HAMILTON COLLEGE
RADIATION SAFETY MANUAL

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FOREWORD

The Radiation Safety Manual represents one part of a commitment by the administration of Hamilton College to keep occupational radiation exposure as low as reasonably achievable (ALARA). It complements organizational units established within the university to provide direction and oversight to activities using radioactive materials and radiation-producing machines.

The pursuit of scholarly endeavors through use of all means available is encouraged, consistent with safe practices that minimize risk to humans and the environment. To this end, adoption of these policies and procedures in research and teaching is fundamental to achieving the goal of ALARA.

The Administration welcomes input from radiation workers about our radiation protection program. Modifications to operating procedures and equipment and facilities will be considered where they substantially reduce radiation exposure at reasonable cost.

President
Hamilton College

A. INTRODUCTION

Ionizing radiation arises from both natural and man-made sources. It's use in teaching and research provides a valuable tool to demonstrate principles and probe the unknown. Hamilton College must operate within the regulations established by the State of New York Department of Health (State Sanitary Code Chapter I - Part 16). This manual constitutes minimum acceptable requirements for use of radioactive materials at Hamilton College. It is the University's policy to keep radiation exposure as low as reasonably achievable (ALARA).

Adherence to the stated regulations, procedures, and protocols will ensure maximum radiation safety to those using radioactive materials. Failure to follow procedures in this manual may result in excessive personnel exposure and may put in jeopardy the authorization of Hamilton College to use radioactive materials.

All personnel using radiation sources are expected to be familiar with radiation safety requirements in this guide and to conduct their operations in accordance with them. The University is committed to a program which will minimize personnel exposure.

Chairman, Radiation Safety Committee
Hamilton College

B. ORGANIZATIONAL CHART

The administrative structure to supervise the possession of radiation sources and their use within the College is set forth in the chart below. For details concerning these relationships, consult Sections C, D, and E of this manual.

President
|
Dean of the Faculty
|
Radiation Safety Committee
|
Radiation Safety Officer
|
Authorized Users
|
Qualified User, Restricted User

C. RADIATION SAFETY COMMITTEE

1. General Description

The Radiation Safety Committee shall be a standing College Committee.

The Radiation Safety Committee (RSC) shall consist of at least five members. It is recommended that the committee be composed of at least three faculty from the Science Departments, the Radiation Safety Officer (RSO), and an administrative representative. All members of the Committee, including the Chairperson, shall be appointed by the authority of the President of Hamilton College. The Radiation Safety Officer and the administrative representative will be permanent members of the Committee and will not be eligible to serve as Chairperson of the Committee. Other members than those designated above may be added as deemed appropriate by the President.

The responsibility of the Radiation Safety Committee shall be to establish and administer the radiation safety program for all licensed users of ionizing radiation sources. The Committee will ensure that all individuals who work with or in the vicinity of radioactive material have sufficient training and experience to enable them to perform their duties safely and in accordance with established regulations and license conditions.

This Committee has been designated by the State of New York as the responsible agent of the College. The RSC shall meet as often as necessary to conduct its business, but not less than once each calendar quarter and upon call of the Chairperson. A quorum shall consist of at least one-half of the Committee's membership, including the Chairperson, RSO and administrative representative.

The Radiation Safety Committee is the final authority in all matters pertaining to radiation safety.

2. Duties and Functions

The duties and functions of the RSC are to:

a. Be familiar with all pertinent New York Health Department regulations (State Sanitary Code, Chapter I - Part 16) and the terms of the license.

b. Establish rules, regulations, and policies regarding College radiation safety and radiation producing equipment.

c. Ensure that the College's program to maintain individual and collective doses as low as reasonably achievable (ALARA) is properly maintained. This will be accomplished by the performance of a semi-annual review of occupational radiation exposure records of all personnel working with radioactive materials (if applicable).

d. Review and act upon all applications for possession and use of sources of ionizing radiation. This will include a review of the individual's training and experience in working with radioactive materials and their ability to perform duties in accordance with specified regulations and license conditions.

e. Prescribe special conditions that will be required during a proposed use of radioactive material such as requirements for bioassays, physical examinations of users, and/or special monitoring procedures.

f. Receive and review periodic reports from the Radiation Safety Officer.

g. Review the entire radiation safety program at least annually to determine that all activities are being conducted safely and in accordance with specified regulations and license conditions.

h. Review with the Radiation Safety Officer major instances of alleged infractions during the use of radionuclides or radiation, or of safety rules, and take necessary action to correct such infractions.

i. Maintain written records of all Committee meetings, actions, recommendations, and decisions.

j. Ensure the byproduct material license is amended, if required, prior to any change in facilities, equipment, personnel, policies and/or equipment.

