Doc No: NSLSII-ESH-PRC-001

NSLS-II Procedure: Beamline Radiological Interlock Test

October 10, 2016
Rev. 1
T. McDonald
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

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

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

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<tr>
<td>1</td>
<td>All</td>
<td>All</td>
<td>10Oct2016</td>
<td>J. Aloi, S. Buda, M. Benmerrouche, B. Lein, E. Orr, C. Porretto, F. Willeke, P. Zschack</td>
<td>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.</td>
</tr>
</tbody>
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**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
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.
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.
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).
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
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
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.
Attachment A

EXAMPLE NSLS-II Beamline Radiological Interlock Test Checklist

<table>
<thead>
<tr>
<th>Test Reason</th>
<th>Test Result: □ Passed □ Failed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Date:</td>
<td>Start Time: Finish Time:</td>
</tr>
<tr>
<td>Tester 1:</td>
<td>Assistant 1:</td>
</tr>
<tr>
<td>Tester 2:</td>
<td>Assistant 2:</td>
</tr>
<tr>
<td>Tester 1 Signature:</td>
<td>Tester 2 Signature:</td>
</tr>
<tr>
<td>*Reviewer 1:</td>
<td>Reviewer 1 sig.:</td>
</tr>
<tr>
<td>Reviewer 2:</td>
<td>Reviewer 2 sig.:</td>
</tr>
<tr>
<td>** Safety Signature 17-BM (Beamline HMI)</td>
<td>Previous 17-BM SS# Date: / /</td>
</tr>
<tr>
<td>A Chain:</td>
<td>B Chain:</td>
</tr>
<tr>
<td>** Safety Signature Pentant 5 Beamline (SR HMI)</td>
<td>Previous Pentant 5 SS# Date: / /</td>
</tr>
<tr>
<td>A Chain:</td>
<td>B Chain:</td>
</tr>
</tbody>
</table>

* 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
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

Out of Sequence Search in the FOE (A hutch)

Press SB2
SB2 does not illuminate

Press SB1
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A3

SB1 illuminates

Close hutch door and press SBE

Hutch does NOT secure

A4 Search timeout

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

<table>
<thead>
<tr>
<th>ES1</th>
<th>ES2</th>
<th>ES3</th>
</tr>
</thead>
</table>

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
FE 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)

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).

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)

Cable Lab 1 Switches/Latch 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

Cable Lab 1 Switch/Latch Permit OFF

FE Critical Device Permits A and B OFF

Replace switch actuator and reset fault

Remove labyrinth actuators and close labyrinth door

Place actuators on the door switches and Maglock.

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

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).

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

A5
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**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*

**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)

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Search hutch</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FOE Interlocked A and B ON (green)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FE Shutter Permit A and B ON (green)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Door Maglock A and B ON (green)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Open FE Shutters</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FE Shutters open (green)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Using FOE test box, turn OFF Maglock</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Door Maglock A OFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FE Shutters closed (red)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FOE Interlocked A OFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FE Shutter Permit A OFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Turn On Maglock and reset fault</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Search hutch</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Using FE Shutter test fixture, Open FE Shutters</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FE Critical Device Permits A and B ON</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Using FOE test box, turn OFF Maglock</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Within 3 seconds</strong>: FE Critical Devices Permits A Chain OFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disconnect the FOE test box and reset fault</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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

**A12 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

**A13 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 fixture

Beamline Online A and B ON (green)

**Live Testing**

**A14 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

<table>
<thead>
<tr>
<th>Search hutch</th>
<th>FE Interlocked A and B ON (green), HMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check Control Room SR HMI (MCR beamline 1)</td>
<td>FE Critical Device Permit A and B ON (green), SR HMI</td>
</tr>
<tr>
<td>Check I/O Box 17 Beamline Enable Panel</td>
<td>FE Critical Devices Permits A and B LEDs ON</td>
</tr>
<tr>
<td>Check I/O Box 28 Beamline Enable Panel</td>
<td>FE Critical Device Permit Sum A and B LEDs ON</td>
</tr>
<tr>
<td>Check Dipole PS (positive) Beamline Interface</td>
<td>A and B Permits ON, Dipole PS Pos. Interface</td>
</tr>
<tr>
<td>Check Dipole PS (negative) Beamline Interface</td>
<td>A and B Permits ON, Dipole PS Neg. Interface</td>
</tr>
<tr>
<td>Check SR RF System C HVPS Beamline Interface</td>
<td>A and B Permits ON, SR RF System C HVPS Interface</td>
</tr>
<tr>
<td>Check SR RF System D HVPS Beamline Interface</td>
<td>A and B Permits ON, SR RF System D HVPS Interface</td>
</tr>
<tr>
<td>Operator enables SR Dipole PS</td>
<td>SR Dipole PS is ON</td>
</tr>
<tr>
<td>Operator enables SR RF System C HVPS</td>
<td>SR RF System C HVPS is ON</td>
</tr>
<tr>
<td>Operator enables SR RF System D HVPS</td>
<td>SR RF System D HVPS is ON</td>
</tr>
<tr>
<td>Using FE Shutter test fixture, open the FE Shutters (SSA, SSB and Photon)</td>
<td>FE Shutters Open</td>
</tr>
</tbody>
</table>

Remove an “A chain” door switch actuator from beamline hutch door

| Check I/O Box 17 Beamline Enable Panel | FE Critical Devices Permits A chain OFF, HMI |
| Check I/O Box 28 Beamline Enable Panel | FE Critical Devices Permit 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 |
| Close Shutters | Shutters closed |

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**Beamline Radiological Interlock Test**

**Effective Date:** 10 Oct 2016
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 17 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 17 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 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 -