

National Synchrotron Light Source II, Brookhaven National Laboratory			
Subject:	NSLS-II Beamline 17-BM Radiological Interlock Test Checklist		
Number:	NSLSII-17BM-CHK-001	Revision:	2
Effective:	18MAY2018	Page:	1 of 11

NSLS-II Beamline 17-BM Radiological Interlock Test Checklist

Test Reason: <i>Search Button SB2 moved Full Certification</i>	Test Result: <input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed
Test Date: <i>5/16/18</i>	Test Type: <input checked="" type="checkbox"/> Full Certification <input type="checkbox"/> Annual <input type="checkbox"/> Partial
Tester 1: <i>Thomas McDermid; Robert Charrel</i>	Start Time: <i>5/4/18</i> Finish Time:
Tester 2: <i>Brian Heneveld; Gabrielle Stene</i>	Assistant 1: <i>Accelerator Operations Staff</i>
Tester 1 Signature: <i>Thomas P. McDermid</i>	Assistant 2:
*Reviewer 1:	Tester 2 Signature: <i>Brian Heneveld</i>
Reviewer 2:	Reviewer 1 Signature:
** Safety Signature 17-BM (Beamline HMI) A Chain: <i>C7F42709</i> B Chain: <i>F15C97CE</i>	Previous 17-BM SS# Date: <i>5/11/17</i> A Chain: <i>C7F42709</i> B Chain: <i>F15C97CE</i>
** Safety Signature Pentant 5 Beamline (SR HMI) A Chain: <i>B527251C</i> B Chain: <i>OD73 AAC1</i>	Previous Pentant 5 SS# Date: <i>5/11/17</i> A Chain: <i>CD804572</i> B Chain: <i>076774D9</i>

* 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 sounders	✓
VI. Request Lead Operator enable Master Shutters	✓

- Test steps highlighted in **Red (Ann)** will be performed during annual test of critical devices
- Test steps in **Red (Ann)** and **Blue** will be performed during Full Certifications

A1 **Verify System Lockouts (Ann)**

- Gun HVPS Enable Switch ✓
- 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 NSLSII-ESH-PRC-032, *Beamline Enclosure Search and Secure and Breaking Security* ✓

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- | | |
|---|----------|
| | A |
| <i>Close the Right door</i> | ✓ |
| "Entry Permitted" sign is ON | ✓ |
| <i>Using the keypad, lock the closed doors</i> | ✓ |
| <i>Press SB1</i> | ✓ |
| SB1 illuminates | ✓ |
| Search sounder sounds | ✓ |
| Search yellow beacon flashing | ✓ |
| <i>Press SB2</i> | ✓ |
| SB2 illuminates | ✓ |
| <i>Exit hutch and close door</i> | ✓ |
| <i>Press SBE and begin timing</i> | ✓ |
| 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 (green), all doors, HMI | ✓ |
| <i>Press the SBE/Access Button</i> | ✓ |
| "Interlocked" sign is OFF, "Entry Permitted" sign is ON | ✓ |
| FOE Interlocked A and B OFF, HMI | ✓ |
| Maglock A OFF (may require opening Maglock on keypad) | ✓ |
| <i>Open door</i> | ✓ |
| Door opens, Maglock B OFF | ✓ |

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

- | | |
|-------------------------|----------|
| | A |
| <i>Press SB2</i> | ✓ |
| SB2 does not illuminate | ✓ |
| <i>Press SB1</i> | ✓ |
| SB1 illuminates | ✓ |

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Close hutch door and press SBE

✓
✓

Hutch does NOT secure

A4 **Search Timeout**

Press SB1 and begin timing

A
✓

Complete search *without pressing SBE*

✓

Search sounders off in 2 minutes

✓

Press SBE

✓

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)

✓

“Beam On” sign is OFF

✓

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

For each ES search hutch.

Open FE Shutters from keypad

<u>ES1</u>	<u>ES2</u>	<u>ES3</u>
✓	✓	✓
✓	✓	✓
✓	✓	✓
✓	✓	✓
✓	✓	✓
✓	✓	✓
✓	✓	✓

FE Shutters A and B open (green)

FOE Interlocked A and B ON (green)

FE Shutter Permits A and B ON (green)

FE Critical Device Permits A and B ON

Right Maglock A and B ON (green)

Left Maglock A and B ON (green)

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A8 FOE Right Door Switches

Place actuators on the door switches and Maglock.



