Appendix A

REGULATIONS FOR THE USE OF RADIOISOTOPES

Evansville Center
Indiana University School of Medicine

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The following procedures are on file in the Radiation Protection Office and are available on request:

"Information for Establishing Bioassay Measurements and Evaluations of Tritium Exposure" (NUREG-0938)

"Guidelines for Bioassay Requirements for Tritium"

"Methods and Frequency for Conducting Surveys"

Introduction

The Evansville Center is permitted to use radioisotopes under license from the United States Nuclear Regulation Commission (formerly from the U.S. Atomic Energy Commission). The types of isotopes, form in which they can be used, persons approved and other pertinent information are contained in the application and license which are appended to this set of regulations.

The regulations themselves have been adapted from the regulations used on the Bloomington Campus of Indiana University.

Three general statements should be kept in mind by all personnel:

1) Approval for use of isotopes is specific. Any procedure not specifically approved is not permitted. Continued license by the NRC depends on observing this principle.

2) At the present time we are not approved for using isotopes in living animals. This will require a substantial revision of our license. Our original application was not approved under that section of our application. Application and approval could take up to 9 to 12 months. Any anticipated use of live animals should allow for this time. No approval has been given on human subjects and in our circumstances such approval should not be anticipated.

* 3) At the present time all isotope use is restricted to the West Campus and any proposal to include the East Campus should be considered as being a major revision of our license and would require justification appropriate to such a change.

* In our current application both campuses are included

I. Responsibilities of the individual USER of Radiation Sources. No person shall use radioactive sources at the Evansville Center who has not been appropriately indoctrinated in the safe use of these sources of radiation.

Each person who uses sources of radiation has a responsibility to:

1. Wear the recommended radiation detectors for personnel, film badges or pocket ionization chambers.

2. Keep his exposure at the lowest feasible value and below the maximum permissible exposure as stated in section III A, a part of these regulations.

3. Maintain good housekeeping practices in laboratories.

4. Be aware of and work in accordance with Government and University regulations concerning the safe use of radiation sources.

5. Survey his person for radioactivity and remove all loose contamination before leaving the laboratory.

6. Use all recommended protective measures.

7. Avoid smoking, eating or drinking in areas where radioactive materials are used.

8. Check working area for contamination after procedures with radioisotopes.

9. Label contaminated equipment and segregate radioactive waste and equipment to avoid cross-contamination.

10. Report immediately to the Radiation Protection Officer the details of spills or accidents involving radioactivity.

11. Conduct decontamination procedures in accordance with emergency procedures outlined in these regulation. (See Sec. VI, Pg. 22)

II. Center Regulations Concerning the Use of Radioactive Materials and Sources.

A. Radioisotope Procurement. All orders for radioactive isotopes must be initiated by a Responsible Investigator.* The order should be placed through an ordinary center requisition which shall contain the name of the Responsible Investigator placing the order. Such orders

* An individual specifically approved in our license is referred to herein as a "Responsible Investigator". Any other person using isotopes does so as a delegated USER by a Responsible Investigator.

are examined by the Radiation Protection Officer who will ascertain whether the person making the request has been authorized under our license to receive radioactive material. Upon receipt of the material, a record must be submitted to the Radiation Protection Officer who will also require that disposal records be maintained and ultimately submitted to him.

In the case of "standing" orders, normally used for short lived radioactive materials, which permit purchase against an approved purchase order, the original requisition setting up such an order, will undergo the same review as a single order for radioisotopes. Subsequent requisitions, against the order, must be authorized by the Responsible Investigator with notices of the order being sent to the Radiation Protection Officer.

Only individuals who have been approved under the Center license may obtain radioactive materials under these regulations.

B. Receipt and Location of Use.

1. Isotopes are to be received, examined, and secured by an authorized user or other designated Center staff. The regulations governing receipt are outlined in Appendices D and E. Copies of these appendices should be made available to all personnel concerned.

2. Radioactive materials are to be used and stored only in those facilities which have been approved by the Radiation Protection Officer acting in compliance with the regulations approved in our license.

3. Individuals may secure approval to use radioactive materials in new areas by submitting to the Radiation Protection Officer a description of the facilities and attesting to the nature of the radioactive materials to be used. The Radiation Protection Officer will examine such facilities and make his recommendation for approval or disapproval.

C. Transfer of Radioisotopes.

1. Transfer of radioactive materials from one area to another must be approved by the Radiation Protection Officer concerned, who must also attend to transfer of records and approval of facilities.

2. No radioactive materials shall be transferred to or from the Center, other than by official procurement, without approval by the Radiation Protection Officer and compliance with Interstate Commerce Regulations (Tariff 10) and/or U.S. Postal Regulations.

D. Instrumentation and Radiation Safety Equipment. Responsible investigators shall ascertain that suitable survey instruments, personnel monitoring devices, and shielding materials are available to assure safety of personnel.

