

National Synchrotron Light Source II, Brookhaven National Laboratory			
Subject:	<b>NSLS-II Beamline 28-ID Radiological Interlock Test Checklist</b>		
Number:	NSLSII-28ID-CHK-001	Revision:	3
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### NSLS-II Beamline 28-ID Radiological Interlock Test Checklist

Test Reason: <i>Addition of 'B' hutch</i>	Test Result: <input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed
	Test Type: <input type="checkbox"/> Pre-Certification <input checked="" type="checkbox"/> Certification <input type="checkbox"/> Partial
Test Date: <i>1/16/2018</i>	Start Time: _____ Finish Time: _____
Tester 1: <i>Thomas McDonald; Brian Henefeld</i>	Assistant 1: <i>Accelerator Operations Staff</i>
Tester 2: <i>Robert Chmiel; Gabrielle Stave</i>	Assistant 2: _____
Tester 1 Signature: <i>Thomas P. McDonald</i>	Tester 2 Signature: <i>R Chmiel</i>
*Reviewer 1:	Reviewer 1 Signature: _____
Reviewer 2:	Reviewer 2 Signature: _____
** Safety Signature 28-ID (Beamline HMI)	Previous 28-ID SS# _____ Date: <i>1/3/2017</i>
A Chain: <i>AF66241C</i> B Chain: <i>5EGE2AFA</i>	A Chain: <i>2CG27COF</i> B Chain: <i>94F31F8B</i>
** Safety Signature Pentant 1 Beamline (SR HMI)	Previous Pentant 1 SS# _____ Date: <i>1/3/2017</i>
A Chain: <i>FCB1FD9Z</i> B Chain: <i>2F2G ADFB</i>	A Chain: <i>FCB1FD9Z</i> B Chain: <i>2F2G ADFB</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 sounder	✓
VI. Request Lead Operator enable Master Shutters	✓

**A1 Verify System Lockouts**

- 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 PS-C-XFD-PRC-010, *Beamline Enclosure Search and Secure and Breaking Security Procedure* ✓





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Cycle Line 1 Beamline key out of place	L1S1 Shutter A and B closed ( <b>red</b> )	✓
	L1S1 Shutter Permit A and B OFF	✓
	L2S2 Shutter Permit A and B OFF	✓
Attempt to Open L2S2 Shutter from keypad	L2S2 Shutter A and B closed ( <b>red</b> )	✓
Cycle Line 2 Beamline key in place	L2S2 Shutter Permit A and B ON ( <b>green</b> )	✓
Open L2S2 Shutter from keypad	L2S2 Shutter A and B open ( <b>green</b> )	✓
Cycle Line 2 Beamline key out of place	L2S2 Shutter A and B closed ( <b>red</b> )	✓
	L2S2 Shutter Permit A and B OFF	✓
Rotate keys in place to enable both lines	L1S1 and L2S2 Shutter Permits A and B ON ( <b>green</b> )	✓

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

For each ES 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**)
- FE Critical Device Permits A and B ON
- Upstream Right Maglock A and B ON
- Upstream Left Maglock A and B ON
- Downstream Right Maglock A and B ON
- Downstream Left Maglock A and B ON

*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

*Pull out ES*

- ES Sum Latch OFF

*Reset fault*

- ES Sum Latch ON (**green**)

ES1	ES2	ES3	ES4
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓

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

	<u>ES1</u>	<u>ES2</u>	<u>ES3</u>
For each ES search hutch.			
<i>Open FE Shutters and LIS1 Shutter from keypad</i>	✓	✓	✓
FE and LIS1 Shutters A and B open (green)	✓	✓	✓
B Interlocked A and B ON (green)	✓	✓	✓
LIS1 Shutter Permit A and B ON (green)	✓	✓	✓
FE Critical Device Permits A and B ON	✓	✓	✓
Front Right Maglock A and B ON (green)	✓	✓	✓
<i>Press ES</i>	✓	✓	✓
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	✓	✓	✓
Front Right Maglock A OFF	✓	✓	✓
<i>Pull out ES</i>	✓	✓	✓
ES Sum Latch OFF	✓	✓	✓
<i>Reset fault</i>	✓	✓	✓
ES Sum Latch ON (green)	✓	✓	✓

A8 **Emergency Stops (ES) C Hutch**

	<u>ES1</u>	<u>ES2</u>	<u>ES3</u>	<u>ES4</u>
For each ES search hutch.				
<i>Open FE Shutters and L2S2 Shutter from keypad</i>	✓	✓	✓	✓
FE and L2S2 Shutters A and B open (green)	✓	✓	✓	✓
C Interlocked A and B ON (green)	✓	✓	✓	✓
L2S2 Shutter Permit A and B ON (green)	✓	✓	✓	✓
FE Critical Device Permits A and B ON	✓	✓	✓	✓
Front Right Maglock A and B ON (green)	✓	✓	✓	✓
Front Left Maglock A and B ON (green)	✓	✓	✓	✓
Rear Maglock A and B ON (green)	✓	✓	✓	✓
<i>Press ES</i>	✓	✓	✓	✓
L2S2 Shutter A and B closed (red)	✓	✓	✓	✓
C Interlocked A and B OFF	✓	✓	✓	✓

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L2S2 Shutter Permit A and B OFF	<input checked="" type="checkbox"/>	<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"/>	<input checked="" type="checkbox"/>
Front Right Maglock A OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Front Left Maglock A OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Rear Maglock A OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Pull out ES</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
ES Sum Latch OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Reset fault</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
ES Sum Latch ON (green)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

**A9 Emergency Stops (ES) D Hutch**

Manually open the Guillotine Shutter in the C hutch.

