PRINCETON UNIVERSITY

RADIATION SAFETY GUIDE

RULES, REGULATIONS & PROCEDURES

Edited by

the Health Physics Staff

of the

Office of Occupational Health and Safety

and

Approved by

the Radiation Safety Committee

and

the Committee on

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1. RADIATION SAFETY PROGRAM

A. Introduction

In September 1971 a consolidation and reorganization of the Princeton University safety organization was completed, and a comprehensive, integrated occupational health and safety program established. This was done, in the words of former President Goheen, "... to better carry out the responsibility we [the University] assume to prevent, to the best of our ability, injury and death to students, staff and members of the general public...and to enable the institution to discharge its legal, moral and regulatory obligations more effectively and efficiently." Since radiation safety is an integral part of the University's health and safety program, an understanding of the overall structure and organization is essential to an understanding of the radiation safety program.

The four primary components or elements of the University's safety organization include a University Committee on Occupational Safety and Health, responsible for policy; an Office of Occupational Health and Safety, responsible for monitoring the implementation of the Committee's decisions; a network of "Departmental Health and Safety Coordinators"; and an explicit statement of health and safety policy.

The University Committee on Occupational Safety and Health is appointed by the Dean of the Faculty on behalf of the President and consists of faculty, research staff members, and University administrators and those *ex officio* members necessary for the conduct of the Committee's business. The Committee normally meets several times during the academic year and is responsible for developing health and safety policy, advising the President and monitoring the progress of the health and safety program. A list of the membership is included in Appendix A.

The Office of Occupational Health and Safety is a division of the University's Health Services. Its staff, consisting of health physicists, industrial hygienists, safety engineers, a sanitarian and supporting clerical and technical staff, functions in an advisory and consultive capacity. They assist the academic and operating departments in the implementation of the health and safety policy and in maintaining compliance with all applicable Federal, State and local health and safety regulations and standards. The health and safety staff provides a variety of services, consultations, evaluations and audits. The Director of the Office of Occupational Health and Safety is responsible to the Director of the University Health Services who, in turn, is responsible to the Vice President for Administrative Affairs. The Director also serves as Executive Secretary for the Committee. A list of the senior Occupational Health and Safety staff is included in Appendix A.

The "Departmental Health and Safety Coordinator" is the individual, or individuals, designated by the department chairman or office head, who acts on behalf of the department in health and safety matters. The coordinator is the primary liaison between the department and the Occupational Health and Safety staff and is generally responsible for becoming familiar with departmental activities involving actual or potential hazards. Coordinators in departments using "Sources of Radiation" have additional responsibilities described below. In the absence of an appointed coordinator, health and safety matters are referred directly to the chairman or office head.

The health and safety policy of Princeton University is to provide, to the best of the University's ability, a safe and healthful environment, free from recognizable hazards for students, staff and visitors, and to comply with all applicable safety and health regulations and standards.

B. Radiation Safety Program

1. Policy and Purpose

Princeton University's radiation safety policy is an extension of the previously stated occupational safety and health policy and applies to the use of "Sources of Radiation" in the various teaching, research and operating activities. The purpose of the radiation safety program is to provide a structure and organization which ensures continuing implementation of the radiation safety policy throughout the University. The objectives of this program are:

a. to make every reasonable effort to maintain radiation exposures, and releases of radioactive material in effluents to unrestricted areas As Low As is Reasonably Achievable (ALARA). The concept of ALARA is applied taking into account the state of technology and the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations;

b. to ensure control of the possession and use of "Sources of Radiation" in University teaching, research and operating programs to minimize, insofar as practicable, hazards to personnel and loss of property arising from the use of such materials; and,

c. to ensure compliance with all Federal, State and local laws covering the use of such materials, machines and devices.

2. Radiation Safety Committee

The Radiation Safety Committee is appointed by the Dean of the Faculty on behalf of the President on recommendation of the Chairman of the Committee on Occupational Safety and Health. It consists of faculty, research staff members, and University administrators, several of whom are knowledgable in the safe use of "Sources of Radiation," and certain *ex officio* members. The Radiation Safety Committee develops and recommends radiation safety policy to its parent committee and monitors the progress and continuity of the radiation safety program. Additionally, and in accordance with the requirements of the various University radioactive materials licenses, the Committee reviews and either approves or denies applications for proposed usage of "Sources of Radiation." Since most of the work of this Committee is done on a continuing basis, formal meetings of the Committee are infrequent, normally one or two per year. A list of the membership is included in Appendix A.

3. Health Physics Section

The "Health Physicists" and supporting technical staff comprise the Health Physics Section of the Office of Occupational Health and Safety. The Head of the Health Physics Section reports to the Director of the Office of Occupational Health and Safety. The "Health Physicists" are listed in Appendix A.

The health physics staff provides a variety of radiation safety services, evaluations and audits, all directed towards assisting the "Authorized User" and his or her department in implementing the radiation safety policy and in controlling exposure to radiation and radioactive materials. The group functions with a strong service orientation, informing the "Authorized User" of his or her obligations and assisting the "User" to anticipate and identify potential radiation safety problems. In carrying out these responsibilities, every reasonable effort is made to relieve the research and operating staffs of as much of the mandated administrative and record keeping detail as is possible. In addition, a number of technical measurements and evaluations are made as a service to the "Authorized User." However, it is neither possible nor desirable to relieve the "Authorized User" of the binding responsibility to ensure that "Sources of Radiation" under his or her control are used safely and in accordance with all applicable rules and regulations.

4. Health Physics Section Responsibilities

The responsibilities of the Health Physics Section include:

a. administration of the five University licenses

b. control of acquisition of "Sources of Radiation" in accordance with provisions of the various licenses

c. maintenance of all centralized records required by regulation and pertinent to the radiation safety program

d. administration of the centralized personnel monitoring program

e. administration of the centralized radioactive waste program

f. provision of radiation safety consultations and participation in preoperational research planning with faculty, research personnel and support staff

g. inspection and surveys of laboratories and areas where "Sources of Radiation" are used

h. conducting radiation safety training seminars, assisting the "Authorized User" in instructing radiation workers, and auditing overall compliance with the radiation safety training policy

i. advising and assisting University personnel regarding the shipment of radioactive materials and monitoring all outgoing and certain incoming shipments of radioactive material

j. performing required leak tests for all "Sealed Sources"

k. collection and dissemination of radiation safety information including radioisotope fact sheets, regulatory changes, health and safety advisories, etc.

l. provision of assistance and advice in all radiation emergencies and supervision of special decontamination operations

m. performing first echelon maintenance and periodic calibration of laboratory survey equipment

n. investigation and analysis of radiation incidents including, for example, spills of radioactive materials, releases, etc., and development of recommendations to prevent reoccurrences

o. auditing the progress and continuity of the radiation safety program

p. developing and refining radiation detection, shielding and health protection techniques

q. when appropriate, representing the University at public hearings concerned with questions of radiation safety

r. provision of advice and assistance to academic and operating departments for the acquisition of radiation detection and dosimetry equipment

s. provision of assistance in the design of new and renovated laboratories in which "Sources of Radiation" are to be used

t. acting as primary liaison between the University, the "Authorized Users" and the various regulatory agencies and accompanying regulatory personnel during their inspection of any University operation.

