PREPTalks

New perspectives for emergency managers

Discussion Guide
Saving Lives After a Nuclear Detonation
Brooke Buddemeier

PrepTalks Discussion Guides provide a framework for community leaders to translate insights from the PrepTalk into community planning and outreach. Community leaders can use the PrepTalks materials at meetings, workshops, and conferences to address critical emergency management topics with whole community partners.

Brooke Buddemeier – Saving Lives After a Nuclear Detonation

Brooke Buddemeier is a certified health physicist at Lawrence Livermore National Laboratory where he focuses on radiological and nuclear terrorism risk assessments and response planning. His modeling of nuclear detonations demonstrates how getting indoors can save lives from the blast effects and fallout. His PrepTalk educates emergency managers, community leaders, and the public on the effects of a nuclear detonation, critical protective actions, and the role of local emergency responders.

Buddemeier is a council member on the National Council on Radiation Protection and Measurements. He served on the writing committee for Responding to a Radiological or Nuclear Terrorism Incident: A Guide for Decision Makers and is the author of Reducing the Consequences of a Nuclear Detonation: Recent Research and Guidance.

> *The most important life-saving decisions are those made in the first few minutes and hours of the event.*
>
> — Brooke Buddemeier

Partners for the Discussion

Buddemeier emphasizes the importance of sharing information about the protective actions for a nuclear detonation and their effectiveness with the public. He also identifies the many resources and tools for emergency managers that support planning, public education, and crisis communications.

Emergency managers should view the video and discuss this important topic with elected officials; leaders and staff from emergency management agencies; public works; police, fire, and emergency medical services; and members of the community's health care organizations. Use this discussion guide to develop strategies for public education, immediate public alerts and warnings, emergency responder safety, clearing debris, and post-event communications with the public.

FEMA · IAEM International Association of Emergency Managers · NEMA National Emergency Management Association · National Homeland Security Consortium · Center for Homeland Defense and Security, Naval Postgraduate School

Discussion Topics

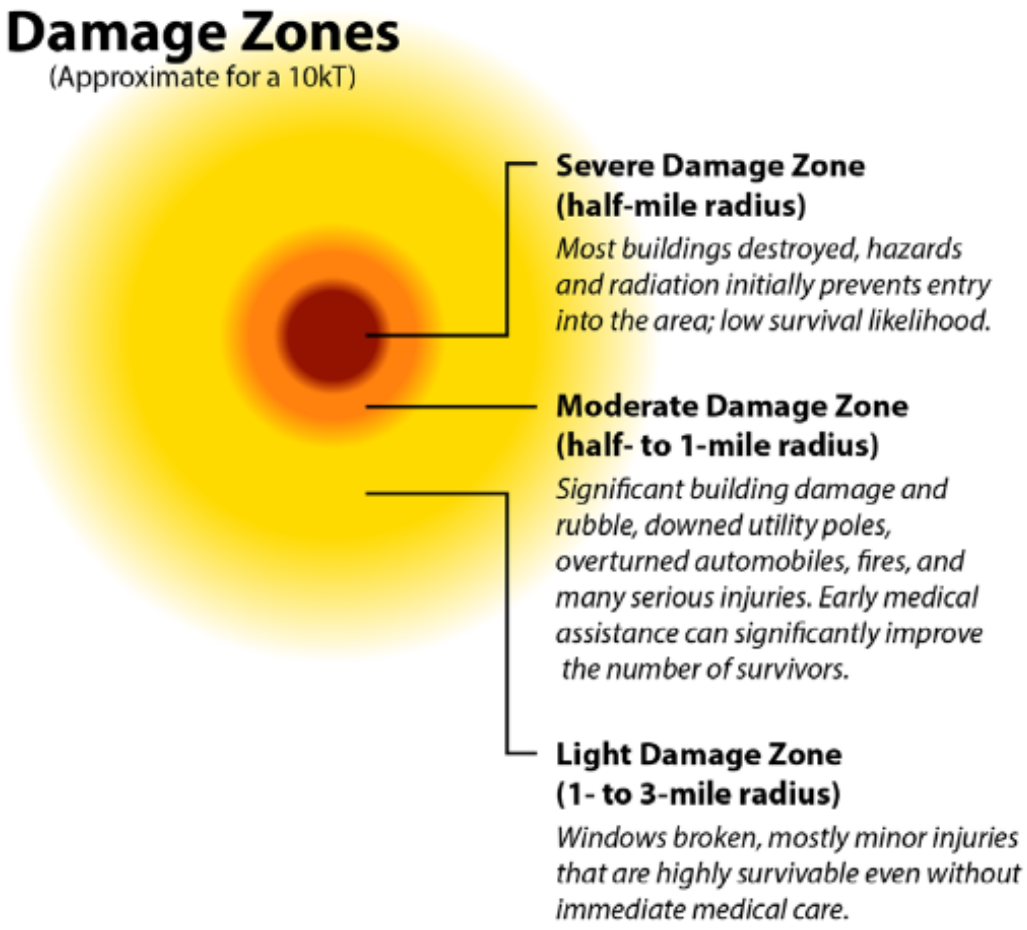
Topic 1: Understanding Nuclear Explosions

