

Interface Control Document **MAGNETS : BAKEOUT SYSTEM**

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National Spherical Torus Experiment Upgrade

Interface Control Document

MAGNETS: BAKEOUT SYSTEM

NSTX-U-ICD-MAG-BOS-0

**Revision 0
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Change Record

Revision	Date	Description of Change
0	May 9, 2019	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, March 8, 2018.
- [3] SYSTEM REQUIREMENTS DOCUMENT, AUXILIARY SYSTEMS, NSTX-U-RQMT-SRD-005-01.

1. Purpose

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

2. Scope

The Magnets consists of Inner and Outer PF and TF coils, OH Solenoid, and Bus Bars. The Bakeout System consists of the Helium Heating and Cooling System, Helium Skid, Ex-Vessel Helium Manifolds, In-Vessel Helium Lines, Bakeout Bus Bar, and Helium Feedthroughs. 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
- Auxiliary 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-MAG-BOS-X] where “X” is a sequential count beginning with 001, MAG represents Magnets, and BOS represents Bakeout 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. 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	Me, Gf	Me	Me	Me				Di		
		Me	Me, Th, Ep	Magnets			Gf	Me			Di		Si	Di		
Si		Me, Va			Heating Systems		Gf	Th		Me		Gf, Si	Si	Si	Si	
					Si, Va, Me, Svw, Gf	Vacuum Pumping System		Si	Si	Gf, Si	Si		Si, Va	Si	Si	
				Gf, Si			Coolant System	Gf				Gf, Svw	Si, Svw	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, Svw	Si	Si		
		Gf	Si			Si, Gf, Va		Gf	Wall Conditioning System			Si, Svw	Si	Si		
		Me, Va	Me, Va	Me	Me	Gf, Si	Gf		Va, Ep	Diagnostics		Si, Svw	Si	Si	Si	
				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			
									Svw		Si	Si, Svw	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
	Bakeout Systems

The remainder of this documents 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 that 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 to include a structural, spatial, location dependent interfaces or areas where penetrations in a wall or floor are required. These are identified independently as the interface parameters will likely be different.

4.2.1. Structural Interfaces

This identifies any interfaces between the 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
1.1.3.4- 1.3.3.3.2.S	Pipes for the medium temperature water system are supported from the bus tower , where supports attach to the bus tower.	See Paragraph 4.2.1.1 Drawing 5GA553

4.2.1.1. Medium Temperature Water Pipe - Bus Tower

Interface Notes:

- This was most likely a field fit as drawing could not be found.

ICD-MAG-BOS-001: The bus tower uses a standard piece of uni-strut similar to that identified in drawing 5GA553 to the Bus Tower and pipe hanger to secure the water pipe as shown in Figure 1.



Figure 1. Water Pipe to Bus Bar Attached to Bus Bar.

4.2.2. Spatial Interface

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

Identifier	Interface	References
N/A		

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		

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 gas (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		
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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.