Safe Work Practice

Animal Projects with Radiological Materials

1.0 Hazard Description

Radioactive materials used in animal studies create a risk of radioactive contamination from the spread of animal urine and faeces as well as handling of the actual radioisotope. Therefore, steps must be taken to minimize the spread of contamination in the work area. In addition to this, some radioactive material produces penetrating radiation that can pose a radiation exposure hazard to persons standing near the animal cage or unshielded radioisotope.

Furthermore, as radioactive materials introduced into the animals are administered in various chemical forms, the Animal Projects with Chemicals Safe Work Practice (EHS-SWP-140) shall also be followed.

1.1 Hazard Assessment Considerations

1. In general, the following should be taken into account when performing a hazard assessment related to the radioactive work with animals:
   - Isotope half-life and ionizing radiation emissions
     - The half life and the type of ionizing radiation emissions depends on the given isotope. This is discussed in detail in the Radiation Safety Training Course available on-line via EHS website.
   - Chemical form of the radioactive compound and it’s biological distribution
     - The biological distribution of a radioisotope introduced into an animal will depend on a variety of factors including the method of introduction into the animal, the type of radioactive compound and the propensity for the radioisotope to be absorbed into specific organs or tissues of the animal. The biological distribution will in turn determine the manner and rate in which the radioisotope is excreted from the animal.
   - Biological half life of the isotope introduced into an animal
     - The rate the radioisotope is excreted from the animal and the radioactive half-life of the radioisotope will determine the biological half-life of the radioisotope which is the time it takes for 50% of the radioisotope to be removed from the body of the animal.

     - The amount of radioactivity excreted by an animal will be proportional to the amount of radioactivity introduced into the animal. The amount of radioactivity excreted will in turn determine the amount of contamination that will occur inside of the animal cage.
Radioactivity that is excreted by an animal through the urine and faeces is likely to be in the form of a radioisotope that is bound to a degradation product of the original compound that was introduced into the animal. However, in the case of tritium compounds introduced into the animal, a significant portion of the tritium will be bound to water molecules that are excreted in the urine of the animal.

The radioactivity excreted by the animal will likely remain in a solid or liquid state and not be a gaseous inhalation hazard. However, there is the potential for radioactive aerosol formation from dried faeces or urine and this should be taken into account when working with large amounts of radioactivity in animal studies.

Activity of the isotope introduced into an animal

Radioisotopes that emit gamma radiation are a potential radiation hazard to persons. Some common gamma emitting radioisotopes used in animal studies include Fluorine 18, Technetium 99m, Iodine 125 and Iodine 131.

The radiation from these radioisotopes can penetrate through the body of the animal and are a hazard to persons standing next to the animal cage or while handling the animal. The degree of radiation hazard depends on the amount of radioactivity introduced into the animal.

Anticipated waste volumes

2.0 Minimum Hazard Controls

The control measures that are required when working with radioactive material are described in the University of Alberta, Code of Practice for the Use and Handling of Radioactive Substances. The control measures that are used for radioactive work involving animals are the same as the controls measures used for other types of work involving radioactive material. In addition to the Minimum Requirements listed in the Animal Research, Teaching and Testing Projects SWP (EHS-SWP-101), PIs working with radiological materials must abide by the following:

2.1 Engineering Controls

1. In order to prevent or minimize the risk of fixed contamination or contamination spread there are some additional requirements that apply to the room or an area that will be utilized for the use or storage of radioactive material. Any work with radioactive material requires the current, applicable Radionuclide Permit(s) and the Canadian Nuclear Safety Commission laboratory rules must be posted within the room. The room design must conform to the requirements described in the Canadian Nuclear Safety Commission Design Guide for Nuclear Substance Laboratories and Nuclear Medicine (GD-51). Selected highlights related to room design expectations are listed below:
- Flooring will have an impervious, chemically resistant, washable surface. Carpets will not be used.
- Either all joints in the flooring material will be sealed, or the flooring will be a one-piece design.
- Flooring will have a strippable coating for easier clean-up if contaminated.
- Flooring will be coved up walls and cabinets to prevent spills form penetrating underneath them.
- Work surfaces, cupboards and shelving will have smooth impervious, washable, and chemically resistant finishes.
- Either all joints on work surfaces will be sealed, or bench tops will have a seamless one-piece design.
- Walls and ceiling will be finished with a smooth and washable surface and the joints will be sealed where applicable, for easier clean-up if contaminated due to backspray from a vial or some other event.
- There should be a minimum of 6 air changes per hour in the room.
- If a fume hood is required to contain volatile radioactive substances within the room, the room access must be controlled. A key, keypad, key fob, or other type of security feature will be in place to ensure that only authorized users can enter the restricted area.
- Any windows on the ground floor will be secured to prevent unauthorized access into the room.
- If the room is to be shared with workers not authorized to use radioactive material, a secondary lockable storage area (refrigerator, freezer, cupboard) will be provided in the room to store radioactive stocks.
- When appropriate, localized shielding will be used in areas where radioactive material is located depending on the quantities of the radioactive material that emit penetrating radiation.
- Sinks will be made of material that is readily decontaminated.
- Sinks will have an overflow outlet.
- Emergency lighting will be provided within the room.
- Drains that may carry radioactive material from the area will go directly to the main building sewer or the facility's controlled active liquid waste system.
- Drains that may carry radioactive material from the area will be identified on plans supplied to maintenance personnel.
- Drains will be constructed of chemically-resistant material.
- Drains that may carry potentially radioactive material will be marked at 3 meter intervals with the radiation warning symbol to indicate the possibility of contamination.
- Sink drain traps will be accessible for monitoring if radioactive material is used in the room.
- Faucets with vacuum or cooling line attachments will include backflow protection devices if radioactive material is used in the room.
- Movement of radioactive material will be minimized by locating in proximity those areas between which radioactive material must be moved.
- If the room or storage area contains radioactive material, then separate labelled areas will be defined for radioactive and non-radioactive work or storage.
- Rooms will have sufficient counter and floor space to allow persons to work safely. In general, allow at least 3 square meters of free floor space for each worker.
- An accessible area will be designated to store materials and equipment used for decontamination and monitoring (spill kits, contamination/survey meters where required).
- Adequate space will be available for radioactive wastes generated by work within the room. This space may be within the laboratory/room or in a separate area.
- Facilities for storing outer garments and personal items will be provided outside the room.