1. Survey instruments must be available which are appropriate to the type and level of ionizing radiation used.

2. Personnel monitoring devices appropriate to the type and level of radiation used must be available and used by all personnel involved with significant levels of ionizing radiation. Federal regulations require the use of such equipment by each individual who enters a restricted (radiation) area under such circumstances that he is likely to receive a dose in any calendar quarter in excess of 25 per cent* of the maximum permissible dose (see Sect. III, a).

   a. Except as provided in part b. below, film badges must be worn by personnel working in the following instances:

      (1) When working with 1 Mev. or greater beta emitters
      (2) When working with all gamma emitters of sufficiently high energy to make badge monitoring feasible

   b. Film badges need not be worn in cases where it has been definitely established by the Radiation Protection Officer that exposures will not exceed the specified limits. This will depend upon the intensity and energy of the radiation and the working conditions involved. See appendix A.

   c. Pocket dosimeters should also be worn by personnel in instances where exposures in excess of the weekly maximum permissible dose are possible. Such dosimeters should be checked daily and records maintained of the readings.

   d. Radiation counts of urine samples may be required for persons working with certain radioactive materials.

3. Shielding materials shall be available appropriate to the types and levels of radiation in all laboratories. Any stored material must be shielded such that the dose rate at the surface of the shield does not exceed 6.25 millirems per hour.

4. See ID 9 for records concerning exposure of individuals.

E. Radioactive Waste Disposal.

   1. Methods of Disposal.

*5 per cent in the case of individuals under 18 years of age.

a. Dosposal as non-radioactive waste.

Radioactive contamination on solid waste , glassware, and other impervious materials shall be reduced to near background levels prior to disposal as non-radioactive wastes. Such wastes shall be surveyed with an appropriate survey meter (capable of detecting low level contamination) to make such determination prior to disposal.

b. Disposal through the Sanitary Sewerage System. See data for individual isotopes (ISOTOPE FACT SHEET, appended).

The following additional rules apply to disposal by this method:

i. All radioactive materials eliminated through sanitary sewers must be freely soluble or readily dispersible in water.

ii. All material must be diluted in a dispersant which will not render the active material volatile.

iii. Disposal shall be limited to drains in posted areas.

iv. Traps must be flushed with large quantities of water during and after entrance of the eliminated material.

v. Insoluble and particulate material, even though inert, shall not be included with the material eliminated.

c. Disposal by incineration.

Incineration of combustible waste requires specific approval of the facilities by amendment to the license. The Evansville Center has no approval for disposal by incineration.

d. Disposal by Burial in Soil.

This will be done by special arrangement with a commercial disposal company. Approval and actual arrangement for such burial or for interim storage must be worked our prior to use of the isotope in experiments.

e. Storage for decay.

Short lived isotopes may be stored for decay before disposal as non-radioactive waste. Such storage must be done in approved, labeled containers with dates, activities and expected storage time as well as the order number of the isotope. Storage will be in an area where it will not interfere with other laboratory work or cause exposure to anyone working in the vicinity.

2. Retention of Waste Materials

   a. Dry Wastes: Special waste containers for disposal of dry contaminated wastes are to be available in all laboratories using isotopes. Such containers must be conspicuously labeled with radioactive-material caution signs in accordance with the requirements of the Code of Federal Regulations, Title 10, Part 20.

   b. Liquid Wastes: Special labeled containers shall be available for liquid wastes which cannot be eliminated immediately through the sanitary sewers. Liquid wastes containing nonvolatile radioactive materials may also be evaporated to dryness under an approved hood or absorbed into solid and subsequently dried for disposal as dry wastes.

III. Federal Regulations Governing the Use of Radioactive Materials.

The NRC has established standards for protection against radiation hazards arising out of use of by-product materials, special nuclear materials, and special source materials obtained under licenses issued by the Nuclear Regulation Commission. These regulations, issued pursuant to the Atomic Energy Act of 1954, are contained in Title 10, Part 20 of the Code of Federal Regulations entitled "Standards for Protection Against Radiation." All Center personnel engaged in work with radioisotopes are subject to the provisions of these regulations. Copies of 10 CFR 20 may be obtained from the Radiation Protection Officer upon request.

