Section 9

Radiation Protection Procedures

Contents

A. Radiation Hazards

Irradiation of the body can happen via two processes, external or internal.

1. External Radiation

External irradiation results from radioactive material, radiation sources, or radiation producing machines. This radiation is produced external to the body and may or may not penetrate deep into the body, depending upon the radiation energy. The irradiation ceases as soon as the radiation source is removed. Some types of external radiation are not significant external hazards.

a. Alpha Emitters and H-3

Alpha particles from alpha emitting radionuclides and beta particles from H-3 (tritium) lack the ability to penetrate the outer layer of the skin and are not considered external radiation hazards.

b. Low-Energy Beta Particles

In addition, low-energy beta particles from C-14 and S-35 do not penetrate the skin significantly and are usually not considered an external hazard when used in typical laboratory quantities.

c. Gamma Emitters, X-rays, and High-Energy Beta Particles

Gamma rays, x-rays, and high-energy beta particles are the typical external radiation hazards.

2. Internal Radiation

Internal irradiation results from the ingestion, inhalation, injection, or absorption of radioactive materials into the body. The radioactive substances irradiate body tissues, and the irradiation continues until the radionuclide physically decays and/or it is biologically removed from the body. The degree of hazard depends upon several factors, including individual radionuclide, chemical form, and amount of activity ingested or inhaled.

a. Alpha and Beta Emitters

Alpha particles cause dense ionization and biological damage close to the point of origin. Alpha particles do not travel outside of the organ in which they are generated.

b. Beta Emitters

Beta emitters are less hazardous (internally) than alpha emitters but can provide significant doses to organs in which they may be concentrated (such as iodine concentrating in the thyroid).

c. Gamma Emitters

All alpha emitters and many beta emitters concurrently emit gamma rays. The gamma rays can deposit energy in surrounding tissues and organs. Some of the gammas may escape the body without depositing energy. Measurement of these escaping gamma rays can be an important means to quantify the activity of a gamma emitter remaining within the body.

d. Organs of Concentration

Internal radiation dosimetry is a complex subject with many variables. One of the complicating factors is that different radionuclides concentrate in different organs or areas of the body depending on the chemical nature of the radionuclide. For example, iodine concentrates in the thyroid, whether it is radioactive or not. This unequal distribution can cause the dose to adjacent organs to be widely different for the same intake.

B. Personal Protective Measures - External Radiation

1. Time

Reduction of exposure time can be used to minimize external radiation hazards through the following mechanisms:

a. Reduce Radionuclide Handling

Think of ways to modify or organize the experiment or procedure to reduce radionuclide handling.

b. "Dry Runs"

Practice "dry runs", without using radionuclides, to improve the pace of laboratory procedures.

c. Planning

Do your thinking, writing, and conversing away from the radiation field.

2. Distance

Increasing the distance between you and the radiation source will reduce exposure by the square of the distance. Distance can be increased by the following practices.

a. Tools

Use tools with long handles for intense sources of penetrating radiation.

b. Separation from Radiation

1) Use stands and clamps to hold the radioactive material and place the radionuclide set up as far back from occupied areas as possible.

2) Step back or out of the area when not directly working with radiation sources.

3. Shielding

Shielding a radiation source can effectively reduce radiation exposure rate, providing the following cautions are observed. It is not always necessary to exactly calculate the shielding properties of a barrier you have erected; simply check out the attenuated beam with a survey instrument.

a. Edges of Shield

Be aware of the approximate size of the protective shadow of the shield and keep away from edges when practical.

b. Scatter Radiation

Remember that shielding effectiveness is lessened when scattered radiation is a significant factor.

c. Proximity to Source

Shielding is most effective when it is placed close to the source.

d. Shielding P-32

Plastic shielding (1/4 inch) is most effective for P-32 and other high-energy beta emitters since plastic reduces bremsstrahlung production.

e. Lead Shielding

Lead is an efficient shield for most gamma emitters. 1/16 inch of lead will shield the weak gamma photons from 1-125, but 1/2 inch to 1-inch lead is needed to reduce most gamma beams to 10% of their original intensity.

