Nuclear Detonation Response Training

Module 3: Response Guidance

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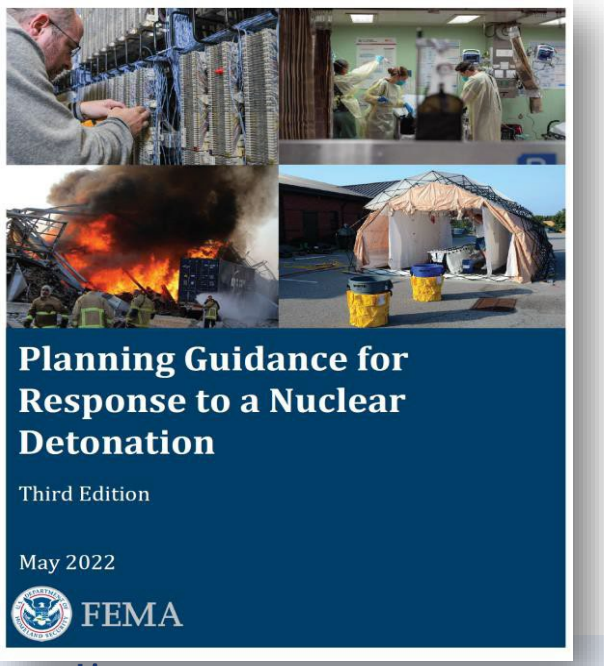
Global Security

Prepared by LLNL under Contract DE-AC52-07NA27344.

Chapter 2: A Zoned Approach

Chapter 2 provides an overview of the Response Zones and Emergency Worker Safety Considerations



Fallout Zones
(Approximate for a 10kT)

Dangerous Radiation Zone (DRZ)
- *Bounded by radiation levels of 100 mGy/h (10 R/h)*
- *Acute Radiation Injury possible within the DFZ*
- *Could reach 15-30 km (10-20 miles) downwind*
- *Begins to shrink after about 1-2 hours*

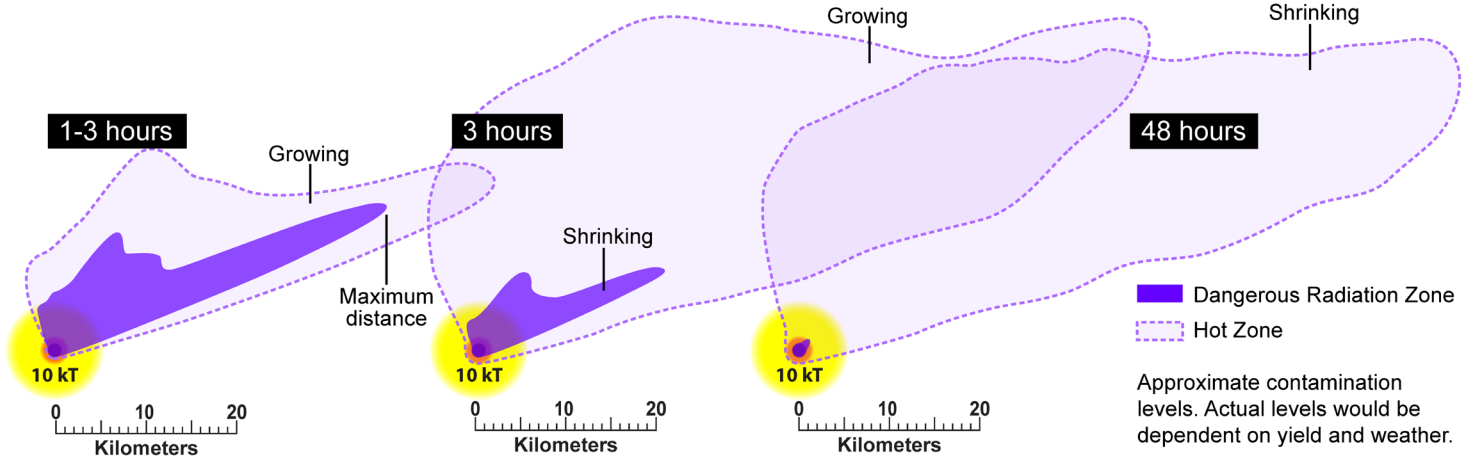
Hot Zone
- *Bounded by radiation levels of 100 µGy/h (10 mR/h)*
- *Acute radiation effects unlikely, however steps should be taken to control exposure*
- *Could extend in a number of directions for 100s of km*
- *Begins to shrink after about 12-24 hours*

Blast Zones
(Approximate for a 10kT)

Severe Damage Zone
(~ 1-km radius)
Most buildings destroyed, hazards and radiation initially prevents entry into the area; low survival likelihood.

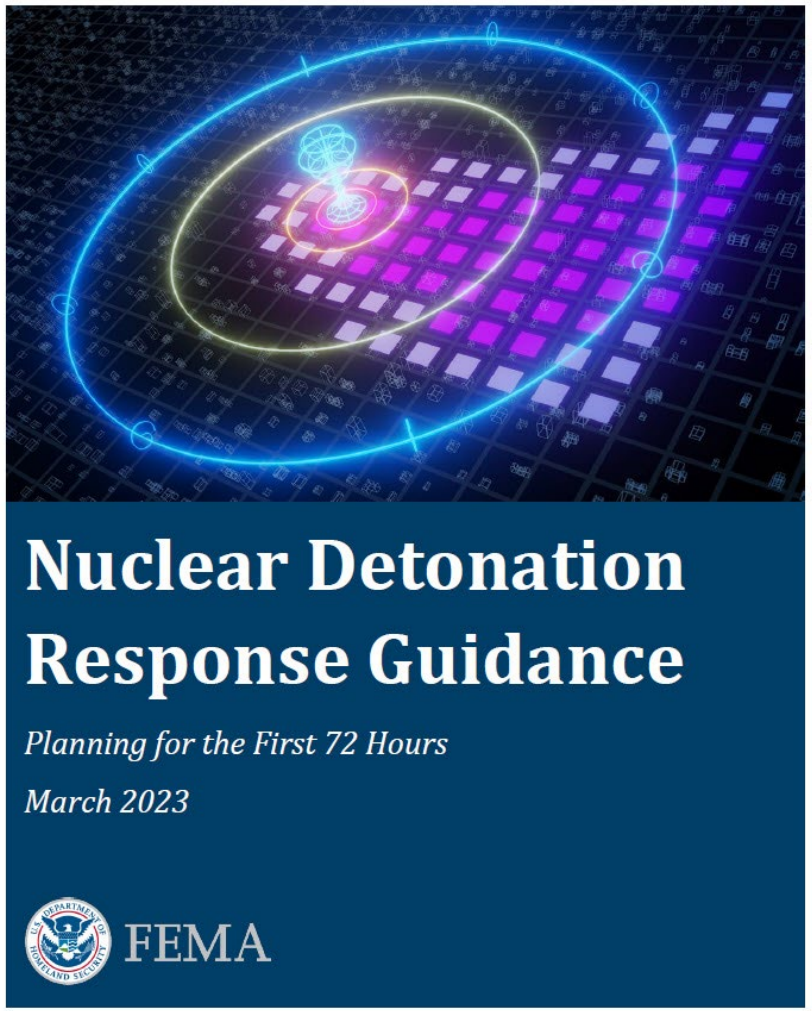
Moderate Damage Zone
(~ 1- to 2-km radius)
Significant building damage and rubble, downed utility poles, overturned automobiles, fires, and many serious injuries. Early medical assistance can significantly improve the number of survivors.

Light Damage Zone
(~ 2- to 5-km radius)
Windows broken, mostly minor injuries that are highly survivable even without immediate medical care.

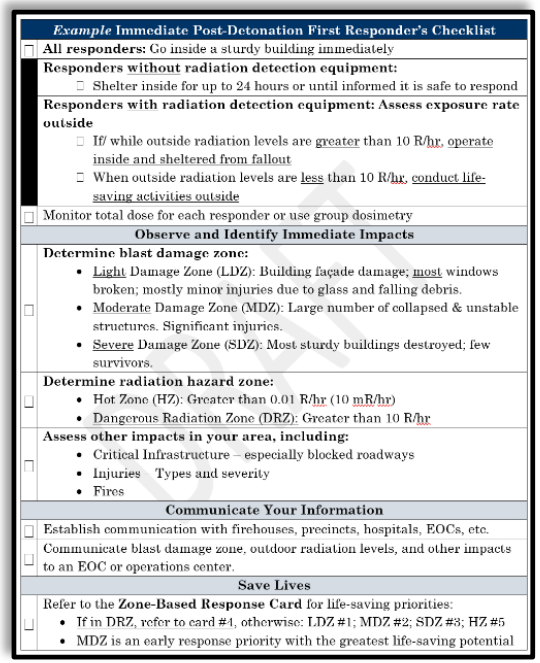



10-MILE RADIUS
Blast Zones
Light Damage Zone (LDZ)
Extensive window/exterior damage and minor injuries. Manage fires, encourage public shelter.
Moderate Damage Zone (MDZ)
Significant damage and injuries. Establish and maintain evacuation corridors. Greatest life-saving potential.
Severe Damage Zone (SDZ)
Radiation and complete destruction of most buildings. Delay response until radiation decays. Survivors unlikely.
Radiation Zones
Dangerous Radiation Zone (DRZ)
Dangerous radiation levels (> 10 R/h) outside. Minimize use of responders outside. Shelter public to save lives.
Hot Zone (HZ)
Elevated radiation levels (> 0.01 R/h). Respond as needed, minimize time outside. Shelter public to minimize dose.
Ranges shown are for a 10 kt detonation

Companion Nuclear Detonation Response Guidance:
Planning for the First 72 Hours



Provides local agencies prioritized, operational guidance on how to initially respond to a nuclear detonation in or near their jurisdiction



