

The only official copy of this document is the one online in the PS 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.

Photon Sciences Directorate, Brookhaven National Laboratory			
Doc No. PS-C-ASD-PRC-122	Author: J. Rank	Effective Date: 17Nov2014 Review Frequency: 3 yrs	Version 2
Title: Lockout/Tagout of Damping Wiggler (DW) Insertion Device at Open Gap			Technical

Reviewed by:					
	12/1/2014		11/24/2014		11/14/2014
X	<u>Toshiya Tanabe</u>	X	<u>James Rank</u>	X	<u>Steve H Moss</u>
	Toshiya Tanabe ID Group Leader Signed by: Tanabe, Toshiya		James Rank ID Group Lead Mechanical Engineer Signed by: Rank, James P		Steve Moss Acting PS Conduct of Operations Manager Signed by: Moss, Steven H
	11/14/2014		11/14/2014		11/14/2014
X	<u>Bruce Lein</u>	X	<u>C. Porretto</u>	X	<u>Robert Lee</u>
	Bruce Lein PS Training Group Leader Signed by: Lein, Bruce		Christopher Porretto PS Quality Assurance Manager Signed by: Porretto, Christopher J		Robert Lee PS ESH Manager Signed by: Lee, Robert J

USI Screening/Resolution	Procedure Validation*
11/14/2014	
X	X
<u>Steve H Moss</u>	<u>NA</u>
Steve Moss PS Authorization Basis Manager Signed by: Moss, Steven H	NA Waived by Author and ConOps Manager
	*for Operations/Technical procedures only

Approved by:
11/25/2014
X
<u>Ferdinand Willeke</u>
Ferdinand Willeke PS Accelerator Division Director Signed by: Willeke, Ferdinand

The only official copy of this document is the one online in the PS 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.

Photon Sciences Directorate, Brookhaven National Laboratory			
Doc No. PS-C-ASD-PRC-122	Author: J. Rank	Effective Date: 17Nov2014 Review Frequency: 3 yrs	Version 2
Title: Lockout/Tagout of Damping Wiggler (DW) Insertion Device at Open Gap			Technical

VERSION HISTORY LOG

VERSION	DESCRIPTION	DATE
1	First Issue.	31Jan2014
2	Give Operations Staff personnel the ability to apply Centrally Controlled LOTO, removed "for Storage Ring Commissioning" from the title, minor editorial changes. Validation waived by Author, J. Rank and Acting Conduct of Operations Manager, S. Moss.	17Nov2014

ACRONYMS

BNL	Brookhaven National Laboratory	NSLS-II	National Synchrotron Light Source II
D/S	Downstream End of ID	N/C	Normally Closed
DVM	Digital Voltmeter	N/O	Normally Open
DW	Damping Wiggler	PMAC	Program. Multi-Axis (motor) Controller
EPS	Equipment Protection System	PPE	Personal Protective Equipment
ESH	Environment, Safety & Health	PS	Photon Sciences
FLOCO	Floor Coordinator	SBMS	Standards Based Management System
GUI	Graphic User Interface	U/S	Upstream End of ID
ID	Insertion Device (generic term)	VAC	Volts Alternating Current
JPM	Job-Performance Measure	VDC	Volts Direct Current
LOTO	Lockout/Tagout		

Photon Sciences Directorate, Brookhaven National Laboratory			
Doc No. PS-C-ASD-PRC-122	Author: J. Rank	Effective Date: 17Nov2014 Review Frequency: 3 yrs	Version 2
Title: Lockout/Tagout of Damping Wiggler (DW) Insertion Device at Open Gap			Technical

1 PURPOSE AND SCOPE

The purpose of this procedure is to provide instructions for LOTO of the NSLS-II Damping Wigglers at their "open gap" position to protect against radiation when the DWs are not in use.

The scope of this procedure includes 1) performing Centrally Controlled LOTO on all DW for beam testing and/or ring commissioning absent Insertion Devices, 2) performing Centrally Controlled LOTO to safely take a single DW out of service before ring operations.

Lockout of a Damping Wiggler at "open gap" is achieved by a physical disconnect and LOTO is applied to the cable connectors for each of the motors (Gap Drive and Elevator Base). The method outlined below continues to power all instrumentation useful for readback of the state (position) of each driven axes. The outer gap limit 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.

