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

<table>
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<th>PS-C-ASD-PRC-129</th>
<th>Author:</th>
<th>T. McDonald</th>
<th>Effective Date:</th>
<th>08Jan2016</th>
<th>Review Frequency:</th>
<th>3 yrs</th>
<th>Version</th>
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<td><strong>NSLS-II Storage Ring Radiological Interlock Test</strong></td>
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#### Reviewed by:

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<tr>
<td>X Scott Buda</td>
<td>X Robert Chmiel</td>
<td>X Ewart Orr</td>
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<tr>
<td>Signed by: Buda, Scott</td>
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<tr>
<td>X John Aloi</td>
<td>X Mo Benmerrouche</td>
<td>X Ferdinand Willeke</td>
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<tr>
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#### USI Screening/Resolution

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<td>X Steven Moss</td>
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#### Procedure Validation*

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<td>X Thomas McDonald</td>
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<td>Signed by: McDonald, Thomas</td>
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*for Operations/Technical procedures only

#### Approved by:

<table>
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<tr>
<td>X Robert Lee</td>
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National Synchrotron Light Source II, Brookhaven National Laboratory

Doc No. PS-C-ASD-PRC-129  
Author: T. McDonald  
Effective Date: 08Jan2016  
Review Frequency: 3 yrs  
Version 5

Title: NSLS-II Storage Ring Radiological Interlock Test  
Technical

VERSION HISTORY LOG

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<tr>
<td>1</td>
<td>First Issue.</td>
<td>31Jan2014</td>
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<td>2</td>
<td>Updated after precertification testing by Accelerator Safety Systems Group; Validation waived by Author, T. McDonald and Conduct of Operations Manager, L. Hill.</td>
<td>14Mar2014</td>
</tr>
<tr>
<td>3</td>
<td>Updated after inconsistencies identified during initial certification (March 2014): Gun and modulators observed during all live tests, A and B chain observations for Access request test steps modified to concur with current PLC programming, energy limiter trip amplifier tests added in Pentant 2 checklist, Magnet test mode steps requiring gun operation deleted, updated SR dipole current setpoints on energy limiter test steps, added injection energy limiter test to Pentant 3 checklist; updated reviewer titles; general formatting; added reference to the Document Control Procedure to sections 7 and 9; Validation waived by Author, T. McDonald and Conduct of Operations Manager, L. Hill.</td>
<td>18Apr2014</td>
</tr>
<tr>
<td>4</td>
<td>Revised wording in Purpose and Scope: to indicate certifications can occur up to the last day of the month due; Centrally Controlled LOTO will disable electron beam if due date expires. Added LOTO of Booster RF and SR low level RF drive. LOTO of the SR dipole only performed during specified checklist steps. Revised retrieving Quick search keys from Control Room to RF system kirk key bank. Revised all checklists: removed references to Building 725; added steps to connect/disconnect test jumpers for SR Dipole PS interface boxes; revised search sequence test steps to utilize quick search feature. Added “Assistants” to Responsibilities (3.2). General formatting throughout.</td>
<td>22May2015</td>
</tr>
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<td>4</td>
<td>MPC No.1 Change to add check that PPS cabinets are secure and locked (6.1.8, Attachment A [A40], B [B50], C [C39], D [D35] and E [E41]).</td>
<td>13Nov2015</td>
</tr>
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<td>5</td>
<td>Revised for installation of RF System “C” into the SR PPS and associated modifications.</td>
<td>08Jan2016</td>
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ACRONYMS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>ABM</td>
<td>Authorization Basis Manager</td>
</tr>
<tr>
<td>ASE</td>
<td>Accelerator Safety Envelope</td>
</tr>
<tr>
<td>BNL</td>
<td>Brookhaven National Laboratory</td>
</tr>
<tr>
<td>BTS</td>
<td>Booster to Storage Ring</td>
</tr>
<tr>
<td>CR</td>
<td>Control Room</td>
</tr>
<tr>
<td>DPSI</td>
<td>Dipole Power Supply Interface</td>
</tr>
<tr>
<td>ESH</td>
<td>Environment, Safety, and Health</td>
</tr>
<tr>
<td>HII</td>
<td>Human Interlock Interface</td>
</tr>
<tr>
<td>HMI</td>
<td>Human Machine Interface</td>
</tr>
<tr>
<td>HV</td>
<td>High Voltage</td>
</tr>
<tr>
<td>HVPS</td>
<td>High Voltage Power Supply</td>
</tr>
<tr>
<td>I/O</td>
<td>Input/Output</td>
</tr>
<tr>
<td>ISA</td>
<td>Injector Service Area</td>
</tr>
<tr>
<td>LOTO</td>
<td>Lockout/Tagout</td>
</tr>
<tr>
<td>LTB</td>
<td>Linac to Booster</td>
</tr>
<tr>
<td>NSLS-II</td>
<td>National Synchrotron Light Source II</td>
</tr>
<tr>
<td>PLC</td>
<td>Programmable Logic Controller</td>
</tr>
<tr>
<td>PPS</td>
<td>Employee Protection System</td>
</tr>
<tr>
<td>PS</td>
<td>Power Supply</td>
</tr>
<tr>
<td>RF</td>
<td>Radio Frequency</td>
</tr>
<tr>
<td>RFPSSI</td>
<td>Radio Frequency Power Supply Interface</td>
</tr>
<tr>
<td>SBMS</td>
<td>Standards Based Management System</td>
</tr>
<tr>
<td>SR</td>
<td>Storage Ring</td>
</tr>
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1 PURPOSE AND SCOPE

The purpose of this procedure is to provide instructions for testing and certifying the radiological interlock system for the BNL NSLS-II Storage Ring. The system will be re-tested every six months, in accordance with the SBMS Program Description: Radiological Control Manual and SBMS Subject Area, Interlock Safety for High Risk Hazards. Certification must be completed sometime during, but no later than, the last day of the calendar month in which it is due. Any PPS going beyond the last day of the month in which it is due will have Centrally Controlled LOTO applied to prohibit operation with electron beam until certification is complete. Testing will also be required after a change in wiring, components, or programming in accordance with PS-ESH-PRM-3.4.1, Procedure for Safety System Work Permits and the guidelines for certification specified in PS-C-ASD-SPC-SR-PPS-001, Storage Ring Employee Protection System (SPPS) Design Description. Changes to the system shall be performed in accordance with PS-C-ASD-PRC-057, NSLS-II PPS Configuration Management.

2 DEFINITIONS

None.

3 RESPONSIBILITIES

3.1 Testers

3.1.1 Coordinate and perform radiological interlock certification testing.

3.1.2 Delegate radiological interlock testing step actions to personnel acting as Assistants.

3.1.3 Complete attached test checklists, as required.

3.2 Assistants

3.2.1 Assist the Tester in performing the storage ring interlock test step actions when directed by the Tester.

3.2.2 Report all radiological interlock test observations to the Tester.
3.3 Accelerator Safety Systems Engineers and Technicians
   3.3.1 Provide technical support throughout testing.

3.4 Primary Authorized Employees
   3.4.1 Apply LOTO in accordance with this procedure.

3.5 Configuration Management Specialist
   3.5.1 Posts completed test checklists on the SharePoint Document Center.

4 PREREQUISITES

4.1 At least one Tester shall be ESH Staff.

4.2 Assistants shall be designated by the Testers.

5 PRECAUTIONS AND LIMITATIONS

5.1 All steps in this procedure that require LOTO of systems/equipment for servicing and maintenance activities shall be performed in accordance with SBMS Subject Area, Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance.

5.2 All steps in this procedure that require LOTO for any purpose other than servicing and maintenance shall be performed in accordance with PS-C-ASD-PRC-005, Centrally Controlled Lockout/Tagout (LOTO) Procedure.

5.3 Mufflers shall be used to reduce noise during testing by placing them on the right hand HII sounders (6 per pentant).

5.4 The radiological interlock system for the storage ring is a credited control in accordance with the ASE. Any deviation or discrepancy from an expected test result may be a violation of the ASE and shall be reported to the ABM as soon as practical.
5.5 All steps in test checklists (Attachments A through E) that require a search shall be performed in accordance with the appropriate procedure as follows:

- Berm in accordance with PS-C-ESH-PRC-004, *Procedure for NSLS-II Injector Berm Search and Secure, and Breaking Injector Berm Security*
- Linac in accordance with PS-C-PRC-LIN-SS-001, *Procedure for NSLS-II Linac Search and Secure, and Breaking Security*
- Booster in accordance with PS-C-ESH-PRC-016, *Procedure for NSLS-II Booster Search and Secure, and Breaking Security*
- Storage Ring in accordance with PS-C-ASD-PRC-111, *Procedure for NSLS-II Storage Ring Search and Secure, and Breaking Security*

6 PROCUREMENT

6.1 Test and Certify Radiological Interlocks

**Note:** Two Testers are required to test and certify the storage ring radiological interlocks.

6.1.1 Testers notify the Lead Operator that a test of the storage ring radiological interlocks will be performed.

6.1.2 Testers obtain the Storage Ring Pentant Quick Search keys for each pentant being tested from the RF kirk key bank located behind the RF HVPS.

6.1.3 Primary Authorized Employees apply LOTO to the following:

- Gun HVPS output cable connector in accordance with SBMS Subject Area, Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance to ensure no signal output to the electron gun cage
- Three linac modulator power supply line cords OR Booster Dipole F Power Supply in accordance with SBMS Subject Area, Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance
- Booster RF HVPS OR Booster low level RF drive termination OR Booster RF output connection to cavity in accordance with PS-C-ASD-PRC-047, *NSLS-II Booster Ring Radio Frequency System High Voltage Power Supply (BR-HVPS) Lockout/Tagout (LOTO)*
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Title: NSLS-II Storage Ring Radiological Interlock Test

- SR System “C” RF HVPS in accordance with PS-C-ASD-PRC-048, NSLS-II Storage Ring Radio Frequency (RF) System High Voltage Power Supply (HVPS) Lockout/Tagout (LOTO)
- SR System “C” low level RF drive termination OR SR System “C” RF output connection to cavity in accordance with SBMS Subject Area, Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance
- SR System “D” RF HVPS in accordance with PS-C-ASD-PRC-048, NSLS-II Storage Ring Radio Frequency (RF) System High Voltage Power Supply (HVPS) Lockout/Tagout (LOTO)
- SR System “D” low level RF drive termination OR SR System “D” RF output connection to cavity in accordance with SBMS Subject Area, Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance

**Note:** The Gun HVPS output cable connector will remain locked and tagged for the full duration of the test. The other LOTOs will be removed during specified test steps.

6.1.4 Tester applies LOTO to each of the following in accordance with PS-C-ASD-PRC-005, Centrally Controlled Lockout/Tagout (LOTO) Procedure:

- Gun HVPS output cable connector
- Three linac modulator power supply line cords OR Booster Dipole F Power Supply
- Booster RF HVPS OR Booster low level RF drive termination OR Booster RF output connection to cavity
- SR RF System “C” HVPS
- SR System “C” low level RF drive termination OR SR System “C” RF output connection to cavity
- SR RF System “D” HVPS
- SR System “D” low level RF drive termination OR SR System “D” RF output connection to cavity
Note: A test checklist is designated for each of the five pentants, as follows:

- Attachment A, *NSLS-II Storage Ring Pentant 1 Radiological Interlock Test Checklist*
- Attachment B, *NSLS-II Storage Ring Pentant 2 Radiological Interlock Test Checklist*
- Attachment C, *NSLS-II Storage Ring Pentant 3 Radiological Interlock Test Checklist*
- Attachment D, *NSLS-II Storage Ring Pentant 4 Radiological Interlock Test Checklist*
- Attachment E, *NSLS-II Storage Ring Pentant 5 Radiological Interlock Test Checklist*

Note: With the exception of LOTO checklist items, checklist items (i.e., tests) specified in Attachments A through E may be performed without the completion of all of the other specified checklist items (i.e., partial radiological interlock test).

6.1.5 Testers use the appropriate test checklist (Attachments A through E) to test and certify the specific pentant radiological interlocks.

- IF the correct corresponding observation has been made, THEN make a checkmark (✓) for each step.
- IF any step results in an undesired event or outcome, THEN contact the Accelerator Safety Systems Engineer and/or Technician.
- IF the undesired outcome or event requires a change to wiring, component(s), or PLC programming, THEN make a checkmark (✓) in the Test Result “Failed” box at the top of the test checklist.
- IF the test checklist is fully completed with desirable outcomes, THEN make a checkmark (✓) in the Test Result “Passed” box at the top of the test checklist.

6.1.6 Testers notify the Lead Operator that the test of the specific pentant radiological interlocks is completed and the resulting outcome (i.e., Passed or Failed).

6.1.7 Testers remove LOTO from each of the following in accordance with PS-C-ASD-PRC-005, *Centrally Controlled Lockout/Tagout (LOTO) Procedure:*

- Gun HVPS output cable connector
Three linac modulator power supply line cords OR Booster Dipole F Power Supply

Booster RF HVPS OR Booster low level RF drive termination OR Booster RF output connection to cavity

SR RF System “C” HVPS

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

SR RF System “D” HVPS

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

6.1.8 Testers ensure all Booster PPS cabinets are secure and locked.

6.1.9 Testers return the Storage Ring Pentant Quick Search keys to the RF kirk key bank located behind the RF HVPS.

6.1.10 Testers notify the Primary Authorized Employee for each of the following systems that interlock testing is complete and removal of LOTO may be performed:

- Gun HVPS output cable connector
- Three linac modulator power supply line cords OR Booster Dipole F Power Supply
- Booster RF HVPS OR Booster low level RF drive termination OR Booster RF output connection to cavity
- SR RF System “C” HVPS
- SR System “C” low level RF drive termination OR SR System “C” RF output connection to cavity
- SR RF System “D” HVPS
- SR System “D” low level RF drive termination OR SR System “D” RF output connection to cavity

6.1.11 Testers provide the completed test checklist to the Configuration Management Specialist for posting on the SharePoint Document Center.
6.2 Alarms and Faults

6.2.1 Clear any existing faults:

a. **IF** fault(s) cannot be cleared, **THEN** contact the Accelerator Safety Systems Staff.

6.2.2 Silence alarms by pressing the “alarm silence” button on the Control Room HMI.

7 REFERENCES

7.1 PS-C-ASD-PRC-005, *Centrally Controlled Lockout/Tagout (LOTO) Procedure*

7.2 PS-C-ASD-PRC-048, *NSLS-II Storage Ring Radio Frequency (RF) System High Voltage Power Supply (HVPS) Lockout/Tagout (LOTO)*

7.3 PS-C-ASD-PRC-057, *NSLS-II PPS Configuration Management*

7.4 PS-C-ASD-SPC-SR-PPS-001, *Storage Ring Employee Protection System (SPPS) Design Description*

7.5 PS-C-ESH-PRC-004, *Procedure for NSLS-II Injector Berm Search and Secure, and Breaking Injector Berm Security*

7.6 PS-C-ESH-PRC-016, *Procedure for NSLS-II Booster Search and Secure, and Breaking Security*

7.7 PS-C-ASD-PRC-111, *Procedure for NSLS-II Storage Ring Search and Secure, and Breaking Security*

7.8 PS-C-PRC-LIN-SS-001, *Procedure for NSLS-II Linac Search and Secure, and Breaking Security*

7.9 PS-ESH-PRM-3.4.1, *Procedure for Safety System Work Permits*

7.10 SBMS Program Description: *Radiological Control Manual*

7.11 SBMS Subject Area, *Interlock Safety for High Risk Hazards*

7.12 SBMS Subject Area, *Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance*
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### Title: NSLS-II Storage Ring Radiological Interlock Test

7.13 PS-C-CMD-PRC-002, *Records Management Procedure*

7.14 PS-C-ASD-PRC-143, *NSLS-II Storage Ring Main Dipole Centrally Controlled Lockout/Tagout (LOTO)*


7.16 PS-C-ASD-PRC-008, *NSLS-II Area Radiation Monitor PPS Test*

### 8 ATTACHMENTS

Attachment A, *NSLS-II Storage Ring Pentant 1 Radiological Interlock Test Checklist*

Attachment B, *NSLS-II Storage Ring Pentant 2 Radiological Interlock Test Checklist*

Attachment C, *NSLS-II Storage Ring Pentant 3 Radiological Interlock Test Checklist*

Attachment D, *NSLS-II Storage Ring Pentant 4 Radiological Interlock Test Checklist*

Attachment E, *NSLS-II Storage Ring Pentant 5 Radiological Interlock Test Checklist*

### 9 DOCUMENTATION

The following documents are generated as a result of this procedure, and shall be maintained in accordance with PS-C-CMD-PRC-002, *Records Management Procedure*:

- NSLS-II Storage Ring Pentant 1 Radiological Interlock Test Checklist
- NSLS-II Storage Ring Pentant 2 Radiological Interlock Test Checklist
- NSLS-II Storage Ring Pentant 3 Radiological Interlock Test Checklist
- NSLS-II Storage Ring Pentant 4 Radiological Interlock Test Checklist
- NSLS-II Storage Ring Pentant 5 Radiological Interlock Test Checklist
Each numbered item below indicates a set of action items for the test procedure. The Tester will either perform the action, or delegate the action to the Assistant(s). For each step a checkmark (√) should be made if the correct corresponding observation has been made.

### Action Taken

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A1</strong> Verify System Lockouts and Connect Dipole Test Jumpers</td>
<td>[Details omitted for brevity]</td>
</tr>
<tr>
<td><strong>A2</strong> Secure Enclosures</td>
<td>[Details omitted for brevity]</td>
</tr>
<tr>
<td><strong>A3</strong> Verify Pentant 1 Single Pentant Search (Mode 1)</td>
<td>[Details omitted for brevity]</td>
</tr>
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**Note:** All Mode Search Verifications can be completed using the Quick Search feature.
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Effective Date: 08Jan2016  
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Title: NSLS-II Storage Ring Radiological Interlock Test  

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search sounder alarm sounds</td>
<td>Yes</td>
</tr>
<tr>
<td>Overhead lighting flashes during search</td>
<td></td>
</tr>
<tr>
<td>One searcher remains on P5 side of gate 1</td>
<td></td>
</tr>
<tr>
<td>Close gate 1 and press SB2</td>
<td></td>
</tr>
<tr>
<td>Press SB3 on HII 1</td>
<td></td>
</tr>
<tr>
<td>Press SB4 on HII 2</td>
<td></td>
</tr>
<tr>
<td>Press SB5 on HII 3</td>
<td></td>
</tr>
<tr>
<td>Searchers simultaneously press P1-SB1 (Service Bldg.) and SB6 on HII 4 until</td>
<td></td>
</tr>
<tr>
<td>the lights illuminate</td>
<td></td>
</tr>
<tr>
<td>Light on SB1 (Service Bldg.) illuminates</td>
<td></td>
</tr>
<tr>
<td>Light on SB6 illuminates</td>
<td></td>
</tr>
<tr>
<td>Amber HII 4 search beacon is ON</td>
<td></td>
</tr>
<tr>
<td>Press SB7 on HII 5</td>
<td></td>
</tr>
<tr>
<td>Press SB8 on HII 6</td>
<td></td>
</tr>
<tr>
<td>One searcher remains on P2 side of gate</td>
<td></td>
</tr>
<tr>
<td>Close Pentant Gate 2</td>
<td></td>
</tr>
<tr>
<td>Press SBSP</td>
<td></td>
</tr>
<tr>
<td>Press P1-SB1</td>
<td></td>
</tr>
<tr>
<td>Exit through Service Building Door</td>
<td></td>
</tr>
<tr>
<td>Press SBE</td>
<td></td>
</tr>
<tr>
<td>Light on SBE illuminates</td>
<td></td>
</tr>
<tr>
<td>Maglock engages/locks- check door</td>
<td></td>
</tr>
<tr>
<td>Service Bldg. 1 Maglock A and B (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Gate 1 switches A and B ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Gate 1 Maglock A and B ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Gate 2 Maglock A and B ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Gate 2 switches A and B ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td>After beam imminent warning sounds:</td>
<td></td>
</tr>
<tr>
<td>(Note: Beam imminent timed in step A4)</td>
<td></td>
</tr>
<tr>
<td>Request Operator grant access permit for P1</td>
<td></td>
</tr>
<tr>
<td>Press Access Request button at Serv. Building Door 1</td>
<td></td>
</tr>
<tr>
<td>if necessary (other pentants secure)</td>
<td></td>
</tr>
<tr>
<td>Open Door</td>
<td></td>
</tr>
<tr>
<td>Light on SBE illuminates</td>
<td></td>
</tr>
<tr>
<td>Maglock engages/locks- check door</td>
<td></td>
</tr>
<tr>
<td>Service Bldg. Door sign illuminates (A and B sect.)</td>
<td></td>
</tr>
<tr>
<td>Pentant 1 Secured A and B chain, HMI</td>
<td></td>
</tr>
<tr>
<td>Gate 1 sign illuminates (A and B sect.)</td>
<td></td>
</tr>
<tr>
<td>Gate 2 sign illuminates (A and B sect.)</td>
<td></td>
</tr>
<tr>
<td>No alarm sounds in Control Room</td>
<td></td>
</tr>
</tbody>
</table>

A2
Verify Pentant 1 Starting Multiple Pentant Search (Mode 2) and Time Beam Imminent Warning

Check HMI status
Three Searchers enter Service Building 1
Press P1-SB1 in Pentant 1 Service Bldg.1
Close Gate 1 and press SB2
Press SB3 on HII 1
Press SB4 on HII 2
Press SB5 on HII 3
Searchers simultaneously press P1-SB1 (Service Bldg.) and SB6 on HII 4 until the lights illuminate
Press SB7 on HII 5
Press SB8 on HII 6
Close Pentant Gate 2
Reach through Gate 2 Press SB9 and begin timing audible alarm

After beam imminent warning sounds:

Operations Enable Switch (Pentant 1 Main I/O box)

Rotate the operation enable switch to OFF
Attempt to secure Pentant 1

A5
Action Taken
Rotate the Operation enable switch to ON
Reset the fault at the Pentant 1 I/O box

A6 Verify Pentant 1 Continuing Multiple Pentant Search (Mode 3) and Time Red Beacons
Check HMI on 740 Pentant I/O Box or CR
Close Gate 1 and press SB2
Press P1-SB3 on HII 1
Press P1-SB4 on HII 2
Press SB5 on HII 3
Searchers simultaneously press P1-SB1 (Service Bldg.) and SB6 on HII 4 until the lights illuminate
Close Pentant Gate 2
Reach through gate 2 Press SB9 and begin timing the
Red Beacons on HII devices (6)

Observation, Location
Pentant 1 not secured A and B chain (grey), HMI
Light on search button illuminates
Light on search button illuminates
Amber HII 1 search beacon is ON
Light on search button illuminates
Amber HII 2 search beacon is ON
Light on search button illuminates
Amber HII 3 search beacon is ON
Light on search button illuminates
Amber HII 4 search beacon is ON
Light on search button illuminates
Amber HII 5 search beacon is ON
Light on search button illuminates
Amber HII 6 search beacon is ON
Light on search button illuminates
HMI
Light on SB1 (Service Bldg.) illuminates
Light on SB6 illuminates
Amber HII 4 search beacon is ON
Light on search button illuminates
Amber HII 5 search beacon is ON
Light on search button illuminates
Amber HII 6 search beacon is ON
Light on search button illuminates
Maglock engages/locks- check door
Service Bldg 1 Maglock A and B (green), HMI
Gate 2 Maglock A and B (green), HMI
Gate 1 switches A and B (green), HMI
Gate 2 switches A and B (green), HMI
Pentant 1 Secured A and B chain, HMI
Red Beacons (6) flash for 60 seconds
HII Red area Secure A and B lights illuminated
Pentant 1 unsecured A and B chain, HMI
No alarm sounds in Control Room

A7 Verify Pentant 1 Completing Multiple Pentant Search (Mode 4)
Check HMI on 740 Pentant I/O Box or CR
Close Gate 1 and press SB2
Press P1-SB3 on HII 1
Press P1- SB4 on HII 2

Pentant 1 not secured A and B chain (grey), HMI
Light on search button illuminates
Light on search button illuminates
Light on search button illuminates
Anthony McDonald

NSLS-II Storage Ring Radiological Interlock Test

Action Taken | Observation, Location
---|---
Press SB5 on HII 3 | Amber HII 2 search beacon is ON

Searchers simultaneously press P1-SB1 (Service Bldg.) and SB6 on HII 4 until the lights illuminate | Light on SB1 (Service Bldg.) illuminates

Light on SB6 illuminates

Amber HII 3 search beacon is ON

Press SB7 on HII 5 | Light on search button illuminates

Amber HII 4 search beacon is ON

Press SB8 on HII 6 | Light on search button illuminates

Amber HII 5 search beacon is ON

Close Pantant Gate 2 | Light on search button illuminates

Press SBSP | Light on search button illuminates

Press P1-SB1 at Service Building Door | Light illuminates on SB1

Exit through Service Building Door | Door is open

Press SBE | Light on SBE illuminates

After Beam Imminent alarm: | Pentant 1 Secured A and B chain, HMI

A8 Access Pantant and Check HII

Request Operator grant access permit for P1 | If other pentants secure the Access Request button at Service Bldg. 1 illuminates

Press Access Request button at Service Building Door | P1 Service Bldg. Door Maglock Off (grey), HMI

if necessary (other pentants secure) | Pantent not secured A and B chain (grey), HMI

Door is open

Check HII indicators | Red Beacons OFF

Red Secure A and B lights OFF

Green HII “Beam Disabled” lights illuminated

Proceed to P1-SB2

A9 Search Timeout (Mode 2)

Press P1-SB2 in Pentant 1 and begin timing | Light on search button illuminates

Search sounder alarm sounds

Complete search in sequence without pressing SB9 | Light and sounders go out in 12 minutes

Press SB9 | Mode 2 Search does not complete

A10 Skip the Two Button Simultaneous Press (Mode 1) using Quick Search

Close Gates and doors and put into Quick Search | Light on search button illuminates

Press SB1 | Light on search button illuminates

Press SB2 |
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## National Synchrotron Light Source II, Brookhaven National Laboratory

**Doc No.**: PS-C-ASD-PRC-129  
**Author**: T. McDonald  
**Effective Date**: 08Jan2016  
**Review Frequency**: 3 yrs  
**Version**: 5

**Title**: NSLS-II Storage Ring Radiological Interlock Test  
**Technical**

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press SB3</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press SB4</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press SB5</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press SB1</td>
<td></td>
</tr>
<tr>
<td>Press SB6</td>
<td></td>
</tr>
<tr>
<td>Press SB7</td>
<td></td>
</tr>
<tr>
<td>Press SB8</td>
<td></td>
</tr>
<tr>
<td>Press SB9</td>
<td>Pentant 1 does NOT Secure on A OR B chains</td>
</tr>
</tbody>
</table>

**Emergency Stop Aborts Search**

- Complete a normal search using ANY Mode  
  - Mode used =
- Before the beam imminent warning sounder stops,  
  - Beam imminent warning stops
- Press an Emergency Stop  
  - Red Beacons are NOT flashing
  
**A12 A Chain Entrance Door Switches Service Building 1**

- Place holders on the A chain Service Building 1 Door switches (4) and attach actuator on Magnetic lock  
  - Close Pentant gates 1 and 2
  - Perform all actions and make observations for both door A chain switches A1 and A2
  
**Quick Search Pentant 1 (A chain)**

- Pentant 1 secured A chain (green), HMI
- Service Bldg 1 Door SW A chain ON (green), HMI
- Pentant 1 unsecured A chain (grey), HMI
- Service Bldg 1 Door SW A chain OFF (grey), HMI
- Replace holder on stationary door

**Remove holder from Service Building 1 stationary door switch**

**Quick Search Pentant 1 (A chain)**

- Pentant 1 secured A chain (green), HMI
- Service Bldg 1 Door SW A chain ON (green), HMI
- Pentant 1 unsecured A chain (grey), HMI
- Service Bldg 1 Door SW A chain OFF (grey), HMI

**Replace holder on active door**

**A13 Pentant 1 A Chain Quick Search Timeout**

- Quick search Pentant 1 and begin timing
  - Pentant 1 secured A chain (green), HMI
  - Pentant 1 unsecured in 5 minutes (grey), HMI
- Remove A chain switch holders
<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A14 B Chain Entrance Door Switches Service Building 1</strong></td>
<td></td>
</tr>
<tr>
<td>Place holders on the B chain Service Building 1 Door switches (4)</td>
<td></td>
</tr>
<tr>
<td>Close Pentant gates</td>
<td></td>
</tr>
<tr>
<td>Perform all actions and make observations for both door B chain switches B1 and B2</td>
<td></td>
</tr>
<tr>
<td>Quick Search Pentant 1 (B chain)</td>
<td>Pentant 1 secured B chain (green), HMI</td>
</tr>
<tr>
<td>Service Bldg 1 Door SW A chain ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Remove holder from Service Building 1 stationary door switch</td>
<td>Pentant 1 unsecured B chain (grey), HMI</td>
</tr>
<tr>
<td>Service Bldg 1 Door SW B chain OFF (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Replace holder on stationary door</td>
<td></td>
</tr>
<tr>
<td>Quick Search Pentant 1 (B chain)</td>
<td>Pentant 1 secured B chain (green), HMI</td>
</tr>
<tr>
<td>Service Bldg 1 Door SW B chain ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Remove holder from Service Building 1 active door switch</td>
<td>Pentant 1 unsecured B chain (grey), HMI</td>
</tr>
<tr>
<td>Service Bldg 1 Door SW B chain OFF (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Replace holder on active door</td>
<td></td>
</tr>
<tr>
<td><strong>A15 Pentant 1 B Chain Quick Search Timeout</strong></td>
<td></td>
</tr>
<tr>
<td>Quick Search Pentant 1 and begin timing</td>
<td>Pentant 1 secured B chain</td>
</tr>
<tr>
<td>Pentant 1 unsecured in 5 minutes</td>
<td></td>
</tr>
<tr>
<td><strong>A16 Service Building 1 Door Emergency Egress</strong></td>
<td></td>
</tr>
<tr>
<td>Attach B chain Maglock Actuator with tape</td>
<td></td>
</tr>
<tr>
<td>Person proceeds to Exit (ring side)</td>
<td></td>
</tr>
<tr>
<td>Perform B chain Pentant 1 quick search</td>
<td>Pentant 1 secured B chain ON (green), HMI</td>
</tr>
<tr>
<td>Service Bldg 1 Door Maglock B chain ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Remove actuator</td>
<td>Service Bldg 1 Door Maglock B chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Remove B chain switches</td>
<td>Pentant 1 unsecured (grey), HMI</td>
</tr>
<tr>
<td>Close door</td>
<td></td>
</tr>
<tr>
<td>Perform A chain Pentant 1 search</td>
<td>Pentant 1 secured A chain (green), HMI</td>
</tr>
<tr>
<td>Service Bldg 1 Door Maglock A chain ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Press in door push bar without opening door</td>
<td>Service Bldg 1 Door Maglock A chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Open door</td>
<td>Pentant 1 unsecured (grey), HMI</td>
</tr>
<tr>
<td>Close door and stay outside of ring</td>
<td></td>
</tr>
</tbody>
</table>
### Action Taken

<table>
<thead>
<tr>
<th>Observation, Location</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A17</strong> <strong>Service Building 1 P1 Emergency Access Button</strong>&lt;br&gt;Perform A chain Pentant 1 quick search</td>
<td>Pentant 1 secured A chain&lt;br&gt;Service Bldg 1 Door Maglock A chain ON (green), HMI&lt;br&gt;Press in P1 emergency access button&lt;br&gt;Pull out P1 emergency access button&lt;br&gt;Reset fault and latch</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>A18</strong> <strong>Pentant 1 HII Emergency Stops</strong>&lt;br&gt;Repeat all steps for each HII:&lt;br&gt;<strong>A Chain:</strong>&lt;br&gt;Quick search Pentant 1 on A Chain&lt;br&gt;Pentant 1 secured A chain (green), HMI&lt;br&gt;Emergency Stop Latch A chain ON (green), HMI&lt;br&gt;Press in Emergency Stop&lt;br&gt;Pentant 1 unsecured A chain (grey), HMI&lt;br&gt;Pull out Emergency Stop&lt;br&gt;Emergency Stop Latch A chain OFF (grey), HMI&lt;br&gt;Reset fault and latch at Pentant 1 I/O box&lt;br&gt;Emergency Stop Latch A chain ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>B Chain:</strong>&lt;br&gt;Quick search Pentant 1 on B Chain&lt;br&gt;Pentant 1 secured B chain (green), HMI&lt;br&gt;Emergency Stop Latch B chain ON (green), HMI&lt;br&gt;Press in Emergency Stop&lt;br&gt;Pentant 1 unsecured B chain (grey), HMI&lt;br&gt;Pull out Emergency Stop&lt;br&gt;Emergency Stop Latch B chain OFF (grey), HMI</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
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<th>5</th>
</tr>
</thead>
</table>

