A Guide for Radioactive Materials Licensees

Radiation Emergency

24-Hour Radiation Emergency Line

206 NUCLEAR

206-682-5327

IMMEDIATELY –

Remove personnel

Secure area

Call for help

Washington State Department of Health

Office of Radiation Protection
Division of
Environmental Public Health

DOH 320-103
May 2014

Contents

Radiation Emergency?

Immediate steps to take:

1. **Restrict access** within 150 feet of the radiation source.
2. **Stay upwind** of fire or explosion.
3. **Reduce exposure** by:
   - **Time** – Limit time near radiation source.
   - **Distance** – Increase distance from source.
   - **Shielding** – Place heavy solid objects between radiation source and people.
4. **Control personnel and equipment** until they can be checked for radioactive contamination.
5. **Warn emergency responders** if injured may be contaminated.
6. **Report any events involving radioactive materials or devices** that contain radioactive materials to the Office of Radiation Protection at the Washington State Department of Health.

   - **transportation accidents**
   - **lost or stolen sources**
   - **major spills**

When you call, a radiation health physicist will determine if sufficient action has been taken or if further response is needed.

Medical emergencies and injuries take priority – Call 9-1-1 immediately

24-hour Radiation Emergency Line

206 - N U C L E A R

206-682-5327

Have the following information ready:

- Your name, organization or company, and phone number.
- Phone number and contact person at the scene or facility.
- Location and description of incident.
- Is the event over or is it still ongoing?
- Is there an immediate life-threatening situation?
- Is there a fire or possibility of explosion?
- Report number, condition, and location of the injured.
- Is radiation or radioactive materials involved?
- Is radioactive material being released? If yes, is there a significant exposure hazard?
- What is the nature of the radiation source? Identify the machine, isotope, curie content, model, and anything else.
- Any local officials that have been notified: radiation safety officer, police, fire, ambulance, hazardous materials experts.

General Survey Techniques

- Be sure to perform pre-operational checks.
- Turn audible function ON; audible response is quicker than needle fluctuation.

Dose Survey Techniques

General area:

- Hold the meter at chest height.
- Turn slowly in the general direction of the source while listening to audible response.
- Record highest reading.

Contact readings:

- Slowly scan the area over the item.
- Listen to audible response.
- Note the location and result of highest reading.
- If possible hold the meter or probe about 1 meter (40 inches) from the source; then note reading.

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Oak Ridge Associated Universities

Contamination Survey Techniques

If there is fire or explosion, do not enter the area until there is no longer potential for fire or explosion.

Establish a controlled area, with a boundary, to survey people or equipment before releasing them outside the contaminated area.

Survey personnel first, then materials and the area.

Direct Contamination Surveys

- Wear gloves and any other appropriate protective gear while surveying.
- Use instrument with probe window open (if applicable).
- If contamination is found and instrument has a window, close window to determine amount of beta contamination present.
- Keep instrument or probe about 1.25 cm (1/2 inch) from surface being monitored.
- Move instrument or probe across slowly about 2.5 cm/sec (1 inch/sec).

Area Contamination Surveys

- Determine if loose or fixed contamination by taking wipes.
- Wear personal protective equipment - disposable gloves, lab coats, etc.
- Begin surveying from the area outside the radiation source, then slowly closer to the source.
- If it's necessary to transport survey material, bag and tape to avoid spread of material.

Decontamination Techniques

If someone is injured, call 9-1-1 FIRST.

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Oak Ridge Associated Universities

NOTE: Vigorous scrubbing is no longer recommended.

If someone is contaminated, follow these steps:

External Contamination

Skin

Gently remove any detectable contamination with a soft, moist cloth, such as a baby wipe. Work from the outer edge toward the center of contaminated area to avoid further spread of contamination.

Wash thoroughly with lukewarm running water and soap; blot dry. **DO NOT SCRUB!**

Monitor the area with an appropriate survey instrument. Repeat until contamination levels stop decreasing, or if skin shows any irritation.

Collect all towels, soap, washcloths, or other items as contaminated material. Place contaminated material in bag and seal bag with tape. Mark bag with appropriate information.

Eye

Immediately flush eyes with clean water or eye wash solution, then survey again for contamination.

