# STANDARD OPERATING PROCEDURE FOR RADIATION TESTING




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PROTECTION

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# STANDARD OPERATING PROCEDURE FOR RADIATION TESTING

## 1. SCOPE

This document outlines radiation protection procedures to be used throughout the laboratory. All suspicious samples, "perceived threat" materials (PTM), and Environmental Response Laboratory Network (ERLN) chemical agent samples must be tested for radiation as part of the initial sample evaluation prior to acceptance for analysis. As described in this SOP, samples or items found to exceed the radiation action levels must not be accepted into the general laboratory. Appropriate safety measures must be taken if the radiation action levels are exceeded.

1.1 Supporting Standard Operating Procedures (SOPs)

Refer to the following Standard Operating Procedures (SOPs) for additional procedural information with regard to sample custody, safety, analytical methods, and non-conformance reporting. These SOPs contain critical details not fully described within this Accountability SOP. The chemical agent operators must be completely familiar with all of these SOPs.

1.1.1 Florida Department of Environmental Protection, *Health and Safety Plan*. April 2010.

1.1.2 Florida Department of Environmental Protection, *Building Security Plan.* May 2010.

1.1.3 Florida Department of Environmental Protection, *Standard Operating Procedure for Receiving Packages and Freight at the Loading Dock (SOP* **LB-022).**

1.1.4 Florida Department of Environmental Protection, *Standard Operating Procedure for Sample Receipt and Entry into the LIMS.* (SOP **LB-016**).

1.1.5 Florida Department of Environmental Protection, *Standard Operating Procedure for Maintaining the Custody and Storage of Environmental Samples in the DEP Laboratory* (SOP **LB-023**).

1.1.6 Florida Department of Environmental Protection, *Laboratory Accountability, Storage and Hazard Communications Procedures* (SOP **ERLN-001**).

1.1.7 Florida Department of Environmental Protection, *Standard Operating Procedure for Receipt and Log-in of Chemical Agent Samples and Standards* (SOP **ERLN-005**).

1.1.8 Florida Department of Environmental Protection, *Chemical Agent Laboratory Training Module, May 2010.*


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1.1.9 Florida Department of Environmental Protection, *Non-Conformance Reporting System* (SOP **LB-002**).

## 2. SUMMARY

A description of the different types of radiation is given below. Understanding the nature of the different radiation categories will help the user differentiate type and risk associated with each.

### 2.1 Radiation Types

A radiation survey meter (Geiger counter) is used to screen packages or coolers containing PTM or ERLN samples. If no exterior radiation is detected, then the inner containers and samples are likewise screened for radiation. The Geiger counter detects for three types of radiation but does not distinguish which type of radiation is detected. The three types of radiation (gamma, beta, alpha) are described below.

#### 2.1.1 Gamma Radiation

- Gamma radiation is electromagnetic radiation like visible light, radio waves, and ultraviolet light. These electromagnetic radiations differ only in the amount of energy they have. Gamma rays, along with X-rays are the most energetic of these.
- Gamma radiation is able to travel many meters in air and many centimeters in human tissue. It readily penetrates most materials and is sometimes called "penetrating radiation."
- Radioactive materials that emit gamma radiation constitute both an external and internal hazard to humans.
- Dense materials are needed for shielding from gamma radiation. Clothing and protective gear provide little shielding from penetrating radiation but will prevent contamination of the skin by radioactive materials.
- Gamma radiation frequently accompanies the emission of alpha and beta radiation.

#### 2.1.2 Beta Radiation

- Beta radiation may travel meters in air and is moderately penetrating.
- Beta radiation can penetrate human skin to the "germinal layer," where new skin cells are produced. If beta-emitting contaminants are allowed to remain on the skin for a prolonged period of time, they may cause skin injury.
- Beta-emitting contaminants may be harmful if deposited internally.
- Most beta emitters can be detected with a survey instrument. Some beta emitters, however, produce very low energy, poorly penetrating radiation that may be difficult or impossible to detect. Examples of these are carbon-14, tritium, and sulfur-35.
- Clothing and protective gear provide some protection against most beta radiation. Protective gear and dry clothing can keep beta emitters off of the skin.

