TOWSON UNIVERSITY

RADIATION PROTECTION PROGRAM

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I. ORGANIZATION FOR CONTROL OF RADIATION

A. Radiation Safety Officer.

The Radiation Safety Officer (RSO) performs those functions outlined in Section II. The RSO is charged with the establishment and supervision of the radiation protection program. Notwithstanding any other sections of this program, the RSO may designate Principle Users or properly licensed vendors to perform various duties.

B. Principal Users.

A Principal User (PU) is a trained University employee or student specifically authorized by the MDE Radioactive Materials License to possess and use radioactive material. Personnel not employed by or attending the University who have been authorized by the University Administration to utilize University facilities may make application to and receive written approval from the RSO for authorization to use radioactive materials and/or radiation producing devices. If the individual is qualified to perform independent work, they may be permitted to do so as a Principle User. Principle User responsibilities are outlined in Section III.

C. Individual Users.

An Individual User (IU) is any person who performs actual operations with radioisotopes or equipment that emits ionizing radiation. An Individual User may only work under the direct supervision of a Principle User. Individual User responsibilities are outlined in Section IV.

II. RADIATION SAFETY OFFICER RESPONSIBILITIES

A. Review and approve all protocols for the use of licensed material.

B. Perform general surveillance of all health physics activities, including personnel and environmental monitoring.

C. Ensure all occupational doses and doses to members of the public are ALARA.

D. Authorize procurement, receipt, use and disposal or transfer of radioactive materials.

E. Receive, distribute and process personnel monitoring devices, including the maintenance of records, and appropriate notifications to individuals and licensing agencies.

F. Provide training for all previously untrained licensed material users prior to beginning duties with or in the vicinity of licensed materials and update training whenever there is a significant change in duties, regulations, or the terms of the license. Provide refresher training to all users and ancillary personnel as required.

G. Supervise and coordinate radioactive material waste disposal procedures, including the maintenance of waste storage, transfer and disposal records.

H. Maintain an inventory of all licensed radioactive materials, including amounts, isotopes and locations.

I. Provide supervision and assistance for the management of emergency, accident, spill, or exposure situations. Promptly investigate all incidents involving licensed materials.

J. Formulate policies and procedures for the control of radiation. Maintain records of active approved protocols on file.

K. Prepare all license revisions and amendments. Be the University's primary point of contact with all regulatory agencies regarding radioactive materials and/or radiation producing devices.

L. Periodically review the results of periodic point of use work area surveys performed under the supervision of Principal Users.

M. Perform monthly surveys of all licensed areas where materials are actively being used or stored. If radioactive materials are not being actively used or stored in the lab, surveys will be performed quarterly. Document the results of these surveys and maintain records on file.

N. Perform or contract for air sampling and/or bioassay procedures as necessary.

O. Review the Radiation Safety Program, at a minimum, annually and make changes as necessary. Document and maintain records of any program changes implemented.

P. In direct compliance with COMAR 26.12.01.01 §D.101 (c) ensure that the University Radiation Safety Program is audited on an annual basis in accordance with the procedures contained in Tab A – Annual Program Review.

Q. Ensure that all licensed material users are familiar with State Radiation Protection Regulations regarding False Statements, Representations, Certifications and Misconduct contained in COMAR 26.12.01.01 Section A. 15 & 16 in Tab I.

III. PRINCIPAL USERS RESPONSIBILITIES

A. Post all areas under their control with proper radiation warning signs. All areas where licensed radioactive materials or radiation producing devices are located are considered "Restricted Areas". The entrances to restricted areas will be locked at all times when there is no one physically in the laboratory/workspace or when the areas are otherwise unattended to prevent unauthorized entry and to prevent unauthorized access to or removal of licensed materials. All visitors are required to be escorted in restricted areas.

B. Equip each laboratory with appropriate survey meters, and ensure the meters are operational and in calibration. Deliver meters to the RSO when they are in need of service (calibration or repair).

C. Responsible for the safe use of licensed materials under their control and the proper supervision of their Individuals Users and for ensuring work areas are not contaminated.

D. Adhere to all applicable regulations and rules governing the safe use of radioactive materials and/or radiation producing devices set forth in the MDE Radioactive Material License.

E. Plan and organize experiments or programs considering the type and activities of radiation used such that exposures are kept as low as reasonable achievable (ALARA) to radiation workers and the general public (see Section V).

F. Contact the RSO prior to changes in operational procedures, equipment changes (additions/removal), or shielding so the RSO may support the implementation of those changes.

G. Notify the RSO concerning a new user to facilitate administrative processing, which includes training and the assignment of dosimetry devices (if required for the work area).

H. Ensure time-of-use health physics surveys are completed. Review the results of time-of-use health physics surveys and report any positive results to the RSO in writing within 5-business days.

H. Ensure legible user survey wipe test log is maintained in each laboratory where radioactive materials are used indicating isotope surveyed for, date of survey, survey results and name of individual performing survey. This log will be maintained for a period of three (3) years by the PI in an accessible location in each lab for periodic inspection by the RSO, MDE or EHS staff. (See Tab H – Contamination Surveys)

I. Instruct Individual Users for whom they have supervisory responsibility with site specific training in the safe use and handling of radioactive materials and or radiation producing devices prior to their use. Training will be documented in writing and a copy provided to the RSO within 5-business days. Closely supervise Individual Users until such time as they are confident in their safe work practices and determine they are capable of working unsupervised.

J. Ensure that Individual Users under their control accept and comply with their individual responsibilities that are described in Section IV.

K. Provide the RSO with proposed research protocols involving the use of radioactive materials or radiation producing devices for review and approval at least 30-days prior to the project start-up.

L. At least annually, review this Radiation Protection Program and submit signed Review Certification to RSO. Failure to do so may result in your loss of the privilege to use radioactive materials. (See Tab J- Annual Radiation Protection Program Review Certification)

M. Comply with the policies of the Radiation Protection Program.

IV. INDIVIDUAL USERS

A. Before beginning work with licensed material or work in radiation areas, each worker must complete administrative processing and receive dosimetry devices (if required for the work area). In addition, all radiation workers must successfully complete a formal site specific training orientation prior to working with any licensed materials or radiation producing device.

B. All areas where licensed radioactive materials or radiation producing devices are located are considered "Restricted Areas". The entrances to restricted areas will be locked at all times when there is no one physically in the laboratory/workspace or when the areas are otherwise unattended to prevent unauthorized entry and to prevent unauthorized access to or removal of licensed materials. All visitors are required to be escorted in restricted areas.

C. Wear the prescribed monitoring equipment (dosimetry), such as film and/or ring badges, in areas authorized for use and/or storage of radioactive materials.

D. Keep occupational exposures and exposures to the public ALARA (see Section V). Comply with the policies of the Radiation Protection Program.

E. Monitor hands, shoes and body for radioactivity before leaving a laboratory where unsealed radioisotopes are used or where contamination is possible.

F. Utilize good laboratory practices to reduce exposures and the spread of contamination, such as the use of personal protective equipment (laboratory coats, gloves, and safety glasses), proper shielding, mechanical pipette devises, spill trays, plastic backed absorbent paper, and approved hoods or glove boxes when working with volatile radionuclides/compounds.

G. Eating, drinking, chewing gum, smoking and applying cosmetics is prohibited in radionuclide laboratories. Refrigerators shall not be used to store foods and radioactive materials jointly.

H. Maintain good personal hygiene; keep fingernails short and clean, double glove or avoid work with radioactive materials if there is a break in the skin below the wrist, and wash hands and arms after use with radioactive material and before eating, drinking, and smoking, handling contact lenses or applying cosmetics.

I. Monitor work areas where radioactive materials are used (hoods, benches, adjacent floors, and equipment) at least once daily or at the end of each procedure for contamination. The contamination check will be performed using an appropriate survey meter (Ludlum Model 3 with Model 44-3 or Model 44-9 detector) for easily detected isotopes such as ^{32}P or ^{33}P or by performing wipe tests and using a liquid scintillation counter (LSC) for analysis for isotopes not easily detected with a survey meter (^{14}C, ^{3}H or ^{35}S). Wipes tests will be performed by the User after each use of ^{32}P and weekly for all other isotopes during periods of active isotope usage. If radioactive materials are not being actively used or stored in the lab, user wipe tests will be performed at least semi-annually. The Principle User is responsible for the performance of these surveys and will maintain written records of all surveys for a period of three (3) years. Any contamination identified should be cleaned immediately. The RSO can provide advice for decontamination procedures. (See Tab H – Contamination Surveys)

J. Promptly and properly label all radioactive waste and contaminated equipment. Once used with radioactive material, equipment shall not be used for other work and shall not be removed from the area for cleaning, repair or for surplus until it is free-released (free of contamination to specified levels). (See Tab B – Action Levels for Removable Contamination).

K. Immediately report accidental inhalation, ingestion, or injury involving radioactive materials to their supervisor and the RSO and carry out their recommended corrective measures. The individual shall cooperate in any and all attempts to evaluate their exposure.

L. Comply with requests from the RSO for body burden measurements and the submission of urine samples for radio-assay. A request for these tests will be made in the event a worker is exposed while using significant quantities of gamma and /or beta emitters.

M. All areas where licensed radioactive materials or radiation producing devices are located are considered “Restricted Areas”. The entrances to restricted areas will be locked at all times when there is no one in the area or when the areas are otherwise unattended. All visitors are required to be escorted in restricted areas.

N. Comply with the policies of the Radiation Protection Program.

O. At least annually, review this Radiation Protection Program and submit signed Review Certification to RSO. Failure to do so may result in your loss of the privilege to use radioactive materials. (See Tab J- Annual Radiation Protection Program Review Certification)

V. RADIATION EXPOSURE CONTROL

A. Each individual who has contact with licensed radioactive materials must adhere to the following procedures:

1. Keep exposures to radiation at levels as low as reasonably achievable (ALARA). The following ALARA limits are established as a goal:

ALARA Dose Limits	
Occupationally Exposed Adults	0.1 rems TEDE 1 rem TODE (except lens of the eye) 0.3 rems EDE (or LDE)
Minors Less than 18 Years Old	500 mrems
Declared Pregnant Woman	.05 rems to embryo/fetus

Notes:

1. The "total effective dose equivalent" (TEDE) is defined as the sum of the "deep-dose equivalent” (for external exposures) and the "committed effective dose equivalent" (for internal exposures).
2. The "total organ dose equivalent" (TODE) applies to the sum of the "deep-dose equivalent" and the "committed dose equivalent" to any individual organ or tissue.
3. In order to avoid confusion with the acronym for effective dose equivalent (EDE), the abbreviation LDE is also used to represent the eye (lens) dose equivalent.

2. Wear the prescribed monitoring equipment, such as film badges and ring badges. All users of $\geq$ 1.0 mCi of ^{32}P are required to obtain and use ring badges.

3. Survey hands, feet, and body for radioactivity before leaving the laboratory area where unsealed radioisotopes are used, or where contamination is possible (except for ^{3}H only).

4. Use all appropriate protective measures such as:

   (a) Wear protective clothing (laboratory coats, disposable gloves & eye protection) whenever contamination is possible; and do not wear such clothing outside the laboratory area.

   (b) The use of disposable gloves and safety glasses is mandatory when working with licensed sealed and unsealed sources of radioactive material. Respiratory protection will be worn when directed by the RSO.

   (c) Use protective barriers and mechanical devices whenever their aid will assist in reducing exposure.

   (d) Use pipette-filling devices. Never pipette radioactive solutions by mouth.

5. Smoking, eating, drinking, chewing gum, the possession of food items or containers or utensils used for food, or the application of cosmetics is prohibited in all laboratories and restricted areas. Refrigerators will not be used jointly for foods and radioactive materials. Food and beverage containers shall not be discarded in radioactive or domestic trash containers in areas utilizing radioactive materials.

6. Food items in the laboratory used for research shall be clearly and legibly marked "Not for Human Consumption – For Research Purposes Only".

7. Maintain good personal hygiene.

   (a) Do not work with radioactive materials if there is a break in the skin below the wrist, or use double gloves.

   (b) Wash hands and arms thoroughly before handling any object that goes into the mouth, nose, or eyes.

8. When working with ^{32}P, low-density shielding materials such as plexiglass <u>will be used</u> in order to minimize Bremsstrahlung radiation.

9. For procedures requiring $\geq$1.0 mCi of ^{32}P, a "dry run" will be performed in order to preclude unexpected complications. It is recommended that the RSO is present during the "dry run" of new procedures requiring the use of $\geq$1.0 mCi of ^{32}P.

10. A pregnant radiation worker may voluntarily declare her pregnancy in writing to the Radiation Safety Officer (RSO) utilizing a Declaration of Pregnancy Form. (See Tab E-Voluntary Pregnancy Declaration) The RSO will review your declaration, and recommend a personnel monitoring program based on the information supplied in the Declaration of Pregnancy form. Upon declaration of pregnancy, the radiation dose to the embryo/fetus during the entire pregnancy will not be allowed to exceed 0.5 rem Total Effective Dose Equivalent (TEDE).

11. Dosimetry reports will be reviewed monthly to determine any occupational exposure. If an exposure occurs, the RSO will review the individuals work practices to determine the cause of exposure and will make the necessary recommendations for changes in procedures, etc., to prevent future exposures.

VI. GENERAL POLICIES AND PROCEDURES

A. Marking of laboratory, areas and equipment.

1. "Caution Radioactive Materials" (CRM) signs must be conspicuously posted on all doors to areas where licensed radioactive materials are being used or stored (other than natural uranium or thorium) in amounts exceeding 10 times the exempt quantity limit. (COMAR 26.12.01.01, Part D, App C).

10x Exempt Quantity Limits:	
Radionuclide	Activity (mCi)
^{3}H	10
^{14}C	10
^{35}S	1
^{33}P	1
^{125}I	0.01

All other authorized areas where radioactive materials are used or stored will be posted with a "Radioactive Materials" sign.

2. Upon the termination of use with radioactive materials in an authorized area, all radiation warning signs will only be removed by the RSO following any necessary user decontamination and after a final RSO clearance inspection survey.

3. Containers in which licensed materials are stored, or contaminated equipment/area's will be marked with a CRM label, tape or sign. Exceptions are made for materials that are continuously attended, are stored for less than 8 hours, or contain less than an exempt quantity of radioactive material.