C. Personal Protective Measures - Internal Radiation

1. Good Hygiene

Good hygiene habits and good housekeeping effectively mitigate the internal radiation hazards presented by radionuclides. Part of good hygiene is control of mouth habits and eating.

a. Mouth Habits

Anything brought to your mouth while working in a lab could result in ingestion of contaminants. Avoid habits such as fingernail biting, chewing on pens, pencils or other objects. Do not lick stamps or envelopes while in the lab. As always, never pipette by mouth or hold laboratory supplies in your mouth.

b. Food, Drinks, Chewing, Smoking, and Cosmetics

The Washington State law prohibits eating, chewing, drinking, smoking, and application of cosmetics in any area where radioactive material is used or stored. *Remember that:*

1) Somebody's lunch, drink, or snacks may become contaminated with

radioactive material and the end result could be accidental ingestion.

2) Preparation of food or drink in a lab is forbidden. There is always a risk of incorporating radionuclides into the food or beverage.

3) Do your eating, drinking, chewing (gum, tobacco, etc.) and/or smoking in a clean area away from the laboratory.

4) Do not use laboratory paper or glass containers for food or drink containers. These containers may have residual radionuclide contamination, or an individual may accidentally ingest a radioactive preparation thinking it is a foodstuff stored in a similar container.

5) Do not store food in refrigerators containing radioactive materials. Signage is available to post refrigerators for "No Food or Drink" or "Only Food and Drink." See Section 10 – Area Classification and Posting.

6) Do not apply facial cosmetics (make-up) in the laboratories. There is a risk of contamination of these items and the potential for ingestion of radioactive materials.

7) Before leaving the laboratory, wash your hands and leave your lab coat and gloves behind, along with any radioactive material they may have collected.

2. Surveys

Identification and control of contamination is one of the primary methods of avoiding internal radiation dose. Proper survey procedures are described in Section 13 – Laboratory Survey Procedures.

a. Self Contamination and Laboratory Surveys

The most essential and often most overlooked problem in coping with a contamination incident is recognizing that the incident has occurred. Frequent surveys of oneself and the areas or items in proximity to the use of radioactive materials are one of the most useful methods of discovering contamination. These surveys do not need to be documented, but should become a matter of habit to a radiation worker.

b. Laboratory Equipment Surveys

Lab procedures utilizing centrifuging, shaking, or freeze-drying techniques may produce aerosols, gases, powders or dusts. Spills or breaks are also a possibility. Each time these types of procedures are performed and special equipment is used with radioactive material, contamination should be suspected and appropriate surveys should be done of the equipment and adjacent areas.

c. Common Use Equipment Surveys

A radiation worker must always be aware of the need to survey for contamination of commonly used items and equipment like light switches, door handles, sink faucets, computers, and telephones. Often, data entry, telephone calls, and other distractions occur during procedures, and this can lead to contamination spreading beyond the laboratory setup. Commonly used items have the greatest potential to pass contamination to several individuals.

d. Survey before Leaving

A radiation worker should always survey oneself before leaving the area after participating in radiation work. Radiation surveys should always be conducted before leaving an experimental setup unattended, and before allowing potentially contaminated items or equipment to be used by others.

3. Decontamination or Control of Contamination

When contamination does occur, the area of contamination should be limited or contained by isolation. Verbal notifications, warning signs, and labels should be used to alert others to the presence of the hazard until subsequent clean up activities are completed. Decontamination is the responsibility of the individual causing the spill, but call for assistance if deemed necessary or if you are inexperienced in decontamination efforts. Radiation Safety (RS) staff is available to provide assistance in decontamination, if necessary. See Section 1 – Emergency Procedures for information regarding decontamination procedures.

4. Airborne Hazards

Initial control of airborne radionuclide contamination is accomplished by:

a. Recognition

Initial control of airborne radionuclide contamination is accomplished by evaluating procedures, material, and equipment that may result in the production of aerosols, volatile gases, or dusts.

b. Preventative Steps

After these opportunities for airborne hazards are identified, precautions must be taken to assure there is minimal chance for exposure to personnel. Examples of precautions would include performing the procedure in a fume hood or enclosing the process in suitable containment.

c. Respirators

The use of respirators for protection from airborne radionuclide hazards is

not a preferred option at the University of Washington. It should be possible to use ventilation or containment in nearly all applications. On rare occasions, respirators have been used at the University in particularly dusty operations involving radioactive materials. In these special situations, the Radiation Safety Office (RSO) must be consulted well in advance of the procedure, and RSO staff will usually choose to be in attendance.

