RADIATION PROCEDURES MANUAL

Procedure Cover Sheet

Procedure Title: Radiological Surveys
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1. **INTRODUCTION**

10 CFR 20 Subpart F requires that routine surveys be performed in all licensed facilities and laboratories. This procedure is designed after the requirements established in the ISU Radiation Safety Manual (RSM), Sections 11 and 12. While handling radioactive material, spills may occur, containers may leak, and physical contact with radionuclides may lead to the spread of radioactive material in unintended locations. Surveys for radioactive contamination help ensure that exposure to radioactive material remains ALARA. Dose rate surveys provide the information about the radiation fields and associated dose rate in the work area. Conditions are subject to change and because of this, both contamination and radiation surveys are performed periodically. Surveys help reduce the spread of contamination and characterize exposure rates. When contamination is detected, it must be removed promptly to prevent its spread and the possible exposure of other individuals. The survey frequency is based on the source classification for a particular radiation use area, as shown in the RSM Section 12 – Table 8, and is specified in the authorized user permit.

In addition to laboratory surveys, this procedure provides instructions for release surveys to demonstrate equipment and material may be released as non-radioactive and surveys for shipping containers to comply with transportation regulations.

2. **PURPOSE**

Create a standard for monitoring contamination and radiation levels from radioactive materials at ISU facilities and to limit the spread of contamination and ensure lab worker exposures are maintained ALARA. The procedure also ensures standard methods are used for release surveys to demonstrate equipment and materials are not radioactive and standard methods for surveying radioactive packages to comply with transportation regulations.

Provide clear instruction on how to perform contamination and radiation surveys. Identify the importance of properly documenting survey results and specify the different types of surveys performed in the ISU Radiation Safety Program.

3. **SCOPE**

This procedure specifies instructions for radiological surveys performed in the ISU Radiation Safety Program as listed below.
• Confirmatory laboratory surveys performed by the Radiation Safety Department
• Authorized user surveys of laboratory spaces
• Release surveys to demonstrate materials are not radioactive
• Transportation surveys for radioactive material packages.

4. ROLES AND RESPONSIBILITIES

• Radiation Safety Officer
  o Maintain this procedure and applicable sections of the Radiation Safety Manual.
• Authorized Users
  o Ensure surveys are performed at the frequency specified in their permit.
  o Review and approve authorized user surveys for their laboratories.
  o Maintain annual radiation safety training.
• Radiation worker
  o Properly perform surveys in accordance with this procedure and the RSM.
  o Maintain annual radiation safety training.
• Radiation Safety Technician
  o Perform confirmatory surveys, release surveys, and transportation surveys.
  o Maintain annual radiation safety training.

5. REQUIRED MATERIAL(S)

• Applicable RPR 11 – Contamination and Radiation Survey Form
• PPE
• Appropriate Survey Instruments defined in authorized user permit
• Swipes, Masslin, and Mop
• Pen

6. PROCEDURE

6.1. Definitions.

6.1.1. Contamination: Radioactive material in an unwanted location. Contamination can be both fixed and removable. Removable contamination is easily removed from the surface it is on while fixed contamination remains on its surface despite removal efforts.

6.1.2. External exposure: Penetrating dose from a radioactive source external to the body.
6.1.3. **Internal Exposure**: radioactive material deposited in the body through inhalation, ingestion, injection, or absorption.

6.1.4. **Contamination Survey**: a survey designed to establish the level of radioactive material that may be on exposed surfaces. Swipes, Large area wipes (LAW's), and direct contact measurements are considered contamination surveys.

6.1.5. **Radiation Survey**: Measuring the dose rate levels in various locations in a room or facility. This is performed with Dose rate instruments to measure x-ray, beta, gamma and neutron fields. Typically done in general area and at 30 cm or 1 meter from the source.

6.1.6. **Formal Map Survey**: Investigation of the area or item to identify possible contaminants and radiation levels. Legibly documented on a map.

6.1.7. **Immediate Work Area Survey**: A survey performed in the immediate work area to grossly identify that there is no significant contamination in the area.

