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Brookhaven National Laboratory National Synchrotron Light Source II Work Instruction	Doc No. NSLSII-28ID1-WIN-002 Effective Date: 06MAR2018 Review Frequency: 5 yrs Rev. No. 1
Title: PDF End Station Bridge Safe Operation, E-stop and Interlock Test	

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1 WORK SCOPE

This document provides general instructions for safe operation of the 28-ID-B detector bridge and for testing the interlock that prevents motion of the detectors when the B hutch door is open. This document also provides instructions for testing the detector bridge emergency stops (E-stops).

To assure personnel safety, the 28-ID Equipment Protection System (EPS) prevents bridge components from being operated with the 28-ID-B hutch door open (unless the door PPS interlock is bypassed). Since the configuration of experimental equipment within the B hutch may vary according to specific experimental needs, collision avoidance and equipment protection are provided by bridge limit switches, end stops, and by using safe operational practices. Information about the bridge limit switches and end stops are in the Axilon PDF End Station Bridge Operation and Maintenance Manual (henceforth, the "Operators' Manual"). This work instruction only provides instructions for safe operation of the bridge as a supplement to the Operators' Manual. Specific bridge control or Control System Studio (CSS) commands are out-of-scope for this work instruction.

Only two operational modes are considered in this work instruction. In Mode 1, the 28-ID-B door is closed, the PPS door interlock is active (i.e., not bypassed), and bridge elements may be moved externally by commands via CSS. This is the default or normal operational mode. In Mode 2, the PPS interlock is bypassed and only operations indicated herein may be performed, assuming all safety precautions are undertaken. When a detector bridge component needs to be moved via CSS with the B-hutch door open, the door PPS interlock may be bypassed as specified herein, with approval from the Lead Beamline Scientist.

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2 PREREQUISITES

Note: PDF Authorized Beamline Staff, with permission from the PDF Lead Beamline Scientist, may allow *limited* bridge operation by Users. Herein the term “approval” implies concurrence from the PDF Lead Beamline Scientist.

- 2.1 No prerequisites are required for normal detector bridge operation (Mode 1). The bypass key and permission from the PDF Lead Beamline Scientist are required in advance for bypassed operation (Mode 2).

Note: The PPS door bypass key is maintained in a locked cabinet or drawer. When not in use, the key shall be returned and locked in the cabinet or desk drawer designated by the PDF Lead Beamline Scientist.

- 2.2 Measuring instruments (tape measure, scales, calipers, and/or laser level as needed) are readily available to measure path lengths (Modes 1 and 2).
- 2.3 Hazards are cleared from inside enclosure 28-ID-B and the bridge translation paths are free of obstructions other than approved hardware required for impending experimentation (Modes 1 and 2).
- 2.4 If the PPS door interlock is to be bypassed, PDF Lead Beamline Scientist approval and familiarity with this procedure are required in advance (Mode 2).
- 2.5 The graphical user interface screen for the detector bridge is visible and all controls are booted up and operational (Modes 1 and 2).
- 2.6 For E-stop and interlock testing, and for bridge operation with the PPS interlock bypassed (Mode 2), the interlock bypass switch is in the "DOOR BYPASS" position (the key is turned to the horizontal position and the red light is flashing, see Figure 1).
- 2.7 For Mode 1 and 2 operations, both detector bridge emergency stop buttons are active (i.e., the buttons are fully extended).
- 2.8 For detector bridge operation with the PPS interlock bypassed and the hutch door open (Mode 2), all unauthorized personnel are cleared from inside the enclosure 28-ID-B, stanchions with chain (or equivalent) are positioned in front of the doorway

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fully blocking entry of unauthorized personnel, and an appropriate warning sign (see Attachment A) is clearly visible.

- 2.9 The Operators' Manual shall be reviewed and followed by PDF Authorized Beamline Staff before operating any Bridge controls.
- 2.10 The 28-ID-B hutch shall be in a state suitable for being searched and secured.