4. Prior to the disposal of an empty uncontaminated container to an unrestricted area, the radioactive material label will be removed, defaced, or otherwise marked to clearly indicate that the container is empty.

B. Shielding of Sources.

1. Radioactive sources or stock solutions in the laboratory shall be shielded in such a manner that the radiation level in any occupied area will not expose individuals in the area to more than 100 mrems in any five (5) consecutive days. All regulated materials will be stored in secured, clearly labeled, permitted locations that are well away from the general public and ensure worker exposures are ALARA.

2. When working with ^{32}P, a low-density shielding materials such as plexiglass will be used in order to minimize Bremsstrahlung radiation.

C. Aerosols, dusts, and gaseous products.

1. Procedures involving aerosols, dusts or gaseous products, or procedures that might produce airborne contamination shall be conducted in a hood, dry box, or other suitably closed system.

1. Radioactive gasses or materials with radioactive gaseous daughters must be stored in gas-tight containers and must be kept in areas having approved ventilation. (E.g. fume hoods, glove boxes, etc.)

2. Prior to the use of volatile forms of radioactive materials fume hoods will be tested by the RSO to insure that they meet the minimum flow rate (100 linear feet per minute for air velocity at the face of the hood) and annually thereafter as long as radioactive use actively continues.

4. Air monitoring for radioactive materials, when required, will be performed in accordance with the procedures contained in Tab C – Air Monitoring.

D. Sealed Sources.

1. All sealed sources (licensed and non-regulated) will be purchased and disposed of through the RSO. All sealed sources containing licensed material will be registered by the RSO. All sealed sources will be managed as follow:

(a) Sealed sources will be legibly labeled as to isotope, activity, manufacturer (if known) and with the procurement date. Unlabelled or unidentifiable sealed sources will be promptly disposed of through the RSO. Sealed sources will not be opened.

(b) Sealed sources will be kept under lock & key except when actively in use. Sealed source storage areas will be posted as required.

(c) All sealed sources will be disposed of through the RSO when no longer required.

2. Each licensed radioactive sealed source, other than ^{3}H, with a half-life greater than thirty days and in any form other than a gas will be tested for leakage and/or contamination every six (6) months. In the absence of a certificate from the transferor indicating that a test has been made within six months prior to the transfer, the sealed source will not be put into use until tested. If there is a reason to suspect that a sealed source might have been damaged, or might be leaking, it will be tested for leakage before further use.

3. Records of leak tests will be kept in units of microcuries (μCi) and maintained by the RSO.

3. If the test reveals the presence of 0.005 μCi or more of removable contamination or in the case of radium, the escape of radon at the rate of 0.001 μCi or more per 24 hours, the RSO will immediately withdraw the sealed source from use and cause it to be decontaminated and repaired or to be disposed of in accordance with Maryland regulations.

4. Any licensed sealed source is exempt from leak tests when the source contains 100 μCi or less of beta and/or gamma emitting material or 10 μCi or less of alpha emitting material.

5. All leak tests will be performed and analyzed by the RSO in accordance with the procedures contained in Tab H – Contamination Surveys.

E. Radioactive Materials in Gas Chromatography (GC) Equipment.

1. All GC sealed sources (licensed and non-regulated) will be purchased and disposed of through the RSO. All sealed sources containing licensed material will be registered by the RSO. All sealed sources will be managed as follows:

(a) Sealed sources will be legibly labeled as to isotope, activity, manufacturer (if known) and with the procurement date. Unlabelled or unidentifiable sealed sources will be promptly disposed of through the RSO. Never open sealed sources.

(b) GC's containing sealed sources will be kept under lock & key except when actively in use. Sealed source storage areas will be posted as required.

2. Each GC cell containing a radioactive foil must have a label showing the radiation caution symbol and the words ``CAUTION - RADIOACTIVE MATERIAL'', and the identity and activity of the radioactive material.

3. The radioactive foil shall not be removed from its identifying cell except for cleaning and shall not be transferred to other cells.

4. The RSO will perform periodic leak tests and maintain the necessary records on such tests every six (6) months.

5. The RSO will be notified prior to the acquisition of any new GC or the transfer, relocation or disposal of any GC's containing any radioactive materials.

F. Work Surfaces

1. All work areas and storage areas where unsealed radioactive materials are used (bench tops, etc.) will be covered with plastic backed absorbent paper or impervious trays or pans to limit the spread of contamination and will be clearly marked/delineated with radiation warning tape. Soiled or contaminated absorbent paper will be replaced, and impervious work surfaces cleaned at least daily when working with radioactive materials or more often as necessary to maintain a clean, uncontaminated work surface.

G. Periodic Surveys

1. The immediate areas in which licensed materials are used in unsealed form will be meter surveyed by the User for contamination at least once daily when radioisotopes are used. (Except ^{3}H areas.) The contamination check will be performed using an appropriate survey meter (Ludlum Model 3 with Model 44-3 or Model 44-9 detector) for easily detected isotopes such as ^{32}P or ^{33}P or by performing wipe tests and using a liquid scintillation counter (LSC) for analysis for isotopes not easily detected with a survey meter (^{14}C, ^{3}H or ^{35}S). Wipe tests will be performed by the User after each use of ^{32}P and weekly for all other isotopes during periods of active isotope usage. If radioactive materials are not being actively used or stored in the lab, user wipe tests will be performed at least semi-annually. The Principle User is responsible for the performance of these surveys and will maintain written records of all surveys <u>for a period of three (3) years</u>. Any contamination identified should be cleaned immediately. The RSO can provide advice for decontamination procedures. (See Tab H – Contamination Surveys)

2. The RSO, designated staff or contractor will conduct monthly surveys of all licensed areas where materials are actively being used or stored. If radioactive materials are not be actively used or stored in the lab, surveys will be performed quarterly. The RSO will maintain reports of these surveys on file.

J. Radiation Detectors

1. Each laboratory where licensed materials are used in unsealed form (except ^{3}H) will be equipped with an appropriate portable radiation detector to be used for personnel and area monitoring. These instruments (and associated probes) will be calibrated semi-annually through the RSO.

I. Removal of Equipment from the Laboratory.

1. Once used for radioactive substances, equipment shall not be disposed of, moved from an authorized radiation laboratory, or used for other work until demonstrated to be free of contamination. It is the Principle User's responsibility to ensure equipment in areas under their control is adequately decontaminated. Contamination limits are outlined in Tab B – Action Levels for Removable Contamination.

J. Repair and Maintenance of Equipment in the Laboratory.

1. Equipment to be repaired/serviced by University maintenance personnel or commercial service contractors will be demonstrated to be free of contamination prior to servicing. It is the Principle User's responsibility to ensure equipment in areas under their control is adequately decontaminated. Contamination limits are outlined in Tab B - Action Levels for Removable Contamination.

K. Radioactive Contamination of Areas

1. In general, no radioactive contamination is permissible. Any contamination that is not confined to protected surfaces will be cleaned immediately. It is the Principle User's responsibility to ensure all areas and equipment under their control is adequately decontaminated. Acceptable contamination limits are outlined in Tab B - Action Levels for Removable Contamination.

L. Decontamination of Personnel

In the event an individual becomes contaminated, the following procedures will be followed:

1. Notify the RSO as soon as possible. Provide the RSO with the isotope and approximate activity of the contaminating source.

2. Immediately wash the body area involved thoroughly for 2 or 3 minutes, repeatedly "soaping" and rinsing. Any cleansing agent may be used, but soaps are preferred to detergents. Avoid the use of organic solvents.

3. The RSO may authorize the use of other washing agents, such as wetting agents, etc.

4. Acceptable contamination limits are outlined in Tab B - Action Levels for Removable Contamination.

VII. RADIATION SPILL PROCEDURES

The consequences of any spill of radioactive material can be minimized by performing all work on plastic-backed absorbent liner to absorb spills. Spreading of radiation beyond the spill area can easily occur by the movement of personnel involved in the spill or clean-up effort. Prevent spread by confining movements of personnel until they have been monitored and found free of contamination. Perform remedial actions without the assistance of safety personnel **only** on minor spills. Major spill cleanup must be supervised by Radiation Safety Office personnel.

A. Minor Spills

A minor spill is defined as:

- A spill resulting in no personal internal contamination; or,
- Is confined to a posted radiation area; or,
- Involves < 500 microcuries (µCi) weak beta emitter spill, e.g. H-3, C-14, S-35; or,
- Involves < 10 µCi hard beta emitter spill, e.g. P-32 ; or,
- Involves < 10 µCi gamma emitter spill.

1. Immediately notify people in immediate area of the spill.

2. If there is a fire or if medical attention is needed, immediately call Baltimore County 911 and then call TUPD at x4-4444.

3. Immediately confine and contain the spill by placing absorbent materials such as paper towels or diaper paper over the spill.

4. Have all potentially contaminated individuals stay in one location until they have been monitored and determined to be free of contamination.

5. Notify the Radiation Safety Office (RSO) at (410) 704-2949. Know the radioactive isotope and activity of the spilled material when you call. (After duty hours, weekends or Holidays, contact the TUPD and request they contact the RSO. Provide the TUPD with a callback telephone number so the RSO can contact you directly.)

6. Prior to spill cleanup, don appropriate personal protective equipment (PPE) such as lab coat, shoe covers, double layer of disposable gloves, etc.

7. Clean spill area using normal cleaning agents. All measurable levels of fixed and removable contamination must be reduced to $\leq$220-dpm/100 cm^2.

8. Collect and dispose of all cleaning materials in a radioactive waste container.

9. Using the appropriate survey meter and scale, monitor the area for contamination and repeat cleaning procedures until no contamination remains.

10. Once the spill has been cleaned up and all contamination removed, monitor hands and shoes for contamination and decontaminate as necessary.

11. Ensure all contaminated cleanup materials and PPE have been disposed of into a radioactive waste container.

12. Submit a written report of the incident to Radiation Safety Office within 2-business days. Include a complete history of the accident, as well as corrective measures taken, and signatures of all individuals involved.

B. Major Spills

A major spill is defined as:

- A spill resulting in potential personal internal contamination; or,
- A spill resulting in potential airborne contamination, e.g. I-125; or,
- Occurs outside of a posted radiation area; or,
- Involves > 500 µCi weak beta emitter spill, e.g. H-3, C-14, S-35; or,
- Involves > 10 µCi hard beta emitter spill, e.g. P-32; or,
- Involves > 10 µCi gamma emitter spill; or,

- Survey Meter readings >5mr/hr at 1 meter.

1. Immediately notify people in immediate area of the spill.

2. If there is a fire or if medical attention is needed, immediately call Baltimore County 911 and then call TUPD at x4-4444.

3. If an individual is injured, apply immediate first aid as necessary. Do not let the possibility of radioactive contamination hinder first aid efforts. Decontamination of wounds, etc., can always be done after the victim's medical condition has been stabilized.

4. Vacate and seal the room to prohibit access and limit contamination. Use rad warning tape across all access routes. Go to a safe area, avoiding additional contamination of personnel. As practical, take precautions to limit the spread of contamination to other areas. Keep hoods running. Turn off any oscillating fans.

5. If the spill is airborne, switch off all ventilators and fans. Facilities Management Work Control should be immediately contacted at X4-2481 to shut down Building HVAC systems.

6. Have all potentially contaminated individuals stay in one location until they have been monitored and determined to be free of contamination.

    - If the spill is on clothing, remove the article at once and discard it in a plastic bag.
    - If the spill is on the skin, flush thoroughly with water and wash with soap or detergent.

7. Confine and contain the spill by placing absorbent materials such as paper towels or diaper paper over the spill.

8. Notify the Radiation Safety Office (RSO) at (410) 704-2949. Know the radioactive isotope and activity of the spilled material when you call. (After duty hours, weekends or Holidays, contact the TUPD and request they contact the RSO. Provide the TUPD with a callback telephone number so the RSO can contact you directly.)

9. Follow RSO instructions. Do not re-enter area until RSO gives approval.

10. Have a person with direct knowledge of incident, the materials involved and the workspace be immediately available for EHS and emergency response personnel.

11. Submit a written report of the incident to Radiation Safety Office within 2-business days. Include a complete history of the accident, as well as corrective measures taken, and signatures of all individuals involved.

C. For Skin & Body Radiation Contamination

1. Notify EHS immediately whenever any case of skin or body contamination occurs.

2. Note the original survey meter reading, the location of the contaminated area and the time of the contamination was discovered. EHS will use this information to calculate dose.

3. Wash skin using mild soap and warm water for 2-3 minutes. Do not abrade skin or use hot water.

4. Measure and record the count rate after the initial attempt at decontamination. Survey and repeat decontamination until the count rate cannot be reduced any further.

5. If the skin becomes irritated, discontinue decontamination.

6. When decontamination efforts are not immediately successful, often a substantial reduction in count rate is achieved during the next 24-hours with periodic washings with soap and water, combined with normal flaking of the skin.

7. The Principle User will complete a written report of the accident, listing the individuals involved and the corrective action taken. A copy shall be sent to the RSO within two (2) working days.

VIII. DOSIMETRY

A. External Radiation Monitoring

1. Whole body exposures will be evaluated with body badges on a monthly exchange basis. Direct reading dosimeters will replace or supplement the body badge for a short duration.

2. Doses to the extremities will be evaluated with ring badges. Personnel working with $\geq$ 1 millicurie of ^{32}P in any one procedure must wear ring badges. These badges will be exchanged monthly.

3. The following procedures will be followed for body and ring badges:

   (a) Wear only your assigned dosimeter; never wear another worker's badge.

   (b) Wear your whole body badge between your collar and waist. Wear your ring badge beneath your gloves with the label on the palm side of the hand that handles the radiation source and thus has the greatest potential for exposure.

(c) Store you dosimetry in a clean, dry environment on campus away from radiation sources or heat sources. Do not take dosimetry home.

(d) Do not get your film badge wet. If your film badge gets wet, immediately contact the RSO and if necessary, you will be given a new badge.

(e) If you suspect contamination on your badge, return it immediately to the RSO, you will be given a new, uncontaminated badge.

(f) Never intentionally expose your badge to any radiation.

