INSTRUCTIONS TO EMPLOYEES CONCERNING RADIATION SAFETY

Illinois Law (as described in 32Ill. Adm. Code 400.120) requires that persons working in an environment which might expose them to radiation must be instructed as to the items described below. Also refer to "Regulations Concerning the Use of Radioactive Materials" at RFUMS issued by the Radiation Safety Committee to all Authorized Users (AU).

I. **Areas which are restricted to the use, storage or transfer of sources of radiation** can be recognized by the symbol for radioactivity, shown below, which will be displayed on laboratory doors, storage cabinets, waste containers, refrigerators, etc. in which such materials are kept.

The label bearing this symbol will also carry wording describing the materials, or radiation source, and in the case of laboratories a telephone number to be called in case of emergency. A special room containing a high-energy source will carry notice forbidding entry by unauthorized personnel. **Radioactive waste in the labeled trash containers should not be touched by the janitorial staff.** This waste shall be handled and removed by authorized personnel.

II. Standard Operating Procedures for Employees in Laboratories Using Radioisotopes

a. Never start an operation without receiving proper instructions.

b. Smoking, eating, drinking, chewing gum, applying make-up, etc. is forbidden in areas where isotopes are handled. Do not discard related trash in laboratories using radioactive materials.

c. No food or personal items may be kept in the areas where radioactive materials are employed.

d. Do not roll up sleeves while working with active materials.

e. Horseplay is forbidden in the laboratory.

f. Laboratory coats (or scrub gowns) and rubber gloves must be worn when handling radioactive materials. Used coats/gloves should be disposed of as radioactive trash in receptacles provided.

g. Do not handle community surfaces (e.g. telephones, door handles) while wearing gloves.

h. Never pipette radioactive solutions with the mouth.

i. Report all injuries, no matter how insignificant they might appear, to the laboratory supervisor as soon as possible.

j. Do not remove "Radioactive Materials" signs without proper authority.

k. Call for help if an accident occurs.

l. Learn the location of fire-fighting equipment, safety showers, etc., and be familiar with their operation.

m. Do not place notebooks or any personal items on laboratory bench tops where work is being done (or has been done) with radioactive materials.

n. Never tamper with personnel monitoring devices (e.g., Film badges, dosimeters, etc.)

o. Never empty "hot" materials into "cold" sinks. No isotopes are to be discarded in the drains.

p. Identify all radioactive materials on top of an attended laboratory bench.

q. Never leave radioactive materials on top of an unattended laboratory bench.

r. Do not use bare hands to pick up contaminated articles.

s. Never work with radioactive materials or contaminated items if there are cuts or wounds on the skin.

t. Wash hands and take any other measures necessary to reduce or eliminate

the transmission of contamination when leaving an area where radioactive materials are being used.

III. Injuries to Personnel Regarding Radioactive Materials:

a. Wash minor wounds under running water immediately while opening the gash, cut, etc. to the water flow. (Call for help if needed).

b. Report **ALL** accidents or injuries to the Radiation Safety Office as soon as possible. This pertains to either over-exposure, ingestion, inhalation, cuts, etc. If at night, call "0" and have Security notify the Radiation Safety Officer at home.

c. Call a physician at once.

d. Permit no person involved in a radioactive injury to return to work without the approval of the Radiation Safety Officer and the attending physician.

e. A written description of each incident will be submitted to the RSO within 7 days.

IV. Fires Involving Radioactive Materials:

a. Notify all personnel in room and/or building at once.

b. Attempt to put out fire if radiation hazard is not immediately present.

c. Notify the Radiation Safety Office at once. If at night, call "0" and have Security notify the Radiation Safety Officer at home.

d. Follow "Standard Operating Procedures" involving fires.

V. Radiation Safety Procedures

EMERGENCY PROCEDURES FOR RADIOACTIVE MATERIAL (RAM)

IMMEDIATE ACTION for ALL SPILLS (general)

- **CLEAR THE AREA**: NOTIFY all persons in the area (same room) that a spill has occurred. All persons not involved in the spill should vacate the room. Prevent access to the area by unauthorized personnel

- **PREVENT THE SPREAD**: Cover the spill with absorbent material. Do not attempt to clean up *major* spills. Ensure that there are no leaks or drains of RAM liquid. Confine the movement of all potentially contaminated personnel to prevent the spread. Do not track spilled RAM around on your shoes.

