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National Synchrotron Light Source II, Brookhaven National Laboratory			
Doc No. PS-C-XFD-PRC-059	Author: T. McDonald	Effective Date: 25Apr2016 Review Frequency: 3 yrs	Version 1
Title: Beamline 21-ID Radiological Interlock Test			Technical

Reviewed by:		
4/25/2016	5/27/2016	4/25/2016
<b>X</b> Robert Chmiel <hr/> Robert Chmiel Safety Officer Signed by: Chmiel, Robert	<b>X</b> Scott Buda <hr/> Scott Buda Accelerator Safety Systems Group Leader Signed by: Buda, Scott	<b>X</b> Ewart Orr <hr/> Ewart Orr Accelerator Safety Systems Engineer Signed by: Orr, Ewart
4/19/2016	4/25/2016	4/19/2016
<b>X</b> John Aloï <hr/> John Aloï Facility Support Representative Signed by: Aloï Jr, John	<b>X</b>  <hr/> Mo Benmerrouche Physicist - Radiation Safety Signed by: Benmerrouche, Mohamed	<b>X</b>  <hr/> Bruce Lein Training Group Leader Signed by: Lein, Bruce
4/19/2016	4/20/2016	5/5/2016
<b>X</b>  <hr/> Christopher Porretto Quality Assurance Manager Signed by: Porretto, Christopher J	<b>X</b>  <hr/> Steve Moss Acting Conduct of Operations Manager Signed by: Moss, Steven H	<b>X</b> Ferdinand Willeke <hr/> Ferdinand Willeke Accelerator Division Director Signed by: Willeke, Ferdinand
5/9/2016	6/3/2016	
<b>X</b> Elio Vescovo <hr/> Elio Vescovo 21-ID Lead Beamline Scientist Signed by: Vescovo, Elio	<b>X</b>  <hr/> Paul Zschack Photon Science Division Director Signed by: Zschack, Paul	

USI Screening/Resolution	Procedure Validation*
4/20/2016	4/19/2016
<b>X</b>  <hr/> Steve Moss Authorization Basis Manager Signed by: Moss, Steven H	<b>X</b> Thomas McDonald <hr/> Thomas McDonald ESH Engineer Signed by: McDonald, Thomas *for Operations/Technical procedures only

Approved by:
5/2/2016
<b>X</b>  <hr/> Robert Lee ESH Manager Signed by: Lee, Robert J

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### VERSION HISTORY LOG

VERSION	DESCRIPTION	DATE
1	First Issue.	25Apr2016

### ACRONYMS

ABM	Authorization Basis Manager	MCR	Main Control Room
ASE	Accelerator Safety Envelope	Neg	Negative
BNL	Brookhaven National Laboratory	NLS-II	National Synchrotron Light Source II
ES	Emergency Stop	P	Pendant
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
GPM	Gallons Per Minute	RF	Radio Frequency
HMI	Human Machine Interface	SAF	Safety Approval Form
HVPS	High Voltage Power Supply	SB	Search Button
ID	Insertion Device	SBE	Search Button External
I/O	Input/Output	SBMS	Standards Based Management System
L	Left	SR	Storage Ring
LED	Light Emitting Diode	SS	Safety Shutter
LOTO	Lockout/Tagout	STA	Safety Test Amplifier

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## 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 21-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.

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### 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 Configuration Management Specialist

3.5.1 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.

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- 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 21-ID shall be voided prior to the start of certification testing.
- 5.7 All steps in the test checklist requiring venting beamline vacuum shall be performed in accordance with PS-C-XFD-PRC-001, *NSLS-II Beamline Vacuum System Venting Procedure*.

## 6 PROCEDURE

### 6.1 Test and Certify Radiological Interlocks

**Note:** Two Testers are required to test and certify Beamline 21-ID radiological interlocks.

- 6.1.1 Testers notify the Lead Operator and the Lead Beamline Scientist that a test of the Beamline 21-ID radiological interlocks will be performed.
- 6.1.2 Testers obtain the Beamline 21-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*

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- 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 21-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 21-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.