3. **Responsibility of Chairperson**

It shall be the responsibility of the Chairperson to:

a. Report periodically the actions of the RSC to the President or his designate.

b. Call for meetings of the RSC.

c. Circulate minutes of the RSC meetings to other committees with responsibility in the area of radiation safety, and to establish coordination with other responsible radiation safety bodies.

d. Appoint sub-committees to deal with specific areas of radiation as necessary.

e. It is a prerogative of the Chairperson to vote in all Committee matters.

4. **Hamilton College Radiation Safety Committee:**

David A. Gapp, Radiation Safety Officer, Professor of Biology
Pearl Gapp, Chair RCS, Laboratory Coordinator in Biology
Patricia Ingalls, Director, Campus Safety
Brian Hansen, Director of Environmental Protection and Safety
David G. Bailey, Associate Professor of Geosciences
Brian Collett, Associate Professor of Physics
Camille Y. Jones, Assistant Professor of Chemistry

D. RADIATION SAFETY OFFICER

1. General Description

The Radiation Safety Officer (RSO) is that person, who is appointed by the authority of the President of the College, and who by reason of education, training, and experience, is qualified to advise others in the safe use of radiation. The primary mission of the RSO is to execute the policies established by the RSC and to ensure compliance with the State regulations. The RSO reports directly to the RSC for matters of radiation safety concern.

2. Radiation Safety Officer is Responsible For:

a. General surveillance over all activities involving radiation and radioactive material, including routine monitoring and special surveys of all areas in which radioactive material is used.

b. Determining compliance with rules and regulations, license conditions, and the conditions of project approval specified by the Radiation Safety Committee.

c. Monitoring and maintaining special ventilation filter systems (fume hoods) associated with the use and or storage of radioactive material.

d. Furnishing consulting services on all aspects of radiation protection to personnel at all levels of responsibility within the College or engaged in College activities.

e. Purchasing and transferring all radioactive materials in accordance with Sections S and T of this manual.

f. Receiving, delivering, and opening all shipments of radioactive material arriving at the institution and receiving, packaging, and shipping all radioactive material leaving the institution.

g. Distributing and processing personnel monitoring equipment; determining the need for and evaluation of bioassays; keeping personnel exposure and bioassay records; and notifying individuals and their supervisors of exposures approaching any limits and recommending appropriate remedial action.

h. Conducting training programs and otherwise instructing personnel in the proper procedures for the use of radioactive materials and other radiation sources prior to use, at periodic intervals (refresher training), and as required by changes in procedures, equipment, regulations, etc.

i. Supervising and coordinating the radioactive waste disposal program, including keeping waste storage and disposal records and monitoring effluents.

j. Storing all radioactive materials not in current use, including wastes.

k. Performing leak tests on all sealed sources.

l. Maintaining an inventory of all radionuclides at the institution and limiting the quantity of radionuclides at the institution to the amounts authorized by the license.

m. Maintaining other records not specifically designated above; for example, receipt, transfer, and survey records.

n. Investigating any and all accidents, spills, unplanned releases to the environment, and other abnormal occurrences regarding radiation or radioactive material.

o. Supervising decontamination in case of accident.

p. Coordinating and submitting licensing applications and amendments to the State of New York.

q. Screening grant applications for licensing feasibility, prior to submission of the grant application to the granting agency.

r. Maintaining a file of radiation-producing and -detecting equipment at Hamilton College.

3. **The Radiation Safety Officer will also perform certain functions for the RSC.**

   a. The RSO will serve as secretary of the RSC, and keep RSC records.

   b. The RSO will furnish reports to the RSC as follows:

      1) The annual report on the status of the radiation safety program within the College.

