



RADIATION SAFETY MANUAL 2011

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Foreward

The rules and regulations that govern the use of radiation and radioactive material on the University of Northern Iowa campus are contained in the State of Iowa Rules and Regulations on Radioactive Material, Chapter 641.38-45, and enforced by the Iowa Department of Public Health (IDPH).

This Radiation Safety Manual was prepared as a guide in administering the IDPH rules and regulations at the University of Northern Iowa. It provides specific requirements that Authorized Users will adhere to. This manual also defines the level of compliance required of individuals who wish to utilize radioactive materials or radiation-producing machines while working at the University of Northern Iowa.

The extent to which radiation safety is practiced in the laboratory depends not only on the quality of the safety related information provided, but also on the willingness of the Authorized Users to model safe practices in the laboratory. It is incumbent on every Authorized User to familiarize themselves with the contents of this manual and to follow the procedures and requirements that pertain to their specific research or teaching program.

The requirements of this Radiation Safety Manual have the authorization of the Vice President for Administration and Finance, the University's Authorized Representative. The University Safety Officer is authorized to provide oversight to the Environmental Health and Safety Office. Knowledge of and adherence to these procedures is the responsibility of every individual who utilizes radioactive materials and radiation producing devices. All users shall cooperate with the Radiation Safety Committee and the Radiation Safety Officer, who have administrative responsibilities for the radiation safety program and related issues on the University of Northern Iowa campus.

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1. GENERAL INFORMATION

INTRODUCTION

As the use of radiation emitting materials and devices has grown, so has our understanding of the potential hazards associated with their use. Concerns over the potential hazards and associated risks have led to recommendations governing the exposure limits and ultimately to strict regulatory controls governing the possession and use of all sources of ionizing radiation.

Current limits for radiation exposure are based on the conservative assumption that there is no completely safe level of exposure. Under this assumption, even the smallest exposure has some probability of causing a latent effect such as genetic damage or cancer. This assumption results in the philosophy and regulatory requirement that exposure limits be kept "As Low As is Reasonably Achievable (ALARA).

This manual contains the information and procedures that must be understood and followed in order to ensure that all uses of ionizing radiation at the University of Northern Iowa are in compliance with existing regulatory requirements and that any resultant radiation exposures are maintained ALARA.

RADIOACTIVE MATERIALS LICENSE

Possession and use of radioactive materials in the United States is governed by strict regulatory controls. The primary regulatory authority for most types and uses of radioactive materials is the federal Nuclear Regulatory Commission (NRC). More than half of the states however have entered into "agreement" with the NRC to assume control of radioactive material within their boundaries. Iowa is an "agreement state" and has given authority to the Iowa Department of Public Health (IDPH) for regulatory compliance oversight.

A license to possess and use radioactive material has been issued to the University of Northern Iowa by the IDPH. It is a class "C" restricted use license with the number 00329-1-07-RD2. As such, it requires UNI to maintain a well-managed and documented radiation protection program to ensure that radioactive materials are used safely. The license contains the information you need to use radioactive material in accordance with UNI policies and Iowa Department of Public Health regulations. Copies of the license and the Iowa Radiation Control Regulations are available for review and inspection at the Environmental Health and Safety Office.

Under the terms of the license, Authorized Users are certified by the Iowa Department of Public Health and fall under the local authority of the Radiation Safety Officer.

RADIATION-PRODUCING MACHINE REGULATIONS

Radiation-producing machines are registered in accordance with the Iowa Department of Public Health Regulations. The Radiation Safety Committee approves use of radiation-producing devices.

RADIATION SAFETY COMMITTEE

A radiation Safety Committee (RSC) has been established at the University of Northern Iowa. The RSC is responsible for ensuring that radioactive materials and radiation-producing devices are used safely and in accordance with state and federal regulations as well as Institute policies.

Membership

The Radiation Safety Committee will be composed of authorized users and technical personnel who work with radioactive materials or X-ray producing devices, including a representative of Management and a representative from each college or department that used ionizing radiation. The Radiation Safety Officer will be an ex-officio member of the RSC.

- Members will be appointed by the Department Heads from each college that uses ionizing radiation for periods of up to three years on staggered terms. Membership is limited to two terms. After two terms, the individual must step down for a period of three years before reappointment. Appointments will be based on a fiscal calendar year running from July 1 – June 30.
- A quorum will consist of a simple majority of RSC members that must include the chair person and the RSO or their proxies.
- The RSO cannot serve as chairperson of the RSC.

Responsibilities

- The RSC will meet quarterly and more often when situations arise that need attention.
- The RSC will review and approve all proposed experiments and tests utilizing radioactive material in excess of exempt quantities and exempt concentrations, and all other types of ionizing radiation on the UNI campus.
- The RSC will review and approve proposed radioactive materials and radiation producing equipment operating procedures for the UNI campus. It will also review and approve revisions to already existing procedures. Minor modifications to procedures and supporting forms which do not change the original intent of the procedure may be approved by the Radiation Safety Officer. Individuals on the RSC will serve as technical content experts providing consultation to the RSO.
- The RSC will review reportable occurrences and take appropriate action.
- The RSC will review and approve proposed changes to the ionizing radiation facilities (i.e. shielding, ventilation) pursuant to the Iowa Department of Public Health rules and regulations.
- The RSC will audit, on an biennial basis, the radiation safety program for adequacy and operational records for compliance with internal rules, procedures, regulations and license conditions. The audit results will be sent to the University Safety Officer.
- The RSC will audit radiation safety equipment performance with particular attention to operating anomalies, reportable occurrences, and the steps taken to identify and correct deficiencies on an annual basis. The audit results will be sent to the University Safety Officer.

- Minutes of the RSC meetings, including any recommendations or occurrences, shall be recorded and distributed to all committee members and the University Safety Officer. Committee minutes will also be on file in the RSO office and posted on the web.
- The RSC shall review and certify all applications for the use of ionizing radiation on the UNI campus including radioactive materials and radiation generating devices prior to sending to IDPH
- The RSC may delegate authority to the Chairperson or a Subcommittee to act in its behalf between normal meeting dates in certain matters. In such a case, at the next meeting of the RSC, the full membership shall be informed of any such action that has taken place (i.e. authorization for a new user).

