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National Synchrotron Light Source II, Brookhaven National Laboratory			
Doc No. PS-C-ASD-PRC-185	Author: H. Fernandes	Effective Date: 01Jun2015 Review Frequency: 3 yrs	Version 1
Title: Lockout/Tagout of HMA 2.8 m IVU at Open Gap at Cells 4, 12 and 16			Technical

Reviewed by:

5/29/2015	5/29/2015	5/29/2015
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<p>USI Screening/Resolution</p> <p style="text-align: center;">5/29/2015</p> <p>X <i>Steve Moss</i></p> <hr/> <p>Steve Moss Authorization Basis Manager Signed by: Moss, Steven H</p>	<p>Procedure Validation*</p> <p style="text-align: center;">5/29/2015</p> <p>X James Rank</p> <hr/> <p>James Rank ID Group Lead Mechanical Engineer Signed by: Rank, James P</p> <p>*for Operations/Technical procedures only</p>
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Approved by:

5/29/2015

X Ferdinand Willeke

Ferdinand Willeke
Accelerator Division Director
Signed by: Willeke, Ferdinand

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VERSION HISTORY LOG

VERSION	DESCRIPTION	DATE
1	First Issue.	01Jun2015

ACRONYMS

BNL	Brookhaven National Laboratory	LOTO	Lockout/Tagout
CSS	Control System Studio	m	Meter
D/S	Downstream	mm	millimeter
CN	Connector	NSLS-II	National Synchrotron Light Source II
EPS	Equipment Protection System	N/C	Normally Closed
ESH	Environment, Safety & Health	PMAC	Program. Multi-Axis (motor) Controller
FLOCO	Floor Coordinator	PPE	Personal Protective Equipment
GUI	Graphic User Interface	U/S	Upstream
HMA	Hitachi Metals Ltd.	VAC	Volts Alternating Current
ID	Insertion Device	VDC	Volts Direct Current
IVU	In-Vacuum Undulators		

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1 PURPOSE AND SCOPE

The purpose of this procedure is to provide instructions for LOTO of the NSLS-II HMA 2.8 m IVUs, located at cells 4, 12 and 16, at their “open gap” position to protect against radiation when the IVUs are not in use.

The scope of this procedure includes: 1) performing Centrally Controlled LOTO on the HMA 2.8 m IVUs for beam testing and/or ring commissioning absent IDs, 2) performing Centrally Controlled LOTO to safely take the HMA 2.8 m IVUs out of service.

Lockout of an IVU at “open gap” is achieved by a physical disconnect with LOTO applied to the junction box pin connection receptacles for each of the motors (Gap Drive). The method outlined below continues to power all instrumentation useful for readback of the state (position) of each of the driven axes. The EPS switches will be used to provide a signal to the EPS system for continual monitoring.

2 DEFINITIONS

- 2.1 Centrally Controlled LOTO: LOTO of systems or equipment to prevent personnel injury and/or exposure to hazardous energy, for operational reasons.
- 2.2 Equipment Protection System (EPS): The engineered interlocks that protect ring-resident equipment during NSLS-II operations.
- 2.3 Primary Authorized Employee: An Authorized Employee who is designated by their department/division to coordinate complex-group LOTO procedures. The Primary Authorized Employee coordinates workforces and ensures continuity of LOTO protection for all involved (both Authorized and Affected Employees). They are the first to apply their lock and the last to remove their lock from a group LOTO. At the NSLS-II, Primary Authorized Employees apply Centrally Controlled LOTO for the protection of other workers as well.

