UCI IONIZING RADIATION SAFETY PROGRAM

A. Scope of the Program

The Radiation Safety Division of EH&S provides assistance to radiation users on campus to ensure safety and to make certain that radiation exposures are reduced to levels that are as low as reasonably achievable (ALARA). The program includes radiation safety training, security of radiation sources, use authorizations for radiation sources, safety surveys, radiation dosimetry, and response to radiation-related emergencies.

The following sources of radiation are included in the UCI Ionizing Radiation Safety Program: radioisotopes, x-ray machines, a nuclear reactor, neutron generators, and particle accelerators.

B. Definitions

Useful ionizing radiation safety terminology is presented below:

Alpha Particle
A charged particle having a mass and charge equal in magnitude to a helium nucleus (a cluster of two protons and two neutrons) that is emitted from the nucleus of an atom.

Beta Particle
Charged particle emitted from the nucleus of an atom, with a mass and charge equal in magnitude to that of the electron.

Curie
The special unit of activity. One curie equals 3.7×10^{10} nuclear disintegrations per second. (Abbreviated Ci.) Several fractions of the curie are in common usage.

Millicurie: One-thousandth of a curie (3.7×10^{7} disintegrations per second). Abbreviated mCi.

Microcurie: One-millionth of a curie (3.7×10^{4}) disintegrations per second). Abbreviated μCi.

Decay, Radioactive
Disintegration of the nucleus of an unstable nuclide by spontaneous emission of charged particles and/or photons.

Detector, Radiation
Any device for converting radiant energy to a form more suitable for observation and measurement. An instrument used to determine the presence, and sometimes the amount, of radiation.

Dose
A general term denoting the quantity of radiation or radiant energy absorbed.

Dosimeter
Instrument to detect and measure accumulated radiation dose. {See Film Badge and TLD.}

Exposure
A measure of the ionization produced in air by x or gamma radiation. It is the sum of the electrical charges on all ions of one sign produced in air when all electrons liberated by photons in a volume of air are completely stopped in air, divided by the mass of the air in the volume. The special unit of radiation exposure is the roentgen (R).

Film Badge
A pack of photographic film which measures radiation exposure for personnel monitoring. The badge may contain two or three films of differing sensitivity and filters to shield parts of the film from certain types of radiation.

Gamma Ray
Short wavelength electromagnetic radiation emitted from the nucleus of an atom during radioactive decay.

Geiger-Mueller Counter
Highly-sensitive, gas-filled radiation-detecting device. It operates at voltages sufficiently high to produce avalanche ionization.

Half-Life, Radioactive
Time required for a radioactive substance to lose 50 percent of its radioactivity by decay. Each radionuclide has a unique half-life.

Ionization
The process by which a neutral atom or molecule acquires a positive or negative charge.

Ion Pair
Two particles of opposite charge, usually referring to the electron and positively charged atomic or molecular residue resulting from the interaction of ionizing radiation with the orbital electrons of atoms.

Monitoring
Periodic or continuous determination of the amount of ionizing radiation or radioactive contamination present in an occupied region.

Photon
A quantity of electromagnetic energy (E) whose value in joules is the product of its frequency (ν) in Hertz and Planck's constant (h). The equation is $E = h\nu$.

Rad
The unit of absorbed dose in rads is equal to 0.01 J of energy deposited in a kilogram of any medium.

Radiation or Ionizing Radiation
Gamma rays and x-rays, alpha and beta particles, neutrons, protons, high-speed electrons and other nuclear particles, but not visible light, sound, radio waves, laser radiation, or microwaves.

Radiation-Producing Machine
Any device capable of producing radiation when the associated control devices are operated or electrical circuits are energized.

Radioactive Material
Any material which emits radiation spontaneously.

Radioactive Contamination
Deposition of radioactive material anywhere where it is not desired, particularly where its presence may be harmful. The harm may be in interfering with an experiment or a procedure, or in actually being a source of danger to personnel.

Rem
A special unit of radiation dose equivalent . The dose equivalent in rems is numerically equal to the absorbed dose in rads multiplied by the quality factor QF.

Roentgen (R)
The unit of radiation exposure. One roentgen equals 2.58×10^{-4} coulomb per kilogram or air.

Scintillation Counter
The combination of phosphor, photomultiplier tube, and associated circuitry for measuring light emissions produced by ionization in the phosphor.

Sealed Radiation Source
Any radioactive material permanently encapsulated in such a manner that it will not be released under the most severe conditions likely to be encountered in normal use. This encapsulation must meet rigid specifications.

TLD (Thermoluminescent Dosimeter)
A crystalline material (e.g., lithium fluoride) which is used to measure an accumulated radiation dose. When exposed to radiation at ambient temperatures, electrons migrate to crystal lattice defects. When heated, the crystal releases this energy as light which can be detected by a photomultiplier tube and correlated to the amount of radiation dose received.

