Nuclear Detonation Response Training

National Radiological / Nuclear Response Doctrine

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Certified Health Physicist

June 2025

Recent Developments in Response Planning

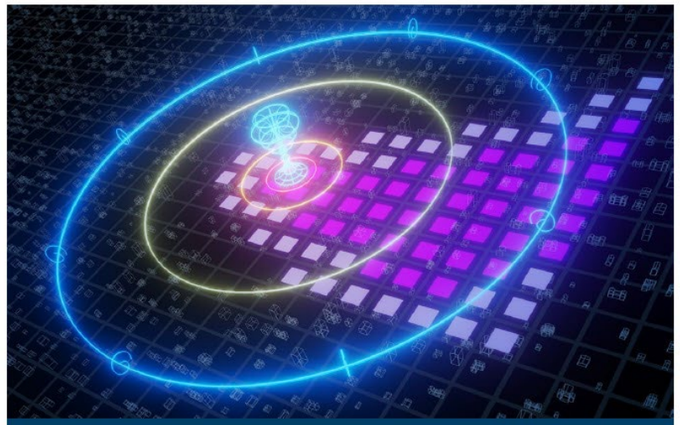
Planning Guidance for Response to a Nuclear Detonation

Third Edition

May 2022

FEMA

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



Nuclear Detonation Response Guidance

Planning for the First 72 Hours

March 2023

FEMA

Companion **Response** Guidance published March 2023

Nuclear/Radiological Incident Annex to the Response and Recovery Federal Interagency Operational Plan

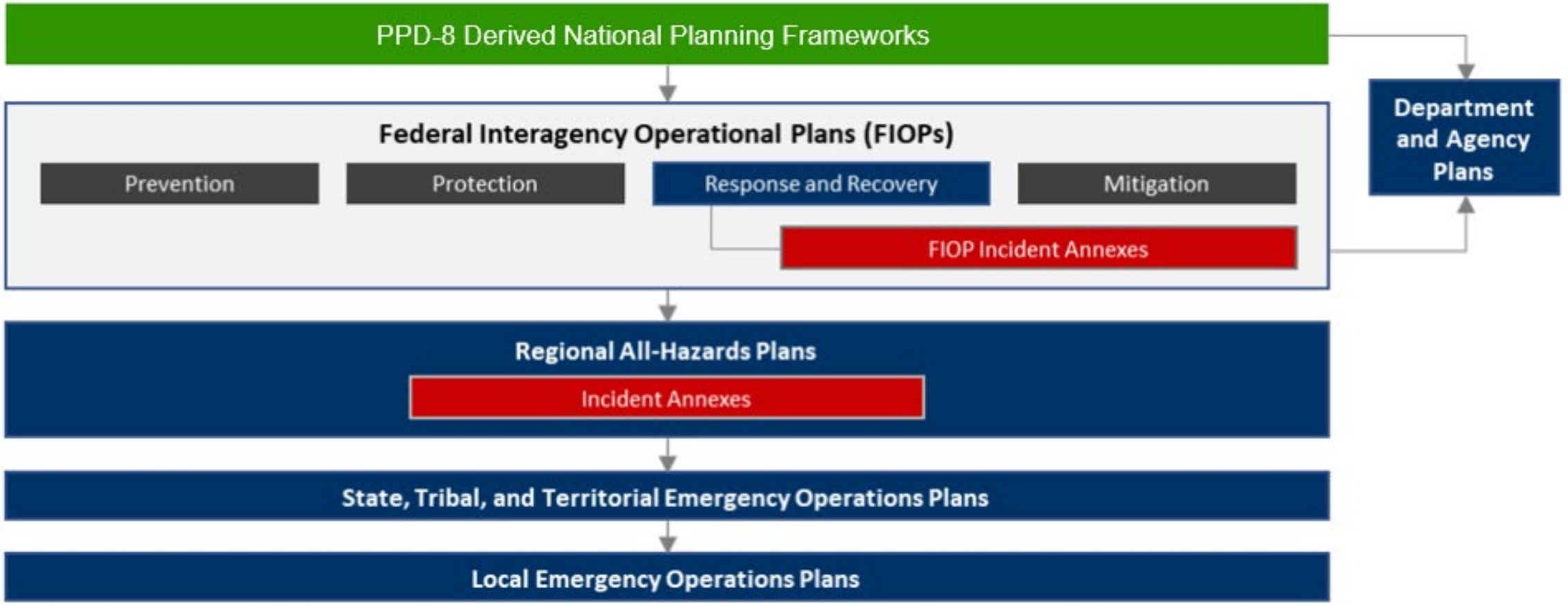
May 2023

Homeland Security

All Rad/Nuc national response framework published May 2023,

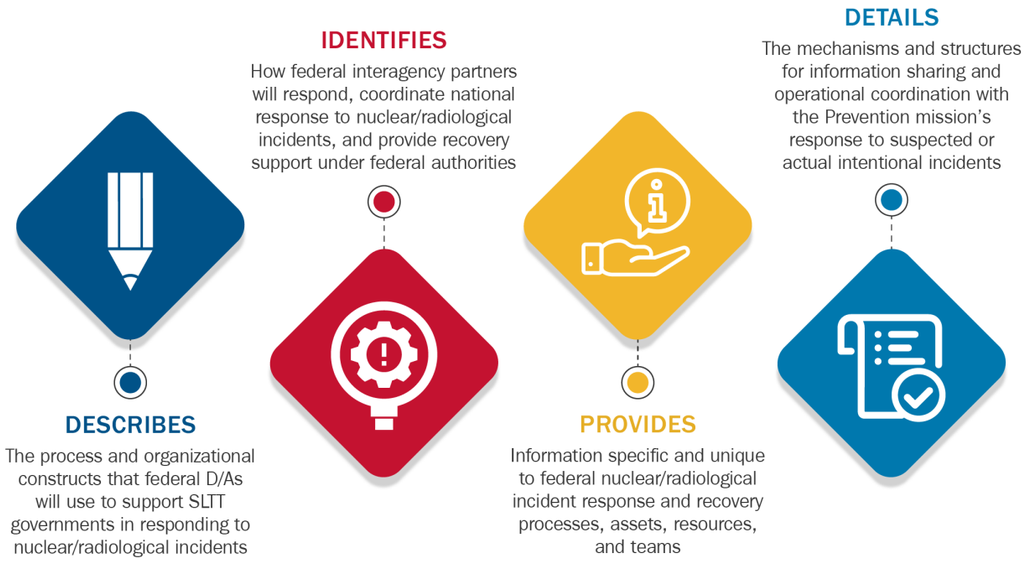
Federal Doctrine, Authorities & Agency-Specific Roles & Responsibilities

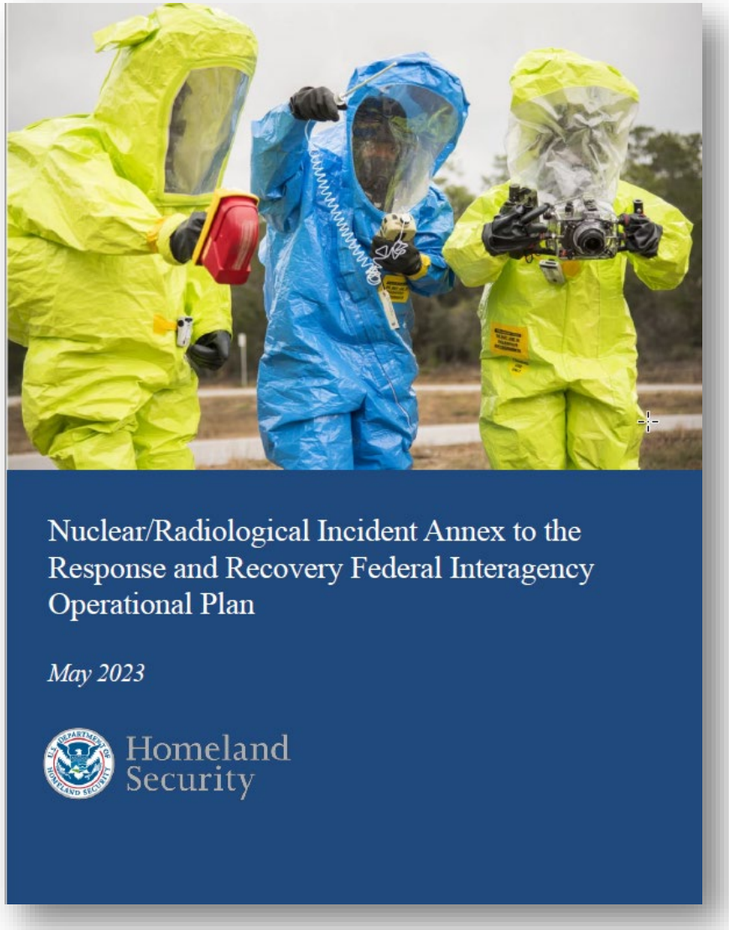
Doctrinal Frameworks & Plans



The Nuclear-Radiological Incident Annex (NRIA)

The NRIA provides incident-specific supplemental information to the Response and Recovery FIOP. Federal interagency partners respond in support to SLTT governments to save lives, to protect safety and health, property, critical infrastructure, and the environment and to meet basic human needs when a nuclear/radiological incident occurs.





