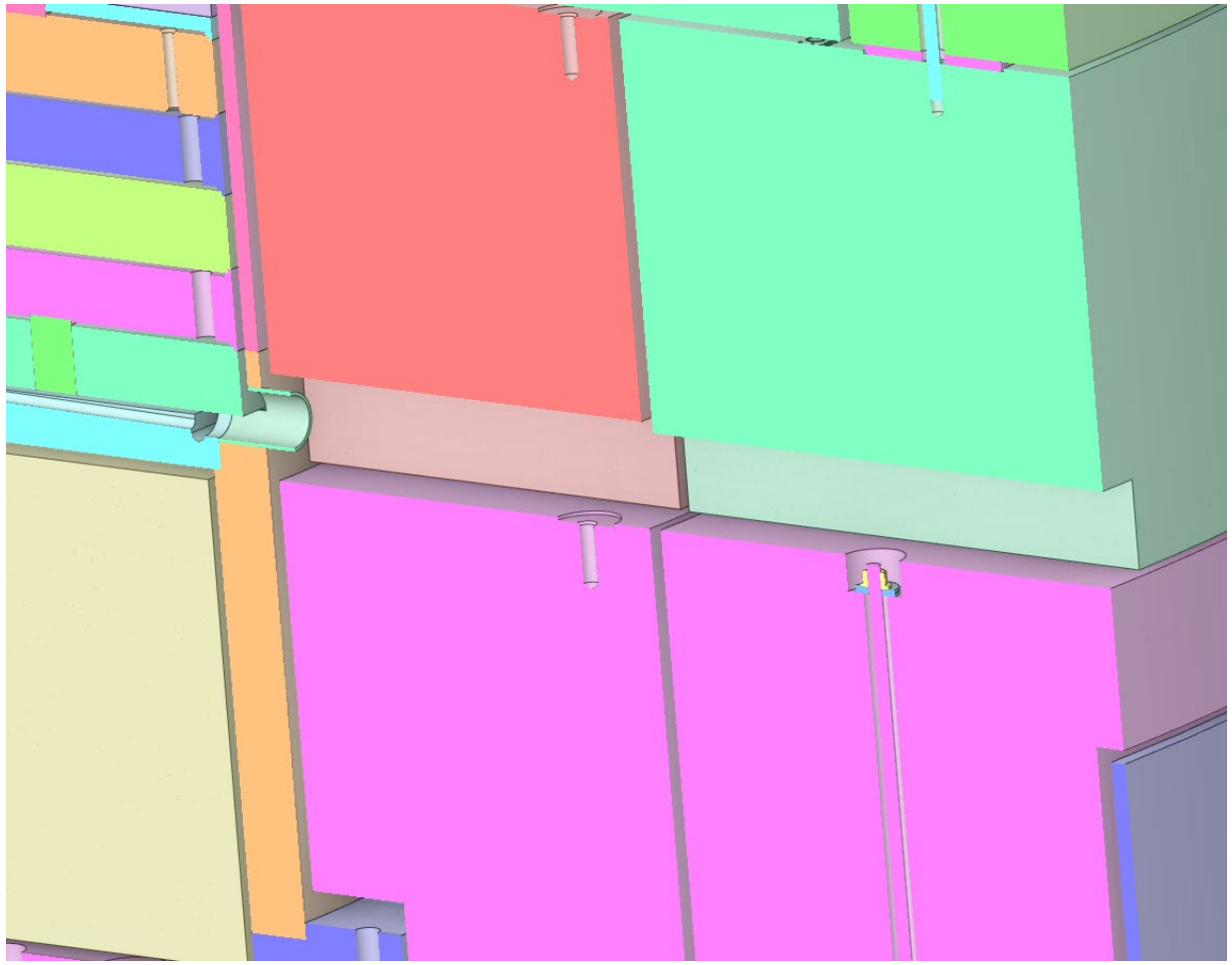
Interface Requirement:

Core Vessel Drain Line Clearance
Target Station Shielding shall provide clearance around the Core Vessel drain line per Interface Sheet S03000000-IST10005.