A. Limits on Personnel Exposure

The following regulations on radiation exposure are reprinted from Section 20.101 of 10 CFR 20 effective January 1, 1961:

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20.101 Exposure of Individuals to radiation in restricted areas

(a) Except as provided in paragraph (b) of this section, no licensee shall possess, use, or transfer licensed material in such a manner as to cause any individual in a restricted area to receive in any period of one calendar quarter from radioactive material and other sources of radiation in the licensee's possession a dose in excess of the limits specified in the following table:

	Rems per Calendar Quarter
1. Whole body; head and trunk; active blood forming organs; lens of eyes; or gonads	1 1/4
2. Hands and forearms; feet and ankles	18 3/4
3. Skin of whole body	7 1/2

(b) A licensee may permit an individual in a restricted area to receive a dose to the whole body greater than that permitted under paragraph (a) of this section provided:

1. During any calendar quarter the dose to the whole body from radioactive material and other sources of radiation in the licensee's possession shall not exceed 3 rems; and

2. The dose to the whole body, when added to accumulated occupational dose to the whole body, shall not exceed 5(N - 18) rems where "N" equals the individual's age in years at his last birthday; and

3, The licensee has determined the individual's accumulated occupational dose to the whole body on Form AEC-4, or on a clear and legible record containing all the information required in the form; and has otherwise complied with the requirements of section 20.102. As used in paragraph (b), "Dose to the whole body" shall be deemed to include any dose to the whole body, gonads, active blood-forming organs, head and trunk, or lens of eye.

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For regulations concerning exposure of individuals to airborne concentrations of radioactive material, exposure to minors, permissible levels of radiation in restricted areas, and concentrations of effluents to unrestricted areas, 10 CFR 20 should be consulted. In general, exposure to minors and individuals in unrestricted areas is limited to 10 percent of the limits specified in the table of paragraph (a) above.

It must be kept in mind that the permissible exposures as given apply only under conditions where one radiation hazard exists. In handling radioisotopes, internal deposition, whole body exposure, and localized exposure all exist together and this may reduce the permissible exposure to each. Simple summation of the ionization contributions at any point in the body from the three enumerated causes or from different types of ionizing radiation is assumed. Note that the contributions from internal deposition or skin contamination will be effective 24 hours per day, 7 days per week.

B. Posting requirements - Caution signs and labels.

Posting of laboratories, areas, and containers containing radioactive materials must be in accordance with the regulations of 10 CFR 20.

Personnel are cautioned that a number of commercial firms sell tape and labels which are not in compliance with Federal Regulations. All caution signs and labels used in the University must comply with the regulations of 10 CFR 20. Thus, for example, each container in which radioactive material is transported, stored or used shall bear a durable, clearly visible label bearing the radiation caution symbol and the words: CAUTION RADIOACTIVE MATERIAL or DANGER RADIOACTIVE MATERIAL. The radiation symbol prescribed is the conventional three-bladed design. Colors shall be magenta or purple on yellow. Where such containers are used for storage, the labels must also state the quantity and kind of radioactive material and the date of measurement of the quantity. Labels may also contain any additional information which may be appropriate in aiding individuals to minimize radiation exposure.

For complete details on other posting requirements, the reader is referred to 10 CFR 20.

IV. State Regulations Governing the Use of Ionizing Radiation.

During the 1959 session the Indiana General Assembly passed an act entitled the "Radiation Control Act of Indiana" (Chapter 77, Acts of 1959, Indiana General Assembly.) This Act:

1. Created an advisory commission to the State Board of Health known as the Radiation Control Advisory Commission. This commission is charged with the duty of reviewing the policies of the State Board as related to radiation, making recommendations to the State Board, and providing such technical assistance and advice as may be required relative to the uses of radiation in the State.

2. Requires any person who produces radiation or who produces, uses, stores, sells or otherwise disposes of radioactive material to register in writing with the State Board of Health giving such pertinent information as the State Board may require.*

3. Provides that the State Board shall adopt and promulgate such rules and regulations concerning the production, transportation, use, storage, sale, or other disposition of radioactive material and radiation machines as may be necessary to prohibit and prevent unnecessary radiation and carry out other provisions of the act.

V. Safe Laboratory Procedure.

Each Responsible Investigator must enforce compliance with the following regulations and procedures by all personnel under his supervision. For purposes of this section a radioisotope laboratory shall be a delineated area in which there shall be more than one-fifth (1/5) of exempt quantities. (See Appendix C, this manual.)

A. Protection Rules - Personal Contamination

Extreme personal cleanliness is the first rule in preventing contamination and protecting against the ingestion of activity. Persons working with radioactive materials should wash exposed parts of the body frequently and as a matter of routine while on the job. Thorough washing and monitoring shall be mandatory whenever leaving the active area. The following rules are desinged for the prevention of this type of contamination:

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*Radiation machines and radioactive materials which do not produce radiation sufficient to result in hazard or injury to health, life, or property are exempted from this requirement.

1. No smoking is permitted in radioisotope laboratories. Smoking shall be permitted only in areas of no radioisotope usage. One of the greatest dangers of smoking is contamination of the cigarette (pipe, etc.) with activity from contaminated hands.

2. Eating, storing, or preparation of food in a radioisotope laboratory or facility where such materials are handled is forbidden. Also the use of milk bottles or other food containers for handling or storing radioisotopes is forbidden. No edibles of any kind including chewing gum, candy, or beverages shall be brought into radioisotope laboratories.