5. Radiation Safety Responsibilities of the "Departmental Health and Safety Coordinator"

The role of the "Departmental Health and Safety Coordinator" has been described elsewhere; however, there are specific responsibilities in those departments where "Sources of Radiation" are used. These include:

a. reviewing and approving, denying or acknowledging, on behalf of the Department, applications for authorization for "Sources of Radiation";

b. arranging for the appointment of an alternate coordinator during an extended absence. The Office of Occupational Health and Safety should be notified of all such appointments and the effective dates; and,

c. other duties as assigned by the department chairman.

6. Broad License

The existence of a comprehensive University radiation safety program enables the University to hold a Nuclear Regulatory Commission broad byproduct materials license. Under this concept the Nuclear Regulatory Commission delegates its responsibility to license the possession and use of radioactive materials to the University Radiation Safety Committee in accordance with the procedures and guidelines established in this Guide and in the University's license application. This concept has over the

years contributed to the effectiveness of the University's radiation safety effort, it is more economical and it provides for more effective control and higher degree of radiation safety. An internal licensing capability also reduces the time required to obtain an authorization number (license) from months to weeks with obvious benefits to one interested in research.

2. DEFINITIONS

When any of the following defined terms appear in the text of this Guide, their meaning is as defined below, and they appear within quotation marks, and the first letter of each word is capitalized.

A. "Airborne Radioactivity Area"

Any room, enclosure, or operating area in which airborne radioactive materials exist or are likely to exist in concentrations in excess of the amounts specified in Table 1, Column 1 of Appendix B, or in which they exist in concentrations which when averaged over the number of hours in any week during which individuals are in the area, exceed 25 percent of the amount specified above.

B. "Authorized User"

The individual who has been authorized (licensed) by the Radiation Safety Committee to possess and use "Sources of Radiation." This includes individuals possessing Authorization Numbers and/or Limited Possession Numbers and individuals authorized to possess and/or use "Radiation Producing Machines and Devices."

C. "Byproduct Material"

Any radioactive material (except "Special Nuclear Material") yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing "Special Nuclear Material."

D. "Controlled Area"

See "Restricted Area."

E. "Departmental Health and Safety Coordinator"

The individual(s), appointed by the department chairman or office head, who is responsible for the departmental health and safety effort and who is the department's primary liaison with the staff of the Office of Occupational Health and Safety.

F. "Generally Licensed Devices"

Devices and equipment into which radioactive materials are built, the distribution of which to the general public is authorized under the terms of a general license, in accordance with 10 CFR Part 31.

G. "Health Physicist"

An individual who, on the basis of professional training and qualifications, is designated by the Director of the Office of Occupational Health and Safety to advise faculty and staff on radiation safety.

H. "High Radiation Area"

Any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body may receive in any one hour a dose in excess of 100 millirems.

I. "Human Use"

The intentional internal or external administration of radiation or radioactive material to human beings.

NOTE: Any such contemplated use shall first be discussed with the Human Use and Radiation Safety Committees, both of which shall make a recommendation to the University Research Board. In addition, specific licenses for "Human Use" have to be obtained from the Nuclear Regulatory Commission and/or the State of New Jersey.

J. "Limited Possessor"

One who has been issued a Limited Possession Number by the Radiation Safety Committee.

K. "Personnel Monitor Contact"

The individual designated by a department to assist the Office of Occupational Health and Safety staff with the internal administration and logistics of the department's personnel monitoring program.

L. "Principal Investigator"

An individual, holding a faculty or research position, who is immediately responsible for the conduct and the safety of a research project.

M. "Radiation Area"

Any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body may receive in any hour a dose in excess of five millirems or in any five consecutive days a dose in excess of 100 millirems.

N. "Radiation Producing Machine or Device"

A machine or device capable of generating radiation, such as X-ray producing machines, particle accelerators, high voltage power supplies, electron microscopes, high voltage rectifiers, high voltage projection equipment, and other types of high voltage machines.

In general, each single unit capable of producing radiation must be considered as a separate device; however, at the discretion of the "Health Physicist," a number of units which form an administrative, spatial, or functional entity, and which may be combined, modified, and/or separated during the course of a research program, may be considered one device.

O. "Radiation Worker List"

A list generated and maintained by the Office of Occupational Health and Safety on which the "Authorized User" provides the names and supplemental information for individuals working with "Sources of Radiation" under his or her authorization.

P. "Restricted Area"

Any area, access to which is controlled by the department or "Authorized User" for the purpose of protecting individuals from exposure to radiation and radioactive materials. The State of New Jersey uses the term "Controlled Area."

NOTE: "Restricted Area" includes all "Radiation Areas," "High Radiation Areas," rooms or areas in which there are present radioactive materials in such quantities that "Caution: Radioactive Material" signs are required in accordance with Section 9 of this Guide, and certain other areas which may be so defined by the "Health Physicist."

Q. "Sealed Source"

A radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal of the radioactive material under the most severe conditions which are likely to be encountered in normal use and handling and which is used in that configuration.

R. "Source Material"

Uranium or thorium or any combination thereof, in any physical or chemical form; or ores which contain by weight 0.05 percent or more of uranium, thorium, or any combination thereof. "Source Material" does not include "Special Nuclear Material."

S. "Sources of Radiation"

Radioisotopes, radioactivated materials (by irradiation or by exchange processes), "Radiation Producing Machines or Devices," "Generally Licensed Devices," and those quantities of radioisotopes defined by regulation to be exempt quantities.

T. "Special Nuclear Material"

Plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235, or any material artificially enriched by any of the foregoing, but does not include "Source Material."

U. "Unrestricted Area"

Any area, access to which is not controlled by the department or the "Authorized User" for the purpose of protecting individuals from exposure to radiation and radioactive material. Areas not owned by the University are unavoidably classified as unrestricted.

V. "User"

A person using "Sources of Radiation" at Princeton University. This includes all "Authorized Users" and all persons using "Sources of Radiation" under the supervision and/or authorization of an "Authorized User."

W. "10 CFR Part 19," "10 CFR Part 20"

A shorthand notation for Parts 19 and 20 of Title 10 of the Code of Federal Regulations. Title 10 contains the regulations issued pursuant to the 1954 Atomic Energy Act and is presently administered by the Nuclear Regulatory Commission. Part 19, entitled "Notices, Instructions, and Reports to Workers; Inspections," and Part 20, entitled "Standards for Protection Against Radiation," are two parts of Title 10. Other parts of general interest include Part 30: "...Domestic Licensing of Byproduct Material, " Part 33: "Specific Domestic Licensing of Broad Scope for Byproduct Material," and Part 71: "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material...."

4. AUTHORIZATION FOR RADIOISOTOPES (INCLUDING ACTIVATED MATERIALS) AND AUTHORIZATION PROCEDURES

A. Authorization

1. All persons planning to possess or use radioisotopes at Princeton University must obtain prior approval of the Radiation Safety Committee and/or the "Health Physicist" for each radioisotope. Persons not qualified for authorization, according to the requirements stated in Section B below, must use radioisotopes only under the supervision of an "Authorized User."