Collect all towels, soap, washcloths, or other items as contaminated material. Bag and tape material and mark with the time, date, and personnel identification number.

Internal Contamination

Inhaled

If inhalation is suspected, ask the person to blow his or her nose into a clean cloth or tissue. Survey the cloth/tissue for contamination.

Place contaminated material in bag and seal bag with tape. Mark bag with appropriate information.

Ingested or Swallowed

Call 9-1-1 immediately!

Radiation Detection Instruments

There are many manufacturers of instruments to detect different types of radiation, often for specific applications. This can get very confusing! There are two detection systems that are most commonly used:

1. **Geiger-Mueller, or GM, detectors** measure lower levels of radiation exposure or find contamination on people or equipment.
2. **Ion Chambers** are detectors filled with gas or air, and are used to measure higher level exposure rates only.

Each type of survey instrument has different magnitudes of scales, such as x1, x10, x100, x1000. Instruments used for contamination have a scale of counts per minute (CPM). Instruments used for external radiation exposure have a scale measurement of Sieverts (Sv) or Roentgens (R) per hour.

Operation

- Anyone using radiation detection instruments should be trained to understand the readings produced.
- Use an approved vendor to calibrate instruments at least once a year.
- Keep rechargeable batteries charged or replace disposable batteries once a year.
- Remove batteries from instruments that are infrequently used.
- Check all survey meters with a known radiation source to ensure the meter will respond to radiation. This should be done before entering an area that may contain radioactive material. Verify audible response is working.
- Start your survey with the meter on the lowest scale (x1).
- As the radiation intensity or contamination level increases (meter approaches maximum scale reading), switch to consecutively higher scales (x100 or x1000).

Examples of Radiation Detection Instruments

Please refer to the technical manual for your specific instrument to insure proper operation.

Dose Rate meter

Contamination Detector (Probe)

GM with dual read-out

Notification and Reporting

Radiation emergency: This is an unplanned event that may expose or contaminate people, property, or the environment to radiation.

Coordinate emergency response directly with the Office of Radiation Protection by calling our 24-hour emergency phone line: **206 - NUCLEAR (206-682-5327**).

State law requires that some events must be reported immediately (WAC-240-221-250). *Unless you are certain of the reporting requirements*, report any event as soon as possible.

Immediately report:

- **Transportation accidents** involving motor vehicles, rail, or aircraft carrying radioactive materials or devices.
- **Stolen** or **lost** radioactive materials or devices.
- **Injuries** involving radioactive materials or devices.
- **Suspected terrorist activity.**
- **Major spills** or releases involving radioactive materials, creating an immediate hazard.
- **Overexposure** of personnel or public.
- **Explosions and fires** at facilities where radioactive material is present.
- Any **natural phenomenon** (such as earthquakes or floods.) involving large quantities of radioactive material or high levels of exposure.
- Report an event that may happen or might be a safety concern.

Medical emergencies take precedence!

Cell phone use: If you use a cell phone, ***be specific about your location***! It's not always possible to track your location.

Be Ready for Emergencies

There is no substitute for emergency preparedness. Licensees should have emergency procedures specific to their programs, and train employees. Frequent drills help employees to be ready for emergencies. When emergency response is practiced, radioactive materials handlers will be more confident in their abilities.

To help you develop your emergency preparedness program, answer the following questions:

Licensee

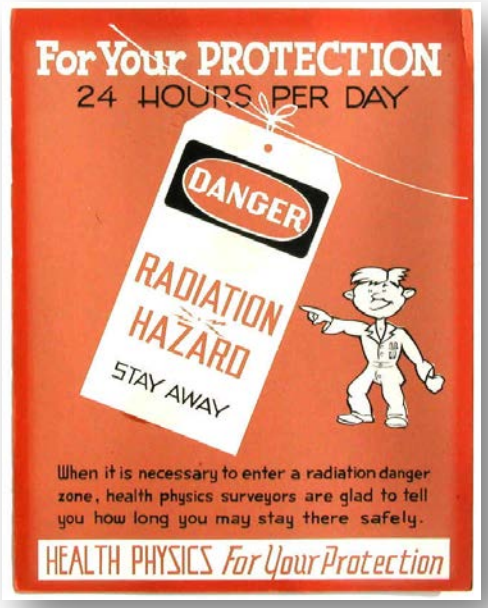
- Has appropriate training been provided to all personnel?
- Do you have appropriate emergency procedures specific to your program?
- Are emergency priorities addressed and communicated to personnel?
- Is emergency notification information readily available?
- Do you use good health and safety practices, such as ALARA (as low as reasonably achievable)?
- Have you incorporated proper use of personal protection equipment into your program?
- Are employees who use radioactive materials aware of emergency procedures?
- Have employees had opportunities to train in an emergency drill scenario?