***Example* Immediate Post-Detonation First Responder's Checklist**

- ☐ **All responders:** Go inside a sturdy building immediately
- **Responders without radiation detection equipment:**
  - ☐ Shelter inside for up to 24 hours or until informed it is safe to respond
- **Responders with radiation detection equipment: Assess exposure rate outside**
  - ☐ If/ while outside radiation levels are greater than 10 R/hr, operate inside and sheltered from fallout
  - ☐ When outside radiation levels are less than 10 R/hr, conduct life-saving activities outside
- ☐ Monitor total dose for each responder or use group dosimetry

Observe and Identify Immediate Impacts

- ☐ **Determine blast damage zone:**
  - Light Damage Zone (LDZ): Building façade damage; most windows broken; mostly minor injuries due to glass and falling debris.
  - Moderate Damage Zone (MDZ): Large number of collapsed & unstable structures. Significant injuries.
  - Severe Damage Zone (SDZ): Most sturdy buildings destroyed; few survivors.
- ☐ **Determine radiation hazard zone:**
  - Hot Zone (HZ): Greater than 0.01 R/hr (10 mR/hr)
  - Dangerous Radiation Zone (DRZ): Greater than 10 R/hr
- ☐ **Assess other impacts in your area, including:**
  - Critical Infrastructure – especially blocked roadways
  - Injuries – Types and severity
  - Fires

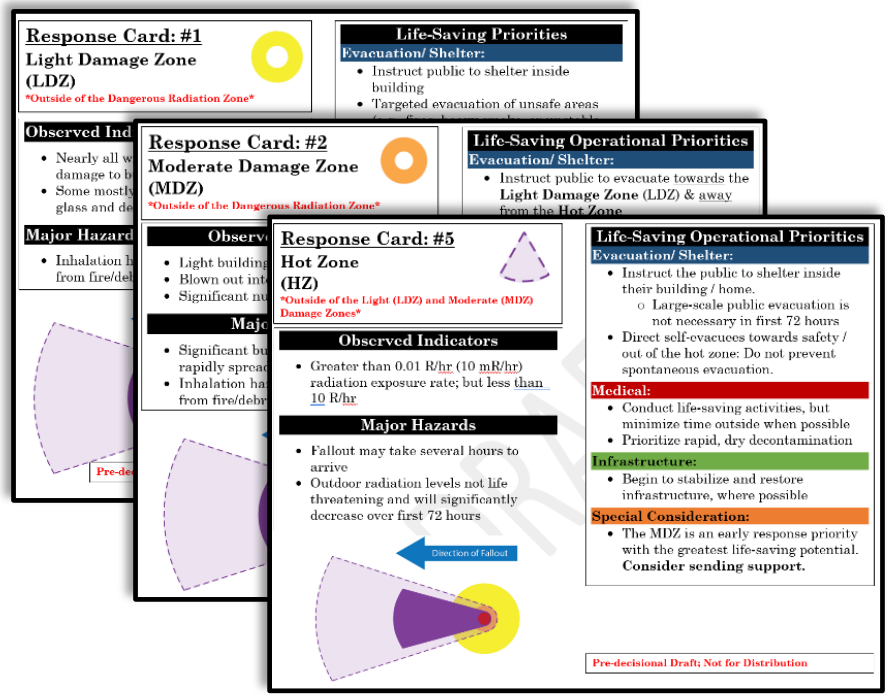
Communicate Your Information

- ☐ Establish communication with firehouses, precincts, hospitals, EOCs, etc.
- ☐ Communicate blast damage zone, outdoor radiation levels, and other impacts to an EOC or operations center.

Save Lives

- ☐ Refer to the **Zone-Based Response Card** for life-saving priorities:
  - If in DRZ, refer to card #4, otherwise: LDZ #1; MDZ #2; SDZ #3; HZ #5
  - MDZ is an early response priority with the greatest life-saving potential

Figure 1 First Responder's Checklist



Response Card: #1
Light Damage Zone (LDZ)
Outside of the Dangerous Radiation Zone

Life-Saving Priorities
Evacuation/ Shelter:
- Instruct public to shelter inside building
- Targeted evacuation of unsafe areas

Response Card: #2
Moderate Damage Zone (MDZ)
Outside of the Dangerous Radiation Zone

Life-Saving Operational Priorities
Evacuation/ Shelter:
- Instruct public to evacuate towards the **Light Damage Zone** (LDZ) & away from the **Hot Zone**

Response Card: #5
Hot Zone (HZ)
Outside of the Light (LDZ) and Moderate (MDZ) Damage Zones

Observed Indicators
- Greater than 0.01 R/hr (10 mR/hr) radiation exposure rate; but less than 10 R/hr

Major Hazards
- Fallout may take several hours to arrive
- Outdoor radiation levels not life threatening and will significantly decrease over first 72 hours

Direction of Fallout

Life-Saving Operational Priorities
Evacuation/ Shelter:
- Instruct the public to shelter inside their building / home.
  - Large-scale public evacuation is not necessary in first 72 hours
- Direct self-evacuees towards safety / out of the hot zone: Do not prevent spontaneous evacuation.

Medical:
- Conduct life-saving activities, but minimize time outside when possible
- Prioritize rapid, dry decontamination

Infrastructure:
- Begin to stabilize and restore infrastructure, where possible

Special Consideration:
- The MDZ is an early response priority with the greatest life-saving potential. **Consider sending support.**

Pre-decisional Draft; Not for Distribution

Figure 2 Zone-Based Response Cards

Structure: Missions and Tactics

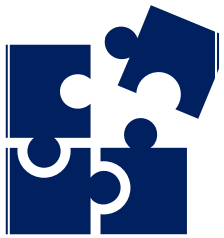
- A framework for how jurisdictions, states, and regions build a coordinated, single response out of disassociated initial actions
- Will need to be executed simultaneously

Protect Responders and the Public

- Tactic 1: Immediately Issue Alert to Get Inside

Gather Information

- Tactic 2: Characterize the Impacts
- Tactic 3: Develop a Common Operating Picture



Organize the Response

- Tactic 4: Initiate a Zone-Based Response
- Tactic 5: Establish Area Command
- Tactic 6: Sustain Critical Infrastructure

Provide Care to Survivors

- Tactic 7: Evacuate
- Tactic 8: Triage, Stabilize, and Transport
- Tactic 9: Decontaminate

Prepare for Intermediate Phase

- Tactic 10: Transition to a Prolonged Response

Mission #1: Protect Responders and the Public

Protect Responders and the Public

- Tactic 1: Immediately Issue Alert to Get Inside

Following a nuclear attack warning or a nuclear detonation, issue immediate shelter-in-place notifications using all available alerts, warnings, and notifications (AWN) systems. After a detonation, the message should instruct everyone (including responders) within 50 miles of the detonation to get inside the nearest building that is not threatened by fire or collapse, stay there, and tune in for more information. This single action may save hundreds of thousands of lives in a large city.

Image credit: CDC.

FEMA

This work was conducted under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory (LLNL) under DE-AC52-07NA27344 and in partnership with the U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T) under Contract 70RSAT21KPM000036.

LLNL-VIDEO-855296

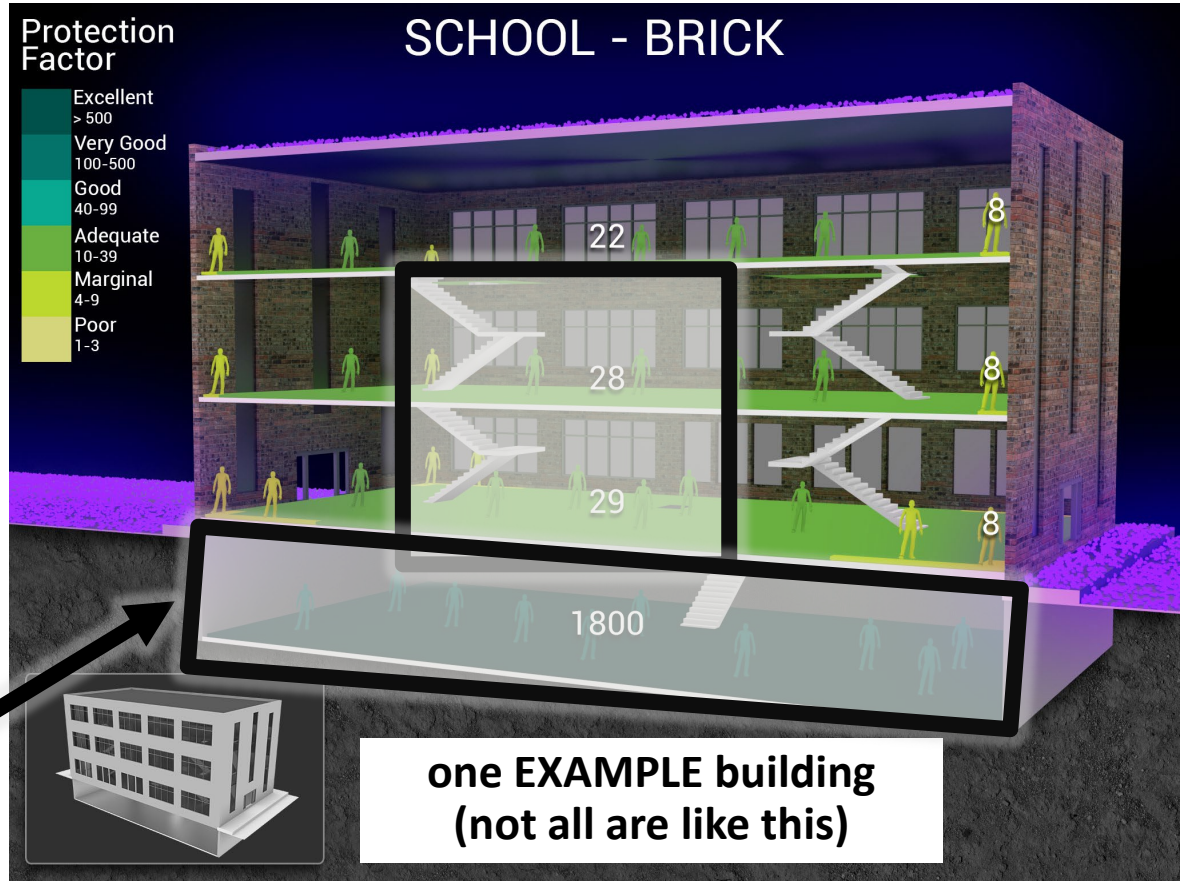
Building Protection Varies Widely

Fallout building protection depends on

- How the building is built (construction details)
- How the building is used (building contents)
- Where people are located in the building

Protection factors can, but not always, vary widely (1 to 1,000+)

- Within a single building
- Among different buildings of same type, such as offices or apartments
- Between different countries



Best protection is in the building center or below ground

For more information:
https://doi.org/10.2172/1358310
https://figshare.com/articles/preprint/US_Fallout_Shelter/20444598

Which US Buildings Have Adequate Protection?