Figure 1: Detector Bridge Interlock Bypass

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3 PRECAUTIONS, WARNINGS, AUTHORIZATIONS, AND LIMITATIONS

- 3.1 The detector bridge can move heavy components through travel paths where people may be present; therefore strict adherence to safe operational procedures is mandatory. Only actions allowed by this work instruction and by the Operators' Manual may be undertaken as indicated.
- 3.2 All E-stop and PPS interlock testing work in this work instruction shall be performed by PDF Authorized Beamline Staff only. Authorization requires permission from the PDF Lead Beamline Scientist, up-to-date 28-ID-B search and secure training, and familiarity with this work instruction.
- 3.3 During Detector Bridge testing and bridge operation with the door interlock bypassed, stanchions shall remain in place and the doorway shall be continuously watched by PDF Authorized Beamline Staff. This requirement extends for the entire time period the door is open and powered detector bridge motion is enabled.
- 3.4 To avoid collisions with equipment, each motion path shall be assessed for collision distances before executing a motion command. Only motions that avoid collisions are permitted.
- 3.5 Only qualified personnel approved by the PDF Lead Beamline Scientist are allowed in the B hutch when the door interlock is bypassed prior to commanded motion of bridge components.
- 3.6 Before operating any Detector Bridge element with the B-hutch door open and interlock bypassed, assure only one authorized person at a time is inside the B-hutch and the authorized person is (a) knowledgeable of the path of travel, (b) informed when motion will occur for each bridge element before the commanded motion commences, and (c) is outside the path of travel for the moving bridge element before and during all motions.
- 3.7 Clear communication between the person inside the B-hutch and the person outside running CSS is required when operating the detector bridge with the PPS door control bypassed (Mode 2). If line-of-sight is unavailable and/or verbal communication is hampered, walkie-talkies may be used. In addition to checking the path of impending motion, the person instituting powered motion via CSS is responsible to effectively

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communicate the path **of impending motion** and any additional requirements needed for safety to personnel inside the B-hutch before a motion is instituted.

4 INSTRUCTIONS AND RESPONSIBILITIES

Note: For door interlock and E-stop testing (Mode 2), Attachment B shall be completed annually. The PDF Lead Beamline Scientist is responsible to assure that the annual testing schedule is tracked with the NSLS-II Safety System Verification Recall System.

Note: When in Mode 2, the key bypasses the bridge over-travel switches and B-hutch PPS status. A flashing light indicates the bridge is not in a safe state; it shall be depressed to re-arm. The light is off when safe.

Warning: If the light does not flash when in the 'DOOR BYPASS' mode, notify the cognizant EPS Engineer. Do not continue until the circuit is tested, repaired or reworked as required, and the cognizant EPS Engineer has approved testing and operation.

4.1 Complete Attachment B, *PDF Beamline (hutch 28-ID-B) Detector Bridge Motion Interlock Certification Checklist* for Interlock and E-stop testing.

Note: Follow NSLSII-ESH-PRC-032, *Beamline Enclosure Search and Secure and Breaking Security* when closing the hutch door.

- a. For all powered bridge motions, a visual assessment with measurements (as needed) is required to assess the full travel path to avoid collisions *before* instituting a commanded motion. Commanded motions may be instituted to position a detector, beam stop, or other element to be moved by the bridge using CSS commands. Motions are only then permitted within the envelope of motion that avoids collisions. Authorized PDF beamline staff may set up detectors and equipment using bridge commands or manually as indicated herein, or may permit Users to do so with clear limitations and/or restrictions specified.
- b. Manual bridge motions are permitted (as allowable by the Operators' Manual and/or the PDF Lead Beamline Scientist) provided (a) the full path of motion has been evaluated as indicated herein for equipment collisions, pinch points, and injury avoidance, (b) applicable bridge brakes are removed, (c) all forces are applied safely and gently to rigid bridge components in a manner that will not

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damage any fragile components or cause injury, and (d) the motion is fully controlled over the entire path length.

- 4.2 Sign and date the worksheet AND file an electronic copy on the XPD/PDF SharePoint site.
- 4.3 When bypassed operation (Mode 2) has been completed, return to the default or normal operation (Mode 1) by turning the bypass key vertically, depressing the “reset” button (see Figure 1), removing then securing the key in its’ locked location.

5 REFERENCES

- 5.1 NSLSII-ESH-PRC-032, *Beamline Enclosure Search and Secure and Breaking Security*
- 5.2 Axilon PDF End Station Bridge Operation and Maintenance Manual

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REVISION HISTORY

REVISION	SECTION(S)	PAGE #	DATE	List of Reviewers	DESCRIPTION
1	All	All	05MAR2018	A. Ackerman O. Ivashkevych L. Stiegler	First Issue.
2	2	3	06MAR2018	See Cover	Updated Figure 1 to reflect what is posted at the beamline.