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3 RESPONSIBILITIES

3.1 Authorized and Qualified ID Group Personnel

3.1.1 Apply Centrally Controlled LOTO, as described in this procedure.

3.1.2 Notify the Control Room, Mechanical Engineering Group Leader and Lead Beamline Scientist of the LOTO.

3.1.3 Communicate this procedure to all Affected Employees.

3.1.4 Address any concerns of the Affected Employees.

3.2 ID Group Cognizant Engineer/Technical Authority

3.2.1 Provides or directs System Expert support for HMA 2.8 m IVU System operation.

3.2.2 Provides clarification on HMA 2.8 m IVU System related issues in this procedure.

3.3 ESH Staff/Operations Staff (e.g., Lead Operator or FLOCO)

3.3.1 ESH Staff provide clarification and guidance on any ESH issues that arise during the execution of this procedure.

3.3.2 Apply Centrally Controlled LOTO, as required.

3.3.3 Ensure the IVU remains fully open during testing of Centrally Controlled LOTO.

4 PREREQUISITES

4.1 Primary Authorized Employees performing this procedure have completed training on PS-C-ASD-PRC-005, *Centrally Controlled Lockout/Tagout (LOTO) Procedure*.

4.2 Each Primary Authorized Employee performing this procedure has facility specific PPE.

4.3 The mezzanine resident Control Racks control the IVU motors and instrumentation, and must be fully configured. The cable configuration is shown in Figure 4-1.

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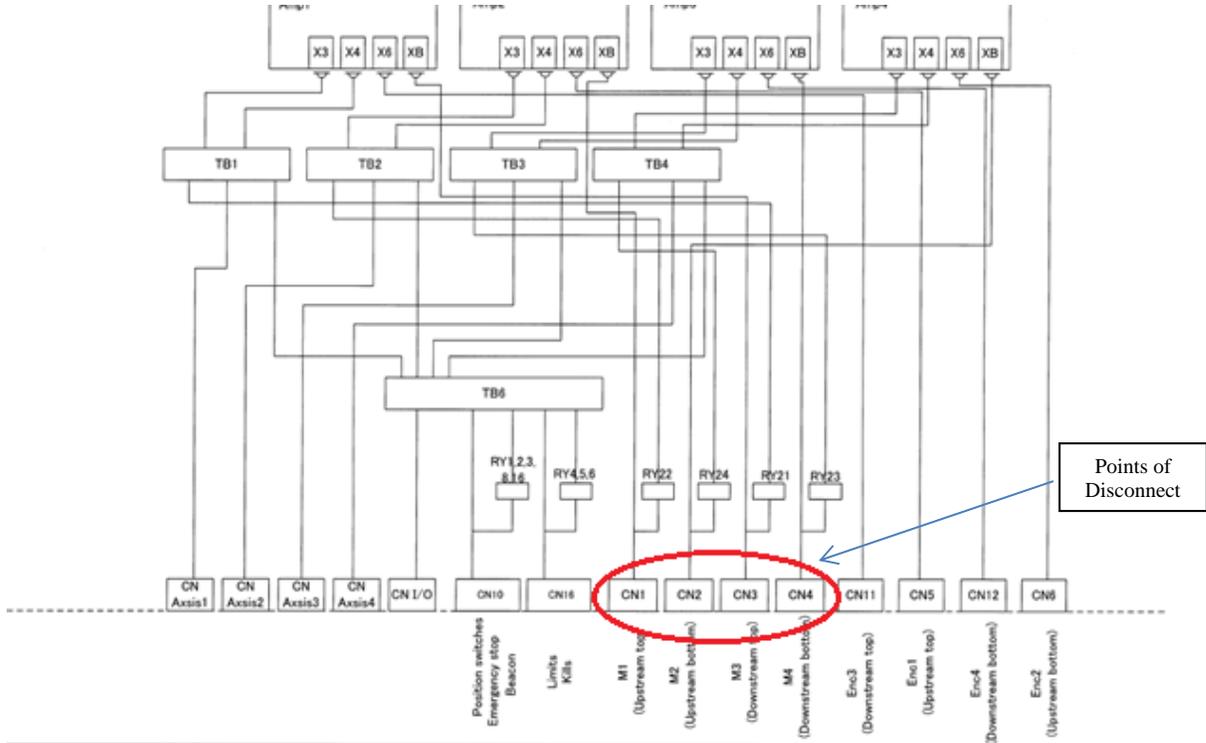


