# Attachment A

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

| | |
|---|---|
| Test Reason: Initial Test | Test Result: ☑ Passed ☐ Failed<br>Test Type: ☐ Pre-Certification ☒ Certification ☐ Partial |
| Test Date: 5/25/2016 | Start Time: Finish Time: |
| Tester 1: Thomas McDonald ; Brian Henault | Assistant 1: |
| Tester 2: Robert Chmiel ; Gabrielle Stone | Assistant 2: |
| Tester 1 Signature: Thomas P. McDonald | Tester 2 Signature: Robert Chmiel |
| *Reviewer 1: | Reviewer 1 sig.: |
| Reviewer 2: | Reviewer 2 sig.: |
| ** Safety Signature 21-ID (Beamline HMI)<br>A Chain: 572503F B Chain: CC39C84D | Previous 21-ID SS# Date: / /<br>A Chain: B Chain: |
| ** Safety Signature Pentant 5 Beamline (SR HMI)<br>A Chain: 447A6ED7 B Chain: 718CC902 | Previous Pentant 3 SS# Date: / /<br>A Chain: B Chain: |

* A review by an Accelerator Safety Systems Engineer and a designated specialist (Reviewer 2) is only required upon a Test failure.
**If Current Safety Signature number (found in top left corner on HMI) is different from previous number, contact the Accelerator Safety Systems Cognizant Engineer.

### PREPARATION:

| | |
|---|---|
| I. All hutch door switches have been evaluated by Mechanical Engineering for proper positioning | ✓ |
| II. Inform Control Room Lead Operator that testing will be done | ✓ |
| III. Obtain Beamline enable and PPS reset keys from Control Room | ✓ |
| IV. Verify that beamline vacuum and water interlocks are satisfied | ✓ |
| V. Place muffler on beam imminent sounder | ✓ |
| VI. Request Lead Operator enable Master shutters | ✓ |

**A1** ***Verify System Lockouts***

Gun HVPS output cable connector ✓

Linac modulator line cords (3) OR Booster Dipole F PS 480V ✓

Booster RF HVPS 480 V OR Booster low level RF drive termination ✓

SR System C low level RF drive termination OR SR System C RF output connection to cavity ✓

SR System D low level RF drive termination OR SR System D RF output connection to cavity ✓

**A2** ***Verify Search and Time Beam Imminent Alarm***

Verify that search path is free from obstacles and line of sight is clear in search mirrors in accordance with PS-C-XFD-PRC-010, *Beamline Enclosure Search and Secure and Breaking Security Procedure* ✓

| | A |
|---|---|
| *Close the Right door* | ✓ |
| "Entry Permitted" sign is ON | ✓ |
| *Using the keypad, lock the closed doors* | ✓ |
| *Press SB1* | ✓ |
| SB1 illuminates | ✓ |
| Search sounder sounds | ✓ |
| Search yellow beacon flashing | ✓ |
| *Press SB2* | ✓ |
| SB2 illuminates | ✓ |
| *Exit hutch and close main door* | ✓ |
| *Press SBE and* ***begin timing*** | ✓ |
| Beam imminent alarm sounds for 30 seconds | ✓ |
| After warning, FOE Interlocked A and B ON (**green**), HMI | ✓ |
| "Interlocked" sign is ON | ✓ |
| Maglock A and B ON, HMI | ✓ |
| *Press the SBE/Access Button* | ✓ |
| Interlocked sign OFF, "Entry Permitted" sign is ON | ✓ |
| FOE Interlocked A and B OFF, HMI | ✓ |
| Maglock A OFF (may require opening Maglock on key pad) | ✓ |
| *Open door* | ✓ |
| Door opens, Maglock B OFF | ✓ |

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

| | A |
|---|---|
| *Press SB2* | ✓ |
| SB2 does not illuminate | ✓ |
| *Press SB1* | ✓ |
| SB1 illuminates | ✓ |
| *Close hutch door and press SBE* | ✓ |
| Hutch does NOT secure | ✓ |

