

EMERGENCY RESPONSE PROCEDURES
FOR EVENTS INVOLVING RADIOACTIVE
MATERIAL



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Radioactive Liquid Spill

Minor Spills

(less than 0.1 mCi for Iodine, or less than 1.0 mCi for other radionuclides with liquid volumes less than 250ml)

1. Immediately notify all persons in the area of the spill.
2. Permit only the minimum number of persons in the area necessary to deal with the spill.
3. Use personal protective equipment (lab coats, gloves, shoe coverings, eye protection) as dictated by circumstances.
4. Confine the spill immediately by absorbing standing or pooled liquids with paper towel or other absorbent material. Do not smear or wipe the area, attempt to absorb the liquids into the absorbent material without increasing the area of the spill.
5. Immediately discard all contaminated absorbent material into radioactive waste containers.
6. Contact the Radiation Safety Officer for assistance in decontamination. Survey frequently to monitor the progress of your efforts.
7. Survey all potentially contaminated individuals before they leave the area.
8. Report all spills to the Radiation Safety Office.

Important: Even a “minor” amount of radioactivity can present a significant clean up and decontamination challenge if a large volume of liquid is involved. For volumes greater than 250ml, contain the spill with absorbent material and call the Radiation Safety Office. Do not attempt to clean or decontaminate.

REMEMBER !!!

1. *Stay Mindful.* The best way to prevent small spills from occurring is maintain a “mindful” attitude while performing laboratory procedures using radioactive material. Spills commonly occur during the days preceding midterms, finals, and holiday breaks. This would tend to indicate that distractions are high and “mindfulness” is low. Be attentive.
2. *Is your professor away at a conference or on sabbatical?* Accidents such as spills tend to increase when the Principal Investigator is away. This would tend to suggest that laboratory researchers are more “mindful” of their actions if their superiors may be observing those actions.
3. *Are you working nights and weekends?* It is not unusual for researchers to work at night and on the weekends and the Principal Investigator is usually not present at this time. Not surprisingly, spills tend to occur at this time as well. Again, “mindfulness” is higher when workers know their actions are under scrutiny. Know this and stay attentive to the tendency to relax on issues of safety when working alone.
4. Contact the Radiation Safety Officer for guidance:
(323) 343-3546 office
(323) 213-1676 after hours, weekends and holidays

Major Spills

(greater than 0.1mCi for Iodine, or 1.0 mCi for other radionuclides, or greater than 250ml of any activity.)

1. Immediately notify all persons in the area of the spill.
2. If other personnel are available, instruct them to prevent entry to laboratory by other individuals.
3. Permit only the minimum number of individuals in the area necessary to place absorbent material over the spill.
4. All individuals involved with containing the spill should wear appropriate PPE. Individuals without proper PPE should not be involved with any aspect of containment or decontamination.
5. Call the Radiation Safety Office immediately (3-3546). If there is no answer contact the RM/RM/EH&S office at 3-3531. Additional contact numbers are at the bottom of this page.
6. Monitor all potentially exposed individuals while awaiting the arrival of the Radiation Safety staff.
7. Take immediate steps to decontaminate involved personnel. Contaminated outer clothing should be discarded into labeled bags for each individual. The Radiation Safety Office can provide temporary clothing in the form of Tyvek coveralls for individuals needing to change.
8. Do not attempt to clean up any major spill. Actions by the laboratory staff should be limited to initial containment of the spill and monitoring individuals for contamination.
9. Individuals with skin contamination may begin decontamination by light washing with soap and lukewarm water. Do not scrub with abrasive material or abrasive soaps.
10. Contaminated individuals should minimize physical contact with non-contaminated individuals.
11. No one is to leave the assembly or decontamination area until being cleared by the Radiation Safety Officer.
12. Members of the laboratory staff may be called upon to assist the Radiation Safety Office in control, clean up, or decontamination efforts and in supplying information for reports.

REMEMBER !!!

- Contact the Radiation Safety Office immediately in the event of a major spill.
- The Radiation Safety Officer may be reached at:
(323) 343-3546 office
(323) 213-1676 after hours, weekends, holidays
- **In the event of an emergency call Public Safety (Campus Police) 911**
Public Safety will handle all coordination of medical assistance.

