National Synchrotron Light Source II, Brookhaven National Laboratory			
Doc No. PS-C-XFD-PRC-057	Author: T. McDonald	Effective Date: 06May2016 Review Frequency: 3 yrs	Version 1
Title: Beamline 4-ID Radiological Interlock Test			Technical

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VERSION HISTORY LOG

VERSION	DESCRIPTION	DATE
1	First Issue.	06May2016

ACRONYMS

ABM	Authorization Basis Manager	MCR	Main Control Room
ASE	Accelerator Safety Envelope	Neg	Negative
BNL	Brookhaven National Laboratory	NSLS-II	National Synchrotron Light Source II
ES	Emergency Stop	P	Pentant
ESH	Environment, Safety and Health	Pos	Positive
FE	Front End	PS	Power Supply
FOE	First Optical Enclosure	PPS	Personnel Protection System
FRM	First Optical Enclosure Radiation Monitor	R	Right
FR	Front Right	RF	Radio Frequency
GPM	Gallons Per Minute	SAF	Safety Approval Form
HMI	Human Machine Interface	SB	Search Button
HVPS	High Voltage Power Supply	SBE	Search Button External
ID	Insertion Device	SBMS	Standards Based Management System
I/O	Input/Output	SR	Storage Ring
LED	Light Emitting Diode	SS	Safety Shutter
LOTO	Lockout/Tagout	STA	Safety Test Amplifier

1 PURPOSE AND SCOPE

The purpose of this procedure is to provide instructions for testing and certifying the radiological interlock system for the BNL NSLS-II Beamline 4-ID. The system will be re-tested every six months, in accordance with the SBMS Program Description: *Radiological Control Manual* and SBMS Subject Area, *Interlock Safety for High Risk Hazards*. Certification shall be completed sometime during, but no later than, the last day of the calendar month in which it is due. Any beamline PPS system going beyond the last day of the month in which it is due will be disabled by ESH Staff using Centrally Controlled LOTO until certification is complete. Testing will also be required after a change in wiring, components, or programming in accordance with PS-ESH-PRM-3.4.1, *Procedure for Safety System Work Permits* and the guidelines for certification specified in PS-C-ASD-SPC-SR-PPS-001, *Storage Ring Personnel Protection System (SPPS) Design Description* and PS-C-XFD-SPC-PPS-001, *Beamline Personnel Protection System (BLPPS) and Front End Personnel Protection System Design Description*. Changes to the system shall be performed in accordance with PS-C-ASD-PRC-057, *NSLS-II PPS Configuration Management*.

2 DEFINITIONS

None.

3 RESPONSIBILITIES

3.1 Testers

3.1.1 Coordinate and perform radiological interlock certification testing.

3.1.2 Delegate radiological interlock testing step actions to personnel acting as Assistants.

3.1.3 Complete attached test checklist as required.

3.2 Assistants

3.2.1 Assist the Tester in performing the interlock test step actions when directed by the Tester.

3.2.2 Report all radiological interlock test observations to the Tester.

3.3 Accelerator Safety Systems Engineers and Technicians

3.3.1 Provide technical support throughout testing.

3.4 Primary Authorized Employees

3.4.1 Apply LOTO in accordance with this procedure.

3.5 Qualified Beamline Staff

3.5.1 Assist with the test of the PPS Aperture.

3.6 Configuration Management Specialist

3.6.1 Posts completed test checklists on the SharePoint Document Center.

4 PREREQUISITES

4.1 At least one Tester shall be ESH Staff.

4.2 Assistants shall be designated by the Testers.

4.3 A Mechanical Engineering Review has been completed for all hutch door switches to ensure proper positioning.

5 PRECAUTIONS AND LIMITATIONS

5.1 All steps in this procedure that require LOTO of systems/equipment for servicing and maintenance activities shall be performed in accordance with SBMS Subject Area, *Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance*.

5.2 All steps in this procedure that require LOTO for any purpose other than servicing and maintenance shall be performed in accordance with PS-C-ASD-PRC-005, *Centrally Controlled Lockout/Tagout (LOTO) Procedure*.

5.3 Mufflers shall be used to reduce noise during testing by placing them on the sounders.

5.4 The radiological interlock systems for the facility are a credited control in accordance with the ASE. Any deviation or discrepancy from an expected test result may be a violation of the ASE and shall be reported to the ABM as soon as practical.

5.5 All steps in the test checklist that require a beamline search shall be performed in accordance with PS-C-XFD-PRC-010, *Beamline Enclosure Search and Secure and Breaking Security Procedure.*

5.6 All configuration control checklists, commissioning approval forms and SAFs for Beamline 4-ID shall be voided prior to the start of certification testing.

6 PROCEDURE

6.1 Test and Certify Radiological Interlocks

Note: Two Testers are required to test and certify Beamline 4-ID radiological interlocks.

6.1.1 Testers notify the Lead Operator and the Lead Beamline Scientist that a test of the Beamline 4-ID radiological interlocks will be performed.

6.1.2 Testers obtain the Beamline 4-ID enable key and Beamline PPS reset key from the Control Room.

Note: LOTO may be applied to other pieces of equipment such as: injection shutters, bending magnet power supplies, linac PPS enable switch, booster PPS enable switch or SR PPS enable switches that offer an equivalent amount of protection. Live testing will require the LOTO listed in 6.1.3 and 6.1.4.

6.1.3 Primary Authorized Employee applies LOTO to the following:

- Gun HVPS output cable connector in accordance with SBMS Subject Area, *Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance* to ensure no signal output to the electron gun cage
- Three linac modulator power supply line cords OR Booster Dipole F Power Supply in accordance with SBMS Subject Area, *Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance*
- Booster RF HVPS OR Booster low level RF drive termination in accordance with PS-C-ASD-PRC-047, *NSLS-II Booster Ring Radio Frequency System High Voltage Power Supply (BR-HVPS) Lockout/Tagout (LOTO)*
- SR System "C" low level RF drive termination OR SR System "C" RF output connection to cavity in accordance with SBMS Subject Area,

Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance

- SR System "D" low level RF drive termination OR SR System "D" RF output connection to cavity in accordance with SBMS Subject Area, *Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance*

6.1.4 Tester applies LOTO to each of the following in accordance with PS-C-ASD-PRC-005, *Centrally Controlled Lockout/Tagout (LOTO) Procedure:*

- Gun HVPS output cable connector
- Three linac modulator power supply line cords OR Booster Dipole F Power Supply
- Booster RF HVPS OR Booster low level RF drive termination
- SR System "C" low level RF drive termination OR SR System "C" RF output connection to cavity
- SR System "D" low level RF drive termination OR SR System "D" RF output connection to cavity

Note: With the exception of LOTO checklist items, checklist items (i.e., tests) specified in Attachment A, *NSLS-II Beamline 4-ID Radiological Interlock Test Checklist* may be performed without all of the specified checklist items (i.e., partial radiological interlock test).

6.1.5 Testers use Attachment A, *NSLS-II Beamline 4-ID Radiological Interlock Test Checklist* to test and certify the radiological interlocks.

a. IF the correct corresponding observation has been made, THEN make a checkmark (✓) for each step.

b. IF any step results in an undesired event or outcome, THEN contact the Accelerator Safety Systems Engineer and/or Technician.

c. IF the undesired outcome or event requires a change to wiring, components, or programming, THEN make a checkmark (✓) in the Test Result "Failed" box at the top of the checklist.

d. IF the checklist is fully completed with desirable outcomes, THEN make a checkmark (✓) in the Test Result "Passed" box at the top of the checklist.

6.1.6 Testers notify the Lead Operator that the test of the NSLS-II Beamline 4-ID radiological interlocks is completed and the resulting outcome (i.e., Passed or Failed).

6.1.7 Testers remove LOTO from each of the following in accordance with PS-C-ASD-PRC-005, *Centrally Controlled Lockout/Tagout (LOTO) Procedure:*

- Gun HVPS output cable connector
- Three linac modulator power supply line cords OR Booster Dipole F Power Supply
- Booster RF HVPS OR Booster low level RF drive termination
- SR System "C" low level RF drive termination OR SR System "C" RF output connection to cavity
- SR System "D" low level RF drive termination OR SR System "D" RF output connection to cavity

6.1.8 Testers ensure all Beamline PPS cabinets are secure and locked.

6.1.9 Testers return the Beamline 4-ID enable key and the Beamline PPS reset key to the Control Room.

6.1.10 Testers notify Primary Authorized Employees for each of the following systems that interlock testing is complete AND removal of LOTO may be performed:

- Gun HVPS output cable connector
- Three linac modulator power supply line cords OR Booster Dipole F Power Supply
- Booster RF HVPS OR Booster low level RF drive termination
- SR System "C" low level RF drive termination OR SR System "C" RF output connection to cavity
- SR System "D" low level RF drive termination OR SR System "D" RF output connection to cavity

6.1.11 Testers provide the completed test checklist to the Configuration Management Specialist for posting on the SharePoint Document Center.