6.1.8. **Swipe/Smear**: removable contamination survey method of swiping surface areas and counting it for gross alpha/beta analysis.

6.1.9. **Direct Scan**: Contact reading of a suspected area of contamination with a survey meter (Geiger probe or alpha/beta probe).

6.1.10. **Large Area Wipe (LAW)**: removable contamination survey method of using a Masslin mop or wipe to cover a large area and then perform a direct scan on the Masslin.

**Note**: Record survey results clearly and legibly so that there is no question what is being written and it can be understood by anyone. RPR-11 clearly identifies the proper way of recording survey results. A completed example form can be found in Appendix B.

6.2. **Confirmatory Surveys**
Confirmatory surveys of permitted laboratory spaces are performed by the Radiation Safety Department. They are documented on the RPR-11a form.

6.2.1. **Preliminary Steps**
6.2.1.1. Obtain the RPR-11a survey form. Every location containing licensed RAM is scheduled for a Confirmatory survey.

6.2.1.2. Identify the radionuclides that may be present in the survey.
   6.2.1.2.1. Obtain a copy of the Authorized Users permit.
   6.2.1.2.2. If multiple alpha and beta/gamma emitters are present write various on RPR-11a form.
   6.2.1.2.3. Identify any neutron sources that are present in the laboratory.

6.2.1.3. Gather the appropriate survey instrument(s) specified in the permit under the section for Radiation Safety surveys.
6.2.1.4. Verify the instruments to be used have been daily checked. See the Instrument Performance Log on google sheets.
   6.2.1.4.1. If the instrument(s) haven’t been checked, complete a daily check by following RS-24, Instrument Response Checks procedure.

6.2.1.5. Record the make, model, calibration due date, measurement unit, and serial number of each instrument on RPR-11a.

6.2.1.6. Take a background measurement with each handheld instrument and record the background range on the RPR-11a form.

6.2.1.7. Gather the necessary survey materials. This includes: PPE and swipes.

6.2.1.8. Draw a map of the location being surveyed.
   6.2.1.8.1. This can be electronically designed and printed on the back of the RPR-11a form or created by hand.
   6.2.1.8.2. Maps should include room numbers, all doorways, RAM storage cabinets, RAM use areas, laboratory furnishings, and any other pertinent information about the area.

6.2.1.9. For confirmatory surveys, contact the Authorized User to schedule an appropriate time to survey.

6.2.2. Survey

6.2.2.1. Measure the dose rate throughout the area. Take enough dose rate measurements to accurately represent the survey area. Focus on RAM use areas and RAM storage areas.
   6.2.2.1.1. Perform a dose rate measurement 30 cm from all RAM storage areas.
   6.2.2.1.2. When the user permit identifies neutron sources, the same principles apply for neutron dose rate measurements.

6.2.2.2. Record dose rate results on form RPR-11a map. If gamma and neutron dose rate measurements are performed, label them with γ and n.
   6.2.2.2.1. Avoid loitering near RAM storage areas. Record results in a low background area to maintain exposure ALARA.

6.2.2.3. Prepare and collect enough swipes to cover all potentially contaminated areas as well as accurately represent the area or item being surveyed.
   6.2.2.3.1. Swipes should be collected in a 100 cm² area.
   6.2.2.3.2. Take swipes at the entrance to the survey area, both inside and outside. Sink drains, sash/lip of fume hoods, rad trash lids, door handles, log books, tools used to process RAM, keyboards, etc.
6.2.2.3.3. Briefly direct scan each swipe to verify that it is not highly contaminated. If highly contaminated note count rate on RPR 11a but do not analyze on laboratory equipment.

6.2.2.3.4. Swipes are either counted on a proportional counter or liquid scintillation counter (see authorized user permit). When results are completed, attach them to the survey map.

6.2.2.3.5. When using the proportional counter, first verify that the daily check has been completed and check the control chart. Record counting information on the proportional counter logbook.

