Authorized User / Radiation Safety Officer Training for Veterinary Users

Module 8: Radiation Safety Program and Waste Management

Chad A. Smith, PhD, CHP, DABR

Satish Nair, PhD, CHP, DABMP

F.X. Massé Associates, Inc. www.fxmasse.com

info@fxmasse.com

978-283-4888

Introduction

- This module focuses on some radiation safety basics, including the safe handling of unsealed
- Also included are the practical aspects of disposing of radioactive material.

- Assigned reading:
  - Radioisotope therapy Manufacturer's Device Label, or FDA Package Insert
  - 10 CFR 20.2003
    https://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-2003.html

  - Owner Precautions

Outline

- **Radiation Safety Program:**
  - Handling
  - Spill Procedure
- **Radioactive Waste Regulations:**
  - 10 CFR 20.2003
- **Decay in Storage:**
  - Regulations
  - Surveys
  - Solid Waste
  - Liquid Waste
- **Liquid Waste Disposal**
- **License Conditions**
- **Organic Waste**

Radiation Safety Program

All licensees are required to maintain a written Radiation Safety Program. The program should contain:

- Policies and Procedures to comply with the facility's License Conditions, as well as applicable State / NRC regulations.
- Standard Operating Procedures (SOPs) to document specific steps in carrying out procedures as applicable.
- ALARA policy – to ensure that radiation worker doses are kept to the lowest practicable levels, and dose to the public is kept within limits.
- Engineering Controls (physical controls such as doors, types of locks, barriers, etc.)
- Administrative Controls
  - Specific Training from AU or RSO
  - All areas of use require daily closeout surveys and weekly wipe tests
  - Unsafe practices or conditions involving radiation should promptly be reported to the AU and / or RSO
- Work Practice Control
  - Techniques for contamination control and to minimize radiation exposure
- Personal Protective Equipment

The next few slides will focus on a routine spill procedure, some basic radiation safety practices, and the ALARA principle.

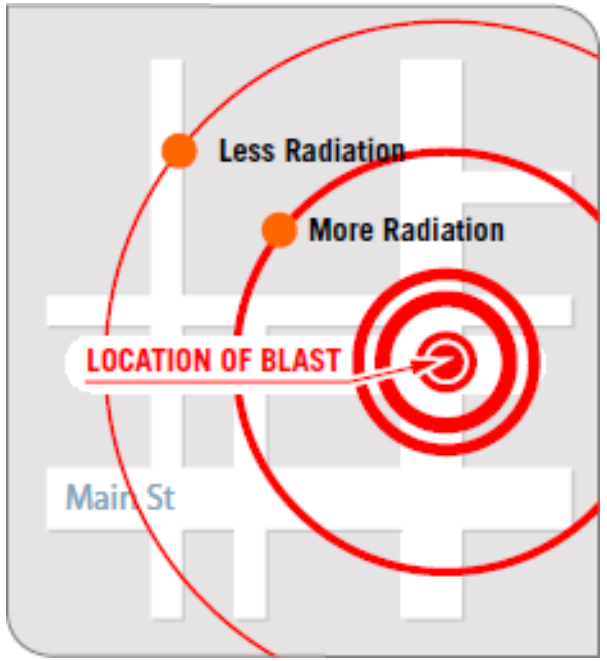
As Low As Reasonably Achievable (ALARA)

- ALARA is the principle of maintaining exposure to ionizing radiation as far below the dose limits as practical, taking into account:
  - The state of technology
  - The economics of improvements in relation to the state of technology
  - The economics of improvements in relation to benefits to the public health and safety
  - Other societal and socioeconomic considerations in relation to utilization of nuclear energy and licensed materials in the public interest
- Requirement for all RAM licensees
- To comply, no person should conduct any operation that generates unnecessary radiation exposure

External Radiation Exposure Reduction

There are three ways to minimize radiation dose: time, distance and shielding.

Time: Minimizing time spent exposed will also reduce your risk.

