Section 13

Laboratory Survey Procedures

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A. Purpose of Surveys

Frequent surveys are required in areas where unwanted contamination or external radiation fields may exist. Surveys with no evidence of contamination indicate good laboratory work practices. Good practices cannot be assured without these survey results.

It is difficult to define a "safe" or "allowable" level of contamination or external radiation. The important word is unwanted. If radiation is unwanted, efforts should be made to reduce it or eliminate it completely. Otherwise, it poses an unnecessary risk, however small. Beyond the safety issue, contamination or external radiation can interfere with experimental sensitivity and results.

It is the responsibility of the Principle Investigator (PI) and his/her laboratory personnel to assure that radioactive material is contained after each use and to perform appropriate surveys.

B. Survey Frequency

1. During Use Surveys and Self-Monitoring

Frequent surveys should be performed while working with radioactive materials. Self-monitoring must be performed before leaving the area. During use and self-monitoring surveys are not required to be documented.

2. After Use Surveys – Work Area(s)

An after use survey must be performed soon after each use of radioactive materials. The after use survey does not need to include the entire laboratory, but may be limited to the particular portion of the laboratory where the work took place. After use surveys do not need to be recorded unless specified in the PI's Radioactive Materials Use Authorization (RMUA).

3. Monthly Surveys – Entire Laboratory

A survey of the entire laboratory must be performed and documented each month. The surveys must be performed with instruments or wipes capable of detecting all authorized radioactive materials.

If radioactive material was not used during the month, a survey of the space is not required. However, the following (or similar) statement must be entered on the laboratory survey log each month; "No radioactive material use – No survey required."

4. Common Use Area Surveys

When more than one authorized group uses a lab or space, the responsibility for performing monthly surveys may be shared. Each group is responsible for performing their own surveys during and after using radioactive material, but the monthly survey only needs to be performed once. Someone should be assigned to perform the monthly survey of the entire lab for all groups to ensure compliance. In common use areas, it is especially important to communicate to everyone involved when contamination is found.

5. Radiation Safety Surveys

Radiation Safety staff perform contamination surveys to satisfy Department of Health requirements for administrative oversight. These surveys are conducted on a monthly, quarterly, or annual basis.

C. Survey Methods

In general, surveys can be carried out in one of three ways. The preferred method depends on the radionuclides being used and the background level in the lab at the time of the survey. Below are more detailed explanations of the three methods.

1. Method 1 - Wipes / Scintillation Counting

The most significant radiation hazard in most laboratories is the potential ingestion or inhalation of transferable radioactive materials, rather than from external exposure. Ingestion or inhalation results in internal dose.

The main method for evaluating the ability for contamination to be transferred is to take a series of wipes from surfaces with small filter paper disks or squares of tissue and then evaluate the wipes with an appropriate detector. Wipes may be taken and counted in a counting device appropriate for the radionuclide(s) expected to be present.

Many investigators find it convenient to take wipes of their work areas immediately after preparing their research samples and running these wipes along with their samples. This gives immediate verification of the cleanliness of the lab and does not require an additional time allotment for lab survey measurements.

a. Choice of Counting System

The same counting system that is used in the experimental work will usually serve to evaluate the wipes, for example, liquid scintillation counting or gamma counting.

1) Liquid Scintillation Counting (LSC)

Low energy beta particles, like those emitted by H-3, C-14, and S-35, have a very short range and detection can be difficult. Liquid scintillation counting has an advantage in this situation since the wipe is mixed intimately with the fluids of the liquid scintillation cocktail. Radiation does not need to travel far to interact with the scintillation media and radiation interactions with extraneous material are reduced to a minimum. Therefore, radiation with short range is detected with reasonable efficiency. LSC also works with higher energy beta emitters as well as alpha and gamma emitters. However, as the energy of gamma rays increases, detection efficiency diminishes.

2) Gamma Counting

Gamma counting is most convenient for detecting the presence of gamma emitters on wipes. The detector in a gamma counter is usually a sodium-iodide crystal, but a semiconductor detector system (such as a germanium-lithium detector) can also be suitable for measuring wipe

counts of gamma emitters. Gamma counters are also often used to check wipes for the presence of positron emitters by detecting the annihilation radiation.

b. Wipes

The typical wipe survey method utilizes dry filter papers being wiped over potentially contaminated surfaces, and then counting these filter papers in a liquid scintillation counter (LSC) or gamma counter.

