

# Accelerator Access Control Interlock System (ACIS) Lockup Training

11.14.52.5 Rev. 1

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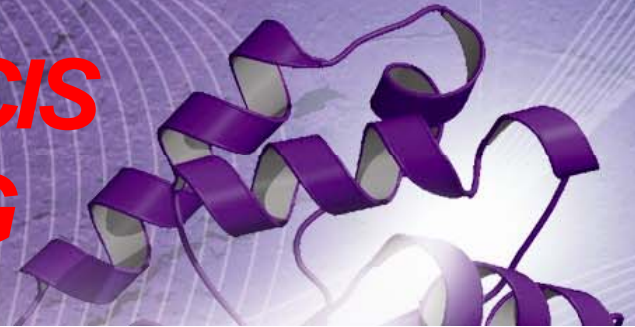
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Mohamed Benmerrouche

## REVISION HISTORY

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<i>Revision</i>	<i>Date</i>	<i>Description</i>	<i>Author</i>
A	2004-09-03	First draft	Mohamed Benmerrouche
B	2004-02-16	Issued for review	Grant Cubbon
0	2004-03-11	Issued for use	Grant Cubbon
0A	2010-04-06	Revised for Linac ACIS Upgrade, Updated Photographs, Mirrors	Grant Cubbon
1	2010-04-07	Issued for use	Grant Cubbon

# ACCELERATOR ACIS LOCKUP TRAINING



Click Mouse to advance to next slide



Health, Safety & Environment Department

1. Purpose of Lockup Training
2. Accelerator ACIS Lockup System
3. Procedure
  1. Linac/LTB Zones 1-5
  2. Booster Zones 6-7
  3. Storage Ring Zones 8-9
4. Exam (80%)
5. Practical session
6. Reference Material



# ***PURPOSE OF LOCKUP TRAINING***

- Train Inspectors to safely and securely clear zones of personnel prior to accelerator operation
  - Qualified Accelerator ACIS Lockup Inspector upon course completion

### ■ Prerequisites:

- General Radiological Training (GRT) or Radiological Worker Training (RWT)

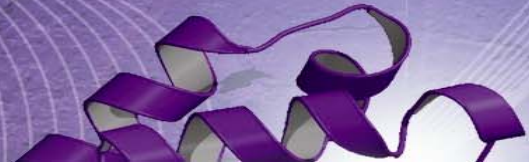


# ***Accelerator Access Control and Interlock System (ACIS)***

### ■ ACIS Lockup Components

- Lock-up Stations (LUS)– (prescribed path)
- Inter and Intra zone Gates
- Limit switches
- Emergency off button
- Horns
- Lockup lights
- Exit Buttons
- Kirk Keys

- ACIS Lockup Hardware Components (Cont.)
  - Zone Bypass Buttons
    - » Zone access without breaking lockup (feature on zones 6 – 9 and BMIT only)
    - » Kirk Key required therefore no beam
  - Electrical Relays
  - Programmable Logic Controller (PLC)
  - Panels
  - ‘Break Bolt’ exit system



- Independent, Redundant, and Diverse
  - Redundancy
    - 2 systems or chains monitor the position of critical devices
      - » Eg... each door has 2 position limit switches
  - Independence
    - Chains are separated, do not share any common pathways to interlocks
  - Diversity
    - Hardwire Relay chain
    - Programmable Logic Controller chain
    - Reduces risk of common failure modes

- Major Fault
  - Linac only
  - Indicated on Control Room Panel
  - Caused by ‘breach’ of lockup
    - » EOS
    - » Entry into locked up zone
  - Interlocks radiation sources
  - HSE can reset

- ACIS Lockup
  - Preparation
    - All EOS must be reset
    - All doors/gates for area/zone are closed (Zones 1-9)
  - Prescribed Path
    - Trained lockup inspectors must push lockup stations (LUS) in correct sequence within allotted time
    - Enforced path means all areas searched
    - Exit through exit gate only within required time
    - Thorough search means no personnel in zone when lockup complete

- **Kirk Keys**
  - All entrance gates/doors have Kirk Keys (Main or Secondary)
  - All Kirk Keys for Linac, BR1, SR1 entrances returned to control room prior to operation
  - 60 second delay after keys turned to enabling radiation sources
- **Safety Features**
  - Gate/Door opened once lockup sequence started requires inspector to restart lockup
  - Gate/Door opened after lockup complete interlocks radiation source
  - EOS pressed at any time interlocks radiation sources
  - Interlocks to Gun and RF Systems