2. The first step to obtain authorization is the filing of an application through the Office of Occupational Health and Safety. Applicants are advised that the application process may take several weeks (or longer if an amendment to a University license must be obtained) and are, therefore, urged to submit their application sufficiently in advance of the planned starting date to avoid delays. The filing of an application sets in motion a procedure which provides for a thorough review of the radiation safety aspects of the proposed usage. The final step in the procedure is the issuance by the Office of Occupational Health and Safety of an Authorization Number or a Limited Possession Number.

3. Temporary Approval

   The "Health Physicist" is authorized by the Committee to grant a temporary approval, if specifically requested by the applicant. However, such approval is granted at the discretion of the "Health Physicist" and is dependent upon receipt of a completed application. Temporary approval is valid for 30 days and is normally issued within 36 hours of receipt of a properly completed application.

4. Duration of Authorization

   Each Authorization Number and Limited Possession Number is coterminous with the applicable University license or terminates with the severance from the University of the "Authorized User." In some instances specific expiration dates are established at the request of the "Health Physicist."

5. Revocation

   The Committee has the right and responsibility to revoke any authorization granted by it if, in its opinion, sufficient justification exists for such action.

6. Amendments

Any change in the use of a radioisotope from that described in the application shall be discussed with the "Health Physicist." Significant changes which could affect radiation safety, such as the use of an open source as opposed to a "Sealed Source," the *in vivo* use of radioisotopes in animals as opposed to *in vitro* work, use of dry powders instead of a less hazardous form, etc., require an amendment. Any such amendments may be approved by the "Health Physicist" except that the "Health Physicist" has the option to refer proposed changes to the Radiation Safety Committee. Increases in the amount of radioisotope authorized for use require a new application.

B. Classes of Authorizations: Description

1. Authorization Numbers

There are two kinds of Authorization Numbers: one for Radioisotopes and one for Activations. They are distinguished as follows:

a. A Radioisotope Authorization Number authorizes possession and use of the requested amount of a specific radioisotope (and its daughters) in accordance with the statements and representations made in the application. Radioisotopes are generally acquired by purchase from a commercial supplier.

b. An Activation Authorization Number authorizes activation of a sample for radioisotope production in an accelerator, reactor, etc., and subsequent possession and use of the product radioactivities in accordance with the statements and representations made in the application. Several types of activations are recognized and are explained in paragraph 3 below.

c. Only persons who are "Principal Investigators," hold a faculty or research position, and have had significant previous experience with radioisotopes similar to those being requested may apply for an Authorization Number. However, upon recommendation of the Department Chairman and with concurrence of the "Health Physicist," the requirement for a faculty or research position may be waived provided the applicant has had extensive radioisotope experience or the radiological hazards associated with the use of the radioisotope are minimal.

d. The amount of radioactive material and the scope of work permitted under an Authorization Number is, in general, limited by the terms and conditions of the relevant University license.

2. Limited Possession Numbers

a. A Limited Possession Number is a restricted or limited Authorization Number. The scope of the activities permitted and the required qualifications of the applicant differ in the following ways:

1) The applicant does not have to meet the qualifications established for a "Principal Investigator." Less emphasis is placed on previous experience with "Sources of Radiation." Therefore, the scope of work permitted is restricted.

2) The maximum amount of radioactivity authorized for use by an individual holding a Limited Possession Number is limited to 100 times the amount listed in column A of Appendix C of a single radioisotope or the equivalent prorated quantity of several as illustrated in the footnote to Appendix C, except that the total amount for any radioisotope may not exceed 15 mCi. However, persons holding at least one valid Authorization Number and therefore meeting the qualifications of a "Principal Investigator" may hold an unlimited number of Limited Possession Numbers, provided no single quantity authorized exceeds the amount described above for a single radioisotope.

3) Limited Possession Numbers are issued at the discretion of the "Health Physicist" and without Committee review, although the Committee is periodically informed of all new Limited Possession Numbers issued. The "Health Physicist" may, at his or her discretion, elect to require full Committee review.

b. Limited Possession Numbers are also issued to authorize possession of "Generally Licensed Devices," such as smoke detector heads, spark gaps, thickness gauges, etc., which contain radioactive material. The licenses for all such devices have general requirements, the specifics of which are dealt with in the application process.

3. Categories of Activation Authorizations

a. An "onsite-internal" activation for radioisotope production is one performed at a University facility by and for University personnel and their collaborators. Persons desiring authorization must obtain an Activation Authorization Number.

There is also the case of "onsite-internal" irradiations not performed for the specific purpose of radionuclide production, which may cause the incidental activation of target holders, machine components, shielding, etc., e.g. target irradiations to produce secondary particle beams. The irradiation may be arranged at the discretion of the "Authorized User" responsible for the facility, and no Authorization Number is issued, provided the irradiation meets the following criteria:

1) it is performed with the active participation of an individual associated on a full-time basis with the University facility at which the irradiation is done: and,

2) no activated material will leave the facility in which the material was incidentally produced.

The "Authorized User" may, however, request a review of the proposed irradiation by the "Health Physicist" and the Radiation Safety Committee. The "Authorized User" has the responsibility for radiation safety, including the inventory and management of any radioactive materials produced.

b. An "onsite-external" activation is one performed at a Princeton University facility to produce radioactive materials used by non-University personnel at either an on- or off campus location. Regardless of where the material is ultimately taken, any person desiring such an activation must file an application for an Authorization Number with the Radiation Safety Committee through the Office of Occupational Health and Safety.

If the proposed use includes any transport of the activated material outside the facility at which it was produced, a formal agreement (part of the application procedure) must be executed by a duly authorized representative of the applicant's organization. Certain conditions regarding such activations have been established by the New Jersey Bureau of Radiation Protection. These are:

1) The person desiring the activation must demonstrate to the Office of Occupational Health and Safety that his or her organization is duly authorized to possess and use the requested materials under the provisions of an appropriate government license.

2) The "Health Physicist" is responsible for reporting the transfer on the next monthly radioisotope inventory and the next State Report, indicating the amount of activity, and the date of transfer, the recipient, and the address of organization.

c. An "offsite" activation is one performed for Princeton University personnel at an off campus facility not owned or operated by the University when the resulting radioactivity, however small or purified, is to be brought on campus. Persons desiring such an activation must obtain an Activation Authorization Number.

C. How to Apply for Authorization

1. Obtain the necessary forms from the Office of Occupational Health and Safety and discuss the proposed work with the "Departmental Health and Safety Coordinator" and the "Health Physicist."

2. Complete the forms, making sure that they are consistent with the guidelines given in Section B above for Authorization Numbers or Limited Possession Numbers. Please type or print in black ink.

3. Consult with the "Health Physicist" to review the proposal and to obtain any assistance needed to complete the application.

4. Sign the completed application and obtain the signature of the "Departmental Health and Safety Coordinator" (or in his or her absence the signature of the department chairman). Forward the completed application to the Office of Occupational Health and Safety.

