

# DSHS Radiation Workshop

Region 2/3

April 19, 2023

# Radiation Basics

Forrest Weston & Rae Walker

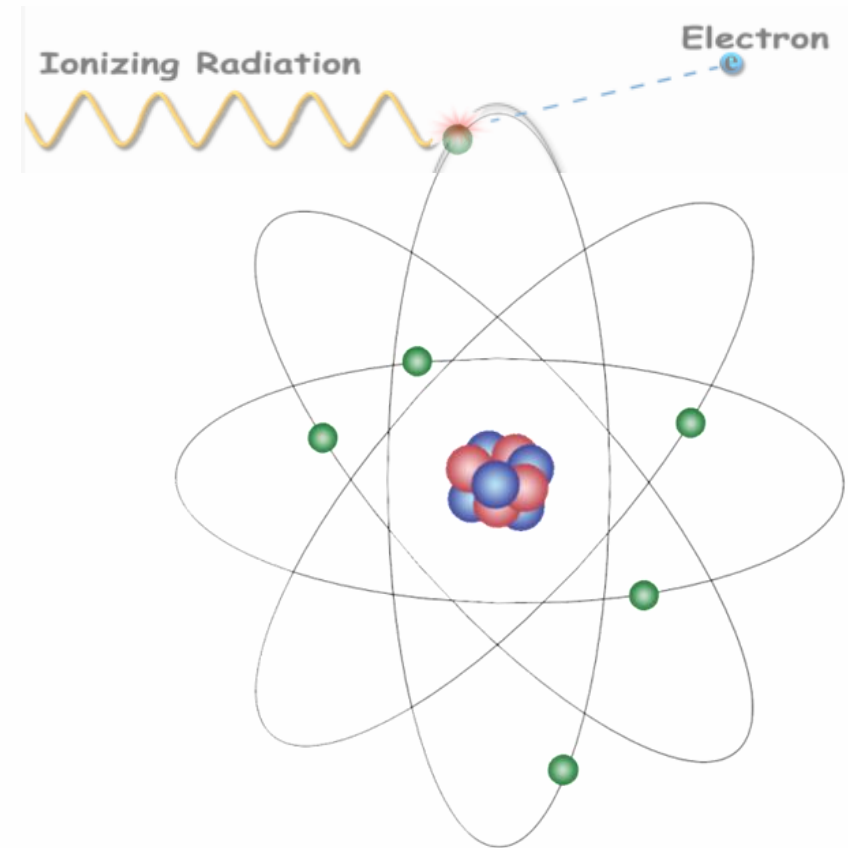


Texas Department of State  
Health Services

Presentation Title

# Objectives

- Identify basic components of an atom
- Define ionizing radiation
- Identify four basic types of ionizing radiation
- Distinguish between radiation exposure and radioactive contamination
- Learn health and biological effects from radiation
- Understand difference between safe and harmful levels of radiation



*Unstable atoms are known  
as radioactive atoms*

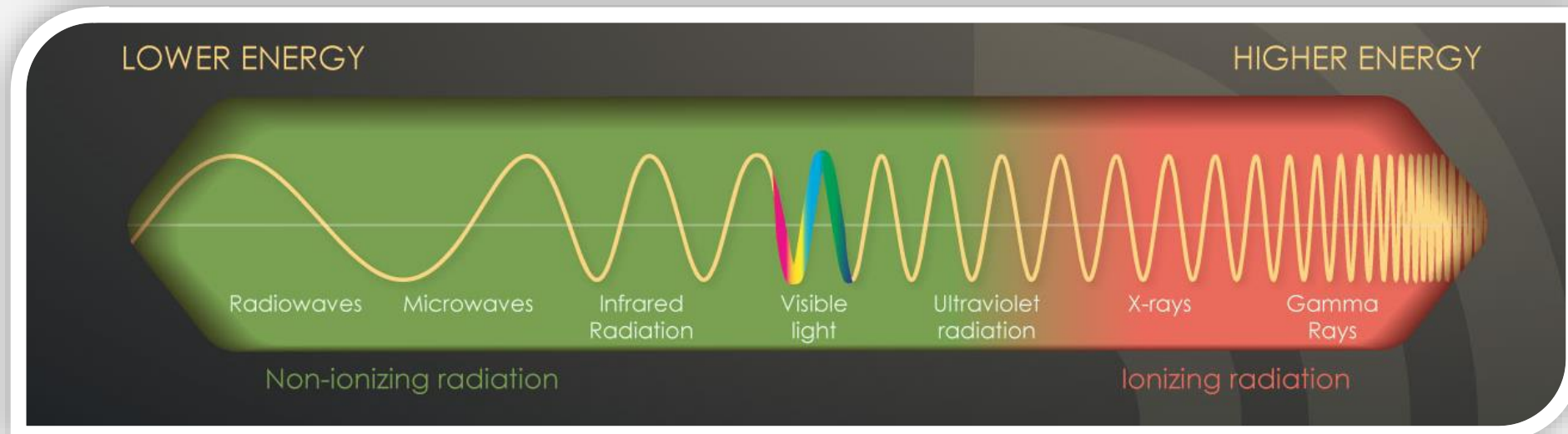
# Ionizing Radiation

## Non-Ionizing Radiation

- Visible light/heat/radio waves/microwaves – Not enough energy to cause ionization

## Ionizing Radiation

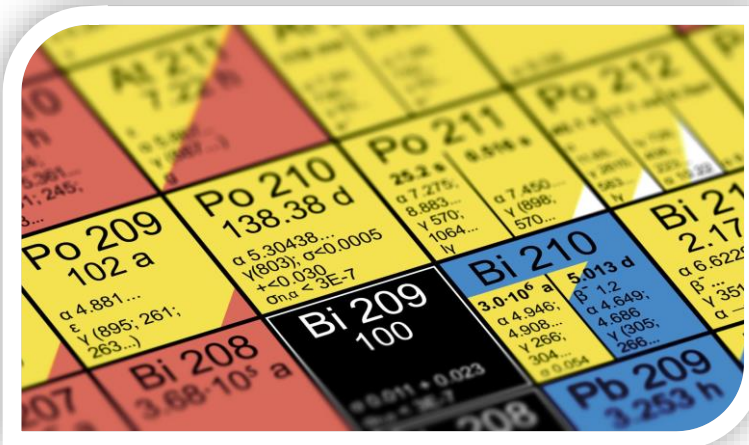
- Physical change in atoms by making them electrically charged—called ionization



