



ENG-064 - ICD - INTERFACE CONTROL DOCUMENT

Magnets - Operations and System Safety Interface Control Document

NSTXU_1-1-3_ICD_100

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National Spherical Torus eXperiment Upgrade

National Spherical Torus Experiment Upgrade

Interface Control Document

MAGNETS : OPERATIONS & SYSTEMS SAFETY

NSTX-U-MAG-OSS-ICD

**Revision 0
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Change Record

Revision	Date	Description of Change
0	January 13, 2020	Initial Release



References

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

[2] SYSTEM REQUIREMENTS DOCUMENT, MAGNET SYSTEMS, NSTX-U-RQMT-SRD-002-02

[3] SYSTEM REQUIREMENTS DOCUMENT, OPERATIONS & SYSTEM SAFETY, NSTX-U-RQMT-SRD-012-01

1. Purpose

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

2. Scope

The Magnets address the TF Inner Legs, OH Solenoid, Outer PF Coils, PF-1a Coils, PF-1b Coils, and PF-1c Coils. The Operational Safety Systems consist of the Personnel Safety - System Safety Instrumented Systems, 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:

- Magnets
- Operations and Systems Safety
- Systems Engineering and Integration

4. Interfaces

Interface requirements in the following sections are identified with a requirement number, ICD followed by a number [ICD-MAG-OSS-X] where X is a sequential count beginning with 001, MAG represents Magnets and OSS represents Operations and Systems Safety. There is also a unique identifier for all interfaces in the format [#####-#####-X]. The identifier is a concatenation of two level 5 SBS 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	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

Magnets	Me
	Operations & Safety Systems

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

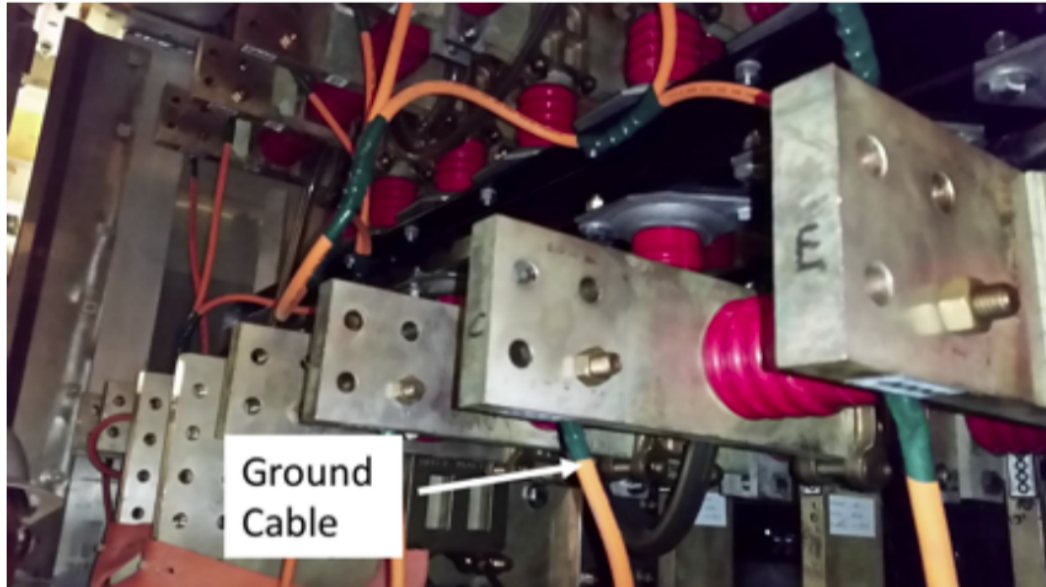
This identifies any interfaces between the system elements pertaining to spatial restrictions or constraints.

Identifier	Interface	References
1.7.3.9.2- 1.1.3.4-Sp	Safeguards are used to prevent individuals from touching otherwise exposed coil bus work in the NSTX-U test cell.	See Paragraph 4.2.2.1, Drawings AE8350, AE8370

4.2.2.1. Bus Work - Safeguards

Interface Notes:

- When power cables not connected to the machine, the bus bar cables are connected to ground as shown in Figure 1



.Figure 1. PCTS Bus Bars Connected to Ground Cables

ICD-MAG-OSS-001: The Power Cable Termination Structure (PCTS) has a cover that provides a safeguard preventing individuals from accessing the interconnection on the bus bars that connect the power systems to the magnets when there is a probability of enabling current to the magnets. Figure 2 provides a front view of the panel with the warning signs. Figure 3 shows the Bus Bars (left) being obstructed by the safeguard (right). Note the PCTS is located behind the safeguard.



Figure 2. PCTS - Bus Bar Safeguard

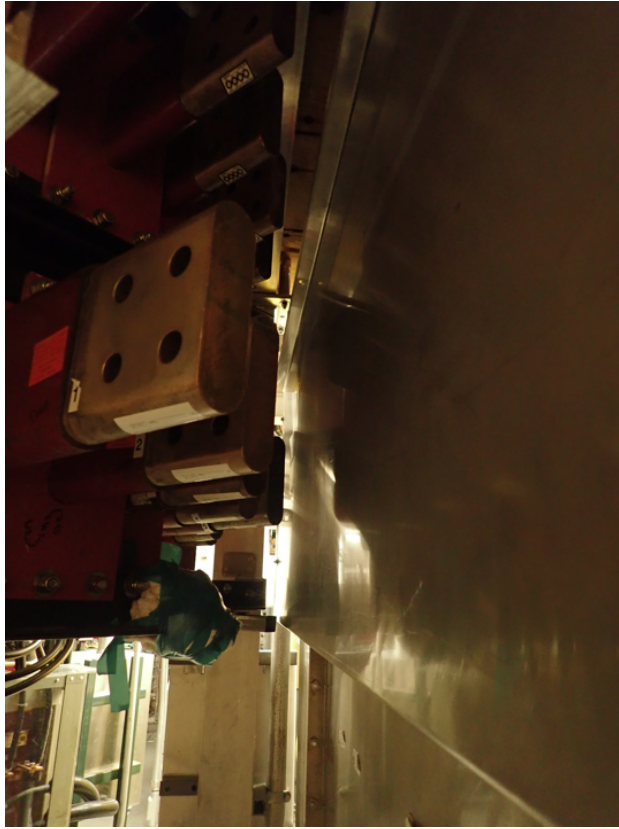


Figure 3. Safeguard preventing access to the Bus Bar

ICD-MAG-OSS-002: There is a light curtain safeguard that is used to ensure no one inappropriately removes the safeguard. The mounting of this PCTS light curtain is detailed in Drawing AE8370.

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		
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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		
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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.