

Center Stack Structure - Coolant System ICD

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REVISION 0

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National Spherical Torus Experiment Upgrade

Interface Control Document

**CENTER STACK STRUCTURE:
COOLANT SYSTEM**

NSTX-U-ICD-CSS-CLS-0

**Revision 0
June 27, 2019**

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Change Record

Revision	Date	Description of Change
0	June 29, 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] NSTX-U Center Stack Casing Heating/Cooling Final Design Review, Heat Transfer Tube (HTT) and Heat Transfer Plate (HTP) Presenter D. Cai , Oct. 24, 2018

1. Purpose

This document describes the various interfaces between the following subsystems: Center Stack Structure and the Coolant System. The interface locations and boundaries that connect the Center Stack Structure to the Coolant System are identified based on different interface types.

2. Scope

The Center Stack Structures include the Center Stack Casing, Pedestal, PF-1a Support Structures, PF-1b Support Structures, and PF-1c Support Structures. The Coolant Systems consist of High and Low-Pressure NTC Coolant Water Distribution, Field Coil and Bus Bar Water Coolant System, Deionization process, and OH-Water Pre-Heater System. 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
- Coolant 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-CSS-CLS-X] where “X” is a sequential count beginning with 001, CSS represents Center Stack Structure, and CLS represents Coolant System. There is also a unique identifier for all interfaces in the format [#####-#####-X]. The identifier is a concatenation of two level 5 WBS 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. References 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 Structure	Me,Di,Pe			Th			Me,Th,Pe	Me		Me,Di,Pe			Di		
		Vacuum Vessel Structure			Me,Va	Me,Va	Me	Me,Th,Pe	Me	Me,Va	Me,Di,Va		Si	Di,Si		
		Va	Centerstack Structure			Va,Th	Me,Gf	Me	Me	Me				Di		
		Me	Me,Th,Ep	Magnets				Me			Di		Si	Di	Me	
Si		Me,Va			Heating Systems		Gf	Th		Me		Gf,Si	Si	Si	Si	
					Si,Va,Me,Sw,Gf	Vacuum Pumping System		Si	Si	Gf,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						Me	Si,Me	
			Gf,Va	Gf,Va	Ep	Gf,Si		Gas Delivery System	Me	Va			Si,Sw	Si	Me	
		Gf				Si,Gf,Va		Gf	Wall Conditioning System				Si,Sw	Si	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	Power Systems	Si	Ep,Si	Ep,Si,Di,Gf	Ep	
					Si				Me,Si	Si		Centralized Instrumentation and Control	Si,Me			
									Sw		Si	Si,Sw	Integrated Machine Operations	Me		
								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.

Center Stack Structure	Me, Gf
	Coolant 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
N/A		

4.2.2. Spatial Interface

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

Identifier	Interface	References
1.1.3.3.7- 1.3.2.1.1-Sp	The pedestal has provision for low pressure NTC cooling water hoses to pass through to the TF inner legs	

4.2.2.1. Pedestal - Cooling Water

ICD-CCS-CLS-001: The pedestal provides clearance for hoses to connect to the coolant connections as shown in Figure 1. The red lines notionally represent hoses that will be connected via a field fit.

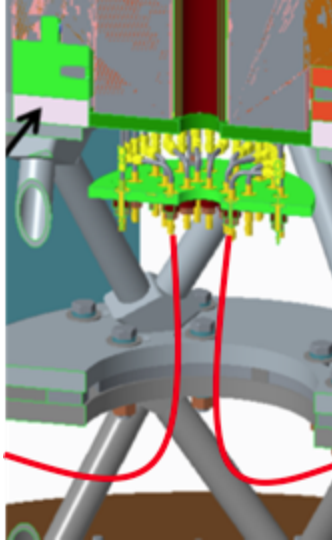


Figure 1. Pedestal clearance for hoses

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		

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
N/A		

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
1.1.3.3.8- 1.3.2.1.1-F	Provides cooling water to the air-side cooling loop on the casing and the ceramic break .	See Paragraph 4.6.2.1, Drawing GA522
1.1.3.3.8- 1.3.2.1.1-F	Low pressure NTC cooling water hose connections to cooling loops on ceramic break assemblies and CS Casing.	See Paragraph 4.6.2.2, Drawing GA522
1.1.3.3.10- 1.3.2.1.1-F	Cooling water is provided to cooling features on the vertical target (HTT).	See Paragraph 4.6.2.3, Ref 4, Drawing GA522

4.6.2.1. Cooling Water - Ceramic Break & HTT

Interface Notes:

- The cooling water connected to the ceramic beak will be described as part of the Machine Core Structure FDR.

ICD-CSS-CLS-002: The Ceramic Break and CS casing HTT connection is identified in Drawing GA522.

