PRINCETON PLASMA PHYSICS LABORATORY

ENG-064 - ICD - INTERFACE CONTROL DOCUMENT

Power Systems - Bakeout Systems Interface Control Document

NSTXU_1-5_ICD_101

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National Spherical Torus eXperiment Upgrade

National Spherical Torus Experiment Upgrade

Interface Control Document

POWER SYSTEMS :
BAKEOUT SYSTEMS

NSTX-U-PWR-BOS-ICD-0

Revision 0
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Change Record

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0	February 14, 2020	Initial Release

References

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

[2] SYSTEM REQUIREMENTS DOCUMENT, POWER SYSTEMS, NSTX-U-RQMT-SRD-006-01.

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

1. Purpose

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

2. Scope

The Power Systems consists of the AC and DC power systems. 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:

- Power Systems
- Bakeout 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-PWR-BOS-X] where X is a sequential count beginning with 001, PWR represents Power Systems and BOS represents Bakeout 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

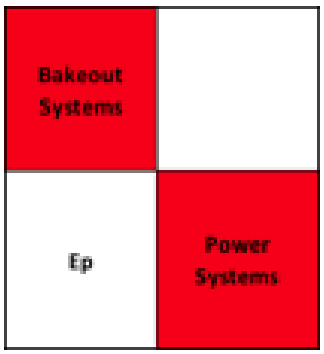
Heading	Abbreviation	Name
4.2	Me	Mechanical
4.3	Ep	Electrical Power
4.4	Si	Signal
4.5	Di	Diagnostics
4.6	Gf	Gas/Fluid
4.7	Va	Vacuum
4.8	Sw	Software
4.9	Th	Thermal
4.10	Pe	Plasma/Eddy/ Halo Current

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



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
1.5.1.2-1.3.3.1.1-P	Electrical power provided for helium skid	See Paragraph 4.3.1, Drawing EB1021, 4B1126A
1.5.1.2-1.3.3.2.2-P	Electrical power for bakeout DC supplies	See Paragraph 4.3.2, Drawing EB1077,EB1096
1.5.1.2-1.3.3.4-P	Electrical power for the bakeout PLC and related controls	See Paragraph 4.3.3, EB1029, LP430
1.5.1.2-1.3.3.3.1-P	Electrical power for the medium temperature water skid	See Paragraph 4.3.4, Drawing 4B1148

4.3.1. Power – Helium Skid

ICD-PWR-BOS-001: Bakeout System Power is routed from MCC-P2-10E as shown in drawings EB1021 and 4B1126A.

ICD-PWR-BOS-002: The voltage is 480 VAC and the current of 60A and is interfaced using wire connections as shown in EB1021.

4.3.2. Power – Bakeout DC Supplies

ICD-PWR-BOS-003: Figure 1 provides a view of the Spare Bus Duct Disconnect Switch that provides power to the supplies. DC Power for Bakeout is routed from a connection located on the west wall as shown in drawing EB1096.

Figure 1. Bus Duct Disconnect Switch

ICD-PWR-BOS-004: The voltage is 480 VAC and the current of 60A welding for each DC power supply as identified in Drawing EB1077.

4.3.3. Power - PLC

ICD-PWR-BOS-005: Helium Skid PLC Power is routed from LP-430, CKT-20 to the PLC power supply inside PLC-HHCS-1 as shown in drawing EB1029.

ICD-PWR-BOS-006: The voltage is 120 VAC and the current of 15A and is interfaced using wire connections as shown in drawings EB1029 and 6000-B-52119-PL.

4.3.4. Power – Medium Temperature Water Skid

ICD-PWR-BO y 480V 400A 3 phase CU B

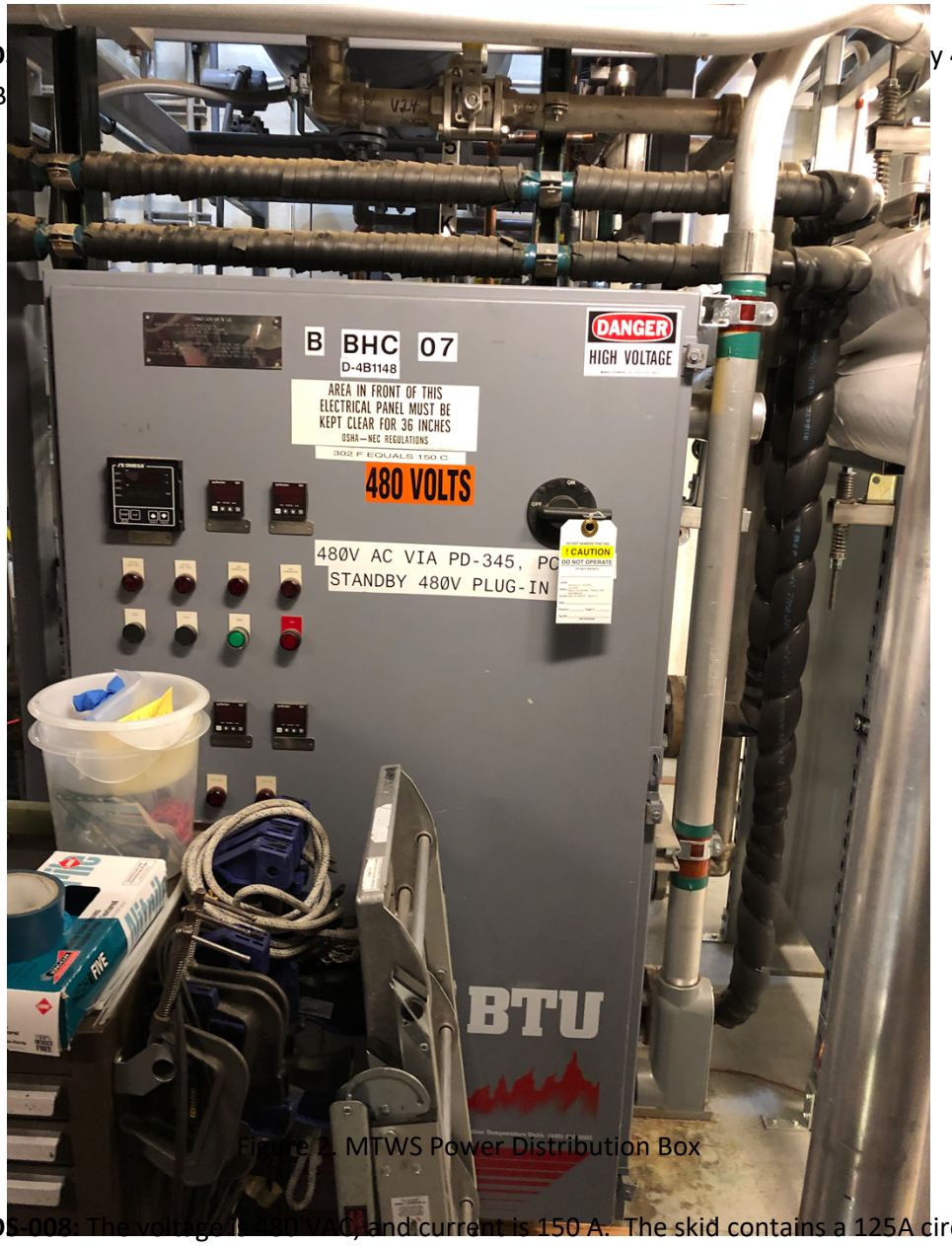


Figure 2. MTWS Power Distribution Box

ICD-PWR-BOS-008: The voltage is 480 VAC, and current is 150 A. The skid contains a 125A circuit breaker.

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 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.