5. Protective Clothing

The use of gloves, laboratory coats and other protective clothing minimizes the chances for the ingestion or absorption of radioactive materials. In rare situations, the use of suitable respirators might be recommended to prevent the inhalation of volatile or airborne radionuclides.

a. Gloves

No unsealed radioactive materials should be manipulated with the unprotected hand. Latex or nitrile gloves are the most common types used in research laboratories at the UW, but several other types of gloves are available from safety supply vendors. The choice of glove type for work with radioactive materials should be based on the carrier material. For example, latex would be satisfactory for work with water based solutions, but nitrile would be necessary when working with toluene based scintillation fluids.

Following are some proper glove procedures:

1) Clean Hand

   It is sometimes possible to use just one hand for "dirty" work and keep the other hand (held behind the back) free of contamination for clean work (hot hand cold hand technique). The clean hand is then available for touching common-use items like computer entry, recording data, and answering the telephone,

2) Sleeves and Cuffs

   Tape up sleeves and cuffs to keep them from dragging on potentially contaminated surfaces.

3) Good Glove Practice

   A gloved hand with contamination on the glove will spread contamination to clean areas and although the individual remains clean, his fellow workers are exposed to contamination. If there is potential for contamination of a glove, it must be removed or surveyed before handling common-use items.

4) Glove Removal

Gloves should be removed by turning them inside out. Grasp the outside surface and strip the glove off inside out. Never insert gloved fingers inside the top of the glove to assist in removal. The fingers of the clean hand can be inserted inside the second glove for removal. Do not blow into glove to return it to its original form for re-use or to check for leaks. This practice allows opportunity for ingestion of material from a contaminated glove.

5) Double Gloves for Radioiodine

Wearing a double layer of gloves is required when doing radio-iodinations, and recommended whenever working with radioiodine (I-125 and I-131). Double gloving protects from radioiodine's tendency to permeate some types of glove materials and also provides some skin protection from beta particles and electrons.

6) Impromptu gloves

Plastic wrap can sometimes be used as impromptu gloves or protective clothing in an emergency. Avoid this for routine use.

b. Lab Coats

Laboratory coats or aprons are recommended to protect one's personal clothing from contamination. Coats or aprons worn as protective clothing should remain behind in the laboratory at the end of the day or whenever the individual leaves the laboratory. It is particularly important not to wear lab coats that may be contaminated with radioactive materials into eating areas, such as cafeterias.

c. Respirators

Respirators are rarely recommended as protective equipment against airborne radioactive material at the University of Washington. In nearly all situations where significant airborne radioactive materials are involved, a fume hood or hot-cell is the preferred control measure. Respirators have been used in particularly dusty operations, such as removing air filters from particle accelerator exhaust ducts.

The Environmental Health and Safety Department has certain requirements for individuals using respirators. Call the Radiation Safety Office (RSO) if the need for a respirator is anticipated when performing a particular operation or experiment.

d. Protective Eyewear

Protective eyewear (safety glasses) is recommended whenever using unsealed radioactive or hazardous materials. This eyewear must be kept clean and replaced if scratched, or the visual field can be affected.

e. Open Sores/Wounds

Open sores or wounds on exposed body surfaces provide an opportunity for absorption of radioactive materials. It is best to avoid work with radioactive materials, or properly dress and protect open sores or wounds before working with radioactive materials.

D. Personal Protective Measures - General

1. Planning Work

All radioactive material work should be carried out according to some prearranged plan. Any departure from the plan should incorporate a reassessment of the radiation hazards involved.

2. Knowledge of Radionuclides Being Used

To prepare laboratory personnel to deal with unusual occurrences, the chemical and physical properties of the radionuclides in the laboratory should be common knowledge to all individuals working in the laboratory.

3. Training and Experience

Lack of training and experience can contribute to an accident or hamper one's ability to mitigate an accident. If you do not feel you have the proper training or experience for using radioactive materials, inform your supervisor. Your supervisor must provide training specific to the tasks you perform and commensurate with the risk you are exposed to. Generic training in radiation safety is provided in the Radiation Safety Training Course offered by the UW Radiation Safety Office. See Section 5 – Training Requirements.

4. Fatigue and/or Emotional Factors

Fatigue and/or emotional factors can contribute to a radiation incident. Be sure you are "clear-headed" when performing work with radioactive materials or any hazardous material.

5. Responsibility and Motivation

Individuals using radioactive or hazardous materials must realize their responsibility for safe use of these materials. It is also necessary to be positively

motivated toward safety to adequately protect oneself and one's co-workers.

