

Vacuum Vessel Structure - Wall Conditioning System Interface Con

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National Spherical Torus eXperiment Upgrade

National Spherical Torus Experiment Upgrade

Interface Control Document

VACUUM VESSEL STRUCTURE : WALL CONDITIONING SYSTEM

NSTX-U-VVS-WCS-ICD

**Revision 0
September 15, 2019**

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Change Record

Revision	Date	Description of Change
0	September 15, 2019	Initial Release

References

[1] GENERAL REQUIREMENTS DOCUMENT, NSTX-U-RQMT-GRD-001-01

[2] SYSTEM REQUIREMENTS DOCUMENT, VACUUM VESSEL AND INTERNAL HARDWARE,
NSTX-U-RQMT-SRD-004-01

[3] SYSTEM REQUIREMENTS DOCUMENT, AUXILIARY SYSTEMS, NSTX-U-RQMT-SRD-005-01.

[4] [3] SYSTEM DESIGN DESCRIPTION, Vacuum and Fueling, NSTX-U-SDD-V&F-R0

1. Purpose

This document describes the various interfaces between the following subsystems: Vacuum Vessel Structure and the Wall Conditioning System. The interface locations and boundaries that connect the Vacuum Vessel Structure to the Wall Conditioning System are identified based on different interface types.

2. Scope

The Vacuum Vessel Structure consists of Vacuum Vessel, Umbrella Structure and Lids, Ports, and Coil supports. The Wall Conditioning System consists of Glow Discharge Cleaning (GDC), the Trimethylboron (TMB) System, and the Li Evaporator (LITER). The scope of this document addresses any defined interfaces between these identified system elements.

3. Responsibilities

The interfaces are managed between the following organizations:

- VVIH
- Wall Conditioning System
- Systems Engineering and Integration

4. Interfaces

Interface requirements in the following sections are identified with a requirement number, ICD followed by a number [ICD-VVS-WCS-X] where X is a sequential count beginning with 001, VVS represents Vacuum Vessel Structure and WCS represents Wall Conditioning System. There is also a unique identifier for all interfaces in the format [#####-#####-X]. The identifier is a concatenation of two level 5 SBS values and the interface type. This is followed by an interface description and a list of references. References provide evidence pertaining to interfaces include but are not limited to drawings, calculations, or specifications. Reference also include a reference to a paragraph that identifies the set of interface definitions.

4.1. Interface Types

The top-level interface types are defined in Table 1. Within each heading there are sub-headings to address any special sub-elements that need consideration. For example, the Mechanical has four sub-elements that need to be addressed: Structural, Spatial, Location, and Wall/Floor Penetration. For those interface types with sub-interfaces there are corresponding sub-sections.

Table 1. Interface Types

Heading	Abbreviation	Name
4.2	Me	Mechanical
4.3	Ep	Electrical Power
4.4	Si	Signal
4.5	Di	Diagnostics
4.6	Gf	Gas/Fluid
4.7	Va	Vacuum
4.8	Sw	Software
4.9	Th	Thermal
4.10	Pe	Plasma/Eddy/Halo Current

Table 2 provides the N2 Diagram identifying all the interfaces for NSTX-U while Table 3 provides the specific details of the interface.

Table 2. N2 Diagram Interface types

Plasma Facing Components	Me,Th,Pe		Me,Th,Va,Pe						Me	Me	Me,Pe		Me			
	In-Vessel Structures	Me,Di,Pe			Th			Me,Th,Pe	Me		Me,Pe			DI		
		Vacuum Vessel Structure			Me,Va	Me,Va	Me	Me,Th,Pe	Me	Me,Va	Me,Di,Va		Si	DI,SI		
		Va	Centerstack Structures			Va,Th	Me,Gf	Me	Me					DI		
		Me	Me,Th,Ep	Magnets				Me			DI		SI	DI	Me	
SI		Me,Va			Heating Systems		Gf	Th		Me		SI	SI	SI	SI	
					SI,Va,Me,Sw,Gf	Vacuum Pumping System		SI	SI	SI	SI		SI,Va	SI	SI	
				Gf,SI			Coolant System	Gf				Gf,Sw	SI,Sw	SI		
	Th,Gf	Ep,DI,Th,Va	Ep,Gf,Th,Pe		SI		SI	Bakeout System							SI,Me	
			Gf,Va			Me,Gf,SI			Gas Delivery System	Gf	Va		SI,Sw		Me	
		Gf				SI,Gf,Va		Me	Wall Conditioning System				SI,Sw		SI	
		Me,Va	Me,Va	Me	Me	Gf,SI	Gf		Va,Ep	Diagnostics			SI,Sw	SI	SI,Me	SI
				Ep	Ep	Ep	Ep	Ep	Ep	Ep	Ep	Power Systems	Ep,SI	Ep,SI	Me,Ep,SI,DI,Gf	Ep
				SI					Me,SI	SI		Centralized Instrumentation and Control	SI,Me			
											SI	SI,Sw	Integrated Machine Operations			
								Ep							Operations & Safety Systems	
Me		Me	Me	Me	Me	Me		Me	Me	Me	Me	Me	Me	Me	Me,Ep	D-Site Locations (Test Cell)

