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 perating 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 5th 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)