D. Processing and Review of Applications for Authorization

1. Authorization Numbers

Upon receipt of a completed application:

a. The "Health Physicist" reviews the application, interviews the applicant, inspects the proposed facilities, and, on the basis of the information obtained, recommends either that the application be

approved, conditionally approved, or denied. At this time, if requested, the thirty day temporary approval will be considered.

b. Copies of the application with the "Health Physicist's" recommendations regarding approval or denial, any conditions suggested by the "Health Physicist," and all supporting documentation are sent to the Radiation Safety Committee.

c. Each member of the Committee reviews the application and may approve, conditionally approve, or deny it. Since an application must be unanimously approved by all available Committee members, a reasonable attempt is made to remove any objections and resolve any concerns. Before making a final decision, committee members are urged to discuss with the "Health Physicist" and the applicant any conditions they wish to impose and objections which could lead to a denial. The Committee members sign the application, annotating it with any comments or conditions, and return it to the Office of Occupational Health and Safety. Denials must be specifically indicated.

d. Following final processing and review of the application, the applicant is notified by memo that the application has been approved and authorization granted. Copies are sent to the Chairman of the Radiation Safety Committee and "Departmental Health and Safety Coordinator." This memo indicates the Authorization Number that has been assigned, the relevant University license, and any conditions or other pertinent information. A copy of the application and all supporting documentation is also returned to the "Authorized User."

e. If the application is denied, a copy of it and all supporting documentation is returned to the applicant, indicating the reasons for denial. The applicant may appeal the decision at a special meeting of the Radiation Safety Committee, requested through the Secretary of the Committee.

2. Limited Possession Numbers

The procedure followed for a Limited Possession Number is the same as that for an Authorization Number except that:

a. The application and supporting documentation is not distributed to the Radiation Safety Committee and the Committee does not review the application.

b. The Committee is notified of all Limited Possession Numbers issued by the "Health Physicist."

6. THE "AUTHORIZED USER'S" RESPONSIBILITIES

A. Acquisition of Authorization

Before any person can begin work with "Sources of Radiation," he or she must satisfy the Radiation Safety Committee and/or the "Health Physicist" through the authorization process that he or she is qualified by training and experience and that the laboratory is properly equipped to handle them safely. Persons not meeting the requirements for authorization must work with "Sources of Radiation" only under the supervision of an "Authorized User."

B. Supervisory Responsibility

The "Authorized User" assumes responsibility for the actions of those persons using "Sources of Radiation" under his or her supervision.

C. Familiarity with Radiation Safety Guide

The "Authorized User" shall become acquainted and comply with the Radiation Safety Guide and shall ensure that other persons under his or her supervision also are acquainted and comply with this Guide. The Radiation Safety Guide must, at all times, be available to these persons.

D. Compliance with Government Regulations

The "Authorized User" shall become acquainted and comply with all applicable government regulations and shall ensure that all persons under his or her supervision also are acquainted and comply with them.

E. Radiation Safety

The acceptance of an authorization obligates the "Authorized User" to ensure radiation safety to him or herself, to all others who can be affected by the presence or use of his or her "Sources of Radiation," and to University property. Prior to short absences the "Authorized User" shall appoint a specific individual to be responsible for radiation safety in his or her absence. An extended absence of the "Authorized User" necessitates a change in responsibility which, in general, means that another individual must obtain the necessary authorization.

F. Records

"Authorized Users" are obligated to maintain certain records. These include those items needed for orderly management of the laboratory such as receipt, use, transfer and disposal records. The "Authorized User" must also keep those records needed to

demonstrate an adequate level of radiation safety, such as survey records.

G. Survey Instruments

The "Authorized User" shall acquire or have available and shall maintain survey instruments appropriate for the radiation in use.

H. Reporting of Incidents

The "Authorized User" shall report to the Office of Occupational Health and Safety any loss or theft, incident, accident, major spill, etc., involving "Sources of Radiation." Such incidents are normally discussed with the Radiation Safety Committee by the "Health Physicist."

I. Training and Orientation of Personnel

1. Radiation Workers

The Health Physics Section provides radiation safety training which meets the requirements of 10 CFR Part 19.12 and other Nuclear Regulatory Commission regulatory guidance in the training area. It is the responsibility of the "Authorized User" to ensure that all persons using radioisotopes under the provisions of his or her authorization attend the mandatory training sessions offered by the Health Physics staff.

The Health Physics staff training sessions are offered to all new radiation workers on a monthly basis. Additionally, all radiation workers are required to attend a refresher training session once a year.

Several of the user departments provide excellent supplemental training in addition to the mandatory training described above. All radiation workers must satisfy the requirements established by their department with respect to training.

2. Ancillary Personnel

The Health Physics staff works with the Public Safety and Building Services departments to establish and implement radiation safety training programs appropriate to the needs of the department and which meet the requirements of 10 CFR Part 19.12 and other Nuclear Regulatory Commission regulatory guidance in the training area. All New employees in these departments who frequent areas where radioactive materials are used must attend initial radiation safety training sessions offered as part of new employee orientation. Additionally, these personnel must attend refresher training on an annual basis.

J. "Radiation Worker List"

The "Authorized User" is responsible for reporting the names of all radiation workers under his or her supervision to the Office of Occupational Health and Safety so that essential radiation safety services, such as personnel monitoring, bioassay services, radiation safety training, prenatal exposure information for women, and special services, are provided for these workers.

To this end the Office of Occupational Health and Safety sends to each "Authorized User," three times a year, a "Radiation Worker List" update to which names can be added or deleted. However, an "Authorized User" should report changes in laboratory personnel immediately, without waiting for the arrival of the "Radiation Worker List" update, so that the essential services can be provided most efficiently.

K. Exposure Control

The "Authorized User" has the responsibility to control work assignments and to ensure that work is carried out in such a manner that the radiation dose to any person from external "Sources of Radiation" and internally deposited radionuclides under his or her control does not exceed the dose limits listed in Appendix D.

L. Emergency Response

The "Authorized User" is responsible for establishing radiation emergency procedures appropriate to the activities in his or her laboratory, and is responsible to ensure that all individuals under his or her supervision are familiar with these procedures and those described in OHS Form #12 and in Section 17 of this Guide. Section 17 provides guidelines which may be useful in formulating emergency procedures for some of the common types of radiation emergencies.

M. Terminations

In the event that an "Authorized User" severs his or her association with the University or discontinues work with "Sources of Radiation," he or she shall inform the Office of Occupational Health and Safety, shall ensure that proper and safe disposal and/or transfer of "Sources of Radiation" is affected, and shall ensure that his or her facility is left in a radiologically safe condition.

9. POSTING, LABELLING, TAGGING, AND SIGNALLING REQUIREMENTS

A. Posting of Required Documents

By regulation each laboratory using "Sources of Radiation" must have posted certain documents. The specific documents to be posted vary, depending on whether the "Sources of Radiation" used by the "Authorized User" are regulated by the Nuclear Regulatory Commission (NRC) or by the State of New Jersey and under which license the laboratory operates. These documents must be posted in a conspicuous place where they will be seen by all persons working in or frequenting a "Restricted Area."

The following listing describes the documents which must be posted for each of the various Federal or State licenses under which an "Authorized User" may operate. If the "Authorized User" operates under more than one license or category, all the relevant categories described below apply. The Office of Occupational Health and Safety will supply the "Authorized User" during the authorization process or machine registration process with the documents appropriate to his or her activities.