Release Involving Airborne Radioactive Gas or Particulates

Background Information

At this university such a release is most likely to be the result of volatile liquids such as solvents labeled with C^{14} or H^3 that are stored as labeled samples or as waste in containers with non-secure closures. However, it is not uncommon for other radioactive materials to be “volatilized”. Material labeled with P^{32} is often placed in “hot water baths”. If left unattended the water in the unit may evaporate and the sample will begin to “boil” volatilizing the P-32. If the lab is unoccupied and there is no air disturbance the material will generally “plume” in the direction of the fume hood or nearby air exchange units. Some procedures involve extractions performed with the use of a vacuum pump. These pumps are notorious for failing to trap H^3 efficiently and often the radioactive material gets into the pump and “exhausted” into the laboratory. Pumps used in conjunction with extraction procedures involving tritiated material or other radionuclides should be monitored closely. Engineering controls such as carbon traps should be considered. Ideally, such pumps should be operated inside a properly functioning and certified fume hood.

Responding to Releases of Radioactive Gas, Vapor, or Particulate

1. No *immediate* attempt should be made on behalf of laboratory staff to clean up any contamination resulting from the release.
2. *If feasible*, limit any continued release by unplugging or shutting off equipment or machinery that may be the cause of the release.
3. Laboratory staff should attempt to “contain” the release by closing windows, entrance doors to the lab and any doors leading to adjacent rooms.
4. Leave the “release area” immediately and restrict the movement of potentially contaminated individuals to an “assembly area” just outside of the “release area” until the extent of personnel contamination can be determined.
5. Notify the Radiation Safety Officer (3-3546) immediately. If no answer, contact RM/EH&S (3-3531). If the incident occurs after hours the Radiation Safety Officer may be reached by at (323) 213-1676.
6. Seal the exterior openings to the release area (such as space beneath closed doors or vents in doors) with duct tape and plastic. Be willing to improvise. Trash bags and lab coats may work.
7. Monitor and decontaminate involved personnel before they leave the “assembly area”. Contaminated outer clothing should be discarded, bagged and labeled for each individual. The Radiation Safety Office can furnish temporary clothing in the form of Tyvek coveralls.
8. After surveys and decontamination of personnel, the assembly area should be monitored for contamination. Once this area is cleared, the Radiation Safety staff will enter the release area and perform appropriate surveys to determine the extent and severity of contamination and plan actions for decontamination.

9. Some members of the laboratory staff should be prepared to remain and assist the Radiation Safety staff with decontamination efforts and with supplying information for any reports that may have to be completed.
10. In some instances, workers may be monitored for several hours or days by bioassay procedures to determine if any internal contamination has occurred. Bioassay procedures may be required if certain levels of iodine and tritium are involved in the release.

REMEMBER !!!

- If the incident involves injured individuals requiring medical assistance call 911, Campus Police / Public Safety.
- Contact the Radiation Safety Officer anytime you do not feel prepared to deal with any incident of contamination or for any accident involving radioactive materials.
(323) 343-3546 office hours
(323) 213-1676 after hours, weekends, holidays
- In some events the Radiation Safety Office may need the assistance of outside firms or consultants to ascertain the extent of contamination and complete decontamination efforts.

Releases of Radioactive Material from “Explosions”

Don't think of the reference to “explosions” as an event similar to an explosion normally associated with a “bomb”. There are a number of situations in which an explosion in the lab could occur. Flammable solvents labeled with radioactive material may ignite. Centrifuges “explode” spewing radioactive material across the lab. Labeled samples being “flash frozen” in liquid nitrogen baths explode (if the tubes are capped). Unlike other forms of contamination and releases we have discussed, which are generally “passive” events, an explosion is “aggressively unexpected”. The first response of most workers nearby is to run. However, a more appropriate response is to stop right where you are. In an explosive event, radioactive material may be ejected everywhere and individuals may be injured by flying debris. Workers need to gather their senses and take mindful consideration as to what actions should be taken.