6.2.2.3.6. The liquid scintillation counter uses a standard rack with background H-3 and C-14 standards that is counted when a sample is started. Record counting details such as the number of vials, date counted, and carrier number(s) in the LSC laboratory logbook in the count lab. A background vial should be used for each carrier. Don’t leave blank spaces between multiple surveys.

6.2.2.3.7. Attach swipe results to the RPR-11a form.

6.2.2.4. Direct scans should be performed in locations likely to find contamination (i.e. Fume Hoods, sinks, sample preparation areas, Re-usable PPE etc.).

6.2.2.4.1. Direct scans are not performed in elevated radiation areas.

6.2.2.4.2. Record all area Direct scans on RPR-11a form. Record maximum count rate observed.

6.2.2.4.3. Scan speeds can be found in Appendix A.

6.2.2.5. When finished with the survey, review that all information is correct, sign it, and submit it to the Radiation Safety Department for review.

6.3. User Surveys

There are two types of User Surveys, Immediate Work Area and Formal Map Surveys. Immediate Work Area Surveys are performed immediately after radiological work is completed. Formal map surveys are recorded on the RPR-11b form. See the authorized user permit for the frequency of Formal Map Surveys.

6.4. Immediate Work Area Post-Job Surveys

Immediate work area surveys confirm there is no significant contamination from the day's operation. If contamination is detected above the limits of Table 7 in the RSM, decontamination shall be performed and a Formal Map Post Job Survey conducted.

6.4.1. Preliminary Steps
6.4.1.1. Be aware of which types of radionuclides are present based on the work performed.

6.4.1.2. Be prepared to conduct the survey by donning the proper PPE and obtaining the needed survey materials. (Lab coat, gloves, Masslin, swipes, friskers etc.).

6.4.2. **Survey**

6.4.2.1. Direct frisk surveys and/or LAW surveys are used to assess the work area when detectable nuclides were used.

6.4.2.2. LAW areas where RAM may have spilled or been released. (Fume-hood sash/lid, floor near work area, etc.)

6.4.2.3. Direct scan each Masslin in a low background area. Scan speeds can be found in Appendix A.

6.4.2.4. Frisk the work area. See Appendix A.

6.4.2.5. When non-detectable nuclides (low-energy beta emitters) or pure alpha-emitting radionuclides are used perform a swipe survey.

6.4.2.6. Collect enough swipes to assess the immediate work area.

6.4.2.7. Swipes should be collected in a 100 cm² area.

6.4.2.8. Record the results of the immediate work area survey in the laboratory log book.

6.5. **Formal Map User Surveys**

6.5.1. **Preliminary Steps**

6.5.1.1. Obtain RPR-11b form

6.5.1.2. Identify the radionuclides that may be present in the survey.

6.5.1.2.1. If multiple alpha and beta/gamma emitters are present write various on RPR-11b form.

6.5.1.2.2. Identify any neutron sources that are present in the area.

6.5.1.3. Gather the appropriate survey instrument(s). See user permit.

6.5.1.4. Verify the instruments to be used have been daily checked. See the Instrument Performance Log on google sheets.

6.5.1.4.1. If the instrument(s) haven’t been checked, complete a daily check by following RS-24, Instrument Response Checks procedure.

6.5.1.5. Record the make, model, calibration due date, measurement unit and serial number of each instrument.

6.5.1.6. Gather the necessary survey materials. This includes: PPE, swipes, and Masslin (if necessary).

6.5.1.7. Draw a map of the location being surveyed.
6.5.1.7.1. This can be electronically designed and printed on the back of the RPR-11 form or created by hand.

6.5.1.7.2. Maps should include room numbers, all doorways, RAM storage cabinets, RAM use areas, laboratory furnishings, and any other pertinent information about the area.

6.5.2. **Survey**

6.5.2.1. For areas with significant potential for removable contamination, take enough LAW’s to cover the majority of the work area and record results on form RPR-11b.

6.5.2.1.1. LAW’s are direct scanned with a survey meter for removable contamination.

6.5.2.1.2. It is acceptable to reuse the same Masslin if the levels are found to be indistinguishable from background.

6.5.2.1.3. If contamination is found from the LAW, decontaminate the area using cleaning products. Dry the area, or wait until dry and repeat LAW in the area. Repeat until the net count rate on the LAW is less than the action level.