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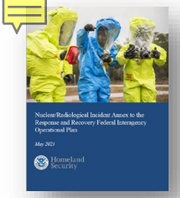


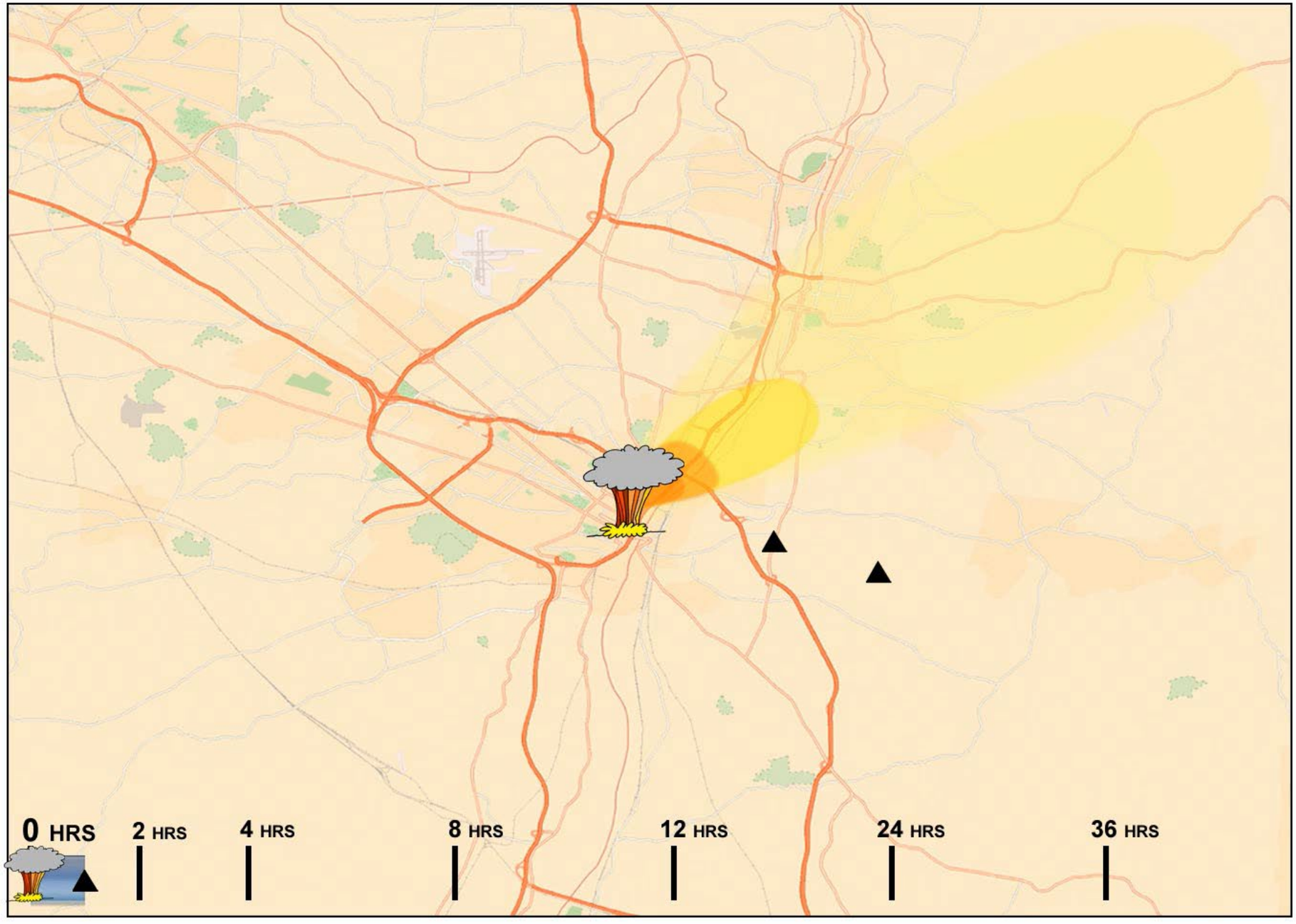
Lead Federal Agencies (Table 1)

INCIDENT TYPE, FACILITIES, OR MATERIALS INVOLVED	LEAD FEDERAL AGENCY WITH PRIMARY AUTHORITY
NUCLEAR FACILITIES	
Owned or operated by the DOD	**DOD**
Owned or operated by the DOE	**DOE**
Licensed by the NRC or an NRC Agreement State	**NRC**
Not licensed, owned, or operated by a federal agency, an NRC Agreement State or currently or formerly licensed facilities for which the owner/operator is not financially viable or is otherwise unable to respond	**EPA**
Nuclear Weapons and Components	
In the custody of the DOD	**DOD**
In the custody of the DOE	**DOE**
Radioactive Materials Owned, Licensed, or Being Transported	
By or for the DOD	**DOD**
By or for the DOE	**DOE**
Containing NRC or NRC Agreement State licensed materials	**NRC**
Within the coastal zone for materials that are not licensed or owned by a federal agency or an NRC Agreement State	**USCG**
All others	**EPA**
Radioactive Materials in Space Vehicles Impacting the United States	
Managed by the National Aeronautics and Space Administration (NASA)	**NASA**
Managed by the DOD	**DOD**
Not managed by the NASA or the DOD, not licensed by the Federal Aviation Administration (FAA) for launch or reentry, and impacting the coastal zone	**USCG**
All others not licensed, permitted, regulated, or managed by a federal D/A	**EPA**
Disused and Unwanted Sealed Sources with no Disposition Pathway	
Off-Site Source Recovery	**DOE**
Unknown or Unlicensed Materials, and Domestic Response to Foreign Materials and International Incidents	
Inadvertently imported radioactive materials that are interdicted at or between U.S. Ports of Entry	**CBP**
Imported contaminated consumer products that are distributed before detection	**EPA**
Within the coastal zone for materials that were not imported	**USCG**
All others	**EPA**
Inadvertent Incidents Involving Lost/Found/Orphaned Radioactive Material	**DOE, NNSA**
U.S. Assistance to Foreign Governments for Incidents with International Impacts	**DOS**
All Intentional Incidents Involving Nuclear/Radiological Facilities or Materials (e.g., RDDs, INDs)	**DHS, FEMA**

Note: DHS/FEMA may be called upon to lead or provide supplemental operational consequence management and response coordination support for the Lead Federal Agency during complex incidents

*This annex does not address acts of nuclear war

ANYTOWN USA



10KT DETONATION

LOCAL FIRST RESPONDERS

48 HRS

72 HRS

Operational Phases (P21)

OPERATIONAL PHASES

2 Coordinated Response and Recovery and Operations

3 Recovery and Restoration Operations

POTENTIAL EXPOSURE PATHWAYS	External Radiation	Inhalation of Radioactivity in Plume	Contamination of Skin and Clothes	External Radiation from Ground Deposition of Activity	Ingestion of Contaminated Food/Water	Inhalation of Re-Suspended Activity
PROTECTIVE ACTIONS	• Sheltering • Evacuation • Control of Access	• Sheltering • Administration of Stable Iodine • Evacuation • Control of Access	• Sheltering • Evacuation • Decontamination of Persons and Animals (including household pets and service animals)	• Evacuation • Relocation • Decontamination of Land and Property	• Food and Water Controls	• Relocation • Decontamination of Land and Property

EARLY | INTERMEDIATE | LATE

PROTECTIVE ACTION PHASES

DOD Roles, Responsibilities, and Capabilities (P24-25)

Roles, Responsibilities, and Capabilities 24
U.S. Department of Defense (DOD) 24
U.S. Department of Energy (DOE) 25
U.S. Department of Homeland Security (DHS) 27
Federal Emergency Management Agency (FEMA) 28
U.S. Customs and Border Protection (CBP) 29
U.S. Coast Guard (USCG) 29
U.S. Department of Justice (DOJ) 30
U.S. Department of State (DOS) 31
U.S. Environmental Protection Agency (EPA) 31
National Aeronautics and Space Administration (NASA) 32
Nuclear Regulatory Commission (NRC) 32
Federal Aviation Administration (FAA) 33
Additional Federal Capabilities 34

U.S. Department of Defense (DOD)

Consistent with applicable Presidential policies and memoranda, U.S. Department of Defense (DOD) is responsible for coordinating federal actions related to nuclear/radiological incidents involving nuclear weapons in DOD custody, DOD facilities (including U.S. nuclear-powered ships), or material otherwise under DOD jurisdiction.

DOE Roles, Responsibilities, and Capabilities (P25)

Roles, Responsibilities, and Capabilities 24
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U.S. Department of Homeland Security (DHS) 27
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Through NEST, DOE can respond to incidents involving U.S. nuclear weapons in DOD and DOE custody via the Accident Response Group (ARG)

U.S. Department of Energy (DOE)

The U.S. Department of Energy (DOE) and the National Nuclear Security Administration (NNSA) maintain a diverse array of authorities, responsibilities, and capabilities for responding to nuclear and radiological incidents. DOE provides technical and operational support to all types of nuclear/radiological incidents via the Nuclear Emergency Support Team (NEST) and is responsible for coordinating the federal response to a nuclear/radiological incident at a DOE facility or involving DOE materials…

NEST performs four principal missions:

1. Countering WMD threats
2. Responding to accidents involving U.S. nuclear stockpile weapons
3. Protecting public health and safety during potential and actual releases of radioactive materials
4. Performing nuclear forensic activities to attribute the origin of nuclear material interdicted outside regulatory control or used in a nuclear device

DOD Roles, Responsibilities, and Capabilities (P24-38)

Additional Federal Capabilities

Defense Threat Reduction Agency (DTRA)

DTRA provides the following capabilities in support of response to and recovery from a nuclear/radiological incident:

- Maintains a 24-hour, year-round Technical Reachback program to provide critical operational support and modeling of chemical, biological, radiological, nuclear, and explosive (CBRNE) events in support of DOD and other interagency customers.
- Provides technical expertise through SMEs in biology, medicine, nuclear/radiology, chemistry, explosives, structural engineering, meteorology, and targeting support.
- Serves as the technical operations hub for FEMA's IMAAC.
- In the event of an emergency, activates the IMAAC and conducts an initial response in about an hour, which includes notifying interagency partners, initiating modeling of the hazard, providing completed modeling products in the IMAAC Portal in CBRNResponder, hosting and coordinating an interagency meeting to exchange incident information and improve modeling products, and coordinating with the requester for recurring modeling updates as necessary.
- Addresses a wide range of nuclear phenomenology through available modeling tools, including space effects, high-altitude electromagnetic pulse, near-surface detonation, and ground shock on hard and deeply buried structures.
- Provides Hazard Prediction and Analysis Capability (HPAC), a fast-running Lagrangian atmospheric transport and dispersion tool for nuclear and radiological atmospheric hazards. Modules within HPAC provide a capability to model effects from a single nuclear device and up to hundreds of strategic incidents, a fissile material release from a nuclear device involved in a chemical explosion or fire, RDDs, and releases from fixed nuclear facilities.

Support and Coordination Elements (P38-45)

Support and Coordination Elements 38
Countering Weapons of Mass Destruction (CWMD) 39
Federal Radiological Monitoring and Assessment Center (FRMAC) 39
Interagency Radiological Aerial Monitoring Concept of Operations 40
Interagency Modeling and Atmospheric Assessment Center (IMAAC) 41
Advisory Team for Environment, Food, and Health (A-Team) 41
Nuclear/Radiological Incident Task Force (NRITF) 42
Unified Coordination Group (UCG) 43
Radiological Operations Branch (Rad Branch) 43
Domestic Emergency Support Team (DEST) 44
Weapons of Mass Destruction Strategic Group (WMDSG) 44
Radiological Operations Support Specialist (ROSS) 45
Planning and Preparedness Support Elements 45

Federal Radiological Monitoring and Assessment Center (FRMAC)

The FRMAC is an interagency coordination element responsible for coordinating all federal radiological monitoring and assessment activities. The FRMAC integrates radiological response resources from DOE/NNSA, EPA, the Advisory Team, and other federal D/As as needed in support of the FRMAC mission.