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- 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 21-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 21-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

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- 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*
- 7.13 PS-C-XFD-PRC-001, *NSLS-II Beamline Vacuum System Venting Procedure.*

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## 8 ATTACHMENTS

Attachment A, *NSLS-II Beamline 21-ID Radiological Interlock Test Checklist*

Attachment B, *NSLS-II 21-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 21-ID Radiological Interlock Test Checklists

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## Attachment A

### NSLS-II Beamline 21-ID Radiological Interlock Test Checklist

Test Reason:	Test Result: <input type="checkbox"/> Passed <input type="checkbox"/> Failed		
	Test Type:	<input type="checkbox"/> Pre-Certification	<input type="checkbox"/> Certification <input type="checkbox"/> 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 21-ID (Beamline HMI) A Chain:                      B Chain:	Previous 21-ID SS#	Date: / /	
** Safety Signature Pentant 5 Beamline (SR HMI) A Chain:                      B Chain:	Previous Pentant 3 SS#	Date: / /	

\* 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 480V \_\_\_\_\_

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**

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* \_\_\_\_\_



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A3 **Out of Sequence Search in the FOE (A hutch)**

	<u>A</u>
<i>Press SB2</i>	_____
SB2 does not illuminate	_____
<i>Press SB1</i>	_____
SB1 illuminates	_____
<i>Close hutch door and press SBE</i>	_____
Hutch does NOT secure	_____

A4 **Search timeout**

	<u>A</u>
<i>Press first search button and <b>begin timing</b></i>	_____
<i>Complete search <b>without pressing Final Search button</b></i>	_____
Search sounders off in 2 minutes	_____
<i>Press Final Search button</i>	_____
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 ( <b>green</b> )	_____
Search the FOE	FE Shutter Permits A and B ON <i>after</i> Beam Imminent Warning	_____
Open FE Shutters	FE Shutters A and B indicate open ( <b>green</b> ) "Beam On" sign is ON	_____
Close FE Shutters	FE Shutters A and B indicate closed ( <b>red</b> )	_____
Line 1 Enable key is out of place	L1S1 Shutter A and B Permits OFF, HMI	_____
Cycle Line 1 Key in place	L1S1 Shutter A and B Permits ON ( <b>green</b> ), HMI	_____
Open L1S1 Shutter	L1S1 Shutter A and B indicate open ( <b>green</b> )	_____
Cycle Line 1 Key out of place	L1S1 Shutter A and B indicate closed ( <b>red</b> ) L1S1 Shutter A and B Permits OFF, HMI	_____
Line 2 Enable key is out of place	L2S2 Shutter A and B Permits OFF, HMI	_____
Cycle Line 2 Key in place	L2S2 Shutter A and B Permits ON ( <b>green</b> ), HMI	_____

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Open L2S2 Shutter	L2S2 Shutter A and B indicate open ( <b>green</b> )	_____
Cycle Line 2 Key out of place	L2S2 Shutter A and B indicate closed ( <b>red</b> )	_____
	L2S2 Shutter A and B Permits OFF, HMI	_____
Rotate keys to enable both lines	L1S1 and L2S2 A and B Permits ON ( <b>green</b> ), HMI	_____

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

For each ES search hutch	<b><u>ES1</u></b>	<b><u>ES2</u></b>	<b><u>ES3</u></b>
<i>Open FE Shutters from keypad</i>	_____	_____	_____
FE Shutters A and B open ( <b>green</b> )	_____	_____	_____
FOE Interlocked A and B ON ( <b>green</b> )	_____	_____	_____
FE Shutter Permit A and B ON ( <b>green</b> )	_____	_____	_____
FE Critical Device Permits A and B ON	_____	_____	_____
Right Maglock A ON ( <b>green</b> )	_____	_____	_____
Left Maglock A ON ( <b>green</b> )	_____	_____	_____
<i>Press ES</i>	_____	_____	_____
FE Shutters A and B closed ( <b>red</b> )	_____	_____	_____
FOE Interlocked A and B OFF	_____	_____	_____
FE Shutter Permit A and B OFF	_____	_____	_____
FE Critical Device Permits A and B OFF	_____	_____	_____
Right Maglock A OFF	_____	_____	_____
Left Maglock A OFF	_____	_____	_____
<i>Pull out ES</i>	_____	_____	_____
ES Sum Latch OFF	_____	_____	_____
<i>Reset fault</i>	_____	_____	_____
ES Sum Latch ON ( <b>green</b> )	_____	_____	_____

**A7 FOE 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).

	<b><u>A1</u></b>	<b><u>A2</u></b>	<b><u>B1</u></b>	<b><u>B2</u></b>	<b><u>Reed</u></b>
<i>Search hutch</i>	_____	_____	_____	_____	_____
<i>Open FE Shutters from keypad</i>	_____	_____	_____	_____	_____
FE Shutters A and B open ( <b>green</b> )	_____	_____	_____	_____	_____