Authorized Users

- Are you familiar with your program's emergency procedures?
- Are you clear about when and who to notify for what condition?
- Are you confident in your abilities to handle emergency situations involving radioactive materials?
- Have you been instructed in the proper use of personal protection equipment and using good health physics practices?
- Have you received sufficient training from your radiation safety officer?

Examples of Basic Emergency Response

The following scenarios provide basic emergency response for common situations a licensee might encounter.



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Lost/Stolen Material Scenario: During a routine inventory, a laboratory employee discovers that a radioactive source is missing.

1. Employee checks information: serial number, location, activity, last use of source.
2. Employee notifies others in laboratory that licensed material is missing and asks other employees if they know anything about the missing material. Warn non-qualified users to stay away from the area.
3. Notify the radiation safety officer (RSO).
4. Isolate laboratory areas where the source is used and search for the missing source with other qualified users.
5. If the source is found, keep away and contact qualified personnel. Update your RSO with actions and findings.
6. If the material is not found, contact the Office of Radiation Protection (ORP) at **206-NUCLEAR (206-682-5327)**.

Overexposure Scenario: A radiographer performing a routine non-destructive operation is informed by an assistant radiographer that an unmonitored worker was discovered inside their controlled area.

1. Radiographers immediately stop operations; secure area and radioactive source.
2. Immediately notify any others in area. Notify your RSO and management, and ask for help.
3. If possible, keep unmonitored worker in the area. If not possible, record contact information for the worker.
4. Verify the isolated area is correctly posted. Maintain controls and verify radiation levels by performing a dose rate survey.
5. Keep unnecessary personnel away from the area. Perform dose reconstruction of the unmonitored worker.

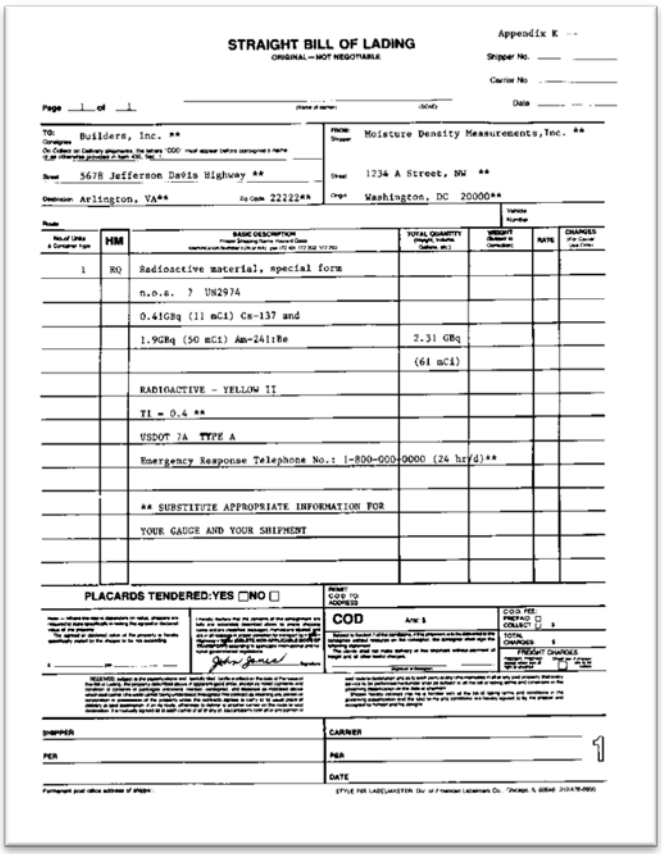
This scenario would require immediate contact with ORP – 206-NUCLEAR (206-682-5327).