**Title:** NSLS-II Storage Ring Radiological Interlock Test

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**A9**

**Action Taken**

**Observation, Location**

Reset fault and latch at Pentant 1 I/O box

- Emergency Stop Latch B chain ON *(green)*, HMI

---

**Pentant 1 Gate 1 Switches**

 Proceed to the gate between pentants 5 and 1

 Place holders on the **A chain** gate switches

 Perform all actions and make observations for both Gate 1 A chain switches A1 and A2

---

<table>
<thead>
<tr>
<th>A1</th>
<th>A2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick Search Pentant 1 (A chain)</td>
<td>Pentant 1 secured A chain <em>(green)</em>, HMI</td>
</tr>
<tr>
<td>Remove holder from Gate A chain switch</td>
<td>Gate 1 SW A chain ON <em>(green)</em>, HMI</td>
</tr>
<tr>
<td>Remove Gate A chain switch holders</td>
<td>Pentant 1 unsecured A chain (grey), HMI</td>
</tr>
<tr>
<td>Place holders on the <strong>B chain</strong> gate switches</td>
<td>Gate 1 SW A chain OFF (grey), HMI</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>B1</th>
<th>B2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick Search Pentant 5 (B chain)</td>
<td>Pentant 5 secured B chain <em>(green)</em>, HMI</td>
</tr>
<tr>
<td>Quick Search Pentant 1 (B chain)</td>
<td>Pentant 1 secured B chain <em>(green)</em>, HMI</td>
</tr>
<tr>
<td>Remove holder from Gate 1 B switch</td>
<td>Gate 1 SW B chain ON <em>(green)</em>, HMI</td>
</tr>
<tr>
<td>Remove switch holders and close gate</td>
<td>Pentant 1 unsecured B chain (grey), HMI</td>
</tr>
<tr>
<td></td>
<td>Gate 1 SW B chain OFF (grey), HMI</td>
</tr>
</tbody>
</table>

---

**Gate 1 P1 Emergency Access (in Pentant 5)**

 Proceed to the gate between pentants 5 and 1

 Place holders on the **A chain** gate switches

 Perform all actions and make observations for both Gate 1 A chain switches A1 and A2

---

<table>
<thead>
<tr>
<th>A1</th>
<th>A2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick Search Pentant 1 on A Chain</td>
<td>Pentant 1 Secured A chain <em>(green)</em>, HMI</td>
</tr>
<tr>
<td>Emergency Stop Latch A chain, <em>(green)</em>, HMI</td>
<td>Gate 1 Maglock A chain ON <em>(green)</em>, HMI</td>
</tr>
<tr>
<td>Press the Gate 1 P1 Emergency Access button</td>
<td>Pentant 1 unsecured (grey), HMI</td>
</tr>
<tr>
<td>Gate 1 Maglock A chain OFF (grey), HMI</td>
<td>Emergency Stop Latch A chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Pull out Gate 1 P1 Emergency Access button</td>
<td>Emergency Stop Latch A chain ON <em>(green)</em>, HMI</td>
</tr>
<tr>
<td>Reset fault and latch</td>
<td></td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>A9</th>
<th>B1</th>
<th>B2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick Search Pentant 1 on B Chain</td>
<td>Pentant 1 Secured B chain <em>(green)</em>, HMI</td>
<td></td>
</tr>
<tr>
<td>Emergency Stop Latch B chain, <em>(green)</em>, HMI</td>
<td>Gate 1 Maglock B chain ON <em>(green)</em>, HMI</td>
<td></td>
</tr>
</tbody>
</table>
### Action Taken | Observation, Location
--- | ---
Press the Gate 1 P1 Emergency Access button | Pantent 1 unsecured (grey), HMI
| Gate 1 Maglock B chain OFF (grey), HMI
Pull out Gate 1 P1 Emergency Access Button | Emergency Stop Latch A chain OFF (grey), HMI
Reset fault and latch | Emergency Stop Latch A chain ON (green), HMI

#### Gate 1 Push Bar Test
- Quick search Pentant 1 on A chain
- Push in gate push bar without opening gate
- Release push bar
- Attach B chain Maglock Actuator with tape
- Place holders on B chain door switches
- Quick search Pentant 1 on B chain
- Remove actuator
- Remove holders and close gate

#### Gate 2 Switches
- Proceed to the gate between pentants 4 and 5
- Place holders on the A chain gate switches
- Perform all actions and make observations for both Gate 2 A chain switches A1 and A2
- Remove Gate 2 A chain switch holders
- Place holders on the B chain gate switches
- Perform all actions and make observations for both Gate 2 B chain switches B1 and B2
Remove holder from Gate 2 switch

Pendant 1 unsecured B chain (grey), HMI
Gate 2 SW B chain OFF (grey), HMI

Remove switch holders and close gate

A23  **Gate 2 Emergency Access button (in Pentant 2)**

Quick Search Pentant 1 on A Chain

Pendant 1 Secured A chain, (green), HMI
Emergency Stop Latch A chain, (green), HMI
Gate 2 Maglock A chain ON (green), HMI

Press the Gate 2 P1 Emergency Access Button

Pendant 1 unsecured (grey), HMI
Gate 2 Maglock A chain OFF (grey), HMI

Pull out Gate 2 P1 Emergency Access Button

Emergency Stop Latch A chain OFF (grey), HMI
Reset fault and latch

Emergency Stop Latch A chain ON (green), HMI

Quick Search Pentant 1 on B Chain

Pendant 1 Secured B chain, (green) HMI
Emergency Stop Latch B chain (green), HMI
Gate 2 Maglock B chain ON (green), HMI

Press the Gate 2 P1 Emergency Access Button

Pendant 1 unsecured (grey), HMI
Gate 2 Maglock B chain OFF (grey), HMI

Pull out Gate 2 P1 Emergency Access Button

Emergency Stop Latch B chain OFF (grey), HMI
Reset fault and latch

Emergency Stop Latch B chain ON (green), HMI

A24  **Gate 2 Push Bar**

Quick search Pentant 1 on A chain

Pendant 1 Secure A chain (green), HMI
Gate 2 Maglock A chain ON (green), HMI

Push in gate push bar without opening gate

Pendant 1 NOT Secure A chain (grey), HMI
Gate 2 Maglock A chain OFF (grey), HMI

Release push bar

Attach B chain Maglock Actuator with tape

Place holders on B chain door switches

Quick search Pentant 1 on B chain

Pendant 1 Secure B chain (green), HMI
Gate 2 Maglock B chain ON (green), HMI

Remove actuator

Pendant 1 NOT Secure B chain (grey), HMI
Gate 2 Maglock B chain OFF (grey), HMI
A25 **Pentant 1 Maintenance Doors A Chain**

Place A chain actuators into each Maintenance door connector and complete all steps for each Maintenance Door (MD)

- Quick Search Pentant 1 on A chain
  - Pentant secured on A chain (green), HMI
  - Sum of Maint Doors A chain ON (green), HMI
- Remove Actuator in switch A1
  - Pentant 1 Not secured A chain (grey), HMI
  - Sum of Maint Doors A chain OFF (grey), HMI
- Replace actuator in A1
  - Quick Search Pentant 1 on A chain
    - Pentant secured on A chain (green), HMI
    - Sum of Maint Doors A chain ON (green), HMI
- Remove Actuator in switch A2
  - Pentant 1 Not secured A chain (grey), HMI
  - Sum of Maint Doors A chain OFF (grey), HMI
- Replace actuator in A2
  - Remove actuators

A26 **Pentant 1 Maintenance Doors B Chain**

Place B chain actuators into each Maintenance door connector and complete all steps for each Maintenance Door (MD)

- Quick Search Pentant 1 on B chain
  - Pentant secured on B chain (green), HMI
  - Sum of Maint Doors B chain ON (green), HMI
- Remove Actuator in switch B1
  - Pentant 1 Not secured B chain (grey), HMI
  - Sum of Maint Doors B chain OFF (grey), HMI
- Replace actuator in B1
  - Quick Search Pentant 1 on B chain
    - Pentant secured on B chain (green), HMI
    - Sum of Maint Doors B chain ON (green), HMI
- Remove Actuator in switch B2
  - Pentant 1 Not secured B chain (grey), HMI
  - Sum of Maint Doors B chain OFF (grey), HMI

Remove actuators and ensure all Pentant 1 Maintenance door connectors are on

A27 **Pentant Access Allowed only with Dipole (Negative) PS Contactors OFF**

Primary Authorized Power Supply Employee LOTOs SR Dipole Power Supply
**National Synchrotron Light Source II, Brookhaven National Laboratory**

Doc No. PS-C-ASD-PRC-129  
Author: T. McDonald  
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<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secure all Pentants</td>
<td>SR secure for OPS, HMI</td>
</tr>
<tr>
<td>Primary Authorized Power Supply Employee open cabinet door to access the <strong>A chain</strong> contactor</td>
<td>Negative PS cabinet door open</td>
</tr>
<tr>
<td>Primary Authorized Power Supply Employee push in the <strong>A chain</strong> contactor with a screwdriver</td>
<td></td>
</tr>
<tr>
<td>Request Operator press P1 Access Request button</td>
<td>Access Request button does <strong>not</strong> illuminate</td>
</tr>
<tr>
<td>Primary Authorized Power Supply Employee push in the <strong>B chain</strong> contactor with a screwdriver</td>
<td></td>
</tr>
<tr>
<td>Request Operator press P1 Access Request button</td>
<td>Access Request button illuminates at Service Building</td>
</tr>
<tr>
<td>Press Access Request button at Service Building when lit</td>
<td>Pendant remains secure on A and B chain</td>
</tr>
<tr>
<td>Primary Authorized Power Supply Employee releases the <strong>B chain</strong> contactor</td>
<td>Serv. Bldg. 1 door remains locked on B chain, HMI</td>
</tr>
<tr>
<td>Close cabinet door</td>
<td></td>
</tr>
<tr>
<td><strong>A28</strong> <strong>Pentant Access Allowed only with Dipole (Positivee) PS Contactors OFF</strong></td>
<td></td>
</tr>
<tr>
<td>Primary Authorized Power Supply Employee LOTOs SR Dipole Power Supply</td>
<td></td>
</tr>
<tr>
<td>Secure all Pentants</td>
<td>SR secure for OPS, HMI</td>
</tr>
<tr>
<td>Primary Authorized Power Supply Employee open cabinet door to access the <strong>A chain</strong> contactor</td>
<td>Positive PS cabinet door open</td>
</tr>
<tr>
<td>Primary Authorized Power Supply Employee push in the <strong>A chain</strong> contactor with a screwdriver</td>
<td></td>
</tr>
<tr>
<td>Request Operator press P1 Access request button</td>
<td>Access permit button does <strong>not</strong> illuminate</td>
</tr>
<tr>
<td>Primary Authorized Power Supply Employee push in the <strong>B chain</strong> contactor with a screwdriver</td>
<td></td>
</tr>
<tr>
<td>Request Operator press P1 Access Request button</td>
<td>Access Request button illuminates at Service Building</td>
</tr>
<tr>
<td>Press Access Request button at Service Building when lit</td>
<td>Pendant remains secure on A and B chain</td>
</tr>
<tr>
<td>Primary Authorized Power Supply Employee releases the <strong>B chain</strong> contactor</td>
<td>Serv. Bldg. 1 door remains locked on B chain, HMI</td>
</tr>
<tr>
<td>Close cabinet door</td>
<td></td>
</tr>
<tr>
<td><strong>A29</strong> <strong>Pentant Access Allowed only with SR System C RF HVPS Contactors OFF</strong></td>
<td></td>
</tr>
<tr>
<td>Primary Authorized Power Supply Employee LOTOs SR System C RF power supply</td>
<td></td>
</tr>
<tr>
<td>Secure all Pentants</td>
<td>SR secure for OPS, HMI</td>
</tr>
<tr>
<td>Primary Authorized RF Group Employee open cabinet door to access the <strong>A chain</strong> contactor</td>
<td>PS cabinet door open</td>
</tr>
<tr>
<td>Primary Authorized Power Supply Employee push in the <strong>A chain</strong> contactor with a screwdriver</td>
<td></td>
</tr>
<tr>
<td>Request Operator press P1 Access Request button</td>
<td>Access Request button does not illuminate</td>
</tr>
<tr>
<td>Primary Authorized RF Group Employee push in the <strong>B chain</strong> contactor with a screwdriver</td>
<td></td>
</tr>
<tr>
<td>Request Operator press P1 Access Request button</td>
<td>Access Request button illuminates at Service Building</td>
</tr>
</tbody>
</table>
Press Access Request button a Service Building when lit  
Pentant remains secure on A and B chain  
Serv. Bldg. 1 door remains locked on B chain, HMI

Primary Authorized RF Group Employee releases the B chain contactor  
Close cabinet door

A30  **Pentant Access Allowed only with SR System D RF HVPS Contactors OFF**
Primary Authorized Power Supply Employee LOTOs SR RF System D power supply  
Secure all Pentants  
SR secure for OPS, HMI

Primary Authorized RF Group Employee open cabinet door to access the A chain contactor  
PS cabinet door open

Primary Authorized Power Supply Employee push in the A chain contactor with a screwdriver  
Request Operator press P1 Access Request button  
Access Request button does not illuminate  
Access Request with critical device On alarm, HMI  
Serv. Bldg. 1 door remains locked on A chain, HMI

Primary Authorized RF Group Employee push in the B chain contactor with a screwdriver  
Request Operator press P1 Access Request button  
Press Access Request button a Service Building when lit  
Pentant remains secure on A and B chain  
Serv. Bldg. 1 door remains locked on B chain, HMI

Primary Authorized RF Group Employee releases the B chain contactor  
Close cabinet door

A31  **Pentant Access Allowed only with BTS Shutter Closed**
Request Operator open the BTS shutter  
BTS Shutter opens  
Access Request button at P1 Serv. Bldg. does not illuminate  
Access Request with critical device On alarm, HMI

Request Operator press P1 Access Request button  
Access Request button illuminates at Service Building  
Operator closes shutter  
BTS shutter closed  
Access Request button illuminates outside P1 Service Building Door main entrance

Request Operator press P1 Access Request button  
Building Door main entrance

A32  **Pentant Access Allowed Only with BTS B2 Bending Magnet OFF**
Using shunt test box, apply current to the #1 BTS B2 shunt box  
Request Operator press P1 Access Request button  
Access Request button at P1 Serv. Bldg. illuminates  
Press the button at Service Building  
Pentant remains secure on A and B chain  
Serv. Bldg. 1 door remains locked on B chain, HMI

Remove test box  
Using shunt test box, apply current to the #2 BTS B2 shunt box  
Request Operator press P1 Access Request button  
Access Request button at P1 Serv. Bldg. illuminates  
Press the button at Service Building  
Pentant remains secure on A and B chain  
Serv. Bldg. 1 door remains locked on B chain, HMI

Remove test box

A33  **Magnet Test Mode Breaks Security**

\[\text{□ Completed on Pentant 3 Test}\]

Pentant 1 Secure A and B chains (green), HMI
Rotate Magnet Test key in place on Pantent 2 Mezzanine
  Magnet Test Mode A and B ON (green), HMI
  Pentant 1 unsecured A and B chain (grey), HMI
  Dipole Permits A and B ON (green), HMI
Request Operator turn on Dipole PS
  Dipole PS is ON
Press in Pantent Emergency Stop
  Dipole PS is OFF
  Dipole Permits A and B OFF (grey), HMI
Pullout Emergency Stop
  Emergency Stop Latched and Dipole PS remains OFF
Reset fault and remove Magnet Test key
  Magnet Test Mode A and B OFF (grey), HMI
  Dipole Permit A and B OFF (grey), HMI

A34 Live Test of Storage Ring Door Switches

WARNING: Do not permit Employee to enter the Storage Ring unless authorized by the Tester who will verify the area is safe to enter.

Place Barrier “CAUTION: DO NOT ENTER” tape across entry path. Post a Watch Outside Service Building Door 1 Main Door Entrance.

The watch shall not allow Employee to enter the pentant unless authorized by the Tester.

Place switch holders on the active P1 Service Building Door switches(4) and attach magnetic lock device
Secure Pantent 1 through 5 SR Secure for OPS ON, HMI
Accelerator Safety Systems Staff disables limiters (set to 0) or check if completed on concurrent test
Request Operator turn on Gun HVPS, Modulator HV, set LTB B1 and B2 bending magnet to injection energy, turn on SR RF HVPS and SR Dipole PS
  Gun UPA-100 is ON, gun cabinet
  Modulators contactor ON, Linac HMI
  SR Dipole PS is ON
Check Dipole PS Positive PS Interface, DPSI
  A1 Permit is ON
  A2 Permit is ON
  “A Chain Contactor Open” light is OFF
  B1 Permit is ON
  B2 Permit is ON
  “B Chain Contactor Open” light is OFF
Check Dipole PS Negative PS Interface, DPSI
  A1 Permit is ON
  A2 Permit is ON
  “A Chain Contactor Open” light is OFF
  B1 Permit is ON
  B2 Permit is ON
  “B Chain Contactor Open” light is OFF
Check RF PS Interfaces, RFPSI RF Building
  A1 Permit is ON C AND D
Check RF Systems C AND D
  A2 Permit is ON C AND D
  “A Chain Contactor Open” light OFF C AND D
  B1 Permit is ON System C AND D
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Title: NSLS-II Storage Ring Radiological Interlock Test

B2 Permit is ON System C AND D
“B Chain Contactor Open” light is OFF C AND D

Turn on the BTS B2 bending magnet and set to injection energy
Bending magnet B2 ON, HMI
Open the BTS Shutter
Shutter is open, HMI

Remove A1 switch holder
Pendant 1 unsecured A Chain (grey), HMI
SR Secure For OPS A chain OFF (grey), HMI
Gun Permits A OFF (grey), Linac HMI
Gun UPA-100 is OFF, gun cabinet
SR Dipole PS shuts OFF, A chain
SR RF HVPS shuts OFF, A chain
Modulators OFF, A chain

Check Dipole PS Positive PS Interface, DPSI
A1 Permit is OFF
A2 Permit is OFF
“A Chain Contactor Open” light is ON
B1 Permit is ON
B2 Permit is ON
“B Chain Contactor Open” light is OFF

Check Dipole PS Negative PS Interface, DPSI
A1 Permit is OFF
A2 Permit is OFF
“A Chain Contactor Open” light is ON
B1 Permit is ON
B2 Permit is ON
“B Chain Contactor Open” light is OFF

Check RF PS Interfaces, RFPSI RF Building
A1 Permit is OFF C AND D

Check RF Systems C AND D
A2 Permit is OFF C AND D
“A Chain Contactor Open” light is ON C AND D
B1 Permit is OFF C AND D
B2 Permit is OFF C AND D C AND D
“B Chain Contactor Open” light is ON C AND D

Replace switch holder

Secure Pentant 1
All Pentants secure A and B (green), HMI
SR Secure For OPS A chain ON (green), HMI
Gun Permits A and B ON (green), Linac HMI

Request Operator turn on Gun HVPS, Modulator HV and set B1 and B2 bending magnet to injection energy

A16
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<table>
<thead>
<tr>
<th>Doc No.</th>
<th>PS-C-ASD-PRC-129</th>
<th>Author: T. McDonald</th>
<th>Effective Date: 08Jan2016</th>
<th>Review Frequency: 3 yrs</th>
<th>Version 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title:</td>
<td>NSLS-II Storage Ring Radiological Interlock Test</td>
<td>Technical</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Gun UPA-100 is ON, gun cabinet**
- **Modulators contactor ON, Linac HMI**
- **SR Dipole PS is ON**
- **SR System C and D RF HVPS ON**

  **Turn on the BTS bending magnet and set to injection energy**
  - Bending magnet ON, HMI
  - Shutter is open, HMI

  **Open the BTS Shutter**

  **Check Dipole PS Positive PS Interface, DPSI**
  - A1 Permit is ON
  - A2 Permit is ON
  - “A Chain Contactor Open” light is OFF
  - B1 Permit is ON
  - B2 Permit is ON
  - “B Chain Contactor Open” light is OFF

  **Check Dipole PS Negative PS Interface, DPSI**
  - A1 Permit is ON
  - A2 Permit is ON
  - “A Chain Contactor Open” light is OFF
  - B1 Permit is ON
  - B2 Permit is ON
  - “B Chain Contactor Open” light is OFF

  **SR System C and D RF HVPS ON C AND D**

  **Check RF PS Interfaces, RFPSI RF Building**
  - A1 Permit is ON C AND D
  - A2 Permit is ON C AND D
  - “A Chain Contactor Open” light is OFF C AND D
  - B1 Permit is ON C AND D
  - B2 Permit is ON C AND D
  - “B Chain Contactor Open” light is OFF C AND D

  **Check RF Systems C AND D**
  - SR Secure For OPS B chain OFF (grey), HMI
  - Gun Permits B OFF (grey), Linac HMI
  - Gun UPA-100 is OFF, gun cabinet
  - SR Dipole PS shuts OFF, B chain
  - SR System C AND D RF HVPS shuts OFF, B chain C AND D
  - Modulators OFF, B chain
  - BTS shutter closed, HMI

  **Remove B1 switch holder**
  - Pentants unsecured B Chain (grey), HMI

  **Check Dipole PS Positive PS Interface, DPSI**
  - A1 Permit is ON
  - A2 Permit is ON
  - “A Chain Contactor Open” light is OFF
  - B1 Permit is OFF
Check Dipole PS Negative PS Interface, DPSI
A1 Permit is ON
A2 Permit is ON
“A Chain Contactor Open” light is OFF
B1 Permit is OFF
B2 Permit is OFF
“B Chain Contactor Open” light is ON

Check RF PS Interfaces, RFPSI RF Building
A1 Permit is OFF C AND D
A2 Permit is OFF C AND D
“A Chain Contactor Open” light is ON C AND D
B1 Permit is OFF C AND D
B2 Permit is OFF C AND D
“B Chain Contactor Open” light is ON C AND D

Remove switch holders and close door
Secure Pentant 1
All Pentants secure A and B (green), HMI
SR Secure For OPS A chain ON (green), HMI

Live Pentant 1 Maintenance Doors
Request Operator turn on gun, Modulators, SR RF HVPS, SR Dipole PS, LTB and BTS B2 magnets, open LTB and BTS shutter
SR Dipole PS is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C and D HVPS is ON
SR RF Permits ON A and B chain (green), HMI
BTS shutter Open, HMI
Gun HVPS is ON
Modulators are ON
Remove an A chain switch from Pentant 1
Maintenance door = ___________
SR Secure For OPS A chain OFF (grey), HMI
SR Dipole PS is OFF
SR Dipole Permits OFF A chain (grey), HMI
SR RF Systems C and D HVPS is OFF
SR RF Permits OFF (grey), HMI
BTS shutter Closed, HMI
Gun and Modulators OFF on A chain
Replace A chain switch and perform a reset
Search Pentant 1
All Pentants secure A and B (green), HMI
SR Secure For OPS A chain ON (green), HMI
Request Operator turn on gun, Modulators, SR RF HVPS, SR Dipole PS, LTB and BTS B2 magnets, open LTB and BTS shutter
SR Dipole is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C and D HVPS is ON
SR RF Permits ON A and B chain (green), HMI
BTS shutter Open, HMI
Gun HVPS is ON
Modulators are ON

Remove a B chain switch from Pentant 1
Maintenance door

Maintenance door = ____________
SR Secure For OPS B chain OFF (grey), HMI
SR Dipole PS is OFF
SR Dipole Permits OFF B chain (grey), HMI
SR RF Systems C and D HVPS is OFF
SR RF Permits OFF (grey), HMI
BTS shutter Closed, HMI
Gun HVPS is OFF on B chain
Modulators are OFF on B chain

Replace B chain switch and perform a reset

Search Pentant 1
All Pentants secure A and B (green), HMI
SR Secure For OPS A chain ON (green), HMI

**A36 Live Pentant 1 Emergency Stop**
Request Operator turn on gun, Modulators, SR RF HVPS, SR Dipole PS, LTB and BTS B2 magnets, open LTB and BTS shutter

SR Dipole is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C AND D are ON
SR RF Permits ON A and B chain (green), HMI
BTS shutter Open, HMI
Gun HVPS is ON
Modulators are ON

Press in Emergency Stop at Service Building 1 entrance

SR secure to Booster A and B chain OFF (grey), HMI
SR Dipole PS is OFF
SR Dipole Permits OFF (grey), HMI
SR RF Systems C AND D are OFF
SR RF Permits OFF (grey), HMI
BTS shutter Closed, HMI
Gun HVPS is OFF
Modulators are OFF

Pull out Emergency Stop
Emergency Stop Latch A and B OFF (grey), HMI
<table>
<thead>
<tr>
<th>A37</th>
<th>Control Room Emergency Stop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Request Operator Turn on SR RF HVPS, SR Dipole PS and open BTS shutter</td>
<td></td>
</tr>
<tr>
<td>SR Dipole PS is ON</td>
<td></td>
</tr>
<tr>
<td>SR RF Systems C AND D are ON</td>
<td></td>
</tr>
<tr>
<td>SR RF Permits ON A and B chain (green), HMI</td>
<td></td>
</tr>
<tr>
<td>BTS shutter Open, HMI</td>
<td></td>
</tr>
<tr>
<td>Press in Emergency Stop in the Control Room</td>
<td></td>
</tr>
<tr>
<td>SR Secure For OPS A chain OFF (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>SR Dipole PS is OFF</td>
<td></td>
</tr>
<tr>
<td>SR Dipole Permits OFF A chain (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>SR RF Systems C AND D are OFF</td>
<td></td>
</tr>
<tr>
<td>SR RF Permits OFF (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>BTS shutter Closed, HMI</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A38</th>
<th>Ignition Key (drops critical devices but not search)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Request Operator Turn on SR RF HVPS, SR Dipole PS and open BTS shutter</td>
<td></td>
</tr>
<tr>
<td>SR Dipole PS is ON</td>
<td></td>
</tr>
<tr>
<td>SR Dipole Permits ON A and B chain (green), HMI</td>
<td></td>
</tr>
<tr>
<td>SR RF Systems C AND D are ON</td>
<td></td>
</tr>
<tr>
<td>SR RF Permits ON A and B chain (green), HMI</td>
<td></td>
</tr>
<tr>
<td>BTS shutter Open, HMI</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A39</th>
<th>Return Energy Limiters</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Completed on Pentant # _______ Test</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A40</th>
<th>Area Radiation Monitors</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Check if completed on concurrent test</td>
<td></td>
</tr>
</tbody>
</table>

Note: This test step may be completed at any time during the testing process but MUST be completed for
PPS test certification. Refer to PS-C-ASD-PRC-008, NSLS-II Area Radiation Monitor PPS Test and complete Attachment C, NSLS-II Storage Ring Area Radiation Monitor Checklist for Monitors SRM-23 through SRM-28

Area Radiation Monitor SRM-23 Test completed
Area Radiation Monitor SRM-24 Test completed
Area Radiation Monitor SRM-25 Test completed
Area Radiation Monitor SRM-26 Test completed
Area Radiation Monitor SRM-27 Test completed
Area Radiation Monitor SRM-28 Test completed

A41 **Test Completion**
Account for all switch holders/actuators
If testing is complete Accelerator Safety Systems Staff restores energy limiter values and complete Pentant 2 steps; B41 SR Injection Energy Limit and B42 Top Energy Interlock (may be completed on concurrent test) Remove the 4 test jumpers to the SR Dipole power supply interface boxes if testing is complete.
Ensure PPS cabinets are secure and locked; challenge locks
Remove LOTO from ALL Linac, Booster and SR devices if testing is complete.
Remove sound mufflers from HII devices (6)
Request Operator make log entry stating Pentant 1 test is complete.

- END OF ATTACHMENT A-
| National Synchrotron Light Source II, Brookhaven National Laboratory |
|---|---|---|---|
| Doc No. | PS-C-ASD-PRC-129 | Author: T. McDonald | Effective Date: 08Jan2016 |
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Attachment B

NSLS-II Storage Ring Pentant 2 Radiological Interlock Test Checklist

<table>
<thead>
<tr>
<th>Test Reason: Verify System Lockouts and Connect Dipole Test Jumpers</th>
<th>Test Result: □ Passed □ Failed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Date:</td>
<td>Start Time:</td>
</tr>
<tr>
<td>Tester 1:</td>
<td>Assistant 1:</td>
</tr>
<tr>
<td>Tester 2:</td>
<td>Assistant 2:</td>
</tr>
<tr>
<td>Tester 1 Signature:</td>
<td>Tester 2 Signature:</td>
</tr>
<tr>
<td>*Reviewer 1:</td>
<td>Reviewer 1 sig.:</td>
</tr>
<tr>
<td>Reviewer 2:</td>
<td>Reviewer 2 sig.:</td>
</tr>
<tr>
<td>** Safety Signature Pentant 2(PLC)</td>
<td>Previous Pentant 2 PLC SS# Date: / /</td>
</tr>
<tr>
<td>A Chain:</td>
<td>B Chain:</td>
</tr>
</tbody>
</table>

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

Each numbered item below indicates a set of action items for the test procedure. The Tester will either perform the action, or delegate the action to the Assistant(s). For each step a checkmark (✓) should be made if the correct corresponding observation has been made.