(g) Do not wear your badge when receiving medical radiation exposure (e.g., x-rays, tests, nuclear medicine, etc.)

(h) Return your badge to the RSO at the end of the monitoring period. Failure to promptly return your badge will result in your being assigned an administrative exposure dose which may preclude your future use of radioactive materials.

B. Internal Radiation Monitoring - Bioassay

1. Although Maryland requires only that dose evaluation and routine bioassay programs are adequate to demonstrate compliance at a level of 10% of the annual dose equivalent standards, it is the practice of this program to provide bioassay monitoring capability to detect an intake potentially resulting in a committed effective dose equivalent of 100 mRem.

2. This program recommends placing workers on a routine bioassay-monitoring program if the 50-year committed effective dose equivalent from a single intake or multiple intakes in a single calendar year may exceed 100 mRem for all radionuclides.

3. The Annual Limit on Intake (ALI) is a useful concept for bioassay planning purposes when acute intakes are considered or exposure may be limited to readily identified quantities or sources. Routine bioassay monitoring will be performed for an acute or chronic intake of activity corresponding to 2% of the ALI.

4. Baseline and ending work samples or measurements will be obtained for a worker whose work assignments will require or have required routine bioassay monitoring.

5. Selection of Nuclides for Bioassay

   Any radionuclide or mixture of radionuclides that may contribute more than 25% to the 100-mRem committed effective dose equivalent criterion will be included in the bioassay-monitoring program.

6. Bioassay Measurement Frequency

   (a) The frequency of bioassay measurements is dictated by two objectives. The first is to monitor the accumulation of radioactive material in the body from low-level chronic intakes. The second is to assure that significant acute depositions are detected so that appropriate corrections can be instituted in the working conditions.

   (b) Generally, quarterly measurements will be used as a minimum frequency. Routine bioassay measurement periods longer than five effective half-lives are also generally not recommended, because the potential deviation of individuals from assumed retention or excretion patterns can substantially affect doses associated with the program design.

7. Recommended Bioassay Measurements and Intervals.

   (a) A summary of recommended combinations of measurements for various nuclides and situations is given below for single nuclides. These programs are recommended primarily based on the ability of routine measurements to meet first year effective dose equivalents of 100 mRem.

   (b) Optimum programs can be designed by the RSO based on characterized sources and potential intake patterns.

BIOASSAY PROGRAMS FOR SOME TYPICAL SINGLE RADIONUCLIDES

	Isotope Activity above which Bioassay is necessary (mCi)	Program Frequency
^{3}H	100	Monthly urine samples for potential chronic or multiple acute exposures. If data indicate potential annual dose in excess of 100 mrem, change to biweekly frequency.
^{14}C	40	Bi-Monthly
^{33}P	60	Bi-Monthly
^{35}S	40	Quarterly
^{125}I	0.8	Quarterly

8. All bioassays will be coordinated in advance by the RSO.

IX. MATERIAL INVENTORY, CONTROL & ACCOUNTABILITY

Principle Users are responsible for accounting for all licensed materials they have received and keeping current written records of all decayed waste materials stored in their possession.

The RSO or designated staff will conduct a physical inventory of all radioactive materials (licensed and non-regulated, exempt quantities) and radioactive wastes on a quarterly basis and calculate the total current activities on-hand for each isotope to ensure that possession limits are not exceeded. Written records will be maintained by the RSO of the inventory. All radioactive materials (licensed and non-regulated, exempt quantities) materials are ordered by the RSO and will ensure that possession limits are not exceeded.

X. PROCUREMENT OF RADIOACTIVE MATERIALS

In order to accurately track and properly account for all radioactive materials on campus, ALL radioactive materials (licensed and non-regulated, exempt quantities) including naturally occurring radioactive materials (NORM) such as uranyl acetate, uranyl nitrate, etc., will be ordered by the RSO and paid for by the ordering department.

A. Unlicensed, Non-Regulated or Exempt Quantity Radioactive Materials

All purchases of unlicensed, non-regulated or exempt quantity radioactive materials or NORM will be made by RSO staff. To purchase these materials, the purchaser shall provide the RSO with the following information:

- Vendor Name & Telephone Number
- Purchasing Department's Account Number with Vendor, if applicable
- Material, Isotope & Activity
- Vendor Catalogue/Part Number
- Desired Quantity
- List Price
- Date Required, if applicable
- Purchaser's Name & Campus Telephone Number

B. Licensed Radioactive Materials

ONLY PRINCIPLE USERS MAY REQUEST THE PURCHASE OF LICENSED RADIOACTIVE MATERIAL.

To purchase licensed materials, the Principle User will provide their Department's Purchasing Officer with the following information:

- Vendor Name & Telephone Number
- Purchasing Department's Account Number with Vendor, if applicable
- Material, Isotope & Activity
- Vendor Catalogue/Part Number
- Desired Quantity
- List Price
- Chemical Form
- Date Required
- Purchaser's Name & Campus Telephone Number

When the Departmental Purchasing Officer receives this information, he/she will assign a Departmental Tracking Number to the order. He/she will then forward the above information, including the Departmental Tracking Number, to the RSO in the Department of Environmental Health & Safety (EHS). RSO Staff will:

- Review the request to insure that license limits are not being exceeded; and,

- If the request is within License limits, will place the order with the specified vendor; and,
- Will notify the appropriate Materiel Management office regarding the delivery and receipt of the order.

Orders that exceed the license limit will not be placed until such time as existing inventories have sufficiently decayed or the License is amended. The RSO will keep an accurate record of all licensed materials (to include radioactive wastes) at all times.

XI. PROCEDURES FOR RECEIPT OF LICENSED MATERIALS

A. All packages of radioactive materials will be received on campus at Smith Receiving (Smith Hall, Room 132) during normal duty hours. Packages of radioactive materials will not be accepted for delivery after normal duty hours or on weekends or holidays.

1. During normal working hours, immediately upon receipt of any package of licensed material and prior to the departure of the Delivery Person, each package must be visually inspected for any obvious signs of shipping damage such as crushed or punctured containers or signs of dampness. Any obvious damage must be immediately reported to the RSO. Do not touch any package suspected of leaking. Request the Delivery Person to remain until monitored by the RSO.

2. Since certain packages of licensed material may have detectable external radiation, all radioactive packages should be immediately placed into a designated, shielded storage area, where they will be checked for contamination and external radiation level by the RSO as soon as possible, but no more than 3 hours after package receipt. As soon as the packages have been cleared by the RSO, they may be released to the Principle User who placed the order. Packages should not be allowed to remain in the receiving area any longer than one (1) business day. If packages have not been picked up by the Principle User's within one (1) business day, contact the RSO.

3. During normal duty hours, if there are questions regarding receiving packages containing radioactive material, please contact the RSO at (410)704-2949. While highly unusual, if a radioactive package arrives after normal duty hours or on a weekend or holiday; contact the Towson University Police (x4-4444) and have them contact the RSO.

B. Procedures for Safely Opening Packages Containing Licensed Materials

1. For packages containing licensed materials, the following procedures shall be followed when opening the packages:

   (a) Wear gloves to prevent hand contamination. Safety glasses and a laboratory coat are recommended.

   (b) Visually re-inspect the package for any obvious sign of shipping damage e.g. crushed, punctured). If damage is noted, stop and immediately notify the RSO at (410) 704-2949.

(c) Check DOT White I, Yellow II, or Yellow III label or packing slip for activity of contents, and ensure shipment is as ordered and does not exceed license possession limits. If shipment is not as ordered or is in excess of license possession limits, immediately stop and contact the RSO at (410) 704-2949.

(d) Meter the external surfaces of all Department of Transportation (DOT) labeled packages to ensure that radiation levels do not exceed DOT maximum levels as specified in 49 CRF 172.403 (shown below).

Radioactive Material Package Labeling Criteria (49 CFR 172.403)		
Transportation Index (TI)	***Max. Radiation Level at Package Surface (RL)***	***DOT Label Category***
N/A (i.e., $\leq$ 0.05)	RL $\leq$ 0.5 mrem/hr	No DOT Label
N/A (i.e., $\leq$ 0.05)	RL $\leq$ 0.5 mrem/hr	White I
0.0 < TI $\leq$ 1.0	0.5 mrem/hr, RL $\leq$50	Yellow II
1.0 < TI $\leq$ 10	50 mrem/hr < RL $\leq$ 200	Yellow III
10 < TI	200 mrem/hr $\leq$ RL $\leq$ 1000 (Exclusive Use Only)	Yellow III

(e) Open the outer package (following supplier's directions if provided) and remove packing slip. Open inner package to verify contents (compare requisition, packing slip and label on the bottle or other container). Check integrity of the final source container (e.g., inspecting for breakage of seals or vials, loss of liquid, discoloration of packaging material, high count rate on survey meter). Again check that the shipment does not exceed license possession limits. If you find anything other than expected, stop and immediately notify the RSO at (410) 704-2949.

(f) Survey (meter) the shipping and packing material for contamination before discarding. If contamination is found, treat as a dry solid radioactive waste. If no contamination is found, obliterate all radiation labels prior to discarding shipping materials as domestic waste.

(g) Maintain records of receipt, package survey, and wipe test results.

(h) Notify the final carrier by telephone, telegram, mailgram, or facsimile, and the Administrator of the appropriate NRC Regional Office listed in 10 CFR 20, Appendix D when removable radioactive surface contamination exceeds the limits of 10 CFR 71.87(I); or external radiation levels exceed the limits of 10 CFR 71.47.

(i) If the package contains dry ice:

- Do not touch dry ice with your skin! Use tongs, insulated (thick) gloves or an oven mitt. Since the temperature of dry ice is so cold, it can cause severe frostbite. If you suspect you have frostbite seek medical help immediately.
- Never store dry ice in an airtight container. As the dry ice melts from a solid directly into a gas, the gas will build up in the container until it bursts.
- Never place dry ice in an unventilated room. Dry ice sublimates into carbon dioxide gas which is an asphyxiant.
- Do not place dry ice directly on countertops. The cold temperature could cause the surface to crack.
- To dispose of dry ice, place in a well ventilated container in a safe, well ventilated area and let it sublimate away.

C. Procedures for the Internal Transfer of Licensed Materials

1. Licensed materials that may be transferred from one Principle User to another should have prior written approval from the RSO. If necessary, a written transfer procedure will be developed by the RSO to ensure that transfers are done in accordance with the conditions of the license. All transfers shall be done in a way that minimizes the probability of spillage or breakage. Double containers should be used, including suitable shielding, for such transfers.

D. Procedures for the External Transfer of TU Licensed Materials

1. The external (off-campus) transfer of licensed material is strictly prohibited.

E. Procedures for the Transfer of Licensed Materials from Other Organizations to TU

1. Prior to transferring licensed materials from other organizations to TU, the RSO must be notified in advance to ensure compliance with license requirements. All licensed materials must be transferred through the RSO in accordance with NRC regulations and with the conditions of our license.

F. Gifts

1. On occasion, Principle Users may be offered or have donated licensed materials by other individuals/organizations as gifts. All gifts of radioactive materials must be approved by the RSO in writing PRIOR to the arrival of the material on campus. The transfer of all gifts of licensed materials to the University must be in accordance with NRC requirements and the conditions of the license.

XII. DISPOSAL OF RADIOACTIVE MATERIALS

No radioactive materials (or materials which may be contaminated with radioactive materials) or radiation producing devices may be disposed of by conventional methods. Radioactive wastes will be managed in accordance with the procedures contained in Tab D – Low Level Radioactive Waste Management Program. Authorized Users are responsible for keeping records of all disposals so that their current inventories reflect actual amounts of isotopes on hand. Authorized Users are responsible for their waste material until possession by the RSO is established. All radioactive wastes will be disposed of through the RSO. To request the disposal of radioactive wastes, contact the RSO at (410) 704-2949 or at safety@towson.edu.

XIII. OTHER PROCEDURES

A. Records of Surveys, Radiation Monitoring and Disposal

1. The RSO will maintain records showing the radiation exposures of all individuals for whom personnel monitoring is required under Section VII above. Such records will be kept on the NRC Form 5, or on clear and legible records containing all the information required by this form. The doses entered on the forms or records shall be for periods of time not exceeding one calendar year.

2. The RSO will maintain records in the same units as required in the Maryland regulations showing the results of required surveys, monitoring required for the receipt of radioactive materials packages, and disposals made to the sanitary sewer system.

3. Records Retention.

(a) Records of individual exposure to radiation and to radioactive material, records of bioassays, including results of whole body counting examinations, as required by Maryland regulations will be preserved until the Maryland Department of the Environment (MDE) authorizes disposition.

(b) Records of the results of surveys and monitoring will be preserved for three (3) years after completion of the survey except that the following records shall be maintained until MDE authorizes their disposition:

(1) Records of the results of surveys to determine compliance with the exposure of individuals to concentrations of radioactive material in air in restricted areas.

(2) In the absence of personnel monitoring data, records of the results of surveys to determine external radiation dose.

(3) Records of the results of surveys used to evaluate the release of radioactive effluents to the environment.

(c) Records of disposal of licensed materials through the sanitary sewer system or via a licensed disposal contractor shall be maintained until MDE authorizes their disposition.

(d) Records, which must be maintained pursuant to this section, may be the originals or a reproduced copy or microform if authorized personnel duly authenticate such reproduced copy or microform and the microform is capable of producing a clear and legible copy after storage for the period specified above.

4. The discontinuance of or curtailment of activities does not relieve the RSO of the responsibility for retaining all records required above.

B. Instructions to Ancillary Personnel

1. The Principle User will ensure that all personnel visiting or frequenting any portion of the restricted areas will receive instructions concerning the hazards of the area, appropriate responses to warnings, and their responsibility to report violations.

2. The extent of these instructions will be commensurate with potential radiological health protection problems in the restricted area.

3. Children under the age of 16 are prohibited from entering laboratory areas or other areas where any radioactive or hazardous materials or conditions may be present. (See Tab F-Exposure of Minors to Radiation)

C. Physical Security of the Restricted Area

1. All areas where licensed radioactive materials or radiation producing devices are located are considered “Restricted Areas”. The entrances to restricted areas will be locked at all times when there is no one physically in the laboratory/workspace or when the areas are otherwise unattended to prevent unauthorized entry and to prevent unauthorized access to or removal of licensed materials. All visitors are required to be escorted in restricted areas.