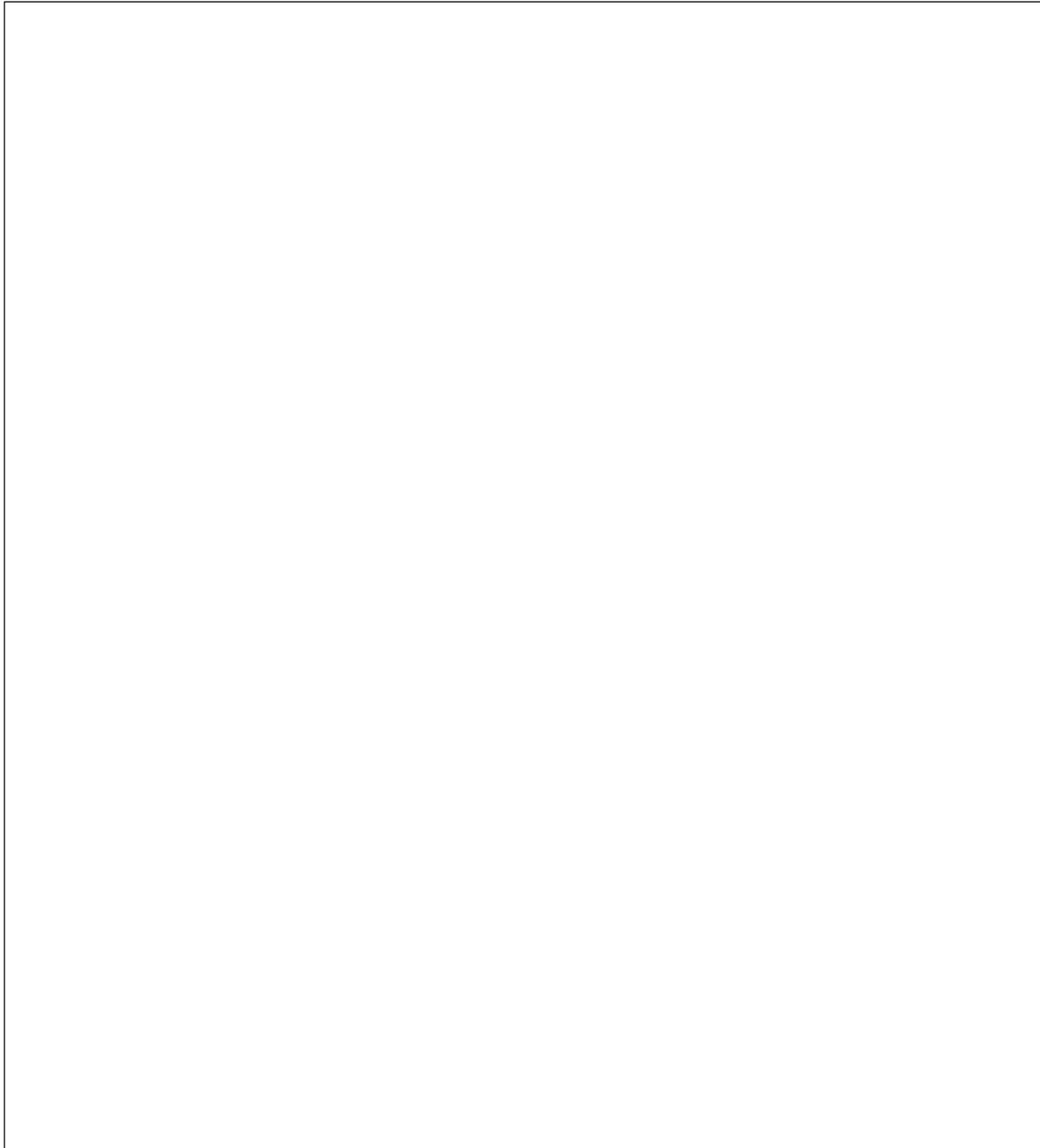
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Attachment A

PDF Beamline (Hutch 28-ID-B) Detector Bridge Motion Interlock Bypass Warning Sign



