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

Test Reason: Initial Test

<table>
<thead>
<tr>
<th>Test Date: 5/16-5/25/2016</th>
<th>Test Result: [ ] Passed [ ] Failed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Type: [ ] Pre-Certification [ ] Certification [ ] Partial</td>
<td></td>
</tr>
<tr>
<td>Start Time:</td>
<td>Finish Time:</td>
</tr>
<tr>
<td>Tester 1:</td>
<td>Tester 2:</td>
</tr>
<tr>
<td>Tester 1 Signature:</td>
<td>Tester 2 Signature:</td>
</tr>
<tr>
<td>Reviewer 1:</td>
<td>Reviewer 2:</td>
</tr>
<tr>
<td>Reviewer 1 sig.:</td>
<td>Reviewer 2 sig.:</td>
</tr>
</tbody>
</table>

**Safety Signature 4-ID (Beamline HMI)**
A Chain: 4FZVY7C15 B Chain: 4FZVY7C15

**Safety Signature Pantent 2 Beamline (SR HMI)**
A Chain: DF9F2804 B Chain: 4FZVY7C15

*Review 1 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:

1. All hutch door switches have been evaluated by Mechanical Engineering for proper positioning
2. Inform Control Room Lead Operator that testing will be done
3. Obtain Beamline enable and PPS reset keys from Control Room
4. Verify that beamline vacuum and water interlocks are satisfied
5. Place muffler on beam imminent sounder
6. 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
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
### Title: Beamline 4-ID Radiological Interlock Test

#### A3 Out of Sequence Search

Repeat steps for each 4-ID hutch (B hutch has only one interior SB)

- **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

- **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

- Enable beamline with key and perform a reset
- Search the FOE
- Open FE shutters
- Close FE shutters

Beamline Online A and B OFF
Beamline Online A and B ON (green)
FE Shutter Permits A and B ON after Beam
Imminent Warning
FE Shutters A and B indicate open (green)
2 “Beam On” signs are ON
FE Shutters A and B indicate closed (red)

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

For each ES search hutch

Open FE Shutters from keypad

<table>
<thead>
<tr>
<th>ES</th>
<th>ES1</th>
<th>ES2</th>
<th>ES3</th>
<th>ES4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

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A3
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| National Synchrotron Light Source II, Brookhaven National Laboratory |
|---|---|---|---|
| Doc No. PS-C-XFD-PRC-057 | Author: T. McDonald | Effective Date: 06 May 2016 | Version 1 |
| Review Frequency: 3 yrs | Technical |

**Title:** Beamline 4-ID Radiological Interlock Test

- 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

**Full out ES**

- ES Sum Latch OFF

**Reset fault**

- ES Sum Latch ON (green)

**A7 Emergency Stops (ES) B Hutch**

For each ES search hutch

**Open FE and LIS1 Shutters from keypad**

<table>
<thead>
<tr>
<th>FS1</th>
<th>ES2</th>
<th>ES3</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE Shutters A and B open (green)</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>LIS1 Shutter A and B open (green)</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>B Interlocked A and B ON (green)</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>LIS1 Shutter Permit A and B ON (green)</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>FE Critical Device Permits A and B ON</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Right Maglock ON A and B (green)</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

**Press ES**

- FE Shutters A and B closed (red)
- LIS1 Shutter A and B closed (red)
- B Interlocked A and B OFF
- LIS1 Shutter Permit A and B OFF
- FE Critical Device Permits A and B OFF
- Rear Maglock A OFF
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</tr>
</thead>
<tbody>
<tr>
<td>Title:</td>
<td>Beamline 4-ID Radiological Interlock Test</td>
<td></td>
<td></td>
<td></td>
<td>Technical</td>
</tr>
</tbody>
</table>

**Pull out ES**

- ES Sum Latch OFF  

**Reset fault**

- ES Sum Latch ON (green)

