RADIATION USERS' SAFETY TRAINING

PURPOSE

This procedure prescribes the training in radiation protection required for all individuals who may be exposed to ionizing radiation in the course of their official duties. The content and frequency of training sessions are specified for each category of radiation user.

POLICY

Regulations governing the possession and use of radioactive materials and other radiation sources require that every individual working with or in the presence of such sources be instructed in the applicable provisions of regulations and license conditions, in the potential health problems associated with exposure to radiation, in the precautions and procedures required for safe use of radiation, and in the proper use of protective and measurement devices. The extent of the training is to be commensurate with the potential risk of radiation exposure to the individual.

The primary responsibility for providing adequate training for individuals who work routinely with radiation sources rests with the responsible user. For individuals who are only occasionally exposed to radiation, e.g. most nurses, housekeeping, maintenance, security and delivery personnel, the responsibility for training lies with their supervisors. Generally, the responsible user or supervisor will fulfill this responsibility by assuring that each person attends the appropriate training program offered by the Radiation Safety Officer (RSO). The supervisor or responsible user may also provide the training and submit a statement to the RSO listing the individuals trained and the content of the training.

The RSO is responsible for developing, conducting and documenting training on radiation protection applicable to all categories of radiation users. For each category of users, the RSO shall establish an appropriate schedule or frequency and the minimal requirements for content of the program. The RSO shall maintain appropriate records of training offered and completed to assure compliance with regulatory requirements.

TRAINING CONTENT

All minimally exposed personnel shall be instructed on specific conditions that could involve exposure, and proper procedures for avoiding unnecessary exposure. Such instruction shall include:

- The nature and risks of exposure to ionizing radiation.
- Recognition and meaning of radiation warning signs.
- Precautions for avoiding unnecessary radiation exposure.
- Who to call for information or assistance on radiation exposure situations.
- Responsibilities and rights of individual employees.

All normally exposed radiation users shall receive instruction on the following topics:

- Characteristics of radiation sources.
- Interaction of radiation with matter.
- Radiation detection and measurement.
- Biological effects and risk estimates.
- Risks to the unborn and control of prenatal exposure.
- ALARA principle; optimizing radiation protection.
- Proper use of protective devices.
- Provisions of regulations and licenses.
- Response to radiation emergencies.
- Responsibilities and rights of radiation users.
- Availability of monitoring and inspection reports.

Radioisotope users shall also receive instruction on:

- Safe handling and storage of radioactive materials.
- Procedures for monitoring both internal and external exposures.

Users of x-ray machines with accessible beams, including users of special radiographic or

fluoroscopic procedures, shall also receive instruction on:

- Effects of machine attributes and usage on patient dose.
- Source and intensity of scattered radiation.
- Proper use of gonadal shielding.

Users of analytical x-ray machines with completely enclosed beams, shall receive instruction on proper use of shutters, interlocks and other safety devices, and on the requirement for a safety survey following any modification or repair.

TRAINING FREQUENCY AND RECORDS

Normally exposed radiation users are required to receive training prior to beginning work with radiation sources. Training received at another institution may be acceptable if it fulfills current requirements. The RSO establishes procedures for verifying and accepting training received elsewhere and may require taking a written examination. The documentation of prior training is retained in the permanent radiation user file for the individual.

Minimally exposed radiation users and others who may occasionally encounter radiation sources, are offered radiation safety training periodically based on group needs. Training records for these personnel are retained in the form of attendance sheets listing the name of the group, the date, the instructor, any handout materials used and the attendees.

REFERENCES

National Council on Radiation Protection and Measurements, *Operational Radiation Safety - Training*, NCRP Report No. 71, 1983.

U.S. Nuclear Regulatory Commission:
Notices, Instructions, and Reports to Workers; Inspections, 10 CFR 19.

Instruction Concerning Risks from Occupational Radiation Exposure, Regulatory Guide 8.29, Rev. 1, Feb. 1996.

- Placement of dosimeters for monitoring partial-body exposures.
- Proper use of special shielding devices.

Instruction Concerning Prenatal Radiation Exposure, Regulatory Guide 8.13, Rev. 2 Dec. 1987.

Utah Division of Radiation Control, *Notices, Instructions and Reports to Workers by Licensee or Registrant - Inspections*, Utah Radiation Control Rules, R313-18.