1) Performing Wipes

The papers are wiped over a surface using moderate finger pressure so that about 100 cm^2 of surface is covered on each wipe. The wipes should be held so that your fingers will not touch the surfaces being wiped

2) Large Area Wipes

Certain surfaces (hood-lip, bench area, floor in front of work area, etc.) could be checked using just one wipe per surface. The advantage of this method is that results are obtained without counting multiple samples. The drawbacks are the potential to spread contamination and subsequent identification of the exact spot of the contamination.

3) Wipes near Radioactive Work

When wiping near radioactive work where contamination is expected, use extra care to avoid contaminating your hands and thereby cross-contaminating subsequent wipes.

c. Liquid Scintillation Counter (LSC)

1) LSC Wipes

a) The most convenient wipes for Liquid Scintillation Counting are filter papers, with a 4 to 5 cm diameter.

b) The papers should be dry when placed into the LSC fluid, or counting efficiency in the LSC will be greatly reduced.

2) Processing

a) Each wipe would then be put into a vial and scintillation cocktail added.

b) Sufficient cocktail should be added to completely wet the wipe. In a large 20 ml vial, at least 10 ml of cocktail should be used.

c) To check for background, you should run a clean wipe with each set of survey wipes.

d) All wipes should be counted twice.

d. Results

1) Wipe results greater than twice the background may indicate that there is a problem with containment in your laboratory and the situation should be investigated.

2) Levels of contamination greater than 0.5 nCi on a wipe must be reported on the survey form and action taken to clean the area(s).

e. Resurvey after Cleanup

To ensure that cleanup was successful, the area must be resurveyed and the results reported on the survey form. If radioactive materials have spread beyond controlled areas, the control procedures should be questioned and reviewed to prevent further contamination.

2. Method 2 - Portable Detector

For some radionuclides, discussed in more detail below, surveys may be done without taking wipes by using a hand-held detector. This is only feasible if the background level in the lab is sufficiently low.

If the background in the lab is more than three times the natural background, the sensitivity of the detector is reduced and low levels of contamination will not be detected. In this case, Method 1 or 3 should be used. To check for natural background, measure the radiation level using your particular instrument in some location that is certain to not be contaminated or influenced by nearby radiation sources.

When working with radionuclides that may be detected with portable instruments, it is extremely important to monitor your hands, clothing, and work areas while doing the work.

a. Sensitivity of Instrument

Your instrument should be sensitive enough to detect the following radiation levels. See Table 1 for a list of radionuclides classified into Hazard Groups.

1) For Group I radionuclides, 10 nCi at a distance of 1 cm from the surface.

2) For Group II radionuclides, 1 nCi at a distance of 1 cm from the surface.

3) For Group III and above radionuclides, 0.1 nCi at a distance of 1 cm from the surface.

b. Calibration

Your instrument must be calibrated annually. The UW Radiation Safety Office operates an instrument calibration facility. Costs of meter calibration at the UW facility are comparable to other calibration facilities. Advantages of using the UW calibration facility are shortened turn-around time and avoidance of shipping charges for on-campus users.

c. Operation

When using a hand-held detector, do the following:

1) Check battery.

2) Remove the protective plastic or metal cap from your probe.

3) Make sure instrument responds to a check source. This can be a commercial check source, stock solution, or other source the detector is known to respond to when properly working.

4) Check background in known low background area.

5) Survey within 2 or 3 cm of surfaces. If contamination is suspected, measure the level with the probe within 1 cm of the surface.

6) Go slowly so your detector has time to respond to contamination.

7) To guard against contamination of your probe, you could cover the probe with plastic wrap.

d. Results and Follow-Up

If instrument readings indicate contamination at more than 500 cpm above background, the contaminated areas or items should be cleaned, labeled, or disposed and the area resurveyed.

3. Method 3 - Portable Detector with Wipes

Even when a hand-held detector is available for survey purposes, there may be situations where wipes must be taken.

a. Background Level Too High

When the background level in a laboratory is too high (more than three times the natural background level as discussed in Method 2 above) wipes must be taken as described in Method 1 above. However, these wipes may be counted with the hand-held detector in an area with low background.

b. After Cleaning of Contamination Areas

Another situation where wipes must be taken would occur after some contaminated areas have been thoroughly cleaned and radiation levels are still observed with the hand-held detector. In this situation, wipes must be taken and counted to verify that the remaining contamination is not removable and would not be transferable to other areas.

c. Performing the Count

1) Screening Wipes

Counting each wipe for 10 seconds is usually long enough to obtain a consistent response and determine whether contamination is present.