# Atomic Structure

## *What is an Isotope:*

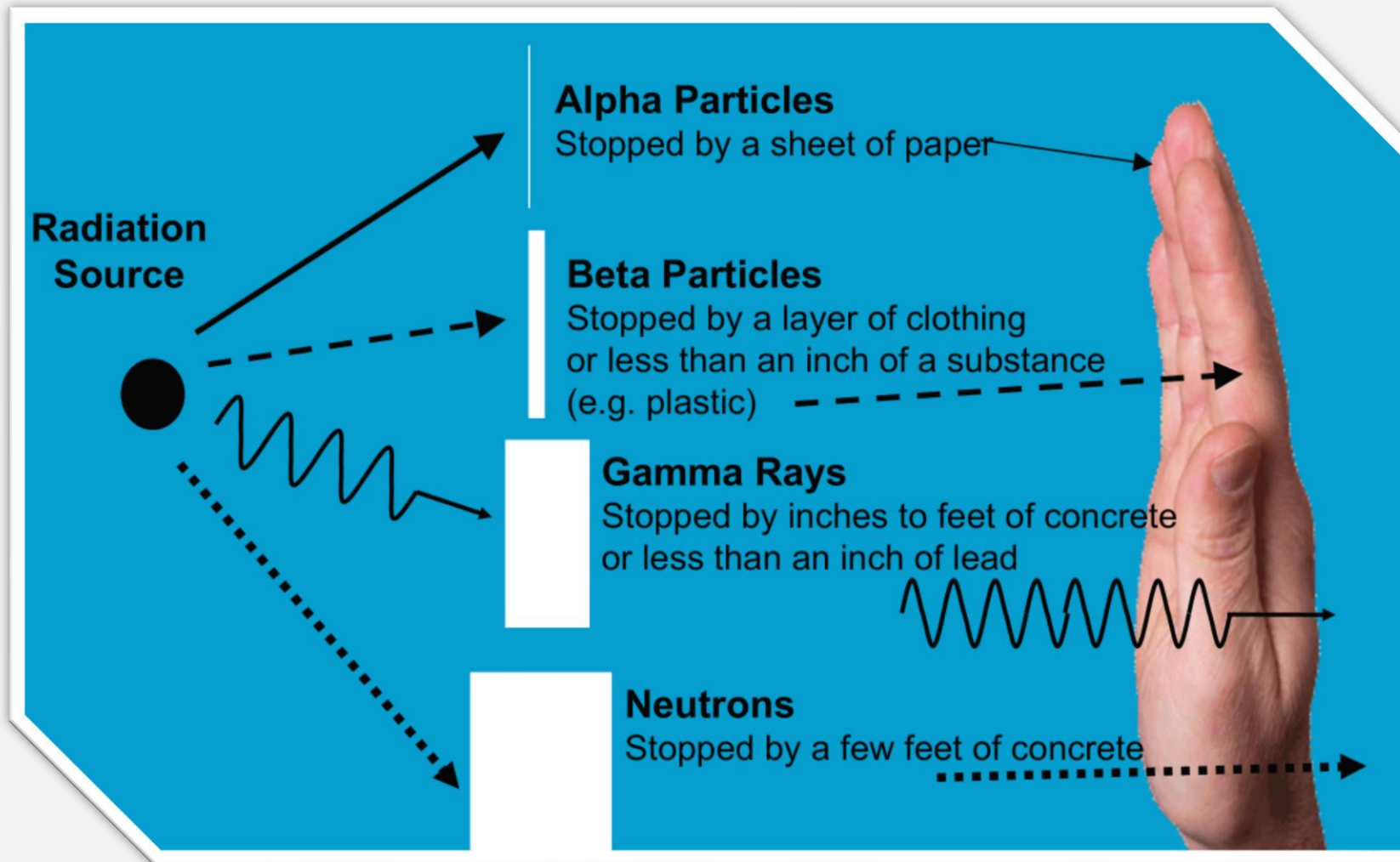
- A nuclide of an element having the same number of protons but a different number of neutrons



## *Key Points:*

- Radioactive decay occurs when a radioactive atom gives off radiation in the form of energy or particles.
- Radioactive atoms give off radiation to become more stable.
- There are four types of radiation given off by radioactive atoms.

# Types Of Radiation



# Public Health Concerns

## RADIATION CONTAMINATION VERSUS EXPOSURE

### EXTERNAL CONTAMINATION

External contamination occurs when radioactive material comes into contact with a person's skin, hair, or clothing.

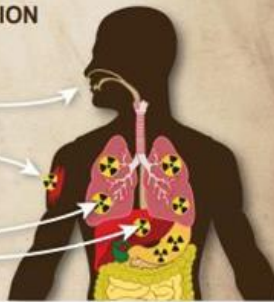


### INTERNAL CONTAMINATION

Internal contamination can occur when radioactive material is swallowed or breathed in.

Internal contamination can also occur when radioactive material enters the body through an open wound.

Different radioactive materials can accumulate in different body organs.



### RADIATION EXPOSURE

Another word for radiation exposure is irradiation.

Radioactive materials give off a form of energy that travels in waves or particles.

A person exposed to radiation is not necessarily contaminated with radioactive material.

For a person to be contaminated, radioactive material must be on or inside of his or her body.

When a person is exposed to certain types of radiation, the energy may penetrate the body.

When a person has an x-ray, he or she is exposed to radiation but is not contaminated.



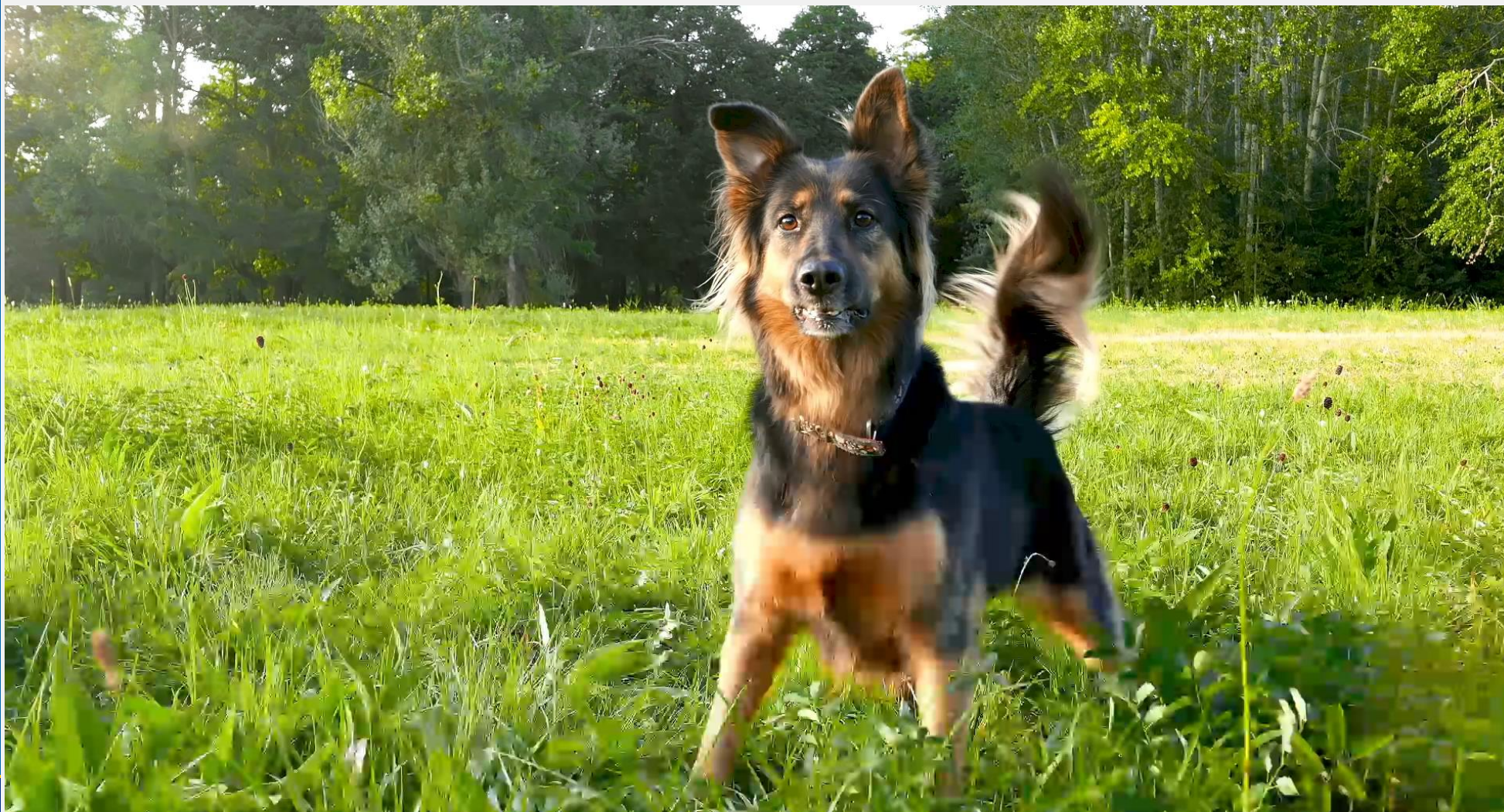
<http://emergency.cdc.gov/radiation>

- **Contamination** (*minimal risk to responders*)
  - ▶ Radioactive material in an unwanted place
  - ▶ 80% to 90% can be removed with the first layer of clothing
- **Exposure** (*possible significant risk to responders*)
  - ▶ Radiation waves/particles penetrate the body
  - ▶ Exposed individuals do not become radioactive or contaminated (no threat to others)

The risk of secondary contamination to medical staff is minimal, and life-saving care should never be delayed due to fear of radiation.

