



FEMA



## TRAINING DOCUMENT

TITLE: Response Strategies

REQUIREMENT: Personnel will be informed best response strategies to implement following detonation of an IND.

TARGET GROUP: Radiological emergency responders and planners at the local, state and federal levels

TIME ALLOTTED: 30 minutes

INSTRUCTOR (s): Health Physicist with Emergency Response Experience

METHOD OF INSTRUCTION: Presentation

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*Date: July 2011*

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## IND Response Strategies

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### Instructional Goal

This module is intended to give an overview of actions responders and regional emergency management authorities can take to save and sustain lives.

### Instructional Objectives

- Understand the Zoned Approach to Response
- Review the Dangerous Fallout Zone and Hot Zones
- Learn safety strategies for the public and responders
- Review evacuation strategies

### Handouts

Student Guide. If available, consider providing some of the references below

### References

Recent research over the last few years has help greatly improve our understanding of appropriate actions for the public and responder community to take after a nuclear detonation. Much of this research was recently highlighted in [a National Academies Bridge Journal on Nuclear Dangers](#). This research points out the potentially misleading shelter / evacuation conclusions that can be drawn from using oversimplified modeling assumptions (a.k.a circles of prompt effects and cigar shaped Gaussian fallout patters using surface wind conditions).

### ***Planning Guidance:***

[Planning Guidance for Response to a Nuclear Detonation](#). Developed by the Homeland Security Council, 2<sup>nd</sup> Ed, June 2010. This interagency consensus document provides excellent background information on the effects of a nuclear detonation and key response recommendations. Its definition of zones (damage and fallout) are becoming the standard for response planning and should be integrated in the planning process.

National Council on Radiation Protection and Measurement (NCRP) Report No. 165 - [Responding to a Radiological or Nuclear Terrorism Incident: A Guide for Decision Makers](#) was released Feb 2011 and is a National Standard that supplies the science and builds on many of the concepts of the Planning Guidance.

For public Health information, an entire edition of the journal for [Disaster Medicine and Public Health Preparedness](#) was dedicated to the public health issues associated with the aftermath of nuclear terrorism. All of the articles are available for free download from the highlighted link.

[DHS Strategy for Improving the National Response and Recovery from an IND Attack](#), April 2010, is an Official Use Only document that breaks the initially overwhelming IND response planning activity down into 7 manageable capability categories with supporting objectives. This can be a valuable document to guide a state and regional planning process as a lot of work has already gone into time phased capability requirements for Doctrine/Plans, Organization, Training, Materiel, Leadership, Personnel, Facilities, and Regulations/Authorities/ Grants/Standards. Please contact Dave Sheehan, [David.Sheehan@FEMA.gov](mailto:David.Sheehan@FEMA.gov) or 202-212-1608 for more information or a copy of the document

## IND Response Strategies

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The 30 minute video, [Reducing the Consequences of a nuclear detonation](#) is available on YouTube (click the title to view) and shows a presentation given last year at an LA County Public Health Conference. It provides a lot of information on DHS IND response planning research and demonstrates the very dynamic nature of an IND event. It was developed to provide “ground level” points of view and demonstrate the timing of the event and the consequences of different actions.

[Key Response Planning Factors for the Aftermath of Nuclear Terrorism](#) developed by Lawrence Livermore National Laboratory in support of the DHS preparedness activity was released in August 2009 reviews the science behind many of the recommendations noted in the video and above doctrine.

### Trainee Preparation

This presentation is the fourth in a series, Previously covered material Includes:

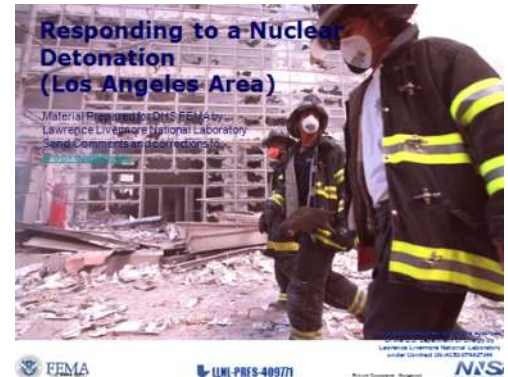
- Nuclear Detonation Modeling and Response Planning
  - Congress identified IND response planning as a priority and part of an all-hazards response planning
  - IND updated analysis indicates a significantly improved understanding from cold war planning
  - Federal and National IND specific response guidance
  - State and local planning is critical to reducing initial loss of life.
- IND Prompt Effects
  - Defined prompt effects from a low yield (10 kT) nuclear explosion
  - Define planning guidance (damage) zones
  - Review recent studies and current understanding of nuclear effects
  - Review response strategies
- IND Fallout Effects
  - Define fallout and explain how it is created
  - Explain how fallout spreads
  - Explain the decay rate of fallout
  - Define planning guidance zones
- IND Shelter / Evacuation Strategies
  - Provide basic information about how and where to shelter-in-place
  - Define the Dangerous Fallout Zone
  - Give figures and explanations for why sheltering-in-place works
  - Explain the concept of informed evacuation
  - Discuss the best public strategy options

