ACCELERATOR DIVISION DEPARTMENTAL PROCEDURE

RF DEPARTMENT

ADDP-RF-2010-4 Rev A

BOOSTER R.F. Test Station ANODE P.S. LOCKOUT/TAGOUT PROCEDURE

For

ANODE P.S. Maintenance or Modulator and PA Testing

RESPONSIBLE DEPARTMENT RF DEPARTMENT

PREPARED BY _____ DATE 4-Mar-2019
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CONTROLLED COPY NO. _____

TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE

The purpose of this Accelerator Division Department Procedure (ADDP) is to outline and detail the conduct of LOCKOUT/TAGOUT (LOTO) for the maintenance of Booster radio frequency Test Station ***anode power supply***. This is to establish compliance with Chapter 5120 of the Fermilab ES&H Manual. This equipment needs to be locked out when working on the power supply, the anode modulator, or the power amplifier in the Test Station.

2.0 PERFORMANCE OF MAINTENANCE ACTIVITIES

LOTO is always performed on the Anode Power Supply by trained employees because of the dangerous voltages that may be present.
The Booster R.F. Test Station anode power supply (**TSAPS**) is located in the Lower Linac Gallery. The supply has a 480 V. lockable disconnect located on the wall along the North side of the power supply which is located between the Linac test station and Klystron #3.

A **Group Lockout/Tagout box** is mounted on a panel on the test stations consoles relay racks, **located in SWA-101**. The authorized person will perform the equipment LOTO and place the Lotto Lock keys into the lock box in which he/she and others will put their locks and tags on. A High Level RF Group's **lead authorized/knowledgeable** person will perform the necessary LOTO procedure for all internal Anode power supply work.

The lead authorized individual will be the first to lock the lock box and the last to remove his lock.

A check list is to be used for this LOTO procedure and a copy is attached. Check lists are to be stored at the lockout center. Quarterly, all lists will be delivered to the Department Head office for storage.

3.0 AUTHORIZED PERSONNEL

An Accelerator Division employee is authorized to perform this LOTO procedure if he/she has necessary knowledge and current training as per section 8.0 under Procedure Training Requirements.

A list of employees who are authorized to perform this procedure is maintained by the RF Department Head.

4.0 **THE NECESSITY OF WRITTEN LOTO PROCEDURE**

This requires a written procedure because:

4.1.0 The equipment has multiple energy sources.

4.1.1 480VAC 3-phase primary power.

4.1.2 120VAC control power

4.2.0 The equipment has the potential for stored or residual energy after it is shutdown.

4.3.3 Persons are not protected by a single lockout device.

4.4.0 Procedural steps must be followed by authorized employees to safely access the power supply.

5.0 **THE STEPS OF LOCKOUT/TAGOUT PRIOR TO MAINTENANCE ACTIVITY**

The authorized employee performs the following steps prior to performance of maintenance activity.

5.1 **Prepare:** The authorized employee shall understand the hazards involved and how to control them and wear required protective clothing needed under NEPA 70E. If an authorized employee does not have this knowledge, he/she is not qualified to perform the LOTO procedure or maintenance activity.

5.2 **Notify:** The authorized employee should, as necessary, notify affected area personnel of the LOTO and maintenance activity. Affected personnel include those who might normally use the equipment or who would be affected by the unavailability of the equipment.

5.3.0 **Shut Down:** The authorized employee shall shut down or turn off the equipment by using the normal stopping procedure.

5.3.1 Turn off the Test Station modulator HV and Solid State Amplifier's Gate Bias.

5.3.2 Turn anode power supply high voltage OFF.

5.4.0 **Isolate:** The authorized employee shall isolate the equipment from the energy source. The anode supply has **two (2) sources of energy 480Vac and 120Vac. The Anode Power Supply also has a capacitor bank which could have residual stored energy.**

5.4.1 Arc-Flash Hazard/Risk: Racking out the 480V fused disconnect is a **Class 0** Arc Flash Hazard/Risk requiring Personal Protective Equipment (PPE).

5.4.2 PPE required clothing:

Clothing Required - Cotton long sleeve shirt and pants, safety glasses, leather insulated cloves, and hearing protection.

5.4.3 480V 3-phase control power from distribution box. Fed from power panels (**DHP L3-4-Circuit#02**) through a local disconnect.

The mechanism to isolate the 480v source of energy is to lockout the 480V 3 phase disconnect switch to the test station anode power supply using the appropriate LOTO Lock and following the Lock out tag out procedure within this document.

5.4.4 120Vac Control power from outlet which is on the wall next to the disconnect switch and is fed from (**LP-L3-Circuit#25**)

The mechanism to isolate the 120v source is to place the plug in the appropriate LOTO locking device, using the Lock out tag out procedure within this document.