      2) A semi-annual report of inventory of radioactive materials at Hamilton College.

      3) A report at every quarterly meeting of the RSC of unusual or abnormal incidents involving radiation and radioactive material.

4. **The Radiation Safety Officer has the authority to terminate immediately a project, activity, or use of radiation or radioactive material that is found to be a threat to health or property.** This would include the closing of a laboratory or the confiscation of radioactive material if such actions would remove or prevent the recurrence of a threat to health or property. Such a termination action shall be reported in writing to the Chairperson of the RSC within 48 hours after such termination action has been taken.

E. Definitions of Users of Radioactive Materials and Radiation Machines

The Radiation Safety Committee is empowered to authorize the possession and use of radioactive materials and radiation machines. Two categories of users have been established for which an individual may apply. These are **"Authorized User"** and **"Qualified User"**. A further discussion of each of these categories including the particular responsibilities and authorizations follows.

A chain of responsibility regarding the safe use of radioactive material and radiation machines exists from individual users to the RSC. This chain is independent of other administrative lines of control within Hamilton College. However, the RSC recognizes the right of any administrative entity within Hamilton College to impose additional restrictions, qualifications, and regulations regarding the use of radioactive material, radiation, or equipment by persons under its control.

Responsibilities of radionuclide users are outlined in Section G, and the procedures an individual must follow to become a user are presented in Section F of this manual.

1. **Authorized User.** A person designated by the RSC as an "Authorized User" may use and possess radioactive materials and/or radiation machines as specified by the RSC. An Authorized User bears the responsibility for the proper storage of materials under his/her control and for their proper use under his/her direction. Only an Authorized User may initiate the purchase or transfer of radioactive materials, as described in Sections S and T of this manual.

   In general, Authorized Users should be permanent members of the Hamilton College faculty or staff and ideally would have a position that would allow them to administer naturally the use of the radioactive materials under their authorization. An Authorized User may sponsor the use of radioactive materials and radiation machines by Qualified Users and personally supervise the use by Restricted Users. Further discussion of these activities appears below.

2. **Qualified User.** The category of "Qualified User" has been established to allow qualified persons to use radioactive material or radiation machines under specific circumstances under the sponsorship of an Authorized User. The latter shall bear primary responsibility for the safe use of the material or equipment. However, in the handling of radioactive materials or radiation machines, the Qualified User category is intended for students or technical employees whose association with Hamilton College may not be permanent and whose backgrounds may not be extensive enough to warrant a broad authorization to use radioactive materials or radiation machines. Such persons, sponsored by and with the written permission of an Authorized User to whom they have demonstrated their competence, may be permitted to use radioactive material or radiation machines in a manner specified by his/her application to the Committee without direct supervision. A Qualified User may not supervise the use of radioactive materials or radiation machines by Restricted Users except as specifically authorized by the RSC in writing.

3. **Restricted User.** A "Restricted User" is one who **has not received** authorization by the RSC as either an Authorized or Qualified User. A Restricted User may not use radioactive materials or radiation machines, except under direct supervision of an Authorized User.

4. Visiting Faculty

a. Visiting Faculty who are Leave Replacements: The RSO will apply for Authorized User status for visiting faculty who plan to use radioactive materials in their teaching laboratories. This requires amendment to the Radioactive Materials License and must be initiated at least two months prior to their arrival on campus.

b. Visiting Researchers and Scholars-in-Residence:

1) Host faculty will apply for Qualified User status (at least one month in advance of a proposed visit) for any visiting researchers and Scholars-in-Residence working under their authorization.

2) Visiting researchers cannot apply for Authorized User status. They must work under a College Authorized User, preferably the faculty member hosting their visit.

3) Host facility will provide dosimetry monitoring, as necessary.

4) Visitors must be instructed on the policies and procedures for radioactive materials handling at the College.

5) Records of instruction and dosimetry will be maintained by the RSO.

6) Visitors may not bring new sources or material on campus without prior approval from the RSC. Transfers will be made as outlined in Section T of this manual.