RADIATION SAFETY OFFICER

The Radiation Safety Officer (RSO), works with the University Safety Office. The RSO is qualified to advise others on safety matters pertaining to ionizing radiation due to their level of education, training and experience. The RSO shall supervise and administer the radiation safety program at the University of Northern Iowa.

Responsibilities

- The RSO shall act in a supervisory/administrative capacity in all aspects of the UNI radiation safety program including maintenance of records, survey methods, waste disposal, and radiological safety practices.
- The RSO will review and recommend all activities and procedures that involve actual or potential exposure of personnel to radiation or the release of radioactive materials to the environment.
- The RSO will be available to consult with all users of ionizing radiation so as to provide advice on radiological safety matters.
- The RSO will maintain an inventory of all radioactive material sources and radiation producing equipment on the UNI campus.
- The RSO will implement a radiation survey program for the UNI campus as deemed appropriate in the interest of radiation safety. Appropriateness in this instance will be based on adherence to and compliance with Iowa Department of Public Health regulatory requirements.
- The RSO will maintain records of radiation surveys and exposures of personnel to ionizing radiation as may be required to demonstrate compliance with state and federal regulations and other industry good practices.
- The RSO will serve as a resource to Authorized Users in the training of users of radionuclides and ionizing radiation producing machines. Annual training will be provided to Authorized Users to keep current with regulations and institutional policies.

Authority

- The RSO has the authority and responsibility to interrupt or suspend any activity that involves the use of radiation if the methods and/or procedures used in such experiments in their professional opinion are deemed to be unsafe and/or contrary to regulations. This includes laboratory shut down or confiscation of materials. The Interruption/suspension will remain in effect until resolved.

- The RSO has the authority and responsibility to review and approve proposed experiments and tests utilizing exempt quantities and exempt concentrations of radioactive materials.
- The RSO has the authority and responsibility to review and approve minor changes in the Authorized user form A approvals (i.e. room changes, minor changes in procedure provided the change does not diminish radiation safety).

AUTHORIZED USER

An Authorized User (AU) is a UNI faculty or staff person who obtains written authorization from the RSO, following the initial RSC certification and approval from the Iowa Department of Public Health, to use radioactive material and/or radiation producing equipment in research, educational and service activities at UNI.

Responsibilities

- The AU is responsible for using radioactive materials in accordance with written procedures that conform to state, federal and institutional rules and regulations.
- The AU is responsible for providing specific laboratory training and familiarity with the Radiation Safety Manual to individuals working under their direct supervision to ensure the individual's personal safety.
- The AU assumes liabilities for any person under their supervision.
- The AU will maintain up-to-date inventory of the radioactive materials and radiation producing equipment for which they are responsible as well as other mandatory records (i.e. After Use Survey, Receipt of Radioactive Materials Wipe Test Survey, and Drain Disposal).
- The AU is responsible to notify the RSO in advance of any changes in the storage or use of radioactive materials or radiation-producing devices. In the case of any damage, fire, or theft of radioactive materials, the AU is responsible to notify the RSO immediately.
- The AU is responsible for preparation and holding of radioactive waste material designated for disposal. While in the laboratory, radioactive waste materials will be stored in appropriate containers. The AU is also responsible for providing the appropriate paperwork regarding radioactive waste material to the RSO at the time of waste transfer to the Waste Storage Room.
- The AU is responsible for posting appropriate radiation signs and labeling containers of radioactive materials with the standard radiation warning symbol in their laboratory area where the material is used.
- The AU will post in the laboratory area, IDPH required postings, UNI Radiation Safety rules and emergency procedures, and other notification directions as deemed necessary to assist individuals in responding appropriately to spills and other emergencies.
- The AU is responsible to continually evaluate their use of radiation to determine if it is possible to further reduce exposure to individuals (ALARA).

2. AUTHORIZATION TO USE RADIOACTIVE MATERIAL

Application for Possession and Use

Faculty members who wish to acquire and use radioactive materials must submit an *Application for Possession and Use of Radioactive Materials* form to the Radiation Safety Committee (RSC) via the Radiation Safety Officer (RSO). A personal statement of training and experience for use of radioactive material must accompany the application form for a new Authorized User (AU). Once the RSC reviews and certifies the application materials, the application materials will be forwarded to IDPH who ultimately grants AU approval.

Each application must be completed in sufficient detail for the RSC evaluation:

- Applications must include the name of the Authorized User, the radionuclide, the chemical or physical forms, the amount for use per experiment and the maximum daily order limits.
- An experiment protocol must accompany each application, describing precautions to avoid the inadvertent release or ingestion/inhalation of radioactive material.
- Name any hazardous chemicals and compounds in addition to the radionuclide that will be used in the experiment.
- The RSC may require additional information such as facility design, type of radiation detection equipment, emergency procedures, waste disposal methods, and any relevant training and experience of personnel.

Application forms "Application for Possession and Use of Radioactive Materials" are available in the University Safety Office. The Radiation Safety Officer is available to assist applicants in completing the forms.

Request for Amendment to Possession and Use of Radioactive Materials

A request for amendment to an approved application is submitted as above on the form Request for Amendment to Application for Possession and Use of Radioactive Materials available from the Safety Office. Amendment requests may be made only for the following changes:

- Chemical/physical form
- Daily order limit
- Location of use
- Use procedure

Any changes other than those listed above require submission of a new Application for Possession and Use of Radioactive Materials form.

3. PROCUREMENT AND TRANSFER OF RADIOACTIVE MATERIAL

Radioactive material may be brought onto campus only with the prior approval of the Radiation Safety Officer or the University Safety Officer.