ATTACHMENTS

"RADIOISOTOPE USERS TRAINING OUTLINE" is for all radioisotope users; separate handout materials are identified in the outline.

"RADIATION SAFETY TRAINING ATTENDANCE RECORD" is for recording group training.

"BASICS OF RADIATION protection" is a handout for groups of minimally-exposed personnel that don't need the entire Radiation Safety Policy Manual.

"RADIATION PROTECTION IN CARDIOLOGY AND OTHER SPECIAL FLUOROSCOPIC PROCEDURES" is a handout used together with "BASICS ..." for cardiology fellows.

"RADIATION SAFETY FOR NURSES AND THERAPISTS" is a handout used together with "BASICS ..." for nurses and occupational therapists.

"RADIATION SAFETY FOR EMERGENCY RESPONSE PERSONNEL" is a handout for fire fighters, police and security officers, and emergency medical teams.

"RADIATION SAFETY FOR CUSTODIANS AND HOSPITAL ENVIRONMENTAL SERVICES" is a handout used for periodic training of custodians and housekeeping personnel.

"RADIATION SAFETY FOR RECEIVING PERSONNEL" is a handout used for personnel who handle packages of radioactive materials.

RADIOISOTOPE USERS TRAINING OUTLINE

Radiation users are encouraged to study the handout materials for this training, available from the RSO at any time.

RADIATION SOURCES AND INTERACTIONS

(80-minutes introduction, handouts, and lecture)

- Basic definitions; energy units
- Interactions of charged particles (electrons) with matter
- Electron ranges and bremsstrahlung production
- Interactions of photons with matter
- Half-value layers for photons
- Radioactive decay modes and emissions
- Radioactivity units
- Radioactivity calculations; decay constant, half-life
- Units of radiation exposure and dose
- Common sources of radiation exposure, natural and manmade

BIOLOGICAL EFFECTS AND RISK FACTORS

(40-minute lecture)

- Sources of information on radiation effects and risks
- Deterministic (non-stochastic) effects of radiation
- Probabilistic (stochastic) effects of radiation
- Somatic vs. genetic effects of radiation
- Dose-response models; linear, non-threshold model
- Risk projection models; absolute and relative

PRINCIPLES OF RADIATION PROTECTION

(50-minute lecture)

- Justification of practices producing radiation exposures
- Optimization of radiation protection (ALARA)
- Individual dose limits; annual limits based on lifetime risk
- Comparison of radiation risks with other common risks
- External radiation dose limits
- Annual limits on intake (ALI)

CONTROL OF RADIOACTIVE MATERIALS

(60-minute lecture, video presentation, and demonstrations)

- Planning experimental procedures
- Preparation and use of fume hoods; checking air flow
- Contamination control; secondary containment
- Proper wearing of gloves, lab coats and monitoring devices
- Proper use of survey instruments; wipe tests for contamination
- Opening and surveying packages; recording changes to inventory
- Response to radiation emergencies, e.g. spills, injuries, etc.

INDIVIDUAL EXPOSURE MONITORING

(50-minutes lecture with visual aids from RPR's)

- Criteria for exemption from individual monitoring based on potential exposure
- Calculating potential external exposures
- Bioassay intervals determined by ALI and metabolism of nuclides
- Bioassay measurements, screening and verification
- Bioassay exemption based on absence of contamination
- Confidentiality of dosimetry records and rights of individuals

ADMINISTRATIVE REQUIREMENTS

(40-minute lecture with visual aids from RPR's)

- Organization: radiation safety committee, RSO
- Radiation Safety Policy Manual and procedures
- Responsible user definition and responsibilities
- Procurement and security of radioactive materials
- Radioactive material inventory and disposal records
- Waste segregation and labeling

EXAMINATION

(multiple-choice and True False; 40 minutes)

RADIATION SAFETY TRAINING ATTENDANCE RECORD

Group: **Date:**

Instructor:

_____

Handout:

On this date, the undersigned attended radiation safety training, received the listed handout material and were given an opportunity to ask questions pertaining to radiation risks and protection. Please provide the Responsible User Number (RU) for the individual in charge of your laboratory, your name, department, and phone #.

