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SECOND TARGET STATION (STS) PROJECT

Interface Sheet for Core Vessel, Target Station Shielding and Accelerator Interface Components

Chris Anton

Neelam Pradhan

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OAK RIDGE NATIONAL LABORATORY

MANAGED BY UT-BATTELLE FOR THE US DEPARTMENT OF ENERGY

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Prepared by
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, TN 37831-6283
managed by
UT-BATTELLE, LLC
for the
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1. PURPOSE

This document defines the interface between Target System's Vessel Systems (VS), Target Station Shielding (TSS) and Accelerator Interface components (AIC). Requirements derived from this document will be included in the System Design Requirements for VS, TSS and AIC.

2. SCOPE

The scope of this document is the complete definition for the interface between VS, TSS and AIC.

2.1 INTERFACING PARTS OR COMPONENTS

No.	Components (MRA)		Components (AIC)	
	Name	Functional reference Number	Name	Functional reference Number
1	Vessel Systems	S03060000-M8U-8800-A10000.asm	Accelerator Interface Components	S03050000-M8U-8800-A10000.asm
2	Target Station Shielding	S03070000-M8U-8800-A10000.asm		
3				
4				

3. ACRONYMS AND DEFINITIONS

AIC Accelerator Interface Components
CV Core Vessel
ICD Interface Control Document
IS Interface Sheet
MRA Moderator Reflector Assembly
PBW Proton Beam Window
PBTA Proton Beam Tube Assembly
SSC Structure, System or Component
STS Second Target Station
TSS Target Station Shielding
TVP Target Viewing Periscope
VS Vessel Systems
WBS Work Breakdown Structure

4. REFERENCES

4.1 DOCUMENTS APPLICABLE TO THE INTERFACING SSCS

Ref	Document Titles	Document Control System Location
[1]		

5. INTERFACE DEFINITION

5.1 TECHNICAL DESCRIPTION OF THE INTERFACE

The AIC consists of the Proton Beam Window, Proton Beam Window Shielding, Target Viewing Periscope and Proton Beam Tube assembly. All the AIC have interfaces with both the TSS and VS which is described in subsequent sections.

5.2 INTERFACE DATA

5.2.1 Vessel Systems

The Vessel Systems has interfaces to AIC via the PBW, PBW shielding and TVP.

- **PBW**

The PBW separates the RTST vacuum environment from the Core Vessel environment (the Core Vessel is a primary component of Vessel Systems). The PBW has an inflatable seal that is required to maintain a leak rate of $< 10^{-4}$ Torr l/s. This leak rate contributes to the overall core vessel leak rate and is a contributor to the core vessel vacuum pump sizing.

The PBW is designed to withstand CV internal pressures ranging from -14.7 psi to 7.35psi. Vessel Systems is responsible for protecting the integrity of the PBW by limiting over pressurization of the Core Vessel.

- **PBW Shielding**

The PBW shielding seals to the core vessel insert and has a physical interface to the Core vessel as shown in Figure 1. The inflatable seals apply a pressure of 22 psi during operation on the mating surface of the core vessel belt line that contributes to the force on the core vessel.

The mating core vessel surface will be a vacuum sealing surface, and so must be polished to a surface finish of 0.20µm (8µin) Ra to ensure the inflatable seal leak rate of $< 10^{-4}$ Torr l/s. The physical location of the polished sealing zone on the core vessel will be formalized in this interface sheet in the future.

The inflatable seal leak rate contributes to the overall core vessel leak rate and is a contributor to the core vessel vacuum pump sizing.

