CHAPTER 6 RADIOLOGICAL SURVEYS

1.0 INTRODUCTION

1.1 Purpose and Scope

This chapter describes the methodology for performance of radiation and contamination surveys of areas where radioactive materials are used, stored, or suspected to be present. Specific survey requirements for radioactive materials shipments, leak rate testing of radioactive sources, and x-ray equipment are not described in this chapter.

The primary purpose of radiation surveys is to identify the magnitude (or verify the absence) of dose rates so that personnel exposure to radiation is maintained **A**s **L**ow **A**s **R**easonably **A**chievable (ALARA).

The primary purpose of contamination surveys is to identify the quantity (or verify the absence) of radioactive contamination on surfaces. The objective is to prevent the inhalation, ingestion, or absorption of radioactive contamination by personnel and to ensure that contamination is not spread to the surrounding environment.

The documented performance of radiological surveys is required by *Title 10, Part 20 of the Code of Federal Regulations* and by the State of Georgia *Rules and Regulations for Radioactive Materials.*

1.2 Precautions and Limitations

Wear appropriate personnel protective equipment (i.e. lab coat & gloves) during the performance of activities with unsealed radioactive materials or the potential to encounter radioactive contamination.

Use the ALARA principles of time, distance, and shielding to reduce your exposure to radiation during the conduct of radiological surveys.

2.0 TERMS / DEFINITIONS

radiological survey – an evaluation of radiological conditions by testing, measurement, or calculation.

contamination – radioactive material in an undesirable location, or transferable contamination in excess of the limits specified in Table 5.1 of this chapter.

radiation – energy in the form of particles or waves emitted from a radiation source.

direct scan survey – use of the direct scan technique to measure the activity emitted from a surface. The radiation detected is the total result of any fixed and transferable contamination on the surface, and of any radiation that may be penetrating through the surface or emanating from another source.

transferable contamination survey – An assessment of the amount of readily removable contamination present on a surface. A collection medium is used to wipe a surface while applying moderate pressure. The amount of activity detected on the collection medium is then determined using radiological instrumentation.

wipe survey – the use of a collection medium (paper disc or equivalent) to cover approximately 100 square centimeters of surface area in the assessment of transferable contamination.

large area wipe survey – the use of a collection medium (paper towel, disposable wipe, or equivalent) to perform a transferable contamination survey of a surface area significantly larger than 100 square centimeters.

cpm – counts per minute; the observed count rate determined from the use of a counting instrument.

dpm – disintegrations per minute; the rate of emission of radioactive material as determined by correcting the counts per minute for background, efficiency, and geometry factors.

contact dose rate – the radiation dose rate at (or near) contact with the radiation source. This value may be used to determine the extremity dose rate.

30 cm dose rate – the radiation dose rate measured 30 cm (approximately 1 foot) from the radiation source, this value may be used to determine the whole body dose rate, skin/lens of eye dose rate, and deep dose equivalent exposure rate.

general area dose rate – the dose rate at approximately 1 meter from the radiation source, or the generally occupied area dose rate, as measured at approximately waist level by the survey technician.

mrem/hr – the unit of dose equivalent rate.

unrestricted area – an area or location that is not controlled for the purpose of limiting exposure to radiation or radioactive materials. Controls include physical boundaries and radiological postings, signs, and labels.

restricted area – an area or location that is controlled for the purpose of limiting exposure to radiation or radioactive materials. A posted Radioactive Materials Area is an example of a restricted area.

ND - a notation used to describe the survey result when no detectable radiation or contamination above instrument background level was found.

3.0 MONITORING INSTRUMENTATION

3.1 Portable Instrumentation

Radiation Safety should be contacted for training in the use of monitoring instrumentation. Refer to the vendor provided instrument technical manual for specific operating information. The following general information is applicable to most types of portable radiation monitoring instrumentation used in UGA laboratories.

1) Pre-operational checks:

- Verify that the instrument has a current and up to date calibration label (instrument calibration services are available from Radiation Safety).
- Inspect the instrument for physical damage.
- Check the batteries, for instruments equipped with a battery test function.
- Verify that the instrument is operational by checking for detection of normal background radiation. This should be done in a low background area away from sources of radiation. If

routinely performed in the same location, consistent, reproducible results are an indication of a properly performing instrument.

- Instruments which are not capable of detecting background levels should be response tested with a radiation source of known quantity. Response check sources may be available from Radiation Safety for this purpose.