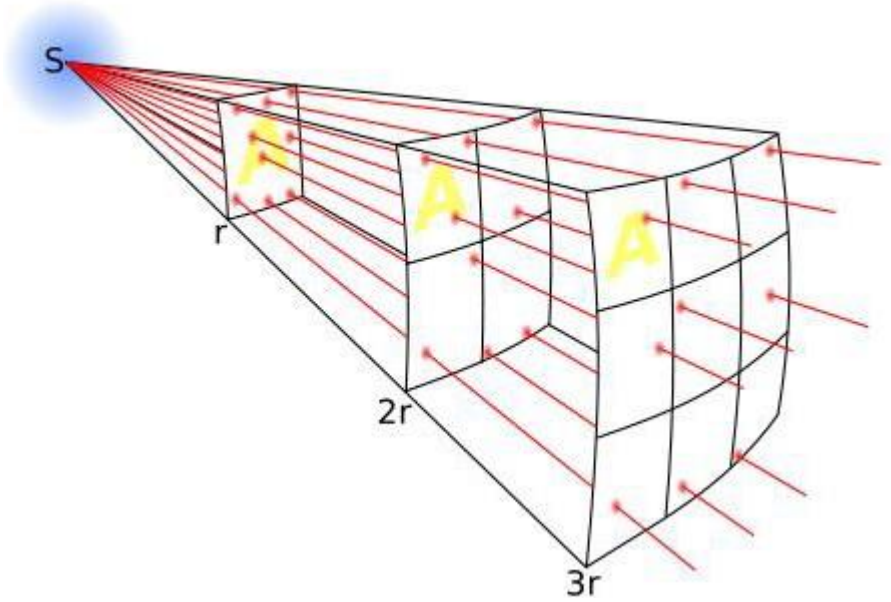


Distance: The farther away you are from the radiation the lower your exposure.

Shielding: If you have a thick shield between yourself and the radioactive materials more of the radiation will be absorbed by the thick shield, and you will be exposed to less.

Exposure Reduction: Inverse Square Law

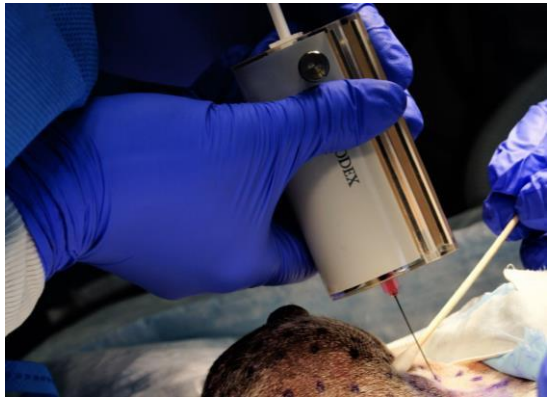
Radiation propagates through space following the inverse square law. Therefore, as you move further away from the source of radiation, your dose decreases by the distance you move away → squared.



Handling

- Always use the basic radiation safety principles when handling radioactivity.
- When handling unit dose syringes, it is always best to use shielding techniques such as a syringe shield.
  - If routine handling is sporadic and the handling time is short, a syringe shield is not necessary.
  - If the syringe shield impedes the delivery or extends the handling time, the AU can opt to handle the dose directly.
- Doses are typically measured in the hot lab and carried to the surgical suite (or treatment table) where the patient is waiting.
  - Doses should be carried to the delivery location in an appropriately shielded container lined with absorbent material.
  - The shielded carrier should also be used to carry any unused radioactive material back to the hot lab for decay in storage.

Syringe Shield and Shielded Carrier Examples



Shielded Carrier Examples:
https://www.alimed.com/shielded-syringe-carriers.html

Syringe Shield Examples:
https://m.biodex.com/nuclear-medicine/products/syringe-vial-shields

Radioactive Spill Control

- Sooner or later, every facility will experience a radioactive spill. It is best to be prepared to handle a spill by reviewing spill control procedures periodically.