## IND Response Strategies

### 0- INTRODUCTION – Introduce Presenter and summarize experience and qualification

#### Response Strategies

- Introduce yourself
- Explain your background
- Why you are giving the presentation



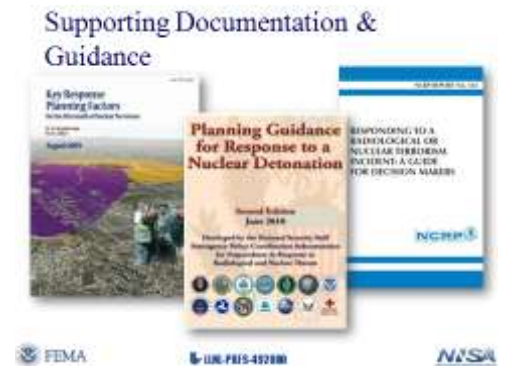
#### References

[Key Response Planning Factors for the Aftermath of Nuclear Terrorism](#) developed by Lawrence Livermore National Laboratory in support of the DHS preparedness activity was released in August 2009 reviews the science behind many of the recommendations noted in the video and above doctrine.

The guidance found in this presentation can be traced back to these three supporting documents:

[Planning Guidance for Response to a Nuclear Detonation](#). Developed by the Homeland Security Council, 2<sup>nd</sup> Ed, June 2010. This interagency consensus document provides excellent background information on the effects of a nuclear detonation and key response recommendations. Its definition of zones (damage and fallout) are becoming the standard for response planning and should be integrated in the planning process.

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## IND Response Strategies

### Immediate Emergency Alerts

**An early priority for federal, state and local officials is to broadcast shelter in place messaging to the public through whatever means is available.**

- Communicating after a nuclear detonation will be difficult. The blast and electromagnetic pulse will damage communication infrastructure and devices for the population in the blast damage zones and potentially cause cascading effects in the surrounding areas, including the most critical region for communications – the dangerous fallout zone
- Planners in adjacent communities should collaborate in advance to determine the assets necessary to reestablish communications after a nuclear detonation. They should also identify and remedy gaps in their capabilities
- After a nuclear detonation, use all information outlets when conveying messages including, but not limited to, television, radio, e-mail alerts, text messaging, and social media outlets
- Planners must consider options for communicating in areas where the infrastructure for electronic communications has been disabled or destroyed. Any remaining operational communications systems will be severely overloaded. Communications into and out of the impacted area via these systems will be extremely difficult. Radio broadcasts may be the most effective means to reach the people closest to and directly downwind from the nuclear explosion site.
- Pre-incident preparedness is essential to saving lives. After a nuclear detonation, public safety depends on the ability to quickly make appropriate safety decisions. Empowering people with knowledge can save thousands of lives.
- Messages prepared and practiced in advance are fundamental to conveying clear, consistent information and instructions during an emergency incident.
- Planners should select individuals with the highest public trust and confidence to deliver messages and should be prepared to

#### Emergency Broadcast Messages

- Communication infrastructure may be damaged, plan for multiple communication methods.
- Planners should select individuals with the highest public trust and confidence to deliver messages and should be prepared to deliver key information to the public in the affected areas about protection almost immediately in order to maximize lives saved.








## IND Response Strategies

deliver key information to the public in the affected areas about protection almost immediately in order to maximize lives saved.

 **Click –Defining Zones appears**

A well-thought out response plan can help maximize life-saving potential, and minimize the risks to emergency responders. When setting up a response plan, it is important to:

-  **Click -Identify Priority Zones:** Priority zones should be identified by deciding which zones have the best chance for saving lives without putting responders into conditions that are too dangerous for them. Look for areas that victims might have found shelter in, and help victims nearest the outside of structures first.
-  **Click -Prioritize Actions within Each Zone:** Determine the actions, in order, which will maximize the response. Determine which structures to enter first, estimate out how much time can be spent in each area before radiation doses get too high, and determine evacuation routes.
-  **Click -Identify Responder Protection in Each Zone:** Ensure that responders are safe in each zone they enter. If responders decide they can enter a zone safely, ensure that adequate safety measures are taken based on the level of radiation and other possible hazards (debris, smoke, etc.) in the area. Use personal protective equipment (PPE) like dosimeters and respirators to ensure safety.
-  **Click -Determine Where to Locate Staging Areas:** There may be multiple staging areas depending on the size of the blast. Staging areas may be set up along each zone to treat victims within those zones. A main staging area should also be set up in an area without any radiation, if possible. This staging area should be used for deploying responders and setting up response plans.
-  **Click –Planning guidance quote appears** –“The goal of a zoned approach to nuclear detonation response is to save lives, while managing risks to emergency response worker life and health.” – from the Planning Guidance for Response to a Nuclear Detonation.




