



ENG-064 - ICD - INTERFACE CONTROL DOCUMENT

Wall Conditioning System - Operations and Systems Safety

NSTXU_1-3-5_ICD_100

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National Spherical Torus eXperiment Upgrade

National Spherical Torus Experiment Upgrade

Interface Control Document

WALL CONDITIONING SYSTEMS: OPERATIONS & SAFETY SYSTEMS

NSTX-U-ICD-WCS-OSS-0

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Change Record

Revision	Date	Description of Change
0	January 18, 2020	Initial Release

References

- [1] GENERAL REQUIREMENTS DOCUMENT, NSTX-U-RQMT-GRD-001-01.
- [2] SYSTEM REQUIREMENTS DOCUMENT, AUXILIARY SYSTEMS, NSTX-U-RQMT-SRD-005-01.
- [3] SYSTEM REQUIREMENTS DOCUMENT, Operations and Safety Systems, NSTX-U-RQMT-SRD-012-00.
- [4] REQUIREMENTS DOCUMENT, Centralized Control System, NSTX-U-RQMT-RD-025-00.

1. Purpose

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

2. Scope

The Wall Conditioning System consists of Glow Discharge Cleaning, Trimethylboron (TMB), Granule Injector, and a Lithium Evaporator (LITER). The OSS consists of the Personnel Safety System - Safety Instrumented System, Trapped Key System, Configuration Managed Safeguards, Centralized Control System, Vessel and Diagnostic Ground Systems, Radiation Monitoring System, and Test Cell Oxygen Deficiency Monitor. The scope of this document addresses any defined interfaces between these identified system elements.

3. Responsibilities

The interfaces are managed between the following organizations:

- Wall Conditioning System
- Operations & Safety 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-WCS-OSS-X] where “X” is a sequential count beginning with 001, WCS represents Wall Conditioning System, and OSS represents Operations & Safety 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 and 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 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,Me		
		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,Me,Di	
					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	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	Si	Si,Me	
		Gf				Si,Gf,Va		Me	Wall Conditioning System				Si,Sw		Me	
		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	Si,Me,Di	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.

Wall Conditioning System	Me
	Operations & System Safety

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 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
1.7.3.9.2- 1.3.5.1.1-Sp	Safeguards are used to prevent individuals from touching conductors which may be at vacuum vessel potential (i.e. elevated during high pots of the vacuum vessel)	See Paragraph 4.2.2.1, Drawing AE8350, AE8354
1.7.3.9.2- 1.3.5.1.2-Sp	Safeguards are used to prevent individuals from touching otherwise exposed high voltage terminals on the in-vessel probes GDC system in the NSTX-U test cell.	See Paragraph 4.2.2.2, Drawing AE8350

4.2.2.1. Configuration Managed Safeguards - GDC Power Supplies

ICD-WCS-OSS-001: The GDC power supplies are located in the North gallery in the TVPS rack. These are existing and protected by cages that act as configuration managed safeguards. The location of the galleries are identified in the red ellipse in Figure 1. Note that these safeguards are also instrumented with trapped key systems that are identified in drawing AE8354.

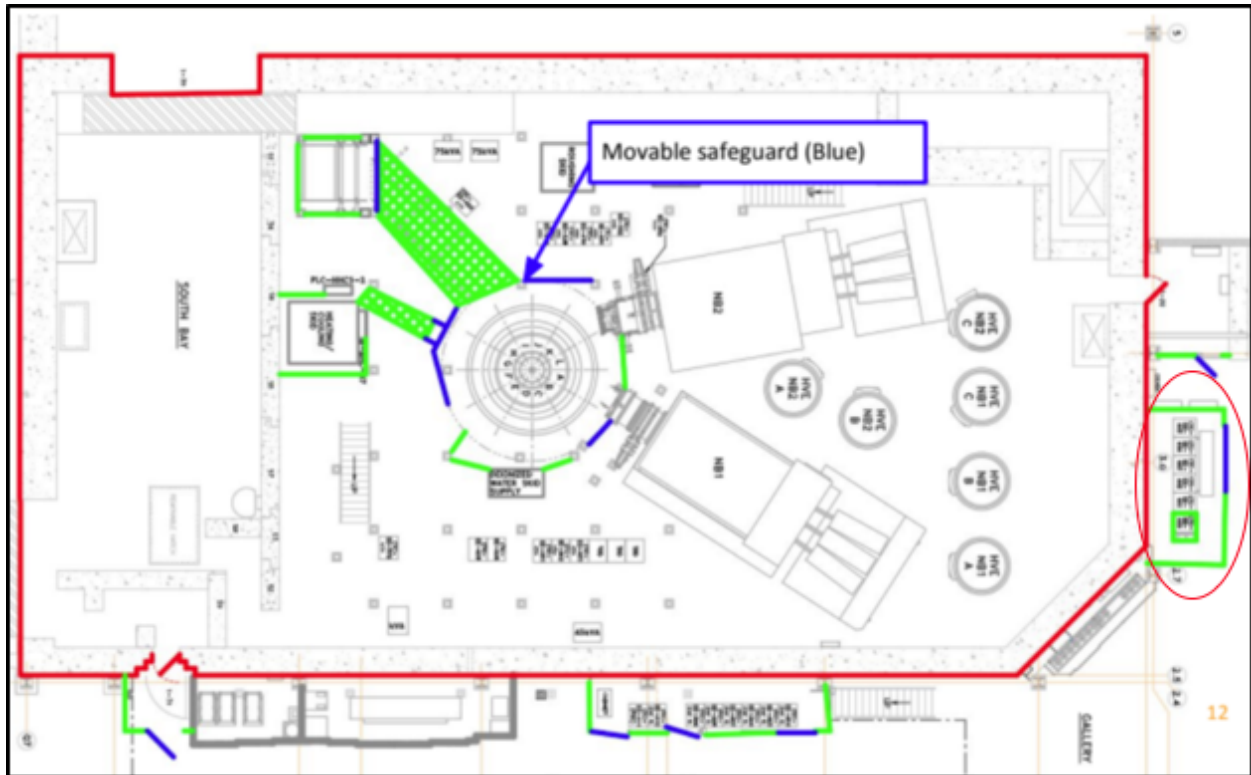


Figure 1. Sample Configuration Managed Safeguards Locations

ICD-WCS-OSS-002: In addition to the caged areas there are bolted safeguards in the North Gallery to ensure there is no potential for a user to experience the electrical hazard. In addition, there are bolted safeguards or insulating materials to protect the electrical connections on the vessel.

4.2.2.2. Configuration Managed Safeguards - GDC & Filaments

ICD-WCS-OSS-003: Access to the GDC & Filaments that are located near the vacuum vessel as shown in the center of Figure 1 is prevented by including safeguards around the vacuum vessel. There are movable (blue) and fixed (green) safeguards, that will be in place when a hazard is present. Figure 2 provides a sample of the safeguard design. Drawing 8350 provides the plan views of the Configuration Managed safeguards at both the 100' and 109' levels.



Figure 2. Sample Safeguard

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		

Interface Notes:

- The No-ESTOP signals that are used by the Wall Conditioning system components and use the Vacuum PLC to provide the No-Estop signals to the GDC components. See the Vacuum Pumping - Operations and System Safety ICD for the interface.

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		
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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 Eddie/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 Eddie/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.