FRMAC provides the following capabilities to support situational awareness and decision making during nuclear/radiological incident response and recovery:

- Ground and aviation-based monitoring and sampling
- Data assessment and management
- Sample processing and laboratory analysis
- Health and safety monitoring
- Technical coordination with radiological response authorities and decision makers
- Data product development and dissemination

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Interagency Modeling and Atmospheric Assessment Center (IMAAC)

The Interagency Modeling and Atmospheric Assessment Center (IMAAC) is an interagency coordination element responsible for production, coordination, and dissemination of federal atmospheric dispersion modeling and hazard predictions for an airborne portion of a hazardous material release. The IMAAC provides the single federal consensus on atmospheric predictions of hazardous material concentration to all levels of the Incident Command and national response organizations. This is achieved through a partnership between DHS, DOC (NOAA), DOD, DOE (NNSA), EPA, HHS, and the NRC. Through plume modeling analysis, the IMAAC provides emergency responders with predictions of hazards associated with atmospheric releases to aid in the decision-making process to protect the public and the environment.

The National Atmospheric Release Advisory Center (NARAC) is the primary provider of the modeling for nuclear/radiological incidents for the IMAAC.

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Advisory Team for Environment, Food, and Health (A-Team)

- The Advisory Team for Environment, Food, and Health (A-Team) includes representatives from the EPA, USDA, FDA, Centers for Disease Control and Prevention (CDC), and other federal D/As as needed…
- The A-Team uses information provided by the IMAAC, FRMAC, and other relevant sources.
- The A-Team makes protective action recommendations, not decisions…
- Examples of PARs include advice on emergency actions such as:
  - Sheltering & evacuation,
  - Prophylactic use of potassium iodide,
  - Restriction of food, and
  - Temporary relocation.

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Radiological Operations Support Specialist (ROSS)

- During nuclear/radiological incidents, the Radiological Operations Support Specialist (ROSS) identifies and provides critical information to responders, key leaders, and decision makers.
- The ROSS is a state and local subject matter expert with the ability to bridge the gap between response and radiological knowledge to minimize the impact of a potential or actual incident involving the release of radiological or nuclear materials.
- A ROSS provides SLTT leadership, decision makers, and responders with appropriate recommendations for hot zone definition, population monitoring and decontamination levels, patient handling, release of vehicles and equipment from a hot zone, responder PPE, decontamination techniques, and dose and turn-back guidance.
- The ROSS also gives SLTT response centers instant expertise in the federal radiological response framework, including assets, capabilities, deployment timelines, logistical needs, and contact information.
- During nuclear/radiological incidents, the ROSS helps responders and decision makers interpret federal and local data products, and deconflict contradictory measurements and models.

ROSS is a NIMS Typed Position

FEMA

Position Qualification for Situational Assessment
Screening, Search, and Detection

RADIOLOGICAL OPERATIONS SUPPORT SPECIALIST

RESOURCE CATEGORY	Screening, Search, and Detection
RESOURCE KIND	Personnel
OVERALL FUNCTION	The Radiological Operations Support Specialist (ROSS): 1. Provides subject-matter expertise and guidance on questions about radiation, the environment, hazard modeling, data and risk management, public protective actions and other scientific and technical issues to incident response leaders at any level 2. Gathers, organizes, synthesizes, documents and distributes incident and resource information to improve situational awareness at all levels of incident management 3. Is able to clearly explain the implications of modeling, measurement and analysis methods, as well as the health risks and hazards that exist during a radiological or nuclear incident 4. May function as a ROSS Strike Team Leader when serving as a Type 1 or Type 2 ROSS as part of a ROSS Strike Team
COMPOSITION AND ORDERING SPECIFICATIONS	1. This position can be ordered as a single resource. 2. Requestor specifies any additional qualifications necessary based on incident complexity and needs 3. Discuss logistics for deploying this position, such as working conditions, length of deployment, security, lodging, transportation and meals, prior to deployment 4. This position typically works 12 hours per shift, is self-sustainable for 72 hours and is deployable up to 14 days

Each type of resource builds on the qualifications of the type below it. For example, Type 1 qualifications include the qualifications in Type 2, plus an increase in capability. Type 1 is the highest qualification level.

COMPONENT	TYPE 1	TYPE 2	TYPE 3	TYPE 4	NOTES
DESCRIPTION	Same as Type 2, PLUS: 1. Has the capacity to work at the ICP and Emergency Operations Center (EOC) levels and to advise AHJ and elected officials 2. Helps the AHJ integrate federal radiological response assets and capabilities from across the government into the response, as necessary 3. Coordinates radiological activities and technical data management with other ROSS staff and federal response assets across the incident 4. Integrates into a state's EOCs and coordinates with the radiological control authority 5. Supports radiological response preparedness activities and exercises at the state and local levels 6. May manage multiple ROSS Strike Team Leaders engaged in a variety of radiological response activities, including human dose and environmental impact projection and assessment and maintaining a consistent radiological situational awareness 7. Manages various ROSS Strike Team activities as the AHJ requests, such as: a. Incident response activities b. Public and emergency worker dose data collection and reduction, for dose management in large populations c. Management of (Continued)	Same as Type 3, PLUS: 1. Creates exposure estimates for a variety of internal and external exposure scenarios 2. Understands key state and federal radiological response assets, capabilities and reporting structures, and integrates them into an effective response 3. Communicates complex radiological issues to large groups and senior managers and supports public message development 4. Helps develop Incident Action Plans (IAP) that balance complex radiological safety concerns with mission priorities 5. Works closely with command staff and emergency management teams 6. Works effectively with other ROSS staff when part of a ROSS Strike Team, or when serving as a ROSS Strike Team Leader, to synthesize large amounts of radiological data from a variety of response and recovery resources to ensure a common radiological operating picture across all affected jurisdictions 7. May coordinate with state and local decision makers to provide necessary radiological assessments of health and environmental impacts	Same as Type 4, PLUS: 1. Works as a technical specialist and advises response personnel and Authority Having Jurisdiction (AHJ) on issues pertaining to radiological and nuclear (rad/nuc) response 2. Provides radiological incident assessment and resource information through: a. Interpreting and communicating model and measurement results and data products b. Proficient use of the CBRNResponder mobile app and website to collect and share data 3. Has knowledge of state radiation control programs and other radiological emergency preparedness assets, as well as key federal radiological response assets 4. Exchanges technical information with other ROSS staff in the response and advisory organizations to ensure effective communication of protection guidance 5. When part of a ROSS Strike Team: Reports to a ROSS Strike Team Leader and works within a ROSS Strike Team at an Incident Command Post (ICP) or other incident management center to ensure the use of a common radiological operating picture throughout the response and recovery periods for compatible, effective decision- (Continued)	The National Incident Management System (NIMS) Type 4 ROSS has completed initial ROSS training and can work as a technical specialist under the supervision of a Type 3 or higher ROSS	When serving as part of a ROSS Strike Team, a NIMS Type 1 or Type 2 ROSS may also function as a team leader

COMPONENT	TYPE 1	TYPE 2	TYPE 3	TYPE 4	NOTES
DESCRIPTION	(Continued) geographically and temporally extensive environmental sampling d. Coordination of radiochemical analysis of samples e. Radiological safety guidance to emergency support functions engaged in lifesaving f. Restoration of critical infrastructure g. Decontamination of people and places h. Radioactive waste management		(Continued) making across all affected jurisdictions 6. Helps develop command post-level objectives for implementing protective actions and emergency worker protections on a unit-by-unit level 7. Guides radiological aspects of response during the incident by having: a. A working knowledge of radiological protection guidance and best practices, including how best to apply the Environmental Protection Agency (EPA) PAG Manual: Protective Action Guides and Planning Guidance for Radiological Incidents, the Department of Homeland Security (DHS) Radiological Dispersal Device (RDD) Response Guidance, FEMA Improvised Nuclear Device Response and Recovery guidance and other rad/nuc emergency response and recovery guidance b. The ability to obtain updated/additional radiological advice and recommendations from appropriate advisory organizations 8. Helps responding agencies and agency decision makers use the CBRNResponder website to maintain situational awareness of radiological aspects of the incident 9. Communicates radiological (Continued)		

COMPONENT	TYPE 1	TYPE 2	TYPE 3	TYPE 4	NOTES
DESCRIPTION			(Continued) issues to nontechnical audiences and provides first responders with just-in-time training on the CBRNResponder mobile app and website, monitoring devices and safety protocols 10. Effectively integrates into the Incident Command System (ICS) structure		
EDUCATION	One of the following: 1. Graduate degree in a radiation-related field 2. Successful completion of part 1 of the American Academy of Health Physics (AAHP) certification exam 3. Equivalent experience, as determined by the AHJ	One of the following: 1. Bachelor's degree in science, technology, engineering, mathematics or a radiation-related field, such as health physics, nuclear engineering or radiological science 2. NRRPT certification 3. Equivalent experience, as determined by the AHJ	Same as Type 4	One of the following: 1. Associate degree in a radiation-related field, such as health physics, nuclear engineering or radiological science 2. National Registry of Radiation Protection Technologists (NRRPT) certification	In lieu of an undergraduate degree, a NIMS Type 3 and 4 ROSS may substitute training and five years of experience as a National Fire Protection Association (NFPA) 472 Hazardous Materials Technician Specialist Employee A with a specialty in radioactive materials and/or weapons of mass destruction or equivalent, determined by the AHJ

Appendix G: DATA & MODELS (P121-127)

Appendix G: Data & Models G-1
Emergency Support Function Leadership Group (ESFLG) Modeling and Data Inventory G-1
Interagency Modeling and Atmospheric Assessment Center (IMAAC) G-1
Federal Radiological Monitoring and Assessment Center (FRMAC) G-2
Radiological Monitoring and Assessment System G-2
TurboFRMAC G-2
National Atmospheric Release Advisory Center (NARAC) Modeling System G-2
CBRNResponder G-3
CRC SimPLER G-3
Radiation Emergency Medical Management (REMM) G-3
Data and Modeling Assets for Decontamination and Cleanup G-3
Incident Waste Decision Support Tool (I-WASTE DST) G-4
RDD Waste Estimation Support Tool (RDD WEST) G-4
Preliminary Remediation Goals Calculator G-4
Residual Radioactivity Family of Codes G-5
Data and Modeling Assets for Electromagnetic Effects G-5
Electromagnetic Pulse Response Model G-5