1. Laboratories in which NRC licensed "Byproduct Material" is used must have posted:

   a. Form NRC 3, "Notice to Employees"

   b. OHS Form #12, "Accident Procedures and Emergency Phone Numbers"

   c. OHS Form #31, "Emergency Information"

   d. Additionally, the following documents need not be posted but a notice* must be posted which describes the documents and states where they may be examined:

      i) "10 CFR Part 19" and "10 CFR Part 20"
      ii) Princeton University Radiation Safety Guide
      iii) NRC Broad License #29-05185-24

2. Laboratories in which NRC licensed "Source Material" is used must have posted:

   a. Form NRC-3, "Notice to Employees"

   b. OHS Form #12, "Accident Procedures and Emergency Phone Numbers"

   c. OHS Form #31, "Emergency Information"

*A poster suitable for this purpose is provided to the "Authorized User" during the authorization process.

d. Additionally, the following documents need not be posted, but a notice* must be posted which describes the documents and states where they may be examined:

i) "10 CFR Part 19" and "10 CFR Part 20"
ii) Princeton University Radiation Safety Guide
iii) NRC License #SUD 381

3. Laboratories in which NRC licensed "Special Nuclear Material" is used must have posted:

a. Form NRC-3, "Notice to Employees"

b. OHS Form #12, "Accident Procedures and Emergency Phone Numbers"

c. OHS Form #31, "Emergency Information"

d. Additionally, the following documents need not be posted but a notice* must be posted which describes the documents and states where they may be examined:

i) "10 CFR Part 19" and "10 CFR Part 20"
ii) Princeton University Radiation Safety Guide
iii) NRC License #SNM 356

4. The laboratory in which the device known as the Gammator B irradiator is used must have posted:

a. Form NRC-3, "Notice to Employees"

b. OHS Form #12, "Accident Procedures and Emergency Phone Numbers"

c. OHS Form #31, "Emergency Information"

d. Additionally, the following documents need not be posted but a notice* must be posted which describes the documents and states where they may be examined:

i) "10 CFR Part 19" and "10 CFR Part 20"
ii) Princeton University Radiation Safety Guide
iii) NRC Broad License #29-05185-25

5. Laboratories in which radioisotopes regulated by the State of New Jersey (naturally-occurring radioisotopes or accelerator-produced radioisotopes) are used must have posted:

*A poster suitable for this purpose is provided to the "Authorized User" during the authorization process.

a. Form BRP-D14, "Notice to Employees"

b. OHS Form #12, "Accident Procedures and Emergency Phone Numbers"

c. OHS Form #31, "Emergency Information"

d. Additionally, the following documents need not be posted, but a notice* must be posted which describes the documents and states where they may be examined:

i) New Jersey Radiation Protection Code
ii) Princeton University Radiation Safety Guide
iii) New Jersey License #80066

6. Laboratories in which "Radiation Producing Machines or Devices" are used must have posted:

a. Form BRP-D14, "Notice to Employees"

b. OHS Form #12, "Accident Procedures and Emergency Phone Numbers"

c. OHS Form #31, "Emergency Information"

d. Additionally, the following documents need not be posted, but a notice* must be posted which describes the documents and states where they may be examined:

i) New Jersey Radiation Protection Code
ii) Princeton University Radiation Safety Guide

B. Design Specifications for Signs, Labels, Tags, and Signals

All signs, labels, tags, and signals, used to indicate the presence of "Sources of Radiation" or to post an area as a "Radiation Area," "High Radiation Area," or "Airborne Radioactivity Area" must conform with "10 CFR Part 20" or the New Jersey Radiation Protection Code as appropriate.

Caution: Some commercially available items may not meet specifications.

C. Posting of Radiation Areas

1. Each "Radiation Area" as defined in Section 2 shall be conspicuously posted with a sign or signs bearing the radiation symbol and the words:

*A poster suitable for this purpose is provided to the "Authorized User" during the authorization process.

CAUTION

RADIATION AREA

2. Each "High Radiation Area" as defined in Section 2 shall be conspicuously posted with a sign or signs bearing the radiation symbol and the words:

CAUTION

HIGH RADIATION AREA

NOTE: Access to "High Radiation Areas" shall be interlocked in such a manner that: 1) the radiation level is reduced to the point that the person(s) entering the area shall absorb less than 100 mrem/hour, or 2) a visible and/or audible signal shall make the individual and the supervisor of the activity (experiment, radiation producing machine, etc.) aware of the entry and the existing danger, or 3) the area shall be maintained locked except during periods when access to the area is required, with positive control over each entry.

An area established as a "High Radiation Area" for less than 30 days must be posted but requires only direct surveillance to prevent unauthorized entry.

3. Each "Airborne Radioactivity Area" as defined in Section 2 shall be conspicuously posted with a sign or signs bearing the radiation symbol and the words:

CAUTION

AIRBORNE RADIOACTIVITY AREA

D. Posting of Areas Containing Radioactive Materials

Each entrance to areas or rooms in which radioactive material is used or stored in an amount greater than 10 times that listed in column A of Appendix C (except that the amount for natural uranium or thorium is 100 times that given in Appendix C) shall bear a clearly visible label bearing the radiation symbol and the words:

CAUTION

RADIOACTIVE MATERIAL

E. Labelling of Equipment and Containers

1. Any equipment (vaults, refrigerator, etc.) or container in which radioactive material is stored or used in an amount greater than that listed in column A of Appendix C (except that the amount for natural uranium or thorium is ten times that given in Appendix C) shall bear a durable, clearly visible label bearing the radiation symbol and the words:

CAUTION

RADIOACTIVE MATERIAL

This label shall, when practicable, also identify the radioisotope, the amount in Curie units, and the date of assay.

The outside of a shielded container must also bear this label as well as the inner container.

2. Labels are not required on laboratory containers such as beakers, flasks, test tubes, etc., used transiently in laboratory procedures under supervision or if the concentration of the radioactive material in the container does not exceed that specified in Table I, Appendix B.

F. Tagging of "Sealed Sources"

All "Sealed Sources" shall bear a durable, legible and visible tag permanently attached to the source. The tag shall be at least one inch square, shall bear the standard radiation symbol and at least the following:

CAUTION - RADIOACTIVE MATERIAL - DO NOT HANDLE

NOTIFY CIVIL AUTHORITIES IF FOUND

NOTE: Properly designed tags are available from the Office of Occupational Health and Safety. If tagging is not feasible or desirable due to source design, properly inscribed pressure-sensitive tape is also available.

G. "Radiation Producing Machines and Devices"

There are special requirements for labels, signs, and signals for "Radiation Producing Machines and Devices." The details are found in Section 16.

10. LABORATORY PROCEDURES FOR RADIOISOTOPES

A. Radioisotope Inventory

In each laboratory a Radioisotope Inventory Log shall be maintained, containing an inventory of radioisotopes, noting the element, its mass number, date received, amount received, dates of withdrawal for use and amount withdrawn, date of disposal of waste, manner of disposal, and estimated amount of waste. In short, a continual record must be maintained from receipt to disposal or decay.

The maintenance of an inventory of target activity levels for the targets which are routinely activated and investigated at the Jadwin Cyclotron is difficult because of the broad spectrum of activities and activity levels met in these targets. However, it is possible to estimate activity levels or to express the data in mr/hour at some specified distance. It is necessary that a record be kept indicating the disposition of these materials.