**A4** ***Search timeout***

| | A |
|---|---|
| *Press first search button and* ***begin timing*** | ✓ |
| *Complete search* ***without pressing Final Search button*** | ✓ |
| Search sounders off in 2 minutes | ✓ |
| *Press Final Search button* | ✓ |
| Search does not complete | ✓ |

**A5** ***Shutter enable***

| | | |
|---|---|---|
| Place actuators on FOE door switches and attach Maglock devices | | ✓ |
| | Beamline Online A and B OFF | ✓ |
| Enable beamline with key and perform a reset | Beamline Online A and B ON (**green**) | ✓ |
| Search the FOE | FE Shutter Permits A and B ON ***after*** Beam Imminent Warning | ✓ |
| Open FE Shutters | FE Shutters A and B indicate open (**green**) | ✓ |
| | "Beam On" sign is ON | ✓ |
| Close FE Shutters | FE Shutters A and B indicate closed (**red**) | ✓ |
| Line 1 Enable key is out of place | L1S1 Shutter A and B Permits OFF, HMI | ✓ |
| Cycle Line 1 Key in place | L1S1 Shutter A and B Permits ON (**green**), HMI | ✓ |
| Open L1S1 Shutter | L1S1 Shutter A and B indicate open (**green**) | ✓ |
| Cycle Line 1 Key out of place | L1S1 Shutter A and B indicate closed (**red**) | ✓ |
| | L1S1 Shutter A and B Permits OFF, HMI | ✓ |
| Line 2 Enable key is out of place | L2S2 Shutter A and B Permits OFF, HMI | ✓ |
| Cycle Line 2 Key in place | L2S2 Shutter A and B Permits ON (**green**), HMI | ✓ |

| | | |
|---|---|---|
| Open L2S2 Shutter | L2S2 Shutter A and B indicate open (**green**) | ✓ |
| Cycle Line 2 Key out of place | L2S2 Shutter A and B indicate closed (**red**) | ✓ |
| | L2S2 Shutter A and B Permits OFF, HMI | ✓ |
| Rotate keys to enable both lines | L1S1 and L2S2 A and B Permits ON (**green**), HMI | ✓ |

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

| For each ES search hutch | ES1 | ES2 | ES3 |
|---|---|---|---|
| *Open FE Shutters from keypad* | ✓ | ✓ | ✓ |
| FE Shutters A and B open (**green**) | ✓ | ✓ | ✓ |
| FOE Interlocked A and B ON (**green**) | ✓ | ✓ | ✓ |
| FE Shutter Permit A and B ON (**green**) | ✓ | ✓ | ✓ |
| FE Critical Device Permits A and B ON | ✓ | ✓ | ✓ |
| Right Maglock A ON (**green**) | ✓ | ✓ | ✓ |
| Left Maglock A ON (**green**) | ✓ | ✓ | ✓ |
| *Press ES* | ✓ | ✓ | ✓ |
| FE Shutters A and B closed (**red**) | ✓ | ✓ | ✓ |
| FOE Interlocked A and B OFF | ✓ | ✓ | ✓ |
| 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**) | ✓ | ✓ | ✓ |

**A7** ***FOE Right Door Switches***

Place actuators on the door switches and Maglock. ✓

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

| | 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 | | | | | ✓ |

**A8** ***FOE Left Door Switches***

Place actuators on the door switches and Maglock. ✓

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

| | 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 | | | | | ✓ |

**A9** ***Magnetic Lock Test (FOE)***

Connect the FOE test box (Attachment B Figure B4) to the PPS cabinet (Attachment B Figure B7). Use the box to turn ON the Maglocks (set switches to "Normal").