2) Selection of audible and response settings on portable instruments is left up to the discretion of the surveyor, however, the following settings are recommended:

- Audible on - Normally used.
- Audible Off - Recommended when the instrument higher scales are used, and at the discretion of the survey technician.
- Fast Response - Recommended when surveying with audible off, using the instrument high range scales, or for contamination surveys.
- Slow response - Normally used for dose rate readings on the low scales.

3.2 Wipe Test Counting Equipment

The type of laboratory equipment selected for counting wipe test samples is dependent on the radioisotope(s) to be detected and equipment availability. Typical instruments include a counter/scaler, gamma counter, or a liquid scintillation counter (LSC). The following general information is applicable to the counting instruments typically used at UGA.

1) Refer to the vendor provided instrument technical manual for specific operating and counting information.

2) Whenever practical utilize known radioactive standards to conduct functional tests and verify instrument efficiencies (instrument cpm/actual source dpm = counter efficiency).

3) Determine the minimum detectable activity (MDA) for the counting instrument prior to counting samples where a minimum activity threshold value is required. MDA varies with changes in counter background and counting times. Lower background levels and longer counting times enable a lower MDA value to be reached. Calculate the MDA by use of the formula:

$$\text{MDA in dpm} = \frac{2.71 + 4.66\sqrt{\text{bkg cpm} \times \text{count time}}}{(\text{efficiency})(\text{count time})}$$

Example: a 1 minute counting time, 50 cpm background (bkg), and LSC efficiency for H-3 of 0.33 would give a MDA of 96 dpm. Therefore, it would be appropriate to count a wipe sample for 1 minute for H-3 at this background level because the most restrictive limit is 200 dpm.

4) Run background samples to calculate net counts per minute (gross cpm – bkg = net cpm).

5) Use instrument efficiencies to convert net cpm to dpm (net cpm / instrument efficiency = dpm).

6) A simpler way to convert net cpm to dpm is to use a correction factor (CF). A correction factor is determined by the following method: CF = 1/efficiency. When using a correction factor to convert cpm to dpm use the following formula: cpm x CF = dpm

7) The standard efficiency to be used when counting wipe samples with a LSC is 33%, which provides a correction factor (CF) value of 3. When counting wipe samples in a LSC, simply multiply the net cpm value by 3 to convert the results to dpm.

8) The standard efficiency is based on the lowest counting efficiency (highest CF) for the radioisotopes typically used at UGA. This provides a uniform standard and eliminates the need for spectral analysis of wipe samples when the probability of multiple unidentified isotopes exists.

9) The standard efficiency is appropriate for use when counting wipes in commercially available scintillation fluid, or for counting exclusively P-32 wipes using water (Cerenkov counting). In Cerenkov counting, water is used instead of liquid scintillation fluid. The Cerenkov effect occurs when visible light in the blue spectrum is produced when a beta particle travels through a transparent medium faster than the speed of light in that medium. Counting wipes in water with an LSC is only approved for P-32, wipes for no other isotopes may be counted by this method.

10) Table 3.2 provides the net cpm value that will equal 200 dpm and 1000 dpm when using the standard efficiency of 33%.

Table 3.2
CPM to DPM Conversion Using the Standard LSC Wipe Counting Efficiency

LSC standard wipe counting efficiency	Correction Factor	Net cpm to equal 200 dpm	Net cpm to equal 1000 dpm
0.33	3	67 cpm	333 cpm

11) The net cpm values provided in the table above may be used as a wipe test counting guideline in meeting the criteria of restricted and unrestricted areas for transferable contamination.

12) When using a counter other than a LSC (only if necessary) for analysis of wipe samples, you should use the actual efficiency for the instrument and isotope being surveyed. An exception to this occurs if the efficiency exceeds 33%: in this case you should use the 33% value to ensure consistency in analysis of wipe samples. The Radiological Survey Form (RSF) automatically calculates this, using 33% to calculate dpm from your cpm.

4.0 DIRECT SCANNING FOR CONTAMINATION

Direct scans of material/equipment/surfaces are performed to identify the amount of contamination (fixed and transferable) present on an accessible surface. It is important to understand that direct scans may also identify the presence of radiation from another source, such as radiation penetrating through the surface of a container. Direct scan surveys may be used to provide an initial assessment of the amount of total surface contamination. The contamination detected by direct scans may be fixed (non-transferable) or transferable. Transferable contamination survey techniques are described later in this procedure.

- Direct scan surveys for contamination are not required to be performed and documented during a routine monthly survey.
- Direct scan surveys are required to be performed and documented when surveying an item or component for release to unrestricted use.
- Direct scan surveys are a primary tool for contamination monitoring during and after the performance of radioisotope work.