REFERENCES

7.1 PS-C-ASD-PRC-005, *Centrally Controlled Lockout/Tagout (LOTO) Procedure*

7.2 PS-C-ASD-PRC-008, *NSLS-II Area Radiation Monitor PPS Test*

7.3 PS-C-ASD-PRC-047, *NSLS-II Booster Ring Radio Frequency System High Voltage Power Supply (BR-HVPS) Lockout/Tagout (LOTO)*

7.4 PS-C-ASD-PRC-057, *NSLS-II PPS Configuration Management*

7.5 PS-ESH-PRM-3.4.1, *Procedure for Safety System Work Permits*

7.6 PS-C-XFD-PRC-010, *Beamline Enclosure Search and Secure and Breaking Security Procedure*

7.7 SBMS Program Description: *Radiological Control Manual*

7.8 SBMS Subject Area, *Interlock Safety for High Risk Hazards*

7.9 SBMS Subject Area, *Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance*

7.10 PS-C-CMD-PRC-002, *Records Management Procedure*

7.11 PS-C-ASD-SPC-SR-PPS-001, *Storage Ring Personnel Protection System (SPPS) Design Description*

7.12 PS-C-XFD-SPC-PPS-001, *Beamline Personnel Protection System (BLPPS) and Front End Personnel Protection System Design Description*

8 ATTACHMENTS

Attachment A, *NSLS-II Beamline 4-ID Radiological Interlock Test Checklist*

Attachment B, *NSLS-II 4-ID Beamline PPS Equipment Photos*

9 DOCUMENTATION

The following document is generated as a result of this procedure, and shall be maintained in accordance with PS-C-CMD-PRC-002, *Records Management Procedure*:

- Completed NSLS-II Beamline 4-ID Radiological Interlock Test Checklists

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Attachment A

NSLS-II Beamline 4-ID Radiological Interlock Test Checklist

Test Reason:	Test Result: ☐ Passed ☐ Failed		
	Test Type: ☐Pre-Certification	☐Certification	☐ Partial
Test Date:	Start Time:	Finish Time:	
Tester 1:	Assistant 1:		
Tester 2:	Assistant 2:		
Tester 1 Signature:	Tester 2 Signature:		
*Reviewer 1:	Reviewer 1 sig.:		
Reviewer 2:	Reviewer 2 sig.:		
** Safety Signature 4-ID (Beamline HMI) A Chain: B Chain:	Previous 4-ID SS# Date: / / A Chain: B Chain:		
** Safety Signature Pentant 2 Beamline (SR HMI) A Chain: B Chain:	Previous Pentant 2 SS# Date: / / A Chain: B Chain:		

* A review by an Accelerator Safety Systems Engineer and a designated specialist (Reviewer 2) is only required upon a Test failure.
**If Current Safety Signature number (found in top left corner on HMI) is different from previous number, contact the Accelerator Safety Systems Cognizant Engineer.

PREPARATION:

I.	All hutch door switches have been evaluated by Mechanical Engineering for proper positioning	
II.	Inform Control Room Lead Operator that testing will be done	
III.	Obtain Beamline enable and PPS reset keys from Control Room	
IV.	Verify that beamline vacuum and water interlocks are satisfied	
V.	Place muffler on beam imminent sounder	
VI.	Request Lead Operator enable Master shutters	

A1 ***Verify System Lockouts***

Gun HVPS output cable connector ____

Linac modulator line cords (3) OR Booster Dipole F PS 480 V ____

Booster RF HVPS 480 V OR Booster low level RF drive termination ____

SR System C low level RF drive termination OR SR System C RF output connection to cavity ____

SR System D low level RF drive termination OR SR System D RF output connection to cavity ____

A2 ***Verify Search and Time Beam Imminent Alarm***

Repeat steps for each 4-ID Hutch

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	A	B	C	D
Verify that search path is free from obstacles and line of sight is clear in search mirrors in accordance with PS-C-XFD-PRC-010, *Beamline Enclosure Search and Secure and Breaking Security Procedure*	____	____	____	____
Close all hutch secondary doors	____	____	____	____
"Entry Permitted" signs ON (2 signs on A and D)	____	____	____	____
Using the keypad, lock the closed doors	____	____	____	____
Press SB1	____	____	____	____
SB1 illuminates	____	____	____	____
Search sounder sounds	____	____	____	____
Search yellow beacon flashing	____	____	____	____
Press SB2	____		____	____
SB2 illuminates	____		____	____
Exit hutch and close main door	____	____	____	____
*Press SBE and **begin timing***	____	____	____	____
Beam imminent alarm sounds for 30 seconds	____	____	____	____
After warning, (FOE, B, C, D) Interlocked A and B ON (**green**), HMI	____	____	____	____
"Interlocked" signs ON (2 signs on A and D)	____	____	____	____
Maglock A and B ON (**green**), all doors, HMI	____	____	____	____
Press the SBE/Access Button	____	____	____	____
"Interlocked" signs OFF, "Entry Permitted" signs are ON	____	____	____	____
FOE, B, C, D Interlocked A and B OFF, HMI	____	____	____	____
Maglock A OFF (may require opening Maglock on key pad)	____	____	____	____
Open door	____	____	____	____
Door opens, Maglock B OFF door	____	____	____	____

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A3 ***Out of Sequence Search***

Repeat steps for each 4-ID hutch (B hutch has only one interior SB)	**A**		**C**	**D**
Press SB2	____		____	____
SB2 does not illuminate	____		____	____
Press SB1	____		____	____
SB1 illuminates	____		____	____
Close hutch door and press SBE	____		____	____
Hutch does NOT secure	____		____	____

A4 ***Search Timeout***

Repeat steps for each 4-ID hutch	**A**	**B**	**C**	**D**
*Press first search button and **begin timing***	____	____	____	____
*Complete search **without pressing Final Search button***	____	____	____	____
Search sounders off in 2 minutes	____	____	____	____
Press Final Search button	____	____	____	____
Search does not complete	____	____	____	____

A5 ***Shutter Enable***

Place actuators on FOE door switches and attach Maglock devices		____
	Beamline Online A and B OFF	____
Enable beamline with key and perform a reset	Beamline Online A and B ON (**green**)	____
Search the FOE	FE Shutter Permits A and B ON ***after*** Beam Imminent Warning	____
Open FE shutters	FE Shutters A and B indicate open (**green**)	____
	2 "Beam On" signs are ON	____
Close FE shutters	FE Shutters A and B indicate closed (**red**)	____

A6 ***Emergency Stops (ES) FOE (A hutch)***

For each ES search hutch	**ES1**	**ES2**	**ES3**	**ES4**
Open FE Shutters from keypad	____	____	____	____
FE Shutters A and B open (**green**)	____	____	____	____
FOE Interlocked A and B ON (**green**)	____	____	____	____
FE Shutter Permit A and B ON (**green**)	____	____	____	____
FE Critical Device Permits A and B ON	____	____	____	____
Upstream Right Maglock A ON (**green**)	____	____	____	____

					____
	Upstream Left Maglock A ON (**green**)	____	____	____	____
	Downstream Right Maglock A ON (**green**)	____	____	____	____
	Downstream Left Maglock A ON (**green**)	____	____	____	____
	Press ES	____	____	____	____
	FE Shutters A and B closed (**red**)	____	____	____	____
	FOE Interlocked A and B OFF	____	____	____	____
	FE Shutter Permit A and B OFF	____	____	____	____
	FE Critical Device Permits A and B OFF	____	____	____	____
	Upstream Right Maglock A OFF	____	____	____	____
	Upstream Left Maglock A OFF	____	____	____	____
	Downstream Right Maglock A OFF	____	____	____	____
	Downstream Left Maglock A OFF	____	____	____	____
	Pull out ES	____	____	____	____
	ES Sum Latch OFF	____	____	____	____
	Reset fault	____	____	____	____
	ES Sum Latch ON (**green**)	____	____	____	____
A7	***Emergency Stops (ES) B Hutch***				
	For each ES search hutch	**ES1**	**ES2**	**ES3**	
	Open FE and L1S1 Shutters from keypad	____	____	____	
	FE Shutters A and B open (**green**)	____	____	____	
	L1S1 Shutter A and B open (**green**)	____	____	____	
	B Interlocked A and B ON (**green**)	____	____	____	
	L1S1 Shutter Permit A and B ON (**green**)	____	____	____	
	FE Critical Device Permits A and B ON	____	____	____	
	Right Maglock ON A and B (**green**)	____	____	____	
	Press ES	____	____	____	
	FE Shutters A and B closed (**red**)	____	____	____	
	L1S1 Shutter A and B closed (**red**)	____	____	____	
	B Interlocked A and B OFF	____	____	____	
	L1S1 Shutter Permit A and B OFF	____	____	____	
	FE Critical Device Permits A and B OFF	____	____	____	
	Rear Maglock A OFF	____	____	____	