With proper response planning, many lives can be saved with minimal risk to the responders.

**Zoned Approach to Response**

- Defining zones can be a useful approach to planning:
  - Identify priority zones
  - Prioritize actions within each zone
  - Identify responder protection in each zone
  - Determining where to locate staging areas

“The goal of a zoned approach to nuclear detonation response is to save lives, while managing risks to emergency response worker life and health.”

–Planning Guidance for Response to a Nuclear Detonation



## IND Response Strategies

### Zone Review

#### 📍 Click –Severe Damage Zone appears

The Severe Damage Zone extends to about half a mile from the blast site. This zone will see severe structure damage from the initial blast wave, and most likely fatal injuries from the blast, thermal pulse, and prompt radiation.

#### 📍 Click –Moderate Damage Zone appears

From ½ a mile to 1 mile from the blast site of a 10KT is the moderate damage zone, This is the area with a large number of significant injuries and represents the area with the most life-saving potential.

This area has significant structural damage and fires. Victims in this area have the greatest chance of avoiding deadly radiation doses by seeking shelter immediately.

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### Severe Damage Zone (SDZ):

- Few, if any, buildings are expected to be structurally sound or even standing
- Very few people would survive; however, some people protected within stable structures (e.g., subterranean parking garages or subway tunnels) at the time of the explosion may survive the initial blast.
- Very high radiation levels and other hazards are expected in the SDZ, significantly increasing risks to survivors and responders. Responders should enter this zone with great caution, only to rescue known survivors and with appropriate radiation monitoring equipment.
- Rubble in streets is estimated to be impassable in the SDZ making timely response impracticable.
- The SDZ may have a radius on the order of a 0.5 mile (0.8 km) for a 10 KT detonation. Blast overpressure that characterizes the SDZ is 5–8 psi and greater.

### Moderate Damage Zone (MDZ):

- Responders may expect they are transitioning into the MDZ when building damage becomes substantial. This damage may correspond to a distance of about one mile (1.6 km) from ground zero for a 10 KT nuclear explosion. The determination is made by ground-level and/or overhead imagery.
- Observations in the MDZ include significant structural damage,

### Recognizing the Severe Damage Zone

- Few, if any, buildings are expected to be structurally sound or even standing
- Very few people would survive; however, some people protected within stable structures (e.g., subterranean parking garages or subway tunnels) at the time of the explosion may survive the initial blast.
- Very high radiation levels and other hazards are expected in the SDZ, significantly increasing risks to survivors and responders. Responders should enter this zone with great caution, only to rescue known survivors.
- Rubble in streets is estimated to be impassable in the SDZ making timely response impracticable.



### Recognizing the Moderate Damage Zone

- Responders may expect they are transitioning into the MDZ when building damage becomes substantial, such as blown out building interiors, blown down utility lines, overturned automobiles, caved roofs, some collapsed buildings, and fires.
- In the MDZ, sturdier buildings (e.g., reinforced concrete) will remain standing, lighter commercial and multi-unit residential buildings may be taller or structurally unstable, and many wood frame houses will be destroyed.
- The MDZ is expected to have the highest proportion of 'survivable victims' who require medical treatment.
- The MDZ presents significant hazards to response workers, including elevated radiation levels, unstable buildings and other structures, downed power lines, ruptured gas lines, hazardous chemicals, asbestos and other particulates released from damaged buildings, and sharp metal objects and broken glass, for which consideration and planning is needed.



## IND Response Strategies

blown out building interiors, blown down utility lines, overturned automobiles, caved roofs, some collapsed buildings, and fires. Some telephone poles and street light poles will be blown over. In the MDZ, sturdier buildings (e.g., reinforced concrete) will remain standing, lighter commercial and multi-unit residential buildings may be fallen or structurally unstable, and many wood frame houses will be destroyed.