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

| | R | L |
|---|---|---|
| *Search hutch* | ✓ | ✓ |
| FOE Interlocked A and B ON (**green**) | ✓ | ✓ |
| FE Shutter Permit A and B ON (**green**) | ✓ | ✓ |
| Door Maglock A and B ON (**green**) | ✓ | ✓ |
| *Open FE Shutters* | ✓ | ✓ |
| FE Shutters open (**green**) | ✓ | ✓ |
| *Using FOE test box, turn OFF Maglock* | ✓ | ✓ |
| Door Maglock A OFF | ✓ | ✓ |
| FE Shutters 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 | | ✓ |

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

Qualified Beamline Staff will perform vacuum venting.

| | SW4 |
|---|---|
| Vacuum sensor SW A and B ON (**green**) | ✓ |
| L1S1 Shutter A and B Permits ON (**green**) | ✓ |
| *Open Beamline Photon Shutter* | ✓ |
| L1S1Shutter OPEN (**green**) | ✓ |

*Beamline Staff vents up section* ✓

Vacuum SW A and B OFF ✓

L1S1 Shutter A and B Permits OFF ✓

L1S1 Shutter CLOSED (**red**) ✓

*Beamline Staff returns vacuum* ✓

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

L1S1 Shutter A and B Permits OFF ✓

*Reset Fault* ✓

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

*Open Beamline Photon Shutter* ✓

L1S1 Shutter OPEN (**green**) ✓

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

Qualified Beamline Staff will perform vacuum venting.

**SW5** ✓

Vacuum SW A and B ON (**green**) ✓

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

*Open Beamline Photon Shutter* ✓

L2S2 Shutter OPEN (**green**) ✓

*Beamline Staff vents up section* ✓

Vacuum SW A and B OFF ✓

L2S2 Shutter A and B Permits OFF ✓

L2S2 Shutter CLOSED (**red**) ✓

*Beamline Staff returns vacuum* ✓

Vacuum SW A and B ON (**green**) ✓

L2S2 Shutter A and B Permits OFF ✓

*Reset Fault* ✓

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

*Open Beamline Photon Shutter* ✓

L2S2 Shutter OPEN (**green**) ✓

**A12** ***Vacuum Sensors Beamline 21-ID FOE Shutter***

Qualified Beamline Staff will perform vacuum venting.

| | SW1 | SW2 | SW3 | |
|---|---|---|---|---|
| Perform steps for each vacuum sensor | | | | |
| Vacuum SW A and B ON (**green**) | ✓ | ✓ | ✓ | |
| FOE A and B Permits ON (**green**) | ✓ | ✓ | ✓ | |
| *Open Beamline Photon Shutter* | ✓ | ✓ | ✓ | |
| FOE Shutter OPEN (**green**) | ✓ | ✓ | ✓ | |
| *Beamline Staff vents up section* | ✓ | ✓ | ✓ | |
| Vacuum SW A and B OFF | ✓ | ✓ | ✓ | |
| FOE Shutter A and B Permits OFF | ✓ | ✓ | ✓ | |
| FOE Shutter CLOSED (**red**) | ✓ | ✓ | ✓ | |
| *Beamline Staff returns vacuum* | ✓ | ✓ | ✓ | |
| Vacuum SW A and B ON (**green**) | ✓ | ✓ | ✓ | |
| FOE Shutter A and B Permits OFF | ✓ | ✓ | ✓ | See **A13** |
| *Reset Fault* | ✓ | ✓ | ✓ | |
| FOE A and B Permits ON (**green**) | ✓ | ✓ | ✓ | |
| *Open Beamline Photon Shutter* | ✓ | ✓ | ✓ | |
| FOE Shutter OPEN (**green**) | ✓ | ✓ | ✓ | |

**A13** ***Vacuum Sensors to FE Permits (use one sensor)***

| | SW3 |
|---|---|
| Qualified Beamline Staff will perform vacuum venting. | ✓ |
| FE Shutter Permits A and B ON (**green**) | ✓ |
| While FOE Permits OFF (Step A12), Open FOE Shutter using the FOE test box | ✓ |
| FE Shutter Permits A and B OFF | ✓ |
| Close shutter and reset fault | ✓ |
| Remove FOE test box | ✓ |

**A14** ***Water Interlock***

Water flow meters for PPS 1, 2 and 3 are located on top of the hutch (Figure 1). Water flow meters for PPS 4 and 5 are further downstream on the beamline.