We calculated detailed building protection estimates for >100,000 cases

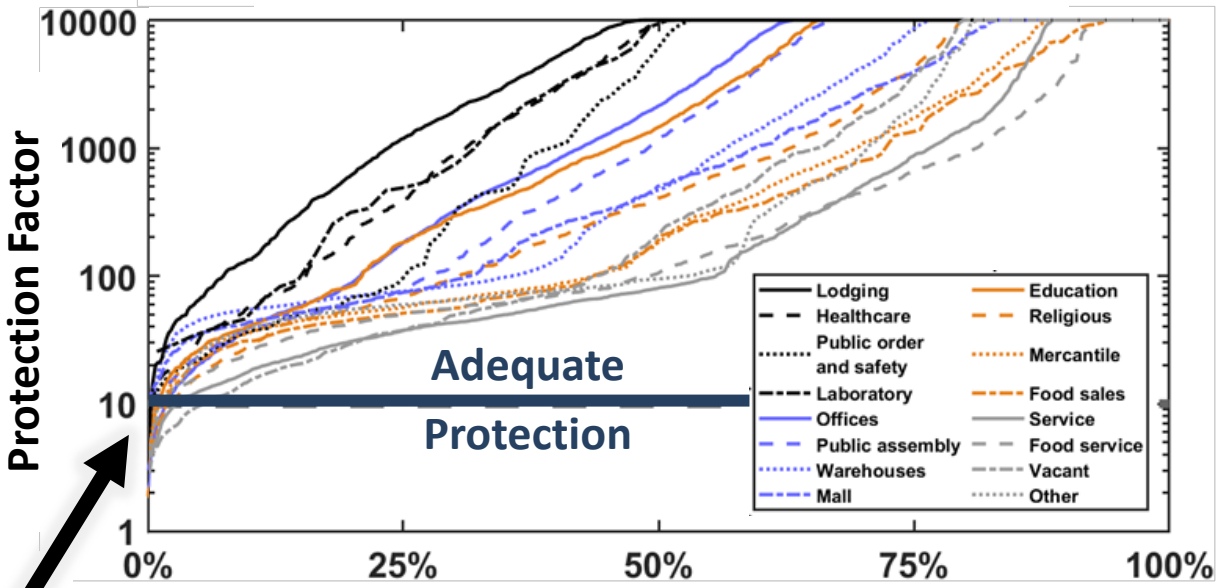
Basements provide adequate protection

Above ground US residential building protection is sensitive to the exterior wall

- Lightweight exterior (wood or vinyl siding) buildings lack adequate protection
- **Masonry exterior (brick or concrete) buildings provide adequate protection**

Most (> 90%) people in non-residential buildings have adequate protection if they go to the building center or below ground

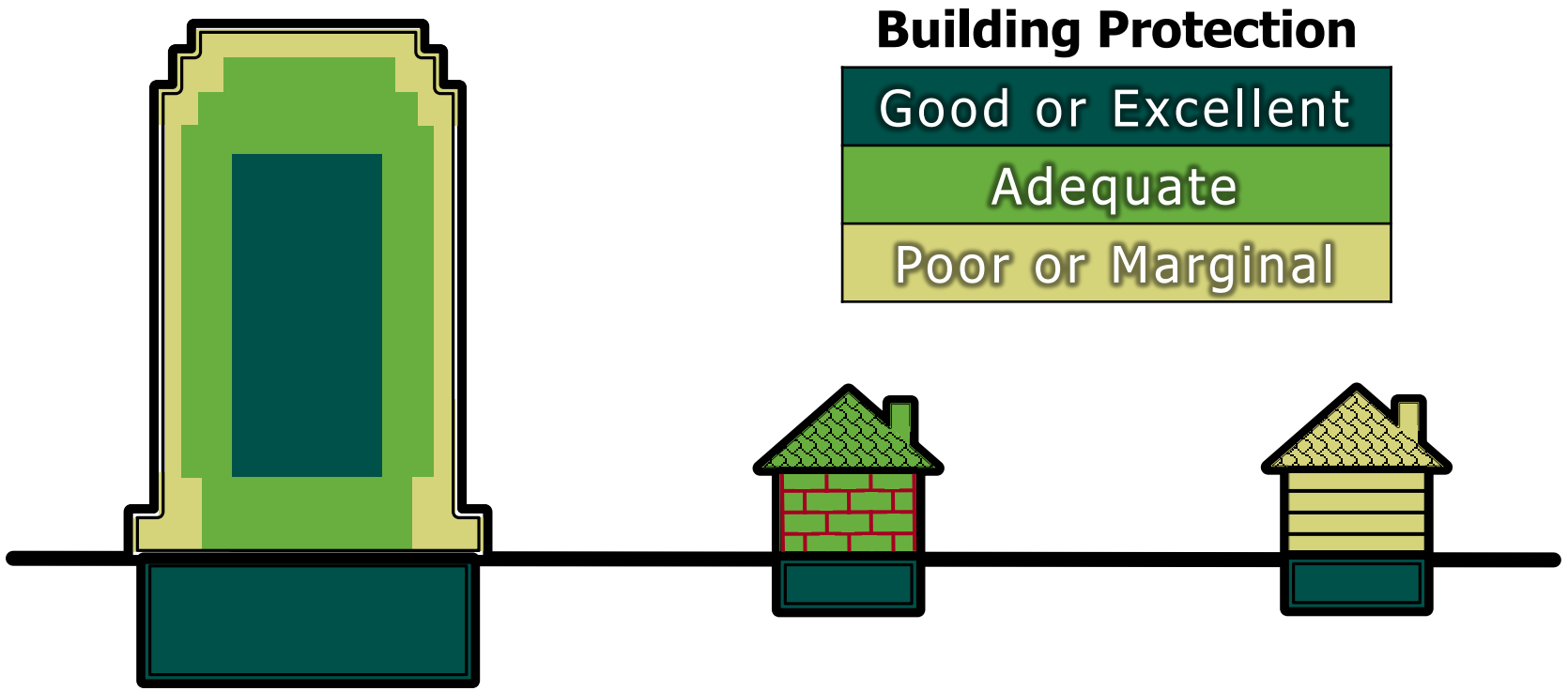
US Non-Residential Buildings
(best protection in each building)



Percent of people sheltered

For more information:
https://figshare.com/articles/preprint/US_Fallout_Shelter/20444598

Illustration of US Building Fallout Protection



Adequate or better protection prevents most severe (acute) fallout radiation injuries

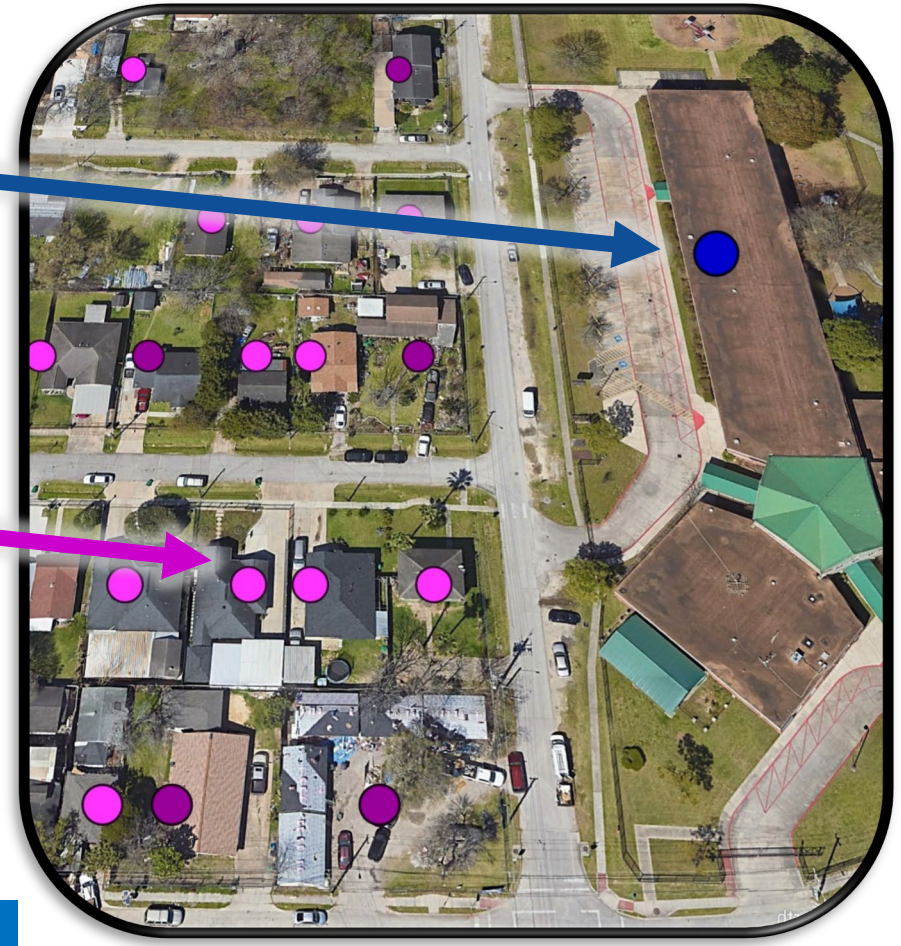
Best protection is in the building center or below ground

For more information
https://figshare.com/articles/preprint/US_Fallout_Shelter/20444598