Source: <https://www.cdc.gov/radiation-emergencies>

# Out for a walk.



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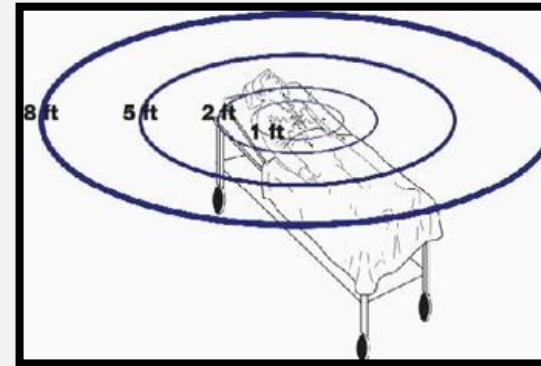
# Oh, boy what that?



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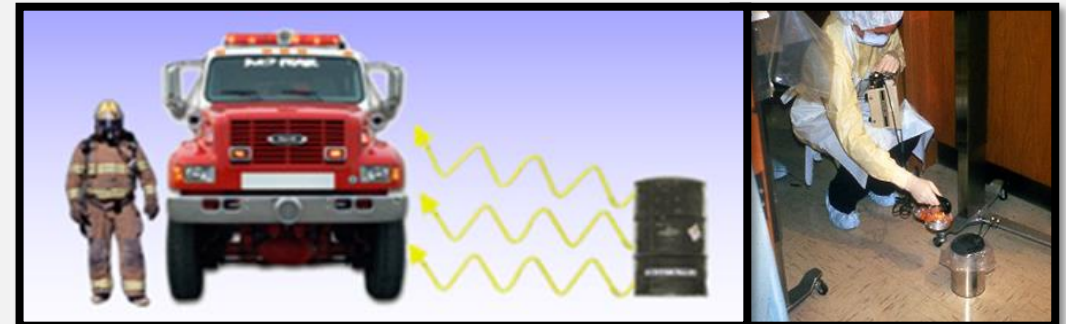
# Radiation Protection Techniques

- Time
  - ▶ Minimize time spent near radiation sources
- Distance
  - ▶ Maintain maximal practical distance from radiation sources
- Shielding
  - ▶ Place radioactive sources in a lead container & shield first responders



To Limit Caregiver Dose to 5 rem

Distance	Rate	Stay time
1 ft	12.5 R/hr	24 min
2 ft	3.1 R/hr	1.6 hr
5 ft	0.5 R/hr	10 hr
8 ft	0.2 R/hr	25 hr



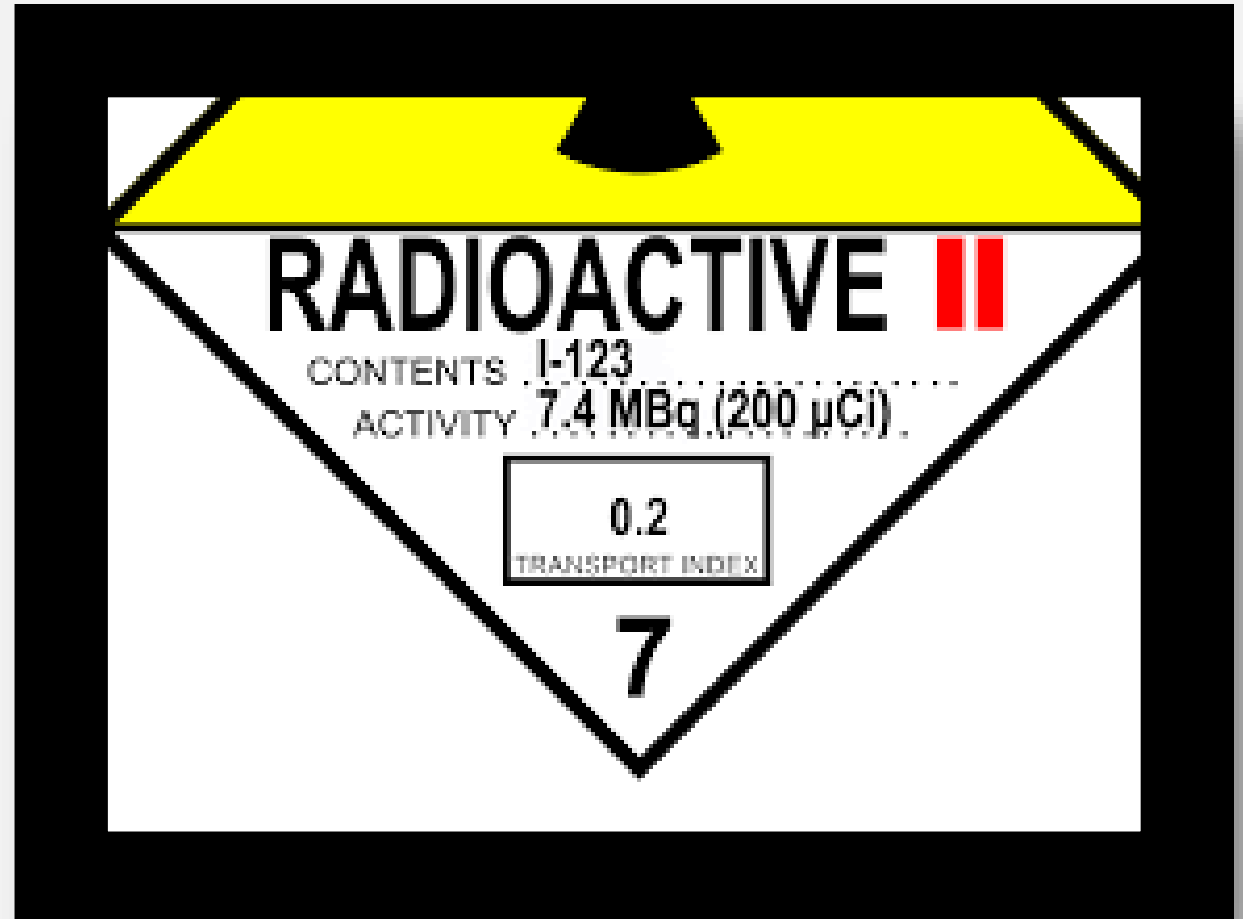
# Radiological Units

## Radiation Measurement:

- Roentgen or milliroentgen (mR)
- Rem or millirem (mrem)
- Sievert (SI unit), 1 sievert = 100 rem

## Activity Measurement:

- Curie (Ci)
- Becquerel (SI unit) (Bq)



# Radiation: Dose and Dose Rate



- **Radiation Dose / Exposure: (mR)**
  - ▶ The amount of radiation energy deposited in the body
  - ▶ Often measured in millirem
- **Dose Rate: (mR/h)**
  - ▶ The rate at which radiation energy is deposited in the body
  - ▶ Often measured in millirem per hour

