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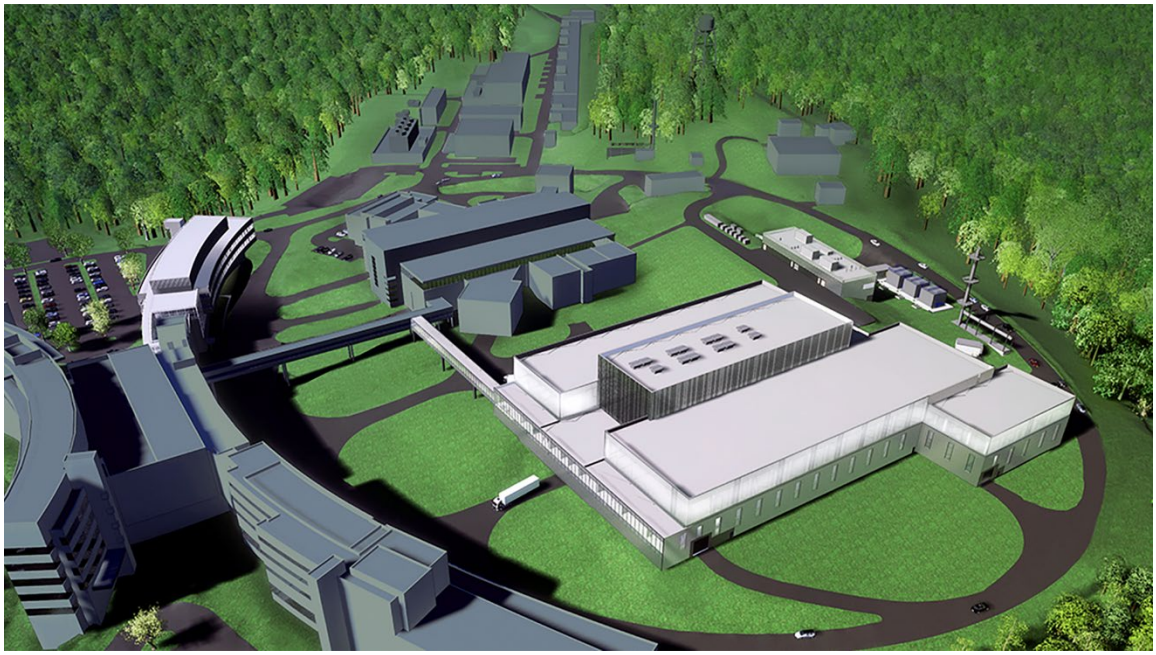
Second Target Station Project: Interface Sheet - Vessel Systems (S.03.06) to Moderator Reflector Assembly (S.03.04)



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July 2026

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Second Target Station Project

INTERFACE SHEET – VESSEL SYSTEMS (S.03.06) TO MODERATOR REFLECTOR ASSEMBLY (S.03.04)

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July 2026

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1. PURPOSE

This document defines the interface between Target System's Vessel Systems (VS) and Moderator Reflector Assembly (MRA). Requirements derived from this document will be included in the System Design Requirements for VS and MRA.

2. SCOPE

The scope of this document is the complete definition for the interface between VS and MRA.

1. INTERFACING PARTS OR COMPONENTS

No.	Components (PS)		Components (VS)	
	Name	Functional reference Number	Name	Functional reference Number
1	Moderator Reflector Assembly	S03040000-M8U-8800-A10000.asm	Vessel Systems	S03060000-M8U-8800-A10000.asm
2				
3				
4				

3. ACRONYMS AND DEFINITIONS

ICD	Interface Control Document
IS	Interface Sheet
MRA	Moderator Reflector Assembly
SSC	Structure, System or Component
STS	Second Target Station
WBS	Work Breakdown Structure
VS	Vessel Systems
CV	Core Vessel

4. DOCUMENTS APPLICABLE TO THE INTERFACING SSCS

Ref	Document Titles	Document Control System Location
[1]	Interface Sheet for Target Assembly, Moderator Reflector Assembly, and Vessel Systems	S01020500-IST10205-R0A

5. INTERFACE DEFINITION

5.1 TECHNICAL DESCRIPTION OF THE INTERFACE

VS consists of the Core Vessel (CV), Core Vessel internal shielding, and Nozzle Extensions. MRA consists of the moderator reflector assembly weldment (including water pipes), MRA mounting hardware and MRA utility pipe tie-downs. The VS components that interface with MRA include the Core Vessel and the Core Vessel shielding. The subsequent sections define the interfaces between VS and MRA.

