

APPLICATION FOR MATERIAL LICENSE

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

FEDERAL AGENCIES FILE APPLICATIONS WITH:

U.S. NUCLEAR REGULATORY COMMISSION
DIVISION OF FUEL CYCLE AND MATERIAL SAFETY, NMSS
WASHINGTON, DC 20555

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS, IF YOU ARE LOCATED IN:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND,
MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, PENNELVANIA,
RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

✓ U.S. NUCLEAR REGULATORY COMMISSION, REGION I
NUCLEAR MATERIAL SECTION B
631 PARK AVENUE
KING OF PRUSSIA, PA 19406

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA,
PUERTO RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR
WEST VIRGINIA, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION II
MATERIAL RADIATION PROTECTION SECTION
101 MARIETTA STREET, SUITE 2900
ATLANTA, GA 30323

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR
WISCONSIN, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION III
MATERIALS LICENSING SECTION
799 ROOSEVELT ROAD
GLEN ELLYN, IL 60137

ARKANSAS, COLORADO, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA,
NEW MEXICO, NORTH DAKOTA, OKLAHOMA, SOUTH DAKOTA, TEXAS, UTAH,
OR WYOMING, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
MATERIAL RADIATION PROTECTION SECTION
611 RYAN PLAZA DRIVE, SUITE 1000
ARLINGTON, TX 76011

ALASKA, ARIZONA, CALIFORNIA, HAWAII, NEVADA, OREGON, WASHINGTON,
AND U.S. TERRITORIES AND POSSESSIONS IN THE PACIFIC, SEND APPLICATIONS
TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION V
MATERIAL RADIATION PROTECTION SECTION
1450 MARIA LANE, SUITE 210
WALNUT CREEK, CA 94596

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S. NUCLEAR REGULATORY COMMISSION JURISDICTION.

1. THIS IS AN APPLICATION FOR (Check appropriate item)

- ☐ A. NEW LICENSE
☐ B. AMENDMENT TO LICENSE NUMBER _____
☒ C. RENEWAL OF LICENSE NUMBER 29-05218-29

2. NAME AND MAILING ADDRESS OF APPLICANT (Include Zip Code)

Rutgers, the State University
Department of Radiation & Environmental
Health and Safety Kilmer Building 4127
Piscataway, NJ 08854

3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

Rutgers, the State University
Gamma Greenhouse, Building 3553 Davidson Road
Busch Campus Piscataway, NJ 08854

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Edward A. Christman, PhD Certified Health Physicist

TELEPHONE NUMBER

201 932-2550

SUBMIT ITEMS 5 THROUGH 11 ON 8 1/2 x 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL

a. Element and mass number, b. chemical and/or physical form, and c. maximum amount which will be possessed at any one time.

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.

9. FACILITIES / 8707010227 870213
REG1 LIC30
29-05218-29 PDR

10. RADIATION SAFETY PROGRAM.

11. WASTE MANAGEMENT.

12. LICENSEE FEES (See 10 CFR 170 and Section 170.31)
FEE CATEGORY AMOUNT
ENCLOSED \$

13. CERTIFICATION. (Must be completed by applicant) THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, AND 40 AND THAT ALL INFORMATION CONTAINED HEREIN, IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948, 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

SIGNATURE—CERTIFYING OFFICER

D. B. Howell

TYPED/PRINTED NAME

D. B. Howell

TITLE

Radiation Safety Officer

DATE

11/24/86

14. VOLUNTARY ECONOMIC DATA

a. ANNUAL RECEIPTS

<\$250K	\$1M-3.5M
\$250K-500K	\$3.5M-7M
\$500K-750K	\$7M-10M
\$750K-1M	>\$10M

b. NUMBER OF EMPLOYEES (Total for entire facility excluding outside contractors)

c. NUMBER OF BEDS

d. WOULD YOU BE WILLING TO FURNISH COST INFORMATION (Dollar and/or staff hours) ON THE ECONOMIC IMPACT OF CURRENT NRC REGULATIONS OR ANY FUTURE PROPOSED NRC REGULATIONS THAT MAY AFFECT YOU? (NRC regulations permit it to protect confidential commercial or financial—proprietary—information furnished to the agency in confidence)

☐ YES

FOR NRC USE ONLY

TYPE OF FEE

FEE LOG

FEE CATEGORY

COMMENTS

Renewal

Dec 8

EX 34

"OFFICIAL RECORD COPY"

AMOUNT RECEIVED

FEE EXEMPT

ML10

106468

APPROVED BY

DATE

[Signature]
12/9/86

PRIVACY ACT STATEMENT

Pursuant to 5 U.S.C. 552a(e)(3), enacted into law by section 3 of the Privacy Act of 1974 (Public Law 93-579), the following statement is furnished to individuals who supply information to the Nuclear Regulatory Commission on NRC Form 313. This information is maintained in a system of records designated as NRC-3 and described at 40 Federal Register 45334 (October 1, 1975).

1. **AUTHORITY:** Sections 81 and 161(b) of the Atomic Energy Act of 1954, as amended (42 U.S.C. 2111 and 2201(b)).
2. **PRINCIPAL PURPOSE(S):** The information is evaluated by the NRC staff pursuant to the criteria set forth in 10 CFR Parts 30, 32, 33, 34, 35 and 40 to determine whether the application meets the requirements of the Atomic Energy Act of 1954, as amended, and the Commission's regulations, for the issuance of a radioactive material license or amendment thereof.
3. **ROUTINE USES:** The information may be (a) provided to State health departments for their information and use; and (b) provided to Federal, State, and local health officials and other persons in the event of incident or exposure, for their information, investigation, and protection of the public health and safety. The information may also be disclosed to appropriate Federal, State, and local agencies in the event that the information indicates a violation or potential violation of law and in the course of an administrative or judicial proceeding. In addition, this information may be transferred to an appropriate Federal, State, or local agency to the extent relevant and necessary for an NRC decision or to an appropriate Federal agency to the extent relevant and necessary for that agency's decision about you.
4. **WHETHER DISCLOSURE IS MANDATORY OR VOLUNTARY AND EFFECT ON INDIVIDUAL OF NOT PROVIDING INFORMATION:** Disclosure of the requested information is voluntary. If the requested information is not furnished, however, the application for radioactive material license, or amendment thereof, will not be processed. A request that information be held from public inspection must be in accordance with the provisions of 10 CFR 2.790. Withholding from public inspection shall not affect the right, if any, of persons properly and directly concerned need to inspect the document.
5. **SYSTEM MANAGER(S) AND ADDRESS:** U.S. Nuclear Regulatory Commission
Director, Division of Fuel Cycle and Material Safety
Office of Nuclear Material Safety and Safeguards
Washington, D.C. 20555

Application for Material License

continuation

5. Radioactive material

a. Cobalt 60 b. Sealed Source c. 50.0 Curies

6. Purpose

Source is used as an irradiator for radiation studies and instrument calibration.

7. Individuals responsible for radiation and training

D.B. Howell, Director of Radiation and Environmental Health and Safety Department

E.A. Christman, PhD., CHP, Supervising Radiological Physicist

Organization chart of REHS and C.V.'s below - attachment 1

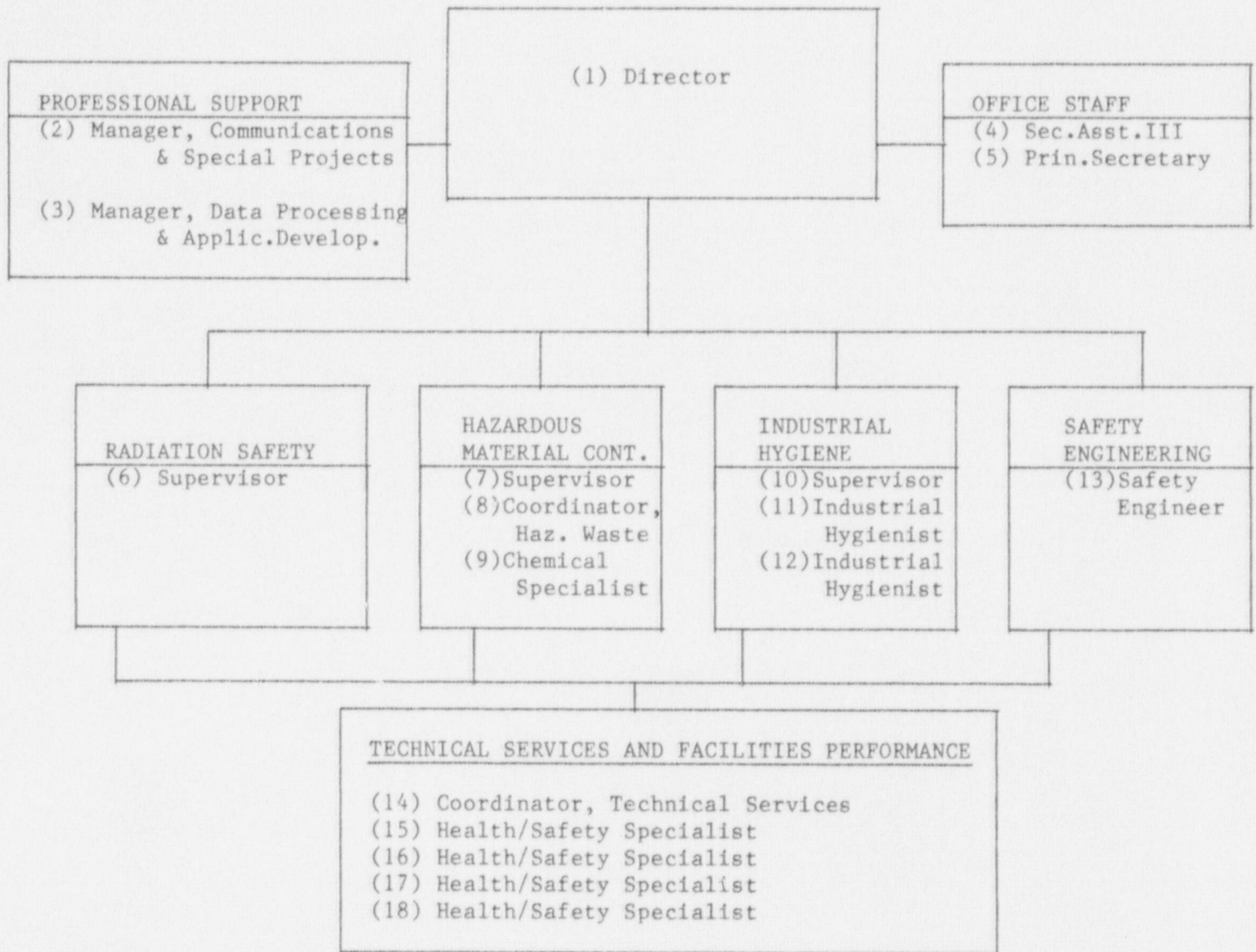
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Attachment 1

Item 7. Individuals responsible for radiation safety and training

ORGANIZATIONAL CHART

Radiation & Environmental Health & Safety



D'H.LC 9/86
AI7/Chart11

DANIEL B. HOWELL

Office: Rutgers, The State University
Radiation & Environmental
Health & Safety
Kilmer Building 4127
Piscataway, NJ 08854
(201) 932-2550

Home: 236 New York Avenue
New Brunswick, NJ 08901
(201) 249-7013

Personal

Born 1930 in Atlanta, Georgia.
Married, with a daughter and a son.
Height: 6'1/2" Weight: 180 lbs. Health: Excellent

Experience

1977 to present - Director of Radiation and Environmental Health and Safety
Department, Rutgers, The State University. Responsible for the design and
direction of a comprehensive program in occupational health and safety and
hazardous waste management for the university.

1966 - 1977 Radiation Safety Officer and Director of the Radiation Safety
Department, Rutgers, The State University.

1961 - 1966 Senior Licensing Reviewer to (GS-14), United States Atomic Energy
Commission, Washington, D. C. Licensed uses of by-product material.

1958 - 1960 Project Engineer (Nuclear Engineering), Lockheed Aircraft
Corporation. Designed, directed, and completed projects on the effects of
reactor radiation on operation of electronic systems.

1956 - 1958 Nuclear Engineer, Convair Aircraft Corporation.
Designed, directed, and completed reports on projects on the effects of
reactor radiation on operation of electronic components.

Education and Training

B. A. in Physics and Mathematics, 1956. Austin College, Texas.

Graduate work in Physics,
Texas Christian University (part-time) 1956-1958 (17 hours).

Atomic Energy Commission Graduate Fellow in Radiological Health 1960-61;
Vanderbilt University 30 graduate hours; and 3 months summer training at Oak Ridge
National Laboratory in Radiological Health.

Professional and University Extension Courses in Industrial Hygiene,
Safety Engineering Chemical Hazards, Toxicology, Computer Basics,
and Technical Writing.

DANIEL B. HOWELL

Professional Memberships

Health Physics Society:

- Organizer of New Jersey Chapter of the Health Physics Society
- Past President of the Greater New York Chapter
and the New Jersey Chapter of the Health Physics Society
- Served on National Health Physics Society
 - ° Annual Meeting Place Committee
 - ° Nominating Committee

American Society for Safety Engineers

Campus Safety Association (President 1987), National Safety Council

(In line of succession to become its chairman for 1987-88)

University Radiation Safety Officers' Conference

Other

Member of NJ State Committee on Asbestos Work Standards

Member of the NJ Statutory Advisory Committee on Public Employees Occupational
Safety and Health (PEOSH) through which all Occupational Safety and Health
laws must be approved.

Member of Standards Subcommittee of NJ PEOSH

National Council on Radiation Protection and Measurements

Member Task Group 7 of Scientific Committee 46 on Emergency Planning

CURRICULUM VITAE

Edward A. Christman, PhD, CHP
Supervising Radiological Physicist, Rutgers University

EDUCATION:

Ph.D. Rutgers University, Radiation Science, New Brunswick, NJ, 08903
1977.
M.S. Rutgers University, Radiation Science, New Brunswick, NJ, 08903
1974
One year of Graduate study in physics, Rensselaer Polytechnic
Institute, Troy, NY, 1965-66.
B.S. cum laude, in Physics, Ohio University, Athens, OH, 1965

PROFESSIONAL INTERESTS:

Radiation Physics and Chemistry
Medical Physics

Radiation Protection

EXPERIENCE:

September, 1977 to present.

Supervising Radiological Physicist, Department of Radiation and Environmental Health and Safety, Rutgers University, New Brunswick, NJ. Responsibilities include general supervision of radiation safety program for a large university and medical school. This includes over 300 radioisotope users, several x-ray diffraction units, and a 20 MeV Tandem Vande Graff accelerator.