# DSHS Radiation Detection Instrumentation



Portal Meters

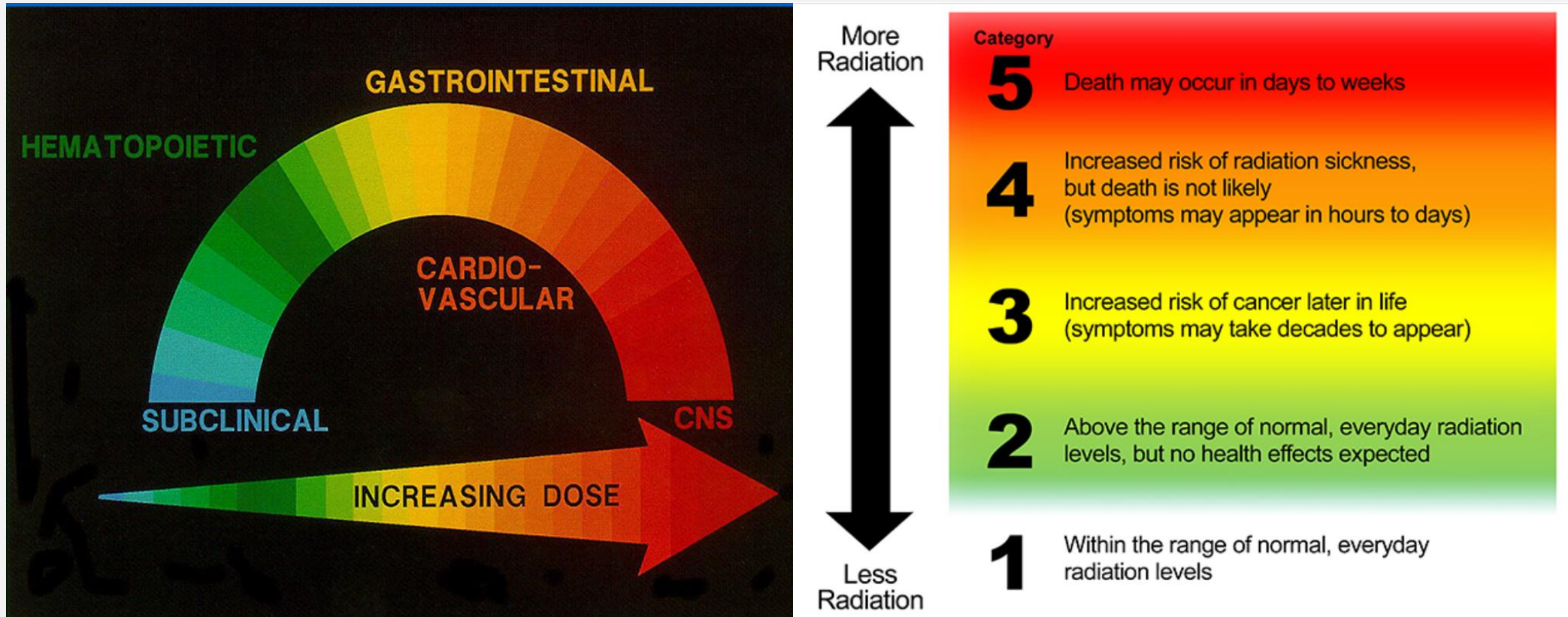


Dosimetry



Radiation Detection & Identification Meters

# How Much Radiation Is Hazardous?



Source: <https://www.cdc.gov/radiation-emergencies/php/toolkit/hazard-scale.html>

- 320-450 rad without advanced med treatment =  $LD_{50/60}$
- 500-700 rad with advanced med treatment =  $LD_{50/60}$

# Chronic Doses

*Small Dose Received Over A Long Period of Time*

Function	Dose (mrem)
DOE, NRC annual dose limit for the public	100
Typical annual dose for airline flight crew	200 – 400
Average annual dose (U.S.)	620
Average annual background Yangjiang, China	≈600
Average annual background Kerala Coast, India	≈1,200
DOE, NRC annual limit for radiation workers	5,000
Typical mission dose on International Space Station	10,000 – 15,000

# Acute Doses

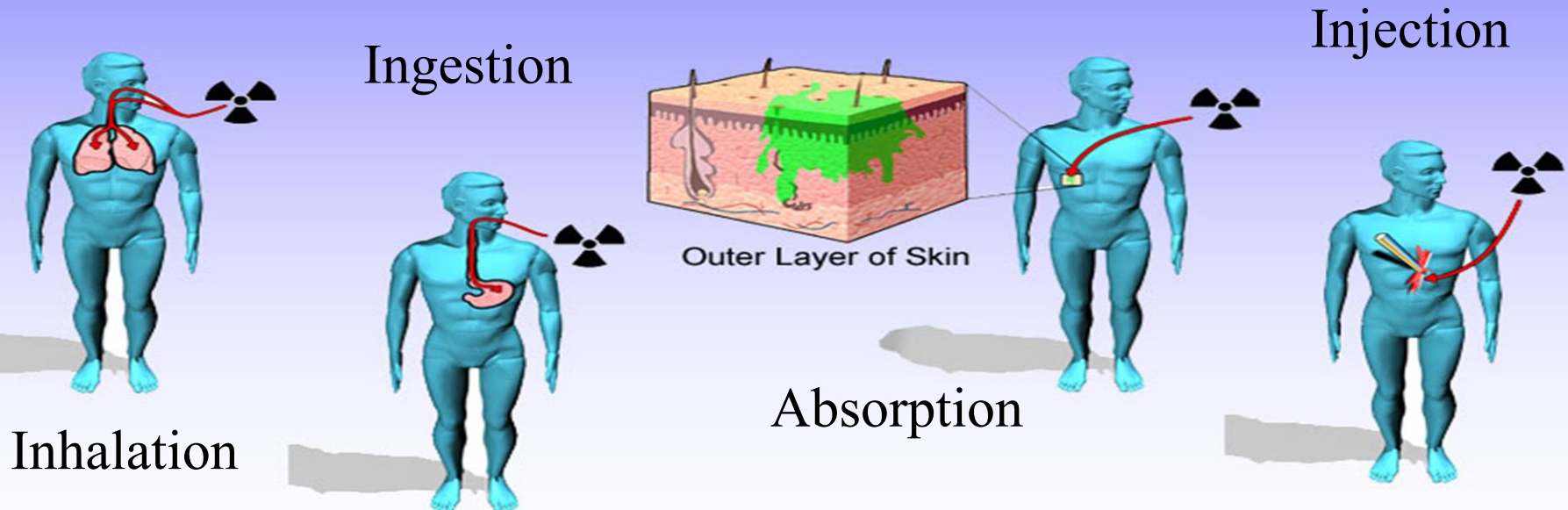
*Large Dose Received Over A Short Period Of Time*

Function/Procedure	Dose (mrem)
Chest / Panoramic Dental X-ray	4 - 9
Mammogram (4 Views) / Lumbar Spine X-ray	70
Abdomen X-ray	120
Heart Stress Test (Tc-99m) / Heart Stress Test (Tl-201)	585 / 1,180
CT of Abdomen or Pelvis	1,000
Various PET Studies (F-18)	1,400
Coronary Angiogram	1,580
Angioplasty (Heart Study)	5,700

*Source: Health Physics Society Fact Sheet titled Radiation Exposure from Medical Diagnostic Imaging Procedures*

# How Radiation Affects The Body

Biological pathways that can introduce internal contamination include:

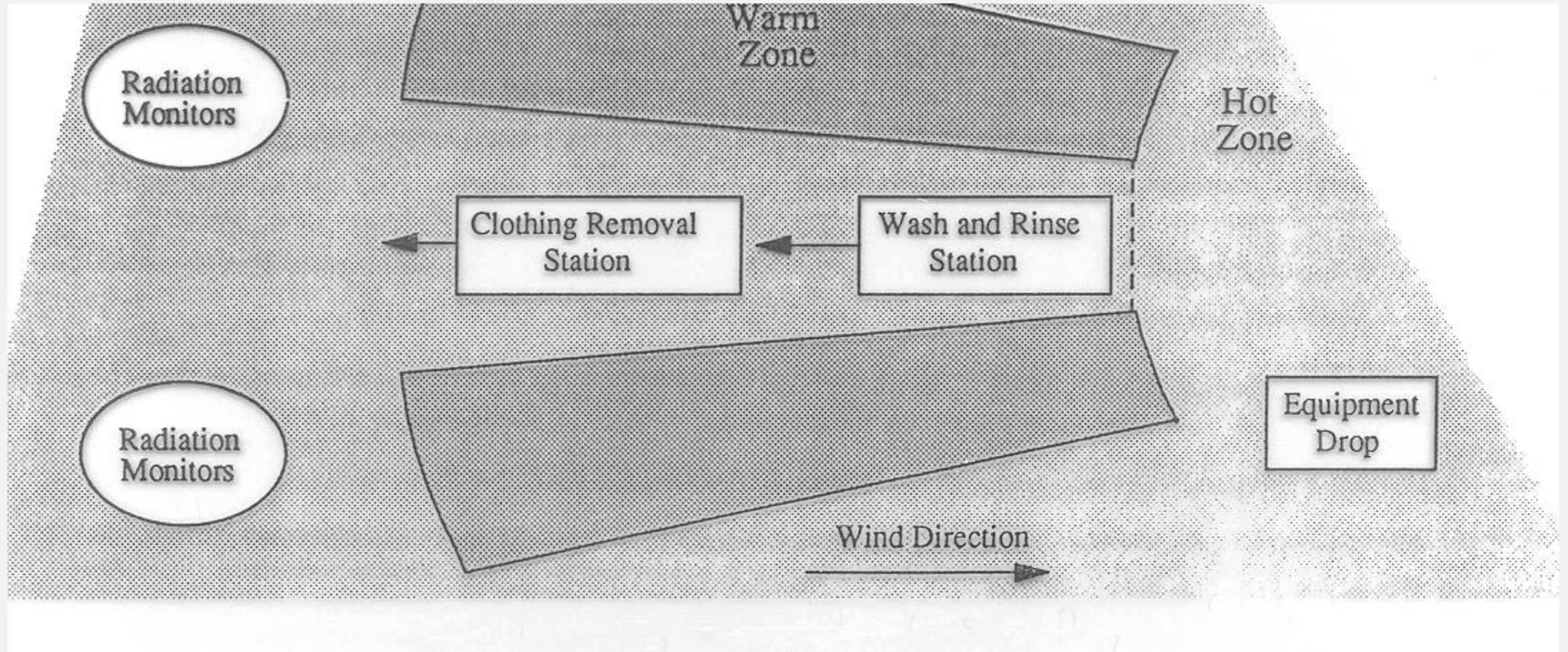


# PPE & Protecting Equipment

- Bag and seal equipment
- Cover tools/exposed surfaces with tape
- Change out gloves or protective gear
- Limit material entering into the hot zone