CodeBeamer reference: S.03.07-7815

Upstream References (1)

S.03.09-6118	Leak Collection



Derived from: S03000000-IST10005 TSS-Process Systems Interface Sheet

Target Station Shielding Requirements

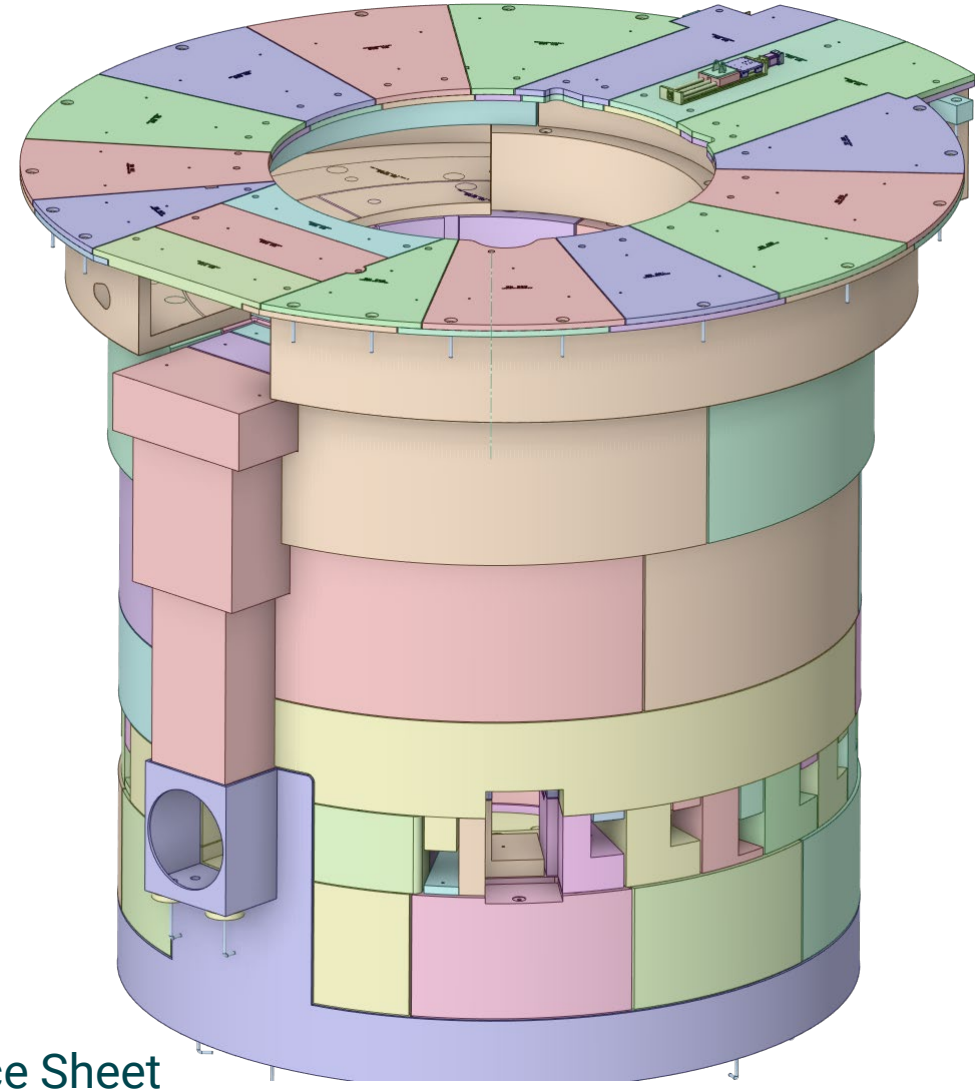
Interface Requirement:

Removable Component Lifting Interfaces
Target Station Shielding shall provide lifting interfaces for all removable Target Station Shielding components per Interface Sheet S03000000-IST10007.

