

# Test Cell - Operations & Systems Safety

Interface Document: NSTXU\_1-8-1-1\_IC\_100

REVISION 0

July 1, 2019

**PREPARED BY:**      **Peter Dugan**      6/25/2019 8:26:41 AM

---

Peter Dugan,

**REVIEWED BY:**      **Mark B. Cropper**      6/25/2019 9:44:51 AM

---

Mark B. Cropper,

**REVIEWED BY:**      **Timothy N. Stevenson**      6/25/2019 11:52:45 AM

---

Timothy N. Stevenson,

**REVIEWED BY:**      **Peter Dugan**      6/26/2019 6:40:05 AM

---

Peter Dugan,

**APPROVED BY:**      **Stefan Gerhardt**      7/1/2019 12:19:49 PM

---

Stefan Gerhardt,

PRINCETON PLASMA PHYSICS LABORATORY  
P.O. BOX 451  
PRINCETON, N.J. 08543



## National Spherical Torus Experiment Upgrade

### **Interface Control Document**

### **TEST CELL SYSTEMS: OPERATIONS & SAFETY SYSTEMS**

NSTX-U-ICD-TCS-OSS-0

**Revision 0  
June 20, 2019**

---

Prepared By: P. Dugan, Systems Engineering

---

Reviewed By: T. Stevenson, Test Cell RE

---

Reviewed: M. Cropper, Radiation Annunciation COG

---

Reviewed By: Y. Zhai, NSTX-U Project Engineer

## Change Record

Revision	Date	Description of Change
0	June 20, 2019	Initial Release



# References

- [1] GENERAL REQUIREMENTS DOCUMENT, NSTX-U-RQMT-GRD-001-01.
- [2] SYSTEM REQUIREMENTS DOCUMENT, Test Cell, NSTX-U-RQMT-SRD-010-02.
- [3] SYSTEM REQUIREMENTS DOCUMENT, Operations and Safety Systems, NSTX-U-RQMT-SRD-012-00.

# 1. Purpose

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

## 2. Scope

The Test Cell consists of the platforms, cable trays, racks, penetrations, floor, and crane. 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:

- Test Cell System
- Operations & 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-TCS-OSS-X] where “X” is a sequential count beginning with 001, TCS represents Test Cell System, and OSS represents Operations & 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 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,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	Weld 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	Ep	Power Systems	Ep,Si	Ep,Si	Me,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.

<b>Power Systems</b>	Me, Ep, Si, Di, Gf
	<b>Operations &amp; Safety Systems</b>

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
1.8.1.1.4- 1.7.3.7-S	<b>Radiation area monitors</b> mounted to <b>wall</b> .	See Paragraph 4.2.1.1
1.8.1.1.4- 1.7.3.1.1-S	Components of the <b>PSS-SIS</b> are supported by the <b>test cell wall</b>	See Paragraph 4.2.1.2
1.7.3.1.3- 1.8.1.1.1-S	<b>Conduits</b> for <b>PSS-SIS</b> Supported by <b>NTC walls</b>	See Paragraph 4.2.1.3
1.7.3.1.3- 1.8.1.1.4-S	Conduits for <b>PSS-SIS</b> Supported by <b>NTC platforms</b> and platform columns	See Paragraph 4.2.1.4
1.7.3.10.1- 1.8.1.1.4-S	<b>TKS</b> is used to enforce that <b>NTC doors</b> (man doors, mobile shield doors) are in proper configuration for NSTX-U operations	See Paragraph 4.2.1.5
1.8.1.1.1- 1.7.3.9.1-S	NSTX-U <b>Machine Perimeter Safeguards</b> may mount to <b>NTC platforms</b> and their supports	See Paragraph 4.2.1.6
1.8.1.1.8- 1.7.3.9.1-S	NSTX-U <b>Machine Perimeter Safeguards</b> may mount to <b>NTC floor</b>	See Paragraph 4.2.1.7
1.8.1.1.5- 1.8.1.1.3-S	<b>ODH monitor system</b> suspended/supported from <b>Test Cell Wall</b>	See Paragraph 4.2.1.8
1.8.1.1.1- 1.8.1.1.3-S	<b>ODH</b> monitor system suspended/supported from <b>platform</b> .	See Paragraph 4.2.1.9

#### 4.2.1.1. Radiation Monitoring-Test Cell Wall

**ICD-TCS-OSS-001:** The neutron and gamma detectors are identified by the orange stars in Figure 1. These monitors are bolted to the wall as defined in the installation procedure.