RU Number / PRINT YOUR NAME LEGIBLY	DEPARTMENT / Phone #

BASICS OF RADIATION PROTECTION

RADIATION PROTECTION POLICIES

Ionizing radiation is capable of producing biological effects that are detrimental to health. For the purpose of establishing radiation control standards, a hypothesis is used which assumes that any radiation dose, no matter how small, could produce some deleterious effect. The purpose of a radiation safety program is to prevent unnecessary radiation exposures, and to control those exposures that are unavoidable.

Each person who is exposed to radiation shall be informed of the risks and of appropriate protection methods, and must accept personal responsibility for using the available protection.

RADIATION-INDUCED HEALTH EFFECTS

Health effects from exposure to ionizing radiation may be deterministic (predictable for an individual) or stochastic (random in an exposed population, but unpredictable for an individual).

Deterministic effects may be observed in an exposed individual when a relatively large radiation dose, exceeding a threshold value, is received in a rather short time. A dose smaller than the threshold value will not produce the effect. Once the threshold dose for a particular effect is exceeded, the effect is almost sure to occur, but the severity of the effect is proportional to the dose.

Stochastic effects are those that may occur randomly in an exposed population, usually after a long latent period. Since these effects cannot be distinguished from those that occur naturally in an unexposed population, the cause-and-effect relationship can only be demonstrated on a statistical basis. For these effects it is assumed that there is no threshold dose and that the probability of occurrence is proportional to the dose. This assumption is often referred to as the linear no-threshold model of dose response, or LNT. It is important to note, however, that for low doses typically encountered in the occupational setting (<5000 millirem per year), neither the existence nor the absence of a threshold has been shown. It is known that the severity of stochastic effects, if they occur, are independent of the dose.

RADIATION DOSES AND RISKS

Radiation doses are normally specified in units of **millirems (mrem) effective dose equivalent**. The effective dose equivalent is the dose to the whole body from penetrating x rays that would impart the same lifetime risk of detrimental health effects as the sum of actual doses to all tissues and organs of the body from all types of ionizing radiation.

In the U.S., the annual average dose from cosmic rays and other natural sources is 100 mrem, the effective dose from radon in homes is 200 mrem, medical examinations contribute an average of 53 mrem and consumer products and other manmade sources deliver another 9 mrem, for a total of approximately 360 mrems per year. In Utah, because of increased cosmic radiation and greater concentrations of radioactive minerals in the ground, the **average annual effective dose is more than 400 mrem**.

The risk of fatal cancer from all causes, averaged over the entire U.S. population, is approximately 1 in 4, or 25%. It is recognized, however, that certain sub-groups, e.g. smokers or residents of large cities, have cancer risks that are above average while other groups have risks that are below the average. For most stochastic effects, a given dose of radiation is believed to add a constant fraction to the baseline risk.

A non-occupational dose-rate of 400 mrem per year for 70 years is estimated to contribute approximately 1.4% to the baseline risk. Most radiation users receive occupational doses of much less than 400 mrem per year. An additional dose

of 400 mrem per year for 20 years would increase the baseline risk by 0.4%.

PRINCIPLES OF RADIATION PROTECTION

Two basic principles apply to every individual that may be exposed to radiation:

1 all radiation doses are to be kept **as low as reasonably achievable (ALARA)**, and

2 no dose to an individual shall be allowed to exceed the appropriate **individual dose limit**.

The **ALARA** principle is applicable even when the potential dose is well below the individual dose limit because it is assumed that some risk is associated with any dose of radiation, no matter how small. ALARA requires balancing of the benefits of dose reduction against social needs and economic considerations.

Dose limits are intended to limit the individual's lifetime risk of stochastic effects from small chronic exposures as well as to prevent deterministic effects from large doses.

For individuals who are exposed to ionizing radiation as a direct result of their employment, individual dose limits are based on the philosophy that their total health risks should be no greater than the risks accepted by workers in comparable occupations or industries who are not exposed to radiation.

For anyone who does not receive a direct benefit, e.g. a salary, related to their radiation exposure, the individual dose limits are much smaller than those for radiation users. These "non-occupational" limits are based on comparisons with the ordinary risks of living, rather than on risks due to employment.

INDIVIDUAL DOSE LIMITS

The primary occupational dose limit for adult workers is 5,000 mrem per year. The embryo-fetus is more susceptible to radiation injury than an adult and is, therefore, subject to a lower dose limit. For a declared pregnancy of a radiation user, **the dose limit for the embryo-fetus is 500 mrem during the entire gestation period**, or approximately 50 mrem per month. This degree of protection for the embryo-fetus can only be achieved with the cooperation of the employee, who should notify her supervisor or the RSO as soon as the pregnancy is known.