3. The pipetting of active solutions by mouth is forbidden. Glass blowing in laboratories containing active materials is discouraged.

4. Personnel are not permitted to work with radioisotopes if there are open cuts or abrasions on the body. Extreme precautions must be taken to avoid cuts or puncture wounds. This is especially true when working with radioisotopes in Classes 1 and 2 (highly toxic), and when working at intermediate and high levels of radioactivity (see Tables I & II at end of this section).

   In the event the skin is broken while working with radioactive substances, immediate action should be taken to remove possible contamination. Wash the wound under large volumes of running water immediately (within 15 seconds if possible) and spread the edges of the gash to permit flushing action by the water. Light tourniquet action to stop venous return (but not restrict arterial flow) may be desirable to stimulate bleeding.

5. Contamination must be kept at a minimum at all times, especially contamination of the air, clothing, and the hands. (Fingernails should be kept short.)

6. Care must be exercised when using organic solvents to avoid skin contact with radioactive materials. (Solvents may make the skin more permeable.)

7. Protective clothing and devices should be used for all manipulations with unsealed sources where the possibility of contamination exists. In particular, suitable gloves shall be worn whenever hand contamination is possible. Gloves should be washed and cleaned before removal. Persons wearing gloves are cautioned to avoid touching uncontaminated objects subject to frequent use, such as door knobs.

8. Monitoring equipment must be available and in operating condition at all times and used frequently during and following work to determine the presence of activity and contamination on hands, clothing, and facilities. Each radioisotope worker is personally responsible to check himself (hands, feet, clothing) for contamination each and every time he has run a risk of contamination.

9. Any person who knowingly swallows, inhales, or otherwise ingests radioactive material must report the accident immediately to the Center Radiation Protection Officer.

B. Protective Rules - Contamination of Laboratory Tools, Glassware and Surfaces

1. All laboratory tools and glassware should be monitored before use, unless it is known with certainty that such items are new stock issue.

2. Care should be taken that no equipment, not immediately necessary to the operations being performed, is brought into the active area.

3. Handling tools and equipment when used, should be placed in non-porous metal trays or pans, which are located off to one side, away from the actual working space. It is desirable to line such trays and pans with absorbent disposable paper, which is changed frequently. These papers should be regarded as radioactive waste only when surveyr indicate activity above background or when known contamination occurs.

4. Auxiliary containers, blotters, and covers shall always be used where danger of spills and contamination of the person or equipment is possible (all groups and levels).

5. Contaminated equipment, or equipment that has been used and is suspected of contamination, shall be isolated in designated areas in the laboratory or in suitable storage spaces.

6. A caution label, sticker, or stencil shall be affixed on all containers actually containing, or contaminated with radioactivity until cleaning can be performed. The use of temporary labels is preferred over permanent stenciling on glassware. Decals and tape for this purpose are available from commercial suppliers.

7. Monitoring of equipment and tools shall be a routine procedure following their use. No equipment shall be released to shock unless it is affirmed to be completely free of contamination inside and out, by a Responsible Investigator.

8. Removable contamination shall not be allowed to remain on floors. Where floors are known or suspected of being so contaminated, the area involved shall be immediately restricted to further traffic and designated as a shoe cover area until such time as it is shown to be free of removable contamination.

   For the purpose of this rule, removable contamination is taken to mean removable amounts of beta-gamma activity greater than 200 cpm or alpha activity greater than 10 dpm as determined by a standard smear test on a surface of 100 square centimeters.

C. Protective Rules - Contamination of Clothing

The rules for prevention of clothing contamination are:

1. It shall be the responsibility of the individual and his supervisor to see that appropriate protective clothing is worn whenever contamination is possible.

2. Protective clothing worn in radioactive areas shall be monitored routinely each day, or when the work with radioactive materials is finished.

3. Coveralls, laboratory coats or other protective garments worn in the laboratory are not to be worn elsewhere, especially in places where smoking, eating, and drinking are a common practice.

4. Contaminated clothing must not be worn in clean areas. Articles which show contamination shall be left in the work area, or other designated areas provided for the purpose. Such clothing shall be marked by the user with his name, the date, and the nature and degree of contamination and held for storage until the activity has decayed to a safe level, decontaminated if possible, or disposed of in the proper manner.

D. Protective Rules - Animals Containing Radioactive Materials.
The Evansville Center is not approved for use of isotopes in live animals.