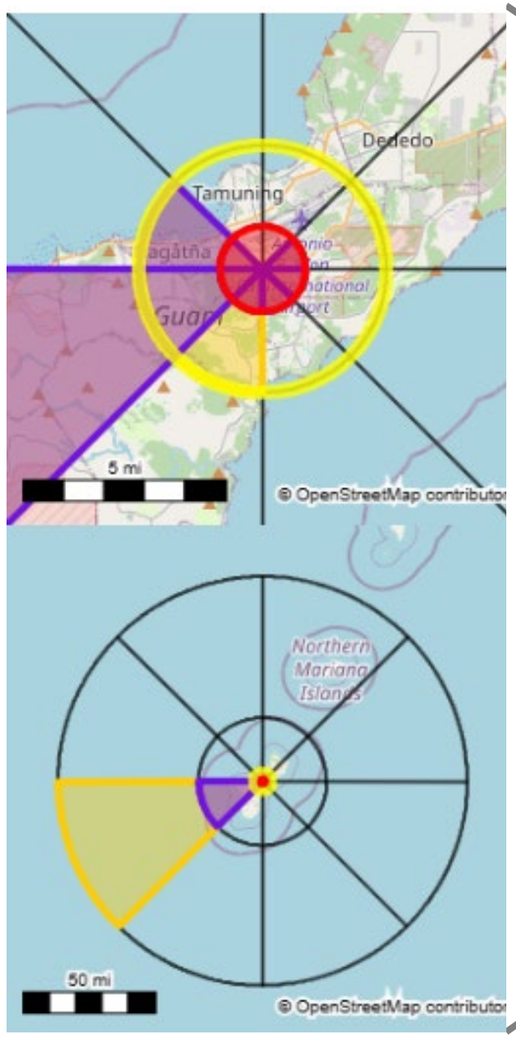
Interagency Modeling and Atmospheric Assessment Center (IMAAC)

- IMAAC provides a **single point for the coordination and dissemination of federal dispersion modeling** and hazard prediction products that represent the Federal position during actual or potential incidents involving hazardous atmospheric releases.
- IMAAC products can be used to **guide protective actions** (shelter or evacuation) and emergency management operations for the incident.
- **Standardized modeling and analysis products** are available (see next slides)

New Capability: Nuclear Hazard Zone

IMAAC Product Zero is for nuclear detonations

- Provides rapid, initial estimate of response zones
- Bounds uncertainty for immediate decision support



NucHazardZones Initial Estimate of Nuclear Detonation Impact DRAFT for review

Detonation Location: (13.467788, 144.786861) **Det. Time:** Jun 13, 2025 13:04 PDT **Yield:** 10 kT **Height of Burst:** 0.00 ft **Weather Time:** Jun 13, 2025 13:00 PDT (NOAA GFS025, Forecast start: Jun 13, 2025 05:00 PDT) **Model Run Time:** Jun 13, 2025 13:08 PDT

Moderate and Severe Damage Zone - Extent: 1.12 mi
Description: In the outer portions of the zone, substantial damage to light structures and minor damage to heavily-reinforced structures. In the inner areas, nearer the detonation location, practically all structures will be severely damaged or collapsed, and survival is unlikely. People in this zone may experience injuries or death from blast over-pressure, building collapse and flying debris, fires and burns from the thermal energy emitted by the detonation. Radiation injuries and death from the immediate prompt radiation or residual radiation on the ground may occur (even for cases when there is no dangerous fallout zone shown). This zone is where the blast over-pressure is greater than 2 psi
Public Actions: Stay indoors unless in danger from fire, building collapse, or other imminent threat.
Responder Actions: In the outer portion of this zone there is less severe damage and many structures have not collapsed. In the areas where structures haven't collapsed and the dose rate is less than 10 R/h (outside of dangerous fallout zone) immediate life-saving actions should be a priority.

Light Damage Zone - Extent: 3.23 mi
Description: Some injuries, most minor. Glass breakage and distorted window/door frames. Little-to-no damage to reinforced structures. Streets generally passable. Stalled/crashed vehicles will slow movement of emergency vehicles. Above 0.5 psi blast overpressure.
Public Actions: Stay indoors unless immediately hazardous due to building damage, seek adequate shelter.
Responder Actions: Treat survivors with serious injuries, direct patients with minor injuries to self/out-patient care.

Dangerous Fallout Zone - Extent: 26.70 mi
Description: Radiation levels are high enough to cause radiation injury or death. Above 10 R/h radiation dose rate. Hazard area reaches its maximum extent in the first few hours and then rapidly shrinks in size in the first day.
Public Actions: Shelter-in-place. Listen for public announcement about planned evacuation after 12-24 hours.
Responder Actions: Shelter-in-place or avoid this area, unless undertaking critical, specifically planned large population protection activities. Responders should have radiation monitoring equipment to alert them of excess exposure.

Shelter-in-Place Area - Extent: 85.48 mi
Description: Potentially elevated cancer risk from fallout radiation. Above 5 rem total radiation dose in 4 days if unsheltered and unprotected. (Note: A larger shelter-in-place area for a lower dose limit of 1 rem can be considered, but is not shown.)
Public Actions: Shelter-in-place for up to 24 hours, followed by planned evacuation, subject to confirming measurements and balancing of other hazards and risks.
Responder Actions: Monitor and minimize radiation exposure to emergency workers, and establish controls to ensure safe operation. Develop evacuation plans after initial shelter-in-place, weighing risks of radiation exposure versus risks from evacuation itself.

WARNING! This report was generated using initial (unverified) information on yield and detonation location and will be quickly superseded as additional information becomes available. Check for updated information one or more hours after the model run time: Jun 13, 2025 13:08 PDT

Yield Info

Yield

10 kT

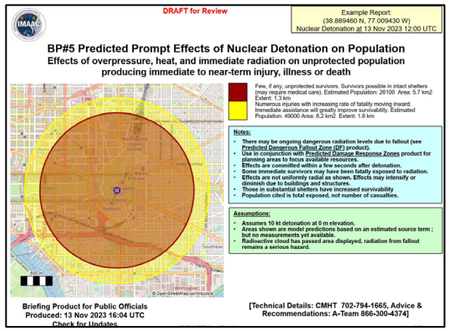
1 kT
10 kT
100 kT

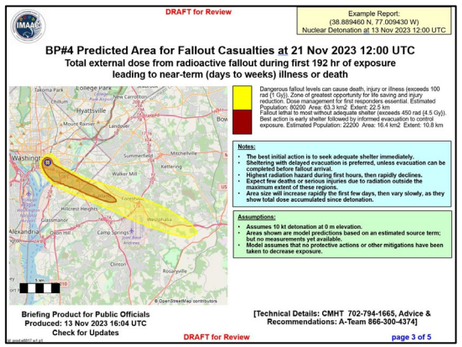
Burst Height

Ground Burst

Ground Burst
Air Burst

Nuclear Detonation SME Briefing Products (intended for use by SMEs to brief others)





Early Phase (minutes)

1. Predicted Dangerous Fallout Zone
2. Predicted Hot Zone /Worker Protection Areas
3. Predicted Damage Response Zones (with Dangerous Fallout Zone)
4. Predicted Area for Potential Fallout Casualties
5. Prompt Effects on Population (single time only)

Early Phase (hours to days)

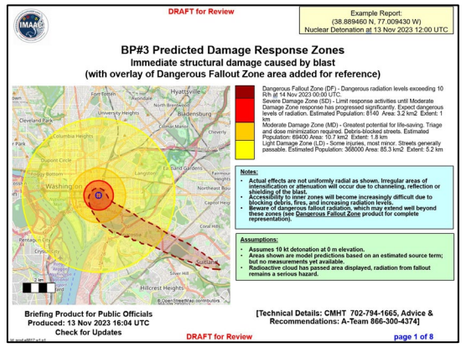
6. Predicted EPA/DHS Sheltering/ Evacuation Areas

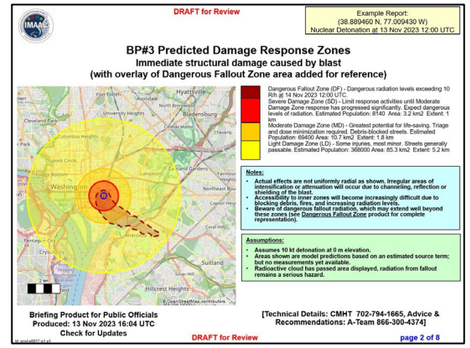
Intermediate Phase (days to months)

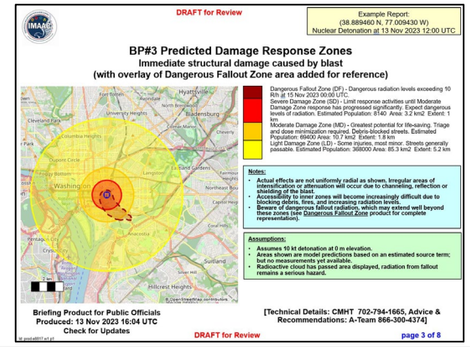
7. Predicted EPA/DHS Relocation Areas

Late Phase (days to years)

8. Predicted Areas of Concern for Agricultural Products

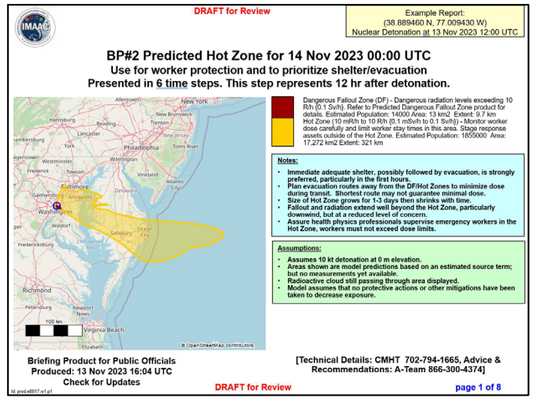






Fallout dose plots may be for multiple times due to the rapid changes due to radioactive decay

IMAAC Subject Matter Expert (SME) Briefing Products (intended for use by SMEs to brief others)


DRAFT for Review

Example Report:
(38.889460 N, 77.009430 W)
Nuclear Detonation at 13 Nov 2023 12:00 UTC

BP#2 Predicted Hot Zone for 14 Nov 2023 00:00 UTC
Use for worker protection and to prioritize shelter/evacuation
Presented in 6 time steps. This step represents 12 hr after detonation.

Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 Rih (0.1 Sv/h). Refer to Predicted Dangerous Fallout Zone product for details. Estimated Population: 14000 Area: 13 km2 Extent: 9.7 km
Hot Zone (10 mR/h to 10 R/h (0.1 mSv/h to 0.1 Sv/h)) - Monitor worker dose carefully and limit worker stay times in this area. Stage response assets outside of the Hot Zone. Estimated Population: 1850000 Area: 17,272 km2 Extent: 321 km

Notes:
- Immediate adequate shelter, possibly followed by evacuation, is strongly preferred, particularly in the first hours.
- Plan evacuation routes away from the DF/Hot Zones to minimize dose during transit. Shortest route may not guarantee minimal dose.
- Size of Hot Zone grows for 1-3 days then shrinks with time.
- Fallout and radiation extend well beyond the Hot Zone, particularly downwind, but at a reduced level of concern.
- Assure health physics professionals supervise emergency workers in the Hot Zone, workers must not exceed dose limits.