Photon Sciences Directorate, Brookhaven National Laboratory			
Doc No. PS-C-ASD-PRC-122	Author: J. Rank	Effective Date: 17Nov2014 Review Frequency: 3 yrs	Version 2
Title: Lockout/Tagout of Damping Wiggler (DW) Insertion Device at Open Gap			Technical

3 RESPONSIBILITIES

3.1 Authorized and Qualified ID Group Personnel

- 3.1.1 Performs the following procedure using proper PPE per the BNL SBMS Subject Area, *Electrical Safety* and the Arc Flash Warning label posted on the disconnect or circuit breaker that powers the equipment to be de-energized.
- 3.1.2 Applies Centrally Controlled LOTO, as described in this procedure.
- 3.1.3 Notifies PS Control Room of the LOTO.
- 3.1.4 Communicates this procedure to all Affected Employees.
- 3.1.5 Addresses any concerns of employees who might be exposed.
- 3.1.6 Ensure each person understands hazards and safety-related work practice to use.

3.2 ID Group Cognizant Engineer/Technical Authority

- 3.2.1 Reviews all revisions to this document and revises this document as needed.
- 3.2.2 Provides or directs system expert support for DW Systems operation.
- 3.2.3 Provides clarification on any DW System related issues in this procedure.
- 3.2.4 Ensures that the on-line copy of this procedure is kept current via periodic review, initiating revisions as necessary.

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

- 3.3.1 ESH Staff provides clarification and guidance on any ESH issues that arise during the execution of this procedure.
- 3.3.2 Applies Centrally Controlled LOTO, as required.
- 3.3.3 Ensure the DW remains at fully open during testing of Centrally Controlled LOTO.

The only official copy of this document is the one online in the PS 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.

Photon Sciences Directorate, Brookhaven National Laboratory			
Doc No. PS-C-ASD-PRC-122	Author: J. Rank	Effective Date: 17Nov2014 Review Frequency: 3 yrs	Version 2
Title: Lockout/Tagout of Damping Wiggler (DW) Insertion Device at Open Gap			Technical

3.4 Storage Ring Manager

3.4.1 Applies Centrally Controlled LOTO, as required.

4 PREREQUISITES

- 4.1 Primary Authorized Employees performing this procedure have completed and have read 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 If for any reason the mezzanine resident Control Racks are unavailable, control will be via the ID Group's custom Portable Control Rack. This requires use of a set of custom jumper cables that reside in storage at ID Group trailer. These cables must then be configured as in Figure 4-1.



Figure 4-2: DW Portable Control Rack to DW Junction Box Cabling (where necessary)

Photon Sciences Directorate, Brookhaven National Laboratory			
Doc No. PS-C-ASD-PRC-122	Author: J. Rank	Effective Date: 17Nov2014 Review Frequency: 3 yrs	Version 2
Title: Lockout/Tagout of Damping Wiggler (DW) Insertion Device at Open Gap			Technical

- 4.4 For each DW to which LOTO will be applied the following equipment/ tools are required:
- Four (4) “Gate Valve” (here, “Plug”) Lockout Discs (National Safety Compliance, Inc. #LO485, manufacturer part# 69342; no customization required, See Fig 4-2).
 - Four (4) yellow Plug Lockout Boot (Prinzing Enterprises # PL023, See Fig 4-3).
 - Eight (8) red-banded padlocks (Master series 31, BNL stock number I65062)
 - Solid red lockout tags, (BNL stock number S81046) for Centrally Controlled LOTO
 - Lockout key Lock Box, (Emedco MGB11, size: 6"h x 9"w x 3-1/2"d or equivalent)
 - Manufactured wooden “gap gauge”, (BNL Drawing# ID-ML-7100)
 - DW Portable Rack and custom jumper cable set in storage at ID Group trailer.

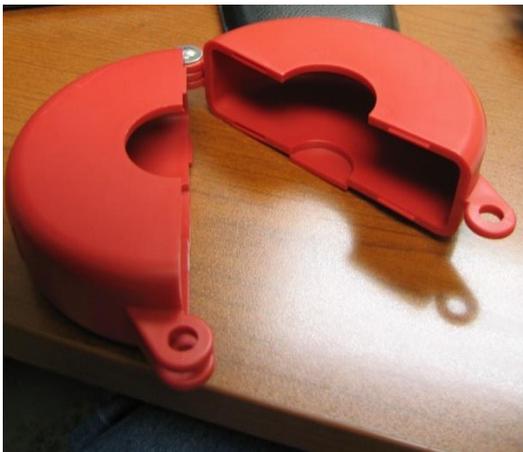


Figure 4-2: Plug Lockout Disc (for motors)



Figure 4-3: Plug Lockout Boot (for brake cables)

- 4.5 Contact Operations Staff or ESH Staff to confirm availability to assist with testing the LOTO.
- 4.6 The gap gauge has been internally inspected within the past 12 months and documented with the inspection report.