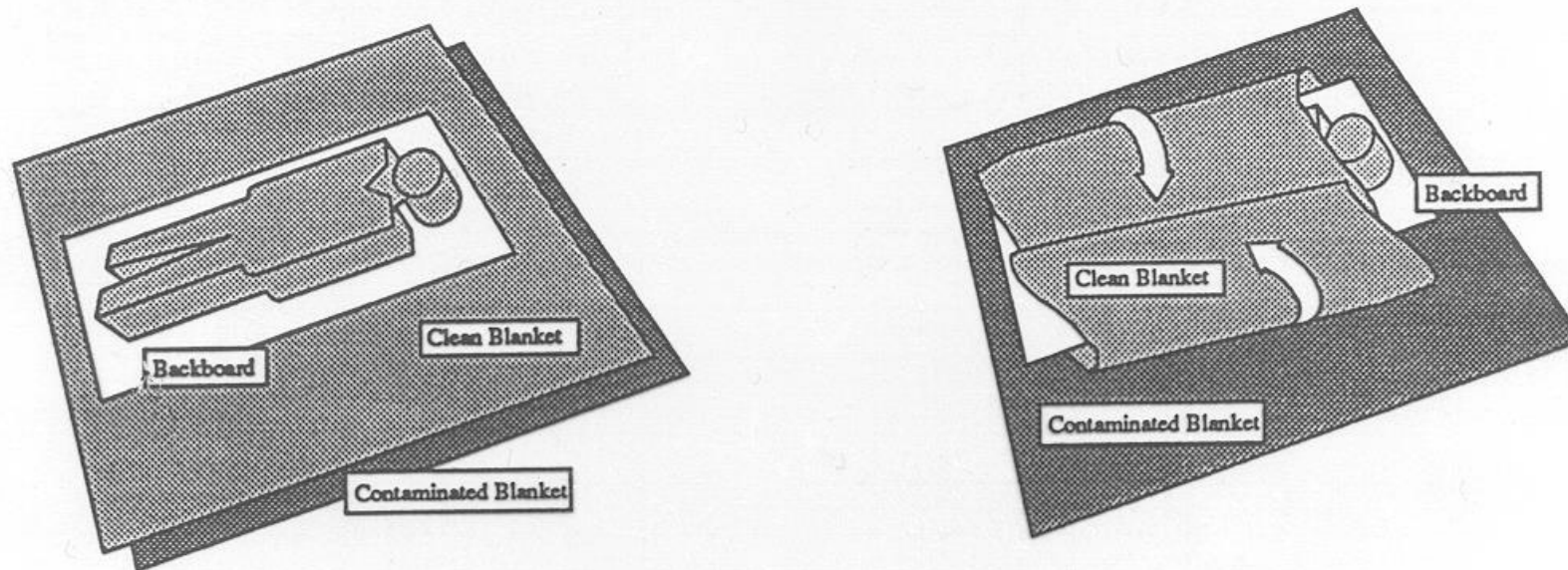


# Decontamination Corridor



# Wrap and Go

Use blankets or tarps large enough to wrap patient and backboard.



Wrap patient in large clean blanket. Handle patient in both blankets when in the hot zone. Leave contaminated bottom blanket at edge of hot zone.

# Patient Management - Priorities

## Prioritize Life Saving Over Radiation!

- Triage – mass casualty
- Medical treatment is the highest priority
- Radiation exposure and contamination are secondary considerations
- Degree of decontamination dictated by number of and capacity to treat other injured patients



# Decontamination Procedures

- **Skin Contamination:**
  - ▶ Dry Decon: use tape or HEPA filtered vacuum.
  - ▶ Wet Decon: Use wet-wipes or wash skin with warm water and mild soap. Avoid scratching or damaging the skin, as this can allow radioactive material to enter the body.
- **Wound Care:** Treat wounds immediately. Cover contaminated wounds with waterproof dressings to prevent contamination spread during decontamination.
- **Orifices:** Flush eyes with water or saline. Clean nose, ears, and mouth gently.
- **Stop Decontamination:** Continue washing until surveys indicate contamination is less than twice the background level or remains unchanged.

# Internal Contamination Treatment

If radioactive material is inhaled or ingested, specific treatments may be required:

- Internal Decontamination Agents: Drugs like Prussian blue (for Cesium-137) or DTPA (for Plutonium/Americium) may be used to reduce absorption and enhance elimination.

Wound Irrigation: Remove radioactive foreign bodies (like shrapnel) using forceps, taking care to minimize radiation exposure to staff.

## **Psychosocial Support**

- Many people may self-refer, having been in the area but not necessarily contaminated. These individuals often require reassurance and counseling.

# Mass Casualties, Contaminated but Uninjured People, and Worried Well

- An incident caused by radiological/nuclear terrorism may create large numbers of contaminated people who are not injured and worried people who may not be injured or contaminated
- Measures must be taken to prevent these people from overwhelming the emergency department
- A triage site should be established outside the ED to intercept such people and divert them to appropriate locations.
  - ▶ Triage site should be staffed with medical staff and security personnel
  - ▶ Precautions should be taken so that people cannot avoid the triage center and reach the ED



# Radiological Terrorism

- Radiological Exposure Device (RED)
- Radiological Dispersal Device (RDD)
- Improvised Nuclear Device (IND)



# Radiological Dispersion Devices (RDD)

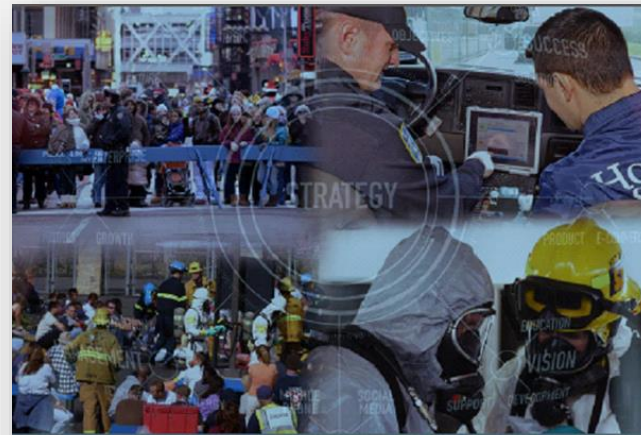
- **Scenario #1: A “dirty bomb”**
  - ▶ Terrorist weapon, not an ‘atomic’ bomb
  - ▶ Conventional weapon using explosives
  - ▶ More danger from explosion than the radiation
- **Scenario #2: Dispersion of unsealed radioactive sources:**
  - ▶ Deposit in soil or water (i.e., treatment facilities)
  - ▶ Drop from airborne device (i.e., crop duster or drone)
- **Radioactive sources** can be solid, aerosol, gas, or liquid
- **Contamination** of people may occur via air, water, soil or food
- **Long-term** economic impact



# RDD Planning Guidance

[https://www.dhs.gov/sites/default/files/2025-08/25\\_0827\\_st\\_second\\_edition\\_2025\\_RDD\\_Immediate\\_Response\\_Guidance.pdf](https://www.dhs.gov/sites/default/files/2025-08/25_0827_st_second_edition_2025_RDD_Immediate_Response_Guidance.pdf)