		____	____	____	
	Pull out ES	____	____	____	
	ES Sum Latch OFF	____	____	____	
	Reset fault	____	____	____	
	ES Sum Latch ON (**green**)	____	____	____	
A8	***Emergency Stops (ES) C Hutch***				
	For each ES search hutch. Beam stop is closed	**ES1**	**ES2**	**ES3**	**ES4**
	Open FE, L1S1 and L1S3 Shutters from keypad	____	____	____	____
	FE Shutters A and B open (**green**)	____	____	____	____
	L1S3 Shutter A and B open (**green**)	____	____	____	____
	C Interlocked A and B ON (**green**)	____	____	____	____
	L1S3 Shutter Permit A and B ON (**green**)	____	____	____	____
	FE Critical Device Permits A and B ON	____	____	____	____
	Right Maglock ON A and B (**green**)	____	____	____	____
	Left Maglock ON A and B (**green**)	____	____	____	____
	Press ES	____	____	____	____
	FE Shutters A and B closed (**red**)	____	____	____	____
	L1S3 Shutter A and B closed (**red**)	____	____	____	____
	C Interlocked A and B OFF	____	____	____	____
	L1S3 Shutter Permit A and B OFF	____	____	____	____
	FE Critical Device Permits A and B OFF	____	____	____	____
	Right Maglock A OFF	____	____	____	____
	Left Maglock A OFF	____	____	____	____
	Pull out ES	____	____	____	____
	ES Sum Latch OFF	____	____	____	____
	Reset fault	____	____	____	____
	ES Sum Latch ON (**green**)	____	____	____	____
A9	***Emergency Stops (ES) D Hutch***				
	For each ES search hutch. Beam stop is open	**ES1**	**ES2**	**ES3**	**ES4**
	Open FE, L1S1and L1S3 Shutters from keypad	____	____	____	____
	FE Shutters A and B open (**green**)	____	____	____	____
	L1S3 Shutter A and B open (**green**)	____	____	____	____
	D Interlocked A and B ON (**green**)	____	____	____	____

L1S3 Shutter Permit A and B ON (**green**)				
FE Critical Device Permits A and B ON				
Front Right Maglock ON A and B (**green**)				
Front Left Maglock ON A and B (**green**)				
Rear Right Maglock ON A and B (**green**)				
Rear Left Maglock ON A and B (**green**)				
Press ES				
FE Shutters A and B closed (**red**)				
L1S3 Shutter A and B closed (**red**)				
D Interlocked A and B OFF				
L1S3 Shutter Permit A and B OFF				
FE Critical Device Permits A and B OFF				
Front Right Maglock A OFF				
Front Left Maglock A OFF				
Rear Right Maglock A OFF				
Rear Left Maglock A OFF				
Pull out ES				
ES Sum Latch OFF				
Reset fault				
ES Sum Latch ON (**green**)				

A10 ***Hutch A Labyrinth 1 Switches and Latches***

Place actuators on the labyrinth switches/latches and downstream left door switches and Maglock. ____

Check the corresponding Permits for each switch tested (e.g., A Permit for switch A1). Latch trips on both A and B Permits. **Note:** B chain reed and push button switches must be cycled together for reset.

	A1	A2	B1	B2	Latch
Search hutch	____	____	____	____	____
Open FE Shutters from keypad	____	____	____	____	____
FE Shutter A and B open (**green**)	____	____	____	____	____
FOE Interlocked A and B ON (**green**)	____	____	____	____	____
FE Shutter Permit A and B ON (**green**)	____	____	____	____	____
Cable Lab 1 Switch/Latch A and B ON (**green**)	____	____	____	____	____
FE Critical Device Permits A and B ON	____	____	____	____	____
Remove one switch actuator	____	____	____	____	____
Cable Lab 1 Switch/Latch Permit OFF	____	____	____	____	____
FOE Interlocked A and B OFF	____	____	____	____	____
FE Shutter Permit OFF	____	____	____	____	____
FE Shutter A and B closed (**red**)	____	____	____	____	____
FE Critical Device Permits A and B OFF	____	____	____	____	____
Replace switch actuator and reset fault	____	____	____	____	____
Remove labyrinth actuators and close labyrinth door					____

A11 ***Hutch B Labyrinth 1 Switches and Latches***

Place actuators on the labyrinth switches/latches and downstream left door switches and Maglock. ____

Check the corresponding Permits for each switch tested (e.g., A Permit for switch A1). Latch trips on both A and B Permits. **Note:** B chain reed and push button switches must be cycled together for reset.

	A1	A2	B1	B2	Latch
Search hutch	____	____	____	____	____
Open FE and L1S1 Shutters from keypad	____	____	____	____	____
L1S1 Shutter A and B open (**green**)	____	____	____	____	____
B Interlocked A and B ON (**green**)	____	____	____	____	____
L1S1 Shutter Permit A and B ON (**green**)	____	____	____	____	____
Cable Lab 1 Switch/Latch A and B ON (**green**)	____	____	____	____	____

FE Critical Device Permits A and B ON	____	____	____	____	____
Remove one switch actuator	____	____	____	____	____
Cable Lab 1 Switch/Latch Permit OFF	____	____	____	____	____
B Interlocked OFF	____	____	____	____	____
L1S1 Shutter Permit OFF	____	____	____	____	____
L1S1 Shutter A and B closed (**red**)	____	____	____	____	____
FE Critical Device Permits A and B OFF	____	____	____	____	____
Replace switch actuator and reset fault	____	____	____	____	____
Remove labyrinth actuators and close labyrinth door					____

A12 ***Hutch C Labyrinth 1 Switches and Latches***

Place actuators on the labyrinth switches/latches and downstream left door switches and Maglock. ____

Check the corresponding Permits for each switch tested (e.g., A Permit for switch A1). Latch trips on both A and B Permits. **Note:** B chain reed and push button switches must be cycled together for reset.

Beam stop is closed, D hutch not secure	**A1**	**A2**	**B1**	**B2**	**Latch**
Search hutch	____	____	____	____	____
Open FE, L1S1 and L1S3 Shutters from keypad	____	____	____	____	____
L1S3 Shutter A and B open (**green**)	____	____	____	____	____
C Interlocked A and B ON (**green**)	____	____	____	____	____
L1S3 Shutter Permit A and B ON (**green**)	____	____	____	____	____
Cable Lab 1 Switch/Latch A and B ON (**green**)	____	____	____	____	____
FE Critical Device Permits A and B ON	____	____	____	____	____
Remove one switch actuator	____	____	____	____	____
Cable Lab 1 Switch/Latch Permit OFF	____	____	____	____	____
C Interlocked OFF	____	____	____	____	____
L1S3 Shutter Permit OFF	____	____	____	____	____
L1S3 Shutter A and B closed (**red**)	____	____	____	____	____
FE Critical Device Permits A and B OFF	____	____	____	____	____
Replace switch actuator and reset fault	____	____	____	____	____
Remove labyrinth actuators and close labyrinth door					____

A13 ***Hutch D Labyrinth 1 Switches and Latches***

Place actuators on the labyrinth switches/latches and downstream left door switches and Maglock. ____

Check the corresponding Permits for each switch tested (e.g., A Permit for switch A1). Latch trips on both A and B Permits. **Note:** B chain reed and push button switches must be cycled together for reset.

Beam stop is open	**A1**	**A2**	**B1**	**B2**	**Latch**
Search hutch	____	____	____	____	____
Open FE, L1S1 and L1S3 Shutters from keypad	____	____	____	____	____
L1S3 Shutter A and B open (**green**)	____	____	____	____	____
D Interlocked A and B ON (**green**)	____	____	____	____	____
L1S3 Shutter Permit A and B ON (**green**)	____	____	____	____	____
Cable Lab 1 Switch/Latch A and B ON (**green**)	____	____	____	____	____
FE Critical Device Permits A and B ON	____	____	____	____	____
Remove one switch actuator	____	____	____	____	____
Cable Lab 1 Switch/Latch Permit OFF	____	____	____	____	____
D Interlocked OFF	____	____	____	____	____
L1S3 Shutter Permit OFF	____	____	____	____	____
L1S3 Shutter A and B closed (**red**)	____	____	____	____	____
FE Critical Device Permits A and B OFF	____	____	____	____	____
Replace switch actuator and reset fault	____	____	____	____	____
Remove labyrinth actuators and close labyrinth door					____

A14 ***Hutch D Labyrinth 2 Switches and Latches***

Place actuators on the labyrinth switches/latches and downstream left door switches and Maglock. ____

Check the corresponding Permits for each switch tested (e.g., A Permit for switch A1). Latch trips on both A and B Permits. **Note:** B chain reed and push button switches must be cycled together for reset.