6.5.2.2. Measure the dose rate in strategic locations throughout the area. Take enough dose rate measurements to accurately represent the survey area. Focus on RAM use areas, high contact areas (i.e., sinks, door handles, etc.), and RAM storage areas. Include a dose rate measurement 30 cm from all RAM storage areas.

6.5.2.3. Record dose rate results on form RPR 11b map. If gamma and neutron dose rate measurements are performed, label them with γ and n.

6.5.2.4. Avoid loitering near RAM storage areas. Record results in a low background area to maintain exposure ALARA.

6.5.2.5. Prepare and collect enough swipes to cover all potentially contaminated areas as well as accurately represent the area or item being surveyed.

6.5.2.5.1. Swipes should be collected in a 100 cm² area.

6.5.2.5.2. Take swipes at the entrance to the survey area, both inside and outside. Sink drains, sash/lip of fume hoods, rad trash lids, door handles, log books, tools used to process RAM, keyboards, etc.

6.5.2.5.3. Briefly direct scan each swipe to verify that it is not highly contaminated.

6.5.2.5.4. Swipes are counted on a proportional counter, liquid scintillation counter, or alpha beta swipe counter. If this instrumentations is not available, contact the Radiation Safety Department and they will analyze the swipes. When results are completed, attach them to the survey map.
6.5.2.5.5. When using the proportional counter, liquid scintillation counter, or alpha beta scalar, first verify that all control measurements have been performed in accordance with the user procedure.

6.5.2.5.6. Staple swipe results to the RPR-11b form.

6.5.2.6. Direct scans should be performed in locations likely to find contamination (i.e. Fume Hoods, sample preparation areas, etc.). No direct scans are performed if elevated radiation fields are present.

6.5.2.6.1. Record all area Direct scans on RPR-11b form.

6.5.2.6.2. Scan speeds can be found in Appendix A.

6.5.2.7. When finished with the survey, review that all information is correct, sign it, and submit it to the Authorized User for review.

6.6. Release Surveys

Release Surveys are performed on items or equipment to be released for repair or unrestricted use that have been used with dispersible radioactive materials or may have been activated. Release surveys are recorded on the RPR-11c form. Release surveys are to be performed by Radiation Safety Technicians from the Radiation Safety Department. Please contact the radiation safety department if something needs to be released.

6.6.1. Preliminary Steps

6.6.1.1. Obtain RPR-11c form.

6.6.1.1.1. Contact the Authorized User to determine if the item is potentially activated.

6.6.1.1.2. Identify if there are internal surfaces where RAM may be present in the comments section.

6.6.1.1.3. Identify the action levels based on what radionuclides may be present (See Table 7 of the RSM). Record action levels for removable and average total contamination on the RPR-11c form.

6.6.1.2. Gather the appropriate survey instrument(s) for the release survey. Appropriate instruments include a rate meter with GM probe or alpha/beta probe, and Model-19 NaI based dose rate meter if the item is potentially activated.

6.6.1.3. Verify the instruments to be used have been daily checked. See the Instrument Performance Log on google sheets.

6.6.1.3.1. If the instrument(s) haven’t been checked, complete a daily check by following RS-24, Instrument Response Checks procedure.

6.6.1.4. Record the make, model, calibration due date, measurement unit, and serial number of each instrument.
6.6.1.5. Take a background measurement to determine the background range for each instrument and record it on the RPR-11c form.

6.6.1.6. Gather the necessary survey materials. This includes: PPE, swipes, and Masslin.

6.6.1.7. Preferably, take photographs of the item.
   6.6.1.7.1. Add survey points to the photographs.

6.6.1.8. Alternatively, prepare a map of the item being surveyed.
   6.6.1.8.1. Maps should include all items surveyed for release.
   6.6.1.8.2. The item being surveyed for release should be stationed in a low background area in order to conduct the survey.

