APPLICATION GUIDE FOR PARTICLE ACCELERATOR LICENSE

ACADEMIC PROGRAMS

Item 1. Self-explanatory

Item 2. If the particle accelerator(s) will be used at address(es) other than that listed in Item 1, list all such addresses.

Item 3. Self-explanatory

Item 4. Self-explanatory

Item 5. List all departments or similar divisions of the institution which will use the particle accelerator(s) (e.g. physics, chemistry).

Item 6. Self-explanatory

Item 7. One person should be designated by, and responsible to, the institution's administration for coordination and management of the institution's radiation safety program (sometimes designated Radiation Safety Officer).

Provide a statement describing this individual's responsibilities and authority for implementing the radiation safety program. The scope of duties will vary according to the scope of the proposed particle accelerator program, but at least the following should be considered in the description of the Radiation Protection Officer's authority and responsibilities:

(1) General surveillance over activities involving the operation of the particle accelerator, including routine monitoring and special surveys of the accelerator and/or target rooms.

(2) Determining compliance with rules and regulations, license conditions, and the conditions of project approval specified by the radiation safety committee.

(3) Monitoring and maintaining absolute and other special filter systems associated with the operation of the particle accelerator, if applicable.

(4) Furnishing consulting services on all aspects of radiation protection to personnel at all levels of responsibility.

(5) Distributing and processing personnel monitoring equipment, keeping personnel exposure records, and notifying individuals and their supervisors of exposures approaching maximum permissible amounts and recommending appropriate remedial action.

(6) Conducting training programs and otherwise instructing personnel in the proper procedure for use of the particle accelerator prior to use, at periodic intervals (refresher training), and as required by changes in procedures, equipment, regulations, etc.

(7) The authority to terminate immediately a project that is found to be a threat to health or property.

Item 8. Particle Accelerator(s)

a. Identify each particle accelerator according to the following.

1. Manufacturer of the accelerator
2. Model number of the accelerator
3. Type accelerator (e.g. vander Graaff, Cockcroft-Walton, etc.)
4. The number of each accelerator present
5. The proposed purpose for which the accelerator will be used.

b. Specify the following operating characteristics for each accelerator (descriptions listed in Item 8.b. should be numerically keyed to the appropriate accelerator in Item 8.a. Characteristics listed in 8.b.(1) should be applicable to the accelerator listed in 8.a.(1) and so on.

1. Operating modalities (e.g. x-ray, electron, deuteron, etc.) available for use on the accelerator.

2. Operating modalities of the accelerator which will actually be used. (For example, a given accelerator may be capable of producing both electron and x-ray beams, but only the x-ray beam is used.)

3. Maximum radiant energy available for each operating modality used.

4. If the accelerator uses radioactive material as a target, specify the isotope, activity, manufacturer, and model number of the target. Radioactive targets must be licensed separately from the accelerators. Facilities possessing an Arkansas Radioactive Material License will have this license amended to include radioactive material as accelerator targets.

Item 9. Identify the radiation detection instruments which will be used in the program by:

A. Type of instrument (e.g. ionization chamber, proportional counter, GM, etc.)

B. Manufacturer of each instrument

C. Model number of each instrument

D. Number of each type instrument available for use

E. Type of radiation each instrument is capable of detecting (e.g. beta, gamma, neutron, etc.)

F. Sensitivity range of each insturment. This range may be expressed in mR/hr, in counts per minute, or in other units. Specify the range of the most sensitive scale on the instrument and of the least sensitive scale, if more than one scale exists.

G. Describe the proposed use of each instrument (e.g. surveys, monitoring, etc.)

NOTES: (1) Radiation detection instruments which would be listed under Item 9 should include the following categories, in order to comply with Paragraph RH-5407:

(a) Portable monitoring equipment for surveys

(b) Area monitors for continuous measurement of radiation levels in all high radiation areas. These units must provide a remote and local readout with visual and/or audible alarms at both the accelerator control panel and at the monitoring station. Area monitors must be set to activate at a level of 100 mrem/hr or lower.

(2) If the accelerator is capable of producing neutrons, some method of measuring the neutron radiation levels must be provided. If detection instruments which are capable of detecting neutrons are not listed under Item 9, some method of evaluating neutron radiation levels must be described.

Item 10. Calibration of Instruments Listed in Item 9.

a. X- and Gamma-ray Detectors

Appendix A to this guide contains a description of acceptable calibration procedures for x- and gamma-ray detection instruments. Use the form in Appendix A to provide information concerning the calibration procedures that will be used for survey instruments and for the area monitor(s), whether these calibrations will be performed by the applicant or by an outside organization.

b. Other Detection Instruments

For survey instruments or area monitors other than x- and gamma-ray detectors (alpha, beta, neutron), submit procedures for calibrating these instruments in the same format as Appendix A, addressing

(1) Calibration source: manufacturer, model number, isotope, and activity

(2) Name, address, and registration number of an outside organization to perform calibrations or the procedures to be followed for in-house calibrations.