Medical attention may be needed, depending on the level of exposure.

Transporting Radioactive Material

Licensee transport requirements can be found in WAC-246-231. The regulating authority for transporting radioactive material is the U.S. Department of Transportation (DOT). This is only a general guide to acquaint licensees with transportation requirements. Licensees are responsible for proper packaging and transport of hazardous materials. We advise consulting with a DOT transportation specialist while setting up your program.

Marking packages and placarding vehicles indicates the presence of radioactive materials during transport by roadway, air, rail, or water. Labels indicate the degree of hazard for intact packages containing radioactive materials. Only small quantities or instruments and articles of radioactive material are allowed to go through the mail.



STRAIGHT BILL OF LADING

ORIGINAL – NOT NEGOTIABLE

Appendix K

Builders, Inc. **

5678 Jefferson Davis Highway **

Arlington, VA** 22222**

Moisture Density Measurements,Inc. **

1234 A Street, NW **

Washington, DC 20000**

	HM	BASIC DESCRIPTION	TOTAL QUANTITY	WEIGHT	RATE	CHARGES
1	RQ	Radioactive material, special form				
		n.o.s. ? UN2974				
		0.41GBq (11 mCi) Cs-137 and				
		1.9GBq (50 mCi) Am-241:Be	2.31 GBq			
			(61 mCi)			
		RADIOACTIVE - YELLOW II				
		TI = 0.4 **				
		USDOT 7A TYPE A				
		Emergency Response Telephone No.: 1-800-000-0000 (24 hrs)**				
		** SUBSTITUTE APPROPRIATE INFORMATION FOR				
		YOUR GAUGE AND YOUR SHIPMENT				

PLACARDS TENDERED:YES ☐NO ☐

COD

SHIPPER

CARRIER

PER

PER

DATE

1

Shipping papers

Unless a package is exempt under DOT requirements, radioactive material shipments *must be accompanied* by shipping papers which must be kept within the reach of the driver or in a pocket on the driver's door. Shipping papers can vary from simple documents, such as bills of lading, to full manifests (form NRC-541). The requirement for these papers is described in detail in Title 49 of the Code of Federal Regulation (CFR), Transportation.

NOTE: SI units in Becquerels (Bq) are used, but it is acceptable to follow by common unit, Curie (Ci).

Shipping papers should contain this information:

- UN Identification number
- Proper shipping name
- Radioactive material and primary hazard class (secondary hazard class)
- Activity and type of each radionuclide
- Activity contained in each package
- Package type
- A description of the physical and chemical form.
- The appropriate DOT label applied to the package with the Transportation Index-TI (maximum radiation levels per package at three feet from the surface).
- Emergency response contacts.
- Emergency response information including immediate health hazard, risk of fire and/or explosion, immediate precautions to be taken in the event of an accident, immediate methods of handling fires, initial methods for handling spills or leaks, and preliminary first aid measures.

About Radiation Measurements

Radiation is measured using either the international system – System Internationale or SI – or the conventional (common) system. *Radioactivity* is the amount of ionizing radiation released by a material. *Absorbed dose* is how much radiation is absorbed by an object or person. *Dose equivalent* (or effective dose) combines the amount of absorbed radiation and the health effects of that type of radiation. *Exposure* is measured by the amount of radiation traveling through the air.

	Radioactivity	Absorbed Dose	Dose Equivalent	Exposure
Common Units	Curie (Ci)	RAD	REM	Roentgen (R)
SI Units	Becquerel (Bq)	Gray (Gy)	Sievert (Sv)	coulomb/kilogram (C/kg)
Equivalents=	1 Ci = 37 billion Bq	100 RAD = 1 Gy	100 REM = 1 Sv	3,880 R = 1 C/kg

μ – micro = 1/1,000,000th m – milli = 1/1,000th

Radiation Labels

Labels for packages of radioactive materials

Here are examples of common radioactive labels and summary of proper use.

Radioactive White I

For packages not exceeding 5 μGy per hour (0.5 mR per hour) at any point on the surface. The radiation reading must not exceed normal background at one meter or 3.3 feet. Each package must have two labels, affixed to opposite sides. TI would be zero, so no box for TI value.