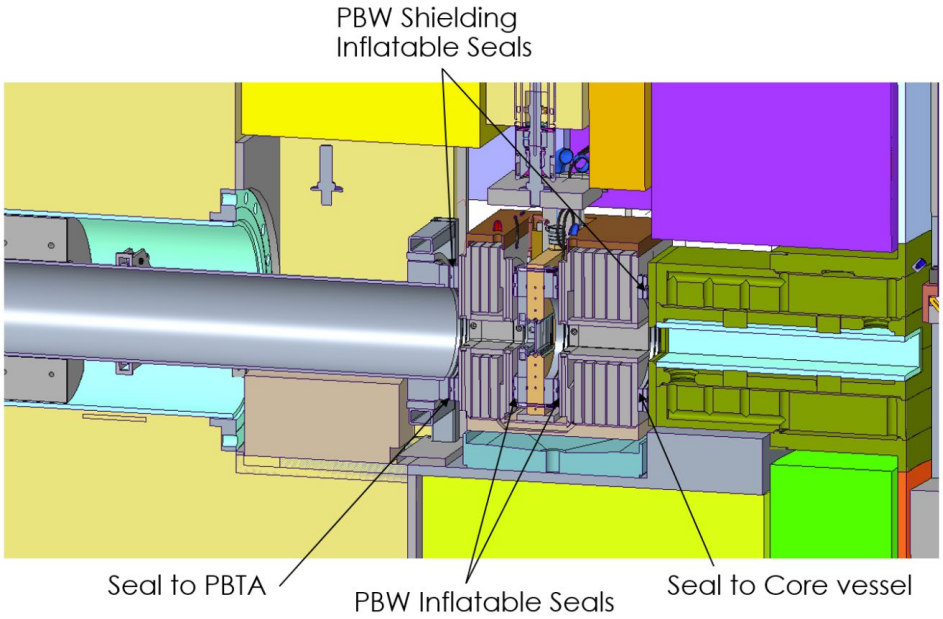

Figure 1: PBW and PBW shielding Seals

- **Target Viewing Periscope**

The TVP is located both inside and outside of the core vessel. The vertical portion of the TVP extends through the core vessel lid and core vessel shielding and aligns to the kinematic canoe sphere mounts in the core vessel shielding. The position of the three canoe sphere mounts attached to the core vessel and core vessel shielding will be defined in an interface drawing at a later date. Table 1 describes the tolerances and shielding clearances for all of the TVP to CV interfacing features. The total gravitational force being exerted on the canoe sphere mounts by the TVP assembly is approximately 42kN.

The CV shielding has an opening for the first section composed of the first mirror to the second mirror of the TVP. CV shielding will maintain a nominal shielding gap of 10mm in between the CV shielding, CV and TVP assembly. The AIC team will define a keep-out zone for the lower portion of the TVP assembly below the integrated shielding. VS will design the core vessel shielding to remain out of this zone.

The core vessel lid has an opening to accommodate the TVP flange - this is a vacuum seal. The TVP has a window made of either ZnSe or BaF_2 and is required to maintain core vessel vacuum. The TVP seals are expected to have a total leak rate of $< 10^{-5}$ Torr l/s. AIC will provide the desired bolt pattern and seal geometry to VS. VS will incorporate tapped holes and an O-ring groove into the CV lid. AIC will provide the flange seal used during TVP installation. The total gravitational force being exerted on the CV lid by the TVP mounting flange is 1kN.

The doghouse shielding over the second mirror is expected to be mounted on the core vessel lid. The third housing of the TVP rests on the core vessel lid as well. AIC will provide the desired location and mounting details for the second mirror doghouse shielding, and VS will provide the required features in the CV lid. The total gravitational force being exerted on CV lid by the mirror #2 doghouse is 49.4kN approx. The total gravitational force being exerted on CV lid by the mirror #3 assembly is 1kN.

There is an opening in the shielding for the viewing path from the TVP 1st mirror to Target face. AIC will define a keep-out zone that provides appropriate line of sight between the TVP first mirror and the target. VS

will design the core vessel shielding to remain out of this zone.

The core vessel lid design also needs to ensure that it provides an unobstructed path from the second to the third mirror and the third to the 4th mirror in the pit in TVP equipment room.

The seismic calculation for the TVP will be done in conjunction with CV and TSS. This will be done after the TVP PDR. Hence it will be decided during the final design phase if additional features or blocks will be needed to avoid tipping for the 1st to 2nd mirror section during a seismic event.