For each ES search hutch.

*Open FE Shutters and L2S2 Shutter from keypad*

	<b>ES1</b>	<b>ES2</b>	<b>ES3</b>	<b>ES4</b>
<i>Open FE Shutters and L2S2 Shutter from keypad</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FE and L2S2 Shutters A and B open (green)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
D Interlocked A and B ON (green)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
L2S2 Shutter Permit A and B ON (green)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FE Critical Device Permits A and B ON	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Front Right Maglock A and B ON (green)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Front Left Maglock A and B ON (green)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Rear Right Maglock A and B ON (green)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Rear Left Maglock A and B ON (green)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Press ES</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
L2S2 Shutter A and B closed (red)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
D Interlocked A and B OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
L2S2 Shutter Permit A and B OFF	<input checked="" type="checkbox"/>	<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"/>	<input checked="" type="checkbox"/>
Front Right Maglock A OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Front Left Maglock A OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Rear Right Maglock A OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Rear Left Maglock A OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

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<i>Pull out ES</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
ES Sum Latch OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Reset fault</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
ES Sum Latch ON (green)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

**A10 FOE Labyrinth 2 Switches and Latch**

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.

	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Latch</u>
<i>Search hutch</i>	<input checked="" type="checkbox"/>				
<i>Open FE Shutters from keypad</i>	<input checked="" type="checkbox"/>				
FE Shutters A and B open (green)	<input checked="" type="checkbox"/>				
FOE Interlocked A and B ON (green)	<input checked="" type="checkbox"/>				
FE Shutter Permit A and B ON (green)	<input checked="" type="checkbox"/>				
Cable Lab 2 Switches/Latch A and B ON (green)	<input checked="" type="checkbox"/>				
FE Critical Device Permits A and B ON	<input checked="" type="checkbox"/>				
<i>Remove one switch actuator</i>	<input checked="" type="checkbox"/>				
Cable Lab 2 Switch/Latch Permit OFF	<input checked="" type="checkbox"/>				
FOE Interlocked OFF	<input checked="" type="checkbox"/>				
FE Shutter Permit OFF	<input checked="" type="checkbox"/>				
FE Shutters A and B closed (red)	<input checked="" type="checkbox"/>				
FE Critical Device Permits A and B OFF	<input checked="" type="checkbox"/>				
<i>Replace switch actuator and reset fault</i>	<input checked="" type="checkbox"/>				
Remove labyrinth actuators and close labyrinth door					<input checked="" type="checkbox"/>

**A11 Hutch B Labyrinth I Switches and Latch**

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.

	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Latch</u>
<i>Search hutch</i>	<input checked="" type="checkbox"/>				

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<i>Open FE Shutters and L1S1 Shutter from keypad</i>	<input checked="" type="checkbox"/>				
FE and LIS1 Shutters A and B open (green)	<input checked="" type="checkbox"/>				
B Interlocked A and B ON (green)	<input checked="" type="checkbox"/>				
L1S1 Shutter Permit A and B ON (green)	<input checked="" type="checkbox"/>				
Cable Lab 1 Switches/Latch A and B ON (green)	<input checked="" type="checkbox"/>				
FE Critical Device Permits A and B ON	<input checked="" type="checkbox"/>				
<i>Remove one switch actuator</i>	<input checked="" type="checkbox"/>				
Cable Lab 1 Switch/Latch Permit OFF	<input checked="" type="checkbox"/>				
B Interlocked OFF	<input checked="" type="checkbox"/>				
L1S1 Shutter Permit OFF	<input checked="" type="checkbox"/>				
L1S1 Shutter A and B closed (red)	<input checked="" type="checkbox"/>				
FE Critical Device Permits A and B OFF	<input checked="" type="checkbox"/>				
<i>Replace switch actuator and reset fault</i>	<input checked="" type="checkbox"/>				
Remove labyrinth actuators and close labyrinth door	<input checked="" type="checkbox"/>				

**A12 Hutch C Labyrinth 1 Switches and Latch**

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.

	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Latch</u>
<i>Search hutch</i>	<input checked="" type="checkbox"/>				
<i>Open FE Shutters and L2S2 Shutter from keypad</i>	<input checked="" type="checkbox"/>				
FE and L2S2 Shutters A and B open (green)	<input checked="" type="checkbox"/>				
C Interlocked A and B ON (green)	<input checked="" type="checkbox"/>				
L2S2 Shutter Permit A and B ON (green)	<input checked="" type="checkbox"/>				
Cable Lab 1 Switches/Latch A and B ON (green)	<input checked="" type="checkbox"/>				
FE Critical Device Permits A and B ON	<input checked="" type="checkbox"/>				
<i>Remove one switch actuator</i>	<input checked="" type="checkbox"/>				
Cable Lab 1 Switch/Latch Permit OFF	<input checked="" type="checkbox"/>				
C Interlocked OFF	<input checked="" type="checkbox"/>				
L2S2 Shutter Permit OFF	<input checked="" type="checkbox"/>				
L2S2 Shutter A and B closed (red)	<input checked="" type="checkbox"/>				
FE Critical Device Permits A and B OFF	<input checked="" type="checkbox"/>				

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Replace switch actuator and reset fault

✓ ✓ ✓ ✓ ✓

Remove labyrinth actuators and close labyrinth door

✓

**A13 Hutch C Labyrinth 2 Switches and Latch**

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.