Radioactive Yellow II

For packages exceeding 5 μGy per hour (0.5 mR per hour) up to 0.5 mGy per hour (50 mR per hour) at any point on the external surface, and not exceeding 10 μGy per hour (1.0 mR per hour) at one meter or 3.3 feet. Each package must have two labels affixed to opposite sides. Transportation Index (TI) values would be between 0.1 and 1.

Radioactive Yellow III

For packages exceeding 0.5 mGy per hour (50 mR per hour) up to 2 mGy per hour (200 mR per hour) at any point on the external surface and not exceeding 0.1 Gy per hour (10 mR per hour) at one meter or 3.3 feet. Each package must have two labels affixed to opposite sides.

Radiation caution signs

Regulations require that radiation areas and sources of radiation be posted with the appropriate caution sign. The trefoil colors must be magenta, purple, or black on a yellow background. See WAC-246-221-120 for further information.

One or more of the signs may be required in any combination depending on associated hazards.

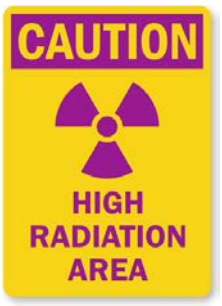
Commonly encountered signs in Washington State:

Caution (or Danger) Radioactive Material

Identifies containers of radioactive material or areas where radioactive material is used or stored.

Caution (or Danger) Radiation Area

Identifies areas where an individual could receive a radiation dose to the whole body in excess 0.05 mSv per hour (5 mR per hour) at 30 cm (1 foot).

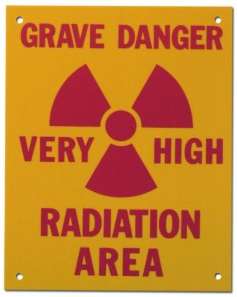


Caution High Radiation Area

Identifies areas where an individual could receive a radiation dose to the whole body in excess of 1 mSv per hour (100 mR per hour) at 30 cm (1 foot).

Grave Danger, Very High Radiation Area

Identifies areas where an individual could encounter radiation levels of 5 Sv per hour at 1 meter (500 REM per hour at 3.3 ft.) from a radiation source – a potentially lethal exposure.



Common Terms and Definitions

49 CFR/DOT – Refers to Title 49 of the Code of Federal Regulations, Pipeline and Hazardous Materials Safety Administration, Department of Transportation. It addresses regulatory authority for transportation on public roadways of hazardous and radioactive materials.

Contamination Survey – A systematic way to measure radiation in an area.

Dose – A generic term for the measure of energy emitted by radioactive materials and the amount received by personnel.

Dose Rate Survey – A systematic way to measure radiation within an area using a dose rate meter to determine human exposure.

Exposure – The condition of being subjected to radiation or radioactive material.

HAZMAT- This is an acronym for *hazardous materials*, including radioactive materials, biohazards, and oxidizers.

Health Physicist/Radiation Professional – A health physicist or radiation professional is trained to protect people, property, and environment from harmful effects of radiation.

Licensee – Any individual or organization licensed to use radioactive material by the Washington State Department of Health in accordance with RCW 70.98 and WAC-246.

Nuclear Medicine – A medical specialty that uses radioactive isotopes and equipment to diagnose and treat disease.

Protective Action – Any action designed to mitigate the effects of radiation exposure following a radiation event or emergency.

Radiation – Radiation is energy that comes from a source and travels through some material or through space. Light, heat and sound are types of radiation. The kind of radiation discussed in this presentation is called ionizing radiation because it can produce charged particles (ions) in matter. Ionizing radiation is produced by unstable atoms. Unstable atoms differ from stable atoms because they have an excess of energy or mass or both.

Unstable atoms are said to be radioactive. In order to reach stability, these atoms give off, or emit, the excess energy or mass. These emissions are called radiation. The kinds of radiation are electromagnetic (like light) and particulate (such as mass given off with the energy of motion). Gamma radiation and X-rays are examples of electromagnetic radiation. Beta and alpha radiation are examples of particulate radiation. Ionizing radiation can also be produced by devices such as X-ray machines.