<https://externaltools.radresponder.net/rosstoolkit/docs/CRCPDHandbookRespondingRadDispersalDevice.pdf>



## Radiological Dispersal Device (RDD) Immediate Response Guidance

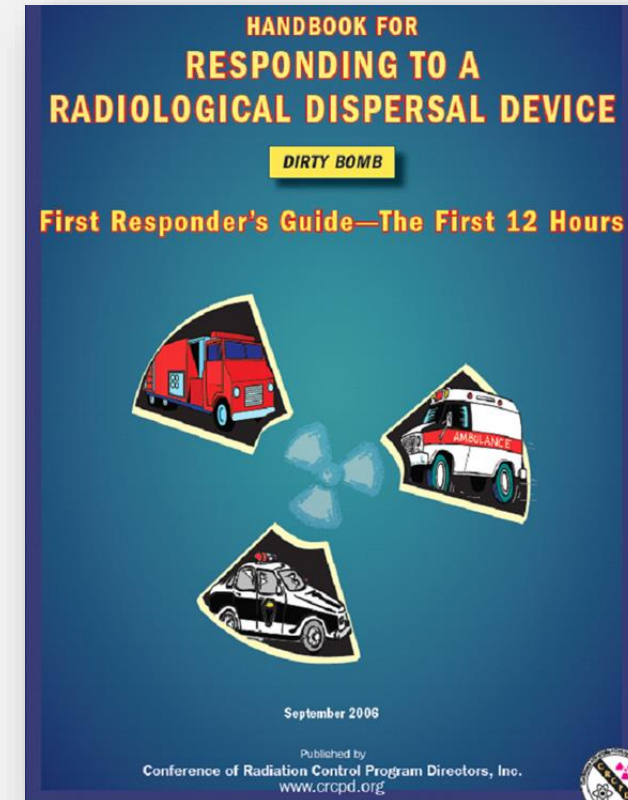
July 2025



Science and  
Technology

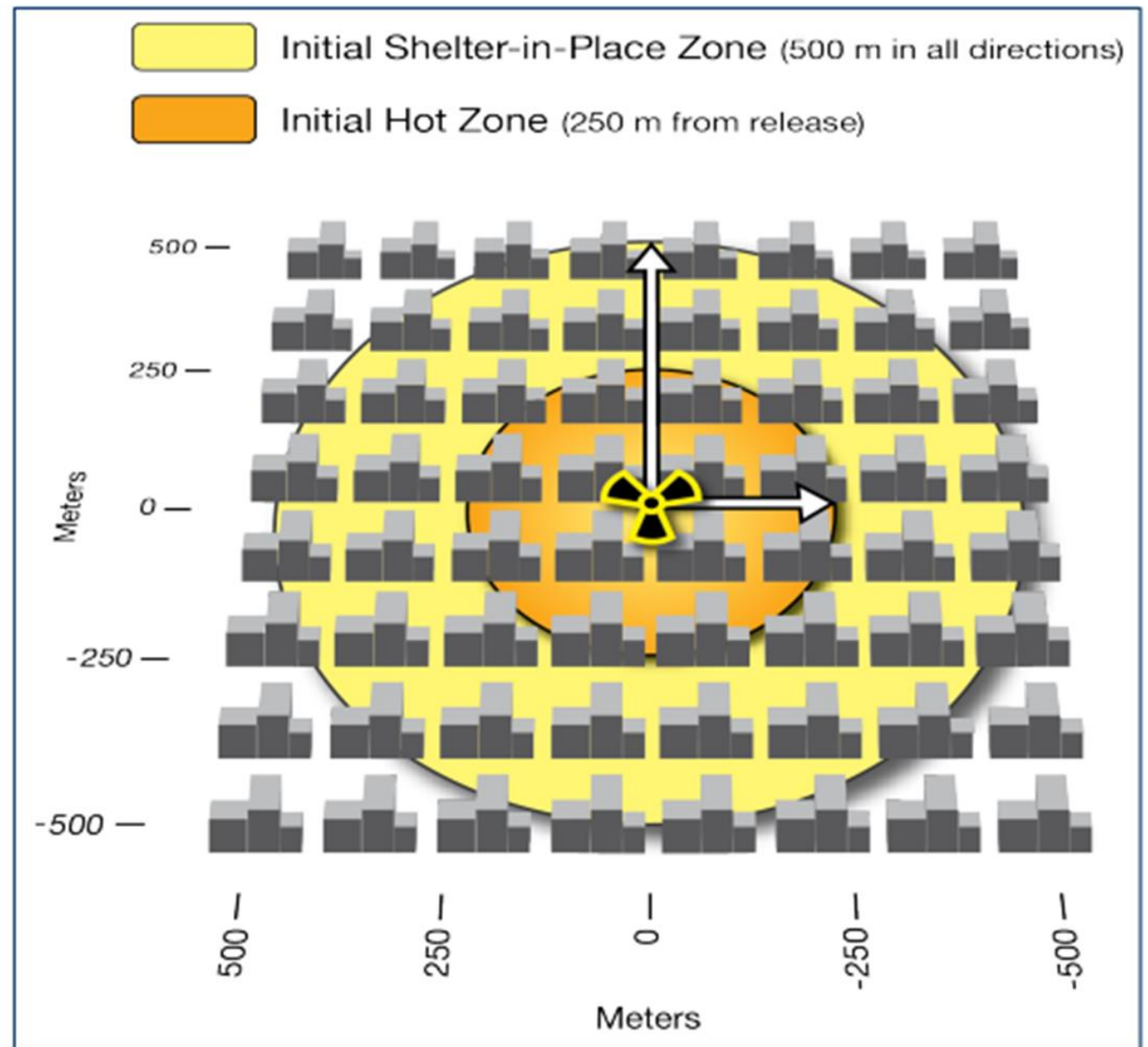


FEMA

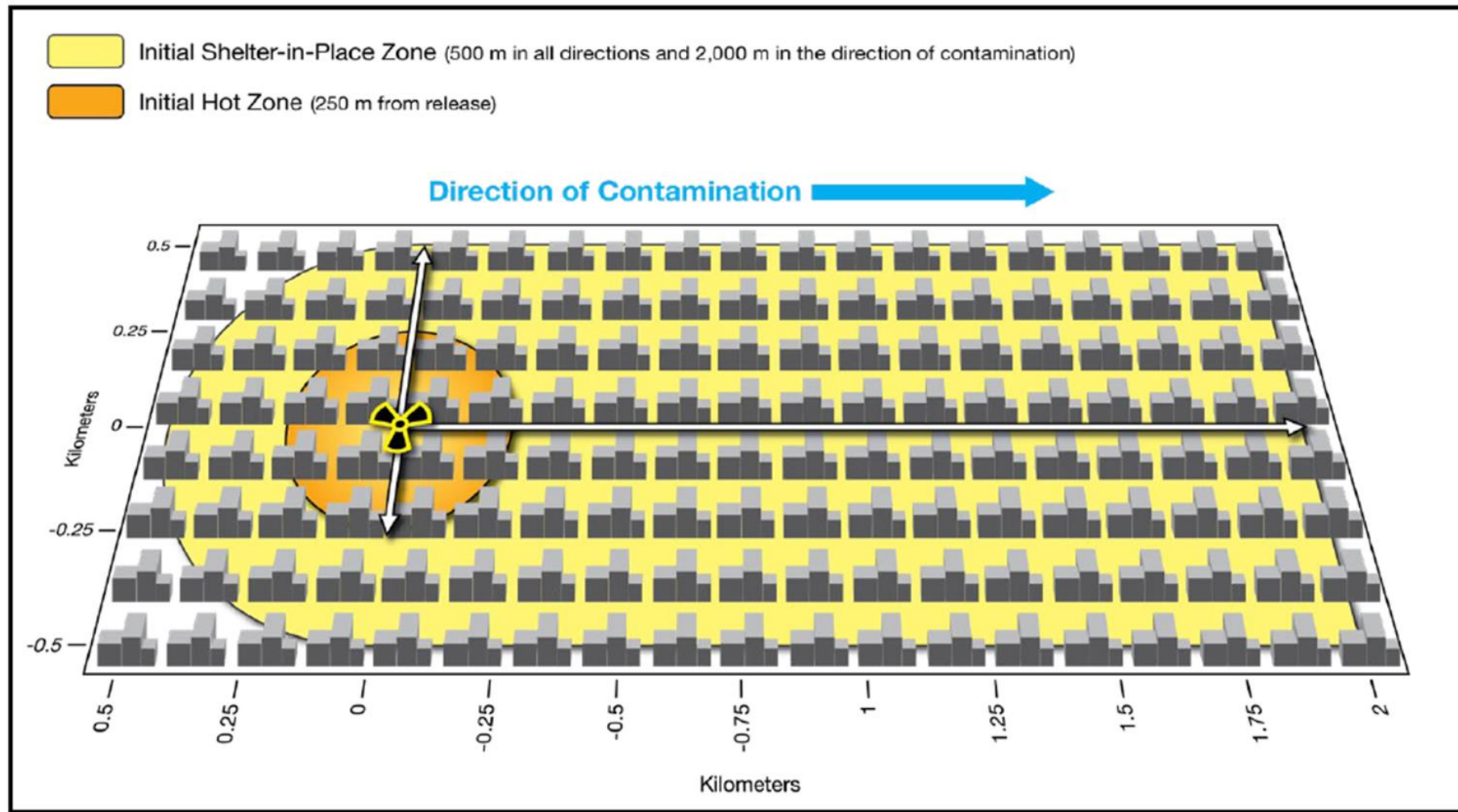


# RDD Response Guidance

- Phased Approach
  - ▶ Early/Immediate
  - ▶ Intermediate
- Local, State, Federal Responder Tactical Missions
- Pre-Scripted Public Messaging



**Figure 3 Initial Hot and Shelter-in-Place Zones with Unknown Direction of Contamination**



**Figure 4 Initial Hot and Shelter-in-Place Zones, with Known Direction of Contamination**



Table 3 Radiation Hazard Zones

Radiation Hazard Zone Type <sup>10</sup>	Indicators	Response Restrictions <sup>11</sup>
N/A	<ul style="list-style-type: none"> <li>▪ <b>Below</b> 10 mR/h (0.1 mGy/hr)</li> </ul>	<ul style="list-style-type: none"> <li>▪ None. Support all operations as needed while monitoring radiation levels.</li> </ul>
Hot Zone (HZ)	<ul style="list-style-type: none"> <li>▪ <b>Above</b> 10 mR/h (0.1 mGy/hr) and <b>Below</b> 10 R/h (0.1 Gy/hr)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Support only emergency operations (lifesaving, firefighting, etc.).</li> <li>▪ Minimize occupancy time in accordance with ALARA.</li> <li>▪ If radiation detectors are available, monitor radiation levels and track exposure of all responders. If radiation detectors are limited or unavailable, track occupancy time and location.</li> </ul>
Dangerous Radiation Zone (DRZ)	<ul style="list-style-type: none"> <li>▪ <b>Above</b> 10 R/h (0.1 Gy/hr)</li> </ul>	<ul style="list-style-type: none"> <li>▪ DRZ-levels of radiation exposure are not likely after an RDD – at least, not over a wide area. Instead, DRZ-levels of radiation may be encountered in the form of “hot spots:” small areas of &gt;10 R/hr (0.1 Gy/hr) exposure, perhaps indicating the presence of highly contaminated ballistic debris or small chunks of radioactive material.</li> </ul>

# Improvised Nuclear Device (IND)



- An illicit nuclear weapon bought, stolen, or otherwise originating from a nuclear state, or a weapon fabricated by a terrorist group from illegally obtained fissile nuclear weapons material that produces a nuclear explosion.