5 PRECAUTIONS AND LIMITATIONS

- 5.1 Most DW 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 guarded,

Photon Sciences Directorate, Brookhaven National Laboratory			
Doc No. PS-C-ASD-PRC-122	Author: J. Rank	Effective Date: 17Nov2014 Review Frequency: 3 yrs	Version 2
Title: Lockout/Tagout of Damping Wiggler (DW) Insertion Device at Open Gap			Technical

magnetic materials should be kept clear of the "beam centerline" area. A selection of non-magnetic tools are available from the ID Group.

- 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 DW and Control Rack.
- 5.4 The output voltage of the PMAC motor controllers is 24 VDC and will be powered throughout the procedure. DW Control Racks for Straight Sections at Cells 8, 18 and 28 reside on the mezzanine level above Cells 7, 17 and 27, respectively. A floor-mounted 208VAC junction box (to the coil power supplies only) and 110VAC power strip outlets on both sides powers these Racks. Throughout this lockout process the DW-resident correction coils, absolute gap encoders (for readback of true gap to the DW Control System), the elevation encoders (for readback of centering of magnetic midplane about the electron beam axis), and all limit switches will also remain powered.
- 5.5 Deviations from expected configuration(s) requires a halt to this procedure for evaluation.

6 PROCEDURE

6.1 Apply Centrally Controlled LOTO

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

- 6.1.1 Obtain the appropriate LOTO Plug Lockouts, padlocks and tags.
- 6.1.2 IF the Control Rack is installed and available at the mezzanine (see section 5.4), THEN proceed to step 6.1.4. Do not perform step 6.1.3.
- 6.1.3 Set-up the Portable Control Rack (See section 4.3) to drive the DW (where necessary) as follows:
 - a. Obtain the full set of jumper cables from the ID Group (See section 4.3).

Photon Sciences Directorate, Brookhaven National Laboratory			
Doc No. PS-C-ASD-PRC-122	Author: J. Rank	Effective Date: 17Nov2014 Review Frequency: 3 yrs	Version 2
Title: Lockout/Tagout of Damping Wiggler (DW) Insertion Device at Open Gap			Technical

- b. Connect all switch and encoder cables per Figure 4-1.
- c. Connect four brake cables to M1 Brake, M2 Brake,...and M4 Brake terminals.
- d. Connect four motor cables to M1 Motor, M2 Motor,...and M4 Motor terminals.
- e. Plug the PC into 110VAC outlet, power and boot up the on board computer
- f. On the motor power supply, turn motor switches to “open”.
- g. Energize the power supply.
- h. Enter username “EPICS” and password ”epics password”.
- i. Start the windows application “IDCS Application-simulated MPS”.
- j. Start the windows application “IDCS GUI”.
- k. Switch to Operations Mode (Manual, with green border GUI). See Figure 6-1.