The steps for obtaining radioactive material are outlined below:

Ordering

The Authorized User initiates the procurement process by contacting the RSO and providing the following information:

- Company
- Authorized User
- Location for delivery
- Nuclide
- Activity
- Form

The RSO will verify the type and amount of radionuclide to be ordered against the “Application for Possession and Use of Radioactive Materials” form for the Authorized User. If the two are consistent, the RSO will approve the purchase.

The same process will be applied to single purchases, establishing open orders, or for non-purchased materials (from other researchers, free samples from vendors, etc).

Upon receipt of a radionuclide shipment, the Authorized User is required to check the package and its content for contamination and to ensure that any existing radiation levels are within the regulatory requirements. A copy of the wipe test procedures and record of the wipe test must be sent to the RSO. The type and amount of material will be entered onto the RSO’s running inventory and the Authorized User’s inventory. See Appendix D for steps on how to perform a wipe test on received materials.

TRANSFER OF RADIOACTIVE MATERIALS

Any proposed transfer of radioactive materials between individuals on campus must be approved by the RSO. Off campus transfers are not allowed.

Prior approval by the RSO is required before transfers have taken place.

On-campus Transfers

Approval of a transfer of radioactive materials between individuals on the UNI campus will depend primarily upon whether the individual who wishes to receive the material has been authorized by the Iowa Department of Public Health for the type and quantity of radioactive material involved and for the specific procedures in which it will be used. If the receiving

person is not authorized to use radioactive materials, then the proper steps towards placement onto the license must be taken for this person. Only after the IDPH has approved this person will the transfer take place.

Once the transfer has taken place, the new location of the material must be documented by the new user, previous user, and the RSO.

Off-campus Transfer

Under no circumstances will off-campus transfers be allowed. All radioactive materials are strictly for on-campus use by the Authorized User licensed for the specific material. This includes any individual working under the AU.

RADIOACTIVE MATERIALS TRAINING PROGRAM

Authorized Users

Training will be required for all A.U. whom are working with radioactive materials at UNI, on an annual basis for a refresher, or when a significant change in the duties, regulations, or terms of the license occur.

New A.U. will be required to take training before starting work with radioactive materials.

The training is available on the UNI Safety Website (http://www.vpaf.uni.edu/fs/healthsafety/radia_safety.shtml) . The training involves viewing a power point presentation, watching a video, and taking a quiz. The quiz will be maintained in the A.U. file to serve as a record of the training. The Radiation Safety Manual is also available to be viewed.

Support Staff

Any worker whose duties may require them to work in the vicinity of radioactive materials, will be required to watch a video on the hazards that could occur while working around radioactivity.

4. POLICIES AND PROCEDURES FOR RADIONUCLIDE USE IN THE LABORATORY AND CLASSROOM

Postings and Marking of Areas and Equipment

“Postings” can be any number of Caution, Warning, IDPH regulations, or Lab Safety Rules provided by the RSO. See Appendix A and B for examples.

Entrance

Each laboratory or area where radioactive materials are used or stored must have posted at the entrance a CAUTION RADIOACTIVE MATERIALS sign, IDPH regulations, and Lab Safety Rules. The sign must include the name and after-hours phone number of the Authorized User. Entry warning signs are to be posted and removed only by the RSO.

Radiation Area

Areas where radiation levels might expose a person to any level of radioactivity (above background) must have the required postings.

Radioactive Material Work Areas

Areas used for work with unsealed radioactive materials must be clearly marked with CAUTION RADIOACTIVE MATERIAL tape.

Storage Areas and Containers

Refrigerators, freezers, and other “in lab” storage areas and containers in which radioactive materials are stored or transported must have a visible CAUTION RADIOACTIVE MATERIAL label. Labels should be removed from containers that are empty and not contaminated.

Equipment

Laboratory equipment (flasks, beakers, centrifuges, etc.) containing radioactive materials should be marked with CAUTION RADIOACTIVE MATERIAL tape.

Contaminated Areas and Equipment

The RSO may mark areas and equipment to indicate significant levels of contamination found during periodic surveys. These markings are to be removed only after the article or area has been decontaminated.

Other

The RSO may specify additional postings to control access or ensure safe operations.

LABORATORY SAFETY PRACTICES

Hazards associated with working with radioactive materials can be minimized through appropriate use and design of facilities and by adherence to standard safety rules and practices.

Through a number of standard procedures, practices, and rules, ALARA can be maintained in the laboratory and the classroom.

Clothing

Protective clothing will be worn when working with radioactive materials. This includes laboratory coats, gloves, and safety glasses. Sandals and bare feet will NOT be permitted in the laboratory.

Pipetting

Pipetting by mouth is extremely dangerous and will not be done under any circumstances.

Food and Cosmetics

Smoking, eating, or drinking shall not be permitted in laboratories where radionuclides are being used.

Food, beverages and their containers shall not be permitted in the laboratory or classroom.

Cosmetics will not be applied in the laboratory where radioactive materials are used or stored.

Personal Care

Do not work with unsealed radioactive materials with open cuts, sores, etc. on exposed skin areas, even if bandaged.

After handling radioactive materials, be sure to wash hands thoroughly before handling food, tobacco, etc.

Work Areas

Radionuclide work areas will be clearly designated and in so far as possible, isolated from the rest of the laboratory. Work with volatile radionuclides will be confined to a fume hood.

Practice First

Procedures involving radioactive materials should be well planned and, when unfamiliar to the user, should be practiced with non-radioactive materials.

Personnel

Persons who have not been approved for radionuclide use shall not work with or handle radioactive materials. The Authorized User is allowed to have someone working with them who is not on the license. This person must be directly supervised at all times by the AU.

Dosimeters

Dosimeters are usually not required for the radionuclides currently on the license. They can be made available for anyone who wishes to wear one. The RSO can recommend a company from which to purchase them, however, the department the AU is working under must purchase them and pay for the tests.

Container Use

All containers of radioactive materials and items suspected or known to be radioactive will be properly labeled (i.e., with a tag or tape bearing the radiation logo and the word radioactive).

To avoid spills, use metal or plastic outer trays or beakers to carry liquid radioactive materials.