Seek Adequate, Nearby Shelter

There may be buildings with adequate protection nearby

Many US homes lack adequate protection (people are at risk in the Dangerous Radiation Zone)



worse
population protection
better

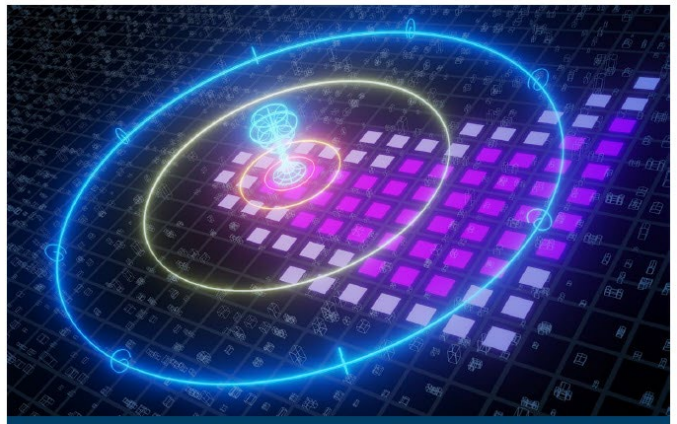
People should travel to nearby, adequate shelter (within 15 min travel)

For more information
https://doi.org/10.1098/rspa.2013.0693

Illustrative protection is shown

Recent Developments in Response Planning

3rd Edition of **Planning** Guidance published May 2022

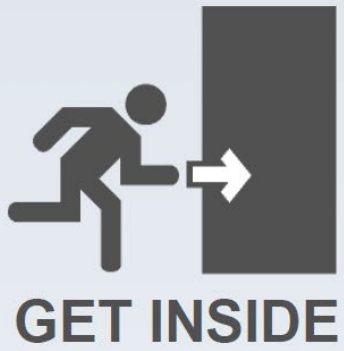


New! Companion **Response** Guidance published March 2023

Pre-scripted emergency message guides, translated into 29 languages (including Korean)

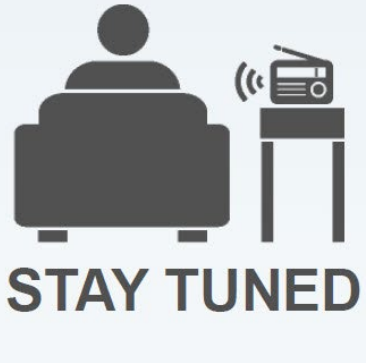
FEMA's **2024** Messaging Guidance and example messages

GET INSIDE. STAY INSIDE. STAY TUNED



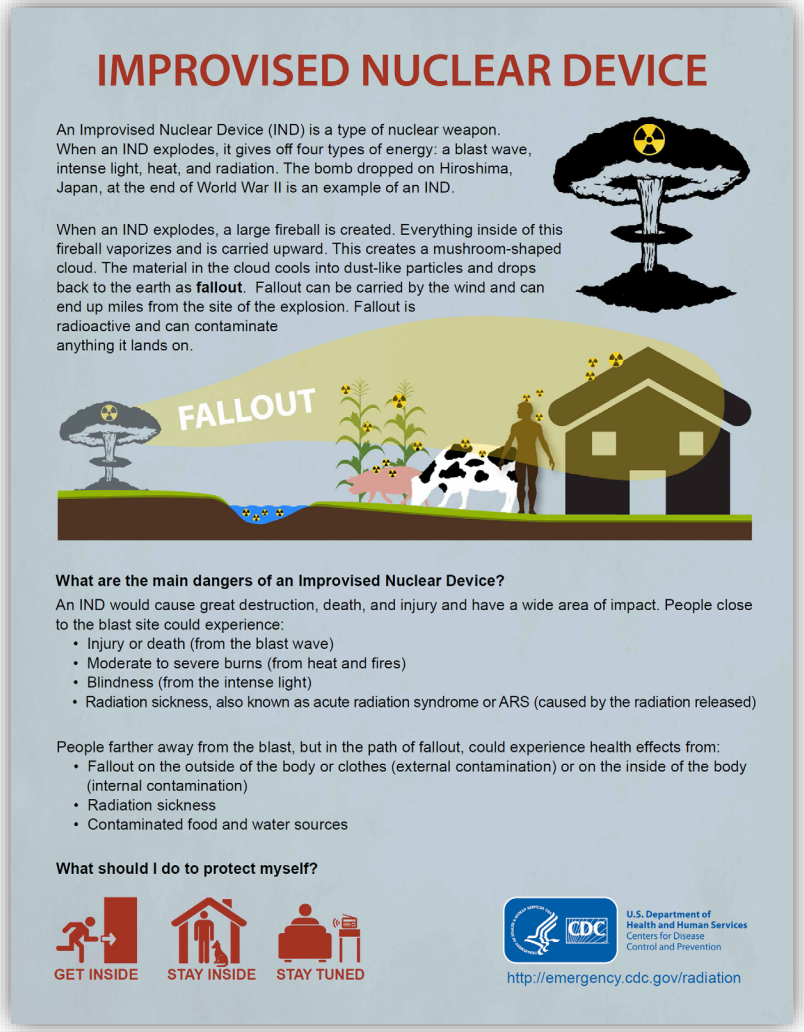
Go to the basement or the middle of a building.

Plan on 12 – 24 hours unless provided updated guidance.



AM/FM Radio is best, Cellular and Internet if available.

Public Information is Available Online



Informational Champaigns Lessons Learned (NYC, 2022)

WHERE TO GO IN A RADIATION EMERGENCY

GET INSIDE

STAY INSIDE

STAY TUNED

If a radiation emergency happens in your area, you should get inside immediately.

No matter where you are, the safest action to take is to: GET INSIDE. STAY INSIDE. STAY TUNED.

- Close and lock all windows and doors.
- Go to the basement or the middle of the building. Radioactive material settles on the outside of buildings; so the best thing to do is stay as far away from the walls and roof of the building as you can.
- If possible, turn off fans, air conditioners, and forced-air heating units that bring air in from the outside. Close fireplace dampers.
- Bring pets inside.
- Stay tuned for updated instructions from emergency response officials.

NOT SAFE

OK SAFER

SAFEST

Adapted from Ventura County Public Health, Ventura County, CA

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

http://emergency.cdc.gov/radiation

First Shelter
(Seek Adequate, Nearby Shelter)

		
Get inside a safe building or underground quickly	Plan to stay inside for 12 to 24 hours	Listen to radio, television, Internet, smartphones, etc.
The safest buildings have thick brick or concrete walls	Dangerous radiation levels decrease with time	Information and instructions will be updated
Cars will not protect you. Get indoors immediately!	Don't leave to get children. Everyone is safer staying inside	Follow instructions of emergency responders

Sheltering is the best default action to take immediately before or following a nuclear explosion

This is Where Emergency Managers Need to be Prepared…

Stay Tuned for Instructions from Emergency Officials

Local emergency officials will provide instructions on what you should do in your area.

Stay tuned to find out what further actions local officials recommend to keep you and your family safe. Emergency officials will provide information on the following:

- Where to Get Screened for Radioactive Contamination
- Mental Health
- Evacuation
- Evacuation with Pets
- Shelters
- Helping Others

CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

Emergency Preparedness and Response

What to Do During a Radiation Emergency: Stay Tuned

Language: English (US)

A nuclear power plant accident, a nuclear explosion or a dirty bomb are examples of radiation emergencies. If something like this happens, you may be asked to get inside a building and **stay inside** for a period of time instead of leaving.

It will be important to **stay tuned** once you get inside for updated instructions from emergency response officials. As officials learn more about the emergency, they will be communicating the latest information to the public. Television, radio, and social media are some examples of ways that you may receive information.

Learn more >>

Ways to Stay Tuned

- A battery-powered or hand crank emergency radio, preferably a National Oceanic and Atmospheric Administration (NOAA) weather radio is one of the best ways to *stay tuned*.
- Try to use text messages (SMS). Making phone calls could be hard.
- If you have a computer, or web-enabled device that works, use email and social media websites (like CDC Emergency on Facebook and Twitter).
- Make sure your electronic devices are working. If your electronic devices with batteries are not working, you can try taking the batteries out of the device, putting them back in, and restarting the device as normal.
- For more information on emergency preparedness kits, go to http://emergency.cdc.gov/preparedness/kit/disasters

Learn more >>

Stay Tuned for Instructions from Emergency Officials

Local emergency officials will provide instructions on what you should do in your area. **Stay tuned** to find out what further actions local officials recommend to keep you and your family safe. Emergency officials will provide information on the following:

- Where to Get Screened for Radioactive Contamination
- Mental Health
- Evacuation
- Evacuation with Pets
- Shelters
- Helping Others

More Information

Resources for Professionals

Additional Resources

CDC Radiation Risk Communication for Public Health
https://www.cdc.gov/nceh/radiation/emergencies/cerc.htm
Health & Human Services https://www.remm.nlm.gov/nuclearexplosion.htm

Public Information Officers: Information for Radiation Emergencies
https://remm.hhs.gov/remm_pio.htm

Quick Thoughts on Messaging and Communicating for Health Physicists
https://summitet.com/2021/04/15/comms-health-physics/

CBRN Responder Public Information Resources
https://www.cbrnresponder.net/app/index#resources/documents/index?rltf=104

Ready.gov - Nuclear Explosion:
https://www.ready.gov/nuclear-explosion

Hawaii's Nuclear Attack Alert

In watching interviews with people in Hawaii after the false alert, it was clear that what generated a significant amount of anxiety was not knowing what to do…

Courtesy of Honolulu Civil Beat. January 13, 2018 Article by Anthony Quintano

Nuclear Emergencies in the Age of Google…

"We were afraid to follow all of the hotel employees calmly telling us to go into a ball room. Then I googled "safety nuclear bomb how shelter" and an article by you was the first thing that popped up. In seconds I read that we should be inside and we quickly followed that advice."