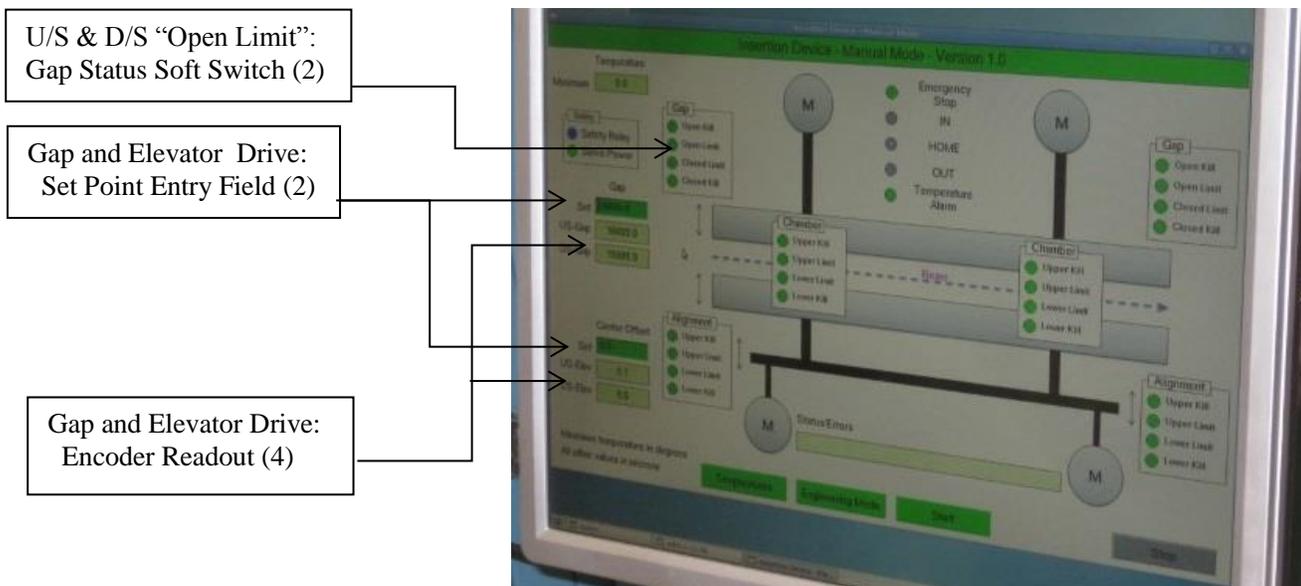


Figure 6-1: DW Control Screen

Photon Sciences Directorate, Brookhaven National Laboratory			
Doc No. PS-C-ASD-PRC-122	Author: J. Rank	Effective Date: 17Nov2014 Review Frequency: 3 yrs	Version 2
Title: Lockout/Tagout of Damping Wiggler (DW) Insertion Device at Open Gap			Technical

6.1.4 In Operations Mode (or Manual, with green border GUI) command the Gap Drive System to drive to a mid gap position (e.g., 50 mm). See middle of Figure 6-1.

- a. Confirm that the readout on encoder position of gap and elevation has reached the set point. See bottom of Figure 6-1.

6.1.5 At the affected DW within the ring, visually inspect the general state of the Gap Drive System (from fully open to fully closed) and Elevator Base System (from high to low).

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

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 150.24 mm gap, just inside of the "kill switches"

6.1.6 In Operations Mode, command the Gap Drive System to drive to full open gap. See middle of Figure 6-1.

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 6-1.

6.1.7 To confirm the fully open gap set point has been reached (nominal 150 mm):

- a. View the red status indicator of the "open limit" soft switch (top of Figure 6-1).

AND

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

AND

- c. Witness the movement of the DW gap to fully open using the "gap gauge".

6.1.8 Notify all Affected Employees of the intent to LOTO the DW.

6.1.9 Ensure DW in the affected straight section and its Control Rack are safe to shut down.

The only official copy of this document is the one online in the PS 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.

Photon Sciences Directorate, Brookhaven National Laboratory			
Doc No. PS-C-ASD-PRC-122	Author: J. Rank	Effective Date: 17Nov2014 Review Frequency: 3 yrs	Version 2
Title: Lockout/Tagout of Damping Wiggler (DW) Insertion Device at Open Gap			Technical

6.1.10 Set up work boundaries at the mezzanine to prevent unauthorized personnel from entering the area near the DW Control Rack set.