Figure 4-1: HMA 2.8 m IVU Control Rack to IVU Junction Box Cabling

4.4 For the HMA 2.8 m IVU to which LOTO will be applied, the following equipment/tools are required:

- Red-band padlocks; (Master series 31, BNL stock# I65062)
- Solid red lockout tags, (BNL stock# S81046) for Centrally Controlled LOTO
- Lockout key Lock Box, (Emedco MGB11, size: 6"h x 9"w x 3-1/2"d or equivalent)
- Custom 3D printed plastic gap gauge, (BNL Drawing# ID-ML-7105, Figure 4-2a and 4-2b)
- IVU junction box receptacle lock guards with ID Group (See Figure 4-3)

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Figure 4-3: IVU Junction Box Receptacle Lock Guards

- 4.5 The Gap Gauge (ID-ML-7105) has been internally calibrated within the past 12 months and documented with an inspection report.
- 4.6 Contact Operations Staff or ESH Staff to confirm availability to assist with the LOTO.
- 4.7 Notify the Mechanical Engineering Group Leader and Lead Beam Line Scientist of the impending LOTO.

5 PRECAUTIONS AND LIMITATIONS

- 5.1 Most IVUs are constructed with permanent magnets that do not have an on/off switch. Internal magnetic loads of many tons may be present. Though the magnetic gap is contained within the vacuum chamber, external fields could exceed 5 Gauss.
- 5.2 All steps in this procedure require Centrally Controlled LOTO, and shall be performed in accordance with PS-C-ASD-PRC-005, *Centrally Controlled Lockout/Tagout (LOTO) Procedure*. LOTO for any other purpose shall not be performed as part of this procedure.
- 5.3 Only a person that is identified as a Primary Authorized Employee may perform Centrally Controlled LOTO on the IVU and Control Rack.

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5.4 The following equipment remains powered during the performance of this procedure:

Note: The HMA 2.8 m IVU Control Racks for Straight Sections are offset by one cell on the mezzanine.

- The output voltage of the motor controllers; 24 VDC (will be powered throughout the procedure to receive instrumentation)
- A floor-mounted 208 VAC junction box (to the coil power supplies only) and 110 VAC power strip outlets on both sides powering the rack
- IVU-resident, absolute gap encoders (for readback of true gap to the IVU Control System)
- All limit switches

5.5 Deviations from expected configuration(s) requires a halt to this procedure for evaluation by the ID Group Cognizant Engineer.

6 PROCEDURE

6.1 Apply Centrally Controlled LOTO

Caution: During and after completion of this LOTO procedure, the IVU Control Rack remains energized; only the cable connectors for each of the motors are disconnected.

- 6.1.1 Obtain the appropriate LOTO junction box receptacle lock guards, padlocks, and tags.
- 6.1.2 Start the IVU windows application “IVU Engineering Mode” and “IVU GUI.”
- 6.1.3 Switch to Operations Mode (Manual, with green border GUI; see Figure 6-1a).