- Required Areas
  - Most lockup zones have one or more areas that must be locked up in sequence
  - Accessing area 2 or 3 of a zone will not break the lockup in area 1 of the same zone if area 1 is not accessed
  - Therefore, a complete lockup of the entire zone is not always required

- Training of personnel (Inspectors)
  - Thorough Search of Zones (clear personnel)
  - Announcements
  - Proper Lockup sequence
  - Return Kirk Keys to control room Kirk Key Panel
  - Accelerator Operations Log Sheet
  - Problem Reporting

- Break Bolt Emergency Exit System
  - When an EOS is pushed, the radiation source is interlocked
  - Egress area by using break bolt to unlock Kirk Key lock
  - Report event to control room operator and HSE
  - Note: Some gates have magnetic door locks so pressing the Exit button is also required.



Every door with a Kirk Key Lock has a wrench on a chain



For egress when locked in, turn wrench as if to tighten to break bolt and release Kirk Lock



Some entrance gates and doors have magnetic locks with Exit Buttons.

If an Exit button fails, the blue pull station will disengage the magnetic lock when pulled.

## ZONE SEARCH

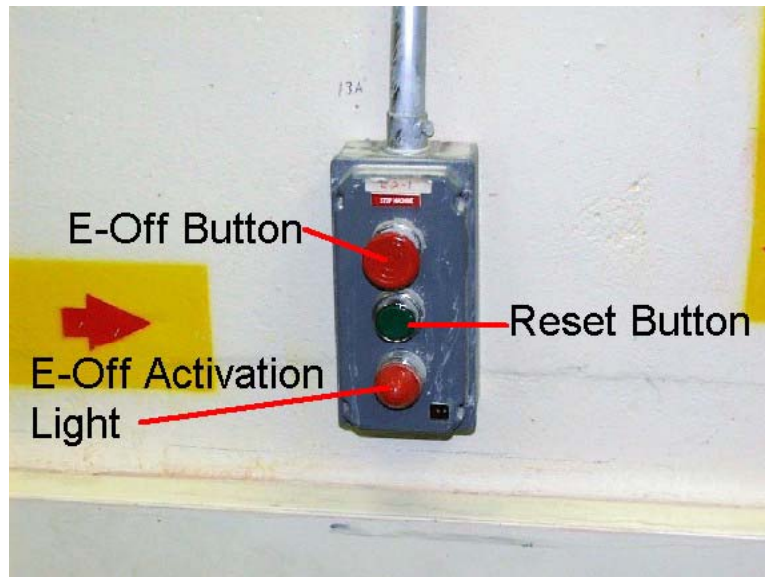
- **Two inspectors required**
  - **Lead Inspector (must be qualified)**
    - ensure zone clear of personnel
    - pushes lockup station buttons in correct sequence
    - completes paper work
  - **Assistant Inspector (does not have to be qualified)**
    - helps clear zone of personnel

- Escort personnel to exit – restart search
- **BE THOROUGH**
- Announce “Lockup” while searching
- Return zone entrance Kirk Keys to Control Room

### PROBLEMS

- Emergency Off
  - Report Emergency Off alarms to the HSE Department.
- ACIS
  - Report any technical problems with the Access Control and Interlock System to the HSE Department.
- Accelerator System
  - Report any other problems (such as water leaks, unusual noise, etc...) to the Control Room Operator.
- Records
  - Record the above problems into the Accelerator Operations Log Sheet
  - Include: Date/Time, your name, a brief description of the problem, and who the problem was reported to.

## Emergency Off Button





- Zone Bypass Button
- Fire Extinguisher
- Fire Extinguisher pull station
- Magnetic Card Reader