B. Reports

At present, two monthly reports must be filed by the "Authorized User" with the Office of Occupational Health and Safety: an inventory of radioisotopes on hand and a summary of radioisotope disposals. The State of New Jersey requires that all radioactive materials be registered, but the Office of Occupational Health and Safety has negotiated an agreement whereby the State will accept a periodic inventory report in lieu of the radioisotope registration requirement. The Office of Occupational Health and Safety collects and collates the inventory data from all "Authorized Users" and files the required State Report. The "Authorized User's" inventory report (using OHS form #5a) is filed with the Office of Occupational Health and Safety no later than the eighth day of each month and identifies all radioactive material on hand, including wastes. The forms for these reports are available from the Office of Occupational Health and Safety.

C. Survey Equipment

A person using open or "Sealed Sources," opening packages containing radioisotopes, or performing physical or chemical manipulation of radioisotopes must have immediately available a suitable, operative radiation detector. This detector must be able to indicate either dose rate or activity as may be proper considering the nature and activity of the source.

D. Operational Work Area Surveys

1. Survey Requirements

a. In addition to the routine surveys made by the Health Physics staff, laboratory personnel manipulating open sources of radioactive materials shall conduct operational work area surveys. Surveys must be performed:

1) at the end of an experimental procedure and at the end of each day for multi-day procedures;

2) during the manipulation of millicurie quantities of open sources (the frequency and exact timing of this type of survey is left to the judgement of the individual performing the experiment);

3) during and following the opening of radioactive material packages; and,

4) following withdrawals from stock sources containing millicurie quantities.

b. Records of such surveys must be kept. The records should include the name of the surveyor, the date, the survey results, whether positive or negative, and follow-up actions taken if contamination is found.

2. Removable Contamination Limits

Removable contamination on surfaces, e.g., floors, walls, etc., in restricted areas in excess of the following limits requires prompt decontamination:

	Alpha Emitters	Beta, Gamma or X-ray Emitters	Low Risk Beta, Gamma or X-ray Emitters*
Surfaces in the Restricted Area	220 dpm/ 100 cm^2	2,200 dpm/ 100 cm^2	22,000 dpm/ 100 cm^2

However, prompt decontamination is encouraged at 100 dpm/ 100 cm^2 for all beta, gamma or X-ray emitters and at 10 dpm/100 cm^2 for alpha emitters.

*Low risk beta, gamma, or X-ray emitters are those isotopes with beta energies less than 0.2 MeV, and/or gamma or X-ray emissions less than 0.1 R/hr at 1 meter per curie and with permissible air concentrations greater than 10^{-6} microcuries per milliliter.

E. Personal Surveys

1. Survey Requirements

a. When manipulating open sources of radioactive material, thorough surveys of one's person and clothing must be performed:

1) at the end of an experiment and at the end of each day for multi-day procedures;

2) during manipulation of millicurie quantities of open sources (the frequency and exact timing of this type of survey is left to the judgement of the individual performing the experiment);

3) during and following the opening of radioactive material packages;

4) following withdrawals from stock sources containing millicurie quantities; and,

5) prior to exiting the restricted area.

b. Records of such surveys must be kept. The records should include the name of the surveyor, the date, the survey results, whether positive or negative, and the follow-up actions taken if contamination is found.

2. Contamination Limits

The limits for contamination on personal protective clothing and the skin are:

	Alpha Emitters	Beta, Gamma or X-ray Emitters	Low Risk Beta, Gamma or X-ray Emitters*
Personal Protective Clothing	220 dpm/ 100 cm^2	2,200 dpm/ 100 cm^2	22,000 dpm/ 100 cm^2
Skin	220 dpm/ 100 cm^2	220 dpm/ 100 cm^2	2,200 dpm/ 100 cm^2

*Low risk beta, gamma, or X-ray emitters are those isotopes with beta energies less than 0.2 MeV, and/or X-ray emissions less than 0.1 R/hr at 1 meter per curie and with permissible air concentrations greater than 10^{-6} microcuries per milliliter.

Skin contamination in excess of these limits requires prompt decontamination. Contamination on clothing in excess of these limits requires prompt removal. However, prompt decontamination of personal clothing is encouraged at 220 dpm/100 cm^2 for all beta, gamma, or X-ray emitters and at 22 dpm/100 cm^2 for alpha emitters. Decontamination of the skin is encouraged at any level of contamination.

F. Smoking and Eating Restrictions

Smoking, eating and drinking in radioisotope laboratories where open sources are used is prohibited. Food for human consumption shall not be placed or stored in any equipment such as refrigerators, freezers or ovens in which radioisotopes are stored or used.

G. Protective Clothing

Protective clothing, including gloves and a lab coat, should be worn at all times for work with open radioactive sources, but gloves and laboratory clothing must be worn when handling 20 or more times the quantities given in column A of Appendix C. It is especially important to wear gloves whenever high specific activity material is used. Protective shoe covers may also be needed during particularly messy operations, such as the cleaning of contaminated areas and equipment.

Since shoes do provide protection for the feet, the wearing of sandals or other open-toed shoes during radioisotope work is strongly discouraged.

H. In-house Movement of Radioisotopes

Radioisotopes moved within a building should be moved in such a way that no radioactive material can be readily released from its container under normal conditions and with sufficient forethought to minimize the spillage of radioactive material. The inner container must be marked "RADIOACTIVE" during transport and shielding must be provided as needed. Radioactive material may not be left unattended during transit. These precautions become especially important when radioactive material is moved through unrestricted areas.

NOTE: Section 14 describes requirements for the intra campus and off campus transportation and shipment of radioactive materials.

I. Fume Hoods and Glove Boxes

Experiments involving the use of open radioactive sources which could result in airborne radioactivity should be carried out in fume hoods or glove boxes. Because even ordinary laboratory manipulations can result in the release of airborne radioactivity, all "Users" are strongly urged to use a chemical fume hood or glove box for any physical or chemical manipulation of radioisotopes.

Any use of a biological safety cabinet for radioactive materials should be discussed beforehand with the "Health Physicist." Biological safety cabinets may not be suitable, for instance, for volatile substances such as radioiodine, since in many cases some air from the cabinet is exhausted to the room.

Except as noted below, hoods for radioisotope work must have an average face velocity of at least 50 linear feet per minute. Experiments involving alpha-emitting radioisotopes and radioiodines must be performed in hoods with an average face velocity of at least 95 linear feet per minute. Hood and glove box surfaces should be protected to prevent contamination of fixed surfaces that may be difficult to decontaminate.

In consideration of University maintenance personnel who may be called to repair possibly contaminated hoods, all hoods which have been used for radioisotope work are labelled by the Office of Occupational Health and Safety, "This Hood used for Radioactive Material." Any "User" who wishes to use an unlabelled hood for radioisotope work should obtain the proper label from the Office of Occupational Health and Safety.

J. Airborne Radioactivity

For experiments that may result in the release of airborne radioactive material, a routine air sampling and bioassay program may be required. No operation may be planned and performed that will knowingly result in the release of airborne radioactivity in excess of permissible levels given in Appendix B.

Caution: It should be remembered that the use of volatile or powdered radioisotopes may result in significant airborne concentrations of radioactive material.