Any leak of water from the PBW and PBW shielding and TVP into the core vessel is handled by the core vessel containment for leaks.

Feature	Location	AIC Vertical Tolerance Allotment	AIC Horizontal Tolerance Allotment	VS Vertical Tolerance Allotment	VS Horizontal Tolerance Allotment	Shielding Clearance
TVP Shielding	Interface Drawing XXX	+/- 2 mm	+/- 2 mm	+/- 3 mm	+/-	10 mm
TVP Keep-Out Zone	Interface Drawing XXX	N/A	N/A	+/- 5 mm	+/- 5 mm	10 mm
Line of Site Keep-Out Zone	Interface Drawing XXX	N/A	N/A	+/- 5 mm	+/- 5 mm	10 mm
TVP Canoe Spheres	Interface Drawing XXX	+/- 0.25 mm	+/- 0.25 mm	+/- 2 mm	+/- 0.25 mm	N/A
TVP Top Flange	Interface Drawing XXX	+/- 0.25 mm	+/- 0.25 mm	+/- 2 mm	+/- 0.25 mm	N/A

Table 1: Physical interface details between the TVP and CV

The TVP cooling and Helium lines are above the core vessel lid and TVP with Process Systems and Vessel Systems design will need to ensure this connection is possible.

- **Proton Beam Tube Assembly**

There is no interface between the PBTA and the Vessel Systems in the present design.

5.2.2 Target Station Shielding

The Target Station Shielding (TSS) interfaces to the PBW, PBW shielding, and the PBTA.

- **PBW**

The shielding above the PBW and PBW shielding is designed by the AIC team but will be procured by the TSS and the cost is included in the TSS Scope. 20mm nominal shielding gaps will be maintained between the TSS and the PBW assembly and associated piping.

PBW weighs about 250kg, which contributes to total weight in TSS.

In case of a leak, the PBW has features such that the cooling water from these components leak to the Target station shielding and TSS design handles the leak containment.

The TSS above and around the PBW shielding assembly will have cut-outs and clearances for the cooling water supply and return lines, Helium lines and Halo thermocouples wires. These cut-outs are defined in the CREO models.

- **PBW Shielding**

PBW Shielding is aligned to the mating kinematic mounts on a base plate that is fixed to the TSS. The PBW Shielding base plate is designed and owned by AIC. This plate is either welded or bolted in place and positional tolerance of the PBW base plate will be determined during final design. The TSS surfaces that the PBW shielding baseplate attaches to will be surveyed during monolith installation, and modifications will be made to the base plate to compensate for variations in shield block position. There will also be motion due to thermal expansion of the TSS which will be determined during the final design. The overall tolerance budget for the PBW assembly and surrounding TSS is shown in Table 2 below.

Feature	Location	AIC Vertical Tolerance Allotment	AIC Horizontal Tolerance Allotment	TSS Vertical Tolerance Allotment	TSS Horizontal Tolerance Allotment	Shielding Clearance
PBW Assembly	Interface Drawing XXX	+/- 1 mm	+/- 1 mm	+/- 2 mm	+/- 2 mm	20 mm
PBW base plate	Interface Drawing XXX	+/- 0.5 mm	+/- 0.5 mm	+/- 1 mm	+/- 1 mm	N/A

Table 2: Physical interface details between TSS and PBW

The bulk shielding liner extends around the PBW and PBTA, the details of which are being discussed and the design is in progress.

The PBW shielding contributes to the weight on the TSS. The mass of the PBW shielding with the base plate is approx. 2400kg.

In case of a leak, the PBW shielding has features such that the cooling water from these components leak to the Target station shielding and TSS design handles the leak containment.

The TSS above and around the PBW shielding assembly will have cut-outs and clearances for the water lines, Helium lines and Halo thermocouples wires. These cut-outs are defined in the CREO models.

- **Target Viewing Periscope**

There should be no interference in the path of the optical beam from the 3rd to the 4th mirror in the TSS.