2) Counting Contaminated Wipes

If contaminated wipes are suspected, count them for at least 30 seconds each to document the contamination level; and if the instrument has a fast/slow response setting, it should be set to "slow" for this purpose.

Action required when contamination is found is the same as discussed in Method 2.

d. Results and Follow-Up

If instrument readings indicate contamination at more than 500 cpm above background, the contaminated areas or items should be cleaned, labeled, or disposed and the area resurveyed.

D. Method for Specific Radionuclides

1. Hydrogen-3

Hydrogen-3 emits a very low energy beta radiation that will not penetrate the walls of most portable instrument probes. It must be surveyed by using Method 1 as described above.

2. Carbon-14 and Sulfur-35

Both Carbon-14 and Sulfur-35 are very low energy beta emitters and are not easily detected using a portable survey instrument. Therefore, the preferred method for surveying laboratories where these radionuclides are used is with wipes counted in a liquid scintillation counter.

However, in situations where a liquid scintillation counter is not readily available, either an end-window or pancake probe Geiger-Mueller counter could be used.

The efficiency is low, but a slow, deliberate survey, with the probe held near the surface, can detect C-14 and S-35 in amounts of 0.5 nanocurie or less. This level of detection can be achieved when the count rate is twice background. This also is the level that must be reported on the survey form, and action must then be taken to clean the area.

3. Iodine-125

Iodine-125 emits very low energy gamma radiation. A Geiger-Muller (G-M) detector is not very effective for this type of radiation. Instead, a portable detector with a special low-energy gamma scintillation probe must be used. This probe contains a thin sodium iodide crystal and is particularly efficient for low-energy gamma radiation. Using this probe and depending on the background radiation in the lab, survey Methods 2 or 3 could be used. If it is more convenient, Method 1 may be used instead of or in addition to Methods 2 or 3.

4. Phosphorus-32, Chromium-51, Iron-55, Iron-59, Iodine-131, and Other High-Energy Beta or Gamma Emitters

These radionuclides are readily detected using a hand-held portable G-M detector with a thin window not more than 2 mg/cm^2 in thickness. Depending on the background activity in the lab, the above Methods 2 or 3 would usually be used for surveys. If it is more convenient, Method 1 may be used instead of or in addition to Methods 2 or 3.

5. Combinations of Radionuclides

In situations where laboratories are using various combinations of several different radionuclides, the required surveys will include a combination of techniques. For instance, if a lab uses H-3 and P-32, the after use surveys may be specific for the radionuclide used (Method 1 for H-3 and probably Method 2 is preferred for P-32). However, the monthly survey should employ LSC counted wipes, which are capable of detecting both types of emitters.

E. Where to Survey

1. General Rule

Surveys should be conducted in all areas where radioactive materials is used or stored. Areas where contamination is more likely should be surveyed with greater attention.

2. Particular Areas of Importance

a. Floors and Storage Areas

l) Floors near storage of radioactive materials, including waste.

2) Floors in front of hoods and workbenches.

3) Floors near exit from lab.

4) Interiors of storage areas.

b. Equipment

1) Hood lip and sash.

2) Handles on refrigerators and freezers where radioactive materials are stored.

3) Telephones.

4) Computers/data entry devices.

5) Doorknobs.

6) Instrument dials.

7) Centrifuges.

8) Other miscellaneous items that could be contaminated.

c. Work Surfaces

1) Areas on work bench where work is done.

2) Desks.

F. How to Record Surveys

Monthly surveys must be recorded. If no radioactive material was used in a laboratory during a month, a "No Use" entry as described in Section B.2 above may be recorded in lieu of performing a survey of that laboratory. In labs where the locations surveyed and the instruments used are always the same, this information can be typed onto the standard form and copies used for each survey.

1. Survey Form

The following information must be recorded for any survey form.

a. Identification

1) Room and building surveyed.

2) Name of surveyor.

3) Date of survey.

b. Survey Map

Diagram or map showing facilities surveyed.

c. Instrument

Instrument used to perform survey, including serial number.

d. Results

1) Results of background count.

2) Results of wipe tests and portable instrument surveys.

e. Action Taken

Actions taken for any contaminated areas or items.

2. Mapping Work Space

A sketch of the floor plan of the work area should be used when making surveys, with a number corresponding to each survey location. If wipes are used for taking contamination measurements, the wipes should be numbered with the survey location. This allows easy mapping and evaluation of contaminated areas and aids in locating the source of the contamination.