#### 2.1.3 Alpha Radiation

- Alpha radiation is not able to penetrate skin.


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- Alpha-emitting materials can be harmful to humans if the materials are inhaled, swallowed, or absorbed through open wounds.
- Instruments cannot detect alpha radiation through even a thin layer of water, blood, dust, paper, or other material, because alpha radiation is not penetrating.
- Alpha radiation travels a very short distance through air.
- Alpha radiation is not able to penetrate working gear, clothing, or a cover on the radiation probe. Protective gear and dry clothing can keep alpha emitters off of the skin.

## 3. APPARATUS AND EQUIPMENT

- Ludlum Model 3 Survey Meter
- Ludlum Model 44-9 Detector – can detect alpha, beta and gamma radiation (does not identify radiation type)
- Equipment Location: Intake Room in Building C

## 4. PROCEDURE FOR RADIATION MONITORING

4.1 After the lab manager has authorized conditional acceptance of any suspicious sample, the sample must be tested for radiation before being stored in the laboratory. Utilize the following procedures for operating the Geiger counter to monitor radiation emissions.

4.1.1 Check the batteries using the "range" switch. The meter needle should move to an area on the scale marked “battery”, indicating the batteries are good. If the batteries are not good, obtain 2 D-cells and put them in the meter -- check these batteries also.
4.1.2 Turn the "audio" switch to "ON."
4.1.3 Check that the "F/S" switch is on "F" (Fast Response).
4.1.4 Move the range switch to the most sensitive position (0.1 mrem).
4.1.5 Remove the probe cover if one is in place.
4.1.6 Hold the probe approximately 1/2 to 1 inch from the item to systematically survey the entire item-- Move the probe slowly (about 1 inch per second).
4.1.7 Do not let the probe touch anything.
4.1.8 Try to maintain a constant distance.
4.1.9 Locate the point that produces the most clicks. (Turn the "F/S" switch to "S" to take a reading at this location. Remember to reset it to "F" before continuing survey.)
4.1.10 If necessary, adjust the range of the instrument by moving the range selector switch.
4.1.11 If necessary use the reset switch to return the reading to 0.
4.1.12 Record the radiation level. If radiation is detected, proceed to Section 5. If no radiation is detected on the outer container or package, the sample container is allowed to enter the laboratory for secondary examination.
4.1.13 Switch off the meter.
4.1.14 Turn off the audio switch
4.1.15 Replace the cap on the meter probe.

4.2 Secondary Examination - Screening Inner Container/Sample


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4.2.1 Open PTM or ERLN samples in the Intake laboratory and wear appropriate protective gear.
4.2.2 Remove the sample from the outer container or package.
4.2.3 Slowly survey the inner container, bottle or plastic zip lock bag with the Geiger counter and **record** the radiation level.
4.2.4 If no radiation is detected, open the inner container and examine the sample. If radiation is detected, proceed to Section 5.

## 5. RADIOLOGICAL ACTION LEVELS AND HANDLING PROCEDURES

ERLN laboratory personnel are required to disclose any inadvertent personal exposures to ionizing radiation. This may include inadvertent exposures received at work, outside of work, or while receiving medical treatment. If a woman suspects or knows she is pregnant, she must declare in writing to laboratory management that she is pregnant. At that time, if she chooses, she may be reassigned to duties that do not involve work with potential radiological materials.

5.1 Between 0 and 0.3 mrem/hr:

- Radiation is equivalent to background. Package/sample may be stored under normal conditions in the lab.

5.2 Between 0.4 and 0.5 mrem/hr:

- Radiation level is equivalent to that given off by computer monitors, etc. Package/sample may be stored under normal conditions in the laboratory.

5.3 Between 0.6 to 0.9 mrem/hr:

There is probably radioactive material present, which could present a disposal problem, but no immediate danger from external gamma radiation. Consult with your supervisor before disturbing or sampling the radioactive material. The source type of radiation (alpha, beta, or gamma) and origin should be determined prior to further handling.