- Zone 6 – 9  
Kirk Key  
Panel in  
Control  
Room



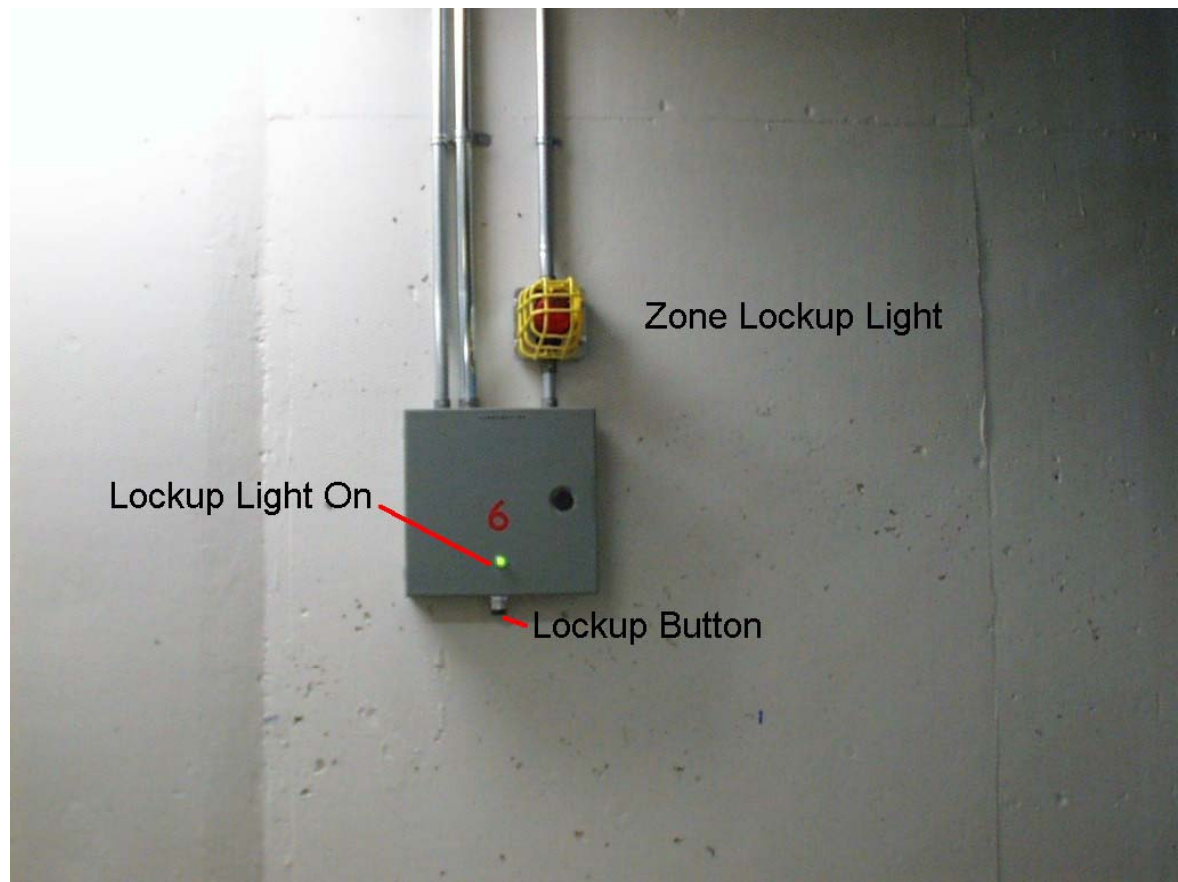
## Kirk Keys





- Mirrors are located on the wall in lockup areas to improve the lockup inspectors' view into areas obscured by equipment.

## Zone 8 Lockup Station (LUS6) and Zone Light



- Zone Lockup Horn (HRN) and Zone Lockup Light (ZLL).