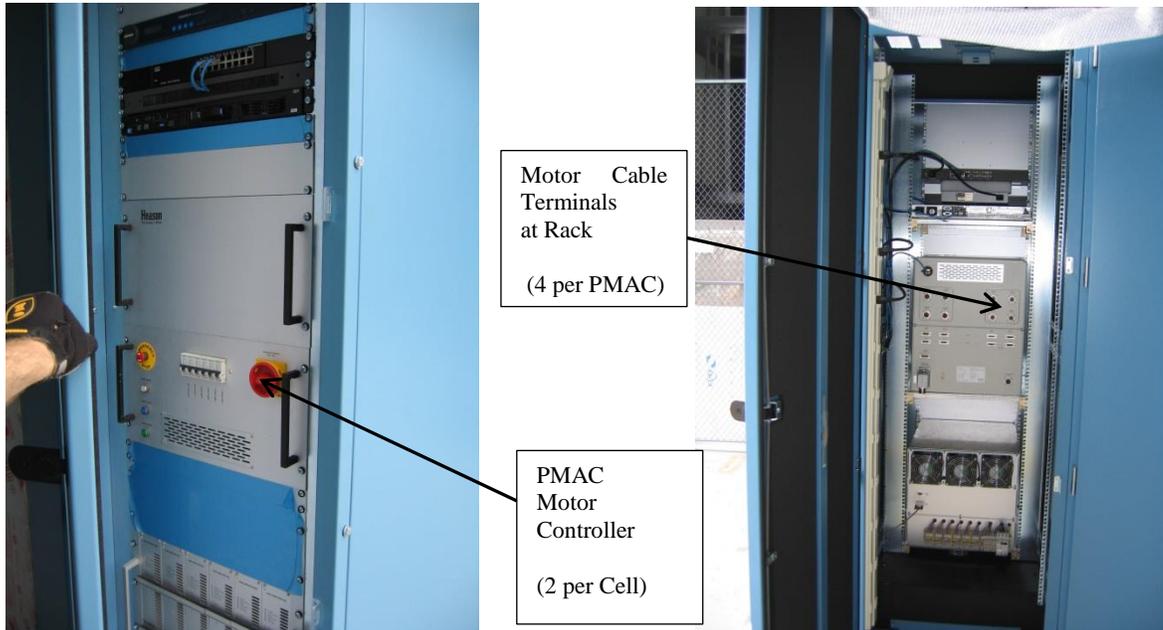


Figure 6-2: DW Control Rack front panel.

Figure 6-3: DW Control Rack back panel.

6.1.11 De-energize the PMAC motor controller as follows:

- a. Turn the red dial on its front panel to switch off power. See Figure 6-2.

AND

- b. Pull the PMAC 110VAC plug to the power strip at the sides of the rack.

Note: Each motor cable routed within the DW is labeled with respective termination symbol. See Figure 6-6, "M1 Power", for example; (e.g., M2 Power, M3 Power..., and M4 Power).

6.1.12 In the ring, identify the cable pin connectors (i.e., "plugs") at each motor (i.e., two Gap Drive, two Elevator Base; total of four). See Figures 6-4 and 6-5, respectively.

The only official copy of this document is the one online in the PS 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.

Photon Sciences Directorate, Brookhaven National Laboratory			
Doc No. PS-C-ASD-PRC-122	Author: J. Rank	Effective Date: 17Nov2014 Review Frequency: 3 yrs	Version 2
Title: Lockout/Tagout of Damping Wiggler (DW) Insertion Device at Open Gap			Technical