Associate Member of the Graduate Faculty in Radiation Science and Environmental Science, Rutgers University. Teach two core curriculum courses in Instrumentation and Dosimetry in the graduate level radiological health program. Adjunct Assistant Professor in Radiology, Johnson Medical School, University of Dentistry and Medicine of New Jersey. Member of the Coordinating Council on Radiation Studies.

Consultant in Radiation Protection to Industry.

Certified by the American Board of Health Physics in Comprehensive Health Physics.

June, 1976-September, 1977

Post Doctoral Appointment, Radiation Science, Rutgers University with Professor Alan Appleby. Participated in Radiation Chemistry studies using heavy ion beams of the Bevalac Accelerator in Lawrence Berkeley Lab., Berkeley, California, as a visiting scientist in the Biology and Medicine Group. Worked on dosimetric and data reduction aspects in studying the response of various chemical systems to heavy ions to help elucidate the physical energy deposition patterns in aqueous solutions.

1974 to 1976

Instructor in Radiation Science, Rutgers University. Taught graduate and undergraduate laboratory and lecture courses in radiation protection, basic radiation physics, applied health physics and radiological techniques. Guest lectured in several other health physics classes. Was involved in several small research projects with the personnel of the Rutgers University Radiation Safety Office. Supervised field problems of radiological health graduate students.

1966 to 1971

Associate Mechanical Engineer, AVCO Corp., Missiles and Space Division, Wilmington, Mass. Participated in all phases of the design and development of guidance and control systems for missile reentry vehicles and satellites.

HONOR SOCIETIES AND PROFESSIONAL ORGANIZATIONS

Sigma Xi, Scientific Research Honorary Society
Sigma Pi Sigma, Honorary Physics Society
Health Physics Society, Both National and Local Chapters; Executive board member of New Jersey chapter, President-Elect (1986-1987)
Radiation Research Society
American Association of Physicists in Medicine(AAPM)

THESIS TITLES

PhD. "Molecular Hydrogen Yields and Tritium-Protium Isotope Effects in Tritium Beta Radiolysis", May, 1977
M.S. "The Radiation Chemistry of Heavy Ions: Fricke Dosimeter Yields and the Track Structure of 3.9 Gev Nitrogen Ions", May, 1974

PUBLICATIONS

"Radiation Chemistry in the Plateau and Bragg Peak Region of 3.9 Gev Nitrogen Ions" (with A. Appleby), Rad.Res.60, 34, 1974
"Radiation Chemistry of Heavy Ions", LBL Report 7432, April, 1978. M. Jayko, A. Appleby, E. Christman, A. Chatterjee, and J. Magee
"Radiation Chemistry of High Energy Carbon, Neon and Argon Ions: Integral Yields from Ferrous Sulfate Solutions", E.A. Christman, A. Appleby, and M. Jayko, Radiation Research, March, 1981
"Increased Thermoluminescence in Lithium Fluoride by Brief Pre-heating", E. Hochhieser, A. Appleby and E. A. Christman, Health Physics, (46) 2, February, 1984
"Radiation Chemistry of High-Energy Carbon, Neon and Argon Ions: Hydroxal Radical Yields", A. Appleby, E.A. Christman and M. Jayko, Radiation Research, 104 p.263-271, 1985.
"Radiation Chemistry of High Energy Carbon, Neon and Argon Ions: Hydrated Electron" A. Appleby, E. A. Christman, and M. Jayko Radiation Research, 106 p.300-306, 1986

CONFERENCE PRESENTATIONS

Radiation Chemistry Conference, May, 1975, Catalina Island;
"Radiation Chemistry of Heavy Ions: LET Effects", with A. Appleby

Radiation Research Conference, May, 1977; San Juan, Puerto Rico.
Two presentations on the Radiation Chemistry of Heavy Ions with A. Appleby and M. Jayko

American Physical Society, Spring Meeting, April, 1980, Washington, D.C.;
"Physico-Chemical Processes in Energy Deposition by Heavy Ions in the 100-400 Mev/nucleon Range"; M. Rapkin, E.A. Christman, and A. Appleby.

Radiation Research Society Meeting, June, 1981, Minneapolis Minn.;
"Effects of Fragmentation in the Heavy Ion Radiolysis of Aqueous Solutions"
with A. Appleby.
Also Co-chaired a session at this Meeting.

Poster: "Hydroxial Radical Yields from High Energy Heavy Ions" with A. Appleby, and M. Jayko, The Seventh International Congress on Radiation Research, Amsterdam, The Netherlands, July 2-7, 1983.

Health Physics Society Annual Meeting, June 6, 1985, New Orleans, LA.
"Radiation Safety at Rutgers University: Protection on a Shoestring Budget"

LECTURE TOUR

In July and August, 1984, I was invited to lecture at and tour several facilities in the People's Republic of China. These included the Peking Institute of Atomic Energy, Beijing; The Institute for Radiation Protection, Taiyuan; and Tianjin University, Tianjin. I gave 8 lectures on various topics in radiation protection, held discussions with the staff members and faculties and toured the facilities during a 4 week period.

AI7/EAC4

Attachment 2

Rutgers University Radiation Safety Guide

- Item 8 Training for individuals . See attachment 2 below. Radiation Safety Guide Appendix 10.
- Item 9. Facilities and Equipment See attachment 3.
- Item 10. Radiation Safety Program. See Radiation Safety Guide

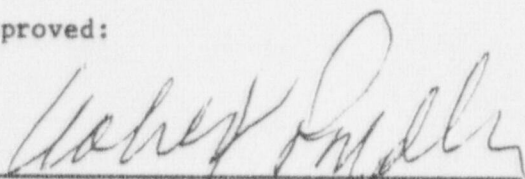
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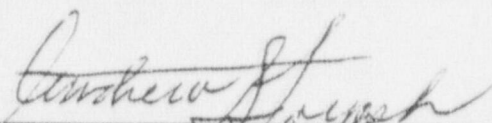
RADIATION SAFETY GUIDE

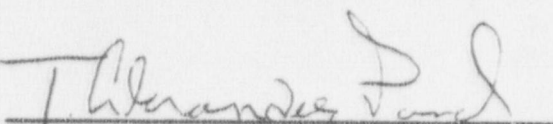
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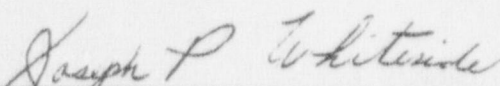
MAY, 1984

Approved:


Robert Snyder, Ph.D., Chairman
University Health-Safety Council


Andrew Forgash, Ph.D., Chairman
Radiation Safety Subcommittee


T. Alexander Pond, Ph.D.
Executive Vice President


Joseph P. Whiteside
Senior Vice President
and Treasurer

Prepared by Rutgers University
Department of Radiation and
Environmental Health and Safety

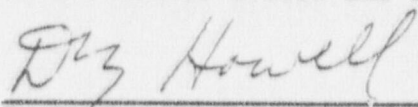

D. B. Howell, Director

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Preface

Persons who use and/or supervise the use of sources of radiation at Rutgers University must be familiar with the contents of this Guide.

To aid in the interpretation of this Guide, some of the terminology used is defined in Appendix 11.

Inquiries regarding the Guide should be directed to the Department of Radiation and Environmental Health and Safety (REHS) at 932-2550.

For emergency radiation assistance, call 932-2550, or after hours, call the University Police Department, as they have current after-hours numbers for REHS personnel.

UNIVERSITY POLICE DEPARTMENTS

New Brunswick . . . 932-7111

Camden 757-6111

Newark 648-5111

1.0 INTRODUCTION

At Rutgers University all potentially hazardous sources of radiation are controlled through an authorization and registration program. The program takes cognizance of the applicable state and federal regulations and standards. The state and federal regulations are generally separated into two radiation categories: ionizing and non-ionizing radiation.

No work with sources of ionizing radiation can be initiated until a written authorization has been received specifically permitting that work.

All uses of ionizing radiation (except ultraviolet radiation) in New Jersey are controlled and regulated by either the U.S. Nuclear Regulatory Commission or the New Jersey Bureau of Radiation Protection (EPA). Rutgers University has received licenses from both of these agencies which permit considerable scope and autonomy in its use of ionizing radiation (see App. 12 for copies of these Licenses).

The use of non-ionizing sources of radiation and ultraviolet radiation are not presently controlled at Rutgers through a government licensing program. There are, however, federal standards and exposure limits and professionally accepted limits pertaining to these sources of radiation.

Rutgers University has appointed a University Health-Safety Council with a Radiation Safety Subcommittee, established a comprehensive radiation control and safety program, and provided the organization which gives the necessary assurances to the Nuclear Regulatory Commission, New Jersey authorities, and University Administration that all potentially hazardous sources of radiation will be continually used safely.

This Guide (1) describes the organization of the Radiation Safety Program and the levels of responsibilities at Rutgers University; (2) specifies the regulations, policies and procedures, and practices which are to be followed in using radiation; and (3) describes the radiation services which Rutgers makes available to aid the user in his safety program. The Guide was presented to the Nuclear Regulatory Commission and the State of New Jersey as describing Rutgers University Radiation Safety Program. It was accepted as such and so referenced in the licenses subsequently issued. Consequently, the Guide is the legal document governing *all* uses of radiation at *all* locations under the jurisdiction of Rutgers University.

It is Rutgers University policy to encourage the use of radiation where appropriate. To this end, the Radiation Safety Program has been designed to relieve individuals of the time-consuming work of obtaining separate state and federal licenses, interpreting complex radiation regulations, and keeping extensive records. The program also provides the radiation user with most of the services necessary for his compliance with state and federal radiation safety standards. Concurrent with its policy of encouraging the use of radiation, Rutgers insists that there be no unwarranted radiation exposures; thus due regard must always be

given to the safety and welfare of the radiation worker and the general public as well as to the protection of Rutgers University property and liability. The Rutgers operational policy places ultimate responsibility for radiation safety on the principal radiation user (Authoree). These individuals can most effectively satisfy their responsibility by adhering to this Guide, and by requesting assistance from the Department of Radiation and Environmental Health and Safety (REHS) when there are questions or suspected problems.

The Guide is organized so that Sections 1 through 6 describe in general terms the Rutgers University Radiation Safety Program, and the appendices describe the detailed procedures and practices which are to be observed during specific uses of radiation. All radiation workers should read Sections 1 through 6 of the Guide, and in addition, those appendices which relate to their particular use of radiation.

2.0 ORGANIZATION AND RESPONSIBILITIES

There are four levels of authority and responsibility in the Rutgers Radiation Safety Program:

1. The University Health-Safety Council - Radiation Safety Subcommittee.
2. The Department of Radiation and Environmental Health and Safety (REHS).
3. The principal user (Authoree) of a source of radiation.
4. The individual who works under supervision of an Authoree.

2.1 The Radiation Safety Committee

The Rutgers University Health-Safety Council is the body at Rutgers which recommends policy and establishes general procedures in all matters of health and safety. The Radiation Safety Committee functions as a subcommittee of the Health-Safety Council, and its chairman is a member of the Health-Safety Council. The membership of the Radiation Safety Committee is representative of the areas within the University in which radiation is used. (See Appendix 2 for present membership.) The Director of REHS at Rutgers is the Secretary and a permanent member of this committee as well as the parent University Health-Safety Council.

The Committee is appointed by University Administration, and is charged with:

1. Developing Rutgers University radiation safety policy in such a manner as to -
 - a. Assure compliance with all federal and state regulations;
 - b. Promote, through a sound safety program, the use of radiation; and
 - c. Assure against unwarranted radiation exposure of University personnel and the public and to protect University property and liability.

2. Acting as trustee to assure the continued quality of the Radiation Safety Program.
3. Adjudicating any difference between faculty and the REHS concerning radiation safety.

The Radiation Safety Committee meets as often as is necessary to carry out its functions, or when a Committee member so requests. Binding Committee deliberations require the presence of a majority of its members or alternates. (An alternate may be designated by an individual member who cannot attend a specific meeting. For that meeting, the alternate has the full rights of the member.) Committee deliberations are normally informal, but will follow Roberts Rules of Order if so requested by a member. Minutes of all Committee meetings are recorded and kept by both the Chairman and the Secretary.

2.2 *Department of Radiation and Environmental Health and Safety (REHS)*

The Rutgers University REHS is responsible for radiation control, safety, and service programs. (See Appendix 1 for a list and description of REHS services.) The REHS interprets, implements, and executes: (1) the policies of the University Health-Safety Council, Radiation Safety Subcommittee, and (2) the radiation regulations of federal and state agencies.

The Department's primary means of administering the control and safety programs is by enforcing the University rules that:

1. NO SOURCE OF RADIATION IS TO BE ALLOWED TO ENTER OR LEAVE THE UNIVERSITY PROPERTY OR TO BE USED OR MOVED FROM AUTHORIZED SITES WITHOUT THE PRIOR KNOWLEDGE AND APPROVAL OF THE REHS.
2. NO INDIVIDUAL IS TO USE A SOURCE OF RADIATION UNTIL HE OR HIS SUPERVISOR RECEIVES WRITTEN AUTHORIZATION. (See Section 4.0)

The Department of Radiation and Environmental Health and Safety is staffed with professional Health Physicists and technicians.

2.3 *Authoree*

The authoree is the person permitted to use radiation by virtue of a written authorization (see Sec. 4.0 for Authorization Procedure), and

has primary responsibility for the radiation safety associated with the use of the source of radiation. He must ascertain that each person using sources of radiation under his authorization is properly trained and experienced and aware of attendant radiation hazards (See App. 9 for Training Requirements).

He must also supervise the use of his sources of radiation to conform to all safety conditions of his authorization and those of this Guide. (See Appendix 4, Use of Radioisotopes; Appendix 6, Use of X-Ray Machines; and Appendix 7, Use of Non-Ionizing Radiation Sources.)

2.4 *Supervised User (Not Specifically Authorized)*

These individuals must use sources of radiation only under the supervision of an authoree. They must follow those procedures and practices established by the authoree in his application for authorization and follow the standard practices given in Appendices 4, 6, or 7.

Users are required to attend a radiation safety orientation lecture as specified in Appendix 9.

3.0 *RADIATION REGULATIONS, POLICIES, PROCEDURES AND PRACTICES*

This Section outlines the regulations, policies, procedures and practices on which the Radiation Safety Program is based.