5. Direct or Personal Supervision

a. Direct supervision requires that the operation in question has been planned by the Authorized User, and the Restricted Users have been told of any potential hazards and been instructed in procedures to be followed both in normal circumstances and in the event of an abnormality or accident.

b. When the operation involves unsealed sources of radioactive material, the Authorized User must remain in the room in which the nuclide use is underway.

c. When the operation involves a sealed source or sources in a setup which does not present dose rates at the accessible boundary of the setup exceeding 2.5 mrem/hr, the Authorized User need not remain in the room, but must be in the same general area of the building in which the radionuclide use is underway, and must be aware of the operation in progress.

F. APPLICATION PROCEDURES AND GENERAL CRITERIA FOR APPROVAL

1. Application for possession and use of sources of radiation, and for Authorized User or Qualified User Status, will be made on the appropriate forms.

2. The application procedure has been broken down into two parts to facilitate application and amendment, and to minimize paperwork. Conceptually, these two parts are a "user" application (Form RSO-1) and a "use" application (Form RSO-2). "Use" and "User" applications must be filed initially and whenever significant changes are made.

3. An application will be submitted to the RSO for preliminary review. The application will then be reviewed by each RSC member, signed, and returned to the Chairperson with the following comments: Approve, Disapprove, Request Meeting of RSC to Discuss, or Questions and Remarks. All questions must be resolved before final approval, and prior to procurement of sources of radiation. Between regularly scheduled meetings, review and approval will ordinarily be done by mail and telephone.

4. Applications will be approved if the RSC is satisfied that the applicant:

   a. possesses adequate facilities and equipment, appropriate for the proposed use, which will ensure the safety of workers and public, and prevent or minimize environmental damage;

   b. has established safe and effective operating, handling, and emergency procedures;

   c. has adequate training and experience to safely carry out the proposed use;

   d. will maintain radiation exposures to workers and the public "as low as reasonably achievable" (ALARA); and

   e. will conform to all applicable regulations and procedures, such as recordkeeping, established by State and local authorities regarding all other aspects of possession and use of ionizing radiation.

5. On approval by the RSC, the user will be assigned a user number by the RSO. This number will be recorded on the user application and a copy of the completed application form will be provided to the user to serve as his/her AUTHORIZATION.

G. INDIVIDUAL RESPONSIBILITY

1. All Users

Each individual at Hamilton College, regardless of category or authorization, who has any contact with radioactive materials or other radiation sources is responsible for:

a. Being familiar with the Hamilton College Radiation Safety Manual.

b. Keeping his/her exposure to radiation and that of those working under his/her supervision as low as reasonably achievable, and specifically below the maximum permissible exposure listed in NY State Sanitary Code, Chapter I, Part 16.6 and Section K of this manual. Concentrations of radioactive materials in laboratory air shall be maintained below levels requiring posting as an airborne radioactivity area.

c. Wearing the prescribed monitoring equipment such as film badges and pocket dosimeters in radiation areas. Personnel who work only with pure alpha emitters or only with pure beta emitters having a maximum energy of less than 0.2 MeV will not be required to wear film badges. Extremity monitoring may be required for those individuals as determined by the RSO.

d. Having precautionary personnel surveys made at frequent intervals with a suitable survey instrument, and for recording the results.

e. Limiting the use of radionuclides authorized to them to individuals working under his/her direct supervision and to the location specified on the authorization form.

f. Keeping current working records of the receipt and disposition of radionuclides in their possession including use in classrooms, research, waste disposal, transfer, storage, etc. These records will be audited by the Radiation Safety Officer.

g. Transferring radioactive materials only according to Section T of this manual.

h. Following safe procedures as outlined in Section H of this manual.

i. Assuring that smoking, eating, drinking, and the application of cosmetics are prohibited in areas in which unsealed radioactive materials are present.

j. Ensuring that female workers are given specific instruction about prenatal exposure risks to the developing embryo and fetus prior to work with radioactive materials and radiation sources.