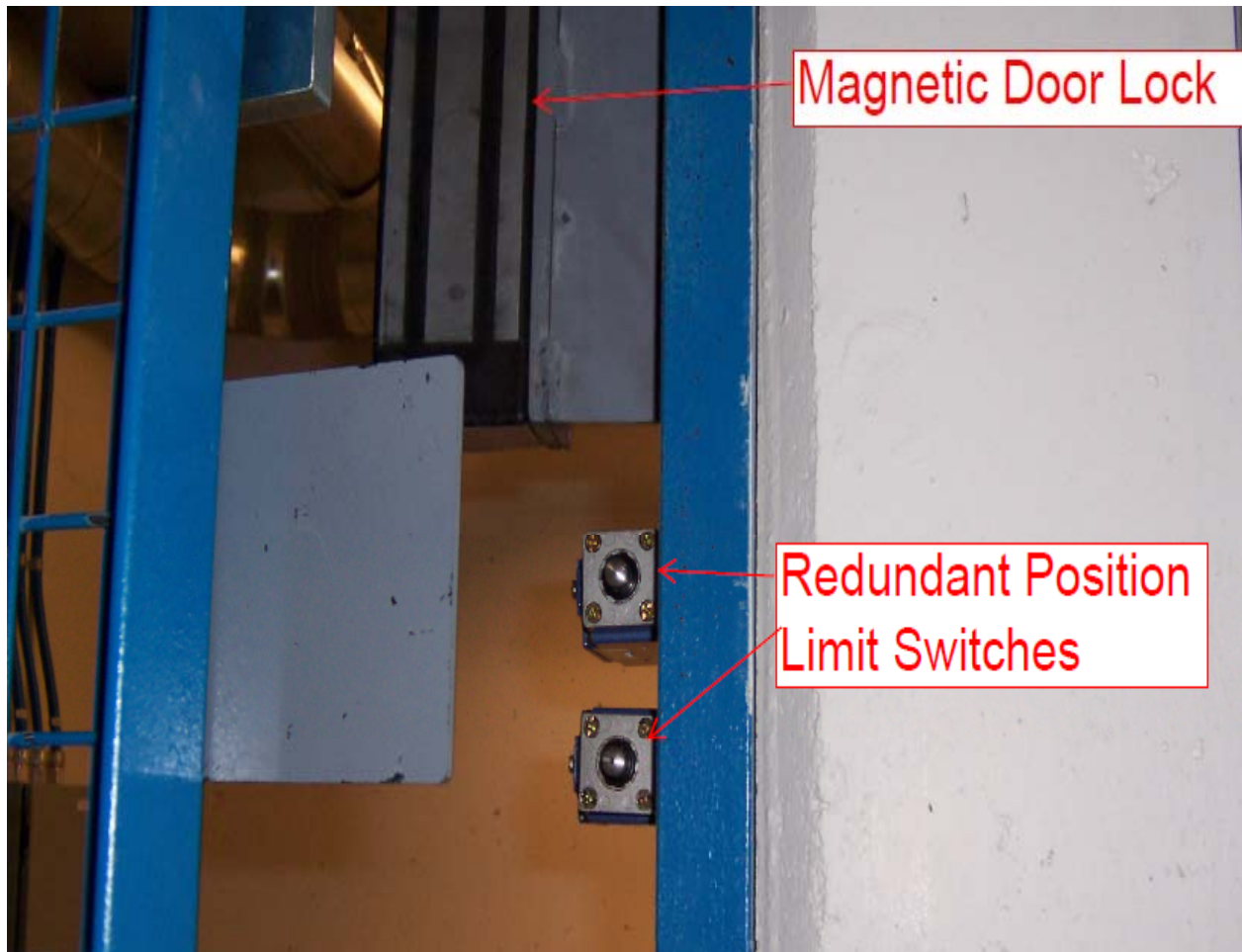


Lockup Station Indicator (LUS)  
Indicator Light  
- Lights up when button pushed  
during lockup sequence