The dose limit for members of the general public, including all persons who are not classified as radiation users, is 100 mrem per year. No person shall be classified as a radiation user simply to justify a higher dose limit.

RADIATION USERS

A **"radiation user"** is any individual whose official duties or authorized activities include handling, operating, or working in the presence of, any type of radiation source, whether or not such use is confined to a restricted area.

A **"normally exposed" radiation user** is an individual who could receive more than one tenth (10%) of the occupational radiation dose limit in any calendar quarter.

A **"potentially exposed" radiation user** is an individual who rarely receives more than 10% of the occupational dose limit in any calendar quarter, but who works with sources that could produce a significant dose accidentally.

A **"minimally exposed" radiation user** is an individual who is unlikely to receive one tenth (10%) of the occupational radiation dose limit in any calendar quarter. This category includes individuals who routinely handle only small quantities of radioactive materials, and others exposed to radiation infrequently or intermittently, e.g. most nurses, emergency and security personnel, maintenance, receiving, custodial and housekeeping personnel.

Any radiation user may communicate directly, in confidence and without prejudice, with the RSO or any member of the Radiological Health Department, the Utah Division of Radiation Control or the U.S. Nuclear Regulatory Commission on any matter concerning radiation protection.

RADIATION PROTECTION IN CARDIOLOGY AND OTHER SPECIAL FLUOROSCOPIC PROCEDURES

RADIATION PROTECTION REVIEW

Cardiac catheterization and other fluoroscopic imaging procedures produce large radiation doses to patients and to attending personnel; the use of good radiation protection techniques is imperative.

Review "BASICS OF RADIATION PROTECTION".

EXPOSURE REDUCTION

Increasing **tube voltage** (kVp) and **beam filtration** reduces the dose to the patient but also reduces image contrast. Reducing the tube voltage increases the dose to the patient but gives higher contrast.

Decreasing the **field size** reduces the total risk to the patient and also reduces the amount of radiation scattered from the patient to nearby personnel.

Exposures from external sources can be minimized by:

1 using the shortest exposure **time** consistent with diagnostic requirements,

2 increasing one's **distance** from the source, and

3 using appropriate **shielding**.

During any medical fluoroscopic procedure, including cardiac catheterization or angiography, the primary source of exposure to attending personnel is radiation scattered from the patient. A useful rule of thumb is that the exposure rate from scattered radiation at 1 meter from the patient is 1/1000 of the primary beam entrance exposure rate to the patient. Since radiation intensity decreases rapidly with distance from the source, it is advisable to step back from the patient whenever possible.

Shielding is very effective against the low-energy radiation scattered from the patient. A leaded apron shall be worn to protect the body, and shielding collars and goggles are also useful for reducing doses to the thyroid and the eyes.
The ceiling-mounted shield should be used to provide additional protection for the eyes and head. Position the shield so that you would have to look through it to see the portion of the patient's body that intersects the primary x-ray beam.

One of the most effective ways to minimize radiation exposure is to develop an awareness of the locations and intensity of radiation associated with various procedures. For this purpose, direct-reading dosimeters (pencil type) are available from the Technical Director of the Cardiac Catheterization Lab. They should be used often to measure exposures to various parts of the body from various procedures. These dosimeters are not used for official dose records, but are very useful for developing a "sixth sense" for avoiding unnecessary radiation exposures.

Direct-reading dosimeters are not assigned to specific individuals and are not used for permanent dosimetry records.

PERSONAL DOSIMETERS

Each individual (except the patient) who is regularly present during any catheterization procedure is required to wear one or more personal dosimeters, assigned by the RSO and used as the official dose record. Each badge is issued to a specific individual and shall not be worn by any other person.

One dosimeter is issued to each person to record the maximum dose to the head, thyroid and eyes. This badge may be referred to as the **"collar" badge**, since it is to be worn at the collar outside of any protective apparel and as close to the exposed area of the head as possible. The "collar" badge shall not be worn on the sleeve.

A second dosimeter may be issued to selected individuals to monitor thoracic dose or in the case of declared pregnancy to monitor the maternal abdomen (embryo-fetus) dose. This badge is referred to as the **"belly" badge or waist badge**, since it must be worn at waist level under the lead apron.