2. All licensed materials that are stored in restricted areas must be secured from unauthorized access or removal, so that individuals who are not knowledgeable about radioactive materials cannot be exposed to or contaminated by the material and cannot take the material.

3. When any licensed materials are in use in restricted areas they must be under constant surveillance so that the radiation worker can prevent others from becoming contaminated by or exposed to the material and to prevent persons from removing the material from the area.

4. Principle Users are responsible for the physical security of their licensed materials.

Tab A

ANNUAL PROGRAM REVIEW

An annual program review is conducted, in part, to fulfill the requirements of Code of Maryland Regulation 26.12.01.01 section D.101 for an annual review of the content and implementation of the licensee's radiation protection program. It should also identify program weaknesses and allow Principle Users to take early corrective actions (before an inspection). The auditor should also evaluate whether the Principle User is maintaining exposures to workers and the general public as low as is reasonably achievable (ALARA) and, if not, make suggestions for improvement.

At a minimum and as appropriate, the following criteria will be reviewed:

A. Audit History: Enter the date of the last audit, whether any deficiencies were identified, and whether actions were taken to correct the deficiencies.

B. Organization and Scope of Program: Give a brief description of the organizational structure, noting any changes in personnel. Describe the scope of licensed activities at the audited location. Check whether the Radiation Safety Officer (RSO) is the person identified in the license and fulfills the duties specified in the license.

C. Training, Retraining, and Instructions to Workers: Ensure that workers have received the training required by 10 CFR 19.12. Be sure that, before being permitted to use byproduct material, the user has received training and has a copy of the University's Radiation Protection Program. Note whether refresher training is conducted in accordance with MDE License commitments. Ensure that each Principle User has a copy of the University's Radiation Protection Program in each licensed area and all Individual Users have unrestricted access to them. Ensure that both Principle and Individual Users will be familiar with procedures contained in the Program and by interview and/or observation of selected workers will ensure that that he/she can implement them.

D. Audits: Verify that audits fulfill the requirements of COMAR 26.12.01.01 Section D.101, and are conducted in accordance with MDE License commitments, and are properly documented.

E. Facilities: Verify that the University's radiation use areas are as described in its license documents.

F. Materials: Verify that the MDE License authorizes the quantities and types of byproduct material that the Principle User possesses.

G. Leak Tests: Verify that all sealed/plated foil sources are tested for leakage at the prescribed frequency and in accordance with MDE License commitments. Ensure leak test records are maintained by the RSO.

H. Inventories: Verify that inventories are conducted at least once every 6 months to account for all sources; inventory records should be maintained.

I. Radiation Surveys: Verify that the Principle User has appropriate, operable and calibrated survey instruments available, that the instruments are calibrated (at the required frequency) in accordance with license conditions and in accordance with section COMAR 26.12.01.01 D.501 and D.1103. Calibration records must be retained by the RSO for 3 years after the record is made. Check that radiation levels in areas adjacent to use are within regulatory limits and in accordance with COMAR 26.12.01.01 section D.301. Verify compliance with COMAR 26.12.01.01 section D.30110. Records of surveys must be retained for 3 years after the record is made.

J. Receipt and Transfer of Radioactive Material (Includes Waste Disposal): Verify that packages containing byproduct material, received from others, are received, opened, and surveyed in accordance with MDE License commitments. (COMAR 26.12.01.01 section D.906) Ensure that transfers are performed by the RSO in accordance with MDE License commitments. Records of surveys, receipt, and transfer must be maintained in accordance with D.1101.

K. Transportation: Determine compliance with Department of Transportation (DOT) requirements. Verify that radioactive packages are prepared, marked, and labeled in accordance with 49 CFR Parts 172 and 173 requirements. Verify that shipping papers are prepared; that they contain all needed information, and that they are readily accessible during transport (49 CFR 172.200, 201, 202, 203, 204 and 177.718).

L. Personnel Radiation Protection: Evaluate the determination that unmonitored personnel are not likely to receive more than 10 percent of the allowable limits. Alternately, if personnel dosimetry is provided and required verify that it complies with MDE License commitments. Review personnel monitoring records; compare exposures of individuals doing similar work; determine reasons for significant differences in exposures. If any worker declared her pregnancy in writing, evaluate the licensee's compliance with MDE Regulations. Check whether records are maintained as required by MDE.

M. Auditor's Independent Measurements (If made): The auditor should make independent survey measurements and compare the results with those made or used by the RSO and/or Principle User.

N. Notification and Reports: Check on the RSO's compliance with the notification and reporting requirements in 10 CFR Parts 19, 20, and 30. Ensure that the licensee is aware of the telephone number for NRC's Emergency Operations Center; (301) 816-5100.

O. Posting and Labeling: Check for compliance with the posting and labeling requirements as required by COMAR.

P. Record keeping for Decommissioning: Check to determine compliance with COMAR 26.12.01.01 section C.29.

Q. Bulletins and Information Notices: As appropriate, check to determine if the licensee is receiving bulletins, information notices, NMSS Newsletters, etc., from NRC. Check whether the licensee took appropriate action in response to NRC mailings.

R. Special License Conditions or Issues: If applicable, verify compliance with any special conditions on the MDE License. If the licensee has any unusual aspect of its work, review and evaluate compliance with regulatory requirements.

S. Evaluation of Other Factors: Evaluate University Senior Academic and Administrative management's involvement with the radiation safety program, whether the RSO has sufficient time to perform his/her duties, and whether the licensee has sufficient staff to handle the workload and maintain compliance with regulatory requirements.

T. Problems or Deficiencies Noted; Recommendations: List any problems or deficiencies noted and make recommendations as to corrective actions.

Tab B

ACTION LEVELS FOR REMOVABLE CONTAMINATION

Surface Location	Beta/Gamma (DPM/100 cm^2)	Alpha (DPM/100 cm^2)
Restricted Areas	220	22
Unrestricted Areas	220	22
Personal Clothing worn outside restricted areas	220	22
Skin	220	22

ACCEPTABLE SURFACE CONTAMINATION LEVELS FOR UNCONTROLLED RELEASE OF EQUIPMENT

Nuclide	Average (DPM/100 cm^2)	Maximum (DPM/100 cm^2)
Transuranics, Radium, ^{228}Th	100	300
U-Nat, ^{239}U, DU, Th-Nat, ^{232}Th, ^{90}Sr, ^{125}I, ^{129}I, ^{131}I	1000	3000
Beta-Gamma Emitters (Except ^{90}Sr and others noted above	5000	15000

Notes:

a. Where surface contamination by both alpha and beta-gamma emitters exist, the limits established for alpha and beta-gamma emitters should apply independently.

b. The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent level should be reduced proportionately and the entire surface should be wiped.

c. Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

d. The maximum contamination level applies to an area of not more than 100 cm^2.

Tab C

AIR MONITORING

A. Periodic air samples, as required by the RSO, shall be taken in the worker's breathing zone for all operations where the airborne radionuclide concentrations may be reasonably expected to exceed ten percent (10%) of the applicable Derived Air Concentration (DAC) (10 CFR Part 20 Appendix B, Table I, Column 3).

B. Areas where the known or suspected airborne radionuclide concentrations are twenty-five percent (25%) or more of the applicable DAC shall be posted with a yellow sign bearing the radiation caution symbol and the words "**Caution - Airborne Radioactivity Area**".

1. Respiratory protection and protective clothing shall be required for access to these areas as designated by the RSO.
2. Exceptions to the access restrictions may be made by the RSO provided that the individual exposures shall not exceed seventy-five percent (75%) of the airborne exposure limits.

C. Air monitoring and sampling shall be conducted by the RSO in all areas where concentrations of airborne radioactive material may reasonably be expected to exceed ten percent (10%) of the DAC. This shall include sampling of all airborne emissions points to the environment to ensure that releases to the environment are within acceptable levels.

D. Projects with air samples indicating airborne radioactivity concentrations from ten percent (10%) to twenty-five percent (25%) of the applicable DAC limits shall be continuously monitored until the project can be stopped. The RSO shall review the project to determine additional controls to be required prior to allowing the project to resume.

E. Projects with air samples exceeding twenty-five percent (25%) of the applicable DAC shall be continuously monitored to ensure that they do not exceed the 10 CFR Part 20 limits until they can be stopped.

1. The project shall be stopped as soon as possible.
2. Access to the sampled areas shall be posted and controlled as in paragraph 2 above.
3. The RSO shall review the project to determine additional controls to be required prior to allowing the project to resume.

F. Projects with air samples exceeding seventy-five percent (75%) of the applicable DAC shall be continuously monitored to ensure that they do not exceed the 10 CFR Part 20 limits and shall be stopped **immediately**.

1. Access to the areas immediately adjacent to the air sample locations shall be secured and access controlled as in paragraph 2 above.
2. Air samples shall be taken in the areas immediately adjacent to the high concentration air sample locations to verify the extent of the airborne contamination and shall be controlled as required by the RSO.
3. The RSO shall review the project to determine additional controls to be required prior to allowing the project to resume.

G. All projects which may require respiratory protection based on the requirements of paragraphs 1 and 2 above shall be reviewed by the RSO to determine the engineering and process controls required to reduce airborne radionuclide concentrations below levels requiring respiratory protection. Individuals anticipating the requirement for respiratory protection must be enrolled in the University Respiratory Protection Program **prior** to use of any potentially volatile airborne radioactive materials. Contact the RSO at (410) 704-2949 or at safety@towson.edu for information regarding enrollment in the University Respiratory Protection Program.

F. Air monitoring, if and when required, will be provided by a qualified licensed contractor. The contractor will provide equipment and supplies, and all analytical evaluation and reports as necessary.

Tab D

LOW LEVEL RADIOACTIVE WASTE MANAGEMENT PROGRAM

I. PURPOSE & SCOPE

Following is a description of the Low Level Radioactive Waste (LLRW) management procedures which will be used to safely manage and dispose of LLRW generated on campus.

II. GENERAL GUIDELINES

1. All radioactivity labels must be defaced or removed from containers and packages prior to disposal in ordinary (non-radioactive) domestic waste. If waste is compacted, all labels that are visible in the compacted mass must be defaced or removed.

2. Non-radioactive waste such as leftover reagents, boxes, and packaging material should not be mixed with radioactive waste.

3. Occasionally monitor all procedures to ensure that radioactive waste is not created unnecessarily. Review all new procedures to ensure that waste is handled in a manner consistent with established procedures.

4. In all cases, consider the entire impact of various available disposal routes. Consider occupational and public exposure to radiation, other hazards associated with the material and routes of disposal (e.g., toxicity, carcinogenicity, pathogenicity, flammability), and costs.

5. Housekeeping staff should be provided adequate training to avoid the possibility of unauthorized disposal or exposure of these individuals to radioactive materials or to radiation.

6. Ensure that sufficient and appropriate rad waste containers are obtained from EHS and that specific instructions for their use are fully understood. To request rad waste containers, contact the RSO at (410) 704-2949 or at safety@towson.edu.

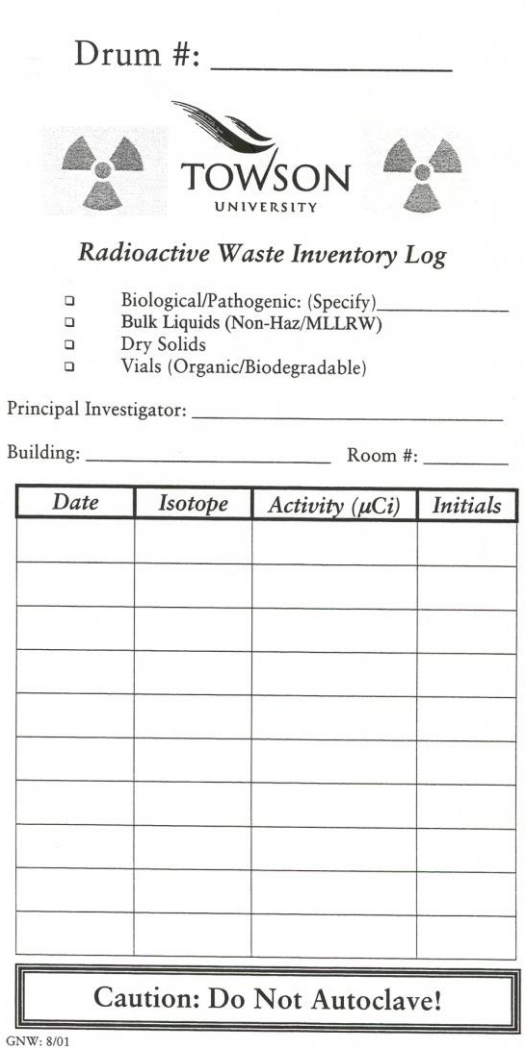
7. Radioactive wastes will be generated, collected and stored at the point of generation only in posted restricted rad use areas approved by the RSO.

8. Aqueous and non-aqueous liquids, vials, and solid wastes will be kept in separate containers.

9. Liquid and solid radioactive waste will be separated by isotope, except as authorized by the RSO. Reactive chemicals must not be mixed.

10. Sharp objects will be disposed of in separate labeled sharps containers, so that personnel who must later handle the waste are protected.

11. A running inventory will be maintained on the outside of each rad waste container by isotope, activity, and chemical composition for liquid containers. Inventory labels (Shown below) are available from the RSO. To request rad waste container labels, contact the RSO at (410) 704-2949 or at safety@towson.edu.



Drum #: _____

TOWSON UNIVERSITY

Radioactive Waste Inventory Log

- ❑ Biological/Pathogenic: (Specify)_____
- ❑ Bulk Liquids (Non-Haz/MLLRW)
- ❑ Dry Solids
- ❑ Vials (Organic/Biodegradable)

Principal Investigator: _____

Building: _____ Room #: _____

Date	*Isotope*	*Activity (μCi)*	*Initials*

Caution: Do Not Autoclave!

GNW: 8/01

12. All containers will be clearly labeled CAUTION RADIOACTIVE WASTE or CAUTION RADIOACTIVE MATERIALS.

13. Radioactive waste will never be placed in regular, non-controlled, non-radioactive designated containers.

14. All radioactive waste will be stored in a manner so as to prevent:
    a. Contamination of laboratory space and personnel.
    b. Generation of airborne hazards.
    c. Incompatible mixing of chemicals.