	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Latch</u>
Search hutch	✓	✓	✓	✓	✓
Open FE Shutters and L2S2 Shutter from keypad	✓	✓	✓	✓	✓
FE and L2S2 Shutters A and B open (green)	✓	✓	✓	✓	✓
C Interlocked A and B ON (green)	✓	✓	✓	✓	✓
L2S2 Shutter Permit A and B ON (green)	✓	✓	✓	✓	✓
Cable Lab 2 Switches/Latch A and B ON (green)	✓	✓	✓	✓	✓
FE Critical Device Permits A and B ON	✓	✓	✓	✓	✓
Remove one switch actuator	✓	✓	✓	✓	✓
Cable Lab 2 Switch/Latch Permit OFF	✓	✓	✓	✓	✓
C Interlocked OFF	✓	✓	✓	✓	✓
L2S2 Shutter Permit OFF	✓	✓	✓	✓	✓
L2S2 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					✓

**A14 Guillotine Shutter Switches and Latch**

Place actuators on the Guillotine Shutter switches/latch 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.

	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Latch</u>
Search hutch	✓	✓	✓	✓	✓
Open FE Shutters and L2S2 Shutter from keypad	✓	✓	✓	✓	✓
FE and L2S2 Shutters A and B open (green)	✓	✓	✓	✓	✓

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L2S2 Shutter Permit A and B ON (green)	✓	✓	✓	✓	✓
Guillotine Switches/Latch A and B closed (red)	✓	✓	✓	✓	✓
FE Critical Device Permits A and B ON	✓	✓	✓	✓	✓
<i>Remove one switch actuator</i>	✓	✓	✓	✓	✓
Guillotine Switch/Latch open (not red)	✓	✓	✓	✓	✓
L2S2 Shutter Permit OFF	✓	✓	✓	✓	✓
L2S2 Shutter A and B closed (red)	✓	✓	✓	✓	✓
FE Critical Device Permits A and B OFF	✓	✓	✓	✓	✓
<i>Replace switch actuator and reset fault</i>	✓	✓	✓	✓	✓
Remove Guillotine Shutter actuators and close labyrinth door	✓	✓	✓	✓	✓

**A15 Hutch D Labyrinth 1 Switches and Latch**

Place actuators on the labyrinth switches/latch and downstream left door switches and Maglock.

**Open Guillotine Shutter.**

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.

	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Latch</u>
<i>Search hutch</i>	✓	✓	✓	✓	✓
<i>Open FE Shutters and L2S2 Shutter from keypad</i>	✓	✓	✓	✓	✓
FE and L2S2 Shutters A and B open (green)	✓	✓	✓	✓	✓
D Interlocked A and B ON (green)	✓	✓	✓	✓	✓
L2S2 Shutter Permit A and B ON (green)	✓	✓	✓	✓	✓
Cable Lab 1 Switches/Latch A and B ON (green)	✓	✓	✓	✓	✓
FE Critical Device Permits A and B ON	✓	✓	✓	✓	✓
<i>Remove one switch actuator</i>	✓	✓	✓	✓	✓
Cable Lab 1 Switch/Latch Permit OFF	✓	✓	✓	✓	✓
D Interlocked OFF	✓	✓	✓	✓	✓
L2S2 Shutter Permit OFF	✓	✓	✓	✓	✓
L2S2 Shutter A and B closed (red)	✓	✓	✓	✓	✓
FE Critical Device Permits A and B OFF	✓	✓	✓	✓	✓
<i>Replace switch actuator and reset fault</i>	✓	✓	✓	✓	✓
Remove labyrinth actuators and close labyrinth door	✓	✓	✓	✓	✓

✓  
✓

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**A16 Hutch D Labyrinth 2 Switches and Latch**

Place actuators on the labyrinth switches/latches and downstream left door switches and Maglock.

**Open Guillotine Shutter.**

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.

✓  
✓

	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Latch</u>
<i>Search hutch</i>	✓	✓	✓	✓	✓
<i>Open FE Shutters and L2S2 Shutter from keypad</i>	✓	✓	✓	✓	✓
FE and L2S2 Shutters A and B open (green)	✓	✓	✓	✓	✓
D Interlocked A and B ON (green)	✓	✓	✓	✓	✓
L2S2 Shutter Permit A and B ON (green)	✓	✓	✓	✓	✓
Cable Lab 2 Switches/Latch A and B ON (green)	✓	✓	✓	✓	✓
FE Critical Device Permits A and B ON	✓	✓	✓	✓	✓
<i>Remove one switch actuator</i>	✓	✓	✓	✓	✓
Cable Lab 2 Switch/Latch Permit OFF	✓	✓	✓	✓	✓
D Interlocked OFF	✓	✓	✓	✓	✓
L2S2 Shutter Permit OFF	✓	✓	✓	✓	✓
L2S2 Shutter A and B closed (red)	✓	✓	✓	✓	✓
FE Critical Device Permits A and B OFF	✓	✓	✓	✓	✓
<i>Replace switch actuator and reset fault</i>	✓	✓	✓	✓	✓
Remove labyrinth actuators and close labyrinth door					✓

**A17 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).

✓

	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Reed</u>
<i>Open FE Shutters from keypad</i>	✓	✓	✓	✓	✓
FE Shutters A and B open (green)	✓	✓	✓	✓	✓
FOE Interlocked A and B ON (green)	✓	✓	✓	✓	✓
FE Shutter Permit A and B ON (green)	✓	✓	✓	✓	✓
FOE Door Switch Sum A and B ON (green)	✓	✓	✓	✓	✓
FE Critical Device Permits A and B ON	✓	✓	✓	✓	✓