Item 11. Facilities and Equipment

a. Permanent installations

For facilities where the particle accelerator is permanently installed at a single location (not portable) the following information should be submitted:

(1) Drawing or sketch of the accelerator facility and surrounding areas, including:

(A) Dimensions of the area, particularly distances to uncontrolled areas. As an alternative, drawings may be done to a specified scale.

(B) Thickness, type, and density of shielding material on all sides, above, and below the accelerator facility. All barriers to the accelerator facility must be permanent barriers.

(C) Identification of entrances to the area.

(D) Identification of all areas adjacent to the accelerator facility.

(2) Radiation levels in adjacent areas should be calculated for the maximum energy output of each operation modaility. Sufficient shielding should be provided to show that the expected levels do not exceed the limits specified in Paragraphs RH-1200 through RH-1204. Copies of any calculations done should be submitted with the application. Refer to the National Council on Radiation Protection (NCRP) Report Number 51 for more information on shielding calculations.

(3) In addition to the calculations addressed above, a radiation survey of the accelerator installation must be performed when the accelerator is first capable of producing radiation. This survey should be conducted to verify that calculated radiation levels are not exceeded and should be capable of locating any possible deficiencies in the shielding.

(4) Controls and Interlocks

(A) All entrances to the accelerator target room or other high radiation areas must be provided with interlocks. Submit a description of the interlocks on these entrances according to the following criteria:

(i) Interlocks should be designed so that they are fail safe. That is, any defect or component failure in the interlock system must prevent operation of the accelerator.

(ii) Each separate interlock should be on an independent single circuit, operating independently of all other safety interlocks.

(iii) The interlocks must be designed so that, when an interlock is tripped, the accelerator cannot be restarted until the interlock has been reset, first at the position where the interlock was tripped, then at the control console.

(B) A "scram" button or an emergency power cut-off switch must be located and easily identificable in all high radiation areas. The location of all scram buttons should be identified on the facility drawing. These emergency switches should be designed so that the accelerator cannot be restarted at the control console without first resetting the cut-off switch.

(C) All high radiation areas and the entrances to these areas must be equipped with flashing or rotating warning lights which operate only when the accelerator is producing radiation.

(D) Barriers and pathways leading to high radiation areas must be posted with warning signs which state, "Caution (or Danger) High Radiation Area" as described in Paragraph RH-1303 (c)(1).

b. Temporary Use Locations

If the particle accelerator is designed so as to be portable, and will be operated at more than one location, describe the radiation safety precautions at these temporary sites, including:

(1) Establishing and posting controlled areas

(2) Control of access to controlled areas

(3) Use of time, distance, and shielding to maintain exposures below regulatory limits

(4) Special tanks, enclosures, or other facilities to provide shielding and controll access. Special facilities should be described as to size, type and quantity of shielding, and exposure rates at the perimeter.

c. Equipment

(1) If any changes have been made in the manufacturer's design of the particle accelerator(s) which effect the operating characteristics, describe these modifications, including the alterations in operating characteristics and explanatory drawings, if appropriate.

(2) Describe the special handling equipment and procedures used for handling activated materials. Include an explanatory drawing, if appropriate.

Item 12. Administrative Controls

a. Describe the precautions taken to secure the particle accelerator from unauthorized use. Procedures may include such provisions as locking and securing the control console, the accelerator facility, and other precautions.

b. The institution should establish a radiation safety committee to approve, in advance, proposals for the use of the particle accelerator, to monitor the operations involving the accelerator, and to maintain the License and procedures in accordance to changes in rules, regulations, facilities, equipment, or operations. Provide the following information regarding the Radiation Safety Committee:

(1) Names and specialties of the Committee members. As an alternative to naming specific individuals, specific positions within the institution may be named as composing the membership.

(2) The duties, responsibilities, and authority of the Committee, including the line of authority in the institution's administration. If less than the full Committee is empowered to act on behalf of the Committee, the number of members which must be present to constitute a quorum should be specified.

(3) The frequency with which the Committee will meet. (Must be at least annually.)

(4) Procedures and criteria established for evaluating radiation safety aspects of proposed uses of the particle accelerator.

Item 13. Operating and Emergency Procedures

A written set of Operating and Emergency Procedures should be established for particle accelerator operations at the facility. Appendix B to this guide is a form which is to be completed which indicates where in the procedures each of the topics addressed in the Appendix can be found.