2. Cages containing animals inoculated with a radiological material must have a radioactive warning label which indicates the radioisotope and approximate amount of radioactivity present. The permit number of the permit holder should also be noted on the label.

3. Radiological materials must be stored in a secured fridge or freezer when not in use.

4. Equipment directly used with radiological materials or with animals inoculated with a radiological material must be decontaminated via a method effective against the radiological material as determined by the hazard assessment before it is removed from the animal housing or support facility for repair, surplus or redeployment. Decontamination of the equipment must be documented on an Equipment Decontamination Form.

2.2 Administrative Controls

1. Personnel directly handling radiological materials, animals inoculated with the materials, or waste potentially contaminated with the materials must complete the EHS on-line Radiation Safety Course available at https://www.ualberta.ca/environment-health-safety/training prior to initiating work.

2. A valid Radionuclide Permit issued by the University of Alberta Radiation Safety Committee must be available before the work may proceed.

3. Contamination surveys must be performed in and around the area where cages holding radioactive animals are located.
- For radioisotope that can be detected with a Geiger counter, daily surveys should be performed with the Geiger counter and weekly surveys performed using the wipe test method.
- For radioisotopes that cannot be detected with a Geiger counter (e.g., tritium) wipe tests should be performed at least weekly. Records shall be kept of all contamination surveys.

4. Measure the radiation exposure rate at the boundary of the cage. If the radiation exposure rate exceeds 2.5 uSv/h then the following control measures should be used to prevent persons from exceeding 20 uSv per week (dose limit for general public).
   - **Time:** Minimize the time spent in the vicinity of the cage.
   - **Distance:** Maximize the distance between the cage and laboratory personnel.
   - **Shielding:** Consider the use of lead shielding around the cage.
   - **Personal Protective Equipment:** Not normally required however lead aprons may be of some value in reducing exposure to animals containing gamma emitting radioisotopes.

5. Animal carcasses, bedding and cages are to be placed into heavy-duty clear plastic bags. In addition, only disposable cages should be used to house radioactive animals.

6. Animal carcasses, bedding and cages disposal method must be approved by Environment, Health and Safety (EHS) in advance of work taking place. This type of waste is usually incinerated, however, incineration of radioactive waste requires the facility to be licenced by the Canadian Nuclear Safety Commission and no such facility is available in Western Canada at present. As such, the waste is typically stored for decay until deemed not radioactive.

7. A record must be kept of the amount of radioactive waste as well as the composition of the waste that was disposed of.

2.4 **Personal Protective Equipment (PPE)**

1. If the hazard assessment of the activities to be conducted with the radiological material identifies the possibility of aerosolization of the material, the PI must assess whether fit-tested N-95 respirators are required for personnel directly handling the radiological preparations, contaminated waste, or inoculated animals.

3.0 **Emergency Preparedness/Response**

1. Refer to the University of Alberta, Code of Practice for the Use and Handling of Radioactive Substances.
2. If an animal previously inoculated with a radiological material goes missing or escapes, efforts must be made to recapture the animal or recover its carcass. The missing animal must be reported immediately to the PI. The PI must report the incident to EHS via their [Incident Portal](#) within 24 hours of discovering the animal missing.
4.0 Applicable Legislation and Regulations

2. Radiation Protection Regulations (SOR/2000-203), Canadian Nuclear Safety Commission

5.0 Related Resources

1. Code of Practice for Use and Handling of Radioactive Substances, University of Alberta
2. Equipment Decontamination Form, Environment, Health & Safety, University of Alberta
3. Safe Work Practice: How to Use Animal Safe Work Practices (EHS-SWP-100), Environment, Health & Safety, University of Alberta
5. Safe Work Practice: Animal Projects with Chemicals (EHS-SWP-140), Environment, Health & Safety, University of Alberta
6. Safe Work Practice: Needle Safety (EHS-SWP-120), Environment, Health & Safety, University of Alberta

6.0 Document Management

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