5.2 INTERFACE DATA

5.2.1 MRA Access

The MRA is housed in the center of the CV, surrounded by CV shielding. A single MRA removable shield block has been designed that resides directly above the MRA within the CV. In order to access the MRA for an MRA change out event, the MRA access hatch in the CV lid is removed and the MRA removable shield block is pulled vertically out of the CV. The sizing of the MRA access hatch must allow for the vertical removal of the MRA shield block and the MRA. Once these two components are removed, a clear line of site from above the CV to the MRA is established. A side utility hatch has also been included in the CV lid to allow for additional access to the MRA utility jumper lines during MRA removal and installation. The VS components that require removal in order to access the MRA are designed to be removed during a single 8 hour shift.

5.2.2 Cooling Water Interface

The MRA design includes 5 water supply and 1 water return pipes that terminate as flanged connections sitting above the CV shielding stack inside the CV. These flanged water lines are connected via jumper lines to flanged utility nozzles located in the side wall of the CV. The jumper lines will include a flexible section and a transition section to match the MRA flange size with the utility nozzle flange size. Enough flex will be designed into the lines to allow for expected deviations in flange locations and thermal expansion effects. Design and procurement of the jumper lines and gaskets is part of Vessel Systems Scope. MRA is responsible for supplying the water lines that are integrated into the MRA, and communicating the supply and water needs to Process Systems. The water line details are show in Table 1 and Table 2, and a CAD model of the lines is shown in Figure 1.

Table 1: Supply and return water line details for all Vessel Systems water cooled components

Item	MRA Connection	CV Utility Nozzle Connection	CV Utility Nozzle ID Number
MRA Return	1.5'' SCH40 Flange	2'' SCH40 Flange	25
MRA Backbone Supply	1.25'' SCH40 Flange	1.5'' SCH40 Flange	34
MRA Upper Premoderator Supply	0.75'' SCH40 Flange	1'' SCH40 Flange	35
MRA Lower Premoderator Supply	0.75'' SCH40 Flange	1'' SCH40 Flange	36
MRA Upper Reflector Supply	0.75'' SCH40 Flange	1'' SCH40 Flange	37
MRA Lower Reflector Supply	0.75'' SCH40 Flange	1'' SCH40 Flange	38