Buddemeier provides a clear explanation of the components of a nuclear detonation:

- An explosion that creates an intensely bright flash and causes temporary flash blindness;
- A blast wave that travels through the air, damaging buildings and causing injuries; and
- Radioactive fallout, composed of dirt and radioactive material, that rises immediately after the explosion and falls back to earth.

Damage Zones: Severe, Moderate, Light

Forecasting damage from a 10kT blast is based on distance from the detonation site and falls into three zones: severe, moderate, and light. All three zones may experience some effects from an electromagnetic pulse (EMP), a high-voltage surge that that may damage electronic equipment.



Source: Courtesy of Livermore National Laboratory

Fallout: Radioactive Particles

Buddemeier explains that a nuclear detonation near the ground produces a fireball that rapidly shoots up into the atmosphere pulls up thousands of tons of dirt and debris. This creates the iconic mushroom-shaped cloud. The cloud stabilizes in the upper atmosphere where radioactive material produced in the explosion mixes with the dirt and small particles of debris from the detonation.

Fallout is the term for when these particles fall back to earth, collect on surfaces, and give off dangerous radiation. Significant fallout can extend 10 to 20 miles from the blast. Going inside a building to shelter as far away from these particles is the best protective action. People will have at least 10 – 15 minutes after the detonation to get inside before the fallout begins.

> *The silver lining of the fallout cloud is that radiation decays rapidly – over 80 percent the first day.*
>
> — Brooke Buddemeier

Buddemeier's presentation includes an animation demonstrating the fast nature of radiation decay. For the first few hours after the blast, the dangerous fallout zone can grow and spread. But after those first few hours, the dangerous area starts to shrink. Much of the danger from radiation is reduced after the first 24 hours.

Buddemeier also explains that winds near the top of the fallout cloud travel much faster than winds near the ground and might be in a different direction than wind at ground level. This makes it difficult to predict the path of the fallout cloud using wind speed and direction at ground level.

Breathing In Radioactive Particles

The potential radiation dose from inhaling or ingesting radioactive particles (internal contamination) is significantly less than the external radiation doses from nuclear fallout. The public should not spend time on seeking respiratory protection, but should go inside as quickly as possible. In public messaging, it is important to understand that internal contamination can be a source of anxiety and concern for the public.

Types and Delivery Methods of Nuclear/Radiological Devices

Higher-Yield Nuclear Devices: Buddemeier explains that most modeling done for nuclear terrorism uses a 10kT device because it was the size of America's first few nuclear explosive devices. He also explains that a nuclear device 10 times the size, or 100kT, would result in only doubling the size of the damage zones. Therefore, planning based on a 10kT device is adequate for emergency response preparation and training.