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

**A18 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).

	<b>A1</b>	<b>A2</b>	<b>B1</b>	<b>B2</b>	<b>Reed</b>
<i>Open FE Shutters from keypad</i>	<input checked="" type="checkbox"/>				
FE Shutters A and B open ( <b>green</b> )	<input checked="" type="checkbox"/>				
FOE Interlocked A and B ON ( <b>green</b> )	<input checked="" type="checkbox"/>				
FE Shutter Permit A and B ON ( <b>green</b> )	<input checked="" type="checkbox"/>				
FOE Door Switch Sum A and B ON ( <b>green</b> )	<input checked="" type="checkbox"/>				
FE Critical Device Permits A and B ON	<input checked="" type="checkbox"/>				
<i>Remove one switch actuator</i>	<input checked="" type="checkbox"/>				
FE Shutters A and B closed ( <b>red</b> )	<input checked="" type="checkbox"/>				
FOE Interlocked OFF	<input checked="" type="checkbox"/>				
FE Shutter Permit OFF	<input checked="" type="checkbox"/>				
FOE Door Switch Sum OFF	<input checked="" type="checkbox"/>				
FE Critical Device Permits A and B OFF	<input checked="" type="checkbox"/>				
<i>Replace switch actuator and reset fault</i>	<input checked="" type="checkbox"/>				
Remove actuators and close door					<input checked="" type="checkbox"/>

**A19 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).

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	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Reed</u>
<i>Open FE Shutters from keypad</i>	✓	✓	✓	✓	✓
FE Shutters A and B open (green)	✓	✓	✓	✓	✓
FOE Interlocked A and B ON (green)	✓	✓	✓	✓	✓
FE Shutter Permit A and B ON (green)	✓	✓	✓	✓	✓
FOE Door Switch Sum A and B ON (green)	✓	✓	✓	✓	✓
FE Critical Device Permits A and B ON	✓	✓	✓	✓	✓
<i>Remove one switch actuator</i>	✓	✓	✓	✓	✓
FE Shutters A and B closed (red)	✓	✓	✓	✓	✓
FOE Interlocked OFF	✓	✓	✓	✓	✓
FE Shutter Permit OFF	✓	✓	✓	✓	✓
FOE Door Switch Sum OFF	✓	✓	✓	✓	✓
FE Critical Device Permits A and B OFF	✓	✓	✓	✓	✓
<i>Replace switch actuator and reset fault</i>	✓	✓	✓	✓	✓
Remove actuators and close door					✓

A20 **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).

	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Reed</u>
<i>Open FE Shutters from keypad</i>	✓	✓	✓	✓	✓
FE Shutters A and B open (green)	✓	✓	✓	✓	✓
FOE Interlocked A and B ON (green)	✓	✓	✓	✓	✓
FE Shutter Permit A and B ON (green)	✓	✓	✓	✓	✓
FOE Door Switch Sum A and B ON (green)	✓	✓	✓	✓	✓
FE Critical Device Permits A and B ON	✓	✓	✓	✓	✓
<i>Remove one switch actuator</i>	✓	✓	✓	✓	✓
FE Shutters A and B closed (red)	✓	✓	✓	✓	✓
FOE Interlocked OFF	✓	✓	✓	✓	✓
FE Shutter Permit OFF	✓	✓	✓	✓	✓
FOE Door Switch Sum OFF	✓	✓	✓	✓	✓
FE Critical Device Permits A and B OFF	✓	✓	✓	✓	✓

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Replace switch actuator and reset fault ✓ ✓ ✓ ✓ ✓  
 Remove actuators and close door ✓

**A21 B Hutch Front Door Switches**

Place actuators on the door switches and Maglock. ✓

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

	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Reed</u>
<i>Open FE Shutters and L1S1 Shutter from keypad</i>	✓	✓	✓	✓	✓
FE and L1S1 Shutters 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	✓	✓	✓	✓	✓
<i>Remove one switch actuator</i>	✓	✓	✓	✓	✓
L1S1 Shutter A and B closed (red)	✓	✓	✓	✓	✓
B Interlocked OFF	✓	✓	✓	✓	✓
L1S1 Shutter Permit OFF	✓	✓	✓	✓	✓
B Door Switch Sum OFF	✓	✓	✓	✓	✓
FE Critical Device Permits A and B OFF	✓	✓	✓	✓	✓
<i>Replace switch actuator and reset fault</i>	✓	✓	✓	✓	✓
Remove actuators and close door					✓

**A22 C 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).

	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Reed</u>
<i>Open FE Shutters and L2S2 Shutter from keypad</i>	✓	✓	✓	✓	✓
FE and L2S2 Shutters A and B open (green)	✓	✓	✓	✓	✓
C Interlocked A and B ON (green)	✓	✓	✓	✓	✓
L2S2 Shutter Permit A and B ON (green)	✓	✓	✓	✓	✓
C Door Switch Sum A and B ON (green)	✓	✓	✓	✓	✓
FE Critical Device Permits A and B ON	✓	✓	✓	✓	✓

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<i>Remove one switch actuator</i>	<input checked="" type="checkbox"/>				
L2S2 Shutter A and B closed ( <b>red</b> )	<input checked="" type="checkbox"/>				
C Interlocked OFF	<input checked="" type="checkbox"/>				
L2S2 Shutter Permit OFF	<input checked="" type="checkbox"/>				
C Door Switch Sum OFF	<input checked="" type="checkbox"/>				
FE Critical Device Permits A and B OFF	<input checked="" type="checkbox"/>				
<i>Replace switch actuator and reset fault</i>	<input checked="" type="checkbox"/>				
Remove actuators and close door					<input checked="" type="checkbox"/>