- Substantial rubble and crashed and overturned vehicles in streets are expected, making evacuation and passage of rescue vehicles difficult or impossible without street clearing. Moving towards ground zero in the MDZ, rubble will completely block streets and require heavy equipment to clear.
- Within the MDZ, broken water, gas, electrical, and communication lines are expected and fires will be encountered.
- The MDZ is expected to have the highest proportion of **'survivable victims'** who require medical treatment.
- The MDZ presents significant hazards to response workers, including elevated radiation levels, unstable buildings and other structures, downed power lines, ruptured gas lines, hazardous chemicals, asbestos and other particulates released from damaged buildings, and sharp metal objects and broken glass, for which consideration and planning is needed.

### **Click –Light Damage Zone appears**

- Damage is caused by shocks, similar to those produced by a thunderclap or a sonic boom, but with much more force. Although some windows may be broken over 10 miles (16 km) away, the injury associated with flying glass will generally occur at overpressures above 0.5 psi. This damage may correspond to a distance of about 3 miles (4.8 km) from ground zero for a 10 KT nuclear explosion. The damage in this area will be highly variable as shock waves rebound multiple times off of buildings, the terrain, and even the atmosphere.
- As a responder moves inward, windows and doors will be blown in and gutters, window shutters, roofs, and lightly constructed buildings will have increasing damage. Litter and rubble will increase moving towards ground zero and there will be increasing numbers of stalled and crashed automobiles that will make emergency vehicle passage difficult.
- Blast overpressures that characterize the LDZ are calculated to be about 0.5 psi at the outer boundary and 2–3 psi at the inner boundary. More significant structural damage to buildings will indicate entry into the moderate damage zone.



**Light Damage Zone**

Outer boundary may be defined by the prevalence of broken windows

1. Zone extends from ~1 mile up to ~3 miles (10kT Example)
2. Damage NOT caused by dynamic (wind-like) pressure, but the "shockwave peak free field overpressure"
3. Damage not just to windows, but other larger flat (and weak) features
4. Mostly superficial wounds from flying glass and debris



## IND Response Strategies

- Much of the LDZ may be essentially non-radioactive. However, responders should be prepared to encounter elevated radiation. The most hazardous radiation levels would be associated predominantly with the major path where fallout deposition overlays the LDZ.
- The severity of injuries responders will encounter in the LDZ should be relatively light and, consist of mostly superficial wounds with occasional flash burns. Glass and other projectile penetrations are expected to be superficial (i.e., about ¼ inch depth) in the torso, limbs, and face. Eyes are particularly vulnerable. As responders proceed inward they will begin to observe an increasing frequency and severity of injuries from flying glass and debris, and crush, translation, and tumbling injuries.

### Recognizing the Light Damage Zone

- Nearly all windows will be broken and there will be external panel damage on most structures.
- The damage in this area will be highly variable as shock waves rebound multiple times off of buildings, the terrain, and even the atmosphere.
- As a responder moves inward, windows and doors will be blown in and gutters, window shutters, roofs, and lightly constructed buildings will have increasing damage.
- The severity of injuries responders will encounter in the LD zone should be relatively light and, consist of mostly superficial wounds with occasional flash burns.



## IND Response Strategies

### More Information on the DFZ

Here is some more crucial information about the DFZ:

- **Bounded by radiation levels of 10R/hr** – determining dose rates early on helps to identify the perimeters of the DFZ
- **Could reach 10-20 miles downwind** – it is important to know weather conditions for the day, to help determine how far, and where, the DFZ will extend to
- **Also called:**
  - ✓ High-Hazard Zone
  - ✓ And the Inner Perimeter

After establishing the perimeter of the DFZ, everyone should be aware that entering that area can cause acute radiation injuries or death. Responders should enter this area only voluntarily, and only after being fully informed of the risks.



#### Dangerous Fallout Zone (DFZ)

- Bounded by radiation levels of 10 R/hr
- Reaches 25 miles downwind
- Reaches maximum extent at 1 hour
- Also Called:
  - High-Hazard Zone (Key Response Factor)
  - Dangerous Radiation Zone (NCRP Report #68)

"Identifying the dangerous radiation zone [exposure rate  $\geq 10$  R/h] will have critical implications on emergency activities in a nuclear fallout area. The dangerous radiation zone is an area where large doses could be delivered to emergency responders in a short period of time."  
 -National Council of Radiation Protection and Measurement, Report #68

In general locations where the dangerous fallout (DFZ) zone is not up to the 10 R/h boundary, response activities should be guided by the generally lethal radiation hazard of the DFZ zone.