4.1 Direct Scan Technique

1) A pancake type GM thin window detector is the recommended instrument to perform direct scan surveys. Even with thin window detectors, these portable instruments will not detect H-3 and have a low efficiency for detecting low energy beta/gamma emitters.

2) Perform direct scan surveys in a low background area. If it is necessary to transport an item to a lower background location, take appropriate steps to prevent the possible spread of contamination (i.e. survey for transferable contamination first).

3) When scanning for contamination, position the detector approximately ½ inch above the surface being surveyed; slowly scan the surface at an approximate rate of 1 to 2 inches per second. Observe closely for increases on the meter display or in the audible signal.

4) If contamination is known to be present on the surface, the scan speed may be adjusted to an appropriate speed for locating the maximum contamination level, as desired.

5) If activity is detected, then hold the probe stationary until the meter stabilizes to obtain a reading.

6) The common background reading on UGA's campuses is 0.02 mR/hr. Anything above this is a positive indication of contamination. The appropriate limit for unrestricted areas, or for items to be released for unrestricted use, is "ND" – no radioactivity detected above 0.02 mR/hr, with RSO exception of a maximum background of 0.05 mR/hr.

7) If high levels of contamination are detected take appropriate precautions to control or prevent the spread of contamination. Notify the Authorized User and/or Radiation Safety for assistance.

8) Direct scan surveys are not required to be documented as a part of your monthly radiological survey. Direct scan surveys for release of potentially contaminated items or components to unrestricted use (see section 7.2) do require documentation. When appropriate, direct scan surveys may be documented on a RSF by identifying the items or locations surveyed and recording the results. "ND" may be used to indicate no detectable contamination. If contamination is identified, the levels found and units measured must be recorded. Refer to the RSF and the instructions provided by Radiation Safety for additional information.

5.0 TRANSFERABLE CONTAMINATION SURVEYS (WIPE TESTS)

Transferable contamination surveys are performed by wiping a known surface area (typically 100 cm^2) with a collection medium. The concentration of radioactivity on the collection medium is then analyzed. This is an important survey technique because transferable contamination can be spread from one location to another and is a potential inhalation, ingestion, or absorption hazard. Also, transferable contamination measurements are required to be performed and documented to maintain compliance with state and federal regulations.

In addition to the standard wipe testing technique described in section 5.1, there are two optional techniques that may be used for special applications as described in sections 5.2 and 5.3. If you do not fully understand the limitations of these optional survey techniques, contact Radiation Safety for assistance.

5.1 Survey Technique - 100 cm^2 Wipe Tests

1) 100 cm^2 wipe tests may be performed using filter papers or commercially available wipes or smears with an approximate diameter of 1" as the collection medium.

2) Wipe the collection medium over the surface of the area being surveyed using moderate pressure such that 100 cm^2 is wiped (typically a 16"-18" lazy S pattern).

3) Analyze the wipes using counting equipment as described in your laboratory standard protocols and section 3.2 of this chapter.

   - If using a LSC, add an appropriate amount of biodegradable scintillation fluid and count the sample for a minimum of 1 minute (see sections 3.2 and 5.2 for special counting considerations if analyzing exclusively for P-32)
   - If using a gamma counter or counter scaler, follow the standard counting protocol for the instrument

4) Subtract the background count rate (cpm) from the gross count rate (cpm) to obtain a result in net cpm. Multiply the net cpm by the conversion factor of 3 to convert the result to dpm/100 cm^2.

5) Wipe test results should be documented in units of dpm/100 cm^2 in the space provided on the radiological survey form (RSF).

6) If wipe test results are <200 dpm (<66 cpm), the counting media should be disposed of as "clean" waste. Biodegradable liquid scintillation fluid may be disposed of via sink drains, empty vials and non-contaminated wipes should be discarded in regular trash.

7) Compare the wipe test results to Table 5.1 (below) and take appropriate actions.

Table 5.1
Transferable Contamination ALARA Action Levels

Description	Action Level for Transferable Contamination (beta-gamma*)
Unrestricted Area	200 dpm/100cm^2 (<66 cpm/wipe)
Restricted Area	1000 dpm/100cm^2 (<333 cpm/wipe)

*****Alpha contamination surveys will not be required unless work is performed with unsealed isotopes that primarily or exclusively decay by emission of alpha radiation. If alpha contamination surveys are required, transferable contamination limits will comply with regulatory guidance.

Note: The ALARA goal is to maintain all normally-occupied, routinely-accessible areas at the unrestricted area transferable contamination action level.