Complete the Appendix B form and submit it and a copy of the Operating and Emergency Procedures as a part of the application.

Item 14. Training Program

a. Describe the program for training persons to operate the particle accelerator. If students are involved in accelerator operations, describe the prerequisites for their participation, including formal course work and "hands-on" training as applicable. As a minimum, this training should include:

(1) Fundamentals of Radiation Safety

(a) Characteristics of radiation

(b) Units of radiation dose and quantity of radioactivity

(c) Measurement of radiation

(d) Methods of controlling radiation dose

(e) Radiation safety procedures, interlocks, and warning systems.

(2) Fundamentals of Radiation Detection

(a) Use of radiation survey instruments

(b) Survey technique

(c) Use of personnel monitoring equipment

(3) Equipment

(a) Remote handling equipment

(b) Handling of activated material

(c) Use of shielding

If students are involved in accelerator operations, describe the supervision of these individuals during the procedures. Operation of the accelerator must be in the physical presence of at least one authorized user.

b. Describe the training given to ancillary personnel (e.g. housecleaning, security) who work in the vicinity of the particle accelerator. This training should address, as a minimum, emergency procedures and possible unsafe conditions. If no ancillary personnel will be involved, so state.

Item 15. Special Considerations for Particle Accelerator Licensees

Appendix C to this guide is a form which lists several regulatory requirements for Particle Accelerator Licensees which are not addressed elsewhere in the application. Complete the form and submit it as a part of the application, indicating that the specific requirements listed will be met.

Item 16. Personnel Monitoring Devices

a. Personnel monitoring devices which are capable of separating component parts (i.e. gamma, x-ray, thermal neutron, fast neutron, etc.) of a mixed radiation field should be used. Indicate the type of monitor to be used (film, thermoluminescent dosimeter, or other), the supplier's name, address, and registration number, and the frequency with which these devices are exchanged. Organizations providing personnel monitoring services must be registered with the Arkansas Department of Health under Paragraph RH-34 (c).

b. If pocket ionization chambers (pocket dosimeters) are used, provide the manufacturer's name and model number, the number of chambers available, and the range of scale readings. Pocket dosimetners with very high ranges, such as Civil Defense dosimeters with ranges of 1 R or higher should not be used.

   Describe the procedures for use of the pocket dosimeters, including calibration procedures and frequency of reading and recording when in use. A copy of any logs or forms used for maintaining these records should be submitted, if available.

Item 17. Formal Training in Radiation Safety

Attach a resume for each individual named in Items 6 and 7. Describe individual's formal training in the following areas where applicable. Include the name of person or institution providing the training, duration of training, when training was received, etc.

a. Principles and practices of radiation protection.

b. Radioactive measurement standardization and monitoring techniques and instruments.

c. Mathematics and calculations basic to the use and measurement of radioactivity.

d. Biological effects of radiation.

Item 18. Experience

Attach a resume for each individual named in Items 6 and 7. Describe individual's work experience with radiation, including where experience was obtained. Work experience or on-the-job training should be commensurate with the proposed use. The resume should include a list of actual experience using particle accelerators, specifying the type of accelerators used and the energy range of each.

Item 19. The application should be signed by an individual authorized to act in behalf of the institution. This item MUST be completed by the applicant before submission to the Department. All unsigned applications will be returned.

II. CALIBRATION OF INSTRUMENTS

Check appropriate items.

A. Survey Instruments

_____ 1. Survey instruments will be calibrated at least annually and following repair.

_____ 2. Calibration will be performed at two points on each scaled used for radiation protection purposes, i.e., at least up to 1 R/hr.

The two points will be approximately 1/3 and 2/3 of full scale. A survey instrument may be considered properly calibrated when the instrument readings are within ± 10 percent of the calculated or known values for each point checked. Readings within ± 20 percent are considered acceptable if a calibration chart, graph, or response factor is prepared, attached to the instrument, and used to interpret readings to within ± 10 percent. Also, when higher scales are not checked or calibrated, an appropriate precautionary note will be posted on the instrument.

3. Survey instruments will be calibrated

_____ a. By the manufacturer

_____ b. At the licensee's facility

(1) Calibration source

Isotope (Element and Mass Number)_____

Manufactruer's name_____

Model No._____

Activity in millicuries_____

or

Exposure rate at a specified distance_____

Accuracy_____

Traceability to primary standard_____

_____ (2) The calibration procedures in Appendix A will be used.

or

_____ (3) The step-by-step procedures, including radiation safety procedures, are attached.

_____ c. By a consultant or outside firm

(1) Name_____

(2) Location_____

(3) Procedures are on file with the Arkansas Department of Health under Registration Number _____.
(Persons performing these calibrations <u>must be</u> registered with the Department pursuant to RH-34 (b)).