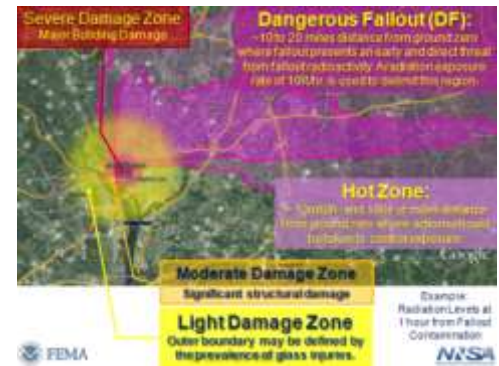
The most important mission in the DFZ area is controlling protective actions taken by the public. Effective preparations require public education, effective communication plans, coverage, and doses of delivery to the DFZ zone.  
 -OSTP Planning Guidelines for the Response to a Nuclear Detonation (2010)

### Hot Zone

Although it is not life threatening, responders need to be aware that there are significant areas outside of the DFZ that have radiation levels that will be easily detectable, and may even saturate many of the instruments.

- Bounded by radiation levels of 10 mR/h (1/1000<sup>th</sup> of the DRZ)
- For a 10KT, could extend 100s of miles
- Reaches maximum extent at ~ 1 day
- Extended Response Actions will NOT result in significant exposures (100 rem)

It is important to emphasize that response operations can and should continue in this area, though additional precautions are warranted to ensure that responders do not spend unnecessary time in the area and have the tools to alert them when they cross over to the DFZ.



#### Hot Zone (0.01 R/h boundary)

- Bounded by radiation levels of 10 mR/hr (0.01 R/h) (1/1000<sup>th</sup> of the DRZ)
- Extends 100 miles
- Reaches maximum extent at ~ 1 day
- Extended Response Actions will NOT result in life threatening exposures (> 100 rem)
- Also Called
  - 0.01 R/h Boundary (Planning Guidance for Response to a Nuclear Detonation)

In routine radiation emergency response entering the zone bounded by 0.01 R/h entails donning appropriate personal protective equipment (PPE) and being properly monitored for radiation. For a nuclear detonation, the 0.01 R/h line can reach a maximum extent of several hundred miles within hours of the incident.  
 -OSTP Planning Guidelines for the Response to a Nuclear Detonation (2010)

## IND Response Strategies

### Movie demonstrating the dynamic nature of the DFZ and 0.01R/r Boundary

The ‘Silver Lining’ of radiation is the short half-life; it decays extremely rapidly.

This animation shows how fallout reaches its peak after about an hour, then begins to recede, but the 0.01 R/h boundary will continue to grow as material is deposited. It will reach its max extent in ~1 days.



### Zone Priorities From Planning Guidance for Response to a Nuclear Detonation

- *Most of the injuries incurred within the LDZ are not expected to be life threatening and would be associated with flying glass and debris from the blast wave and traffic accidents.*
- *If injured survivors are able to move on their own, they should be directed to medical care or assembly shelters.*
- *The MDZ should be the focus of early life-saving operations. Focus on medical triage with constant consideration of radiation dose minimization.*
- *Response within the SDZ should not be attempted until radiation dose rates have dropped and the MDZ response is significantly advanced.*
- *All response missions must be justified to minimize responder risks based on risk/benefit considerations built into worker safety plans.*

### Zone Priorities From Planning Guidance for Response to a Nuclear Detonation

- Most of the injuries incurred within the LDZ are not expected to be life threatening and would be associated with flying glass and debris from the blast wave and traffic accidents.
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- All response missions must be justified to minimize responder risks based on risk/benefit considerations built into worker safety plans.



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### Priorities for Immediate Life Safety

The two most important aspects of a successful response effort are saving as many lives as possible and keeping responders safe.

In the case of an IND, saving lives involves a set Public Protection Strategy. To maximize life-saving potential, having everyone in the Dangerous Fallout Zone (DZF) seek immediate, adequate shelter followed by an informed, phased evacuation is the best course of action.

### Priorities for Immediate Life Safety

- **Public Protection Strategy:**  
 Early, adequate shelter followed by informed, phased evacuation
- **Response Strategy:**
  1. Protect response personnel
  2. Support regional situational assessment
  3. Support public safety

*From Key Response Planning Factors*

 **Click –Response Strategy appears**

## IND Response Strategies

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In order to accomplish this, response personnel need to take a number of critical steps.

We will go into more detail on each of these, but the key point of this slide is the priority order. There may be an intuitive response to try and help nearby victims, but support to regional situation assessment can save far more lives in the long run.

Just they perform a “size up” of a scene, a regional “size up” is required to define the zones that are critical for immediate action. Just as important is defining low radiation hazard zones and communicating those to a central location so outside response elements know where it is safe to initially provide assistance.

With that information, the regionally coordinated response has the best potential to save and sustain lives and public safety.

