



ENG-064 - ICD - INTERFACE CONTROL DOCUMENT

Cooling System - Bakeout System Interface Control Document

NSTXU_1-3-2_ICD_100

Work Planning #:
Effective Date: **02/10/2020**
Prepared By: **Peter Dugan**

Reviewed By	Joseph Petrella, Responsible Engineer	02/06/2020 15:15:32 PM
Reviewed By	Mark B. Cropper, Responsible Engineer	01/13/2020 06:50:28 AM
Reviewed By	Yuhu Zhai, Project Engineer	01/13/2020 14:44:18 PM
Approved By	Robert A. Ellis, Chief Engineer	02/10/2020 12:57:19 PM



National Spherical Torus eXperiment Upgrade

National Spherical Torus Experiment Upgrade

Interface Control Document

COOLANT SYSTEMS– BAKEOUT SYSTEMS

NSTX-U-ICD-CLS-BOS-0

**Revision 0
December 18, 2019**

Prepared By: P. Dugan, Systems Engineering

Reviewed By: J Petrella, Coolant RE

Reviewed By: M. Cropper, Bakeout RE

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

Approved By: R. Ellis, Chief Engineer





Change Record

Revision	Date	Description of Change
0	December 18, 2019	Initial Release



References

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

[2] SYSTEM REQUIREMENTS DOCUMENT, AUXILIARY SYSTEMS, NSTX-U-RQMT-SRD-005-01

[3] Design Point Spreadsheet, NSTX_CS_Upgrade_Open_Revision_03_20_18

1. Purpose

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

2. Scope

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 Coolant Systems consists of High and Low-Pressure NTC Coolant Water Distribution, Field Coil and Bus Bar Water Coolant System, Deionization process, and OH-Water Pre-Heater System. The scope of this document addresses any defined interfaces between these identified system elements.

3. Responsibilities

The interfaces are managed between the following organizations:

- Coolant Systems
- Bakeout System
- Systems Engineering and Integration

4. Interfaces

Interface requirements in the following sections are identified with a requirement number, ICD followed by a number [ICD-CLS-BOS-X] where X is a sequential count beginning with 001, CLS represents Coolant System 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 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	
					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	
		Gf				Si,Gf,Va			Me	Wall Conditioning System			Si,Sw		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		
												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

Coolant Systems	Gf
Gf, Si	Bakeout

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 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
N/A		

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
1.3.3.4- 1.3.2.4.Si	Transfer of information at the Water system PLC I/O rack regarding status of cooling water flow and the Bakeout PLC and Controls in coils and vessel cooling loops.	See Paragraph 4.4.1, Drawings 56A550, EB1063

4.4.1. Coolant System to Bakeout System PLC

ICD-CLS-BOS-001: A control connection is established between the cooling water system and the bakeout as shown in the block diagram in drawing 56A550. The Water Cooling resides in rack CTC-EE-573

ICD-CLS-BOS-002: The control signals uses two wires with a +24VDC signal as identified in drawing EB1063.

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

1.3.2.1.1- 1.3.3.2.1-F	NTC low-pressure water distribution system provides cooling for the bakeout bus work at the hose fittings on the bus work.	See Paragraph 4.6.2.1, Drawing 5GA522
1.3.3.2.2- 1.3.2.1.1-F	Provision of water cooling to the Bakeout DC power supplies at the location where hoses connect to the Low Pressure cooling water system	See Paragraph 4.6.2.2, EB1092

4.6.2.1. Water Cooling -Bakeout Bus Bar

Interface Notes:

- The drawing requires updating as it still shows the CHI bus, which is being replaced as part of the recovery scope.
- The Drawing 5GA522 Sheet 3 provides a Flow rate of between 200 PSI TO 300 PSI. This likely needs to be updated.

ICD-CLS-BOS-003: The type of fluid is Deionized water using a connection of 1/2" PARKER HOSE: MULTIPURPOSE OIL RESISTANT AIR & WATER HOSE, NONCONDUCTIVE, SERIES 7094, COLOR - RED as shown on Drawing 5GA522 Sheet 3.

ICD-CLS-BOS-004: The maximum working pressure is 120 PSI per the RE between 200 PSI TO 300 PSI per drawing. The actual working pressure will be validated in the field.

4.6.2.2. Water Cooling -Bakeout Bus Power Supplies

Interface Notes:

- A hose is used to connect the DC power supplies are field fit to interconnect the supplies to the water source

ICD-CLS-BOS-005: The water lines are run to the 119' platform and terminated near the power supplies as shown in the black line on the left of Drawing EB1092

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.