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

The PPS Water Safety Test Amplifiers (STA) are located in the cabinet to the upper right of the meters on top of the hutch (Figure 2).

**Figure 2:** PPS Water STAs

Record the pretest water flows for the PPS meters in GPM.

| Meter Reading | | Meter Reading | | Current STA A | | Current STA B | |
|---|---|---|---|---|---|---|---|
| A1= | 1.8 | B1= | 1.75 | A STA1= | 1.75 | B STA1= | 1.75 |
| A2= | 1.16 | B2= | 1.17 | A STA2= | 1.16 | B STA2= | 1.17 |
| A3= | 1.80 | B3= | 1.82 | A STA3= | 1.80 | B STA3= | 1.82 |
| A4= | 1.16 | B4= | 1.15 | A STA4= | 1.16 | B STA4= | 1.14 |
| A5= | 0.55 | B5= | 0.55 | A STA5= | 0.55 | B STA5= | 0.54 |

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).

| Trip Points | Trip Points (- 15 %) | Recorded A Trip | Recorded B Trip |
|---|---|---|---|
| PPS 1: ~~1.5~~ 1.2 GPM | 1.3 GPM 5/25/16 | A STA1= 1.2 | B STA1= 1.2 |
| PPS 2: ~~1.5~~ 0.7 GPM | 1.3 GPM | A STA2= 0.7 | B STA2= 0.7 |
| PPS 3: ~~1.5~~ 1.2 GPM | 1.3 GPM | A STA3= 1.2 | B STA3= 1.2 |
| PPS 4: ~~1.5~~ 0.7 GPM | 1.3 GPM | A STA4= 0.7 | B STA4= 0.7 |
| PPS 5: ~~1.5~~ 0.4 GPM | 1.3 GPM | A STA5= 0.4 | B STA5= 0.4 |

Repeat each step for all water flow meters

| | PPS1 | PPS2 | PPS3 | PPS4 | PPS5 |
|---|---|---|---|---|---|
| *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 | ✓ | ✓ | ✓ | ✓ | ✓ |

**A15** ***Water Safety Test Amplifier Faults***

Repeat each step for all water flow meters

| | PPS1 | PPS2 | PPS3 | PPS4 | PPS5 |
|---|---|---|---|---|---|
| *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* | ✓ | ✓ | ✓ | ✓ | ✓ |

**A16** ***Observe Beamline Photon Shutter Operation***

| | FOE | L1S1 | L2S2 |
|---|---|---|---|
| *Close Beamline Photon Shutter* | ✓ | ✓ | ✓ |
| Shutter indicates closed A and B (**red**), HMI | ✓ | ✓ | ✓ |
| *Open Beamline Photon Shutter* | ✓ | ✓ | ✓ |
| Shutter opens smoothly without hesitation | ✓ | ✓ | ✓ |
| Shutter indicates open A and B (**green**), HMI | ✓ | ✓ | ✓ |
| *Close Beamline Photon Shutter* | ✓ | ✓ | ✓ |

**A17** ***Observe FE Safety Shutter(s) Operation***

| | | |
|---|---|---|
| With Maintenance Door open, connect FE Shutter test fixture (Attachment B Figure B5). | | ✓ |
| | Shutters are in the closed (down) position | ✓ |
| | FE Shutter Closed A and B (**red**), HMI | ✓ |
| *Turn the "Air" switch ON* | | ✓ |
| *Open FE Photon Shutter and SSs A and B* | Shutters open freely without hesitation | ✓ |