Beam stop is open	**A1**	**A2**	**B1**	**B2**	**Latch**
Search hutch	____	____	____	____	____
Open FE, L1S1 and L1S3 Shutters from keypad	____	____	____	____	____
L1S3 Shutter A and B open (**green**)	____	____	____	____	____
D Interlocked A and B ON (**green**)	____	____	____	____	____
L1S3 Shutter Permit A and B ON (**green**)	____	____	____	____	____
Cable Lab 2 Switch/Latch A and B ON (**green**)	____	____	____	____	____

FE Critical Device Permits A and B ON	____	____	____	____	____
Remove one switch actuator	____	____	____	____	____
Cable Lab 2 Switch/Latch Permit OFF	____	____	____	____	____
D Interlocked OFF	____	____	____	____	____
L1S3 Shutter Permit OFF	____	____	____	____	____
L1S3 Shutter A and B closed (**red**)	____	____	____	____	____
FE Critical Device Permits A and B OFF	____	____	____	____	____
Replace switch actuator and reset fault	____	____	____	____	____
Remove labyrinth actuators and close labyrinth door					____

A15 ***FOE Upstream Right Door Switches***

Place actuators on the door switches and Maglock. ____

Check the corresponding Permits for each switch tested (e.g., A Permit for switch A1).

	A1	**A2**	**B1**	**B2**	**Reed**
Search hutch	____	____	____	____	____
Open FE Shutters from keypad	____	____	____	____	____
FE Shutters A and B open (**green**)	____	____	____	____	____
FOE Interlocked A and B ON (**green**)	____	____	____	____	____
FE Shutter Permit A and B ON (**green**)	____	____	____	____	____
FOE Door Switch Sum A and B ON (**green**)	____	____	____	____	____
FE Critical Device Permits A and B ON	____	____	____	____	____
Remove one switch actuator	____	____	____	____	____
FE Shutters A and B closed (**red**)	____	____	____	____	____
FOE Interlocked OFF	____	____	____	____	____
FE Shutter Permit OFF	____	____	____	____	____
FOE Door Switch Sum OFF	____	____	____	____	____
FE Critical Device Permits A and B OFF	____	____	____	____	____
Replace switch actuator and reset fault	____	____	____	____	____
Remove actuators and close door					____

A16 ***FOE Upstream Left Door Switches***

Place actuators on the door switches and Maglock. ____

Check the corresponding permits for each switch tested (e.g., A Permit for switch A1).

	A1	**A2**	**B1**	**B2**	**Reed**

Search hutch	____	____	____	____	____
Open FE Shutters from keypad	____	____	____	____	____
FE Shutters A and B open (**green**)	____	____	____	____	____
FOE Interlocked A and B ON (**green**)	____	____	____	____	____
FE Shutter Permit A and B ON (**green**)	____	____	____	____	____
FOE Door Switch Sum A and B ON (**green**)	____	____	____	____	____
FE Critical Device Permits A and B ON	____	____	____	____	____
Remove one switch actuator	____	____	____	____	____
FE Shutters A and B closed (**red**)	____	____	____	____	____
FOE Interlocked OFF	____	____	____	____	____
FE Shutter Permit OFF	____	____	____	____	____
FOE Door Switch Sum OFF	____	____	____	____	____
FE Critical Device Permits A and B OFF	____	____	____	____	____
Replace switch actuator and reset fault	____	____	____	____	____
Remove actuators and close door					____

A17 ***FOE Downstream Right Door Switches***

Place actuators on the door switches and Maglock. ____

Check the corresponding permits for each switch tested (e.g., A Permit for switch A1).

	A1	**A2**	**B1**	**B2**	**Reed**
Search hutch	____	____	____	____	____
Open FE Shutters from keypad	____	____	____	____	____
FE Shutters A and B open (**green**)	____	____	____	____	____
FOE Interlocked A and B ON (**green**)	____	____	____	____	____
FE Shutter Permit A and B ON (**green**)	____	____	____	____	____
FOE Door Switch Sum A and B ON (**green**)	____	____	____	____	____
FE Critical Device Permits A and B ON	____	____	____	____	____
Remove one switch actuator	____	____	____	____	____
FE Shutters A and B closed (**red**)	____	____	____	____	____
FOE Interlocked OFF	____	____	____	____	____

FE Shutter Permit OFF	____	____	____	____	____
FOE Door Switch Sum OFF	____	____	____	____	____
FE Critical Device Permits A and B OFF	____	____	____	____	____
Replace switch actuator and reset fault	____	____	____	____	____
Remove actuators and close door					____

A18 ***FOE Downstream Left Door Switches***

Place actuators on the door switches and Maglock. ____

Check the corresponding permits for each switch tested (e.g., A Permit for switch A1).

	A1	**A2**	**B1**	**B2**	**Reed**
Search hutch	____	____	____	____	____
Open FE Shutters from keypad	____	____	____	____	____
FE Shutters A and B open (**green**)	____	____	____	____	____
FOE Interlocked A and B ON (**green**)	____	____	____	____	____
FE Shutter Permit A and B ON (**green**)	____	____	____	____	____
FOE Door Switch Sum A and B ON (**green**)	____	____	____	____	____
FE Critical Device Permits A and B ON	____	____	____	____	____
Remove one switch actuator	____	____	____	____	____
FE Shutters A and B closed (**red**)	____	____	____	____	____
FOE Interlocked OFF	____	____	____	____	____
FE Shutter Permit OFF	____	____	____	____	____
FOE Door Switch Sum OFF	____	____	____	____	____
FE Critical Device Permits A and B OFF	____	____	____	____	____
Replace switch actuator and reset fault	____	____	____	____	____
Remove actuators and close door					____

A19 ***B Hutch Right Door Switches***

Place actuators on the door switches and Maglock. ____

Check the corresponding permits for each switch tested (e.g., A Permit for switch A1).

		A1	A2	B1	B2	Reed
	Search hutch	____	____	____	____	____
	Open FE and L1S1 Shutters from keypad	____	____	____	____	____
	FE Shutters A and B open (**green**)	____	____	____	____	____
	L1S1 Shutter A and B open (**green**)	____	____	____	____	____
	B Interlocked A and B ON (**green**)	____	____	____	____	____
	L1S1 Shutter Permit A and B ON (**green**)	____	____	____	____	____
	B Door Switch Sum A and B ON (**green**)	____	____	____	____	____
	FE Critical Device Permits A and B ON	____	____	____	____	____
	Remove one switch actuator	____	____	____	____	____
	L1S1 Shutter A and B closed (**red**)	____	____	____	____	____
	B Interlocked OFF	____	____	____	____	____
	L1S1 Shutter Permit OFF	____	____	____	____	____
	B Door Switch Sum Permit OFF	____	____	____	____	____
	FE Critical Device Permits A and B OFF	____	____	____	____	____
	Replace switch actuator and reset fault	____	____	____	____	____
	Remove actuators and close door					____
A20	***C Hutch Right Door Switches***					
	Place actuators on the door switches and Maglock.					____
	Check the corresponding permits for each switch tested (e.g., A Permit for switch A1).					
	Beam stop is closed, D hutch not secure	**A1**	**A2**	**B1**	**B2**	**Reed**
	Search hutch	____	____	____	____	____
	Open FE, L1S1 and L1S3 Shutters from keypad	____	____	____	____	____
	FE Shutters A and B open (**green**)	____	____	____	____	____
	L1S3 Shutter A and B open (**green**)	____	____	____	____	____
	C Interlocked A and B ON (**green**)	____	____	____	____	____
	L1S3 Shutter Permit A and B ON (**green**)	____	____	____	____	____
	C Door Switch Sum A and B ON (**green**)	____	____	____	____	____
	FE Critical Device Permits A and B ON	____	____	____	____	____
	Remove one switch actuator	____	____	____	____	____

L1S3 Shutter A and B closed (**red**)	____	____	____	____	____
C Interlocked OFF	____	____	____	____	____
L1S3 Shutter Permit OFF	____	____	____	____	____
C Door Switch Sum Permit OFF	____	____	____	____	____
FE Critical Device Permits A and B OFF	____	____	____	____	____
Replace switch actuator and reset fault	____	____	____	____	____
Remove actuators and close door					____

A21 ***C Hutch Left Door Switches***

Place actuators on the door switches and Maglock. ____

Check the corresponding permits for each switch tested (e.g., A Permit for switch A1).

Beam stop is closed, D hutch not secure	**A1**	**A2**	**B1**	**B2**	**Reed**
Search hutch	____	____	____	____	____
Open FE, L1S1 and L1S3 Shutters from keypad	____	____	____	____	____
FE Shutters A and B open (**green**)	____	____	____	____	____
L1S3 Shutter A and B open (**green**)	____	____	____	____	____
C Interlocked A and B ON (**green**)	____	____	____	____	____
L1S3 Shutter Permit A and B ON (**green**)	____	____	____	____	____
C Door Switch Sum A and B ON (**green**)	____	____	____	____	____
FE Critical Device Permits A and B ON	____	____	____	____	____
Remove one switch actuator	____	____	____	____	____
L1S3 Shutter A and B closed (**red**)	____	____	____	____	____
C Interlocked OFF	____	____	____	____	____
L1S3 Shutter Permit OFF	____	____	____	____	____
C Door Switch Sum Permit OFF	____	____	____	____	____
FE Critical Device Permits A and B OFF	____	____	____	____	____
Replace switch actuator and reset fault	____	____	____	____	____
Remove actuators and close door					____

A22 ***Beam Stop***

Place actuators on the beam stop switches and latch. ____

Check the corresponding permits for each switch tested (e.g., A Permit for switch A1).