Lab Surveys

Every nuclide user will perform a radiation survey at the conclusion of each procedure. All items found to be radioactive will be disposed of or cleaned properly. Any surface found to be contaminated will be labeled and decontaminated before further use.

Records

A record of the types and quantities of radionuclides possessed by each authorized user at a given time will be maintained.

RADIOACTIVE LAB REQUIREMENTS

At the University of Northern Iowa, only labs specified on the current Radioactive Materials License can be used for radioactive materials research. For certain types and uses of radioactive materials however, additional facility requirements (shielding, etc.) must be met.

The RSO must be notified prior to any use outside of these specified labs.

In general, the following are minimum facility requirements for the use of radioactive materials:

Requirements for Specified Radioactive Labs

Floors must have smooth, nonporous, easily cleaned surfaces. Appropriate floor materials include vinyl, tile, and sealed concrete.

Postings must be in a visible place on the entryway door.

Areas which will be used for radioactive materials must be marked with tape stating that radioactive materials are used in the area.

Benches must have nonporous, easily decontaminated surfaces. Surfaces of high quality polymer or stainless steel are preferred.

Sinks should be stainless steel or of seamless molded construction. Sinks must be labeled as a sink where radioactive materials are permitted to be dumped. They must also have the radioactive materials postings by them.

Hoods, when required, are preferably constructed of stainless steel or molded fiberglass. Air flow rates measured at the hood front opening must be a minimum of 75 linear feet per minute. The hoods must also have the radioactive materials postings and be ASME certified.

The ventilation rate for the entire lab should be 5 to 10 air changes per hour. The actual rate required will vary with the potential for radionuclide release to the air within the particular laboratory.

Shielding shall be provided when appropriate. Specific requirements will be determined in consultation with the RSO on a case by case basis.

Storage

When not in use, radioactive sources and stock solutions in the laboratory must be stored or shielded so that radiation levels in occupied areas will not expose persons unnecessarily. These storage areas must be locked and controlled by the A.U.

Shielding

Radiation	Shielding
Low and intermediate energy beta (H-3, C-14, S-35)	These do not usually represent an external radiation hazard and do not require shielding
High energy beta (P-32, Sr-90)	These should be shielded first with at least 1/4" thick Lucite. Lead can then be used, if necessary, to shield any bremsstrahlung x-rays produced in the Lucite.
Gamma (I-125)	These should be shielded with lead.

Contaminated Items

Any small items that become contaminated (paper, clothing, etc.) must be double bagged. Contact the RSO as soon as possible to arrange to have the bag placed in Radioactive Waste Storage.

Waste

Radioactive waste must be doubled bagged and placed in a closed, labeled container. Liquids must be kept separate from solids.

Sharps

Sharp items such as razor blades, needles, broken glass, etc., shall be placed in a suitable "sharps" container and properly labeled.

GUIDELINES FOR LABORATORY SURVEYS

Surveys of Work Areas

In order to ensure that safety rules are observed and that radioactive materials have been adequately controlled, the RSO will conduct inspections of radionuclide laboratories each *semester*. During the inspection, both external radiation levels and surface contamination levels are monitored. Also reviewed at this time are the Authorized User's radionuclide inventory, survey records, wipe test records and drain disposal records.

The Authorized user is required to survey their work areas (hoods, bench tops, sinks, floors, etc.) after each experiment and at any time there is a reason to suspect a spill or contamination incident.

Laboratories are required to keep written documentation of contamination surveys and send a copy to the RSO.

Required surveys are listed in the table below.

Type of Survey	Frequency	Performed By	Documented
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Routine survey	After each experiment and at any time there is reason to suspect a spill or contamination incident	User	Yes
Radiation Safety Survey	Every 6 months	RSO	Yes – in Safety Office
Annual Survey	Annually	RSO	Yes – in Safety Office

*Internal surveys will be required until the laboratory has had four consecutive Radiation Safety surveys with no high level contamination found.

Survey Meters

Authorized Users must use calibrated radiation survey meters for quantitative measurements in laboratories where radioactive materials are used. They must also be used for wipe tests on received materials, after use surveys, spill, and all documented incidents.

Authorized Users must know how to use the survey meters.

Recommended Instruments

RADIATION	INSTRUMENT
Low energy beta (H-3)	Liquid scintillation counter for wipe surveys
Intermediate energy beta (S-35, C-14, P-33)	G-M survey meter; Liquid scintillation counter for wipe surveys
High energy beta (P-32, Sr-90)	G-M survey meter.
Low energy gamma (I-125)	Liquid scintillation counter or gamma counter for wipe surveys.
High energy gamma (Co-60)	G-M survey meter

Location of G-M counters

Meter /Model #	Location
Victoreen 1700	CEE 18

#190	
Ludlum 161377 PR165357	PPL
Civil Defense	MSH 168A
Ludlum 185423 PR191122	MSH 168A
Ludlum 141009 PR144883	MSH 060A
Civil Defense	CEE 018
Civil Defense	CEE 018
Ludlum Model 3 209036	MSH 277

Maintenance of Meters

The RSO will coordinate the calibration of survey meters, check for proper operation, and replace weak or defective batteries every 12 months. If meter needs repairs, the A.U. is responsible for having it repaired. If new batteries are needed prior to the 12 months, the department is responsible for purchasing and installing new batteries.

It is the Authorized User's responsibility to make the meters available and to obtain any other servicing or repairs necessary to keep the meters operational.

CONTROL OF RADIOACTIVE MATERIAL

Radioactive Materials Controls

Authorized Users are only allowed to use materials on application as approved by the RSC. Materials must not be loaned or transferred to persons not named on the license. Transfer to a person named on the license must be approved for use by the RSC and reported to the RSO. It must also comply with use described on the application submitted to the RSC. An amendment to the license must be made *before* any changes take place.

Loss or Damage

The loss, disappearance, or damage of radioactive materials or radiation sources must be reported to the RSO *immediately* upon discovery. The RSO is responsible for the notification of the IDPH.