- Results in catastrophic loss of life, destruction of infrastructure, and contamination of a very large area.

# IND Health Effects

- **Injury or death**
  - ▶ from the blast wave
- **Moderate to severe burns**
  - ▶ from heat and fires
- **Blindness**
  - ▶ from the intense light
- **Radiation sickness/ARS**
  - ▶ caused by the radiation released

## IMPROVISED NUCLEAR DEVICE

An Improvised Nuclear Device (IND) is a type of nuclear weapon. When an IND explodes, it gives off four types of energy: a blast wave, intense light, heat, and radiation. The bomb dropped on Hiroshima, Japan, at the end of World War II is an example of an IND.



When an IND explodes, a large fireball is created. Everything inside of this fireball vaporizes and is carried upward. This creates a mushroom-shaped cloud. The material in the cloud cools into dust-like particles and drops back to the earth as **fallout**. Fallout can be carried by the wind and can end up miles from the site of the explosion. Fallout is radioactive and can contaminate anything it lands on.



**What are the main dangers of an Improvised Nuclear Device?**

An IND would cause great destruction, death, and injury and have a wide area of impact. People close to the blast site could experience:

- Injury or death (from the blast wave)
- Moderate to severe burns (from heat and fires)
- Blindness (from the intense light)
- Radiation sickness, also known as acute radiation syndrome or ARS (caused by the radiation released)

People farther away from the blast, but in the path of fallout, could experience health effects from:

- Fallout on the outside of the body or clothes (external contamination) or on the inside of the body (internal contamination)
- Radiation sickness
- Contaminated food and water sources

**What should I do to protect myself?**



GET INSIDE



STAY INSIDE



STAY TUNED



U.S. Department of Health and Human Services  
Centers for Disease Control and Prevention

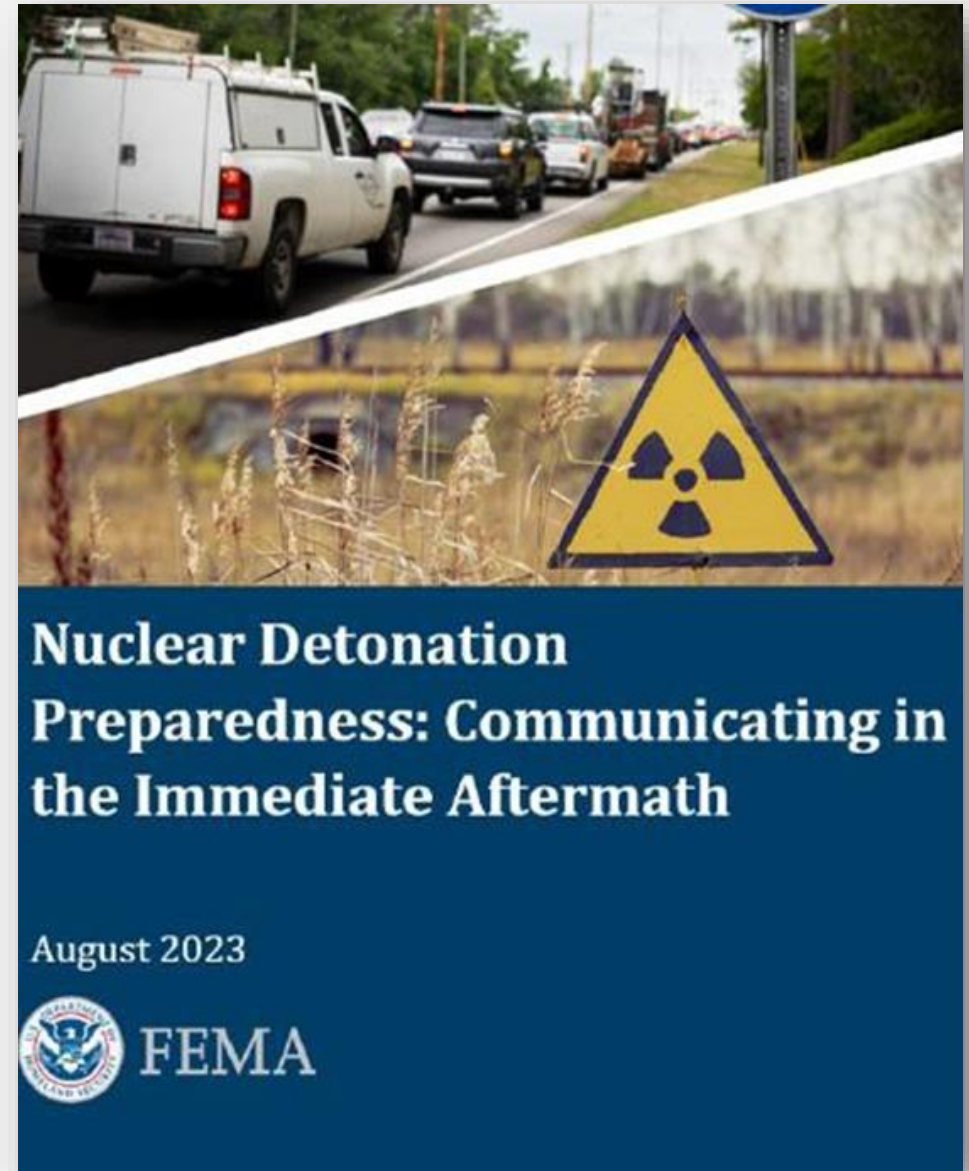
<http://emergency.cdc.gov/radiation>

Source: <https://www.cdc.gov/radiation-emergencies/infographic/improvised-nuclear-device.html>