2. **Authorized Users**

In addition to items listed above, Authorized Users are further responsible for:

a. Adequate planning. Before an experiment is performed, the User should determine the types and amounts of radiation or radioactive material to be used. This will generally give a good indication of the protection required. The procedure must be well outlined. In most cases, before the procedure is actually performed with radioactive materials, it should be rehearsed so as to preclude accidents or unexpected circumstances.

b. Being present when radionuclides are used under their supervision.

c. Instructing those persons for whom they are responsible in the use of safe techniques and in the application of approved radiation safety practice.

d. Furnishing the Radiation Safety Officer with information concerning individuals and activities in their areas, particularly additions to or deletions from their personnel rosters.

e. Contacting the RSO whenever changes in operational procedures which might lead to personnel exposure are anticipated.

f. Complying with the regulations governing the use of radioactive materials as established by the State of New York and the Radiation Safety Committee for:

1) Correct procedure for the procurement of radioactive materials by purchase or transfer.

2) Posting radiation areas and areas where radioactive materials are used or stored.

3) Accounting for the disposition and amounts of radioactive materials in their area. Inventories of nuclides must be completed and received by the RSO every calendar quarter.

4) Assuring that all radioactive waste materials are consigned to the Radiation Safety Officer for disposal.

g. Reporting any incident or unusual occurrence related to the radioactive material or radiation producing equipment under their supervision. See Section O, "EMERGENCY PROCEDURES".

h. Informing the Radiation Safety Committee promptly of any employment of minors (persons under age 18) in activities involving radiation and radioactivity, or of possible radiation exposure of minors. Minors may not work in or frequent any Radiation Area or High Radiation Area.

H. LABORATORY RULES AND PROCEDURES

The purpose of this section is to provide procedures that ensure a safe working environment for laboratory personnel, to ensure public safety, and to avoid contamination of equipment and facilities.

1. **In advance of any work, the Authorized User must:**

   a. Discuss with the employees the work to be done and the necessary safety precautions in accordance with NY State Sanitary Code, Chapter 1, Part 16.13;

   b. Outline in writing the procedure for each job (make the amount of detail commensurate with the hazard);

   c. Stock the laboratory with plastic or rubber gloves, lab coats, safety goggles, warning tags and labels, wipes, appropriate survey/counting instruments, forms for necessary records, poly bags and tape for waste disposal, absorbent paper, etc. The use of good procedures is greatly facilitated by having proper tools/supplies at hand;

   d. Make arrangements with the RSO for radioactive waste disposal; and

   e. Have available and use when appropriate, remote handling devices, automatic pipettes or dispensers, tongs, etc., for the manipulation and transfer of radioactive preparations.

2. **The Rules and Procedures listed below should be followed by all laboratory personnel.**

   a. High standards of cleanliness and good housekeeping must be maintained in all laboratories where radioactive material is present.

   b. A RESTRICTED AREA is any area to which access is controlled for purposes of protection of individuals from exposure to radiation and radioactive materials. In general, laboratories or rooms where radioactive materials are stored or used are considered Restricted Areas with the exceptions noted below.

   c. In order to prevent accidental ingestion of radioactive materials, eating, drinking, smoking, storage and preparation of food, and application of cosmetics are not permitted in Restricted Areas unless within a specially marked CLEAN AREA. Such a Clean Area adjacent to a Restricted Area must:

      1) Have prior approval by the Radiation Safety Officer.

      2) Have its boundaries clearly delineated.

      3) Be labeled to exclude the use or storage of radioactive materials.

      4) Be located so that radioactive materials will not be transported through the area to be used or stored elsewhere in the laboratory.

      5) Not be in a laboratory where there is any reasonable expectation of airborne radioactivity.

   Ordinarily a Clean Area will not be approved by the RSO if there is a reasonable alternative.

Food, drink, coffee cups, ash trays, etc. found in Restricted Areas may be confiscated by the RSO. Specifically, food and drink must not be stored in refrigerators or cold rooms which are located in Restricted Areas or which are used for the storage of radioactive materials.