5.5.0 **Lock and Tag Out:** The authorized employee shall lock and tag out the energy isolating devices. The locks installed shall be red in color and have only one key. The authorized employee shall keep the single keys in his/her exclusive control at all times from application until return to service or shift change. Approved DANGER - DO NOT OPERATE tags, properly filled out, should be securely attached to the locks.

5.5.1 For Test Station work to be performed on the modulator or PA test resonator, switch the 480v local circuit breaker

on the front of the anode supply to the off position (located in Linac basement).

5.5.2 Move handle on 480v local disconnect (located to the right of the power supply) to the off position. Place RED LOTO Lock (**Key #36578**) on the local Disconnect arm using approved DANGER DO NOT OPERATE tag (properly filled out).

5.5.3 The TAPS LOTO disconnect key(**Key #36578**) shall be placed in the Group Lockout/Tagout box which is mounted on a panel on the test station's console relay rack, located in SWA-101. All other authorized employees performing maintenance shall place their locks on the Group Lockout/Tagout.

5.5.4 **For** internal work to the TAPS it is required that both the local disconnect and the 480 breaker (***DHP L3-4-Circuit#02 Located in XGW-003***) have locks applied (two air gaps).

A High Level RF Group's lead authorized/knowledgeable person will apply the approved DANGER - DO NOT OPERATE tags, properly filled out, and securely attached to the LOTO locks. The authorized employee shall place the keys in the Group Lockout/Tagout box which is mounted on a panel on the test stations consoles relay racks, located in SWA-101.

5.5.5 For ***120Vac*** Control isolation, remove 120Vac plug from the outlet on the wall next to the disconnect switch, (**LP-L3-Circuit#25**) place plug in the appropriate locking device and lock with RED LOTO lock and tag. Place key in the Group Lockout/Tagout box which is mounted on a panel on the test stations consoles relay racks, located in SWA-101.

5.6 **Relieve/Restrain Stored Hazardous Energy:**
(For working on the Test Stations APS)

A grounding stick is required when entering the TAPS. Specifically, it will be placed as follows:

5.6.1 Arc-Flash Hazard/Risk: Using the grounding stick to ground the TAPS capacitor bank and HV output bus requires Personal Protective Equipment (PPE).

5.6.2 PPE required clothing:

PPE: Hard Hat, Face Shield, Hearing Protection, Leather Gloves, Leather Work Shoes, and cotton shirt.

5.6.3 A grounding stick is stored inside the entry door of the anode power supply. The grounding hook will be placed on the HV output bus, and then used to touch each capacitor in the capacitor bank. The grounding hook must be used to touch each capacitor individually at its terminals to verify they are discharged. This will be done using a face shield and PPE as described in Section 5.6.2 when placing the grounding hook on the HV output bus and when using the grounding hook to touch each capacitor.

5.6.4 The grounding hook will be left touching the HV output bus as long as one is in the cabinet.

5.7 **Verify:** The authorized employee shall check by conclusive test that the source of energy has been isolated from the equipment and that the equipment is inoperable. Check to see that the dead man is showing a fault on the control unit interlock display panel and check the meter on the anode supply to make sure it reads 0V. Grounding as described in section 5.6.3 and 5.6.4 is the verification of zero volts on the DC side of the power supply.
At the conclusion of the verification step, return all controls to the neutral or off position.
The equipment is now locked out and tagged out. Service and maintenance activity may begin.

6.0 **SPECIAL REQUIREMENTS FOR SHIFT/PERSONNEL CHANGE**

N/A

7.0 **THE FIVE STEPS FOR RETURN TO SERVICE**
The authorized employee must perform the following five steps prior to returning the equipment to service after service or maintenance activity.

7.1 **Check Equipment:** Check the equipment and the immediate area around it to ensure that nonessential items and tools are cleared and that the equipment is ready for safe operation. Remember to remove all shorting wires from the capacitors if they were used.

7.2 **Check Work Area:** Check the work area to ensure that all employees are safely positioned or removed from the area as necessary and/or appropriate.

7.3 **Verify:** Verify that all controls for the equipment are in the neutral or off position.

7.4 **Remove Padlocks and Tags and Reenergize:** The authorized employee who installed the lock(s) and tag(s) shall remove them and reconnect the equipment to the energy source(s) from which it was isolated.

7.5 **Notify:** The authorized employee should, as necessary, notify affected area personnel of the completion of maintenance and LOTO activity.

This completes the requirements for returning the equipment to service.

8.0 **PROCEDURE TRAINING REQUIREMENTS**

Authorized employees are required to have NFPA 70E training, LOTO training (Level 1 and Level 2), and have read and understood this LOTO procedure. Personnel using this procedure shall be trained on the job. After reviewing this document, the employee shall perform the steps accompanied by an authorized employee with previous experience.