Assumptions:
- Assumes 10 kt detonation at 0 m elevation.
- Areas shown are model predictions based on an estimated source term; but no measurements yet available.
- Radioactive cloud still passing through area displayed.
- Model assumes that no protective actions or other mitigations have been taken to decrease exposure.

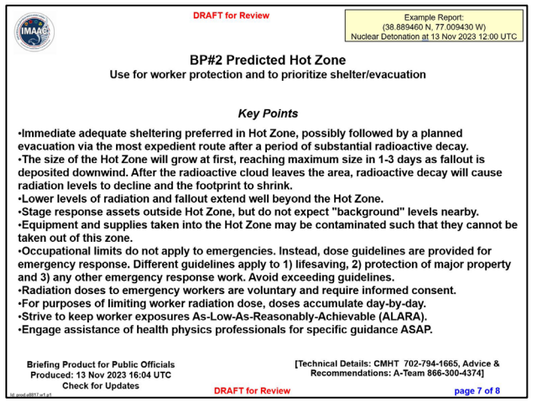
Briefing Product for Public Officials
Produced: 13 Nov 2023 16:04 UTC
Check for Updates

[Technical Details: CMHT 702-794-1665, Advice & Recommendations: A-Team 866-300-4374]

DRAFT for Review page 1 of 8

Slide 1. Map

- Map of colored areas of concern
- Legend describing colored areas
- Notes with key actions to consider (blue box)
- Assumptions and limitations (green box)


DRAFT for Review

Example Report:
(38.889460 N, 77.009430 W)
Nuclear Detonation at 13 Nov 2023 12:00 UTC

BP#2 Predicted Hot Zone
Use for worker protection and to prioritize shelter/evacuation

Key Points

- Immediate adequate sheltering preferred in Hot Zone, possibly followed by a planned evacuation via the most expedient route after a period of substantial radioactive decay.
- The size of the Hot Zone will grow at first, reaching maximum size in 1-3 days as fallout is deposited downwind. After the radioactive cloud leaves the area, radioactive decay will cause radiation levels to decline and the footprint to shrink.
- Lower levels of radiation and fallout extend well beyond the Hot Zone.
- Stage response assets outside Hot Zone, but do not expect "background" levels nearby.
- Equipment and supplies taken into the Hot Zone may be contaminated such that they cannot be taken out of this zone.
- Occupational limits do not apply to emergencies. Instead, dose guidelines are provided for emergency response. Different guidelines apply to 1) lifesaving, 2) protection of major property and 3) any other emergency response work. Avoid exceeding guidelines.
- Radiation doses to emergency workers are voluntary and require informed consent.
- For purposes of limiting worker radiation dose, doses accumulate day-by-day.
- Strive to keep worker exposures As-Low-As-Reasonably-Achievable (ALARA).
- Engage assistance of health physics professionals for specific guidance ASAP.

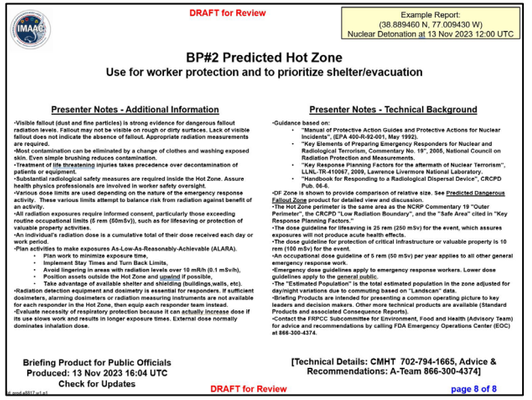
Briefing Product for Public Officials
Produced: 13 Nov 2023 16:04 UTC
Check for Updates

[Technical Details: CMHT 702-794-1665, Advice & Recommendations: A-Team 866-300-4374]

DRAFT for Review page 7 of 8

Slide 2. Key Points

- Additional information on relevant actions for consideration (evacuation, sheltering, relocation, worker protection)
- Highlights key points to present


DRAFT for Review

Example Report:
(38.889460 N, 77.009430 W)
Nuclear Detonation at 13 Nov 2023 12:00 UTC

BP#2 Predicted Hot Zone
Use for worker protection and to prioritize shelter/evacuation

Presenter Notes - Additional Information

- Visible fallout (dust and fine particles) is strong evidence for dangerous fallout radiation levels. Fallout may not be visible on rough or dirty surfaces. Lack of visible fallout does not indicate the absence of fallout. Appropriate radiation measurements are required.
- Most contamination can be eliminated by a change of clothes and washing exposed skin. Even simple brushing reduces contamination.
- Treatment of life threatening injuries takes precedence over decontamination of patients or equipment.
- Substantial radiological safety measures are required inside the Hot Zone. Assure health physics professionals are involved in worker safety oversight.
- Various dose limits are used depending on the nature of the emergency response activity. These various limits attempt to balance risk from radiation against benefit of an activity.
- All radiation exposures require informed consent, particularly those exceeding routine occupational limits (5 rem (50mSv)), such as for lifesaving or protection of valuable property activities.
- An individual's radiation dose is a cumulative total of their dose received each day or work period.
- Plan activities to make exposures As-Low-As-Reasonably-Achievable (ALARA).
  - Plan work to minimize exposure time.
  - Implement Stay Times and Turn Back Limits.
  - Avoid lingering in areas with radiation levels over 10 mR/h (0.1 mSv/h).
  - Position assets outside the Hot Zone and upwind if possible.
  - Take advantage of available shelter and shielding (buildings,walls, etc).
- Radiation detection equipment and dosimetry is essential for responders. If sufficient dosimeters, alarming dosimeters or radiation measuring instruments are not available for each responder in the Hot Zone, then equip each responder team instead.
- Evaluate necessity of respiratory protection because it can actually increase dose if its use slows work and results in longer exposure times. External dose normally dominates inhalation dose.

Presenter Notes - Technical Background

- Guidance based on:
  - "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents", (EPA 400-R-92-001, May 1992).
  - "Key Elements of Preparing Emergency Responders for Nuclear and Radiological Terrorism, Commentary No. 19", 2005, National Council on Radiation Protection and Measurements.
  - "Key Response Planning Factors for the Aftermath of Nuclear Terrorism", LLNL-TR-410087, 2009, Lawrence Livermore National Laboratory.
  - "Handbook for Responding to a Radiological Dispersal Device", CRCPD Pub. 06-6.
- DF Zone is shown to provide comparison of relative size. See Predicted Dangerous Fallout Zone product for detailed view and discussion.
- The Hot Zone perimeter is the same area as the NCRP Commentary 19 "Outer Perimeter", the CRCPD "Low Radiation Boundary", and the "Safe Area" cited in "Key Response Planning Factors".
- The dose guideline for lifesaving is 25 rem (250 mSv) for the event, which assures exposures will not produce acute health effects.
- The dose guideline for protection of critical infrastructure or valuable property is 10 rem (100 mSv) for the event.
- An occupational dose guideline of 5 rem (50 mSv) per year applies to all other general emergency response work.
- Emergency dose guidelines apply to emergency response workers. Lower dose guidelines apply to the general public.
- The "Estimated Population" is the total estimated population in the zone adjusted for daytime/nighttime variations due to commuting based on "Landscan" data.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRMAC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations by calling FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 13 Nov 2023 16:04 UTC
Check for Updates

[Technical Details: CMHT 702-794-1665, Advice & Recommendations: A-Team 866-300-4374]

DRAFT for Review page 8 of 8

Slide 3. Notes

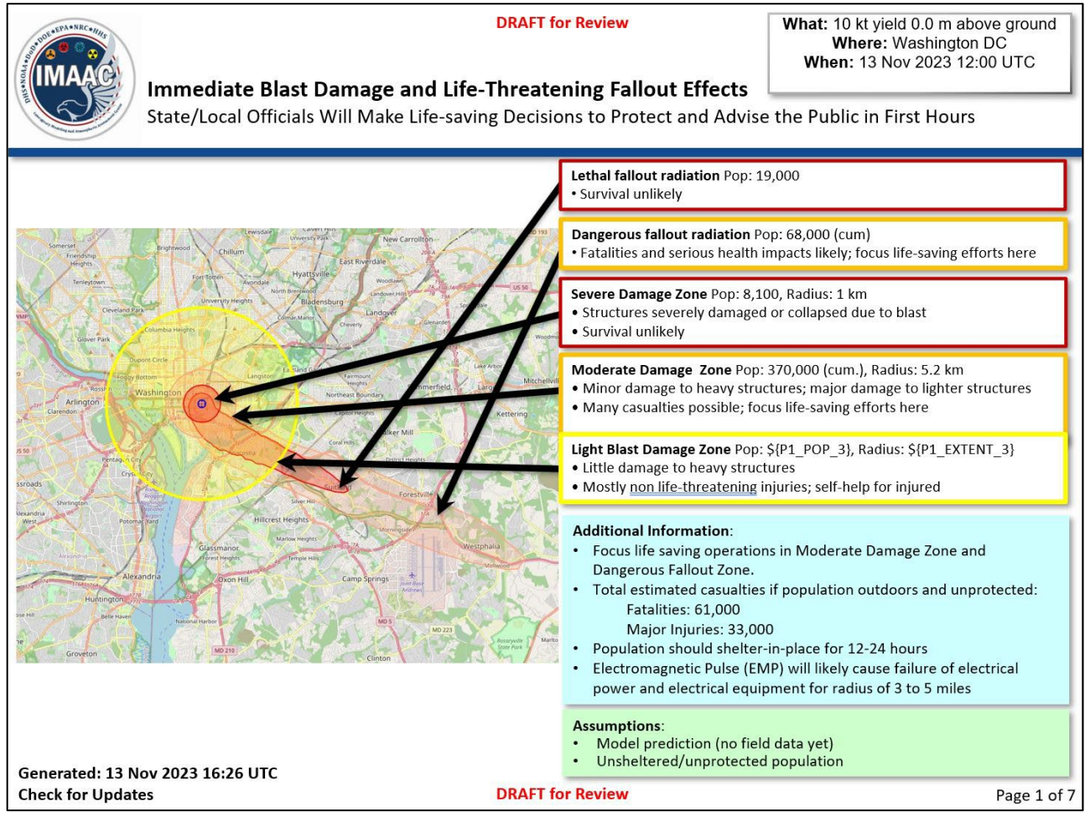
- Background and technical information
- Intended for use by the presenter (not for display)