- Record the radiation level and contact the supervisor
- Supervisors should do an additional survey to determine if the radiation at this level might be due to background or natural radiation.
- Contact the handler or sample submitter to determine the origin of the sample.
- Place the package in the lead-lined container designed for isolating samples that emit radiation.
- Contact Department of Health (DOH) at 850-245-4266.
- Notify anyone that came into contact with the sample that it emits a low-level of radiation.

5.4 Between 1 and 2 mrem/hr:

There is the potential for radiation hazard. Consult your supervisor before disturbing, unpacking, or sampling the radioactive material. Isolate the material by placing it in a remote area, and handle it as little as possible.


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- Do not bring the package into the laboratory complex.
- Warn the delivery person that this package emits radiation levels that could have a potential adverse health effect.
- Call the radiation safety officer at 510-6821 and contact the local Department of Health.
- Carefully, place the package into the lead-lined container and await further instructions from DOH.

5.5 Greater than 2 mrem/hr:

There is a radiation hazard present. Pull back from the area and establish a "hot line" where the area gamma measurements are 0.3 mrem/hr. This establishes a formal radiation area, and should be posted as such. No personnel should enter this radiation area without the Safety Officers supervision, badging, and other specific radiation protection measures.

- Do not bring the package into the laboratory complex.
- Warn the delivery person and other staff to move away from this package to a level where the Geiger counter reading drops below 0.3 mrem/hr.
- Set up a perimeter guard and post signs "DO NOT ENTER, KEEP OUT".
- Contact your supervisor and Radiation Safety Officer immediately.
- A supervisor or a radiation safety officer should contact the Department of Health and the medical monitoring physician for any necessary treatment.

## 6. SAFETY AND WASTE MANAGEMENT

Always wear the appropriate safety equipment when accepting suspicious packages, such as rubber gloves, safety eyewear, lab coat, and long pants. Do not handle any packages with bare hands.

Do not dispose of any radioactive materials into trash containers or hazardous waste drums.

Contact the radiation safety officer for proper disposal of any radioactive materials.

## 7. REFERENCES

7.1. Florida Department of Environmental Protection Health and Safety Plan. April 2010.

7.2. Florida Department of Environmental Protection, *Building Security Plan.* May 2010.

7.3. Florida Department of Environmental Protection, *Standard Operating Procedure for Receipt and Log-in of Chemical Agent Samples and Standards* (SOP **ERLN-005**).

7.4. Florida Department of Environmental Protection, Standard Operating Procedure **ERLN-001** *Laboratory Accountability, Storage, and Hazard Communication for Chemical Agent Dilute Solution Laboratories*, December 2009

7.5. Florida Department of Environmental Protection Comprehensive Quality Assurance Plan, Chemistry Section, Bureau of Labs, 2010.


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7.6. Florida Department of Environmental Protection, *Standard Operating Procedure for Receiving Packages and Freight at the Loading Dock (SOP* **LB-022).**

7.7 Florida Department of Environmental Protection, *Standard Operating Procedure for Sample Receipt and Entry into the LIMS.* (SOP **LB-016**).

7.8 Florida Department of Environmental Protection, *Standard Operating Procedure for Maintaining the Custody and Storage of Environmental Samples in the DEP Laboratory* (SOP **LB-023**).

7.9 Florida Department of Environmental Protection, Standard Operating Procedure **LB-002** *Non-Conformance Reporting System*.

7.10 Florida Department of Environmental Protection, *Chemical Agent Laboratory Training Module, May 2010.*

## 8.0 APPENDIX OF SIGNIFICANT CHANGES

09/16/2010 The following revisions were made to this SOP from the prior version.

- Incremented revision number and date.
- Added cover page.
- Edited scope section and added information on supporting SOPs.
- Added reference section.
- Added more language to Radiological Action Level section.
- Added SOP Update Revision Summary.


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