Inventory

The RSO maintains the campus running inventory of all incoming and outgoing shipments of radioactive materials, including waste.

Semi-Annual Report by Authorized User

Each Authorized User is required to report every 6 months the amount of radioactive material on hand.

DISPOSAL PROCEDURES

Radioactive Waste Disposal Procedures

The RSO is responsible for the storing and maintaining of all radioactive waste generated at the University of Northern Iowa. In order to facilitate this process, Authorized Users are required to follow a number of specific procedures regarding radioactive waste generated in their laboratories.

Preparing for Pick-Up

To dispose of radioactive waste, pick-up must be coordinated with the RSO. Preparation includes:

- Test the container for exterior contamination.
- Seal all containers properly.
- Disinfect any waste that contains biological, pathogenic, or infectious materials with a biocide prior to pick-up

Separation by Isotope

Radioactive waste will be separated and labeled according to isotope. The RSO will determine the half-life and further categorize the waste.

Liquids

An Authorized User may dispose of liquid waste IF a time period of 10 times the Half-Life has passed. If this amount of time exceeds 24 hours, then the RSO will be called to coordinate storage of the liquid containers. The containers are to be double bagged prior to placement in storage. The liquid will then be placed in the Waste Storage Area until the 10 times the Half-Life period has passed.

The liquids need to be identified by isotope and if biodegradable or hazardous waste.

All drain disposal must be limited to a designated radioactive materials drain. Drain must be approved by the RSO and posted as to which isotope is being dumped.

Any drain disposal of radioactive materials must be documented on the Drain Disposal Log indicating the isotope, AU, and the date of disposal.

Solid Waste

Solid waste should be double bagged and labeled according to isotope. The RSO should be called to coordinate storage of radioactive materials. All radioactive material will be stored for 10 times the half life or until alternative disposal is contracted.

Mixed Hazardous/Radioactive Waste

Radioactive waste containing any hazardous chemicals requires special handling. The RSO must be consulted *before* any such waste is stored.

Storage of Radioactive Waste

The RSO has sole access to the storage room for radioactive waste. The RSO is also responsible for organizing the waste into short-lived and long-lived radionuclides. The purpose of this storage is to allow time for the decay of waste containing short-lived radionuclides and to facilitate the proper disposal of all radioactive waste.

Scintillation Vials

All scintillation vials must be kept for 10 times the half-life of the isotope. They must be capped and labeled according to their isotope. If 10 times the half-life is longer than 24 hours, the RSO must be called and the vials will be double bagged and placed in waste storage.

5. RADIATION DOSE STANDARDS AND PERSONNEL MONITORING

Radiation Dose Standards

Permissible occupational radiation dose levels are set by the Iowa Department of Public Health, and are available in the "IDPH Research and Development, Laboratory, and Industrial Use of Small Quantities of By-Product Material Regulatory Guide", Appendix A.

Current limits for occupational radiation exposure have been established at levels which, in light of present knowledge, should prevent all acute radiation effects (e.g., erythema, epilation); and limit the risks of late effects such as cancer or genetic damage to very low, "acceptable" levels. Table 1 provides a summary of exposure limits.

Table 1

**Limits for Occupational External Exposures to Ionizing Radiation
Investigation Levels (mrems per month)**

	Level 1	Level 2
Whole body; head and trunk; active blood forming organs; gonads	200	400
Skin of whole body, extremities	2000	4000
Lens of eye	600	1200

Minors

Radiation dose limits for radiation workers under the age of 18 are 10 % of those listed above for adult workers.

Pregnancy

The human embryo and fetus are particularly susceptible to damage from ionizing radiation. The National Council on Radiation Protection and Measurement (NCRP) recommends that the whole body dose received by a female worker during the 9 months of her pregnancy not exceed 500 mrem (one-tenth of the normal occupational dose limit).

If a woman is a radiation worker, she must be instructed of her rights as far as pregnancy is concerned. A woman has the right to declare, undeclared, or not to declare if she is pregnant.

Declared Pregnancy

The pregnancy, if chosen to declare, must be declared in *writing* to her employer or the licensee (if her employer is not the licensee) and a copy to the RSO. In this case, she will be assigned a fetal dosimeter or temporarily assigned to a different job.

The dose limit for the embryo/fetus of a declared pregnant worker is 500 mrem over the course of the pregnancy, with no deviation above 50 mrem in any month.

Undeclared Pregnancy

The woman has the right to undeclare a declared pregnancy at any time if she no longer wants the pregnancy considered for employment (job assignments) or dose reduction purposes. In which case, the reduced fetal dose will not apply.

Not Declaring a Pregnancy

Alternatively, she may choose not to declare her pregnancy at all, in which case the reduced fetal dose limit would not apply.

Members of the Public (MOP)

Anyone entering the area where radioactive materials are being used or stored who is NOT on the license, is considered a Member of the Public and must be discouraged from entry.

The dose limits for MOP are 100 mrem per year or 2 mrem per hour.

The Authorized User is responsible for any MOP coming into the area. Access must be restricted to the AU, RSO, and anyone supervised by the A.U.

ALARA GUIDELINES

In practice, radiation doses should be *As Low As Reasonably Achievable*. ALARA is a guideline meant to strike a balance between the cost of radiation protection and the health benefit derived from that protection.

It is the responsibility of everyone including radiation workers, Authorized Users, the RSC, and the RSO to operate within the ALARA guideline. This is achievable by outlining safety procedures for radiation environments and by monitoring the workplace environment to control contamination and minimize doses.

NON COMPLIANCE

In the case of non-compliance with radionuclides or radiation producing machines, the RSO has the right to take immediate action if conditions warrant. The misuse of radionuclides or equipment will be reported to the RSC to determine the consequences to the Authorized User at fault.

6. RADIATION PRODUCING MACHINES

General Definitions

Radiation Producing Machine: any device capable of producing ionizing radiation when the associated control devices are operated, except devices which produce radiation only by the use of radioactive material.

Enclosed System: A radiation producing machine which satisfies the requirement that all areas with exposure rates greater than 0.25 mR/hr are enclosed within an interlocked barrier.