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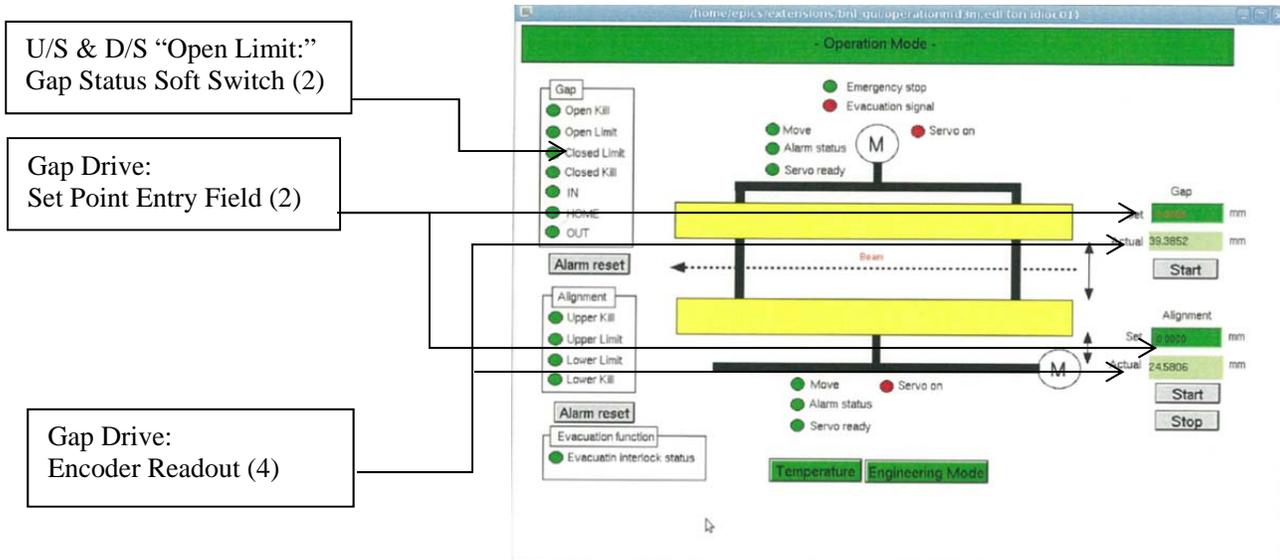


Figure 6-1a: IVU Control Screen

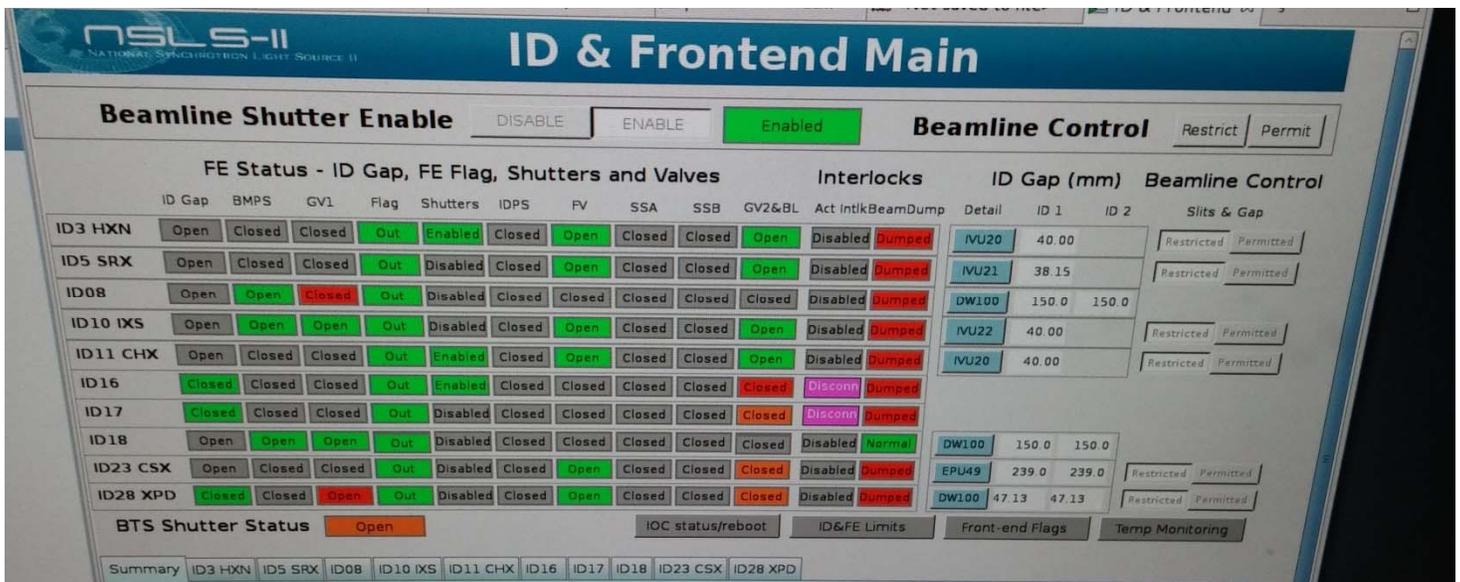


Figure 6-1b: EPS Control Screen, "ID and Front End" CSS Page

6.1.4 In Operations Mode (or Manual, with green border GUI) command the Gap Drive System to drive to a mid gap position (i.e., 20.0 mm; see middle of Figure 6-1a).