**A23 C 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).

	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Reed</u>
<i>Open FE Shutters and L2S2 Shutter from keypad</i>	<input checked="" type="checkbox"/>				
FE and L2S2 Shutters A and B open ( <b>green</b> )	<input checked="" type="checkbox"/>				
C Interlocked A and B ON ( <b>green</b> )	<input checked="" type="checkbox"/>				
L2S2 Shutter Permit A and B ON ( <b>green</b> )	<input checked="" type="checkbox"/>				
C Door Switch Sum A and B ON ( <b>green</b> )	<input checked="" type="checkbox"/>				
FE Critical Device Permits A and B ON	<input checked="" type="checkbox"/>				
<i>Remove one switch actuator</i>	<input checked="" type="checkbox"/>				
L2S2 Shutter A and B closed ( <b>red</b> )	<input checked="" type="checkbox"/>				
C Interlocked OFF	<input checked="" type="checkbox"/>				
L2S2 Shutter Permit OFF	<input checked="" type="checkbox"/>				
C Door Switch Sum OFF	<input checked="" type="checkbox"/>				
FE Critical Device Permits A and B OFF	<input checked="" type="checkbox"/>				
<i>Replace switch actuator and reset fault</i>	<input checked="" type="checkbox"/>				
Remove actuators and close door					<input checked="" type="checkbox"/>

**A24 C 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).

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	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Reed</u>
<i>Open FE Shutters and L2S2 Shutter from keypad</i>	<input checked="" type="checkbox"/>				
FE and L2S2 Shutters A and B open (green)	<input checked="" type="checkbox"/>				
C Interlocked A and B ON (green)	<input checked="" type="checkbox"/>				
L2S2 Shutter Permit A and B ON (green)	<input checked="" type="checkbox"/>				
C Door Switch Sum A and B ON (green)	<input checked="" type="checkbox"/>				
FE Critical Device Permits A and B ON	<input checked="" type="checkbox"/>				
<i>Remove one switch actuator</i>	<input checked="" type="checkbox"/>				
L2S2 Shutter A and B closed (red)	<input checked="" type="checkbox"/>				
C Interlocked OFF	<input checked="" type="checkbox"/>				
L2S2 Shutter Permit OFF	<input checked="" type="checkbox"/>				
C Door Switch Sum OFF	<input checked="" type="checkbox"/>				
FE Critical Device Permits A and B OFF	<input checked="" type="checkbox"/>				
<i>Replace switch actuator and reset fault</i>	<input checked="" type="checkbox"/>				
<i>Remove actuators and close door</i>					<input checked="" type="checkbox"/>

A25 **D Hutch Front Right Door Switches**

Place actuators on the door switches and Maglock.

**Open Guillotine Shutter.**

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

	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Reed</u>
<i>Open FE Shutters and L2S2 Shutter from keypad</i>	<input checked="" type="checkbox"/>				
FE and L2S2 Shutters A and B open (green)	<input checked="" type="checkbox"/>				
D Interlocked A and B ON (green)	<input checked="" type="checkbox"/>				
L2S2 Shutter Permit A and B ON (green)	<input checked="" type="checkbox"/>				
D Door Switch Sum A and B ON (green)	<input checked="" type="checkbox"/>				
FE Critical Device Permits A and B ON	<input checked="" type="checkbox"/>				
<i>Remove one switch actuator</i>	<input checked="" type="checkbox"/>				
L2S2 Shutter A and B closed (red)	<input checked="" type="checkbox"/>				
D Interlocked OFF	<input checked="" type="checkbox"/>				
L2S2 Shutter Permit OFF	<input checked="" type="checkbox"/>				
D Door Switch Sum OFF	<input checked="" type="checkbox"/>				

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FE Critical Device Permits A and B OFF	✓	✓	✓	✓	✓
<i>Replace switch actuator and reset fault</i>	✓	✓	✓	✓	✓
Remove actuators and close door					✓

**A26 D Hutch Front Left Door Switches**

Place actuators on the door switches and Maglock.

**Open Guillotine Shutter.**

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

✓  
✓

	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Reed</u>
<i>Open FE Shutters and L2S2 Shutter from keypad</i>	✓	✓	✓	✓	✓
FE and L2S2 Shutters A and B open (green)	✓	✓	✓	✓	✓
D Interlocked A and B ON (green)	✓	✓	✓	✓	✓
L2S2 Shutter Permit A and B ON (green)	✓	✓	✓	✓	✓
D Door Switch Sum A and B ON (green)	✓	✓	✓	✓	✓
FE Critical Device Permits A and B ON	✓	✓	✓	✓	✓
<i>Remove one switch actuator</i>	✓	✓	✓	✓	✓
L2S2 Shutter A and B closed (red)	✓	✓	✓	✓	✓
D Interlocked OFF	✓	✓	✓	✓	✓
L2S2 Shutter Permit OFF	✓	✓	✓	✓	✓
D Door Switch Sum OFF	✓	✓	✓	✓	✓
FE Critical Device Permits A and B OFF	✓	✓	✓	✓	✓
<i>Replace switch actuator and reset fault</i>	✓	✓	✓	✓	✓
Remove actuators and close door					✓

**A27 D Hutch Rear Left Door Switches**

Place actuators on the door switches and Maglock.