# IND Planning Guidance

## *Pre-Scripted Messaging*

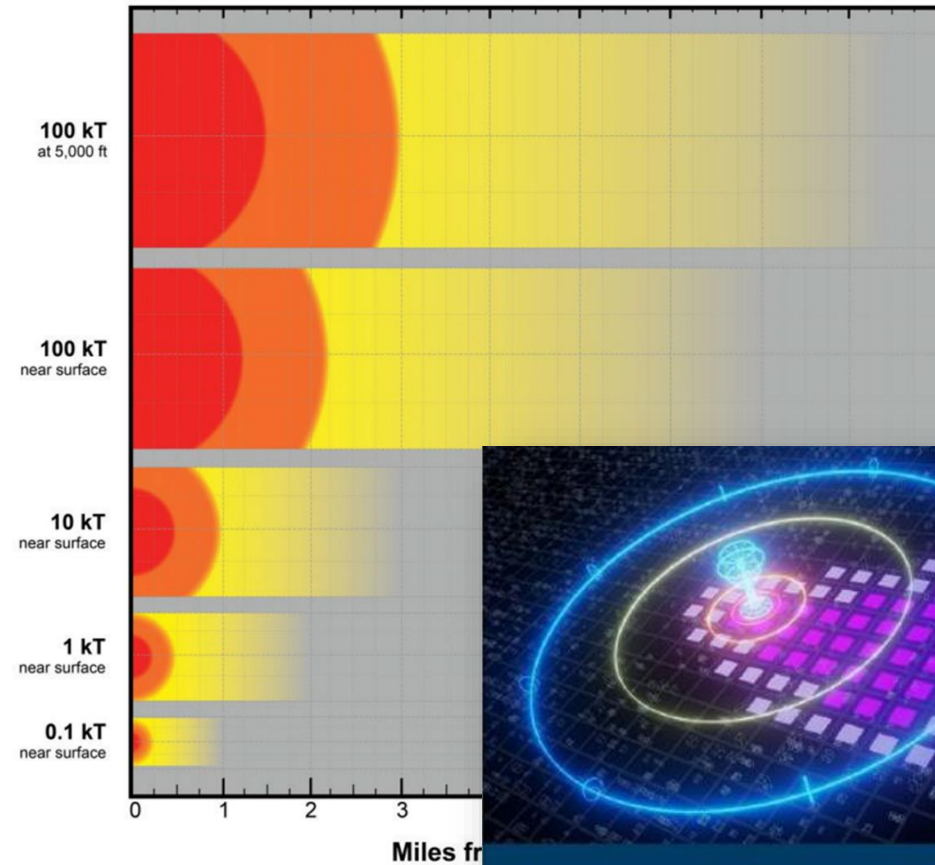
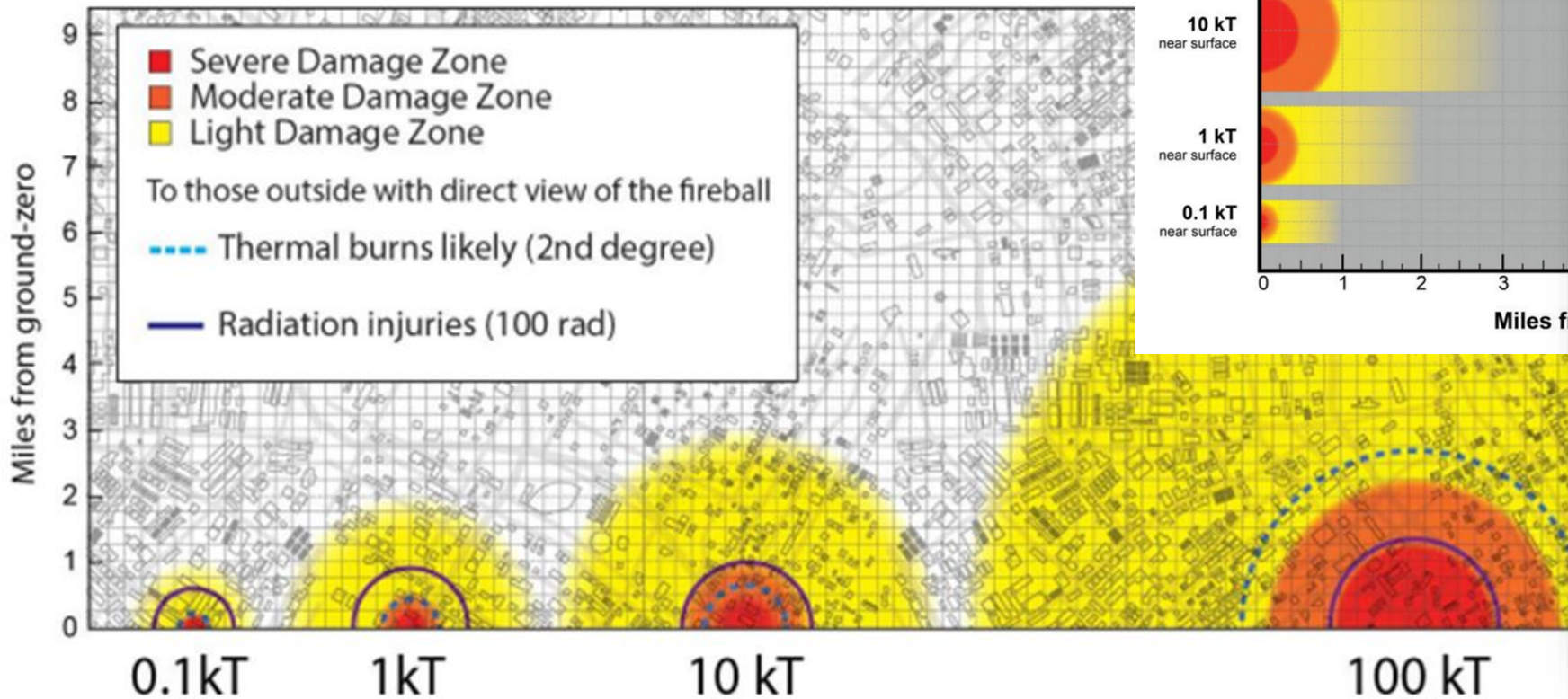
- **Emergency Notifications**
  - ▶ Immediate Protective Actions
  - ▶ IPAWS Messages
- **Key Messages**
  - ▶ Social Media
  - ▶ Food, Water, Medications
  - ▶ Decontamination
- **Infographics**



# IND Blast Effects

[https://www.fema.gov/sites/default/files/documents/fema\\_oet-72-hour-nuclear-detonation-response-guidance.pdf](https://www.fema.gov/sites/default/files/documents/fema_oet-72-hour-nuclear-detonation-response-guidance.pdf)

Planning Guidance for Response to a Nuclear Detonation, Third Edition



## Nuclear Detonation Response Guidance

Planning for the First 72 Hours

March 2023



FEMA



**TEXAS**  
Health and Human  
Services

Texas Department of State  
Health Services

# Thank you!

[Forrest.westin@dshs.Texas.gov](mailto:Forrest.westin@dshs.Texas.gov)

[Rae.walker@dshs.Texas.gov](mailto:Rae.walker@dshs.Texas.gov)