"Did you ever think your article would be used in that way? If the alarm had been real, your article and the work of those researchers might very well have saved lives. I'm curious how many others followed that link today."

~ E-mail to Dave Mosher at Business Insider

BUSINESS INSIDER

SCIENCE

If a nuclear bomb goes off, this is the most important thing you can do to survive

Dave Mosher Jun. 11, 2017, 2:11 PM 233,651

An illustration of a nuclear bomb exploding in a city. Shutterstock

- A small nuclear bomb set off by a terrorist is one of 15 disaster scenarios the US government plans for.
- Such a blast would create radioactive fallout, which could kill or hurt people many miles away.
- If you were to survive a nuclear attack, you should take shelter indoors, stay put, and listen to a radio for instructions.
- Sheltering from fallout could save hundreds of thousands of lives in a city.

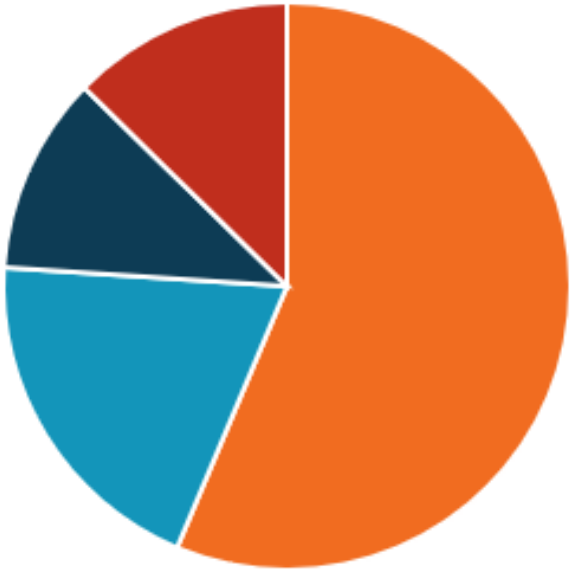
Pop Quiz

So how much of nuclear terrorism guidance applies to the Nation-State Intercontinental Ballistic Missile Threat?

1. Should work pretty well
2. Inadequate for the ICBM Threat
3. Might not have a Fallout hazard
4. Doesn't matter, we're all dead anyway

Audience participation from Riverside Preparedness

How much of this applies to a Nation-State Inter-Continental Ballistic Missile Threat?



- Should work pretty well - 56%
- ICBM effects 10X worse - 20%
- Might not have a Fallout hazard - 11%
- It doesn't matter, we're dead anyway - 13%

Immediate Response: “Duck and Cover”

A Bright Flash of Light could indicate a nearby Nuclear Detonation.

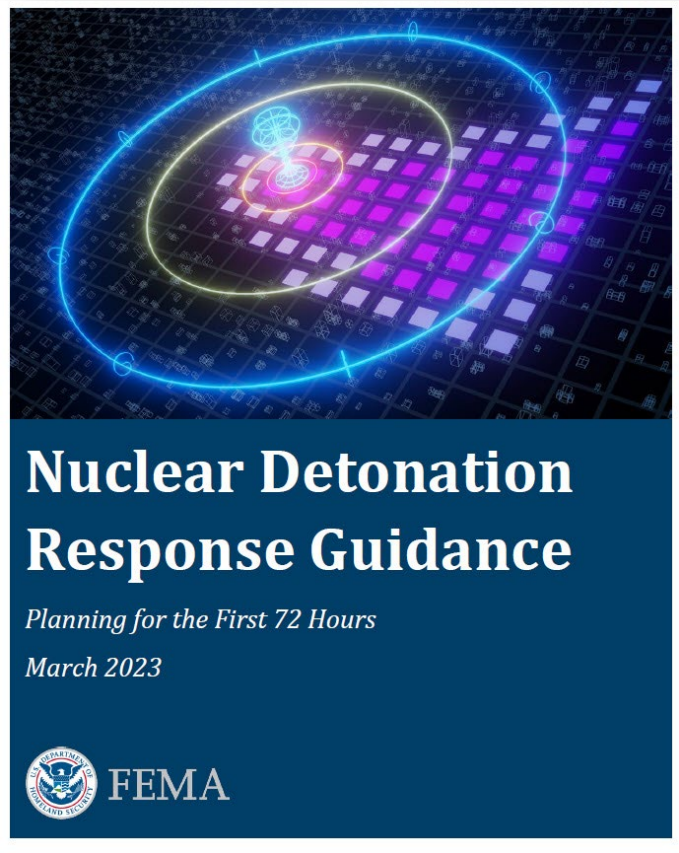
- For a large yields (> 10 kt), the thermal pulse can cause skin burns several kilometers away.
  - The pulse is intense, but short (a few seconds) so even covering with cloth or paper can protect you
- The shock wave can cause injury but may take several seconds to reach your location. You can be injured by:
  - Being knocked over and/or blown into structures
  - Flying and falling debris
  - Ear and lung injury if with kilometer
- Immediately ducking down and covering up can help protect you for these effects. This is the basis of the “Duck and Cover” program

Duck and Cover 2.0:
Addressing our Expanded Threat Base

- **Imminent Nuclear Threat**
  - Protective Actions for Prompt Effects
  - 10 – 20 minutes to get into a good shelter
  - Get inside a basement or central room away from windows and doors, stay inside, stay tuned for more information
- **No Notice Detonation**
  - “Duck and cover” for prompt effects protection
  - Prompt effect protection difficult without “hyper vigilance”
- **Nuclear Fallout**
  - 15 minutes or more to take action after detonation
  - Get inside a basement or central room, stay inside for 12-24 hours, stay tuned for more information

Get Inside, Stay Inside, Stay Tuned still works, but the details may change.

Mission 2: Gather Information



Gather Information

- Tactic 2: Characterize the Impacts
- Tactic 3: Develop a Common Operating Picture

Responder Checklist: Safety

Immediate Post-Detonation First Responder's Checklist
All responders: Go inside a thick-walled building/underground basement immediately
Responders without radiation detection equipment: ☐ Shelter inside for up to 24 hours or until informed it is safe to respond
Responders with radiation detection equipment: Assess exposure rate outside ☐ If outside radiation levels are greater than 100 mGy/h (10 R/h), stay inside and sheltered from fallout ☐ When outside radiation levels are less than 100 mGy/h (10 R/h), conduct lifesaving activities outside
Monitor total dose for each responder or use group dosimetry

Observe and Identify Immediate Impacts

Determine blast damage zone:

- Light Damage Zone (LDZ): Mostly building facade damage, nearly all windows broken,
- Moderate Damage Zone (MDZ): Large number of collapsed and unstable structures, significant injuries
- Severe Damage Zone (SDZ): Even sturdy buildings destroyed, few survivors

Determine radiation hazard zone:

- Hot Zone (HZ): Greater than 0.1 mGy/h (same as 100 uGy/h)
- Dangerous Radiation Zone (DRZ): Greater than 100 mGy/h

Assess other impacts in your area, including:

- Critical infrastructure, especially blocked roadways
- Injuries: types and severity
- Fires

Communicate Your Information

Establish communication with firehouses, police stations, hospitals, emergency operations centers (EOCs), etc.

Communicate blast damage zone, outdoor radiation levels, and other impacts to operations centers or an EOC

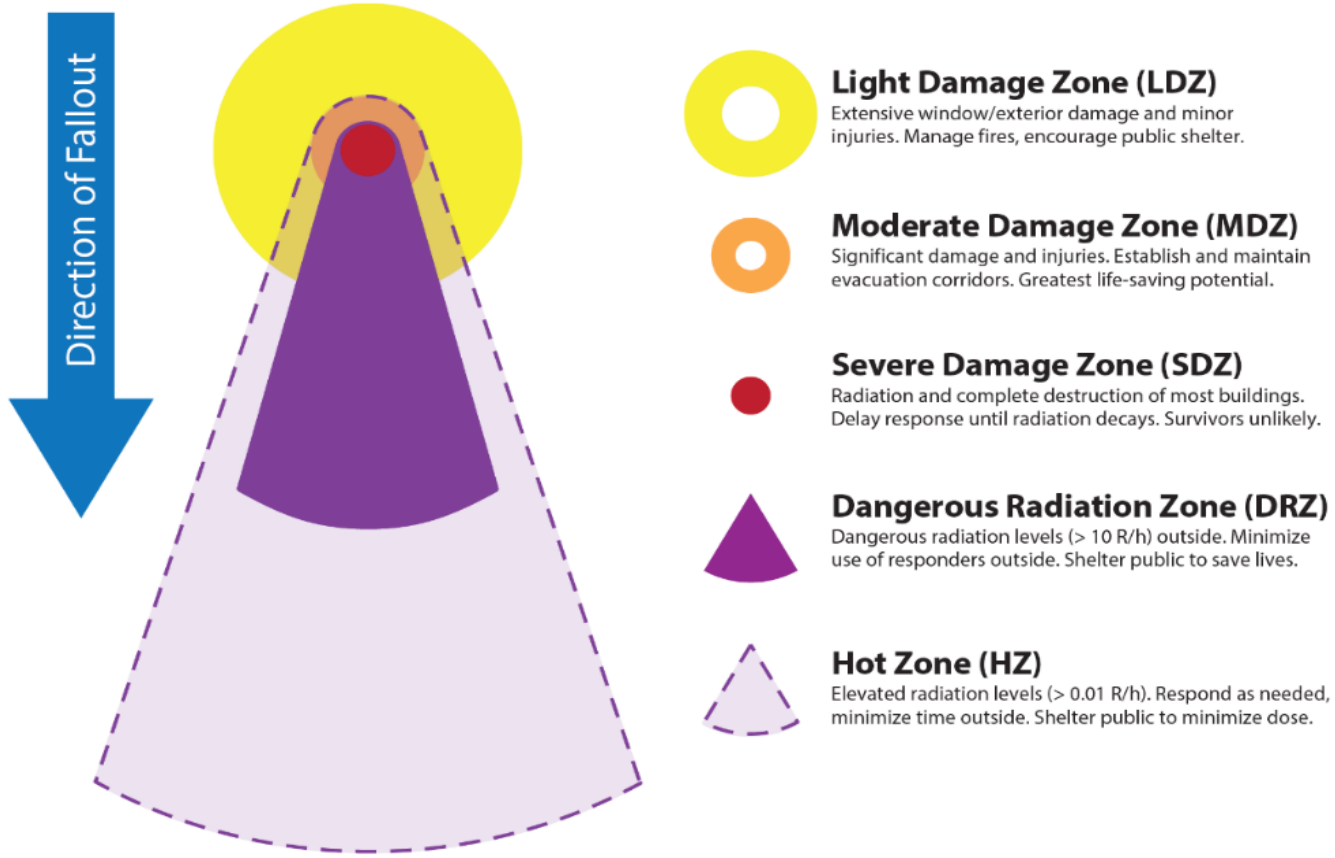
Save Lives

Refer to relevant zone-based Response Card for lifesaving priorities:

