



ENG-064 - ICD - INTERFACE CONTROL DOCUMENT

Gas Delivery System - Centralized Instrumentation & Control Interface Control Document

NSTXU_1-3-4_ICD_101

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National Spherical Torus eXperiment Upgrade

National Spherical Torus Experiment Upgrade

Interface Control Document

GAS DELIVERY SYSTEM : CENTRALIZED INSTRUMENTATION & CONTROL

NSTX-U-GDS-CIC-ICD

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Change Record

Revision	Date	Description of Change
0	November 12, 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] SYSTEM REQUIREMENTS DOCUMENT, CENTRAL INSTRUMENTATION AND CONTROL, NSTX-U-RQMT-SRD-009-00.

1. Purpose

This document describes the various interfaces between the following subsystems: Gas Delivery System and the Centralized Instrumentation & Control. The interface locations and boundaries that connect the Gas Delivery System to the Centralized Instrumentation & Control are identified based on different interface types.

2. Scope

The Gas Delivery and Injection System consists of three Low Field Side Injectors, High Field Side Injectors, Lower Divertor Hi Flow injections system, Massive Gas Injectors, Private Flux Region Fueling and Supersonic Gas Injector (future). The Central Instrumentation and Control consists of Control I/O, Plant Control and Monitoring, Timing and Synchronization System, Data I/O systems, and Data Archiving Systems. The scope of this document addresses any defined interfaces between these identified system elements.

3. Responsibilities

The interfaces are managed between the following organizations:

- Gas Delivery System
- Centralized Instrumentation & Control
- Systems Engineering and Integration

4. Interfaces

Interface requirements in the following sections are identified with a requirement number, ICD followed by a number [ICD-GDS-CIC-X] where X is a sequential count beginning with 001, GDS represents Gas Delivery System and CIC represents Centralized Instrumentation & Control. 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 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 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,SI		
		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	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,SI		Gas Delivery System	Me	Va		SI,Sw		Me		
		Gf				SI,Gf,Va		Gf	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	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

Gas Delivery System	SI, Sw
	Centralized Instrumentation & Control

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
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
1.3.4.5- 1.6.1.1-Si	OPC (ethernet) networking is used to communicate with the Vacuum System PLC	See Paragraph 4.4.1, EA1500
1.3.4.5- 1.6.1.3.1-Si	MGI system receives timing information from Epics	See Paragraph 4.4.1, AE4005 AE1015

Interface Notes:

- The Vacuum System PLC performs the control functions for the Gas Delivery System.

4.4.1. Network – Vacuum System PLC

Interface Notes:

- The drawings referenced were last updated in 2013 and require a red-line and/or drawing updates.
- The OPC is an industry standard providing a common format for interacting with PLCs.

ICD-GDS-CIC-001: The network that connects the OPC Server with the Vacuum Pumping PLC via the PPPL fiber optic network per Drawing EA1500 Sheet 106. The OPC server reside in the FCC and the Vacuum Pumping PLC resides in the Gallery Rack CTC-EE-443.

ICD-GDS-CIC-002: The open platform communications (OPC) protocol operates over the fiber optic connection.

4.4.2. Timing Signal – MGI

ICD-GDS-CIC-003: Timing signals are routed from CAMAC H412 shown in drawing AE1015 to the Fiber Optic Utility Panel controlling the MGI system using BNC connectors and 50/125 uM LCST-10GIG-3M, D61-S1 connector as shown in drawing AE4005 SH. 55

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
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
1.3.4.3.2- 1.6.2.2-Sw	MGI system receives timing information from MDS+, archives data to MDS+	See Paragraph 4.8.1

Interface Notes:

- The Private Flux Region data is stored via the Plasma Control System and is addressed in the Integrated Machine Operations

4.8.1. MGI - MDS+

ICD-GDS-CIC-004: The MDS+ system sends a timing event to the MGI using the MDS+ APIs.

ICD-GDS-CIC-005: The MDS+ system stores the MGI data as part of the engineering tree using the MDS+ APIs.

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.

There are no external interfaces.