15. Radioactive waste will be stored separately from other types of hazardous waste or chemicals.

III. SOLID RADIOACTVE WASTE

1. Solid radioactive wastes are all solid, dry, radioactive materials and laboratory waste such as gloves, absorbent paper, and used lab equipment which is or may be contaminated with radioactive materials.

2. Materials which have become contaminated (and cannot be decontaminated) and contains any organic solvents such as benzene, toluene, or xylene, will be strictly segregated from other dry waste. Even a small amount of these organic solvents will cause the entire container to be classified as organic radioactive waste and the entire shipment will be rejected at the disposal site.

3. Containers for solid radioactive waste are available from the RSO. To request rad waste container labels, contact the RSO at (410) 704-2949 or at safety@towson.edu.

4. Waste containers for solid radioactive waste will be lined with a removable plastic liner that will be supplied by the RSO when empty waste containers are delivered.

5. Care will be taken to ensure that no sharp objects, such as needles, knives, razor blades, pipettes, or glassware are put in the plastic liner. These items will be placed into labeled sharps containers before placing into dry solid rad waste containers. (Dry waste is normally compacted and must be handled by RSO personnel.)

6. Containers will be identified as to isotopes and a reasonable estimate of the activity of each isotope present in the container. A continuous listing will be maintained for all waste deposited in the container. (See rad waste inventory label above.)

IV. LIQUID RADIOACTIVE WASTE

1. All liquids, such as solvents, water, scintillation fluid, or other solutions, which contain or may contain radioactive materials are considered liquid radioactive waste.

2. Liquids will be segregated by type such as aqueous, organic solvent, scintillation cocktail, and by isotope except as authorized by the RSO. The techniques of waste preparation for final disposal vary greatly with each of these categories. The slightest solvent contamination causes the entire container to be classified as a mixed waste and disposal of this category is the most expensive and extremely difficult to dispose of off-site.

3. Waste containers for liquid wastes are poly-ethylene jugs and will be stored in such a manner that should the container be damaged or break, the contents will be completely contained (i.e., **within a secondary container**). Secondary containers are available from the RSO.

4. Waste containers must have tightly fitting screw caps and must be kept closed at all times except when wastes are being added to the container.

5. No material other than liquids will be placed in liquid radioactive waste containers.

6. Water and solvents will be separated at all times.

7. Special consideration will be given to liquid wastes to ensure that mixing of liquids does not result in an altered pH, unstable solutions, or the generation of gases.

8. Ether will be disposed of only after consulting with the RSO.

9. Containers will be identified as to the isotope and a reasonable estimate of the activity of each isotope present in the container. A detailed chemical composition is also required. A continuous listing of this information will be maintained for all waste deposited in the container. If the waste container contains EPA regulated hazardous wastes, a Hazardous Waste label will also required.

Drum #: _____

TOWSON UNIVERSITY

Radioactive Waste Inventory Log

- ❑ Biological/Pathogenic: (Specify)_____
- ❑ Bulk Liquids (Non-Haz/MLLRW)
- ❑ Dry Solids
- ❑ Vials (Organic/Biodegradable)

Principal Investigator: _____

Building: _____ Room #: _____

Date	*Isotope*	*Activity (µCi)*	*Initials*

Caution: Do Not Autoclave!

GNW: 8/01

Hazardous Waste

Accumulation Start Date:

Container Contents:

Handle With Care!

IN THE EVENT OF AN EMERGENCY WITH THIS CONTAINER CONTACT ENVIRONMENTAL HEALTH & SAFETY AT X42949

V. RADIOACTIVE VIALS

1. Scintillation vials containing liquid samples will be collected and treated separately from solid or liquid radioactive wastes.

2. Vials may be plastic or glass containing 5 to 15 ml of radioactive liquid or scintillation fluid. Each type will be disposed of in separate containers.

    a. Aqueous only. Radioactive Vials containing aqueous biodegradable scintillation cocktail and no hazardous chemicals will be placed into the appropriate container designated for aqueous scintillation vials.
    b. Organic only - Radioactive Vials containing a controlled hazardous substance, and not exceeding 0.05 µCi/ml per vial will be disposed of as chemical waste only and not as a radioactive waste.
    c. Mixed vials - Those meeting or exceeding the 0.05 µCi/ml limit shall be disposed of as radioactive waste vials and will be placed in their respective waste container separate from the Aqueous and Organic only vial. Vials containing ^{32}P, $^{33}3P$, and ^{35}S containing organic scintillation cocktail, and/or containing hazardous chemical wastes not exceeding the limits specified by the RSO are allowed.

VI. ANIMAL CARCASSES

1. Animal carcasses which may contain radioactive materials will be separated from other radioactive waste and from other animal carcasses.

2. All animal carcasses contaminated with radioactive materials will be placed in watertight bags or wrapped and isolated from other wastes. Carcasses need not be individually wrapped.

3. Carcasses will be frozen and stored in freezers approved, and appropriately labeled, for the storage of radioactive materials.

4. All syringes, needles, knives, glass and/or other sharp objects will be removed before packaging.

5. Large animal carcasses may have to be stored in a special manner as prescribed by the RSO on an individual basis.

6. All packages of animal carcasses containing radioactive materials will be marked with appropriate radiation labels, accurately labeled as to contents and identified to the isotope(s) present and a reasonable estimate of activity. Any additional chemical or pathological hazards will also be identified.

7. Do not autoclave radioactive animal carcasses without written RSO approval.

8. Radioactive animal carcasses contaminated with ^{3}H or ^{14}C are exempt from regulation as a radioactive waste if the waste contains <0.05 µCi/gram when averaged over the weight of the entire animal. It is the PI's responsibility for determining whether or not his animal wastes will be regulated for disposal as radioactive waste.

VII. SPECIAL OR UNUSUAL WASTES

The RSO must be notified in advance when an experiment may cause special disposal problems, generate unusual wastes, an abnormally large quantity of waste, or when large animal carcasses are used.

VIII. DISPOSAL OF RADIOACTIVE WASTES

A. Removal by the Environmental Health & Safety/RSO

1. All radioactive materials and radiation producing devices (regulated and exempt) will be disposed of through the RSO. To request disposal of radioactive wastes or to request additional waste containers, contact the RSO at (410) 704-2949 or at safety@towson.edu.

B. Disposal into the Sanitary Sewer System

1. The disposal of radioactive materials into the sanitary sewer system (sinks, drains, etc.) by laboratory personnel is strictly prohibited. "Hot Sinks" are no longer authorized.

C. Final Off-Campus Disposal

1. EHS/RSO will transport and process all radioactive wastes in accordance with applicable regulations as established by the US Department of Transportation, the NRC, and State of Maryland Department of the Environment. Final disposal and removal from Campus is accomplished by approved contractors authorized for the functions by the above agencies.

Tab E

Voluntary Pregnancy Declaration Procedures

Memorandum

Department of
Environmental Health & Safety

Towson University
8000 York Road
Towson, MD 21252-0001

t. 410 704-2949
f. 410 704-2993

To: Radioactive Material and/or Radiation-producing Device Users

From: Diane A. Douglass, Program Coordinator

Date: Declared Pregnancies

Re:

CC:

In the new revision of the Regulations for the Control of Ionizing Radiation (COMAR 26.12.01.01), each employer is required to ensure that the accumulated radiation dose to the embryo and fetus for a declared pregnant worker is kept below 500 millirems for the entire gestation period. If an employee chooses to have the University involved with the protection of her fetus, she must declare her actual, suspected or planned pregnancy to her supervisor and the Radiation Safety Officer (RSO) at the Department of Environmental Health & Safety (EHS). At the time of declaration, the worker, their supervisor and the RSO will meet to discuss fetal dose control procedures. These procedures may include use of additional external dosimetry to monitor the embryo/fetus exposure, bioassays to monitor internal exposure, radiation exposure investigations when a monthly dose exceeds 50 millirem, minimizing time in a restricted area, and, if the potential for the total exposure exceeds 500 millirem, reassignment of duties during the declared pregnancy time period. The declared pregnancy time period will be in effect until the employee provides written documentation to discontinue fetal dose control procedures.

Declaring a pregnancy is not a requirement. An employee may choose to keep their pregnancy status confidential. If the pregnancy is not declared, normal limits for the accumulated radiation dose will be observed. However, an informal meeting between the employee and the RSO may be requested to discuss prenatal radiation safety procedures.

For your information, I have provided copies of the document used for a declared pregnancy and the U.S. Nuclear Regulatory Commission Regulatory Guide 8.13 which provides information regarding prenatal radiation exposure. If you have any questions regarding this issue, please contact EHS at (410) 704-2949.

Memorandum

Department of
Environmental Health & Safety

Towson University
8000 York Road
Towson, MD 21252-0001

t. 410 704-2949
f. 410 704-2993

To: Diane A. Douglass, Program Coordinator

From:

Date:

Re: Declaration of Pregnancy

CC:

This is to inform you that I am currently pregnant or suspect that I am pregnant and would like to schedule a meeting to discuss fetal dose control procedures.

Expected delivery date: _____

Telephone number: _____
(For scheduling purposes)

Supervisor's name: _____

U.S. NUCLEAR REGULATORY COMMISSION

Revision 3
June 1999

REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 8.13

(Draft was issued as DG-8014)

INSTRUCTION CONCERNING PRENATAL RADIATION EXPOSURE

A. INTRODUCTION

The Code of Federal Regulations in 10 CFR Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations," in Section 19.12, "Instructions to Workers," requires instruction in "the health protection problems associated with exposure to radiation and/or radioactive material, in precautions or procedures to minimize exposure, and in the purposes and functions of protective devices employed." The instructions must be "commensurate with potential radiological health protection problems present in the work place."

The Nuclear Regulatory Commission's (NRC's) regulations on radiation protection are specified in 10 CFR Part 20, "Standards for Protection Against Radiation"; and 10 CFR 20.1208, "Dose to an Embryo/Fetus," requires licensees to "ensure that the dose to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, does not exceed 0.5 rem (5 mSv)." Section 20.1208 also requires licensees to "make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman." A declared pregnant woman is defined in 10 CFR 20.1003 as a woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

This regulatory guide is intended to provide information to pregnant women, and other personnel, to help them make decisions regarding radiation exposure during pregnancy. This Regulatory Guide 8.13 supplements Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Radiation Exposure" (Ref. 1), which contains a broad discussion of the risks from exposure to ionizing radiation.

Other sections of the NRC's regulations also specify requirements for monitoring external and internal occupational dose to a declared pregnant woman. In 10 CFR 20.1502, "Conditions Requiring Individual Monitoring of External and Internal Occupational Dose," licensees are required to monitor the occupational dose to a declared pregnant woman, using an individual monitoring device, if it is likely that the declared pregnant woman will receive, from external sources, a deep dose equivalent in excess of 0.1 rem (1 mSv). According to Paragraph (e) of 10 CFR 20.2106, "Records of Individual Monitoring Results," the licensee must maintain records of dose to an embryo/fetus if monitoring was required, and the records of dose to the embryo/fetus must be kept with the records of dose to the declared pregnant woman. The declaration of pregnancy must be kept on file, but may be maintained separately from the dose records. The licensee must retain the re-

quired form or record until the Commission terminates each pertinent license requiring the record.

The information collections in this regulatory guide are covered by the requirements of 10 CFR Parts 19 or 20, which were approved by the Office of Management and Budget, approval numbers 3150-0044 and 3150-0014, respectively. The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

B. DISCUSSION

As discussed in Regulatory Guide 8.29 (Ref. 1), exposure to any level of radiation is assumed to carry with it a certain amount of risk. In the absence of scientific certainty regarding the relationship between low dose exposure and health effects, and as a conservative assumption for radiation protection purposes, the scientific community generally assumes that any exposure to ionizing radiation may cause undesirable biological effects and that the likelihood of these effects increases as the dose increases. At the occupational dose limit for the whole body of 5 rem (50 mSv) per year, the risk is believed to be very low.

The magnitude of risk of childhood cancer following in utero exposure is uncertain in that both negative and positive studies have been reported. The data from these studies "are consistent with a lifetime cancer risk resulting from exposure during gestation which is two to three times that for the adult" (NCRP Report No. 116, Ref. 2). The NRC has reviewed the available scientific literature and has concluded that the 0.5 rem (5 mSv) limit specified in 10 CFR 20.1208 provides an adequate margin of protection for the embryo/fetus. This dose limit reflects the desire to limit the total lifetime risk of leukemia and other cancers associated with radiation exposure during pregnancy.

In order for a pregnant worker to take advantage of the lower exposure limit and dose monitoring provisions specified in 10 CFR Part 20, the woman must declare her pregnancy in writing to the licensee. A form letter for declaring pregnancy is provided in this guide or the licensee may use its own form letter for declaring pregnancy. A separate written declaration should be submitted for each pregnancy.

C. REGULATORY POSITION

1. Who Should Receive Instruction

Female workers who require training under 10 CFR 19.12 should be provided with the information contained in this guide. In addition to the information contained in Regulatory Guide 8.29 (Ref. 1), this information may be included as part of the training required under 10 CFR 19.12.

2. Providing Instruction

The occupational worker may be given a copy of this guide with its Appendix, an explanation of the contents of the guide, and an opportunity to ask questions and request additional information. The information in this guide and Appendix should also be provided to any worker or supervisor who may be affected by a declaration of pregnancy or who may have to take some action in response to such a declaration.

Classroom instruction may supplement the written information. If the licensee provides classroom instruction, the instructor should have some knowledge of the biological effects of radiation to be able to answer questions that may go beyond the information provided in this guide. Videotaped presentations may be used for classroom instruction. Regardless of whether the licensee provides classroom training, the licensee should give workers the opportunity to ask questions about information contained in this Regulatory Guide 8.13. The licensee may take credit for instruction that the worker has received within the past year at other licensed facilities or in other courses or training.

3. Licensee's Policy on Declared Pregnant Women

The instruction provided should describe the licensee's specific policy on declared pregnant women, including how those policies may affect a woman's work situation. In particular, the instruction should include a description of the licensee's policies, if any, that may affect the declared pregnant woman's work situation after she has filed a written declaration of pregnancy consistent with 10 CFR 20.1208.