**Open Guillotine Shutter.**

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

✓  
✓

	<u>A1</u>	<u>A2</u>	<u>B1</u>	<u>B2</u>	<u>Reed</u>
<i>Open FE Shutters and L2S2 Shutter from keypad</i>	✓	✓	✓	✓	✓
FE and L2S2 Shutters A and B open (green)	✓	✓	✓	✓	✓
D Interlocked A and B ON (green)	✓	✓	✓	✓	✓

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L2S2 Shutter Permit A and B ON (green)	✓	✓	✓	✓	✓
D Door Switch Sum A and B ON (green)	✓	✓	✓	✓	✓
FE Critical Device Permits A and B ON	✓	✓	✓	✓	✓
<i>Remove one switch actuator</i>	✓	✓	✓	✓	✓
L2S2 Shutter A and B closed (red)	✓	✓	✓	✓	✓
D Interlocked OFF	✓	✓	✓	✓	✓
L2S2 Shutter Permit OFF	✓	✓	✓	✓	✓
D Door Switch Sum OFF	✓	✓	✓	✓	✓
FE Critical Device Permits A and B OFF	✓	✓	✓	✓	✓
<i>Replace switch actuator and reset fault</i>	✓	✓	✓	✓	✓
Remove actuators and close door					✓

A28 **D Hutch Rear Right Door Switches**

Place actuators on the door switches and Maglock.

**Open Guillotine Shutter.**

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

	<b>A1</b>	<b>A2</b>	<b>B1</b>	<b>B2</b>	<b>Reed</b>
<i>Open FE Shutters and L2S2 Shutter from keypad</i>	✓	✓	✓	✓	✓
FE and L2S2 Shutters A and B open (green)	✓	✓	✓	✓	✓
D Interlocked A and B ON (green)	✓	✓	✓	✓	✓
L2S2 Shutter Permit A and B ON (green)	✓	✓	✓	✓	✓
D Door Switch Sum A and B ON (green)	✓	✓	✓	✓	✓
FE Critical Device Permits A and B ON	✓	✓	✓	✓	✓
<i>Remove one switch actuator</i>	✓	✓	✓	✓	✓
L2S2 Shutter A and B closed (red)	✓	✓	✓	✓	✓
D Interlocked OFF	✓	✓	✓	✓	✓
L2S2 Shutter Permit OFF	✓	✓	✓	✓	✓
D Door Switch Sum OFF	✓	✓	✓	✓	✓
FE Critical Device Permits A and B OFF	✓	✓	✓	✓	✓
<i>Replace switch actuator and reset fault</i>	✓	✓	✓	✓	✓
Remove actuators and close door					✓

✓  
✓

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**A29 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: Upstream Right (USR), Upstream Left (USL), Downstream Right (DSR) and Downstream Left (DSL)

	<u>USR</u>	<u>USL</u>	<u>DSR</u>	<u>DSL</u>
<i>Search hutch</i>	✓	✓	✓	✓
FOE Interlocked A and B ON (green)	✓	✓	✓	✓
FE Shutter Permit A and B ON (green)	✓	✓	✓	✓
Door Maglock A and B ON (green)	✓	✓	✓	✓
<i>Open FE Shutters</i>	✓	✓	✓	✓
FE Shutters open (green)	✓	✓	✓	✓
<i>Using FOE test box, turn OFF Maglock</i>	✓	✓	✓	✓
Door Maglock A OFF	✓	✓	✓	✓
FOE Shutters closed (red)	✓	✓	✓	✓
FOE Interlocked A OFF	✓	✓	✓	✓
FE Shutter Permit A OFF	✓	✓	✓	✓
<i>Turn On Maglock and reset fault</i>	✓	✓	✓	✓
<i>Search hutch</i>	✓	✓	✓	✓
<i>Using FE Shutter test fixture, Open FE Shutters</i>	✓	✓	✓	✓
FE Critical Device Permits A and B ON	✓	✓	✓	✓
<i>Using FOE test box, turn OFF Maglock</i>	✓	✓	✓	✓
<i>Within 3 seconds: FE Critical Device Permit A Chain OFF</i>	✓	✓	✓	✓
<i>Close FE Shutters and reset fault</i>	✓	✓	✓	✓
Disconnect FOE test box				✓

**A30 Magnetic Lock Test (B Hutch)**

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



	<u>FR</u>
<i>Search hutch</i>	✓
B Interlocked A and B ON (green)	✓
LIS1 Shutter Permit A and B ON (green)	✓
Door Maglock A and B ON (green)	✓



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<i>Turn On Maglock and reset fault</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Search hutch</i>	<input checked="" type="checkbox"/>	<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"/>	<input checked="" type="checkbox"/>
<i>Using FOE test box, Open L2S2 Shutter</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FE Critical Device Permits A and B ON	<input checked="" type="checkbox"/>	<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"/>	<input checked="" type="checkbox"/>
<i>Within 3 seconds: FE Critical Device Permit A Chain OFF</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Close all Shutters and reset fault</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Disconnect FOE test box</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

A32 **Magnetic Lock Test (D Hutch)**

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: Front Right (FR), Front Left (FL), Rear Right (RR) and Rear Left (RL)

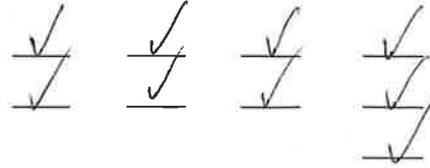
	<u>FR</u>	<u>FL</u>	<u>RR</u>	<u>RL</u>
<i>Search hutch</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
D Interlocked A and B ON (green)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
L2S2 Shutter Permit A and B ON (green)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Door Maglock A and B ON (green)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Open FE Shutters and L2S2 Shutter</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FE and L2S2 Shutters A and B open (green)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<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"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Door Maglock A OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Shutters closed (red)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
D Interlocked A OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
L2S2 Shutter Permit A OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Turn On Maglock and reset fault</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Search hutch</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<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"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Using FOE test box, Open L2S2 Shutter</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FE Critical Device Permits A and B ON	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<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"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

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Within 3 seconds: FE Critical Device Permit A Chain OFF

Close all Shutters and reset fault

Disconnect FOE test box



**A33 Water Interlock**

Water flow meters are located on top of the hutch (Figure 1).