Table I. Classification of Isotopes According to Relative Toxicity
(The isotopes in each class are listed in order of increasing atomic number)

Toxicity	Isotope
Class 1: Very Dangerous	Sr-90 + Y-90, *Pb-210 + Bi-210 (Ra D + E), Po-210, At-211, Ra-226, Ac-227, *U-233, Pu-239, *Am-241, Cm-242
Class 2: Dangerous	Ca-45, *Fe-59, Sr-89, Y-91, Ru-106 + *Rh-106, *I-131, *Ba-140 + La-140, Ce-144 + *Pr-144, Sm-151, *Eu-154, *Tm-170, *Th-234 + *Pa-234, Natural Th, Natural U
Class 3: Moderately Dangerous	*Na-22, *Na-24, P-32, S-35, Cl-36, *K-42, *Sc-46, Sc-47, *Sc-48, *V-48, *Mn-52, *Mn-54, *Mn-56, Fe-55, *CO-58, *Co-60, Ni-59, *Cu-64, *Zn-65, *Ga-72, *As-74, *As-76, *Br-82, *Rb-86, *Zr-95 + *Nb-95, *Nb-95, *Mo-99, Tc-98, *Rh-105, Pd-103 + Rh-103, *Ag-105, Ag-111, Cd-109 + *Ag-109, *Sn-113, *Te-127, *Te-129, *I-132, Cs-137 + *Ba-137, *La-140, Pr-143, Pm-147, *HO-166, *Lu-177, *Ta-182, *W-181, *Re-183, *Ir-190, *Ir-192, Pt-191, *Pt-193, *Au-196, *Au-198, *Au-199, Tl-200, Tl-202, Tl-204, *Pb-203.
Class 4: Slightly Hazardous	H-3, *Be-7, C-14, F-18, *Cr-51, Ge-71, *Tl-201

*Gamma Emitters

Table II

Radio Toxicity of Isotopes	Levels			
	Low	Intermediate	High	Very High
1. Very Dangerous	0.1 uc	10 uc or less	10 uc-10 mc	10 mc or more
2. Dangerous	1.0 uc	100 uc or less	100 uc-100 mc	100 mc or more
3. Moderately Dangerous	10 uc	1 mc or less	1 mc - 1 c	1 curie or more
4. Slightly Hazardous	100 uc	10 mc or less	10 mc-10 c	10 curies or more

VI. Radiation Emergency Procedures (See Appendix E)

A copy of the following procedures shall be available in each area where emergencies involving radiations are possible.

A. Minor Spills involving no radiation hazard to personnel

1. Notify all other persons in the room at once
2. Permit only the minimum number of persons necessary to deal with the spill into the area.
3. Confine the spill immediately.
   a. Liquid Spills--Don protective gloves
      --Drop absorbent paper on spill
   b. Dry Spills--Don protective gloves
      --Dampen thoroughly*, taking care not to spread the contamination.
4. Notify your Responsible Investigator as soon as possible.'

B. Major Spills involving radiation hazards to Personnel

1. Notify all persons not involved in the spill to vacate the room--at once.
2. Make no immediate attempt to clean up the spill.**
3. If the spill is on the skin, flush thoroughly with water. If the spill is on clothing, discard outer clothing at once.
4. Vacate the room and prohibit entrance to contaminated area. Remain in the area to avoid spread of contamination.
5. Notify the Radiation Protection Officer as soon as possible giving all details of the spill.

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* Water may be used except when chemical reaction with water would generate an air contaminant. Oil should then be used.

** If spill is liquid, and the hands are protected, right the container.

6. Under no circumstances should an untrained person attempt to examine or clean up the radioactive material. The Radiation Protection Officer will supervise the clean up operation.

7. Permit no person to work in the area until the approval of the Radiation Protection Officer is obtained.

C. Accidents involving Radioactive Dusts, Mist, Fumes, Organic Vapors, and Gases

1. Notify all other persons to vacate the room immediately.

2. Hold breath and close all windows, escape valves; switch off air circulating devices, if time permits.

3. Vacate the room.

4. Notify the Radiation Protection Officer at once.

5. Ascertain that all doors giving access to the room are closed and locked. If necessary, post guards to prevent accidental opening of doors.

6. Do not re-enter the room until approval of Radiation Protection Officer is obtained.

D. Injuries to Personnel Involving Radiation Hazard

1. Wash minor wounds immediately, under running water, while spreading the edges of the gash.

2. Report all radiation accidents (wounds, over-exposure, ingestion, inhalation) to the Radiation Protection Officer.

3. Permit no person involved in a radiation injury to return to work without the approval of Radiation Protection Officer and the attendant physician.

E. Fires Involving Radioactivity

1. Notify all persons in the room and building at once.

2. Attempt to put out fires if radiation hazard is not immediately present.

3. Notify the fire department.

4. Notify the Radiation Protection Officer.

APPENDIX A

GUIDES FOR THE USE OF FILM BADGES

Federal and State laws specify the wearing of personnel dosimeters for individuals entering restricted areas who receive or are likely to receive more than 25% of the maximum permissible doses. It is, however, recommended that radiation workers should wear dosimeters where it is likely that 10% of these limits may be exceeded: i.e., where the maximum permissible dose for members of the general public may be exceeded.