** Action Taken **

** B1 Verify System Lockouts and Connect Dipole Test Jumpers **

- Gun HVPS Output Cable Connector
- Modulator PS line cords (3) OR Booster Dipole F PS
- Booster RF HVPS OR booster low level RF drive termination OR Booster RF output connection to cavity
- SR System C RF HVPS
- SR System C low level RF drive termination OR System C SR RF output connection to cavity
- SR System D RF HVPS
- SR System D low level RF drive termination OR SR System D RF output connection to cavity
- Apply mufflers to the right hand HII side sounders 6
- Connect the 4 test jumpers to the SR Dipole Power Supply interface boxes

- Observation, Location

** B2 Secure enclosures **

- Secure the injector berm area Berms secured, Linac HMI
- Secure the linac Linac secured, Linac HMI
- Secure the booster ring Booster secured, Booster HMI

- Note: All Mode Search Verifications can be completed using the Quick Search feature

** B3 Verify Pentant 2 Single Pentant Search (Mode 1) **

- Check HMI on 740 Pentant I/O Box OR CR Pentant 2 not secured A and B chain (grey), HMI
- Three Searchers enter Service Building 2
- Press P2-SB1 Service Bldg. 2 Light on search button illuminates
- Search sounder alarm sounds
- Overhead lighting flashes during search

- Observation, Location

- B1
**Action Taken**

- One searcher remains on P1 side of Gate 2
- Close Gate 2 and press SB2
- Press SB3 on HII 1
- Searchers *simultaneously* press P2-SB1 (ISA door) and SB4 on HII 2 until the lights illuminate
- Press SB5 on HII 3
- Searchers *simultaneously* press P2-SB1 (Service Bldg.) and SB6 on HII 4 until the lights illuminate
- One searcher remains on P3 side of gate
- Close Pentant Gate 3
- Press SBSP
- Press P2-SB1
- Exit through Service Building Door
- Press SBE

**Observation, Location**

- Light on search button illuminates
- Light on SB4 illuminates
- Amber HII 1 search beacon is ON
- Light on SB1 (ISA) illuminates
- Light on SB4 illuminates
- Amber HII 3 search beacon is ON
- Light on SB1 (Service Bldg.) illuminates
- Light on SB6 illuminates
- Amber HII 4 search beacon is ON
- Press SB7 on HII 5
- Light on search button illuminates
- Amber HII 5 search beacon is ON
- Press SB8 on HII 6
- Light on search button illuminates
- Amber HII 6 search beacon is ON
- One searcher remains on P3 side of gate
- Close Pentant Gate 3
- Press SBSP
- Press P2-SB1
- Exit through Service Building Door
- Press SBE

**After beam imminent warning sounds:**

- Service Bldg Door sign illuminates (A and B sect.)
- ISA door sign illuminates (A and B sect.)
- Pentant 2 Secured A and B chain, HMI
- Gate 3 sign illuminates (A and B sect.)
- Gate 2 sign illuminates (A and B sect.)
- Request operator grant access permit for P2
## NSLS-II Storage Ring Radiological Interlock Test

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press Access Request button at Serv. Building Door 2, if necessary (other pentants secure)</td>
<td>Pentant 2 unsecured A and B chain, HMI</td>
</tr>
<tr>
<td>Open Door</td>
<td>No alarm sounds in Control Room</td>
</tr>
</tbody>
</table>

### B4 Verify Pentant 2 Starting Multiple Pentant Search (Mode 2) and time Beam imminent warning

- Check HMI on 740 Pentant I/O Box or CR
- Three Searchers enter Service Building 2
- Press P2-SB1 in Pentant 2 Service Bldg. 2
- Close Gate 2 and press SB2
- Press SB3 on HII 1
- Searchers simultaneously press P2-SB1 (ISA door) and SB4 on HII 2 until the lights illuminate
- Press SB5 on HII 3
- Searchers simultaneously press P2-SB1 (Service Bldg.) and SB6 on HII 4 until the lights illuminate
- Press SB7 on HII 5
- Press SB8 on HII 6
- Close gate
- Reach through Gate 3 Press SB9 and begin timing audible alarm

- Maglock engages/check gate
- Service Bldg 2 Maglock A and B ON (green), HMI
- ISA Door A and B Maglock ON (green), HMI
- Gate 2 Maglock A and B ON (green), HMI
- Gate 3 Maglock A and B ON (green), HMI
- Gate 2 switches A and B (green), HMI
- Gate 3 switches A and B (green), HMI
- Beam Imminent alarm sounds for 60 seconds

### After beam imminent warning sounds:
- Pentant 2 Secured A and B chain, HMI
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<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
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</thead>
<tbody>
<tr>
<td>B5 Operations Enable Switch (Pentant 2 Main I/O box)</td>
<td></td>
</tr>
<tr>
<td>Rotate the operations enable switch to OFF</td>
<td>Pentant 2 Secured A and B chain, (green), HMI</td>
</tr>
<tr>
<td>Attempt to secure Pentant 2</td>
<td>Pentant 2 NOT Secured A and B chain (grey), HMI</td>
</tr>
<tr>
<td>Rotate the operations enable switch to ON</td>
<td>Pentant 2 will not secure</td>
</tr>
<tr>
<td>Reset the fault at the Pentant 2 I/O box</td>
<td></td>
</tr>
<tr>
<td>B6 Verify Pentant 2 Continuing Multiple Pentant Search (Mode 3) and time Red Beacons</td>
<td></td>
</tr>
<tr>
<td>Check HMI on 740 Pentant I/O Box or CR</td>
<td>Pentant 2 not secured A and B chain (grey), HMI</td>
</tr>
<tr>
<td>Close Gate 2 and press SB2</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press P2-SB3 on HII 1</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Searchers simultaneously press P2-SB1 (ISA door) and SB4 on HII 2 until the lights illuminate</td>
<td>Amber HII 1 search beacon is ON</td>
</tr>
<tr>
<td>Light on SB1 (ISA) illuminates</td>
<td></td>
</tr>
<tr>
<td>Light on SB4 illuminates</td>
<td></td>
</tr>
<tr>
<td>Press SB5 on HII 3</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Amber HII 3 search beacon is ON</td>
<td></td>
</tr>
<tr>
<td>Press SB7 on HII 5</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Amber HII 4 search beacon is ON</td>
<td></td>
</tr>
<tr>
<td>Press SB8 on HII 6</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Amber HII 6 search beacon is ON</td>
<td></td>
</tr>
<tr>
<td>Close Pentant Gate 3</td>
<td></td>
</tr>
<tr>
<td>Reach through Gate 3 Press SB9 and begin timing the Red Beacons on HII devices (6)</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Maglock engages/locks- check door</td>
<td></td>
</tr>
<tr>
<td>Service Bldg 2 Maglock A and B (green), HMI</td>
<td></td>
</tr>
<tr>
<td>ISA Door Maglock A and B (green), HMI</td>
<td></td>
</tr>
<tr>
<td>ISA Door SW A and B (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Gate 2 Maglock A and B (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Gate 2 switches A and B (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Gate 3 Maglock A and B (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Gate 3 switches A and B (green), HMI</td>
<td></td>
</tr>
<tr>
<td>After Beam Imminent alarm:</td>
<td>Pentant 2 Secured A and B chain, HMI</td>
</tr>
<tr>
<td>Red Beacons (6) flash for 60 seconds</td>
<td></td>
</tr>
</tbody>
</table>

B4
<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Request Operator grant access permit for P2</td>
<td>HII Red area Secure A and B lights illuminated</td>
</tr>
<tr>
<td>Open gate</td>
<td>No alarm sounds in Control Room</td>
</tr>
<tr>
<td><strong>B7</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Verify Pentant 2 Completing Multiple Pentant Search (Mode 4)</strong></td>
<td></td>
</tr>
<tr>
<td>Check HMI on 740 Pentant I/O Box or CR</td>
<td>Pendant 2 not secured A and B chain (grey), HMI</td>
</tr>
<tr>
<td>Close Gate 3 and press SB2</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press P2-SB3 on HII 1</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Searchers simultaneously press P2-SB1 (ISA door) and SB4 on HII 2 until the lights illuminate</td>
<td>Amber HII 1 search beacon is ON</td>
</tr>
<tr>
<td>Press SB5 on HII 3</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Searchers simultaneously press P2-SB1 (Service Bldg.) and SB6 on HII 4 until the lights illuminate</td>
<td>Amber HII 3 search beacon is ON</td>
</tr>
<tr>
<td>Press SB7 on HII 5</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press SB8 on HII 6</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Close Pentant Gate 2</td>
<td>Amber HII 4 search beacon is ON</td>
</tr>
<tr>
<td>Press SBSP</td>
<td>Amber HII 5 search beacon is ON</td>
</tr>
<tr>
<td>Press P2-SB1 at Service Building Door</td>
<td>Amber HII 6 search beacon is ON</td>
</tr>
<tr>
<td>Exit through Service Building Door</td>
<td></td>
</tr>
<tr>
<td>Press SBE</td>
<td>Light on SBE illuminates</td>
</tr>
<tr>
<td>After Beam Imminent alarm:</td>
<td>Pendant 2 Secured A and B chain, HMI</td>
</tr>
<tr>
<td><strong>B8</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Access Pentant and check HII (6)</strong></td>
<td></td>
</tr>
<tr>
<td>Request Operator grant access permit for P2</td>
<td>If other Pentants secure the Access Request button at Service Bldg. 2 illuminates</td>
</tr>
<tr>
<td>Press Access Request button at Service Building Door if necessary (other pentants secure)</td>
<td>P2 Service Bldg. Door Maglock OFF (grey), HMI</td>
</tr>
<tr>
<td></td>
<td>Pendant 2 not secured A and B chain (grey), HMI</td>
</tr>
<tr>
<td></td>
<td>Door is open</td>
</tr>
<tr>
<td>Check HII indicators</td>
<td>Red Beacons OFF</td>
</tr>
<tr>
<td></td>
<td>Red Secure A and B lights OFF</td>
</tr>
<tr>
<td></td>
<td>Green HII “Beam Disabled” lights illuminated</td>
</tr>
</tbody>
</table>
Action Taken

Search Timeout (Mode 2)

Proceed to P2-SB2

Press P2-SB2 in Pentant 2 and begin timing

Complete search in sequence without pressing SB9

Press SB9

Skip the Two Button Simultaneous Press (Mode 1) using Quick Search

Close gates and doors and put into Quick Search

Press SB1

Press SB2

Press SB3

Press SB4

Press SB5

Press SB1

Press SB6

Press SB7

Press SB8

Press SB9

Emergency Stop Aborts Search

Complete a normal search using ANY Mode

Before the beam imminent warning sounder stops,

Press an Emergency Stop

Press an Emergency Stop

A Chain Entrance Door Switches Service Building 2

Place holders on the A chain Service Building 2 Door switches (4) and attach actuator on Magnetic lock

Close Pentant gates 2 and 3

Perform all actions and make observations for both door A chain switches A1 and A2

Quick Search Pentant 2 (A chain)

Remove holder from Service Building 2 stationary door switch

Replace holder on stationary door

Quick Search Pentant 2 (A chain)
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National Synchrotron Light Source II, Brookhaven National Laboratory

Doc No. PS-C-ASD-PRC-129
Author: T. McDonald
Effective Date: 08Jan2016
Review Frequency: 3 yrs
Version 5

Title: NSLS-II Storage Ring Radiological Interlock Test

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove holder from Service Building 2 active door switch</td>
<td>Pentant 2 unsecured A chain (grey), HMI Replace holder on active door</td>
</tr>
<tr>
<td>Pentant 2 secured A chain (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Service Bldg 2 Door SW A chain OFF (grey), HMI</td>
<td></td>
</tr>
</tbody>
</table>

**B13 Pentant 2 A Chain Quick Search Timeout**

Quick search Pentant 2 and begin timing
Pentant 2 secured A chain (green), HMI
Pentant 2 unsecured in 5 minutes (grey), HMI
Remove A chain switch holders

**B14 B Chain Entrance Door Switches Service Building 2**

Place holders on the B chain Service Building 2 Door switches (4)
Close Pentant gates
Perform all actions and make observations for both door B chain switches B1 and B2

- Quick Search Pentant 2 (B chain)
  - Pentant 2 secured B chain (green), HMI
  - SR secure to Booster B chain ON (green), HMI
  - Dipole Permit B ON (green), HMI
  - Service Bldg 2 Door SW A chain ON (green), HMI

- Remove holder from Service Building 2 stationary door switch
  - Pentant 2 unsecured B chain (grey), HMI
  - Service Bldg 2 Door SW B chain OFF (grey), HMI

- Replace holder on stationary door

- Quick Search Pentant 2 (B chain)
  - Pentant 2 secured B chain (green), HMI

- Remove holder from Service Building 2 active door switch
  - Pentant 2 unsecured B chain (grey), HMI

- Replace holder on active door

**B15 Pentant 2 B Chain Quick Search Timeout**

Quick search Pentant 2 and begin timing
Pentant 2 secured B chain
Pentant 2 unsecured in 5 minutes

**B16 Service Building 2 Door Emergency Egress**

Person proceeds to Exit (ring side)
Attach B chain Maglock Actuator with tape
Perform B chain Pentant 2 quick search
Pentant 2 secured B chain ON (green), HMI
Service Bldg 2 Door Maglock B chain ON (green), HMI
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### Action Taken

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove actuator</td>
<td>Service Bldg 2 Door Maglock B chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Close door</td>
<td>Pentant 2 unsecured (grey), HMI</td>
</tr>
<tr>
<td>Perform A chain Pentant 2 search</td>
<td>Pentant 2 secured A chain (green), HMI</td>
</tr>
<tr>
<td></td>
<td>Service Bldg 2 Door Maglock A chain ON (green), HMI</td>
</tr>
<tr>
<td>Press in door push bar without opening door</td>
<td>Service Bldg 2 Door Maglock A chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Open door</td>
<td>Pentant 2 unsecured (grey), HMI</td>
</tr>
<tr>
<td>Close door and stay outside of ring</td>
<td>Door opens</td>
</tr>
</tbody>
</table>

#### B17 Service Building Door P2 Emergency Access button

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform A chain Pentant 2 quick search</td>
<td>Pentant 2 secured A chain</td>
</tr>
<tr>
<td>Press in external emergency access button</td>
<td>Service Bldg 2 Door Maglock A chain ON (green), HMI</td>
</tr>
<tr>
<td>Pull out emergency access button</td>
<td>Emergency Stop Latch A chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Reset fault</td>
<td>Emergency Stop Latch A chain ON (green), HMI</td>
</tr>
<tr>
<td>Perform B chain Pentant 2 search</td>
<td>Pentant 2 secured B chain</td>
</tr>
<tr>
<td>Press in emergency access button</td>
<td>Service Bldg 2 Door Maglock B chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Pull out emergency access button</td>
<td>Emergency Stop Latch B chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Open door</td>
<td>Door opens</td>
</tr>
<tr>
<td>Reset fault</td>
<td>Emergency Stop Latch B chain ON (green), HMI</td>
</tr>
<tr>
<td>Close door</td>
<td>All gates and doors closed</td>
</tr>
</tbody>
</table>

#### B18 A Chain ISA Door Switches

Place holders on the A chain ISA Door switches (2)
and attach actuator on Magnetic lock
Close Pentant gates 2 and 3
Perform all actions and make observations for both door A chain switches A1 and A2

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick Search Pentant 2 (A chain)</td>
<td>Pentant 2 secured A chain (green), HMI</td>
</tr>
<tr>
<td>Remove holder from ISA door switch</td>
<td>Pentant 2 unsecured A chain (grey), HMI</td>
</tr>
<tr>
<td>Replace holder on ISA Door</td>
<td>ISA Door SW A chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Action Taken</td>
<td>Observation, Location</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------</td>
</tr>
<tr>
<td><strong>B19</strong> B Chain ISA Door Switches</td>
<td></td>
</tr>
<tr>
<td>Place holders on the B chain ISA Door switches (2) and attach actuator on Magnetic lock</td>
<td></td>
</tr>
<tr>
<td>Close Pentant gates 2 and 3</td>
<td></td>
</tr>
<tr>
<td>Perform all actions and make observations for both door B chain switches B1 and B2</td>
<td></td>
</tr>
<tr>
<td>Quick Search Pentant 2 (B chain)</td>
<td>Pentant 2 secured B chain (green), HMI</td>
</tr>
<tr>
<td>ISA Door SW B chain ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Remove holder from ISA door switch</td>
<td>Pentant 2 unsecured B chain (grey), HMI</td>
</tr>
<tr>
<td>ISA Door SW B chain OFF (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Replace holder on ISA Door</td>
<td></td>
</tr>
<tr>
<td><strong>B20</strong> ISA 2 Door Push Bar</td>
<td></td>
</tr>
<tr>
<td>Person proceeds inside ISA (ring side)</td>
<td></td>
</tr>
<tr>
<td>Attach B chain Maglock Actuator with tape</td>
<td></td>
</tr>
<tr>
<td>Perform B chain Pentant 2 quick search</td>
<td>Pentant 2 secured B chain ON (green), HMI</td>
</tr>
<tr>
<td>ISA Door Maglock B chain ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Remove actuator</td>
<td>ISA door Maglock B chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Pentant 2 unsecured (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Close door</td>
<td></td>
</tr>
<tr>
<td>Perform A chain Pentant 2 search</td>
<td>Pentant 2 secured A chain (green), HMI</td>
</tr>
<tr>
<td>ISA Maglock A chain ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Press in door push bar without opening door</td>
<td>ISA Door Maglock A chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Pentant 2 unsecured (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Open door</td>
<td></td>
</tr>
<tr>
<td>Close door and stay outside of ring</td>
<td></td>
</tr>
<tr>
<td><strong>B21</strong> ISA Door Emergency Access button</td>
<td></td>
</tr>
<tr>
<td>Perform A chain Pentant 2 quick search</td>
<td>Pentant 2 secured A chain</td>
</tr>
<tr>
<td>ISA Door Maglock A chain ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Press in emergency access button</td>
<td>ISA Door Maglock A chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Pentant 2 unsecured, HMI</td>
<td></td>
</tr>
<tr>
<td>Pull out emergency access button</td>
<td>Emergency Stop Latch A chain OFF (grey), HMI</td>
</tr>
</tbody>
</table>
**Title:** NSLS-II Storage Ring Radiological Interlock Test

<table>
<thead>
<tr>
<th><strong>Action Taken</strong></th>
<th><strong>Observation, Location</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Open door</td>
<td>Door opens</td>
</tr>
<tr>
<td>Reset emergency stop</td>
<td>Emergency Stop Latch B chain ON (green), HMI</td>
</tr>
<tr>
<td>Close door</td>
<td>All gates and doors closed</td>
</tr>
</tbody>
</table>

B22 **Pentant 2 HII Emergency stops**

Repeat all steps for each HII

**A Chain:**

<table>
<thead>
<tr>
<th>Pentant 2 secured A chain (green), HMI</th>
<th>Emergency Stop Latch A chain ON (green), HMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press in emergency stop</td>
<td></td>
</tr>
<tr>
<td>Pull out emergency stop</td>
<td></td>
</tr>
<tr>
<td>Emergency Stop Latch A chain OFF (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Reset fault and latch at Pentant 2 I/O box</td>
<td></td>
</tr>
<tr>
<td>Emergency Stop Latch A chain ON (green), HMI</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>B Chain:</strong></th>
<th>HII-1</th>
<th>HII-2</th>
<th>HII-3</th>
<th>HII-4</th>
<th>HII-5</th>
<th>HII-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick search Pentant 2 on B Chain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pentant 2 secured B chain (green), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency Stop Latch B chain ON (green), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Press in emergency stop</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pull out emergency stop</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency Stop Latch B chain OFF (grey), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reset fault and latch at Pentant 2 I/O box</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency Stop Latch B chain ON (green), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B23 **Pentant 2 Gate 3 Switches**

Proceed to the gate between pentants 2 and 3

Place holders on the A chain gate switches

Perform all actions and make observations for both Gate 3 A chain switches A1 and A2

<table>
<thead>
<tr>
<th>Quick Search Pentant 3 (A chain)</th>
<th>Pentant 3 secured A chain (green), HMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick Search Pentant 2 (A chain)</td>
<td>Pentant 2 secured A chain (green), HMI</td>
</tr>
<tr>
<td>Gate 3 SW A chain ON (green), HMI</td>
<td></td>
</tr>
</tbody>
</table>

Remove holder from Gate A chain switch

Pentant 2 unsecured A chain (grey), HMI
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<table>
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<th>Doc No.</th>
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<th>Review Frequency</th>
<th>Version</th>
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<tr>
<td>PS-C-ASD-PRC-129</td>
<td>T. McDonald</td>
<td>08Jan2016</td>
<td>3 yrs</td>
<td>5</td>
</tr>
</tbody>
</table>

**Title:** NSLS-II Storage Ring Radiological Interlock Test

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove Gate A chain switch holders</td>
<td>Gate 3 SW A chain OFF (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Place holders on the B chain gate switches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform all actions and make observations for both Gate 3 B chain switches B1 and B2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quick Search Pentant 3 (B chain)</td>
<td>Pentant 3 secured B chain (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Quick Search Pentant 2 (B chain)</td>
<td>Pentant 2 secured B chain (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Remove holder from Gate 3 B switch</td>
<td>Gate 3 SW B chain ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Remove switch holders and close gate</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>B24</strong> Gate 3 Emergency Access (in Pentant 2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quick Search Pentant 2 on A Chain</td>
<td>Pentant 2 Secure A chain (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Emergency Stop Latch A chain (green), HMI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate 3 Maglock A chain ON (green), HMI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Press the Gate 3 Emergency stop</td>
<td>Pentant 2 unsecured (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Gate 3 Maglock A chain OFF (grey), HMI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pull out Gate 3 Emergency stop</td>
<td>Emergency Stop Latch A chain OFF (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Reset fault and latch</td>
<td>Emergency Stop Latch A chain ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Quick Search Pentant 2 on B Chain</td>
<td>Pentant 2 Secured B chain (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Emergency Stop Latch B chain, (green), HMI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate 3 Maglock B chain ON (green), HMI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Press the Gate 3 Emergency stop</td>
<td>Pentant 2 unsecured (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Gate 3 Maglock B chain OFF (grey), HMI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pull out Gate 3 Emergency stop</td>
<td>Emergency Stop Latch A chain OFF (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Reset fault and latch</td>
<td>Emergency Stop Latch A chain ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td><strong>B25</strong> Gate 3 Push Bar Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quick Search Pentant 2 on A chain</td>
<td>Pentant 2 Secure A chain (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Gate 3 Maglock A chain ON (green), HMI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Push in gate Push Bar without opening gate</td>
<td>Pentant 2 NOT Secure A chain, HMI</td>
<td></td>
</tr>
<tr>
<td>Gate 3 Maglock A chain OFF (grey), HMI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Release Push bar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attach B chain Maglock Actuator with tape</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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Title: NSLS-II Storage Ring Radiological Interlock Test

Action Taken

- Apply holders to B chain switches
- Quick search Pentant 2 on B chain
- Remove actuator
- Remove holders and close gate

Observation, Location

- Pentant 2 Secure B chain, (green) HMI
- Gate 3 Maglock B chain ON (green), HMI
- Pentant 2 NOT Secure B chain (grey), HMI
- Gate 3 Maglock B chain OFF (grey), HMI

Gate 2 Switches

B26

- Proceed to the gate between pentants 1 and 2
- Place holders on the A chain gate switches
- Perform all actions and make observations for both Gate 2 A chain switches A1 and A2

A1  A2

- Quick Search Pentant 1 (A chain) Pentant 1 secured A chain (green), HMI
- Quick Search Pentant 2 (A chain) Pentant 2 secured A chain (green), HMI
- Remove holder from Gate 2 switch
- Remove Gate 2 A chain switch holders
- Place holders on the B chain gate switches
- Perform all actions and make observations for both Gate 2 B chain switches B1 and B2

B1  B2

- Quick Search Pentant 1 (A chain) Pentant 1 secured B chain (green), HMI
- Quick Search Pentant 2 (B chain) Pentant 2 secured B chain (green), HMI
- Remove holder from Gate 2 switch
- Remove switch holders and close gate

B27

- Place A chain actuators into each Maintenance Door connectors and complete all steps for each Door (MD)

29ID  30ID  1ID  2ID  3ID  4ID

- Quick Search Pentant 2 on A chain
  - Pentant secured on A chain (green), HMI
  - Sum of Maint Doors A chain ON (green), HMI
- Remove Actuator in switch A1
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<table>
<thead>
<tr>
<th>Doc No.</th>
<th>PS-C-ASD-PRC-129</th>
<th>Author: T. McDonald</th>
<th>Effective Date: 08Jan2016</th>
<th>Review Frequency: 3 yrs</th>
<th>Version 5</th>
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<tbody>
<tr>
<td><strong>Title:</strong></td>
<td>NSLS-II Storage Ring Radiological Interlock Test</td>
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<td></td>
</tr>
</tbody>
</table>

| Pentant 2 Not secured A chain (grey), HMI | | | | | |
| Sum of Maint Doors A chain OFF (grey), HMI | | | | | |
| Replace actuator in A1 | | | | | |
| Quick Search Pentant 2 on A chain | | | | | |
| Pentant secured on A chain (green), HMI | | | | | |
| Sum of Maint Doors A chain ON (green), HMI | | | | | |
| Remove Actuator in switch A2 | | | | | |
| Pentant 2 Not secured A chain (grey), HMI | | | | | |
| Sum of Maint Doors A chain OFF (grey), HMI | | | | | |
| Replace actuator in A2 | | | | | |
| Remove actuators | | | | | |

**B28 Pentant 2 Maintenance Doors B Chain**

Place B chain actuators into each Maintenance door connector and complete all steps for each Maintenance Door (MD)

| Quick Search Pentant 2 on B chain | | | | | |
| Pentant secured on B chain (green), HMI | | | | | |
| Sum of Maint Doors B chain ON (green), HMI | | | | | |
| Remove Actuator in switch B1 | | | | | |
| Pentant 2 Not secured B chain (grey), HMI | | | | | |
| Sum of Maint Doors B chain OFF (grey), HMI | | | | | |
| Replace actuator in B1 | | | | | |
| Quick Search Pentant 2 on B chain | | | | | |
| Pentant secured on B chain (green), HMI | | | | | |
| Sum of Maint Doors B chain ON (green), HMI | | | | | |
| Remove Actuator in switch B2 | | | | | |
| Pentant 2 Not secured B chain (grey), HMI | | | | | |
| Sum of Maint Doors B chain OFF (grey), HMI | | | | | |
| Remove actuators and ensure all Pentant 2 Maintenance door connectors are ON | | | | | |

**B29 Pentant Access Allowed only with Dipole (Negative) PS Contactors OFF**

Primary Authorized Power Supply Employee

- Secure all Pentants
- Primary Authorized Power Supply Employee open SR Dipole power supply
- LOTOs SR Dipole (Negative) PS Contactors OFF
- Primary Authorized Power Supply Employee open cabinet door to access the A chain contactor
- Primary Authorized Power Supply Employee push in the A chain contactor with a screwdriver
- Request Operator press P2 Access Request button
- Access Request button does not illuminate
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Title: NSLS-II Storage Ring Radiological Interlock Test

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Access Request with critical device On alarm, HMI
Serv. Bldg. 2 door remains locked on A chain, HMI

Primary Authorized Power Supply Employee releases the A chain contactor

Primary Authorized Power Supply Employee push in the B chain contactor with a screwdriver

Request Operator press P2 Access Request button
Press Access Request button at Service Building when lit
Primary Authorized Power Supply Employee release the B chain contactor

B30 **Pentant Access Allowed only with Dipole (Positive) PS Contactors OFF**

Primary Authorized Power Supply Employee releases the A chain contactor
Primary Authorized Power Supply Employee push in the B chain contactor with a screwdriver

Request Operator press P2 Access Request button
Press Access Request button at Service Building when lit
Primary Authorized Power Supply Employee releases the B chain contactor

Close cabinet door

Remove LOTO from SR Dipole Power supply

B31 **Pentant Access Allowed only with SR System C RF HVPS Contactors OFF**

Primary Authorized RF Employee releases the A chain contactor
Primary Authorized RF Employee push in the RF HVPS B chain contactor with a screwdriver
Request Operator press P2 Access Request button
Access Request button illuminates
Press Access Request button at Service Building
when lit
Pendant remains secure on A and B chain
Serv. Bldg. 2 door remains locked on B chain, HMI

Primary Authorized RF Employee releases the B chain contactor
Close cabinet door
Remove LOTO from SR System C RF HVPS

**B32 Pentant Access Allowed only with SR System D RF HVPS Contactors OFF**

Primary Authorized Power Supply Employee LOTOs SR System D RF power supply
Secure all Pentants SR secure for OPS, HMI
Primary Authorized RF Group Employee open cabinet door to access the A chain contactor
PS cabinet door open
Primary Authorized Power Supply Employee push in the A chain contactor with a screwdriver
Request Operator press P1 Access Request button
Access Request button does not illuminate
Access Request with critical device On alarm, HMI
Serv. Bldg. 1 door remains locked on A chain, HMI
Primary Authorized RF Group Employee push in the B chain contactor with a screwdriver
Primary Authorized RF Group Employee push in the B chain contactor with a screwdriver
Request Operator press P1 Access Request button
Access Request button illuminates at Service Building
Press Access Request button at Service Building
Pendant remains secure on A and B chain
Serv. Bldg. 1 door remains locked on B chain, HMI
Primary Authorized RF Group Employee releases the B chain contactor
Close cabinet door

**B33 Pentant Access Allowed only with BTS Shutter Closed**

Request Operator open the BTS shutter
BTS Shutter opens
Request Operator press P2 Access Request button
Access Request button at P2 Serv. Bldg. does not illuminate
Operator closes shutter
BTS shutter closed
Request Operator press P2 Access Request button
Access Request button illuminates outside P2 Service Building Door main entrance

**B34 Pentant Access Allowed Only with BTS B2 Bending Magnet OFF**

Using shunt test box, apply current to the # 1 BTS B2 shunt box
Request Operator press P2 Access Request button
Access Request button at P2 Serv. Bldg. illuminates
Press the button at Service Building
Pendant remains secure on A and B chain
Serv. Bldg. 2 door remains locked on B chain, HMI
Remove test box
Using shunt test box, apply current to the # 2 BTS B2 shunt box
Request Operator press P2 Access Request button
Access Request button at P2 Serv. Bldg. illuminates
Press the button at Service Building
Pendant remains secure on A and B chain
## NSLS-II Storage Ring Radiological Interlock Test

<table>
<thead>
<tr>
<th>B35</th>
<th>Magnet Test Mode Breaks Security</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Completed on Pentant 3 Test</td>
</tr>
<tr>
<td></td>
<td>Pantent 2 Secure A and B chains (green), HMI</td>
</tr>
<tr>
<td></td>
<td>Magnet Test Mode A and B ON (green), HMI</td>
</tr>
<tr>
<td></td>
<td>Pantent 2 unsecured A and B chain (grey), HMI</td>
</tr>
<tr>
<td></td>
<td>Dipole Permits A and B ON (green), HMI</td>
</tr>
<tr>
<td></td>
<td>Request Operator turn on Dipole PS</td>
</tr>
<tr>
<td></td>
<td>Dipole PS is ON</td>
</tr>
<tr>
<td></td>
<td>Press in Pentant Emergency Stop</td>
</tr>
<tr>
<td></td>
<td>Dipole PS is OFF</td>
</tr>
<tr>
<td></td>
<td>Pull out Emergency Stop</td>
</tr>
<tr>
<td></td>
<td>Emergency Stop Latched and Dipole PS remains OFF</td>
</tr>
<tr>
<td></td>
<td>Reset fault and remove Magnet Test key</td>
</tr>
<tr>
<td></td>
<td>Magnet Test Mode A and B OFF (grey), HMI</td>
</tr>
<tr>
<td></td>
<td>Dipole Permit A and B OFF (grey), HMI</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B36</th>
<th>Live Test of Storage Ring Door Switches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WARNING: Do not permit Employee from entering the Storage Ring unless authorized by the Tester who will verify the area is safe to enter.</td>
</tr>
<tr>
<td></td>
<td>Place Barrier “CAUTION: DO NOT ENTER” tape across entry path.</td>
</tr>
<tr>
<td></td>
<td>Post a Watch Outside Service Building Door 2 Main Door Entrance.</td>
</tr>
<tr>
<td></td>
<td>The watch shall not allow Employee to enter the pentant unless authorized by the Tester.</td>
</tr>
<tr>
<td></td>
<td>Place switch holders on the active P2 Service Building Door switches (4) OR ISA Door and attach magnetic lock device</td>
</tr>
<tr>
<td></td>
<td>Accelerator Safety Systems Staff disables limiters (set to 0) or check if completed on concurrent test</td>
</tr>
<tr>
<td></td>
<td>Secure the SR</td>
</tr>
<tr>
<td></td>
<td>All Pentants secure A and B (green), HMI</td>
</tr>
<tr>
<td></td>
<td>SR Secure for OPS A chain ON (green), HMI</td>
</tr>
<tr>
<td></td>
<td>Gun Permits A and B ON (green), linac HMI</td>
</tr>
<tr>
<td></td>
<td>Request Operator turn on Gun HVPS, Modulator HV and set B1 and B2 bending magnet to injection energy</td>
</tr>
<tr>
<td></td>
<td>Gun UPA-100 is ON, gun cabinet</td>
</tr>
<tr>
<td></td>
<td>Modulators contactor ON, Linac HMI</td>
</tr>
<tr>
<td></td>
<td>SR Dipole PS is ON</td>
</tr>
<tr>
<td></td>
<td>SR System C and D RF HVPS ON</td>
</tr>
<tr>
<td></td>
<td>Check Dipole PS Positive PS Interface, DPSI</td>
</tr>
<tr>
<td></td>
<td>A1 Permit is ON</td>
</tr>
<tr>
<td></td>
<td>A2 Permit is ON</td>
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<tr>
<td></td>
<td>“A Chain Contactor Open” light is OFF</td>
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<td></td>
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<td>Check Dipole PS Negative PS Interface, DPSI</td>
</tr>
<tr>
<td></td>
<td>A1 Permit is ON</td>
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<tr>
<td>Task</td>
<td>Status</td>
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<tr>
<td>----------------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Check RF PS Interface, RFPSI RF Building</td>
<td></td>
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<tr>
<td>A2 Permit is ON</td>
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</tr>
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<tr>
<td>SR System C and D RF HVPS ON</td>
<td></td>
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<tr>
<td>A1 Permit is ON C AND D</td>
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</tr>
<tr>
<td>Check SR RF Systems C AND D</td>
<td></td>
</tr>
<tr>
<td>Turn on the BTS bending magnet and set to injection energy</td>
<td></td>
</tr>
<tr>
<td>Bending magnet ON, HMI</td>
<td></td>
</tr>
<tr>
<td>Open the BTS Shutter</td>
<td></td>
</tr>
<tr>
<td>Shutter is open, HMI</td>
<td></td>
</tr>
<tr>
<td>Remove A1 switch holder</td>
<td></td>
</tr>
<tr>
<td>Pentants unsecured A Chain (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>SR Secure For OPS A chain OFF (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Gun Permits A OFF (grey), Linac HMI</td>
<td></td>
</tr>
<tr>
<td>Gun UPA-100 is OFF, gun cabinet</td>
<td></td>
</tr>
<tr>
<td>SR Dipole PS shuts OFF, A chain</td>
<td></td>
</tr>
<tr>
<td>SR RF HVPS shuts OFF, A chain</td>
<td></td>
</tr>
<tr>
<td>Modulators OFF, A chain</td>
<td></td>
</tr>
<tr>
<td>BTS shutter closed, HMI</td>
<td></td>
</tr>
<tr>
<td>Check Dipole PS Positive PS Interface, DPSI</td>
<td></td>
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<tr>
<td>A1 Permit is OFF</td>
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<td>Check RF PS Interface, RFPSI RF Building</td>
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<td>A1 Permit is OFF C AND D</td>
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<td>---------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Replace switch holder</td>
<td></td>
</tr>
<tr>
<td>Secure Pentant 2</td>
<td></td>
</tr>
<tr>
<td>All Pentants secure A and B (green), HMI</td>
<td></td>
</tr>
<tr>
<td>SR Secure For OPS A chain ON (green), HMI</td>
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<td>SR Dipole PS is ON</td>
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<td><strong>SR System C and D RF HVPS ON</strong></td>
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<tr>
<td>Check RF PS Interface, RFPSI RF Building</td>
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<td><strong>Check SR RF Systems C AND D</strong></td>
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</tr>
<tr>
<td>Turn on the BTS bending magnet and set to injection energy</td>
<td></td>
</tr>
<tr>
<td>Bending magnet ON, HMI</td>
<td></td>
</tr>
<tr>
<td>Open the BTS Shutter</td>
<td></td>
</tr>
<tr>
<td>Shutter is open, HMI</td>
<td></td>
</tr>
<tr>
<td>Remove B1 switch holder</td>
<td></td>
</tr>
<tr>
<td>Pentants unsecured B chain (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>SR Secure For OPS B chain OFF (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Gun Permits B OFF (grey), Linac HMI</td>
<td></td>
</tr>
</tbody>
</table>
Gun UPA-100 is OFF, gun cabinet
SR Dipole PS shuts OFF, B chain
SR RF HVPS shuts OFF, B chain
Modulators OFF, B chain
BTS shutter closed, HMI

Check Dipole PS Positive PS Interface, DPSI
A1 Permit is ON
A2 Permit is ON
“A Chain Contactor Open” light is OFF
B1 Permit is OFF
B2 Permit is OFF
“B Chain Contactor Open” light is ON

Check Dipole PS Negative PS Interface, DPSI
A1 Permit is ON
A2 Permit is ON
“A Chain Contactor Open” light is OFF
B1 Permit is OFF
B2 Permit is OFF
“B Chain Contactor Open” light is ON

Check RF PS Interface, RFPSI RF Building
A1 Permit is OFF C AND D

Check SR RF Systems C AND D
A2 Permit is OFF C AND D
“A Chain Contactor Open” light is ON C AND D
B1 Permit is OFF C AND D
B2 Permit is OFF C AND D
“B Chain Contactor Open” light is ON C AND D

Remove switch holders and close door
Secure Pentant 2
All Pentants secure A and B (green), HMI
SR Secure For OPS A chain ON (green), HMI

B37 Live Pentant 2 Maintenance Doors
Request Operator turn on gun, Modulators, SR RF HVPS, SR Dipole PS, LTB and BTS B2 magnets, open LTB and BTS shutter

SR Dipole PS is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C AND D are ON
SR RF Permits ON A and B chain (green), HMI
BTS shutter Open, HMI
Gun HVPS is ON
Modulators are ON

Remove an A chain switch from Pentant 2
Maintenance door = __________
SR Secure For OPS A chain OFF (grey), HMI
SR Dipole PS is OFF
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SR Dipole Permits OFF A chain (grey), HMI
SR RF Systems C AND D are OFF
SR RF Permits OFF (grey), HMI
BTS shutter Closed, HMI
Gun HVPS is OFF on A chain
Modulators are OFF on A chain

Replace A chain switch and perform a reset
Search Pentant 2
All Pentants secure A and B (green), HMI
SR Secure For OPS A chain ON (green), HMI
Request Operator turn on gun, Modulators, SR RF HVPS, SR Dipole PS, LTB and BTS B2 magnets, open LTB and BTS shutter.