The instruction should also identify who to contact for additional information as well as identify who should receive the written declaration of pregnancy. The recipient of the woman's declaration may be identified by name (e.g., John Smith), position (e.g., immediate supervisor, the radiation safety officer), or department (e.g., the personnel department).

4. Duration of Lower Dose Limits for the Embryo/Fetus

The lower dose limit for the embryo/fetus should remain in effect until the woman withdraws the declaration in writing or the woman is no longer pregnant. If a declaration of pregnancy is withdrawn, the dose limit for the embryo/fetus would apply only to the time from the estimated date of conception until the time the declaration is withdrawn. If the declaration is

not withdrawn, the written declaration may be considered expired one year after submission.

5. Substantial Variations Above a Uniform Monthly Dose Rate

According to 10 CFR 20.1208(b), "The licensee shall make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman so as to satisfy the limit in paragraph (a) of this section," that is, 0.5 rem (5 mSv) to the embryo/fetus. The National Council on Radiation Protection and Measurements (NCRP) recommends a monthly equivalent dose limit of 0.05 rem (0.5 mSv) to the embryo/fetus once the pregnancy is known (Ref. 2). In view of the NCRP recommendation, any monthly dose of less than 0.1 rem (1 mSv) may be considered as not a substantial variation above a uniform monthly dose rate and as such will not require licensee justification. However, a monthly dose greater than 0.1 rem (1 mSv) should be justified by the licensee.

D. IMPLEMENTATION

The purpose of this section is to provide information to licensees and applicants regarding the NRC staff's plans for using this regulatory guide.

Unless a licensee or an applicant proposes an acceptable alternative method for complying with the specified portions of the NRC's regulations, the methods described in this guide will be used by the NRC staff in the evaluation of instructions to workers on the radiation exposure of pregnant women.

REFERENCES

1. USNRC, "Instruction Concerning Risks from Occupational Radiation Exposure," Regulatory Guide 8.29, Revision 1, February 1996.

2. National Council on Radiation Protection and Measurements, *Limitation of Exposure to Ionizing Radiation*, NCRP Report No. 116, Bethesda, MD, 1993.

QUESTIONS AND ANSWERS CONCERNING PRENATAL RADIATION EXPOSURE

1. Why am I receiving this information?

The NRC's regulations (in 10 CFR 19.12, "Instructions to Workers") require that licensees instruct individuals working with licensed radioactive materials in radiation protection as appropriate for the situation. The instruction below describes information that occupational workers and their supervisors should know about the radiation exposure of the embryo/fetus of pregnant women.

The regulations allow a pregnant woman to decide whether she wants to formally declare her pregnancy to take advantage of lower dose limits for the embryo/fetus. This instruction provides information to help women make an informed decision whether to declare a pregnancy.

2. If I become pregnant, am I required to declare my pregnancy?

No. The choice whether to declare your pregnancy is completely voluntary. If you choose to declare your pregnancy, you must do so in writing and a lower radiation dose limit will apply to your embryo/fetus. If you choose not to declare your pregnancy, you and your embryo/fetus will continue to be subject to the same radiation dose limits that apply to other occupational workers.

3. If I declare my pregnancy in writing, what happens?

If you choose to declare your pregnancy in writing, the licensee must take measures to limit the dose to your embryo/fetus to 0.5 rem (5 millisievert) during the entire pregnancy. This is one-tenth of the dose that an occupational worker may receive in a year. If you have already received a dose exceeding 0.5 rem (5 mSv) in the period between conception and the declaration of your pregnancy, an additional dose of 0.05 rem (0.5 mSv) is allowed during the remainder of the pregnancy. In addition, 10 CFR 20.1208, "Dose to an Embryo/Fetus," requires licensees to make efforts to avoid substantial variation above a uniform monthly dose rate so that all the 0.5 rem (5 mSv) allowed dose does not occur in a short period during the pregnancy.

This may mean that, if you declare your pregnancy, the licensee may not permit you to do some of your normal job functions if those functions would have allowed you to receive more than 0.5 rem, and you may not be able to have some emergency response responsibilities.

4. Why do the regulations have a lower dose limit for the embryo/fetus of a declared pregnant woman than for a pregnant worker who has not declared?

A lower dose limit for the embryo/fetus of a declared pregnant woman is based on a consideration of greater sensitivity to radiation of the embryo/fetus and the involuntary nature of the exposure. Several scientific advisory groups have recommended (References 1 and 2) that the dose to the embryo/fetus be limited to a fraction of the occupational dose limit.

5. What are the potentially harmful effects of radiation exposure to my embryo/fetus?

The occurrence and severity of health effects caused by ionizing radiation are dependent upon the type and total dose of radiation received, as well as the time period over which the exposure was received. See Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Exposure" (Ref. 3), for more information. The main concern is embryo/fetal susceptibility to the harmful effects of radiation such as cancer.

6. Are there any risks of genetic defects?

Although radiation injury has been induced experimentally in rodents and insects, and in the experiments was transmitted and became manifest as hereditary disorders in their offspring, radiation has not been identified as a cause of such effect in humans. Therefore, the risk of genetic effects attributable to radiation exposure is speculative. For example, no genetic effects have been documented in any of the Japanese atomic bomb survivors, their children, or their grandchildren.

7. What if I decide that I do not want any radiation exposure at all during my pregnancy?

You may ask your employer for a job that does not involve any exposure at all to occupational radiation dose, but your employer is not obligated to provide you with a job involving no radiation exposure. Even if you receive no occupational exposure at all, your embryo/fetus will receive some radiation dose (on average 75 mrem (0.75 mSv)) during your pregnancy from natural background radiation.

The NRC has reviewed the available scientific literature and concluded that the 0.5 rem (5 mSv) limit

provides an adequate margin of protection for the embryo/fetus. This dose limit reflects the desire to limit the total lifetime risk of leukemia and other cancers. If this dose limit is exceeded, the total lifetime risk of cancer to the embryo/fetus may increase incrementally. However, the decision on what level of risk to accept is yours. More detailed information on potential risk to the embryo/fetus from radiation exposure can be found in References 2-10.

8. What effect will formally declaring my pregnancy have on my job status?

Only the licensee can tell you what effect a written declaration of pregnancy will have on your job status. As part of your radiation safety training, the licensee should tell you the company's policies with respect to the job status of declared pregnant women. In addition, before you declare your pregnancy, you may want to talk to your supervisor or your radiation safety officer and ask what a declaration of pregnancy would mean specifically for you and your job status.

In many cases you can continue in your present job with no change and still meet the dose limit for the embryo/fetus. For example, most commercial power reactor workers (approximately 93%) receive, in 12 months, occupational radiation doses that are less than 0.5 rem (5 mSv) (Ref. 11). The licensee may also consider the likelihood of increased radiation exposures from accidents and abnormal events before making a decision to allow you to continue in your present job.

If your current work might cause the dose to your embryo/fetus to exceed 0.5 rem (5 mSv), the licensee has various options. It is possible that the licensee can and will make a reasonable accommodation that will allow you to continue performing your current job, for example, by having another qualified employee do a small part of the job that accounts for some of your radiation exposure.

9. What information must I provide in my written declaration of pregnancy?

You should provide, in writing, your name, a declaration that you are pregnant, the estimated date of conception (only the month and year need be given), and the date that you give the letter to the licensee. A form letter that you can use is included at the end of these questions and answers. You may use that letter, use a form letter the licensee has provided to you, or write your own letter.

10. To declare my pregnancy, do I have to have documented medical proof that I am pregnant?

NRC regulations do not require that you provide medical proof of your pregnancy. However, NRC regulations do not preclude the licensee from requesting medical documentation of your pregnancy, especially if a change in your duties is necessary in order to comply with the 0.5 rem (5 mSv) dose limit.

11. Can I tell the licensee orally rather than in writing that I am pregnant?

No. The regulations require that the declaration must be in writing.

12. If I have not declared my pregnancy in writing, but the licensee suspects that I am pregnant, do the lower dose limits apply?

No. The lower dose limits for pregnant women apply only if you have declared your pregnancy in writing. The United States Supreme Court has ruled (in *United Automobile Workers International Union v. Johnson Controls, Inc.*, 1991) that "Decisions about the welfare of future children must be left to the parents who conceive, bear, support, and raise them rather than to the employers who hire those parents" (Reference 7). The Supreme Court also ruled that your employer may not restrict you from a specific job "because of concerns about the next generation." Thus, the lower limits apply only if you choose to declare your pregnancy in writing.

13. If I am planning to become pregnant but am not yet pregnant and I inform the licensee of that in writing, do the lower dose limits apply?

No. The requirement for lower limits applies only if you declare in writing that you are already pregnant.

14. What if I have a miscarriage or find out that I am not pregnant?

If you have declared your pregnancy in writing, you should promptly inform the licensee in writing that you are no longer pregnant. However, if you have not formally declared your pregnancy in writing, you need not inform the licensee of your nonpregnant status.

15. How long is the lower dose limit in effect?

The dose to the embryo/fetus must be limited until you withdraw your declaration in writing or you inform the licensee in writing that you are no longer pregnant. If the declaration is not withdrawn, the written declaration may be considered expired one year after submission.

16. If I have declared my pregnancy in writing, can I revoke my declaration of pregnancy even if I am still pregnant?

Yes, you may. The choice is entirely yours. If you revoke your declaration of pregnancy, the lower dose limit for the embryo/fetus no longer applies.

17. What if I work under contract at a licensed facility?

The regulations state that you should formally declare your pregnancy to the licensee in writing. The licensee has the responsibility to limit the dose to the embryo/fetus.

18. Where can I get additional information?

The references to this Appendix contain helpful information, especially Reference 3, NRC's Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Radiation Exposure," for general information on radiation risks. The licensee should be able to give this document to you.

For information on legal aspects, see Reference 7, "The Rock and the Hard Place: Employer Liability to Fertile or Pregnant Employees and Their Unborn Children—What Can the Employer Do?" which is an article in the journal *Radiation Protection Management*.

You may telephone the NRC Headquarters at (301) 415-7000. Legal questions should be directed to the Office of the General Counsel, and technical questions should be directed to the Division of Industrial and Medical Nuclear Safety.

You may also telephone the NRC Regional Offices at the following numbers: Region I, (610) 337-5000; Region II, (404) 562-4400; Region III, (630) 829-9500; and Region IV, (817) 860-8100. Legal questions should be directed to the Regional Counsel, and technical questions should be directed to the Division of Nuclear Materials Safety.

REFERENCES FOR APPENDIX

1. National Council on Radiation Protection and Measurements. *Limitation of Exposure to Ionizing Radiation*, NCRP Report No. 116, Bethesda, MD, 1993.

2. International Commission on Radiological Protection, *1990 Recommendations of the International Commission on Radiological Protection*, ICRP Publication 60, Ann. ICRP 21: No. 1-3, Pergamon Press, Oxford, UK, 1991.

3. USNRC, "Instruction Concerning Risks from Occupational Radiation Exposure," Regulatory Guide 8.29, Revision 1, February 1996.[1] (Electronically available at www.nrc.gov/NRC/RG/index.html)

4. Committee on the Biological Effects of Ionizing Radiations, National Research Council, *Health Effects of Exposure to Low Levels of Ionizing Radiation* (BEIR V), National Academy Press, Washington, DC, 1990.

5. United Nations Scientific Committee on the Effects of Atomic Radiation, *Sources and Effects of Ionizing Radiation*, United Nations, New York, 1993.

6. R. Doll and R. Wakeford, "Risk of Childhood Cancer from Fetal Irradiation," *The British Journal of Radiology*, 70, 130-139, 1997.

7. David Wiedis, Donald E. Jose, and Timm O. Phoebe, "The Rock and the Hard Place: Employer Liability to Fertile or Pregnant Employees and Their Unborn Children—What Can the Employer Do?" *Radiation Protection Management*, *11*, 41-49, January/February 1994.

8. National Council on Radiation Protection and Measurements, *Considerations Regarding the Unintended Radiation Exposure of the Embryo, Fetus, or Nursing Child*, NCRP Commentary No. 9, Bethesda, MD, 1994.

9. National Council on Radiation Protection and Measurements, *Risk Estimates for Radiation Protection*, NCRP Report No. 115, Bethesda, MD, 1993.

10. National Radiological Protection Board, *Advice on Exposure to Ionising Radiation During Pregnancy*, National Radiological Protection Board, Chilton, Didcot, UK, 1998.

11. M.L. Thomas and D. Hagemeyer, "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities, 1996," Twenty-Ninth Annual Report, NUREG-0713, Vol. 18, USNRC, 1998.[2]

[1]Single copies of regulatory guides, both active and draft, and draft NUREG documents may be obtained free of charge by writing the Reproduction and Distribution Services Section, OCIO, USNRC, Washington, DC 20555–0001, or by fax to (301)415–2289, or by email to <DISTRIBUTION@NRC.GOV>. Active guides may also be purchased from the National Technical Information Service on a standing order basis. Details on this service may be obtained by writing NTIS, 5285 Port Royal Road, Springfield, VA 22161. Copies of active and draft guides are available for inspection or copying for a fee from the NRC Public Document Room at 2120 L Street NW., Washington, DC; the PDR's mailing address is Mail Stop LL-6, Washington, DC 20555; telephone (202)634–3273; fax (202)634–3343.

[2]Copies are available at current rates from the U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20402–9328 (telephone (202)512–1800); or from the National Technical Information Service by writing NTIS at 5285 Port Royal Road, Springfield, VA 22161. Copies are available for inspection or copying for a fee from the NRC Public Document Room at 2120 L Street NW., Washington, DC; the PDR's mailing address is Mail Stop LL-6, Washington, DC 20555; telephone (202)634–3273; fax (202)634–3343.

FORM LETTER FOR DECLARING PREGNANCY

This form letter is provided for your convenience. To make your written declaration of pregnancy, you may fill in the blanks in this form letter, you may use a form letter the licensee has provided to you, or you may write your own letter.

DECLARATION OF PREGNANCY

To:_____

In accordance with the NRC's regulations at 10 CFR 20.1208, "Dose to an Embryo/Fetus," I am declaring that I am pregnant. I believe I became pregnant in_____ (only the month and year need be provided).