**Emergency Stops (ES) C Hutch**

For each ES search hutch. Beam stop is closed

<table>
<thead>
<tr>
<th></th>
<th>ES1</th>
<th>ES2</th>
<th>ES3</th>
<th>ES4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open FE, L1S1 and L1S3 Shutters from keypad</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>FE Shutters A and B open (green)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>L1S3 Shutter A and B open (green)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>C Interlocked A and B ON (green)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>L1S3 Shutter Permit A and B ON (green)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>FE Critical Device Permits A and B ON</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Right Maglock ON A and B (green)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Left Maglock ON A and B (green)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

**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)

**Emergency Stops (ES) D Hutch**

For each ES search hutch. Beam stop is open

<table>
<thead>
<tr>
<th></th>
<th>ES1</th>
<th>ES2</th>
<th>ES3</th>
<th>ES4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open FE, L1S1 and L1S3 Shutters from keypad</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>FE Shutters A and B open (green)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>L1S3 Shutter A and B open (green)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>D Interlocked A and B ON (green)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Title: Beamline 4-ID Radiological Interlock Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1S3 Shutter Permit A and B ON (green)</td>
</tr>
<tr>
<td>FE Critical Device Permits A and B ON</td>
</tr>
<tr>
<td>Front Right Maglock ON A and B (green)</td>
</tr>
<tr>
<td>Front Left Maglock ON A and B (green)</td>
</tr>
<tr>
<td>Rear Right Maglock ON A and B (green)</td>
</tr>
<tr>
<td>Rear Left Maglock ON A and B (green)</td>
</tr>
</tbody>
</table>

**Press ES**

<table>
<thead>
<tr>
<th>FE Shutters A and B closed (red)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1S3 Shutter A and B closed (red)</td>
</tr>
<tr>
<td>D Interlocked A and B OFF</td>
</tr>
<tr>
<td>L1S3 Shutter Permit A and B OFF</td>
</tr>
<tr>
<td>FE Critical Device Permits A and B OFF</td>
</tr>
<tr>
<td>Front Right Maglock A OFF</td>
</tr>
<tr>
<td>Front Left Maglock A OFF</td>
</tr>
<tr>
<td>Rear Right Maglock A OFF</td>
</tr>
<tr>
<td>Rear Left Maglock A OFF</td>
</tr>
</tbody>
</table>

**Pull out ES**

<table>
<thead>
<tr>
<th>ES Sum Latch OFF</th>
</tr>
</thead>
</table>

**Reset fault**

<table>
<thead>
<tr>
<th>ES Sum Latch ON (green)</th>
</tr>
</thead>
</table>
**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.

**Search hutch**

- **Open FE Shutter 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.

**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)

**ONLY 1 SET OF SWITCHES ON THIS Labyrinth**

**A7**
# Beamline 4-ID Radiological Interlock Test

<table>
<thead>
<tr>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE Critical Device Permits A and B ON</td>
</tr>
<tr>
<td>Remove one switch actuator</td>
</tr>
<tr>
<td>Cable Lab 1 Switch/Latch Permit OFF</td>
</tr>
<tr>
<td>B Interlocked OFF</td>
</tr>
<tr>
<td>L1S1 Shutter Permit OFF</td>
</tr>
<tr>
<td>L1S1 Shutter A and B closed (red)</td>
</tr>
<tr>
<td>FE Critical Device Permits A and B OFF</td>
</tr>
<tr>
<td>Replace switch actuator and reset fault</td>
</tr>
<tr>
<td>Remove labyrinth actuators and close labyrinth door</td>
</tr>
</tbody>
</table>

**A12 Hutz 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

**Search hutch**

**Open FE, L1S1 and L1S3 Shutters from keypad**

<table>
<thead>
<tr>
<th>A1</th>
<th>A2</th>
<th>B1</th>
<th>B2</th>
<th>Latch</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1S3 Shutter A and B open (green)</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>C Interlocked A and B ON (green)</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1S3 Shutter Permit A and B ON (green)</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Cable Lab 1 Switch/Latch A and B ON (green)</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>FE Critical Device Permits A and B ON</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>

**Remove one switch actuator**

<table>
<thead>
<tr>
<th>✔️</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable Lab 1 Switch/Latch Permit OFF</td>
</tr>
<tr>
<td>C Interlocked OFF</td>
</tr>
<tr>
<td>L1S3 Shutter Permit OFF</td>
</tr>
<tr>
<td>L1S3 Shutter A and B closed (red)</td>
</tr>
<tr>
<td>FE Critical Device Permits A and B OFF</td>
</tr>
</tbody>
</table>