The above prohibitions do not apply to Restricted Areas in which the only radioactive materials are in the form of encapsulated Sealed Sources. The category of "Sealed Sources" does not include "unopened stock vials".

d. **NOTE: The only designated "hot sink" for cleaning of contaminated glassware and disposal of aqueous radioactive material is located in the hot-lab (Science Building Room 219b).** This sink should be labeled and the drain tagged to warn personnel prior to any repair work being performed. Repair and construction personnel who must work in Restricted Areas shall be instructed in the health and safety aspects of radiation on their job. Such instruction shall be provided by the Authorized or Qualified User or, at the Authorized User's request, by the RSO.

e. Designate and label a **storage area** for radionuclides. Keep them there when not in immediate use.

f. Radioactive materials shall be used and stored in such a manner as to restrict unauthorized persons from using or removing such materials. Restricted Areas shall be kept locked when not attended by qualified personnel.

g. Measure and record the photon radiation levels (in mR/hr) in the work and storage area and adjacent non-controlled areas, with an appropriately calibrated detector. A GM or scintillation probe may be useful to detect "hot spots" even if not calibrated for that particular energy. Provide sufficient shielding to keep radiation exposures as low as reasonably achievable and always below established limits. Consult the Radiation Safety Officer for help in designing shielding and minimizing expense.

h. Designate and label the radioactive work area(s). Consider the consequences of leakage or equipment failure. Use stainless steel or plastic trays to help confine liquids if spilled.

i. As with any laboratory research activity, all individuals **must** wear safety glasses when working with loose radioactive materials.

j. When working with radioactive materials, wear a lab coat, and plastic or rubber gloves for protection of clothes and skin. To avoid spread of contamination, remove gloves at work area. Change gloves frequently to prevent spread of contamination. Do not handle faucets, light switches, door knobs, telephones, etc. with potentially contaminated gloves. Special protection may be required for open cuts or wounds.

k. Respirators are not an approved method of protection from airborne radioactive materials. Experiments and equipment shall be designed so that respirators are not needed. Confine work with gaseous, volatile or dust-forming radioactive material to hoods or glove boxes as appropriate.

l. Confine radioactive solutions in covered containers plainly identified and with name of compound, radionuclide, date, activity, and radiation level if applicable. Labels shall conform with standards in Section N of this manual and in NY State Sanitary Code, Chapter I, Part 16.12.

m. Never pipette radioactive solutions by mouth. Mechanical devices must be used. Push-button pipettors with disposable tips are strongly recommended. Segregate pipetting devices used with radioactive materials from those used with non-radioactive solutions.

n. Persons who are designated to wear personnel monitoring equipment (film badges, TLDs, pocket dosimeters, etc.) by the Radiation Safety Officer should wear such devices at all times when they work with or near radioactive materials for which the devices are appropriate. Placement of monitoring devices will be as outlined in Section M of this manual.

o. Supply containers for radioactive waste and contaminated glassware at the work location. Avoid transporting contaminated articles from the work area through clean lab areas. Shield the waste containers as required to prevent unnecessary exposure. Waste containers should be secured and adequately labeled to prevent accidental disposal by housekeeping personnel.

p. If working with millicurie quantities of gamma or hard beta emitters (>1 MeV), check hands, feet and clothing with end window GM meter or other appropriate instrument for contamination after handling radioactive materials. The immediate work area should be checked for contamination **at least** at the end of each working day.

q. Never perform extensive radiochemical work with significant levels of radioactive material (>1 mCi) until the procedure has been tested by a "dry run" to preclude unexpected complications.

r. In case of spill or other accident, alert nearby personnel, confine spill, block off and mark area, decontaminate, and monitor before moving temporary signs or barricade. If personnel contamination is involved, remove contaminated outer clothing, wash skin, and monitor; seek medical advice if contamination persists and/or if injury has occurred. Report all accidents and injuries to the Radiation Safety Officer (RSO). See Section O, "EMERGENCY PROCEDURES," in this manual.

s. The individual responsible for a spill is responsible for decontamination. Do not use custodial personnel unless specifically assigned the task by the RSO and the Authorized User.

t. All equipment which is suspected to have come in contact with loose radioactive material shall be considered potentially contaminated and shall be monitored for contamination by Radiation Safety personnel before being removed from the laboratory for repair, modification, calibration, storage, or use elsewhere.

u. Custodial personnel shall clean only areas designated by the Authorized User. The users or their qualified laboratory personnel shall be responsible for the rest of the housecleaning. The Authorized User is responsible to ensure that housekeeping personnel do not come in contact with radioactive contamination.

v. When use or storage of radioactive material in a facility is terminated, the RSO is to be notified. The RSO will perform a termination survey before releasing the area for other uses.