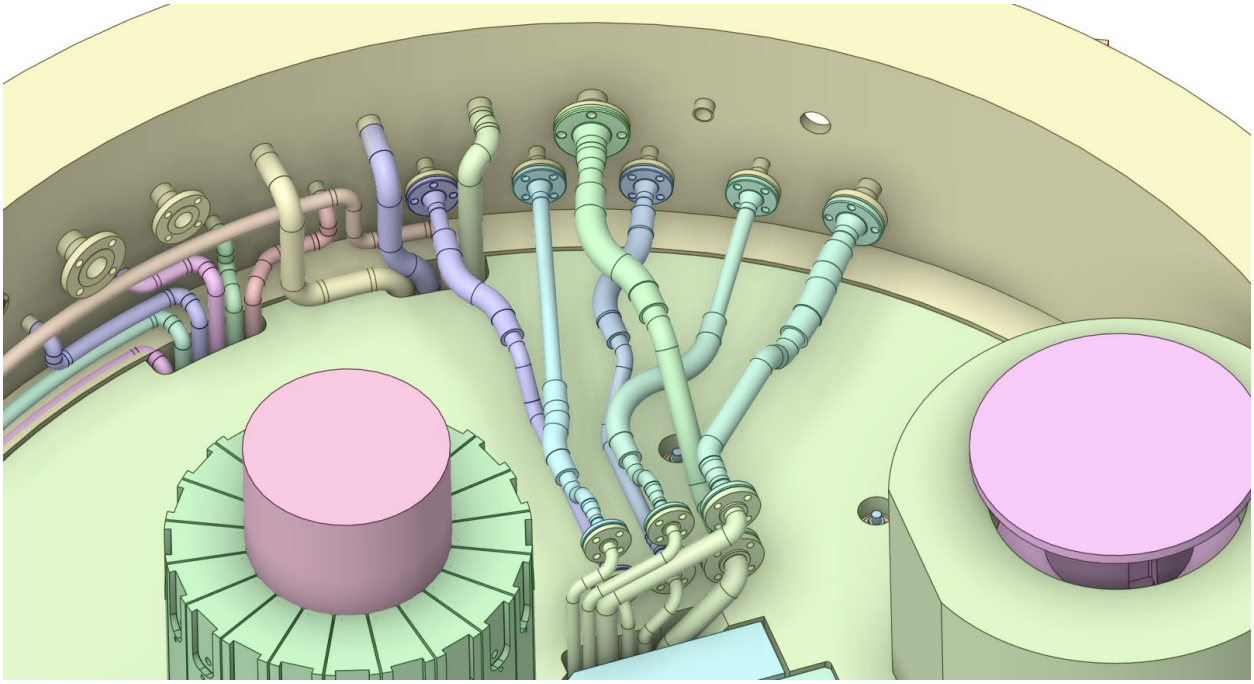

Figure 5.1: Utility jumper lines connecting the MRA flanged water lines to the CV utility nozzles. The MRA water line cover shield has been removed from the image for clarity.

Table 2: Locations of the MRA water line flange centers relative to the STS Global Coordinate System

Item	MRA Connection	X (mm)	Y (mm)	Z (mm)
MRA Return	1.5'' SCH40 Flange	-482	4032	483
MRA Backbone Supply	1.25'' SCH40 Flange	-482	4178	483
MRA Upper Premoderator Supply	0.75'' SCH40 Flange	-352	4178	483
MRA Lower Premoderator Supply	0.75'' SCH40 Flange	-352	4032	483
MRA Upper Reflector Supply	0.75'' SCH40 Flange	-218.5	4178	483
MRA Lower Reflector Supply	0.75'' SCH40 Flange	-237.97	4032	483