Radiation Level – Generally refers to radioactive emissions per unit of time; also called "dose rate." These levels are expressed in the terms Gray per hour – Gy/hr (R/hr) or milliSievert per hour – mSv/hr (mR/hr).

Radioactive Material – Any substance that contains unstable atoms and produces ionizing radiation.

Radiation Safety Officer (RSO) – Someone with the knowledge and responsibility to apply appropriate radiation protection and who has been identified in the state radioactive materials license. The RSO is guided by the provisions of WAC 246-221-250 and state rules that apply to the specific program of responsibility.

Radioisotope – A radioactive isotope, or a radioactive nuclide, is an atom with an unstable nucleus, characterized by excess energy.

Sealed Source – Any radioactive material in a capsule designed to prevent leakage or escape of the material.

Shipping Papers – Papers that accompany transport of radioactive material that comply with federal regulations for hazardous materials, including emergency response.

Unsealed Radioactive Material – Any radioactive material that is not contained or encapsulated to prevent exposure.

Unusual Occurrence – Any event or situation involving radioactive material which deviates from the norm and may affect public health.

Radiation Generating Device – A device that generates ionizing radiation either directly or inadvertently.

For more information

- **Guidance for Radiation Accident Management**, Oak Ridge Institute for Science and Education orise.orau.gov/
- **Radiation Emergencies**, U.S. Centers for Disease Control and Prevention www.bt.cdc.gov/radiation/
- **Health Physics Training,** Oak Ridge Associated Universities www.orau.org
- **Radiological Emergency Preparedness**, Washington State Department of Health www.doh.wa.gov/radiation

Radiation Emergency

IMMEDIATELY ➢ **Remove personnel** ➢ **Secure area** ➢ **Call for help**

Medical emergencies and injuries take priority –

Call 9-1-1 immediately

24-hour Radiation Emergency Line:

206 - N U C L E A R 206-682-5327

Have this information ready:

- Your name, organization or company, and phone number.
- Phone number and contact person at the scene or facility.
- Location and description of incident.
- Is the event ongoing or over?
- Is there an immediate life-threatening situation?
- Report the number, condition, and location of the injured.
- Radioactive materials involved and the quantity.
- Any local officials that have been notified: radiation safety officer, police, fire, ambulance, hazardous materials experts.