SR Dipole PS is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C AND D are ON
SR RF Permits ON A and B chain (green), HMI
BTS shutter Open, HMI
Gun HVPS is ON
Modulators are ON

Remove a B chain switch from Pentant 2
Maintenance door
SR Secure For OPS B chain OFF (grey), HMI
SR Dipole PS is OFF
SR Dipole Permits OFF B chain (grey), HMI
SR RF Systems C AND D are OFF
SR RF Permits OFF (grey), HMI
BTS shutter Closed, HMI
Gun HVPS is OFF on B chain
Modulators are OFF on B chain

Replace B chain switch and perform a reset
Search Pentant 2
All Pentants secure A and B (green), HMI
SR Secure For OPS A chain ON (green), HMI

B38 Live Pentant 2 Emergency Stop
Request Operator turn on gun, Modulators, SR RF HVPS, SR Dipole PS, LTB and BTS B2 magnets, open LTB and BTS shutter

SR Dipole PS is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C AND D are ON
SR RF Permits ON A and B chain (green), HMI
BTS shutter Open, HMI
Gun HVPS is ON
Press in Emergency Stop at Service Building 2 entrance

Modulators are ON

SR Secure For OPS OFF (grey), HMI
SR Dipole PS is OFF
SR Dipole both Permits OFF (grey), HMI
SR RF Systems C AND D are OFF
SR RF Permits OFF (grey), HMI
BTS shutter Closed, HMI
Gun is OFF
Modulators OFF

Pull out Emergency Stop
Reset fault and latch at Pentant 2 I/O box
Secure Pentant 2

Emergency Stop Latch A and B OFF (grey), HMI
Emergency Stop Latch A and B ON (green), HMI
All Pentants secure A and B (green), HMI
SR secure to Booster A and B chain ON (green), HMI

Control Room Emergency Stop

Request Operator Turn on SR RF HVPS, SR Dipole PS and open BTS shutter

SR Dipole PS is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C AND D are ON
SR RF Permits ON A and B chain (green), HMI
BTS shutter Open, HMI

Press in Emergency Stop in the Control Room

SR Secure For OPS A chain OFF (grey), HMI
SR Dipole PS is OFF
SR Dipole Permits OFF A chain (grey), HMI
SR RF Systems C AND D are OFF
SR RF Permits OFF (grey), HMI
BTS shutter Closed, HMI

Pull out Emergency Stop
Reset fault and latch in the control room

Emergency Stop Latch A and B OFF (grey), HMI
Emergency Stop Latch A and B ON (green), HMI

Ignition Key (drops critical devices but not search)

Request Operator Turn on SR RF HVPS, SR Dipole PS and open BTS shutter

SR Dipole PS is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C AND D are ON
SR RF Permits ON A and B chain (green), HMI
BTS shutter Open, HMI
Remove the SR Ignition key

Secure P1 through P5

Operator turns on: Gun HVPS, Modulators. Open the LTB shutter and set LTB B1 and B2 at injection energy. Turn on Booster RF HVPS and Dipole F (no setpoint).

Gun HVPS is ON
Gun Permits A and B ON (green), linac HMI
(3) Modulators UPA-100 are ON
Modulator Permits A and B ON (green), HMI
LTB shutter is OPEN
LTB B1 PS is ON
LTB B2 PS is ON at injection energy (65 A)

Operator opens BTS shutter and turns on the Dipoles to the following currents

Booster B1 PS set to **219.3 A**
Booster B2 PS set to **298.0 A**
Storage Ring Dipole set to **364 A**

Vacuum group member trips Storage Ring Vacuum interlock (i.e., valve or ion gauge)

Vacuum group restores SR vacuum interlock condition

Request Operator set Dipole to **356.72 A**

**SR Injection Energy Limit (2.0 - 3.3 GeV)**

Accelerator Safety System Staff return energy limiters to Operations

Secure all pentants

Operator turns on Gun HVPS

Gun HVPS is ON
Gun Permits A and B ON (green), linac HMI
SR Injector Energy Limiter A and B ON (green)
Storage ring Dipole PS at **364 A**

Storage ring secure to booster
Gun HVPS is ON
Gun Permits A and B ON (green), linac HMI
SR Injector Energy Limiter A and B ON (green)
Storage ring Dipole PS at **356.72 A**

Gun HVPS is OFF
Gun Permits A and B OFF (grey), linac HMI
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Title: NSLS-II Storage Ring Radiological Interlock Test

SR Injector Energy Limiter A and B OFF (grey)
Storage ring Dipole PS at 364 A

SR Injector Energy Limiter A and B ON (green)
Gun HVPS is ON
Gun Permits A and B ON (green), linac HMI

Storage ring Dipole PS at 371.28 A
Gun HVPS is OFF
Gun Permits A and B OFF (grey), linac HMI
SR Injector Energy Limiter A and B OFF (grey)

Storage ring Dipole PS at 364 A
SR Injector Energy Limiter A and B ON (green)

Top Energy Interlock
Request operator: set Dipole Power Supply to injection energy

Dipole Current set at injection energy 364 A
SR System C and D RF HVPS ON
RF A and B Permits are ON (green), HMI

Dipole PS at 372.8 A (3.3 GeV value)
SR Systems C and D RF HVPS shuts OFF
RF A and B permits OFF (grey), HMI

Return Dipole PS to injection energy setpoint
Dipole at 364 A

Area Radiation Monitors
This test step may be completed at any time during the testing process but MUST be completed for PPS test certification. Refer to PS-C-ASD-PRC-008, NSLS-II Area Radiation Monitor PPS Test and complete Attachment C, NSLS-II Storage Ring Area Radiation Monitor Checklist for Monitors SRM-29 through SRM-4.

Area Radiation Monitor SRM-29 Test completed
Area Radiation Monitor SRM-30 Test completed
Area Radiation Monitor SRM-1 Test completed
Area Radiation Monitor SRM-2 Test completed
Area Radiation Monitor SRM-3 Test completed
Area Radiation Monitor SRM-4 Test completed

Energy Limiter Trip Amplifier (Steps B44-B49)
Use the Figures below as a reference for the energy limiter trip amplifier test steps (B44-B49). For each step, the following conditions must exist: LTB shutter open, BTS shutter open, Gun ON, SR Dipole at 364 A and SR RF ON.

STA A1 Connector (A chain trips RF- Top Energy)
All Pentants Secure
SR Secure for OPS, HMI
<table>
<thead>
<tr>
<th>Title</th>
<th>Technical</th>
</tr>
</thead>
<tbody>
<tr>
<td>B24</td>
<td>Gun HVPS is ON</td>
</tr>
<tr>
<td></td>
<td>SR RF is ON, A and B permits ON, RFPSI C AND D</td>
</tr>
<tr>
<td></td>
<td><strong>Remove STA A1</strong></td>
</tr>
<tr>
<td></td>
<td>SR RF is OFF, A chain permits OFF, RFPSI C AND D</td>
</tr>
<tr>
<td></td>
<td><strong>Replace STA A1</strong></td>
</tr>
<tr>
<td>B46</td>
<td><strong>Fuse F1 (A Chain trips RF and Gun- Top Energy)</strong></td>
</tr>
<tr>
<td></td>
<td>Request Operator turn on RF HVPS</td>
</tr>
<tr>
<td></td>
<td>Gun HVPS is ON, A and B permits ON, HMI</td>
</tr>
<tr>
<td></td>
<td>SR RF is ON, A and B permits ON, RFPSI C AND D</td>
</tr>
<tr>
<td></td>
<td><strong>Remove Fuse F1</strong></td>
</tr>
<tr>
<td></td>
<td>Gun HVPS is OFF, A permits OFF, HMI</td>
</tr>
<tr>
<td></td>
<td>SR RF is OFF, A chain permits OFF, RFPSI C AND D</td>
</tr>
<tr>
<td></td>
<td><strong>Replace Fuse</strong></td>
</tr>
<tr>
<td>B47</td>
<td><strong>STA A2 Connector (A chain trips Gun- Injection Energy)</strong></td>
</tr>
<tr>
<td></td>
<td>Request Operator turn on RF and Gun HVPS</td>
</tr>
<tr>
<td></td>
<td>Gun HVPS is ON, A and B permits ON, HMI</td>
</tr>
<tr>
<td></td>
<td>SR RF is ON, A and B permits ON, RFPSI C AND D</td>
</tr>
<tr>
<td></td>
<td><strong>Remove STA A2 connector</strong></td>
</tr>
<tr>
<td></td>
<td>Gun HVPS is OFF, A permits OFF, HMI</td>
</tr>
<tr>
<td>B48</td>
<td><strong>STA B1 Connector (B chain trips RF- Top Energy)</strong></td>
</tr>
<tr>
<td></td>
<td>All Pentants Secure</td>
</tr>
<tr>
<td></td>
<td>SR Secure for OPS, HMI</td>
</tr>
<tr>
<td></td>
<td>Request Operator turn on Gun HVPS</td>
</tr>
<tr>
<td></td>
<td>Gun HVPS is ON</td>
</tr>
<tr>
<td></td>
<td><strong>Check SR RF Systems C AND D</strong></td>
</tr>
<tr>
<td></td>
<td>SR RF is ON, A and B permits ON, RFPSI C AND D</td>
</tr>
<tr>
<td></td>
<td><strong>Remove STA B1</strong></td>
</tr>
<tr>
<td></td>
<td>SR RF is OFF, A chain permits OFF, RFPSI C AND D</td>
</tr>
<tr>
<td></td>
<td><strong>Replace STA B1</strong></td>
</tr>
<tr>
<td>B49</td>
<td><strong>Fuse F2 (B Chain trips RF and Gun- Top Energy)</strong></td>
</tr>
<tr>
<td></td>
<td>Request Operator turn on RF HVPS</td>
</tr>
<tr>
<td></td>
<td>Gun HVPS is ON, A and B permits ON, HMI</td>
</tr>
<tr>
<td></td>
<td><strong>Check SR RF Systems C AND D</strong></td>
</tr>
<tr>
<td></td>
<td>SR RF is ON, A and B permits ON, RFPSI C AND D</td>
</tr>
<tr>
<td></td>
<td>Remove Fuse F2</td>
</tr>
<tr>
<td></td>
<td>Gun HVPS is OFF, B permits OFF, HMI</td>
</tr>
<tr>
<td></td>
<td>SR RF is OFF, B chain permits OFF, RFPSI C AND D</td>
</tr>
<tr>
<td></td>
<td><strong>Replace Fuse F2</strong></td>
</tr>
<tr>
<td>B50</td>
<td><strong>STA B2 Connector (B chain trips Gun- Injection Energy)</strong></td>
</tr>
<tr>
<td></td>
<td>Request Operator turn on RF and Gun HVPS</td>
</tr>
<tr>
<td></td>
<td>Gun HVPS is ON, A and B permits ON, HMI</td>
</tr>
<tr>
<td></td>
<td><strong>Check SR RF Systems C AND D</strong></td>
</tr>
<tr>
<td></td>
<td>SR RF is ON, A and B permits ON, RFPSI C AND D</td>
</tr>
<tr>
<td></td>
<td>Remove STA B2 connector</td>
</tr>
<tr>
<td></td>
<td>Gun HVPS is OFF, B permits OFF, HMI</td>
</tr>
<tr>
<td></td>
<td><strong>Replace connector</strong></td>
</tr>
</tbody>
</table>
National Synchrotron Light Source II, Brookhaven National Laboratory

Doc No. PS-C-ASD-PRC-129
Author: T. McDonald
Effective Date: 08Jan2016
Review Frequency: 3 yrs
Version 5

Title: NSLS-II Storage Ring Radiological Interlock Test

Top Energy A Chain Cabinet

Top Energy B Chain Cabinet

A Chain Fuse and Connector Locations
**Test Completion**

Account for all switch holders/actuators

Remove LOTO from ALL Linac, Booster and SR devices if testing is complete

Disconnect the 4 test jumpers to the SR Dipole power supply interface boxes.

Ensure PPS cabinets are secure and locked; challenge locks

Remove sound mufflers from HII devices (6)

Request Operator make log entry stating Pentant 2 test is complete.

---

- END OF ATTACHMENT B -
Attachment C

NSLS-II Storage Ring Pentant 3 Radiological Interlock Test Checklist

<table>
<thead>
<tr>
<th>Test Reason:</th>
<th>Test Result: □ Passed □ Failed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Date:</td>
<td>Start Time: Finish Time:</td>
</tr>
<tr>
<td>Tester 1:</td>
<td>Assistant 1:</td>
</tr>
<tr>
<td>Tester 2:</td>
<td>Assistant 2:</td>
</tr>
<tr>
<td>Tester 1 Signature:</td>
<td>Tester 2 Signature:</td>
</tr>
<tr>
<td>*Reviewer 1:</td>
<td>Reviewer 1 sig.:</td>
</tr>
<tr>
<td>Reviewer 2:</td>
<td>Reviewer 2 sig.:</td>
</tr>
<tr>
<td>** Safety Signature Pentant 3(PLC)</td>
<td>Previous Pentant 3 PLC SS# Date: / /</td>
</tr>
<tr>
<td>A Chain:</td>
<td>B Chain:</td>
</tr>
<tr>
<td>A Chain:</td>
<td>B Chain:</td>
</tr>
</tbody>
</table>

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

Each numbered item below indicates a set of action items for the test procedure. The Tester will either perform the action, or delegate the action to the Assistant(s). For each step a checkmark (✓) should be made if the correct corresponding observation has been made.

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
<th>✓</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td><strong>Verify System Lockouts and Connect Dipole Test Jumpers</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gun HVPS Output Cable Connector</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Modulator PS line cords (3) OR Booster Dipole F PS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Booster RF HVPS OR booster low level RF drive termination OR Booster RF output connection to cavity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SR System C RF HVPS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SR System C low level RF drive termination OR System C SR RF output connection to cavity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SR System D RF HVPS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SR System D low level RF drive termination OR SR System D RF output connection to cavity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Apply mufflers to the right hand HII side sounders 6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connect the 4 test jumpers to the SR Dipole Power Supply interface boxes</td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td><strong>Secure enclosures</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Secure the injector berm area</td>
<td>Berm secured, Linac HMI</td>
</tr>
<tr>
<td></td>
<td>Secure the linac</td>
<td>Linac secured, Linac HMI</td>
</tr>
<tr>
<td></td>
<td>Secure the booster ring</td>
<td>Booster secured, Booster HMI</td>
</tr>
<tr>
<td></td>
<td>Note: All Mode Search Verifications can be completed using the Quick Search feature</td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td><strong>Verify Pentant 3 Single Pentant Search (Mode 1)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check HMI on 740 Pentant I/O Box or CR</td>
<td>Pentant 3 not secured A and B chain (grey), HMI</td>
</tr>
</tbody>
</table>

Three Searchers enter Service Building 3
The only official copy of this document is the one online in the SharePoint Document Center. Before using a printed copy, verify that it is current by checking the printed document’s version history log (p. ii) with that of the online version.

<table>
<thead>
<tr>
<th><strong>Action Taken</strong></th>
<th><strong>Observation, Location</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Press P3-SB1 Service Bldg. 3</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td></td>
<td>Search sounder alarm sounds</td>
</tr>
<tr>
<td></td>
<td>Overhead lighting flashes during search</td>
</tr>
<tr>
<td>One searcher remains on P2 side of Gate 3</td>
<td></td>
</tr>
<tr>
<td>Close Gate 3 and press SB2</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press SB3 on HII 1</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td></td>
<td>Amber HII 1 search beacon is ON</td>
</tr>
<tr>
<td>Press SB4 on HII 2</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td></td>
<td>Amber HII 2 search beacon is ON</td>
</tr>
<tr>
<td>Press SB5 on HII 3</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td></td>
<td>Amber HII 3 search beacon is ON</td>
</tr>
<tr>
<td>Searchers simultaneously press P3-SB1 (Service Bldg.) and SB6 on HII 4 until the lights illuminate</td>
<td>Light on SB1 (Service Bldg.) illuminates</td>
</tr>
<tr>
<td></td>
<td>Amber HII 4 search beacon is ON</td>
</tr>
<tr>
<td>Press SB7 on HII 5</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td></td>
<td>Amber HII 5 search beacon is ON</td>
</tr>
<tr>
<td>Press SB8 on HII 6</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td></td>
<td>Amber HII 6 search beacon is ON</td>
</tr>
<tr>
<td>One searcher remains on P4 side of gate</td>
<td></td>
</tr>
<tr>
<td>Close Pentant Gate 4</td>
<td></td>
</tr>
<tr>
<td>Press SBSP</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press P3-SB1</td>
<td>Light illuminates on SB1</td>
</tr>
<tr>
<td>Exit through Service Building Door</td>
<td></td>
</tr>
<tr>
<td>Press SBE</td>
<td>Light on SBE illuminates</td>
</tr>
<tr>
<td></td>
<td>Maglock engages/locks- check door</td>
</tr>
<tr>
<td></td>
<td>Service Bldg 3 Maglock A and B (green), HMI</td>
</tr>
<tr>
<td></td>
<td>Gate 3 switches A and B ON (green), HMI</td>
</tr>
<tr>
<td></td>
<td>Gate 3 Maglock A and B ON (green), HMI</td>
</tr>
<tr>
<td></td>
<td>Gate 4 Maglock A and B ON (green), HMI</td>
</tr>
<tr>
<td></td>
<td>Gate 4 switches A and B ON (green), HMI</td>
</tr>
</tbody>
</table>

**After beam imminent warning sounds:**

Service Bldg Door sign illuminates (A and B sect.)

(Note: beam imminent timed in step C4)

Pentant 3 Secured A and B chain, HMI

Gate 3 sign illuminates (A and B sect.)

Gate 4 sign illuminates (A and B sect.)

Request operator grant access permit for P3

Press Access Request button at Serv. Building Door

3Pentant 3 unsecured A and B chain, HMI

C2
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<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>if necessary (other pentants secure)</td>
<td>✓</td>
</tr>
<tr>
<td>Open Door</td>
<td>No alarm sounds in Control Room</td>
</tr>
</tbody>
</table>

### C4 Verify Pentant 3 Starting Multiple Pentant Search (Mode 2) and time Beam imminent warning

- **Check HMI on 740 Pentant I/O Box or CR**: Pantent 3 not secured A and B chain (grey), HMI
- **Three Searchers enter Service Building 3**
- **Press P3-SB1 in Pentant 3 Service Bldg.** Light on search button illuminates
- **Search sounder alarm sounds**
- **Overhead lighting flashes during search**
- **Close Gate 3 and press SB2**
- **Press SB3 on HII 1** Light on search button illuminates
- **Amber HII 1 search beacon is ON**
- **Press SB4 on HII 2**
- **Light on search button illuminates**
- **Amber HII 2 search beacon is ON**
- **Press SB5 on HII 3**
- **Light on search button illuminates**
- **Amber HII 3 search beacon is ON**
- **Searchers simultaneously press P3-SB1(Service Bldg.) and SB6 on HII 4 until the lights illuminate**
- **Light on SB1 (Service Bldg.) illuminates**
- **Light on SB6 illuminates**
- **Amber HII 4 search beacon is ON**
- **Press SB7 on HII 5**
- **Light on search button illuminates**
- **Amber HII 5 search beacon is ON**
- **Press SB8 on HII 6**
- **Light on search button illuminates**
- **Amber HII 6 search beacon is ON**
- **Close Pentant Gate 4**
- **Reach through Gate 4 Press SB9 and begin timing audible alarm**
- **Light on search button illuminates**
- **Maglock engages/check gate**
- **Service Bldg 1 Maglock A and B ON (green), HMI**
- **Gate 4 Maglock A and B ON (green), HMI**
- **Gate 3 switches A and B (green), HMI**
- **Gate 4 switches A and B (green), HMI**
- **Beam Imminent alarm sounds for 60 seconds**

*After beam imminent warning sounds:*

- **Pentant 3 Secured A and B chain, HMI**
- **Gate 4 sign illuminates (A and B sect.)**
<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
<th>✓</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5 <strong>Operations Enable Switch (Pentant 3 Main I/O box)</strong></td>
<td>Pentant 3 Secured A and B chain (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Rotate the operations enable switch to OFF</td>
<td>Pentant 3 NOT Secured A and B chain (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Attempt to secure Pentant 3</td>
<td>Pentant 3 will not secure</td>
<td></td>
</tr>
<tr>
<td>Rotate the operations enable switch to ON</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reset the fault at the Pentant 1 I/O box</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C6 <strong>Verify Pentant 3 Continuing Multiple Pentant Search (Mode 3) and time Red Beacons</strong></td>
<td>Pentant 3 not secured A and B chain (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Check HMI on 740 Pentant I/O Box or CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Close Gate 3 and press SB2</td>
<td>Light on search button illuminates</td>
<td></td>
</tr>
<tr>
<td>Press P3-SB3 on HII 1</td>
<td>Light on search button illuminates</td>
<td></td>
</tr>
<tr>
<td>Press P3-SB4 on HII 2</td>
<td>Light on search button illuminates</td>
<td></td>
</tr>
<tr>
<td>Press SB5 on HII 3</td>
<td>Light on search button illuminates</td>
<td></td>
</tr>
<tr>
<td>Searchers simultaneously press P3-SB1 (Service Bldg.) and SB6 on HII 4 until the lights illuminate</td>
<td>Light on SB1 (Service Bldg.) illuminates</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Light on SB6 illuminates</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Amber HII 4 search beacon is ON</td>
<td></td>
</tr>
<tr>
<td>Press SB7 on HII 5</td>
<td>Light on search button illuminates</td>
<td></td>
</tr>
<tr>
<td>Press SB8 on HII 6</td>
<td>Light on search button illuminates</td>
<td></td>
</tr>
<tr>
<td>Close Pentant Gate 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reach through Gate 4 Press SB9 and begin timing the Red Beacons on HII devices (6)</td>
<td>Light on search button illuminates</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maglock engages/locks- check door</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Service Bldg 3 Maglock A and B (green), HMI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gate 4 Maglock A and B (green), HMI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gate 3 switches A and B (green), HMI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gate 4 switches A and B (green), HMI</td>
<td></td>
</tr>
<tr>
<td>After Beam Imminent alarm:</td>
<td>Pentant 3 Secured A and B chain, HMI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Red Beacons (6) flash for 60 seconds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HII Red area Secure A and B lights illuminated</td>
<td></td>
</tr>
<tr>
<td>Request operator grant access permit for P3</td>
<td>Pentant 3 unsecured A and B chain, HMI</td>
<td></td>
</tr>
</tbody>
</table>
**NSLS-II Storage Ring Radiological Interlock Test**

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open gate</td>
<td>No alarm sounds in Control Room</td>
</tr>
</tbody>
</table>

**C7 Verify Pentant 3 Completing Multiple Pentant Search (Mode 4)**

- Check HMI on 740 Pentant I/O Box or CR
- Close Gate 3 and press SB2
- Press P3-SB3 on HII 1
- Press P3-SB4 on HII 2
- Press SB5 on HII 3
- Searchers **simultaneously** press P3-SB1 (Service Bldg.) and SB6 on HII 4 until the lights illuminate

<table>
<thead>
<tr>
<th>Pentant 3 not secured A and B chain (grey), HMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Amber HII 1 search beacon is ON</td>
</tr>
<tr>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Amber HII 2 search beacon is ON</td>
</tr>
<tr>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Amber HII 3 search beacon is ON</td>
</tr>
<tr>
<td>Light on SB1 (Service Bldg.) illuminates</td>
</tr>
<tr>
<td>Light on SB6 illuminates</td>
</tr>
<tr>
<td>Amber HII 4 search beacon is ON</td>
</tr>
<tr>
<td>Press SB7 on HII 5</td>
</tr>
<tr>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Amber HII 5 search beacon is ON</td>
</tr>
<tr>
<td>Press SB8 on HII 6</td>
</tr>
<tr>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Amber HII 6 search beacon is ON</td>
</tr>
<tr>
<td>Close Pentant Gate 4</td>
</tr>
<tr>
<td>Press SBSP</td>
</tr>
<tr>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press P3-SB1 at Service Building Door</td>
</tr>
<tr>
<td>Light illuminates on SB1</td>
</tr>
<tr>
<td>Exit through Service Building Door</td>
</tr>
<tr>
<td>Press SBE</td>
</tr>
<tr>
<td>Light on SBE illuminates</td>
</tr>
<tr>
<td>After Beam Imminent alarm:</td>
</tr>
<tr>
<td>Pentant 3 Secured A and B chain, HMI</td>
</tr>
</tbody>
</table>

**C8 Access Pentant and check HII (6)**

- Request Operator grant access permit for P3
- Press Access Request button at Service Building Door if necessary (other pentants secure)
- Exit through Service Building Door
- Press SBE
- After Beam Imminent alarm:

  - If other pentants secure the Access Request button at Service Bldg. 3 illuminates
  - P3 Service Bldg. Door Maglock OFF (grey), HMI
  - Pentant 3 not secured A and B chain (grey), HMI
  - Door is open
  - Check HII indicators
    - Red Beacons OFF
    - Red Secure A and B lights OFF
    - Green HII “Beam Disabled” lights illuminated
  - Proceed to P3-SB2