1. Take care of injured individuals first!
If possible, move injured co-workers to an area of safety (the assembly area) just outside of the laboratory.
2. If fire is present, notify other lab personnel, pull the fire alarm and call 911 before attempting to extinguish the fire using the portable fire extinguishers located in the laboratory.
3. If there are several individuals working in the lab, have someone call the Radiation Safety Officer while injured parties are being relocated to the assembly area and any fire is being extinguished. If there are injuries, call 911 for emergency medical services *before contacting the Radiation Safety Officer*.
4. The lab staff should work as a team caring for injured individuals and monitoring one another for contamination until assistance arrives. Do not leave the area unless the situation is deteriorating and may get out of control due to fire, electrical “sparking” or reactions of incompatible chemicals.
5. Explosions tend to attract nearby workers in nearby offices and labs. It is as important to keep these people from getting into the release area, as it is to get your co-workers out of the release area. Keep all spectators at a distance unless additional assistance is needed with injured individuals.
6. Monitor *everyone* for contamination. Discard contaminated outer clothing into labeled bags for each individual. The Radiation Safety Office will provide temporary clothing. Injured workers will be assessed to determine the severity and nature of their injury prior to initiation of decontamination efforts.
7. In the event medical assistance arrives before Radiation Safety staff, inform the medical responders of the possible presence of radioactive contamination both on the injured parties and in the general area.
8. Once the injured are properly cared for (triage) the Radiation Safety staff will monitor and decontaminate each individual.
9. Once all individuals are properly monitored and decontaminated, the assembly area will be monitored and decontaminated.
10. After the Radiation Safety staff decontaminates the “assembly area” the “release area” will be thoroughly surveyed for contamination. Explosions tend to create

significant spread of radioactive material. A proper monitoring and decontamination of the laboratory may require several days. During this time the laboratory may be closed or have very limited access to work areas, depending upon the scope and severity of contamination. The laboratory staff may be called upon to assist the Radiation Safety Office in efforts to return the laboratory to service, determining the cause of the explosion, and supplying information for any required reports.

REMEMBER !!!!!

- Never attempt to handle an emergency situation alone.
- If you are working alone in a laboratory and an emergency occurs, limit your actions to extinguishing small fires with portable fire extinguisher or placing absorbent material over spills.
- Exit the area and call for assistance.
- Contact the Radiation Safety Officer at:
(323) 343-3546 office
(323) 213-1676 after hours, weekends and holidays
- If an emergency or if medical assistance is required call:
911 (Public Safety / Campus Police)

Leaks, Releases and Contamination from Sealed Sources

The university has a number of radioactive sealed sources. Generally, these sources are encapsulated in a hard resin or acrylic material and are not likely to leak under conditions of normal usage. However, due to accidents or abuse the encasement of these sources may be damaged or break apart. In such an event, a leak resulting in contamination could occur. Typically these sources are small and have very low activities, but because of the type of radioisotopes encased in the material a leak resulting in contamination of personnel could present a serious problem and a challenge to decontamination efforts. In some cases, regulatory guidelines require that the appropriate state agency be contacted and the broken sealed source reported. Generally, the situation is manageable and contamination can be contained to a very localized area in the vicinity of the source if researchers adhere to the following guidelines.

In the event of a broken or leaking sealed source:

1. Do not move the source! Do not attempt to “put the source back together”. Do not handle the source to inspect it. If you are holding the source at the time it breaks gently lie the source down.
2. Notify any workers in the area of the damaged source and instruct them to stay away from the area where the source is located.
3. Notify the Radiation Safety Office immediately.
4. Stay near the source location and remain available to the Radiation Safety Officer.
5. The Radiation Safety Office will monitor for contamination of personnel. If contamination is found, appropriate decontamination procedures will be initiated.
6. After monitoring personnel, The Radiation Safety Office will initiate actions to recover and contain all fragments of the source and then proceed with monitoring the area where the source broke for contamination.
7. Decontamination action will be initiated as needed.
8. The Radiation Safety Office will refer to Title 17, CFR 20, to determine if the incident requires reporting to the appropriate State agency.

REMEMBER !!!

- Inspect all sealed sources prior to use. If cracks or damage are observed report this immediately to the Radiation Safety Office.
- Never knowingly handle a cracked or damaged sealed source.
- Always use tongs when handling a sealed source.
- All damaged, broken, or missing sealed sources must be reported to the Radiation Safety Office immediately.