Push button  
- Pushed during lockup sequence

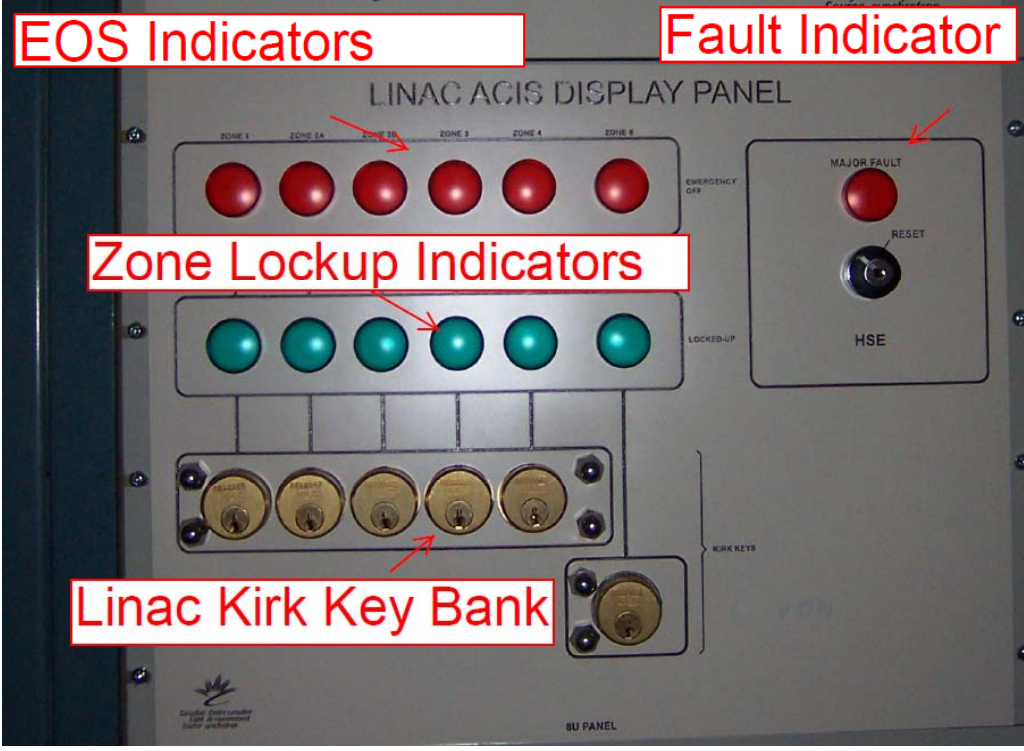
Linac ACIS  
Lockup  
Station



Position  
Limit  
Switches



Booster  
Ring/  
Storage  
Ring ACIS  
Status  
Display  
Panel



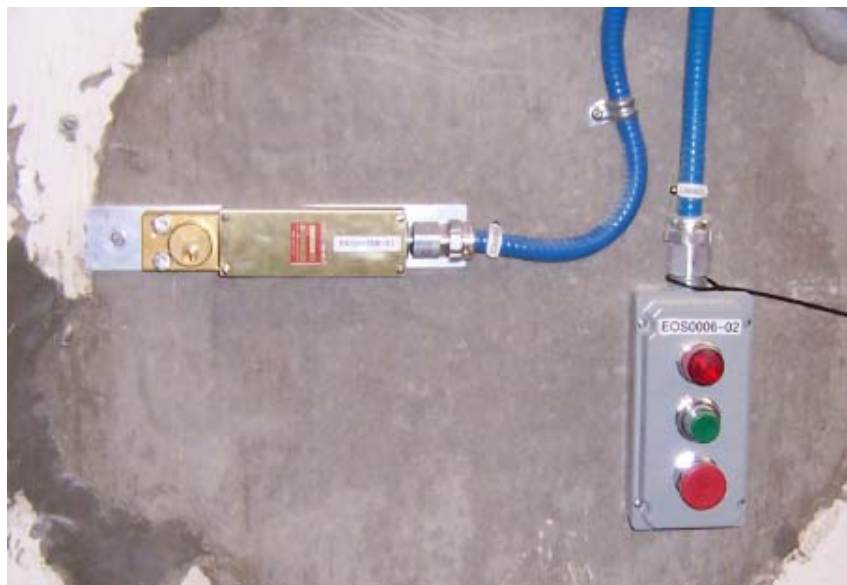
Control Room  
Linac ACIS  
Display Panel

# *Lockup Procedures*

*LINAC/LTB*

*Zones 1 – 5*

- Reference material:
  - Lockup procedures
  - Lockup zone drawings
- Review Residual Radiological Survey Map  
Located at the entrance gate for the zone  
being locked up (ALARA).
- Dosimeter must be worn at all times.
- Access card required
- Practical session



Kirk Key Bank for Zone 4  
Elevator Stairwell Kirk Key



Elevator Stairwell exit door  
with Kirk Key in Lock

# *Lockup Procedures*

## *Booster Ring*

### *Zones 6 – 7*

- Reference Material:
  - Lockup procedure
  - Lockup zone maps
- Review Residual Radiological Survey Map  
Located at the entrance gate for the zone  
being locked up (ALARA).
- TLD must be worn at all times.
- Access card required
- Practical session