- a. Confirm that the readout on the encoder position of gap has reached the set point (see bottom of Figure 6-1a).

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6.1.5 At the HMA 2.8 m IVU within the ring, visually inspect the general state of the external girders of the Gap Drive System (from fully open to fully closed).

6.1.6 Use the gap gauge to confirm that the nominal position is mid gap.

- a. Locate the space between the upper and lower carriage plates that move each external girder (see Figure 6-2a).
- b. Insert gap gauge between the upper and lower carriage plates with the flat resting on the horizontal machined surface of the lower green plate (see Figure 6-2b).

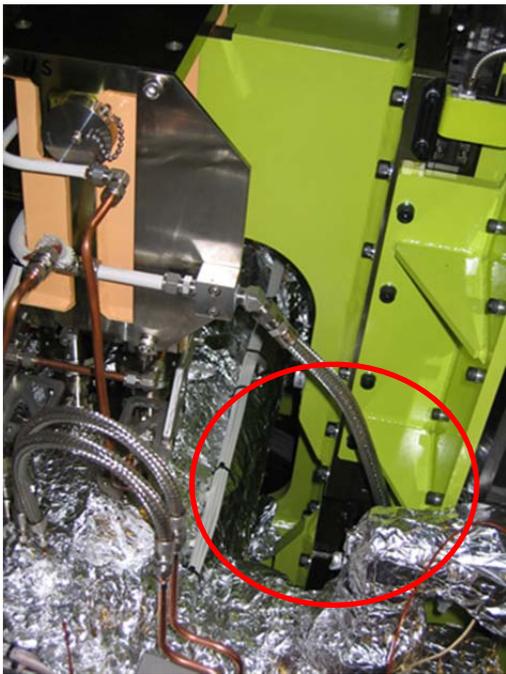


Figure 6-2a: Upper "Carriage Plate" Assembly

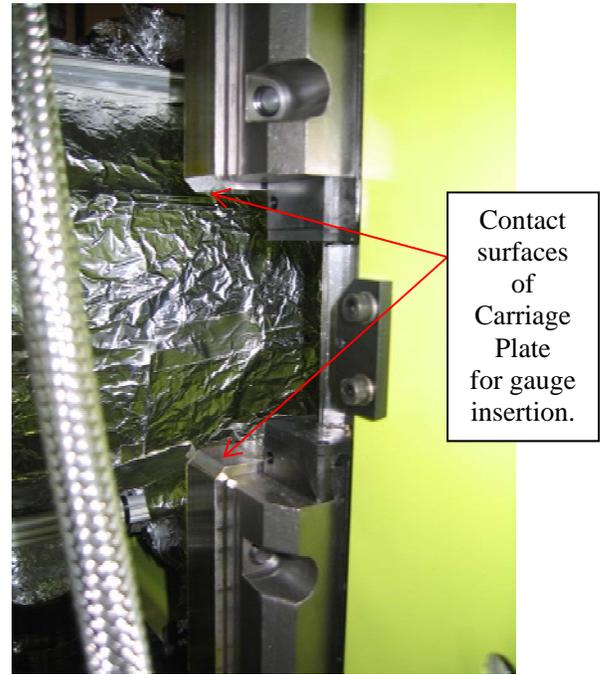


Figure 6-2b: Detail Area to Insert Gauge

Note: A Gap Drive motor decelerates to a stop whenever an outermost gap "open limit" switch is triggered. The "open limit" switch position is nominally set at 40.0 mm gap, just inside of the "kill switches."