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

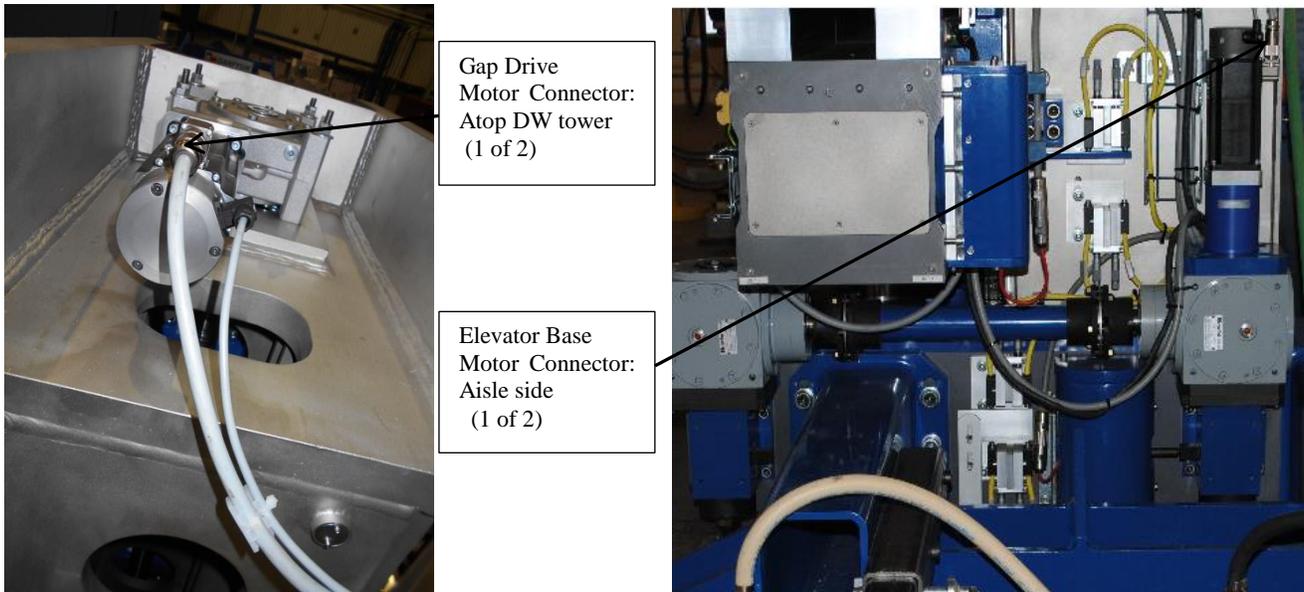


Figure 6-4 & 6-5: DW Gap and Elevation Motors (one U/S and one D/S for each, total four per DW).

6.1.14 For each Gap Drive motor atop the tower (two places) clamp a Plug Lockout Disc over the motor connector. See Figure 6-6.

6.1.15 For each Elevator motor on the aisle side (two places) clamp a Plug Lockout Disc over the connector behind the lexan guard. See Figure 6-7.

The only official copy of this document is the one online in the PS 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.

Photon Sciences Directorate, Brookhaven National Laboratory			
Doc No. PS-C-ASD-PRC-122	Author: J. Rank	Effective Date: 17Nov2014 Review Frequency: 3 yrs	Version 2
Title: Lockout/Tagout of Damping Wiggler (DW) Insertion Device at Open Gap			Technical

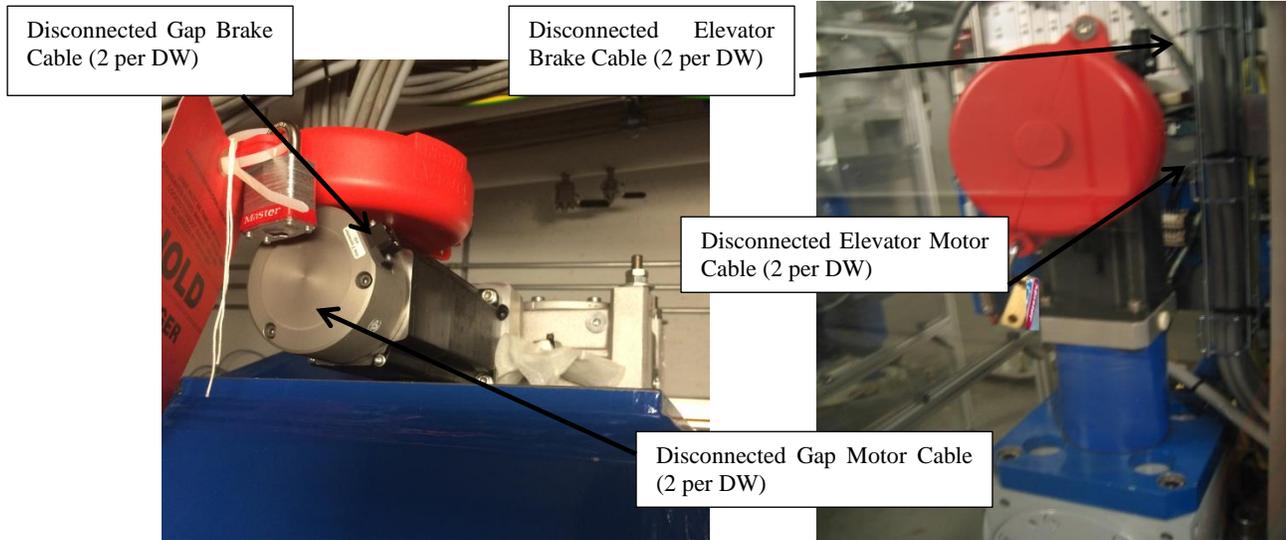


Figure 6-6 & 6-7: LOTO applied to Gap(left) and Elevation (right) Motors(total four places per DW).

6.1.16 Locate the motor brake cables as shown in Figure 6-6 and 6-7 (total of four).

6.1.17 For each brake cable remove the fastener atop the plug.

Note: Each motor brake cable routed within the DW is labeled with respective termination markings (e.g., M1 Brake, M2 Brake, ..., and M4 Brake).

6.1.18 Perform a physical disconnect of each motor brake cable plug (both Gap Drive and Elevator Base, four places total).