- Generally speaking, a spill happens when a dose is mishandled, and the contents is ejected to non-intended surface, such as a treatment table, the floor, or on the body of the animal or personnel.

- A hot-spot detected at the daily closeout survey, or urine from a treated animal is not necessarily a spill.

- NUREG 1557 Vol 7, appendix L directs that "Licensees should not neglect, delay, or ignore appropriate first aid and other immediate medical needs of injured individuals due to suspected contamination" from a spill. In other words, medical needs of an individual take precedence over spill control procedures.

- Spills can be loosely classified into **major** and **minor** spills. Spills of activities less than 1 mCi may be considered minor, and spills involving >1 mCi, or any personnel contamination may be considered major.

- Each hot lab must have a **spill kit**, the recommended contents of which are listed on the next page. The spill kit must be examined at least annually to make sure its contents are intact and usable. Discovering that latex gloves have stuck together, or plastic waste bags are in tatters when you have a spill to clean up, is counterproductive.

- The most practical tip for spill cleanup is not to spread it and make it worse, for instance using a mop on the floor. Delineating the extent of the spill by carefully surveying with a meter, and confining cleaning to a small area is the way to go.

Radioactive Spill Control *(continued)*

Recommended contents of a spill kit. A commercial spill kit may be purchased, or one can be put together using in-house materials.

— disposable gloves
— housekeeping gloves
— disposable lab coats
— disposable head coverings
— disposable shoe covers
— roll of absorbent paper with plastic backing
— masking tape
— plastic trash bags with twist ties
__ cleanup solution such as RadiacWash®
__ cleanup gel such as DeconGel ®
__ scrubbers, sponges
— "Radioactive Material" labeling tape
— marking pen
— pre-strung "Radioactive Material" labeling tags
— box of wipes
— instructions for "Emergency Procedures"
— clipboard with a copy of the Radioactive Spill Report Form for the facility
— pencil

Radioactive Spill Control *(continued)*

General guidelines for spill cleanup:

- Notify others / AU. If necessary (spill is estimated to be greater than 1 mCi) contact Radiation Safety Officer
- Isolate the spill
- Leave affected area
- Check for personal contamination
  - Decontaminate as appropriate
- Begin decontamination procedures when appropriate to do so
  - Work from the perimeter inwards
  - Collect absorbent material as radioactive waste
- Cleaning contamination from a surface can be done with any standard cleaning product. When cleaning, try to avoid spreading the contamination with high-pressure hoses or spray nozzles.
- For ^{90}Y: Surface contamination can result from microscopic ^{90}Y-phosphate particles landing on a surface and/or droplets of IsoPet® contacting a surface. dried particles can often be removed by contacting the surface with the sticky side of a piece of tape to lift the contamination from the surface.
- For ^{131}I: Spills can typically happen during injection if the cat gets out of control. Carefully isolating the 'hot spots' on the treatment table and floor using a survey meter are critical to preventing the spread of contamination. Placing a lead brick temporarily on the spill will decrease personnel exposure when other spots are cleaned up.
- Survey the contaminated area after cleaning for removable and fixed contamination and rewash if necessary

Radioactive Spill Control *(continued)*

- For contamination that is not easily removed, alcohol wipes are effective for decontamination. Alternatively, standard cleaning products can be used to clean the surface.
- Collect cleaning materials as radioactive waste.
- Personnel should wash their contaminated skin with warm water and soap.
- Each spill must be documented in a report to the RSO.
- An Area Contamination Form and / or a Personnel Contamination Form must be filled out, as appropriate
- The report must include details of how the spill occurred, and how things can be improved to precent recurrence
- A spill report is not meant to be punitive; it is a means to improve practice and offers an opportunity to correct systematic mistakes, If identified.
- The Spill Control Protocol (see sample next page) must be posted in the hot lab for ready reference, and must include contact information of the RSO

Radioactive Spill Control *(continued)*

Minor Spills of Liquids and Solids

1. Notify persons in the area that a spill has occurred.
2. Prevent the spread of contamination by covering the spill with absorbent paper.
3. Clean up the spill using disposable gloves and absorbent paper. Carefully fold the absorbent paper with the clean side out and place in a plastic bag for transfer to a radioactive waste container. Also put contaminated gloves and any other contaminated disposable material in the bag.
4. Survey the area with a low-range radiation detector survey meter. Check the area around the spill. Also check your hands, clothing, and shoes for contamination.
5. Report the incident to the Radiation Safety Officer (RSO).
6. The RSO or his designee will follow up on the cleanup of the spill and will complete the Radioactive Spill Report and the Radioactive Spill Contamination Survey.