6.1.7 In Operations Mode, command the Gap Drive System to drive to full open gap (see middle of Figure 6-1a).

Note: On the control screen, each GUI soft switch indicator changes from green to red as the outermost N/C gap limit contactors go from closed to open (see top of Figure 6-1a).

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6.1.8 To confirm the fully open gap set point has been reached (nominal 40.0 mm):

- a. View that the status indicator of the “open gap” limit switch is red (top of Figure 6-1a).

AND

- b. View the gap encoder readout on the control screen (bottom of Figure 6-1a).

AND

- c. Confirm the movement of the IVU gap to fully open using the “gap gauge.”

AND

- d. Check the “ID and Front End” CSS page to ensure that the EPS switch indicates “Open” as shown in Figure 6-1b.

6.1.9 Notify all Affected Employees of the intent to LOTO the IVU.

6.1.10 Ensure that the IVU in the affected straight section and its Control Rack are safe to shut down.

6.1.11 De-energize the PMAC motor controller as follows:

- a. Switch the motor amplifier breaker switch to the “Off” position as indicated in Figure 6-3.

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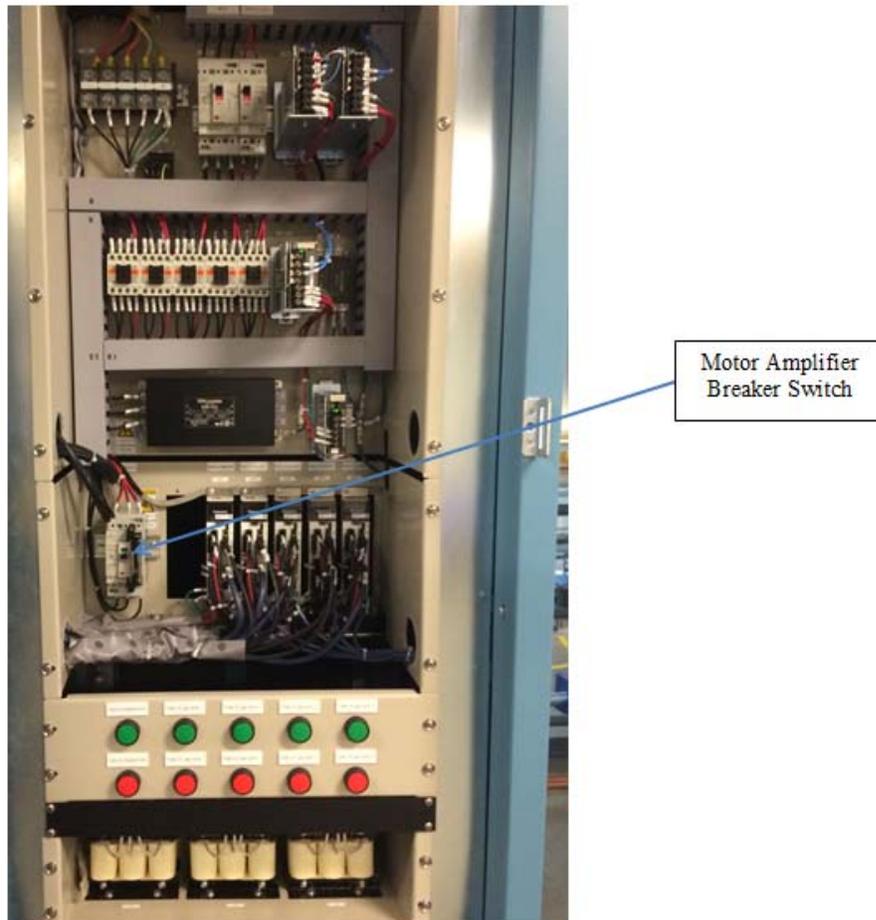


Figure 6-3: HMA IVU Control Rack front panel

Note: Each motor cable routed within the IVU is labeled with the respective termination symbol. For the HMA 2.8 m IVU: CN 1, 2, 3 and 4.