3.1 *Federal and State Regulations*

The Nuclear Regulatory Commission has established "Standards for Radiation Protection" 10 CFR 20 (see Appendix 8 for a copy of the Standards). These standards must be strictly adhered to during all uses of byproduct sources and special nuclear materials (radioisotopes). Likewise, the State of New Jersey has adopted a "Radiation Protection Code" (see Appendix 8) which controls the use of all sources of radiation not under NRC jurisdiction. Consequently, in New Jersey there are governmental laws controlling the use of all sources of ionizing radiation and establishing the standards for their safe use. The NRC has adopted regulations which assure that workers will be advised of the sources of radiation being used, the hazards, the safety precautions in effect, etc., at their place of employment. These rights are presented in "Notices of Instructions and Reports to Workers; Inspection", 10 CFR, Part 19 (See Appendix 8).

3.2 *Rutgers University Policies and Procedures*

The Radiation Safety Committee recognizes both the Nuclear Regulatory Commission and New Jersey State regulations as well as Rutgers policy of preventing unwarranted exposures to radiation as the basic criteria for establishing the radiation policies and procedures at the University. The principle means which the Committee has instituted to assure the safe use of radiation are:

1. To require that a person become authorized prior to permitting his use of sources of radiation. (See Section 4.0)
2. To require that all acquisitions of radiation sources be approved by REHS, and that all receipts and transfers of radioisotopes be channeled through the REHS.

Specific procedures and practices for most routine or recurrent situations have been established to assure compliance with governmental regulations and Rutgers University policy. For unusual problems, the REHS will interpret existing regulations, policies, and procedures to establish guidelines. Presently, there are procedures and practices which cover the following:

1. Radioisotope Authorization - Appendix 3.
2. Use of Radioisotopes - Appendix 4.
3. X-Ray Producing Machines - Appendix 5.
4. Use of X-Ray Producing Machines - Appendix 6.
5. Use of Non-Ionizing Radiation Sources - Appendix 7.

3.3 Professional Standards

The Department of Radiation and Environmental Health and Safety also uses as operational guides the published data and recommendations of professionally recognized national and international committees and organizations concerned with health physics or radiation protection, examples of which are:

1. The National Committee on Radiation Protection (NCRP).
2. The International Commission on Radiological Protection (ICRP).
3. The International Atomic Energy Agency (IAEA).
4. The Health Physics Society.

4.0 AUTHORIZATION TO USE SOURCES OF RADIATION

An individual can only possess or use a source of radiation at the University after he or his supervisor becomes authorized. To be authorized, an individual must be a faculty or staff member with at least the rank of Instructor, Research Associate, or equivalent, and present evidence of proper training. An application form must be submitted to the REHS, and a formal, written authorization must be received by the individual before his use of radiation begins.

4.1 Initial Application

Authorization application forms may be requested from the REHS. The following Appendices describe application and authorization requirements and protocol:

Appendix 3 - Radioisotope Authorization

Appendix 5 - X-Ray Producing Machine Authorization

Appendix 7 - Authorization for Sources of Non-Ionizing Radiation

4.2 *Expiration and Renewal of Authorization*

Radioisotope authorizations expire two years from the date of issuance, at which time they must be renewed for uninterrupted use of radionuclides. A Health Physicist visits the authoree to update the authorization and evaluate any changes.

4.3 *Amendment to Authorization*

If the authoree wishes to use sources of radiation different from those for which he is authorized, if he wishes to increase the possession limit of a radioisotope, or if he wishes to change experimental conditions, he must receive an amendment to his authorization before the change is effected. The amendment application may be submitted in memorandum form, specifying in detail the changes in the initial application. The amended uses may not begin until authorization of the amendment is received by the authoree.

4.4 *Termination of Authorization*

The authorization will be terminated if the Authoree leaves employment of Rutgers University or ends his/her use of the radiation source. All sources shall be placed under the responsibility of an active Authoree or REHS before the authorization is terminated. Any source shipped to or transported from Rutgers University should be routed through REHS so that packaging and paperwork can be prepared in accordance with the current transport regulations.

5.0 *RIGHTS OF WORKERS*

Individuals who use sources of radiation under a U.S. Nuclear Regulatory Commission License have certain rights described in Title 10, Part 19, "Notices, Instructions, and Reports to Workers; Inspections" (see copy in Appendix 8). In accordance with Part 19, copies of the Rutgers University Licenses are also included for information in Appendix 12. Also included in Appendix 12 is a copy of the Notice that is posted in radioisotope areas to advise persons in those areas that work with radioisotopes is being conducted and to describe the documents and regulations pertinent to that work.

Rutgers has designed its training program (see Appendix 9) to assure that all persons working in or frequenting areas of radiation usage are aware of the attendant hazards.

6.0 *RADIATION SERVICES*

To assist the authoree, the University provides many services without charge through the Department of Radiation and Environmental Health and Safety. These services are listed and explained in Appendix 1.

APPENDIX 1

RADIATION SAFETY SERVICES

The following services are provided through the Department of Radiation and Environmental Health and Safety (REHS) at no charge, except where noted.

1. Radiation and Contamination Surveys

Radiation and contamination surveys are routinely conducted in each area where sources of radiation are used. The frequency and detail of these surveys is based on potential hazard. All areas where radioisotopes are being actively used are surveyed routinely; and all radiation producing machines are surveyed upon installation and when major modifications are made. Records are kept of the results of these surveys. If significant radiation levels or contamination is detected, the authoree is notified. If a significant hazard is indicated, a follow-up survey is conducted and appropriate remedial action is recommended and supervised by the REHS.

The individual authoree is encouraged to make surveys a routine part of his experimental procedure to assure the absence of contamination.

2. Radioactive Waste Pick Up and Disposal

No individual is permitted to dispose of radioactive waste except through the REHS. All the waste generated must be collected, including contaminated animals, tissue, and first washings from radioisotope containers. The exception to this rule is excreta from humans who have been administered radioisotopes: these wastes should be disposed in a normal manner through the toilet and sanitary sewer, except in unusual circumstances. Waste is routinely picked up by the staff of the REHS to prevent contamination of property or an individual's personal vehicle. (See Appendix 4 for specific instructions on storing waste and marking waste containers.)

3. Personnel Radiation Monitoring

Persons who use sources of radiation, except those who exclusively use low-energy beta emitters such as ^3H , ^{14}C , and ^{35}S , may be required to use thermoluminescent badges (TLD's). The TLD badge is provided by REHS, and is used to detect total body exposure of the individual to penetrating radiation. Badges are presently exchanged on a three-month basis. The exposure indicated on each badge is reviewed and recorded by the REHS. If a significant exposure is indicated, the wearer is advised through a form letter, and may be visited by a Health Physicist who may recommend changes to reduce future exposures.

The records of cumulative radiation exposure are available to each wearer upon written request.

4. *Bioassays*

Persons using radioisotopes may be required to provide a urine specimen on a routine, six-month basis. An initial background specimen is taken before the work begins. The specimens are assayed by liquid scintillation counting. Significant levels of internal contamination are reported to the person, and a Health Physicist may visit the individual to review the work procedures in an effort to reduce the level.

Persons may also request a bioassay if there is a possibility of accidental ingestion or inhalation of radioactive substances.

Persons working with millicurie levels of ^{125}I or ^{131}I will be required to come to the REHS office for a thyroid count to determine if any Iodine was taken up. Bioassays associated with other uses of radioisotopes are also provided as deemed necessary by the Radiation Safety Officer.

5. *Instrument Maintenance, Repair, and Calibration*

All of the authoree's radiation monitoring instruments which are made available in his laboratory will be checked for proper operation during routine surveys; otherwise, they will be checked or calibrated on request. Individuals may also request repair service at any time. In addition to monitoring instruments, the authoree may also request repair of other nuclear instrumentation. There is a charge only for replacement parts.

6. *Experimental Assistance*

In cases where the authoree does not have adequate facilities, equipment, or training and experience for a proposed non-human use of radiation, he may request the REHS to provide these for the "first experimental run(s)." The authoree would then be required to provide comparable arrangements for his future work.

7. *Radiation Safety Training*

See Appendices 4, 6, and 9 for training requirements.

The REHS will also design training courses adapted for specific needs. For example, the authoree may wish to use technicians who have not had previous training and experience in the safety aspects of radiation. For such people, the REHS provides instruction in the safe use of radiation, consisting of demonstration laboratories, lectures on radiation techniques, University procedures, and use of monitoring instruments. The instruction outlines those practices which constitute a sound laboratory radiation safety program, and gives guidance on the services and assistance which can be obtained from REHS. The course is designed so that it is also appropriate for those with radiation experience, since it describes the procedures and practices of the Rutgers University Program and provides a review in the safe handling of radiation sources. This service is provided on an "as needed" basis or upon request.

8. *Emergency Assistance*

In any case where there is doubt as to whether radiation safety may be, or has been compromised, the REHS should be called immediately on 932-2550. If the situation arises after hours, call the University Police Department, as they have current after-hours numbers for REHS personnel.

UNIVERSITY POLICE DEPARTMENTS

New Brunswick . . . 932-7111

Camden 757-6111

Newark 648-5111

9. *Consultant Service*

Members of the REHS are available to discuss any aspect of radiation safety. They also offer assistance on all aspects of the design of radiation experiments or facilities, and selection of equipment, instruments, or supplies. The REHS maintains a current, comprehensive supplier file on the instruments, equipment, materials, and services related to the use of radiation that is available to everyone.

APPENDIX 2
RADIATION SAFETY COMMITTEE
of the
UNIVERSITY HEALTH-SAFETY COUNCIL
1984-85

Dr. Georges Temmer	Physics Dept., Busch Nuclear Physics Lab.	2400
Dr. Alan Appleby	Bldg. 4087, KILMER Radiation Sci., Cook College	2551
Dr. Harvey Feder	Inst. of Animal Behavior, Smith Hall, Newark	122-5858 5862
Dr. Sidney Katz	Chemistry, Camden	121-6153
Dr. William Mayo	Mech. & Material Science, Engineering, Busch	3669
Dr. Marie Spoerlein	College of Pharmacy, Busch	3287
Dr. Francesco Trama	Biological Sciences Nelson, Busch	2810
Mr. Alfred Brady, <i>ex officio</i>	Physical Plant Divn., Kilmer	2156
Dr. E. A. Christman, <i>ex officio</i>	Rad. & Env. Health & Safety Building 4127, Kilmer	2550
D. B. Howell, Secretary <i>ex officio</i>	Rad. & Env. Health & Safety Building 4127, Kilmer	2550

APPENDIX 3

RADIOISOTOPE AUTHORIZATION

Introduction

All persons at Rutgers University who use radioisotopes must be authorized or work under the supervision of one who is authorized.

Prerequisites for Authorization

The individual must:

1. Be a faculty or staff member with at least the rank of Instructor, Research Associate, or equivalent;
2. Have adequate training and experience for the proposed uses; (Adequacy of training and experience for the proposed uses is evaluated by the Department of Radiation and Environmental Health and Safety at the time of issuance of an authorization.)
3. Have the use of adequate facilities and equipment to contain and detect the presence of the radioisotopes he will use, so that there is reasonable assurance that radiation levels and contamination will be minimized.

Protocol

1. Application forms (See Page 15) for authorization may be obtained from the REHS by calling 932-2550.
2. Two application forms should be completed fully. The use of each radioisotope should be described in sufficient detail to permit an evaluation of the radiation safety of the work. This should include, but not be limited to: the activities (in mCi or uCi) of each radioisotope to be kept in stock and the storage location of the isotopes; the activity to be used in an experimental run; the expected fate of the radioisotope during use, i.e., whether it is taken up in a compound, metabolized, evolved as a gas, remains in the precipitate, etc.; the method of containing the radioisotope during use; the means for collecting radioactive waste; the radiation surveys to be performed before, during, and after the experiment to monitor the degree of containment; and other information pertinent to the evaluation of radiation safety.
3. The completed application should be sent to the Department of Radiation and Environmental Health and Safety where it will be reviewed by a Health Physicist. An appointment will be made with the applicant to discuss the application and observe his laboratory facilities and equipment. The Health Physicist may require clarification of aspects of the experimental procedures to permit a conclusive determination of the degree of hazard presented to workers and the public. He will advise the applicant of any additional

requirements which must be met prior to the issuance of an authorization. This may include new containment requirements, purchase of detection equipment, as well as procedural changes.

When the Health Physicist concludes his evaluation, he will recommend to the Radiation Safety Officer: (1) authorization without restrictions, or (2) authorization with restrictions, or (3) denial of authorization. The Radiation Safety Officer will review the evaluation and take the action deemed appropriate. Where the requested use of a radioisotope(s) represents a new or unusual radiation hazard, or the experimental design includes complexities beyond the scope of the Radiation Safety Officer's and his staff's capabilities, the facts will be presented to the full radiation Safety Committee for their evaluation and decision. All actions on applications taken by the Radiation Safety Officer are subject to review by the Radiation Safety Committee.

The applicant or authoree can appeal to the full Radiation Safety Committee any action he feels the Department of Radiation and Environmental Health and Safety has taken unjustly in restricting or denying the use of radioisotopes.

The regulations, procedures, and practices to be observed by the authoree during his use of radioisotopes are specified in Appendix 4.

RUTGERS UNIVERSITY
APPLICATION FOR USE OF RADIONUCLIDES

Instructions: Complete Items 1 through 10 and submit to the Department of Radiation and Environmental Health and Safety. Authorization requires applicant to comply with Rutgers' *Radiation Safety Guide*.

1. Name of Applicant		3. Location where material to be used																
2. Department		4. Location to be stored																
5. Names of persons using radioisotopes under direction of applicant (including technicians)																		
6. Radioactive Materials a. Chemical symbol & mass number each	Form of Materials b. Chemical &/or physical		Possession Limit c. Max. number mCi you will have at any one time															
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="4" style="text-align: left; padding: 5px;">7. Training (Complete for each individual listed in Items 1 and 5)</th> </tr> <tr> <th style="width: 25%; text-align: center; padding: 5px;">Names</th> <th style="width: 25%; text-align: center; padding: 5px;">Where Trained</th> <th style="width: 25%; text-align: center; padding: 5px;">Duration of Training</th> <th style="width: 25%; text-align: center; padding: 5px;">Type of Training (Formal courses, on-the-job, etc.)</th> </tr> <tr> <td style="height: 100px;"></td> <td></td> <td></td> <td></td> </tr> </table>				7. Training (Complete for each individual listed in Items 1 and 5)				Names	Where Trained	Duration of Training	Type of Training (Formal courses, on-the-job, etc.)							
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<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="5" style="text-align: left; padding: 5px;">9. Experience (Actual use of radioactive materials. Complete for Applicant)</th> </tr> <tr> <th style="width: 15%; text-align: center; padding: 5px;">Isotope</th> <th style="width: 15%; text-align: center; padding: 5px;">Maximum Amount</th> <th style="width: 25%; text-align: center; padding: 5px;">Where Experience was Gained</th> <th style="width: 20%; text-align: center; padding: 5px;">Duration of Experience</th> <th style="width: 25%; text-align: center; padding: 5px;">Type of Use</th> </tr> <tr> <td style="height: 100px;"></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>				9. Experience (Actual use of radioactive materials. Complete for Applicant)					Isotope	Maximum Amount	Where Experience was Gained	Duration of Experience	Type of Use					
9. Experience (Actual use of radioactive materials. Complete for Applicant)																		
Isotope	Maximum Amount	Where Experience was Gained	Duration of Experience	Type of Use														

9. Radiation Detection Instruments				
Type of Instruments	Number Available	Radiation Detected	Range of Instrument	Use (Monitoring, measuring, etc.)