X-rays

Penetrating electromagnetic radiation whose wavelengths are shorter than those of visible light and ultraviolet radiation. X-rays are usually produced by bombarding a metallic target with fast electrons in a high vacuum. In nuclear reactions, it is customary to refer to photons originating in the nucleus as gamma rays, and those originating in the extra-nuclear part of the atom as x-rays. These rays are sometimes called roentgen rays after their discoverer, W.C. Roentgen.

C. Responsibilities

It is the policy of the University to maintain an environment for its students, faculty, staff, and visitors that will neither adversely affect their health and safety nor expose them to avoidable risk of injury, insofar as is reasonably achievable.

1. Chancellor

The Chancellor is responsible for implementation of the University's radiation safety policies and for establishing supplementary campus policies and standards. He/she has delegated his/her responsibilities to various campus committees, departments and individuals (see below).

2. Campus Radiation Safety Committee (RSC)

The Campus Radiation Safety Committee reports to the Vice Chancellor for Administrative and Business Services on all matters related to radiation safety and recommends such policies and procedures it deems appropriate to ensure an adequate radiation safety program. It is responsible for reviewing and approving all proposed uses of radiation and radioisotopes, and for advising and guiding the Environmental Health and Safety (EH&S) Office in carrying out the campus radiation safety program. The RSC has the authority to suspend or revoke the authorization of a PI to use radiation sources and direct the Radiation Safety Officer (RSO) to impound radioactive materials or stop the use of radiation-producing machines for violations of any of the provisions of the program.

3. Institutional Review Board (IRB)

The Institutional Review Board reports to the Vice Chancellor for Research on all matters regarding the welfare of human research subjects and is responsible for reviewing all applications for human subjects use involving radioactive materials or radiation-producing machines on campus (except diagnostic x-rays at the Student Health Center). The IRB and RSC must both approve all uses of human research subjects prior to the administration of any radiation source to the subjects. Either committee has the authority to suspend or revoke their authorization.

4. Reactor Operations Committee

The Reactor Operations Committee (ROC) reports to the Executive Vice Chancellor and is responsible for review of all matters relating to the use of the UCI Nuclear Reactor Facility in Rowland Hall. All users must comply with the Facility's Standard Operating Procedures Manual, the Facility's Nuclear Reactor License, and all applicable federal regulations and campus policies. The Reactor Supervisor is a member, ex-officio, of the ROC and the RSC.

5. Environmental Health And Safety (EH&S) Office

The Environmental Health and Safety (EH&S) Office is responsible for surveillance of all uses of radioactive materials and radiation-producing machines and providing consultation and radiation safety services in conformance with accepted policies and standards, government regulations, license conditions, and national radiation protection standards and recommendations.

a. Director, Environmental Health & Safety

The Director, Environmental Health & Safety, is responsible for reviewing campus performance regarding policies and procedures on radiation safety, and assuring that the university administration is adequately informed of its responsibilities on matters related to radiation safety.

b. Manager, Radiation Safety Division/Radiation Safety Officer (RSO)

The Manager, Radiation Safety Division, designated as the campus Radiation Safety Officer, is responsible for administering the UCI radiation safety program; for assuring that use of radiation is in conformance with University and campus policies and with applicable governmental regulations; and for referring to the Radiation Safety Committee matters requiring its review and approval.

The RSO is a member, ex-officio, of the Radiation Safety Committee and the Reactor Operations Committee. The RSO has the authority to immediately terminate any operation involving the use of radiation which in his/her judgement presents a significant hazard to the health and safety of UCI students, staff, faculty, visitors, or the general population.

6. Purchasing Department

A buyer, designated by the campus Purchasing Manager, is responsible for control of the acquisition, through established procedures, of all radioactive materials and machines capable of producing ionizing radiation. He or she is assisted by EH&S in determining whether the person submitting the request is authorized for its possession and use. This designated buyer is a member, ex-officio, of the Radiation Safety Committee.

7. *Deans, Department Chairs And Administrative Officers*

Deans, Department Chairs, and Administrative Officers are responsible for review and approval of proposed uses of radioisotopes and radiation-producing machines within their jurisdiction. Such approval signifies that the department will provide the resources necessary to control hazards and will assist in the enforcement of pertinent campus and governmental standards and regulations. Each department shall possess radiation survey instruments capable of detecting the types of radiation that are used in that department. These instruments shall be continuously available for routine monitoring and emergency uses, and shall be calibrated/operationally checked on a routine basis.

8. *Responsible Principal Investigator (RPI)*

The RPI is personally responsible for compliance with campus and governmental regulations as they pertain to his/her authorized use of radioactive materials or radiation-producing machines. Specific responsibilities are identified in the UCI Radiation Safety Manual.