4.6.2.2. Cooling Water - Ceramic Break

Interface Notes:

- The cooling water connected to the ceramic break will be described as part of the Machine Core Structure FDR.
- Cooling water is supplied to the OD of the ceramic break assembly's mounting flange.

ICD-CSS-CLS-003: The type of fluid is deionized water. It uses a standard Flare connector and hose as shown in Figure 2. The figure shows the supply/return fittings. The water is supplied in one fitting, goes once around the mounting flange, and returns through the other fitting.

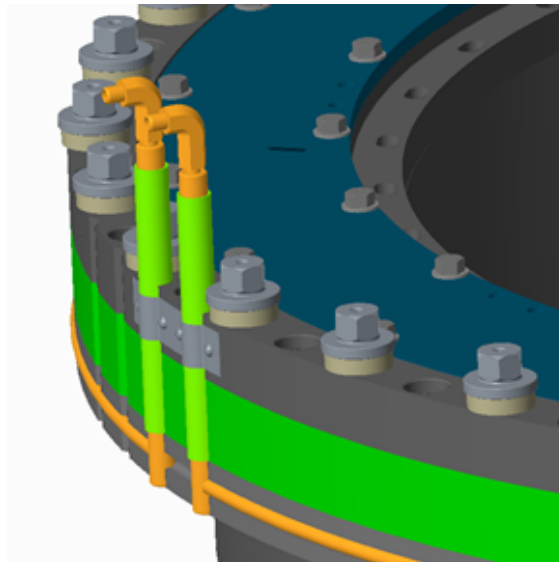


Figure 2. Ceramic Break Cooling Water Assembly

4.6.2.3. Cooling Water - HTT

ICD-CSS-CLS-004: The hoses (Red) connect to the 3/8" tube and the 1/4" tube as shown in Figure 3. Standard Flair hose connections are used. The type of fluid is deionized water.

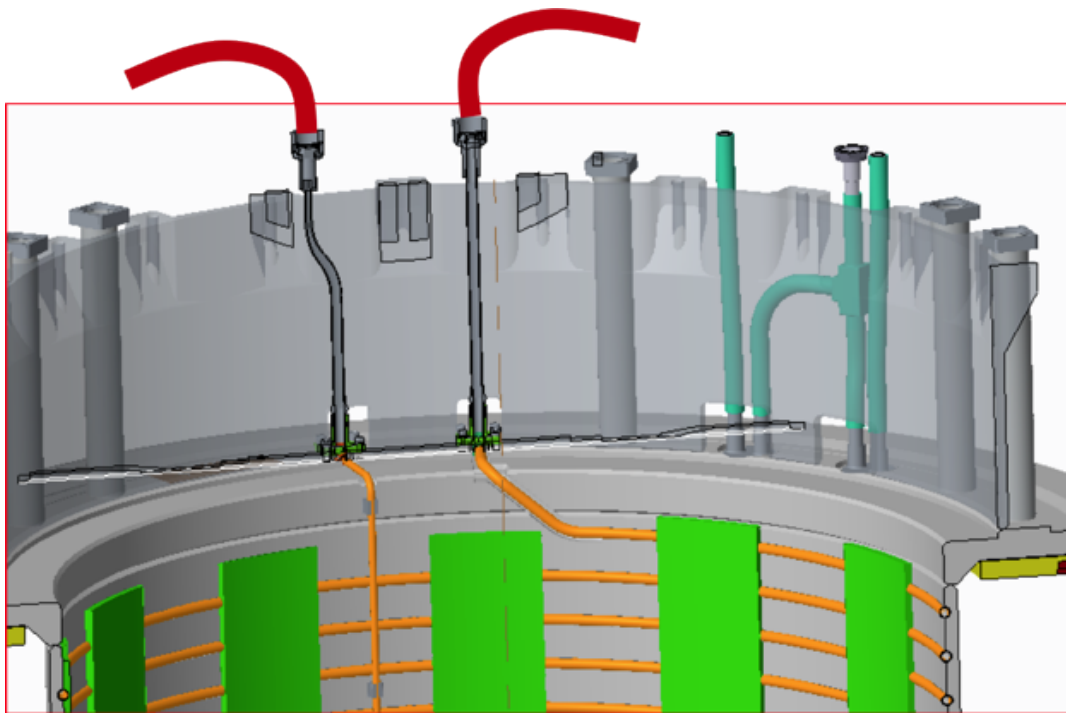


Figure 3. HTT Cooling Water Connection

ICD-CSS-CLS-005: The flow rates are identified in Ref 4 Page 6. The actual working pressure will be validated in the field.

4.7. Vacuum Interfaces

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

Identifier	Interface	References
N/A		

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.