Nuclear Missiles: If a nuclear weapon is delivered via missile, some advance notice to the target area is likely, possibly 15–20 minutes or more. With advanced notice, taking shelter in a basement or the middle of building without a basement is the best protective action to survive the effects of the blast. If the missile detonates in the air, the potential for fallout is greatly reduced or eliminated because the radioactive material does not mix with dirt and debris from the ground. Damage from the blast will be far-reaching, so staying inside and following instructions from authorities is still the best course of action.

Dirty Bomb or Radiological Dispersal Device (RDD): An RDD is NOT a nuclear explosion. Rather, it is a chemical explosive device that also disperses radioactive material. The radioactive material does not create a larger explosion, but it complicates the response by introducing hazardous material to the scene of the explosion. RDDs are much smaller than nuclear explosions and might only create a radioactive "hot zone" of a few blocks, whereas the hot zone from a nuclear explosion can extend for hundreds of miles. Radiation levels from RDDs are much lower and are not anticipated to pose an immediate health risk to anyone outside of the immediate area of the explosion.

Questions for Discussion

- ❑ Do emergency response personnel and elected and community leaders in your community understand the different effects of a nuclear detonation?
- ❑ Does your emergency response plan include a process for defining damage zones (based on limited initial incident information)? The new Rapid Rad/Nuc Hazard Assessment Tools under development for local emergency managers will quickly provide key response and public hazard information after a nuclear detonation.

Topic 2: Advance Public Education: Sheltering Saves Lives

Buddemeier notes that many people, including emergency managers, believe that the consequences of a nuclear detonation would be so catastrophic that little could be done at the local level. However, recent modeling of the effects of a 10 KT nuclear detonation in an urban setting suggests that ***hundreds of thousands of potential casualties can be avoided if people simply go indoors***.

> *Casualties from fallout are almost entirely preventable.*
>
> — Brooke Buddemeier

Fallout generally begins to accumulate about 15 minutes after the explosion; this window gives survivors of the blast time to find adequate shelter. The protection factor (PF) of a shelter location depends on the shielding from radiation offered by walls and the distance from outdoor fallout particles. Fallout particles will coat the ground, buildings, and other horizontal surfaces outside. Even the basement of a one story-wood frame building can increase protection from radiation by a factor of ten, which is considered adequate by the Federal Planning Guidance for Response to a Nuclear Detonation, Second Edition.

Buddemeier provides an example analysis of a 10kT explosion in Washington, DC. If everyone stayed outside for the first 12 hours in this scenario, there would be 280,000 casualties from fallout radiation. But if everyone in the area just went into an adequate (PF of 10) shelter, like the basement a single-story home or a multistory brick building, this action would ***prevent*** 245,000 significant radiation exposures.

