

Interface Control Document TEST CELL : PLASMA FACING COMPONENTS

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National Spherical Torus eXperiment Upgrade

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Interface Control Document

TEST CELL: PLASMA FACING COMPONENTS

NSTX-U-ICD-TCS-PFC-0

**Revision 0
May 16, 2019**

Change Record

Revision	Date	Description of Change
0	May 16, 2019	Initial Release

References

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

[2] SYSTEM REQUIREMENTS DOCUMENT, Test Cell, NSTX-U-RQMT-SRD-010-0.

[3] SYSTEM REQUIREMENTS DOCUMENT, Plasma Facing Components, NSTX-U-RQMT-SRD-003-00.

1. Purpose

This document describes the various interfaces between the following subsystems: Test Cell and the Plasma Facing Components. The interface locations and boundaries that connect the Test Cell to the Plasma Facing Components are identified based on different interface types.

2. Scope

The Test Cell consists of the platforms, cable trays, racks, penetrations, floor, and crane. The Center Stack Structures include the Center Stack Casing, Pedestal, PF-1a Support Structures, PF-1b Support Structures, and PF-1c Support Structures. The PFCs consist of tiles and mounting hardware for the Center Stack First Wall, Center Stack Angle Section, Inboard Divertor Vertical and Horizontal Targets, and Thermocouples. The major focus of this ICD is the cabling for the PFC thermocouples. The scope of this document addresses any defined interfaces between these identified system elements.

3. Responsibilities

The interfaces are managed between the following organizations:

- Test Cell
- Plasma Facing Components
- Systems Engineering and Integration

4. Interfaces

Interface requirements in the following sections are identified with a requirement number, ICD, followed by a number [ICD-TCS-PFC-X] where “X” is a sequential count beginning with 001, TCS represents Test Cell, and PFC represents Plasma Facing Components. 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 and 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 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		
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	Si	
		Gf	Si			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	Si
				Ep	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		
								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.

Plasma Facing Components	
Me	Test Cell

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
1.8.1.1.2- 1.1.1.1.8-S	PFC Thermocouples cables use cable trays until they reach signal processing electronics and digitizers located in Test Cell racks	See Paragraph 4.2.1.1

4.2.1.1. PFC Thermocouples – Cable Trays

Interface Notes:

- N-type cable trays are used for low voltage connections

ICD-TCS-PFC-001: The cables will be run in the most efficient method coming using the nearest available N-type cable trays. Existing trays and cable runs will be used for the thermocouples used in the design.

4.2.2. Spatial Interface

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

Identifier	Interface	References
1.8.1.1.7- 1.1.1.1.8-Sp	Rack space in Test Cell required for signal processing electronics and digitizers for PFC Thermocouples .	See Paragraph 4.2.2.1, Drawing AE1024, AE1026, AE1002, 9D1095

4.2.2.1. PFC Thermocouples – Rack Space

Interface Notes:

- Passive Plates and NB armor are not in recovery scope but are part of the existing NSTX-U

ICD-TCS-PFC-002: Thermocouples are connected to cross-connects that are connected to multiplexers and digitizers in racks CTC-EE-429 (First Wall IBDH, IBDV), CTC-EE 434 (OBD, Passive Plate, & NB Armor) . The drawings AE1024 and AE1026 provide the rack layout. Drawing AE1002 Sheet 34 provides the Thermocouple block diagram.

ICD-TCS-PFC-003: Spare CAMAC multiplexor channels will be used to accommodate the additional thermocouples drawing 9D1095 Sheets 511-516, 518,520, & 521 and AE1026 have been red-lined to add thermocouples.

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 and any penetrations or modifications to the wall or floor of the D-Site building.

Identifier	Interface	References

N/A		
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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
N/A		

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 over a part of the interface. They are provided for completeness.

There are no external interfaces.