5.2 Optional Survey Technique – Portable Instrument Counting of P-32 Wipes

Transferable contamination surveys that are preformed exclusively to monitor for P-32 in restricted areas (Radioactive Material Areas) may use the following technique. This technique is suitable for meeting the restricted area limit of 1000 dpm/100 cm^2, but is not to be used to meet the unrestricted area limit of 200 dpm/100 cm^2. In other words, this method of counting wipes may be used for monthly surveys and routine monitoring inside of Radioactive Material Areas, but may not be used for surveys for release of items or equipment to unrestricted use, or for out-going radioactive materials shipments.

1) Collect wipes by using 1.5" diameter paper or cloth disc smears (commercially available).

2) Using a pancake GM detector (Ludlum 44-9 probe or equivalent), hold the detector approximately 1/4 inch above the collection surface of the wipe for approximately 5 seconds.

3) Perform this check in a low background area only (<0.05 mR/hr). The instrument must be on a scale suitable to read <0.02 mR/hr (the x 0.1 scale for a Ludlum Model 3). Use of the audible response is recommended.

4) If no increase is noted (listen for audible response) in the count rate, the results are equivalent to <1000 dpm/100 cm^2. The results should be recorded as ND in the cpm space provided for wipe test results on the Radiological Survey Form.

5) If activity is indicated by use of the portable instrument, or if a more accurate count is desired, count the wipe in a LSC. Deposit the wipe in a scintillation vial and add an appropriate volume of water to fill the vial. Count the vial in the LSC for a minimum of 1 minute (Cerenkov counting). Subtract the background count rate and use the correction factor of 3 to convert the net counting results from cpm to dpm.

5.3 Optional Survey Technique - Large Area Wipes

Large area wipes are useful for routine monitoring of work areas. Large area wipes are not required to be performed and documented during routine monthly surveys. However, for specific situations approved by the RSO, large area wipes may be substituted for 100cm^2 wipe testing on a limited basis.

Large area wipes are only to be used as a positive/negative test for the presence of contamination. Due to the potential to spread contamination when wiping a large area, the primary use for large area wipes is to verify that normally "clean" areas have not become contaminated. Since large area wipes are read with a portable survey instrument, they will not detect H-3 and may not be suitable for detecting small quantities (i.e. 200 dpm) of low energy beta/gamma emitters.

Perform large area wipes in accordance with the following instructions.

1) Large area wipes can be performed using paper towels, disposable wipes, disc smears or equivalent as the collection medium. Floors may also be surveyed by the use of dust mops that utilize treated cloths. If disc smears are used for large area wipe testing, a minimum disc diameter of 1.5" is preferred for optimum collection and counting results.

2) Wipe the collection medium over the surface using moderate pressure. You should wipe an area at least 500 cm^2, but not so large as to cause degradation of the collection medium. A recommended technique for large surfaces (desks, bench tops, etc.) is to wipe in an "S" shaped pattern of approximately 6.5 feet in length. Use multiple wipes when checking large surfaces or different locations.

3) Perform a direct scan of the surface of the collection medium using a portable survey instrument, as detailed in section 4.1 of this chapter.

4) If contamination is detected take appropriate measures to control the potential spread of the contamination. A 100 cm^2 wipe test must be performed in order to quantify results. Compare the results to Table 5.1 for appropriate actions.

5) Large area wipe surveys are not required to be performed and documented as a part of your monthly radiological survey. However, large area wipes may be recorded on radiological surveys as a supplement to regular wipe testing. If large area wipes are performed and no contamination is detected, the results may be documented by identifying the items or locations surveyed and recording the results. "ND" may be used to indicate no detectable contamination.

A large area wipe survey that indicates contamination should not be documented, but must be followed by a sufficient number of wipe test surveys to accurately determine the magnitude and extent of the contamination. Refer to the RSF and the instructions provided by Radiation Safety for additional information.

6.0 RADIATION SURVEYS

Radiation surveys are performed to measure the dose rates (radiation fields) produced by sources of radiation, or to confirm the absence of these dose rates. Unless specifically exempted, radiation dose rate measurements are required to be performed and documented to maintain compliance with state and federal regulations.

The performance of radiation dose rate surveys is not required in authorized use locations where the radioactive materials are limited exclusively to milliCi quantities of isotopes that emit primarily beta radiation with energies below 250 keV (H-3, C-14, S-35, and P-33). The exclusive use of I-125 immunoassay kits with <25 microCi per kit is also exempted.

Radiological surveys of all other authorized use locations must include radiation dose rate surveys. The minimum requirement is to measure the radiation levels at 30 cm (1 foot) from potential sources of radiation, including storage areas, waste containers, and isotope use locations. Even if no increase over the background reading is noted, the survey must be documented as proof of compliance with the regulations.