10. How the Radioactive Material Will be Used (Give sufficient detail concerning the use of the radioactive material to provide a basis for evaluation of the health hazards and possible building contamination. This should include a description of the experimental objective, the manner in which the experiment will be carried out, the chemical and physical fates of the isotope or its compounds, the maximum activity to be used each experimental run, manner in which all radioactive waste will be handled, and other information pertinent to radiation safety. Include radiation safety procedures, such as manner of contamination survey, storage procedures, and restriction of working areas. Use supplementary sheets if necessary.)

Signature of Applicant

Date

APPENDIX 4

USE OF RADIOISOTOPES

The authoree is responsible to see that the use of radioisotopes under his authorization complies with all governmental regulations; the specific conditions and limitations of his authorization; and the procedures and practices outlined in this Appendix. He must ascertain that all persons who use radioisotopes under the coverage of his authorization are supervised, properly trained and experienced, aware of the attendant radiation hazards, and observe the procedures of this Guide.

1. Training and Experience

The authoree's training and experience will have been determined to be adequate for the uses specified in his authorization. Changes in experimental design, increases in radioactivity, or use of more hazardous radioisotopes would require authorization amendment and an attendant re-evaluation of the authoree's training and experience.

The adequacy of the training and experience of those working with radioisotopes under the supervision of the authoree are determined only if the authoree has supplied names and pertinent information. If not specifically approved, each supervised user must attend a lecture as specified in Appendix 9 to assure compliance with governmental regulations. All other persons frequenting radiation areas, but not actually working with radiation, must also attend a lecture as specified in Appendix 9. The authoree is responsible to assure that all persons having access to his area during normal working hours attend one of these training sessions. Prior to attending a session, the worker must be advised by the authoree of the potential hazards of the work he is asked to perform. The REHS will identify the people and provide the proper training for persons who have access during non-routine working hours.

2. Receipt, Transfer, and Disposal of Radioisotopes

(See also Sections 7 and 8 of this Appendix and Section 2 of Appendix 1.)

The REHS must approve all intended receipts and subsequent transfers of radioisotopes.

A purchase requisition must be used to order radioisotopes, and must be countersigned by the Radiation Safety Officer after the Purchasing Department assigns a purchase authorization number and before distribution. The REHS address must be entered as the destination for shipments, as follows:

Ship to: Radiation and
Environmental Health and Safety
Kilmer Campus, Bldg. #4127
Piscataway, NJ 08854
Attention: (Name of authoree)

The Nuclear Regulatory Commission (NRC) or New Jersey State License number, whichever is appropriate, and the authoree's Rutgers authorization number must be typed on the purchase order beneath the description of the radioisotope being ordered.

A purchase requisition cannot be used to confirm a radioisotope order unless the authoree has received prior verbal approval from the REHS and the Purchasing Department. He must also request that the supplier send the order to the Department of Radiation and Environmental Health and Safety at the address shown on Page 14. Radioisotopes must not be ordered under a blanket order without prior verbal approval from the REHS.

All radioisotopes, when received, are checked for contamination and their receipt recorded (for legal purposes). The authoree is notified when the radioisotope is received, and delivery is made on the day of receipt, or in accordance with the authoree's instructions. Upon receipt, the authoree, or his representative, signs a form provided by the REHS.

Subsequent to the receipt of radioisotopes, the authoree must receive approval from the REHS prior to:

- a. Moving radioisotopes to locations other than those specified in his authorization, or
- b. Transferring radioisotopes to other authorees.

This must be done not only for reasons of safety, but also for compliance with government regulations.

3. *Radiation Surveys*

The Department of Radiation and Environmental Health and Safety conducts routine radiation and contamination surveys in all laboratories where sources of radiation are used. (See Section 1, Appendix 1.)

The user should supplement these routine surveys as follows:

RADIATION SURVEYS SHOULD BE MADE AFTER EACH
EXPERIMENTAL RUN OR AT THE END OF EACH DAY
RADIOISOTOPES ARE USED IN ORDER TO DETERMINE
THE EXTENT OF RADIOACTIVE CONTAMINATION AND
TO ASCERTAIN THAT ALL WASTE AND STOCK MATERIAL
HAS BEEN PROPERLY DISPOSED OR STORED.

When material is known to have been spilled or become airborne, wipe test surveys of the affected area should be made by the worker. Such tests can be made with filter paper or squares of any absorbent paper, and the wipes measured with an appropriate counting instrument. The REHS should be called if the experimenter has reason to believe that his work has resulted in gross contamination or constitutes an emergency situation. (See Emergency Procedures, Section 9 of this Appendix.)

4. *Storage of Radioisotopes*

Radioisotopes must be stored to permit access only by the authoree and those whom he designates. Each area and room where radioisotopes are stored must be posted with a "radioactive materials" sign. Radiation levels around storage areas should be measured. If radiation doses could exceed five millirem per hour in an occupiable area, the area must be posted with a "radiation area" sign. Proper signs can be obtained from the REHS.

Refrigerators used for radioisotope storage must not be used to store food.

Radioisotopes which could become airborne must be stored in a ventilated hood. The control switch for the hood ventilation should be secured in the ON position.

All radioisotope storage containers must bear the radiation symbol and be labelled, naming the radioisotope and its activity and denoting the date on which the activity was recorded.

5. *Records*

Each user should maintain a radioisotope log to record the receipt, use, and disposal of all radioisotopes he receives.

The log should also be used to record the date and results of radiation and contamination surveys, even when the results are negative. This log is subject to inspection by REHS, the Nuclear Regulatory Commission, and the State of New Jersey.

Other records required by federal and state law are kept by the REHS.

6. *Restriction of Radioisotope Areas*

Access to areas where radioisotopes are stored and used must be restricted to those persons cognizant of the associated hazards. This is a government regulation.

7. *Radioactive Waste*

Radioactive waste must be disposed through the REHS. No waste is to be washed down drains, incinerated, or otherwise disposed without prior clearance through the REHS.

Waste should not be transported by the authoree to the Department, since this could result in contamination of the individual's personal vehicle or University property. The REHS picks up radioactive waste upon request of authoree. Arrangements for special pick-ups may be made by calling the Department.

Waste must be stored in approved containers as follows:

- a. Dry waste in containers lined with plastic bags. REHS will provide containers and plastic bags. There must be no free-standing liquids and no scintillation vials in the dry waste.
- b. Liquid waste in metal or plastic containers (never in glass, except when specifically approved by REHS). The liquid must be neutral (pH between 6 and 9) and must not be toxic or flammable.
- c. Animal tissue should be surrounded by sufficient preservative (supplied by REHS) to retard decay and minimize odor, wrapped in plastic bags, and stored in a freezer or refrigerator until it is picked up by REHS. Never put animal tissue in the dry waste container.
- d. Waste posing special corrosive, toxic, or explosive problems should be stored only after approval of REHS. Liquid waste is normally combined and stored in 30-gallon drums at the REHS. These drums are then held until picked up by the contractor; thus if some waste would present special problems when combined with other liquids, the REHS should be so advised beforehand.
- e. Liquid scintillation vials must be separated from all other waste, their caps tightly sealed, and stored in separate containers for REHS pick-up. Dumping of liquid scintillation cocktail solution into the liquid waste is prohibited.

Each waste container must bear a radioactive materials sign. A card is normally taped on the container by the REHS, and must be marked *each time* waste is put into the container with the following information:

- a. The identity by radioisotope and activity of each separate waste entry. (It is realized that an educated estimate of radioactivity is the best that can be expected in some cases.)
- b. The date of each waste entry.
- c. The name of the authoree under which each radioisotope was used.

The card is picked up with the waste. Waste will not be taken until the card has been properly completed. Information from this card is used to record the total amount of University waste, as is required by government regulations.

NON-RADIOACTIVE WASTE SHOULD *NOT* BE DISPOSED IN
RADIOACTIVE WASTE CONTAINERS.

The REHS consolidates the waste, compresses dry waste, and packages it in shipping drums for disposal by a licensed contractor.

(11/83)

8. Movement of Radioisotopes

Radioisotopes are not to be moved from authorized places of storage and use without the prior approval of the REHS.

9. Emergency Procedures (See also Page 24)

A radiation emergency occurs when a set of circumstances results in hazardous radiation levels, hazardous concentrations of airborne radioisotopes, or gross contamination of property. Examples of radiation emergencies and actions to be taken are:

- a. Personnel contamination.
 - 1) Remove contaminated clothing.
 - 2) Wash contaminated skin with mild soap and water.
Do not use abrasives.
 - 3) Call the Department of Radiation and Environmental Health and Safety (REHS) at 932-2550.
- b. Spill of radioisotope where radioisotope does not become airborne.
 - 1) Wipe up with absorbent paper with a blotting action so as not to spread contamination.
 - 2) Dispose of contaminated paper in radioactive waste container.
 - 3) Call the REHS.
- c. Volatilization of liquid or dispersal of solid radioisotope outside a ventilated enclosure.
 - 1) If possible, keep contamination localized by closing doors and restricting access to area.
 - 2) Leave the area.
 - 3) Call the Department of Radiation and Environmental Health and Safety (REHS).
- d. Fire in radioisotope area.
 - 1) Treat fire in normal manner.
 - 2) Call the REHS as soon as is practical.

ALWAYS USE COMMON SENSE IN HANDLING RADIATION EMERGENCIES, AND CALL THE DEPARTMENT OF RADIATION AND ENVIRONMENTAL HEALTH AND SAFETY (REHS) AS SOON AS PRACTICAL. DO NOT TRACK OR OTHERWISE PERMIT RADIOISOTOPES TO BE SPREAD INTO CLEAN AREAS.

10. *Personnel Monitoring*

The Health Physicist determines during the authorization evaluation the need for personnel dosimetry.

It is the responsibility of the authoree to ascertain that all persons who use radioisotopes or work in his area wear appropriate radiation dosimeters when required. Personnel dosimeters are provided free of charge through the REHS. (See Appendix 1, Section 3)

Since all radioisotope shipments are delivered to the REHS, some dosimetry programs are initiated at that time.

11. *Radioisotope Laboratory Design*

The design and furnishings of a laboratory must be commensurate with the hazards presented by the radioisotope and its conditions of use. Each laboratory must, therefore, be evaluated individually by the REHS in light of its intended use. In practical terms, some possible requirements are that:

- a. Bench tops or other surfaces on which radioisotopes will be used must be stainless steel or covered with a permanently impervious surface.
- b. Floors must be covered with an impervious material; properly waxed, vinyl asbestos tiles are normally acceptable.
- c. Walls must present a smooth, crack and hole-free surface.
- d. Proper room ventilation and adequate radioisotope storage must be provided.

12. *Rules for Working with Radioactive Materials*

Following is a set of laboratory rules found to be very useful in reminding laboratory workers of good radiation safety practices. Posters containing these rules are placed in each laboratory by REHS. Copies are given to all radiation workers at orientation. Additional copies are available free from the REHS.

RULES FOR WORKING WITH RADIOACTIVE MATERIALS
ROUTINE PROCEDURES

- | | |
|---|---|
| Eating, drinking
smoking | 1. Eating, drinking, smoking, or using cosmetics is not permitted in this laboratory. |
| Wash hands | 2. Wash hands after handling any radioactive material <i>before</i> going about other work. Always wash before handling any object which goes to the mouth, nose, or eyes. Keep fingernails short and clean. |
| Pipetting | 3. <i>Never</i> pipette anything (even water) by mouth. |
| Protective
clothing | 4. Always use rubber or plastic gloves when handling radioisotopes. Lab coats should be worn in the laboratory and left in the laboratory. |
| Confine the
activity | 5. Always work over trays lined with absorbent material. Keep and transport radioactive materials doubly contained. |
| Spills | 6. Notify the Department of Radiation and Environmental Health and Safety of <i>all spills</i> except those of a very minor nature (see Emergency Procedures). |
| Labeling | 7. Label radioactive material with your name, date, isotope, and quantity of isotope. |
| Before leaving | 8. After completing your project, but before leaving the laboratory, you should clean up and monitor your work area and yourself. |
| Dispose of <i>liquid</i>
radioactive waste | 9. Liquid radioactive waste should be held in plastic bottles or metal containers if the liquid attacks plastic. The quantity being disposed of, the date, and the authoree's name should be recorded on the container. <i>No radioactive waste should be disposed via the sink unless specifically authorized by the REHS.</i> |
| Dispose of <i>solid</i>
radioactive waste | 10. Solid radioactive waste should be placed in plastic-lined boxes. The quantity being disposed of, the date, and the authoree's name should be recorded on the waste container. |
| Counting room | 11. Take only prepared samples into the counting room. <i>No potentially contaminated material or apparatus is permitted in the counting room.</i> This includes lab coats. |
| Hoods | 12. Materials which could become airborne must be stored and used in a hood. Hood ventilation should be left "ON" at all times. |
| Food | 13. <i>Never</i> keep or store beverages or foods in radioisotope labs, especially in refrigerators or freezers with radioisotopes. |

RULES FOR WORKING WITH RADIOACTIVE MATERIALS

EMERGENCY PROCEDURES

Be prepared for an emergency by mentally rehearsing the following:

Extreme hazards; e.g., high radiation levels or the possibility of airborne contamination from dry or volatile radioactive materials.

Evacuate the laboratory immediately; close and lock the door or stand guard to prevent entrance; have the Radiation Safety Department summoned immediately. (If you must leave the area to call the REHS, remove your shoes if you suspect contamination, and do not touch anything unnecessarily.)

Other hazards; e.g., spills or suspected spills of radioactive material where material does not become airborne.

Keep calm, use common sense, protect people, do not spread contamination (always assume you are contaminated until a survey proves differently), and use the following as guides.

1. *Confine contamination.*

- a. Localize the spill. Right tipped container; drop absorbent material on the spill. Damp down a dry spill.
- b. Do not track contamination about the laboratory.
Call, do not go for help, if possible!
- c. Close door and where possible adjust ventilation to prevent spread of airborne contamination.
- d. Check shoes before leaving area of a cleaned up spill.