- **Proton Beam Tube Assembly**

PBTA is aligned and kept in place via a locking plate and a locating flange that is fixed to the TSS. This is shown in Figure 2. The PBTA locking plate is welded or screwed to the TSS and alignment and installation positional tolerances will be determined for final design.

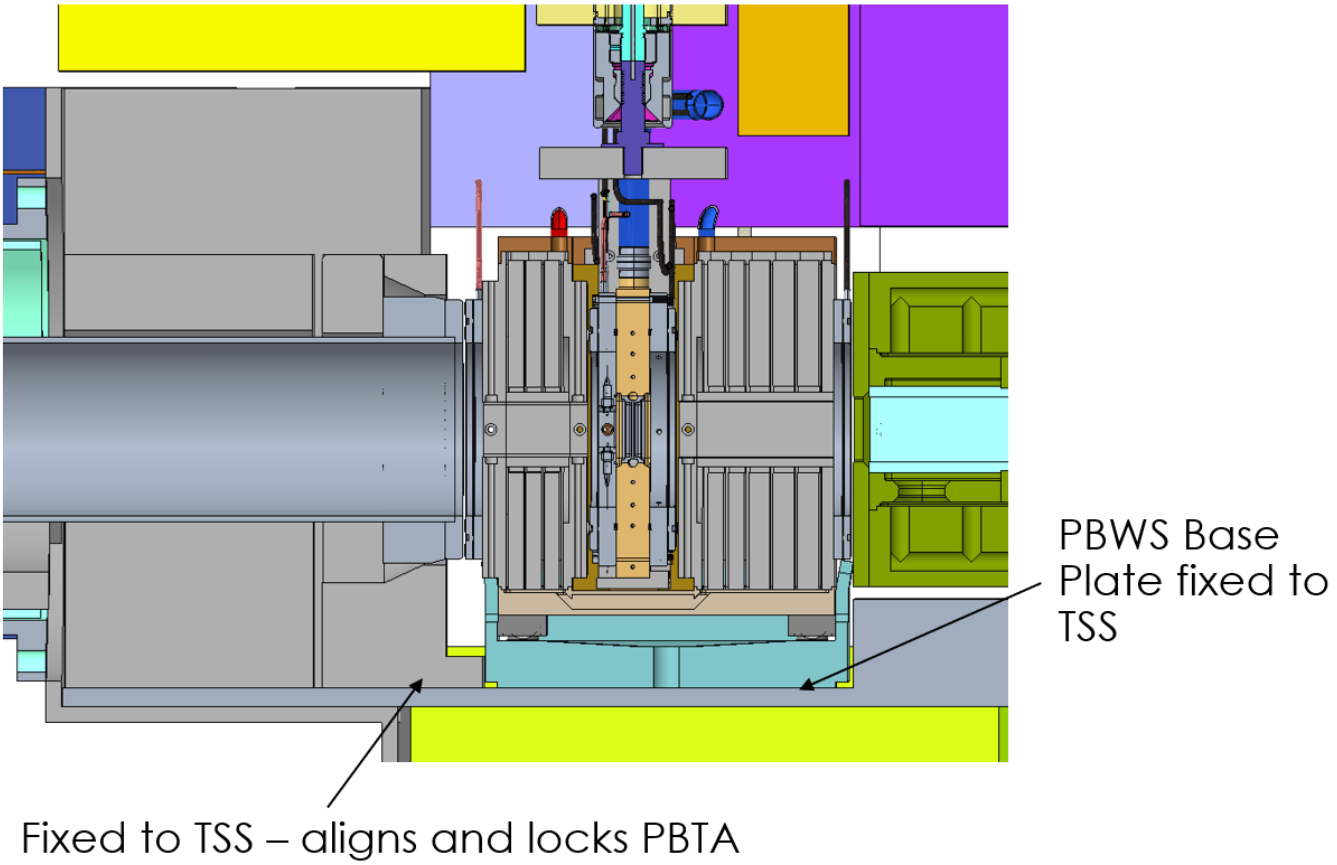

Figure 2: TSS alignment to PBTA and PBW shielding

There will be clearance for the PBTA to pass through the bulk shielding liner.