**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

**Search hutch**

**Open FE, L1S1 and L1S3 Shutters from keypad**

<table>
<thead>
<tr>
<th></th>
<th>A1</th>
<th>A2</th>
<th>B1</th>
<th>B2</th>
<th>Latch</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1S3 Shutter A and B open (green)</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>D Interlocked A and B ON (green)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>L1S3 Shutter Permit A and B ON (green)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Cable Lab 1 Switch/Latch A and B ON (green)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>FE Critical Device Permits A and B ON</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

**Remove one switch actuator**

<table>
<thead>
<tr>
<th></th>
<th>A1</th>
<th>A2</th>
<th>B1</th>
<th>B2</th>
<th>Latch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable Lab 1 Switch/Latch Permit OFF</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>D Interlocked OFF</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>L1S3 Shutter Permit OFF</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>L1S3 Shutter A and B closed (red)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>FE Critical Device Permits A and B OFF</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

**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

**Search hutch**

**Open FE, L1S1 and L1S3 Shutters from keypad**

<table>
<thead>
<tr>
<th></th>
<th>A1</th>
<th>A2</th>
<th>B1</th>
<th>B2</th>
<th>Latch</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1S3 Shutter A and B open (green)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>D Interlocked A and B ON (green)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>L1S3 Shutter Permit A and B ON (green)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Cable Lab 2 Switch/Latch A and B ON (green)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
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Title: Beamline 4-ID Radiological Interlock Test

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).

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).

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

<table>
<thead>
<tr>
<th>A1</th>
<th>A2</th>
<th>B1</th>
<th>B2</th>
<th>Reed</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>
**Beamline 4-ID Radiological Interlock Test**

- 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).

<table>
<thead>
<tr>
<th>Search hutch</th>
<th>A1</th>
<th>A2</th>
<th>B1</th>
<th>B2</th>
<th>Reed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open FE Shutters from keypad</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

- 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).
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

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

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
Title: Beamline 4-ID Radiological Interlock Test

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
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 hutch; D hutch not secured

Open FE, LIS1 and LIS3 Shutters

- FE Shutters A and B open (green)
- FE Critical Device Permits A and B ON
- LIS3 Shutter A and B open (green)
- Beam Stop indicates Open (green)
- C Interlocked A and B ON (green)
- LIS3 Shutter Permit A and B ON (green)

Remove one actuator

- Beam Stop Does Not indicate Open (red)
- LIS3 Shutter A and B closed (red)
- LIS3 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

Search hutch

Open FE, LIS1 and LIS3 Shutters from keypad

- FE Shutters A and B open (green)
- LIS3 Shutter A and B open (green)
- D Interlocked A and B ON (green)
- LIS3 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
Title: Beamline 4-ID Radiological Interlock Test

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

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

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).
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*

**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).

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*
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---

**Beamline 4-ID Radiological Interlock Test**

| 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

**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).

| Search hutch | ✓ | ✓ | ✓ | ✓ |
| L1S3 Shutter A and B ON (green) | ✓ | ✓ | ✓ | ✓ |
| FE Shutter Permit A and B ON (green) | ✓ | ✓ | ✓ | ✓ |
| Door Maglock A and B ON (green) | ✓ | ✓ | ✓ | ✓ |

Open FE Shutters

FE Shutter open (green)

Using FOE test box, turn OFF Maglock

Door Maglock A OFF

FOE Shutter 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

**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

**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**

---

**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)

**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)
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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

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.