6. Corrective Eyewear

Individuals must wear appropriate corrective eyewear to properly visualize their work. Sometimes, individuals choose to forego use of corrective lenses when using safety glasses, but this is an unsafe course of action. Preferred alternatives for individuals needing corrective eyewear would be to wear contact lenses under safety glasses, use corrective safety glasses, or use safety glasses specially designed to fit corrective eyewear.

7. Environmental Factors

a. Proper Lighting

Proper illumination is necessary to visualize the tasks that one is doing. This can be particularly problematic when using a fume-hood with poor illumination or a dirty sash. Keep hood sashes clean, replace burned-out lighting, and use supplemental lighting if necessary.

b. Proper Temperature

Temperatures less than 60° Fahrenheit (F) reduce dexterity and control, while temperatures greater than 75° F foster deterioration of coordination.

c. Cluttered Working Conditions

Crowded, cluttered, or contorted experimental setups promote fatigue and irritability and can foster an accident. Re-configure or clean up your workspace, if necessary.

E. Radiation Area Control Procedures

The following radiation safety procedures and practices protect the radiation worker, co-workers, and the general public.

1. Authorizing Radionuclide Use

All areas, rooms, or laboratories in which radioactive materials are to be used or stored, must be certified as radioactive materials usage areas, and must be added to an Authorization to Use Radioactive Materials. See Chapter 4 – Authorization Process.

2. Security

Security of radioactive materials, radiation sources, or radiation producing machines protects the user from liability, and the unauthorized user or the public

from radiation exposure.

a. Prevent Relocation, Loss, or Theft

Radioactive material, including that in animals, patients, and equipment/sealed sources, should be prevented from leaving designated controlled areas under circumstances that may subject other persons to unnecessary exposure to radiation. One of the key responsibilities of the Authorized Investigator (AUI) is the security against theft of radioactive materials, and unauthorized use of radiation sources or radiation producing machines. When the radionuclide laboratory is to be left unoccupied by responsible laboratory personnel, it should be locked.

b. Secure Storage

Radionuclides should be stored in a secure and preferably locked place so that unauthorized personnel (casual visitors at the laboratory, custodians, etc.) do not have access to these materials. Those radionuclides that generate an external radiation hazard should have adequate shielding to protect individuals working in the vicinity of the storage area.

c. Report of Suspected Loss or Theft

Suspected loss or theft of radioactive material must be reported immediately to the RSO. An investigation may include a follow-up inspection by the State of Washington Department of Health.

3. Appropriate Signs and Labeling

Appropriate radiation warning signs or labels must be used to designate radiation areas and to identify radioactive material containers or rooms containing radioactive materials. During the setup of a new laboratory, RS staff usually post or provide appropriate signage, but the AUI is responsible for maintaining that posting. Requirements for the types and locations of these signs or labels are provided in Section 10 - Area Classification and Posting.

a. Label Radioactive Material Containers

Clearly label all containers of radioactive materials. This includes containers of working solutions, stock solutions, and waste. Custodians occasionally mistakenly collect radioactive waste. A very apparent sign should be attached to each waste container to indicate radioactive waste and forestall accidental pickup by the custodial service. Use the standard radiation sign or a strip of “radioactive” labeled tape.

b. Obliterate Labels when No Longer Applicable

Standard radioactive waste packages or boxes should be used only for radioactive material. Containers that once contained radioactive material should have labels or signs removed or marked out before the container is discarded or empty containers are placed in storage. The labels are intended as a warning. When a warning is not necessary, there is a false concern, or worse, a future disregard for the proper warning. When these empty containers appear in public areas or in normal trash, they cause unnecessary alarm. It is also illegal to intentionally use radiation warning labels on non-radioactive items.

c. Penalties for Non-Defaced Labels

Custodians are alerted against picking up containers with an intact radiation symbol. However as noted above, containers with radiation markings are occasionally mistakenly picked-up by custodians. UW containers that no longer contain radioactive materials yet still had intact labels have been found in off-site transfer stations operated by Seattle's disposal contractor. The alarm raised by these incidents has resulted in warnings to the UW and the threat of penalty charges or refusal to accept waste.