Table 3. Callout

Vacuum Vessel Structure	Me, Va
Gf	Wall Conditioning System

The remainder of this document addresses each of the interfaces. Note the template includes a paragraph heading for each interface and a table for each interface type. In the event there is no interface, the table will remain blank with a blank row.

The following paragraphs in Section 4 address each of the interfaces, and Section 5 addresses any off-project interfaces. Off-project interfaces are those external interfaces that interact with the NSTX-U system.

4.2. Mechanical Interfaces

This paragraph addresses any type of mechanical interfaces that include a structural, spatial, location dependent interfaces or areas where penetrations into a wall or floor are required. These are identified independently as interface parameters will likely be different.

4.2.1. Structural Interfaces

This identifies any interfaces between system elements that require a structural interface. This could be based on various forces placed on the system and by the system.

Identifier	Interface	References
1.1.2.1.2- 1.3.5.3-S	LITER probes are mounted on umbrella structures	See Paragraph 4.2.1.1, Drawing ED1347
1.1.2.1.1- 1.3.5.1.2-S	GDC electrodes and filaments are mounted to the vessel inner wall, which supports them. The vessel is also the cathode of the system.	See Paragraph 4.2.1., Drawing EA4500, ED1438
1.1.2.1.2- 1.3.5.3-S	Gas delivery line for the dTMB system supported by the outer PF supports	See Paragraph 4.2.1.3, Drawing EA3521, EA3514

4.2.1.1. LITER – Umbrella Structure

ICD-VVS-WCS-001: The LITRE probes are welded to the upper Umbrella Structure by Bays F & K as identified in Drawing ED1347.

4.2.1.2. GDC & Filament – Inner Vessel Wall

ICD-VVS-WCS-002: Drawing EA4500 Sheet 3 provides the control drawing of the GDC and Filament. It shows the penetration of the probes. The GDC probes are bolted to the inner vessel wall is shown in Figure 1. Drawing ED1438 provides the locations of probe insulators at Bays B & G.