Search FOE, B and C hutches; D hutch not secured	**A1**	**B1**	**Latch**	
Open FE, L1S1 and L1S3 Shutters	____	____	____	
FE Shutters A and B open (**green**)	____	____	____	
FE Critical Device Permits A and B ON	____	____	____	
L1S3 Shutter A and B open (**green**)	____	____	____	
Beam Stop indicates Open (**green**)	____	____	____	
C Interlocked A and B ON (**green**)	____	____	____	
L1S3 Shutter Permit A and B ON (**green**)	____	____	____	
Remove one actuator	____	____	____	
Beam Stop Does Not indicate Open	____	____	____	
L1S3 Shutter A and B closed (**red**)	____	____	____	
L1S3 Shutter Permit OFF	____	____	____	
FE Critical Device Permits A and B OFF	____	____	____	
Replace switch actuator and reset fault	____	____	____	
Remove actuators and close beam stop				____

A23 ***D Hutch Front Right Door Switches***

Place actuators on the door switches and Maglock. ____

Check the corresponding permits for each switch tested (e.g., A Permit for switch A1).

Open beam stop, C hutch secure	**A1**	**A2**	**B1**	**B2**	**Reed**
Search hutch	____	____	____	____	____
Open FE, L1S1 and L1S3 Shutters from keypad	____	____	____	____	____
FE Shutters A and B open (**green**)	____	____	____	____	____
L1S3 Shutter A and B open (**green**)	____	____	____	____	____
D Interlocked A and B ON (**green**)	____	____	____	____	____
L1S3 Shutter Permit A and B ON (**green**)	____	____	____	____	____
D Door Switch Sum A and B ON (**green**)	____	____	____	____	____
FE Critical Device Permits A and B ON	____	____	____	____	____
Remove one switch actuator	____	____	____	____	____

L1S3 Shutter A and B closed (**red**)	____	____	____	____	____
D Interlocked OFF	____	____	____	____	____
L1S3 Shutter Permit OFF	____	____	____	____	____
D Door Switch Sum Permit OFF	____	____	____	____	____
FE Critical Device Permits A and B OFF	____	____	____	____	____
Replace switch actuator and reset fault	____	____	____	____	____
Remove actuators and close door					____

A24 ***D Hutch Front Left Door Switches***

Place actuators on the door switches and Maglock. ____

Check the corresponding permits for each switch tested (e.g., A Permit for switch A1).

Open beam stop, C hutch secure	**A1**	**A2**	**B1**	**B2**	**Reed**
Search hutch	____	____	____	____	____
Open FE, L1S1and L1S3 Shutters from keypad	____	____	____	____	____
FE Shutters A and B open (**green**)	____	____	____	____	____
L1S3 Shutter A and B open (**green**)	____	____	____	____	____
D Interlocked A and B ON (**green**)	____	____	____	____	____
L1S3 Shutter Permit A and B ON (**green**)	____	____	____	____	____
D Door Switch Sum A and B ON (**green**)	____	____	____	____	____
FE Critical Device Permits A and B ON	____	____	____	____	____
Remove one switch actuator	____	____	____	____	____
L1S3 Shutter A and B closed (**red**)	____	____	____	____	____
D Interlocked OFF	____	____	____	____	____
L1S3 Shutter Permit OFF	____	____	____	____	____
D Door Switch Sum Permit OFF	____	____	____	____	____
FE Critical Device Permits A and B OFF	____	____	____	____	____
Replace switch actuator and reset fault	____	____	____	____	____
Remove actuators and close door					____

A25 ***D Hutch Rear Right Door Switches***

Place actuators on the door switches and Maglock. ____

Check the corresponding permits for each switch tested (e.g., A Permit for switch A1).

	A1	A2	B1	B2	Reed
Open beam stop, C hutch secure					
Search hutch	____	____	____	____	____
Open FE, L1S1 and L1S3 Shutters from keypad	____	____	____	____	____
FE Shutters A and B open (**green**)	____	____	____	____	____
L1S3 Shutter A and B open (**green**)	____	____	____	____	____
D Interlocked A and B ON (**green**)	____	____	____	____	____
L1S3 Shutter Permit A and B ON (**green**)	____	____	____	____	____
D Door Switch Sum A and B ON (**green**)	____	____	____	____	____
FE Critical Device Permits A and B ON	____	____	____	____	____
Remove one switch actuator	____	____	____	____	____
L1S3 Shutter A and B closed (**red**)	____	____	____	____	____
D Interlocked OFF	____	____	____	____	____
L1S3 Shutter Permit OFF	____	____	____	____	____
D Door Switch Sum Permit OFF	____	____	____	____	____
FE Critical Device Permits A and B OFF	____	____	____	____	____
Replace switch actuator and reset fault	____	____	____	____	____
Remove actuators and close door					____

A26 ***D Hutch Rear Left Door Switches***

Place actuators on the door switches and Maglock. ____

Check the corresponding permits for each switch tested (e.g., A Permit for switch A1).

	A1	A2	B1	B2	Reed
Open beam stop, C hutch secure					
Search hutch	____	____	____	____	____
Open FE, L1S1 and L1S3 Shutters from keypad	____	____	____	____	____
FE Shutters A and B open (**green**)	____	____	____	____	____
L1S3 Shutter A and B open (**green**)	____	____	____	____	____
D Interlocked A and B ON (**green**)	____	____	____	____	____
L1S3 Shutter Permit A and B ON (**green**)	____	____	____	____	____
D Door Switch Sum A and B ON (**green**)	____	____	____	____	____
FE Critical Device Permits A and B ON	____	____	____	____	____
Remove one switch actuator	____	____	____	____	____

L1S3 Shutter A and B closed (**red**)	____	____	____	____	____
D Interlocked OFF	____	____	____	____	____
L1S3 Shutter Permit OFF	____	____	____	____	____
D Door Switch Sum Permit OFF	____	____	____	____	____
FE Critical Device Permits A and B OFF	____	____	____	____	____
Replace switch actuator and reset fault	____	____	____	____	____
Remove actuators and close door					____

A27 ***Magnetic Lock Test (FOE)***

Connect the FOE test box (Attachment B Figure B4) to the PPS cabinet (Attachment B Figure B7). Use the box to turn ON the Maglocks (set switches to "Normal"). ____

Repeat steps for each door: Upstream Right (USR), Upstream Left (USL), Downstream Right (DSR) and Downstream Left (DSL).

	USR	**USL**	**DSR**	**DSL**
Search hutch	____	____	____	____
FOE Interlocked A and B ON (**green**)	____	____	____	____
FE Shutter Permit A and B ON (**green**)	____	____	____	____
Door Maglock A and B ON (**green**)	____	____	____	____
Open FE Shutters	____	____	____	____
FE Shutters open (**green**)	____	____	____	____
Using FOE test box, turn OFF Maglock	____	____	____	____
Door Maglock A OFF	____	____	____	____
FOE Shutters closed (**red**)	____	____	____	____
FOE Interlocked A OFF	____	____	____	____
FE Shutter Permit A OFF	____	____	____	____
Turn On Maglock and reset fault	____	____	____	____
Search hutch	____	____	____	____
Using FE Shutter test fixture, Open FE Shutters	____	____	____	____
FE Critical Device Permits A and B ON	____	____	____	____
Using FOE test box, turn OFF Maglock	____	____	____	____
Within 3 seconds: FE Critical Devices Permits A Chain OFF	____	____	____	____
Reset fault	____	____	____	____
Disconnect FOE test box				____

A28 ***Magnetic Lock Test (B Hutch)***

Connect the FOE test box (Attachment B Figure B4) to the PPS cabinet (Attachment B Figure B7). Use the box to turn ON the Maglocks (set switches to "Normal"). ___

Complete steps for Right (R) door

	R
Search hutch	___
B Interlocked A and B ON (**green**)	___
L1S1 Shutter Permit A and B ON (**green**)	___
Door Maglock A and B ON (**green**)	___
Open FE and L1S1 Shutters	___
Shutters open (**green**)	___
Using FOE test box, turn OFF Maglock	___
Door Maglock A OFF	___
Shutters closed (**red**)	___
B Interlocked A OFF	___
L1S1 Shutter Permit A OFF	___
Turn On Maglock and reset fault	___
Search hutch	___
Using FE Shutter test fixture, Open FE Shutters	___
FE Critical Device Permits A and B ON	___
Using FOE test box, turn OFF Maglock	___
Within 3 seconds: FE Critical Devices Permits A Chain OFF	___
Disconnect FOE test box and reset fault	___

