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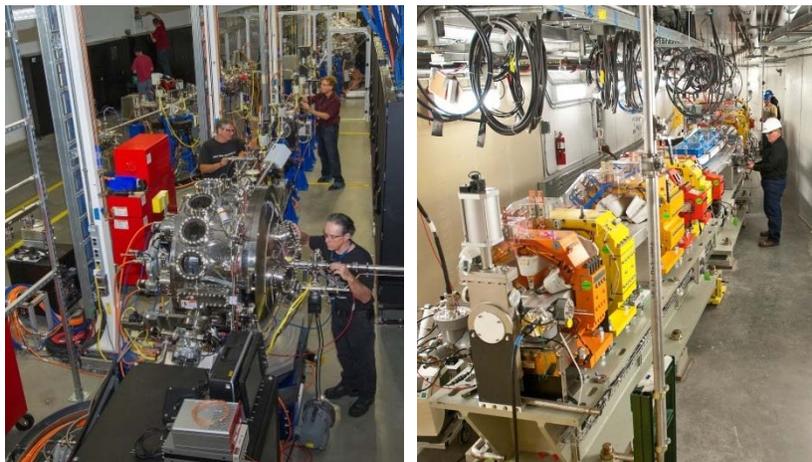
Doc No: NSLSII-ESH-PRC-001

## **NSLS-II PROCEDURE: BEAMLINE RADIOLOGICAL INTERLOCK TEST**

October 10, 2016

Rev. 1

T. McDonald



 **Think Safety. Act Safely.**

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Doc No. NSLSII-ESH-PRC-001	Author: T. McDonald	Review Frequency: 3 yrs	Rev. 1
Title: <b>Beamline Radiological Interlock Test</b>			Effective Date: 10Oct2016

### ESH Review:

10/10/2016

X Robert Chmiel

Robert Chmiel  
NSLS II Safety Officer  
Signed by: Chmiel, Robert

By signing this Procedure I acknowledge that it complies with all ESH requirements and if performed correctly, will not present a significant hazard to personnel or equipment.

### Authorization Basis Review:

10/11/2016

X 

Steve Moss  
Authorization Basis Manager  
Signed by: Moss, Steven H

By signing this Procedure I acknowledge that a USI Screening/Evaluation has been performed and this Procedure does not adversely impact the NSLS-II Authorization Basis Documents.

### Approved:

10/11/2016

X 

Robert Lee  
ESH Manager  
Signed by: Lee, Robert J

By approving this Procedure I agree that the appropriate personnel have reviewed this document and I authorize this work to commence as written.

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### REVISION HISTORY

REVISION	SECTION(S)	PAGE #	DATE	List of Reviewers	DESCRIPTION
1	All	All	10Oct2016	J. Aloï. S. Buda, M. Benmerrouche, B. Lein, E. Orr, C. Porretto, F. Willeke, P. Zschack	First Issue. Procedure created to replace multiple procedures originally developed for each specific NSLS-II beamline. Beamline Radiological test checklists, formerly captured as "Attachment A" in individual test procedures, will now be saved as "Templates" in NSLS-II SharePoint Key Safety Records.

### ACRONYMS

ABM	Authorization Basis Manager
ARM	Area Radiation Monitor
ASE	Accelerator Safety Envelope
BNL	Brookhaven National Laboratory
ESH	Environment, Safety and Health
FOE	First Optical Enclosure
HVPS	High Voltage Power Supply
LOTO	Lockout/Tagout
NSLS-II	National Synchrotron Light Source II
PPS	Personnel Protection System
PS	Power Supply
RF	Radio Frequency
SAF	Safety Approval Form
SBMS	Standards-Based Management System
SR	Storage Ring

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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 all BNL NSLS-II Beamlines. Each beamline PPS system will be re-tested every six months, in accordance with 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 EHS 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 PREREQUISITES

- 2.1 At least one Tester shall be ESH Staff.
- 2.2 Assistants shall be designated by the Testers.
- 2.3 An NSLS-II Engineering Review has been completed for all hutch door switches to ensure proper positioning.

## 3 HAZARDS, CONTROLS AND LIMITS

- 3.1 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*.
- 3.2 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*.
- 3.3 Mufflers shall be used to reduce noise during testing by placing them on the sounders.