I. RADIATION MONITORING AND CONTROL

1. Surveys

a. Radiological surveys of areas where radioactive materials are used, stored, or released are an essential part of any radiation safety program. **It is the responsibility of the Authorized User or his/her designee to conduct and record the required surveys as described below.** Records of such surveys are required by law, and will be examined in each Authorized User's work area during State inspections and inspections by the RSO. Records must be signed and dated. Survey records are the property of the licensee, not the individual user, and shall be retained as required by NY State Sanitary Code, Chapter I, Part 16.14.

b. A complete survey includes monitoring for fixed and removable contamination, and exposure rate measurements.

1) Fixed radioactive contamination can only be detected by a survey instrument appropriate to detect the type, energy and quality of radiation present. Fixed tritium contamination is very difficult to detect; however, most other common tracers can be detected with a thin end window GM instrument.

2) Removable radioactive contamination is generally a more serious problem. It can be detected by wipe tests (also called smears or swipes). Wipe surveys are performed by wiping the surface to be evaluated with a small piece of filter paper or cotton swab. A surface of approximately 100 cm^2 (4x4 in^2) should be wiped, and the paper or swab should be counted in an appropriately calibrated liquid scintillation counter or a gamma scintillation counter.

3) Exposure rate or absorbed dose rate measurements must be made and recorded in areas where they are significant. This excludes soft-beta emitters, such as H-3, C-14, and S-35, but includes P-32, and, of course, any gamma emitters. Geiger-Mueller (GM) counters are only good for exposure rate measurements if they have been calibrated at the energy in question. GMs are best used for the detection of small amounts of activity. A thin sodium iodide detector is excellent for Iodine-125.

4) Monthly radiation surveys shall be performed in laboratories using gamma (photon) emitting sources, other than exempt reference standards. Radiation surveys shall also be performed after the acquisition of additional radioactive material, or after any change has been made in shielding.

5) Hazard evaluations will be made periodically by the RSO, but all radiation workers must be alert for radiological and other hazards in the laboratory.

c. Other kinds of surveys include air and water sampling as deemed necessary by the RSO.

d. Areas should be surveyed at reasonable intervals, depending on the amount and type of radioactive material used, and the nature and frequency of work. "Reasonable intervals" will be deemed to be at least monthly in areas where radioactive materials were used. The immediate areas (e.g., hoods, bench tops) in which radioactive materials are being used

should be checked for contamination at least once daily by the radiation workers in the laboratory. More extensive surveys shall be performed at the completion of an experiment or if contamination is suspected. Such surveys are required to be documented, even if no contamination is found.

e. Below are some examples of areas that should be surveyed:

- benches, tables and counter tops
- apparatus
- storage areas
- fraction collectors
- refrigerators and freezers
- waste storage areas
- cold rooms
- sinks
- balances
- centrifuges
- stirrers
- floor
- fume hoods
- counting rooms
- drawers where hot equipment is kept

f. Equipment and/or areas found with removable contamination must be decontaminated to reduce the radioactive contamination ALARA but not to exceed the limits specified in Table I-1. Exposure rates must be kept ALARA, and anything over 1.0 mR/hr should be reported to the RSO.

g. It is imperative that every survey performed is properly documented. Surveys are a legal record and should be done neatly and accurately in a black ball point pen. The survey document should include a floor plan of the area surveyed and include the following information.

1) Location of the survey

2) Purpose of the survey (routine, post-spill, etc.)

3) Date and time the survey was performed

4) Make, model, and serial number of each instrument used for measuring direct radiation and/or for counting wipes

5) Efficiency of counting instruments

6) Calibration due date for each instrument (this date must be *after* the date of the survey)

7) Surveyor's name and signature

h. Copies of survey documents shall be maintained by the Authorized User's. The Authorized User will submit a copy of Form RSO-3 monthly to the RSO indicating the performance of the required radiological survey or that radioactive materials were not used in the area for the month.

i. The RSO will conduct an annual survey/assessment of each laboratory authorized to use radioactive materials. This survey will include radiation and contamination surveys and evaluation of radiation safety practices employed by the Authorized Users, such as proper signs and labels, posting of notices to employees, control of radioactive material, shielding materials, and waste disposal. Reports of the surveys shall be sent to the Authorized User with recommended corrective actions as appropriate.