**C9 Search Timeout (Mode 2)**

- Press P3-SB2 in Pentant 3 and begin **timing**

  - Light on search button illuminates
<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete search in sequence <em>without</em> pressing SB9</td>
<td>Search sounder alarm sounds</td>
</tr>
<tr>
<td>Press SB9</td>
<td>Light and sounders go out in 12 minutes</td>
</tr>
<tr>
<td><strong>C10</strong> Skip the Two Button Simultaneous Press (Mode 1) using Quick Search</td>
<td>Mode 2 Search does not complete</td>
</tr>
<tr>
<td>Close gates and doors and put into Quick Search</td>
<td></td>
</tr>
<tr>
<td>Press SB1</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press SB2</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press SB3</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press SB4</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press SB5</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press SB6</td>
<td></td>
</tr>
<tr>
<td>Press SB7</td>
<td></td>
</tr>
<tr>
<td>Press SB8</td>
<td></td>
</tr>
<tr>
<td>Press SB9</td>
<td>Pentant 3 does NOT Secure on A or B chains</td>
</tr>
<tr>
<td><strong>C11</strong> Emergency Stop Aborts Search</td>
<td></td>
</tr>
<tr>
<td>Complete a normal search using ANY Mode</td>
<td>Mode used =</td>
</tr>
<tr>
<td>Before the beam imminent warning sounder stops, press an Emergency Stop</td>
<td>Beam imminent warning stops</td>
</tr>
<tr>
<td>Red Beacons are NOT flashing</td>
<td></td>
</tr>
<tr>
<td>Pentant 3 does not secure on either chain, HMI</td>
<td></td>
</tr>
<tr>
<td><strong>C12</strong> A Chain Entrance Door Switches Service Building 3</td>
<td></td>
</tr>
<tr>
<td>Place holders on the A chain Service Building 3 Door switches (4) and attach actuator on Magnetic lock</td>
<td></td>
</tr>
<tr>
<td>Close Pentant gates 3 and 4</td>
<td></td>
</tr>
<tr>
<td>Perform all actions and make observations for both door A chain switches A1 and A2</td>
<td>A1 A2</td>
</tr>
<tr>
<td>Quick Search Pentant 3 (A chain)</td>
<td>Pentant 3 secured A chain <em>(green)</em>, HMI</td>
</tr>
<tr>
<td>Remove holder from Service Building 3 <em>stationary</em> door switch</td>
<td>Pentant 3 unsecured A chain <em>(grey)</em>, HMI</td>
</tr>
<tr>
<td>Replace holder on <em>stationary</em> door</td>
<td></td>
</tr>
<tr>
<td>Quick Search Pentant 3 (A chain)</td>
<td>Pentant 3 secured A chain <em>(green)</em>, HMI</td>
</tr>
<tr>
<td>Remove holder from Service Building 3 <em>active</em> door switch</td>
<td>Pentant 3 unsecured A chain <em>(grey)</em>, HMI</td>
</tr>
<tr>
<td>Action Taken</td>
<td>Observation, Location</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Replace holder on <strong>active</strong> door</td>
<td>Service Bldg 3 Door SW A chain OFF (grey), HMI</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C13 Pentant 3 A Chain Quick Search Timeout</strong></td>
<td></td>
</tr>
<tr>
<td>Quick search Pentant 3 and <em>begin timing</em></td>
<td>Pentant 3 secured A chain (green), HMI</td>
</tr>
<tr>
<td></td>
<td>Pentant 3 unsecured in 5 minutes (grey), HMI</td>
</tr>
<tr>
<td>Remove A chain switch holders</td>
<td></td>
</tr>
<tr>
<td><strong>C14 B Chain Entrance Door Switches Service Building 3</strong></td>
<td>Place holders on the B chain Service Building 3 Door switches (4)</td>
</tr>
<tr>
<td></td>
<td>Close Pentant gates</td>
</tr>
<tr>
<td>Perform all actions and make observations for both door B chain switches B1 and B2</td>
<td></td>
</tr>
<tr>
<td>Quick Search Pentant 3 (B chain)</td>
<td>Pentant 3 secured B chain (green), HMI</td>
</tr>
<tr>
<td></td>
<td>Service Bldg 3 Door SW A chain ON (green), HMI</td>
</tr>
<tr>
<td>Remove holder from Service Building 3 <strong>stationary</strong></td>
<td>Pentant 3 unsecured B chain (grey), HMI</td>
</tr>
<tr>
<td>door switch</td>
<td>Service Bldg 3 Door SW B chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Replace holder on <strong>stationary</strong> door</td>
<td></td>
</tr>
<tr>
<td>Quick Search Pentant 3 (B chain)</td>
<td>Pentant 3 secured B chain (green), HMI</td>
</tr>
<tr>
<td></td>
<td>Service Bldg 3 Door SW B chain ON (green), HMI</td>
</tr>
<tr>
<td>Remove holder from Service Building 3 <strong>active</strong></td>
<td>Pentant 3 unsecured B chain (grey), HMI</td>
</tr>
<tr>
<td>door switch</td>
<td>Service Bldg 3 Door SW B chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Replace holder on <strong>active</strong> door</td>
<td></td>
</tr>
<tr>
<td><strong>C15 Pentant 3 B Chain Quick Search Timeout</strong></td>
<td></td>
</tr>
<tr>
<td>Quick search Pentant 3 and <em>begin timing</em></td>
<td>Pentant 3 secured B chain</td>
</tr>
<tr>
<td></td>
<td>Pentant 3 unsecured in 5 minutes</td>
</tr>
<tr>
<td><strong>C16 Service Building 3 Door Emergency Egress</strong></td>
<td></td>
</tr>
<tr>
<td>Attach B chain Maglock Actuator with tape</td>
<td>Pentant 3 secured B chain ON (green), HMI</td>
</tr>
<tr>
<td>Person proceeds to Exit (ring side)</td>
<td>Service Bldg 3 Door Maglock B chain ON (green), HMI</td>
</tr>
<tr>
<td>Perform B chain Pentant 3 quick search</td>
<td></td>
</tr>
<tr>
<td>Remove actuator</td>
<td>Service Bldg 3 Door Maglock B chain OFF (grey), HMI</td>
</tr>
<tr>
<td></td>
<td>Pentant 3 unsecured (grey), HMI</td>
</tr>
</tbody>
</table>
Action Taken                  Observation, Location
Remove holders and close door
Perform A chain Pentant 3 search  Pentant 3 secured A chain (green), HMI  Service Bldg 3 Door Maglock A chain ON (green), HMI
Press in door push bar without opening door  Service Bldg 3 Door Maglock A chain OFF (grey), HMI
Open door  Pentant 3 unsecured (grey), HMI
Close door and stay outside of ring  Door opens
C17 Service Building 3 Door P3 Emergency Egress
Perform A chain Pentant 3 quick search  Pentant 3 secured A chain  Service Bldg 3 Door Maglock A chain ON (green), HMI
Press in external emergency egress button  Service Bldg 3 Door Maglock A chain OFF (grey), HMI  Pentant 3 unsecured, HMI
Pull out external emergency egress button  Emergency Stop Latch A chain OFF (grey), HMI
Reset emergency stop latch and fault  Emergency Stop Latch A chain ON (green), HMI
Perform B chain Pentant 3 search  Pentant 3 secured B chain  Serv. Bldg 3 Door Maglock B chain ON (green), HMI
Press in external emergency egress button  Service Bldg 3 Door Maglock B chain OFF (grey), HMI  Pentant 3 unsecured, HMI
Pull out external emergency egress button  Emergency Stop Latch B chain OFF (grey), HMI
Open door  Door opens
Close door and stay outside of ring
C18 Pentant 3 HII Emergency stops
Repeat all steps for each HII
A Chain:

Hi
Quick search Pentant 3 on A Chain  --- --- --- --- --- ---
Pentant 3 secured A chain (green), HMI  --- --- --- --- --- ---
Emergency Stop Latch A chain ON (green), HMI  --- --- --- --- --- ---
Press in emergency stop  --- --- --- --- --- ---
Pentant 3 unsecured A chain (grey), HMI  --- --- --- --- --- ---
Pull out emergency stop  --- --- --- --- --- ---
Emergency Stop Latch A chain OFF (grey), HMI  --- --- --- --- --- ---
Reset fault and latch at Pentant 3 I/O box  --- --- --- --- --- ---
Emergency Stop Latch A chain ON (green), HMI  --- --- --- --- --- ---
**B Chain:**

Quick search Pentant 3 on B Chain
- Pentant 3 secured B chain (green), HMI
- Emergency Stop Latch B chain ON (green), HMI
- Press in emergency stop
  - Pentant 3 unsecured B chain (grey), HMI
- Pull out emergency stop
  - Emergency Stop Latch B chain OFF (grey), HMI
- Reset fault and latch at Pentant 3 I/O box
  - Emergency Stop Latch B chain ON (green), HMI

---

**C19 Pentant 3 Gate 3 Switches**

Proceed to the gate between pentants 3 and 4
Place holders on the A chain gate switches
Perform all actions and make observations for both Gate 3 A chain switches A1 and A2

Quick Search Pentant 2 (A chain)  
Pentant 2 secured A chain (green), HMI
Quick Search Pentant 3 (A chain)  
Pentant 3 secured A chain (green), HMI  
Gate 3 SW A chain ON (green), HMI
Remove holder from Gate A chain switch
- Pentant 3 unsecured A chain (grey), HMI
- Gate 3 SW A chain OFF (grey), HMI
Remove Gate A chain switch holders
Place holders on the B chain gate switches
Perform all actions and make observations for both Gate 3 B chain switches B1 and B2

Quick Search Pentant 2 (B chain)  
Pentant 2 secured B chain (green), HMI
Quick Search Pentant 3 (B chain)  
Pentant 3 secured B chain (green), HMI  
Gate 3 SW B chain ON (green), HMI
Remove holder from Gate 3 B switch
- Pentant 3 unsecured B chain (grey), HMI
- Gate 3 SW B chain ON (green), HMI
Remove switch holders and close gate
C20  **Gate 4 Switches**

Proced to the gate between pentants 4 and 5

Place holders on the **A chain** gate switches

Perform all actions and make observations for both Gate 4 A chain switches A1 and A2

<table>
<thead>
<tr>
<th>A1</th>
<th>A2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick Search Pentant 2 (A chain)</td>
<td>Pentant 2 secured A chain (<strong>green</strong>), HMI</td>
</tr>
<tr>
<td>Quick Search Pentant 3 (A chain)</td>
<td>Pentant 3 secured A chain (<strong>green</strong>), HMI</td>
</tr>
<tr>
<td>Remove holder from Gate 4 switch</td>
<td>Pentant 3 unsecured A chain (grey), HMI</td>
</tr>
<tr>
<td></td>
<td>Gate 4 SW A chain OFF (grey), HMI</td>
</tr>
</tbody>
</table>

Remove Gate 4 A chain switch holders

Place holders on the **B chain** gate switches

Perform all actions and make observations for both Gate 4 B chain switches B1 and B2

<table>
<thead>
<tr>
<th>B1</th>
<th>B2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick Search Pentant 2 (A chain)</td>
<td>Pentant 2 secured B chain (<strong>green</strong>), HMI</td>
</tr>
<tr>
<td>Quick Search Pentant 3 (B chain)</td>
<td>Pentant 3 secured B chain (<strong>green</strong>), HMI</td>
</tr>
<tr>
<td>Remove holder from Gate 4 switch</td>
<td>Pentant 3 unsecured B chain (grey), HMI</td>
</tr>
<tr>
<td></td>
<td>Gate 4 SW B chain OFF (grey), HMI</td>
</tr>
</tbody>
</table>

Remove switch holders and close gate

C21  **Gate 4 Emergency Stop (in Pentant 4)**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick Search Pentant 3 on A Chain</td>
<td>Pentant 3 Secured A chain (<strong>green</strong>), HMI</td>
</tr>
<tr>
<td>Press the Gate 4 Emergency stop</td>
<td>Pentant 3 unsecured (grey), HMI</td>
</tr>
<tr>
<td>Pull out Gate 4 Emergency stop</td>
<td>Gate 4 Maglock A chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Reset fault and latch</td>
<td>Emergency Stop Latch A chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Quick Search Pentant 3 on B Chain</td>
<td>Pentant 3 Secured B chain (<strong>green</strong>), HMI</td>
</tr>
<tr>
<td></td>
<td>Emergency Stop Latch B chain (<strong>green</strong>), HMI</td>
</tr>
<tr>
<td></td>
<td>Gate 4 Maglock B chain (<strong>green</strong>), HMI</td>
</tr>
<tr>
<td>Action Taken</td>
<td>Observation, Location</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Press the Gate 4 Emergency stop</td>
<td>Pentant 3 unsecured (grey), HMI</td>
</tr>
<tr>
<td>Pull out Gate 4 Emergency stop</td>
<td>Emergency Stop Latch B chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Reset fault and latch</td>
<td>Emergency Stop Latch B chain ON (green), HMI</td>
</tr>
</tbody>
</table>

**C22 Gate 4 Push Bar**

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick search Pentant 3 on A chain</td>
<td>Pentant 3 Secure A chain (green), HMI</td>
</tr>
<tr>
<td>Push in gate Push Bar without opening gate</td>
<td>Gate 4 Maglock A chain ON (green), HMI</td>
</tr>
<tr>
<td>Release Push bar</td>
<td>Gate 4 Maglock A chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Put holders on B chain switches</td>
<td></td>
</tr>
<tr>
<td>Attach B chain Maglock Actuator with tape</td>
<td></td>
</tr>
<tr>
<td>Quick search Pentant 4 on B chain</td>
<td>Pentant 3 Secure B chain (green), HMI</td>
</tr>
<tr>
<td>Push in gate Push Bar without opening gate</td>
<td>Gate 4 Maglock B chain ON (green), HMI</td>
</tr>
<tr>
<td>Remove actuator</td>
<td></td>
</tr>
</tbody>
</table>

**C23 Pentant 3 Maintenance Doors A Chain**

Place A chain actuators into each Maintenance door connectors and complete all steps for each Maintenance Door (MD)

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick Search Pentant 3 on A chain</td>
<td></td>
</tr>
<tr>
<td>Pentant secured on A chain (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Sum of Maint Doors A chain ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Remove Actuator in switch A1</td>
<td></td>
</tr>
<tr>
<td>Pentant 3 Not secured A chain (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Sum of Maint Doors A chain OFF (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Replace actuator in A1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick Search Pentant 3 on A chain</td>
<td></td>
</tr>
<tr>
<td>Pentant secured on A chain (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Sum of Maint Doors A chain ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td>Remove Actuator in switch A2</td>
<td></td>
</tr>
<tr>
<td>Pentant 3 Not secured A chain (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Sum of Maint Doors A chain OFF (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Replace actuator in A2</td>
<td></td>
</tr>
</tbody>
</table>
Remove actuators

C24 **Pentant 3 Maintenance Doors B Chain**
Place B chain actuators into each Maintenance door connector and complete all steps for each Maintenance Door (MD)

<table>
<thead>
<tr>
<th></th>
<th>5ID</th>
<th>6ID</th>
<th>7ID</th>
<th>8ID</th>
<th>9ID</th>
<th>10ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick Search Pentant 3 on B chain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pentant secured on B chain (green), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum of Maint Doors B chain ON (green), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove Actuator in switch B1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pentant 3 Not secured B chain (grey), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum of Maint Doors B chain OFF (grey), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace actuator in B1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quick Search Pentant 3 on B chain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pentant secured on B chain (green), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum of Maint Doors B chain ON (green), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove Actuator in switch B2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pentant 3 Not secured B chain (grey), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum of Maint Doors B chain OFF (grey), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove actuators and ensure all Pentant 3 Maintenance door connectors are on</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C25 **Pentant Access Allowed only with Dipole (Negative) PS Contactors OFF**
Primary Authorized Power Supply Employee LOTOs SR Dipole power supply

Secure all Pentants | SR secure for OPS, HMI |     |
Primary Authorized Power Supply Employee open | Negative PS cabinet door open |     |
cabinet door to access the A chain contactor |     |
Primary Authorized Power Supply Employee push in the A chain contactor with a screwdriver |     |

Request Operator press P3 Access Request button | Access Request button does not illuminate |     |
Access Request with critical device On alarm, HMI |     |
Serv. Bldg. 3 door remains locked on A chain, HMI |     |

Primary Authorized Power Supply Employee releases the A chain contactor |     |
Primary Authorized Power Supply Employee push in the B chain contactor with a screwdriver |     |

Request Operator press P3 Access Request button | Access Request button illuminates |     |
Press Access Request button at Service Building when lit | Pentant remains secure on A and B chain |     |
Serv. Bldg. 3 door remains locked on B chain, HMI |     |

Primary Authorized Power Supply Employee releases the B chain contactor |     |
Close cabinet door |     |

C26 **Pentant Access Allowed only with Dipole (Positive) PS Contactors OFF**
NSLS-II Storage Ring Radiological Interlock Test

Primary Authorized Power supply Employee LOTOs SR Dipole power supply

Secure all Pentants

Primary Authorized Power Supply Employee open cabinet door to access the A chain contactor

Primary Authorized Power Supply Employee push in the A chain contactor with a screwdriver

Request Operator press P3 Access Request button

Press Access button at Service Building when lit

Primary Authorized Power Supply Employee releases the A chain contactor

Primary Authorized Power Supply Employee push in the B chain contactor with a screwdriver

Request Operator press P3 Access Request button

Press Access button at Service Building when lit

Primary Authorized Power Supply Employee releases the B chain contactor

Close cabinet door

Remove LOTO from SR Dipole Power supply

C27  **Pentant Access Allowed only with SR System C RF HVPS Contactors OFF**

Primary Authorized RF Employee apply LOTO on SR RF System C HVPS

Primary Authorized RF Employee open cabinet door to access the A chain contactor

Primary Authorized RF Employee push in the RF HVPS A chain contactor with a screwdriver

Request Operator press P3 Access Request button

Access Request button does not illuminate

Access Request with critical device On alarm, HMI

Serv. Bldg. 3 door remains locked on A chain, HMI

Primary Authorized RF Employee releases the A chain contactor

Primary Authorized RF Employee push in the RF HVPS B chain contactor with a screwdriver

Request Operator press P3 Access Request button

Access Request button does not illuminate

Access Request with critical device On alarm, HMI

Serv. Bldg. 3 door remains locked on B chain, HMI

Primary Authorized RF Employee releases the B chain contactor

Close cabinet door

C28  **Pentant Access Allowed only with SR System D RF HVPS Contactors OFF**

Primary Authorized RF Employee apply LOTO on SR System D RF HVPS

Primary Authorized RF Employee open cabinet door to access the A chain contactor
Primary Authorized RF Employee push in the RF HVPS A chain contactor with a screwdriver
Request Operator press P3 Access Request button
Access permit light goes out
Access Request button does not illuminate
Alarm sounds in the Control Room
Access Request with critical device On alarm, HMI
Serv. Bldg. 3 door remains locked on A chain, HMI

Primary Authorized RF Employee releases the A chain contactor
Primary Authorized RF Employee push in the RF HVPS B chain contactor with a screwdriver
Request Operator press P3 Access Request button
Access Request button does not illuminate
Access Request with critical device On alarm, HMI
Serv. Bldg. 3 door remains locked on B chain, HMI

Primary Authorized RF Employee releases the B chain contactor
Close cabinet door

**C29 Pentant Access Allowed only with BTS Shutter Closed**
Request Operator open the BTS shutter
BTS Shutter opens
Request Operator press P3 Access Request button
Access permit button at P3 Serv. Bldg. does not illuminate
Access Request with critical device On alarm, HMI
Operator closes shutter
BTS shutter closed
Request Operator press P3 Access Request button
Access Request button illuminates outside P1 Service Building Door main entrance

**C30 Pentant Access Allowed Only with BTS B2 Bending Magnet OFF**
Using shunt test box, apply current to the # 1 BTS B2 shunt box
Request Operator press P3 Access Request button
Access Request button at P3 Serv. Bldg. illuminates
Press the button at Service Building
Pentant remains secure on A and B chain
Serv. Bldg. 3 door remains locked on B chain, HMI
Remove test box
Using shunt test box, apply current to the # 2 BTS B2 shunt box
Request Operator press P3 Access Request button
Access Request button at P3 Serv. Bldg. illuminates
Press the button at Service Building
Pentant remains secure on A and B chain
Serv. Bldg. 3 door remains locked on B chain, HMI
Remove test box

**C31 Magnet Test Mode ( Drops security, P1-P5 Emergency stops, Search disabled in Test mode)**
All Pentants Secure A and B, HMI
C AND D RF Permit A and B chain ON (green), HMI
Dipole Permit A and B chain ON (green), HMI
Request Operator open BTS shutter
BTS Shutter open, HMI
Rotate Magnet Test Key at I/O Box 3
All Pentants Unsecured A and B, HMI
BTS Shutter Closed, HMI
C AND D RF Permit A and B chain OFF (grey), HMI
Dipole Permit A and B chain OFF (grey), HMI

Reset fault and latch

Dipole Permit A and B chain ON (green), HMI

Gun Permits A and B OFF (grey), HMI

BTS Shutter Closed, HMI

C AND D RF Permit A and B chain OFF (grey), HMI

Perform each step below using one emergency stop in each pentant (P1-P5)

<table>
<thead>
<tr>
<th>Step Description</th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>P4</th>
<th>P5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press an Emergency Stop</td>
<td>Dipole Permits ON (green), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pull out Emergency Stop</td>
<td>Dipole B Permit remains OFF (grey), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reset fault</td>
<td>Dipole Permits ON (green), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attempt pentant search</td>
<td>Search cannot be completed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Live Test of Storage Ring Door Switches**

**WARNING:** Do not permit Employee from entering the Storage Ring unless authorized by the Tester who will verify the area is safe to enter.

- Place Barrier “CAUTION: DO NOT ENTER” tape across entry path OR
- Post a Watch Outside Service Building Door 3 Main Door Entrance.

The watch shall not allow Employee to enter the pentant unless authorized by the Tester.

Place switch holders on the active P3 Service Building Door switches(4) and attach magnetic lock device

**Accelerator Safety Systems Staff disables limiters (set to 0) or check if completed on concurrent test**

Secure the SR

- All Pentants secure A and B (green), HMI
- SR Secure for OPS A chain ON (green), HMI
- Gun Permits A and B ON (green), Linac HMI

Request Operator turn on Gun HVPS, Modulator HV, set LTB B1 and B2 bending magnet to injection energy, turn on SR RF HVPS and SR Dipole PS

- Gun UPA-100 is ON, gun cabinet
- Modulators contactor ON, Linac HMI
- SR Dipole PS is ON

**SR System C and D RF HVPS ON**

Check Dipole PS Positive PS Interface, DPSI

- A1 Permit is ON
- A2 Permit is ON
- “A Chain Contactor Open” light is OFF
- B1 Permit is ON
- B2 Permit is ON
- “B Chain Contactor Open” light is OFF

Check Dipole PS Negative PS Interface, DPSI

- A1 Permit is ON
- A2 Permit is ON
- “A Chain Contactor Open” light is OFF
- B1 Permit is ON
- B2 Permit is ON
- “B Chain Contactor Open” light is OFF
The only official copy of this document is the one online in the SharePoint Document Center. Before using a printed copy, verify that it is current by checking the printed document’s version history log (p. ii) with that of the online version.

<table>
<thead>
<tr>
<th>Title: NSLS-II Storage Ring Radiological Interlock Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SR System C and D RF HVPS ON</strong></td>
</tr>
<tr>
<td>Check RF PS Interface, RFPSI RF Building</td>
</tr>
<tr>
<td>Check SR RF Systems C AND D</td>
</tr>
<tr>
<td><strong>Check SR RF Systems C AND D</strong></td>
</tr>
<tr>
<td>A1 Permit is ON C AND D</td>
</tr>
<tr>
<td>A2 Permit is ON C AND D</td>
</tr>
<tr>
<td>“A Chain Contactor Open” light is OFF C AND D</td>
</tr>
<tr>
<td>B1 Permit is ON C AND D</td>
</tr>
<tr>
<td>B2 Permit is ON C AND D</td>
</tr>
<tr>
<td>“B Chain Contactor Open” light is OFF C AND D</td>
</tr>
<tr>
<td>Turn on the BTS bending magnet and set to injection energy</td>
</tr>
<tr>
<td>Open the BTS Shutter</td>
</tr>
<tr>
<td>Remove A1 switch holder</td>
</tr>
<tr>
<td>Pentants unsecured A chain (grey), HMI</td>
</tr>
<tr>
<td>SR Secure for OPS A chain OFF (grey), HMI</td>
</tr>
<tr>
<td>Gun Permits A OFF (grey), Linac HMI</td>
</tr>
<tr>
<td>Gun UPA-100 is OFF, gun cabinet</td>
</tr>
<tr>
<td>SR Dipole PS shuts OFF, A chain</td>
</tr>
<tr>
<td>SR RF HVPS shuts OFF, A chain</td>
</tr>
<tr>
<td>Modulators OFF, A chain</td>
</tr>
<tr>
<td>BTS shutter closed, HMI</td>
</tr>
<tr>
<td>Check Dipole PS Positive PS Interface, DPSI</td>
</tr>
<tr>
<td>A1 Permit is OFF</td>
</tr>
<tr>
<td>A2 Permit is OFF</td>
</tr>
<tr>
<td>“A Chain Contactor Open” light is ON</td>
</tr>
<tr>
<td>B1 Permit is ON</td>
</tr>
<tr>
<td>B2 Permit is ON</td>
</tr>
<tr>
<td>“B Chain Contactor Open” light is OFF</td>
</tr>
<tr>
<td>Check Dipole PS Negative PS Interface, DPSI</td>
</tr>
<tr>
<td>A1 Permit is OFF</td>
</tr>
<tr>
<td>A2 Permit is OFF</td>
</tr>
<tr>
<td>“A Chain Contactor Open” light is ON</td>
</tr>
<tr>
<td>B1 Permit is ON</td>
</tr>
<tr>
<td>B2 Permit is ON</td>
</tr>
<tr>
<td>“B Chain Contactor Open” light is OFF</td>
</tr>
<tr>
<td>Check RF PS Interface, RFPSI RF Building</td>
</tr>
<tr>
<td>Check SR RF Systems C AND D</td>
</tr>
<tr>
<td>Replace switch holder</td>
</tr>
</tbody>
</table>

C16
Secure Pentant 3

- All Pentants secure A and B (green), HMI
- SR Secure for OPS A chain ON (green), HMI
- Gun Permits A and B ON (green), linac HMI

Request Operator turn on Gun HVPS, Modulator HV, set LTB B1 and B2 bending magnet to injection energy, turn on SR RF HVPS and SR Dipole PS

- Gun UPA-100 is ON, gun cabinet
- Modulators contactor ON, Linac HMI
- SR Dipole PS is ON
- SR System C and D RF HVPS ON

Turn on the BTS bending magnet and set to injection energy

- Bending magnet ON, HMI

Open the BTS Shutter

- Shutter is open, HMI

Check Dipole PS Positive PS Interface, DPSI

- A1 Permit is ON
- A2 Permit is ON
- “A Chain Contactor Open” light is OFF
- B1 Permit is ON
- B2 Permit is ON
- “B Chain Contactor Open” light is OFF

Check Dipole PS Negative PS Interface, DPSI

- A1 Permit is ON
- A2 Permit is ON
- “A Chain Contactor Open” light is OFF
- B1 Permit is ON
- B2 Permit is ON
- “B Chain Contactor Open” light is OFF

Check RF PS Interface, RFPSI RF Building

- A1 Permit is ON C AND D
- A2 Permit is ON C AND D
- “A Chain Contactor Open” light is OFF C AND D
- B1 Permit is ON C AND D
- B2 Permit is ON C AND D
- “B Chain Contactor Open” light is OFF C AND D

Check SR RF Systems C AND D

- A1 Permit is ON C AND D
- A2 Permit is ON C AND D
- “A Chain Contactor Open” light is OFF C AND D
- B1 Permit is ON C AND D
- B2 Permit is ON C AND D
- “B Chain Contactor Open” light is OFF C AND D

Remove B1 switch holder

- Pentants unsecured B chain (grey), HMI
- SR Secure for OPS B chain OFF (grey), HMI
- Gun Permits B OFF (grey), linac HMI
- Gun UPA-100 is OFF, gun cabinet
- SR Dipole PS shuts OFF, B chain
- SR RF HVPS shuts OFF, B chain
- Modulators OFF, B chain
- BTS shutter closed, HMI
Check Dipole PS Positive PS Interface, DPSI

A1 Permit is ON
A2 Permit is ON
“A Chain Contactor Open” light is OFF
B1 Permit is OFF
B2 Permit is OFF
“B Chain Contactor Open” light is ON

Check Dipole PS Negative PS Interface, DPSI

A1 Permit is ON
A2 Permit is ON
“A Chain Contactor Open” light is OFF
B1 Permit is OFF
B2 Permit is OFF
“B Chain Contactor Open” light is ON

Check RF PS Interface, RFPSI RF Building

A1 Permit is OFF C AND D
A2 Permit is OFF C AND D
“A Chain Contactor Open” light is ON C AND D
B1 Permit is OFF C AND D
B2 Permit is OFF C AND D
“B Chain Contactor Open” light is ON C AND D

Remove switch holders and close door

Secure Pentant 3
All Pentants secure A and B (green), HMI
SR Secure for OPS A chain ON (green), HMI

C33 **Live Pentant 3 Maintenance Doors**
Request Operator turn on Gun HVPS, Modulator HV, set LTB B1 and B2 bending magnet to injection energy, turn on SR RF HVPS and SR Dipole PS

SR Dipole PS is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C AND D are ON
SR RF Permits ON A and B chain (green), HMI
BTS shutter Open, HMI
Gun HVPS is ON
Modulators are ON

Remove an A chain switch from Pentant 3 Maintenance door

Maintenance door =
SR Secure for OPS A chain OFF (grey), HMI
SR Dipole PS is OFF
SR Dipole Permits OFF A chain (grey), HMI
SR RF Systems C AND D are OFF
SR RF Permits OFF (grey), HMI
BTS shutter Closed, HMI
Gun HVPS is OFF on A chain
Replace A chain switch and perform a reset
Search Pentant 3
Request Operator Turn on SR RF HVPS, SR Dipole PS and open BTS shutter

Modulators are OFF on A chain
All Pentants secure A and B (green), HMI
SR Secure For OPS A chain ON (green), HMI
SR Dipole PS is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C AND D are ON
SR RF Permits ON A and B chain (green), HMI
BTS shutter Open, HMI
Gun HVPS is ON
Modulators are ON

Remove a B chain switch from Pentant 3
Maintenance door

SR Secure for OPS B chain OFF (grey), HMI
SR Dipole PS is OFF
SR Dipole Permits OFF B chain (grey), HMI
SR RF Systems C AND D are OFF
SR RF Permits C AND D OFF (grey), HMI
BTS shutter Closed, HMI
Gun HVPS is OFF on B chain
Modulators are OFF on B chain

Replace B chain switch and perform a reset
Search Pentant 3

SR Dipole PS is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C AND D are ON
SR RF Permits ON A and B chain (green), HMI
BTS shutter Open, HMI
Gun HVPS is ON
Modulators are ON

C34 Live Pentant 3 Emergency Stop
Request Operator turn on gun, Modulators, SR RF HVPS, SR Dipole PS, LTB and BTS B2 magnets, open LTB and BTS shutter

SR Dipole PS is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C AND D are ON
SR RF Permits ON A and B chain (green), HMI
BTS shutter Open, HMI
Gun HVPS is ON
Modulators are ON

Press in Emergency Stop at Service Building 3 entrance

SR Secure For OPS A chain OFF (grey), HMI
SR Dipole PS is OFF
SR Dipole Permits OFF (grey), HMI
SR RF Systems C AND D are OFF
SR RF Permits OFF (grey), HMI
BTS shutter Closed, HMI
Gun HVPS is OFF
Modulators are OFF

Pull out Emergency Stop
Emergency Stop Latch A and B OFF (grey), HMI

Reset fault and latch at Pentant 3 I/O box
Emergency Stop Latch A and B ON (green), HMI

Secure Pentant 3
All Pentants secure A and B (green), HMI
SR Secure For OPS A chain ON (green), HMI

C35 **Control Room Emergency Stop**
Request Operator Turn on SR RF HVPS, SR Dipole PS and open BTS shutter
☐ Completed on Pentant # _______ Test

SR Dipole PS is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C AND D are ON
SR RF Permits ON A and B chain (green), HMI
BTS shutter Open, HMI

Press in Emergency Stop in the Control Room
SR Dipole PS is OFF
SR Dipole Permits OFF A chain (grey), HMI
SR RF Systems C AND D are OFF
SR RF C AND D Permits OFF (grey), HMI
BTS shutter Closed, HMI

Pull out Emergency Stop
Emergency Stop Latch A and B OFF (grey), HMI

Reset fault and latch in the Control Room
Emergency Stop Latch A and B ON (green), HMI

C36 **Ignition Key (drops critical devices but not search)**
Request Operator Turn on SR RF HVPS, SR Dipole PS and open BTS shutter
☐ Completed on Pentant # _______ Test

SR Dipole PS is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C AND D are ON
SR RF Permits ON A and B chain (green), HMI
BTS shutter Open, HMI

Remove the SR Ignition Key
SR Dipole PS is OFF
SR Dipole Permits OFF A chain (grey), HMI
SR RF Systems C AND D are OFF
SR RF Permits OFF (grey), HMI
BTS shutter Closed, HMI
SR Secure to Booster A and B
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National Synchrotron Light Source II, Brookhaven National Laboratory

<table>
<thead>
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<th>Doc No.</th>
<th>PS-C-ASD-PRC-129</th>
<th>Author: T. McDonald</th>
<th>Effective Date: 08 Jan 2016</th>
<th>Review Frequency: 3 yrs</th>
<th>Version 5</th>
</tr>
</thead>
</table>

**Title:** NSLS-II Storage Ring Radiological Interlock Test

Replace the Ignition Key

**C37 Top Energy Interlock turns OFF RF**

☐ Completed on Concurrent test ______

Accelerator Safety Systems Staff returns limiters to Operational values

Request Operator turn on RF HVPS and Dipole PS. Set Dipole PS to 364 A

- SR System C and D RF HVPS ON
- RF Permits A and B ON, (green), HMI

Request Operator set Dipole PS to 371.28 A

- SR System C and D RF HVPS is OFF
- SR System C and D RF Permits A and B OFF (grey), HMI

Reset fault and turn OFF Dipole

**C38 SR Injection Energy Limit (2.0 - 3.3 GeV)**

☐ Completed on Concurrent test ______

Secure all pentants

Storage ring secure to booster

Operator turns on Gun HVPS

- Gun HVPS is ON
- Gun Permits A and B ON (green), linac HMI
- SR Injector Energy Limiter A and B ON (green)

Request Operator set Dipole to 356.72 A

- Storage ring Dipole PS at 356.72 A
- Gun HVPS is OFF
- Gun Permits A and B OFF (grey), linac HMI
- SR Injector Energy Limiter A and B OFF (grey)

Request Operator return Dipole to 364 A

- Storage ring Dipole PS at 364 A
- Reset energy limiter by preforming a reset in the Control Room

Operator turns on Gun HVPS

- SR Injector Energy Limiter A and B ON (green)
- Gun HVPS is ON
- Gun Permits A and B ON (green), linac HMI

Request Operator set Dipole to 371.28 A

- Storage ring Dipole PS at 371.28 A
- Gun HVPS is OFF
- Gun Permits A and B OFF (grey), linac HMI
- SR Injector Energy Limiter A and B OFF (grey)

Request Operator return Dipole to 364 A

- Storage ring Dipole PS at 364 A
- Reset energy limiter by performing a reset in the Control Room

SR Injector Energy Limiter A and B ON (green)

**C39 Area Radiation Monitors**

This test step may be completed at any time during the testing process but MUST be completed for PPS test certification. Refer to PS-C-ASD-PRC-008, NSLS-II Area Radiation Monitor PPS Test and complete Attachment C, NSLS-II Storage Ring Area Radiation Monitor Checklist for Monitors SRM-5 through SRM-10.