I understand the radiation dose to my embryo/fetus during my entire pregnancy will not be allowed to exceed 0.5 rem (5 millisievert) (unless that dose has already been exceeded between the time of conception and submitting this letter). I also understand that meeting the lower dose limit may require a change in job or job responsibilities during my pregnancy.

_____

(Your signature)

_____

(Your name printed)

_____

(Date)

Tab F

Exposure of Minors to Radiation

No person under eighteen (18) years of age shall be employed or permitted to enter any campus location where exposure to radioactive substances and/or ionizing radiation could potentially exceed 10 percent of any of the annual occupational dose limits specified for adult workers.

Minors less than 16 years old ("Children") are strictly prohibited from entering or working in any campus location where any regulated radioactive substances are used or stored or where there is any potential for exposure to ionizing radiation. Educational exceptions may be granted on a case-by-case basis by contacting the RSO.

A minor student (≤18 years old and >16 years old) will be allowed to be present or work in such an area as part of an educational program, provided the following conditions are met:

1. The minor is an authorized Towson University Student, Student Employee or Research Intern; and,
2. The minor has satisfactorily completed the following radiation safety training and all training has been documented:
    - Basic Radiation Worker Safety Training offered by TU Radiation Safety Office (RSO).
    - A review of the TU Radiation Protection Program manual with the Laboratory Supervisor or Principle Investigator (PI).
    - The minor receives site-specific radiation safety training from the Laboratory Supervisor or PI.
    - Copies of all training documentation has been received by the RSO.
3. The minor is supervised in the laboratory at all times by a qualified adult when working with radioactive substances or ionizing radiation.
4. The sponsoring Department has a "Waiver" (attached) signed by the minors' parents/legal guardian.
5. The minor must be assigned a dosimeter prior to working in the laboratory or use area. Contact the Radiation Safety Office (RSO) at (410) 704-2949 to request a dosimeter. All radiation safety training must be completed and documentation forwarded to the RSO PRIOR to requesting dosimetry. Prior to leaving the University, the minor must be instructed to turn in their dosimeter to the PI for return to the RSO. Any unreturned dosimetry will be presumed lost and charged to the host Department.
6. If a radioactive materials spill occurs when a minor is present in a laboratory, the RSO staff must be contacted immediately and arrangements made to perform appropriate bioassay monitoring.

AGREEMENT, WAIVER, HOLD HARMLESS AND COVENANT NOT TO SUE

Notice: This Agreement is a contract with legal consequences. Read it carefully before signing!

Minor Student's Name (printed or typed): _____

In consideration of the above-named minor's participation in to make the following contractual representations and agreements:

_____
_____
_____

on (dates): _____,

I hereby freely agree that I fully realize the dangers of the minor's participation in an event of this type and voluntarily assume all the risks associated with such participation. I understand the risks include, by way of example, and not limitation, the following:

Potential exposure to radiation above Federal and State Regulatory Occupational Exposure Limits from:

1) Radiation producing devices; or,
2) Sealed radioactive sources; or,
3) Open source radioactive materials.

I agree that it is my sole responsibility to be familiar with the physical and/or mental demands associated with the above named event. With these demands in mind, the minor has no physical or mental condition which. to my knowledge, would endanger him/herself or others if he/she participates in this event, or would interfere with his/her ability to participate in the event. I also agree that the minor will abide by any established rules or regulations while engaged in this activity.

I understand and expressly assume all the risks and dangers of the activities contemplated by this Agreement, and I hereby release, waive, discharge, and covenant not to sue Towson University, the University System of Maryland, the State of Maryland, and their officers, agents, servants, and employees (collectively, the "Releasees") from all liability, claims, demands, actions, or causes of action whatsoever arising out of any damages, loss, or injury to me or to the minor, or to my/his/her property while participating in any of the activities contemplated by this Agreement, whether such damage, loss, or injury results from the negligence of the Releasees or for any other cause. I also hereby release, waive, discharge and covenant not to sue the Releasees from any claims whatsoever on account of any first aid, treatment, or service rendered to the minor during his/her participation in the above activity.

I hereby agree to indemnify and hold harmless the Releasees from any loss, liability, damage, or costs, including court costs and attorneys' fees, that they may incur due to the minor's participation in said activities, whether caused by the negligence of Releasees or otherwise.

I agree, for myself and my successors, that the above representations and agreements are contractually binding, and are not mere recitals. I agree that my failure or refusal to sign such agreements or releases shall in no way affect the validity of this Agreement, nor revoke or cancel any of the terms of this Agreement. I or any of my successors shall be liable for the expenses (including legal fees) incurred by the party or parties in defending against such claim or suit. This Agreement shall not be modified orally.

I have carefully read this form and fully understand its contents. I am aware that this is a release of liability, a waiver of claims, an agreement not to sue, an indemnity, and a contract between myself and Towson University and for the benefit of others described herein, I sign it of my own free will.

PARENT OR GUARDIAN OF A MINOR: I, as parent or guardian of the above named minor, hereby give my permission for my child or ward to participate in the above named activity, and further agree, individually and on behalf of my child or ward, to the terms of the above.

Parent's or Guardian's Signature: _____

Date: _____

Parent's or Guardian's Signature: _____

Date: _____

Signature of Witness: _____

Date: _____

Return Original to:

Radiation Safety Officer
Environmental Health & Safety
Towson University
8000 York Road
Towson, MD 21252

Retain copy for your records.

Tab G

RADIOACTIVE ANIMALS

A. Prior to the use radioactive materials with animals, Principle Investigators (PI's) must obtain written approval from the Institutional Animal Care & Use Committee (IACUC).

Copies of all radioactive animal research protocols must be submitted to, reviewed and approved by the RSO in advance prior to the purchase of any radioactive materials.

B. Radioactive animals may only be handled and housed in rooms licensed, approved and posted by the RSO for the use of radioactive materials. No radioactive animals will be kept, even temporarily, in areas not approved and posted for the use of radioactive materials.

Animals containing radioactive materials should be kept separate from non-radioactive animals.

All hands-on care and feeding of animals containing radioactive materials must be performed only by laboratory research personnel performing the research and who have been specifically trained in the handling and use of radioactive materials. Only radiation safety trained individuals may handle radioactive animals, cages, and bedding or animals wastes.

Before handling radioactive animals, animal cages, bedding or animal wastes, don the proper Personal Protective Equipment (PPE). All users should wear double gloves, lab coat and protective eyewear. If issued, users should also wear assigned rad dosimetry.

When working with radioactive animals, check hands and sleeves frequently to assure no contamination has occurred. Change gloves often and check feet for contamination before leaving the area.

Injection of radioactive material into animals, where appropriate, shall be performed in trays lined with absorbent material.

All cages, water bottles, equipment and containers used with radioactive animals must be labeled appropriately. It should be obvious to any individual entering the room what is contaminated or contains radioactivity. Additionally,

1. Containers, beakers, etc., must have a label on them identifying the isotope, activity (in mCi or uCi) and start date (date isotope administered to animal) of material inside.
2. Cages containing radioactive animals must have a "Caution Radioactive Material" sticker on them. Each cage must be labeled with the radioisotope, the activity per animal or, in the case of feeding, the activity per unit weight of feed or water.
3. Each cage must be labeled with the external radiation level at the cage surface in mr/hr if $\geq$ 0.5 mr/hr.

4. If the cage surface radiation level is >2 mr/hr, the cage must be shielded or removed to another area approved by the RSO where workers will not be exposed to a radiation level > 2 mr/hr.

C. All ancillary research personnel including general animal caretakers, students and technical personnel who enter areas where radioactive animals are kept must be fully informed of the potential hazards posed by the radioactive animal research specifically, radioactive materials in general; emergency procedures; restrictions on areas; waste handling; carcass disposal; and procedures for cleaning/decontaminating contaminated equipment.

D. When working with isotopes easily detected with a Geiger Counter (^{32}P, ^{33}P), place the meter next to the work area and turn it on prior to beginning to work. This will allow you to check your hands and equipment without contaminating the meter turning it on.

If working with radioactive materials not easily detected with a Geiger Counter (^{14}C, ^{3}H, ^{35}S), wipe tests and sample counting in a Liquid Scintillation Counter (LSC) is required.

When finished working with animals and/or radioactive materials, survey the work area to assure that no contamination has occurred. Survey all work areas, waste accumulation areas and floors to prevent the spread of contamination. Document survey results. (See Tab H – Contamination Surveys) Clean up any contamination immediately.

Before leaving work area, survey hands and feet to assure no contamination is present. Securely close all waste containers and label with isotope, activity and start date. Secure all radioactive source materials.

It is the PI's responsibility to monitor all radioactive animal cages and equipment for radioactive contamination and to ensure all contamination is removed.

E. All animal bedding, feces and urine from animals containing radioactive materials are presumed radioactive and will be treated as such until proven otherwise. These wastes will be packaged for disposal as follows:

1. Place all animal bedding and waste into a heavy duty zip-lock bag and seal. Place the first sealed zip-lock into a second heavy duty zip-lock bag ("double-bagged") and seal.
2. All syringes, needles, knives, glass and/or other sharp objects will be removed before packaging.
3. Attach a "Caution- Radioactive Material" label to the exterior of the outer bag. Label each bag with the isotope, the activity, the date and the PI's name.
4. Bagged bedding and wastes will be kept frozen (-20C) in freezers approved, and appropriately labeled, for the storage of radioactive materials pending disposal by the RSO.

All blood, tissues and animal carcasses containing radioactive materials are presumed radioactive and will be treated as such until proven otherwise. These wastes will be packaged for disposal as follows:

1. Place all animal waste into a heavy duty zip-lock bag and seal. Place the first sealed zip-lock into a second heavy duty zip-lock bag ("double-bagged") and seal.
2. All syringes, needles, knives, glass and/or other sharp objects will be removed before packaging.
3. All packages of animal carcasses containing radioactive materials will be marked with appropriate radiation labels, accurately labeled as to contents and identified to the isotope(s) present and a reasonable estimate of activity. Any additional chemical or pathological hazards will also be identified.
4. Bagged carcasses will be frozen (-20^{C}) and stored in freezers approved, and appropriately labeled, for the storage of radioactive materials.

Radioactive animal wastes other than excreta and bedding such as tissues, blood and carcasses contaminated with ^{3}H or ^{14}C are exempt from regulation as a radioactive waste if the waste contains <0.05 µCi/gram when averaged over the weight of the entire animal. It is the PI's responsibility for determining whether or not his animal wastes will be regulated for disposal as radioactive waste.

F. All cages and equipment used with animals containing radioactivity must be wipe tested and counted and, if necessary, decontaminated before re-use.

Tab H

CONTAMINATION SURVEYS

Frequent surveys performed by knowledgeable laboratory personnel are the main line of defense to detect spills and to prevent the spread of contamination within and beyond the laboratory.

A. Types of Contamination

1. **Removable contamination** can be readily removed using proper decontamination procedures. Removable contamination in any amount may present both an external and internal hazard because it can be picked up on skin and possibly ingested.

2. **Fixed contamination** cannot be readily decontaminated. Fixed contamination generally does not present a significant hazard unless the material comes loose or is present in such large amounts that it presents an external radiation hazard.

B. Types of Surveys

1. **Meter surveys**, using Geiger detectors or scintillation probes, can identify gross contamination (total contamination consisting of both fixed and removable contamination) but will detect only certain isotopes.

2. **Wipe surveys**, using "wipes" counted on a liquid scintillation counter or a gamma counter, can identify removable contamination only but will detect most isotopes. Wipe tests are the most versatile and most sensitive method of detecting low-level contamination in the laboratory.

3. **Leak Tests**, using cotton swabs or filter paper, are used to identify leaking sealed sources.

C. Survey Instrumentation

1. The portable Geiger-Muller (G-M) survey meter is best used for ^{32}P, a high energy beta emitter, and other high energy beta and gamma emitters, such as ^{60}Co, ^{65}Zn, ^{137}Cs, and ^{238}U. A G-M meter can also be used to identify areas heavily contaminated with lower energy betas, such as ^{14}C or ^{35}S, for which the G-M meter has a relatively low efficiency. G-M meters should not be used to survey for ^{125}I contamination, since G-M meters will detect ^{125}I only when there are very high levels of contamination.

2. The portable thin crystal NaI scintillation survey meter is used to locate ^{125}I contamination and to conduct surveys around low-energy x-ray sources such as x-ray diffractometers, XRF's and electron microscopes.

3. The liquid scintillation counter (LSC), used for counting wipe tests, is not portable but is the most versatile counting instrument because it has a high counting efficiency for a wide range of radionuclides.

4. Gamma counters are not portable and are used to count wipe tests for photon emitters, such as ^{51}Cr or ^{125}I. TU does not have a Gamma Counter and would have to send samples off-campus to be counted.

D. When to Perform a Survey

1. The immediate areas in which licensed materials are used in unsealed form will be meter surveyed by the User for contamination at least once daily when radioisotopes are used. (Except ^{3}H areas.)

2. Wipe tests will be performed by the User after each use of ^{32}P and weekly for all other isotopes during periods of active isotope usage. If radioactive materials are not being actively used or stored in the lab, user wipe tests will be performed and documented at least semi-annually.

3. The Principle User is responsible for the performance of these surveys and will maintain written records of all surveys for a period of three (3) years. Survey records will be kept in each lab in a readily accessible location for immediate access by RSO Staff or other Compliance Inspectors. Any contamination identified should be cleaned immediately. The RSO can provide advice for decontamination procedures.

    (a) Document all survey results especially whenever contamination is discovered to show follow-up actions whenever contamination has been cleaned up.

E. Where to Perform a Survey

1. Survey areas where splashes or spills may have occurred and areas where a person could unknowingly transfer contamination. Typical survey locations include, but are not limited to:

    - Bench tops, including the edges
    - Fume hoods (aprons, sashes, sash handles)
    - Beta shields
    - Refrigerator and freezer door handles (inside surfaces also)
    - Sinks designated for radioactive material disposal (sink basin, surrounding bench, faucet handles)
    - Floors: at working areas, laboratory entrances, waste containers, fume hoods
    - Communal equipment, such as pipettors, timers, incubators, centrifuges, water baths, LSC controls & racks, etc.
    - Non-radioactive trash (to ensure that contaminated waste is not disposed of as regular trash)
    - Clean areas (offices, desks, door knobs, phones, computers, etc.)