Leaks, Contamination, and Releases from “Plated Sources”

The university has a few sources defined as “plated” sources. Often these are included in the category of sealed sources and are leak tested for contamination twice each year. However, these sources are not sealed and the radioactive material is not enclosed as it is with sealed sources. Typically, plated sources are small metallic disks with the radioactive material electrochemically “plated” onto one side of the disk. This deposition of radioactive material is not sealed and is easily removed due to inappropriate handling, misuse, or improper storage of the source.

Preventing Contamination from “Plated” Sources

1. Always handle the source with tongs and always wear gloves.
2. Always hold the source by the “edges” avoiding contact with the plated surface area.
3. Do not drop the source or allow the plated surface to come into contact with other material or surfaces.
4. Plated sources should never be stored with other items. Each plated source should have a dedicated container that is properly labeled. Do not allow plated sources to “migrate” from one storage container to another. Cross contamination of the plated sources is highly likely which may compromise the integrity of the source for research purposes.
5. If a plated source is dropped or if some accident occurs which may dislodge the radioactive material from the surface of the plated disk, call the Radiation Safety Office immediately.
6. Do not attempt to handle or inspect dropped or damaged plated sources. Wait for assistance from the Radiation Safety Office.
7. The Radiation Safety Office will monitor personnel for contamination and then proceed to monitor the incident area.
8. Decontamination actions will be initiated as needed by the Radiation Safety Office.

REMEMBER !!!

Always contact the Radiation Safety Officer regarding any problem with a “plated source”.

- (323) 343-3546 (office), from a campus phone 3-3546
- (323) 213-1676 (cellular) after hours and weekends

Contact the Campus Police in the event of an emergency, injury, or suspected theft of material.

- Campus Police / Public Safety: 911

Emergency Response for “Irradiators”

The university has several pieces of equipment designed to generate highly focused beams or fields of radiation onto very small areas. The irradiators fall into the following two general categories:

1. “Sealed Source” Irradiators
2. “Machine” Irradiators

Sealed Source Irradiators

The devices generate radiation in a passive manner. They have an actual source of radioactive material inside a shielded container housing. By manipulating a lever a slot (or port) in the housing will open allowing the radiation to escape in a highly localized “pattern” or “field”. These irradiators do not have any electrical components, warning lights or other “warning systems” that are typically associated with machine irradiators. In some instances these sources could cause severe exposure to radiation if the subject were to expose any part of their body to the primary beam (or field) for an extended period of time. Precise exposure times and resultant immediate effects and delayed effects would depend upon to which source an individual had been exposed, duration of exposure and distance from the source. Any dose determination would have to be “reconstructed” via time and activity analysis. The opportunity for anyone to become *accidentally* exposed to these sources is minimal. All but one of the sealed source irradiators have been removed from “circulation” and relocated to a secure location. All of the sources have been shielded appropriately for their energy, including cement and paraffin for the neutron irradiators. Radiation readings taken through the walls of adjacent rooms indicate radiation levels indistinguishable from background radiation.

The one sealed source irradiator that remains in active use is a source of Cs-137 with an activity of 0.36 Curies. This source is in a secure room and there is a keyed padlock on the shutter port control. This source cannot be “opened” except by removal of the lock. Obviously, a determined individual could remove the lock and open the shutter port and potentially irradiate themselves. Such an act would, by nature, be deliberate.

Emergency Response Situations

Because of the nature of these sources, emergency response would likely be limited to the following scenarios:

An accidental exposure to one or more individuals that occurred during the course of normal use.

This would likely be a laboratory experiment in which individuals did not receive proper training or where shielding for scatter radiation was not utilized, or both. In such a scenario the emergency actions would not be triggered unless the situation was brought to the attention of Public Safety or the Radiation Safety Officer by a member

of the “exposed group” or the Principal Investigator on the project. Once notification is received the following steps should be taken promptly:

1. Public Safety shall secure access to the unit until all incident investigation actions are complete.
2. Identify all potential exposed subjects and have them report to the RM/EH&S Office immediately.
3. Collect all personal dosimetry devices from each individual and send them to the appropriate firm, via overnight mail, for immediate processing and reporting of results. The firm should be contacted by phone and instructed to fax the results to the Radiation Safety Officer.
4. Event reconstruction should be performed so as to derive an estimated dose that any member of the exposed group may have received. This will require the involvement of the Radiation Safety Officer, Public Safety, the Principal Investigator, and the Director of the Campus Health Center.
5. Potentially exposed individuals may participate in a medical monitoring program and they will also be advised to report anything unusual such as “reddening” of skin.