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## IND Response Strategies

### Protecting Response Personnel

Again, keeping responders safe allows response efforts to continue, and as many lives as possible to be saved.

Steps to protecting responders include:

- **Responders without radiation detection instruments, follow the general public protection strategy** – seek shelter and wait for informed evacuation instructions
- **Click – Responders with radiation instruments, shelter using radiation detection equipment to monitor shelter conditions:**
  - ✓ **Click- Do not exit....appears** - wait until radiation levels are below 10R/hr, unless there is an immediate risk to safety like a fire or building collapse
  - ✓ **Click – Provided outdoor....appears** – When outside radiation levels are below 10R/hr, responders can begin to perform scene assessment for hazards around their shelter.

### Protect 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.

### Responder PPE

The best way to prevent radiation exposure is to avoid it. The only way to receive a lower dose of radiation is to avoid the DFZ. HAZMAT suits, respirators and SCBAs do not offer any protection against the primary hazard of radiation – penetrating gamma rays.

Inhalation and ingestion are secondary concerns. Attempting to wear hazard suits or respirators will only slow down a responder and cause them to spend more time in dangerous areas. These suits have proven to reduce speed, the ability to communicate and cut down on worker efficiency.

It is also important to consider **all** of the hazards, not just radiation. There will be fires, sharp metal and glass debris piles, and possibly other hazardous material in the air like the dust after the trade towers came down.

When working with dangerous levels of radiation, the best course of action is to simply stay out of the DFZ until radiation levels drop below 10R/hr and it is safe to enter and begin response efforts.

This is why Radiation and Dose monitoring equipment are so important, as they can help you identify when you are in a hazardous radiation environment.

The next slide contains civil defense movies about contamination.

### 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



### Decontamination Issues



Entering Shelter



Actual Fallout Decon

- 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.





## IND Response Strategies

### Support Regional Situational Assessment

Coordination can speed up response efforts and prevent unnecessary harm. Coordination is aided through regional situation assessment. This can be done by:

- **Designating a regional situational assessment center** – this should be outside of the DFZ and away from other hazardous conditions
- **Establishing communication with responders in the affected area** – be aware of conditions for responders in all affected areas, as well as their radiation dose reports
- **Report radiation levels in the area** – Responders in affected zones should continue to monitor outside dose rates until conditions are safe. Those in safe areas (areas where radiation levels are below 10R/hr) should also report dose rates to help determine safe evacuation routes and response staging areas.

### Support Regional Situational Assessment

- Designate a regional situational assessment center
- Establish communication with responders in the affected area.
- Report approximate radiation levels in the area.
  - Identification of high hazard zones (reading greater than 10R/hr) is a priority, but
  - reporting safe areas (reading less than 10mR/hr) is also important for the determination of safe evacuation routes and response staging areas.

### Fire Station Location Example

Knowing where the highest radiation levels are is crucial to responder safety. Knowing how to determine the DFZ can help responders know which areas to avoid, as well as which parts of the damage zones are safe to enter for response activities.

#### Fire station locations appear

These dots represent the fire stations in the NCR.

Assuming they are equipped with radiation detection instruments, the Responders in affected zones should monitor outside dose rates and report them to the assessment center.

#### Click –Dose rates appear

The fire stations that have turned dark purple on the map represent stations that are in the DFZ at ~ 1hr.

The responders should know (as they see the readings at the door) to go back inside and shelter for their own protection.

Also, by finding a way to report their radiation readings (along with their brethren in the Hot Zone (yellow) or Cold Zone (White), a pattern can be determined.

#### Click –DFZ lines appear



## IND Response Strategies

After determining the pattern of fire stations with 10R/hr and higher ratings, perimeters for the DFZ can be established. The nice thing is that exact numbers (dose rates) are not required, just report which Zone you are in is sufficient.

 **Click –plume model appear**

As can be seen, this simple method can quickly determine the hazard zone to help guide a response, without even having to report exact numbers or having to rely on a model.

### Support to Public Safety

Although “shelter in place” broadcast messages can begin immediately, most offensive response actions will require knowledge of the hazard zones, particularly the DFZ so we know the areas to avoid and can begin preparing a Public Safety plan.

Once the DFZ is established, response actions such as safe staging areas, injured extractions, and firefighting can begin that make the best use of response actions.

Some actions can be performed in the DFZ, but they require such a significant amount of support that it is not an effective use of limited response resources.

We mentioned the Moderate Damage Zone is the best place to apply response resources, but we haven’t said why yet.

FEMA modelers took the average daytime population data for the DC area and overlaid the damage caused by Prompt Effects from our scenario.