F. How to Perform a Meter Survey

1. Perform a battery test. Check the survey meter's battery by turning the meter knob to the battery test position. If the battery is adequately charged, the meter needle will swing to the battery test position on the meter face. Replace the batteries if the batteries are low.

2. Perform an operational check the first time you use the meter each day or when you suspect it may have been misused or damaged. Look at the calibration sticker on the side of the meter and note what the expected reading for the operational check source should be. Turn the meter on and turn the meter's multiplier switch to a setting that will measure the check source and will provide a mid-scale reading but will not cause the needle to swing beyond full scale. For a Ludlum G-M survey meter the multiplier knob should generally be set to the X1 position. Place the probe firmly against the check source on the side of the meter and note the meter response. Meter background should be less than (<) 100 counts per minute (cpm) for a G-M meter and < 300 cpm for a sodium iodide (NaI) scintillation meter. If the observed meter response differs from the expected response by more than 20%, the meter should be considered nonfunctional and should be taken out of service.

3. Take the meter to an area away from sources of radiation and note the meter background reading. Typically, the background for a G-M meter with a pancake survey probe should be < 100 counts per minute (cpm) while the background reading for a meter with a NaI scintillation crystal should be <300 cpm. If the meter's background reading is substantially greater than expected, confirm that there are no unexpected sources of radiation or radioactive materials in the vicinity, and then call Environmental Health & Safety (EHS) to report a contaminated meter.

4. Do not cover the probe surface with parafilm or other protective covering. Parafilm and similar materials will shield the low energy betas from ^{14}C, ^{33}P and ^{35}S and will prevent the meter from detecting contamination.

5. Slowly move the probe about 1 centimeter above the area of interest.

6. If an item or area with a sustained count rate more three times (3X) background is found, the item or area should be considered to be contaminated.

7. Immediately label the area or item and promptly decontaminate it. If an area cannot be decontaminated, the contaminated area should be marked and labeled to indicate the isotope, date and level of contamination.

8. Sometimes, especially in the presence of other radioactive materials, the meter survey may be equivocal. When the meter survey indicates that low level contamination may be present, a wipe survey should be performed to confirm or disprove the presence of contamination.

9. Document the survey results whenever any contamination is discovered or if 250 µCi or more of any isotope have been handled. Record survey results on the *Contamination Meter Survey Log* below. (Contact the RSO for a full sized PDF file copy of this form.)

G. How to Perform a Wipe Test

1. Wipe surveys must be performed when H-3 is used and is the survey method of choice to detect the presence of low levels of removable ^{14}C, ^{33}P and ^{35}S contamination. Wipe surveys should also be performed to confirm the presence of contamination when a meter survey suggests that low level contamination may be present.

   (a) Using a piece of filter paper (about 1" in diameter), Q-tip or other swab, wipe approximately 100 cm^2 of the area being surveyed for the presence of removable contamination. Individually wipe test each potentially contaminated item or area (floors, bench top, waste containers, etc.) If the area is very large, subdivide it into smaller areas and use several wipes to better pinpoint the location of contamination. For some surfaces, including skin and clothing, the wipe media should be moistened with water or other appropriate solvent.

   (b) Prepare the sample for counting in accordance with the LSC's operating manual and then run the samples in the LSC.

   (c) Sample activity is determined by dividing the sample count by the counter's efficiency for the isotope in question. The LSC operating manual provides information about efficiencies and activity determination.

   (d) Document all wipe surveys on the *Radiation Wipe Survey Log* shown below. (Contact the RSO for a full sized PDF file copy of this form.) Show the location of all wipe samples. Sketch your radiation area in the space labeled "Room Diagram". Extensive detail is not necessary, however, the location of key components such as fume hoods, sinks, radioactive use benches, radioactive materials storage freezers, rad waste containers, etc., should be included and labeled. (See example below.) It is strongly recommended that you save your drawing as a template for future surveys.

   NOTE: Never use correction fluid (white-out) on a radiation safety record. Make corrections by drawing a single line through the error, then initial and date the correction.

   (e) Contact the RSO with questions about LSC use.

H. How to Perform a Leak Test

1. Sealed source leaks tests will be performed at least every 6 months on sources actively in service. Sources in storage are exempt from this requirement but will be tested prior to re-use, transfer or disposal. Tests will be performed in accordance with procedures contained in the model leak test program contained in Appendix R to NUREG – 1556, Vol. 7. "Program-Specific Guidance about Academic, Research and Development, and Other Licenses of Limited Scope", dated December 1999, below.

Appendix R
Model Leak Test Procedures

Model Leak Test Procedures

This appendix provides applicants and licensees with model leak test procedures and sample calculations for determining activity on a wipe test sample.

Frequency for Conducting Leak Tests of Sealed Sources

Leak tests will be conducted at the frequency specified in the respective SSD Registration Certificate.

Procedure for Performing Leak Testing and Analysis

For each source to be tested, list identifying information such as manufacturer, model number, serial number, radionuclides, and activity.

- If available, use a survey meter to monitor exposure.
- Prepare a separate wipe sample (e.g., cotton swab or filter paper) for each sealed source.
- Number each wipe to correlate with identifying information for each source.
- Wipe the most accessible area (but not directly from the surface of a source) where contamination would accumulate if the sealed source were leaking.
- Prepare the wipe sample for counting in the LSC and ensure that its calibration is current.
- Using the selected instrument, count and record background count rate.
- Calculate efficiency as shown below

For example: $\frac{[(\text{cpm from std}) - (\text{cpm from bkg})]}{\text{activity of std in Bq}} = \text{efficiency in cpm/Bq}$

where: cpm = counts per minute
std = standard
bkg = background
Bq = Becquerel

- Count each wipe sample; determine net count rate.
- For each sample, calculate and record estimated activity in becquerels (or microcuries).

For example: $\frac{[(\text{cpm from wipe sample}) - (\text{cpm from bkg})]}{\text{efficiency in cpm/Bq}} = \text{Bq on wipe sample}$

- Sign and date the list of sources, data and calculations. Retain records for 3 years (10 CFR 20.2103(a)).
- If the wipe test activity is 185 Bq (0.005 μCi) or greater, notify the RSO, so that the source can be withdrawn from use and disposed of properly.

TOWSON UNIVERSITY

Contamination Meter Survey Log

Building & Room #: _____

Date[1]	Time	Surveyor's Name (Print Legibly)	Isotope Used	Survey Type		Survey Results (CPM)	Survey Meter Used[2]	Comments[3]
				Personal	Work Area			

1. Use full date, including year.
2. Manufacturer, Model, Serial Number & Probe Type
3. Do not Use 'OK" or "Background – Be specific.

NOTE: THIS SURVEY RECORD MUST BE KEPT THREE (3) YEARS FROM THE LAST SURVEY DATE ON THE SHEET.

Radiation Wipe Survey Log

Building: _____ Survey Date: _____

Room #: _____ Person Performing Survey: _____

(Room Diagram – Not to Scale)	"X" indicates non-compliance Labeling Requirements: _____ Signs & Labels: Room _____ Source Containers _____ LSC Vials _____ Rad Waste Container(s) _____ Other Equipment Safety Requirements: _____ Absorbent Paper/Spill Trays _____ Adequate Hood Flow _____ Adequate Personnel Monitoring _____ Routine use of PPE _____ Adequate Shielding _____ Prohibition of Eating/Drinking _____ Contamination (Wipes <100dpm/cm^2) _____ Survey Meter Operational _____ Survey Meter in Calibration Program Requirements: _____ Security of Licensed Materials _____ Survey Records Other:

Wipe Sample Results: Instrumentation Used: Calibration Date:

☐ All Results <100dpm/100cm^2 Ludlum Model 3: SN#: _____ _____

☐ See Attached LSC Printout

Comments:

NOTE: THIS SURVEY RECORD MUST BE KEPT THREE (3) YEARS FROM THE SURVEY DATE.

gnw:12/06

EXAMPLE

TOWSON UNIVERSITY

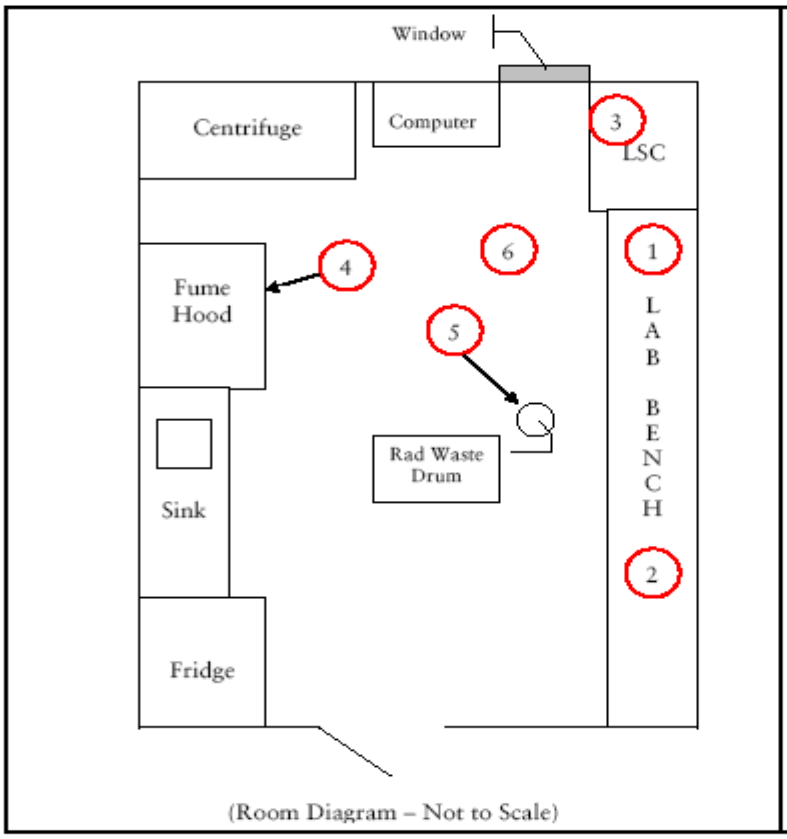
Radiation Wipe Survey Log

Building: Smith Hall

Survey Date: (Today's Date)

Room #: 468A

Person Performing Survey: Joe College



(Room Diagram – Not to Scale)

"X" indicates non-compliance

Labeling Requirements:
_____ Signs & Labels: Room
_____ Source Containers
_____ LSC Vials
_____ Rad Waste Container(s)
_____ Other Equipment

Safety Requirements:
_____ Absorbent Paper/Spill Trays
_____ Adequate Hood Flow
_____ Adequate Personnel Monitoring
_____ Routine use of PPE
_____ Adequate Shielding
_____ Prohibition of Eating/Drinking
_____ Contamination (Wipes <100dpm/cm^2)
_____ Survey Meter Operational
_____ Survey Meter in Calibration

Program Requirements:
_____ Security of Licensed Materials
_____ Survey Records

Other:

Wipe Sample Results:
☑ All Results <100dpm/100cm^2
☐ See Attached LSC Printout

Instrumentation Used:
Ludlum Model 3: SN#: 12345

Calibration Date:
(Located on Meter)

Comments:

NOTE: THIS SURVEY RECORD MUST BE KEPT THREE (3) YEARS FROM THE SURVEY DATE.

gnw:12/06

Tab I

COMAR 26. 12. 01. 01 SECTION A. 15 & 16

FALSE STATEMENTS, REPRESENTATIONS, CERTIFICATIONS AND MISCONDUCT

Sec. A.15 False Statements, Representations and Certifications.

No person shall:

(a) make a false statement, representation, or certification in any application, record, report, plan or other document regarding radiation levels, tests performed, radiation safety conditions, practices or notices, or

(b) falsify, tamper with or render inaccurate any monitoring device or method for data collection if the data collected by that device or method is required by these regulations, or by any license or registration condition.

Sec A.16 Deliberate Misconduct.

(a) Any licensee, certificate of registration holder, applicant for a license or certificate of registration, employee of a licensee, certificate of registration holder or applicant; or any contractor (including a supplier or consultant), subcontractor, employee of a contractor or subcontractor of any licensee or certificate of registration holder or applicant for a license or certificate of registration, who knowingly provides to any licensee, applicant, certificate holder, contractor, or subcontractor, any components, equipment, materials, or other goods or services that relate to a licensee's, certificate holder's or applicant's activities in this part, may not:

(1) Engage in deliberate misconduct that causes or would have caused, if not detected, a licensee, certificate of registration holder, or applicant to be in violation of any rule, regulation, or order; or any term, condition, or limitation of any license issued by the Department; or

(2) Deliberately submit to the Department, a licensee, certificate of registration holder, an applicant, or a licensee's, certificate holder's or applicant's, contractor or subcontractor, information that the person submitting the information knows to be incomplete or inaccurate in some respect material to the Department.

(b) A person who violates paragraph (a)(1) or (a)(2) of this section may be subject to enforcement action in accordance with Maryland Environmental Article, Sections 1-301, 8-101, 8-509(b) and 8-510(b).

(c) For the purposes of paragraph (a)(1) of this section, deliberate misconduct by a person means an intentional act or omission that the person knows:

(1) Would cause a licensee, certificate of registration holder or applicant to be in violation of any rule, regulation, or order; or any term, condition, or limitation, of any license issued by the Department; or

(2) Constitutes a violation of a requirement, procedure, instruction, contract, purchase order, or policy of a licensee, certificate of registration holder, applicant, contractor, or subcontractor.

Tab J

Annual Radiation Protection Program Review Certification

Certification

Radiation Protection Plan Review

Environmental Health
& Safety

Towson University
8000 York Road
Towson, MD 21252-0001

t. 410 704-2948
f. 410 704-2983

In accordance with NRC Regulation 10 CRF 20.1101 (c) which requires annual radiation protection program review, I certify that on the date below I have completely reviewed the Towson University *Radiation Protection Plan*, dated _____, and acknowledge my responsibilities contained in this document.

_____ _____
Printed Name Date

_____
Signature

Return original signed document via campus mail to:

Environmental Health & Safety
Radiation Safety Office
Administration Bldg
Campus