Figure 6-8: Disconnected DW motor and brake cable plug pair.

6.1.19 Gather free ends of disconnected motor and brake cable plugs, insert into the Plug Lockout Boot and enclose (four places total). See Figure 4-3 and 6-8.

Photon Sciences Directorate, Brookhaven National Laboratory			
Doc No. PS-C-ASD-PRC-122	Author: J. Rank	Effective Date: 17Nov2014 Review Frequency: 3 yrs	Version 2
Title: Lockout/Tagout of Damping Wiggler (DW) Insertion Device at Open Gap			Technical

6.1.20 Primary Authorized Employee applies a padlock and red tag to each Plug Lockout in accordance with PS-C-ASD-PRC-005, *Centrally Controlled LOTO Procedure* (total eight places). Hang the solid red lockout tag (BNL stock number S81046) using a 50 lb. rated zip-tie from each padlock.

6.1.21 Challenge the Plug Lockouts 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. Plug in the PMAC to the 110VAC power strip at the sides of the rack.

AND

- b. Turn the red dial on its front panel to switch on power. See Figure 6-2.

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

- a. In Operations Mode (i.e., Manual,) command the Gap Drive System to drive to mid gap position (e.g., 50 mm). See middle of Figure 6-1.

6.2.3 To confirm that neither the Gap Drive nor Elevation motors were actuated:

- a. Confirm red status indicator of the "open limit" soft switch (top of Figure 6-1).

AND

- b. IF the ring is accessible, THEN Contact Operations Staff or ESH Staff to witness the position of the DW 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 Operations Staff or ESH Staff applies a lock and red tag to the Lock Box.

Note: After the Operations Staff or ESH Staff applies their lock to the Lock Box, it will be kept in the Main Control Room for the duration of the LOTO.

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

Photon Sciences Directorate, Brookhaven National Laboratory			
Doc No. PS-C-ASD-PRC-122	Author: J. Rank	Effective Date: 17Nov2014 Review Frequency: 3 yrs	Version 2
Title: Lockout/Tagout of Damping Wiggler (DW) Insertion Device at Open Gap			Technical

6.2.7 Notify the Control Room 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 all DW and Control Racks in the affected straight section are safe to enable

6.3.3 Contact Operations Staff or ESH Staff for removal of their lock from the Lock Box.

6.3.4 Notify the Control Room of the intent to return to service.

6.3.5 De-energize the PMAC motor controller:

a. Turn the red dial on its front panel to switch off power. See Figure 6-2.

AND

b. Pull the PMAC 110VAC plug to the power strip at the sides of the rack.

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

Note: A total of eight Plug Lockouts are removed from eight cables and four plugs.

6.3.7 At the DW in the ring, remove all tags, padlocks and Plug Lockouts.

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

6.3.9 To re-energize the PMAC motor controller:

a. Plug in the PMAC to the 110VAC power strip at the sides of the rack.

AND

b. Turn the red dial on its front panel to switch on power. See Figure 6-2.

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

Photon Sciences Directorate, Brookhaven National Laboratory			
Doc No. PS-C-ASD-PRC-122	Author: J. Rank	Effective Date: 17Nov2014 Review Frequency: 3 yrs	Version 2
Title: Lockout/Tagout of Damping Wiggler (DW) Insertion Device at Open Gap			Technical

- a. In Operations Mode (or Manual, with green border GUI), command Gap Drive System to drive to a mid gap position (e.g., 50 mm). See middle of Figure 6-1.
 - a.1 Confirm that the readout on encoder position of gap and elevation has reached the set point. See bottom of Figure 6-1.
- b. At the affected DW within the ring, visually inspect the general state of the Gap Drive System (from fully open to fully closed) and Elevator Base System (from high to low).
 - b.1. Use the provided "gap gauge" to confirm the nominal position is mid gap.

6.3.11 Notify Affected Employees work is complete, equipment ready for use.

6.3.12 Return group LOTO red tags to LOTO station.

6.3.13 Notify the Control Room that LOTO has been successfully removed.

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

7 REFERENCES

- 7.1 BNL SBMS Subject Area, *Electrical Safety*
- 7.2 PS-C-ASD-PRC-005, *Centrally Controlled Lockout/Tagout (LOTO) Procedure*
- 7.3 Gap gauge, BNL Drawing# ID-ML-7100

8 ATTACHMENTS AND DOCUMENTATION

None.

-END-