<table>
<thead>
<tr>
<th>Meter Reading</th>
<th>Meter Reading</th>
<th>Current STA A</th>
<th>Current STA B</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1= 1.54</td>
<td>B1= 1.68</td>
<td>A STA1= 1.54</td>
<td>B STA1= 1.68</td>
</tr>
<tr>
<td>A2= 1.57</td>
<td>B2= 1.67</td>
<td>A STA2= 1.57</td>
<td>B STA2= 1.67</td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th>Trip Points</th>
<th>Trip Points (- 15%)</th>
<th>Recorded A Trip</th>
<th>Recorded B Trip</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPS 1: 1.5 GPM</td>
<td>1.3 GPM</td>
<td>A STA1= 1.3</td>
<td>B STA1= 1.3</td>
</tr>
<tr>
<td>PPS 2: 1.3 GPM</td>
<td>1.3 GPM</td>
<td>A STA2= 1.3</td>
<td>B STA2= 1.3</td>
</tr>
<tr>
<td>PPS 3: TBD</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Repeat each step for all water flow meters

**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

**Water Safety Test Amplifier Faults**

Repeat each step for all water flow meters
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

**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).
Record the Transmitter meter readings (absolute pressure):

<table>
<thead>
<tr>
<th>Meter Reading</th>
<th>Meter Reading</th>
<th>Current STA A</th>
<th>Current STA B</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 = 35.1</td>
<td>B1 = 37.1</td>
<td>A STA1 = 32.07</td>
<td>B STA1 = 33.08</td>
</tr>
</tbody>
</table>

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)

- 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

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
# Beamline 4-ID Radiological Interlock Test

**Reset fault at I/O box**

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

**A35 Observe Beamline Photon Shutter Operation**

<table>
<thead>
<tr>
<th></th>
<th>L1S1</th>
<th>L1S3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close Beamline Photon Shutter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shutter indicates closed A and B (red), HMI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Beamline Photon Shutter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shutter opens smoothly without hesitation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shutter indicates open A and B (green), HMI</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Shutter test fixture</td>
<td></td>
</tr>
<tr>
<td>Shutter indicates closed A and B (red), HMI</td>
<td></td>
</tr>
</tbody>
</table>

**Turn the “Air” switch ON**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn the “Air” switch ON</td>
<td></td>
</tr>
<tr>
<td>Shutter indicates open A and B (green), HMI</td>
<td></td>
</tr>
</tbody>
</table>

**Actuate Shutters closed**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Actuate Shutters closed</td>
<td></td>
</tr>
<tr>
<td>Shutter indicates closed A and B (red), HMI</td>
<td></td>
</tr>
</tbody>
</table>

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

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Search hutch</td>
<td>FOE Interlocked A and B ON (green), HMI</td>
</tr>
<tr>
<td>Open FE SSA</td>
<td>SSA Open</td>
</tr>
<tr>
<td>Open FE Photon Shutter</td>
<td>FE Critical Devices Permits A and B ON (green), HMI</td>
</tr>
<tr>
<td>Close Shutters</td>
<td></td>
</tr>
<tr>
<td>Reset fault</td>
<td>FE Critical Devices Permits A and B ON (green), HMI</td>
</tr>
<tr>
<td>Open FE SSB</td>
<td>SSB Open</td>
</tr>
<tr>
<td>Open FE Photon Shutter</td>
<td>FE Critical Devices Permits A and B OFF, HMI</td>
</tr>
</tbody>
</table>
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National Synchrotron Light Source II, Brookhaven National Laboratory

**Title:** Beamline 4-ID Radiological Interlock Test

### Close shutters
- Reset fault

#### Beamline Enable Key (Opening Shutter Without Key Trips SR RF and Dipole PS)
- Remove beamline enable key
- Search FOE
- Using FE Shutter test fixture, Open FE Shutters
- Replace beamline enable key and reset faults

### Live Testing

#### Reach Back FOE Door Switches
- Secure P1 through P5
- Place actuators on FOE hatch downstream left door switches and Maglock
- Search hutch
- Check Control Room SR HMI (MCR beamline 1)
- Check I/O Box 4 Beamline Enable Panel
- Check I/O Box 28 Beamline Enable Panel
- Check Dipole PS (positive) Beamline Interface
- Check Dipole PS (negative) Beamline Interface
- Check SR RF System C HVPS Beamline Interface
- Check SR RF System D HVPS Beamline Interface
- Operator enables SR Dipole PS
- Operator enables SR RF System C HVPS
- Operator enables SR RF System D HVPS
- Using FE Shutter test fixture, open the FE Shutters (SSA, SSB and Photon)