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- 3.4 The radiological interlock system for the beamline is 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.
- 3.5 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*.
- 3.6 All configuration control checklists, commissioning approval forms, and SAFs for beamline's requiring venting vacuum shall be voided prior to the start of certification testing.
- 3.7 All steps in the test checklist requiring venting beamline vacuum shall be performed in accordance with PS-C-XFD-PRC-001, *Beamline Vacuum System Venting Procedure*.
- 3.8 All steps in the test checklist requiring testing of beamline FOE ARMs shall be performed in accordance with PS-C-ASD-PRC-008, *NSLS-II Area Radiation Monitor PPS Test*

## 4 PROCEDURE

### 4.1 Test and Certify Radiological Interlocks

**Note:** Two Testers are required to test and certify beamline radiological interlocks.

4.1.1 Testers notify the Lead Operator and Lead Beamline Scientist that a test of the Beamline radiological interlocks will be performed.

4.1.2 Testers obtain the Beamline 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 4.1.3 and 4.1.4.

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4.1.3 Primary Authorized Employee applies LOTO to the following:

- 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*

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

- Gun HVPS Enable switch
- 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 the specific *NSLS-II Beamline Radiological Interlock Test Checklists* may be performed without all of the specified checklist items (i.e., partial radiological interlock test).

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**Note:** The most current version of the specific Beamline Radiological Interlock Checklists are maintained in the Key Safety Records section of the NSLS-II SharePoint Document Center, under the heading “PPS” (<https://ps.bnl.gov/docs/Reference/Forms/KSRPPS.aspx>).

4.1.5 Testers use the specific *NSLS-II Beamline Radiological Interlock Test Checklist* (example in Attachment A) 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.

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

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

- Gun HVPS Enable switch
- 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

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

4.1.9 Testers return the Beamline enable key and the Beamline PPS reset key to the Control Room.

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

- 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

4.1.11 Testers provide the completed test checklist to the Configuration Management Specialist for posting on the NSLS-II SharePoint Document Center.

## 5 REFERENCES

- 5.1 PS-C-ASD-PRC-005, *Centrally Controlled Lockout/Tagout (LOTO) Procedure*
- 5.2 PS-C-ASD-PRC-008, *NSLS-II Area Radiation Monitor PPS Test*
- 5.3 PS-C-ASD-PRC-047, *NSLS-II Booster Ring Radio Frequency System High Voltage Power Supply (BR-HVPS) Lockout/Tagout (LOTO)*
- 5.4 PS-C-ASD-PRC-057, *NSLS-II PPS Configuration Management*
- 5.5 PS-ESH-PRM-3.4.1, *Procedure for Safety System Work Permits*
- 5.6 PS-C-XFD-PRC-010, *Beamline Enclosure Search and Secure and Breaking Security Procedure*
- 5.7 SBMS Program Description: *Radiological Control Manual*
- 5.8 SBMS Subject Area, *Interlock Safety for High Risk Hazards*

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- 5.9 SBMS Subject Area, *Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance*
- 5.10 PS-C-CMD-PRC-002, *Records Management Procedure*
- 5.11 PS-C-ASD-SPC-SR-PPS-001, *Storage Ring Personnel Protection System (SPPS) Design Description*
- 5.12 PS-C-XFD-PRC-001, *Beamline Vacuum System Venting Procedure*
- 5.13 PS-C-XFD-SPC-PPS-001, *Beamline Personnel Protection System, (BLPPS) and Front End Personnel Protection System Design Description*

## 6 ATTACHMENTS

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

## 7 DOCUMENTATION

The following record 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 Radiological Interlock Test Checklists

## 8 DEFINITIONS

None.

[If you have any questions or feedback regarding this document, please click this link.](#)

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## Attachment A

### EXAMPLE NSLS-II Beamline 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 17-BM (Beamline HMI)	Previous 17-BM SS#	Date: / /	
A Chain:                      B Chain:	A Chain:	B Chain:	
** Safety Signature Pentant 5 Beamline (SR HMI)	Previous Pentant 5 SS#	Date: / /	
A Chain:                      B Chain:	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 NSLS-II 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**

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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**A**

*Close the Right door*

“Entry Permitted” sign is ON

*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 Interlocked A and B ON (**green**), HMI

“Interlocked” sign is ON

Maglock A and B ON, HMI

*Press the SBE/Access Button*

Interlocked sign OFF, “Entry Permitted” sign is ON

FOE Interlocked A and B OFF, HMI

Maglock A OFF (may require opening Maglock on key pad)