During the performance of radiation surveys, remember to keep personnel exposure ALARA. In the event that significant radiation levels are detected, control access and notify Radiation Safety.

6.1 Radiation Survey Techniques

1) Survey the entire area concern, noting fluctuations in the meter or audible response. Investigate any increase to determine the magnitude and location of the highest reading.

2) Obtain 30 cm dose rate readings by measuring the radiation level at 30 cm (1 foot) from the radiation source or any surface from which the radiation emanates. 30 cm radiation levels may be used to establish whole body and skin/lens of eye exposure rates. These readings are also used in establishing radiological postings of areas.

3) General area dose rates should be measured at an approximate distance of 1 meter from the radiation source, or from any surface from which the radiation emanates. These dose rates are appropriate for estimating exposure to support personnel working in the vicinity of personnel whose exposure rates are determined by 30 cm dose rates.

4) General area dose rates are also useful in determining exposure rates for walkways and routinely occupied areas. General area dose rates taken for this purpose should consist of dose rate measurements taken at approximately waist level in normally occupied areas. If dose rates above area background are revealed by this method, additional surveys should be performed to determine the source of the radiation.

5) Contact dose rates shall be taken with the detector of the instrument at or near contact with the surface from which the radiation emanates. In addition to locating the source of radiation, contact dose rates provide useful information for estimating extremity exposure.

6.2 Radiation Dose Rate ALARA Action Levels

1) The ALARA action levels for radiation dose rates are shown in Table 6.2. Distances are measured from the source of the radiation, or from any surface from which the radiation is penetrating.

Table 6.2
Radiation Dose Rate ALARA Action Levels

Location	Dose Rate Action Level	Type of Measurement (source to detector distance)
Unrestricted Area	≤0.02 mrem/hr	30 cm (whole body dose rate)
Restricted Area	<2 mrem/hr	30 cm (whole body dose rate)

2) If the dose rates exceed the criteria described in Table 6.2 take appropriate actions. Locate the radiation source and consider shielding or re-locating the radiation source to reduce the dose rates. Consult with a member of the Radiation Safety staff for additional assistance.

3) Dose rates in certain locations or situations are allowed to exceed the ALARA action levels of Table 6.2 if appropriate radiological controls are implemented. For example, these action levels may be exceeded during the conduct of procedures performed for a limited duration under the continuous control of trained Radiation Workers who ensure that no untrained personnel (members of the public) are exposed to radiation hazards. Contact Radiation Safety for evaluation of a specific situation.

4) Radiation dose rates due to radioactive material shipments that are appropriately packaged, labeled, and are in transport are exempt from the guidelines of Table 6.2.

5) Radiographic (x-ray) procedures are also exempt from the restricted area radiation dose rate ALARA action levels specified above.

7.0 RADIOLOGICAL SURVEY REQUIREMENTS

7.1 Documented Monthly Surveys of Authorized Use Locations

The AU is responsible to ensure that areas where unsealed radioactive materials are used or stored are surveyed on a minimum frequency of monthly, unless no use of unsealed radioactive materials occurred in that location during the month. This survey must be documented on the Radiological Survey Form (RSF), or an RSO approved equivalent.

Perform a monthly radiological survey as follows:

1) Prepare a diagram of the room or location to be surveyed on a RSF. At a minimum, the diagram should include the general layout of the room or location. Radiological work areas, fume hoods, storage areas, waste containers, etc. should be noted on the diagram. The building, room number, Authorized User, and Radioactive Materials Permit number must be listed on the form. It is recommended that a prepared form be maintained electronically, or be hand drawn once and photocopied for future use to promote efficiency.

2) Prepare instruments for use in accordance with section 3.0 of this procedure.

Note:	The performance of radiation dose rate surveys is not required in authorized use locations where the radioactive materials are limited exclusively to milliCi quantities of isotopes that emit primarily beta radiation with energies below 250 keV (H-3, C-14, S-35, and P-33). The exclusive use of I-125 immunoassay kits with <25 microCi per kit is also exempted. Monthly radiological surveys of these locations are only required to include contamination surveys by wipe testing.

3) Measure the radiation levels at 30 cm (approximately 1 foot) from locations where radioactive materials are stored or typically used (waste containers, hoods, benchtops, freezers, etc.) throughout the survey location.

4) If all 30 cm radiation levels are <0.05 mR/hr, you may record this data on the RSF by using the statement "all dose rates are <0.05 mR/hr."