Area Radiation Monitor SRM-5 Test completed
Area Radiation Monitor SRM-6 Test completed
Area Radiation Monitor SRM-7 Test completed
Area Radiation Monitor SRM-8 Test completed
Area Radiation Monitor SRM-9 Test completed
Area Radiation Monitor SRM-10 Test completed

**Test Completion**

Account for all switch holders/actuators
Remove LOTO from ALL Linac, Booster and SR devices if testing is complete
Ensure PPS cabinets are secure and locked; challenge locks
Disconnect the 4 test jumpers to the SR Dipole power supply interface boxes.
Remove sound mufflers from HII devices (6)
Request Operator make log entry stating Pentant 3 test is complete.

- END OF ATTACHMENT C -
Each numbered item below indicates a set of action items for the test procedure. The Tester will either perform the action, or delegate the action to the Assistant(s). For each step a checkmark (√) should be made if the correct corresponding observation has been made.

### Action Taken

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>D1</strong> Verify System Lockouts and Connect Dipole Test Jumper</td>
<td></td>
</tr>
<tr>
<td>Gun HVPS Output Cable Connector</td>
<td></td>
</tr>
<tr>
<td>Modulator PS line cords (3) OR Booster Dipole F PS</td>
<td></td>
</tr>
<tr>
<td>Booster RF HVPS OR booster low level RF drive termination OR Booster RF output connection to cavity</td>
<td></td>
</tr>
<tr>
<td>SR System C RF HVPS</td>
<td></td>
</tr>
<tr>
<td>SR System C low level RF drive termination OR System C SR RF output connection to cavity</td>
<td></td>
</tr>
<tr>
<td>SR System D RF HVPS</td>
<td></td>
</tr>
<tr>
<td>SR System D low level RF drive termination OR System D SR RF output connection to cavity</td>
<td></td>
</tr>
<tr>
<td>Apply mufflers to the right hand HII side sounders 6</td>
<td></td>
</tr>
<tr>
<td>Connect the 4 test jumpers to the SR Dipole Power Supply interface boxes</td>
<td></td>
</tr>
<tr>
<td><strong>D2</strong> Secure enclosures</td>
<td></td>
</tr>
<tr>
<td>Secure the injector berm area</td>
<td>Berm secured, Linac HMI</td>
</tr>
<tr>
<td>Secure the linac</td>
<td>Linac secured, Linac HMI</td>
</tr>
<tr>
<td>Secure the booster ring</td>
<td>Booster secured, Booster HMI</td>
</tr>
<tr>
<td><strong>Note:</strong> All Mode Search Verifications can be completed using the Quick Search feature</td>
<td></td>
</tr>
<tr>
<td><strong>D3</strong> Verify Pentant 4 Single Pentant Search (Mode 1)</td>
<td></td>
</tr>
<tr>
<td>Check HMI on 740 Pentant I/O Box or CR</td>
<td>Pentant 4 not secured A and B chain (grey), HMI</td>
</tr>
<tr>
<td>Three Searchers enter Service Building 4</td>
<td></td>
</tr>
<tr>
<td>Press P4-SB1 Service Bldg. 4</td>
<td>Light on search button illuminates</td>
</tr>
</tbody>
</table>
### NSLS-II Storage Ring Radiological Interlock Test

<table>
<thead>
<tr>
<th><strong>Action Taken</strong></th>
<th><strong>Observation, Location</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>One searcher remains on P3 side of gate 4</td>
<td>Overhead lighting flashes during search</td>
</tr>
<tr>
<td>Close gate 4 and press SB2</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press P4-SB3 on HII 1</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press P4-SB4 on HII 2</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press SB5 on HII 3</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Searchers simultaneously press P4-SB1 (Service Bldg.) and SB6 on HII 4 until the lights illuminate</td>
<td>Light on SB1 (Service Bldg.) illuminates</td>
</tr>
<tr>
<td></td>
<td>Light on SB6 illuminates</td>
</tr>
<tr>
<td></td>
<td>Amber HII 4 search beacon is ON</td>
</tr>
<tr>
<td>Press SB7 on HII 5</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press SB8 on HII 6</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>One searcher remains on P5 side of gate</td>
<td>Amber HII 6 search beacon is ON</td>
</tr>
<tr>
<td>Close Pentant Gate 5</td>
<td></td>
</tr>
<tr>
<td>Press SBSP</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press P4-SB1</td>
<td>Light illuminates on SB1</td>
</tr>
<tr>
<td>Exit through Service Building Door</td>
<td></td>
</tr>
<tr>
<td>Press SBE</td>
<td>Light on SBE illuminates</td>
</tr>
<tr>
<td></td>
<td>Maglock engages/locks- check door</td>
</tr>
<tr>
<td></td>
<td>Service Bldg 1 Maglock A and B (green), HMI</td>
</tr>
<tr>
<td></td>
<td>Gate 4 switches A and B ON (green), HMI</td>
</tr>
<tr>
<td></td>
<td>Gate 5 Maglock A and B ON (green), HMI</td>
</tr>
<tr>
<td></td>
<td>Gate 5 switches A and B ON (green), HMI</td>
</tr>
</tbody>
</table>

**After beam imminent warning sounds:**

(Note: beam imminent timed in step D4)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Bldg Door sign illuminates (A and B sect.)</td>
<td></td>
</tr>
<tr>
<td>Pentant 4 Secured A and B chain, HMI</td>
<td></td>
</tr>
<tr>
<td>Gate 4 sign illuminates (A and B sect.)</td>
<td></td>
</tr>
<tr>
<td>Gate 5 sign illuminates (A and B sect.)</td>
<td></td>
</tr>
</tbody>
</table>

Request operator grant access permit for P4

Press Access Request button at Serv. Building Door 4 if necessary (other pentants secure)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pentant 4 unsecured A and B chain, HMI</td>
<td></td>
</tr>
<tr>
<td>No alarm sounds in Control Room</td>
<td></td>
</tr>
</tbody>
</table>
**Action Taken** | **Observation, Location** |
--- | --- |
D4 **Verify Pentant 4 Starting Multiple Pentant Search (Mode 2) and time Beam imminent warning**
Check HMI on 740 Pentant I/O Box or CR | Pentant 4 not secured A and B chain (grey), HMI
Three Searchers enter Service Building 4 |  
Press SB1 in pentant 4 Service Bldg.4 | Light on search button illuminates
Search sounder alarm sounds |  
Overhead lighting flashes during search |  
Close gate 4 and press SB2 | Light on search button illuminates
Press SB3 on HII 1 | Light on search button illuminates
Amber HII 1 search beacon is ON |  
Press SB4 on HII 2 | Light on search button illuminates
Amber HII 2 search beacon is ON |  
Press SB5 on HII 3 | Light on search button illuminates
Amber HII 3 search beacon is ON |  
Searchers simultaneously press P4-SB1 (Service Bldg.) and SB6 on HII 4 until the lights illuminate |  
Light on SB1 (Service Bldg.) illuminates |  
Light on SB6 illuminates |  
Amber HII 4 search beacon is ON |  
Press SB7 on HII 5 | Light on search button illuminates
Amber HII 5 search beacon is ON |  
Press SB8 on HII 6 | Light on search button illuminates
Amber HII 6 search beacon is ON |  
Close Pentant Gate 5 |  
Reach through gate 5 Press SB9 and begin timing audible alarm | Light on search button illuminates
Maglock engages/check gate
Service Bldg 4 Maglock A and B ON (green), HMI
Gate 5 Maglock A and B ON (green), HMI
Gate 4 switches A and B (green), HMI
Gate 5 switches A and B (green), HMI
Beam Imminent alarm sounds for 60 seconds |  
After beam imminent warning sounds: |  
Pentant 4 Secured A and B chain, HMI
Gate 5 sign illuminates (A and B sect.) |
**NSLS-II Storage Ring Radiological Interlock Test**

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>D5 Operations Enable Switch (Pentant 4 Main I/O box)</strong></td>
<td></td>
</tr>
<tr>
<td>Rotate the operations enable switch to OFF</td>
<td>Pentant 4 Not Secured A and B chain (green), HMI</td>
</tr>
<tr>
<td>Attempt to secure Pentant 4</td>
<td>Pentant 4 will not secure</td>
</tr>
<tr>
<td>Rotate the operations enable switch to ON</td>
<td></td>
</tr>
<tr>
<td>Reset the fault at the Pentant 4 I/O box</td>
<td></td>
</tr>
<tr>
<td><strong>D6 Verify Pentant 4 Continuing Multiple Pentant Search (Mode 3) and time Red Beacons</strong></td>
<td></td>
</tr>
<tr>
<td>Check HMI on 740 Pentant I/O Box or CR</td>
<td>Pentant 4 not secured A and B chain (grey), HMI</td>
</tr>
<tr>
<td>Close gate 4 and press SB2</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press P4-SB3 on HII 1</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press P4-SB4 on HII 2</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press SB5 on HII 3</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Searchers simultaneously press P4-SB1 (Service Bldg.) and SB6 on HII 4 until the lights illuminate</td>
<td>Light on SB1 (Service Bldg.) illuminates</td>
</tr>
<tr>
<td>Press SB7 on HII 5</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press SB8 on HII 6</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Close Pentant Gate 5</td>
<td></td>
</tr>
<tr>
<td>Reach through gate 2 Press SB9 and begin timing the Red Beacons on HII devices (6)</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>After Beam Imminent alarm:</td>
<td></td>
</tr>
<tr>
<td>Request operator grant access permit for P4</td>
<td></td>
</tr>
</tbody>
</table>
Pentant 4 not secured A and B chain (grey), HMI

Open gate
No alarm sounds in Control Room

D7 Verify Pentant 4 Completing Multiple Pentant Search (Mode 4)
Check HMI on 740 Pentant I/O Box or CR Pantent 4 not secured A and B chain (grey), HMI
Close gate 4 and press SB2 Light on search button illuminates
Press P4-SB3 on HII 1 Light on search button illuminates Amber HII 1 search beacon is ON
Press P4-SB4 on HII 2 Light on search button illuminates Amber HII 2 search beacon is ON
Press SB5 on HII 3 Light on search button illuminates Amber HII 3 search beacon is ON

Searchers simultaneously press P4-SB1 (Service Bldg.) and SB6 on HII 4 until the lights illuminate
Light on SB1 (Service Bldg.) illuminates
Light on SB6 illuminates
Amber HII 4 search beacon is ON
Press SB7 on HII 5 Light on search button illuminates Amber HII 5 search beacon is ON
Press SB8 on HII 6 Light on search button illuminates Amber HII 6 search beacon is ON

Close Pentant Gate 5
Press SBSP Light on search button illuminates
Press P4-SB1at Service Building Door Light illuminates on SB1
Exit through Service Building Door
Press SBE Light on SBE illuminates
After Beam Imminent alarm: Pantent 4 Secured A and B chain, HMI

D8 Access Pentant and check HII (6)
Request Operator grant access permit for P4 If other pants secure the Access Request button at Service Bldg. 4 illuminates
Press Access Request button at Service Building Door if necessary (other pants secure) P4 Service Bldg. Door Maglock Off (grey), HMI Pantent 4 not secured A and B chain (grey), HMI Door is open
Check HII indicators Red Beacons OFF Red Secure A and B lights OFF Green HII “Beam Disabled” lights illuminated

Proceed to P4-SB2

D9 Search Timeout (Mode 2)
Press P4-SB2 in Pentant 4 and begin timing Light on search button illuminates
Search sounder alarm sounds

Complete search in sequence without pressing SB9

Light and sounders go out in 12 minutes

Press SB9

Mode 2 Search does not complete

**D10** Skip the Two Button Simultaneous Press (Mode 1) using Quick Search

Close gates and doors and put into Quick Search

Press SB1

Light on search button illuminates

Press SB2

Light on search button illuminates

Press SB3

Light on search button illuminates

Press SB4

Light on search button illuminates

Press SB5

Light on search button illuminates

Press SB1

Press SB6

Press SB7

Press SB8

Press SB9

Pentant 4 does NOT Secure on A or B chains

**D11** Emergency Stop Aborts Search

Complete a normal search using ANY Mode

Before the beam imminent warning sounder stops,

Press an Emergency Stop

Beam imminent warning stops

Red Beacons are NOT flashing

Pentant does not secure on either chain

**D12** A Chain Entrance Door Switches Service Building 4

Place holders on the A chain Service Building 4 Door switches (4) and attach actuator on Magnetic lock

Close Pentant gates 1 and 5

Perform all actions and make observations for both door A chain switches A1 and A2

Quick Search Pentant 4 (A chain)

Pentant 4 secured A chain (green), HMI

SR Secure for OPS A chain ON (green), HMI

Service Bldg 4 Door SW A chain ON (green), HMI

Remove holder from Service Building 4 stationary door switch

Pentant 4 unsecured A chain (grey), HMI

Service Bldg 4 Door SW A chain OFF (grey), HMI

Replace holder on stationary door

Quick Search Pentant 4 (A chain)

Pentant 4 secured A chain (green), HMI

Service Bldg 4 Door SW A chain ON (green), HMI

Remove holder from Service Building 4 active door switch
Pentant 4 unsecured A chain (grey), HMI
Service Bldg 4 Door SW A chain OFF (grey), HMI

D13 **Pentant 4 A Chain Quick Search Timeout**
Quick search Pentant 4 and begin timing
Pentant 4 secured A chain (green), HMI
Pentant 4 unsecured in 5 minutes (grey), HMI

Remove A chain switch holders

---

D14 **B Chain Entrance Door Switches Service Building 4**
Place holders on the B chain Service Building 4 Door switches (4)
Close Pentant gates

Perform all actions and make observations for both door B chain switches B1 and B2

Quick Search Pentant 4 (B chain)
Remove holder from Service building 4 stationary door switch
Replace holder on stationary door

Quick Search Pentant 4 (B chain)
Remove holder from Service building 4 active door switch
Replace holder on active door

D15 **Pentant 4 B Chain Quick Search Timeout**
Quick search Pentant 4 and begin timing
Pentant 4 secured B chain
Pentant 4 unsecured in 5 minutes

D16 **Service Building 4 Door Emergency Egress**
Attach B chain Maglock Actuator with tape
Perform B chain Pentant 4 quick search
Remove actuator

---
D17 **Service Building 4 Door P4 Emergency Access Button**

**Perform A chain Pentant 4 quick search**
- Pentant 4 secured A chain (green), HMI
- Serv.Bldg 4 Door Maglock A chain ON (green), HMI

**Press in emergency access button**
- Serv.Bldg 4 Door Maglock A chain OFF (grey), HMI
- Pentant 4 unsecured (grey), HMI

**Pull out emergency access button**
- Emergency Stop Latch A chain OFF (grey), HMI

**Reset emergency stop fault**
- Emergency Stop Latch A chain ON (green), HMI

**Perform B chain Pentant 4 search**
- Pentant 4 secured B chain
- Serv.Bldg 4 Door Maglock B chain ON (green), HMI

**Press in emergency access button**
- Serv.Bldg 4 Door Maglock B chain OFF (grey), HMI
- Pentant 4 unsecured, HMI

**Pull out emergency access button**
- Emergency Stop Latch B chain OFF (grey), HMI

**Open door**
- Door opens

**Close door**
- Door opens

D18 **Pentant 4 HII Emergency stops**

Repeat all steps for each HII

*A Chain:*

**Quick search Pentant 4 on A Chain**
- Pentant 4 secured A chain (green), HMI
- Emergency Stop Latch A chain ON (green), HMI

**Press in emergency stop**
- Pentant 4 unsecured A chain (grey), HMI

**Pull out emergency stop**
- Emergency Stop Latch A chain OFF (grey), HMI

**Reset fault and latch at Pentant 4 I/O box**
- Emergency Stop Latch A chain ON (green), HMI
B Chain:

Quick search Pentant 4 on B Chain

Pentant 4 secured B chain (green), HMI

Emergency Stop Latch B chain ON (green), HMI

Press in emergency stop

Pentant 4 unsecured B chain (grey), HMI

Pull out emergency stop

Emergency Stop Latch B chain OFF (grey), HMI

Reset fault and latch at Pentant 4 I/O box

Emergency Stop Latch B chain ON (green), HMI

D19 **Pentant 4 Gate 4 Switches**

Proceed to the gate between pentants 3 and 4

Place holders on the A chain gate switches

Perform all actions and make observations for both gate 4 A chain switches A1 and A2

Quick Search Pentant 3 (A chain)

Quick Search Pentant 4 (A chain)

Remove holder from Gate 1 switch

Remove Gate A chain switch holders

Place holders on the B chain gate switches

Perform all actions and make observations for both gate 4 B chain switches B1 and B2

Quick Search Pentant 3 (B chain)

Quick Search Pentant 4 (B chain)

Remove holder from Gate 4 B switch

Remove switch holders and close gate

D20 **Gate 5 Switches**

Proceed to the gate between pentants 4 and 5

Place holders on the A chain gate switches

Perform all actions and make observations for both gate 5 A chain switches A1 and A2

Quick Search Pentant 5 (A chain)

Pentant 5 secured A chain (green), HMI
Quick Search Pentant 4 (A chain) Pentant 4 secured A chain (green), HMI
Gate 5 SW A chain ON (green), HMI
Remove holder from Gate 5 switch
Pentant 4 unsecured A chain (grey), HMI
Gate 5 SW A chain OFF (grey), HMI
Remove Gate 2 A chain switch holders
Place holders on the B chain gate switches
Perform all actions and make observations for both gate 1 B chain switches B1 and B2

Quick Search Pentant 5 (A chain) Pentant 5 secured B chain (green), HMI
Quick Search Pentant 4 (B chain) Pentant 4 secured B chain (green), HMI
Gate 5 SW B chain ON (green), HMI
Remove holder from Gate 5 switch
Pentant 4 unsecured B chain (grey), HMI
Gate 5 SW B chain OFF (grey), HMI
Remove switch holders and close gate

D21 **Pentant 4 Maintenance Doors A Chain**
Place A chain actuators into each Maintenance door connectors and complete all steps for each Maintenance Door (MD)

Quick Search Pentant 4 on A chain
Pentant secured on A chain (green), HMI
Sum of Maint Doors A chain ON (green), HMI
Remove Actuator in switch A1
Pentant 4 Not secured A chain (grey), HMI
Sum of Maint Doors A chain OFF (grey), HMI
Replace actuator in A1
Quick Search Pentant 4 on A chain
Pentant secured on A chain (green), HMI
Sum of Maint Doors A chain ON (green), HMI
Remove Actuator in switch A2
Pentant 4 Not secured A chain (grey), HMI
Sum of Maint Doors A chain OFF (grey), HMI
Replace actuator in A2
Remove actuators

D22 **Pentant 4 Maintenance Doors B Chain**
Place B chain actuators into each Maintenance door connector and complete all steps for each Maintenance Door (MD)
Quick Search Pentant 4 on B chain
- Pentant secured on B chain (green), HMI
- Sum of Maint Doors B chain ON (green), HMI

Remove Actuator in switch B1
- Pentant 4 Not secured B chain (grey), HMI
- Sum of Maint Doors B chain OFF (grey), HMI

Replace actuator in B1

Quick Search Pentant 4 on B chain
- Pentant secured on B chain (green), HMI
- Sum of Maint Doors B chain ON (green), HMI

Remove Actuator in switch B2
- Pentant 4 Not secured B chain (grey), HMI
- Sum of Maint Doors B chain OFF (grey), HMI

Remove actuators and ensure all Pentant 4 Maintenance door connectors are on

D23 **Pentant Access Allowed only with Dipole (Negative) PS Contactors OFF**

Primary Authorized Power Supply Employee LOTOs SR Dipole power supply
- Secure all Pentants SR secure for OPS, HMI
- Primary Authorized Power Supply Employee open cabinet door to access the A chain contactor Negative PS cabinet door open
- Primary Authorized Power Supply Employee push in the A chain contactor with a screwdriver

Request Operator press P4 Access Request button
- Access Request button does not illuminate
- Access Request with critical device On alarm, HMI
- Serv. Bldg. 4 door remains locked on A chain, HMI

Primary Authorized Power Supply Employee releases the A chain contactor

Primary Authorized Power Supply Employee push in the B chain contactor with a screwdriver

Request Operator press P4 Access Request button
- Access Request button illuminates
- Press Access Request button a Service Building when lit
- Pentant remains secure on A and B chain
- Serv. Bldg. 4 door remains locked on B chain, HMI

Primary Authorized Power Supply Employee releases the B chain contactor

Close cabinet door

D24 **Pentant Access Allowed only with Dipole (Positive) PS Contactors OFF**

Primary Authorized Power Supply Employee LOTOs SR Dipole power supply
- Secure all Pentants SR secure for OPS, HMI
- Primary Authorized Power Supply Employee open cabinet door to access the A chain contactor Positive PS cabinet door open
Primary Authorized Power Supply Employee push in the A chain contactor with a screwdriver

Request Operator press P4 Access Request button Access Request button does not illuminate

Access Request with critical device On alarm, HMI

Serv. Bldg. 4 door remains locked on A chain, HMI

Primary Authorized Power Supply Employee releases the A chain contactor

Primary Authorized Power Supply Employee push in the B chain contactor with a screwdriver

Request Operator press P4 Access Request button Access Request button illuminates

Press Access Request button at Service Building when lit

Pentant remains secure on A and B chain

Serv. Bldg. 4 door remains locked on B chain, HMI

Primary Authorized Power Supply Employee releases the B chain contactor

Close cabinet door

Remove LOTO from SR Dipole Power supply

D25 **Pentant Access Allowed only with SR System C RF HVPS Contactors OFF**

Primary Authorized Power Supply Employee LOTOs SR RF HVPS

Secure all Pentants SR secure for OPS, HMI

Primary Authorized RF Employee open cabinet door to access the A chain contactor

Primary Authorized RF Employee push in the RF HVPS A chain contactor with a screwdriver

Request Operator press P4 Access Request button Access Request button does not illuminate

Access Request with critical device On alarm, HMI

Serv. Bldg. 4 door remains locked on A chain, HMI

Primary Authorized RF Employee releases the A chain contactor

Primary Authorized RF Employee push in the RF HVPS B chain contactor with a screwdriver

Request Operator press P4 Access request button Access Request button illuminates

Press Access Request button at Service Building when lit

Pentant remains secure on A and B chain

Serv. Bldg. 4 door remains locked on B chain, HMI

Primary Authorized RF Employee releases the B chain contactor

Close cabinet door

Remove LOTO from SR RF HVPS

D26 **Pentant Access Allowed only with SR System D RF HVPS Contactors OFF**

Primary Authorized Power Supply Employee LOTOs SR RF HVPS

Secure all Pentants SR secure for OPS, HMI

Primary Authorized RF Employee open cabinet door to access the A chain contactor

Primary Authorized RF Employee push in the RF HVPS A chain contactor with a screwdriver

Request Operator press P4 Access Request button Access Request button does not illuminate
Title: NSLS-II Storage Ring Radiological Interlock Test

Access Request with critical device On alarm, HMI
Serv. Bldg. 4 door remains locked on A chain, HMI

Primary Authorized RF Employee releases the A chain contactor

Primary Authorized RF Employee push in the RF HVPS B chain contactor with a screwdriver

Request Operator press P4 Access request button
Press Access Request button a Service Building
when lit
Pentant remains secure on A and B chain
Serv. Bldg. 4 door remains locked on B chain, HMI

Request Operator press P4 Access Request button

Request Operator open the BTS shutter
Request Operator press P4 Access Request button
Operator closes shutter
Request Operator press P4 Access Request button

BTS Shutter opens
Access Request button at P4 Serv. Bldg. does not illuminate
Access Request with critical device On alarm, HMI
BTS shutter closed
Access Request button illuminates outside P4 Service Building Door main entrance

Using shunt test box, apply current to the # 1 BTS B2 shunt box
Using shunt test box, apply current to the # 2 BTS B2 shunt box

Access Request button at P4 Serv. Bldg. illuminates
Pentant remains secure on A and B chain
Serv. Bldg. 4 door remains locked on B chain, HMI

Disconnect shunt box from shunt 1
Disconnect shunt box from shunt 2, clear fault

Magnet Test Mode Breaks Security

Completed on Pentant 3 Test
Pentant 1 Secure A and B chains (green), HMI

Rotate Magnet Test key in place on Pentant 2 Mezzanine

Magnet Test Mode A and B ON (green), HMI
Pentant 1 unsecured A and B chain (grey), HMI
Dipole Permits A and B ON (green), HMI

Request Operator turn on Dipole PS
Press in Pentant Emergency Stop
Pull our Emergency Stop
Reset fault and remove Magnet Test key

Dipole PS is ON
Dipole PS is OFF
Emergency Stop Latched and Dipole PS remains OFF

Magnet Test Mode A and B OFF (grey), HMI
D30 **Live Test of Storage Ring Door Switches**

**WARNING:** Do not permit Employee from entering the Storage Ring unless authorized by the Tester who will verify the area is safe to enter.

Place Barrier “CAUTION: DO NOT ENTER” tape across entry path.

**Post a Watch Outside Service Building Door 4 Main Door Entrance.**

The watch shall not allow Employee to enter the pentant unless authorized by the Tester.

Place switch holders on the active P4 Service Building Door switches(4) and attach magnetic lock device

Secure the SR
- All Pentants secure A and B *(green)*, HMI
- SR Secure For OPS A chain ON *(green)*, HMI
- Gun Permits A and B ON *(green)*, linac HMI

Request Operator turn on Gun HVPS, Modulator HV and set B1 and B2 bending magnet to injection energy
- Gun UPA-100 is ON, gun cabinet
- Modulators contactor ON, Linac HMI
- SR Dipole PS is ON
- **SR System C and D RF HVPS ON**

Turn on the BTS bending magnet and set to injection energy
- Bending magnet ON, HMI

Open the BTS Shutter
- Shutter is open, HMI

Check Dipole PS Positive PS Interface, DPSI
- A1 Permit is ON
- A2 Permit is ON
- “A Chain Contactor Open” light is OFF
- B1 Permit is ON
- B2 Permit is ON
- “B Chain Contactor Open” light is OFF

Check Dipole PS Negative PS Interface, DPSI
- A1 Permit is ON
- A2 Permit is ON
- “A Chain Contactor Open” light is OFF
- B1 Permit is ON
- B2 Permit is ON
- “B Chain Contactor Open” light is OFF

Check RF PS Interface, RFPSI RF Building
- A1 Permit is ON C AND D
- A2 Permit is ON C AND D
- “A Chain Contactor Open” light is OFF C AND D
- B1 Permit is ON C AND D
- B2 Permit is ON C AND D
- “B Chain Contactor Open” light is OFF C AND D

Check SR RF Systems C AND D
- A1 Permit is ON C AND D
- A2 Permit is ON C AND D
- “A Chain Contactor Open” light is OFF C AND D
- B1 Permit is ON C AND D
- B2 Permit is ON C AND D
- “B Chain Contactor Open” light is OFF C AND D

Remove A1 switch holder
- Pentants unsecured A Chain (grey), HMI
- SR Secure For OPS A chain OFF (grey), HMI
| Check Dipole PS Positive PS Interface, DPSI | A1 Permit is OFF | Gun Permits A OFF (grey), Linac HMI |
| Check Dipole PS Positive PS Interface, DPSI | A2 Permit is OFF | Gun UPA-100 is OFF, gun cabinet |
| Check Dipole PS Positive PS Interface, DPSI | “A Chain Contactor Open” light is ON | SR Dipole PS shuts OFF, A chain |
| Check Dipole PS Positive PS Interface, DPSI | B1 Permit is ON | SR RF HVPS shuts OFF, A chain |
| Check Dipole PS Positive PS Interface, DPSI | B2 Permit is ON | Modulators OFF, A chain |
| Check Dipole PS Positive PS Interface, DPSI | “B Chain Contactor Open” light is OFF | BTS shutter closed, HMI |

| Check Dipole PS Negative PS Interface, DPSI | A1 Permit is OFF | |
| Check Dipole PS Negative PS Interface, DPSI | A2 Permit is OFF | |
| Check Dipole PS Negative PS Interface, DPSI | “A Chain Contactor Open” light is ON | |
| Check Dipole PS Negative PS Interface, DPSI | B1 Permit is ON | |
| Check Dipole PS Negative PS Interface, DPSI | B2 Permit is ON | |
| Check Dipole PS Negative PS Interface, DPSI | “B Chain Contactor Open” light is OFF | |

| Check RF PS Interface, RFPSI RF Building | A1 Permit is OFF C AND D | |
| Check RF PS Interface, RFPSI RF Building | A2 Permit is OFF C AND D | |
| Check RF PS Interface, RFPSI RF Building | “A Chain Contactor Open” light is ON C AND D | |
| Check RF PS Interface, RFPSI RF Building | B1 Permit is OFF C AND D | |
| Check RF PS Interface, RFPSI RF Building | B2 Permit is OFF C AND D | |
| Check RF PS Interface, RFPSI RF Building | “B Chain Contactor Open” light is ON C AND D | |

Replace switch holder

Secure Pentant 4

| Secure Pentant 4 | All Pentants secure A and B (green), HMI |
| Secure Pentant 4 | SR Secure For OPS A chain ON (green), HMI |
| Secure Pentant 4 | Gun Permits A and B ON (green), linac HMI |

Request Operator turn on Gun HVPS, Modulator HV and set B1 and B2 bending magnets to injection energy

| Request Operator turn on Gun HVPS, Modulator HV and set B1 and B2 bending magnets to injection energy | Gun UPA-100 is ON, gun cabinet |
| Request Operator turn on Gun HVPS, Modulator HV and set B1 and B2 bending magnets to injection energy | Modulators contactor ON, Linac HMI |
| Request Operator turn on Gun HVPS, Modulator HV and set B1 and B2 bending magnets to injection energy | SR Dipole PS is ON |
| Request Operator turn on Gun HVPS, Modulator HV and set B1 and B2 bending magnets to injection energy | SR System C and D RF HVPS ON |

Turn on the BTS bending magnet and set to injection energy

| Turn on the BTS bending magnet and set to injection energy | Bending magnet ON, HMI |

Open the BTS Shutter

| Open the BTS Shutter | Shutter is open, HMI |

Check Dipole PS Positive PS Interface, DPSI

| Check Dipole PS Positive PS Interface, DPSI | A1 Permit is ON |
NSLS-II Storage Ring Radiological Interlock Test

Check Dipole PS Negative PS Interface, DPSI

A1 Permit is ON
A2 Permit is ON
“A Chain Contactor Open” light is OFF
B1 Permit is ON
B2 Permit is ON
“B Chain Contactor Open” light is OFF

Check RF PS Interface, RFPSI RF Building

A1 Permit is ON C AND D
A2 Permit is ON C AND D
“A Chain Contactor Open” light is OFF
B1 Permit is ON C AND D
B2 Permit is ON C AND D
“B Chain Contactor Open” light is OFF

Remove B1 switch holder

Pentants unsecured B Chain (grey), HMI
SR Secure For OPS B chain OFF (grey), HMI
Gun Permits B OFF (grey), Linac HMI
Gun UPA-100 is OFF, gun cabinet
SR Dipole PS shuts OFF, B chain
SR C AND D RF HVPS shuts OFF, B chain
Modulators OFF, B chain
BTS shutter closed, HMI

Check Dipole PS Positive PS Interface, DPSI

A1 Permit is ON
A2 Permit is ON
“A Chain Contactor Open” light is OFF
B1 Permit is OFF
B2 Permit is OFF
“B Chain Contactor Open” light is ON