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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 \_\_\_\_\_

**A8 FOE 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).

	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Reed</u>
<i>Search hutch</i>	_____	_____	_____	_____	_____
<i>Open FE Shutters from keypad</i>	_____	_____	_____	_____	_____
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	_____	_____	_____	_____	_____
<i>Remove one switch actuator</i>	_____	_____	_____	_____	_____
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	_____	_____	_____	_____	_____
<i>Replace switch actuator and reset fault</i>	_____	_____	_____	_____	_____
Remove actuators and close door	_____	_____	_____	_____	_____

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**A9 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: Right (R), Left (L)

	<u>R</u>	<u>L</u>
<i>Search hutch</i>	_____	_____
FOE Interlocked A and B ON (green)	_____	_____
FE Shutter Permit A and B ON (green)	_____	_____
Door Maglock A and B ON (green)	_____	_____
<i>Open FE Shutters</i>	_____	_____
FE Shutters open (green)	_____	_____
<i>Using FOE test box, turn OFF Maglock</i>	_____	_____
Door Maglock A OFF	_____	_____
FE Shutters closed (red)	_____	_____
FOE Interlocked A OFF	_____	_____
FE Shutter Permit A OFF	_____	_____
<i>Turn On Maglock and reset fault</i>	_____	_____
<i>Search hutch</i>	_____	_____
<i>Using FE Shutter test fixture, Open FE Shutters</i>	_____	_____
FE Critical Device Permits A and B ON	_____	_____
<i>Using FOE test box, turn OFF Maglock</i>	_____	_____
<i>Within 3 seconds: FE Critical Devices Permits A Chain OFF</i>	_____	_____
Reset fault	_____	_____
Disconnect FOE test box	_____	_____

**A10 Vacuum Sensors Beamline 21-ID-1**

Qualified Beamline Staff will perform vacuum venting.

	<u>SW4</u>
Vacuum sensor SW A and B ON (green)	_____
L1S1 Shutter A and B Permits ON (green)	_____
<i>Open Beamline Photon Shutter</i>	_____
L1S1Shutter OPEN (green)	_____

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*Beamline Staff vents up section*

Vacuum SW A and B OFF

L1S1 Shutter A and B Permits OFF

L1S1 Shutter CLOSED (**red**)

*Beamline Staff returns vacuum*

Vacuum sensor SW A and B ON (**green**)

L1S1 Shutter A and B Permits OFF

*Reset Fault*

L1S1 Shutter A and B Permits ON (**green**)

*Open Beamline Photon Shutter*

L1S1 Shutter OPEN (**green**)

**A11 Vacuum Sensors Beamline 21-ID-2**

Qualified Beamline Staff will perform vacuum venting.

**SW5**

Vacuum SW A and B ON (**green**)

L2S2 Shutter A and B Permits ON (**green**)

*Open Beamline Photon Shutter*

L2S2 Shutter OPEN (**green**)

*Beamline Staff vents up section*

Vacuum SW A and B OFF

L2S2 Shutter A and B Permits OFF

L2S2 Shutter CLOSED (**red**)

*Beamline Staff returns vacuum*

Vacuum SW A and B ON (**green**)

L2S2 Shutter A and B Permits OFF

*Reset Fault*

L2S2 Shutter A and B Permits ON (**green**)

*Open Beamline Photon Shutter*

L2S2 Shutter OPEN (**green**)



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**Figure 1:** Water Meters (PPS 1, 2, and 3)

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= _____	B3= _____	A STA3= _____	B STA3= _____
A4= _____	B4= _____	A STA4= _____	B STA4= _____
A5= _____	B5= _____	A STA5= _____	B STA5= _____

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).