TRACER STUDIES

A whole body dose of 40 mrad per month or a hand dose of 600 mrad per month is unlikely to be exceeded during the conventional daily use of 100 uc or less of a gamma emitter, or 1000 uc or less of a beta emitter in tracer studies.

Where quantities of radioisotope greater than these levels are handled, or where the period of daily handling of such quantities comprises a large fraction of the day, it would be prudent to wear a film badge. The Radiation Safety Officer should be consulted.

LOW ENERGY BETA EMITTERS

The beta rays from soft beta emitters such as C-14 and S-35 have insufficient range to affect film badges as normally packaged.

Beta rays, from Tritium will not affect film badges even when modified, and, therefore, individuals handling only Tritium should not wear badges.

TYPES OF BADGES

Body film badges, which can be clipped to the outer clothing, are normally used to record accummulated doses. A permanent record of exposure is established for each film badge user and this will be forwarded to any future employer on request.

For special handling, such as first dilutions of 32p, a ring badge may be more appropriate. These are also available for users when needed.

Request for a badge does take time since the purchase order covering this cost has to be ammended and the company has to establish a new file and send the badge. Appropriate allowance for this time should be made by any anticipated user.

Finally - thought should be given to <u>where</u> a film badge is worn. Consider the geometry of the experiment. If the isotope is primarily present at bench height, wear your badge at that height on the other hand. If you should be layering a labeled material onto a sucrose gradient, for example, your head, neck and shoulders may be close to the isotopic solution for an extended period and the badge should be shifted to an appropriate position, perhaps your collar.

APPENDIX B

ISOTOPE FACT SHEET

1. Isotope: C^{14}

2. Characteristics:
   a. Type of emission - beta particle
   b. Maximum energy of particle, 0.155 MEV
   c. Decay product - N^{14}
   d. Half life - 5600 years

3. Maximum recommended body burden, 300 uC

4. Critical Organ - fat

5. Maximum recommended concentration in water: $2X10^{-2}$ uC/CC

6. Disposal:
   a. Liquid
      1) sink disposal - 50cc H_2O/uC C^{14}
      2) radioactive decay - not practical
   b. Solid:
      1) burial - see Area Radiation Safety Officer
      2) incineration - see Area Radiation Safety Officer
      3) radioactive decay - not practical
   c. Glassware: may be decontaminated by washing in most cases and discarded as non-radioactive waste or re-used.

7. Survey of work areas:
   a. Wipe tests of area most likely to become contaminated and count using instrument used for counting regular samples. Should be done pre and post experiment.

8. Personnel Monitor:
   a. Film Badge - is of no value for C^{14}
   b. Bioassay - may be of value, depending on chemical form and level of activity. Consult Area Radiation Safety Officer and Radiation Safety Officer.

9. Records:
   a. Receipt - amount and date
   b. Disposal - date, approximate activity and method

GOOD HOUSEKEEPING IS A MUST IN A PROPERLY RUN RADIOISOTOPE LABORATORY

ISOTOPE FACT SHEET

1. Isotope: P^{32}

2. Characteristics:
   a. Type of emission - beta particle
   b. Maximum energy of particle, 1.7 MEV
   c. Decay product - S^{32}
   d. Half life - 14.3 days

3. Maximum recommended body burden, 6 μC

4. Critical Organ - Bone

5. Maximum recommended concentration in water $5X10^{-4}$ $\mu C/CC$

6. Disposal:
   a. Liquid:
      1) sink disposal - 2 liters $H_2O/\mu C$ P^{32}
      2) radioactive decay - until background (less than 100 CPM) as determined by end window GM Survey Meter, and discard as non radioactive waste
   b. Solid:
      1) burial - See Area Radiation Safety Officer
      2) incineration - See Area Radiation Safety Officer
      3) radioactive decay - until background (less than 100 CPM) as determined by end window GM Survey Meter, and discard as non radioactive waste.
   c. Glassware: may be decontaminated by washing in most cases and discarded as non-radioactive waste or re-used.

7. Survey of work areas:
   a. Before experiment check area with GM Survey Meter. After experiment re-check area and decontaminate, if needed.