K. Pipetting

Mouth pipetting of radioactive material is prohibited.

L. Dummy Runs

Work which requires extensive physical and/or chemical manipulation of radioisotopes should not be performed with radioactive material until the techniques, procedures, and equipment have been tested in a "dummy" or trial run.

M. Working Surfaces

All work involving physical or chemical manipulation of open radioactive sources shall be performed directly on work surfaces suitable for containment of contamination and easy decontamination. The lining of work surfaces with plastic backed absorbent paper has been found to reduce the spread of contamination.

N. Labelling

Although labelling of equipment and containers is required only under certain conditions (see Section 9), it is good practice to label all contaminated objects and work surfaces to indicate the presence of radioactive material. Such labelling reduces confusion and prevents others from unsuspectingly using contaminated equipment.

O. Opening of Shipments

The opening of shipments of radioisotopes must be done in a properly equipped laboratory and only by the "Authorized User" or by an adequately trained individual designated by the "Authorized User." Additional details are found in Section 8.

P. Security

Access to "Restricted Areas" must be controlled, and visitors should be supervised by a member of the laboratory staff who is familiar with the activities of the laboratory. Radioisotopes shall not be left unattended in places where unauthorized persons may gain access to them. Unoccupied laboratories in which radioactive material is stored shall be locked or otherwise secured to prevent unauthorized access to the material.

Q. Special Equipment and Requirements

In cases where the use of radioactive material presents unique or unusual hazards, special radiation safety equipment, precautions, and procedures may be required as determined in consultation with the "Health Physicist." These might include specialized shielding and equipment, clothing, monitoring equipment, etc. Such requirements are generally made conditions of approval for authorization.

R. Animal Use and Care

The use and care of animals used for *in vivo* experiments with radioisotopes must be done in compliance with the provisions of the Animal Welfare Act of 1970 and amendments thereto, as determined by the Animal Care Subcommittee of the University Research Board. In addition to those requirements, consideration must be given to the special problems of animal waste collection, the disposal of carcasses, airborne radioactivity resulting from exhaled radioactive materials, and the cleaning and decontamination of cages. Required precautions, as determined by the "Health Physicist," are generally made conditions of approval for authorization.

11. EXTERNAL DOSE CONTROL AND PERSONNEL MONITORING

A. Control

As a matter of policy and practical necessity, the "Authorized User" must be the individual responsible for controlling the dose received by personnel under his or her supervision and/or using "Sources of Radiation" under his or her authorization so that no person receives a total dose in excess of the maximum permissable limits specified in Appendix D. The total dose includes both that due to exposure to external "Sources of Radiation" and exposure to internally deposited radioisotopes. The monitoring of radiation dose provides information essential to the control process. The program under which external dose is monitored is described below while the program under which the dose due to internally deposited radioisotopes is monitored is described in Section 12.

B. External Monitoring Requirement

By regulation any person who receives or is likely to receive more than 25 percent (5 percent for minors) of the maximum permissible dose (see Appendix D) or who enters a "High Radiation Area" must be provided with and must wear personnel monitoring devices. Additionally, persons manipulating millicurie quantities of Phosphorous-32, Iodine-125, or other sources that may cause significant hand exposure shall be provided with and must wear finger dosimeters. The "Authorized User" is responsible for ensuring that persons under his or her supervision and/or using "Sources of Radiation" under his or her authorization are provided with suitable personnel monitors and that these monitors are actually worn when appropriate. Any question of interpretation of this section shall be referred to the "Health Physicist."

C. Centralized Personnel Monitoring Program

The Office of Occupational Health and Safety administers a centralized personnel monitoring program which is utilized by all laboratories requiring personnel monitoring. In the operation of this program the Office of Occupational Health and Safety provides, upon request, personnel monitors for routine and temporary use, distributes personnel monitors to the departments, collects personnel monitors from the departments after use, ships the monitors to the personnel monitoring service vendor for interpretation, receives and distributes the dose reports to the departments, maintains centralized records, investigates unusual or excessive doses, and honors requests for dose history summaries. The "Authorized User" continually reviews the need for personnel monitoring and requests personnel monitoring service from the Office of Occupational Health and Safety, notifies that office when service is no longer needed, arranges for the distribution and collection of personnel monitors in accordance with departmentally

established procedures, reviews the reports of personnel monitoring results for the purpose of controlling dose, and takes positive action to ensure that all monitored individuals under his or her supervision are informed of their dose status. In certain departments, individuals designated as "Personnel Monitor Contacts" coordinate the distribution and collection of monitors and receive dose reports from the Office of Occupational Health and Safety. It is up to the "Authorized User" to make arrangements with the "Personnel Monitor Contact" regarding receipt of the dose report.

There are certain features of the personnel monitoring program which concern the "Authorized User" and all monitored individuals. These are:

1. The University is required to control the exposure of the individual radiation worker to "Sources of Radiation" at Princeton University so that his or her total occupational dose, including the dose due to radiation exposure outside the immediate control of the University (e.g., at other universities, national laboratories, second jobs, etc.) does not exceed the maximum permissible limits specified in Appendix D. University employees, students, faculty, etc., must, therefore, promptly report to the Office of Occupational Health and Safety any occupational dose received under conditions outside the University's control and should request that all dose information be routinely sent to the Princeton University Office of Occupational Health and Safety.

2. A cumulative summary of the occupational radiation dose received by any individual monitored for exposure to radiation at Princeton University is available from the Office of Occupational Health and Safety upon request. Such a summary is also available at any time following the termination of the individual's employment. The request for the cumulative summary must include the dates of employment, department of employment, and social security number.

3. Any individual who has been monitored for exposure to radiation during a calendar quarter in which he or she terminates employment at the University, at the time of termination, may request a summary of the dose received during that quarter. This information may be requested of the worker by subsequent employers during that calendar quarter.

D. Suspected Overexposures

1. If it appears that an individual has received or is suspected of receiving a dose greater than the maximum permissible dose limits specified in Appendix D, the Office

of Occupational Health and Safety must be notified immediately. The "Health Physicist" will take steps to determine the actual dose, investigate and document the circumstances, file reports if required, and recommend corrective or preventative action.

2. Individuals who are believed to have been overexposed shall be suspended from further work with "Sources of Radiation" pending the outcome of the "Health Physicist's" investigation.

E. Exposure of Minors

Because the allowable dose to persons under 18 is limited to 10% or less of the limits specified in Appendix D, it is recommended that minors not be employed as full-time radiation workers.

F. Exposure of Pregnant Women

There are special requirements relating to the dose limits for pregnant women (see Appendix D). Because of this, each female radiation worker, at the time of the beginning of work with "Sources of Radiation," is provided by the Office of Occupational Health and Safety with an information packet discussing the risks of prenatal exposure and the special requirements. A female radiation worker who discovers she is pregnant is strongly encouraged to discuss future work assignments with the "Authorized User."

G. Exposure of Visitors

1. The host, i.e. the person visited, bears the responsibility of ensuring that his or her visitors, who may include guests, maintenance and repair personnel, etc., are informed of the hazards, comply with all applicable rules, regulations, and procedures, and wear personnel monitors when appropriate.