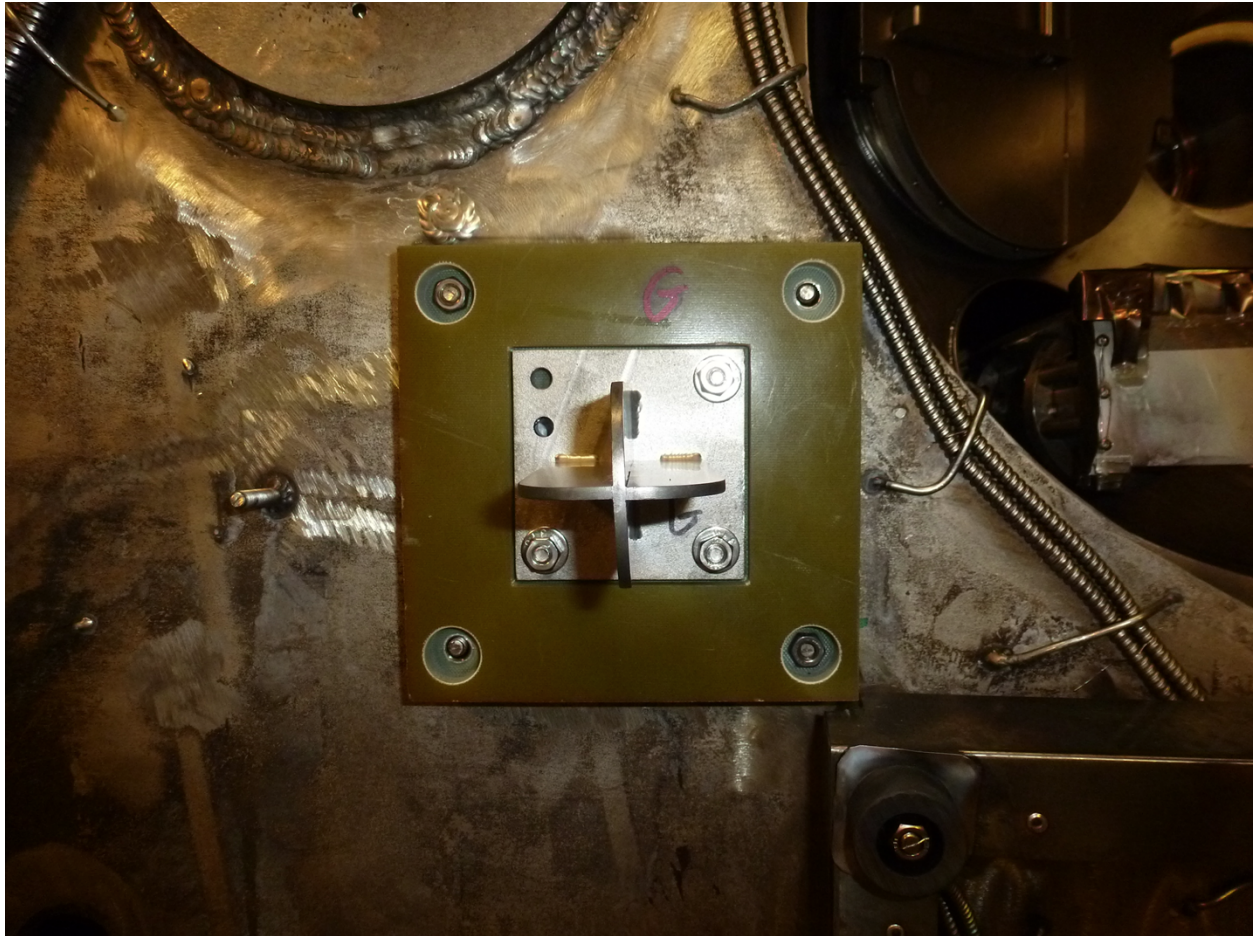


Figure 1. GDC probes bolted on inner Vessel Wall

4.2.1.3. TMB – Outer PF Supports

ICD-VVS-WCS-003: This assembly supports the coaxial tubing. Drawing EA3514 shows the routing to include the connection to the PF-5 connection assembly is bolted the support structure as shown in Section B of the identified drawing. The dTMB connection assembly is identified in Drawing EA-3521.

4.2.2. Spatial Interface

This identifies any interfaces between the system elements pertaining to spatial restrictions or constraints.

Identifier	Interface	References
N/A		

4.2.3. Location Interfaces

This identifies any interfaces between the system elements that have any particular dependencies on element location or location constraints.

Identifier	Interface	References
N/A		

4.2.4. Wall/Floor Penetration Interfaces

This identifies any interfaces between the system elements any penetrations or modifications to the wall or floor of the D-Site building.

Identifier	Interface	References
N/A		

4.3. Electrical Power Interfaces

This identifies any interfaces between the system elements requiring AC, DC, rectification or power conditioning.

Identifier	Interface	References
N/A		

4.4. Signal Interfaces

This identifies any interfaces between the system elements and signals that are used to either send or receive control information or data. It explicitly includes the type of physical interface such as Ethernet or Fiber Optic or any specific protocols.

Identifier	Interface	References

N/A		
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4.5. Diagnostic Interfaces

This identifies any interfaces between the system elements with any instrumentation or diagnostic equipment to collect performance data.

Identifier	Interface	References
N/A		

4.6. Gas/Fluid Interfaces

This paragraph has two different types of interfaces: Gas and Fluid.

4.6.1. Gas Interfaces

This identifies any interfaces between the system elements that use any type of gas (e.g., He).

Identifier	Interface	References
1.3.5.2- 1.1.2.1.1-G	Provides ports for injection of gas for GDC and dTMB	See Paragraph 4.6.1.1, Ref 4

4.6.1.1. GDC & TMB - PORTS

ICD-VVS-WCS-004: The type of gas is GDC is helium and other gases and Deuterated Trimethylboron (dTMB)

ICD-VVS-WCS-005: Delivery pressure of dTMB will be between 3 to 40 PSIG. Each dTMB bottle is filled with 5% of dTMB and 95% of Helium to a pressure close to 380PSIG, and contains about 9.7 grams of dTMB.