Zone 7 lockup will be discussed as example

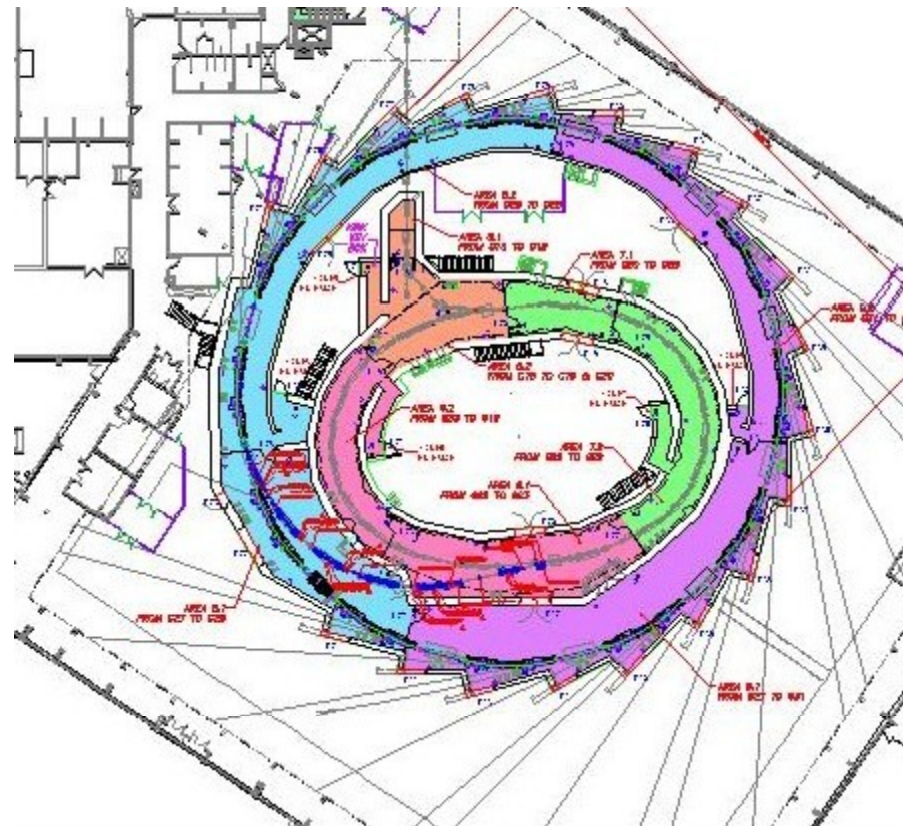
1. Inspector 1 and Inspector 2 – obtain dosimeter and access card

NOTE: EPD required for access into accelerator zones if residual survey has not been completed.

2. Review Residual Radiological Survey Map on Zone 7 Gate

Zone 7 contains 2 lockup areas

- 7.1 and 7.2
- Indicated in Green on drawing



### ■ NOTE:

- Lead Inspector (Inspector 1) responsible that zone is cleared of all personnel when lockup complete
- Escort personnel to exit, restart lockup
- Inspector 2 assists Inspector 1 in clearing the zone of personnel



### Preparation:

- Inspector 1 or Inspector 2  
– Obtain Zone 7 Key from Control Room Panel of the Booster Lockup Key Box
- Insert into Zone 7 Entrance Gate G26
- Enter Zone 7 and close gate but leave unlocked

### Area 7.1

- a) Inspector 2 – Ensure Gates G20, G25, Doors D18, D19 are closed
- b) Inspector 2 – Clear Zone 7 of all personnel
- c) Inspector 1 – Press LUS #1 button
- d) Inspector 1 – Press LUS #2 button
- e) Inspector 1 and Inspector 2 – Exit Zone 7.1 through G25 within 10 seconds of pressing LUS #2

### Area 7.2

- a) Inspector 2 – Ensure Gates G22, G26 are closed
- b) Inspector 1 – Press LUS #3 button
- c) Inspector 1 – Press LUS #4 button
- d) Inspector 1 – Press LUS #5 button
- e) Inspector 1 and Inspector 2 – Exit Zone 7.1 through G23 within 10 seconds of pressing LUS #6
- f) Inspector 2 – Lock Gate G26 with Zone 7 Key and remove it

- When zone lights begin to flash, the zone ACIS has been activated.
- Return to control room and place Zone 7 key in Key Bank.

NOTE: When the Zone 6 and 7 keys are inserted in the Key Bank and turned, the horn in the booster ring will sound for **1 minute**.

