

In-Vessel Structures - Integrated Machine Operations ICD

Interface Document: NSTXU_1-1-1-2_IC_102

REVISION 0

June 24, 2019

PREPARED BY: **Peter Dugan** 6/19/2019 4:19:49 PM

Peter Dugan,

REVIEWED BY: **George D. Loesser** 6/24/2019 7:40:00 AM

George D. Loesser,

REVIEWED BY: **Peter Dugan** 6/24/2019 7:49:06 AM

Peter Dugan,

REVIEWED BY: **Robert A. Ellis** 6/24/2019 8:37:26 AM

Robert A. Ellis,

APPROVED BY: **Yuhu Zhai** 6/24/2019 9:17:31 AM

Yuhu Zhai,

PRINCETON PLASMA PHYSICS LABORATORY
P.O. BOX 451
PRINCETON, N.J. 08543



National Spherical Torus Experiment Upgrade

Interface Control Document

IN-VESSEL STRUCTURE : INTEGRATED MACHINE OPERATIONS

NSTX-U-ICD-IVS-IMO-0

**Revision 0
June 19, 2019**

Prepared By: P. Dugan, Systems Engineering

Reviewed By: D. Loesser, VVIH RE

Reviewed: R. Ellis, Diagnostics RE

Reviewed By: Y. Zhai NSTX-U Project Engineer

Change Record

Revision	Date	Description of Change
0	June 19, 2019	Initial Release

References

- [1] GENERAL REQUIREMENTS DOCUMENT, NSTX-U-RQMT-GRD-001-01
- [2] SYSTEM REQUIREMENTS DOCUMENT, VACUUM VESSEL AND INTERNAL HARDWARE, NSTX-U-RQMT-SRD-004-01
- [3] SYSTEM REQUIREMENTS DOCUMENT, Diagnostics, NSTX-U-RQMT-SRD-011-01

1. Purpose

This document describes the various interfaces between the following subsystems: In-Vessel Structure and the Integrated Machine Operations. The interface locations and boundaries that connect the In-Vessel Structure to the Integrated Machine Operations are identified based on different interface types.

2. Scope

The In-Vessel Structure consists of the Passive Plates, Outboard Divertor, and Neutral Beam Armor. The Integrated Machine Operations consists of instrumentation specifically accelerometers. The scope of this document addresses any defined interfaces between these identified system elements.

3. Responsibilities

The interfaces are managed between the following organizations:

- VVIH
- Diagnostics
- Systems Engineering and Integration

4. Interfaces

Interface requirements in the following sections are identified with a requirement number, ICD followed by a number [ICD-IVS-IMO-X] where X is a sequential count beginning with 001, IVS represents In-Vessel Structure and IMO represents Integrated Machine Operations. 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 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

Process / Equipment	Me, Th, Fe		Me, Th, Va, Fe					Me	Me	Me, Fe		Me			
	Hydraulic Pumps	Me, DI, Fe			Th			Me, Th, Fe	Me		Me, DI, Fe			DI	
		Variable Viscosity Pumps			Me, Va	Me	Me	Me, Th, Fe	Me	Me, Va	Me, DI, Va		SI	DI, SI	
		Va	Control Valve			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, Sw			SI	SI	GF, SI	SI		SI, Va	SI	SI
				GF, SI			Control System	GF				GF, Sw	SI, Sw	SI	
	Th, GF	Ep, DI, Th, Va	Ep, GF, Th, Fe		SI		SI	Refrigeration System						Me	SI
			GF, Va	GF, Va	Ep	GF, SI		Gas Delivery System	Me	Va			SI, Sw	SI	SI
		GF	SI			SI, GF, Va		GF	Wall Conditioning System				SI, Sw	SI	SI
		Me, Va	Me, Va	Me	Me	GF, SI	GF		Va, Ep	Diagnostics			SI, Sw	SI	SI
				Ep	Ep	Ep	Ep	Ep	Ep	Ep	Power Systems		SI	Ep, SI	Ep, SI, DI, GF
					SI				Me, SI	SI			Centralized Instrumentation and Control	SI, Me	
									Sw		SI		SI, Sw	Integrated Machine Operations	
							Ep								Operations & Safety Systems
Me		Me	Me	Me	Me	Me		Me	Me	Me	Me	Me	Me	Me, Ep	On-Site Locations (Test Cells)

Table 3. Callout

In Vessel Structure	Di
	Integrated Machine Ops

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
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
1.1.1.2.1- 1.7.3.4.3.Di	Accelerometers measure motion of passive plates during disruptions	See Paragraph 4.5.1, Drawings ED1322, ED1323, ED1471

4.5.1. Passive Plates - Accelerometers

ICD-IVS-IMO-001: The accelerometers access are identified in Drawings ED1322 and ED1323. The access consists of a threaded screw hole: #10 screw hole/32 threads per inch.