CodeBeamer reference: S.03.07-7225

Upstream References (1)

RH-AIC-Conv_Req-2244	Conveyance Systems - AIC



Derived from: S03000000-IST10007 TSS-Remote Handling Interface Sheet

Target Station Shielding Requirements

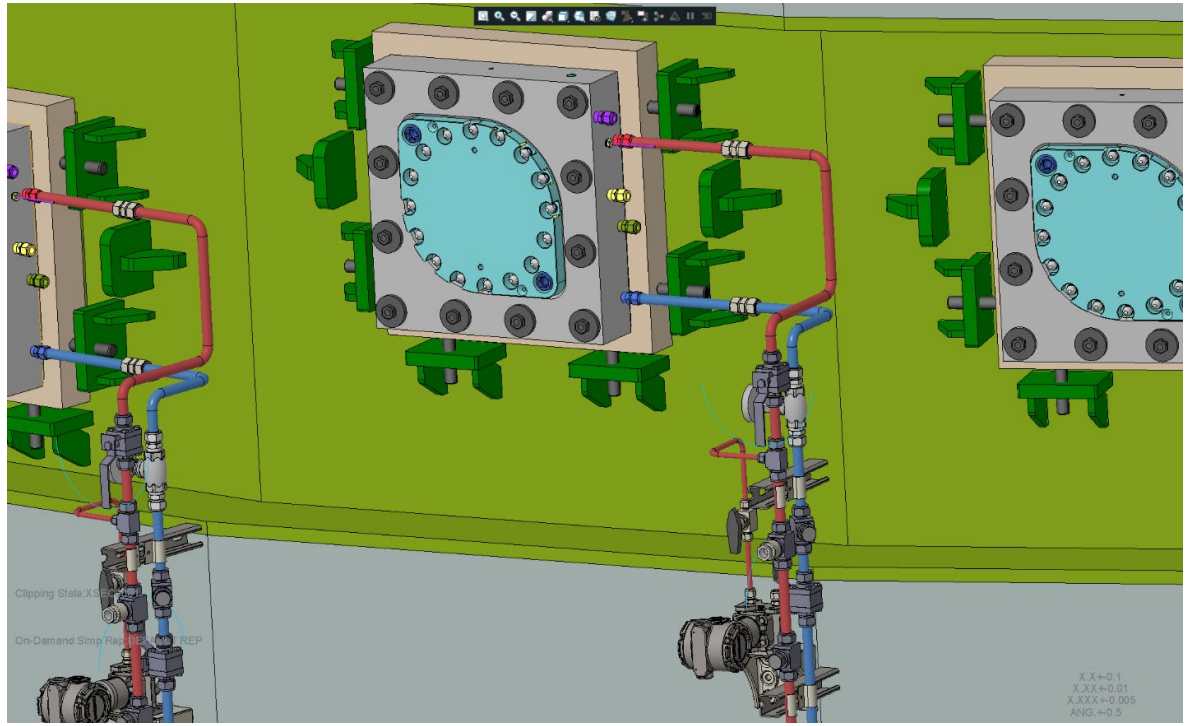
Interface Requirement:

Monolith Port Clearance
Target Station Shielding shall provide appropriate physical clearance between the monolith insert rear flanges, utility connections and the monolith ports per Interface Sheet S01020500-IS0025.

CodeBeamer reference: S.03.07-7228

Upstream References (1)