- **IDENTIFY**: Identify spilled isotope. Identify any hazardous material also involved.

1. <u>MAJOR SPILLS</u> (the amount of RAM or the area of the spill arouses your special concern)

a. **SHIELD THE SOURCE**: If possible, the spill should be shielded, but only if it can be done without further contamination, without spreading the liquid, or without significantly increasing exposure of personnel to radiation.

b. **CLOSE THE ROOM**: Leave the room and lock the door(s) to prevent entry. Post a sign for no-entry.

c. **CALL FOR HELP**: Immediately notify one of the following:

RSO:	Dr. LeVan (x8318)
Radiation Technician:	Jesse Soco (x3446 or overhead page)
Radiation Safety Committee Chair:	Dr. D. Kim(x3364)
After normal working hours:	Security (x3288)

d. **PERSONNEL DECONTAMINATION**: Contaminated clothing should be removed and stored properly. Flush contaminated skin thoroughly and then wash with soap and water.

e. **CLEAN UP**: To be conducted with the assistance of the RSO staff, including utilization of MSDS information if hazardous material is involved.

f. **INJURIES**: Injured persons should be decontaminated and first aid performed as necessary. With life threatening injuries, the individual should be given immediate life-saving first aid and Security (x3288) should be notified to obtain emergency medical treatment.

2. <u>MINOR SPILLS</u> (any spill other than that judged to be a major spill)

a. **CLEAN UP**: Use disposable gloves, absorbent paper, and remote handling tongs. Carefully fold the absorbent material and insert it into a plastic bag (use a second one, if necessary) and dispose of it in the radioactive waste containers. Also insert all other contaminated materials, such as disposable gloves, into the plastic bag. Follow MSDS sheet for clean-up of hazardous material.

b. **SURVEY**: With an appropriate survey instrument, check the area around the spill, hands, and clothing for contamination. For alpha and low energy beta emitters, conduct wipe tests at the spill area. Continue to decontaminate, as necessary.

<u>REPORTS</u>: For *major* incidents a preliminary written report must be filed with the RSO within 24 hours and a final written report within two (2) weeks. For *minor* incidents a written report must be filed with the RSO within 48 hours. All incidents involving improper handling of RAM have to be reported to the RSO. Accidental ingestion, injection, or inhalation of RAM or exposure to sources of radiation should be reported immediately to the RSO by phone.

3. EXPOSURE TO SOURCES OF RADIATION

Terminate the source of exposure and prevent others from being exposed. Use additional shielding as needed. Notify the Radiation Safety Officer (Dr. LeVan, X8322, Pager 847-817-2060) so that the nature and extent of exposure can be determined. Seek medical attention if severe exposure is suspected.

4. LOSS, THEFT, OR DAMAGE TO A SOURCE OF RADIOACTIVE MATERIAL

In addition to following the applicable procedures outlined above, notify the RSO immediately and the Illinois Emergency Management Agency at (800)-782-7860 or (217)-782-7860.

RADIATION SAFETY OFFICER (RSO): Dr. John LeVan
OFFICE PHONE: Ext. 8322 PAGER: (847)-817-2060

ALTERNATE NAMES AND TELEPHONE NUMBERS DESIGNATED BY RSO:

Dr. Donghee Kim, X3364

VI. Badges and Exposure Records

Personnel who may be exposed to radiation will be required to wear badges measuring whole-body exposure. The badges **must** be returned promptly each month when the new monthly badges are issued. Secretaries of each department will keep a check-list of badges issued and returned. In addition, laboratory personnel who are handling millicurie amounts of isotopes emitting high-energy radiation, e.g. 32P, 86Rb, 51Cr, 125I, 22Na, must wear at least one ring-badge under their laboratory gloves. Use of 14C, 35S, or 3H will not require ring badges.