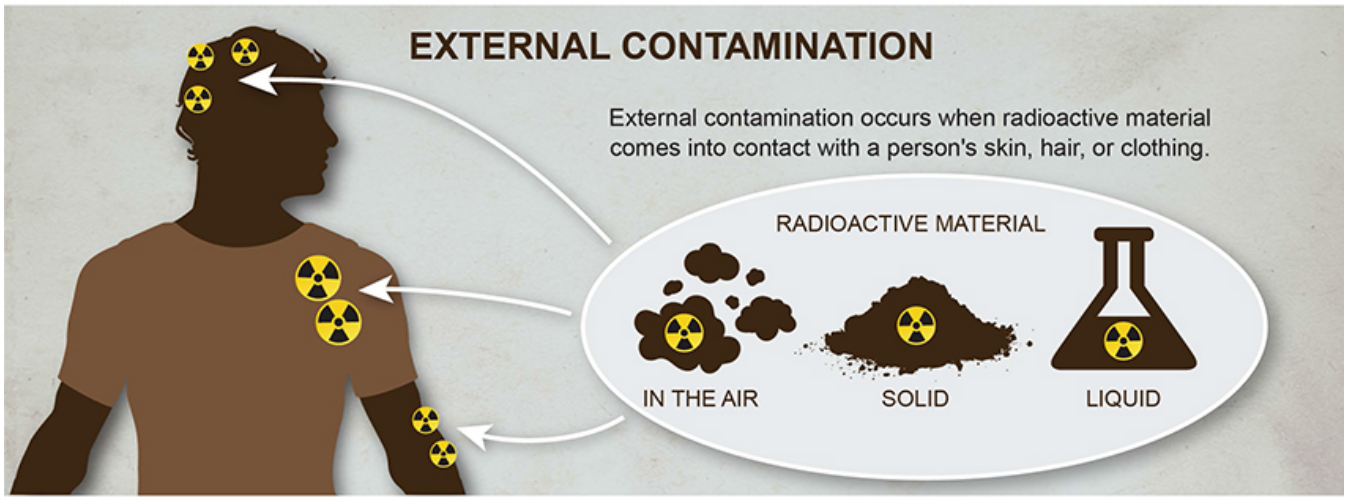
Washington State Department of Health

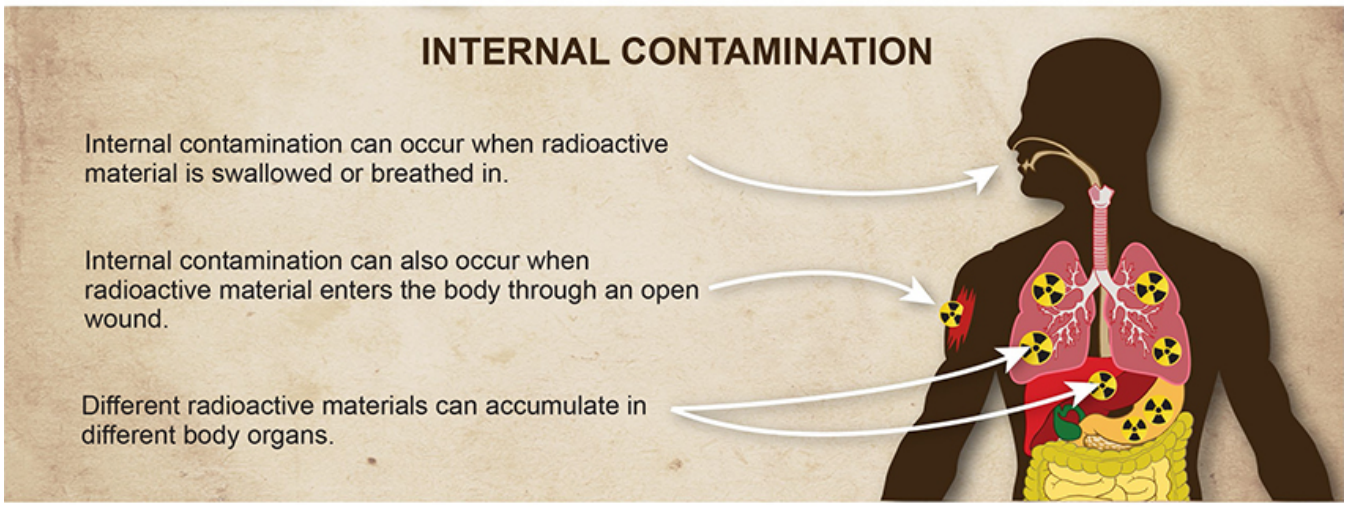
Office of Radiation Protection ● Division of Environmental Public Health

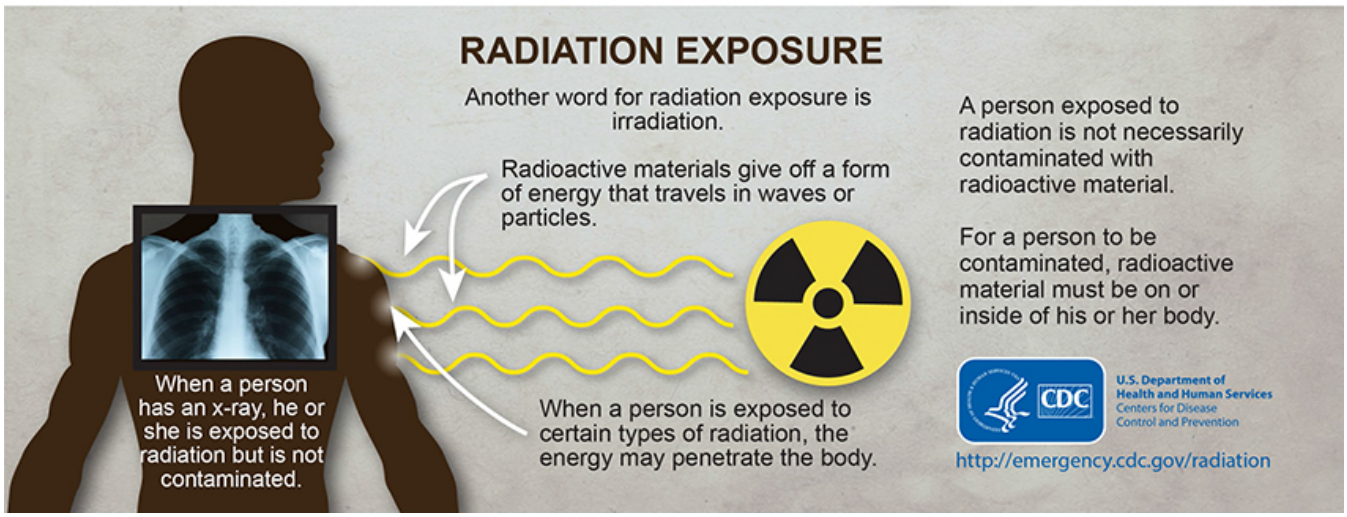
Washington State requires licensees to post radiation emergency procedures for employees.