4.6.2. Fluid Interfaces

This identifies any interfaces between the system elements that use any type of fluid (e.g., ionized water).

Identifier	Interface	References
N/A		

4.7. Vacuum Interfaces

This identifies any interfaces between the system elements that pertain to the Vacuum.

Identifier	Interface	References
N/A	LITER probes have port covers on the vessel, provide both vacuum boundaries and some structural interface	See Paragraph 4.7.1, Drawing 9D1033

4.7.1. LITER – Vessel Port Covers

ICD-VVS-WCS-006: The Flange Upper Bay K, F as shown in Figure 2. Drawing 9D1033 provide the Bay F, and similarly Bay K, port cover machining and layout.

NSTX Cal. 4 Tie Diagnostics: NSTX345
NSTX Cal. 3 Tie Diagnostics: ED1324
NSTX Vessel Mounted Diagnostics: ED11296
NSTX RWM Coil Details: DC11329

Port assignment for 2015 Operations Gas Injectors and Ion Gauges on Separate Port Drawing

13 1/4" Port Cover Drawings
ED11270
ED11290
ED1917
ED1598

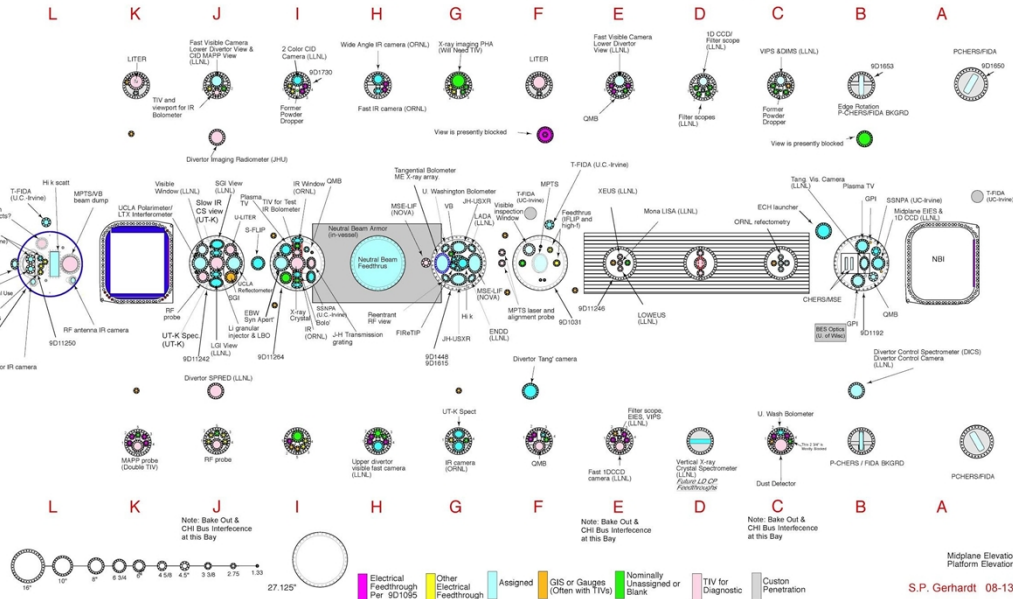


Figure 2. Outer Vessel Port Assignment

4.8. Software Interfaces

This identifies any interfaces between the system elements that use software that may exchange interfaces with other software components. This includes application programming interfaces (APIs) or any other exchange of information between different software applications.

Identifier	Interface	References
N/A		

4.9. Thermal Interfaces

This identifies any interfaces between the system elements that pertain to Thermal characteristics.

Identifier	Interface	References
N/A		

4.10. Plasma Interfaces

This paragraph has two different types of interfaces: Plasma and Eddy/Halo Current.

4.10.1. Plasma Interfaces

This identifies any interfaces between the system elements with the Plasma.

Identifier	Interface	References
N/A		

4.10.2. Eddy/Halo Current Interfaces

This identifies any interfaces between the system elements with the Eddy/Halo Currents.

Identifier	Interface	References
N/A		

5. Off-Project Interfaces

The off-project interfaces are components that are not specifically part of the NSTX-U system. They may include external systems and interfaces where the program has little control on part of the interface. They are provided for completeness.

There are no external interfaces.