*Open door*

Door opens, Maglock B OFF door

A3

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

**A**

*Press SB2*

SB2 does not illuminate

*Press SB1*

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SB1 illuminates \_\_\_\_\_

Close hutch door and press SBE \_\_\_\_\_

Hutch does NOT secure \_\_\_\_\_

**A4 Search timeout**

**A**

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**) \_\_\_\_\_

“Beam On” sign is 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**

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 \_\_\_\_\_

Right Maglock A ON (**green**) \_\_\_\_\_

Left Maglock A ON (**green**) \_\_\_\_\_

Press ES \_\_\_\_\_

FE Shutters A and B closed (**red**) \_\_\_\_\_

FOE Interlocked A and B OFF \_\_\_\_\_

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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 (green)	_____	_____	_____

**A7** **FOE 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).

	<u>A</u>	<u>B</u>	<u>Latch</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)	_____	_____	_____
Cable Lab 1 Switches/Latch 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	_____	_____	_____
Cable Lab 1 Switch/Latch Permit OFF	_____	_____	_____
FE Critical Device Permits A and B OFF	_____	_____	_____
<i>Replace switch actuator and reset fault</i>	_____	_____	_____
Remove labyrinth actuators and close labyrinth door			_____

**A8** **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).

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	<u>A</u>	<u>B</u>	<u>Reed</u>
<i>Search hutch</i>	_____	_____	_____
<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> )	_____	_____	_____
FOE Door Switch Sum A and B ON ( <b>green</b> )	_____	_____	_____
FE Critical Device Permits A and B ON	_____	_____	_____
<i>Remove one switch actuator</i>	_____	_____	_____
FE Shutters A and B closed ( <b>red</b> )	_____	_____	_____
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			_____

A9

**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>A</u>	<u>B</u>	<u>Reed</u>
<i>Search hutch</i>	_____	_____	_____
<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> )	_____	_____	_____
FOE Door Switch Sum A and B ON ( <b>green</b> )	_____	_____	_____
FE Critical Device Permits A and B ON	_____	_____	_____
<i>Remove one switch actuator</i>	_____	_____	_____

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FE Shutters A and B closed ( <b>red</b> )	_____	_____	_____
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			_____

**A10** **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)

	<b><u>R</u></b>	<b><u>L</u></b>
<i>Search hutch</i>	_____	_____
FOE Interlocked A and B ON ( <b>green</b> )	_____	_____
FE Shutter Permit A and B ON ( <b>green</b> )	_____	_____
Door Maglock A and B ON ( <b>green</b> )	_____	_____
<i>Open FE Shutters</i>	_____	_____
FE Shutters open ( <b>green</b> )	_____	_____
<i>Using FOE test box, turn OFF Maglock</i>	_____	_____
Door Maglock A OFF	_____	_____
FE Shutters closed ( <b>red</b> )	_____	_____
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:</i> FE Critical Devices Permits A Chain OFF	_____	_____

**A11** **Observe FE Safety Shutter(s) Operation**

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

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	Shutters are in the closed (down) position	_____
	FE Shutter Closed A and B ( <b>red</b> ), HMI	_____
<i>Turn the "Air" switch ON</i>		_____
<i>Open FE Photon Shutter and SSs A and B</i>	Shutters open freely without hesitation	_____
	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>A12</b>	<b><i>FE Safety Shutters can only be Closed if FE Photon Shutter is Closed</i></b>	
<i>Search hutch</i>	FOE Interlocked A and B ON ( <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>A13</b>	<b><i>Beamline Enable Key (Opening shutter without key trips SR RF and Dipole PS)</i></b>	
<i>Remove beamline enable key</i>	Beamline Online A and B OFF	_____
<i>Search FOE</i>	FOE Interlocked A and B ON ( <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><i>Live Testing</i></b>	
<b>A14</b>	<b><i>Reach Back FOE Door Switches</i></b>	
<i>Secure P1 through P5</i>	SR Secure, A and B chain, SR HMI	_____

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<i>Place actuators on FOE hutch downstream left door switches and Maglock</i>		_____
<i>Search hutch</i>	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 17 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, HMI	_____
	FE Critical Devices Permits A chain OFF, HMI	_____
<i>Check I/O Box 17 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 Shutters</i>	Shutters closed	_____

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Replace A chain door switch holder and reset fault(s)		_____
<i>Search hutch</i>		_____
	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 17 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	_____
Remove " <b>B chain</b> " switch actuator	FOE Interlocked B OFF, HMI	_____
	FE Critical Devices Permits B OFF, HMI	_____
<i>Check I/O Box 17 Beamline Enable Panel</i>	FE Critical Devices Permit B LED OFF	_____
<i>Check Control Room SR HMI (MCR beamline 1)</i>	FE Critical Device Permits 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>		_____

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*Remove hutch switch holders and Maglock actuator* \_\_\_\_\_

**A15 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 Shutters and remove test device* \_\_\_\_\_

**A16 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 -**