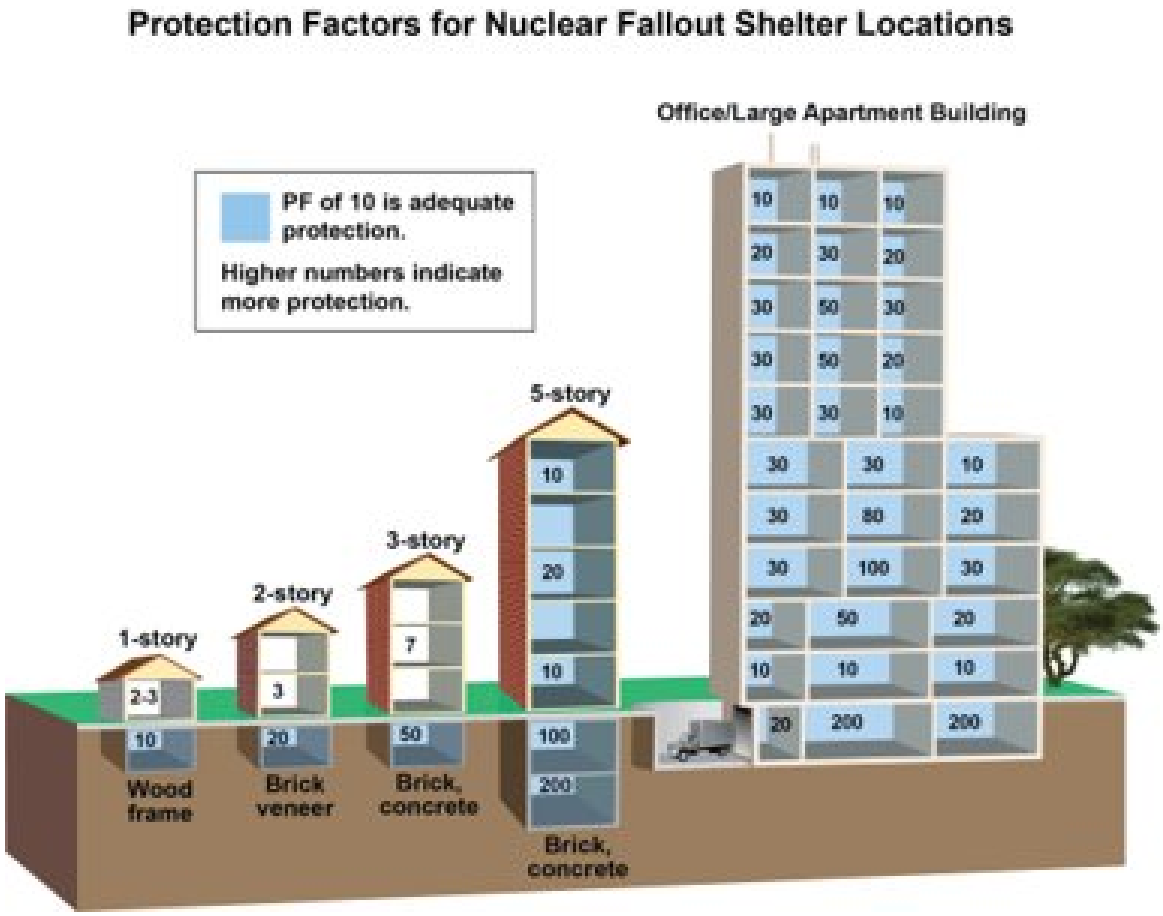
To be effective, public education should promote a sense of **self efficacy** (*I can take action to keep myself safe*) and **response efficacy** (*these actions will make a difference to the quality of my survival*).

Protective Actions of Nuclear Detonation

- Sheltering is best. You will generally have 15 minutes or more to find adequate shelter before radioactive fallout begins.
- Do not try to reunite with family members before taking shelter.
- Stay sheltered for 12–24 hours and listen to authorities.
- If people who were outside when the fallout began come to your shelter location with fallout particles on their clothes or hair, let them in! Decontamination (removing the fallout) is quick and simple.