| | | |
|---|---|---|
| | 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 | ✓ |
| **A18** ***FE Safety Shutters can only be Closed if FE Photon Shutter is Closed*** | | |
| *Search hutch* | FOE Interlocked A and B (**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 | ✓ |
| **A19** ***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 (**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 key and reset faults* | Beamline Online A and B ON (**green**) | ✓ |
| ***Live Testing*** | | |
| **A20** ***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* | | ✓ |
| *Search hutch* | FOE Interlocked A and B (**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 21 Beamline Enable Panel* | FE Critical Devices Permits A and B LEDs ON | ✓ |
| *Check I/O Box 28 Beamline Enable Panel* | FE Critical Device Permit Sum A and B LEDs ON | ✓ |
| | 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 an "**A chain**" door switch actuator from beamline hutch door* | | ✓ |
| | FOE Interlocked OFF A chain, HMI | ✓ |
| | FE Critical Devices Permits A OFF, HMI | ✓ |
| *Check I/O Box 21 Beamline Enable Panel* | FE Critical Devices 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 (**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 | ✓ |
| | 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 | ✓ |
| 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 21 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 Permit B OFF, HMI | ✓ |
| *Check I/O Box 21 Beamline Enable Panel* | FE Critical Devices Permit B LED OFF | ✓ |
| *Check Control Room SR HMI (MCR beamline 1)* | FE Critical Device Permit 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 beamline hutch switch holders and Maglock actuator* | | ✓ |

**A21** ***Water Interlock (Live)***

| | | |
|---|---|---|
| *Search FOE* | FOE Interlocked A and B ON (**green**), HMI | ✓ |
| | FE Shutter Permits A and B ON (**green**), HMI | ✓ |
| | FE Critical Devices Permits A and B ON (**green**), HMI | ✓ |
| *Check I/O Box 21 Beamline Enable Panel* | FE Critical Devices 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 Control Room SR HMI (MCR beamline 1)* | FE Critical Device Permit A and B ON (**green**), SR HMI | ✓ |
| *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, turn on air and open Photon then SSs* | | |
| | FE Shutters indicate open (**green**), HMI | ✓ |
| *Using water trip points in Step A14, 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 21 Beamline Enable Panel* | FE Critical Devices Permits 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)* | | ✓ |

**A22** ***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* | | ✓ |

**A23** ***FOE Area Radiation Monitor***

**Refer to PS-C-ASD-PRC-008, *NSLS-II Area Radiation Monitor PPS Test* and complete Attachment D, *NSLS-II Beamline (FOE) Area Radiation Monitor Checklist.***

| | | |
|---|---|---|
| | FRM 21-ID Test Checklist Completed | ✓ |

**A24** ***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 21-ID Initial Radiological Interlock test Certification completed in May, 2016**

***A1 Water Interlock***

| Meter Reading | | Meter Reading | | Current STA A | | Current STA B | |
|---|---|---|---|---|---|---|---|
| A1= | 1.06 | B1= | 1.05 | A STA1= | 1.06 | B STA1= | 1.05 |
| A2= | 0.95 | B2= | 0.95 | A STA2= | 0.95 | B STA2= | 0.95 |
| A3= | 1.57 | B3= | 1.59 | A STA3= | 1.57 | B STA3= | 1.59 |
| A4= | 1.01 | B4= | 1.0 | A STA4= | 1.01 | B STA4= | 1.0 |
| A5= | 0.62 | B5= | 0.62 | A STA5= | 0.62 | B STA5= | 0.62 |

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).

| Trip Points | Trip Points (- 15 %) | Recorded A Trip | Recorded B Trip |
|---|---|---|---|
| PPS 1: 1.0 GPM | 0.85 GPM | A STA1= 0.99 | B STA1= 0.99 |
| PPS 2: 0.7 GPM | 0.6 GPM | A STA2= 0.68 | B STA2= 0.68 |
| PPS 3: 1.2 GPM | 1.0 GPM | A STA3= 1.2 | B STA3= 1.2 |
| PPS 4: 0.7 GPM | 0.6 GPM | A STA4= 0.68 | B STA4= 0.68 |
| PPS 5: 0.4 GPM | 0.34 GPM | A STA5= 0.4 | B STA5= 0.40 |

| Repeat each step for all water flow meters | PPS1 | PPS2 | PPS3 | PPS4 | PPS5 |
|---|---|---|---|---|---|
| Water Permits A and B ON (**green**), HMI | ✓ | ✓ | ✓ | ✓ | ✓ |
| *Using the valve, turn water flow to trip point* | ✓ | ✓ | ✓ | ✓ | ✓ |
| Water Permits A and B OFF, HMI | ✓ | ✓ | ✓ | ✓ | ✓ |
| Recorded STA A and B levels 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 | ✓ | ✓ | ✓ | ✓ | ✓ |