- MDZ is the early response priority with the greatest lifesaving potential

Develop a Common Operating Picture

- Establish communications with first response facilities and other assets, especially those in the Impacted Jurisdiction
- EOCs receive and map first-responder and facility **observations on** fallout, fire, blast, casualty, infrastructure impacts
- Designate and map hazard zones
- Coordinate to establish a single location where local observations impacts are aggregated into a COP

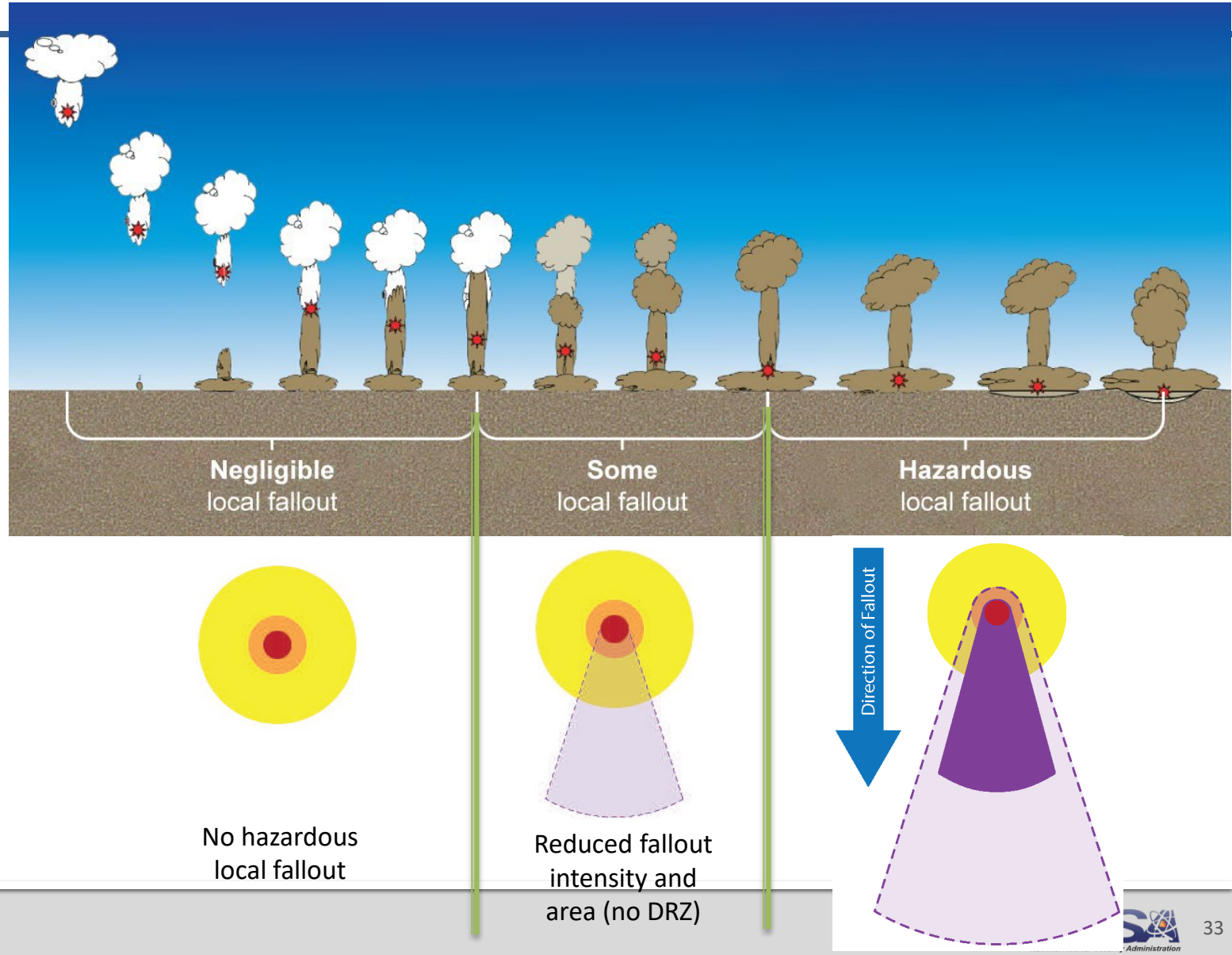


Simplified zone graphics can aid initial assessments

Variations Based on Height of Burst

For elevated detonations, fallout related zones may be reduced or absent.

- Light Damage Zone (LDZ)
- Moderate Damage Zone (MDZ)
- Severe Damage Zone (SDZ)
- Dangerous Radiation Zone (DRZ)
- Hot Zone



Build a Common Operating Picture

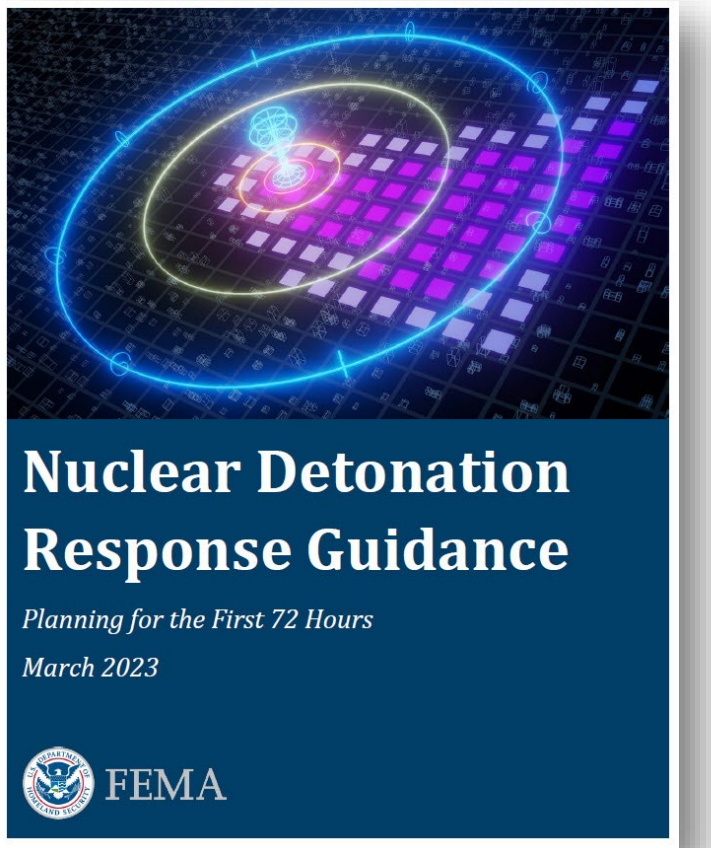
Zone	Observables
LDZ	**Extensive window/exterior damage** • Structures intact, but most windows broken • Some (mostly) minor injuries due to glass & debris • Fires possible, especially near MDZ
MDZ	**Significant Damage and Injuries** • Large number of collapsed & unstable structures • Many fatalities and severely injured. • Rubble and fires, potential for firestorm
SDZ	**Complete destruction of most buildings** • The few survivors, only in large buildings or underground. • High radiation hazard from activation and fallout.
DRZ	**Dangerous radiation levels outdoors** • > 100 mGy/h outdoor dose rates • Radiation hazard primarily first few hours, will overlap MDZ & LDZ • Outdoor radiation hazard, recedes over first day
Hot Zone	**Elevated radiation levels** • > 0.1 mGy/h outdoor dose rates • Potentially large area (100s of miles), will overlap MDZ & LDZ • Protective public to reduce reduce long term cancer concern. • May take hours for fallout to arrive in outlaying areas, recedes after a day

Zones are based on **observables** and **measurable** radiation levels.

Information should be reported back to a centralized location.

Vista Forge Seminar of Tactic 3

Missions 3 & 4



Organize the Response

- Tactic 4: Initiate a Zone-Based Response
- Tactic 5: Establish Area Command
- Tactic 6: Sustain Critical Infrastructure

Provide Care to Survivors

- Tactic 7: Evacuate
- Tactic 8: Triage, Stabilize, and Transport
- Tactic 9: Decontaminate

Public Shelter / Evacuation Strategy

Zone Type	Shelter and Evacuation Priorities
LDZ	Instruct public to shelter inside. ▪ Conduct targeted evacuation of unsafe areas (e.g., fires, heavy smoke, unstable structures). ▪ Direct evacuees towards safety and away from HZ. Do not prevent spontaneous evacuation.
MDZ	Instruct public to evacuate towards the LDZ and away from the HZ. ▪ Prioritize assisted evacuation for the non-ambulatory. ▪ Recruit volunteers to support evacuation.
SDZ	Instruct everyone – responders included – to remain sheltered indoors. ▪ Move if shelter threatened by fire, collapse, or other hazards. ▪ Prepare to evacuate once radiation levels are less than 10 R/h. ▪ Consider evacuating through subterranean structures (e.g., subways, tunnels).
DRZ*	Instruct everyone – responders included – to remain sheltered indoors. ▪ Prepare to evacuate (in 12–24 hours) once radiation levels are less than 10 R/h. ▪ Consider evacuating through subterranean structures (e.g., subways, tunnels).
HZ (beyond MDZ & LDZ)	Instruct public to shelter inside. ▪ Targeted evacuation of unsafe areas (e.g., fires, heavy smoke, unstable structures). ▪ Direct self-evacuees towards safety and away from HZ: Do not prevent spontaneous evacuation.