Check the corresponding Permits for each switch tested.

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

A9 FOE Left Door Switches

Place actuators on the door switches and Maglock.



Check the corresponding Permits for each switch tested.

	<u>A</u>	<u>B</u>	<u>Reed</u>
<i>Search hutch</i>	<u>✓</u>	<u>✓</u>	<u>✓</u>
<i>Open FE Shutters from keypad</i>	<u>✓</u>	<u>✓</u>	<u>✓</u>
FE Shutters A and B open (green)	<u>✓</u>	<u>✓</u>	<u>✓</u>
FOE Interlocked A and B ON (green)	<u>✓</u>	<u>✓</u>	<u>✓</u>
FE Shutter Permits A and B ON (green)	<u>✓</u>	<u>✓</u>	<u>✓</u>
FOE Door Switch Sum A and B ON (green)	<u>✓</u>	<u>✓</u>	<u>✓</u>
FE Critical Device Permits A and B ON	<u>✓</u>	<u>✓</u>	<u>✓</u>

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<i>Remove one switch actuator</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FE Shutters A and B closed (red)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FOE Interlocked OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FE Shutter Permit OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FOE Door Switch Sum OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FE Critical Device Permits A and B OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Replace switch actuator and reset fault</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Remove actuators and close door	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

A10 **Magnetic Lock Test (FOE)**

Connect the FOE test box to the PPS cabinet. Use the box to turn ON the Maglocks (set switches to "Normal").



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

	R	L
<i>Search hutch</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FOE Interlocked A and B ON (green)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FE Shutter Permits A and B ON (green)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Door Maglock A and B ON (green)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Open FE Shutters</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FE Shutters open (green)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Using FOE test box, turn OFF Maglock</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Door Maglock A OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FE Shutters closed (red)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FOE Interlocked A OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FE Shutter Permit A OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Turn On Maglock and reset fault</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Search hutch</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Using FE Shutter test fixture, Open FE Shutters</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FE Critical Device Permits A and B ON	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Using FOE test box, turn OFF Maglock</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Within 3 seconds: FE Critical Device Permit A chain OFF</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

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Close FE Shutters and reset fault

✓ ✓

Disconnect the FOE test box

✓

A11 Observe FE Safety Shutter(s) Operation

With Maintenance Door open, connect FE Shutter test fixture.

✓

Shutters are in the closed (down) position

✓

FE Shutters A and B closed (**red**), HMI

✓

Turn the "Air" switch ON

✓

Open FE SSs A and B and Photon Shutter

Shutters open freely without hesitation

✓

Shutters are in the open (up) position

✓

FE Shutters A and B open (**green**), HMI

✓

Actuate Shutters closed

FE Shutters A and B closed (**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 Device Permits A and B ON (**green**), HMI

✓

Open FE SSA

SSA Open

✓

Open FE Photon Shutter

FE Critical Device Permits A and B OFF, HMI

✓

Close Shutters

✓

Reset fault

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

✓

Open FE SSB

SSB Open

✓

Open FE Photon Shutter

FE Critical Device Permits A and B OFF, HMI

✓

Close Shutters

✓

Reset fault

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

✓

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Using FE Shutter test fixture, Open FE Shutters

FE Critical Device Permits A and B OFF

✓

Using FE Shutter test fixture, Close FE Shutters

✓

Replace beamline enable key and reset faults

Beamline Online A and B ON (**green**)

✓

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

✓

Live Testing

A14 **Reach Back FOE Door Switches (Ann)**

Secure P1 through P5

SR Secure, A and B chain, SR HMI

✓

Place actuators on FOE hutch door switches and Maglock

✓

Search hutch

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

✓

FE Critical Device 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 Permits A and B LEDs ON

✓

Check I/O Box 28 Beamline Enable Panel

FE Critical Device Permit Sum A and B LEDs ON

✓

Check 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 an "A chain" door switch actuator from beamline hutch door

FOE Interlocked A OFF, HMI

✓

FE Critical Device Permit A OFF, HMI

✓

Check I/O Box 17 Beamline Enable Panel

FE Critical Device Permit A LED OFF

✓

Check I/O Box 28 Beamline Enable Panel

FE Critical Device Permit Sum A LED OFF

✓

Check Control Room SR HMI (MCR beamline 1)