S.03-1029	Peak Brightness



Derived from: S01020500-IST100025 TSS-Instrument Systems Interface Sheet

Target Station Shielding Requirements

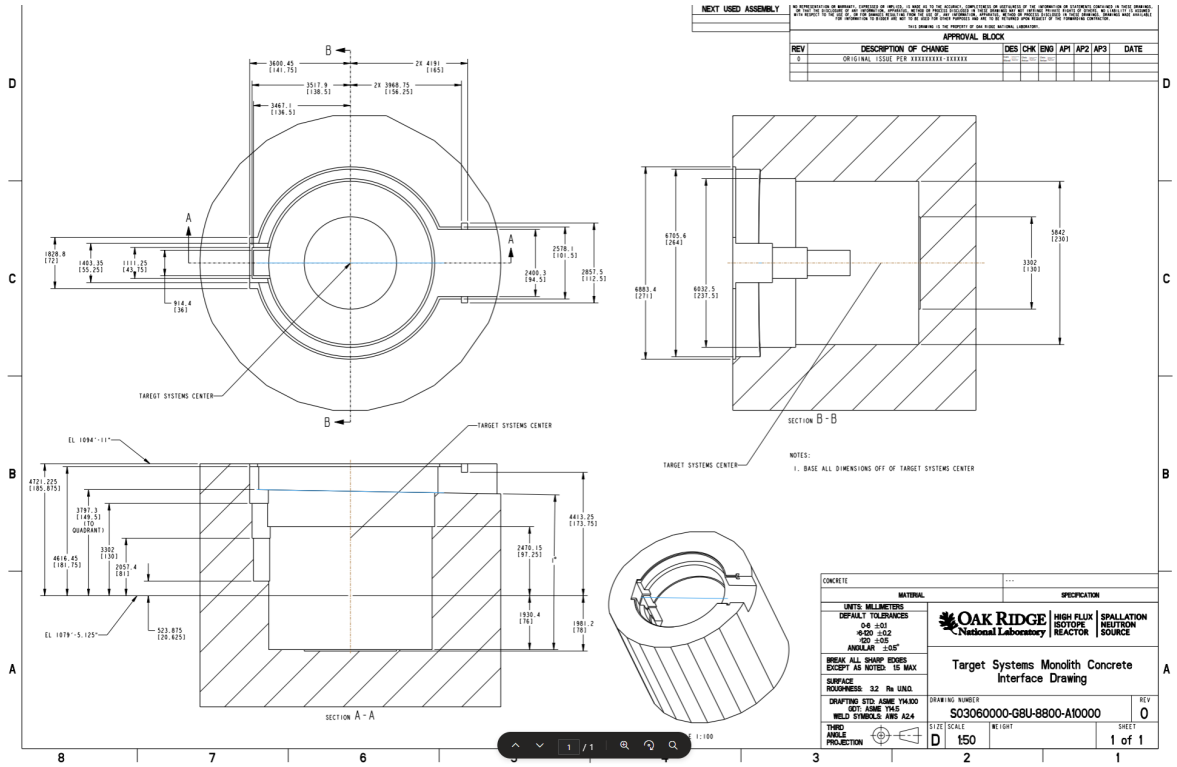
Interface Requirement:

Monolith internal concrete profile
Target Station Shielding shall supply the required monolith internal concrete profile to Conventional Facilities per Interface Sheet S01020500-IST10064.

CodeBeamer reference: S.03.07-7230

Upstream References (2)