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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*

\_\_\_\_\_

**A16 Observe Beamline Photon Shutter Operation**

**FOE   L1S1   L2S2**

*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*

\_\_\_\_\_

**A17 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

\_\_\_\_\_

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	Shutters are in the open (up) position	_____
	FE Shutter Open A and B ( <b>green</b> ), HMI	_____
<i>Actuate Shutters closed</i>	FE Shutter Closed A and B ( <b>red</b> ), HMI	_____
<b>A18</b>	<b>FE Safety Shutters can only be Closed if FE Photon Shutter is Closed</b>	
<i>Search hutch</i>	FOE Interlocked A and B ( <b>green</b> ), HMI	_____
	FE Critical Devices Permits A and B ON ( <b>green</b> ), HMI	_____
<i>Open FE SSA</i>	SSA Open	_____
<i>Open FE Photon Shutter</i>	FE Critical Devices Permits A and B OFF, HMI	_____
<i>Close Shutters</i>		_____
<i>Reset fault</i>	FE Critical Devices Permits A and B ON ( <b>green</b> ), HMI	_____
<i>Open FE SSB</i>	SSB Open	_____
<i>Open FE Photon Shutter</i>	FE Critical Devices Permits A and B OFF, HMI	_____
<i>Close shutters</i>		_____
<i>Reset fault</i>	FE Critical Devices Permits A and B ON ( <b>green</b> ), HMI	_____
<b>A19</b>	<b>Beamline Enable Key (Opening shutter without key trips SR RF and Dipole PS)</b>	
<i>Remove beamline enable key</i>	Beamline Online A and B OFF	_____
<i>Search FOE</i>	FOE Interlocked A and B ( <b>green</b> ), HMI	_____
	FE Critical Devices Permits A and B ON ( <b>green</b> ), HMI	_____
<i>Using FE Shutter test fixture, Open FE Shutters</i>	FE Critical Devices Permits A and B OFF	_____
<i>Replace beamline enable key and reset faults</i>	Beamline Online A and B ON ( <b>green</b> )	_____
	<b>Live Testing</b>	
<b>A20</b>	<b>Reach Back FOE Door Switches</b>	
<i>Secure P1 through P5</i>	SR Secure, A and B chain, SR HMI	_____
<i>Place actuators on FOE hutch downstream left door switches and Maglock</i>		_____
<i>Search hutch</i>	FOE Interlocked A and B ( <b>green</b> ), HMI	_____
	FE Critical Devices Permits A and B ON ( <b>green</b> ), HMI	_____
<i>Check Control Room SR HMI (MCR beamline 1)</i>	FE Critical Device Permit A and B ON ( <b>green</b> ), SR HMI	_____

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<i>Check I/O Box 21 Beamline Enable Panel</i>	FE Critical Devices Permits A and B LEDs ON	_____
<i>Check I/O Box 28 Beamline Enable Panel</i>	FE Critical Device Permit Sum A and B LEDs ON	_____
	FE Shutters Closed A and B LEDs ON	_____
<i>Check Dipole PS (positive) Beamline Interface</i>	A and B Permits ON, Dipole PS Pos. Interface	_____
<i>Check Dipole PS (negative) Beamline Interface</i>	A and B Permits ON, Dipole PS Neg. Interface	_____
<i>Check SR RF System C HVPS Beamline Interface</i>	A and B Permits ON, SR RF System C HVPS Interface	_____
<i>Check SR RF System D HVPS Beamline Interface</i>	A and B Permits ON, SR RF System D HVPS Interface	_____
<i>Operator enables SR Dipole PS</i>	SR Dipole PS is ON	_____
<i>Operator enables SR RF System C HVPS</i>	SR RF System C HVPS is ON	_____
<i>Operator enables SR RF System D HVPS</i>	SR RF System D HVPS is ON	_____
<i>Using FE Shutter test fixture, open the FE Shutters (SSA, SSB and Photon)</i>		_____
	FE Shutters Open	_____
<i>Remove an "A chain" door switch actuator from beamline hutch door</i>		_____
	FOE Interlocked OFF A chain, HMI	_____
	FE Critical Devices Permits A OFF, HMI	_____
<i>Check I/O Box 21 Beamline Enable Panel</i>	FE Critical Devices Permit A LED OFF	_____
<i>Check I/O Box 28 Beamline Enable Panel</i>	FE Critical Device Permit Sum A LED OFF	_____
<i>Check Control Room SR HMI (MCR beamline 1)</i>	FE Critical Device Permit A ( <b>red</b> ), SR HMI	_____
<i>Check SR RF System C HVPS Beamline Interface</i>	A Permits OFF, SR RF System C HVPS Interface	_____
<i>Check SR RF System D HVPS Beamline Interface</i>	A Permits OFF, SR RF System D HVPS Interface	_____
<i>Check Dipole PS (positive) Beamline Interface</i>	A Permits OFF, Dipole PS Pos. Interface	_____
<i>Check Dipole PS (negative) Beamline Interface</i>	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	_____
<i>Close FE Shutters with test fixture</i>	Shutters closed	_____
<i>Replace A chain door switch holder and reset fault(s)</i>		_____
<i>Search hutch</i>		_____

