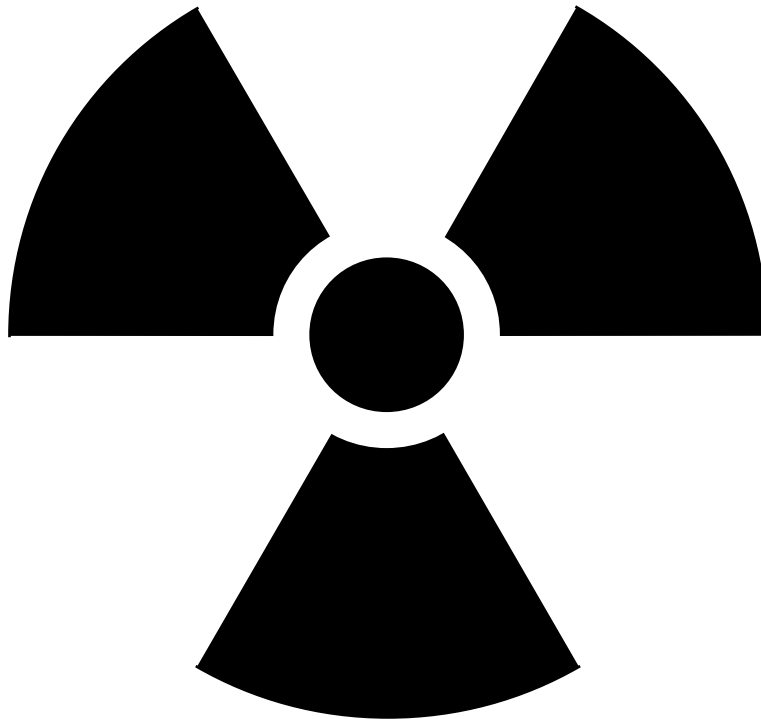


UNIVERSITY OF PENNSYLVANIA

*CYCLOTRON FACILITY
USERS' GUIDE*



This Guide has been prepared as an information manual for University personnel involved with the use of cyclotron accelerator.

ONE COPY OF THIS GUIDE SHOULD BE READILY AVAILABLE AT EACH CYCLOTRON FACILITY.

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I. General Radiation Safety Practices

- A. Lab coats or other protective clothing shall be worn when handling radioactive material, or working in an area designated as a Radioactive Material (RAM) work area.
- B. Disposable gloves shall be worn when handling RAM.
- C. Personnel shall not eat, drink, smoke, store food, or mouth pipette in areas where RAM is used or stored.
- D. Careful experimental planning, dry runs, shielding, distance, and monitoring shall be required for minimizing exposure.
- E. RAM shall be used, stored, and transported in appropriate containers.
- F. The facility shall be secured at all the times against unauthorized entrance.
- G. Inventory records must be kept for the following:
 - 1. Receipt of radioactive materials
 - 2. Shipment/transfer of radioactive materials
 - 3. Sealed source inventory (performed by EHRS)
- H. Radioactive waste disposal and procedures.
 - 1. Radioactive waste shall be collected in appropriate containers.
 - 2. The radionuclides that make up the waste must be identified.
 - 3. Waste being stored for decay ($T_{1/2} < 65$ days) must be stored for a minimum of 10 half-lives and have exposure rate from the unshielded surface of the container no greater than background prior to disposal.
- I. Approved fume hoods or glove boxes shall be used to control possible airborne contamination.
- J. The facility and RAM containers must be labeled with proper radiation signs.
- K. Hands should be thoroughly washed after working with RAM.
- L. Airflow control
 - 1. The air flow measurements for RAM fume hoods are taken semi-annually by EHRS.
 - 2. Static pressures must be maintained so that the cyclotron vault is negative to all surrounding areas, and laboratory areas are negative to office areas.
- M. Requirements for transporting radioactive material.
 - 1. User authorization and verification must be obtained prior to shipment.
 - 2. Records must be maintained for shipments of radioactive materials.
 - 3. Only individuals designated by the cyclotron facility director can hand deliver a package containing radioactive materials. The transporter must be wearing the appropriate personnel monitoring device(s).
- N. All personnel working in the facility shall have radiation safety training prior to working with RAM, and annually thereafter.
- O. Daily operations log book shall be kept. All operation parameters shall be recorded in this book.

- P. EHRS shall be notified promptly in the event of:
1. Personnel contamination
 2. Any accident resulting in direct exposure to personnel
 3. Unexpected loss of RAM to air or sewer
 4. Loss of RAM

II. BADGING & DOSIMETRY POLICY

A. Personnel Dosimeter Policy

All personnel working at Cyclotron facility are required to wear the radiation monitoring devices provided by the RSO. These devices are:

1. Film Badge or LUXEL Dosimeter to monitor doses to the whole body.
2. Ring TLD Dosimeter to monitor extremity doses.
3. Pocket dosimeter or PRDs are available to indicate the accumulated exposure when working at high radiation areas (vault).