2. *Protect personnel.*

- a. Remove contaminated clothing and wash contaminated parts of the body with detergent.
- b. Be especially thorough in flushing out wounds.
- c. Warn other workers.

3. *Decontaminate.*

- a. If thorough washing with detergent does not remove contamination from body, consult REHS.
- b. You will be expected to perform the major work of decontamination of the area of your spill. REHS will survey for contamination and advise on procedures and assist as necessary.

IN ALL EMERGENCIES, EXCEPT VERY MINOR SPILLS OF RADIOACTIVE MATERIALS, REHS SHOULD BE CALLED AS SOON AS POSSIBLE. DO NOT TRACK OR OTHERWISE PERMIT RADIOISOTOPES TO BE SPREAD INTO CLEAN AREAS.

Call 932-2550 -- Monday through Friday 8:30 A.M. to 5:00 P.M. After normal working hours, call your campus University Police Department:

New Brunswick . . . 932-7111

Camden . . . 757-6111

Newark . . . 648-5111

EMERGENCY PROCEDURES (continued)

During an electrical power blackout of less than 24-hour duration, the following procedures are recommended:

1. Cease work as rapidly and safely as possible.
If hood is being used, close the hood face door.
2. If contamination is present outside the hood, keep it as localized as possible. If shoes have become contaminated, remove them.
3. Evacuate the area immediately. Close and lock the laboratory door. Stand guard to assure that no one enters the area if emergency lighting is on. Have the REHS summoned immediately. If phones are operable, call on extension 2550.
4. If there is no emergency lighting, a notice not to enter the room must be put on the door to prevent entry after power is regained. This can be done by re-entry of the building with a flashlight.
5. Remove any contaminated clothing and wash any contaminated areas of the body with mild detergent if facilities are available and lighted. Otherwise, take precautions not to spread contamination and proceed to available facilities for decontamination. Call the REHS as soon as possible, or your campus University Police Department, who will contact the proper persons.

APPENDIX 4-A

*HANDLING PROCEDURE FOR
ANIMALS CONTAINING RADIOACTIVITY*

Animals containing radioactivity will be caged only in radioisotope research laboratories, unless specific, written clearance is obtained from the Radiation Safety Officer and written handling instructions are provided to the regular animal care facility before the animals are received there.

APPENDIX 5

X-RAY PRODUCING MACHINE AUTHORIZATION

For the purpose of this Guide, the term "X-Ray Producing Machine" refers to X-ray machines of both the standard diagnostic and therapeutic types, X-ray diffraction units, electron microscopes, high-voltage rectifiers with voltages exceeding 20 KeV, and in some cases, high-voltage vacuum switches.

The use of each X-ray machine must be covered by an authorization. An application form (See Page 24) can be obtained from the REHS by calling 2550. The acquisition of an X-ray machine must have the prior approval of the REHS to assure that adequate facilities are available for its use.

After receipt of an X-ray machine and prior to its use, a Health Physicist will make an appointment to discuss its use with the applicant. A radiation survey will be made when the X-ray machine is operable. Only after determination that the X-ray machine can be used safely is an authorization issued. The authorization permits only the use of the specific machine identified in the application, and only under the conditions and in the location for which an evaluation was made. No changes in location or conditions of use may be made until a specific amendment to the authorization is requested and received from the REHS.

Disposal of an X-ray machine must have the prior approval of the REHS.

The regulations, procedures, and practices to be observed by the authoree during his use of an X-ray producing machine are specified in Appendix 6.

APPLICATION FOR AUTHORIZATION TO USE A RADIATION PRODUCING MACHINE

INSTRUCTIONS. Complete Items 1 through 9 if this is an initial application. If application is for renewal, complete Items 1 through 5 and Item 9, and indicate new information or changes in the program as requested in Items 6 through 8. Submit two copies to the chairman of the University Radioisotopes Committee. Authorization by the University Radioisotopes Committee requires the applicant to comply with the Rutgers University "Radiation Safety Guide."

1. NAME OF APPLICANT(S).

3. LOCATION AT WHICH RADIATION PRODUCING MACHINE WILL BE USED. (Building[s] and room number[s].)

2. DEPARTMENT AND COLLEGE OF APPLICANT

4. PREVIOUS RUTGERS AUTHORIZATION NUMBER(S).

5. CHARACTERISTICS OF THIS MACHINE

TYPE:	(a) X-ray	(1) Max. tube voltage	KVP	(2) Max. tube current	ma
	(b) Fluoroscope	(1) Max. tube voltage	KVP	(2) Max. tube current	ma
	(c) Other (Identify)			(1) Max. voltage	KVP
				(2) Max. current	ma

DESCRIPTION:

(1) Name of machine

(2) Manufacturer

(3) Model No.

(4) Serial No.

(5) Age of machine years.

6. TRAINING (Complete for each individual listed in Item 1)

Name(s)

Where Trained

Duration of Training

Type of Training (Formal courses, on-the-job, etc.)

7. EXPERIENCE (Complete for each individual listed in Item 1)

Name(s)

Where Experience Was Gained

Duration of Experience

Type of Use

8. RADIATION DETECTION INSTRUMENTS.

Type of Instruments (Include make, model and serial number.)	Number Available	Radiation Detected	Range of Instrument	Use (monitoring, measuring, etc.)

- 9. USE OF RADIATION PRODUCING MACHINE** (Give sufficient details concerning the methods and/or control devices that will be used to prevent accidental radiation exposures and the purpose(s) for which the machine will be used.)

.....
Signature of Applicant

.....
Date

APPENDIX 6

*USE OF X-RAY PRODUCING MACHINES**

An X-ray producing machine authoree has the following responsibilities to assure that state regulations and University policy are being followed:

1. To assure that his X-ray device meets all the requirements of the New Jersey State Regulations. Copies of these Regulations are supplied to the authoree at the time of his application for use. The REHS will help to interpret these Regulations upon request.
2. To provide written, detailed instruction for the safe operation of the device to each person using and to ascertain that all users of the device are adequately trained in its proper use.
3. To see that proper use is made of personnel monitoring equipment (TLD badges or dosimeters) which is assigned to those under his supervision.
4. To notify the Department of Radiation and Environmental Health and Safety immediately in the following circumstances:
 - a. When an over-exposure to radiation is indicated or suspected.
 - b. Upon failure of an interlock or "fail-safe" device.
 - c. When change in experimental design could result in significant hazard.
 - d. Before shielding is changed or the machine relocated.
 - e. For other situations which the authoree believes could result in a hazard.
5. To request, in the case of an industrial (including diffraction units) or therapy unit, a recalibration of output whenever the X-ray tube, high-voltage rectifier, or any other major component is replaced.
6. To notify the REHS before the X-ray machine is moved or disposed of or before the responsibility for its safety or use is transferred to another person.

* See Appendix 11, Glossary, for definition of X-ray producing machines.

APPENDIX 7

USE OF NON-IONIZING RADIATION SOURCES

All sources of non-ionizing radiation (such as microwave, lasers, and ultra-violet) that have the potential for exposing an individual to hazardous levels of radiation must be registered with the Department of Radiation and Environmental Health and Safety. Because of the diversity of devices that emit non-ionizing radiation, safeguards to be applied will be specified for each device and the circumstances surrounding its use.

The safeguards will be the minimum to assure that exposure during normal conditions and credible accidents will be kept to a safe level. Safe levels are defined to be either those required by governmental agencies or those recommended by professionally recognized national and international committees, commissions, or associations.

*LASER SAFETY POLICY AND PROCEDURES*A. Policy

Rutgers University policy requires that all devices capable of emitting light be registered with the Department of Radiation and Environmental Health and Safety (REHS). The REHS staff will evaluate each device and determine the adequacy of the safety procedures and devices and personnel training based on current professional standards. Approval for use of the device will be granted when it is determined that all these aspects are adequate.

The person responsible for the laser device must be a faculty member or staff member with a rank of Instructor, Research Associate, or equivalent. This person (Supervisor) is ultimately responsible for the health and safety of all those who use the device. A copy of the Laser Safety Guide will be given to all supervisors. Any persons using the laser are responsible for using the device under the conditions specified by the REHS and agreed to by the supervisor, and for reporting any discrepancies or malfunctions to the supervisor and or REHS.

When the power of the device and conditions warrant it, REHS will require that all users submit to a medical examination of the eyes and skin at University expense before use of the laser.

B. Acquisition

All purchase requisitions for laser devices must be approved by REHS before processing by the Purchasing Department. Laser devices obtained by other means (e.g., gifts, loans) must be approved by REHS prior to the acquisition of the device.

C. Evaluation and Registration

The supervisor shall complete the application form and submit it to REHS. REHS staff will visit the site and evaluate the adequacy of the facility, safety devices, and procedures. The evaluations will determine compliance with current professional standards. Inadequacies must be corrected before approval for use is granted by REHS.

D. REHS Services

After the initial evaluation and registration of the laser, REHS will be available to the users for consultations, including:

1. Evaluation of changes in the use of or modifications to the device; and
2. For training and education of the users.

E. Medical Surveillance

As part of the evaluation procedure, REHS staff may determine that users be required to submit to an eye examination and possibly a skin examination prior to using the laser device. These examinations will be performed by an REHS-designated ophthalmologist at University expense. Copies of the examination results will be kept in REHS files.

Further examinations may be required under the following conditions:

1. When a person no longer works with the laser.
2. Immediately after suspected laser eye or skin damage.
3. Every three (3) years while working with lasers.

References:

American National Standard Institute, *Safe Use of Lasers*, ANSI 2136.1, 1973.
Sliney and Wolbarsht, *Safety with Lasers and Other Optical Sources*, Plenum, N.Y., 1980.

APPENDIX 8

CRITERIA FOR RADIATION SAFETY PROGRAM

The procedures and practices established by Rutgers University were formulated with due regard for all state and federal regulations; therefore, in most cases, the authoree's radiation safety program must, by law, be designed to comply with these regulations. The most important of these regulations are the U.S. NRC's "Radiation Protection Standards", 10 CFR 20; and "Notices, Instructions and Reports to Workers; Inspection", 10 CFR 19; and the New Jersey "Radiation Protection code", (copies of which are included with this Appendix).

To implement the government regulations, the Department of Radiation and Environmental Health and Safety uses as guides the published data and recommendations of professionally recognized national and international committees and professional organizations who are concerned with radiation safety, examples of which are:

1. The National Committee on Radiation Protection (NCRP).
2. The International Commission on Radiological Protection (ICRP).
3. International Atomic Energy Agency (IAEA).
4. The Health Physics Society.

Much of the data and recommendations of these organizations are normally published as handbooks. The handbooks are available at the REHS for use by any interested persons.

The REHS closely monitors all uses of radiation, provides services, and keeps extensive records which provide reasonable assurance that the authoree will comply with most aspects of federal and state regulations. The authoree must, however, assure compliance in those areas where the REHS cannot do so. Special problems associated with the use of a source of radiation which could cause non-compliance with government regulations would normally be discussed and resolved at the time of issuance of an authorization. The authoree can be reasonably certain that he will be in accord with applicable governmental regulations in all but unusual cases if he conducts his program in accordance with the applicable procedures and practices specified in this Radiation Safety Guide and with the conditions of his authorization.

Questions concerning interpretation of government regulations or use of professional standards should be directed to the REHS.

UNITED STATES NUCLEAR REGULATORY COMMISSION

TITLE 10, CFR, PART 20

"STANDARDS FOR PROTECTION AGAINST RADIATION"

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF RADIATION PROTECTION

"RADIATION PROTECTION CODE"

(A copy of the State code will be furnished
by the Department of Radiation and Environ-
mental Health and Safety upon request to
932-2550.)

APPENDIX 9

RADIATION TRAINING REQUIREMENTS

The Department of Radiation and Environmental Health and Safety assures that the Nuclear Regulatory Commission Regulations for radiation safety training are met as specified in 10 CFR 19 for persons working in the University as follows:

1. Authorees' training and experience are evaluated and determined to be adequate prior to authorization.
2. Users (those persons working directly with sources of radiation and those persons frequenting areas where sources of radiation are used are required to attend the first radiation safety lecture offered after they begin employment. These lectures are given the first Tuesday of every month. The location and time are announced in advance to authorees. Call 932-2550 for reservations. The lecture is also offered to groups of at least ten people at other locations upon request.

The authoree is responsible for instructing the worker in the potential hazards of his work as interim training until he can attend the REHS lecture.

3. Maintenance personnel must either attend the lecture specified in Item 1 above, or their supervisor must make arrangements for a special session. The supervisors are aware of this training requirement.
4. Custodians are provided training in special sessions on arrangement by their supervision, or are instructed to only clean the floors and empty "cold" waste containers in laboratories that have doors posted with the radiation symbol.

Records of attendance at the above training sessions are kept by REHS.

Attached are outlines of content of training sessions and the sign-off form presently used to record attendance at the training sessions, (pp. 32-38).

OUTLINE

RADIATION SAFETY ORIENTATION LECTURE

1. Why are we here?
 - a. Regulations
 - b. Orientation to Rutgers Radiation Safety Program
2. All uses of radiation require License (in New Jersey).
3. Describe Rutgers Licenses (and sources of radiation).
4. Licenses require University to assure safe use through:
 - a. Organization
 - b. Facilities and equipment
 - c. Evaluation
 - d. Control
 - e. Services
5. Radioactivity and radioactive decay: alpha, beta, gamma (X-ray), heavy particles.
6. Interaction of radiation with matter (and penetration).
7. Dosimetry (Roentgen - Rad - Rem)
8. Bioeffects:
 - a. Somatic
 - b. Genetic
9. Regulations - based on ICRP and NCRP recommendations.
10. Rutgers Radiation Safety Program.
 - a. Committee responsibility and composition
 - b. Radiation and Environmental Health and Safety Department
 - c. Control program
 - d. Evaluation
 - e. Compliance
 - f. Services
11. Laboratory practices.
 - a. External hazards, including X-rays
 - b. Internal hazards
 - c. Surveys

Laboratory practices (continued)

- d. Instrumentation - which instrument to use?
- e. Records
- f. Waste disposal
- g. Labelling and marking
- h. Storage
- i. Restriction of access
- j. As low as readily achievable
- k. Emergency procedures (posted)

12. Specific problems.

- a. ^3H
- b. ^{14}C
- c. ^{32}P
- d. ^{125}I
- e. Concept of MPC and regulatory requirements
- f. Radiation exposure artifacts
- g. TLD - return of badges
- h. Marking of waste containers
- i. Ordering radioisotopes
- j. Changes in experimental design and hardware
- k. Hesitancy to ask for help and where to get it
- l. Rules for use of radioisotopes

RADIATION SAFETY DEPARTMENT
ORIENTATION LECTURE ATTENDANCE

Date: _____

<u>Name</u>	<u>Dept./Bldg./Campus</u>	<u>Source of Radiation</u>	<u>Authoree</u>
-------------	---------------------------	----------------------------	-----------------

TRAINING PROCEDURE

*RADIATION SAFETY ORIENTATION FOR
MAINTENANCE AND CUSTODIAL PERSONNEL*

Newly appointed supervisors for maintenance and custodial personnel are given a briefing, individually, by the Radiation and Environmental Health and Safety staff, as follows:

1. General functions of the REHS, and introduction to the Radiation Safety Guide, and the basic ideas of 10 CFR 20.
2. The nature of harmful radiation effects, and the need to avoid all unnecessary radiation. (Ref: NRC Regulation Guide 8.10)
3. The individual's right to notify the NRC of any alleged safety infraction and to meet with NRC Inspectors privately or with counsel. (Ref: 10 CFR 19)
4. Their right to be informed when they are being monitored for radiation protection purposes, and their right to obtain any data accumulated about them. (Ref: 10 CFR 19)
5. Their responsibility to inform their workers of potential radiation hazards and of the workers' rights under 10 CFR 19 and 10 CFR 20.
6. The supervisors are given a sheet of specific procedures to be followed when dealing with radiation sources at the University as well as copies of instructional sheets to be given to new employees under their supervision. Copies of these instructional sheets follow.