Major Spills of Liquids and Solids

1. Clear the area. Notify all persons not involved in the spill to vacate the room.
2. Prevent the spread of contamination by covering the spill with absorbent paper, but do not attempt to clean it up. To prevent the spread of contamination, limit the movement of all personnel who may be contaminated.
3. Shield the source if possible. This should be done only if it can be done without further contamination or a significant increase in radiation exposure.
4. Close the room and lock or otherwise secure the area to prevent entry.
5. Notify the RSO immediately.
6. Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water and then washing with mild soap. If contamination remains, induce perspiration by covering the area with plastic. Then wash the affected area again to remove any contamination that was released by the perspiration.
7. The RSO or designee will supervise cleanup of the spill and will complete the Radioactive Spill Report and the Radioactive Spill Contamination Survey.

Radiation Safety Officer _____ Telephone No. _____

Radioactive Waste: The Basics

- Radioactive waste can be liquid or solid.
- Radioactive waste cannot be disposed of as regular waste.
- Radioactive waste must be segregated from non-radioactive waste, documented, and disposed of according to the conditions of your radioactive materials (RAM) license.
- Before you dispose of any radioactive waste, be sure to read your individual RAM license conditions and state or federal regulations.

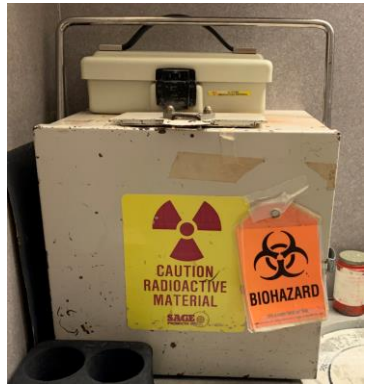
RAM License Conditions: Waste Disposal

- Because most license conditions dictate that only a certain amount of radioactive material may be at a physical location at any point in time, an inventory must be kept of all radioactivity, including radioactive waste.
- When radioactive waste is disposed of, that disposal must be accounted for in the inventory and documented in a "waste log."
- Solid waste:
  - Long-lived—must be transferred to a waste site for disposal.
  - Short-lived (isotopes with half life < 120 days) — can undergo **D**ecay **I**n **S**torage (**DIS**) and then be disposed of as regular waste. DIS involves holding the waste for *up to 10 half lives*, or until the dose rate is not distinguishable from natural background. At that time, it is disposed of as regular trash (or has to follow the pathway of biohazard waste, if applicable). All signs and labels indicating the presence of radioactivity must be removed or obliterated before disposal.
    - ^{131}I, ^{90}Y, and ^{117m}Sn, with their 8.04 day, 2.67 day, and 14 day half lives, respectively, are all categorized as "short-lived. " Therefore, all these wastes can be disposed of as regular waste after 10 half-lives. Short-lived solid waste can be further categorized as "sharps" and "non-sharps.", with the former held in a sharps container. Alternatively, used syringes with their needles cane be picked up by the dose vendor.
- Liquid waste:
  - Liquid radioactive waste can be disposed of down the sewerage system via a designated sink, as long as it is **readily soluble**, or readily dispersible biological material, and does not contain organic solvents that are prohibited.
  - If ^{90}Y liquid waste is generated, it **cannot** be disposed down the drain since the ^{90}Y microspheres are insoluble in water. The possibility of generating liquid ^{131}I and ^{117m}Sn wastes are also minimal. Therefore, decay-in-storage or offsite disposal will be required.
- Refer to your RAM license or state/federal regulations for approved disposal methods.