DOH 320-102 May 2014

RADIATION CONTAMINATION VERSUS EXPOSURE



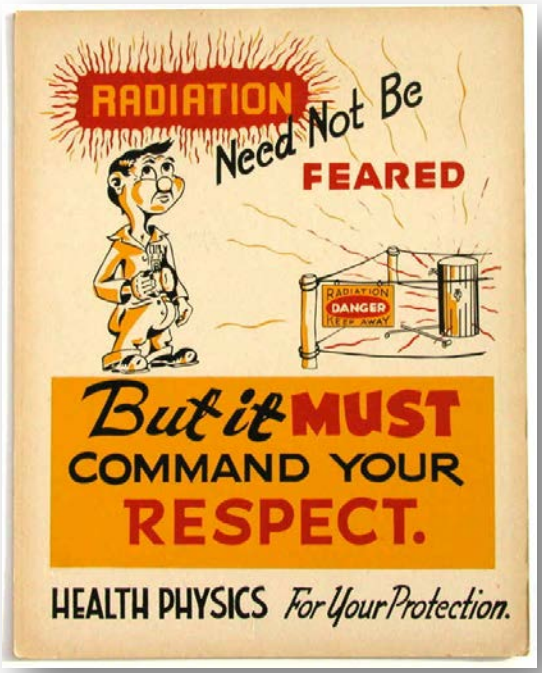




About the Radiation Emergency Guide

This guide is intended for anyone licensed to use or handle radioactive materials in Washington State. This includes radiation safety officers, authorized users and handlers of radioactive materials who may be called on to help during a radiation emergency.

The information in this guide includes basic emergency procedures for the most likely radiological emergencies, using sound health physics practices and radiation safety principles. The guidebook is a standard reference for anyone licensed by the Office of Radiation Protection to be able to respond to emergencies involving radiological materials.



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Our responsibilities at the Office of Radiation Protection

The Office of Radiation Protection is responsible for protecting the health and safety of people in Washington by making sure that individuals and organizations licensed to use radioactive materials and radiation-generating devices are doing so safely. We offer technical assistance and advice to licensees, and inspect radioactive materials and devices to ensure they are being used in a way that protects people, property, and the environment.

Washington is a Nuclear Regulatory Commission (NRC) agreement state. Agreement states operate radiation protection programs that assume regulatory authority on behalf of the state.

Once our office is notified about an adverse event involving radiological materials, we'll determine if further response is needed. Depending on the extent of the emergency, we may dispatch a radiation health physicist or field team to the scene. Small-scale events may be handled via telephone with no further action taken.

Your responsibilities as a radiation materials licensee

Washington rules and regulations for radiation protection require that licensees report any theft, loss, overexposure, or accident involving radioactive materials or radiation generating devices (RGDs) to the Office of Radiation Protection at the Washington State Department of Health.

You are expected to have emergency response procedures in place that apply to your specific program and use of radioactive material. The licensee, management, and individual users are responsible for taking appropriate action to assess, control, and mitigate hazards. You also are required to make sure that authorized users of radioactive materials are trained in emergency response.