2. **Acceptable Limits of Contamination**

Areas should be maintained essentially free of removable contamination but in any case contamination shall not exceed the values listed in the Tables I-1.

TABLE I-1

RADIOACTIVE SURFACE CONTAMINATION LIMITS

APPLICATION	ALPHA (dpm/100 cm^2)		BETA/GAMMA[1]	
	Total	Removable	Total (mR/h)	Removable (dpm/100cm^2)
Controlled Area				
Basic Guide	25,000 (Max.) 500 (Ave.)	500	1.0	5,000
Clean Area	1,000	100	0.5	1,000
Non-Controlled Area				
Skin, Personal clothing	500	N.D.[2]	0.1	N.D.[2]
Release of Materials or Facilities	2,500 (Max.) 500 (Ave.)	100	0.2	1,000

[1] Measured at 1 cm from the surface

[2] N.D. Non-detectable

3. **Dose Equivalent Rate Limits**

Dose equivalent rates above the levels stated below will be considered excessive unless they are of short duration, or, in the case of restricted areas, unless other steps are taken to limit personnel exposure. Barring these exceptions, action must be taken to reduce the dose equivalent rates as far as reasonably achievable below the levels listed in Table I-2.

TABLE I-2

DOSE EQUIVALENT GUIDELINE VALUES

Area	Action Level
Restricted	2.5 mrem/hour
Unrestricted	0.2 mrem/hour

4. **Survey Instruments**

Authorized Users will be required by the RSC to have immediate access to suitable survey instruments such as Geiger-Mueller detectors. Such instruments will be maintained and calibrated as stated in Section J of this manual.

5. In the event that the spread of radioactive contamination is suspected, all work in the area shall be halted immediately. The RSO shall be contacted as soon as possible. See Section O, "Emergency Procedures", of this manual.

J. INSTRUMENT CALIBRATIONS

Radiation detection instrumentation requires periodic checking and calibration. Radiation detection instrumentation is required to be calibrated at least once annually and after repairs by a licensed organization such as:

RSA Laboratories, Inc. 19 Pendleton Drive PO Box 61 Hebron, CT 06248	Harshaw/Bicron 6801 Cochran Road Solon, Ohio 44139	Ludlum Instruments, Inc. P. O. Box 810 501 Oak Street Sweetwater, Texas 79556
NRC License No. 06-30007-01	NRC License No. 34-13845-01	State of Texas Calibration License No. LO-1963

or another company specifically licensed by the U.S. NRC or an Agreement State to perform such services.

Prior to using any portable instrument to perform a radiological survey the user will perform the following checks.

1. Check the physical condition of the meter. Look for damage, and listen for apparent loose internal components. Check the cable for a good connection, and report any deficiencies to the RSO.

2. Ensure that the instrument has been calibrated within the last year.

3. Check battery/power supply.

4. Perform a source check. Put the selector switch on one of the operating positions, then expose the detector to a check source and ensure that the detector responds properly to radiation. Check the instrument again after use to ensure that it didn't fail during use.

K. IONIZING RADIATION DOSE LIMITS

1. Dose Limits

a. No person shall be permitted to receive an annual dose in excess of that listed in Table K-1 below.

Table K-1

DOSE LIMITS

Exposure Category	Annual Dose Limit (rem)
Total effective dose equivalent	**5**
Lens of eyes	**15**
Extremities	**50**
Skin	**50**
Committed dose equivalent (organs)	**50**

b. In no case shall an individual under the age of 18 years be permitted to receive a radiation dose in excess of 10 percent of the limits set forth in table K-1.

c. No individual shall be exposed to airborne radioactive material in concentrations:

1) In excess of the derived air concentrations (DACs) specified in Appendix 16-C, Table 1, Column 3 to the NY State Sanitary Code Chapter I, or

2) to such a degree that an individual present in the area without respiratory protection equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI), or 12 DAC-hours.

d. The dose to an embryo/fetus during the entire pregnancy, due to occupational exposure of a **declared pregnant woman** *, shall not be allowed to exceed 0.5 rem.

** A **declared pregnant woman** is a woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.*