Shelter Protection Factors

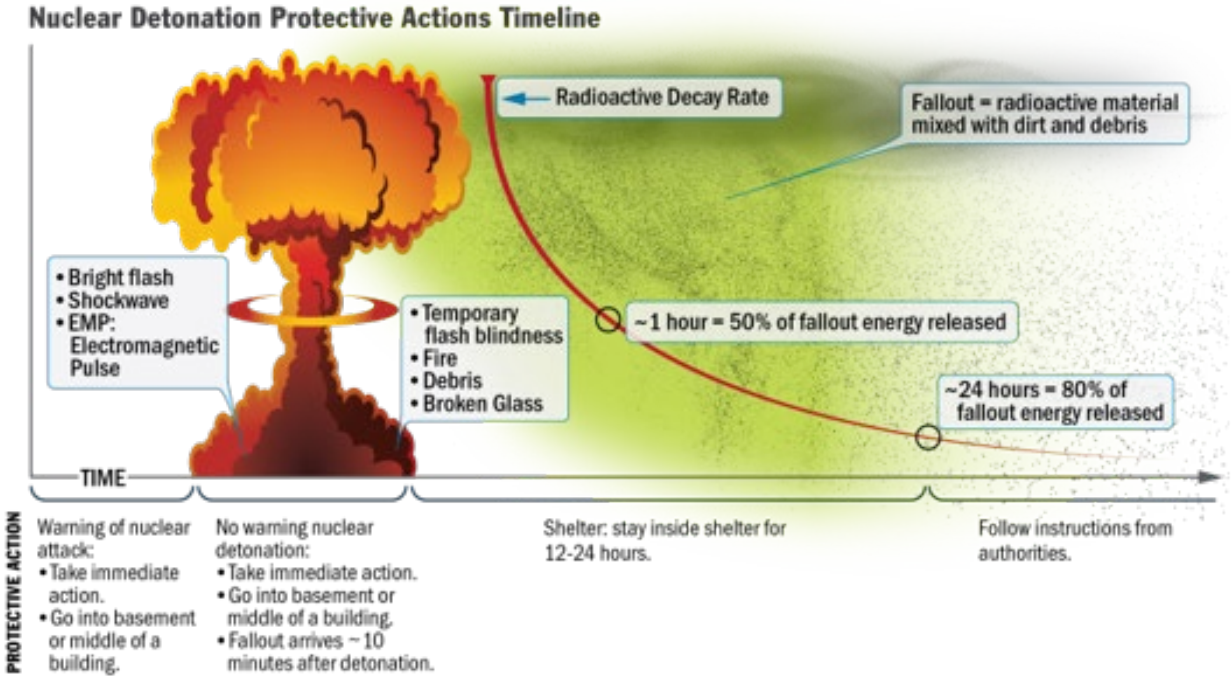
The higher the number, the greater the protection from radioactive fallout. Note that even the basement of a wood frame structure provides adequate protection. The subfloors or core of office/apartment buildings provide high levels of protection (PF of 100 or higher).



Source: Courtesy of Livermore National Laboratory

Protective Action Timeline

When a nuclear device detonates without warning, blast effects will occur immediately. However, the timeline below shows that even in a no-notice event, individuals still have time to protect themselves from radioactive fallout.



Source: Adapted from Buddemeier's PrepTalk Presentation

Decontamination

If individuals are outside when the fallout begins, they need to get clean (a.k.a. decontaminate) once they get to a shelter. Most individuals believe that decontamination is or should be a complex process, but Buddemeier notes that it is, in fact, relatively simple.

Simply brushing off fallout particles can be effective for expedient decontamination. Additionally, removing the outer layer of clothing and, if possible, wiping or washing with soap and water the skin that wasn't covered by clothing, reduces exposure. Individuals already in a shelter must understand that letting individuals who have been exposed to fallout inside the shelter will not endanger their lives.

Questions for Discussion

- ❑ Have you included education on protective actions for nuclear detonation in your public outreach efforts? Providing information that people can survive a nuclear detonation and explaining the important steps to take will help motivate people to take appropriate protective action in the moment.

- ❑ Do community leaders know and understand the components of a nuclear detonation and the protective actions for fallout? Specifically, business owners, homeowners associations, school principals and teachers, and faith-based leaders. These community leaders can spread the message to help others be prepared. Make sure these community leaders have a point of contact who can answer clarifying questions to build confidence in providing guidance to others.
- ❑ Have you provided community leaders with readily accessible, authoritative resources to support appropriate protective action measures? The Centers for Disease Control and Prevention has a number of resources that support public education before and during the event. These include a YouTube video (Protective Actions for Radiation Emergencies – Self-Decontamination), Radiation Basics Made Simple, Myths of Radiation, a Radiation Hazard Scale, and a Thermometer that helps people understand common radiation doses and assess their risk.
- ❑ Understand likely public reaction to a nuclear explosion and develop communication strategies and messages to encourage positive behaviors. Social, Psychological, and Behavioral Responses to a Nuclear Detonation in a US City: Implications for Health Care Planning and Delivery reviews the research of the public's response to similar events and notes that positive behaviors are supported by "perception of a common fate, social norms, unambiguous need, and knowledge of an appropriate response or action.
- ❑ Consider the buildings in your community. What sheltering quality do the buildings provide? The IND City Planner Resource (iCPR) Tool has precalculated nuclear detonation effects for 60 US cities. This FEMA tool also analyzes detonation effects on infrastructure and provides local shelter data. For more information, contact the FEMA Response Directorate's CBRN Support Branch at cbrn@fema.dhs.gov.