Open Systems: Any other radiation producing machine that does not fit the definition for an enclosed system. Examples are x-ray diffraction and radiography units, particle accelerators, electron microscopes, tokamaks, and high voltage rectifiers operating above 10kV.

Regulation

Use of radiation producing machines is regulated by the Iowa Department of Public Health.

Regulations can be found on the IDPH website at: http://www.idph.state.ia.us/eh/radiological_health.asp

Registration

Radiation producing machines must be registered with the IDPH and a registration fee paid.

The RSO must be notified of the acquisition, transfer, or disposal of any radiation producing machine. Some machines may be exempt from registration. The IDPH will make that determination.

APPLICATION FOR USE

Notify the Safety Office

The Safety Office is responsible for verifying location and condition of all radiation producing machines on campus.

Fill Out the Forms

The forms can be found on the IDPH website: http://www.idph.state.ia.us/eh/xray_machines.asp

The Department in which the radiation producing machine(s) will be used is responsible for registration and fees. The IDPH has the right to refuse to register any machine, in which case, the machine cannot be plugged in and used.

During this process, the RSO can be used as a resource for any help needed in filling out the forms. However, the RSP is not responsible for filling out the forms.

Approval

Upon approval, the IDPH will send an original Certification of Annual Registration to the RSO which is forwarded to the department.

An annual list which includes all certified Radiation Producing Equipment with the associated fees will be sent to the Environmental Health and Safety Office. The RSO will verify the equipment location and condition. The fees are distributed to the responsible departments, and the departments send a check to the Office of Business Operations (OBO). OBO then sends the check to the IDPH.

Inspection

An annual inspection and location verification of the radiation producing machine will be performed by the RSO in order to check that all policies and procedures are being followed.

Any deficiencies or discrepancies will be addressed by the RSO and department prior to recertifying the equipment.

POLICIES AND PROCEDURES FOR THE USE OF RADIATION PRODUCING MACHINES

Authorized Users

Only Authorized Users or students working with direct supervision by the Authorized User are allowed to use the radiation producing machines. The Authorized User is the individual listed on the registration.

Training Requirements

The Authorized User is responsible for training anyone working directly under them. These individuals must satisfactorily demonstrate knowledge of operating and safety procedures while operating any radiation producing machine.

Access Control

Key control must be maintained for each machine. For older machines which do not have a keyed control device, this requirement may be fulfilled by controlling access to the laboratory.

While any open system is in operation, an operator must be present or the laboratory must be kept locked.

Emergency Procedures

The department is responsible for any emergency associated with radiation producing machines.

NON COMPLIANCE

In the case of non-compliance with radionuclides or radiation producing machines, the RSO has the right to take immediate action if conditions warrant. The misuse of radionuclides or equipment will be reported to the RSC to determine the consequences to the Authorized User at fault.

Appendix A: IDPH Posting for Employees

INTRODUCTION

During the course of routine operations, radioactive material may be spilled resulting in contamination of personnel or lab equipment and areas. Corrective action taken during such an incident can prevent unnecessary doses to personnel and further spread of contamination.

The IDPH has promulgated the radiation producing machines and radioactive materials rules to set standards for your protection against radiation hazards and has established procedures for you, the employee, to report any suspected items of noncompliance in an Iowa licensed or registered facility.

WHAT RESPONSIBILITY DOES MY EMPLOYER HAVE?

Any company that conducts activities licensed or registered by the IDPH must comply with the IDPH requirements. If a company violates the IDPH requirements, it can be fined or have its license modified, suspended, or revoked.

Your employer must tell you which IDPH radiation requirement apply to your work and must post IDPH Notices of Violation involving radiological work conditions.

WHAT IS MY RESPONSIBILITY?

For your own protection and the protection of your co-workers, you should know how the IDPH requirements relate to your work and should obey them. If you observe violations of the requirements or have a safety concern, you should report them.

WHAT IF I CAUSE A VIOLATION?

If you are engaged in deliberate misconduct that may cause a violation of the IDPH requirements, or would have caused a violation if it had not been detected, or deliberately provided inaccurate or incomplete information to either the IDPH or to your employer, you may be subject to an enforcement action. If you report such a violation, the IDPH will consider the circumstances surrounding your reporting in determining the appropriate enforcement action, if any.

HOW DO I REPORT VIOLATIONS AND SAFETY CONCERNS?

If you believe that violations of IDPH rules or the terms of the license have occurred, or if you have a safety concern, you should report them immediately to your supervisor. You may report violations or safety concerns directly to the IDPH. However, the IDPH encourages you to raise your concerns with the licensee or registrant because they have primary responsibility and are most able to ensure safe operation of regulated facilities. If you choose to report your concern directly to the IDPH, you may report concerns to an IDPH inspector, call or write the IDPH at the address indicated below. If you send your concern in writing, it will assist the IDPH in protecting your identify if you clearly state that you have a safety concern or that you are submitting an allegation.

WHAT IF I WORK WITH RADIOACTIVE MATERIAL OR IN THE VICINITY OF A RADIOACTIVE SOURCE?

If you work with radioactive materials or near a radiation source, the amount of radiation exposure that you are permitted to receive is limited by the IDPH regulations. The limits on your exposure are contained in Iowa Department of Public Health Radiation Machine and Radioactive Materials Rules 641 Chapter 40. While these are the maximum allowable limits, your employers should also keep your radiation exposure “as low as reasonably achievable” (ALARA).

MAY I GET A RECORD OF MY RADIATION EXPOSURE?

Yes. Your employer is required to advise you of your dose annually if you are exposed to radiation for which monitoring was required by the IDPH. In addition, you may request a written report of your exposure when you leave your job.

HOW ARE VIOLATIONS OF IDPH REQUIREMENTS IDENTIFIED?

The IDPH conducts regular inspections at licensed and registered facilities to assure compliance with IDPH requirements. In addition, your employer and site contractors conduct their own inspections to assure compliance.