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	FOE Interlocked A and B ON ( <b>green</b> ), HMI	_____
	FE Critical Devices Permits A and B ON ( <b>green</b> ), HMI	_____
<i>Check Control Room SR HMI (MCR beamline 1)</i>	FE Critical Device Permit A and B ON ( <b>green</b> ), SR HMI	_____
<i>Check I/O Box 21 Beamline Enable Panel</i>	FE Critical Device Permit Sum A and B LEDs ON	_____
<i>Check I/O Box 28 Beamline Enable Panel</i>	FE Shutters Closed A and B LEDs ON	_____
<i>Check Dipole PS (positive) Beamline Interface</i>	A and B Permits ON, Dipole PS Pos. Interface	_____
<i>Check Dipole PS (negative) Beamline Interface</i>	A and B Permits ON, Dipole PS Neg. Interface	_____
<i>Check SR RF System C HVPS Beamline Interface</i>	A and B Permits ON, SR RF System C HVPS Interface	_____
<i>Check SR RF System D HVPS Beamline Interface</i>	A and B Permits ON, SR RF System D HVPS Interface	_____
<i>Operator enables SR Dipole PS</i>	SR Dipole PS is ON	_____
<i>Operator enables SR RF System C HVPS</i>	SR RF System C HVPS is ON	_____
<i>Operator enables SR RF System D HVPS</i>	SR RF System D HVPS is ON	_____
<i>Using FE Shutter test fixture, open the FE Shutters (SSA, SSB and Photon)</i>		_____
	FE Shutters Open	_____
<i>Remove “B chain” switch actuator</i>	FOE Interlocked B OFF, HMI	_____
	FE Critical Devices Permit B OFF, HMI	_____
<i>Check I/O Box 21 Beamline Enable Panel</i>	FE Critical Devices Permit B LED OFF	_____
<i>Check Control Room SR HMI (MCR beamline 1)</i>	FE Critical Device Permit B OFF ( <b>red</b> ), SR HMI	_____
<i>Check I/O Box 28 Beamline Enable Panel</i>	FE Critical Device Permit Sum B LED OFF	_____
<i>Check SR RF System C HVPS Beamline Interface</i>	B Permits OFF, SR RF System C HVPS Interface	_____
<i>Check SR RF System D HVPS Beamline Interface</i>	B Permits OFF, SR RF System D HVPS Interface	_____
<i>Check Dipole PS (positive) Beamline Interface</i>	B Permits OFF, Dipole PS Pos. Interface	_____
<i>Check Dipole PS (negative) Beamline Interface</i>	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	_____
<i>Close FE Shutters with test fixture</i>		_____
<i>Remove beamline hutch switch holders and Maglock actuator</i>		_____

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A21 **Water Interlock (Live)**