Check Dipole PS Negative PS Interface, DPSI

A1 Permit is ON
A2 Permit is ON
“A Chain Contactor Open” light is OFF
B1 Permit is OFF
B2 Permit is OFF
“B Chain Contactor Open” light is ON

Check RF PS Interface, RFPSI RF Building

A1 Permit is OFF C AND D
A2 Permit is OFF C AND D

Check SR RF Systems C AND D
NATIONAL SYNCHROTRON LIGHT SOURCE II, BROOKHAVEN NATIONAL LABORATORY

DOC NO. PS-C-ASD-PRC-129

AUTHOR: T. McDonald

EFFECTIVE DATE: 08 JAN 2016

REVIEW FREQUENCY: 3 YRS

VERSION 5

TITLE: NSLS-II Storage Ring Radiological Interlock Test

"A Chain Contactor Open" light is ON C AND D

B1 Permit is OFF C AND D

B2 Permit is OFF C AND D

"B Chain Contactor Open" light is ON C AND D

Remove switch holders and close door

Secure Pentant 4

All Pentants secure A and B (green), HMI

SR Secure For OPS A chain ON (green), HMI

D31 Live Pentant 4 Maintenance Doors

Request Operator turn on gun, Modulators, SR RF HVPS, SR Dipole PS, LTB and BTS B2 magnets, open LTB and BTS shutter

SR Dipole PS is ON

SR Dipole Permits ON A and B chain (green), HMI

SR RF Systems C AND D are ON

SR RF Permits ON A and B chain (green), HMI

BTS shutter Open, HMI

Gun HVPS is ON

Modulators are ON

Remove an A chain switch from pentant 4

Maintenance door = ___________

SR Secure For OPS A chain OFF (grey), HMI

SR Dipole PS is OFF

SR Dipole Permits OFF A chain (grey), HMI

SR RF Systems C AND D are OFF

SR RF C AND D Permits OFF (grey), HMI

BTS shutter Closed, HMI

Gun HVPS is OFF A chain

Modulators are OFF A chain

Replace A chain switch and perform a reset

Search Pentant 4

All Pentants secure A and B (green), HMI

SR Secure For OPS A chain ON (green), HMI

Request Operator turn on gun, Modulators, SR RF HVPS, SR Dipole PS, LTB and BTS B2 magnets, open LTB and BTS shutter

SR Dipole PS is ON

SR Dipole Permits ON A and B chain (green), HMI

SR RF Systems C AND D are ON

SR RF Permits C AND D ON A and B chain (green), HMI

BTS shutter Open, HMI

Gun HVPS is ON

Modulators are ON
Remove a B chain switch from pentant 4
Maintenance door = ___________
SR Secure For OPS B chain OFF (grey), HMI
SR Dipole PS is OFF
SR Dipole Permits OFF B chain (grey), HMI
SR RF Systems C AND D are OFF
SR RF Permits C AND D OFF (grey), HMI
BTS shutter Closed, HMI
Gun HVPS is OFF B chain
Modulators are OFF B chain

Replace B chain switch and perform a reset

D32 **Live Pentant 4 Emergency Stop**
Request Operator turn on gun, Modulators, SR RF HVPS, SR Dipole PS, LTB and BTS B2 magnets, open LTB and BTS shutter

SR Dipole PS is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C AND D are ON
SR RF Permits C AND D ON A and B chain (green), HMI
BTS shutter Open, HMI
Gun HVPS is ON
Modulators are ON

Press in Emergency Stop at Service Building 4 entrance

SR Secure For OPS A chain OFF (grey), HMI
SR Dipole PS is OFF
SR Dipole Permits OFF A chain (grey), HMI
SR RF Systems C AND D are OFF
SR RF C AND D Permits OFF (grey), HMI
BTS shutter Closed, HMI
Gun HVPS is OFF
Modulators are OFF

Pull out Emergency Stop
Reset fault and latch at Pentant 4 I/O box
Secure Pentant 4

D33 **Control Room Emergency Stop**
Request Operator turn on SR RF HVPS, SR Dipole PS and open BTS shutter

SR Dipole PS is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C AND D are ON

☑ Completed on Pentant # ________ Test

Test
<table>
<thead>
<tr>
<th>Title: NSLS-II Storage Ring Radiological Interlock Test</th>
<th>Technical</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR RF C AND D Permits ON A and B chain (green), HMI</td>
<td></td>
</tr>
<tr>
<td>BTS shutter Open, HMI</td>
<td></td>
</tr>
<tr>
<td>Press in Emergency Stop in the Control Room</td>
<td></td>
</tr>
<tr>
<td>SR Dipole PS is OFF</td>
<td></td>
</tr>
<tr>
<td>SR Dipole Permits OFF A chain (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>SR RF Systems C AND D are OFF</td>
<td></td>
</tr>
<tr>
<td>SR RF C AND D Permits OFF (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>BTS shutter Closed, HMI</td>
<td></td>
</tr>
<tr>
<td>Pull out Emergency Stop</td>
<td></td>
</tr>
<tr>
<td>Emergency Stop Latch A and B OFF (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>Reset fault and latch in the Control Room</td>
<td></td>
</tr>
<tr>
<td>Emergency Stop Latch A and B ON (green), HMI</td>
<td></td>
</tr>
<tr>
<td>D34 Ignition Key (drops critical devices but not search)</td>
<td>☐ Completed on Pentant # _____ Test</td>
</tr>
<tr>
<td>Request Operator Turn on SR RF HVPS, SR Dipole PS and open BTS shutter</td>
<td></td>
</tr>
<tr>
<td>SR Dipole PS is ON</td>
<td></td>
</tr>
<tr>
<td>SR Dipole Permits ON A and B chain (green), HMI</td>
<td></td>
</tr>
<tr>
<td>SR RF Systems C AND D are ON</td>
<td></td>
</tr>
<tr>
<td>SR RF C AND D Permits ON A and B chain (green), HMI</td>
<td></td>
</tr>
<tr>
<td>BTS shutter Open, HMI</td>
<td></td>
</tr>
<tr>
<td>Remove the SR Ignition Key</td>
<td></td>
</tr>
<tr>
<td>SR Dipole PS is OFF</td>
<td></td>
</tr>
<tr>
<td>SR Dipole Permits OFF A chain (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>SR RF Systems C AND D are OFF</td>
<td></td>
</tr>
<tr>
<td>SR RF C AND D Permits OFF (grey), HMI</td>
<td></td>
</tr>
<tr>
<td>BTS shutter Closed, HMI</td>
<td></td>
</tr>
<tr>
<td>Replace the Ignition Key</td>
<td></td>
</tr>
<tr>
<td>SR Secure to Booster A and B</td>
<td></td>
</tr>
<tr>
<td>D35 Area Radiation Monitors</td>
<td></td>
</tr>
<tr>
<td>This test step may be completed at any time during the testing process but MUST be completed for PPS test certification. Refer to PS-C-ASD-PRC-008, NSLS-II Area Radiation Monitor PPS Test and complete Attachment C, NSLS-II Storage Ring Area Radiation Monitor Checklist for Monitors SRM-11 through SRM-16.</td>
<td></td>
</tr>
<tr>
<td>Area Radiation Monitor SRM-11 Test completed</td>
<td></td>
</tr>
<tr>
<td>Area Radiation Monitor SRM-12 Test completed</td>
<td></td>
</tr>
<tr>
<td>Area Radiation Monitor SRM-13 Test completed</td>
<td></td>
</tr>
<tr>
<td>Area Radiation Monitor SRM-14 Test completed</td>
<td></td>
</tr>
<tr>
<td>Area Radiation Monitor SRM-15 Test completed</td>
<td></td>
</tr>
<tr>
<td>Area Radiation Monitor SRM-16 Test completed</td>
<td></td>
</tr>
<tr>
<td>D36 Test Completion</td>
<td></td>
</tr>
</tbody>
</table>
Account for all switch holders/actuators
If testing is complete: Accelerator Safety Systems staff restores energy limiter values and complete Pentant 2 steps; B41 SR Injection Energy Limit and B42 Top Energy Interlock (may be completed on concurrent test)
Remove LOTO from ALL Linac, Booster and SR devices if testing is complete
Ensure PPS cabinets are secure and locked; challenge locks
Disconnect the 4 test jumpers to the SR Dipole power supply interface boxes.
Remove sound mufflers from HI devices (6)
Request Operator make log entry stating Pentant 4 is complete.

- END OF ATTACHMENT D -
Attachment E
NSLS-II Storage Ring Pentant 5 Radiological Interlock Test Checklist

<table>
<thead>
<tr>
<th>Test Reason:</th>
<th>Test Result:</th>
<th>Test Type:</th>
<th>Test Date:</th>
<th>Start Time:</th>
<th>Finish Time:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>E1</th>
<th>Verify System Lockouts and Connect Dipole Test Jumpers</th>
<th>Observation, Location</th>
<th>✓</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gun HVPS Output Cable Connector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modulator PS line cords (3) OR Booster Dipole F PS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Booster RF HVPS OR booster low level RF drive termination OR Booster RF output connection to cavity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR System C RF HVPS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR System C low level RF drive termination OR System C SR RF output connection to cavity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR System D RF HVPS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR System D low level RF drive termination OR SR System D RF output connection to cavity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apply mufflers to the right hand HII side sounders 6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connect the 4 test jumpers to the SR Dipole Power Supply interface boxes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>E2</th>
<th>Secure enclosures</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Secure the injector berm area</td>
<td>Berm secured, Linac HMI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secure the linac</td>
<td>Linac secured, Linac HMI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secure the booster ring</td>
<td>Booster secured, Booster HMI</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: All Mode Search Verifications can be completed using the Quick Search feature

<table>
<thead>
<tr>
<th>E3</th>
<th>Verify Pentant 5 Single Pentant Search (Mode 1)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Check HMI on 740 Pentant I/O Box or CR</td>
<td>Pentant 5 not secured A and B chain (grey), HMI</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three Searchers enter Service Building 5</td>
<td>Light on search button illuminates</td>
</tr>
<tr>
<td>Press P5-SB1 Service Bldg. 5</td>
<td>Search sounder alarm sounds</td>
</tr>
<tr>
<td></td>
<td>Overhead lighting flashes during search</td>
</tr>
</tbody>
</table>

| One searcher remains on P4 side of Gate 5                                   | Light on search button illuminates                                                   |

| Close Gate 5 and press SB2                                                 | Light on search button illuminates                                                   |
| Press SB3 on HII 1                                                        | Light on search button illuminates                                                   |
| Amber HII 1 search beacon is ON                                            |                                                                                      |

| Press SB4 on HII 2                                                        | Light on search button illuminates                                                   |
| Amber HII 2 search beacon is ON                                            |                                                                                      |

| Press SB5 on HII 3                                                        | Light on search button illuminates                                                   |
| Amber HII 3 search beacon is ON                                            |                                                                                      |

| Searchers simultaneously press P5-SB1 (Service Bldg.) and SB6 on HII 4 until the lights illuminate | Light on SB1 (Service Bldg.) illuminates                                             |

|                                                                             | Light on SB6 illuminates                                                             |
|                                                                             | Amber HII 4 search beacon is ON                                                      |

| Press SB7 on HII 5                                                        | Light on search button illuminates                                                   |
| Amber HII 5 search beacon is ON                                            |                                                                                      |

| Press SB8 on HII 6                                                        | Light on search button illuminates                                                   |
| Amber HII 6 search beacon is ON                                            |                                                                                      |

| One searcher remains on P1 side of gate                                    |                                                                                      |

| Close Pentant Gate 1                                                      |                                                                                      |

| Press SBSP                                                               | Light on search button illuminates                                                   |

| Press P5-SB1                                                             | Light illuminates on SB1                                                              |

### Technical

| Exit through Service Building Door                                       |                                                                                      |

| Press SBE                                                                | Light on SBE illuminates                                                              |

|                                                                              | Maglock engages/locks- check door                                                     |

|                                                                              | Service Bldg. 5 Maglock A and B (green), HMI                                         |
|                                                                              | Gate 5 switches A and B ON (green), HMI                                               |
|                                                                              | Gate 5 Maglock A and B ON (green), HMI                                               |
|                                                                              | Gate 1 switches A and B ON (green), HMI                                               |

After beam imminent warning sounds: Service Bldg Door sign illuminates (A and B sect.)

(Note: beam imminent timed in step E4)

| Pentant 5 Secured A and B chain, HMI                                      |
| Gate 5 sign illuminates (A and B sect.)                                   |
| Gate 1 sign illuminates (A and B sect.)                                  |

### Request Operator grant access permit for P5

| Press Access Request button at Serv. Building Door 5 Pentant 5 unsecured A and B chain, HMI |             |
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### NSLS-II Storage Ring Radiological Interlock Test

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Observation, Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Door</td>
<td>No alarm sounds in Control Room</td>
</tr>
</tbody>
</table>

**E4 Verify Pentant 5 Starting Multiple Pentant Search (Mode 2) and time Beam imminent warning**

- Check HMI on 740 Pentant I/O Box or CR
- Three Searchers enter Service Building 5
- Press P5-SB1 in Pentant 5 Service Bldg. 5
- Close Gate 5 and press SB2
- Press SB3 on HII 1
- Press SB4 on HII 2
- Press SB5 on HII 3
- Searchers **simultaneously** press P5-SB1 (Service Bldg.) and SB6 on HII 4 until the lights illuminate
- Press SB7 on HII 5
- Press SB8 on HII 6
- Close Pentant Gate 1
- Reach through Gate 1 Press SB9 and **begin timing audible alarm**

*After beam imminent warning sounds:*

- Beam Imminent alarm sounds for 60 seconds
- Pentant 5 Secured A and B chain, HMI
- Gate 1 sign illuminates (A and B sect.)
E5 Operations Enable Switch (Pentant 5 Main I/O box)

- Pentant 5 Secured A and B chain, (green) HMI
- Rotate the operations enable switch to OFF
  - Pentant 5 NOT Secured A and B chain (grey), HMI
- Attempt to secure Pentant 5
  - Pentant 5 will not secure
- Rotate the operations enable switch to ON
- Reset the fault at the Pentant 5 I/O box

E6 Verify Pentant 5 Continuing Multiple Pentant Search (Mode 3) and time Red Beacons

- Check HMI on 740 Pentant I/O Box or CR
  - Pentant 5 not secured A and B chain (grey), HMI
- Close Gate 5 and press SB2
  - Light on search button illuminates
- Press P5-SB3 on HII 1
  - Light on search button illuminates
  - Amber HII 1 search beacon is ON
- Press P5-SB4 on HII 2
  - Light on search button illuminates
  - Amber HII 2 search beacon is ON
- Press SB5 on HII 3
  - Light on search button illuminates
  - Amber HII 3 search beacon is ON
- Searchers simultaneously press P5-SB1 (Service Bldg.) and SB6 on HII 4 until the lights illuminate
  - Light on SB1 (Service Bldg.) illuminates
  - Light on SB6 illuminates
  - Amber HII 4 search beacon is ON
- Press SB7 on HII 5
  - Light on search button illuminates
  - Amber HII 5 search beacon is ON
- Press SB8 on HII 6
  - Light on search button illuminates
  - Amber HII 6 search beacon is ON
- Close Pentant Gate 1
- Reach through Gate 1 press SB9 and begin timing the Red Beacons on HII devices (6)
  - Light on search button illuminates
  - Maglock engages/locks- check door
  - Service Bldg. 5 Maglock A and B (green), HMI
  - Gate 1 Maglock A and B (green), HMI
  - Gate 5 switches A and B (green), HMI
  - Gate 1 switches A and B (green), HMI
- After Beam Imminent alarm:
  - Pentant 5 Secured A and B chain, HMI
  - Red Beacons (6) flash for 60 seconds
  - HII Red area Secure A and B lights illuminated
- Request Operator grant access permit for P5
  - Pentant 5 not secured A and B chain (grey), HMI
- Open Gate
  - No alarm sounds in control room
Verify Pentant 5 Completing Multiple Pentant Search (Mode 4)

Check HMI on 740 Pentant I/O Box or CR
Close Gate 5 and press SB2
Press P5-SB3 on HII 1
Press P5-SB4 on HII 2
Press SB5 on HII 3
Press SB7 on HII 5
Press SB8 on HII 6
Close Pentant Gate 1
Press SBSP
Press P5-SB1 at Service Building Door
Exit through Service Building Door
Press SBE
After Beam Imminent alarm:

Searchers simultaneously press P5-SB1 (Service Bldg.) and SB6 on HII 4 until the lights illuminate

Access Pentant and check HII (6)

Request Operator grant access permit for P5
Press Access Request button at Service Building Door if necessary (other pentants secure)
Check HII indicators
Proceed to P5-SB2

Search Timeout (Mode 2)

Press P5-SB2 in Pentant 5 and begin timing
Complete search in sequence without pressing SB9
Light and sounders go out in 12 minutes

Press SB9

Mode 2 Search does not complete

**E10**  Skip the Two Button Simultaneous Press (Mode 1) using Quick Search

Close gates and doors and put into Quick Search

Press SB1

Light on search button illuminates

Press SB2

Light on search button illuminates

Press SB3

Light on search button illuminates

Press SB4

Light on search button illuminates

Press SB5

Light on search button illuminates

Press SB1

Press SB6

Press SB7

Press SB8

Press SB9

Pendant 5 does NOT Secure on A or B chains

**E11**  Emergency Stop Aborts Search

Complete a normal search using ANY Mode

Mode used =

Before the beam imminent warning sounder stops,

Press an Emergency Stop

Beam imminent warning stops

Red Beacons are NOT flashing

Pendant does not secure on either chain, HMI

**E12**  A Chain Entrance Door Switches Service Building 5

Place holders on the A chain Service Building 5 door switches (4) and attach actuator on Magnetic lock

Close Pentant gates 4 and 5

Perform all actions and make observations for both door A chain switches A1 and A2

Quick Search Pentant 5 (A chain)

Pendant 5 secured A chain (green), HMI

Remove holder from Service Building 5 **stationary** door switch

Pendant 5 unsecured A chain (grey), HMI

Replace holder on **stationary** door

Quick Search Pentant 5 (A chain)

Pendant 5 secured A chain (green), HMI

Remove holder from Service Building 5 **active** door switch

Pendant 5 unsecured A chain (grey), HMI

Replace holder on **active** door
E13 **Pentant 5 A Chain Quick Search Timeout**
Quick search Pentant 5 and *begin timing*

- Pentant 5 secured A chain *(green)*, HMI
- Pentant 5 unsecured in 5 minutes *(grey)*, HMI

Remove A chain switch holders

---

E14 **B Chain Entrance Door Switches Service Building 5**
Place holders on the B chain Service Building 5 Door switches (4)
Close Pentant gates

Perform all actions and make observations for both door B chain switches B1 and B2

- Quick Search Pentant 5 (B chain)
  - Pentant 5 secured B chain *(green)*, HMI
  - Service Bldg. 5 Door SW A chain ON *(green)*, HMI

- Remove holder from Service Building 5 *stationary* door switch
  - Pentant 5 unsecured B chain *(grey)*, HMI
  - Service Bldg. 5 Door SW B chain OFF *(grey)*, HMI

- Replace holder on *stationary* door

---

- Quick Search Pentant 5 (B chain)
  - Pentant 5 secured B chain *(green)*, HMI
  - Service Bldg. 5 Door SW B chain ON *(green)*, HMI

- Remove holder from Service Building 5 *active* door switch
  - Pentant 5 unsecured B chain *(grey)*, HMI
  - Service Bldg. 5 Door SW B chain OFF *(grey)*, HMI

- Replace holder on *active* door

---

E15 **Pentant 5 B Chain Quick Search Timeout**
Quick search Pentant 5 and *begin timing*

- Pentant 5 secured B chain
- Pentant 5 unsecured in 5 minutes

---

E16 **Service Building 5 Door Emergency Egress**
Attach B chain Maglock Actuator with tape
Perform B chain Pentant 5 quick search

- Pentant 5 secured B chain ON *(green)*, HMI
- Service Bldg. 5 Door Maglock B chain ON *(green)*, HMI

Remove actuator
- Service Bldg. 5 Door Maglock B chain OFF *(grey)*, HMI
- Pentant 5 unsecured *(grey)*, HMI

Close door

Perform A chain Pentant 5 search
- Pentant 5 secured A chain *(green)*, HMI
- Service Bldg. 5 Door Maglock A chain ON *(green)*, HMI
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<tr>
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</thead>
</table>

Press in door push bar without opening door  Service Bldg. 5 Door Maglock A chain OFF (grey), HMI  
Pantent 5 unsecured (grey), HMI  
Open door  Door opens  
Close door and stay outside of ring  

**E17 Service Building 5 Door Emergency Stop**

| Press in internal emergency stop  Service Bldg. 5 Door Maglock A chain OFF (grey), HMI  
Pantent 5 unsecured, HMI  
Pull out emergency stop  Emergency Stop Latch A chain OFF (grey), HMI  
Reset emergency stop  Emergency Stop Latch A chain ON (green), HMI  
Perform A chain Pentant 5 quick search  Pentant 5 secured A chain  
Service Bldg. 5 Door Maglock A chain ON (green), HMI  

| Press in external emergency stop  Service Bldg. 5 Door Maglock A chain OFF (grey), HMI  
Pantent 5 unsecured, HMI  
Pull out emergency stop  Emergency Stop Latch A chain OFF (grey), HMI  
Reset emergency stop  Emergency Stop Latch A chain ON (green), HMI  
Perform B chain Pentant 5 search  Pentant 5 secured B chain  
Serv. Bldg. 5 Door Maglock B chain ON (green), HMI  

| Press in emergency stop  Service Bldg. 5 Door Maglock B chain OFF (grey), HMI  
Pantent 5 unsecured, HMI  
Pull out emergency stop  Emergency Stop Latch B chain OFF (grey), HMI  
Open door  Door opens  
Reset emergency stop  Emergency Stop Latch B chain ON (green), HMI  
Close door  All gates and doors closed  

**E18 Pentant 5 HII Emergency stops**

Repeat all steps for each HII  

*A Chain:*

| Quick search Pentant 5 on A Chain  
Pantent 5 secured A chain (green), HMI  
Emergency Stop Latch A chain ON (green), HMI  
Press in emergency stop  
Pantent 5 unsecured A chain (grey), HMI  
Pull out emergency stop  
Emergency Stop Latch A chain OFF (grey), HMI  
Reset fault and latch at Pentant 5 I/O box  
Emergency Stop Latch A chain ON (green), HMI  |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HII-1</td>
<td>HII-2</td>
<td>HII-3</td>
<td>HII-4</td>
<td>HII-5</td>
<td>HII-6</td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>

* B Chain:
### NSLS-II Storage Ring Radiological Interlock Test

#### E19 Pentant 5 Gate 5 Switches

- Proceed to the gate between pentants 4 and 5
- Place holders on the A chain gate switches
- Perform all actions and make observations for both Gate 5 A chain switches A1 and A2

<table>
<thead>
<tr>
<th></th>
<th>HI-1</th>
<th>HI-2</th>
<th>HI-3</th>
<th>HI-4</th>
<th>HI-5</th>
<th>HI-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Quick Search Pentant 4 (A chain)
- Quick Search Pentant 5 (A chain)
- Remove holder from Gate A chain switch
- Remove Gate A chain switch holders
- Place holders on the B chain gate switches
- Perform all actions and make observations for both Gate 5 B chain switches B1 and B2

<table>
<thead>
<tr>
<th></th>
<th>HI-1</th>
<th>HI-2</th>
<th>HI-3</th>
<th>HI-4</th>
<th>HI-5</th>
<th>HI-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Quick Search Pentant 4 (B chain)
- Quick Search Pentant 5 (B chain)
- Remove holder from Gate B chain switch
- Remove switch holders and close gate

<table>
<thead>
<tr>
<th></th>
<th>HI-1</th>
<th>HI-2</th>
<th>HI-3</th>
<th>HI-4</th>
<th>HI-5</th>
<th>HI-6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### E20 Gate 5 Emergency Stop (in Pentant 5)

- Press the Gate 5 Emergency stop
- Pull out Gate 5 Emergency stop

<table>
<thead>
<tr>
<th></th>
<th>HI-1</th>
<th>HI-2</th>
<th>HI-3</th>
<th>HI-4</th>
<th>HI-5</th>
<th>HI-6</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Quick Search Pentant 5 on A Chain
- Emergency Stop Latch A chain (green), HMI
- Gate 5 Maglock A chain ON (green), HMI

<table>
<thead>
<tr>
<th></th>
<th>HI-1</th>
<th>HI-2</th>
<th>HI-3</th>
<th>HI-4</th>
<th>HI-5</th>
<th>HI-6</th>
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<tbody>
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</tr>
</tbody>
</table>

- Pentant 5 Secured A chain (green), HMI
- Gate 5 SW A chain ON (green), HMI
- Pentant 5 unsecured A chain (grey), HMI
- Gate 5 SW A chain OFF (grey), HMI

<table>
<thead>
<tr>
<th></th>
<th>HI-1</th>
<th>HI-2</th>
<th>HI-3</th>
<th>HI-4</th>
<th>HI-5</th>
<th>HI-6</th>
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</tbody>
</table>

- Emergency Stop Latch B chain ON (green), HMI
- Emergency Stop Latch B chain OFF (grey), HMI
- Emergency Stop Latch B chain OFF (grey), HMI

<table>
<thead>
<tr>
<th></th>
<th>HI-1</th>
<th>HI-2</th>
<th>HI-3</th>
<th>HI-4</th>
<th>HI-5</th>
<th>HI-6</th>
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</tbody>
</table>

- Emergency Stop Latch B chain ON (green), HMI
- Emergency Stop Latch B chain OFF (grey), HMI
- Emergency Stop Latch B chain OFF (grey), HMI

<table>
<thead>
<tr>
<th></th>
<th>HI-1</th>
<th>HI-2</th>
<th>HI-3</th>
<th>HI-4</th>
<th>HI-5</th>
<th>HI-6</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

- Gate 5 Maglock A chain OFF (grey), HMI
- Pull out Gate 5 Emergency stop
## Reset fault and latch

- Emergency Stop Latch A chain ON (green), HMI

## Quick Search Pentant 5 on B Chain

- Pentant 5 Secured B chain (green), HMI
- Emergency Stop Latch B chain, (green), HMI
- Gate 5 Maglock B chain ON (green), HMI

## Press the Gate 5 emergency stop

- Pentant 5 unsecured (grey), HMI
- Gate 5 Maglock B chain OFF (grey), HMI

## Pull out Gate 5 Emergency stop

- Emergency Stop Latch A chain OFF (grey), HMI

## Reset fault and latch

- Emergency Stop Latch A chain ON (green), HMI

### E21 Gate 5 Push Bar Test

#### Quick Search Pentant 5 on A chain

- Pentant 5 Secure A chain (green), HMI
- Gate 5 Maglock A chain ON (green), HMI

#### Push in gate Push Bar without opening gate

- Pentant 5 NOT Secure A chain, HMI
- Gate 5 Maglock A chain OFF (grey), HMI

#### Release Push bar

#### Place holders on B chain switches

#### Attach B chain Maglock Actuator with tape

#### Quick search Pentant 5 on B chain

- Pentant 5 Secure B chain (green), HMI
- Gate 5 Maglock B chain ON (green), HMI
- Pentant 5 NOT Secure B chain (OFF), HMI
- Gate 5 Maglock B chain OFF (grey), HMI

#### Release Push bar

#### Remove holders and close gate

### E22 Gate 1 Switches

#### Proceed to the gate between pentants 5 and 1

#### Place holders on the A chain gate switches

Perform all actions and make observations for both Gate 1 A chain switches A1 and A2

<table>
<thead>
<tr>
<th>A1</th>
<th>A2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Quick Search Pentant 1 (A chain)

- Pentant 1 secured A chain (green), HMI

#### Quick Search Pentant 5 (A chain)

- Pentant 5 secured A chain (green), HMI
- Gate 1 SW A chain ON (green), HMI

#### Remove holder from Gate 1 switch

- Pentant 5 unsecured A chain (grey), HMI
- Gate 1 SW A chain OFF (grey), HMI

#### Place holders on the B chain gate switches

Perform all actions and make observations for both Gate 1 B chain switches B1 and B2

<table>
<thead>
<tr>
<th>B1</th>
<th>B2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Quick Search Pentant 1 (A chain)  
Pentant 1 secured B chain (green), HMI

Quick Search Pentant 5 (B chain)  
Pentant 5 secured B chain (green), HMI
Gate 1 SW B chain ON (green), HMI

Remove holder from Gate 1 switch
Pentant 5 unsecured B chain (grey), HMI
Gate 1 SW B chain OFF (grey), HMI

Remove switch holders and close gate

E23 **Pentant 5 Maintenance Doors A Chain**
Place A chain actuators into each Maintenance door connectors and complete all steps for each Maintenance Door (MD)

<table>
<thead>
<tr>
<th>17ID</th>
<th>18ID</th>
<th>19ID</th>
<th>20ID</th>
<th>21ID</th>
<th>22ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick Search Pentant 5 on A chain</td>
<td>Pentant secured on A chain (green), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sum of Maint Doors A chain ON (green), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove Actuator in switch A1</td>
<td>Pentant 5 Not secured A chain (grey), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sum of Maint Doors A chain OFF (grey), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace actuator in A1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quick Search Pentant 5 on A chain</td>
<td>Pentant secured on A chain (green), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sum of Maint Doors A chain ON (green), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove Actuator in switch A2</td>
<td>Pentant 5 Not secured A chain (grey), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sum of Maint Doors A chain OFF (grey), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace actuator in A2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove actuators</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

E24 **Pentant 5 Maintenance Doors B Chain**
Place B chain actuators into each Maintenance door connector and complete all steps for each Maintenance Door (MD)

<table>
<thead>
<tr>
<th>17ID</th>
<th>18ID</th>
<th>19ID</th>
<th>20ID</th>
<th>21ID</th>
<th>22ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick Search Pentant 5 on B chain</td>
<td>Pentant secured on B chain (green), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sum of Maint Doors B chain ON (green), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove Actuator in switch B1</td>
<td>Pentant 5 Not secured B chain (grey), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sum of Maint Doors B chain OFF (grey), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace actuator in B1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quick Search Pentant 5 on B chain</td>
<td>Pentant secured on B chain (green), HMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
NSLS-II Storage Ring Radiological Interlock Test

Sum of Maint Doors B chain ON (green), HMI

Remove Actuator in switch B2

Pentant 5 Not secured B chain (grey), HMI

Sum of Maint Doors B chain OFF (grey), HMI

Remove actuators and ensure all Pentant 5 Maintenance door connectors are on

---

**E25 Pentant Access Allowed only with Dipole (Negative) PS Contactors OFF**

Primary Authorized Power Supply Employee LOTOs SR Dipole power supply

Secure all Pentants SR secure for OPS, HMI

Primary Authorized Power Supply Employee open cabinet door to access the A chain contactor Negative PS door cabinet open

Primary Authorized Power Supply Employee push in the A chain contactor with a screwdriver

Request Operator press P5 Access Request button Access Request button does not illuminate

Access Request with critical device On alarm, HMI

Serv. Bldg. 5 door remains locked on A chain, HMI

Primary Authorized Power Supply Employee releases the A chain contactor

Primary Authorized Power Supply Employee push in the B chain contactor with a screwdriver

Request Operator press P5 Access Request button Access Request button illuminates

Press Access request button at Service Building when lit Pentant remains secure on A and B chain

Serv. Bldg. 5 door remains locked on B chain, HMI

Primary Authorized Power Supply Employee releases the B chain contactor

Close cabinet door

---

**E26 Pentant Access Allowed only with Dipole (Positive) PS Contactors OFF**

Primary Authorized Power Supply Employee LOTOs SR Dipole power supply

Secure all Pentants SR secure for OPS, HMI

Primary Authorized Power Supply Employee open cabinet door to access the A chain contactor Positive PS cabinet door open

Primary Authorized Power Supply Employee push in the A chain contactor with a screwdriver

Request Operator press P5 Access Request button Access request button does not illuminate

Access Request with critical device On alarm, HMI

Serv. Bldg. 5 door remains locked on A chain, HMI

Primary Authorized Power Supply Employee releases the A chain contactor

Primary Authorized Power Supply Employee push in the B chain contactor with a screwdriver

Request Operator press P5 Access Request button Access Request button illuminates

Press Access Request button at Service Building when lit Pentant remains secure on A and B chain
<table>
<thead>
<tr>
<th>Title: NSLS-II Storage Ring Radiological Interlock Test</th>
<th>Technical</th>
</tr>
</thead>
</table>

Serv. Bldg. 5 door remains locked on B chain, HMI

Primary Authorized Power Supply Employee releases the B chain contactor

Close cabinet door

Remove LOTO from SR Dipole Power Supply

**E27  Pentant Access Allowed only with SR System C RF HVPS Contactors OFF**

Primary Authorized RF Employee applies LOTO to RF HVPS

Primary Authorized RF Employee open cabinet door to access the A chain contactor

Primary Authorized RF Employee push in the RF HVPS A chain contactor with a screwdriver

Request Operator press P5 Access Request button Access Request button does not illuminate

Access Request with critical device On alarm, HMI

Serv. Bldg. 5 door remains locked on A chain, HMI

Primary Authorized RF Employee releases the A chain contactor

Primary Authorized RF Employee push in the RF HVPS B chain contactor with a screwdriver

Request Operator press P5 Access Request button Access Request button illuminates

Press Access Request button at Service Building when lit

Pentant remains secure on A and B chain

Serv. Bldg. 5 door remains locked on B chain, HMI

Primary Authorized RF Employee releases the B chain contactor

Close cabinet door

**E28  Pentant Access Allowed only with SR System D RF HVPS Contactors OFF**

Primary Authorized RF Employee applies LOTO to RF HVPS

Primary Authorized RF Employee open cabinet door to access the A chain contactor

Primary Authorized RF Employee push in the RF HVPS A chain contactor with a screwdriver

Request Operator press P5 Access Request button Access Request button does not illuminate

Access Request with critical device On alarm, HMI

Serv. Bldg. 5 door remains locked on A chain, HMI

Primary Authorized RF Employee releases the A chain contactor

Primary Authorized RF Employee push in the RF HVPS B chain contactor with a screwdriver

Request Operator press P5 Access Request button Access Request button illuminates

Press Access Request button at Service Building when lit

Pentant remains secure on A and B chain

Serv. Bldg. 5 door remains locked on B chain, HMI

Primary Authorized RF Employee releases the B chain contactor

Close cabinet door

**E29  Pentant Access Allowed only with BTS Shutter Closed**

Request Operator open the BTS shutter BTS Shutter opens

Request Operator press P5 Access Request button Access Request button at P5 Serv. Bldg. does not illuminate
NSLS-II Storage Ring Radiological Interlock Test

Operator closes shutter
Access Request with critical device On alarm, HMI

Request Operator press P5 Access Request button
BTS shutter closed

Access Request button illuminates outside P5 Service Building Door main entrance

E30 **Pentant Access Allowed Only with BTS B2 Bending Magnet OFF**

Using shunt test box, apply current to the # 1 BTS B2 shunt box

Request Operator press P5 Access Request button
Access Request button at P5 Serv. Bldg. illuminates

Press the button at Service Building
Pentant remains secure on A and B chain

Serv. Bldg. 5 door remains locked on B chain, HMI

Disconnect shunt box from shunt 1

Using shunt test box, apply current to the # 2 BTS B2 shunt box

Request Operator press P5 Access Request button
Access Request button at P5 Serv. Bldg. illuminates

Press the button at Service Building
Pentant remains secure on A and B chain

Serv. Bldg. 5 door remains locked on B chain, HMI

Disconnect shunt box from shunt 2

---

**E31 Magnet Test Mode Breaks Security**

Caution: Failure to OPEN Q1 for Waveguide Switch test can result in damage to the power supply

Rectangular bar

- Magnet Test Mode A and B ON (green), HMI
- Pantent 1 unsecured A and B chain (grey), HMI
- Dipole Permits A and B ON (green), HMI

Request Operator turn on Dipole PS
Dipole PS is ON

Press in Pentant Emergency Stop
Dipole PS is OFF

Pull out Emergency Stop
Emergency Stop Latched and Dipole PS remains OFF

Reset fault and remove Magnet Test key
Magnet Test Mode A and B OFF (grey), HMI

Dipole Permit A and B OFF (grey), HMI

---

**E32 System C Waveguide Switch Test (Cavity Mode)**

Secure the Storage Ring
Pentants 1 through 5 are secure

A Primary Authorized RF Employee performs the following steps:
- Disconnect System C low level RF drive to the SR System C RF HVPS
- In the AC contactor enclosure: Turn OFF AC switch Q1
- Locate relay K10 and place the manual operator in the ACTUATED position (manual operator is flipped up).
- Close the AC contactor enclosure and secure with appropriate latch tool.