Individuals performing or routinely assisting in interventional fluorography may be issued and required to wear both collar and belly badges. The Webster Effective Dose Equivalent, being a more accurate predictor of true dose, and calculated as $0.04 \times \text{Dose}_{\text{collar}} + 1.5 \times \text{Dose}_{\text{belly}}$, is used to account for protective apparel worn by fluoroscopy staff.

When not being worn, dosimeters shall be stored away from heat and radiation sources but they should not be taken home or worn away from work. All dosimeters shall be returned promptly at the end of the monitoring period.

All regularly assigned dosimeters are issued (placed on the badge rack) on the first working day of each calendar month. Badges used during the preceding month shall be returned (to the badge rack) within the next week. To ensure that valid dosimeter readings are obtained, fees (fines) are assessed for badges that are lost or not returned for processing.

RECORDS AND REPORTS

Each employee who may be "normally exposed" to radiation shall complete a RADIATION USER PERSONAL DATA form. The required information includes (1) primary identification data, e.g. full name, birth date, sex, and social security number; (2) previous training and experience with radiation sources; and (3) current employment status, including job title or description, department, supervisor, and work location.

Individual radiation user records are treated as confidential and are available only to those with a legitimate need for the information. An individual may review the contents of his or her personal radiation user file at any time, and may obtain a summary of his or her radiation exposure history annually, or upon termination of employment, upon written request to the RSO.

Any radiation dose that exceeds the normal for the type of work performed is investigated by the RSO. The intent of the investigation is to prevent overexposures before they happen or from recurring; this can only be effective with the cooperation of the employee.

For any investigation of an actual overexposure, the University requires a written, signed statement from the exposed individual describing the reasons for the excessive exposure and the steps that will be taken to control exposures in the future.

A dose exceeding any regulatory dose limit shall be reported by the RSO to the Utah Division of Radiation Control.

RADIATION SAFETY FOR NURSES AND THERAPISTS

LEARNER OBJECTIVES

1 Describe two basic principles of radiation protection.

2 Describe two practical techniques for reducing exposures to external sources of radiation, e.g. x-ray machines.

3 Define the terms "normally exposed radiation user" and "minimally exposed radiation user" as used for radiation protection purposes.

4 State the annual dose limits for members of the general public, for the embryo-fetus, and for radiation users.

5 State the quarterly radiation dose that justifies the wearing of a personal radiation dosimeter.

BASICS OF RADIATION PROTECTION

The handout "BASICS OF RADIATION PROTECTION" provides an overview of doses from natural background radiation, health risks from lifetime radiation doses, and dose limits for workers and the general public. This handout should be carefully reviewed.

EXPOSURE REDUCTION

Understanding and using basic methods for controlling radiation exposures is important for all radiation users, including those who are only minimally exposed.

Exposures can be minimized by:

1 keeping the exposure **time** as short as possible,

2 increasing one's **distance** from the source and

3 by using appropriate **shielding**.

During fluoroscopic procedures, the most common source of exposure to attending personnel is radiation scattered from the patient. Since radiation intensity decreases rapidly with distance from the source, it is advisable to step back from the patient whenever possible. At 6 feet or more from the patient, the exposure rate is low enough that wearing of leaded aprons is not necessary.

Even a little shielding is very effective for protection from low-energy scattered radiation. Typical leaded aprons stop more than 95% of the x-rays. Even an apron that appears to be cracked is an effective barrier against scattered x rays. **If you must be near the patient, wear a lead apron.**

During any fluoroscopic procedure, it is very important to **avoid exposure to the primary beam**. Patients should be immobilized for x-ray examinations without being held. Never allow any part of your body to be in the primary x-ray beam. If it is absolutely necessary to hold a patient, or the x-ray film cassette, with your hands anywhere near the x-ray beam, **wear leaded gloves.**

EXPOSURE EVALUATION AND MONITORING

External exposures are readily detectable with portable instruments and personal monitoring devices (dosimeters). Potential radiation exposures from any source, or within any facility, are evaluated by the Radiation Safety Officer (RSO) to determine protection and monitoring requirements. In most cases, exposures are evaluated for groups of individuals engaged in similar activities and exposed to comparable sources. In some situations, monitoring of individual exposures may be necessary.