All personnel may have access to their own confidential exposure record upon request. These records are maintained in the departmental offices as well as in the

Office of Research Administration. At the request of a worker, the annual record of exposure to radiation of that person will be supplied in writing. At the request

of a worker the Institution will supply in writing a report of the workers exposure record upon termination of employment. When the Institution is required, pursuant to 32 Ill. Adm. Code 340.4050, to report to the Illinois Emergency Management Agency any exposure of an individual to radiation, the Institution will at the same time report such exposure to that individual.

Our institution has a program which is designed to keep exposure as low as reasonably achievable (ALARA see page 9). In the event of an exposure appearing on a workers badge, the Radiation Safety Officer will alert the worker of this exposure, and will discuss possible procedures for avoiding future exposures. All personnel are urged to consult the Radiation Safety Officer or any member of the Radiation Safety Committee about details of our ALARA program, which are also outlined in our Book of Regulations (issued to all Authorized Users of Isotopes).

VII. Questions

All workers are urged to consult their immediate supervisor, or the Radiation Safety Officer or Members of the Radiation Safety Committee if they have questions about safety procedures or other concerns arising out of their work.

VIII. Special Procedures For Employing Tritium-Labeled Compounds

A. General

The radioactive isotope of Hydrogen, tritium (3H), requires special considerations while being employed. The basic standard Operating Procedures, Section 2 of this manual, are applicable due to the radioactive nature of the isotope; however, the chemical behavior of Hydrogen and the

extremely low energy beta particles (0.018 MeV) complicate contamination and detection principles.

Chemically, tritium behaves like hydrogen, reacting readily with oxidizing agents. The most common reaction is the production of tritiated water. Therefore, extreme care must be employed where there is a possibility of producing tritiated water vapor from a research use. If this is expected, or unknown, the use of tritium must be confined to a well-ventilated hood in the laboratory.

Since hydrogen bonding is the type bonding associated with tritium, it is important to be aware of the tritium transfer mechanism. This is identical to hydrogen transfer or exchange. In this mechanism, tritium can transfer from molecule to molecule and/or compound to compound. Full description of these and other reactions may be found in suitable reference textbooks. In essence, the tritium behaves as though it "diffuses" through various hydrogen-containing materials such as skin, rubber gloves, and plastics. Thus, prolonged use of tritium-labeled compounds should be performed in glass or stainless steel containers; it must be pointed out that some tritium will adhere to the sides and will have a tendency to eventually "creep" to the top and escape if not tightly covered. This would result in widespread contamination when large amounts of tritium activity are employed if precautionary measures are not taken.

Since hydrogen-transfer will occur in rubber, it will occur in rubber gloves as well. Thus, rubber gloves should be discarded as "Radioactive Waste" following a given procedure, and the hands should be washed thoroughly with hot soapy water.

B. **Monitoring**

Monitoring a laboratory for tritium contamination is extremely difficult. Due to its extremely low energy beta radiation, ordinary laboratory survey instruments are not capable of detecting the presence of tritium contamination. Since the beta particles will not penetrate the detector walls or thin end windows of survey meters, an individual who is monitoring an area for tritium may gain a sense of false security when no evidence of contamination is indicated by his survey instrument. Likewise, film badges will not detect personnel exposures to the beta particles emitted from tritium.

Liquid scintillation counters and proportionality counters are used in most quantitative measurements involving tritium compounds (as well as for Carbon-14 and Sulfur - 35).

C. **Hazard**

Tritium is primarily an internal hazard. Therefore, the major concern is to prevent the internal deposition of tritium-labeled compounds and the spread of these compounds into low background areas.

D. **Specific Safety Procedures**

a. Laboratory work surfaces should be a material such as stainless steel and should be free of pits, cracks, and other irregularities. Plastic backed absorbent paper or "Diaper paper" should also be employed over the surface and discarded following the procedure.

b. Rubber or neoprene gloves (disposable-type) are to be worn while handling tritium. They should be discarded into the waste container following each procedure.

c. All tritium-labeled compounds should be stored in closed containers within hoods. If refrigeration is necessary, make certain that the screw-cap is tightly affixed to the storage bottle prior to placing in the refrigerator or freezer. All waste materials should be stores in closed containers in a suitable hood.

d. If tritium contamination is suspected, contact the Radiation Safety Officer, so that proper monitoring and decontamination techniques can be employed.