6.1.12 In the ring, identify the cable pin connectors (i.e., “plugs”) at each motor (see Figures 6-4 and 6-5).

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Figure 6-4: 2.8 m IVU Junction Boxes (2)



Figure 6-5: 2.8 m IVU Junction Box (2)

6.1.13 For each motor plug, loosen the knurled sleeve and disconnect the pin connector.

6.1.14 Apply the receptacle lock guards over each junction box (see Figure 6-6).

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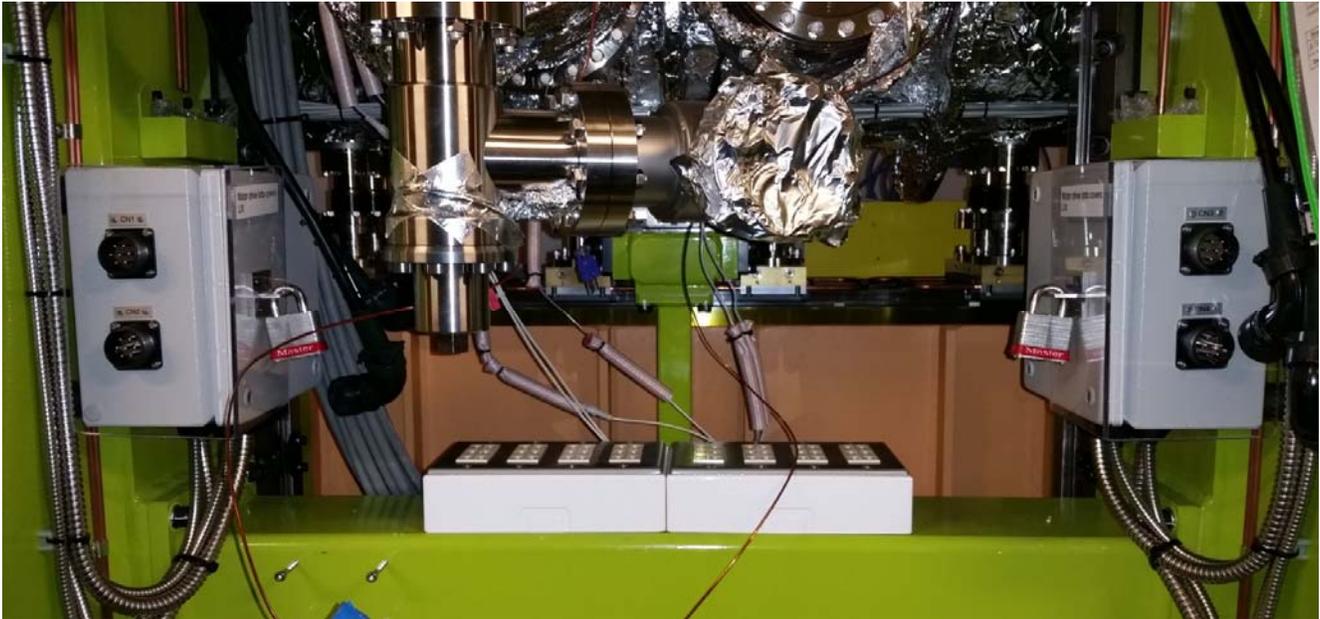


Figure 6-6: Receptacle lock guards (2) applied to 2.8 m IVU

Note: Hang a red lockout tag with a 50 lb. zip-tie from each padlock (see Figure 6-7).

6.1.15 Primary Authorized Employee applies a padlock AND red tag to each receptacle lock guard in accordance with PS-C-ASD-PRC-005, *Centrally Controlled Lockout/Tagout (LOTO) Procedure*.

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Figure 6-7: Properly applied LOTO lock and tag.

6.1.16 Challenge the receptacle lock guards and padlocks to ensure they are installed securely.

6.2 Test Centrally Controlled LOTO

6.2.1 Re-energize the PMAC motor controller as follows:

- a. Switch the motor amplifier breaker switch to the “On” position (see Figure 6-3).

