

# PARTICLE ACCELERATORS

## PURPOSE

This procedure specifies radiation safety requirements for particle accelerators not used in medicine, including registration, physical safety features, training and operating requirements for users, and regular safety inspections.

## POLICY

All operable research accelerators used in University of Utah facilities shall be authorized by the Radiation Safety Committee and shall be registered with the Utah Division of Radiation Control. All authorizations and registrations (including fees) shall be submitted to the Radiation Safety Officer (RSO) for review and processing. The RSO shall also be notified before moving, transferring or disposing of any particle accelerator.

The responsible user for each accelerator shall ensure that detailed operating procedures are available and that each operator has received appropriate training and understands and follows the correct procedures.

## DEFINITIONS

**"Accelerator"** refers to machines or systems used to produce charged particles with energies up to 2 MeV.

**"Exposed beam"** means the operation of an accelerator with any beam-blocking device removed while the particle beam is on.

**"Fail safe"** means features that prevent exposure of personnel upon the failure of a safety or warning device.

**"Open beam"** means any mode of operation in which any portion of the user's body could be placed into the primary beam during normal

operation if no further safety devices or procedure were incorporated.

A **"normally exposed radiation user"** is an individual who could receive more than one tenth (10%) of the occupational dose limit in any calendar quarter. This category includes individuals who rarely receive radiation exposures, but who work with sources that could produce a significant dose accidentally.

A **"minimally exposed radiation user"** is an individual who is unlikely to receive one tenth (10%) of the occupational radiation dose limit in any calendar quarter.

## EQUIPMENT REQUIREMENTS

The requirements specified in regulation R313-35 apply to the University's equipment. The important requirements are itemized in "PARTICLE ACCELERATOR SAFETY INSPECTION" (RPR 32A). The inspection check list is a generic list for x-ray generating machines that should be adapted to the specific accelerator. This record is **to be completed by the responsible user** at the time the machine is first registered and submitted to the RSO. The inspection form is also to be used as a safety check list after any maintenance or modification that requires disassembly.

## OPERATING REQUIREMENTS

Written operating procedures covering both normal and abnormal (emergency) conditions shall be available to, and followed by, all users of the particle accelerators. Each operator of a particle accelerator shall be given a copy and demonstrate an understanding of "Requirements for X-Ray Equipment Used for Non-Medical Applications.", R313-35, *Utah Radiation Control Rules*,

Each person who will operate or maintain an accelerator shall **first** be given the same training

as all other radioisotope users, but shall also be given appropriate instruction by the responsible user and shall demonstrate competence in normal operation of the accelerator and on emergency procedures.

No person shall bypass a safety device without the written authorization of the RSO. Individuals who expect to perform maintenance that requires the presence of the primary beam when beam-blocking devices are removed shall be authorized in advance by the Radiation Safety Committee and shall notify the RSO that such work is expected.

## RADIATION SURVEYS

The RSO shall survey the radiation exposure rates in accessible areas near an accelerator at least once a year. **The responsible user shall request, or perform and record**, a radiation survey:

- 1 following any change in the arrangement, number or type of components,
- 2 following any maintenance requiring disassembly or removal of a component,
- 3 during any maintenance or alignment procedure that requires the presence of a primary x-ray beam when a component is disassembled or removed, or
- 4 any time a visual inspection reveals an abnormal condition.

## EXPOSURE MONITORING

Users of **open beam** particle accelerators and users of enclosed units who are approved to perform maintenance procedures with an **exposed beam**, are classified as **normally exposed**. Each **normally exposed radiation user** of accelerators shall complete the "RADIATION USER PERSONAL DATA" form (RPR 1A). A body dosimeter will be issued within approximately one week after the data form is received by the RSO. The dosimeter shall be worn whenever the accelerator is

operating and shall be kept in an unexposed location at all other times.

All dosimeters shall be returned promptly at the end of the monitoring period. Dosimeters not returned by the 5<sup>th</sup> of the month after they are worn, but within the next 30 days, are considered to be late. Dosimeters returned more than 30 days, or damaged or misused in any way that invalidates the reading, are considered to be lost. Fines are imposed for late or lost dosimeters (see the *Radiation Safety Policy Manual*).

Users of enclosed particle beam accelerators who are not specifically approved to perform maintenance procedures with an exposed beam are classified as **minimally exposed** and are not issued personal dosimeters.

Any suspected exposure to the primary beam of an accelerator shall be reported promptly to the RSO.

## REFERENCES

"Requirements for X-Ray Equipment Used for Non-Medical Applications.", R313-35, *Utah Radiation Control Rules*, Utah Department of Environmental Quality.

"Radiation Protection Design Guidelines For 0.1 - 100 MeV Particle Accelerator Facilities", NCRP Report No. 51 and "Radiation Alarms and Access Control Systems", NCRP Report No. 88.