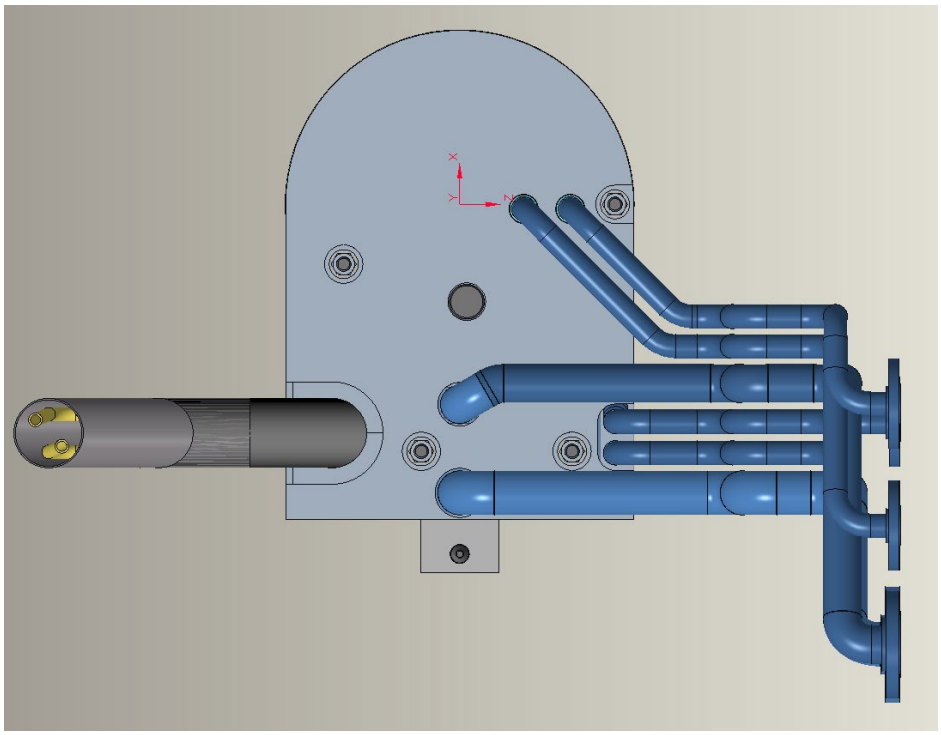

Figure 5.2: MRA Water Flanges Relative to the STS Global Coordinate System.

5.2.3 MRA Alignment and Support

The MRA will be supported and aligned via three mounting interfaces located on the top of the Layer 1 CV shielding. The three MRA mounts will have flat surfaces that meet the top of CV shield block 1 at Y=-405.275mm in the STS global coordinate system. The Core Vessel will provide three 20 mm diameter pins with the full diameter protruding 9 mm from the top of CV shield block 1. The worst case expected horizontal force applied to the pins in a seismic event is 5.60 kN. The three MRA mounts have 20 mm slots aimed towards the center of the moderators so that the moderator locations do not shift with unform temperature changes of the MRA or CV shield block 1. The slots are nominal size until 8 mm from the bottom of the mounts to allow 1 mm of full engagement. The pins and the slots are tapered to 6 mm and 8 mm respectively to ensure the MRA mounts are guided onto the CV pins. The MRA mount locations will be adjusted based on survey of CV shield block 1 after installation to allow moderators to be positioned ideally relative to the global coordinate system.

The MRA mounts are also tapered on their outer diameter to assist with guiding the MRA into the MRA hole in the CV permanent shielding. Because there is no permanent shielding in the positive X direction from the MRA on the proton beam center (this region is occupied by the target segment staves), the MRA will include 2 guiding blocks which will guide the MRA off the adjacent CV shielding. The CV shielding is chamfered in the regions near to the path of rear MRA mounting blocks and the guide blocks to further assist in guiding the MRA into the MRA hole upon installation.

Table 3: CV MRA Alignment Pin Base Nominal Locations Relative to STS Global Coordinate System.

CV Pin	X (mm)	Y (mm)	Z (mm)
1	160.5	-405.275	0
2	-315.5	-405.275	-160.5
3	-315.5	-405.275	160.5