4. Records

Proper records are necessary for documenting protection of radiation users and the general public, as well as being required for compliance with radiation protection regulations, and conditions of authorization.

a. Radiation Use Records (RSO Form 160)

Records of the use of radioactive materials must be kept. A tally of the disposition of radioactive materials should be made on the back of the RSO Form 160, which accompanies any delivery of radioactive material. After the order of radioactive materials has been accounted for, the completed Form 160 must be returned to the Radiation Safety Office for computer record entry. You should keep a copy of the Form 160. See Section 11 - Procurement of Radioactive Material for a further description of the use of RSO Form 160.

b. Radioactive Waste Disposal Records (RSO Forms 150 and 170)

1) Boxes, Pails, or LSC Fluid

Records of the disposal of radioactive materials into boxes, pails, or in liquid scintillation (LSC) fluid should be recorded on RSO Form 150 or its equivalent. When the package of waste is ready for transfer to the Radiation Safety Office, totals from the Form 150 must be included with the package. The Form 150 should remain in laboratory records.

2) Sewer

Disposal of soluble or dispersible radioactive materials into the sink must be recorded on RSO Form 170 or its equivalent. See Section 14 - Radioactive Waste for more information on waste collection, packaging, and recording.

c. Survey Records

Records of radiation surveys must be kept in the laboratory for examination by RS staff and DOH inspectors. See Section 13 - Laboratory Survey Procedures for information regarding requirements for performing and recording laboratory surveys.

d. Calibration Records

Records on the calibration of radiation detection instruments should be kept in the laboratory for reference. The UW Radiation Safety calibration staff also attaches calibration records to the side of the instrument.

e. Records of Unusual Occurrences

Records of unusual occurrences such as incidents and accidents should be recorded for future reference. Incidents reported to the RSO are kept in office files, but the laboratory is encouraged to keep their own records. These records may be useful if a DOH investigation occurs at a later date.

f. Records Retention

Records noted above generally need to be kept for at least two years. Records of unusual occurrences may need to be kept longer at the discretion of the Authorized Investigator.

5. Reportable Incidents

To protect radiation workers and the general public, certain situations must be reported to the UW Radiation Safety Office, and may need to be further reported to the State of Washington DOH on an immediate basis. Contact the RSO immediately to make an initial investigation in the event of suspected lost, stolen, or missing radioactive material; suspected excessive radiation exposure of an individual; or suspected release of excessive quantities of radionuclides to the environment.

6. Organizational Plan for Radiation Protection

Organization of procedures and practices in the laboratory should be accomplished in advance of the actual start of laboratory operations. Prior to issuing an

authorization, policies and procedures are reviewed between Radiation Office staff and new investigators. This is also an opportunity to discuss any questions regarding radiation safety matters.

a. Responsibilities and Duties

Good radiation safety practice depends on an effective health and safety organizational plan. Responsibilities and duties must be clearly assigned to assure safety and comply with authorization requirements and regulations. RS staff will discuss organizational issues with investigators prior to issuing an Authorization to Use Radioactive Materials.

b. Emergency Procedures

An emergency procedure plan should be in writing and readily available to all of the laboratory personnel. The plan should be discussed with all personnel so that each individual is aware of his/her role in the event of an emergency. Such a plan should include the emergency procedures included in the Authorized Investigator's application and authorization. Emergency procedures must be posted in all areas where radioactive materials are used. See Section 1 - Emergency Procedures and Section 10 - Area Classifications and Posting.

1) Special Hazards

In addition to general radiological control and decontamination procedures, emergency procedures should address the special hazards peculiar to the operations in the laboratory (i.e. associated chemical or biological hazards, unusually large activities, or special equipment).

2) Laboratory Radiation Safety Agent

The plan for major emergencies shall list the Authorized Investigator and the Laboratory Radiation Safety Agent (an individual designated to be in charge of directing emergency procedures) and both of their home phone numbers. For on campus emergencies, dial 9-911. For off-campus emergencies, call University Police at (206) 543-9331.