A29 ***Magnetic Lock Test (C Hutch)***

Connect the FOE test box (Attachment B Figure B4) to the PPS cabinet (Attachment B Figure B7). Use the box to turn ON the Maglocks (set switches to "Normal"). ___

Repeat steps for each door: Right (R), Left (L)

	R	**L**
Search hutch	___	___
C Interlocked A and B ON (**green**)	___	___
L1S3 Shutter Permit A and B ON (**green**)	___	___
Door Maglock A and B ON (**green**)	___	___
Open FE, L1S1 and L1S3 Shutters	___	___
Shutters open (**green**)	___	___

Using FOE test box, turn OFF Maglock ____ ____

Door Maglock A OFF ____ ____

Shutters Closed (**red**) ____ ____

C Interlocked A OFF ____ ____

L1S3 Shutter Permit A OFF ____ ____

Turn On Maglock and reset fault ____ ____

Search hutch ____ ____

Using FE Shutter test fixture, Open FE Shutters ____ ____

FE Critical Device Permits A and B ON ____ ____

Using FOE test box, turn OFF Maglock ____ ____

Within 3 seconds:

FE Critical Devices Permits A Chain OFF ____ ____

Reset fault ____ ____

Disconnect FOE test box and rese ____

A30 ***Magnetic Lock Test (D Hutch)***

Connect the FOE test box (Attachment B Figure B4) to the PPS cabinet (Attachment B Figure B7). Use the box to turn ON the Maglocks (set switches to "Normal"). ____

Repeat steps for each door: Front Right (FR), Front Left (FL), Rear Right (RR), Rear Left (RL)

Open beam stop	**FR**	**FL**	**RR**	**RL**
Search hutch	____	____	____	____
D Interlocked A and B ON (**green**)	____	____	____	____
L1S3 Shutter Permit A and B ON (**green**)	____	____	____	____
Door Maglock A and B ON (**green**)	____	____	____	____
Open FE, L1S1 and L1S3 Shutters	____	____	____	____
Shutters open (**green**)	____	____	____	____
Using FOE test box, turn OFF Maglock	____	____	____	____
Door Maglock A OFF	____	____	____	____
Shutters Closed (**red**)	____	____	____	____
D Interlocked A OFF	____	____	____	____
L1S3 Shutter Permit A OFF	____	____	____	____
Turn On Maglock and reset fault	____	____	____	____
Search hutch		____	____	____

	____	____	____
Using Shutter test fixture, Open FE Shutters	____	____	____
FE Critical Device Permits A and B ON	____	____	____
Using FOE test box, turn OFF Maglock	____	____	____
Within 3 seconds:	____	____	____
FE Critical Devices Permits A Chain OFF	____	____	____
Rest fault	____	____	____
Disconnect FOE test box			____

A31 ***Water Interlock***

Water flow meters are located on top of the hutch (Figure 1).

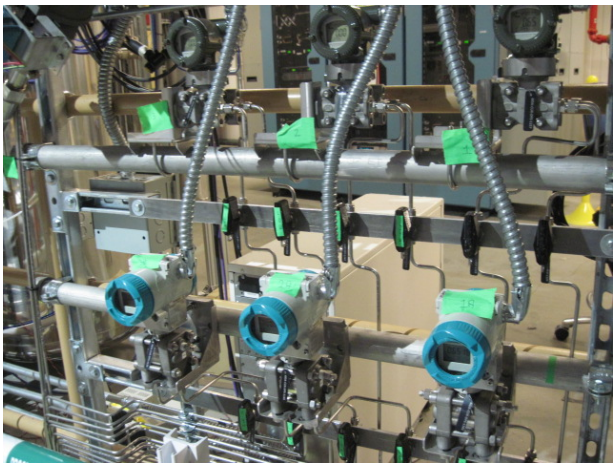

Figure 1: Water Meters

The PPS Water Safety Test Amplifiers (STA) are located in the cabinet to the upper right of the meters on top of the hutch (Figure 2).

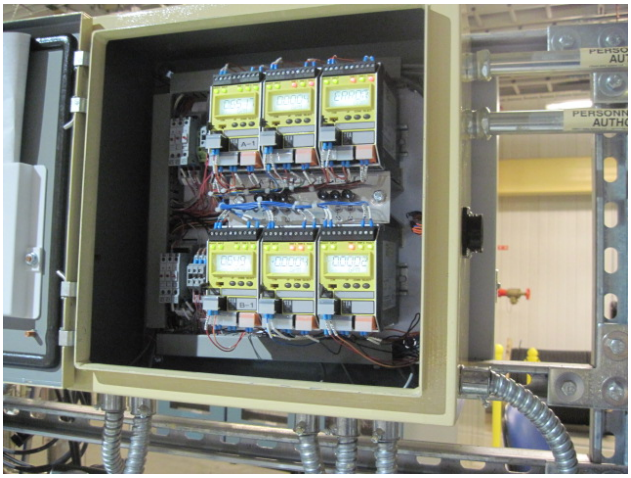

Figure 2: PPS Water STAs

Record the pretest water flows for the PPS meters in GPM.

Meter Reading	Meter Reading	Current STA A	Current STA B
A1= _____	B1= _____	A STA1= _____	B STA1= _____
A2= _____	B2= _____	A STA2= _____	B STA2= _____
A3 For future Use	B3 For future Use		

The current programmed trip settings for the amplifiers are in column 1. The STA readouts for each tested A and B chain STAs will be recorded in columns 3 and 4. These recordings should be within 15% of the programmed trip point (column 2).

Trip Points	Trip Points (- 15 %)	Recorded A Trip	Recorded B Trip
PPS 1: 1.5 GPM	1.3 GPM	A STA1= _____	B STA1= _____
PPS 2: 1.5 GPM	1.3 GPM	A STA2= _____	B STA2= _____
PPS 3: TBD			

Repeat each step for all water flow meters	**PPS1**	**PPS2**
Open FE Shutters	____	____
FE Shutters A and B open (**green**)	____	____
Water Permits A and B ON (**green**), HMI	____	____
FE Shutter Permits A and B ON (**green**), HMI	____	____
Using the valve, lower water flow to trip point	____	____
FE Shutters A and B closed (**red**)	____	____
In 5 seconds: FE Shutter Permits A and B OFF, HMI	____	____
Water Permits A and B OFF, HMI	____	____
Recorded STA A and B levels above; within 15%	____	____
Return water flow to pretest values	____	____
Water Permits A and B remain OFF, HMI	____	____
Reset fault at PPS cabinet	____	____
Water Permits ON (**green**), HMI	____	____
FE Shutter Permits A and B ON (**green**), HMI	____	____

A32 ***Water Safety Test Amplifier Faults***

Repeat each step for all water flow meters

	PPS1	PPS2
Open FE Shutters with keypad	____	____
FE Shutters A and B open (**green**)	____	____
Water Permits A and B ON (**green**), HMI	____	____
FE Shutter Permits A and B ON (**green**), HMI	____	____
Press A chain fault/reset button	____	____
FE Shutters A and B closed (**red**)	____	____
Water Permit A OFF, HMI	____	____
In 5 seconds: FE Shutter Permit A OFF, HMI	____	____
Reset fault	____	____
Open FE Shutters with keypad	____	____
FE Shutters A and B open (**green**)	____	____
Water Permits A and B ON (**green**), HMI	____	____
FE Shutter Permits A and B ON (**green**), HMI	____	____
Press B chain fault/reset button	____	____
FE Shutters A and B closed (**red**)	____	____
Water Permit B OFF, HMI	____	____
In 5 seconds: FE Shutter Permit B OFF, HMI	____	____
Reset fault	____	____

A33 ***PPS Aperture***

The PPS Aperture Transmitter meters are located inside the FOE (Figure 3). The STAs are located in the PPS cabinet outside of the FOE (Figure 4).

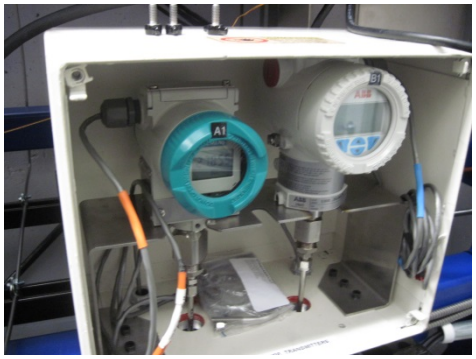

Figure 3: PPS Aperture Transmitters

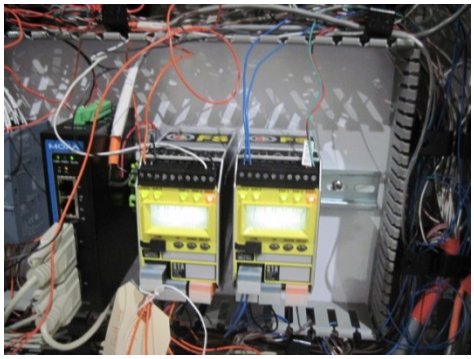

Figure 4: PPS Aperture STAs

Record the Transmitter meter readings (absolute pressure):

Meter Reading	Meter Reading	Current STA A	Current STA B
A1= _____	B1= _____	A STA1= _____	B STA1= _____

Qualified Beamline Staff will adjust the valve to lower the absolute pressure (trip point at 18 psia).