Solid Waste Disposal

- Solid waste can be kept in acrylic-shielded waste containers (^{90}Y and ^{117m}Sn) or lead lined containers / drums (^{131}I).
  - Typically includes contaminated gloves, gauze, packaging, kitty litter, chux, etc.
- Sharps waste should be kept in a segregated “hot” sharps container (a regular sharps container identified with a “Caution Radioactive Material” label) to prevent confusion with “cold” sharps containers. A lead-lined sharps container is required for ^{131}I. However, since ^{131}I is generally purchased as a unit dose, generating 1 syringe/needle per treatment as waste, it can be returned to the dose vendor in its lead pig if DOT requirements are met.
- Radiation labels are not allowed to be disposed of in regular waste. Always deface them before placing into a waste stream.
- Biohazardous or organic material cannot be placed into solid waste and must be held separately.
- Include waste containers in your daily closeout and weekly wipe test surveys. Remote waste rooms need to be surveyed weekly, but a wipe test is not required.

Plastic, and lead-lined sharps containers



Solid Waste: Decay in Storage

- Solid radioactive waste must be allowed to “decay in storage”(DIS), *i.e*, held until its radioactivity is not distinguishable from background radiation levels. The industry standard is to wait 10 half-lives before disposing of it in a regular waste stream. However, if there are space constraints in storage, they can be disposed of before the 10 half life period based on measured dose rate: If a bag measures no greater than background radiation.
- Typically a facility will have at least two solid radioactive waste containers—one to fill while the other is decaying.
- After filling a solid radioactive waste container, it is closed, dated, and left to decay. For good measure, The 30 day DIS clock for ^{90}Y starts when the container is closed (or 140 day Clock for ^{117m}Sn). ^{131}I wastes can be held in 55-gallon steel drums in a remote room.
- After the decay period is over, the waste is removed and surveyed to be sure that no radiation is detectable from the outside of the container. The survey is documented in the waste log, and the waste can be disposed of in the regular waste stream.

Above is a standard waste container labeled for radioactive waste. Shielding is required depending on dose rate outside the container.

https://www.nrc.gov/reading-rm/doc-collections/gen-comm/info-notices/2007/in200710.pdf

Organic Waste

- There is always a possibility that an animal treated with a radioisotope could die from unrelated causes during the precautionary period post-treatment.
- If this were to occur, the animal must be returned to the licensee for decay in storage (DIS). The licensee would need to designate a freezer for DIS for the remainder of the decay period.
- Pet owners must be informed about this possibility during the screening interview.
- After the decay period (total of 10 half-lives), the animal may be disposed of routinely. Cremation is allowed only if residual activity in the carcass is not distinguishable from background.
  - Alternatively, the carcass can be measured with a calibrated GM counter. If the measurement is “not distinguishable from background” the carcass may be treated as regular waste.

Summary of Module 8: Radiation Safety Program, and Waste Management

- Radioactive waste must be handled according to local and federal regulations.
- Solid waste may be held to decay in storage, then disposed of in a regular waste stream.
- Owners of animals are provided with instructions to return an animal who dies within 10 half lives of the treatment date, to the licensee to DIS.
- Spills happen when working with unsealed radioactivity. Follow your license conditions and notify your RSO should a spill occur.
- When handling radioactivity or spending time near a radiation source, always follow the three basic principles of radiation safety:

1. Minimize time
2. Maximize distance
3. Use shielding when practical

Supplemental Reading Material

- Assigned reading material for Module 8:
  - 10 CFR 20.2003: https://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-2003.html
  - Waste Policy, if available
  - Spill Procedure
- Upon successful completion the Module 8 quiz, along with those of the other 7 modules, a certificate of completion will be sent to the email that was used to register for the training program. Retain this certificate for future licensing actions.
- For additional training, see the www.FXMasse.com website:
  - DOT training for shipping and receiving radioactivity