S.03-1036	Radiation Safety
S.03-1035	Safe Operation



Derived from: S01020500-IST100064 TSS-Conventional Facilities Interface Sheet

Target Station Shielding Requirements

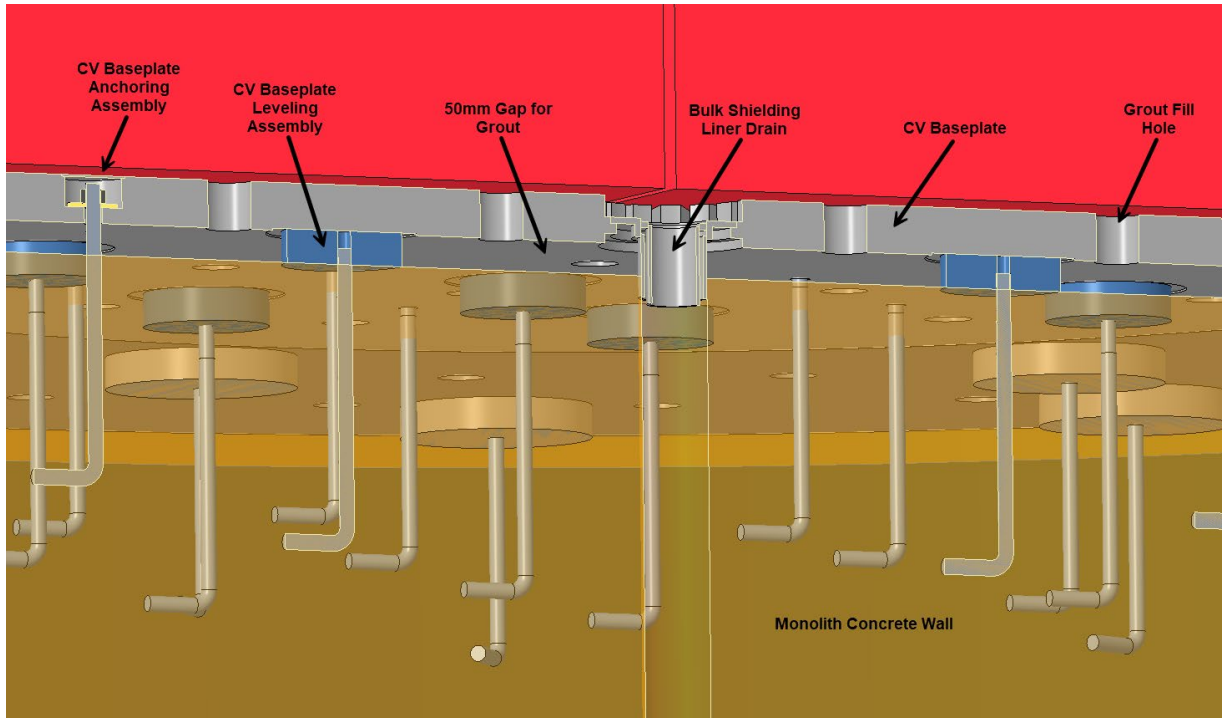
Interface Requirement:

Concrete Anchor Details
Target Station Shielding shall supply the location, size, connection type and mechanical loading of the concrete anchors required by Target Station Shielding per Interface Sheet S01020500-IST10064.

CodeBeamer reference: S.03.07-7232

Upstream References (1)

S.03-1035	Safe Operation



Derived from: S01020500-IST100064 TSS-Conventional Facilities Interface Sheet

Target Station Shielding Requirements

Interface Requirement:

Mechanical Loading Details
Target Station Shielding shall supply the mechanical loads imparted on the concrete by the monolith interior components per Interface Sheet S01020500-IST10064.

CodeBeamer reference: S.03.07-7233

Upstream References (1)

S.03-1035	Safe Operation

Derived from: S01020500-IST100064 TSS-Conventional Facilities Interface Sheet

Target Station Shielding Requirements

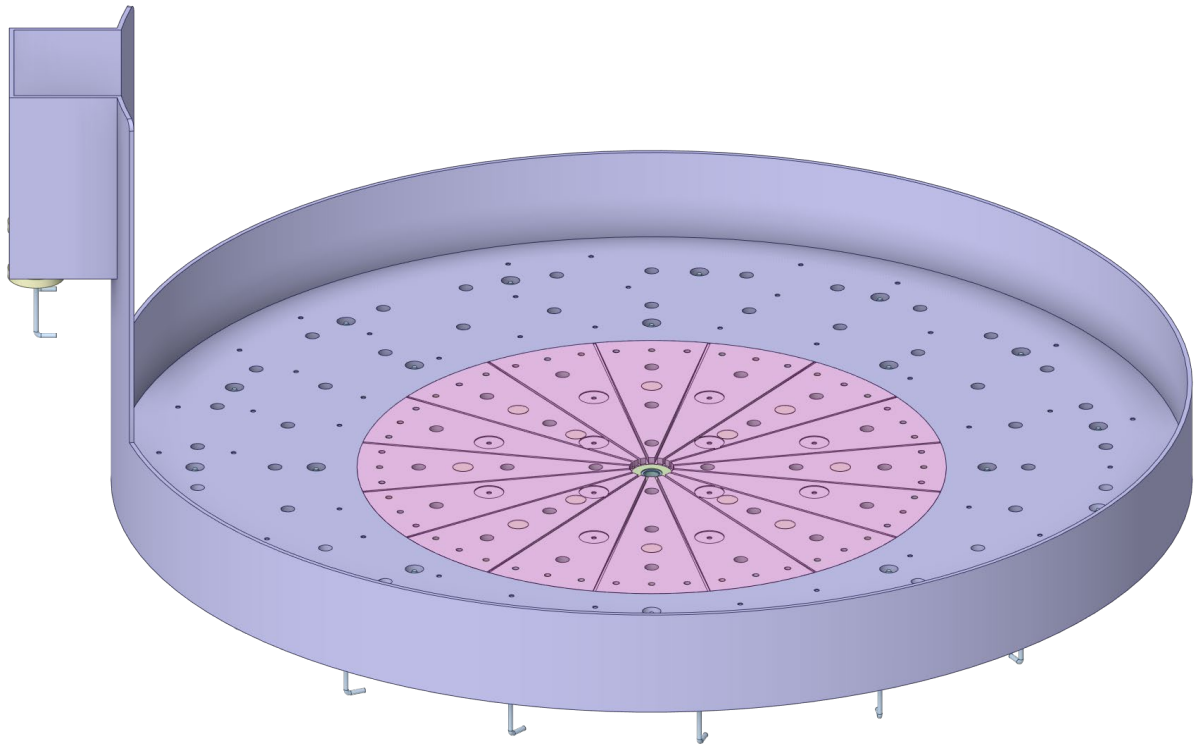
Interface Requirement:

Grout Holes
Target Station Shielding shall include features that allow grouting of Target Station Shielding hardware per Interface Sheet S01020500-IST10064.

CodeBeamer reference: S.03.07-7234

Upstream References (1)

S.03-1032	Operational Life



Derived from: S01020500-IST100064 TSS-Conventional Facilities Interface Sheet

Target Station Shielding Requirements

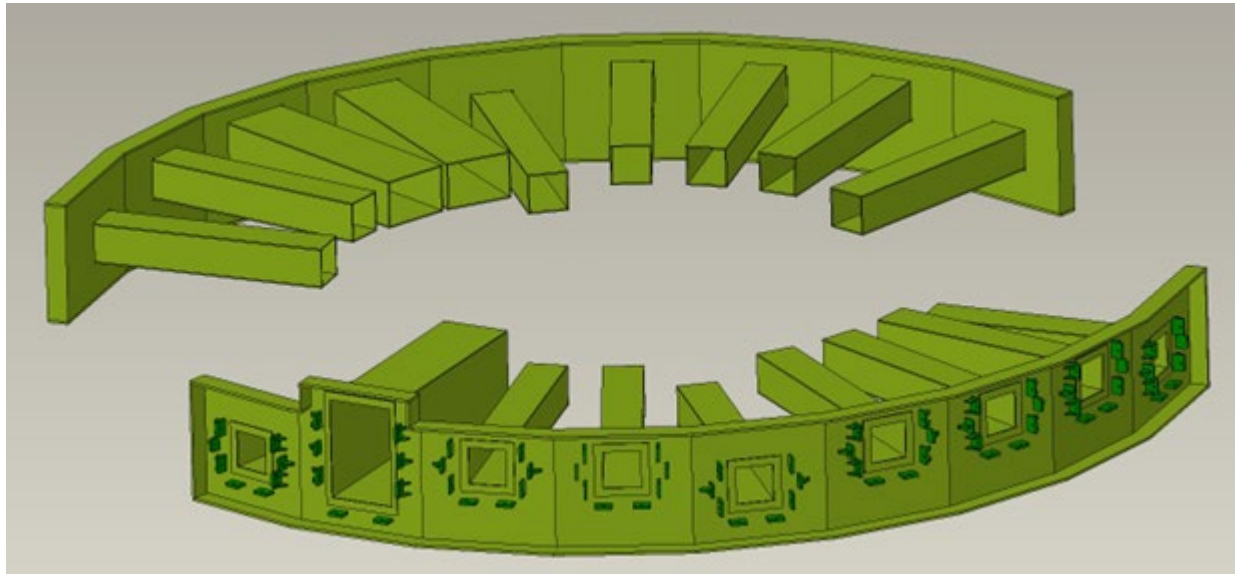
Interface Requirement:

Monolith Port Geometry
Target Station Shielding shall supply the required interior profile of the monolith ports per Interface Sheet S01020500-IST10064.