**Click:** 150 K in the Severe Damage Zone  
 Unfortunately most of these people would not survive.

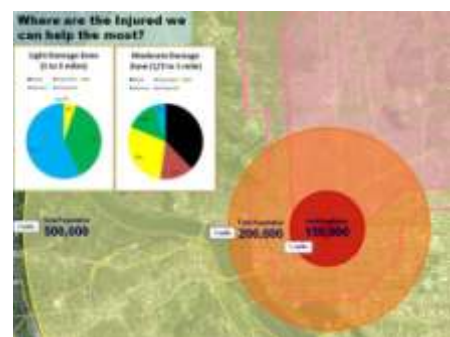
**Click:** 200K in the Moderate Damage Zone  
 The pie chart represents the types of injuries that might be seen in this area.

- In this area, there are more initial survivors than fatalities, though a large % of these survivors (almost 30%) would be seriously injured and would most benefit from advanced medical care.

**Click:** and 500K in the Light Damage Zone  
 But notice that in the LDZ – at distances greater than 1 mile from

### Support Public Safety

- Use emergency broadcast systems to shelter populations
- Once the DFZ has been determined, the following activities can occur *outside* of the DFZ:
  - Establish reception centers and triage sites
  - Direct response resources to the moderate Damage Zone to support injured extraction
  - Fight fires and control hazards



## IND Response Strategies

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ground zero –

- There would be few deaths attributed directly to Prompt Effects and, in fact, over half the people in this area would be uninjured.
  - The second biggest LDZ injury class (in green) are with injuries that are not life threatening, even without medical assistance; these include lacerations, minor crush, and eye injuries.
-

## IND Response Strategies

### Offensive Response

#### 🔗 Click –Initial Priority: MDZ

The MD zone should be the focus of nuclear explosion emergency response efforts, with the goal of managing the impacted scene through aggressive rubble removal and site access, fire suppression, and structural and utility stabilization, in order to facilitate expeditious search and rescue and medical triage. On a city-specific basis, response planners should develop plans for MD zone response that includes:

- Establishing nuclear emergency response procedures that maximize rescue operations focused on survivable victims
- Minimizing the total risk to responders
- Organizing neighboring response units (and sharing such plans with the State emergency management officials so they will be aware which jurisdictions would be stepping in)
- Pre-deploying appropriate supplies to locations likely to contain large populations, including fallout shelters or subways
- Deploying radiation assessment teams, engineering response teams (e.g., road clearing, debris hauling, and stabilization capabilities), Hazmat, search and rescue teams, medical response teams, and law enforcement (to secure the scene)

The MD zone should be the focus of early life-saving operations. Early response activities should focus on medical triage with constant consideration of radiation dose minimization.

#### 🔗 Click –Secondary Priority

Response within the SD zone should not be attempted until radiation dose rates have dropped substantially in the days following a nuclear detonation, and the MD zone response is significantly advanced. All response missions must be justified to minimize responder risks based on risk/benefit considerations built into worker safety plans.

#### Recommended Response Priorities



## IND Response Strategies

### Evacuation Considerations

We didn't mention this earlier, so we'll address it now:

The first bullet on this slide speaks to the fact that --Even during the initial (most dangerous) phases of the event -- we can't let "tunnel vision" which focuses solely on the radiation hazard -- take our sights off of all the other life safety issues.

- In particular, it does no good to shelter from the radiation if your shelter collapses on you or is on fire.

We need to ensure that the public knows that other life threatening hazards can take priority.

- If the shelter you are in is compromised, you should relocate immediately!

Our First Responders are in their stations and they've been reporting back their radiation readings back to the regional assessment center

- That center has at least an initial indication of where the DFZ and Hot Zones are.

Several hours (or days) into the event public safety agencies should have a better handle on potential evacuation routes out of the elevated radiation areas.

- If these evacuation routes are blocked, they should be attempting to clear them.
- This is easier said than done. Remember one of the first animations we showed was the highway littered with wrecked vehicles caused by flash blindness.
- Having situational awareness of the state of evacuation routes will be imperative before advising the public to evacuate!
- Routes that take advantage of sheltered passage (subways, underground connectors, through building lobbies) should be used whenever possible

Most people in the Dangerous Fallout zone will likely receive some exposure to fallout; this is, unfortunately, unavoidable.

- However, knowing how long to shelter and the direction to evacuate can significantly lower the exposure.

When to evacuate a shelter depends on how much protection a person is getting from the structure, and how long it will take an average person to complete the evacuation route.

So the key question is "how long should people remain in their shelter?"

The federal planning guidance recommends 12-24

### Evacuation Considerations

- Those in shelters threatened by fire, building collapse, or other life endangering hazard should evacuate or relocate immediately.