Periodically, an orientation lecture is presented by the staff of the Department of Radiation and Environmental Health and Safety for all maintenance and custodial personnel. At this time, all of the above information is reviewed and expanded on, as appropriate.

MAINTENANCE STAFF

PROCEDURES FOR DEALING WITH EQUIPMENT IN LABORATORIES
USING RADIOACTIVE MATERIALS

1. Any device which has a radiation symbol on it (except X-ray machines) might be contaminated with radioactive material. Before you work on or around such a device, call the Department of Radiation and Environmental Health and Safety at 932-2550 so that the device may be checked for safety.
2. Equipment within or servicing a radioisotope laboratory which may be contaminated by radioactive material includes hoods, exhaust blower motors, pumps, drain pipes, ventilation ducts, etc. Call the Department of REHS to check before beginning work on any such equipment.
3. If you think you may have gotten some radioactive material on your skin or clothing, wash it off as soon as possible, and then call the Department of REHS so that they can assure you that all the contamination has been removed. Do not leave the general area until you have been checked.
4. Wash your hands before eating or at the completion of the job. Clean any cuts or scrapes extra well with mild soap and water.
5. Do not eat or drink in any area which has the radiation signs displayed.
6. If you have any questions, call the Department of Radiation and Environmental Health and Safety at 932-2550.

I have read the above and understand my responsibilities.

Signature

Date

(See reverse side for Spanish translation.)

EAC (5/82)

PERSONAL DE MANTENIMIENTO

PROCEDIMIENTOS PARA EL MANTENIMIENTO DEL EQUIPO EN
LABORATORIOS QUE USAN SUSTANCIAS RADIOACTIVAS

1. Cualquier aparato que tenga un símbolo de radiación (excepto el aparato de radiografías) puede estar contaminado con sustancias radioactivas. Antes de trabajar en este aparato o en sus alrededores, llame al Department of Radiation and Environmental Health and Safety al 932-2550 para que como medio de protección, pueda revisarse el aparato.
2. El equipo que forma parte o está al servicio de un laboratorio radioisotopo y que puede estar contaminado por sustancias radioactivas, incluye tapas, extractores, bombas, tubos de drenaje, conductos de ventilación, etc. Antes de empezar a trabajar en cualquiera de estos equipos, llame al Department of Radiation and Environmental Health and Safety.
3. Si usted cree que le ha caído alguna sustancia radioactiva en la piel o en la ropa, lávela lo antes posible y llame al Department of Radiation and Environmental Health and Safety para que puedan asegurarle que se le ha quitado toda la contaminación. No abandone el área general hasta que se le haya revisado.
4. Lávese las manos antes de comer o al terminar de trabajar. Límpiense bien con agua y un jabón suave, cualquier cortada o arañazo que se haya hecho.
5. No coma ni beba en ninguna de las áreas que tienen carteles que indican radiación.
6. Si tiene alguna pregunta, llame al Department of Radiation and Environmental Health and Safety al 932-2550.

He leído lo de arriba y entiendo mis reponsabilidades.

Firma

Fecha

CUSTODIAL STAFF SUPERVISOR

PROCEDURES FOR RADIOISOTOPE LABORATORIES

1. Read "What to do About Radioactive Materials" sheet.
2. Give an explanatory sheet, "What to do About Radioactive Materials," to each member of your staff and to new employees as they begin work. Make sure that they understand everything it says. Have new employees sign two sheets that they understand, and give them a copy.
3. Waste receptacles which are labelled with the radiation symbol must not be emptied with normal waste.
4. Empty waste containers (boxes, bottles, cartons, etc.) which have a radiation symbol affixed to their surfaces should not be disposed in regular waste. If any such containers are found in the regular waste, call the Department of Radiation and Environmental Health and Safety (REHS) at 932-2550 and report the location.
5. If a worker gets radioactive material on his skin, have him wash the skin gently with mild detergent as soon as possible. Clothing with radioactive material on it should be removed and stored separately. Call REHS so that we may assure you that all the radioactive material has been safely removed. The worker should remain in the area until an REHS staff member has checked on everything. After hours, call the University Police, who will contact the appropriate staff member.
6. If you suspect that radioactive material has been spilled on floors or other surfaces, call REHS from 8 A.M. to 5 P.M. on Mondays through Fridays, or after hours, call the University Police, who will contact the appropriate departmental staff member.
7. If you have any questions concerning radiation sources, please call REHS at 932-2550, or after hours, call the University Police Department, as they have current after-hours numbers for REHS personnel.

UNIVERSITY POLICE DEPARTMENTS

New Brunswick . . . 932-7111

Camden 757-6111

Newark 648-5111

CUSTODIAL STAFF

WHAT TO DO ABOUT RADIOACTIVE MATERIALS

1. Rooms which have the radiation symbol shown at right on the door contain radioactive materials. You should be careful when working in these rooms. You can sweep, mop, and wax the floors and remove the waste from containers not labelled with the radiation symbol, just as in any other room. Do not dust surfaces. Do not move or handle objects on bench tops.
2. Any container (boxes, bottles, cartons, etc.) which has radioactive material in it will have the radiation symbol on it also. You should not touch these containers. If the contents of these containers are spilled, DO NOT TOUCH THEM OR ATTEMPT TO CLEAN THEM UP. Tell your supervisor or call the Department of Radiation and Environmental Health and Safety at 932-2550.
3. DO NOT empty any waste container which has the radiation symbol on it.
4. DO NOT empty any waste container which has waste material, such as boxes or bottles, with the radiation symbol on it. Tell your supervisor about it.
5. DO NOT eat, drink or use cosmetics in any room which has the radiation symbol on its door.
6. In an emergency, or if you have any questions, ask your supervisor.
7. Wash your hands before eating or going home. Clean cuts and scrapes extra well.

I have read (or have had the above explained to me) and understand my responsibilities.

Signature

Date

Person providing the sheet and explaining its contents:

Signature

Date

(See reverse side for Spanish translation.)

EAC (5/82)

PERSONAL DE LIMPIEZA

Que hacer acerca de Materiales Radioactivos

1. Salones o cuartos que tengan el simbolo que aparece a su derecha contienen materiales radioactivos. Ustedes deben de tener mucha precaucion cuando trabajen en dichos cuartos. Pueden barrer, mapear y pasar cera a los pisos, e incluso remover todo desperdicios, siempre y cuando no esten rotulados con el simbolo de radiacion, como usualmente lo harian en cualquier otro cuarto.
2. Todo envase (sean botellas, cajas, cartones, ect.) que contengan materiales de radiacion estaran debidamente rotulados con dicho simbolo. Estos envases no deben ser tocados por ustedes. Si el contenido de estos envases se derraman, NO LOS TOQUEN, NI TRATEN DE LIMPIARLOS. Informe de inmediato a su Supervisor o llamen al Departamento de Salud y Seguridad Ambiental al 932-2550, o despues de horas, llamen la Policia Universitaria.
3. NO VACIEN ningun envase rotulado con el simbolo de radiacion.
4. NO VACIEN ningun envase rotulado con el simbolo de radiacion que contengan desperdicios de materiales radioactivos, tales como cajas o botellas. Informe a su Supervisor de tales desperdicios.
5. Comer en los cuartos donde aparecen dichos simbolos esta terminantemente PROHIBIDO.
6. En caso de emergencias, o si desean hacer cualquier pregunta, consulten a su Supervisor, o al Departamento de Radiacion, tambien pueden consultar a Salud y Seguridad Ambiental al 932-2550, despues de horas, llamen al Departamento de Policia Universitaria, pues hay personal adiestrado para ayudarles.

DEPARTAMENTO DE POLICIA UNIVERSITARIA

New Brunswick. . . 932-7111
Camden. 757-6111
Newark. 648-5111

Yo he leído (o lo mencionado arriba ha sido explicado a mi persona) y entiendo mis responsabilidades.

Firma

Fecha

Persona que provee el papel y explica su contenido:

Firma

Fecha

STAFF SUPERVISOR

PROCEDURES FOR RADIOISOTOPE LABORATORIES

H/S
110

1. Read "What to do About Radioactive Materials" sheet.
2. Give an explanatory sheet, "What to do About Radioactive Materials", to each member of your staff and to each new employee as he/she begins work. Make sure that he/she understands everything it says. Have each new person sign two sheets that he/she understands. Send one copy to the Department of Radiation and Environmental Health and Safety, Doolittle Building, Busch Campus, and give the other copy to the person.
3. Waste receptacles which are labelled with the radiation symbol must not be emptied with normal waste.
4. Empty waste containers (boxes, bottles, cartons, etc.) which have a radiation symbol affixed to its surface should not be disposed in regular waste, unless the radiation symbol is obscured. Call the Department of Radiation and Environmental Health and Safety at 932-2550 and report the location of any such containers in regular waste.
5. If a worker gets radioactive material on his skin, have him wash the skin gently with mild detergent as soon as possible. Clothing with radioactive material on it should be removed and stored separately. Call the Department of REHS (or a staff member after hours - see below), so that we may assure you that all the radioactive material has been safely removed. The worker should remain in the area until a staff member of the Department of REHS gives him permission to leave.
6. If you suspect that radioactive material has been spilled on floors or other surfaces, call the Department of REHS from 8 A.M. to 5 P.M. Mondays through Fridays, or a departmental staff member after hours.
7. If you have any questions concerning radiation sources, please call the Department of Radiation and Environmental Health and Safety at 932-2550, or a staff member after hours, as follows:

Edward A. Christman 201-297-7399

Julius A. Bodzas 201-247-9034

Daniel B. Howell 201-249-7013

(See reverse side for Spanish translation)

EAC (5/82)

SUPERVISOR DE PERSONAL

PROCEDIMIENTO PARA LOS LABORATORIOS DE RADIOISÓTOPO

1. Lea la hoja que explica "Qué hacer con respecto a las sustancias radioactivas".
2. Dé una hoja de explicaciones, "Qué hacer con respecto a las sustancias radioactivas" a cada miembro del personal y a cada persona nueva en cuanto empiece a trabajar. Asegúrese de que él/ella comprende todo lo que explica. Haga que cada persona nueva firme dos hojas haciendo constar de que él/ella entiende. Envíe una copia al Department of Radiation and Environmental Health and Safety (Departamento de Radiación y Salud y Protección del Medio Ambiente), Doolittle Building, Busch Campus, y dé la otra copia a la persona.
3. Los cestos de basura que estén marcados con el símbolo de radiación NO deben vaciarse en los de la basura normal.
4. Los envases vacíos desperdiciables (cajas, botellas, envases de cartón, etc.) que tengan marcado en la superficie un símbolo de radiación, NO deben echarse en la basura regular, a menos que el símbolo de radiación esté oscurecido. Llame al Department of Radiation and Environmental Health and Safety al 932-2550, e infórmeles del lugar de basura regular en el cual dichos envases han sido tirados.
5. Si a un trabajador le cae sustancia radioactiva en la piel, haga que se lave la piel delicadamente con un detergente suave, lo antes posible. La ropa que le caiga sustancia radioactiva debe quitársela y guardarla aparte. Llame al Department of Radiation and Environmental Health and Safety (o a un miembro, después de las horas regulares - vea abajo), para que podamos asegurarle de que se le ha quitado bien toda la sustancia radioactiva. El trabajador debe quedarse en el área hasta que un miembro del personal del Department of Radiation and Environmental Health and Safety le dé la autorización de salir.
6. Si usted sospecha que se ha derramado alguna sustancia radioactiva en el piso o en otras superficies, llame al Department of Radiation and Environmental Health and Safety de 8 A.M. a 5 P.M. de lunes a viernes, o a un miembro del personal después de las horas mencionadas.
7. Si tiene alguna pregunta en relación a las fuentes de radiación, llame al Department of Radiation and Environmental Health and Safety al 932-2550, o a un miembro del personal después de las horas mencionadas. Vea la lista de miembros a continuación:

Edward A. Christman	201-297-7399
Julius A. Bodzas	201-247-9034
Daniel B. Howell	201-249-7013

APPENDIX 10

USE OF THE ⁶⁰COBALT GAMMA GREENHOUSE

The Gamma Greenhouse is available for use to all Rutgers personnel. Authorization may be requested from the Department of Radiation and Environmental Health and Safety. After authorization, space in the Greenhouse may be reserved by calling the secretary at the Dept. of REHS, extension 2550.