CodeBeamer reference: S.03.07-7235

Upstream References (1)

S.03-1036	Radiation Safety



Derived from: S01020500-IST100064 TSS-Conventional Facilities Interface Sheet

Target Station Shielding Requirements

Interface Requirement:

Concrete Temperature
Target Station Shielding shall ensure that the monolith concrete temperature does not exceed 65 C for prolonged periods due to radiation heating per Interface Sheet S01020500-IST10064.

CodeBeamer reference: S.03.07-7236

Upstream References (1)

S.03-1032	Operational Life

Derived from: S01020500-IST100064 TSS-Conventional Facilities Interface Sheet

Target Station Shielding Requirements

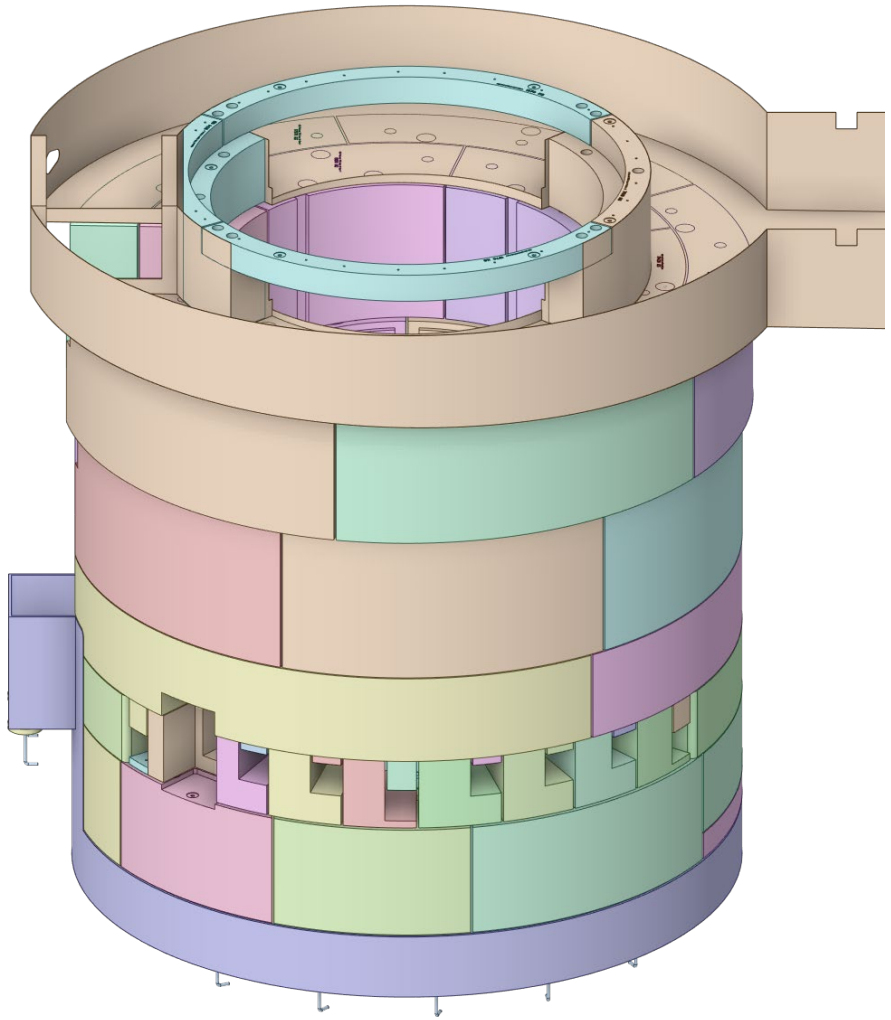
Interface Requirement:

Target Station Shielding shall provide penetrations in the pipe pan side wall for instrumentation wiring per Interface Sheet S01020500-IST10220.