II. CALIBRATION OF INSTRUMENTS
(Cont'd)

(4) The consultant's report will contain the information on

_____ the attached "Certificate of Instrument Calibration".

_____ the consultant's reporting form as attached.

B. Area Monitors

_____ 1. Area monitors will be tested for proper response using radionuclide sources.

Frequency of testing_____

Check source: isotope (element and mass number)_____

activity_____

_____ 2. Procedures for tesing area monitor attached.

3. Area monitor alarms will be set to activate when radiation levels are _____ mR/hr. (This level must not be higher than 100 mR/hr.)

CERTIFICATE OF INSTRUMENT CALIBRATION

For:

Instrument:

Manufacturer _____

Type _____

Model No. _____

Serial No. _____

Calibration Data:

Scale	Exposure rate (mR/hr)	Instrument reading (mR/hr)	Exposure rate (mR/hr)	Instrument reading (mR/hr)	Exposure rate (mR/hr)	Instrume readi (mR/hr

Comments:

Nuclide	Activity or Exposure Rate at Specified Distance	Calibration Accuracy

Calibration Source:

Calibrated by _____ Date _____

APPENDIX B

OPERATING AND EMERGENCY PROCEDURES

Complete the following form by indicating where in the particle accelerator operating and emergency procedures (page number, section number, or other appropriate notation) each of the topics is addressed. This list constitutes the minimum topics to be covered by these procedures.

1. Use of the particle accelerator, including maintaining exposures below the regulatory limits and prohibition against using the interlock system to routinely turn the accelerator beam on and off.

   Information found _____

2. Procedures for checking safety and warning devices, including interlocks, for proper operation. These checks should be done at intervals not to exceed three months and records must be maintained for these checks.

   Information found _____

3. Procedures to be followed if an interlock is intentionally bypassed. This action must have the authorization of the radiation safety committee, be recorded in a permanent log book, and have a notice posted at the accelerator control console.

   Information found _____

4. Methods and occasions for conducting radiation surveys, including:

   (a) Radiation survey by a qualified individual when changes have been made in shielding, operation, equipment, or occupancy of adjacent areas, and at specified periodic intervals to check for unknown changes and malfunctioning equipment.

   (b) Periodic surveys to detect and quantify the amount of airborne particulate radioactivity, if applicable.

   (c) Periodic smear surveys to detect and quantify the degree of contamination in target and scattering chamber areas, if applicable.

   (d) Procedures for maintaining records of surveys.

   Information found _____

5. Personnel monitoring and the use of personnel monitoring equipment.

   Information found _____

6. Emergency procedures, including:

   (a) Minimizing exposures in the event of an accident.

   (b) Notifying proper individuals in the event of an accident. Specific names and phone numbers should be given.

   Information found _____

7. Maintenance of records including utilization logs or other records.

   Information found _____

8. Ventilation systems in areas where airborne radioactivity exceeds the limits of Paragraph RH-2200, Appendix A, Table I for the specified radioisotope. Ventilation of these areas must be performed with sufficient dilution to maintain concentrations below the limits specified in RH-2200, Appendix A, Table II. (Concentrations may be averaged over a period of one year.)

   Information found_____

9. Procedures for disposal of solid and liquid radioactive wastes produced at the accelerator facility. The disposal of these wastes must follow the requirements of Paragraphs RH-1402 and RH-1403.

   Information found_____

APPENDIX C

SPECIAL CONSIDERATIONS FOR PARTICLE ACCELERATOR LICENSEES

The following requirements from the Arkansas Rules and Regulations for Control of Sources of Ionizing Radiation are administrative requirements for Particle Accelerator Licensees. Each paragraph referenced should be read and understood. Completion of this application implies agreement to abide by these requirements. Indicate that each of these requirements is understood and will be followed by checking the blank in front of each item.

_____ 1. Electrical circuit diagrams of the accelerator, and the associated interlock systems, will be kept current and on file at each accelerator facility. (Refer to Paragraph RH-5405 (d))

_____ 2. A copy of the Operating and Emergency Procedures will be maintained at the accelerator control panel. (Refer to Paragraph RH-5405 (f))

_____ 3. Paragraph RH-1305, Instruction of Personnel; Posting of Notice to Employees.

_____ 4. Section 3, Part F, Paragraph RH-1500 through RH-1506, Records, Reports, and Notification.

_____ 5. Section 3, Part N, Paragraph RH-2801 through RH-2808, Notices, Instructions and Reports to Workers; Inspections.