6.6.2. **Survey**

6.6.2.1. Scan 100% of the item with the contamination survey instrument.
   6.6.2.1.1. Complete questions regarding direct frisk.
   6.6.2.1.2. Scan speeds can be found in Appendix A.
   6.6.2.1.3. If positive results are found in the direct frisk, perform 30 second static counts at the location and record results on RPR-11c form.
   6.6.2.1.4. Note all internal surfaces and areas in the comments where direct scans or swipes are not possible.

6.6.2.2. If potentially activated, survey the entire surface of the item with a Ludlum Model 19 μR meter. Survey 1 to 2 cm from the surface of the item. Use the same survey speed specified for frisking in Appendix A.
   6.6.2.2.1. Answer questions regarding activation and μR survey on Form RPR-11c.

6.6.2.3. Take enough LAW’s to cover all surfaces of the object and record results on form RPR-11c form.
   6.6.2.3.1. A LAW is performed by using the Masslin cloth and wiping the surface areas with a gloved hand.
   6.6.2.3.2. LAW’s are direct scanned with a survey meter for removable contamination.
   6.6.2.3.3. It is acceptable to reuse the same Masslin if the levels are found to be indistinguishable from background.
   6.6.2.3.4. If contamination is found from the LAW, decontaminate the item by using cleaning product. Dry the area, or wait until dry and perform a second LAW on the item. Repeat until indistinguishable from background or less than action levels specified in Table 7, Section 11 of the RSM. Record results on Form RPR-11c.

6.6.2.4. Prepare and collect enough swipes to cover all openings as well as accurately represent the item being surveyed.

6.6.2.5. Swipes should be collected in a 100 cm² area for release items.
6.6.2.5.1. Swipes are either counted on a proportional counter or liquid scintillation counter. When results are completed, attach them to the survey map.

6.6.2.5.2. When using the proportional counter, first verify that the daily check has been completed and check the control chart. Record counting information on the proportional counter log notebook and survey map comments section so that no information is lost in interpretation.

6.6.2.5.3. The liquid scintillation counter uses a standard rack that is counted when a sample is started. Record counting details such as the number of vials, date counted, and carrier number in the laboratory notebook in the count lab. A background vial should be used for each carrier. Don’t leave blank spaces between multiple surveys.

6.6.2.6. When the survey is complete, review that all information is correct, sign it, and submit it to the Radiation Safety department for review.

6.7. **Transportation Surveys**

Radiation Safety Technicians perform transportation surveys in conjunction with RS-08, Transportation of Radioactive Material

6.7.1. **Preliminary Steps**

6.7.1.1. Gather required materials (Gamma dose rate meter, frisker, swipes, LAW, and neutron meter if neutron-emitting sources are present) A μR meter must be used for White I labeled shipments preferably an ion chamber such as the Ludlum 9DP.

6.7.1.2. Record the make, model, calibration due date, measurement unit, and serial number of each instrument.

6.7.1.3. Perform surveys in a low background area.

6.7.1.4. Take a background measurement to determine the average background range for each instrument and record it on the RPR-11d form.

6.7.1.5. Enter the Shipment number, UN number, and label category.

6.7.2. **Survey**

6.7.2.1. Perform a dose rate survey on the shipment container. Find the highest on-contact reading and record on the RPR-11d form. Measure 1 meter from the highest point and take a second reading. Record the 1 meter reading on the RPR-11d form.

6.7.2.1.1. Measure neutron dose rates in the same manner when neutron-emitting material is present.

6.7.2.2. Collect 300 cm² swipes of the container and record the location on the RPR-11d form.
6.7.2.2.1. When using the proportional counter, liquid scintillation counter, or alpha beta scalar, first verify that all control measurements have been performed in accordance with the user procedure.

6.7.2.2.2. Attach a print out of the swipe results to the form.

6.7.2.3. Take a LAW over the surface of the entire container.

6.7.2.4. Scan the LAW with a GM frisker for removable contamination. Record the result on the RPR-11d form.

6.7.2.5. When the survey is complete, review that all information is correct, sign it, and submit it in to the Radiation Safety department for review.