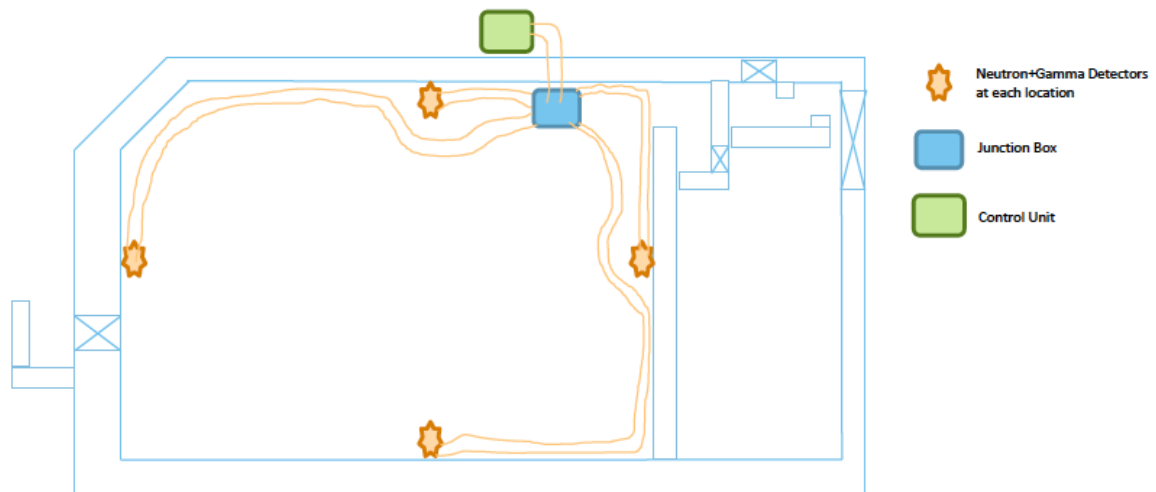


Figure 1. Radiation Monitoring locations

#### 4.2.1.2. PSS-SIS Components -Test Cell Wall

**Interface Notes:**

- The interface has been defined and is currently being developed and will be completed by the FDR.

#### 4.2.1.3. PSS-SIS Conduits-Test Cell Wall

**Interface Notes:**

- The interface has been defined and is currently being developed and will be completed by the FDR.

#### 4.2.1.4. PSS-SIS Conduits- Platform

**Interface Notes:**

- The interface has been defined and is currently being developed and will be completed by the FDR.

#### 4.2.1.5. Trapped Key System - Test Cell

**Interface Notes:**

- The interface has been defined and is currently being developed and will be completed by the FDR

#### 4.2.1.6. Radiation Monitoring-Test Cell Wall

- The interface has been defined and is currently being developed and will be completed by the FDR.

**Interface Notes:**

- The interface has been defined and is currently being developed and will be completed by the FDR.

#### 4.2.1.7. Safeguards-Test Cell Floor

**Interface Notes:**

- The interface has been defined and is currently being developed and will be completed by the FDR.

#### 4.2.1.8. ODH Monitor-Safeguards-Test Cell Wall

**Interface Notes:**

- The interface has been defined and is currently being developed and will be completed by the FDR.

#### 4.2.1.9. ODH Monitor-Platform

**Interface Notes:**

- The interface has been defined and is currently being developed and will be completed by the FDR.