An alternative to producing a sketch of the floor plan for each survey is to make a detailed drawing with several numbered locations. Then, survey documentation can be attached on subsequent sheets of paper. These subsequent sheets would specify the actual survey locations (by number) and survey results, with inferred reference back to the original drawing.

G. General Laboratory Practices

When performing your required laboratory surveys, it is a good practice to be alert for unsafe laboratory practices or conditions in the lab that could lead to the loss of radioactive materials or to uncontrolled contamination. These are discussed more completely in Section 9 of this manual, Radiation Protection Procedures. Some conditions that should be noted and corrected are:

1. Poor Laboratory Housekeeping

If laboratories are messy and housekeeping is especially poor, these conditions could contribute to the uncontrolled release of radioactive materials.

2. Food and Drink

a. Consumption Not Allowed

1) Food and drink must not be consumed in laboratory space.

2) The presence of food and beverages in radioactive material laboratories at the University of Washington is strictly prohibited, unless in enclosures dedicated only to storage of food and drink.

3) Laboratory glassware/equipment should not be used for food or drink.

4) Food or drink containers should not be used for chemicals or radioactive materials.

5) Avoid creating the misleading appearance that food or beverage was consumed in a laboratory. For example, do not discard drink containers or food in laboratory trash receptacles.

b. Food Storage

1) Refrigerators or enclosures that protect food from radioactive contamination may be used for the storage of food or drink in laboratories. Refrigerators used for this purpose must be clearly marked with an "Only Food and Drink" label.

2) Food or drink must not be stored in enclosures, refrigerators, or cold rooms that contain radioactive materials.

3. Radioactive Waste

a. Proper Disposal

Radioactive waste receptacles should be clearly identified with the proper warning labels, tape, or stickers.

b. Improper Disposal

1) Radioactive waste should not be placed in the hallways.

2) Radioactive waste must not be mixed with normal trash or placed in ordinary wastebaskets.

4. Laboratory Security

Radioactive material laboratories must not be left open and unattended while radioactive materials is accessible.

H. Inspection of Records

Survey records will be inspected periodically by Radiation Safety staff. Laboratories in which records are found to be incomplete or missing will be checked during the next survey. If the records are still missing, further action will be determined at this time.

Table 13-1
Radionuclides Arranged in Hazard Groups
According to Annual Limit on Intake (ALI)

Group I	Group II		Group III		Group IV	Group V	Group VI & Above
ALI > 10	10 > ALI > 1		1 > ALI > 0.1		0.1 > ALI > 0.01	0.01 > ALI > 0.001	0.001 > ALI
H-3	C-14	Ru-103	Na-22	Ag-110m	Sr-90	I-129	Po-208 * (VI)
Be-7	Na-24	In-111	P-32	Sn-113 *	Ru-106 *	Ra-228	Po-209 * (VI)
C-11	P-33	I-123	Cl-36 *	Ba-133 *	Cd-109 *		Po-210 *(VI)
F-18	S-35	Sm-153	Ca-45 *	Cs-137	In-114m *		Pb-210 (VI)
Cr-51	K-42	Re-186	Sc-46	Ce-139 *	Cd-115m		Ra-226 * (VI)
Cu-64	Fe-55	Hg-193m	Ca-47	Ce-141 *	I-125		Th-228 * (VII)
Ga-68	Co-57	Hg-195m	V-48	Gd-153 *	I-131		Th-229 * (VIII)
Br-77	Co-58	Hg-197	Mn-54 *	Ho-166	Cs-134		Th-230 * (VII)
Rb-81	Ni-63	Tl-204	Fe-59	Yb-169 *	Eu-155 *		U-233 * (VI)
Kr-85	Ga-67		Co-60	Ir-192			U-236 * (VI)
Tc-99m	Ge-68		Zn-65	Hg-203 **			Pu-238 * (VII)
Ag-104	As-73		As-74	Bi-207 *			Pub-239 * (VII)
Ag-106	Br-82		Se-75	Pa-233 *			Am-241 * (VIII)
In-113m	Sr-85		Sr-82				Am-243 * (VIII)
Xe-122	Nb-95		Rb-86				Cm-244 * (VII)
Xe-127	Tc-95m		Y-88				Cf-252 * (VII)
Xe-133	Tc-99		Sr-89				
Tl-201	Mo-99		Y-90				

Groups are based on Annual Limits on Intake (ALI) Values (mCi) from EPA Federal Guidance Report No. 11.

* Group classification based on inhalation ALI - all others based on ingestion ALI
** Organic form - inorganic form in Group II