**Figure 1:** Water Flow Meter PPS 1 (A1 and B1) **Figure 2:** Water Flow Meter PPS 2 (A13 and B13)

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 3).



**Figure 3:** PPS Water STAs

Record the pretest water flows for the 4 PPS meters in GPM. Valve numbers are in parentheses:

Meter Reading	Meter Reading	Current STA A	Current STA B
A1(1)= <u>2.56</u>	B1= <u>2.49</u>	A STA1= <u>2.56</u>	B STA1= <u>2.49</u>
A2(13)= <u>2.97</u>	B2= <u>2.92</u>	A STA2= <u>2.97</u>	B STA2= <u>2.92</u>

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).



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<i>Reset fault</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Open FE Shutters with keypad</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FE Shutters A and B open ( <b>green</b> )	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Water Permits A and B ON ( <b>green</b> ), HMI	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FE Shutter Permits A and B ON ( <b>green</b> ), HMI	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Press B chain fault/reset button</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FE Shutters A and B closed ( <b>red</b> )	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Water Permit B OFF, HMI	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
In 5 seconds: FE Shutter Permit B OFF, HMI	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Reset fault</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

A35 **Observe Beamline Photon Shutter Operation**

	<u>L1S1</u>	<u>L2S2</u>
<i>Close Beamline Photon Shutter</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Shutter indicates closed A and B ( <b>red</b> ), HMI	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Open Beamline Photon Shutter</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Shutter opens smoothly without hesitation	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Shutter indicates open A and B ( <b>green</b> ), HMI	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Close Beamline Photon Shutter</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Shutter indicates closed A and B ( <b>red</b> ), HMI	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

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

With Maintenance Door open, connect FE Shutter test fixture.

Shutters are in the closed (down) position	<input checked="" type="checkbox"/>
FE Shutters A and B closed ( <b>red</b> ), HMI	<input checked="" type="checkbox"/>
<i>Turn the "Air" switch ON</i>	<input checked="" type="checkbox"/>
<i>Open FE Photon Shutter and SSs A and B</i>	<input checked="" type="checkbox"/>
Shutters open freely without hesitation	<input checked="" type="checkbox"/>
Shutters are in the open (up) position	<input checked="" type="checkbox"/>
FE Shutters A and B open ( <b>green</b> ), HMI	<input checked="" type="checkbox"/>
<i>Actuate Shutters closed</i>	<input checked="" type="checkbox"/>
FE Shutters A and B closed ( <b>red</b> ), HMI	<input checked="" type="checkbox"/>

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A37 **FE Safety Shutters Can Only be Closed if FE Photon Shutter is Closed**

<i>Search Hutch</i>	FOE Interlocked A and B ON (green), HMI	✓
	FE Critical Device Permits A and B ON (green), HMI	✓
<i>Open FE SSA</i>	SSA Open	✓
<i>Open FE Photon Shutter</i>	FE Critical Device Permits A and B OFF, HMI	✓
<i>Close Shutters</i>		✓
<i>Reset fault</i>	FE Critical Device Permits A and B ON (green), HMI	✓
<i>Open FE SSB</i>	SSB Open	✓
<i>Open FE Photon Shutter</i>	FE Critical Device Permits A and B OFF, HMI	✓
<i>Close Shutters</i>		✓
<i>Reset fault</i>	FE Critical Device Permits A and B ON (green), HMI	✓

A38 **Beamline Enable Key (Opening Shutter Without Key Trips SR RF and Dipole PS)**

<i>Remove beamline enable key</i>	Beamline Online A and B OFF	✓
<i>Search FOE</i>	FOE Interlocked A and B ON (green), HMI	✓
	FE Critical Device Permits A and B ON (green), HMI	✓
<i>Using FE Shutter test fixture, Open FE Shutters</i>	FE Critical Devices Permits A and B OFF	✓
<i>Using FE Shutter test fixture, Close FE Shutters</i>		✓
<i>Replace beamline enable key and reset faults</i>	Beamline Online A and B ON (green)	✓
	FE Critical Device Permits A and B ON (green), HMI	✓

**Live Testing**

A39 **Reach Back FOE Door Switches**

<i>Secure P1 through P5</i>	SR Secure, A and B chain, SR HMI	✓
<i>Place actuators on FOE hutch door switches and Maglock</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 Permit A and B ON (green), SR HMI	✓
<i>Check I/O Box 28 Beamline Enable Panel</i>	FE Critical Device Permits A and B LEDs ON	✓
	FE Critical Device Permit Sum A and B LEDs ON	✓