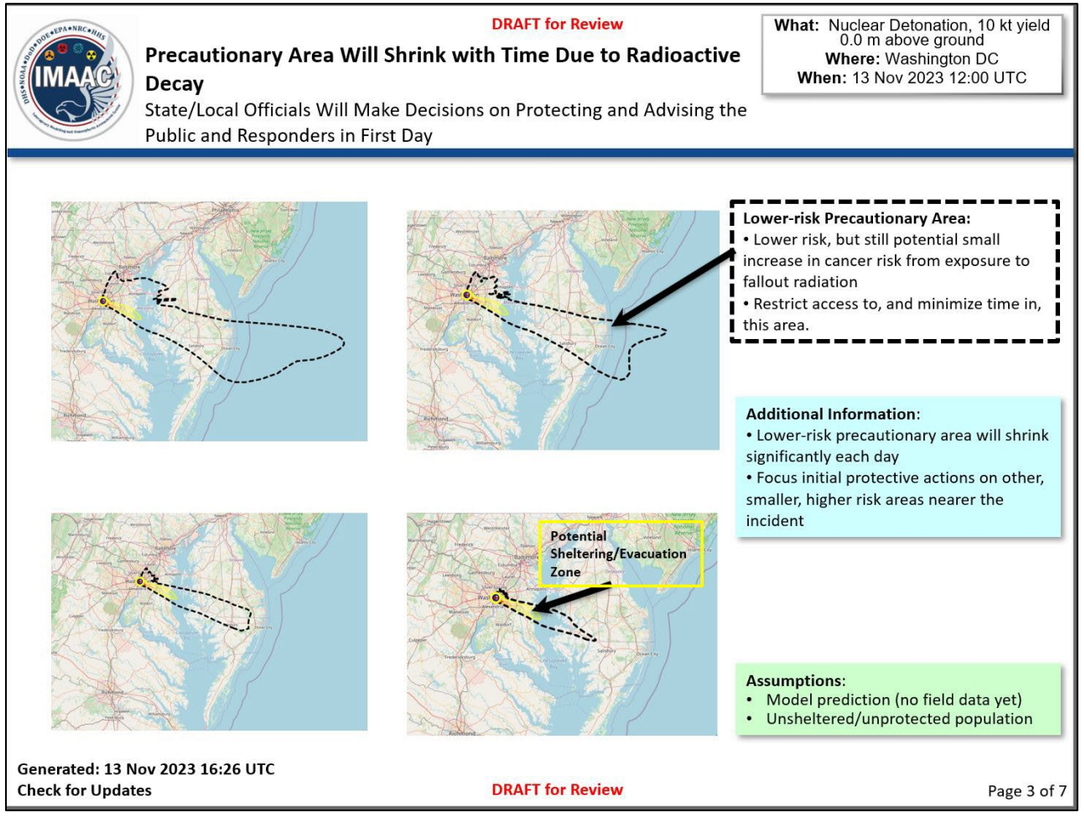
Slides include product titles and sub-titles, short scenario description, product creation date/time, and contact phone numbers for technical details and advice (NARAC/IMAAC, CMHT/FRMAC or Federal Advisory Team for Environment, Food and Health for radiological advice, EPA for chemical advice)

Additional Product: Executive Products

Executive Products summarize information presented in the SME briefing products

These are not fully automated at this time and will follow the SME briefing products





Focus on US Department of Energy FRMAC (Federal Radiological Monitoring and Assessment Center)

Mission Statement

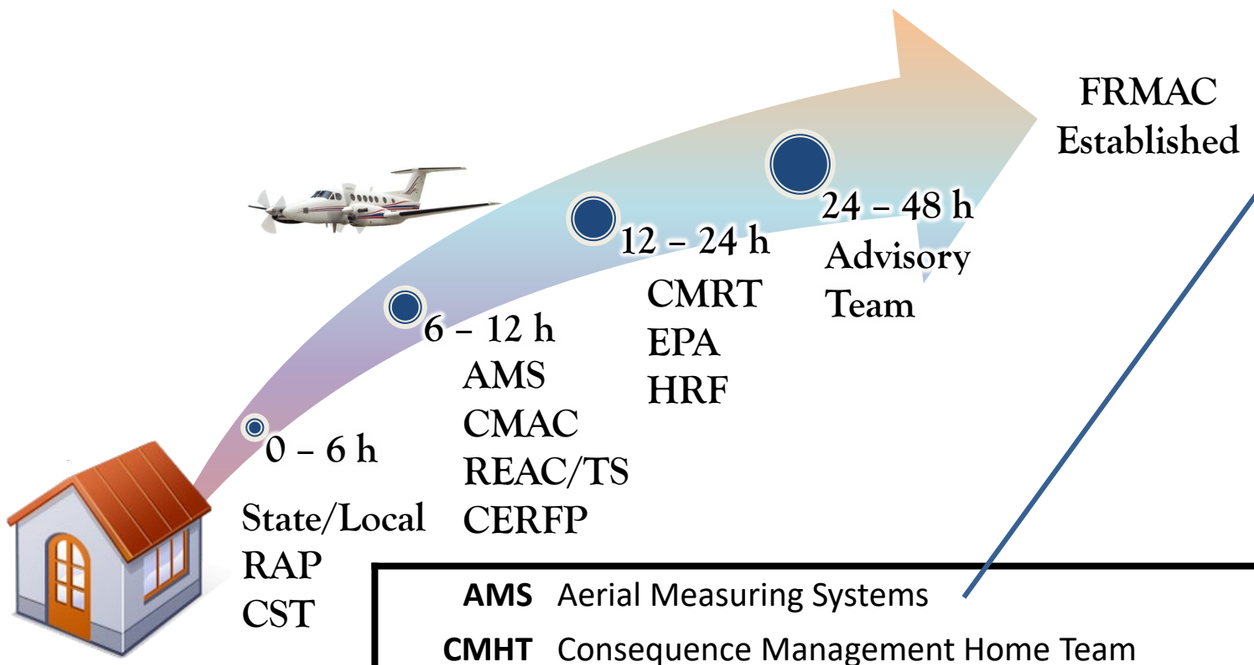
Provide timely, high-quality predictions, measurements, analyses, and assessments to promote efficient and effective emergency response for the protection of the public from the consequences of nuclear or radiological incidents.

DOE FRMAC Mission

Provide additional technical expertise and assistance to support local responders in the event of a radiological release or accident.

- Technical Expertise
  - Health Physics
  - Atmospheric Modeling
  - Aerial Measurements
  - Environmental Monitoring & Sampling
- Technical Assistance
  - Data Visualization
  - Sample Control & Management

FRMAC Assets and Timeline



AMS	Aerial Measuring Systems
CMHT	Consequence Management Home Team
CMAC	Consequence Management Advance Command
CMRT	Consequence Management Response Team
NARAC	National Atmospheric Release Advisory Center
REAC/TS	Radiation Emergency Assistance Center/Training Site
RAP	Radiological Assistance Program
CERFP	CBRNE Enhanced Response Force Package
CST	Civil Support Team
HRF	Homeland Response Force

Aerial Measuring Systems (AMS)

Rapidly develop maps of potential radiation exposure and radiological materials deposited on the ground

National Atmospheric Release Advisory Center (NARAC)

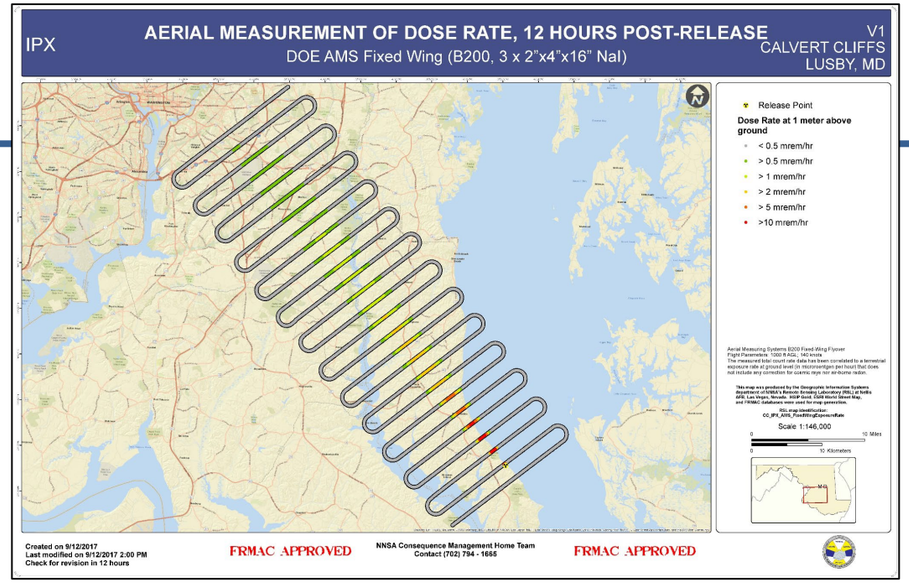
Transport and diffusion models simulate the release and predict the extent of the hazard.

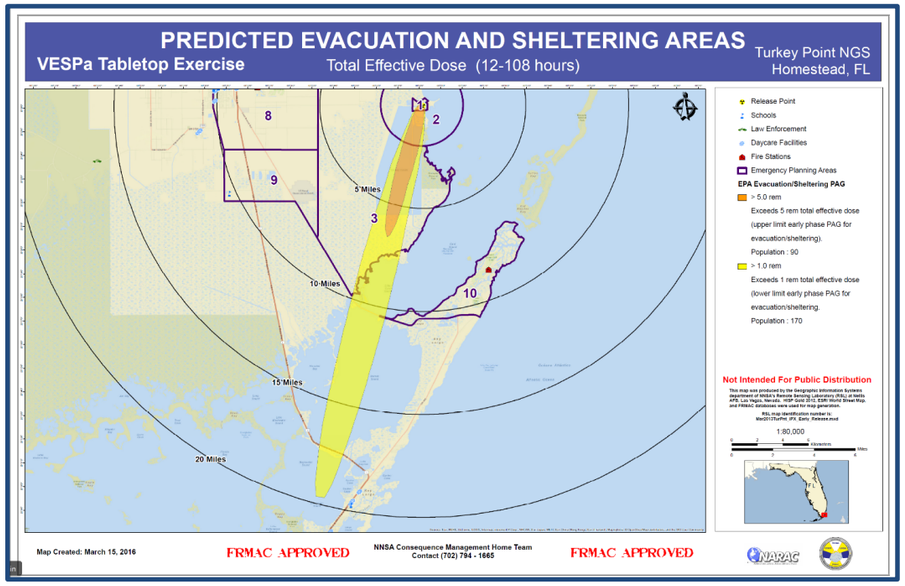
Radiological Assistance Program (RAP)

Locate and identify radiological materials

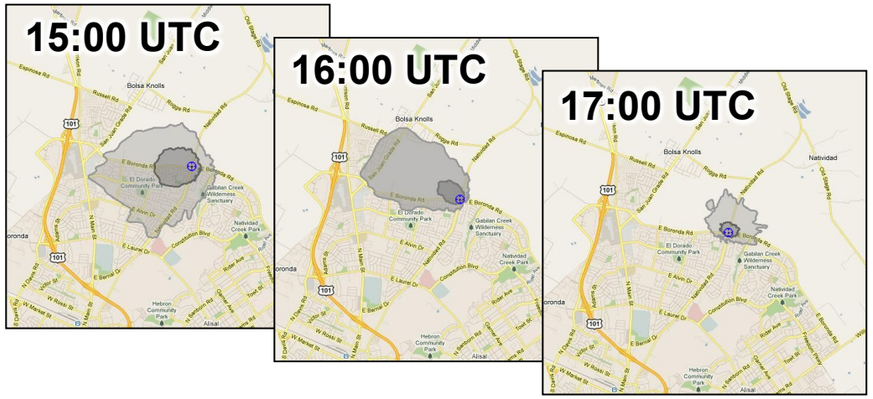
Example FRMAC products

- Aerial Measurement (AMS) Products
  - Exposure Rate Maps
  - Extrapolated Isotopic Deposition Maps
- Protective Action Guidance Products
  - Evacuation/Shelter Guidance Map
  - Relocation Guidance Map
  - Potassium Iodide Guidance Map
  - Worker Protection Dose Rate /Stay Time Map
  - Agricultural Impacts (Mature Produce or other)
  - Dairy/Beef Impacts
- Situational Awareness Products
  - Monitoring Status Map
  - Planning Maps





Technical Products you may encounter (intended for use by SMEs for SMEs)



Unknown Material Plots

- Used when there is not sufficient information about a release to estimate a source term
- Provide a picture of the downwind plume location
- Plot time series shows hourly changes in plume position
- Grey contours indicate no health-effect guidelines are used.