5) If the radiation levels at 30 cm are >0.05 mR/hr but <2mR/hr, record the actual (as found) dose rate on the survey diagram in locations on the diagram that correspond to the survey points. Any individual survey points that are <0.05 mR/hr should be recorded as "<0.05."

6) If the radiation survey is performed in an unrestricted area and the 30 cm dose rates exceed 0.02 mR/hr, control access to the affected area and notify Radiation Safety for assistance.

7) In the event an instrument is used for a restricted area survey that will not detect 0.05 mR/hr, you should use the lowest value that the instrument will detect when recording dose rates in the manner listed above. For example, if the lowest range of an instrument is 0.2 mR/hr, and no increase is noted during the survey, record results as <0.2 mR/hr.

8) If the 30 cm dose rates are >2 mR/hr but <5 mR/hr, the surveyor should perform the following:

- Locate the radiation source.
- Determine the contact, 30 cm, and 1-meter dose rates of the primary radiation source that is producing the radiation levels. The results should be recorded on the RSF in the format: contact / 30 cm / 1 meter.
- If appropriate, relocate the source to reduce the dose rates.
- If appropriate, shield the source to reduce the dose rates.
- Perform additional radiation surveys to verify that the dose rates have been reduced to <2 mR/hr at 30 cm and record the results on the survey form.

9) If the 30 cm dose rates cannot be reduced to <2 mR/hr or are ≥5 mR/hr, control access to the affected area and notify Radiation Safety for assistance.

10) Perform a representative number of wipe tests in accordance with your professional judgment with consideration given to the type, quantity, and locations of radioactive materials use that has occurred since the last survey. A total of 10 to 20 wipe test locations are generally appropriate for a typical radioisotope use laboratory. No more than 5 wipe test locations would be appropriate for a location used exclusively for sample counting, such as a LSC room where no other radioisotope work is performed.

Recommended wipe test locations include the following:

- areas normally used for radioisotope work (countertops, hoods, sinks, etc.)
- adjacent areas with the potential to have become contaminated

- floor locations in high traffic areas (hallways, doorways) and in areas adjacent to locations where radioisotopes are commonly handled (in front of hoods, sinks, benchtops, etc.)
- items frequently handled when moving from radioisotope use/storage areas to unrestricted areas (doorknobs, freezer handles, etc.)
- exterior surfaces of radioactive waste containers
- boundaries between restricted and unrestricted areas.

11) You may use large area wipes to supplement 100 cm^2 wipe tests during the performance of monthly surveys. To use this option, you must follow the requirements of section 5.3 of this chapter.

12) When performing wipe surveys, it is recommended that you survey areas with the least potential for contamination first and work your way to areas with the greatest potential for contamination last. This reduces the potential for cross contamination of wipes and survey locations.

13) Wipe test locations may be identified on the map by using circled numbers, or as otherwise described on the RSF.