PERSONAL DOSIMETERS (BADGES)

A radiation dosimeter does not provide protection; it merely verifies, after the fact, the adequacy of the radiation control program. Also, radiation

dosimetry data are not, of themselves, appropriate to determine risk to any individual; however, they can sometimes help an individual to develop safe work habits.

All radiation users who are "normally exposed" to external sources of penetrating radiation are required to wear one or more personal dosimeters. Users subject to whole-body exposures are issued "body badges", which are to be worn on the front of the torso at all times while working with radiation sources. Females subject to significant radiation exposures may be issued a second badge to be worn on the front of the abdomen under the lead apron. The purpose of the second badge is to monitor the potential dose to the embryo-fetus in the event of a pregnancy.

Radiation users who are "minimally exposed" to penetrating radiation from external sources, i.e. those who are unlikely to receive more than 100 mrem to a major portion of the body during any calendar quarter, are not required to wear personal dosimeters.

When adequate evidence exists to conclude that individuals in a particular group or job function are **unlikely to receive 100 mrem per calendar quarter**, radiation doses are not monitored individually and lifetime exposure records are not maintained.

At the discretion of the RSO, groups of minimally exposed radiation users may be issued individual dosimeters for a limited time period to obtain exposure data for the group. The results of such monitoring are analyzed statistically to determine the exposure potential for individual members of the group.

Individuals who are issued personal dosimeters for any reason are required to wear them properly, to protect them from damage and to exchange them promptly at the end of the monitoring period. Fines are imposed for dosimeters that are lost or not returned within the scheduled exchange period.

RADIATION SAFETY FOR EMERGENCY RESPONSE PERSONNEL

The radiation sources at the University of Utah may be divided into three categories, depending on the kinds of risk they might impose on emergency response personnel.

Radioisotopes used in many laboratories are easily dispersed and may cause **contamination** of the skin and may be taken into the body. The quantities found in research laboratories are usually too small to be of concern as an external radiation source during an emergency.

Sealed radionuclide sources are normally shielded and produce minimal risks. However, if the shielding is damaged or the source is otherwise exposed, **high radiation intensities** may be present. If the source capsule is ruptured, serious **contamination** is also possible.

X-ray machines produce **radiation** only when the power switch is on; they do not produce radioactivity and there is no possibility of contamination.

DOSE RATES AND BIOLOGICAL HARM

For general use in emergency situations, the radiation dose units of roentgen (R), rad and rem are interchangeable. Dose rates are usually given in milliroentgens (0.001 R) per hour (mR/hr).

The **dose rate** depends upon the distance from the source and shielding.

The **total dose** received depends on the dose rate and the total time of exposure, i.e.:

dose = dose rate x time.

Detectable biological damage does not occur unless a dose of more than 25 rem (25,000 millirem) is received in a short interval. The dose limit for radiation workers is 5,000 mrem per year. A dose rate of a few hundred, or even a few thousand, mrem/hour encountered during an emergency is of little concern if the exposure time is less than an hour and if such occurrences are rare.

RADIATION DETECTION

Geiger-Mueller survey meters ("Geiger counter") are very sensitive and excellent for detecting contamination. However, a Geiger counter may be swamped (saturated) by a high exposure rate and give a false zero reading. To be safe, start reading the instrument away from the source, then move toward the source.

An ionization-chamber survey meter is not as sensitive as a Geiger counter, but can measure the actual exposure rate, even at high intensities.

EXPOSURE AND CONTAMINATION CONTROL

Dose rates are reduced greatly by distance and shielding; don't linger near a source.

Air contamination is not a concern unless fire or explosion occurs; avoid obvious smoke and dust.

Most personal contamination comes from direct contact; keep pedestrian and vehicular traffic out of area.

Evacuation of the immediate area is justified in the event of fire or explosion involving a radiation source or radioisotope laboratory.

Contamination should be detected, confined and removed as promptly as possible; **keep potentially exposed persons in the area until cleared by the Radiation Safety Officer.**

RADIATION SAFETY FOR CUSTODIANS AND HOSPITAL ENVIRONMENTAL SERVICES

OBJECTIVES

1 Know the difference between radiation exposure from contained sources, such as x-ray machines, and contamination with radioactive materials.