Open FE Shutters ____

FE Shutters A and B open (**green**) ____

Aperture Low Press. A and B ON (**green**), HMI ____

FE Critical Device Permits A and B ON (**green**), HMI ____

Using the valve, lower pressure to below trip point at 18 psia ____

Both A and B chains trip within 5% of 18 psia (>17.1) **A** ____ **B** ____

FE Shutters A and B closed (**red**) ____

FE Critical Device Permits A and B OFF, HMI ____

Aperture Low Press. A and B OFF, HMI ____

Qualified Beamline Staff return pressure to pretest values ____

Aperture Low Press. A and B ON (**green**), HMI ____

Reset fault at I/O Box ____

FE Critical Device Permits A and B ON (**green**), HMI ____

A34 ***PPS Aperture (Module Fault)***

Repeat for A and B chain STAs	**A1**	**B1**
Open FE Shutters	____	____
FE Shutters A and B open (**green**)	____	____
Aperture Module Fault A and B ON (**green**), HMI	____	____
FE Critical Device Permits A and B ON (**green**), HMI	____	____
Generate a trip amplifier fault	____	____
FE Shutters A and B closed (**red**)	____	____
FE Critical Device Permits A and B OFF, HMI	____	____
Aperture Module Fault OFF (**red**), HMI	____	____
Return trip amplifier to operating condition	____	____
Aperture Module Fault A and B ON (**green**), HMI	____	____

Reset fault at I/O box ____ ____

FE Critical Device Permits A and B ON (**green**), HMI ____ ____

A35 ***Observe Beamline Photon Shutter Operation***

	L1S1	L1S3
Close Beamline Photon Shutter	____	____
Shutter indicates closed A and B (**red**), HMI	____	____
Open Beamline Photon Shutter	____	____
Shutter opens smoothly without hesitation	____	____
Shutter indicates open A and B (**green**), HMI	____	____
Close Beamline Photon Shutter	____	____

A36 ***Observe FE Safety Shutter(s) Operation***

With Maintenance Door open, connect FE Shutter test fixture (Attachment B Figure B5). ____

	Shutters are in the closed (down) position	____
	FE Shutter Closed A and B (**red**), HMI	____
Turn the "Air" switch ON		____
Open FE Photon Shutter and SSs A and B	Shutters open freely without hesitation	____
	Shutters are in the open (up) position	____
	FE Shutter Open A and B (**green**), HMI	____
Actuate Shutters closed	FE Shutter Closed A and B (**red**), HMI	____

A37 ***FE Safety Shutters can only be Closed if FE Photon Shutter is Closed***

Search hutch	FOE Interlocked A and B ON (**green**), HMI	____
	FE Critical Devices Permits A and B ON (**green**), HMI	____
Open FE SSA	SSA Open	____
Open FE Photon Shutter	FE Critical Devices Permits A and B OFF, HMI	____
Close Shutters		____
Reset fault	FE Critical Devices Permits A and B ON (**green**), HMI	____
Open FE SSB	SSB Open	____
Open FE Photon Shutter	FE Critical Devices Permits A and B OFF, HMI	____

	Close shutters		____
	Reset fault	FE Critical Devices Permits A and B ON (**green**), HMI	____
A38	***Beamline Enable Key (Opening Shutter Without Key Trips SR RF and Dipole PS)***		
	Remove beamline enable key	Beamline Online A and B OFF	____
	Search FOE	FOE Interlocked A and B ON (**green**), HMI	____
		FE Critical Devices Permits A and B ON (**green**), HMI	____
	Using FE Shutter test fixture, Open FE Shutters	FE Critical Devices Permits A and B OFF	____
	Replace beamline enable key and reset faults	Beamline Online A and B ON (**green**)	____
	Live Testing		
A39	***Reach Back FOE Door Switches***		
	Secure P1 through P5	SR Secure, A and B chain, SR HMI	____
	Place actuators on FOE hutch downstream left door switches and Maglock		____
	Search hutch	FOE Interlocked A and B ON (**green**), HMI	____
		FE Critical Devices Permits A and B ON (**green**), HMI	____
	Check Control Room SR HMI (MCR beamline 1)	FE Critical Device Permit A and B ON (**green**) SR HMI	____
	Check I/O Box 4 Beamline Enable Panel	FE Critical Devices Permits A and B LEDs ON	____
	Check I/O Box 28 Beamline Enable Panel	FE Critical Device Permit Sum A and B LEDs ON	____
		FE Shutters Closed A and B LEDs ON	____
	Check Dipole PS (positive) Beamline Interface	A and B Permits ON, Dipole PS Pos. Interface	____
	Check Dipole PS (negative) Beamline Interface	A and B Permits ON, Dipole PS Neg. Interface	____
	Check SR RF System C HVPS Beamline Interface	A and B Permits ON, SR RF System C HVPS Interface	____
	Check SR RF System D HVPS Beamline Interface	A and B Permits ON, SR RF System D HVPS Interface	____
	Operator enables SR Dipole PS	SR Dipole PS is ON	____
	Operator enables SR RF System C HVPS	SR RF HVPS C is ON	____
	Operator enables SR RF System D HVPS	SR RF HVPS D is ON	____
	Using FE Shutter test fixture, open the FE Shutters (SSA, SSB and Photon)		____
		FE Shutters Open	____
	*Remove an "**A chain**" door switch actuator from beamline hutch door*		____
		FOE Interlocked OFF A, HMI	____

	FE Critical Devices Permits A chain OFF, HMI	____
Check I/O Box 4 Beamline Enable Panel	FE Critical Devices Permit A LED OFF	____
Check I/O Box 28 Beamline Enable Panel	FE Critical Device Permit Sum A LED OFF	____
Check Control Room SR HMI (MCR beamline 1)	FE Critical Device Permit A (**red**), SR HMI	____
Check SR RF System C HVPS Beamline Interface	A Permits OFF, SR RF System C HVPS Interface	____
Check SR RF System D HVPS Beamline Interface	A Permits OFF, SR RF System D HVPS Interface	____
Check Dipole PS (positive) Beamline Interface	A Permits OFF, Dipole PS Pos. Interface	____
Check Dipole PS (negative) Beamline Interface	A Permits OFF, Dipole PS Neg. Interface	____
	SR RF System C HVPS is OFF	____
	SR RF System D HVPS is OFF	____
	SR Dipole PS is OFF	____
Close FE Shutter with test fixtures	Shutters closed	____
Replace A chain door switch holder and reset fault(s)		____
Search hutch		____
	FOE Interlocked A and B ON (**green**), HMI	____
	FE Critical Devices Permits A and B ON (**green**), HMI	____
Check Control Room SR HMI (MCR beamline 1)	FE Critical Device Permit A and B ON (**green**), SR HMI	____
Check I/O Box 4 Beamline Enable Panel	FE Critical Device Permit Sum A and B LEDs ON	____
Check I/O Box 28 Beamline Enable Panel	FE Shutters Closed A and B LEDs ON	____
Check Dipole PS (positive) Beamline Interface	A and B Permits ON, Dipole PS Pos. Interface	____
Check Dipole PS (negative) Beamline Interface	A and B Permits ON, Dipole PS Neg. Interface	____
Check SR RF System C HVPS Beamline Interface	A and B Permits ON, SR RF System C HVPS Interface	____
Check SR RF System D HVPS Beamline Interface	A and B Permits ON, SR RF System D HVPS Interface	____
Operator enables SR Dipole PS	SR Dipole PS is ON	____
Operator enables SR RF System C HVPS	SR RF System C HVPS is ON	____
Operator enables SR RF System D HVPS	SR RF System D HVPS is ON	____
Using FE Shutter test fixture, open the FE Shutters (SSA, SSB and Photon)		____
	FE Shutters Open	____