MAY I TALK WITH AN IDPH INSPECTOR?

Yes. The IDPH inspectors want to talk to you if you are worried about radiation safety or have other safety concerns about regulated activities, such as the quality of construction or operations at your facility. Your employer may not prevent you from talking with an inspector. The IDPH will make all reasonable efforts to protect your identity where appropriate and possible.

MAY I REQUEST AN INSPECTION?

Yes. If you believe that your employer has not corrected violations involving radiological working conditions, you may request an inspection. Your request should be addressed to the IDPH and must describe the alleged violation in detail. You or your representative must sign it.

CAN I BE FIRED FOR RAISING A SAFETY CONCERN?

Federal law prohibits an employer from firing or otherwise discriminating against you for bringing safety concerns to the attention of your employer or the IDPH. You may not be fired or discriminated against because you:

- Ask the IDPH to enforce its rules against your employer.
- Refuse to engage in activities which violate IDPH requirements.
- Provide information or are about to provide information to the IDPH or your employer about violations of requirements of safety concerns.
- Are about to ask for, testify at, help, or take part in an IDPH, state or federal proceeding.

WHAT FORMS OF DISCRIMINATION ARE PROHIBITED?

It is unlawful for an employer to fire you or discriminate against you with respect to pay, benefits, or working conditions because you help the IDPH or raise a safety issue or otherwise engage in protected activities. Violations of Section 211 of the Energy Reorganization Act (ERA) of 1974 include actions such as harassment, blacklisting, and intimidation by employers of; (i) employees who bring safety concerns directly to their employers or to the IDPH (ii) employees who have

refused to engage in an unlawful practice, provided that the employee has identified the illegality to the employers; (iii) employees who have testified or are about to testify in any federal or state proceeding regarding any provision (or proposed provision) of the ERA or the Atomic Energy Act (AEA) of 1954; (iv) employees who have commenced or caused to be commenced a proceeding for the administration or enforcement of any requirement imposed under the ERA or AEA or who have, or are about to testify, assist, or participate in such a proceeding.

HOW DO I FILE A DISCRIMINATION COMPLAINT?

If you believe that you have been discriminated against for bringing violations or safety concerns to the IDPH or your employers, you may file a complaint with the IDPH or U.S. Department of Labor (DOL). If you desire a personal remedy, you must file a complaint with the DOL pursuant to Section 211 of the ERA. Your complaint to the DOL must describe in detail the basis for your belief that the employer discriminated against you on the basis for your belief that the employer discriminated against you on the basis of your protected activity, and it must be filed in writing either in person or by mail within 180 days of the discriminatory occurrence. Additional information is available at the DOL web site at www.osha.gov. Filing an allegation, complaint, or request for action with the IDPH does not extend the requirements to file a complaint with the DOL within 180 days. You must file the complaint with the DOL. To do so, you may contact the

Department of Labor
City Center Square
1100 Main Street, Suite 800
Kansas City, MO 64105
(816) 426-5866

WHAT CAN THE DEPARTMENT OF LABOR DO?

If your complaint involves a violation of Section 211 of the ERA by your employers, it is the DOL, NOT THE IDPH, that provides the process for obtaining a personal remedy. The DOL will notify your employer that a complaint has been filed and will investigate your complaint.

If the DOL finds that your employer has unlawfully discriminated against you, it may order that you be reinstated, receive back pay, or be compensated for any injury suffered as a result of the discrimination and be paid attorney's fees and costs.

Relief will not be awarded to employees who engage in deliberate violations of the Energy Reorganization Act or the Atomic Energy Act.

WHAT WILL THE IDPH DO?

The IDPH will evaluate each allegation of harassment, intimidation, or discrimination. Based on the evaluation, the IDPH will decide whether to pursue the matter further through an investigation. The IDPH may not pursue an investigation to the point that a conclusion can be made as to whether the harassment, intimidation, or discrimination actually occurred. However, if you have filed a complaint with the DOL, the IDPH will monitor the results of the DOL investigation.

If the IDPH or the DOL finds that unlawful discrimination has occurred, the IDPH may issue a Notice of Violation to your employers, impose a fine, or suspend, modify, or revoke your employer's IDPH license.

APPENDIX B: RADIATION SAFETY LABORATORY RULES AND EMERGENCY PROCEDURES

1. Smoking, eating or drinking shall not be permitted in radionuclide laboratories.
2. Food or food containers shall not be permitted in the laboratory and refrigerators shall not be used for common storage of food and radioactive materials.
3. Radionuclide work areas shall be clearly designated and should, to the extent possible, be isolated from the rest of the laboratory. The work area shall be within a hood if the radioactive material to be used is in a highly volatile form.
4. All work surfaces shall be covered with absorbent paper which should be changed regularly to prevent the buildup of contamination.
5. Work involving relatively large volumes or activities of liquid radioactive materials should be performed in a spill tray lined with absorbent paper.
6. Protective clothing shall be worn when working with radioactive materials. This includes laboratory coat, gloves and safety glasses (when working with liquids which could be hazardous to the eyes).
7. Dosimeters shall be worn when working with relatively large quantities of radionuclides which emit penetrating radiations.
8. Mouth pipetting shall not be permitted in radionuclide laboratories.
9. All containers of radioactive materials and items suspected or known to be contaminated shall be properly labeled (i.e., with tape or tag bearing the radiation logo and the word "radioactive").
10. All contaminated waste items shall be placed in a container specifically designated for radioactive waste. Sharp items such as needles or razor blades shall be placed in a cardboard box, glass bottle, or "sharps" container.
11. A radiation survey shall be performed by the radionuclide user at the end of each procedure involving radioactive materials. All items found to be contaminated shall be placed either in the radioactive waste container or an appropriately designated area. Any surfaces found to be contaminated shall be labeled and decontaminated as soon as possible. EH&S shall be notified immediately if extensive contamination is found within the laboratory.
12. A record of the types and quantities of radionuclides possessed by each principal investigator at a given time shall be maintained.