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

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<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>	Operator enables SR RF System C HVPS	✓
<i>Operator enables SR RF System D HVPS</i>	Operator enables SR RF System D HVPS	✓
<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 28 Beamline Enable Panel</i>	FE Critical Device Permit B LED OFF	✓
	FE Critical Device Permit Sum B LED OFF	✓
<i>Check Control Room SR HMI (MCR beamline 1)</i>	FE Critical Device Permit B OFF ( <b>red</b> ), SR HMI	✓
<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	✓
<i>Check Dipole PS (positive) Beamline Interface</i>	B Permit OFF, Dipole PS Pos. Interface	✓
<i>Check Dipole PS (negative) Beamline Interface</i>	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	✓
<i>Close FE Shutters with FE Shutter test fixture</i>	FE Shutters closed	✓
<i>Remove beamline hutch switch actuators and Maglock actuator</i>		✓

A40 **Water Interlock (Live)**

<i>Search FOE</i>	FOE Interlocked A and B ON ( <b>green</b> ), HMI	✓
	FE Shutter Permits A and B ON ( <b>green</b> ), HMI	✓
	FE Critical Device Permits A and B ON ( <b>green</b> ), HMI	✓
<i>Check I/O Box 28 Beamline Enable Panel</i>	FE Critical Device Permits A and B LEDs ON	✓
	FE Critical Device Permit Sum A and B LEDs ON	✓

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- 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 A33, lower flow to one meter* ✓
- Water Permits A and B OFF, HMI ✓
- FE Shutter Permits A and B OFF, HMI ✓
- Within 5 seconds FE Critical Device Permits A and B OFF, HMI ✓
- Check I/O Box 28 Beamline Enable Panel* FE Critical Device Permits A and B OFF ✓
- FE Critical Device Permit Sum A and B LEDs OFF ✓
- Check Control Room SR HMI (MCR beamline 1)* FE Critical Device Permits 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 FE Shutter test fixture* FE 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 ✓

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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

✓  
✓  
✓  
✓  
✓

A42 **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 28-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 keys 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 -

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**Reviewed by:**

1/25/2018

**X** Scott W Buda

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Scott Buda  
 Accelerator Safety Systems Group Leader  
 Signed by: Buda, Scott

1/12/2018

**X** Robert Chmiel

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

**Approved by:**

1/16/2018

**X** 

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

**Revision History**

Revision	Description	Date
1	First Issue.	23DEC2016
2	Revised with the addition of the "B" hutch PPS	21DEC2017
3	Removed ES4 from step A7.	10JAN2018

National Synchrotron Light Source II, Brookhaven National Laboratory			
Doc No. <b>PS-C-ASD-PRC-008</b>	Author: <b>T. McDonald</b>	Effective Date: <b>17 April 2015</b> Review Frequency: <b>3 yrs</b>	Version <b>4</b>
Title: <b>NLSL-II Area Radiation Monitor PPS Test</b>			<b>Technical</b>

### Attachment D

### NLSL-II Beamline (FOE) Area Radiation Monitor Checklist

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

DET# IN07414

Monitor # <b>FRM ID 28</b>	ID # <b>IN07408</b>	Beamline: <b>28 ID</b>
Test Reason: <input checked="" type="checkbox"/> Beamline Certification <input type="checkbox"/> Replacement/Repair		
Test Date: <b>11/3/18</b>	Test Result	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed
Tester: <b>Thomas P. McDonald</b>	RCD:	<b>J. Dobrick</b>
Tester Signature: <i>Thomas P. McDonald</i>	RCD Signature:	<i>J. Dobrick</i>

**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 <input checked="" type="checkbox"/>	Gun Contactor ON A Chain	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
RCD Disables Monitor		Alarm sounds in Control Room		<input checked="" type="checkbox"/>
	Fail alarm ON HMI (yellow border around ARM icon)		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Silence CR Alarm		Alarm silences		<input checked="" type="checkbox"/>
Gun turns OFF	Gun HVPS is OFF <input checked="" type="checkbox"/>	Gun Contactor OFF A Chain	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Return monitor to normal	Gun HVPS remains OFF <input checked="" type="checkbox"/>	Fail alarm remains ON HMI	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Reset fault in Control Room		Monitor normal HMI	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
RCD ensures ARM is locked	ARM is locked <input checked="" type="checkbox"/>			

**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 <input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Apply source until low alarm	Yellow light on Monitor <input checked="" type="checkbox"/>	Radiation level increases on EPICS		<input checked="" type="checkbox"/>
	FE Shutters Closed <input checked="" type="checkbox"/>	Alarm sounds in Control Room		<input checked="" type="checkbox"/>
		Low level alarm ON, HMI	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Return monitor to normal		Monitor normal, HMI	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	FE Critical Device Permit A chain ON		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Apply source until low alarm	Yellow light on Monitor <input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>
	FE Critical Device Permit A chain OFF		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Return monitor to normal		Monitor normal, HMI	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

**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 <input checked="" type="checkbox"/>	Gun Contactor ON A Chain	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Apply source until high alarm	Red light on Monitor <input checked="" type="checkbox"/>	Radiation level increases on EPICS		<input checked="" type="checkbox"/>
	Monitor alarm sounds	Alarm sounds in Control Room		<input checked="" type="checkbox"/>
		High level alarm ON, HMI	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Silence Alarm		Alarm silences		<input checked="" type="checkbox"/>
Gun turns OFF	Gun HVPS is OFF <input checked="" type="checkbox"/>	Gun Contactor OFF A Chain	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Return monitor to normal	Gun HVPS remains OFF <input checked="" type="checkbox"/>	High level alarm remains ON, HMI	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Reset fault in Control Room		Monitor normal, HMI	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

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