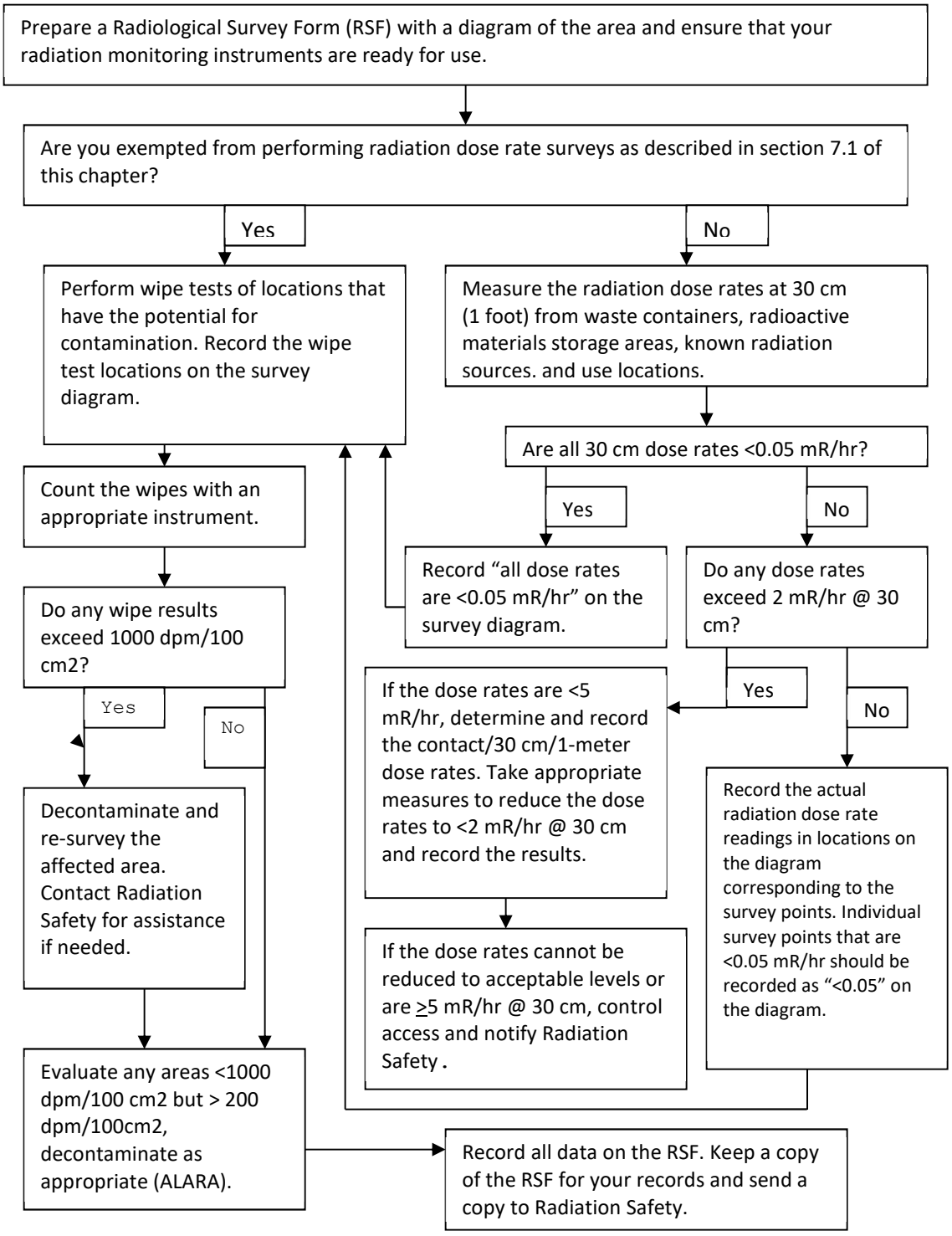
14) Analyze the wipe samples in an appropriate counter, document the results, and compare the wipe test results to the ALARA action levels of Table 5.1 of this chapter.

15) If the ALARA action levels for transferable contamination are exceeded, take the following actions:

- If unrestricted area contamination levels exceed 200 dpm/100cm^2 but are less than 1000 dpm/100cm^2; perform decontamination, re-survey, and document the results on the survey form. In the comments section of the survey form indicate that the affected areas were decontaminated and resurveyed.
- If unrestricted area contamination levels exceed 1000 dpm/100cm^2; prevent personnel access to the affected area and promptly contact Radiation Safety for assistance.
- If restricted area contamination levels exceed 1000 dpm/100cm^2 but are less than 10,000 dpm/100cm^2; perform decontamination, re-survey, and document the results on the survey form. In the comments section of the survey form indicate that the affected areas were decontaminated and resurveyed.
- If restricted area contamination levels exceed 10,000 dpm/100cm^2; prevent personnel access to the affected area and promptly contact Radiation Safety for assistance.
- If decontamination is widespread or is not reduced after three decontamination attempts; prevent personnel access to the affected area and promptly contact Radiation Safety for assistance.

16) Document results on the RSF. Keep a copy of the RSF for your records and submit the original to Radiation Safety to be maintained in project files.

Flow Chart for the Performance of a Monthly Radiological Survey in a Restricted Area



7.2 Surveys for Release to Unrestricted Use

1) Potentially contaminated items, components, or areas must be surveyed prior to being released for unrestricted use. This includes items which have been in contact with, or in the near proximity of unsealed radioactive materials. Small hand carried items that have the potential for contamination should be surveyed to the limits specified in this procedure for unrestricted use by the AU, Advanced Radworker, or designee. Routine checks of these small items are not required to be documented on a Radiological Survey Form.

Note:	In most cases, a member of the Radiation Safety staff will perform surveys for release to unrestricted use for the items or locations listed below. However, a survey by any qualified AU or Advanced Radworker that is properly performed and documented may be approved by the RSO or designee as a suitable record of release to unrestricted use.

2) The following items, locations, or components must have a documented radiological survey performed and approved by the Radiation Safety Officer or designee prior to being released for unrestricted use:

- Authorized use locations, radiological use laboratories, or posted radioactive material areas in radiological use laboratories (bench tops, hoods, sinks, etc.).
- Large components or equipment that has been used with radioactive materials (freezers, refrigerators, centrifuges, etc.) and are potentially contaminated.
- Furniture that has been used for radioisotope work, including desktops, cabinets or drawers used to store radioactive materials or potentially contaminated laboratory items (glassware, pipettes, etc.).