Nuclear Detonation Products

Prompt

- Nuclear Detonation Pop. Effects (Pressure, Thermal, Radiation)
- Thermal Effects on Personnel
- Nuclear Detonation Heavy Structure Effects (concrete/brick buildings)
- Nuclear Detonation Light Structure Effects (light residential buildings)

Fallout

- Early Fallout Casualties (1-Day Groundshine Dose)
- Early Phase Dose (0-96 hrs), includes groundshine and plume passage
- Early Phase Evacuation/Sheltering PAGs (12-108 hrs)
- Worker Protection
- Intermediate Phase Relocation PAGs
- Intermediate Phase Dose

Appendix G: DATA & MODELS (P121-127)

Appendix G: Data & Models G-1
Emergency Support Function Leadership Group (ESFLG) Modeling and Data Inventory G-1
Interagency Modeling and Atmospheric Assessment Center (IMAAC) G-1
Federal Radiological Monitoring and Assessment Center (FRMAC) G-2
Radiological Monitoring and Assessment System G-2
TurboFRMAC G-2
National Atmospheric Release Advisory Center (NARAC) Modeling System G-2
CBRNResponder G-3
CRC SimPLER G-3
Radiation Emergency Medical Management (REMM) G-3
Data and Modeling Assets for Decontamination and Cleanup G-3
Incident Waste Decision Support Tool (I-WASTE DST) G-4
RDD Waste Estimation Support Tool (RDD WEST) G-4
Preliminary Remediation Goals Calculator G-4
Residual Radioactivity Family of Codes G-5
Data and Modeling Assets for Electromagnetic Effects G-5
Electromagnetic Pulse Response Model G-5

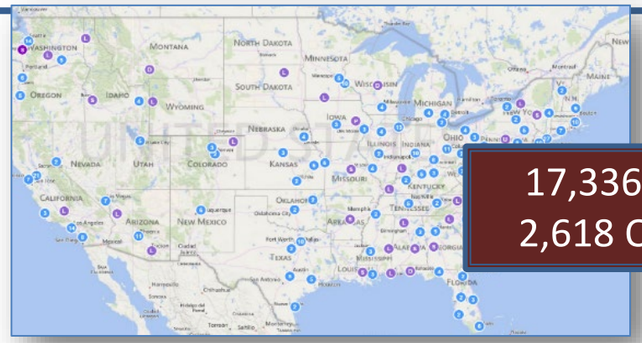
RadResponder

- The RadResponder Network is the national standard and Whole Community solution for the management of radiological data. It is a product of collaboration between Federal Emergency Management Agency (FEMA), Department of Energy (DOE) / National Nuclear Security Administration (NNSA), NA-84 and the Office of Radiological Security (ORS), the Environmental Protection Agency (EPA), the Defense Threat Reduction Agency (DTRA), and the Department of Homeland Security's Science and Technology Directorate (DHS S&T), and is **provided free of charge to all Federal, state, local, tribal, and territorial response organizations**.

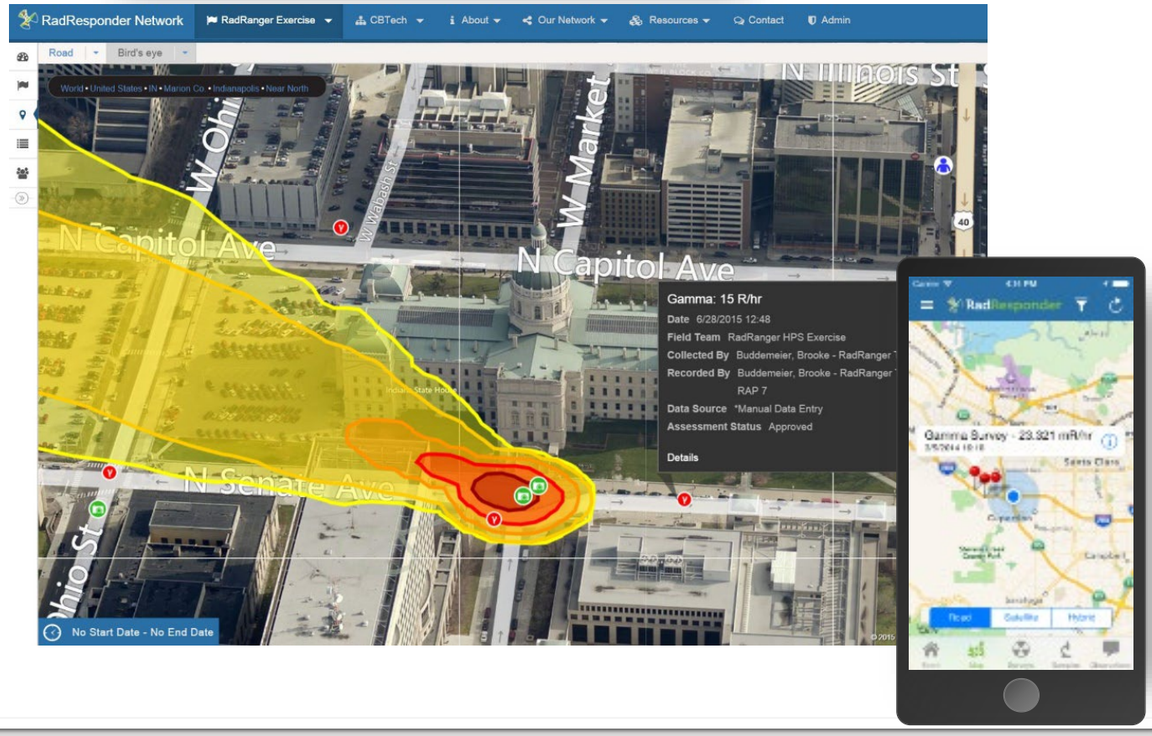
- RadResponder's flexible architecture enables organizations to rapidly and securely record, share and aggregate large quantities of data while managing their equipment, personnel, interagency partnerships, and multijurisdictional event space.

- RadResponder can be accessed on smartphones, tablets, and via the web, allowing it to be seamlessly and rapidly employed at all levels of government during a response to a radiological or nuclear emergency.

- RadResponder has a growing community and innovative technology designed to accelerate radiological emergency response to today's speed of information.



17,336 Responders
2,618 Organizations

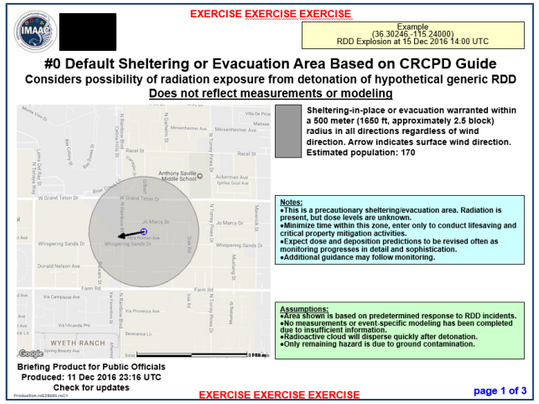


Appendix H: ADDITIONAL ASSETS (P127-133)