IX. <u>Health protection problems</u>. Exposure to radiation during pregnancy.

If a pregnant woman declares such pregnancy in writing to the Radiation Safety Committee, specific records of exposure will be made for the duration of the pregnancy. In addition, counseling with regard to these exposure issues may be obtained from the staff of the RSO (As per 10CFR, Part 20).

Probably one of the most concerned aspects of radiation safety and protection is
the possibility of damage caused by radiation to the developing fetus, the reason being that there is some evidence that the embryo or fetus is more sensitive to radiation than the adult. The two main effects of radiation are (i) malformation and growth defects, particularly in developing organs being exposed to radiation; and (ii) cancer developing during childhood.

Although the results concerning possible radiation-induced damage to the embryo

and fetus were derived from animal experiments, (mostly involving mice), it has been concluded that it is plausible and valid to extrapolate these damaging effects from mouse to man.

From mouse experiments, it has been observed that the probability of radiation related mutations caused by radiation in the mouse (particularly in the female mouse), depends on dose-rate, fractionation of the dose, and interval between the time of radiation exposure and conception (see below). Also, the stage of development and the total radiation dose are important contributing factors.

A. DOSE RATE

The first factor is dose rate. To produce any observable effects attributable to radiation exposure, the dose-rate must be relatively high. For example, at 9 millirem/minute (540 millirem/hour), the observed mutation rate is not significantly different from the spontaneous mutation rate. Note that a dose rate of 9 millirem/minute is very high compared to most occupation exposure rates, or the rates to which full-time radiation workers are normally subjected. For supporting personnel such as housekeeping, security and other staff, whose jobs do not require them to be in the vicinity of a source of radiation as often, these occupational exposure rates are substantially less.

B. DOSE FRACTIONATION

The second factor influencing the possible genetic effect is the fractionation of the radiation dose involved. As logically expected, a reduction in the mutagenic effect is also evident when the radiation doses are delivered in several fractions with an intervening time delay.

C. TIME INTERVAL

The third factor involves the time delay between irradiation and conception. It is observed that a lapse of 7 weeks or more between radiation exposure and conception in the female mouse also reduces the number of genetic changes in the offspring.

D. DEVELOPMENT STAGE - the last factor

The last factor is the development stage. There are three significant stages in pregnancy: preimplantation, organogenesis and fetal stage. For example, when a radiation dose of 100 rems is delivered during the preimplantation stage, which lasts about 9 days in humans, embryonic death is observed as the major effect, and there is no chance for malformation at this stage. The second stage, organogenesis, which takes place between the 3rd and 7^{th} week (14-50 days) of pregnancy, has been known as the most radiosensitive period. A great many malformations and development deficiencies may be produced during this stage, continuing with lower probability into the last period of pregnancy, the fetal stage. The types of deficiencies observed depend on the particular organ system being developed at the time of irradiation. In humans, the peak radiosensitive period is in the 3rd and 4th weeks. In general, the first trimester has been considered as the most sensitive time for organ malformation.

XI. Reducing Exposure: ALARA

Although work in the laboratory using small amounts of radioactive materials would unlikely result in high-level radiation exposure,always make every effort to reduce exposure as much as possible. There are three ways to reduce exposure to radiation by observing and taking advantage of the simple radiation protection precautions involving *time, distance* and *shielding*. In addition, users should strictly follow the rules and regulations promoted by the University Radiation Safety Committee and the Radiation Safety Staff (see Regulations). Please always remember the concept and practice of As
Low As Reasonably Achievable (ALARA)

XII. The License

The license of the Institution and Title 32, Illinois Administrative Code may be examined in the Office of the Radiation Safety Officer, Dr. J. LeVan, Room 2.263, Ext. 8322

Declaration kept in the Office of Research Administration, Room 1.324. Please return completed form to that office.

Declaration:

I have received and read the document entitled: "Instruction to Employees Concerning Radiation Safety" and I understand its contents.

Date	**Signature**
	Print Name
	Print Department Name