



ENG-064 - ICD - INTERFACE CONTROL DOCUMENT

Heating Systems - Operations & System Safety Interface Control Document

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National Spherical Torus eXperiment Upgrade

National Spherical Torus Experiment Upgrade

Interface Control Document

HEATING SYSTEMS: OPERATIONS & SAFETY SYSTEMS

NSTX-U-HTG-OSS-ICD-0

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Change Record

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0	February 27, 2020	Initial Release

References

- [1] GENERAL REQUIREMENTS DOCUMENT, NSTX-U-RQMT-GRD-001-01.
- [2] SYSTEM REQUIREMENTS DOCUMENT, Heating Systems, NSTX-U-RQMT-SRD-007-01.
- [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: Heating Systems and the Operations & Safety Systems. The interface locations and boundaries that connect the Heating Systems to the Operations & Safety Systems are identified based on different interface types.

2. Scope

The Heating Systems consists of the Neutral Beams, HHFW, and ECH. 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:

- Heating Systems
- 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-HTG-OSS-X] where X is a sequential count beginning with 001, HTG represents Heating Systems 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 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	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.

Heating Systems	Me, Si, Di
	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
1.2.4.6- 1.7.3.1.3-S	Conduit for PSS-SIS is mounted to, and interfaces with, neutral beam power equipment.	See Paragraph 4.2.1.1, Drawings AE8301. AE8309
1.2.1.7- 1.7.3.1.3	TKS ensures that the RF baseball switches are in a position to prevent power from entering the NTC when access is allowed	See Paragraph 4.2.1.1, AE8354

4.2.1.1. Conduit - Neutral Beam Power Equipment

ICD-HTG-OSS-001: The master conduit runs for the PSS are identified in Drawing AE8301. Specific Neutral Beam power systems conduit diagrams are presented in Drawing AE8309.

4.2.1.2. Structural Interfaces

ICD-HTG-OSS-002: The trapped key system provides a status of the HHFW Coaxial switches as identified in the assembly Drawing AE8354 Sheet 15.

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, and 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		
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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
1.2.4.7- 1.7.3.10.1-Si	TKS inhibits the enabling of primary power when access to the test cell and related areas is allowed.	See Paragraph 4.4.1, Drawing AE1026
1.2.1- 1.7.3.1.1-Si	The CCS provides permits to enable and arm to the HHFW systems, and receives status information on the enable/arm status from HHFW control system	See Paragraph 4.4.2, Drawing 6782E16220
1.2.3- 1.7.3.8-Si	The CCS provides permits to enable and arm the ECH pre-ionization system, and receives status information from the system	See Paragraph 4.4.3 Drawings 6782E16220, 8C3351
1.2.4.7- 1.7.3.8-Si	The CCS provides permits to enable and arm to the neutral beam systems, and receives status information on the enable/arm status from the neutral beams	See Paragraph 4.4.4, Drawing 6782E16220

4.4.1. TKS – Test Cell Access

ICD-HTG-OSS-003: The Trapped Key System is instrumental in ensuring that no personnel are inside the test cell of other relevant locations when power is applied to the coils. Drawing AE8126 provides a loop diagram for the monitoring the Trapped Keys

4.4.2. CCS - HHFW

ICD-HTG-OSS-004: The CCS sends enable and arm signals to the HHFW. An enable signal is a pre-condition for an arm as shown in Drawing 6782E16220

ICD-HTG-OSS-005: The CCS receives the following feedback signals: Enable, Disarm, Disable, and Shutdown from the HHFW as shown in Drawing 6782E16220.

ICD-HTG-OSS-006: The signal is 120 Volts.

4.4.3. CSS - ECH

ICD-HTG-OSS-007: An enable/arm is sent to the ECH-PI as defined in Drawing 8C3351 Sheet 164. The drawing also includes a permissive simulator box.

ICD-HTG-OSS-008: An enable is received from the COE interface CC-EE-203 G38 while the arm is received from the COE interface CC-EE-203 G40.

ICD-HTG-OSS-009: The signal is 120 Volts.

4.4.4. CCS – Neutral Beams

ICD-HTG-OSS-010: The CCS sends enable and arm signals to the Neutral Beams. An enable signal is a pre-condition for an arm as shown in Drawing 6782E16220.

ICD-HTG-OSS-011: The CCS receives the following feedback signals: Enable, Arm, Disarm, and Disable from the Neutral Beams as shown in Drawing 6782E16220.

ICD-HTG-OSS-012: The signal is 120 Volts.

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
1.2.4.6- 1.7.3.1.1-D	PSS-SIS detects the position of the NBI Ross ground switches	See Paragraph 4.5.1, Drawings AE8005, AE8158
1.2.4.6- 1.7.3.1.1-D	PSS-SIS detects the position of the NBI Pringle switches	See Paragraph 4.5.2, Drawings AE8005, AE8158

4.5.1. PSS-SIS - NBI Ross Ground Switches

ICD-HTG-OSS-013: The NBI Ross Ground Switches are detected by PSS-SIS as identified in the Controlled Wiring Diagram AE8005 Sheet 325 and Loops Diagram AE8158.

4.5.2. PSS-SIS - NBI Pringle Switches

ICD-HTG-OSS-014: The NBI Pringle Switches are by PSS-SIS as identified in the Controlled Wiring Diagram AE8005 Sheet 320 and Loops Diagram AE8158.

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 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.