Install J1 Interlock test connectors on the A and B Chain Power Supply Interface Boxes
Remove tester LOTO from the SR RF-1-PS-C breaker.
The Primary Authorized RF Employee removes their LOTO and turns ON the SR RF-1-PS-C breaker. The A and B contactors will turn on but there will be **no dc output** of the power supply.

Place actuators into the System C Cavity Mode waveguide switches 1A and 1B

Reset at I/O Box

<table>
<thead>
<tr>
<th>Remove the actuator from the 1A switch</th>
<th>RF in Cavity Mode, HMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observe System C RF HVPS Interfaces</td>
<td>RF HVPS Interface “A1 Permit” light is ON</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “A2 Permit” light is ON</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “B1 Permit” light is ON</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “B2 Permit” light is ON</td>
</tr>
<tr>
<td>RF in Cavity Mode, HMI</td>
<td><strong>OFF</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Request Operator open the BTS shutter</th>
<th>B Camera Permits A Permit OFF, Linac HMI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shutters do not open</td>
</tr>
<tr>
<td>RF HVPS Interface “A chain Contactor Open”</td>
<td>OFF</td>
</tr>
<tr>
<td>RF HVPS Interface “B chain Contactor Open”</td>
<td>OFF</td>
</tr>
<tr>
<td>RF HVPS Interface “A1 Permit” light is OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>RF HVPS Interface “A2 Permit” light is OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>RF HVPS Interface “B1 Permit” light is ON</td>
<td>ON</td>
</tr>
<tr>
<td>RF HVPS Interface “B2 Permit” light is ON</td>
<td>ON</td>
</tr>
</tbody>
</table>

**Observations:**

- RF HVPS Interface “A1 Permit” light is ON
- RF HVPS Interface “A2 Permit” light is ON
- RF HVPS Interface “B1 Permit” light is ON
- RF HVPS Interface “B2 Permit” light is ON
Observe System D RF HVPS Interfaces
- D RF HVPS Interface “A1 Permit” light is ON
- D RF HVPS Interface “A2 Permit” light is ON
- D RF HVPS Interface “B1 Permit” light is ON
- D RF HVPS Interface “B2 Permit” light is ON

Remove the actuator from the 1B switch
Observe System C RF HVPS Interfaces
- RF HVPS Interface “A chain Contactor Open” is OFF
- RF HVPS Interface “B chain Contactor Open” is ON
- RF HVPS Interface “A1 Permit” light is ON
- RF HVPS Interface “A2 Permit” light is ON
- RF HVPS Interface “B1 Permit” light is OFF
- RF HVPS Interface “B2 Permit” light is OFF
- D RF HVPS Interface “A1 Permit” light is ON
- D RF HVPS Interface “A2 Permit” light is ON
- D RF HVPS Interface “B1 Permit” light is ON
- D RF HVPS Interface “B2 Permit” light is ON

Request Operator open the BTS shutter
- Shutter does not open

Remove actuators from the #1 switches

---

**E33 System C RF Waveguide Switch Test (Test Load Mode)**

Place actuators into the System C waveguide switches 3A and 3B
- RF in Test Mode, HMI

Request Operator open the BTS shutter
- Shutter does not open

Remove the actuator from the 3A switch
- RF HVPS Interface “A chain Contactor Open” is OFF
- RF HVPS Interface “B chain Contactor Open” is OFF
- RF HVPS Interface “A1 Permit” light is ON
- RF HVPS Interface “A2 Permit” light is ON
- RF HVPS Interface “B1 Permit” light is ON
- RF HVPS Interface “B2 Permit” light is ON

Replace the actuator in the 3A switch
- RF HVPS Interface “A chain Contactor Open” is OFF

Reset at I/O box
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Title: **NSLS-II Storage Ring Radiological Interlock Test**

---

RF HVPS Interface “B chain Contactor Open” is OFF
RF HVPS Interface “A1 Permit” light is ON
RF HVPS Interface “A2 Permit” light is ON
RF HVPS Interface “B1 Permit” light is ON
RF HVPS Interface “B2 Permit” light is ON

Remove the actuator from the 3B switch
RF HVPS Interface “A chain Contactor Open” is OFF
RF HVPS Interface “B chain Contactor Open” is ON
RF HVPS Interface “A1 Permit” light is ON
RF HVPS Interface “A2 Permit” light is ON
RF HVPS Interface “B1 Permit” light is OFF
RF HVPS Interface “B2 Permit” light is OFF

Remove actuators from the # 3 switches
Primary Authorized RF Employee LOTO the system C RF HVPS and return Q1 to the ON position
Remove the J1 Test Plugs from the System C RF HVPS Interface boxes
Primary Authorized RF Employee remove LOTO from the System C RF HVPS

**Caution: Failure to OPEN Q1 for Waveguide Switch test can result in damage to the power supply**

---

**System D Waveguide Switch Test (Cavity Mode)**

A Primary Authorized RF Employee performs the following steps:

a. Disconnect System D low level RF drive to the SR System D RF HVPS
b. In the AC contactor enclosure: Turn OFF AC switch Q1
c. Locate relay K10 and place the manual operator in the ACTUATED position (manual operator is flipped up).
d. Close the AC contactor enclosure and secure with appropriate latch tool.

---

Install J1 Interlock test connectors on the A and B Chain Power Supply Interface Boxes
Remove tester LOTO from the SR RF-1-PS-D breaker.
The Primary Authorized RF Employee removes their LOTO and turns ON the SR RF-1-PS-D breaker. The A and B contactors will turn on but there will be **no dc output** of the power supply.
Place actuators into the System D Cavity Mode waveguide switches 1A and 1B
Reset at I/O Box

Gun Permits A and B ON, Linac HMI
Shutter Open

---

Request Operator open the BTS shutter
Observe System D RF HVPS Interfaces

RF HVPS Interface “A chain Contactor Open” is OFF
RF HVPS Interface “B chain Contactor Open” is OFF
RF HVPS Interface “A1 Permit” light is ON
RF HVPS Interface “A2 Permit” light is ON
RF HVPS Interface “B1 Permit” light is ON
RF HVPS Interface “B2 Permit” light is ON
RF in Cavity Mode, HMI

---

Observe System C RF HVPS Interfaces
C RF HVPS Interface “A1 Permit” light is ON
Remove the actuator from the 1A switch

Observe System D RF HVPS Interfaces

- RF HVPS Interface “A chain Contactor Open” is ON
- RF HVPS Interface “B chain Contactor Open” is OFF
- RF HVPS Interface “A1 Permit” light is OFF
- RF HVPS Interface “A2 Permit” light is OFF
- RF HVPS Interface “B1 Permit” light is ON
- RF HVPS Interface “B2 Permit” light is ON

Gun Permits A Permit OFF, Linac HMI

Observe System C RF HVPS Interfaces

- C RF HVPS Interface “A1 Permit” light is OFF
- C RF HVPS Interface “A2 Permit” light is OFF
- C RF HVPS Interface “B1 Permit” light is ON
- C RF HVPS Interface “B2 Permit” light is ON

BTS Shutter Closes

Request Operator open the BTS shutter
Shutter does not open

Replace the actuator in the 1A switch

Reset at I/O box

Observe System C RF HVPS Interfaces

- C RF HVPS Interface “A1 Permit” light is ON
- C RF HVPS Interface “A2 Permit” light is ON
- C RF HVPS Interface “B1 Permit” light is ON
- C RF HVPS Interface “B2 Permit” light is ON

Remove the actuator from the 1B switch

Observe System C RF HVPS Interfaces

- C RF HVPS Interface “A1 Permit” light is ON
- C RF HVPS Interface “A2 Permit” light is ON
- C RF HVPS Interface “B1 Permit” light is OFF
- C RF HVPS Interface “B2 Permit” light is OFF

BTS Shutter Closes
<table>
<thead>
<tr>
<th>E35</th>
<th><strong>System D RF Waveguide Switch Test (Test Load Mode)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Place actuators into the waveguide switches 3A and 3B</td>
</tr>
<tr>
<td></td>
<td>Reset at I/O Box</td>
</tr>
<tr>
<td></td>
<td>Request Operator open the BTS shutter</td>
</tr>
<tr>
<td></td>
<td>Shutter does not open</td>
</tr>
<tr>
<td></td>
<td>Remove actuators from the #1 switches</td>
</tr>
<tr>
<td></td>
<td>Observe System D RF HVPS Interfaces</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “A chain Contactor Open” is OFF</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “B chain Contactor Open” is OFF</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “A1 Permit” light is ON</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “A2 Permit” light is ON</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “B1 Permit” light is ON</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “B2 Permit” light is ON</td>
</tr>
<tr>
<td></td>
<td>Remove the actuator from the 3A switch</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “A chain Contactor Open” is ON</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “B chain Contactor Open” is OFF</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “A1 Permit” light is ON</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “A2 Permit” light is ON</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “B1 Permit” light is ON</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “B2 Permit” light is ON</td>
</tr>
<tr>
<td></td>
<td>Replace the actuator in the 3A switch</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “A chain Contactor Open” is OFF</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “B chain Contactor Open” is OFF</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “A1 Permit” light is ON</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “A2 Permit” light is ON</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “B1 Permit” light is ON</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “B2 Permit” light is ON</td>
</tr>
<tr>
<td></td>
<td>Remove the actuator from the 3B switch</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “A chain Contactor Open” is OFF</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “B chain Contactor Open” is OFF</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “A1 Permit” light is ON</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “A2 Permit” light is ON</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “B1 Permit” light is OFF</td>
</tr>
<tr>
<td></td>
<td>RF HVPS Interface “B2 Permit” light is OFF</td>
</tr>
<tr>
<td></td>
<td>Remove actuators from the #3 switches</td>
</tr>
<tr>
<td></td>
<td>Primary Authorized RF Employee LOTO the system D RF HVPS and return Q1 to the ON position</td>
</tr>
<tr>
<td></td>
<td>Remove the J1 Test Plugs from the System D RF HVPS Interface boxes</td>
</tr>
<tr>
<td></td>
<td>Primary Authorized RF Employee remove LOTO from the System D RF HVPS</td>
</tr>
</tbody>
</table>

**E36 Blockhouse Waveguide Switch Test**
Place waveguide switches into either Cavity Mode in both Systems C and D
Perform a reset
System C RF permits ON, RFPSI
System D RF permits ON, RFPSI
Attempt to turn on Systems C AND D
Systems C AND D turn ON
Turn System C AND D OFF
Systems C AND D turn OFF
Remove Cavity Mode Waveguide switches and put actuators into the Blockhouse Waveguide System C switches
Perform a reset
System C RF permits OFF, RFPSI
System D RF permits OFF, RFPSI
Attempt to turn on Systems C AND D
Systems C AND D do NOT turn ON
Remove actuator from Blockhouse Waveguide switches.
Return System C AND D to Cavity Mode
Perform a reset
System C RF permits ON, RFPSI
System D RF permits ON, RFPSI

E37 Remove Transfer Bank Key System C

Attempt to turn on System C
System C turns ON
Turn System C OFF
System C turns OFF
Cycle the Control Room SR Quick Search Test key in place

System C Storage Ring Quick Search Box

Attempt to turn on System C
System C does NOT turn ON
Return SR QuickSearch key
Perform a reset
Attempt to turn on System C
System C turns ON
Turn System C OFF
System C turns OFF

E38 Remove Transfer Bank Key System D

Cycle Quick Search C from System C and transfer to System D RF Test/QS Box
Attempt to turn on System D
System D turns ON
Turn System D OFF
System D turns OFF
Cycle the Control Room SR Quick Search Test key in place
The only official copy of this document is the one online in the SharePoint Document Center. Before using a printed copy, verify that it is current by checking the printed document’s version history log (p. ii) with that of the online version.

National Synchrotron Light Source II, Brookhaven National Laboratory

Doc No. PS-C-ASD-PRC-129  Author: T. McDonald  Effective Date: 08Jan2016  Review Frequency: 3 yrs  Version 5

Title: NSLS-II Storage Ring Radiological Interlock Test

System D RF Test/ Quick Search Transfer Box

Attempt to turn on System D  System D does NOT turn ON
Return SR QuickSearch key
Perform a reset
Attempt to turn on System D  System D turns ON
Turn System D OFF  System D turns OFF
Remove Quick Search keys

E39 Live Test of Storage Ring Door Switches

WARNING: Do not permit Employee from entering the Storage Ring unless authorized by the Tester who will verify the area is safe to enter.

Place Barrier “CAUTION: DO NOT ENTER” tape across entry path.
Post a Watch Outside Service Building Door 5 Main Door Entrance.

The watch shall not allow Employee to enter the pentant unless authorized by the Tester.

Place switch holders on the active P5 Service Building Door switches(4) and attach magnetic lock device
Secure the SR  All Pentants secure A and B (green), HMI
          SR Secure For OPS A chain ON (green), HMI
          Gun Permits A and B ON (green), linac HMI

Request Operator turn on Gun HVPS, Modulator HV and set B1 and B2 bending magnet to injection energy
          Gun UPA-100 is ON, gun cabinet
          Modulators contactor ON, Linac HMI
          SR Dipole PS is ON
          SR System C and D RF HVPS ON

Turn on the BTS bending magnet and set to injection energy  Bending magnet ON, HMI
Open the BTS Shutter  Shutter is open, HMI
Check Dipole PS Positive PS Interface, DPSI  A1 Permit is ON
          A2 Permit is ON
          “A Chain Contactor Open” light is OFF
          B1 Permit is ON
          B2 Permit is ON
          “B Chain Contactor Open” light is OFF
<table>
<thead>
<tr>
<th>Task Description</th>
<th>Action</th>
</tr>
</thead>
</table>
| Check Dipole PS Negative PS Interface, DPSI | A1 Permit is ON  
A2 Permit is ON  
“A Chain Contactor Open” light is OFF  
B1 Permit is ON  
B2 Permit is ON  
“B Chain Contactor Open” light is OFF |
| Check RF PS Interfaces, RFPSI RF Building | A1 Permit is ON C AND D  
A2 Permit is ON C AND D  
“A Chain Contactor Open” light is OFF C AND D  
B1 Permit is ON C AND D  
B2 Permit is ON C AND D  
“B Chain Contactor Open” light is OFF |
| Check SR RF Systems C AND D | Remove A1 switch holder  
Pentants unsecured A Chain (grey). HMI  
SR Secure For OPS A chain OFF (grey), HMI  
Gun Permits A OFF (grey), Linac HMI  
Gun UPA-100 is OFF, gun cabinet  
SR Dipole PS shuts OFF, A chain  
SR RF HVPS shuts OFF, A chain C AND D  
Modulators OFF, A chain  
BTS shutter closed, HMI |
| Check Dipole PS Positive PS Interface, DPSI | A1 Permit is OFF  
A2 Permit is OFF  
“A Chain Contactor Open” light is ON  
B1 Permit is ON  
B2 Permit is ON  
“B Chain Contactor Open” light is OFF |
| Check Dipole PS Negative PS Interface, DPSI | A1 Permit is OFF  
A2 Permit is OFF  
“A Chain Contactor Open” light is ON  
B1 Permit is ON  
B2 Permit is ON  
“B Chain Contactor Open” light is OFF |
| Check RF PS Interface, RFPSI RF Building | A1 Permit is OFF C AND D  
A2 Permit is OFF C AND D  
“A Chain Contactor Open” light is OFF C AND D  
B1 Permit is ON C AND D  
B2 Permit is ON C AND D  
“B Chain Contactor Open” light is OFF C AND D |
| Replace switch holder | }
### NSLS-II Storage Ring Radiological Interlock Test

<table>
<thead>
<tr>
<th>Secure Pentant 5</th>
<th>All Pentants secure A and B (green), HMI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SR Secure for OPS A chain ON (green), HMI</td>
</tr>
<tr>
<td></td>
<td>Gun Permits A and B ON (green), linac HMI</td>
</tr>
<tr>
<td></td>
<td>Gun UPA-100 is ON, gun cabinet</td>
</tr>
<tr>
<td></td>
<td>Modulators contactor ON, Linac HMI</td>
</tr>
<tr>
<td></td>
<td>SR Dipole PS is ON</td>
</tr>
<tr>
<td></td>
<td><strong>SR System C and D RF HVPS ON</strong></td>
</tr>
<tr>
<td>Request Operator turn on Gun HVPS, Modulator HV and set B1 and B2 bending magnet to injection energy</td>
<td></td>
</tr>
<tr>
<td>Turn on the BTS bending magnet and set to injection energy</td>
<td>Bending magnet ON, HMI</td>
</tr>
<tr>
<td>Open the BTS Shutter</td>
<td>Shutter is open, HMI</td>
</tr>
<tr>
<td>Check Dipole PS Positive PS Interface, DPSI</td>
<td>A1 Permit is ON</td>
</tr>
<tr>
<td></td>
<td>A2 Permit is ON</td>
</tr>
<tr>
<td></td>
<td>“A Chain Contactor Open” light is OFF</td>
</tr>
<tr>
<td></td>
<td>B1 Permit is ON</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td>“B Chain Contactor Open” light is OFF</td>
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<td>Check Dipole PS Negative PS Interface, DPSI</td>
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</tr>
<tr>
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</tr>
<tr>
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<td>“A Chain Contactor Open” light is OFF</td>
</tr>
<tr>
<td></td>
<td>B1 Permit is ON</td>
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<tr>
<td></td>
<td>B2 Permit is ON</td>
</tr>
<tr>
<td></td>
<td>“B Chain Contactor Open” light is OFF</td>
</tr>
<tr>
<td>Check RF PS Interface, RFPSI RF Building</td>
<td>A1 Permit is ON C AND D</td>
</tr>
<tr>
<td>Check SR RF Systems C AND D</td>
<td>A2 Permit is ON C AND D</td>
</tr>
<tr>
<td></td>
<td>“A Chain Contactor Open” light is OFF C AND D</td>
</tr>
<tr>
<td></td>
<td>B1 Permit is ON C AND D</td>
</tr>
<tr>
<td></td>
<td>B2 Permit is ON C AND D</td>
</tr>
<tr>
<td></td>
<td>“B Chain Contactor Open” light is OFF C AND D</td>
</tr>
<tr>
<td>Remove B1 switch holder</td>
<td>Pentants unsecured B chain (grey), HMI</td>
</tr>
<tr>
<td></td>
<td>SR Secure for OPS B chain OFF (grey), HMI</td>
</tr>
<tr>
<td></td>
<td>Gun Permits B OFF (grey), Linac HMI</td>
</tr>
<tr>
<td></td>
<td>Gun UPA-100 is OFF, gun cabinet</td>
</tr>
<tr>
<td></td>
<td>SR Dipole PS shuts OFF, B chain</td>
</tr>
<tr>
<td></td>
<td>SR C AND D RF HVPS shuts OFF, B chain</td>
</tr>
<tr>
<td></td>
<td>Modulators OFF, B chain</td>
</tr>
<tr>
<td></td>
<td>BTS shutter closed, HMI</td>
</tr>
</tbody>
</table>
Check Dipole PS Positive PS Interface, DPSI

A1 Permit is ON
A2 Permit is ON
“A Chain Contactor Open” light is OFF
B1 Permit is OFF
B2 Permit is OFF
“B Chain Contactor Open” light is ON

Check Dipole PS Negative PS Interface, DPSI

A1 Permit is ON
A2 Permit is ON
“A Chain Contactor Open” light is OFF
B1 Permit is OFF
B2 Permit is OFF
“B Chain Contactor Open” light is ON

Check RF PS Interface, RFPSI RF Building

A1 Permit is ON C AND D
A2 Permit is ON C AND D
“A Chain Contactor Open” light is OFF C AND D
B1 Permit is OFF C AND D
B2 Permit is OFF C AND D
“B Chain Contactor Open” light is ON C AND D

Check SRRF Systems C AND D

A1 Permit is ON C AND D
A2 Permit is ON C AND D
“A Chain Contactor Open” light is OFF C AND D
B1 Permit is OFF C AND D
B2 Permit is OFF C AND D
“B Chain Contactor Open” light is ON C AND D

Remove switch holders and close door

Secure Pentant 5

All Pentants secure A and B (green), HMI
SR Secure for OPS A chain ON (green), HMI

**Live Pentant 5 Maintenance Doors**

Request Operator turn on gun, Modulators, SR RF HVPS, SR Dipole PS, LTB and BTS B2 magnets, open LTB and BTS shutter

SR Dipole PS is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C AND D are ON
SR RF C AND D Permits ON A and B chain (green), HMI
BTS shutter Open, HMI
Gun HVPS is ON
Modulators are ON

Remove an A chain switch from Pentant 5

Maintenance door = __________
SR Secure For OPS A chain OFF (grey), HMI
SR Dipole PS is OFF
SR Dipole Permits OFF A chain (grey), HMI
SR RF Systems C AND D are OFF
SR RF C AND D Permits OFF (grey), HMI
BTS shutter Closed, HMI
Gun HVPS is OFF A chain
Modulators are OFF A chain

Replace A chain switch and perform a reset

Search Pentant 5

All Pentants secure A and B (green), HMI
SR Secure For OPS A chain ON (green), HMI

Request Operator turn on gun, Modulators, SR RF HVPS, SR Dipole PS, LTB and BTS B2 magnets, open LTB and BTS shutter

SR Dipole PS is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C AND D are ON
SR RF C AND D Permits ON A and B chain (green), HMI
BTS shutter Open, HMI
Gun HVPS is ON
Modulators are ON

Remove a B chain switch from Pentant 5

Maintenance door

SR Secure for OPS B chain OFF (grey), HMI
SR Dipole PS is OFF
SR Dipole Permits OFF B chain (grey), HMI
SR RF Systems C AND D are OFF
SR RF C AND D Permits OFF (grey), HMI
BTS shutter Closed, HMI
Gun HVPS is OFF B chain
Modulators are OFF B chain

Replace B chain switch and perform a reset

Search Pentant 5

All Pentants secure A and B (green), HMI
SR Secure for OPS A chain ON (green), HMI

Live Pentant 5 Emergency Stop

Request Operator turn on gun, Modulators, SR RF HVPS, SR Dipole PS, LTB and BTS B2 magnets, open LTB and BTS shutter

SR Dipole PS is ON
SR Dipole Permits ON A and B chain (green), HMI
SR RF Systems C AND D are ON
SR RF C AND D Permits ON A and B chain (green), HMI
BTS shutter Open, HMI
Gun HVPS is ON
Modulators are ON

Press in Emergency Stop at Service Building 5 entrance

SR Secure For OPS A chain OFF (grey), HMI
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National Synchrotron Light Source II, Brookhaven National Laboratory

| Doc No. | PS-C-ASD-PRC-129 | Author: T. McDonald | Effective Date: 08Jan2016 | Review Frequency: 3 yrs | Version: 5 |

**Title:** NSLS-II Storage Ring Radiological Interlock Test

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>SR Dipole PS is OFF</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SR Dipole Permits OFF (grey), HMI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SR RF Systems C AND D are OFF</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SR RF C AND D Permits OFF (grey), HMI</strong></td>
<td></td>
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</tr>
<tr>
<td><strong>BTS shutter Closed, HMI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gun HVPS is OFF</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Modulators are OFF</strong></td>
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</tbody>
</table>

**Pull out Emergency Stop**

**Reset fault and latch at Pentant 5 I/O box**

**Secure Pentant 5**

**E42 Control Room Emergency Stop**

<p>| | | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Completed on Pentant # _______ Test</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Request Operator Turn on SR RF HVPS, SR Dipole PS and open BTS shutter</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SR Dipole PS is ON</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SR Dipole Permits ON A and B chain (green), HMI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SR RF Systems C AND D are ON</strong></td>
<td></td>
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</tr>
<tr>
<td><strong>SR RF C AND D Permits ON A and B chain (green), HMI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BTS shutter Open, HMI</strong></td>
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**Press in Emergency Stop in the Control Room**

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<thead>
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<tbody>
<tr>
<td><strong>SR Secure For OPS A chain OFF (grey), HMI</strong></td>
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<td><strong>SR Dipole Permits OFF A chain (grey), HMI</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>SR RF Systems C AND D are OFF</strong></td>
<td></td>
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</tr>
<tr>
<td><strong>SR RF C AND D Permits OFF (grey), HMI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BTS shutter Closed, HMI</strong></td>
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</tbody>
</table>

**Pull out Emergency Stop**

**Reset fault and latch in the Control Room**

**E43 Ignition Key (drops critical devices but not search)**

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<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Completed on Pentant # _______ Test</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Request Operator Turn on SR RF HVPS, SR Dipole PS and open BTS shutter</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SR Dipole PS is ON</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SR Dipole Permits ON A and B chain (green), HMI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SR RF Systems C AND D are ON</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SR RF C AND D Permits ON A and B chain (green), HMI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BTS shutter Open, HMI</strong></td>
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</tbody>
</table>

**Remove the SR Ignition Key**

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<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>SR Dipole PS is OFF</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SR Dipole Permits OFF A chain (grey), HMI
SR RF Systems C AND D are OFF
SR RF C AND D Permits OFF (grey), HMI
BTS shutter Closed, HMI
SR Secure to Booster A and B

Replace the Ignition Key

E44  **RF Test Mode opening BTS shutter shuts off the Gun**
Break security in the Booster ring. Connect the shutter test device to BTS shutter and run extension cord to the ISA.

Secure the booster  
Booster secure, Booster HMI

Secure Pantants 5 and 1  
Pantants 5 and 1 secure

Gun permits A and B chain ON  (green) linac HMI

Rotate the RF Test Mode key

System C Permits A and B  chain ON  (green), HMI
System D Permits A and B  chain ON  (green), HMI

Request Operator turn on the Gun HVPS
Gun HVPS is ON

Actuate the BTS shutter with testing device
BTS shutter is OPEN,  Booster HMI
Gun HVPS is OFF
Gun A chain permit OFF (grey), linac HMI

Close the shutter, break security in the booster and remove shutter testing device.

E45  **RF Test Mode Pantants 5 and 1 Secure**
Cycle the RF Test Key out of place

System C and D RF Permits A and B OFF, HMI
Systems C and D do NOT turn ON
System C and D RF Permits A and B ON, HMI
Systems C and D are  ON

Attempt to turn on Systems C and D
Press Control Room Emergency Stop

RF C AND D Permits A and B OFF, HMI
RF C AND D HVPS remain Off

Pull out Emergency Stop
Reset fault and latch in Control Room
Break Security in Pantant 1 or 5
Put waveguide switches into test load mode
Perform a reset
Remove Test Load wave guide switches
Remove the RF test key and return to Control room

E46  **Area Radiation Monitors**
This test step may be completed at any time during the testing process but MUST be completed for PPS
**NSLS-II Storage Ring Radiological Interlock Test**

Test certification. Refer to PS-C-ASD-PRC-008, *NSLS-II Area Radiation Monitor PPS Test and complete Attachment C, NSLS-II Storage Ring Area Radiation Monitor Checklist for Monitors SRM-17 through SRM-22*.

<table>
<thead>
<tr>
<th>Test</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area Radiation Monitor SRM-17 Test completed</td>
<td></td>
</tr>
<tr>
<td>Area Radiation Monitor SRM-18 Test completed</td>
<td></td>
</tr>
<tr>
<td>Area Radiation Monitor SRM-19 Test completed</td>
<td></td>
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<tr>
<td>Area Radiation Monitor SRM-20 Test completed</td>
<td></td>
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<tr>
<td>Area Radiation Monitor SRM-21 Test completed</td>
<td></td>
</tr>
<tr>
<td>Area Radiation Monitor SRM-22 Test completed</td>
<td></td>
</tr>
</tbody>
</table>

**Test Completion**

- Account for all switch holders/actuators
- If testing is complete Accelerator Safety Systems staff restores energy limiter values and complete Pantent 2 steps SR Injection Energy Limit and Top Energy Interlock (may be completed on concurrent test)
- Remove LOTO from ALL Linac, Booster and SR devices if testing is complete
- Ensure PPS cabinets are secure and locked; challenge locks
- Disconnect the 4 test jumpers to the SR Dipole power supply interface boxes.
- Remove sound mufflers from HII devices (6)
- Request Operator makes log entry stating Pantent 5 test is complete.

- END OF ATTACHMENT E-