8. Personnel Monitor:
   a. Film Badge - of value if you routinely work with millicurie amounts
   b. Bioassey - should be performed if ingestion of isotope is suspected

9. Records:
   a. Receipt - amount and date
   b. Disposal - date, approximate activity and method

GOOD HOUSEKEEPING IS A MUST IN A PROPERLY RUN RADIOISOTOPE LABORATORY

ISOTOPE FACT SHEET

1. Isotope: I^{131}

2. Characteristics:
   a. Type of emission - beta - gamma
   b. Maximum energy of particle, beta 0.608 MEV (major Beta)
   c. Major gamma - 0.364 MEV
   d. Decay product - $Xenon^{131}$
   e. Half life - 8 days

3. Maximum recommended body burden, 0.7 μC

4. Critical Organ - thyroid

5. Maximum recommended concentration in water $6X10^{-5}$ $\mu C/CC$

6. Disposal:
   a. Liquid:
      1) sink disposal - 17 liters H_2O/1 μC I^{131}
      2) radioactive decay - until background (less than 100 CPM) as determined by end window GM Survey Meter, and discard as non radioactive waste.
   b. Solid:
      1) burial - See Area Radiation Safety Officer
      2) incineration - not practical
      3) radioactive decay - until background (less than 100 CPM) as determined by end wondow GM Survey Meter, and discard as non radioactive waste.
   c. Glassware: may be decontaminated by washing in most cases and disposed of as non-radioactive waste or re-used.

7. Survey of work areas:
   a. Before experiment check area with GM Survey Meter. After experiment re-check area and decontaminate, if needed.

8. Personnel Monitor:
   a. Film Badge - of value if you routinely work with millicurie amounts
   b. Bioassey - should be performed if ingestion of isotope is suspected

9. Records:
   a. Receipt - amount and date
   b. Disposal - date, approximate activity and method

GOOD HOUSEKEEPING IS A MUST IN A PROPERLY RUN RADIOISOTOPE LABORATORY

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ISOTOPE FACT SHEET

1. Isotope: I^{125}

2. Characteristics:
   a. Type of emission - gamma
   b. Maximum energy of particle, .035 MEV
   c. Decay product - Te^{125}
   d. Half life - 60 days

3. Maximum recommended body burden, 0.7 μC

4. Critical Organ - thyroid

5. Maximum recommended concentration in water $4X10^{-5}$ μC/CC

6. Disposal:
   a. Liquid:
      1) sink disposal - 25 liters H_2O/μC I^{125}
      2) radioactive decay - would take about 2 years, depending upon initial activity.
   b. Solid:
      1) burial - See Area Radiation Safety Officer (limited to less than 50 μC per burial, which is ½ of limit for total University per Burial)
      2) incineration - not practical
      3) radioactive decay - would take about 2 years, depending upon initial activity.
   c. Glassware: may be decontaminated by washing in most cases and disposed of as non-radioactive waste or re-used.

7. Survey of work areas:
   a. Before experiment check area with GM Survey Meter. After experiment re-check area and decontaminate, if needed. Wipe tests is the preferred method of survey.

8. Personnel Monitor:
   a. Film Badge - not accurate as for I^{131} of little or no value in working with μC amounts.
   b. Bioassey - should be performed if ingestion of isotope is suspected

9. Records:
   a. Receipt - amount and date
   b. Disposal - date, approximate activity and method

GOOD HOUSEKEEPING IS A MUST IN A PROPERLY RUN RADIOISOTOPE LABORATORY

ISOTOPE FACT SHEET

1. Isotope: H^3

2. Characteristics:
   a. Type of Emission - beta particle
   b. Maximum energy of particle, 0.018 MEV
   c. Decay product - He^3
   d. Half life - 12.3 years.

3. Maximum recommended body burden, 1.0 mC

4. Critical Organ - soft tissue

5. Maximum recommended concentration in water: 0.1 μC/ml.

6. Disposal:
   a. Liquid
      1) sink disposal 10cc $H_2O/\mu C$ H^3
      2) radioactive decay - not practical because of long half life.
   b. Solid:
      1) burial - see Area Radiation Safety Officer
      2) incineration - see Area Radiation Safety Officer
      3) radioactive decay - not practical.
   c. Glassware: may be decontaminated by washing in most cases and disposed of as non-radioactive waste or re-used.

7. Survey of work areas:
   a. Wipe tests of area most likely to become contaminated and count using instrument used for counting regular samples. Should be done pre and post experiment.

8. Personnel Monitor:
   a. Film badge - is of no value for H^3
   b. Bioassay - should be performed after working with uncontained sources of 10 mC or more.

9. Records:
   a. Receipt - amount and date
   b. Disposal - date, approximate activity and method

GOOD HOUSEKEEPING IS A MUST IN A PROPERLY RUN RADIOISOTOPE LABORATORY

APPENDIX C

*EXEMPT QUANTITIES (SELECTED RADIOISOTOPES)

Isotope	Microcuries	Isotope	Microcuries
Antimony-124	10	Iridium-192	10
Cadmium-109	10	Mercury-203	10
Calcium-45	10	Nickel-63	10
Carbon-14	100	Phosphorus-32	10
Cerium-141	100	Praseodymium-143	100
Cerium-144	1	Promethium-147	10
Cesium-134	1	Ruthenium-103	10
Cesium-137	10	Silver-110m	1
Chlorine-36	10	Sodium-24	10
Cobalt-60	1	Strontium-85	10
Europium-152 13 yr	1	Strontium-90	0.1
Europium-154	1	Sulphur-35	100
Gadolinium-153	10	Terbium-160	10
Gold-198	100	Thallium-204	10
Hydrogen-3	1,000	Thulium-170	10
Iodine-125	1	Tin-113	10
Iodine-131	1	Yttrium-91	10