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Attachment B

PDF beamline (hutch 28-ID-B) Detector Bridge Motion Interlock Certification Checklist

(Shall be completed annually and filed in accordance with section 4 of this procedure)

I. Hutch Secured, Detector Bridge Operable Test

- Manually verify both Bridge E-stop buttons are fully extended and not depressed. The E-stops are located on the two outboard bridge legs.
- Search and secure the enclosure, 28-ID-B Hutch, in accordance with NSLSII-ESH-PRC-032, *Beamline Enclosure Search and Secure and Breaking Security*.
- Verify PPS bypass is not active and the red light is not flashing.
- Using the CSS display for the detector bridge, verify the bridge status is "active" for commanded operation (See Figure A-1).
- Using the CSS display for the detector bridge and all precautions indicated in this procedure, command both detectors and the M6 grid to move in each axis using all individual translation motors (one at a time) and then actuate the air cylinder for vertical D1 detector lift:
 - a. Command motion of each axis in both directions.
 - b. Visually confirm normal operation of each motion.

Note: Both detectors and the M6 grid should move smoothly.

IF the detectors and M6 grid do not move smoothly as required to the commanded position, THEN the detector bridge operation needs to be fixed AND section I of this checklist shall be repeated prior to proceeding.

- After the above checks, verify the detector bridge status is "active" for commanded operation using the CSS display for the detector bridge (Figure A-1).

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II. Emergency Stop Button Test

- Deactivate the interlock of the PPS 28-ID-B hutch in accordance with NSLSII-ESH-PRC-032, *Beamline Enclosure Search and Secure and Breaking Security*.
- Enter the hutch AND press the detector bridge emergency-stop button.
- Repeat all steps in section I, "Hutch Secured, Detector Bridge Operable Test" above.

Note: The detector bridge should not operate. No movement of any detector bridge component is allowed in response to any motion commands. This constitutes successful emergency-stop button test criteria.

III. Reset the Emergency Stop Button Test

- Re-enter the hutch AND deactivate (release) the detector bridge emergency-stop button.
- Repeat all steps in section I, "Hutch Secured, Detector Bridge Operable Test" above.

IV. Hutch Unsecured, Detector Bridge Inoperable

Note: Throughout the entire test sequence, X and Z translations of the M6 grid and detectors shall not operate (excluding when an approved interlock bypass is active).

- Ensure the interlock of the 28-ID-B hutch is deactivated in accordance with NSLSII-ESH-PRC-032, *Beamline Enclosure Search and Secure and Breaking Security*.
- Ensure that the B hutch door is closed AND no personnel are within the enclosure.
- Ensure no hazards are present.

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- Using the CSS display for the detector bridge, verify that the detector bridge status is “active” for commanded operation (Figure A-1).
- Command a detector bridge component to move.

Note: The detector bridge should report a Following Error (Figure A-2). This indicates that a command was issued to the detector bridge while it was not allowed to operate.

- Click the “Clear Following Error” tab on CSS-screen).
- Command another detector bridge component to move.

Note: The detector bridge should report a Following Error. This indicates that a command was issued to the detector bridge while it was not allowed to operate.