7. LIST OF FORMS

RPR 11a – Laboratory Confirmatory Survey Form

RPR 11b – User Formal Map Survey Form

RPR 11c – Release Survey Form

PRP 11d – Transportation Survey Form
APPENDIX A

- For survey meters it is important to strive to maintain a consistency of survey rate and distance.
- When surveying something, ¼ to ½” distance from the surface should be maintained so that the probe is not too far away from the surface to measure contamination but not too close to touch a potentially contaminated area and become contaminated.
  - Avoid using the probe to survey the bottom of something. When surveying feet or shoe covers, lift your leg up so that the probe is surveying vertically to prevent contaminating the probe.
- In general, the best way to determine how to survey something is by covering the width of the detector per second.
  - This is only about 1-2” per second for the 44-9 GM probe.
- The fast response should be used when looking for contamination, such as in a direct scan.
- The slow response should be when you want to quantify contamination.
- When scanning an area, use an “S” pattern making sure to stop when you audibly or visually see counts recording above background.
### RPR 11a Laboratory Confirmatory Survey Form

**Building:** CAES  
**Room:** RCL  
**Program:** 128  
**Date:** 08/13/2020  
**Performed by:** Syl Barrett  
**Reviewed by:** Rodger Waters  

#### Comments:
Quarterly Survey

#### Instruments were Source Checked 12 prior to survey

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#### Action Levels:
- $\alpha$: 20 dpm/100cm²  
- $\beta$: 1000 dpm/100cm²  

---

### For Reviewer:

Are survey results$^1$ > Action Level? Y/N  
Are survey results$^1$ > MDA? Y/N  

---

$^1$ If swipes are > action level after 2nd analysis notify RSO or designee and decontaminate area.
* On contact Dose Rate (y/n)

-30cm To indicate a Dose Rate at 30 cm (y/n)

☐ Swipe

# Direct Scan

1 If swipes are > action level after 2nd analysis notify RSO or designee and decontaminate area.
### Radiological Surveys

**Building:** CAES  
**Room:** RCL  
**Program:** 128  
**Date:** 08/12/2020  
**Approval Date:** September 16, 2020  
**Effective Date:** October 12, 2020  
**Comments:** Bengali glovebox waste removal. 1 bag of DU was removed from glovebox and placed in waste drum.

**Performed by:** Syd Baskett  
**Reviewed by:** Roger Waters

#### Swipe Log

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<th>LAW</th>
<th>Location</th>
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<th>Direct</th>
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**Instruments were Source Checked** prior to survey  
**Action Levels:**  
\[
\begin{align*}
\alpha & : 20 \text{ dpm/100cm}^2 \\
\beta & : 1000 \text{ dpm/100cm}^2
\end{align*}
\]

**Radiation Levels**

-  > 5 mrem/hr @ 30 cm <br>  (Y/N) \( \text{ N } \)
-  If Y, Radiation Area Posted <br>  (Y/N) \( \text{ N } \)
-  Radiation Levels > 100 mrem/hr @ 30 cm <br>  (Y/N) \( \text{ N } \)
-  If Y, High Radiation Area Posted <br>  (Y/N) \( \text{ N } \)

**For Reviewer:**

- Are survey results > Action Level? \( \text{ Y } \)  
- Are survey results > MDA? \( \text{ Y } \)  

1. If swipes are > action level after 2nd analysis notify Authorized User or designee and decontaminate area.
Page 21 of 23
**Sample Report**

**Batch ID:** Smear - 202006081712  
**Group:** B  
**Device:** SSXLB 10106542  
**Batch Key:** 7824  

**Selected Geometry:** 1/8" Stainless Steel

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Reviewed by: [Signature]

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**Page 1 of 1**

**Print Date:** 6/8/2020  
**Print Time:** 7:11:59PM
## Radiological Surveys

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**Date:** 8/7/2020

**Survey Description:** PS R108 Aug. 2020 Survey

**Instrument:** Tri-Carb 2810

**S/N:** 04129161

**Protocol:** 7

**Count Time (min):** 4