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

FOE Interlocked OFF A, HMI
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<table>
<thead>
<tr>
<th>Title: Beamline 4-ID Radiological Interlock Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Check I/O Box 4 Beamline Enable Panel</strong></td>
</tr>
<tr>
<td><strong>Check I/O Box 28 Beamline Enable Panel</strong></td>
</tr>
<tr>
<td><strong>Check Control Room SR HMI (MCR beamline 1)</strong></td>
</tr>
<tr>
<td><strong>Check SR RF System C HVPS Beamline Interface</strong></td>
</tr>
<tr>
<td><strong>Check SR RF System D HVPS Beamline Interface</strong></td>
</tr>
<tr>
<td><strong>Check Dipole PS (positive) Beamline Interface</strong></td>
</tr>
<tr>
<td><strong>Check Dipole PS (negative) Beamline Interface</strong></td>
</tr>
<tr>
<td><strong>Close FE Shutter with test fixtures</strong></td>
</tr>
<tr>
<td><strong>Replace A chain door switch holder and reset fault(s)</strong></td>
</tr>
<tr>
<td><strong>Search hutch</strong></td>
</tr>
<tr>
<td><strong>Close FE Shutters closed</strong></td>
</tr>
<tr>
<td><strong>Check Control Room SR HMI (MCR beamline 1)</strong></td>
</tr>
<tr>
<td><strong>Check I/O Box 4 Beamline Enable Panel</strong></td>
</tr>
<tr>
<td><strong>Check I/O Box 28 Beamline Enable Panel</strong></td>
</tr>
<tr>
<td><strong>Check Dipole PS (positive) Beamline Interface</strong></td>
</tr>
<tr>
<td><strong>Check Dipole PS (negative) Beamline Interface</strong></td>
</tr>
<tr>
<td><strong>Check SR RF System C HVPS Beamline Interface</strong></td>
</tr>
<tr>
<td><strong>Check SR RF System D HVPS Beamline Interface</strong></td>
</tr>
<tr>
<td><strong>Operator enables SR Dipole PS</strong></td>
</tr>
<tr>
<td><strong>Operator enables SR RF System D HVPS</strong></td>
</tr>
<tr>
<td><strong>Operator enables SR RF System D HVPS</strong></td>
</tr>
<tr>
<td><strong>Using FE Shutter test fixture, open the FE Shutters (SSA, SSB and Photon)</strong></td>
</tr>
<tr>
<td><strong>Using FE Shutter test fixture, open the FE Shutters (SSA, SSB and Photon)</strong></td>
</tr>
<tr>
<td><strong>Using FE Shutter test fixture, open the FE Shutters (SSA, SSB and Photon)</strong></td>
</tr>
<tr>
<td><strong>Using FE Shutter test fixture, open the FE Shutters (SSA, SSB and Photon)</strong></td>
</tr>
</tbody>
</table>
## Beamline 4-ID Radiological Interlock Test