7. Radionuclide Use in Animals

The Animal Care Committee in the Department of Comparative Medicine controls the use of animals in research studies at the UW. Animals may be housed in a research laboratory for up to 24 hours. If procedures will take a longer period of time, animals must be held in facilities approved by the Animal Care Committee.

a. Certified Radioactive Materials Space

If research involves the use of radioactive materials in animals, either

approved animal care space or the researchers own space must be certified for radioactive materials use by the Radiation Safety Office. A RSO Form 50 must be filled out for the space and submitted to the RSO. Space may be assigned either for a short period of time, "short-term use", or for a longer period of time. Please indicate on the Form 50 the estimated length of time that the room will be used.

b. Posting

All cages or pens containing animals with radioactive materials must be labeled with appropriate warning signs. The Radiation Safety Office will advise the Authorized Investigator of the appropriate signage. Similar to other rooms where radioactive materials are used, animal rooms must be posted with appropriate signs, emergency procedures, survey requirements, and certification documents. These signs and postings will be provided during certification of the space by RS staff.

c. Monitoring/Calculation

Monitor or calculate the activity levels and the activity per gram of animal carcasses, bedding, and waste materials as they are produced. These activity levels will be necessary to determine proper methods or disposal.

d. Waste Disposal

Methods for the appropriate disposal of animal carcasses, contaminated animal waste, and bedding are described in Section 14 - Radioactive Waste.

8. Termination or Inactivation of Radionuclide Use

a. Termination

Authorized Investigators who will be leaving the University of Washington or who will be retiring and no longer maintaining an active research program should arrange for termination of their authorization.

b. Inactivation

Authorized Investigators who do not have a current need to use radioactive materials in their research programs, and who do not expect such need to arise for an extended period of time, should arrange for inactivation of their authorizations.

c. Termination/Inactivation Requirements

Both termination and inactivation require that the entire inventory of radioactive materials be disposed and properly accounted for, all radioactive waste be removed from the laboratory, and all equipment that was used for

radioactive materials work be properly and completed decontaminated.

The AUI should work with the Radiation Safety Office to determine that all paperwork has been completed, and all correct procedures have been followed. Once the Authorized Investigator is certain that all areas are free from contamination and materials, the Radiation Safety Office should be informed that the AUI's lab(s) are ready for inactivation/termination surveys.

9. Hospital Use of Radiation

The use of radionuclides at the University of Washington Medical Center and Harborview Medical Center are also covered under the UW Radioactive Materials License of Broad Scope. The specific hospital use of radiation differs in many ways from the general use of radiation covered under this manual. Therefore, hospital radiation use is covered under separate policies and procedures.

G. Laboratory and Equipment Requirements

The majority of research laboratories where radioactive material is used can be classified as chemical laboratories. Chemical laboratory setup is generally adequate for the small quantities of radioactive materials involved in most situations. However, some additional thought and preparation are recommended for work with radioactive materials.

1. Laboratory Layout

Radiation work should be consolidated both in respect to the area allotted to handling radioactive materials and to the amount of time spent in handling this material. Limiting the area expedites survey and decontamination procedures. Limiting the time spent in handling the radionuclides minimizes external radiation exposure and decreases opportunities for accidents.

a. Radiation Workspace

Layout of a laboratory where radioactive materials (RAM) are used should include assigning special places for the handling of these materials. These areas should be marked clearly. They should be located, as much as possible, away from the regular traffic patterns in the laboratory. In laying out the RAM work area, the possibility of accidental spills and the spread of contamination to adjacent areas and equipment should be kept in mind.

b. Storage Areas

Storage of the radioactive material should be such that the transfer route of the radionuclide to the working area is over as short a distance as possible. However, crowded areas should be avoided for the transfer route.

c. Waste Disposal Areas

Waste disposal containers should be close to the working area.

d. Record Keeping Areas

Record keeping of radionuclide use and disposal should be comprehensive and easily accomplished during the work or waste disposal processes without a disruption of the workflow or unnecessary trips to files located elsewhere in the laboratory.

2. Laboratory Requirements

The following are minimum facility requirements for use of radioactive materials. For certain types and uses of radioactive materials, however, additional facility requirements must be met. The specific requirements, which will vary from one situation to another, are determined at the time of authorization by RS staff.

a. Floors

Floors should be smooth, nonporous, easily cleaned surfaces. Appropriate floor materials include vinyl, tile and sealed concrete.

b. Benches

Benches must have nonporous, easily decontaminated surfaces. Surfaces of high quality plastic laminate or stainless steel are preferable.

c. Sinks

Sinks should be stainless steel or seamless molded construction. The sink designated for radioactive waste disposal should be clearly marked and should be located in the general area designated for radionuclide work. Forms for recording increments of radioactive waste disposal should be right beside the sink to encourage accurate record keeping of this type of disposal.

d. Hoods

1) Hood Not Required

Use of liquid radioactive material in a room without a fume hood is permitted if the ventilating rate is such that a spill and total volatilization would result in less than 10% of an annual limit on intake (ALI). If the radionuclide is in a nonvolatile form, the amount used can be greater. Using these criteria, a fume hood is seldom required for most procedures involving unsealed liquid radioactive materials at the UW, except for evaporations, iodinations (sodium iodide labeling reagent), and H-3 (tritium) labeling (in quantities greater than 8 mCi).