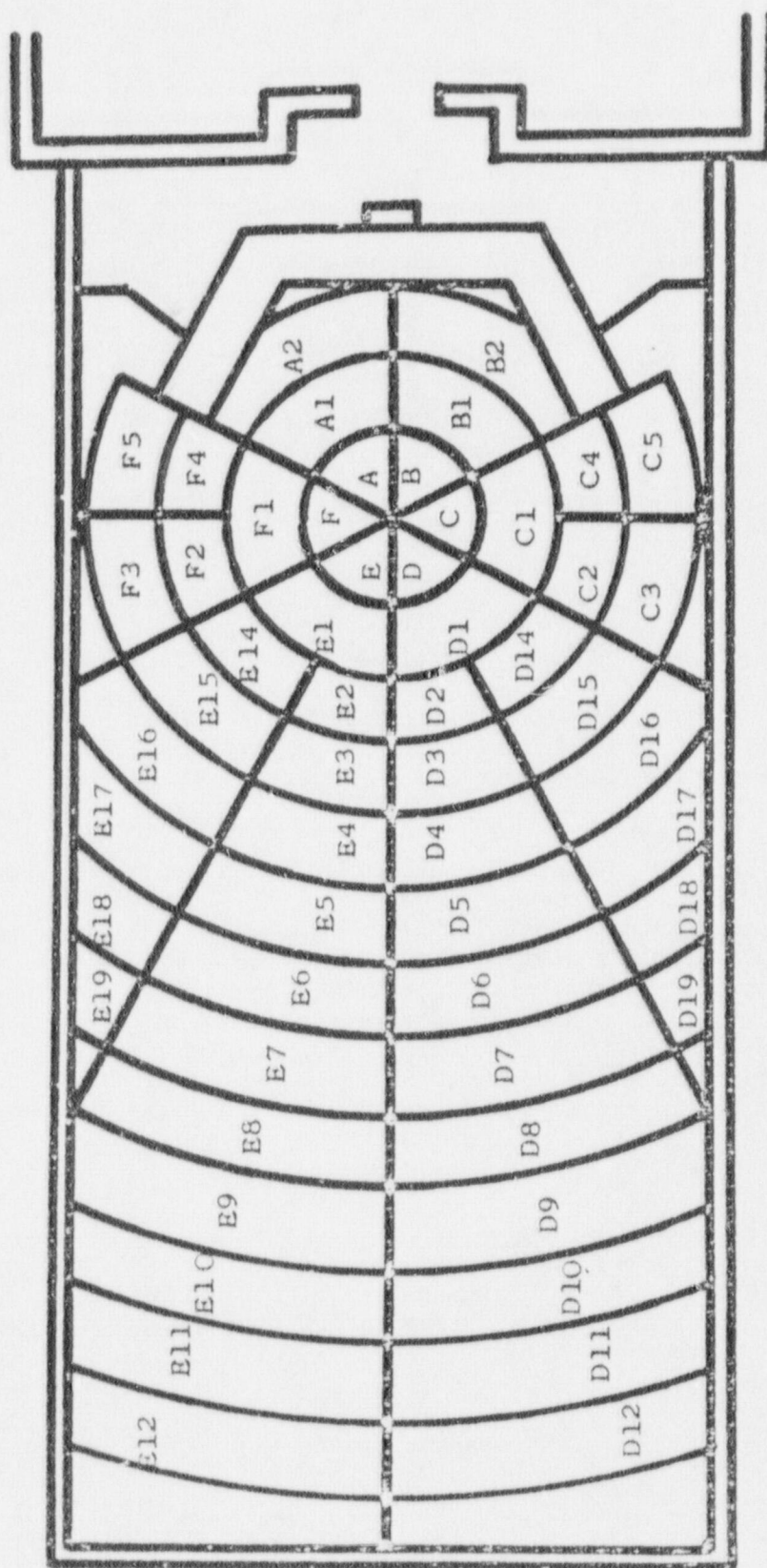
A high activity ⁶⁰Co gamma source is located near one end of a standard 30 X 60 foot greenhouse. Attached to this greenhouse is a headhouse approximately 30 X 15 feet for preparation of experimental specimens. The headhouse and the source operating area of the greenhouse are shielded by a U-shaped "heavy" concrete shield.

The following safety rules apply to the use of the Gamma Greenhouse:

1. All authorees must be briefed on radiation safety and operational procedures before their initial use of the greenhouse. This briefing will be by a member of the Dept. of REHS.
2. The source will be raised and lowered only by authorized persons.
3. Monitoring badges must be worn at all times by individuals working in this facility.
4. A Log Book provided in the headhouse must be signed and dated by the person raising or lowering the source.
5. All persons other than those authorized must be accompanied, when entering the Gamma Greenhouse, by a member of the Dept. of REHS.
6. All those authorized must familiarize themselves with the area radiation monitoring system. It consists of a rate meter (mounted in the head house) and Geiger Muller tube placed in the headhouse. The GM tube is located such that it is a sensitive indicator of the position of the source. After lowering the source to its storage position and before disengaging the mechanical safety interlocks, the radiation level must be read. If radiation above background is indicated, the greenhouse must not be entered, but the user should proceed as in Item 7 below.
7. In the event that the area monitoring system indicates abnormal radiation levels when the source is supposed to be in its storage condition, or in the event of unusual operating difficulties, the user must immediately contact the Department of REHS at extension 2550. The user must not attempt any corrective measures such as "freeing up" a stuck source before the Dept. of REHS responds to his call.

FIGURE 1

GAMMA GREENHOUSE SECTORS



APPENDIX 11

GLOSSARY

Radioactivity (activity) - the spontaneous disintegration of unstable nuclei with the resulting emission of nuclear radiation.

Curie (Ci) - the traditional unit for measuring radioactivity
= 3.7×10^{10} disintegrations per second (dps)

Becquerel (Bq) - the S.I. unit for radioactivity
= 1 disintegration per second (1 s^{-1})

Prefixes:

<i>Pico</i> (p)	= 1/1,000,000,000,000	or 10^{-12}	X	_____
<i>Nano</i> (n)	= 1/1,000,000,000	or 10^{-9}	X	_____
<i>Micro</i> (m)	= 1/1,000,000	or 10^{-6}	X	_____
<i>Milli</i> (m)	= 1/1,000	or 10^{-3}	X	_____
<i>Kilo</i> (k)	= 1,000	or 10^3	X	_____
<i>Mega</i> (M)	= 1,000,000	or 10^6	X	_____
<i>Giga</i> (G)	= 1,000,000,000	or 10^9	X	_____

Conversions:

1 Becquerel = 27 picocuries
1 microcurie = 37 kiloBecquerels

Radiation - any ionizing or non-ionizing electromagnetic or particulate radiation.

Ionizing Radiation - Electromagnetic or corpuscular radiation capable of producing ions directly or indirectly in its passage through matter (e.g., alpha particles, beta particles, gamma or X-rays, neutrons).

Roentgen - the traditional unit of radiation exposure.

1 Roentgen = 2.58×10^{-4} Coulombs/kg

Exposure is defined as the quotient Q/m where Q is the charge either sign created in a mass of air, m , by photons (gamma or X-rays) of moderate energy.

rad - the traditional unit of absorbed dose.

1 rad = 100 erg/gm

The quantity of radiation absorbed per unit mass of any material. The S.I. unit is the *Gray* (Gy) = 1 Joule/kg = 100 rads

rem - the traditional unit of dose equivalent.

A measure of the absorbed dose of any ionizing radiation by body tissue in terms of its estimated biological effect relative to an absorbed dose of X-rays. The S.I. unit for the dose equivalent is the *Sievert* (Sv)

1 Sievert = 1 Joule/kg = 100 rem

The following are considered to be equivalent to a dose of 1 Sievert:

- . An exposure of one hundred Roentgens due to X- or gamma radiation.
- . A dose of one Gray due to X-, gamma, or beta radiation.
- . A dose of 0.1 Gray due to neutrons or high-energy protons.

rem (continued)

- . A dose of 0.05 Gray due to particles heavier than protons and with sufficient energy to reach the lens of the eye.
- . A dose of 0.05 Gray due to alpha particles deposited in body tissue.

Source of Radiation - any radioisotope, X-ray producing machine, accelerator, electron microscope, or other device which emits ionizing radiation.

X-Ray Producing Machine - For the purpose of this guide, the term "X-ray producing machine" refers to X-ray machines of both the standard diagnostic and therapeutic types, X-ray diffraction units, electron microscopes, high-voltage rectifiers with voltages exceeding 20 KeV and in some cases high-voltage vacuum switches.

Authoree - one who is authorized by Rutgers to use specific sources of radiation, and who has primary responsibility for the radiation safety associated with the use of sources of radiation.

Radiation Emergency - an unforeseen combination of circumstances involving use of sources of radiation which calls for immediate action. This includes contamination of people or property, unnecessary exposure to radiation, and release of radioactive material into the air.

Radioisotope - used in this Guide to mean radionuclide.

APPENDIX 12

NUCLEAR REGULATORY COMMISSION LICENSE 29-05218-28

NEW JERSEY STATE LICENSE NJSL-80091

WORKERS' RIGHTS NOTICE

MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 40 and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee

1. Rutgers, The State University
Department of Radiation and Environmental
Health and Safety
2. P. O. Box 1179
Piscataway, New Jersey 08854

In accordance with letter dated
November 11, 1983

29-05218-28 is amended in its
3. License number
entirety to read as follows:

December 31, 1988
4. Expiration date

030-00883
5. Docket or
Reference No.

6. Byproduct, source, and/or
special nuclear material

7. Chemical and/or physical
form

8. Maximum amount that licensee
may possess at any one time
under this license

A. Any byproduct material
between
Atomic Nos. 3
through 83, inclusive
Any byproduct material
between Atomic Nos. 84
through 98, inclusive

A. Any

B. Any

C. Cobalt 60
D. Cesium 137
E. Hydrogen 3
F. Polonium 210
G. Thorium 228
H. Americium 241
I. Strontium 90
J. Americium 241

C. Any
D. Any
E. Any
F. Any
G. Any
H. Sealed sources
I. Sealed sources
J. Sealed sources (Troxler
Electronic Laboratories
Inc. Am-Be neutron sources)

K. Cesium 137

K. Sealed sources (Troxler
Electronic Laboratories
Inc.)

L. Cesium 137

L. Sealed Source (Amersham
Searle Model (8502-33)

M. Cesium 137

M. Sealed source (Nuclear
Chicago Model RR-137)

N. Cesium 137

N. Sealed Source (New
England Nuclear Model
NER-560)

O. Americium 241

O. Sealed Source (New
England Nuclear Model
NER-560)

A. 1 curie of each
byproduct material
between Atomic Nos.
3 and 83 inclusive
B. 5 millicuries of each
byproduct material
between Atomic Nos.
84 and 98, inclusive
C. 5 curies
D. 5 curies
E. 40 curies
F. 2 curies
G. 200 millicuries
H. 5 millicuries
I. 20 curies
J. No source to exceed 100
millicuries
K. No source to exceed 10
millicuries
L. 10 curies
M. 3.5 millicuries
N. 11 millicuries
O. 60 millicuries

Total not to exceed 100 curies

8502250657 Jpp

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License number

29-05218-28

Docket or Reference number

030-00883

Amendment No. 38

(continued)

Authorized use:

- A. through I. Research and development as defined in Section 30.4(q) of Title 10, Code of Federal Regulations, Part 30.
- J. and K. For use in Troxler Electronic Laboratories, Inc. depth moisture gauges for measurement of moisture content.
- L. For storage.
- M. For use in Nuclear Chicago Model P-20 subsurface soil moisture/density gauge.
- N. and O. For use in Soiltest Model NIC-5DT surface moisture gauge.

CONDITIONS

- 10.
 - A. Licensed material shall be used at the Campuses of Rutgers University, The State University of New Jersey as approved by the University Committee on Radio-isotopes.
 - B. Licensed material may be used at Hutcheson Memorial Forest located seven(7) miles from Busch Campus, Piscataway, New Jersey, as outlined in Attachment 6 of application dated May 22, 1978.
 - C. Two (2) millicuries of carbon 14 may be used at temporary job sites at sea where the U.S. Nuclear Regulatory Commission maintains jurisdiction for regulating the use of licensed material in accordance with Attachment 7 of application dated May 22, 1978.
 - D. Licensed material listed in Item 6.J and 6.K above may be used at temporary job sites of the licensee anywhere in the United States where the U.S. Nuclear Regulatory Commission maintains jurisdiction for regulating the use of licensed material.
- 11. The licensee shall comply with the provisions of Title 10, Chapter 1, Code of Federal Regulations, Part 19, "Notices, Instructions, and Reports to Workers; Inspections" and Part 20, "Standards for Protection Against Radiation."
- 12. Licensed material shall be used by, or under the supervision of, individuals designated by the Radiation Safety Committee, Andrew Forgash, Ph.D. Chairman.
- 13.
 - A. (1) Each sealed source acquired from another person and containing licensed material, other than Hydrogen 3, with a half-life greater than thirty days and in any form other than gas shall be tested for contamination and/or leakage prior to use. In the absence of a certificate from a transferor indicating that a test has been made within six months prior to the transfer, a sealed source received from another person shall not be put into use until tested.

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License number

29-05218-28

Docket or Reference number

030-00883

Amendment No. 38

(13.A.1. continued)

CONDITIONS

(2) Notwithstanding the periodic leak test required by this condition, any licensed sealed source is exempt from such leak tests when the source contains 100 microcuries or less of beta and/or gamma emitting material or 10 microcuries or less of alpha emitting material.

(3) Except for alpha sources, the periodic leak test required by this condition does not apply to sealed sources that are stored and not being used. The sources excepted from this test shall be tested for leakage prior to any use or transfer to another person unless they have been leak tested within six months prior to the date of use or transfer.

B. Each sealed source fabricated by the licensee shall be inspected and tested for construction defects, leakage, and contamination prior to use or transfer as a sealed source. If the inspection or test reveals any construction defects or 0.005 microcurie or greater of contamination, the source shall not be used or transferred as a sealed source until it has been repaired, decontaminated and retested.

C. Each sealed source containing licensed material, other than Hydrogen 3, with a half-life greater than thirty days and in any form other than gas shall be tested for leakage and/or contamination at intervals not to exceed six months except that each source designed for the purpose of emitting alpha particles shall be tested at intervals not to exceed three months.

D. The test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. The test sample shall be taken from the sealed source or from the surfaces of the device in which the sealed source is permanently or semipermanently mounted or stored on which one might expect contamination to accumulate. Records of leak test results shall be kept in units of microcuries and maintained for inspection by the Commission.

E. If the test required by Subsection A. or C. of this condition reveals the presence of 0.005 microcurie or more of removable contamination, the licensee shall immediately withdraw the sealed source from use and shall cause it to be decontaminated and repaired or to be disposed of in accordance with Commission regulations. A report shall be filed within 5 days of the test with the U.S. Nuclear Regulatory Commission, Region I, 631 Park Avenue, King of Prussia, Pennsylvania 19406, describing the equipment involved, the test results, and the corrective action taken.

14. A. Detector cells containing titanium tritide foil shall only be used in conjunction with a properly operating temperature control mechanism which prevents foil temperatures from exceeding 225 degrees Centigrade.

B. Detector cells containing scandium tritide foil shall only be used in conjunction with a properly operating temperature control mechanism which prevents foil temperatures from exceeding 325 degrees Centigrade.