2. There are very few circumstances in which any real contribution to the scientific community can result from the visit of a child to a "Restricted Area." For this reason, such visits shall be discouraged and should not be permitted without benefit of careful consideration. Prolonged or frequent visits by children to "Restricted Areas" are prohibited.

12. INTERNAL DOSE CONTROL AND BIOASSAYS

A. Control

As a matter of policy and practical necessity, the "Authorized User" must be the individual responsible for controlling the dose received by personnel under his or her supervision and/or using "Sources of Radiation" under his or her authorization so that no person receives a total dose in excess of the maximum permissible limits specified in Appendix D. The total dose includes both that due to exposure to internally deposited radioisotopes and exposure to external "Sources of Radiation." The monitoring of radiation dose provides information essential to the control process. The program under which the internal dose is monitored is described below. The program under which the external dose is monitored is described in Section 11.

Exposure investigations, regulatory notifications and physician referrals all depend on the outcome of bioassays performed as required by this section. The University is legally required to initiate these actions via license conditions and the regulations in 10 CFR Part 20. The cooperation of the "Principal Investigator" and the individual is essential to ensure compliance with this section of the Radiation Safety Guide.

B. Internal Monitoring Requirement

The "Authorized User" is responsible for ensuring that persons under his or her supervision or using radioisotopes under his or her authorization are provided with bioassay services. Arrangements for bioassays are made by contacting the Office of Occupational Health and Safety when the criteria given below are met.

Bioassays commonly involve urinalysis, external counting of the thyroid, breath analysis, or whole body counting.

1. Special Bioassays

Bioassay analyses may be required of any person or persons who:

a. have been exposed to air or water concentrations of radioactive material equal to or in excess of 25 percent of those specified in Table I of Appendix B, or

b. have been involved in a spill, an incident, or other occurrence during which radioactive material may have been taken into the body either by inhalation, ingestion, or by absorption through the skin or a wound.

2. Routine Bioassays

The use of any radioisotope may require that routine bioassays be required upon the determination of the "Health Physicist." Such a determination has been made for certain uses of tritium and radioiodine; the criteria for bioassay for these radioisotopes are described below:

a. Tritium

Routine bioassays are required for those persons who handle tritium under the following conditions:

1) Use in an open room or on a bench top with possible release*

Form	Amount Requiring Routine Bioassay**
H-3 gas in a sealed vessel	1 Ci
Nucleotide precursors	10 mCi
HTO and other forms	100 mCi

2) Use in an adequate fume hood with possible release*

Form	Amount Requiring Routine Bioassay**
H-3 gas in a sealed vessel	10 Ci
Nucleotide precursors	100 mCi
HTO and other forms	1 Ci

3) The "Health Physicist" may determine, depending on handling procedures and other conditions, that bioassays are required for the use of smaller or greater amounts of tritium.

*Possible release means that the possibility of a significant airborne release of radioactive material exists because 1) the techniques used to process the material may create an aerosol, 2) the material is inherently volatile, or 3) the techniques used to process the material may increase its volatility.

**The amount requiring routine bioassay is considered to be either the amount handled at any one time by an individual who uses tritium on an infrequent basis or the cumulative amount of activity handled during any period when smaller amounts of tritium are used on a frequent basis.

4) Frequency of Routine Bioassays

Routine bioassays samples should be submitted within 48 hours of the initial exposure to tritium and then once a month while routine use of tritium continues. When work with tritium is on an infrequent basis (less frequently than every two weeks) bioassays should be performed within 72 hours of the end of the work period during which tritium is handled.

5) Types of Required Bioassays

The tritium bioassay program for each individual should consist of the following bioassays:

a) Baseline (within one month prior to the beginning of any tritium use requiring bioassay)

b) Routine

c) Post operational (within one month following last tritium use)

d) Follow up (to follow the course of a significant uptake of tritium)

b. Radioiodine

Routine bioassays are required for those persons who handle I-125 or I-131 under the following conditions:

1) Use in an open room or bench top with possible release*

Form	Amount Requiring Routine Bioassay**
Volatile	1 mCi
Bound to non-volatile agent	10 mCi

*Possible release means that the possibility of a significant airborne release of radioactive material exists because 1) the techniques used to process the material may create an aerosol, 2) the material is inherently volatile, or 3) the techniques used to process the material may increase its volatility.

**The amount requiring routine bioassay is considered as the cumulative quantity handled by an individual during a 3-month period or on one or more occasions in that period by opening stock reagent containers from which radioiodine may escape.

2) Use in an adequate fume hood with possible release*

Form	Amount Requiring Routine Bioassay**
Volatile	10 mCi
Bound to non-volatile agent	100 mCi

3) The "Health Physicist" may determine, depending on handling procedures and other conditions, that bioassays are required for the use of smaller or larger amounts of radioiodine.

4) Frequency of Routine Bioassay

Routine bioassay for I-125 should be performed within 6 to 72 hours after the initial exposure to radioiodine and then once every three months provided the results of the initial routine bioassay are negative and routine use continues. When work with I-125 is on an infrequent basis (less frequently than every two weeks), bioassays should be performed within 10 days of the end of the work period in which the I-125 is handled.

Routine bioassays for I-131 shall be performed within 6 to 72 hours after initial exposure and then once a month provided the results of the initial routine are negative and routine use continues. When work with I-131 is on an infrequent basis (less frequently than every two weeks) bioassays shall be performed within 6 to 72 hours of the end of the work period in which I-131 is handled.

5) Types of Bioassays Required

The bioassay program for each individual should consist of the following bioassays:

*Possible release means that the possibility of a significant airborne release of radioactive material exists because 1) the techniques used to process the material may create an aerosol, 2) the material is inherently volatile, or 3) the techniques used to process the material may increase its volatility.

**The amount requiring routine bioassay is considered as the cumulative quantity handled by an individual during a 3-month period or on one or more occasions in that period by opening stock reagent containers from which radioiodine may escape.

a) Baseline (within one month prior to the beginning of any use of radioiodine requiring bioassay)

b) Routine

c) Post iodination (within 6 to 72 hours of the end of a procedure in which 5 mCi or more of free iodine is used)

d) Post-operational (within one month following the last possible exposure to radioiodine, when work is being discontinued)

e) Follow-up (to follow the course of a significant uptake of radioiodine)

6) Depending on the nature of the work and if a significant uptake of radioiodine is found for one individual, other persons who frequent the laboratory may be required by the "Health Physicist" to obtain bioassays.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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12/86

BETWEEN: William O. Miller, Chief
License Fee Management Branch
Office of Administration

Regional License Section
Material Licensing Branch
FCMS, Office of Nuclear Material
Safety & Safeguards

LICENSE FEE TRANSMITTAL

A. REGION I

1. APPLICATION ATTACHED

Applicant/Licensee: Princeton University

Application Dated: 1/20/86

Control No.: 119501

License No.: 29-05185-25

2. FEE ATTACHED

Amount: _____

Check No.: _____

3. COMMENTS

Signed _____

Date _____

B. LICENSE FEE MANAGEMENT BRANCH

1. Fee Category and Amount: 3E FEE EXEMPT

2. Correct Fee Paid. Application may be processed for: 170.11(a)(4)
per 10/28/81 application

Amendment ✓

Renewal _____

License _____

Signed G Jackson

Date 2/1/86