2) Hood Required

Iodinations, evaporations, high level tritium labeling, use of gaseous materials, or work with liquid radionuclides in amounts greater than those stated above must be done in a fume hood. Note that very small quantities of volatile radioiodine (5 μCi) can result in 10% of an ALI, whereas much greater quantities of volatile H-3 (8 mCi) could result in 10% of an ALI.

3) Hood Certification

Fume hoods must be currently certified. Hood airflow is checked with a calibrated instrument on an annual basis by personnel from the Environmental Health and Safety (EH&S) Department. In between annual checks, the airflow should be monitored with strips of paper or ribbons attached to the bottom of the sash.

4) Hood Flow and Construction

Hoods should preferably be constructed of stainless steel or molded fiberglass, and produce a regular flow of air as specified by the manufacturer. Higher velocities are acceptable if no turbulence is generated. The speed of the airflow should be such that there can be no escape of air into the working place from the fume hood under typical operating conditions, including opening of windows and/or doors. The suction of other fume hoods or eddies caused by individuals moving quickly across the face of the hood must also be taken into consideration. This can be checked by smoke tests.

5) Hood Sink Traps

Because they dry out, hood sink traps should be checked periodically.

6) Hood Clutter

The hood should be kept free of clutter and large objects should be located to the rear of the hood to minimize the formation of eddy currents. Keep radioactive materials at least 6 inches inside the sash to avoid spilling it out through the sash of the hood.

7) Sash Height

The hood sash should be kept clean and lowered as far as practical to maintain appropriate face velocity. When in use, the sash should not be raised above the line on the hood frame demarcating the linear feet per minute specified by the hood manufacturer.

e. Structural shielding

The need for structural shielding shall be evaluated when appropriate. For

example, in facilities where large quantities of radionuclides emitting penetrating radiations are used. Specific requirements for special shielding will be determined on a case by case basis by RS staff.

3. Equipment Requirements

Laboratories in which radioactive materials are to be used must have the following basic equipment and supplies:

a. Absorbent Paper and Spill Trays

Manipulations should be carried out over a suitable drip tray or with some form of double container, which will minimize the affects of container breakage or spills. It is also useful to cover the working surfaces with absorbent material to soak up minor spills.

b. Portable Radiation Survey Meter

A portable radiation survey meter is necessary for performing contamination surveys, although this is not required for laboratories in which only carbon-14, sulphur-35, or hydrogen-3 is used. Proper working order of the meter must be verified by checking the response against a stock solution of radioactive materials, or a "check source". The instrument must also be calibrated at least yearly. The UW Radiation Safety Office maintains a calibration facility that is comparable in price to other facilities. An advantage of the UW facility for on-campus users is quick turn-around time and avoidance of shipping/handling fees.

c. Access to a Liquid Scintillation Counter

Use of a liquid scintillation counter is necessary for analyzing wipes from contamination surveys when meter surveys alone are not adequate. Examples would be when carbon-14, sulfur-35, or hydrogen-3 (tritium) is used. See Section 13 - Laboratory Survey Procedures. Calibration of the liquid scintillation counter for detection of the radionuclide of interest must be also assured.

d. Portable Beta-Shield

A portable plastic shield (Plexiglas or Lexan of at least ¼ inch) is recommended for laboratories in which high-energy beta emitters are used, such as P-32. This is particularly so when quantities of P-32 exceed 10 mCi.

e. Waste Containers

Appropriate containers are necessary for solid and liquid radioactive waste. See Section 14 - Handling Radioactive Waste.

f. Personal Protective Apparel

Laboratory personnel must have access to appropriate protective apparel, such as lab coats and disposable gloves.

g. Radioactive Material Warning Tape

Radioactive material warning tape must be available for marking contaminated areas or equipment.

h. Appropriate Absorbent Materials and Cleaning Supplies

Appropriate absorbent materials and cleaning supplies must be available for spill control and decontamination.