<i>Search FOE</i>	FOE Interlocked A and B ON ( <b>green</b> ), HMI	_____
	FE Shutter Permits A and B ON ( <b>green</b> ), HMI	_____
	FE Critical Devices Permits A and B ON ( <b>green</b> ), HMI	_____
<i>Check I/O Box 21 Beamline Enable Panel</i>	FE Critical Devices Permits A and B LEDs ON	_____
<i>Check I/O Box 28 Beamline Enable Panel</i>	FE Critical Device Permit Sum A and B LEDs ON	_____
<i>Check Control Room SR HMI (MCR beamline 1)</i>	FE Critical Device Permit A and B ON ( <b>green</b> ), SR HMI	_____
<i>Check Dipole PS (positive) Beamline Interface</i>	A and B Permits ON, Dipole PS Pos. Interface	_____
<i>Check Dipole PS (negative) Beamline Interface</i>	A and B Permits ON, Dipole PS Neg. Interface	_____
<i>Check SR RF System C HVPS Beamline Interface</i>	A and B Permits ON, SR RF System C HVPS Interface	_____
<i>Check SR RF System D HVPS Beamline Interface</i>	A and B Permits ON, SR RF System D HVPS Interface	_____
<i>Operator enables SR Dipole PS</i>	SR Dipole PS is ON	_____
<i>Operator enables SR RF System C HVPS</i>	SR RF System C HVPS is ON	_____
<i>Operator enables SR RF System D HVPS</i>	SR RF System D HVPS is ON	_____
<i>Using FE Shutter test fixture, turn on air and open Photon then SSs</i>	FE Shutters indicate open ( <b>green</b> ), HMI	_____
<i>Using water trip points in Step A14, lower flow to one meter</i>		_____
	Water Permits A and B OFF, HMI	_____
	FE Shutter Permits A and B OFF, HMI	_____
<i>Within 3 seconds</i>	FE Critical Devices Permits A and B OFF, HMI	_____
<i>Check I/O Box 21 Beamline Enable Panel</i>	FE Critical Devices Permits A and B OFF	_____
<i>Check I/O Box 28 Beamline Enable Panel</i>	FE Critical Device Permit Sum A and B LED OFF	_____
<i>Check Control Room SR HMI (MCR beamline 1)</i>	FE Critical Device Permit A and B OFF, SR HMI	_____
<i>Check SR RF System C HVPS Beamline Interface</i>	A and B Permits OFF, SR RF System C HVPS Interface	_____
<i>Check SR RF System D HVPS Beamline Interface</i>	A and B Permits OFF, SR RF System D HVPS Interface	_____
<i>Check Dipole PS (positive) Beamline Interface</i>	A and B Permits OFF, Dipole PS Pos. Interface	_____
<i>Check Dipole PS (negative) Beamline Interface</i>	A and B Permits OFF, Dipole PS Neg. Interface	_____
	SR RF System C HVPS is OFF	_____

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	SR RF System D HVPS is OFF	_____
	SR Dipole PS is OFF	_____
<i>Close FE Shutters with test fixture</i>	Shutters closed	_____
<i>Return water flow to recorded level</i>		_____
<i>Reset fault(s)</i>		_____
<b>A22</b>	<b>Observe All Shutters Closed Sum</b>	
<i>Check I/O Box 28 Beamline Enable Panel</i>	FE Shutters closed A chain light ON	_____
	FE Shutters closed B chain light ON	_____
<i>Using FE Shutter test fixture open both FE SSs and then Photon Shutter</i>		_____
	FE Shutters open (green), HMI	_____
<i>Check I/O Box 28 Beamline Enable Panel</i>	FE Shutters closed A chain light OFF	_____
	FE Shutters closed B chain light OFF	_____
<i>Close FE Shutters and remove test device</i>		_____
<b>A23</b>	<b>FOE Area Radiation Monitor</b>	
	<b>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.</b>	
	FRM 21-ID Test Checklist Completed	_____
<b>A24</b>	<b>Test Completion</b>	
	Inspect all hatch 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 -**

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## Attachment B - NSLS-II 21-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

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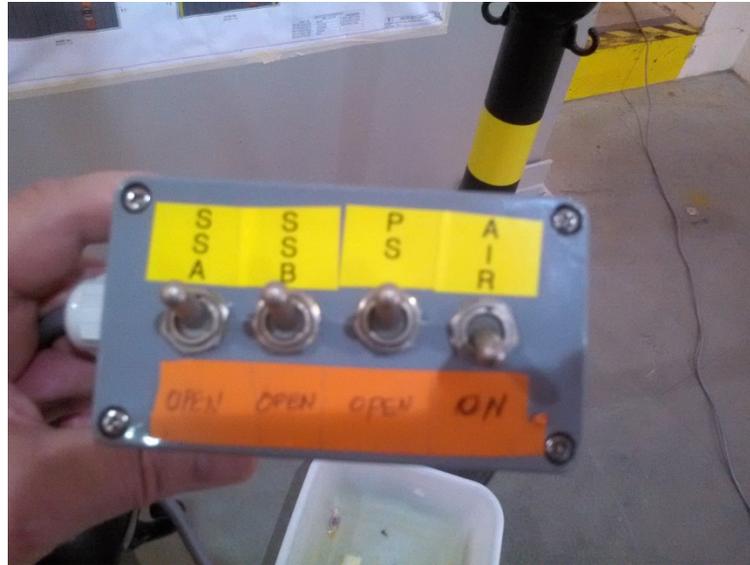
**Figure B3: FE Photon Shutter**



**Figure B4: FOE Test Box**

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**Figure B5:** FE Shutter Test Fixture



**Figure B6:** FE Shutter Junction Boxes (inside SR)

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**Figure B7:** FOE Test Box Connection inside PPS Cabinet

**-END-**