9. *Radiation User*

All persons must be adequately trained regarding, and comply with, the campus' radiation safety requirements and the rules prescribed by the RPI.

When a person knows or suspects that an accident has occurred involving a radioisotope or a radiation-producing machine, that person must immediately inform the RPI, and if the PI is not available, the person is to notify the campus RSO.

D. Program Components

The major elements of the UCI Ionizing Radiation Safety Program are listed below. Links to these documents are available at http://www.ehs.uci.edu/radsafe.html.

a) Providing information dealing with the recognition, evaluation and control of the hazards associated with ionizing radiation:

- *UCI Radiation Safety Manual*
- *UCI Radiation Safety Factsheet*
- *Prenatal Radiation Exposure Policy*
- *Radiation Safety Syllabus for New Users of Radioactive Materials*
- *Radiation-Producing Machine Safety Syllabus*
- *State of California Notice to Employees*

b) Training radiation users regarding the related safety principles.

- *For Radioactive Material Users*
- *For Radiation-producing Machine Users*

c) Informacion en Espanol Acerca de Seguridad de Radiacion.

- *Informacion con Referencia a la Seguridad de Materiales Radioactivos*

d) English to Spanish Translations of Radiation Safety-related Terms and Expressions.

- *Interactions with Spanish-speaking Housekeeping Personnel*

D. Reporting Requirements

The UCI Radiation Safety Officer (RSO) must be notified well in advance whenever a radiation source will be brought onto campus, unless it is purchased through UCI Procurement Services, in which case the Responsible Principal Investigator will already have been authorized to receive the device or material.

If a radiation-producing machine is modified or moved such that the hazards attendant to its use might have increased, the RSO must be notified before the machine is operated again in order to ensure that external radiation readings are still within safe limits.

If a person knows or suspects that he/she has been over-exposed to radiation or contaminated with radioactivity, EH&S must be notified as soon as possible.

If somebody is observed to be handling radioactive material or operating a radiation-producing machine in an irresponsible manner, the EH&S must be notified immediately.

E. Information

For information regarding the various aspects of ionizing radiation safety, contact the following individuals:

- Authorization to use radiation sources on campus – Debbie Hamano (x4-1081)
- Radiation detection instrument calibration/limited repair – Rocky Dendo (x4-4557)
- External radiation dosimetry – Helen Tang (x4-6904)
- Internal radiation dosimetry – Rocky Dendo (x4-5100)
- Radiation protection surveys – Rick Mannix (x4-6098)
- Radiation Safety Committee – Debbie Hamano (x4-1081)
- Radioactive Drug Research Committee -- Debbie Hamano (x4-1081)
- Radioactive shipments/receipts -- call the Health Physics Laboratory (x4-7100)
- UCI Radioactive Material License -- Debbie Hamano (x4-1081)
- Radiation Use Authorizations (RUAs) – Helen Tang (x4-6904)
- California radiation-producing machine registration – Rick Mannix (x4-6098)

☞ ***For information regarding safety considerations when operating sources of non-ionizing radiation, including lasers, contact Rick Mannix (x4-6098).*** ☜

F. Training and Testing

a) Radioactive Materials Users

The training program consists of three elements: Radiation Safety Part I, Radiation Safety Part II, and on-the-job training.

Radiation Safety Part I – Radiation Safety Part I is an online course comprised of several modules and assessments. Completion of the Statement of Training and Experience form, along with reviewing the Prenatal Radiation Exposure Policy (if female), is also required. Registration is available through TED. Radiation Safety Part I is a pre-requisite for Radiation Safety Part II.

Radiation Safety Part II - Radiation Safety Part II classes include information on radiation survey instrumentation, spill handling procedures, waste handling procedures and program requirements specific to UCI. Registration is through TED. A competency assessment is given to ensure the material presented was learned.

On-The-Job Training - New radiation users are required to complete approximately 20 hours of carefully supervised on-the-job training under the direct, personal supervision of the responsible principal investigator or a senior researcher designated by the responsible principal investigator. A completed On-the-Job Training form must be submitted within 6 months of beginning work with radioactive materials.

b) Radiation Safety Training For Radiation-Producing Machine Users

Regulations issued by the Radiologic Health Branch of the California Department of Health Services set minimum training requirements for x-ray machine, neutron generator, and/or particle accelerator users. The training program consists of two elements: general radiation-producing machine safety training and laboratory specific on-the-job training.

Radiation-Producing Machine Safety Orientation – This includes completing several required forms and taking a computer-based course which includes both radiation safety and electrical safety information. A competency assessment is given to ensure that the material presented was learned. Registration is through TED.

On-The-Job Training - New users of radiation-producing machines are required to be adequately trained in the safe operation of the machines they will be using. A completed On-the-Job Training form must be submitted within 6 months of beginning work with radiation-producing machines.