# RPR 32A. PARTICLE ACCELERATOR SAFETY INSPECTION

Responsible user: \_\_\_\_\_ Group #: \_\_\_\_\_

Phone: \_\_\_\_\_

Location (Bldg. & Room) \_\_\_\_\_ Installation date: \_\_\_\_\_

Type and use \_\_\_\_\_ Manufacturer \_\_\_\_\_ Model \_\_\_\_\_ Serial No. \_\_\_\_\_

Open beam Control unit: \_\_\_\_\_

Enclosed beam Inspection date: \_\_\_\_\_

## **FACILITY REQUIREMENTS**

"CAUTION - X-RAY EQUIPMENT" (or equivalent) sign at entrance? **Yes No**

"NOTICE TO WORKERS" (DRC-04) posted conspicuously? **Yes No**

"CAUTION HIGH RADIATION AREA" posted? **Yes No**

## **CONTROL AND INTERLOCK SYSTEMS**

Controls labeled? **Yes No**

Interlocked High Radiation Areas? **Yes No**

Scram or Emergency stop button? **Yes No**

## **WARNING DEVICES**

Rotating or flashing warning light at entrances? **Yes No**

Audible warning 15 seconds prior to system activation? **Yes No**

## **OPERATING PROCEDURES**

System secured from unauthorized use? **Yes No**

Warning and safety devices are tested quarterly? **Yes No**

Circuit diagrams available? **Yes No**

## **VENTILATION CONTROL**

for research electron accelerators

Ozone concentration < 0.1 ppm (TLV) **Yes No**

## **RADIATION MONITORING**

Continuous radiation monitoring in high radiation areas, independent of accelerator controls and interlock systems, with readout at the console? **Yes No**

Radiation monitors calibrated annually and after repairs? **Yes No**

### **RADIATION SURVEYS**

Annual survey instrument calibration? **Yes No**

Was the last radiation survey/facility evaluation performed no more than 12 months ago? **Yes No**

Since the last radiation survey, have any of the following conditions occurred?

Removal or disassembly of any component that normally stops the primary beam? **Yes No**

Exposure of more than 1,000 mrem per quarter to any finger dosimeter? **Yes No**

### **EQUIPMENT REQUIREMENTS**

#### **Signs and Labels**

"CAUTION: HIGH INTENSITY X-RAY BEAM" - on source housing? **Yes No**

"CAUTION - RADIATION. THIS EQUIPMENT PRODUCES RADIATION WHEN ENERGIZED"

- near switch used to turn on unit? **Yes No**

#### **Warning Lights or Devices - All Units**

"BEAM - ON" light - near any switch that energizes the system **Yes No**

On new equipment installed after November 1983 light shall be fail safe **Yes No**

### **OPERATING REQUIREMENTS**

Are written operating procedures available to all users of x-ray equipment? **Yes No**

Has written approval been granted by the Radiation Safety Committee or the RSO for operation of the unit in a manner other than specified in the written procedure or for bypassing safety devices? **Yes No**

### **PERSONNEL REQUIREMENTS**

Have all persons operating x-ray equipment received instruction and demonstrated adequate knowledge of:

Utah Rules (R313-44) and facility operating procedures; **Yes No**

radiation hazards associated with use of equipment; **Yes No**

significance of radiation warning and safety devices; **Yes No**

symptoms of acute localized exposure; and **Yes No**

procedure for reporting actual or suspected exposure? **Yes No**

#### **Personnel Monitoring**

Have personal monitoring devices (body or ring badges) been issued? **Yes No**

If "Yes", are they used in compliance with University requirements?

**Yes No**

**RADIATION SURVEY DATA**

**Radiation survey meter(s) available at facility:**

Make/Model: \_\_\_\_\_ Ser. No.: \_\_\_\_\_ Calibration Date: \_\_\_\_\_

Make/Model: \_\_\_\_\_ Ser. No.: \_\_\_\_\_ Calibration Date: \_\_\_\_\_

**Radiation survey meter(s) used for this survey, if different:**

Make/Model: \_\_\_\_\_ Ser. No.: \_\_\_\_\_ Calibration Date: \_\_\_\_\_

Make/Model: \_\_\_\_\_ Ser. No.: \_\_\_\_\_ Calibration Date: \_\_\_\_\_

**Survey results:**

With machine operating at usual kVp and mA:

Maximum exposure rate within 30 cm from shield walls: \_\_\_\_\_ mR/hr

Is the dose rate less than 2.5 mrem/hr? **Yes No**

Maximum exposure rate at operator's position: \_\_\_\_\_ mR/hr

Is the dose rate less than 2.5 mrem/hr? **Yes No**

**Surveyed By:** \_\_\_\_\_

**Upon completion, send this inspection report to:  
Radiological Health Department, 322 RAB (Campus Address )**