*From paragraph 30.71 of Atomic Energy Commission Regulations

11/1/70

APPENDIX C

PROCEDURES FOR OPENING PACKAGES CONTAINING RADIOACTIVE MATERIAL

1. Visually inspect package for any sign of damage (e.g., wetness, crushed). If damage is noted stop procedure and notify Radiation Protection Officer.

2. Measure exposure rate at 3 feet from package surface--record. If >10 mR/hr—stop procedure and notify Radiation Protection Officer.

3. Measure surface exposure rate and record. If >200 mR/hr--stop procedure and notify Radiation Protection Officer.

4. Put on gloves.

5. Open the outer package (following manufacturer's directions, if supplied) and remove packing slip. Open inner package to verify contents (compare requisition, packing slips, and label on bottle) check integrity of final source container (inspect for breakage of seals or vials, loss of liquid, discoloration of packing material). Fill out the receiving slip to indicate condition and contents of order compared to the packing slip.

6. Wipe external surface of final source container with moistened cotton swab or filter paper held with forceps, assay and record.

7. Monitor the packing material and packages for contamination before discarding:

   a. if contaminated, treat as radioactive waste.

   b. if not, obliterate radiation labels before discarding in regular trash.

8. Return packing slip and receiving slip to be processed.

Appendix D

INDIANA UNIVERSITY SCHOOL OF MEDICINE
EVANSVILLE CENTER
P. O. Box 3287 – Evansville, Indiana 47732
(812) 479-2061

April 17, 1979

TO: Mailroom
Security Office

FROM: Dr. Guthrie

SUBJECT: Receipt of Radioisotopes

From time to time we will receive packages of radioisotopes as part of our normal supply shipments. These packages will be marked with an emblem similar to the one reproduced below. These packages should be delivered to the Center within three hours of receipt. One of the individuals listed below or their designated representative should receive the package.

During off-duty hours, if a package should be delivered, one of these individuals should be notified by phone of the receipt of the package. Notification should be attempted in the order listed.

Medical Education Building 8600 University Blvd.	Office Phone	Home Phone
Dr. George Guthrie	464-1831	985-2046
Dr. Howell Rogers	464-1832	464-8296
Dr. Godfrey Tunnicliff	464-1833	479-3711

Health Science Bldg. 1901 E. Walnut St.	Office Phone	Home Phone
Dr. John Schaeffer	479-2061	477-8225
Dr. Keith Matheson	479-2061	867-6189
Dr. George Guthrie	464-1831	985-2046

A COPY OF THIS APPENDIX SHOULD BE POSTED IN AREAS WHERE ISOTOPES ARE USED

Appendix E

Outline of EMERGENCY PROCEDURES to be Followed
in the Event of a RADIOISOTOPE SPILL

Minor Spills:

1. NOTIFY: Notify persons in the area that a spill has occurred.

2. PREVENT THE SPREAD: Cover the spill with absorbent paper.

3. CLEAN UP: Use disposable gloves and remote handling tongs. Carefully fold the absorbent paper and pad. Insert into a plastic bag and dispose of in the radioactive waste container. Include all other contaminated materials such as disposable gloves.

4. SURVEY: With a G.M. Survey Meter, check the area around the spill, your hands and clothing for contamination.

5. REPORT: Report incident to the Radiation Protection Officer.

Major Spills:

1. CLEAR THE AREA: Notify all persons not involved in the spill to vacate the room.

2. PREVENT THE SPREAD: Cover the spill with absorbent pads, but do not attempt to clean it up. Confine the movement of all personnel potentially contaminated to prevent the spread.

3. SHIELD THE SOURCE: If possible, the spill should be shielded, but only if it can be done without further contamination or without significantly increasing your radiation exposure.

4. CLOSE THE ROOM: Leave the room and lock the door(s) to prevent entry.

5. CALL FOR HELP: Notify the Radiation Protection Officer immediately.

6. PERSONNEL DECONTAMINATION: Contaminated clothing should be removed and stored for further evaluation by the Radiation Protection Officer. If the spill is on the skin, flush thoroughly and then wash with mild soap and lukewarm water.

RADIATION PROTECTION OFFICER George D. Guthrie, Ph.D.

OFFICE PHONE: (812) 464-1831

HOME PHONE: (812) 985-2046

OR John F. Schaeffer, Ph.D.

OFFICE PHONE: (812) 479-2061

HOME PHONE: (812) 477-8225