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C-A OPERATIONS PROCEDURES MANUAL

2.6.1 Procedure for Lockout/Tagout for the AGS and Booster Rings,  
During Accelerator Operations

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Attachments

Hand Processed Changes

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Approved: \_\_\_\_\_ *Signature on File* \_\_\_\_\_  
 Collider-Accelerator Department Chairman                      Date

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## 2.6.1 Lockout-Tagout Procedure for the AGS and Booster Rings, During Accelerator Operations

### 1. Purpose

- 1.1 This procedure provides instructions to Operations Coordinators, MCR Operators, Collider-Accelerator Support Technicians (CAS), and AGS Main Magnet Operators for locking out the AGS and/or Booster Accelerator Rings, during particle beam operations (including maintenance periods), under Controlled or Restricted access conditions, so that personnel can enter with the assurance that electrical hazards have been secured or are properly barriered.
- 1.2 C-A Policy states that the preferred method to protect workers from energy sources is Lockout/Tagout. See [C-A-OPM 2.6.2](#) for situations where LOTO cannot be performed.

**Note:**

This procedure is to be applied only to the AGS and Booster Rings.

### 2. Responsibilities

- 2.1 Responsibilities of the Operations Coordinator
  - 2.1.1 The Operations Coordinator (OC), the Head of the MCR Group, or the Deputy Accelerator Division Head, shall inform the MCR Operators or CAS Personnel, whether access to the accelerator is to be "Controlled" or "Restricted", and which lockout/tagout checklist (see attachments) shall be used.
  - 2.1.2 If alternate energy control devices are used to achieve an equivalent level of safety, the OC shall note this on the appropriate checklist and the equivalent checklist.
  - 2.1.3 The OC shall designate two individuals (Operators or CAS Technicians), with lockout/tagout training, one as the Responsible Authorized Person (RAP), and the other as the Safety Watch Verifier (SWV).
  - 2.1.4 If Operations-applied LOTO is in effect during an operator shift change the OC shall:
    - Designate a new RAP and SWV,
    - Follow the provisions of paragraph 5.1.4.

2.1.5 The OC should insure that those individuals called to work in the accelerator during off-hours have properly and fully assessed any electrical hazards that may be present after the application of Operations-applied LOTO and which may impact the work that the individuals are performing or which may impact the worker's personal safety. If the OC has any doubts about the worker's preparedness, it is the OC's responsibility to review the work with the technical supervisor or to call in the technical supervisor to do the work planning as the OC deems appropriate.

2.2 Responsibilities of the MCR Operators, CAS Technicians.

2.2.1 One individual (MCR Operator or CAS Technician), shall act as the RAP and one as the SWV. They shall perform Lockout/Tagout (LOTO) for the AGS and/or Booster Rings.

### 3. Prerequisites

3.1 All personnel working on any electrical system or equipment in the C-AD shall be familiar with BNL [SBMS Electrical Safety](#), BNL [SBMS Lockout/Tagout \(LO/TO\)](#), [C-A-OPM 1.5, "Electrical Safety Implementation Plan"](#), [C-A-OPM 1.5.3 "Procedure to Open or Close Breakers and Switches and Connecting/Disconnecting Plugs"](#), [C-A-OPM 2.36, "Lockout/Tagout for Control of Hazardous Energy"](#). C-AD will provide on-site/work specific training to individuals in the electrical safety aspects of their job functions and assignments.

3.2 Before conducting any work in the accelerators, all personnel must insure that they have properly and fully assessed all of the electrical hazards that their work may impact or that may impact the worker's personal safety. All such hazards should be properly mitigated and energy controls (LOTO) applied before work commences including those devices not locked and tagged in Operations-applied LOTO. Workers must apply their personal or group locks and tags to any device deemed to pose a hazard to the worker while performing a particular job and that are not part of Operations-applied LOTO. In addition, workers must add their personal or group lock to the Operations-applied LOTO lock.

3.3 Prerequisites of importance for the Operations Coordinator.

3.3.1 LOTO must precede an HP survey as described in [C-A-OPM 4.1](#).

3.3.2 The following systems have been reviewed and are properly barriered, or are in a range A category, as defined in reference 7.1:

3.3.2.1 Vacuum systems: all vacuum pumps and gauges,

3.2.2.2 Ring general services: i.e., 120 V, 208 V, 480 V power receptacles, fire detection and protection equipment, lighting and ventilation equipment.