Topic 3: Post-Detonation Communications and Immediate Response

During the first minutes and hours of a nuclear event, local decision makers will have limited information, but must provide guidance to encourage individuals to take proven protective actions.

> *Emergency managers, [the public] is looking for you to provide a message… informed by situational awareness. Where is the best place to go? How do you avoid fallout?*
>
> — Brooke Buddemeier

Work with your crisis communications team to develop templates for messages, on shelter locations, fallout, and decontamination. Watch the Prep Talk on Modernizing Public Warning Messaging by Dennis Mileti to learn about effective communications to the public. Discuss to whom and how you will send these messages, including backup plans if your traditional communications capabilities are compromised by the EMP.

After the immediate, live-saving messaging, and when the risk of significant fallout exposure has passed (12-24 hours), communications need to address post-sheltering priorities and movement. Emergency response will be impacted by the debris from the blast and congested roads, and communications should outline

emergency response plans and include the public as partners in the response. Making the public partners in the response means requesting that only critically injured people go to hospital and explaining how to use text messages and social media to communicate with family and friends.

Questions for Discussion

Communication

- ❑ Does your public emergency preparedness communication strategy include guidance on protective actions for a nuclear detonation? The public needs to know that sheltering immediately after a nuclear detonation to save their life and the lives of family and neighbors.
- ❑ Improvised Nuclear Device Response and Recovery: Communicating in the Immediate Aftermath has ready-to-use draft key messages. Are these messages are programmed into all communication systems and tested in exercises? Pre-scripted social media messages and links to radiation safety infographics for nuclear detonations can be found in sections 8 and 9 of the Radiological Annex to the Emergency Support Function #15 Standard Operating Procedures.
- ❑ What back-up communication systems may be available if primary communication equipment is damaged by the EMP? Have you tested the interoperability of communication equipment with neighboring jurisdictions?

Response

- ❑ Do your plans identify response resources from surrounding communities? Are you able to assess response resources and capabilities without internet connectivity? Are your mutual aid agreements with neighboring jurisdictions up-to-date, and do they include the extent of resources required to respond to a nuclear detonation?
- ❑ Given clogged roads from debris and car crashes, does your emergency response plan prioritize public works resources to help clear streets to allow movement of response resources?
- ❑ Have you conducted training with emergency response units so they understand the need to shelter during the initial aftermath? HAZMAT suits do not protect against radiation exposure and the best protective action is to reduce time spent in high dose areas and use radiation detection equipment to monitor exposure rate and total dose. Do your emergency response units (and those of neighboring jurisdictions) have radiation monitoring instruments and a plan to monitor first responder exposure? For more information, see NCRP Report No. 179 – Guidance for Emergency Response Dosimetry.
- ❑ Do your plans include a process for maintaining emergency responder safety as they seek to rescue the injured in the fallout zone? Responding to a Radiological or Nuclear Terrorism Incident: A Guide for Decision Makers provides analysis of key decision points and information needed by decision makers at the local, regional, state, tribal, and Federal levels in responding to this event.

- ❑ Have your first responders been trained on how to monitor and limit exposure to radiation risk? Is appropriate personal protective equipment available to support their response? See Health and Safety Planning Guide for Planners, Safety Officers, and Supervisors for Protecting Responders Following a Nuclear Detonation and the Quick Reference Guide: Radiation Risk Information for Responders Following a Nuclear Detonation for key considerations.
- ❑ Have you conducted a tabletop exercise with elected leaders and first responders to prepare everyone to clearly communicate the same message? The FEMA iCPR Tool contains all the resources needed to conduct a tabletop exercise. For more information on the iCPR Tool, contact the FEMA Response Directorate's CBRN Support Branch at cbrn@fema.dhs.gov.

For the companion Facilitator Slides and Resource List for this PrepTalk, visit:
https://www.fema.gov/blog/preptalks-brooke-buddemeier-saving-lives-after-nuclear-detonation