3) Perform surveys for release to unrestricted use as follows:

- Perform a direct scan survey of all accessible surfaces with the potential to be contaminated in accordance with section 4.1 of this procedure.
- The use of a thin window GM pancake type detector and an instrument sensitivity and background of <0.02 mR/hr is required for the performance of unrestricted release surveys, unless otherwise approved in writing by the RSO. The use of a low energy gamma detector may be needed if isotopes such as I-125 and Cr-51 are known to be present.
- If contamination is detected via direct scans, determine the location of the contamination and evaluate the possibilities for decontamination.
- Collect and analyze a representative number of wipe samples as described in section 5.0 of this procedure.
- Document results on the Radiological Survey Form, if required per item 2 above.
- Compare survey results to the unrestricted release values of the following table.

Table 7.2
Unrestricted Release Limits

Direct Scan Limit	Transferable Contamination Limit
ND, unless with RSO exception of maximum background of 0.05 mR/hr	<200 dpm/100cm^2 (<66 cpm/wipe)

- If the survey results exceed the specified values; decontaminate in accordance with section 7.1, re-survey, and document results
- If the results are below the limits specified in Table 7.2 the material is suitable for release to unrestricted use
- If the material meets the criteria where a documented survey is required as described in item 2 above, provide a copy of the survey to the Radiation Safety Officer or designee for approval prior to release for unrestricted use. Keep a copy of the survey for your records.
- Destroy or deface any radiological markings prior to releasing items for unrestricted use.

4) Liquids, bulk material, and components with inaccessible surfaces with the potential for contamination require special survey techniques or analysis. Contact the RSO or designee for release of these materials to unrestricted use.

7.3 Other Survey Requirements

The frequency of radiological surveys in the work place must be adequate to ensure that personnel exposure to radiation and radioactive materials is ALARA. Documentation of these surveys on a RSF is not required. Specific instances when monitoring is needed include, but are not limited to, the following:

- monitoring of conditions during work with radioisotopes
- surveys of work areas after handling radioisotopes
- personnel contamination monitoring (direct scans of hands, clothing, shoes) after working with any unsealed radioactive materials and prior to exiting the laboratory
- direct scans of lab coats, furniture, and other routinely used and potentially contaminated items
- surveys of laboratory equipment after being used with radioisotopes
- radiation surveys of storage areas and waste containers after adding radioactive materials to those locations, to verify that dose rates are within limits
- surveys to ensure that unrestricted areas (i.e. office or break areas) are free from radiological hazards
- surveys in support of radioactive material shipments or transfers
- surveys of waste containers prior to pick up by the Radiation Safety Staff
- monitoring in support of any suspected spill of radioactive materials.

7.4 Use of the Radiological Survey Form

- Not all surveys have to be documented on a RSF. Examples of surveys that do not require documentation include routine work area surveys and personnel contamination monitoring. Also, surveys in support of radioactive material shipments or transfers may be documented on paperwork other than a RSF. Duplicate documentation of these surveys is not necessary.
- As a general rule, monthly surveys and surveys of potentially contaminated items for release to unrestricted use are the only surveys required to be documented by an AU (or their designee) on a RSF. When in doubt about the need to document a survey consult with the Radiation Safety staff.
- A radiological survey is not required if no use of radioactive materials in an unsealed form is performed in an authorized use location during a calendar month. This information should be reported to Radiation Safety by use of an RSO-approved electronic reporting method or by sending in a *Radiological Survey Form* with a statement in the *Comments* section denoting that no radioactive materials use occurred. In the case of an Authorized User with multiple rooms approved for radioactive materials use, only those rooms where unsealed radioactive materials were used during the calendar month are required to be surveyed. Individual rooms that do not require a monthly survey should be noted on the RSF so that all approved rooms are accounted for.
- The *Radiological Survey Form* should be completed in an electronic format for increased efficiency. The electronic format must be approved by the RSO and obtained from Radiation Safety. After the electronic form is completed it must be printed and signed. The signed copy must be sent to Radiation Safety either electronically or by mail, to be reviewed and stored with project files. Laboratory copies may be maintained in either electronic or hard-copy format, but must be available for inspection.
- If the electronic format *Radiological Survey Form* is unavailable or is not being used for any reason, a radiological survey may still be documented on a paper copy of the form. Some calculations would then have to be performed manually. Contact Radiation Safety for assistance if needed.

8.0 ATTACHMENTS

Radiological Survey Form (example)