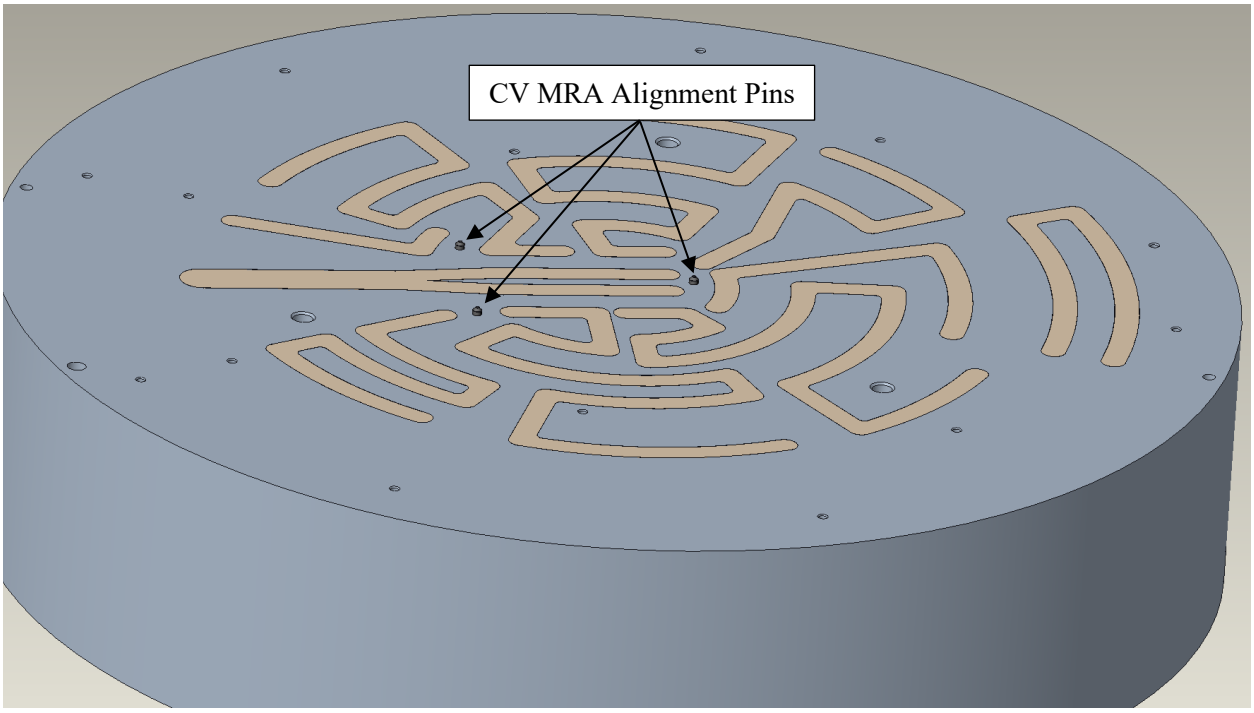

Figure 5.3 Core Vessel Shield Block 1 showing the 3 MRA Alignment Pins

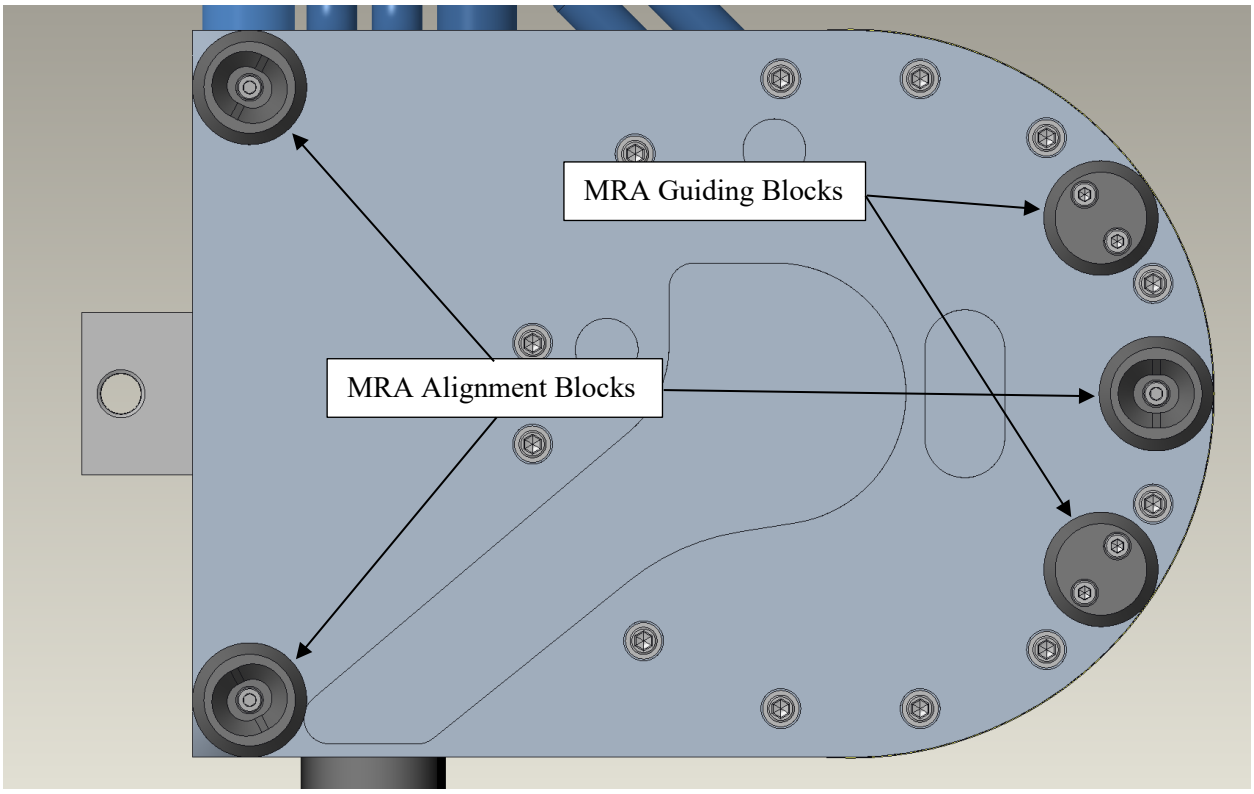

Figure 5.4: MRA Alignment and Guiding Blocks Looking from the Bottom of the MRA.

