



# ENG-064 - ICD - INTERFACE CONTROL DOCUMENT

## Diagnostics - Operations and System Safety Interface Control Document

*NSTXU\_1-4-1\_ICD\_100*

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# **National Spherical Torus eXperiment Upgrade**

## National Spherical Torus Experiment Upgrade

### **Interface Control Document**

### **DIAGNOSTIC: OPERATIONS & SAFETY SYSTEMS**

NSTX-U-ICD-DIA-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, Operations and Safety Systems, NSTX-U-RQMT-SRD-012-00
- [3] SYSTEM REQUIREMENTS DOCUMENT, Diagnostics, NSTX-U-RQMT-SRD-011-01.
- [4] REQUIREMENTS DOCUMENT, Centralized Control System, NSTX-U-RQMT-RD-025-00.

# 1. Purpose

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

# 2. Scope

The Diagnostics consists of Neutron measurements, Magnetics Multi-pulse Thompson Scattering (MPTS), Plasma TV, CHERS, Langmuir probes, spectroscopy, FIDA, BES, MSE, High-K Scattering, and microwave diagnostics, among other instrumentation and diagnostics. 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 main focus of this interface is the MPTS. The scope of this document addresses any defined interfaces between these identified system elements.

# 3. Responsibilities

The interfaces are managed between the following organizations:

- Diagnostics
- Operations and Safety Systems
- Systems Engineering and Integration

# 4. Interfaces

Interface requirements in the following sections are identified with a requirement number, ICD followed by a number [ICD-DIA-OSS-X] where X is a sequential count beginning with 001, DIA represents Diagnostics and OSS represents Operations and Safety Systems. 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. Reference also includes 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	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.

Diagnostics	Me, Si
	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 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
1.4.1.8- 1.7.3.9.2-Sp	Safeguard are used to prevent exposure to the high voltage of the MSE-LIF neutral beam components	

#### 4.2.2.1. Configuration Managed Safeguards - MSE-LIF

**ICD-DIA-OSS-001:** The MSE-LIF located near the vacuum vessel on the platform. The MSE-LIF is protected with a cover and warning labels as shown in Figure 1.





Figure 1. MSE-LIF 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
1.4.1.3- 1.7.3.8-Si	<b>CCS</b> provides No E-STOP and Loop Set signal to the <b>MPTS Laser</b> Interlock Box. This box uses these signals along with other MPTS related signals to determine the Laser Permissive and allow the laser guillotine to open.	See Paragraph 4.4.1, Drawings 9D1236, AE2034, AE2006
1.4.1.8- 1.7.3.8-Si	The CCS provides a No-Estop signal to the MSE-LIF	See Paragraph 4.4.2, Drawing 4BA181
1.7.3.4.5- 1.7.3.8-Si	The CCS provides a No-Estop signal to the TF-Twist Laser instrumentation	See Paragraph 4.4.3, Drawings AE2012_2

#### 4.4.1. CCS - MPTS

**ICD-DIA-OSS-002:** The No-ESTOP signal is sent to the MPTS. The Loop Set is required by MPTS and will be jumpered with the No- ESTOP Signal to provide the required signals for MPTS operations as identified in the block diagram in drawing 9D1236.

**ICD-DIA-OSS-003:** In addition to No-Estop, Loop Set, Test Mode signals are being added to MPTS and are identified in Drawings AE2034, AE2006.

**ICD-DIA-OSS-004:** The signals are 120 VAC.

#### 4.4.2. CCS - MSE-LIF

##### Interface Notes:

- The No-ESTOP signals will be available when the MSE-LIF comes back on-line.

**ICD-DIA-OSS-005:** The No-ESTOP signal is sent to the MSE-LIF and is identified in Drawing 4BA181.

**ICD-DIA-OSS-006:** The signals are 120 VAC.

#### 4.4.3. CCS - TF Twist Laser Instrumentation

**ICD-DIA-OSS-007:** The No-ESTOP signal is sent to the TF-twist Laser Instrumentation as identified in drawings AE2012\_2 and 9D11578. Figure 2 provides a diagram showing the flow of the loop set signal as it reaches a junction box to provide the No-STOP signal.

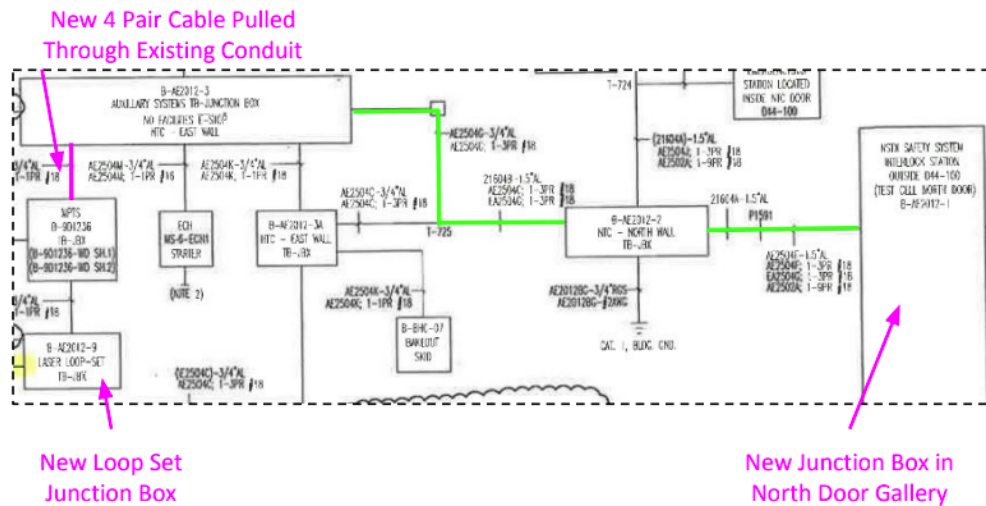


Figure 2. Laser Loop Set junction box

**ICD-DIA-OSS-008:** The signal is 120 VAC.

#### 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		

## 4.7. 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		

## 4.8. Vacuum Interfaces

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

Identifier	Interface	References

## 4.9. 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		

## 4.10. Thermal Interfaces

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

Identifier	Interface	References
N/A		

## 4.11. Plasma Interfaces

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

### 4.11.1. Plasma Interfaces

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

Identifier	Interface	References
N/A		

### 4.11.2. 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.