2 Recognize radiation warning signs and their meaning.

3 Know the restrictions on removing materials, including wastes, from radioisotope laboratories.

4 Know what to do and who to call for help related to any radiation problem or emergency.

METHOD

The training consists of a short oral presentation with ample opportunity for questions and answers. This outline will be provided as a handout and the listed topics will be discussed in detail. Radiation warning signs and labels will be displayed.

RADIATION AND RADIOACTIVITY

Radiation is energy transmitted through space. Radiation may come from x-ray machines or from radioactive material (radioisotopes). Radiation from an x-ray machine stops when the machine is turned off. Radiation from a radioactive material cannot be turned off, but it can be confined.

A material that emits radiation is radioactive. Radioactive material can be spilled, lost, or dispersed, but it cannot be destroyed.

Contamination refers to any radioactive material that is not where it belongs, such as on the floor, on clothing or on the hands or body.

RADIATION AREAS

The entrance to an area where an x-ray machine or any other source of radiation can produce a significant radiation exposure is labeled with a yellow and magenta "CAUTION - RADIATION AREA" sign. It is generally safe to enter such areas, but one should not stay in the area without good reason. Warning lights on x-ray machines and other radiation sources are used to indicate that the unit is on.

RADIOACTIVE MATERIAL AREAS

The entrance to an area where radioactive materials are used is labeled with a yellow and magenta "CAUTION - RADIOACTIVE MATERIALS" sign. You must recognize these labels and follow the instructions for such areas.

Containers of radioactive materials, including wastes, are identified with small yellow and magenta labels with the radiation symbol.

Do not empty waste containers marked with radioactive material labels. Do not remove empty boxes or other containers with radioactive material labels unless the label has been thoroughly obliterated, i.e. destroyed or covered.

RADIOACTIVE CONTAMINATION

Under normal conditions, contamination is not a problem because radioisotopes are carefully contained. Small spills are to be cleaned up by the laboratory personnel who use the radioisotopes. Care must be taken to avoid spreading the contamination. Each person involved in the spill shall be monitored carefully to assure that no one leaves the area with contamination.

If contamination is found on clothing or on the body, it shall be removed promptly using ordinary washing, and the Radiation Safety Officer should be notified.

RADIATION EMERGENCIES

Any accident, injury or loss of control of a radiation source that could cause an excessive or uncontrolled radiation exposure to any individual is referred to as a radiation emergency. The proper response to any radiation emergency depends upon a thorough understanding of the magnitude of risks, priorities for action and the application of common sense.

Protect People!

The first consideration in any emergency is to assist injured persons and to prevent any further injury. For medical assistance, dial 9-911 immediately and report the nature of the illness or injury. If the person may be contaminated with radioactive material, inform the 911 dispatcher of the situation. If you are qualified to render first aid, do so without regard to the presence of radioactivity. **There are no radiation sources at the University that produce radiation exposure risks large enough to prevent giving first aid!** Except for the usual precautions for moving an injured person, individuals should immediately leave the room or area until the extent of the radiological hazard has been evaluated. However, all individuals should remain available in the vicinity until checked for contamination or exposure.

EMERGENCY TELEPHONE NUMBERS

Fire, Ambulance or Medical Assistance: 9-911

Radiological Health Department (Radiation Safety Officer)

Office Hours: 581-6141

All Other Times:

University Police: 585-2677

Get Help!

Each individual should know in advance who to call in case of a radiation emergency. If fire, injury or other emergency conditions in addition to radiation are involved, first call the appropriate numbers listed in the front of the Campus Directory. Then call the Radiation Safety Officer (Radiological Health Department).

When reporting any emergency, be sure to state the exact nature of the emergency; then give your name and the phone number from which you are calling, the exact location of the emergency (building, room, nearest entrance, etc.) and the name of the person responsible for the room.

Do not hang up! Let the other person end the conversation after all information is clearly understood.

Contain the Hazard!

Any of the following actions appropriate to the situation should be performed provided they can be carried out safely:

Place absorbent material on spilled liquids.

Close the sash on fume hoods, but do not turn off hood exhaust fans.

Close doors to the area and post signs or guards to prevent unauthorized entry.

Allow no one to leave the area without being checked for contamination.

Follow-up Action

Any necessary decontamination or repairs required after a radiation emergency shall be performed only under the direction of the Radiation Safety Officer (RSO). Re-entry or re-occupancy must be authorized by the RSO.

RADIATION SAFETY FOR RECEIVING PERSONNEL

OBJECTIVES

1 Know the difference between radiation exposure from contained sources, such as sealed packages, and contamination with radioactive materials from leaking packages..