* For areas in the MDZ and LDZ that are also in the DRZ, follow the DRZ shelter/evacuation priorities until radiation decays below DRZ levels.

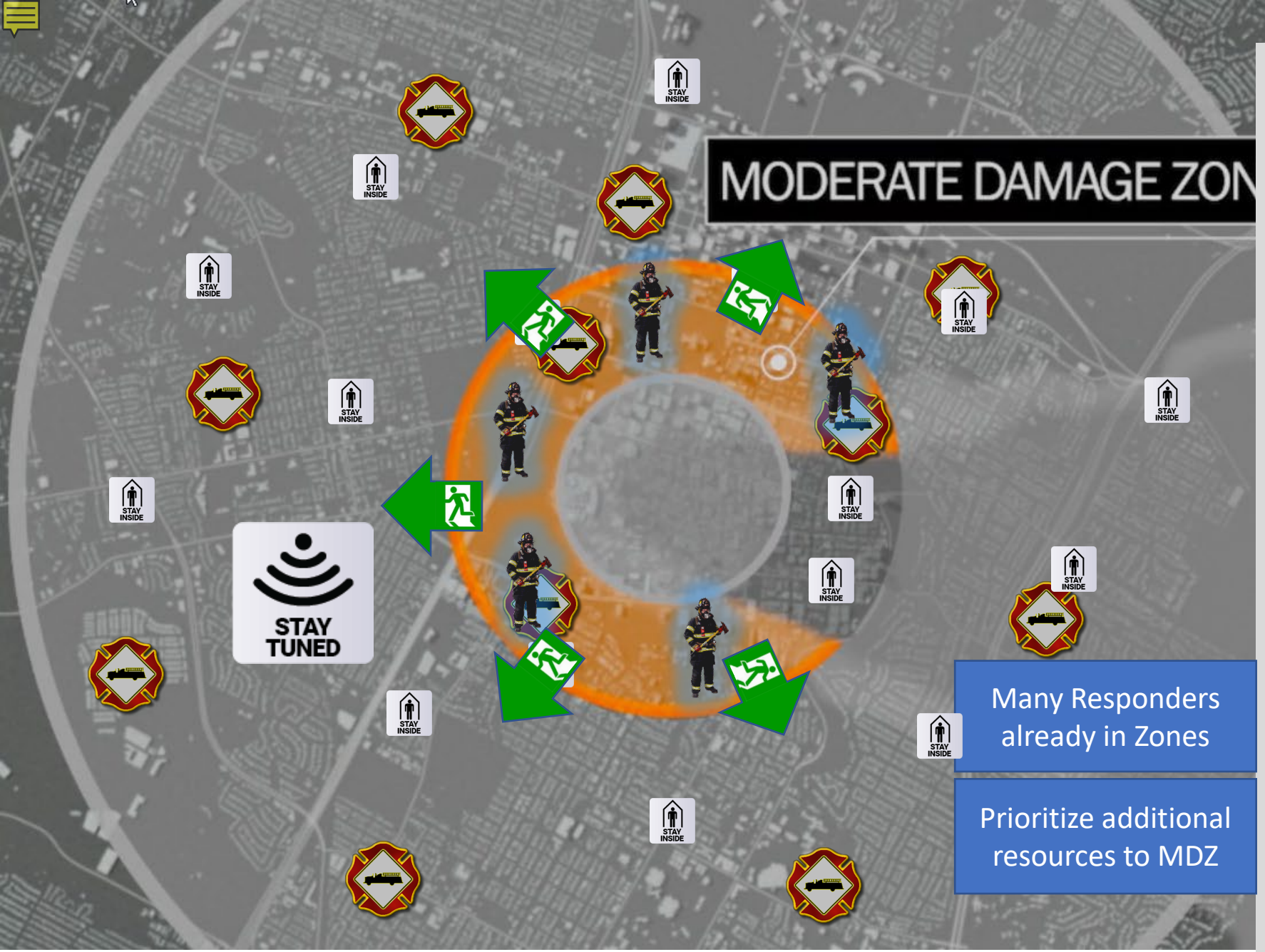
- **SHELTER** is the priority in all zones…
- **EXCEPT** the Moderate Damage Zone…
- **Outside** of the Dangerous Radiation Zone..

Fire Stations

MODERATE DAMAGE

IMPACTS

- Moderate to Major damage, large number of collapsed or partially collapsed structures
- Large number of fatalities and severely injured
- No power, though most battery-operated equipment should function
- Fires



PUBLIC ACTION

- Shelter unless threatened by fire or collapse
- Tune in and evacuate where and when safe to do so

RESPONSE PRIORITIES

- Defensive firefighting tactics; maintain evacuation corridors
- Rapid, assisted evacuation
- Triage and forward injured to care centers

RESPONDER SAFETY

- PPE for non-radiological hazards (sharps, silica dust, fire, & unstable piles)
- Monitor radiation levels, do not enter SDZ or DRZ without plan
- Gross decon after shift

MDZ Evacuation will Initially be Done with Minimal Resources

- Resources not available for traditional urban search and rescue
- Conduct defensive actions to maintain evacuation corridor
- Use whatever communication method you can (including bullhorns)
- Promote self-help and volunteers to evacuate injured

Expanding Evacuation Areas

Population Decontamination Issues

Fallout Decon

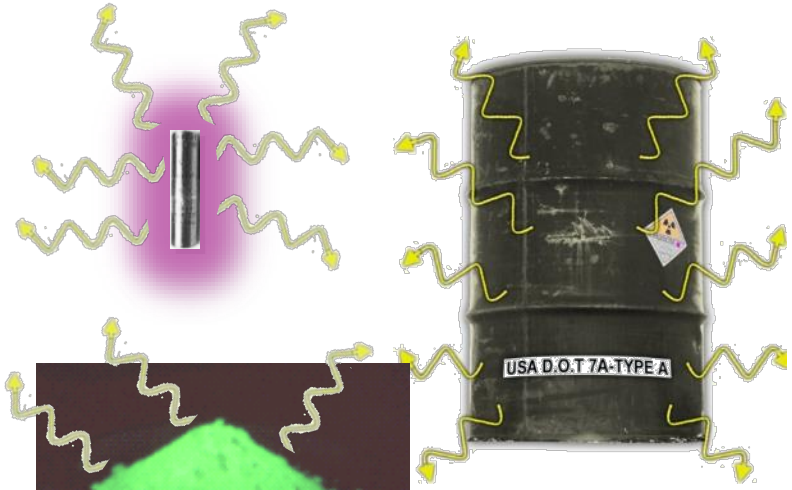
Entering Shelter

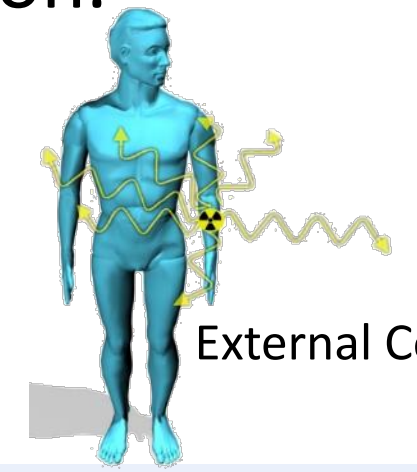
- Simple self-decontamination techniques (such as removing outer clothing, showering, and brushing away fallout material) are effective.
- Techniques should be used as the impacted population leaves the high-hazard zone or enters a shelter

Protecting Responders

Radiation is energy; Contamination is material

- Exposure to ***Radiation*** will **not** contaminate you or make you radioactive.
- ***Contamination*** is loose radioactive material spilled someplace you don't want it.
- Radioactive contamination emits radiation.
- Contact with ***Contamination*** can contaminate you with the material.





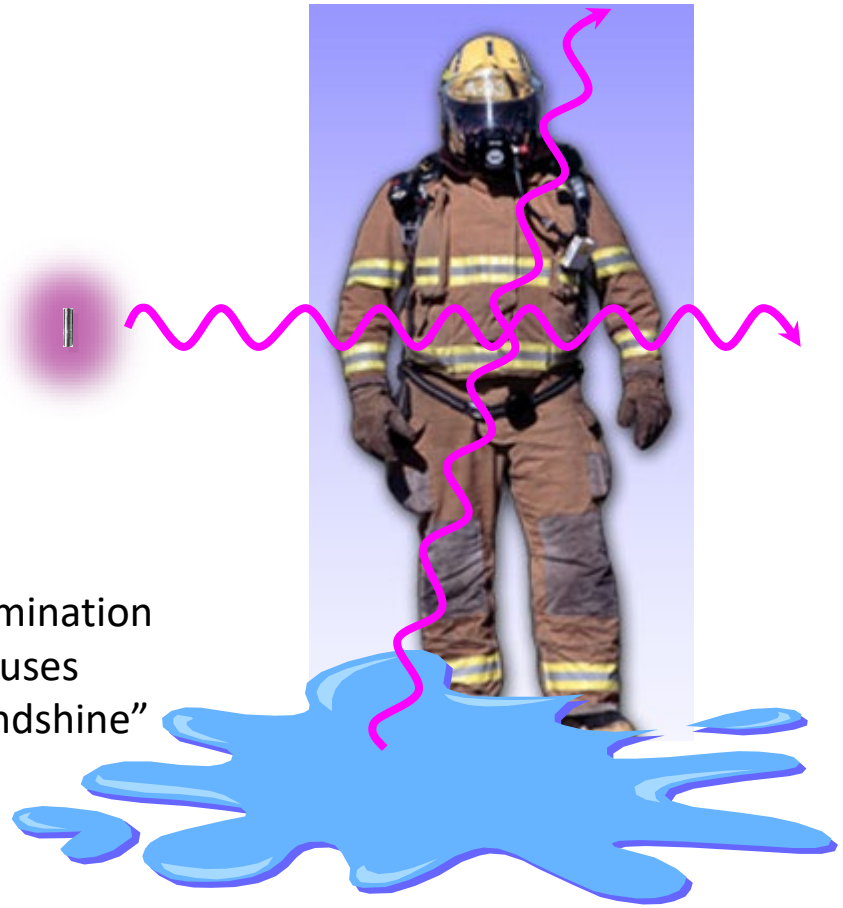
External Contamination

Image Credit: Department of Energy Transportation Emergency Preparedness Program Training