EMERGENCY PROCEDURES

Minor Spills

Incidents involving the release or spillage of less than 100 microcuries of a radionuclide in a nonvolatile form can generally be regarded as minor. In such cases:

1. Notify all other persons in the room at once.
2. Clear the room of all persons except those needed to deal with the spill.
3. Confine the spill immediately.
 - Liquids: Drop absorbent paper or chemical (e.g., calcium bentonite) on the spill. EH&S has prepared standard "Spill Control Kits" which are available from Chemistry Stores.
 - Solids: Dampen thoroughly, taking care not to spread contamination. Use water, unless a chemical reaction would release air contaminants; otherwise use oil.

4. Notify the laboratory supervisor.
5. Notify UNI Public Safety, 273-2712.

Major Spills

Incidents which occur outside of the hood and involve the release of more than 100 microcuries of a radionuclide in a nonvolatile form, or the release of any amount of a radionuclide in a volatile form, should be considered "major." In such cases:

1. Evacuate the room immediately shutting doors and windows on the way out.
2. Notify the laboratory supervisor.
3. Notify the Radiation Safety Officer. Phone: 273-3445/ cell phone 319-230-6315.
4. Post the laboratory door with a "Keep Out" sign.
5. Assemble those persons who were present in the laboratory near the laboratory entrance.
6. Wait for assistance.

APPENDIX C: Wipe test procedures

1. Make a list of all sources to be tested. This should include at least the isotope, the activity on a specified date, and the physical form.
2. If you will be testing sources stronger than a few millicuries, set out a survey meter, preferably with a speaker, so you can monitor your exposure rate.
3. Prepare a separate wipe sample for each source. A cotton swab, injection prep pad, filter paper, or tissue paper is suitable. Number each wipe so you will know for which source it is to be used. Samples should be taken as follows:
 - a. For small sealed sources, it may be easier to wipe the entire accessible surface area. Pay particular attention to seams and joints. However, do not wipe the port of beta applicators.
 - b. For larger sealed sources and devices (survey meter calibrator), take the wipe near the radiation port and on the activating mechanism.
 - c. If you are testing radium sources, they should also be checked for radon leakage. Submerging the source in a vial of fine-grained charcoal or cotton for a day can do this. Then remove the source and analyze the absorbent sample as described below. A survey should be done to be sure that sources are adequately shielded during the leak-test period.

Analysis

Analysis of the samples is as follows:

1. Select an instrument that is sufficiently sensitive to detect the levels appropriate for the isotope being tested. For beta sources, a proportional flow counter, liquid scintillation counter, or thin-end window GM survey meter may be appropriate. For gamma sources, a GM instrument or a scintillation detector with a rate meter or scaler may be appropriate. Dose calibrators used in nuclear medicine are not sufficiently sensitive.
2. To estimate the detection efficiency of the analyzer used to assay the wipe samples, assay a certified check source that has the same isotope as the sealed source. If one is not available, it will be necessary to use a certified check source with a different isotope that has a similar spectrum. If calculations demonstrate that the instrument is not sufficiently sensitive to detect 0.005 microcurie for beta or gamma emitters or 0.001 microcurie for alpha emitters, a different instrument must be used.
3. Assay the wipe sample. It must be in the same geometry relative to the detector as was the certified check source.
4. Record the wipe sample in counts per minute. Then calculate and record the estimated activity in microcuries on the wipe sample.
5. Continue the same analysis procedure for all wipe samples.

6. If the wipe sample activity is 0.005 microcurie or greater, notify the RSO. The source must be withdrawn from use to be repaired or disposed of in accordance with IDPH rules.

7. Record model number and serial number (if assigned) of each source tested, radionuclide and estimated activity, measured activity of each test sample in microcuries, description of method used to test each sample, date of test, and signature of RSO. Maintain records for five (5) years.

APPENDIX D: Safely Opening Packages Containing Radioactive Materials

1. All shipping packages received and known to contain radioactive material must be monitored for radiation levels and radioactive surface contamination according to 40.65.
2. The following procedure for opening each package will be followed:
 - a. Put on gloves to prevent hand contamination
 - b. Visually inspect the package for any sign of damage (e.g., wet or crushed). If damage is noted, stop the procedure and notify the RSO.
 - c. Measure the exposure rate from the package at one meter. If it is in excess of 10 millirems per hour at 3 feet, stop and notify the RSO. (The “transport index” noted on packages with “yellow II” or a “yellow III” label is the approximate dose rate, in millirem per hour, at one meter from the package surface.)
 - d. Measure the dose rate on the surface of the package. The surface dose rate for such packages should not exceed 200 millirem per hour at any point on the package. The dose rate from packages with “white I” labels should be less than 0.5 millirem per hour on the external surface of the package.
 - e. Wipe the external surface of the package, approximately 300 square centimeters in the most appropriate location to detect contamination. The amount of radioactivity measured on any single wiping material when averaged over the surface wiped, must not exceed the following limits:
 - Beta-gamma-emitting radio nuclides;
all radio nuclides with half-lives less than ten days.....22 dpm/cm².
 - All other alpha-emitting radio nuclides.....2.2 dpm/cm²
 - f. Open the package with the following precautionary steps:
 - 1) Remove the packing slip
 - 2) Open outer package following the supplier’s instructions, if provided.
 - 3) Verify that the contents agree with the packing slip.
 - 4) Check the integrity of the final source container. Look for broken seals or vials, loss of liquid, condensation, or discoloration of the packing material.
 - 5) If anything is other than expected, stop and notify the RSO.
 - g. If there is any reason to suspect contamination, wipe the external surface of the final source container and remove the wipe sample to a low-background area. Assay the wipe sample to determine if there is any removable radioactivity.
 - h. Check the user’s request to ensure that the material received is the material that was ordered.
 - i. Before discarding the packing material and the empty packages, monitor for contamination with a radiation survey meter.

- 1) If contaminated, treat this material as radioactive waste.
- 2) If not contaminated, remove or obliterate the radiation labels before discarding it.

j. Make a record of the receipt.