<table>
<thead>
<tr>
<th>Task</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove “B chain” switch actuator</td>
<td>✔</td>
</tr>
<tr>
<td>FOE Interlocked B OFF, HMI</td>
<td>✔</td>
</tr>
<tr>
<td>FE Critical Devices Permits B OFF, HMI</td>
<td>✔</td>
</tr>
<tr>
<td>Check I/O Box 4 Beamline Enable Panel</td>
<td>✔</td>
</tr>
<tr>
<td>FE Critical Devices Permit B LED OFF</td>
<td>✔</td>
</tr>
<tr>
<td>Check Control Room SR HMI (MCR beamline 1)</td>
<td>✔</td>
</tr>
<tr>
<td>FE Critical Device Permits B OFF (red), SR HMI</td>
<td>✔</td>
</tr>
<tr>
<td>Check I/O Box 28 Beamline Enable Panel</td>
<td>✔</td>
</tr>
<tr>
<td>FE Critical Device Permit Sum B LED OFF</td>
<td>✔</td>
</tr>
<tr>
<td>Check SR RF System C HVPS Beamline Interface</td>
<td>✔</td>
</tr>
<tr>
<td>B Permits OFF, SR RF System C HVPS Interface</td>
<td>✔</td>
</tr>
<tr>
<td>Check SR RF System D HVPS Beamline Interface</td>
<td>✔</td>
</tr>
<tr>
<td>B Permits OFF, SR RF System D HVPS Interface</td>
<td>✔</td>
</tr>
<tr>
<td>Check Dipole PS (positive) Beamline Interface</td>
<td>✔</td>
</tr>
<tr>
<td>B Permits OFF, Dipole PS Pos. Interface</td>
<td>✔</td>
</tr>
<tr>
<td>SR Dipole is OFF</td>
<td>✔</td>
</tr>
<tr>
<td>Check Dipole PS (negative) Beamline Interface</td>
<td>✔</td>
</tr>
<tr>
<td>B Permits OFF, Dipole PS Neg. Interface</td>
<td>✔</td>
</tr>
<tr>
<td>SR RF System C HVPS is OFF</td>
<td>✔</td>
</tr>
<tr>
<td>SR RF System D HVPS is OFF</td>
<td>✔</td>
</tr>
<tr>
<td>Close FE Shutters with test fixture</td>
<td>✔</td>
</tr>
<tr>
<td>Remove beamline hutch switch holders and Maglock actuator</td>
<td>✔</td>
</tr>
</tbody>
</table>

### Water Interlock (Live)

<table>
<thead>
<tr>
<th>Task</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search FOE</td>
<td>✔</td>
</tr>
<tr>
<td>FOE Interlocked A and B ON (green), HMI</td>
<td>✔</td>
</tr>
<tr>
<td>FE Shutter Permits A and B ON (green), HMI</td>
<td>✔</td>
</tr>
<tr>
<td>Check I/O Box 4 Beamline Enable Panel</td>
<td>✔</td>
</tr>
<tr>
<td>FE Critical Devices Permits A and B ON (green), HMI</td>
<td>✔</td>
</tr>
<tr>
<td>Check I/O Box 28 Beamline Enable Panel</td>
<td>✔</td>
</tr>
<tr>
<td>FE Critical Device Permit Sum A and B LEDs ON</td>
<td>✔</td>
</tr>
<tr>
<td>Check Control Room SR HMI (MCR beamline 1)</td>
<td>✔</td>
</tr>
<tr>
<td>FE Critical Device Permit A and B ON (green), SR HMI</td>
<td>✔</td>
</tr>
<tr>
<td>Check Dipole PS (positive) Beamline Interface</td>
<td>✔</td>
</tr>
<tr>
<td>A and B Permits ON, Dipole PS Pos. Interface</td>
<td>✔</td>
</tr>
<tr>
<td>Check Dipole PS (negative) Beamline Interface</td>
<td>✔</td>
</tr>
<tr>
<td>A and B Permits ON, Dipole PS Neg. Interface</td>
<td>✔</td>
</tr>
<tr>
<td>Check SR RF System C HVPS Beamline Interface</td>
<td>✔</td>
</tr>
<tr>
<td>A and B Permits ON, SR RF System C HVPS Interface</td>
<td>✔</td>
</tr>
<tr>
<td>Check SR RF System D HVPS Beamline Interface</td>
<td>✔</td>
</tr>
<tr>
<td>A and B Permits ON, SR RF System D HVPS Interface</td>
<td>✔</td>
</tr>
<tr>
<td>Operator enables SR Dipole PS</td>
<td>✔</td>
</tr>
<tr>
<td>SR Dipole PS is ON</td>
<td>✔</td>
</tr>
<tr>
<td>Operator enables SR RF System C HVPS</td>
<td>✔</td>
</tr>
<tr>
<td>SR RF System C HVPS is ON</td>
<td>✔</td>
</tr>
<tr>
<td>Operator enables SR RF System D HVPS</td>
<td>✔</td>
</tr>
<tr>
<td>SR RF System D HVPS is ON</td>
<td>✔</td>
</tr>
</tbody>
</table>
**Title:** Beamline 4-ID Radiological Interlock Test

**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**
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National Synchrotron Light Source II, Brookhaven National Laboratory