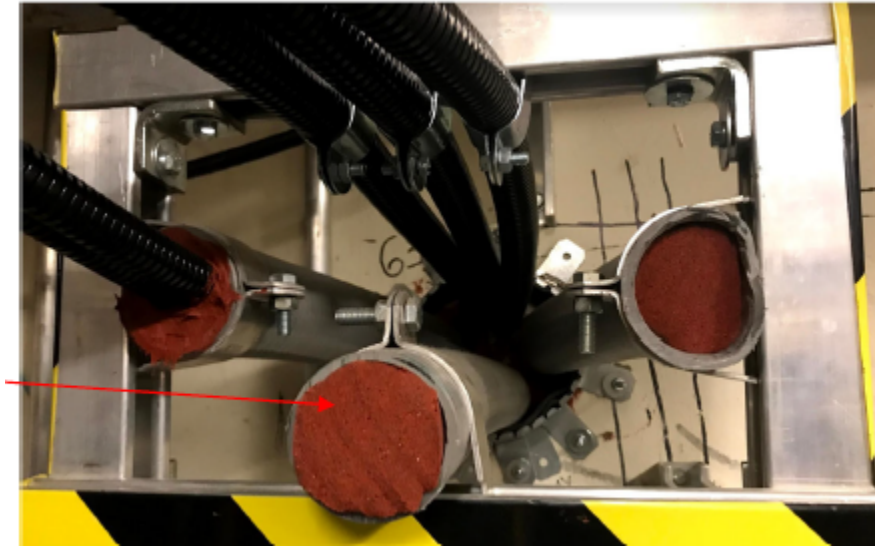
## 4.2.2. Spatial Interface

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

Identifier	Interface	References
1.8.1.1.5- 1.7.3.7-Sp	Signals that <b>enable area monitors</b> to illuminate the radiation warning sign pass through penetrations in the <b>NTC wall</b> .	See Paragraph 4.2.2.1

#### 4.2.2.1. Radiation monitoring – NTC Wall

**ICD-TCS-OSS-004:** The penetration be come through penetration number 6360 that houses the cable bundle as shown in Figure 2.



**Figure 2. Cable Bundle**

#### 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
1.8.1.3- 1.7.3.7-L	<b>Radiation warning signs</b> are located in the <b>galleries</b> near the test cell entrances.	See Paragraph 4.2.3.1

##### 4.2.3.1. Radiation Sign – Gallery

**ICD-TCS-OSS-005:** The signed will be mounted near the doors in the locations identified in Figure 3. Figure 4 provides a sample of the signed with a red arrow pointing to the black text with Yellow background.



Figure 3. Sign locations



Figure 4. Illuminated Sign

#### 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
1.7.3.1.3- 1.8.1.1.5-W	<b>Conduits for PSS-SIS pass through NTC Penetrations</b>	See Paragraph 4.2.4.1
1.8.1.1.3- 1.8.1.1.5-W	<b>ODH monitor tubes pass through penetrations in the test cell wall</b>	See Paragraph 4.2.4.2

##### 4.2.4.1. Conduits - NTC Penetration

###### Interface Notes:

- The interface has been defined and is currently being developed and will be completed by the FDR.

##### 4.2.4.2. ODH Test Cell Wall

###### Interface Notes:

- The interface has been defined and is currently being developed and will be completed by the FDR.

### 4.3. Electrical Power Interfaces

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

Identifier	Interface	References
1.8.1.1.7- 1.7.3.2.3-P	Specific <b>NTC racks</b> receive an electrical reference to the <b>vessel ground</b> .	See Paragraph 4.3.1
1.8.1.1.7- 1.7.3.2.4-P	Specific NTC <b>racks</b> receive an electrical reference to <b>diagnostic ground</b> .	See Paragraph 4.3.2

#### 4.3.1. NTC Racks - Vessel Ground

##### Interface Notes:

- The interface has been defined and is currently being developed and will be completed by the FDR.

#### 4.3.2. NTC Racks – Diagnostic Ground

##### Interface Notes:

- The interface has been defined and is currently being developed and will be completed by the FDR.

### 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
------------	-----------	------------

## 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.

- Other Interface: The PSS prevents access when the NTC is in an unsafe state, via 1) prevention of door opening, or 2) shutting down of interlocked equipment when doors are opened.
- Radiation area monitors are network connected devices using the PPPL Network Ethernet infrastructure (0.1.1.3) from the network switch.