ICD-IVS-IMO-002: Figure 1 shows the location of the accelerometers.

Table 1. Accelerometer Locations

Upper or Lower	Passive Plate Type	Location (Between Bays)
Upper	Primary Passive Plate	I&J
		L&A
	Secondary Passive Plate	K&L
Lower	Primary Passive Plate	L&K
	Secondary Passive Plate	A&L

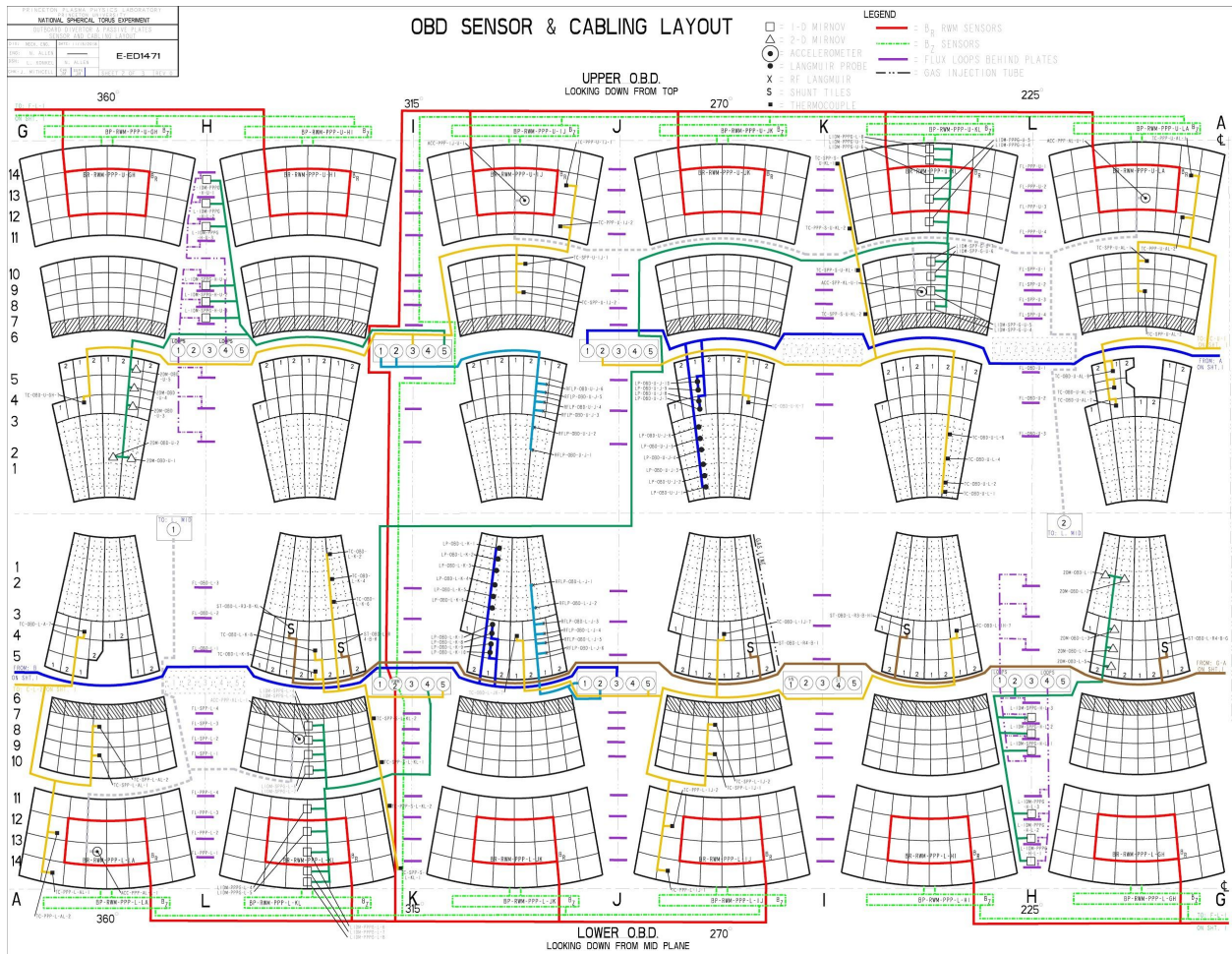


Figure 1. Accelerator Locations

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		

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.