3.3.3 If a device cannot be locked out, but an equivalent lockout achieves the same level of safety, then [C-A-OPM-ATT 2.6.1.e](#) shall be used in conjunction with the appropriate checklist.

3.2.3.1 The OC shall determine, with the help of the systems specialist, whether a lockout is equivalent.

3.4 Prerequisites of importance for the MCR Operators and CAS Technicians.

3.4.1 Only qualified and trained MCR Operators, Operations Coordinator, and CAS Technicians, may perform the LOTO steps outlined in this procedure.

3.4.2 The appropriate attachment, listed in Section 8.0 of this procedure, is filled out prior to allowing entry to an accelerator.

**Note:**

The Booster and the AGS each have their respective TOKENS, TOKEN BOXES, and lock boxes.

**4. Precautions**

4.1 All personnel shall ensure their own safety by following the standards, safety rules, and the training they receive. In general, all energy sources must be locked out and tagged. Working on or near energized sources is not permitted unless a valid working on or near hot permit has been issued. Personnel shall utilize tools, instruments, equipment (e.g. proper connectors and proper ac line cords), etc., that are safe and proper for the job. If any part of a job appears unsafe to any individual, it is their duty to discontinue work and inform the supervisor, manager, ESH Coordinator, or the C-A ESSHQ Division Head, of the unsafe condition, or issue a STOP WORK order as appropriate.

4.2 Precautions of interest to the Operations Coordinator

4.2.1 All of the energy disconnect switches on the appropriate Lockout-Tagout Checklist shall be opened, locked, and tagged, according to this procedure.

4.2.1.1 If any apparatus on the appropriate checklist, or an equivalent checklist, cannot be locked out for operational reasons, use procedure [C-A-OPM 2.6.2](#).

- 4.2.2 Depending on the Physics Program that the accelerator is serving, the Head of the MCR Group may designate a RAP and SWV, to perform the LOTO for items not in operation but listed on the checklists.

For example, if SBE, and/or FEB, and/or Polarized Protons, is not running, then the lockout/tagout shall already have been performed, and the keys shall be in the MCR key locker. The RAP and SWV shall verify, record the lock number, and initial the checklist and the tag on the energy control device.

- 4.2.3 Workers are required to identify all electrical hazards that their work in the accelerator may impact or that might impact the worker's personal safety including those devices not locked out through Operations-applied LOTO. For these devices, workers are required to apply their personal or group locks and tags. In addition, workers are required to apply their locks and tags to the Operations-applied LOTO lock. Furthermore, if workers encounter an unexpected or unanticipated hazard that poses an imminent danger to themselves or others, they should issue a formal STOP WORK order and immediately report the condition to allow review and reassessment of the work conditions and procedures.

- 4.3 Precautions of interest to MCR Operators, CAS Technicians.

- 4.3.1 The RAP and SWV shall wear appropriate PPE, including safety glasses, when opening energy control devices.

- 4.3.2 MCR personnel that enter an accelerator ring are subject to the requirements of workers as described in [C-A-OPM 2.6](#).

**Warning:**

To avoid damaging the AGS MMPS 95 switches, LOTO \*'d items before executing the MMPS LOTO procedure.

- 4.4 Ring equipment testing shall be allowed under Restricted Access if the restrictions in [C-A-OPM 2.6.2](#) or [C-A-OPM 2.6.8](#) are followed.

**5. Procedure**

- 5.1 Procedures for the Operations Coordinator:

5.1.1 **RESTRICTED ACCESS**

- 5.1.1.1 With the accelerator on Controlled Access, the OC shall instruct the Operators, and /or CAS Technicians, to perform LOTO using the Standard (Restricted Access) Checklists ([C-A-OPM-ATT 2.6.1.b](#) and/or [2.6.1.d](#)).

5.1.1.2 When LOTO is completed, and an HP survey completed (where required), the accelerator may be switched to the Restricted Access state.

### 5.1.2 CONTROLLED ACCESS

5.1.2.1 With the accelerator on Controlled Access, the OC shall instruct the MCR Operators, or CAS Technicians, to perform LOTO using either the Standard Checklists ([C-A-OPM-ATT 2.6.1.a](#) and/or [2.6.1.c](#)), an Equivalent Checklist, or a Special Checklist.