B. Dosimeter Placement

Interpretation of the measured dose is dependent upon the placement of the dosimeter. It is important that all personnel wear their dosimeters correctly.

1. The film badge shall be worn on top of lab coat at a location close to collar.
2. The ring badges shall be worn when handling RAM. Each individual is assigned two ring badges to monitor the dose to each hand.
3. An individual who enters the vault area for emergency repairs shall wear an audible pocket dosimeter device. The accumulated exposure shall be recorded at the end of each day. This device shall be worn over the lab coat.

C. Dose Reports

The Radiation Safety Office sends dose summary reports on a monthly and an annual basis . These reports should be posted in a conspicuous location in the facility.

III. RADIATION SAFETY PRECAUTIONS FOR VISITORS

- A. Each visitor should sign their name in the log book. The cyclotron staff will provide the visitor a digital dosimeter and/or a personal dosimeter issued by EHRS before entering the work area.
- B.. Each visitor who enters the cyclotron facility shall be escorted by a cyclotron staff upon entrance to the facility.
- C. A record of the cumulated dose will be entered in the log book upon departure from the facility.

IV. RADIATION SAFETY PROCEDURES FOR STAFF ENTERING THE VAULT

- A. No individual shall enter the vault area while the cyclotron is operating.
- B. No individual should enter the vault area for the purpose of routine maintenance unless the cyclotron was not in operation for at least 24 hours.
- C. Before leaving the vault the extremities should be checked with survey instrument for possible contamination.

V. RADIATION SAFETY PROCEDURES FOR EMERGENCY REPAIRS

- A. The individual who is responsible for maintenance shall check the exposure reading before entering vault area.
- B. The individual may enter the vault if the exposure is less than 100 mR/hr.
- C. Before entering the vault the individual should wear a disposable coverall, shoe covers, and gloves.
- D. A monitoring device should be carried into the vault to alarm the existence of high exposure rate areas.
- E. The protective clothing and extremities should be checked for possible contamination before leaving the vault.

VI. INTERLOCK AND SAFETY SYSTEMS

- A. The safety interlock shall be fail-safe, that is, designed so that a defect or component failure in the interlock system prevents operation of the accelerator.
- B. The interlock system shall be checked at least quarterly.
- C. The interlock trip system shall be checked to insure that the cyclotron will resume operation only after manually resetting the controls at interlocks position and lastly at the main control console.
- D. The functionality of scram buttons or other emergency power cutoff switches which are located in high radiation areas shall be checked. The check shall include the cutoff switch, manual reset, and the inability to restart the accelerator from the control console without resetting the cutoff switch.
- E. At no time shall the interlock switch be bypassed without prior authorization from the Radiation Safety Officer. The bypass shall be recorded in the daily operational log book with RSO signature.
- F. The vault area shall be equipped with video monitoring cameras. The vault area shall be monitored to assure that the area is cleared of personnel prior to operation of the cyclotron. If the video monitoring system malfunctions, the cyclotron may not be operated until a suitable replacement has been made, and approved by the Radiation Safety Officer.
- G. The area shall be equipped with devices that will automatically activate visible and audible alarms to alert personnel in the vault area to operation of the cyclotron. The system shall allow sufficient time for an individual in the area to operate a clearly identified control device which shall be present in the area, and which can prevent the initiation of irradiation.

VII. MONITORING SYSTEM

- A. Monitoring Procedure
Airborne activity shall be monitored.
- B. Exposure Survey

The Radiation Safety Office will perform routine exposure checks at the laboratory.
- C. Contamination Survey
 - 1. Removable contamination surveys shall be performed and recorded daily by EHRS staff.
 - 2. Leak testing of sealed sources shall be performed semi-annually by EHRS Staff.
 - 3. Wipes in the Vault shall be performed periodically by EHRS Staff.

VIII. RADIATION DETECTION INSTRUMENTATION

A. Survey instruments

All survey instruments shall be performance checked annually or following a repair. All instruments have to be checked for proper response to radiation before each use.

B. Well counters

Calibration of the well counter shall be performed annually by EHRS.

The use of energized equipment, and the radioactive materials made by energized equipment is regulated by the Commonwealth of Pennsylvania's Department of Environmental Protection. Copies of the applicable Pennsylvania regulations are available at the cyclotron control panel. Copies of the pertinent State and Federal regulations and licenses are available at the Environmental Health and Radiation Safety Office, 3160 Chestnut St, 898-7187.