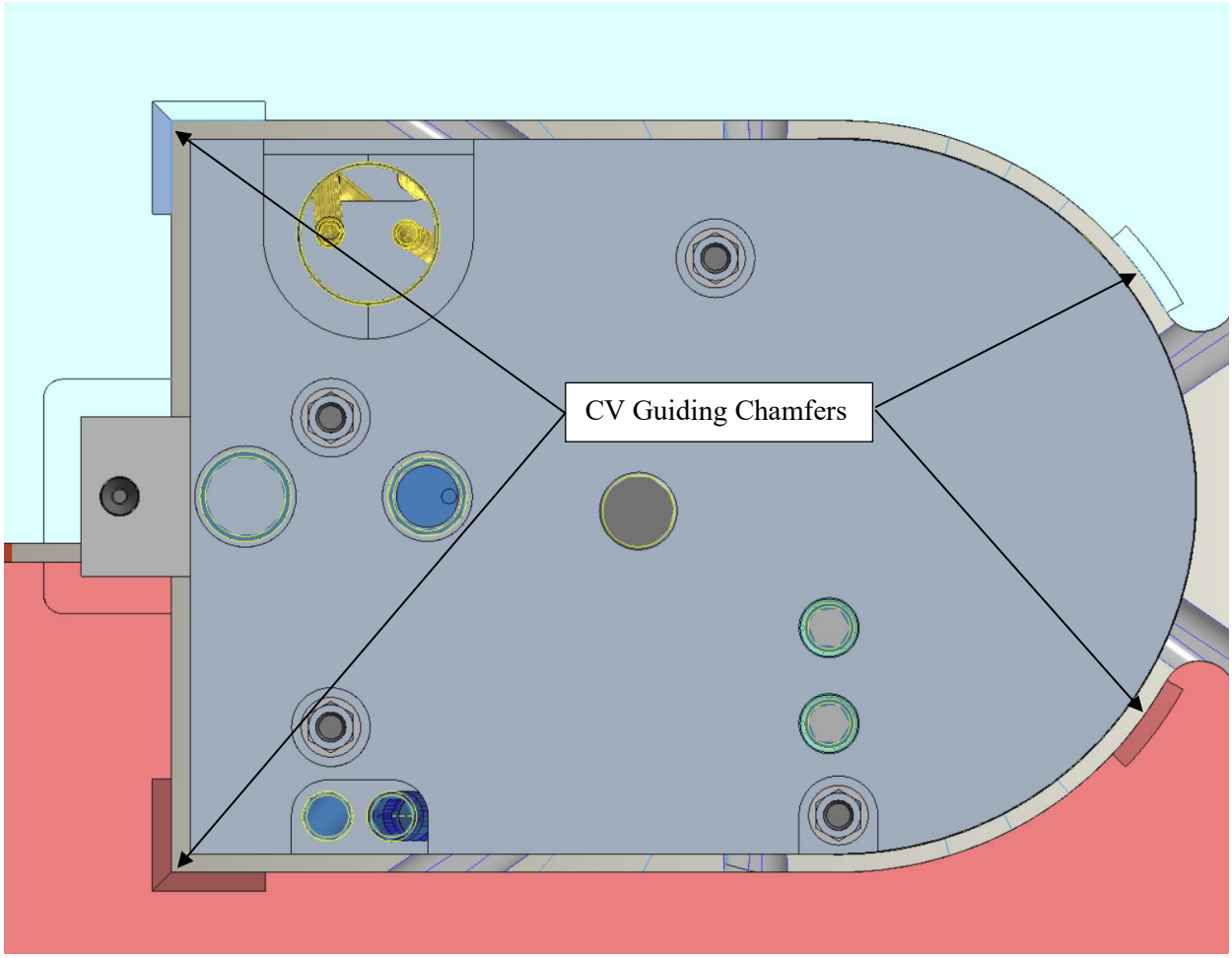

Figure 5.5 Top View of MRA in Operating Position

5.2.4 MRA Seismic Block

In order to prevent the MRA from tipping during a seismic event, an MRA seismic block has been added to the top rear of the MRA. The Core Vessel will supply a 20 mm pin with a base location of -383 mm, 1240 mm, 0 mm. The expected horizontal force on the pin in a seismic event is 2.73 kN. The MRA seismic block will feature a 22 mm hole which will allow for thermal motion between the MRA seismic block and CV pin without causing the MRA to rock off its alignment mounts unintentionally.

5.2.5 MRA Clearance Management

The Core Vessel will provide the MRA with 10 mm of nominal clearance to the MRA body and 12 mm of nominal clearance to the MRA utility lines. The utility line chases provide at least 12 mm of nominal clearance from the utility lines to the outside edge of the chase so that the lines will be protected during installation of the MRA removable shield block.