5.1.2.2 After LOTO is implemented and HP is available to enter the enclosure with the first work team, then the ring may be opened for entry.

**Note:**

The OC may order the state of the Radiation Access Control System to be changed from Controlled Access to Restricted Access after a LOTO, using the appropriate checklist of Attachments 2.6.1.a-e has been executed, and Health Physics survey.

### 5.1.3 CHECKLISTS

5.1.3.1 Standard Checklist (Attachments 2.6.1.a through 2.6.1.d) is a list of energy control devices, which when opened, locked, and tagged, shall produce a condition of minimal electrical hazard in the ring enclosure.

5.1.3.2 Equivalent Checklist, [C-A-OPM-ATT 2.6.1.e](#), provides the same level of safety as the Standard Checklist.

It may be employed, with Safety Section concurrence, when authorized by the Deputy Division Head, the Head of the MCR Group, the Chief Electrical Engineer, or the Work Coordinator. This checklist is used in conjunction with the Standard Checklist by:

- Referencing the item(s) on the Standard Checklist that are not locked out and,
- Listing the Energy Isolation Devices that are locked out instead, or
- Listing the devices whose circuits entering the ring, have been disconnected, locked and tagged.

5.1.3.3 Use [C-A-OPM-ATT 2.6.1.e](#) to document partial LOTO.

5.1.3.3.1 When being used for partial LOTO, Strike through the word "equivalent" at top of the form.

5.1.4 INSTRUCTING OPERATORS, AND CAS TECHNICIANS

5.1.4.1 During Accelerator Operations, the Operations Coordinator shall designate a RAP and SWV to perform the lockout.

5.1.4.2 During shutdown periods, the RAP and SWV may be selected from qualified personnel, by the Head of the MCR Group or the C-A Work Coordinator.

5.2 Procedures for MCR Operators, CAS Technicians to perform LOTO.

5.2.1 The RAP and the SWV shall utilize Operations-applied LOTO Red Tags. A sample of which is shown below.



5.2.2 The RAP and SWV shall lockout and tagout the appropriate energy control devices for the accelerator rings, using the checklist(s) designated by the OC.

5.2.2.1 The RAP and SWV shall enter the appropriate information on the checklist, as each energy control device on the checklist is opened, locked, and tagged.

5.2.2.2 The RAP shall note, on the back of the checklist, any special instructions or hazards.

5.2.3 The RAP shall turn each switch to the open/off position, then confirm that the power supplies associated with the switch have been de-energized using one of following methods:

5.2.3.1 Test each of the associated power supplies for local operation.

5.2.3.1.1 Consult [C-A-OPM 2.6.1 attachment](#) to obtain specific verification steps.

5.2.3.1.2 On the appropriate checklist, check off each supply as verification tests are completed.

5.2.3.2 Instead of checking each associated supply, the RAP may use an approved voltmeter to check for voltage on the load side of the switch. THIS STEP MAY ONLY BE DONE IF THE RAP IS WEARING APPROPRIATE Personal Protective Equipment.

**Caution:**

UNDER NO CIRCUMSTANCES SHALL COMPONENTS OR WIRING INSIDE THE SWITCH BE TOUCHED, SINCE THEY MAY BE ENERGIZED.

**Caution:**

DUE TO THE ELECTRICAL HAZARD, ALL LINE-TO-LINE VOLTAGES (A-B, B-C, C-A) AND/OR ALL LINE-TO-GROUND VOLTAGES SHALL BE ZERO FOR THE SWITCH TO BE CONSIDERED OPEN.

5.2.4 The RAP shall then close the door if necessary, and apply the lock and tag to the switch handle.

5.2.4.1 Both the RAP and the SWV shall initial the entry in the column marked RAP on and SWV on, respectively.

5.2.4.2 If ES&F apparatus is LOTO, then place the kirk keys to the apparatus into the ESF lock box in the ESF Tech Shop, and apply one MCR lock and tag to the lock box, and place this key in the MCR/AGS Lockbox.

5.2.5 After all switches for the AGS have been locked and tagged open, the RAP shall:

5.2.5.1 Place the set of keys into the AGS lock box located in the MCR and apply a lock to this box. The key to this lock is the AGS TOKEN.