FE Critical Device Permit A OFF (**red**), SR HMI

✓

✓

✓

✓

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<i>Check SR RF System C HVPS Beamline Interface</i>	A Permit OFF, SR RF System C HVPS Interface	✓
<i>Check SR RF System D HVPS Beamline Interface</i>	A Permit OFF, SR RF System D HVPS Interface	✓
<i>Check Dipole PS (positive) Beamline Interface</i>	A Permit OFF, Dipole PS Pos. Interface	✓
<i>Check Dipole PS (negative) Beamline Interface</i>	A Permit OFF, Dipole PS Neg. Interface	✓
	SR RF System C HVPS is OFF	✓
	SR RF System D HVPS is OFF	✓
	SR Dipole PS is OFF	✓
<i>Close FE Shutters with FE Shutter test fixture</i>	FE Shutters closed	✓
<i>Replace "A chain" door switch actuator and reset fault(s)</i>		✓
<i>Search hutch</i>	FOE Interlocked A and B ON (green), HMI	✓
	FE Critical Device Permits A and B ON (green), HMI	✓
<i>Check Control Room SR HMI (MCR beamline 1)</i>	FE Critical Device Permits A and B ON (green), SR HMI	✓
<i>Check I/O Box 17 Beamline Enable Panel</i>	FE Critical Device Permits A and B LEDs ON	✓
<i>Check I/O Box 28 Beamline Enable Panel</i>	FE Critical Device Permit Sum A and B LEDs ON	✓
<i>Check Dipole PS (positive) Beamline Interface</i>	A and B Permits ON, Dipole PS Pos. Interface	✓
<i>Check Dipole PS (negative) Beamline Interface</i>	A and B Permits ON, Dipole PS Neg. Interface	✓
<i>Check SR RF System C HVPS Beamline Interface</i>	A and B Permits ON, SR RF System C HVPS Interface	✓
<i>Check SR RF System D HVPS Beamline Interface</i>	A and B Permits ON, SR RF System D HVPS Interface	✓
<i>Operator enables SR Dipole PS</i>	SR Dipole PS is ON	✓
<i>Operator enables SR RF System C HVPS</i>	SR RF System C HVPS is ON	✓
<i>Operator enables SR RF System D HVPS</i>	SR RF System D HVPS is ON	✓
<i>Using FE Shutter test fixture, open the FE Shutters (SSA, SSB and Photon)</i>		✓
	FE Shutters open	✓
<i>Remove "B chain" switch actuator</i>	FOE Interlocked B OFF, HMI	✓
	FE Critical Device Permit B OFF, HMI	✓
<i>Check I/O Box 17 Beamline Enable Panel</i>	FE Critical Device Permit B LED OFF	✓
<i>Check Control Room SR HMI (MCR beamline 1)</i>	FE Critical Device Permit B OFF (red), 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 Permit OFF, SR RF System C HVPS Interface	✓
<i>Check SR RF System D HVPS Beamline Interface</i>	B Permit OFF, SR RF System D HVPS Interface	✓

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Check Dipole PS (positive) Beamline Interface B Permit OFF, Dipole PS Pos. Interface

Check Dipole PS (negative) Beamline Interface B Permit OFF, Dipole PS Neg. Interface

SR Dipole PS is OFF

SR RF System C HVPS is OFF

SR RF System D HVPS is OFF

Close FE Shutters with FE Shutter test fixture FE Shutters closed

Remove beamline hutch switch actuators and Maglock actuator

A15 *Observe All Shutters Closed Sum (Ann)*

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 FE Shutter test fixture

A16 *Test Completion (Ann)*

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

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Reviewed By:

 Invalid signature

X Scott Buda

Scott Buda
Accelerator Safety Systems Group Leader
Signed by: sbuda

5/24/2018

X Robert Chmiel

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

Approved By:

5/24/2018

X 

Robert Lee
NSLS-II ESH Manager
Signed by: Lee, Robert J

Revision History

Revision	Description	Date
1	First Issue.	16MAY2017
2	Edited required test headers to indicate what will be tested on the annual test of critical devices.	18MAY2018