# *Lockup Procedures*

## *Storage Ring*

### *Zones 8 – 9*

- Reference material:
  - Lock-up procedure
  - Lockup zone maps
- Review Residual Radiological Survey Map  
Located at the entrance gate for the zone  
being locked up (ALARA).
- Dosimeter must be worn at all times.
- Access card required
- Practical session

## SR1 Shielding Door D23 Closed



## SR1 Zone 8.1 LUS1



Zone 8.1 LUS 1 with Kirk -  
Key Installed and LUS Light  
Activated

## SR1 Shielding Door D23 Open



# *Exam*

- Contact HSE for exam

# *Practical Session*

- Practical session will provide ‘hands-on’ lockup training to test the students understanding of the lockup process
- Practical session must be successfully completed before certification as lockup inspector attained
- Contact HSE to arrange Practical Session
- HSE Maintains list of qualified Lockup Inspectors

# *Reference Material*

- Documents
  - Linac to LTB1 Lockup Procedure '2.7.37.2'
  - Booster Lockup Procedure '3.7.37.1'
  - Storage Ring Lockup Procedure '5.7.52.1'
- Drawings
  - Linac, LTB1, BR1, and SR1 Access Control and Emergency Off system Layout 'RAD/0039405'



**ACIS  
Accelerator Lockup Training  
Practical Session Instructor  
Checklist**

**FORM**

Number: 11.11.52.10 REV. 1

Issued: 2010-04-07

**Information:**

Student Name:	
Examiner Name:	
Date:	

**Testing:**

Zone Number for Lockup Test	
Completed Escort of worker(s) to zone gate (N/A if no personnel in zone)	
Check of all zone gates	
Correct Sequence of LUS	
Strong Clear Announcement 'Lockup'	
Thorough search of zone during lockup sequence	
Lockup Successful	

**Examiners comments:**

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Pass                  Fail

Circle one

\_\_\_\_\_  
Examiner Signature

This form is to be used by qualified Lockup Training Instructors for the practical training component of Lockup Inspector Certification.

Prior to examination:

1. Confirm student has attained passing grade of at least 80% on written examination.
2. Bring copy of ACIS layout drawing RAD/0039405 to practical test
3. Complete 'walk-through' of at least one zone lockup to identify devices, process, and features of lockup
4. Answer any questions

Procedure:

- 1) Select zone to lockup (not visited in walk-through)
- 2) Inform Student if they are Lockup Inspector # 1
- 3) Observe student completing lockup
- 4) Check box as items are completed
- 5) Circle Pass or Fail

Note: As an option, the lockup training examiner may choose to

- 1) have a third individual hiding in the zone being locked up
- 2) hide the 'dummy' in the zone being locked up
- 3) judge the competence of the lockup inspector without having to escort someone out of the lockup zone.
- 4) participate as lockup inspector 2 during examination

## Accelerator ACIS Lockup Training Exam

Name: \_\_\_\_\_ Date \_\_\_\_\_

Instructor: \_\_\_\_\_ Score \_\_\_\_\_ %

**For each question circle the letter which best answers the question**

1. What is the purpose of the Lockup Procedure?
  - a. Search and secure a lockup zone to ensure it is clear of personnel
  - b. Activate the accelerator system
  - c. Inspect a lockup zone for safety violations
  - d. All of the above
  
2. A Zone lockup is required to
  - a. Turn electron gun off
  - b. Enable the radiation sources in a lockup area
  - c. Perform maintenance on the accelerator system
  - d. None of the above
  
3. A Zone lockup includes the following components
  - a. Lockup stations
  - b. Zone Lockup Lights
  - c. Gates and Doors
  - d. All of the above
  
4. During a lockup inspectors are required to follow
  - a. Random path through each zone within the preset time limit
  - b. Prescribed path through each zone within the preset time limit
  - c. Their own path through each zone within the preset time limit
  - d. Path of the shortest distance through each zone within the preset time limit
  
5. During a Zone lockup one of the Zone gates does not close all the way preventing the lockup inspection to proceed.
  - a. It is acceptable for one of the inspector to hold the gate close while the other is performing the lockup
  - b. Use duct tape to maintain the gate contact in the closed position and carry on with lockup.
  - c. Use any means necessary to close the gate because we need to run the accelerator ASAP.
  - d. Record the incident in the Accelerator Start-up Log book and notify the Controls and Instrument Manager or designate.