Once DFZ and 0.01 R/h Boundary are established

- Evacuation planning should begin to move sheltered populations out of harms way.
- Evacuation routes should be cleared if possible
- Routes that take advantage of sheltered passage:
  - subways,
  - underground connectors, and
  - building lobbies
- Execution should be phased to reduce the time spent transiting through fallout areas





## IND Response Strategies

hours, unless you receive alternate instructions or you are threatened by fire, building collapse, or other life threatening emergency.

### Evacuation Strategies

As stated in the planning guidance:

When evacuations are executed, travel should be at right angles to the fallout path (to the extent possible) and away from the plume centerline, sometimes referred to as “lateral evacuation.”

For more complex fallout patterns like the one pictured here, ensure that evacuations move people down the length of the fallout pattern or into another fallout contamination area.

Evacuation Planning (After Initial Shelter Period)



FEMA    LLNL-PRES-492000    NNSA

This slide demonstrates the areas that can lead to acute effects, the initial blast zones where there could be injuries from flying glass and debris out to 3 miles, and the dangerous fallout area could extend for 10-20 miles.

 **Click –Animation begins**

As you can see, the areas of potential injury are small when compared to the resources of the area. While it will still be devastating, it is not the “nuclear end-all” situation that many people envision when they think about a nuclear bomb and there are a lot of resources in the surrounding area that can safely help save and sustain lives... If they know what to do!

Putting It Into Perspective



## IND Response Strategies

### Early, adequate shelter followed by informed, phased evacuation

- It is important *to be in the shelter when the fallout arrives*.
- There should be *several minutes* before fallout arrives.
- If you are outside or in a car, seek the nearest adequate shelter.
- If you are already in an adequate shelter, shelter in place.
- *Adequate Shelters* are Protection Factor 10 or higher
- **Protect Response Force**
  - Shelter until hazard identified
  - Provide PPE and Zone priorities
- **Local Emergency Management:**
  - Establish early public communication
  - Rapid identification of hazard zones
  - Established coordinated safe evacuation routes
  - Identify priority candidates for early shelter departure (i.e., those in inadequate shelters or threatened by other hazards)
- **The first hour is the most critical** – The worst radiation doses will be received within the first hour following detonation of the IND. If everyone can seek immediate, adequate shelter, 100,000s of lives can be saved.
- **100,000s of people can be saved through proper action (both individual and leadership)** – Again, if residents are aware of that they must seek an adequate shelter immediately, many lives will be saved. After the detonation, leadership roles must be quickly established (preferably based on decisions made from prior response planning documents), and decisions about damage zones, the DFZ and evacuation results must be made quickly.
- **Situational awareness and communication will be difficult, but essential** – Communication systems may be down following detonation. It is critical that these systems be quickly reestablished, and responders know that the priority is to report radiation readings and emergency broadcast messages are broadcasted to the public. Anyone in a response capacity must be aware of their surroundings, and realize that they may have to wait to start response until they are not in danger from radiation.
- **Knowing what to do before the event is critical** – Prior response planning and training for responders and the public is the key to saving many lives after detonation of an IND.
- **Rapid, independent responder actions are also key** – Many

### Conclusions

- Public Protection Strategy: Early, adequate shelter followed by informed, phased evacuation
- Response Strategy
  - Protect Response Force
  - Rapid identification of hazard areas and safe evacuation routes
  - Establish communication (Responder and Public)
- First hour most critical
- 100,000s of people can be saved through proper action (both individual action and leadership)
- Situational awareness, communication, and independent responder actions essential
- Knowing what to do before the event is critical



## IND Response Strategies

responders may not be able to assist initially due to their locations within the DFZ. Other responders must be able to carry out actions in a situation where they are temporarily without leadership.

- **Rapid, independent responder actions are also key** – Many responders may not be able to assist initially due to their locations within the DFZ. Other responders must be able to carry out actions in a situation where they are temporarily without leadership.

- **The modeling and analysis presented here represent one possible scenario, it is important to recognize the yield, location of detonation, and the Weather (as demonstrated from these fallout patterns using the 14<sup>th</sup> of each month in 2009 demonstrates) all play an important role in the outcome and are difficult to predict in advance.**

**Do not write a plan for the specific scenario, but plan to the dynamic nature of the event as discussed.**



- **Also realize that this presentation has focused on the immediately life threatening levels of radiation. Lower levels of fallout contamination, enough to represent long term cancer concerns will remain an issue for months after the detonation.**

**In fact, this image demonstrate how large the Hot Zone is even after a week, over 20 miles long!**