	Remove "**B chain"** switch actuator	FOE Interlocked B OFF, HMI	____
		FE Critical Devices Permits B OFF, HMI	____
	Check I/O Box 4 Beamline Enable Panel	FE Critical Devices Permit B LED OFF	____
	Check Control Room SR HMI (MCR beamline 1)	FE Critical Device Permits B OFF (**red**), SR HMI	____
	Check I/O Box 28 Beamline Enable Panel	FE Critical Device Permit Sum B LED OFF	____
	Check SR RF System C HVPS Beamline Interface	B Permits OFF, SR RF System C HVPS Interface	____
	Check SR RF System D HVPS Beamline Interface	B Permits OFF, SR RF System D HVPS Interface	____
	Check Dipole PS (positive) Beamline Interface	B Permits OFF, Dipole PS Pos. Interface	____
	Check Dipole PS (negative) Beamline Interface	B Permits OFF, Dipole PS Neg. Interface	____
		SR Dipole is OFF	____
		SR RF System C HVPS is OFF	____
		SR RF System D HVPS is OFF	____
	Close FE Shutters with test fixture		____
	Remove beamline hutch switch holders and Maglock actuator		____
A40	***Water Interlock (Live)***		
	Search FOE	FOE Interlocked A and B ON (**green**), HMI	____
		FE Shutter Permits A and B ON (**green**), HMI	____
		FE Critical Devices Permits A and B ON (**green**), HMI	____
	Check I/O Box 4 Beamline Enable Panel	FE Critical Devices Permits A and B LEDs ON	____
	Check I/O Box 28 Beamline Enable Panel	FE Critical Device Permit Sum A and B LEDs ON	____
	Check Control Room SR HMI (MCR beamline 1)	FE Critical Device Permit A and B ON (**green**), SR HMI	____
	Check Dipole PS (positive) Beamline Interface	A and B Permits ON, Dipole PS Pos. Interface	____
	Check Dipole PS (negative) Beamline Interface	A and B Permits ON, Dipole PS Neg. Interface	____
	Check SR RF System C HVPS Beamline Interface	A and B Permits ON, SR RF System C HVPS Interface	____
	Check SR RF System D HVPS Beamline Interface	A and B Permits ON, SR RF System D HVPS Interface	____
	Operator enables SR Dipole PS	SR Dipole PS is ON	____
	Operator enables SR RF System C HVPS	SR RF System C HVPS is ON	____
	Operator enables SR RF System D HVPS	SR RF System D HVPS is ON	____

Using FE Shutter test fixture, turn on air and open Photon then SSs		____
	FE Shutters indicate Open (**green**), HMI	____
Using water trip points in Step A31, lower flow to one meter		____
	Water Permits A and B OFF, HMI	____
	FE Shutter Permits A and B OFF, HMI	____
Within 3 seconds	FE Critical Devices Permits A and B OFF, HMI	____
Check I/O Box 4 Beamline Enable Panel	FE Critical Devices Permit A and B OFF	____
Check I/O Box 28 Beamline Enable Panel	FE Critical Device Permit Sum A and B LED OFF	____
Check Control Room SR HMI (MCR beamline 1)	FE Critical Device Permit A and B OFF, SR HMI	____
Check SR RF System C HVPS Beamline Interface	A and B Permits OFF, SR RF System C HVPS Interface	____
Check SR RF System D HVPS Beamline Interface	A and B Permits OFF, SR RF System D HVPS Interface	____
Check Dipole PS (positive) Beamline Interface	A and B Permits OFF, Dipole PS Pos. Interface	____
Check Dipole PS (negative) Beamline Interface	A and B Permits OFF, Dipole PS Neg. Interface	____
	SR RF System C HVPS is OFF	____
	SR RF System D HVPS is OFF	____
	SR Dipole PS is OFF	____
Close FE Shutters with test fixture	Shutters closed	____
Return water flow to recorded level		____
Reset fault(s)		____

A41 ***Observe All Shutters Closed Sum***

Check I/O Box 28 Beamline Enable Panel	FE Shutters closed A chain light ON	____
	FE Shutters closed B chain light ON	____
Using FE Shutter test fixture open both FE SSs and then Photon Shutter		____
	FE Shutters open (**green**), HMI	____
Check I/O Box 28 Beamline Enable Panel	FE Shutters closed A chain light OFF	____
	FE Shutters closed B chain light OFF	____
Close FE Shutters and remove test device		____

A42 ***FOE Area Radiation Monitor***

Refer to PS-C-ASD-PRC-008, *NSLS-II Area Radiation Monitor PPS Test* and complete Attachment D, *NSLS-II Beamline (FOE) Area Radiation Monitor Checklist.*

FRM 4-ID Test Checklist Completed ____

A43 ***Test Completion***

Inspect all hutch doors and labyrinths to ensure all PPS switch and Maglock actuators have been removed ____

Return Beamline enable key and Beamline PPS reset key to the Control Room ____

Remove muffler from beam imminent sounder ____

Ensure PPS cabinets are secure and locked; challenge locks ____

Remove all LOTO ____

Inform Lead Operator that testing is complete ____

- END ATTACHMENT A -

National Synchrotron Light Source II, Brookhaven National Laboratory			
Doc No. PS-C-XFD-PRC-057	Author: T. McDonald	Effective Date:06May2016 Review Frequency: 3 yrs	Version 1
Title: Beamline 4-ID Radiological Interlock Test			Technical

Attachment B - NSLS-II 4-ID Beamline PPS Equipment Photos

Figure B1: NSLS-II Beamline Enable Panel (Mounted on Mezzanine I/O Box)

Figure B2: FE Safety Shutters B and A

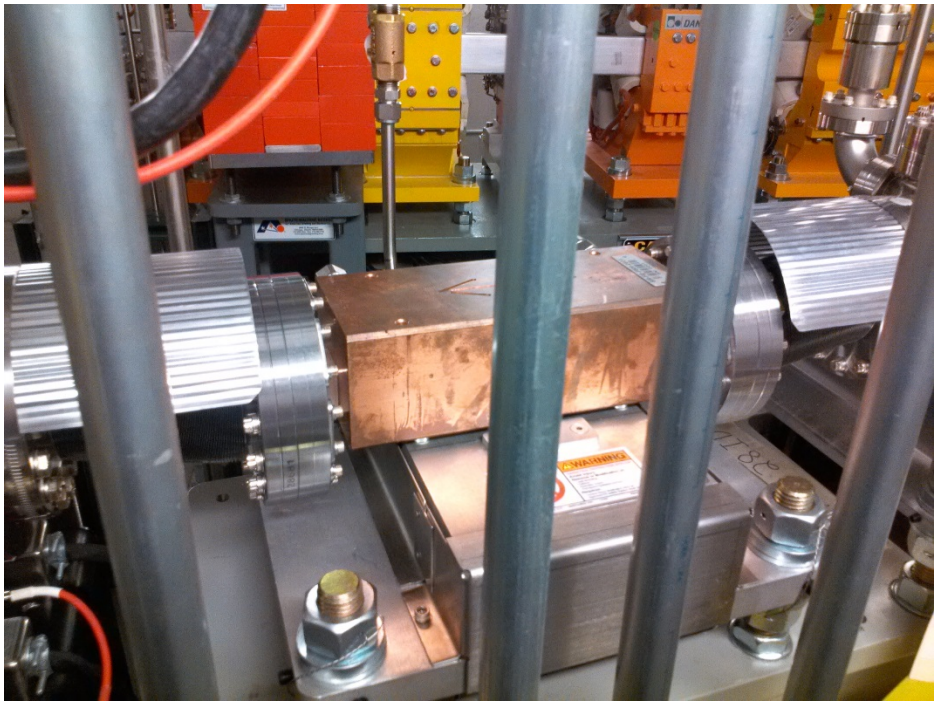

Figure B3: FE Photon Shutter

Figure B4: FOE Test Box

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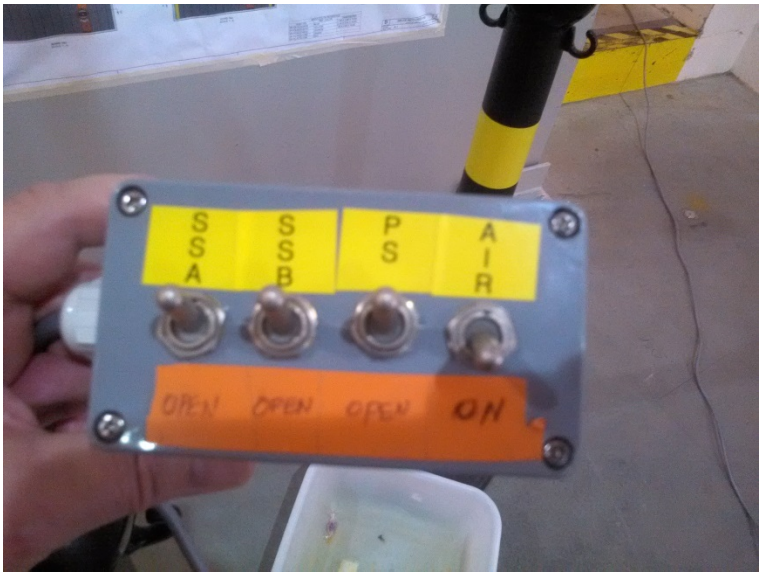

Figure B5: FE Shutter Test Fixture

Figure B6: FE Shutter Junction Boxes (inside SR)

Figure B7: FOE Test Box Connection inside PPS Cabinet

-END-