5.2.5.2 The RAP shall place the AGS TOKEN in the AGS TOKEN BOX.

**Note:**

The AGS Token Box can be mobile and may be placed at an AGS gate chosen by the OC or the Maintenance Coordinator.

5.2.5.3 Lock and tag the TOKEN BOX using a lock multiplier.

- 5.2.5.3.1 Store this key in the captured key locker above MCR\_2.
- 5.2.5.4 When not in use, the AGS token shall be stored in the captured key locker on top of MCR\_2.
- 5.2.6 After all switches for the Booster have been locked and tagged open, the RAP shall:
  - 5.2.6.1 Place the set of keys into the Booster lock box located in building 914, and apply a lock to this box. The key to this lock now becomes the BOOSTER TOKEN.
  - 5.2.6.2 The RAP shall place the BOOSTER TOKEN in the BOOSTER TOKEN BOX, located in building 914, next to the "Man gate", and
  - 5.2.6.3 Lock and tag the TOKEN BOX, using a lock multiplier.
  - 5.2.6.4 When not in use, the BOOSTER TOKEN shall be stored in the captured key locker on top of MCR\_2.
- 5.2.7 The RAP shall store the key(s) to the TOKEN boxes in the MCR Captured Key Box.
- 5.2.8 The RAP shall affix the checklists (one to each side of the page) in the MCR LOTO Logbook, which shall consist of a bound volume.
- 5.3 Procedures for MCR Operators, CAS Technicians to remove LOTO.
  - 5.3.1 When in Restricted Access, the OC shall have an announcement made to exit the ring and remove locks from the TOKEN box.
  - 5.3.2 The OC shall then have the accelerator placed into the Controlled Access state, and the enclosure shall be swept free of personnel ([C-A-OPM-ATT 4.56.a](#) and [OPM-ATT 4.56.f](#))
  - 5.3.3 The RAP shall open the appropriate TOKEN BOX and then use the TOKEN to open the appropriate Lock Box.

**Note:**  
Only the designated RAP on a shift may remove Operations-applied LOTO.

- 5.3.4 Using the keys from the Lock Box, the RAP accompanied by the SWV, shall unlock and re-close the required energy control devices, and make

the apparatus ready for operations.

5.3.5 The RAP and SWV shall use the SAME checklist(s) that was used to install the LOTO, and initial RAP off and SWV off columns, as each item is unlocked and re-closed.

5.3.5.1 The RAP shall note any special instructions or hazards written on the back of the checklist.

5.3.6 The RAP shall return all red tags, locks and multipliers to the appropriate MCR LOTO station and placethe TOKEN(S) in the MCR Captured Key Locker above MCR\_2.

## 6. **Documentation**

6.1 MCR LOTO Logbook

6.2 Appropriate Checklist (see attachments)

## 7. **References**

7.1 [C-A-OPM 1.5, "Electrical Safety Implementation Plan"](#).

7.2 [C-A-OPM 1.5.3 "Procedure to Open or Close Breakers and Switches and Connecting/Disconnecting Plugs"](#).

7.3 [C-A-OPM 2.36, "Lockout/Tagout for Control of Hazardous Energy"](#).

7.4 [SBMS Electrical Safety](#).

7.5 [SBMS Lockout/Tagout \(LOTO\)](#).

7.6 [C-A-OPM 2.6.3 "LOTO for Booster MMPS"](#).

7.7 [C-A-OPM 2.6.2 "Procedure for Partial Lockout for the AGS and Booster Rings, During Accelerator Operations, Under Controlled Access Conditions"](#).

7.8 [C-A-OPM 2.6 "Personnel Entry to AGS and Booster"](#).

## 8. **Attachments**

8.1 [C-A-OPM-ATT 2.6.1.a, "AGS Ring Lockout-Tagout Checklist--Controlled Access"](#).

8.2 [C-A-OPM-ATT 2.6.1.b, "AGS Ring Lockout-Tagout Checklist--Restricted Access"](#).

- 8.3 [C-A-OPM-ATT 2.6.1.c, "Booster Ring Lockout-Tagout Checklist--Controlled Access"](#).
- 8.4 [C-A-OPM-ATT 2.6.1.d, "Booster Ring Lockout-Tagout Checklist-- Restricted Access"](#).
- 8.5 [C-A-OPM-ATT 2.6.1.e, "Equivalent Checklist -- Controlled Access"](#).