CodeBeamer reference: S.03.07-7410

Upstream References (1)

S.06-1120	S.6-R001 Integrated Control Systems shall provide remote control, monitoring, alarms, and data archiving to enable supervisory control automation, and operational analysis from an appropriate control roo for STS scope including accelerator, target, conv



Derived from: S01020500-IST100220 TSS-Integrated Controls Interface Sheet

Target Station Shielding Requirements

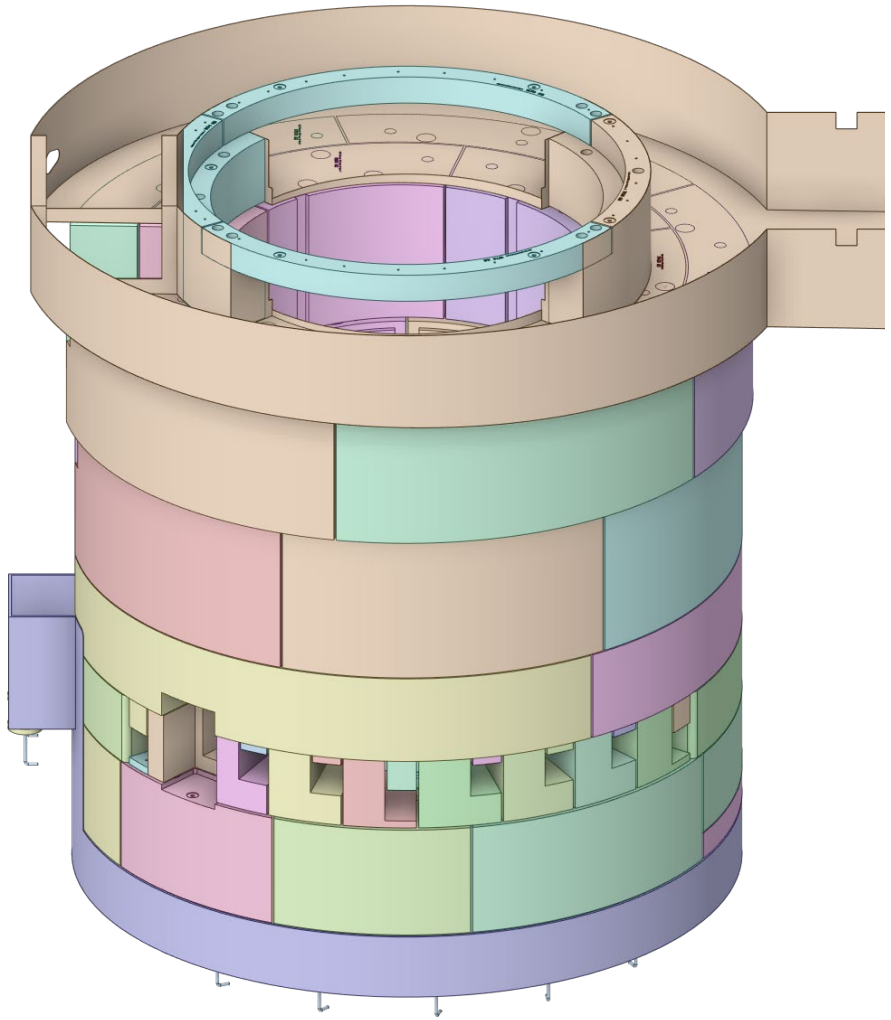
Interface Requirement:

Instrumentation Wire Pipe Chase
Target Station Shielding shall provide a pipe chase through the bulk shielding for instrumentation wiring per Interface Sheet S01020500-IST10220.

CodeBeamer reference: S.03.07-7411

Upstream References (1)

S.06-1120	S.6-R001 Integrated Control Systems shall provide remote control, monitoring, alarms, and data archiving to enable supervisory control automation, and operational analysis from an appropriate control roo for STS scope including accelerator, target, conv



Derived from: S01020500-IST100220 TSS-Integrated Controls Interface Sheet