Exposure & Contamination

Penetrating Radiation Exposure (External)

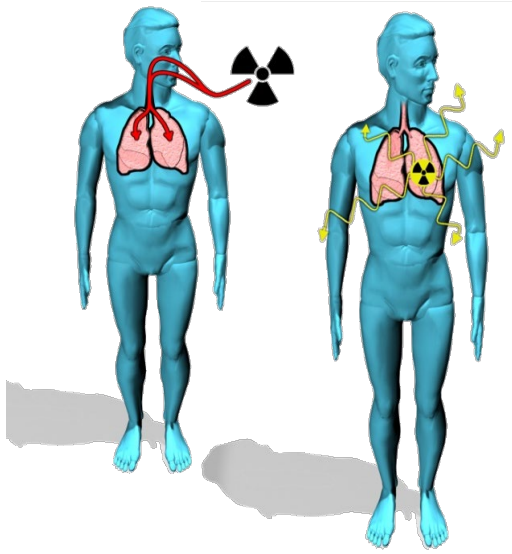
PPE <u>does not</u> protect against this



Contamination causes "groundshine"

Internal Contamination

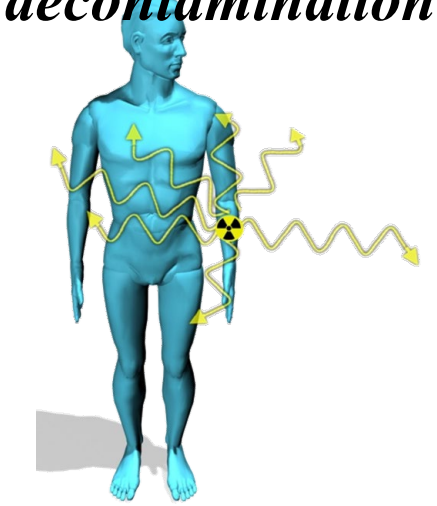
PPE can prevent inhalation



<u>But</u> not all radioactive sources (like fallout) are inhalation hazards

External Contamination

PPE can facilitate decontamination



<u>But</u> radioactive contamination is not a life safety hazard

Pop Quiz: What is the Right Emergency Worker PPE?

1. Level D
2. Level C / Class III or IV
3. Level B / FF Turnouts + SCBA
4. Level A

1

2

Level C / Class III

3

Level B / FF Turnouts + SCBA

4

Level A

Personal Protective Equipment (PPE)

SCBAs, Respirators, Firefighter "turnouts", Level A, B, or C HAZMAT suits do not protect against the primary hazard - the penetrating gamma radiation given off by fallout.

- **Radiation / dose monitoring primary protection**
- **Inhalation & ingestion is a secondary concern compared to the external exposure.**
- **Turnouts and anti-contamination clothing can help ease decontamination after entries, but not required for time-critical, life saving activities.**

"Reducing the time spent in high dose-rate areas is the greatest protective measure. Bulky isolation suits and elaborate respiratory protection methods may actually increase exposure as they reduce the speed, the ability to communicate, and worker efficiency."

~Key Response Planning Factors for the Aftermath of Nuclear Terrorism

Responder Inhalation and Decontamination Issues

- Examples from our Nuclear Tests

Select PPE based on the Non-Radiological Hazards

- Sharp debris
- Silica dust
- Fires
- Unstable structures

etc

Protecting Response Personnel

- Responders without radiation detection instruments: Follow the general public protection strategy.
- Responders with radiation instruments: Shelter using radiation detection equipment to monitor shelter conditions.
  - Do not exit shelter or enter areas if radiation levels exceed 10R/hr unless there is a time critical life safety issue (e.g., avoiding fire or building collapse).
  - Provided outdoor radiation levels are below 10R/hr, perform scene assessment of the immediate area for hazards.

Emergency Worker Safety Requirements

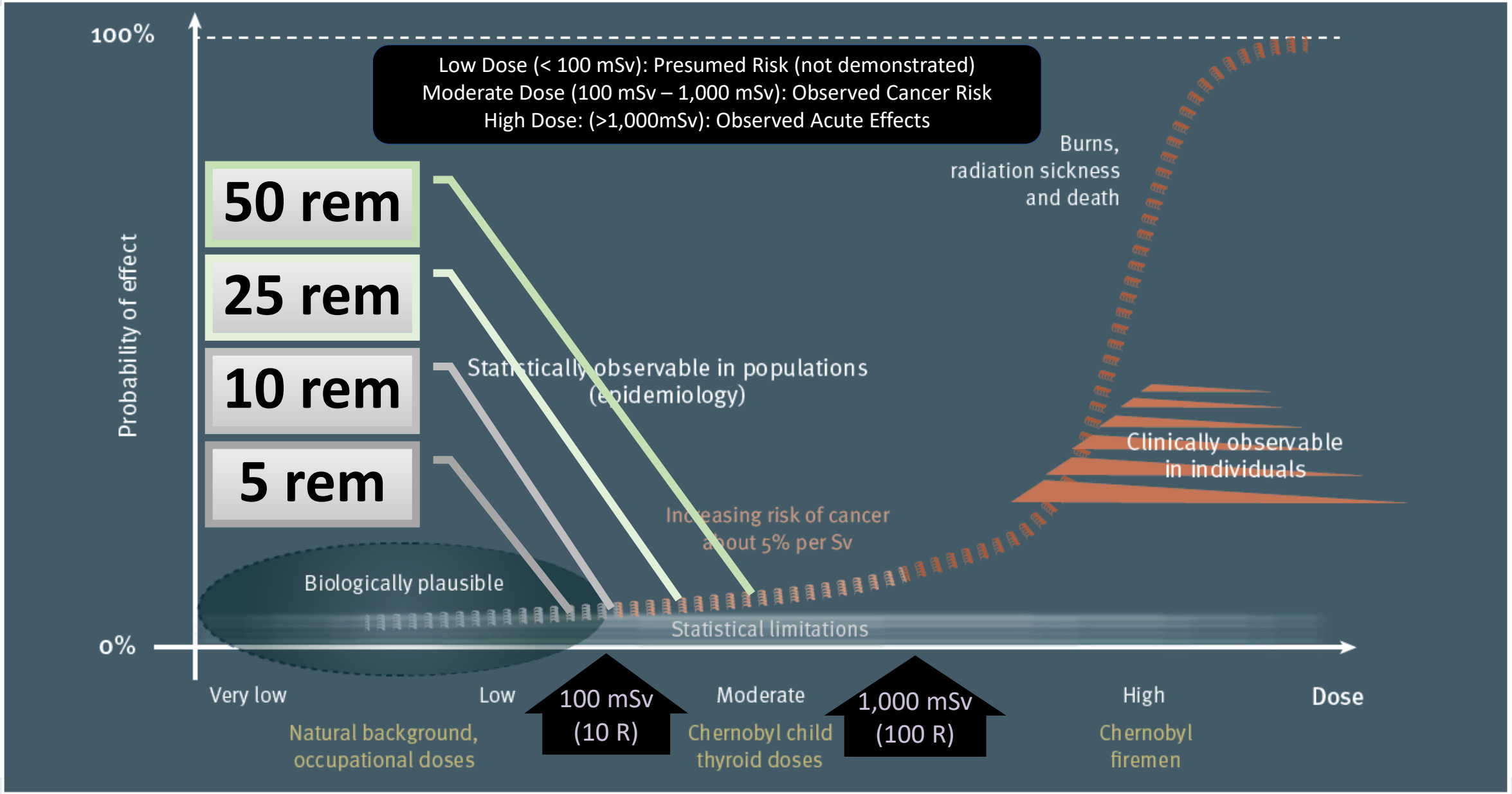
- Emergency worker:
  - Not just firefighters and police officers; may include other public/private sector staff supporting the response
- Personal protective equipment (PPE):
  - PPE, other than rad detection equipment, should be selected based on non-radiological hazards (e.g., sharp debris, silica dust, fires, unstable structures)
- Emergency dosimetry:
  - Establish dose decision-points
  - Implement group dosimetry techniques
  - Observe ALARA ("as low as reasonably achievable")

Decision Point	Activity	Condition
50 mSv (5 rem[a])	All occupational exposures	All reasonably achievable actions have been taken to minimize dose.
100 mSv (10 rem[a])	Protecting valuable property necessary for public welfare	Exceeding 100 mSv unavoidable & all actions taken to reduce dose. Monitoring available to project or measure dose
250 mSv (25 rem[a])	Lifesaving or protection of large populations	
250 mSv (>25 rem[a])		All conditions above & only for people fully aware of the risks.
500 mGy (50 rad[b])		NCRP recommended decision-point for whether to withdraw a responder from the hot zone.

[a] EPA Protective Action Guides Manual. 2017. (link).
[b] NCRP Commentary No 28

Relationship of radiation doses and health effects

UNEP; RADIATION EFFECTS and SOURCES
http://www.unscear.org/unscear/en/publications/booklet.html?print



Conclusions

- Sheltering can save lives!
  - Shelter population and responders out to 80 km (50 miles) until fallout direction and magnitude is established.
  - Use visual observations of the damage, early fallout cloud, and detector readings to determine the magnitude to fallout and effects.
- Use the Zone-based response approach to:
  - Quickly build a common operating picture
  - Establish priority zones
  - Implement predetermined public and responder actions within each zone
  - Establish responder safety protocols
- Responder Safety
  - Those without radiation detection should wait until hazard extent established
  - Primary radiation hazard is EXTERNAL grounds shine, not a respirable hazards.
  - PPE requirements should be selected based on the NON-Radiological hazards.