<table>
<thead>
<tr>
<th>Doc No.</th>
<th>PS-C-XFD-PRC-057</th>
<th>Author: T. McDonald</th>
<th>Effective Date: 06 May 2016</th>
<th>Review Frequency: 3 yrs</th>
<th>Version 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Beamline 4-ID Radiological Interlock Test</td>
<td>Technical</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**A42 FOE Area Radiation Monitor**

Refer to PS-C-ASD-PRC-003, 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 -
Addendum to 4-ID Initial Radiological Interlock test Certification (Certified May 2016)

A1 PPS Aperture

Record the Transmitter meter readings (absolute pressure):

<table>
<thead>
<tr>
<th>Meter Reading</th>
<th>Meter Reading</th>
<th>Current STA A</th>
<th>Current STA B</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 = 30.2</td>
<td>B1 = 30.2</td>
<td>STA A = 30.2</td>
<td>STA B = 30.2</td>
</tr>
</tbody>
</table>

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

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

Using the valve, turn to below trip point at 18 psia

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

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

Test Result:

☑ Passed    ☐ Failed

Tested By: [Signature] Date: 6/21/16

Tested By: [Signature] Date: 6/21/2016
### Attachment D

**NSLS-II Beamline (FOE) Area Radiation Monitor Checklist**

*Note:* Signatures below indicate that the test has been completed.

<table>
<thead>
<tr>
<th>Monitor #</th>
<th>ID #</th>
<th>Beamline:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1NO7372</td>
<td>4ID</td>
</tr>
</tbody>
</table>

**Test Reason:** [ ] Beamline Certification [ ] Replacement/Repair

<table>
<thead>
<tr>
<th>Test Date:</th>
<th>Test Result</th>
<th>Tester Signature:</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/24/16</td>
<td>[ ] Passed</td>
<td>T. McDonald</td>
</tr>
</tbody>
</table>

**RCD Signature:**

---

**Fail Alarm:** Place checkmark (✓) in checkbox (☐) for each correct response.

<table>
<thead>
<tr>
<th>Local Expected Observation</th>
<th>HMI/CR Expected Observation</th>
<th>Linac HMI</th>
<th>CR HMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator turns on Gun</td>
<td>Gun HVPS is ON ☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>RCD Disables Monitor</td>
<td>Gun Contactor ON A Chain</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Silence CR Alarm</td>
<td>Alarm sounds in Control Room</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Gun turns Off</td>
<td>Fail alarm ON HMI (yellow border around ARM icon)</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Return monitor to normal</td>
<td>Gun HVPS remains OFF ☑</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Reset fault in Control Room</td>
<td>Monitor normal HMI</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>RCD ensures ARM is locked</td>
<td>ARM is locked ☑</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**Low Alarm:** Place checkmark (✓) in checkbox (☐) for each correct response.

<table>
<thead>
<tr>
<th>Local Expected Observation</th>
<th>HMI/CR Expected Observation</th>
<th>Beamline HMI</th>
<th>CR HMI/EPICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opens FE shutter (w/kepap)</td>
<td>FE Shutter open ☑</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Apply source until low alarm</td>
<td>Yellow light on Monitor ☑</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Return monitor to normal</td>
<td>FE Critical Device Permit A chain ON</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Apply source until low alarm</td>
<td>Yellow light on Monitor ☑</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Return monitor to normal</td>
<td>FE Critical Device Permit A chain OFF</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**High Alarm:** Place checkmark (✓) in checkbox (☐) for each correct response.

<table>
<thead>
<tr>
<th>Local Expected Observation</th>
<th>HMI/CR Expected Observation</th>
<th>Linac HMI</th>
<th>CR HMI/EPICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator turns on Gun</td>
<td>Gun HVPS is ON ☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Apply source until high alarm</td>
<td>Red light on Monitor ☑</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Silence Alarm</td>
<td>Monitor alarm sounds</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Gun turns OFF</td>
<td>Alarm silences</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Return monitor to normal</td>
<td>Gun HVPS remains OFF ☑</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Reset fault in Control Room</td>
<td>Monitor normal HMI</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**Description of Test Failures (if any):**