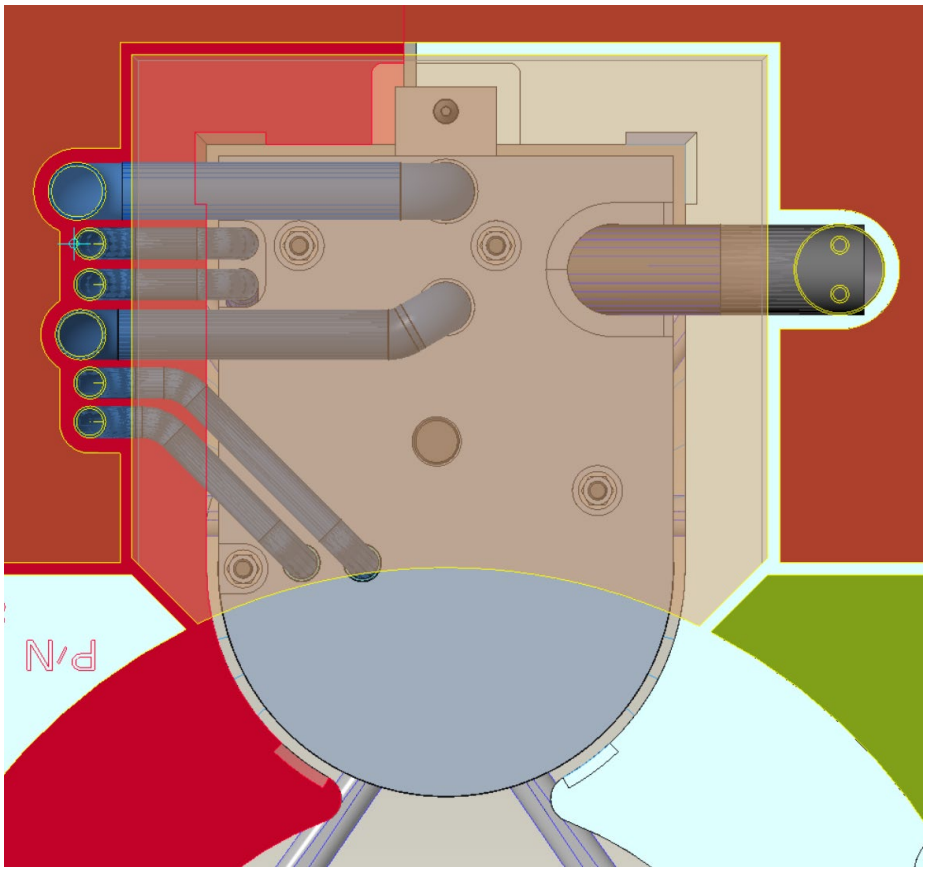

Figure 5.6 MRA Piping Chases above the first MRA Piping Jog

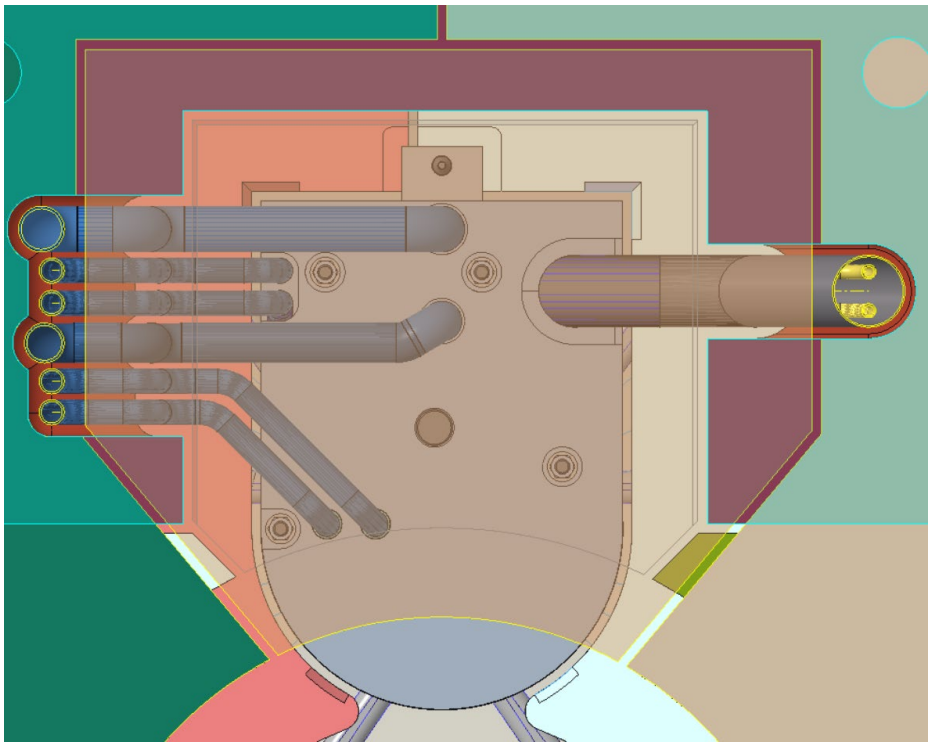

Figure 5.7 MRA Piping Chases at the Top of the CV Shielding

5.2.6 MRA Utility Line Restraints

It will be necessary to secure the water and hydrogen transfer lines to the CV shielding in order to limit line deflections in a seismic event, and to ensure that the lines remain in position during removal and installation of the MRA removable shield block. MRA is responsible for the design, procurement and installation of the utility line restraints. Vessel Systems is responsible for providing the necessary features in the CV shield stack to allow for installation of the utility line restraints. The utility line restraints will be designed during the MRA piping analysis, after which design details will be added to this section to finalize the interface.

5.2.7 MRA Thermocouple Routing

The MRA will include 4 thermocouples to allow for monitoring of MRA temperatures by I&C. MRA The MRA thermocouple leads will be terminated at the Core Vessel port 14 thermocouple vacuum feedthrough as described in the Vessel Systems and Vessel Systems I&C Interface Sheet. MRA will provide the thermocouples on the MRA as well as thermocouple leads sized to reach the designated feedthrough. Vessel Systems will be responsible for terminating the leads at the feedthrough. Routing outside of the Core Vessel is covered by the Vessel Systems and Vessel Systems I&C Interface Sheet. Both the Process Control Description and P&ID which detail the controls implementation of the thermocouples are designated to Process Systems scope as detailed in the MRA-MRA I&C Interface Sheet.