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License number

29-05218-28

Docket or Reference number

030-00883

Amendment No. 38

(continued)

CONDITIONS

15. In lieu of using the conventional radiation caution colors (magenta or purple on yellow background) as provided in Section 20.203(a)(1), Title 10, Code of Federal Regulations, Part 20, the licensee is hereby authorized to label detector cells and cell baths, containing licensed material and used in gas chromatography devices, with conspicuously etched or stamped radiation caution symbols without a color requirement.
16. The licensee shall not use licensed material in or on human beings or in field applications where activity is released except as provided otherwise by specific condition of this license.
17. The licensee may transport licensed material or deliver licensed material to a carrier for transport in accordance with the provisions of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."
18. Pursuant to Sections 20.106(b) and 20.302, 10 CFR 20, the licensee is authorized to dispose of licensed material by incineration provided the gaseous effluent from incineration does not exceed the limits specified for air in Appendix B, Table II, 10 CFR 20. Ash residues may be disposed of as ordinary waste provided appropriate surveys pursuant to Section 20.201 are made to determine that concentrations of licensed material appearing in the ash residues do not exceed the concentrations (in terms of microcuries per gram) specified for water in Appendix B, Table II, 10 CFR 20.
19. Notwithstanding Conditions 10 and 16, 2.0 millicuries of carbon-14 labeled pesticide may be used for field study at the licensee's property in Cream Ridge, New Jersey, in accordance with letters dated April 5, 1983, and April 15, 1983.
19. Except as specifically provided otherwise by this license, the licensee shall possess and use licensed material described in Items 6, 7, and 8 of this license in accordance with statements, representations, and procedures contained in application dated May 22, 1978; letters dated October 27, 1978, October 16, 1980, May 28, 1981, April 5, 1983, April 15, 1983, November 11, 1983 and December 5, 1983; and Radiation Safety Guide, Fifth Edition, dated December 1983. The Nuclear Regulatory Commission's regulations shall govern the licensee's statements in applications or letters, unless the statements are more restrictive than the regulations.

For the U.S. Nuclear Regulatory Commission

Date FEB 07 1984

By

Philip C. DeMan
Nuclear Materials and Safeguards Branch
Region I
King of Prussia, Pennsylvania 19406

NEW JERSEY STATE DEPARTMENT OF HEALTH
P.O. Box 1540, Trenton, New Jersey 08625

RADIOACTIVE MATERIALS LICENSE

Pursuant to the New Jersey Radiation Protection Code, and in reliance on statements and representations heretofore made by the licensee designated below, a license is hereby issued authorizing such licensee to transfer, receive, possess and use the radioactive material(s) designated below; and to use such radioactive materials for the purpose(s) and at the place(s) designated below. This license is subject to all applicable rules, regulations, and orders of the State Department of Health, now or hereafter in effect, and to any conditions specified below.

LICENSEE		3. License number
		NJSL - 80091-01
1. Name	Rutgers, The State University	4. Expiration date
2. Address	New Brunswick, New Jersey 08903	July 31, 1971
		5. Reference number
6. Radioactive materials (element and mass number)	7. Chemical and/or physical form	8. Maximum quantity licensee may possess at any one time
A. All naturally occurring accelerator produced radioactive materials between Atomic Nos. 1 and 92, except as provided below.	A. Any	A. 200 millicuries of each radioactive material.
B. See Page 2	B. See Page 2	B. See Page 2

CONDITIONS

9. Authorized use. (Unless otherwise specified, the authorized place of use is the licensee's address stated in Item 2 above.)
- A. Radioactive material specified in this License shall be used and/or stored at University locations approved by the University Committee on Radioisotopes.
 - B. Radioactive materials specified in this License may be used at all Colleges of the University and University Extension Divisions approved by the University Committee on Radioisotopes.
 - C. Radioactive material specified in this License may be used for field use in specified courses of the New Jersey Civil Defense Training Program throughout the State as approved by the University Committee on Radioisotopes.

Continued on Next Page

RADIOACTIVE MATERIALS LICENSE

Supplementary Sheet

6. Radioactive Materials	7. Chemical and/or Physical Form	8. Maximum Quantity
B. Hydrogen 3	B. Any	B. 5000 millicuries
C. Carbon 14	C. Any	C. 1000 millicuries
D. Phosphorous 32	D. Any	D. 1000 millicuries
E. Sulfur 35	E. Any	E. 500 millicuries
F. Cobalt 60	F. Any	F. 1000 millicuries
G. Strontium 90	G. Any	G. 400 millicuries
H. Iodine 131	H. Any	H. 400 millicuries
I. Unidentified and unseparated radio-isotopes arising from accelerator operation.	I. Any	I. 1000 millicuries

Total maximum possession unit not to exceed 50 curies.

9. D. Radioactive material specified in this License may be used at Hutchinson Memorial Forest, property owned by the University, located 7 miles from University Heights Campus, New Brunswick, New Jersey as outlined in Attachment 4 to letter and radioactive material renewal application dated June 6, 1969.

E. Radioactive materials specified in this License are to be used for the purpose of (1) Instruction and (2) Research and Development as defined by Section 2.49 of the Radiation Protection Guide.

10. Licensee shall comply with the provisions of the New Jersey Radiation Protection Code.

Continued on Next Page

RADIOACTIVE MATERIALS LICENSE

Supplementary Sheet

11. Radioactive material shall be used and supervised by individuals authorized by the University Committee on Radioisotopes in accordance with procedures described in Appendix 3 of the Radiation Safety Guide, Third Edition, dated January 1969. Radioactive material may also be received, monitored, transported and used by or in the presence of the Radiation Safety Office personnel in carrying out the routine duties and responsibilities of the Radiation Safety Office.
12. Radioactive material shall not be used in human beings, or in products distributed to the Public, or in field applications where activity is released except as provided by specific conditions of this License.
13. Each sealed source of licensed material containing Radium 226, and its daughter products, and/or naturally occurring radioactive materials used outside of a shielded exposure device shall have a durable, legible and visible tag permanently attached. The tag shall bear a conventional radiation symbol prescribed in Section 11 of the Code and a minimum of the following instructions:

"DANGER RADIOACTIVE MATERIAL, DO NOT HANDLE, NOTIFY RADIATION SAFETY OFFICER IF FOUND."
14. Sealed sources containing radioactive material subject to the licensing regulations of the State of New Jersey shall not be opened by the Licensee.
15. A. Sealed sources containing Radium 226 shall be tested for leakage and/or contamination at intervals not to exceed six months.

B. The test shall be capable of detecting the presence of 0.005 microcuries of radioactive material on the test sample. The test sample shall be taken from the sealed source or from the surfaces of the device in which the sealed source is permanently mounted or stored on which one might expect contamination to accumulate.

C. If the test reveals the presence of 0.005 microcuries of removable contamination, the Licensee shall immediately withdraw the sealed source from use and shall cause it to be decontaminated and repaired or to be disposed of in accordance with the Department regulations. Within five days after obtaining results of the test, a report shall be filed with the Department describing the circumstances, the test results and the corrective action taken.

Continued on Next Page

RADIOACTIVE MATERIALS LICENSE

Supplementary Sheet

15. D. The sealed sources specified in Items 6, 7 and 8 of this License may be tested for leakage and/or contamination by, or under the supervision of the Radiation Safety Officer, Daniel B. Howell, and/or by persons specifically licensed to perform this service.
16. Except as specifically provided otherwise by this License, the Licensee may possess and use radioactive material described in Items 6, 7 and 8 of this License only in accordance with statements, representations and procedures contained in License application dated June 6, 1969 and the following Radiation Safety Guideline:
- A. Radiation Safety Guide, 3rd Edition, dated January 1969.

Date July 29, 1969

By

William Adams

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF ENVIRONMENTAL QUALITY
BUREAU OF RADIATION PROTECTION
380 Scotch Road, Trenton, New Jersey 08628

Page 1 of 1 Pages

RADIOACTIVE MATERIALS LICENSE
Supplementary Sheet

License Number 80091
Amendment No. 6

Rutgers, The State University
Radiation Science Center
Univeristy Heights Campus
New Brunswick, New Jersey 08903

In accordance with radioactive material letter dated December 5, 1983, New Jersey State Radioactive Material License NJSL-80091 is amended as follows:

Supplemental Condition:

Authorization to possess the soil moisture density probes indicated below:

- a. Nuclear Chicago Model P-19; S.N. 164 (3-19-60) 226; 4.28 millicuries 226 RaBe in U.S. Radium Corporation Model 598-1 configuration.
- b. Nuclear Chicago Model 5901; S.N. 37 (11-29-63) 4.03 millicuries 226 RaBe in U.S. Radium Corporation 598-1 configuration.

All remaining conditions of New Jersey State Radioactive Material License #80091 remain unchanged.

Date February 10, 1984

For the State of New Jersey
Department of Environmental Protection

By Joseph J. Santoro

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF ENVIRONMENTAL QUALITY
BUREAU OF RADIATION PROTECTION
380 Scotch Road, Trenton, New Jersey 08628

Page 1 of 1 PagesLicense Number 80091
Amendment No. 5

RADIOACTIVE MATERIALS LICENSE
Supplementary Sheet

Rutgers, The State University
Radiation Science Center
University Heights Campus
New Brunswick, New Jersey 08903

Attention: Mr. Daniel B. Howell, Director
Radiation and Environmental Health and Safety
Department

In accordance with radioactive material renewal application dated
May 5, 1982, New Jersey State Radioactive Material License
NJSL-80091 is amended as follows:

1. Item No. 4 is amended to read July 31, 1987.

All other conditions of New Jersey State Radioactive Material
License NJSL-80091 remain the same.

CC: Dr. Andrew Forgash, Chairman
Radiation Safety Committee
Staff 12/7/82

November 9, 1982

For the State of New Jersey
Department of Environmental Protection

By Patsia Anne M. Hillman

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Page 1 of 1 Pages

380 Scotch Road, Trenton, New Jersey 08628
RADIOACTIVE MATERIALS LICENSE

NJSL
License Number 80091
Amendment No. 4

Supplementary Sheet

Rutgers, The State University
Radiation Science Center
University Heights Campus
New Brunswick, New Jersey 08903

Attention: Mr. Daniel B. Howell, Director
Radiation and Environmental
Health and Safety Department

In accordance with radioactive material renewal application dated
June 28, 1977, New Jersey State Radioactive Material License NJSL-80091
is amended as follows:

Item 4 is amended to read July 31, 1982.

All other conditions of New Jersey State Radioactive Material License
NJSL-80091 remain the same.

cc: Dr. James Gunckel, Chairman
University Radiation Safety Committee
Health-Safety Council
Staff 3/17/78

10/7/81 to NEN - bh
2/21/82 to NEN - CT

For the State of New Jersey
Department of Environmental Protection

Date August 26, 1977

By

Joseph P. D'Amico

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
~~380 Scotch Road, Trenton, New Jersey 08628~~
380 Scotch Road, Trenton, N.J. 08628
RADIOACTIVE MATERIALS LICENSE
Supplementary Sheet

Page 1 of 1 Pages

NJSL
License Number 80091
Amendment No. 3

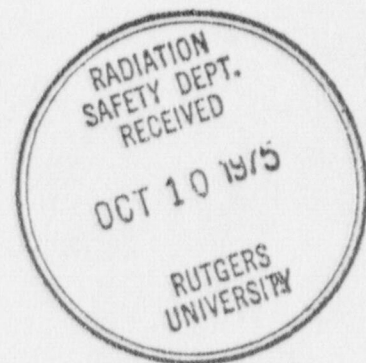
Rutgers, The State University
Radiation Science Center
University Heights Campus
New Brunswick, New Jersey 08903

Attention: Mr. Daniel B. Howell
Radiation Safety Officer

In accordance with radioactive material renewal letter dated June 13, 1975,
New Jersey State License No. 80091 is amended as follows:

Item 4 is amended to read: July 31, 1977.

All other conditions of New Jersey State License NJSL 80091 remain the
same.



For the State of New Jersey
Department of Environmental Protection

Date September 30, 1975

By John J. Russo

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
P.O. Box 1390, Trenton, New Jersey 08625

RADIOACTIVE MATERIALS LICENSE
Supplementary Sheet

Page 1 of 1 Pages

License Number NJSL-80091
Amendment No. 2

Rutgers, The State University
Radiation Science Center
University Heights Campus
New Brunswick, New Jersey 08903

Attention: Mr. Daniel B. Howell

In accordance with radioactive material license renewal application letter dated June 25, 1973, New Jersey State Radioactive Material License NJSL-80091 is amended as follows:

Item 4 is amended to read July 31, 1975.

All other conditions of Radioactive Materials License NJSL-80091 remain the same.

cc: J.W. Gunchel

Date August 1, 1973

For the State of New Jersey
Department of Environmental Protection

By John J. Russo /s/

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
P.O. Box 1390, Trenton, New Jersey 08625

RADIOACTIVE MATERIALS LICENSE
Supplementary Sheet

Page 1 of 1 Pages

License Number NJSL-80091
Amendment No. 1

Rutgers, The State University
Radiation Science Center
University Heights Campus
New Brunswick, New Jersey 08903

Attention: Mr. Daniel B. Howell

In accordance with radioactive material license renewal application dated July 28, 1971,
New Jersey State Radioactive Material License NJSL 80091 is amended as follows:

Item 4 is amended to read July 31, 1973.

All other conditions of Radioactive Materials License NJSL 80091 remain the same.

Date October 22, 1971

For the State of New Jersey
Department of Environmental Protection

By John J. Russo

CAUTION

Work with sources of radiation is being carried out in this area. In accordance with United States Nuclear Regulatory Commission Regulation 10 CFR 19.11, the following documents relating to the work are available to you from the researcher under whom the work is being conducted, or at the Radiation and Environmental Health and Safety Department, Building 4127, Kilmer Campus.

1. 10 CFR 19 - which describes the Nuclear Regulatory Commission Regulation pertaining to notices, instructions, and reports to workers and inspections of radiation activities.
2. 10 CFR 20 - which describes the Nuclear Regulatory Commission Standards for Radiation Protection which must be adhered to in the use of sources of radiation.
3. *Nuclear Regulatory Commission Licenses and application files:*

Rutgers NRC License Number 29-05218-28 (12/88)
Rutgers NRC License Number 29-05218-29 (12/86)
Rutgers NRC License Number 29-05218-30 (11/84)
Rutgers NRC License Number SNM-314 (12/88)
Rutgers NJ License Number 80091 (7/87)

which specify the special conditions under which radiation work must be conducted at Rutgers.

4. *Rutgers Radiation Safety Guide* - which specifies University radiation policies and procedures.
5. The University *Authorization* under which the work in this area is being conducted.

(05/84)

Attachment 3

Item 9, Facilities and Equipment

Facilities remain unchanged from time of prior application.

The current security key arrangements are described in the letter below.