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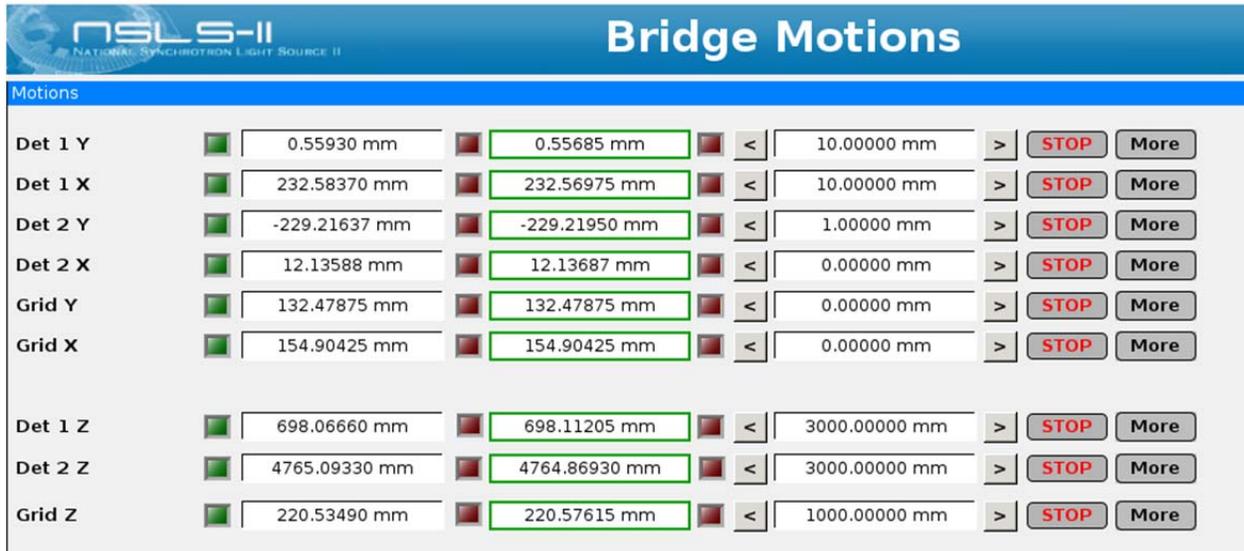


Figure A-1: CSS-Screen showing the detector bridge status is “active” for commanded operation. When active, none of the motions will display the message “Disconnected”.

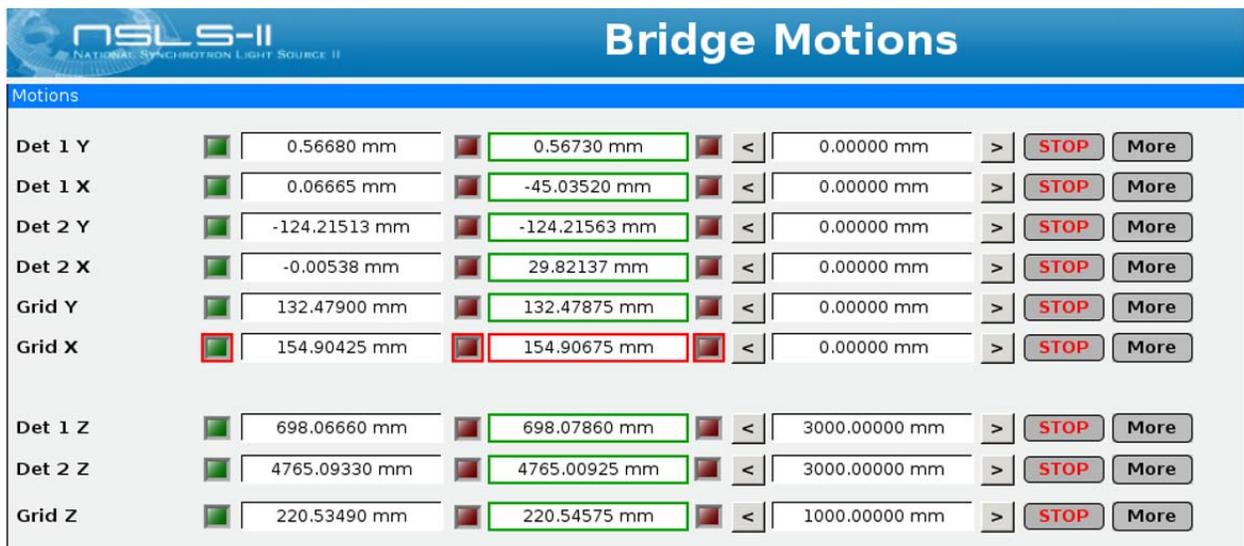


Figure A-2: CSS-Screen showing a following error with the X motion of the Grid.

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V. Hutch Secured, Detector Bridge Operable (Retest)

- Repeat all steps in section I, "Hutch Secured, Detector Bridge Operable Test" above.

PDF Detector Bridge Motion Check Worksheet

Rev A

Element	X' Horiz Axis	Y' Vert Axis	Z' Beam Axis	Air Cylinder
M6 Grid, w/o interlock				N/A
M6 Grid, w/ interlock				N/A
Detector 1 w/o interlock				
Detector 1 w/ interlock				
Detector 2 w/o interlock				N/A
Detector 2 w/ interlock				N/A

Completed by:

Printed Name
Signature
Date