2 Recognize radiation labels on packages and their meaning.

3 Know the restrictions on transporting packages with "YELLOW III" labels.

4 Know what to do and who to call for help related to any radiation problem or emergency.

METHOD

The training consists of a short oral presentation with ample opportunity for questions and answers. This outline will be provided as a handout and the listed topics will be discussed in detail. Radioactive package labels will be displayed.

RADIATION AND RADIOACTIVITY

Radiation is energy transmitted through space. Radiation may come from x-ray machines or from radioactive material (radioisotopes). Radiation from an x-ray machine stops when the machine is turned off. Radiation from a radioactive material cannot be turned off, but it can be confined.

A material that emits radiation is radioactive. Radioactive material can be spilled, lost, or dispersed, but it cannot be destroyed.

Contamination refers to any radioactive material that is not where it belongs, such as on the floor, on clothing or on the hands or body.

RADIOACTIVE PACKAGE LABELS

"LIMITED QUANTITY" does not have a radiation symbol and is not required to say "radioactive" on the outside of the package. This kind of package contains a very small quantity of radioactivity.

"WHITE I" identifies a package that gives no external radiation exposure.

"YELLOW II" identifies a package that produces a very low external exposure.

"YELLOW III" identifies a package that produces an external exposure for which the total exposure time at a distance of less than 5 feet should be limited. Packages with "YELLOW III" labels shall be transported in a vehicle with "RADIOACTIVE MATERIAL" placards on all 4 sides. This is done by Radiological Health personnel.

RADIOACTIVE CONTAMINATION

Under normal conditions, contamination of packages is not a problem because radioisotopes are tightly contained. **If any damage or leakage of a radioactive material package is discovered, notify the Radiation Safety Officer at once.** In case of leakage, care must be taken to avoid spreading the contamination. Each person who may have been contaminated shall be monitored carefully to assure that no one leaves the area with contamination. If contamination is found on clothing or on the body, it shall be removed promptly using ordinary washing, and the Radiation Safety Officer should be notified.

RADIATION EMERGENCIES

Any accident, injury or loss of control of a radiation source that could cause an excessive or uncontrolled radiation exposure to any individual is referred to as a radiation emergency. The proper response to any radiation emergency depends upon a thorough understanding of the magnitude of risks, priorities for action and the application of common sense.

Protect People!

The first consideration in any emergency is to assist injured persons and to prevent any further injury. For medical assistance, dial 9-911 immediately and report the nature of the illness or injury. If the person may be contaminated with radioactive material, inform the 911 dispatcher of the situation. If you are qualified to render first aid, do so without regard to the presence of radioactivity. **There are no radiation sources at the University that produce radiation exposure risks large enough to prevent giving first aid!** Except for the usual precautions for moving an injured person, individuals should immediately leave the room or area until the extent of the radiological hazard has been evaluated. However, all individuals should remain available in the vicinity until checked for contamination or exposure.

EMERGENCY TELEPHONE NUMBERS	
Fire, Ambulance or Medical Assistance:	**9-911**
Radiological Health Department (Radiation Safety Officer)	
Office Hours:	**581-6141**
All Other Times:	
University Police:	**585-2677**

Get Help!

Each individual should know in advance who to call in case of a radiation emergency. If fire, injury or other emergency conditions in addition to radiation are involved, first call the appropriate numbers listed in the front of the Campus Directory. Then call the Radiation Safety Officer (Radiological Health Department).

When reporting any emergency, be sure to state the exact nature of the emergency; then give your name and the phone number from which you are calling, the exact location of the emergency (building, room, nearest entrance, etc.) and the name of the person responsible for the room. **Do not hang up!** Let the other person end the conversation after all pertinent information is clearly understood.

Contain the Hazard!

Any of the following actions appropriate to the situation should be performed provided they can be carried out safely:

Place absorbent material on spilled liquids.

Close the sash on fume hoods, but do not turn off hood exhaust fans.

Close doors to the area and post signs or guards to prevent unauthorized entry.

Allow no one to leave the area without being checked for contamination.

Follow-up Action

Any necessary decontamination or repairs required after a radiation emergency shall be performed only under the direction of the Radiation Safety Officer (RSO). Reentry or re-occupancy shall be authorized by the RSO.