NOTE: Due to the configuration and positioning of the only remaining sealed source irradiator in use, any exposure to the highest field of radiation for a duration capable of causing significant or immediate health effects would be very difficult to achieve accidentally.

An accidental exposure to an individual caused by inappropriate use of the source or failure of authorized users to safeguard the source after normal use.

Typically such a scenario involves a maintenance worker or custodian that begins work in the vicinity of the source, usually after hours and prior users of the irradiator had failed to close the port and secure it with a lock. The worker gets inadvertently exposed during the course of performing work in the vicinity of the irradiator. Such events are very difficult to manage. The visible effects of the exposure, if any, may not appear for several days. With the delay in onset of visible indications of exposure it may be unlikely that the exposed individual would associate physical symptoms with the exposure to radiation. The presence of any physical symptoms may be so slight as to be of relatively low concern to the individual and there is a probability that no medical professional would be notified. However, in the event a situation such as this were to occur, procedure would be similar to the scenario directly above:

1. Public safety will secure the room until an incident investigation is complete.
2. Dose determination by reconstructing the event will be completed by the Radiation Safety Officer.
3. The exposed individual may participate in the medical monitoring program.
4. The Department of Health Services, Radiologic Health Branch, may require notification.

NOTE: During all investigations, security of the room may include the confiscation, from every individual, all keys to the unit in question. Locks and keys may be changed at the discretion of the Radiation Safety Officer during this time with future distribution permitted only upon written consent of the Radiation Safety Officer. Key recipients may be required to attend training on safety protocols associated with the unit prior to re-issuance of keys.

The deliberate exposure of oneself to radiation.

As unlikely as it may seem, there is a precedent for such an occurrence on a college campus in California. The precise intent of the exposed individual would be difficult to ascertain without questioning or interrogating the exposed individual. The investigation overlap of authority in such a situation would potentially place Public Safety, representatives of State investigative agencies, and the Radiation Safety Officer in precarious legal positions if the matter were not handled with a high degree of sensitivity and interagency communication with respect to delegation of roles and a clear delineation of authority. There would be a high probability that the University may be faced with serious legal matters. While it is difficult, perhaps impossible, to stop someone from doing to one's self what they are determined to do. It is nonetheless a regulatory requirement that all radioactive sources should be safeguarded in such a way that a deliberate exposure of this type should not be possible. Therefore, the very fact that the event occurred may be considered *de facto* evidence that the University has not adequately prevented access to a radioactive source. Legal challenges may originate from the victim or from the parents or guardians of the victim. While the success of such a legal challenge may be debated, the appropriate engineering and administrative controls to prevent the occurrence from happening should be in place. Upon notification of such an event the University's response should be as follows:

1. Public Safety shall secure the room or facility housing the unit and conduct preliminary investigations as needed. This may be limited to determining how access was granted and a roster of all individuals known to be in possession of a key to the device. All keys to the room and the device should be confiscated until the matter is fully investigated.
2. University legal counsel shall be notified immediately and shall coordinate and approve the University's investigation of the incident.
3. The Radiation Safety Officer shall be notified immediately and shall commence dose determination by reconstructing the exposure event. The Radiation Safety Officer would have to communicate with the "victim" in determining the precise location where the individual stood in relation to the beam, the time in that position, and numerous other questions of similar nature. The Radiation Safety Officer shall not in any way grant any answers as "off the record" or otherwise indicate to the "victim" that his statements are "protected". It is highly advisable that University counsel (or representative), a sworn officer of the law (preferably with investigative skills), or other appropriate parties be present anytime that the Radiation Safety Officer is in direct contact with the "victim" or during any

encounter in which the “victim” is accompanied by his own investigative team or legal representative. The Radiation Safety Officer shall limit questions to issues specifically related to exposure determination and dose reconstruction.

4. Appropriate recording and reporting of the incident to several regulatory agencies may be required. The campus OSHA compliance officer, Director of Risk Management, and the Department of Health Services shall be notified by the appropriate parties within prescribed reporting time limits.
5. Outside consultants may be brought in as needed and as determined by the Radiation safety Officer and University legal counsel.
6. The device/unit may be secured and access restricted until such time as all investigations are complete.