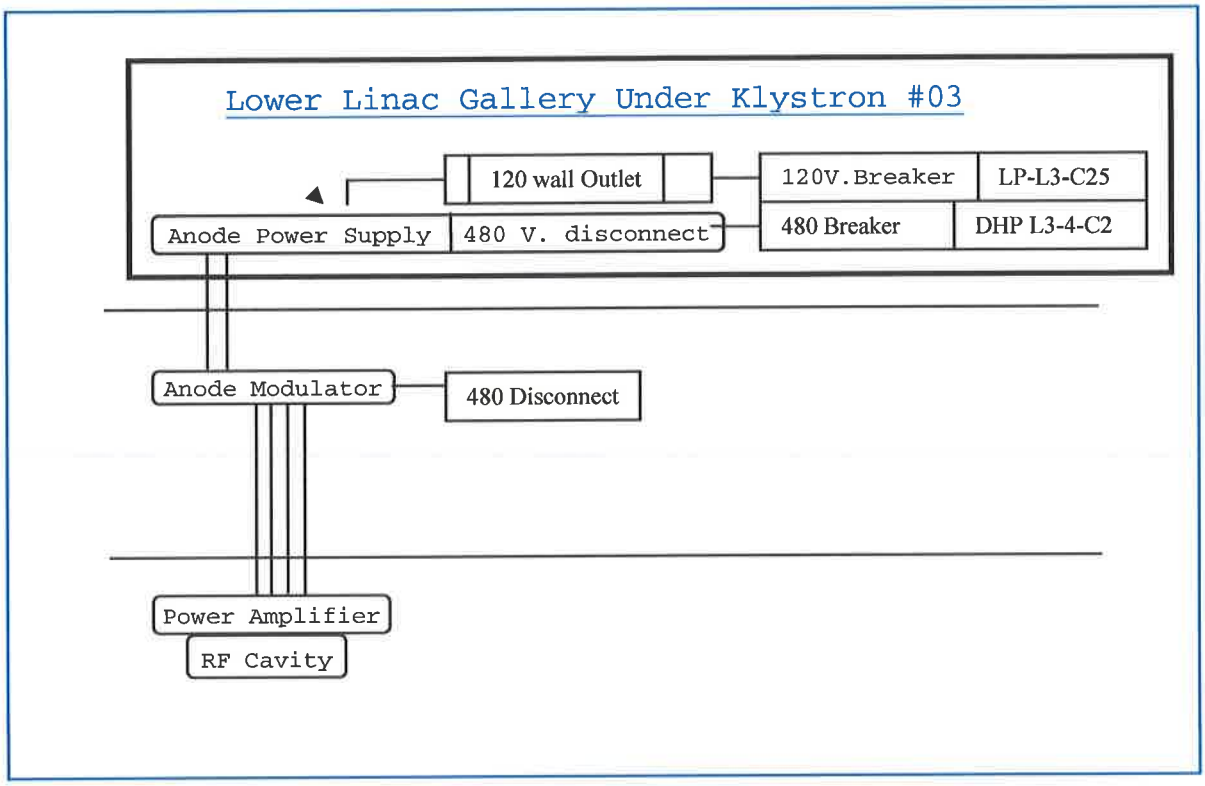
9.0 **PROCEDURE DISTRIBUTION**

A single controlled copy of this procedure shall be assigned and distributed to:

- The Accelerator Division Operations Department Head.

10.0

Block Diagram



BOOSTER RF TEST STATION ANODE SUPPLY LOTO CHECK LIST

☐ 1. Notify affected personnel include those who might normally use the equipment or who would be affected by the unavailability of the equipment.

☐ 2. Turn HV off on modulator.

☐ 3. Turn off anode power supply.

☐ 4. Turn off Solid State Driver gate bias (if used).

☐ 5. Switch the local disconnect, to the off position.

☐ 6. Lockout the 480Vac disconnect to the Anode Power Supply using the appropriate Lotto Lock.

☐ 7. **IF** internal work to the TSAPS is required, then both devices, the local disconnect and the 480Vac breaker (***Located in the XGW-003)*** must have locks applied.

☐ 8. Place the **TSAPS** keys in the Group Lockout/Tagout box is mounted on a panel on the test stations consoles relay racks, located in SWA-102.

☐ 9. The lead authorized individual will be the first to lock the lock box and the last to remove his lock. Place lock and tag on Group Lockout/Tagout box where keys have been placed.

☐ 10. **IF** internal work to the TSAPS is required, use grounding stick to enter DC cabinet. Check that all capacitors in capacitor bank are discharged.

☐ 11. Anode supply is now ready for maintenance.

LOTO COMPLETED BY _____ Signature 1 _____

Date _____ Signature 2 _____

Returned to service date _____