6.2.2 Attempt to close the gap to confirm proper disconnect by performing the following:

- a. In Operations Mode (or Manual, with green border GUI), command the Gap Drive System to drive to mid gap position (i.e., 20.0 mm; see middle of Figure 6-1a).

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6.2.3 To confirm that the Gap Drive was NOT actuated:

- a. Confirm that the status indicator of the “open gap” limit switch is red (top of Figure 6-1a).

AND

- b. Check the “ID and Front End” CSS page to ensure that the EPS switch indicates “Open” as shown in Figure 6-1b.

AND

- c. ESH Staff OR Operations Staff ensures that the position of the IVU remains at fully open using the “gap gauge.”

6.2.4 Stow all keys to the padlocks in the lockout key Lock Box.

6.2.5 Primary Authorized Employee applies a lock and red tag to the Lock Box.

Note: After the Primary Authorized Employee applies their lock to the Lock Box, it will be kept in the Control Room for the duration of the LOTO.

- a. Apply lock and red tag in accordance with PS-C-ASD-PRC-005, *Centrally Controlled Lockout/Tagout (LOTO) Procedure*.

6.2.6 Document Centrally Controlled LOTO in accordance with PS-C-ASD-PRC-005, *Centrally Controlled Lockout/Tagout (LOTO) Procedure*.

6.2.7 Notify the Control Room, Lead Beamline Scientist and Mechanical Engineering Group Leader that LOTO has been successfully applied.

6.3 Restoring Equipment to Service - Clear LOTO

6.3.1 Verify that the reason for the LOTO is complete.

6.3.2 Ensure that all IVU and Control Racks in the affected straight section are safe to enable.

6.3.3 Notify the Control Room, Mechanical Engineering Group Leader and Lead Beamline Scientist of the intent to return to service.

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6.3.4 De-energize the PMAC motor controller:

- a. Switch the motor amplifier breaker switch to the "Off" position as indicated in Figure 6-3.

6.3.5 Primary Authorized Employee retrieves the keys to the padlocks from the Control Room in accordance with PS-C-ASD-PRC-005, *Centrally Controlled Lockout/Tagout (LOTO) Procedure*.

6.3.6 At the IVU in the ring, remove all tags, padlocks and receptacle lock guards.

6.3.7 Reconnect the cable connectors for each of the motors and brakes (for Gap Drive) to the proper plugs.

6.3.8 To re-energize the PMAC motor controller:

- a. Switch the motor amplifier breaker switch to the "On" position (see Figure 6-3).

6.3.9 Close the gap to confirm proper connection by performing the following:

- a. In Operations Mode (or Manual, with green border GUI), command the Gap Drive System to drive to a mid gap position (i.e., 20.0 mm) (see middle of Figure 6-1a).

- a.1 Confirm that the readout on encoder position of gap has reached the set point (see bottom of Figure 6-1a).

- b. At the HMA 2.8 m IVU within the ring, visually inspect that the general state of the Gap Drive System has moved (from fully open to mid gap).

- b.1 Use the provided "gap gauge" to confirm the nominal position is mid gap.

6.3.10 Notify Affected Employees that the work is complete, AND that the equipment is ready for use.

6.3.11 Return LOTO red tags and locks to the LOTO station.

6.3.12 Notify Control Room, Mechanical Engineering Group Leader and Lead Beamline Scientist that LOTO has been successfully removed.

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6.3.13 Document clearing of Centrally Controlled LOTO in accordance with PS-C-ASD-PRC-005, *Centrally Controlled Lockout/Tagout (LOTO) Procedure*.

7 REFERENCES

- 7.1 PS-C-ASD-PRC-005, *Centrally Controlled Lockout/Tagout (LOTO) Procedure*
- 7.2 Gap gauge, BNL Drawing# ID-ML-7105

8 ATTACHMENTS

None.

9 DOCUMENTATION

None.

-END