Test Result: ☑ Passed ☐ Failed

Tested By: Thomas D. McDowell Date: 6/27/16

Tested By: Rick Clark Date: 6/27/16

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# Attachment D
## NSLS-II Beamline (FOE) Area Radiation Monitor Checklist

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

| | | |
|---|---|---|
| **Monitor #** FRM ID21 | **ID #** IN07575 | **Beamline:** 21 ID |
| **Test Reason:** ☑ **Beamline Certification** | ☐ **Replacement/Repair** | |
| **Test Date:** 5/23/16 | **Test Result** ☑ **Passed** | ☐ **Failed** |
| **Tester :** Thomas McDonald | **RCD:** Kim Wehrnt / John Aloi | |
| **Tester Signature:** Thomas P McDonald | **RCD Signature:** [signature] | |

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

| | Local Expected Observation | HMI/CR Expected Observation | Linac HMI | CR HMI |
|---|---|---|---|---|
| Operator turns on Gun | Gun HVPS is ON ☑ | Gun Contactor ON A Chain | ☑ | ☑ |
| RCD Disables Monitor | | Alarm sounds in Control Room | | ☑ |
| | Fail alarm ON HMI (yellow border around ARM icon) | | ☑ | ☑ |
| Silence CR Alarm | | Alarm silences | | ☑ |
| Gun turns OFF | Gun HVPS is OFF ☑ | Gun Contactor OFF A Chain | ☑ | ☑ |
| Return monitor to normal | Gun HVPS remains OFF ☑ | Fail alarm remains ON HMI | ☑ | ☑ |
| Reset fault in Control Room | | Monitor normal HMI | ☑ | ☑ |
| RCD ensures ARM is locked | ARM is locked ☑ | | | |

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

| | Local Expected Observation | HMI/CR Expected Observation | Beamline HMI | CR HMI/EPICS |
|---|---|---|---|---|
| Opens FE shutter (w/keypad) | FE Shutters open ☑ | | ☑ | ☑ |
| Apply source until low alarm | Yellow light on Monitor ☑ | Radiation level increases on EPICS | | ☑ |
| | FE Shutters Closed ☑ | Alarm sounds in Control Room | | ☑ |
| | | Low level alarm ON, HMI | ☑ | ☑ |
| Return monitor to normal | | Monitor normal, HMI | ☑ | ☑ |
| | FE Critical Device Permit A chain ON | | ☑ | ☑ |
| Apply source until low alarm | Yellow light on Monitor ☑ | | | ☑ |
| | FE Critical Device Permit A chain OFF | | ☑ | ☑ |
| Return monitor to normal | | Monitor normal, HMI | ☑ | ☑ |

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

| | Local Expected Observation | HMI/CR Expected Observation | Linac HMI | CR HMI/EPICS |
|---|---|---|---|---|
| Operator turns on Gun | Gun HVPS is ON ☑ | Gun Contactor ON A Chain | ☑ | ☑ |
| Apply source until high alarm | Red light on Monitor ☑ | Radiation level increases on EPICS | | ☑ |
| | Monitor alarm sounds | Alarm sounds in Control Room | | ☑ |
| | | High level alarm ON, HMI | ☑ | ☑ |
| Silence Alarm | | Alarm silences | | ☑ |
| Gun turns OFF | Gun HVPS is OFF ☑ | Gun Contactor OFF A Chain | ☑ | ☑ |
| Return monitor to normal | Gun HVPS remains OFF ☑ | High level alarm remains ON, HMI | ☑ | ☑ |
| Reset fault in Control Room | | Monitor normal, HMI | ☑ | ☑ |

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