6. Which lockup station do you start the Zone lockup sequence with?
  - a. 3
  - b. 2
  - c. 1
  - d. It doesn't matter.
  
7. Equipment, material and supplies required before starting zone lockup includes
  - a. Zone key, TLD, Personnel Security Access card
  - b. Gun key, TLD, EPD
  - c. Safety glasses, steel toe boots, hard hat
  - d. Lab coat, Zone key, TLD
  
8. Gates and doors are an integral part of the inspection area. What happens if one of the gates or doors is left open?
  - a. Nothing
  - b. Alarm sounds
  - c. Cannot lock up zone
  - d. Can still lock up zone.
  
9. What happens if a gate or door is opened during the lockup?
  - a. No change
  - b. Alarms sounds
  - c. Continue with lockup
  - d. Lockup drops out
  
10. How many inspectors are required to perform the lockup?
  - a. 2
  - b. 1
  - c. 3
  - d. 4
  
11. A timer starts when the last lockup station within a lockup area button is pushed to allow
  - a. Inspectors to leave the area without altering the status of the inspection.
  - b. Inspectors to take a break during the inspection
  - c. Inspectors to wait until the zone light starts flashing before exiting the area
  - d. Inspectors to return to the first lockup station and push its button
  
12. A timer starts when the first lockup station within the lockup area is pushed to
  - a. Allow inspectors to complete the lockup of the area within a preset time
  - b. Record the time it takes the inspectors to complete the lockup of the area
  - c. Begin count down before the accelerator starts
  - d. To allow inspectors to take a break during the inspection

13. After successful completion of a zone lockup, the zone Kirk key should be placed in
  - a. The cardboard Key Box in the control room
  - b. ACIS key panel in the control room for the corresponding zone
  - c. HSE mailbox
  - d. In the zone entrance Kirk Key Lock
  
14. The zone lockup lights begin to flash when
  - a. You start the area lockup
  - b. You complete zone lockup
  - c. All zones are locked up
  - d. Building power shuts off
  
15. If personnel are found in an area you prior to starting a zone lockup:
  - a. Leave them to finish their work and continue with the lockup
  - b. Ask them to help with the lockup
  - c. Escort them to the zone's exit and restart the lockup
  - d. Ask them to lockup the zone when they are finished their work
  
16. To maintain exposure as low as reasonably achievable (ALARA) and to avoid unnecessary exposure to high radiation, the inspectors should review the radiological surveys at the entrance gate to each zone:
  - a. each morning after coffee
  - b. after completing successfully a zone lockup
  - c. prior to entering a zone to perform the lockup procedure
  - d. prior to entering the new part of the building
  
17. If the storage ring door D23 (man door) is unlocked, the Kirk Key for this door can be found:
  - a. In the Control Room Kirk Key Bank
  - b. In the HSE Manager office
  - c. In Zone 8.1 Lockup Station 1
  - d. In the D23 lock
  
18. While executing the Linac lockup procedure, you notice a puddle of water on the floor which is obviously leaking from a pipe. You should:
  - a. Immediately turn off the water supply
  - b. Notify your supervisor immediately
  - c. Notify the Engineering and Technical Services Manager or designate and record the incident in the Accelerator Start-up Log book
  - d. Notify HSE immediately
  
19. While locking up Zone 5, you notice that one of the bulbs on a lockup station does not turn on when the button is pressed. You confirm that the lockup stations you already pressed are still lit. You try the button again but the light still doesn't turn on. You should:

- a. Start the lockup procedure over again
  - b. Report the problem to the HSE Department and record the problem in the accelerator operations log sheet
  - c. Complete the lockup procedure because the bulb is probably just burnt out
  - d. Replace the bulb immediately
20. The purpose of the zone bypass button is:
- a. To allow access to the Lockup zone while the accelerator is ON
  - b. To allow access to the Lockup zone for a short period of time (less than 10 minutes) without dropping off the lockup.
  - c. To turn the accelerator off in case of an emergency
  - d. To allow more time for the other inspector to exit the lockup zone.
21. Which zones are included in the Linac/LTB Lockup Procedure?
- a. Zones 1-5
  - b. Zones 6-7
  - c. Zones 8-9
  - d. Zones 10-12
22. Which zones are included in the Booster Ring Lockup Procedure?
- a. Zones 1-5
  - b. Zones 6-7
  - c. Zones 8-9
  - d. Zones 10-12
23. Which zones are included in the Storage Ring Lockup Procedure?
- a. 7-9
  - b. 6-7
  - c. 8-9
  - d. 10-12

**END OF QUESTIONS**

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