Organization	Resource Name	Description
DHS (CBP Laboratories and Scientific Services)	Weapons of Mass Radiological/Nuclear Reachback	Provides national-level 24/7 nuclear/radiological reachback capability to federal D/As and SLTT governments.
DHS (CWMD Office)	Mobile Detection Deployment Units	Provides radiological/nuclear detection equipment capability that allows end users to screen, search, and detect radiological/nuclear materials.
DHS (Federal Protective Service)	Hazardous Response Program	Includes initial investigations of suspicious or threatening chemical, biological, radiological, nuclear, and explosive (CBRNE) incidents; conduction of CBRNE threat assessments; confirmations of unauthorized presence of CBRNE agents and materials; and the conduct of emergency operations. The Hazardous Response Program also provides evacuation support during CBRNE incidents, CBRNE mutual aid response through agreement, and training assistance. The program is compliant with OSHA and National Fire Protection Association guidance and regulations.
DHS (FEMA)	Radiological Operations Support Specialist (ROSS)	Provides technical radiological/nuclear support to Incident Command at the state emergency operations center level.
DOC/NOAA	Air Resources Laboratory (ARL)	Focuses its dispersion research on the development and improvement of sophisticated dispersion models and other tools for air quality and emergency response applications. This includes volcanic eruptions, forest fires, nuclear accidents, and homeland security incidents. ARL also designs and evaluates high resolution observing networks, develops instrumentation, and conducts tracer field studies to improve the accuracy of atmospheric transport and dispersion projections.
DOD	CBRN Response Enterprise: Command and Control CBRN Response Elements (C2CREs)	Designed to be employed by U.S. Northern Command (USNORTHCOM) or U.S. Indo-Pacific Command (USINDOPACOM) in support of a federal response to a CBRN incident and are designed to provide incident commanders with the following capabilities: urban search and rescue, mass casualty decontamination, and emergency medical triage and stabilization. Additionally, the C2CREs may be able to support mission assignments in the functional areas of logistics, transportation, and CBRN assessment. C2CREs can easily scale down for incidents that do not require all resident capability sets.
DOD	CBRN Response Enterprise: Defense CBRN Response Force (DCRF)	Designed to be employed by USNORTHCOM or USINDOPACOM in support of a federal response to a CBRN incident. Joint Task Force – Civil Support is the designated headquarters of the DCRF. This DCRF is designed to provide incident commanders with the following capabilities: urban search and rescue, mass decontamination, emergency medical triage and trauma care (including limited surgical and intensive care), limited patient holding, and patient movement via both ground and rotary-wing MEDEVAC/CASEVAC. Additionally, the DCRF may be able to support mission assignments in the functional areas of logistics, ground/air transportation, site assessment, road clearing, and horizontal engineering. A health physicist from Air Force Radiological Assistance Team or another DOD organization will likely serve as an interface to the FRMAC and Advisory-Team (A-Team). The DCRF can easily scale down for incidents that do not require all resident capability sets. Furthermore, if additional assets are needed, DOD can request forces that are available and appropriate to support Lead Federal Agency requests for capabilities.
DOD	CBRN Response Enterprise: National Guard Teams	Comprised of Active Duty and Reserve Component forces in a Title 10 (federalized) duty status and National Guard forces in a Title 32 (non-federalized) duty status that provide life-saving capabilities for a national and regional CBRN response during major or catastrophic CBRN incidents. National Guard forces consist of Weapons of Mass Destruction-Civil Support Teams (WMD-CSTs), CBRNE Enhanced Response Force Packages (CERFPs), and Homeland Response Forces (HRFs) employed under state control. In extremis, all CRE units may be federalized to a title 10 status and allocated to U.S. Northern Command (USNORTHCOM) for command and control. WMD-CSTs are full-time National Guard units and provide 24/7 CWMD and CBRN detection, identification and threat characterization for prevention and response missions in support of federal and SLTT responders in all 54 states and territories. All National Guard CRE forces support National Special Security Events (NSSEs) and other Special Event Assessment Rating (SEAR) events.
DOD/Armed Forces Radiobiology Research Institute (AFRRI)	Medical Radio-Biology Advisory Team	Provides health physics, medical, and radiobiological advice to military and civilian command and control operations worldwide in response to nuclear and radiological incidents requiring a coordinated federal response. Through "reach back," the deployed team of radiation medicine physicians and senior health physicists can call on the knowledge and skills of radiobiologists, biodosimetrists, and other research professionals at AFRRI as well as those of other DOD response teams.
DOE (NNSA)	Nuclear Radiological Advisory Team	Provides an emergency response capability for on-scene scientific and technical advice for both domestic and international nuclear or radiological incidents. It is led by a Senior Energy Official who runs the NNSA field operation and who coordinates NNSA follow-on assets as needed.
DOE (NNSA)	Nuclear Weapons Accident Response Group	Provides technical guidance and responds to U.S. nuclear weapons accidents. The team assists in assessing weapons damage and risk and in developing and implementing procedures for safe weapon recovery, packaging, transportation, and disposal.
DOE (NNSA - NEST)	Radiological Assistance Program	First responder program for assessing and characterizing radiological hazards from nine regional offices at DOE sites throughout the United States. Each region has a minimum of three teams with a standard composition of eight personnel. Teams can be augmented with other specialists and will be tailored to the specific mission. The team conducts field monitoring and sampling measurements and provides radiological advice to protect the health and safety of responders and the public.
DOE (NNSA - NEST)	NEST Incident Management Team (IMT)	A Type 1 capable IMT that is flexible, scalable, and deploys to support the management of nuclear/radiological incidents. The NEST IMT effectively and efficiently organizes, coordinates, supports, and manages the NEST field-level response. The NEST IMT is led by the DOE/NNSA Senior Response Official (SRO).
DOE (NNSA - NEST)	Aerial Measuring System (AMS)	A fleet of rapidly deployable aircraft equipped with specialized radiation detection systems to provide real-time measurements of ground radiation contamination.
DOE (NNSA - NEST)	Consequence Management Home Team (CMHT)	Provides analytical and operational support to NEST responders in the field, which includes the analysis and interpretation of the initial release based on early data. The CMHT also provides map products, coordination of laboratory assets, and situational awareness of response teams deployed to an incident.
DOE (NNSA - NEST)	Consequence Management Response Team (CMRT)	A multi-functional team that conducts radiological monitoring and sampling, data assessment, laboratory analysis, and radiological health and safety support. CMRT can deploy the Consequence Management Advanced Command (CMAC) in advance of the rest of the team. CMRT is the foundation of the FRMAC, a DOE/NNSA led interagency entity to coordinate federal radiological monitoring and assessment in response to nuclear/radiological incidents.
DOE (NNSA - NEST)	National Atmospheric Release Advisory Center (NARAC)	Provides tools and expertise to map and model the spread of hazardous and radioactive material in the atmosphere.

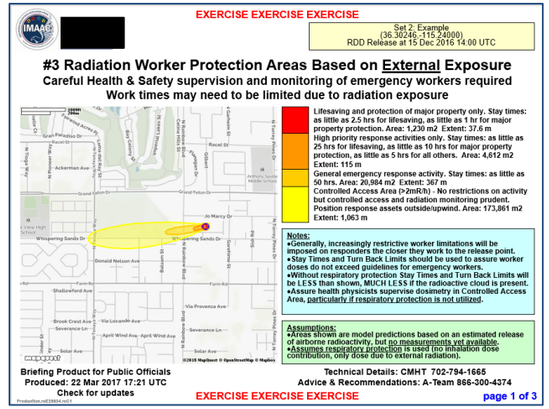
This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC

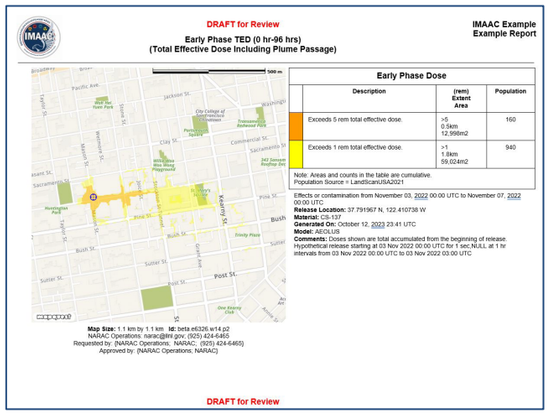
Radiological Dispersal Device (RDD)



Early Phase (minutes)

1. Evacuation and Sheltering Area based on CRCPD guide (BP#0)
2. Evacuation/Sheltering Areas based on EPA/DHS Guides (cloud present/passed) (BP#1, 2)
3. Worker Protection Areas (BP#3)
4. Potassium Iodine Administration Areas (for releases involving radioactive iodine) (BP#4)



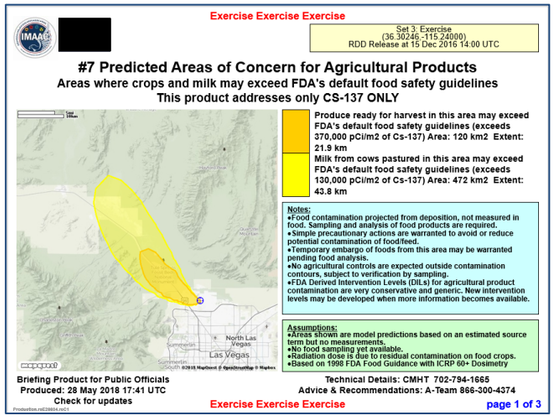


Intermediate Phase (days to months)

5. Predicted EPA/DHS Relocation Areas (BP#5)
6. Predicted area of concern for long term recovery (BP#6)

Late Phase (days to years)

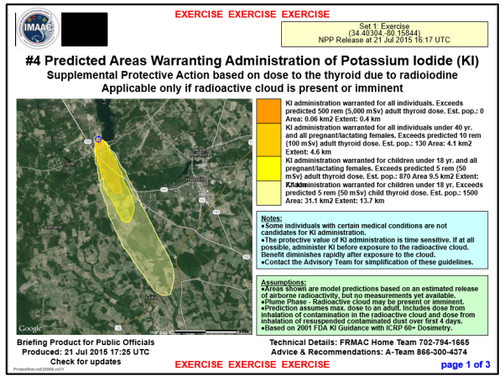
7. Predicted Areas of Concern for Agricultural Products



Nuclear Power Plant (NPP)

Early Phase (minutes)

1. Evacuation/Sheltering Areas based on EPA/DHS Guides (cloud present/passed) (BP #1,2)
2. Worker Protection Areas (BP#3)
3. Potassium Iodine Administration Areas (for releases involving radioactive iodine) (BP#4)


EXERCISE EXERCISE EXERCISE

Set 1: Exercise
(34.40304,-80.15844)
NPP Release at 21 Jul 2015 16:17 UTC

#4 Predicted Areas Warranting Administration of Potassium Iodide (KI)
Supplemental Protective Action based on dose to the thyroid due to radioiodine
Applicable only if radioactive cloud is present or imminent

KI administration warranted for all individuals. Exceeds predicted 500 rem (5,000 mSv) adult thyroid dose. Est. pop.: 0 Area: 0.06 km2 Extent: 0.4 km

KI administration warranted for all individuals under 40 yr. and all pregnant/lactating females. Exceeds predicted 10 rem (100 mSv) adult thyroid dose. Est. pop.: 130 Area: 4.5 km2 Extent: 4.6 km

KI administration warranted for children under 18 yr. and all pregnant/lactating females. Exceeds predicted 5 rem (50 mSv) adult thyroid dose. Est. pop.: 870 Area 9.5 km2 Extent: 5 km

KI administration warranted for children under 18 yr. Exceeds predicted 5 rem (50 mSv) child thyroid dose. Est. pop.: 1500 Area: 31.1 km2 Extent: 13.7 km

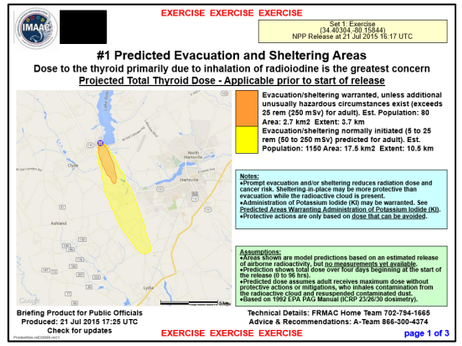
Notes:
•Some individuals with certain medical conditions are not candidates for KI administration.
•The protective value of KI administration is time sensitive. If at all possible, administer KI before exposure to the radioactive cloud. Benefit diminishes rapidly after exposure to the cloud.
•Contact the Advisory Team for simplification of these guidelines.

Assumptions:
•Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.
•Prediction shows total dose over four days beginning at the start of the release (0 to 96 hrs).
•Prediction assumes max. dose to an adult, includes dose from inhalation of contamination in the radioactive cloud and dose from inhalation of resuspended contaminated dust over first 4 days.
•Based on 2001 FDA KI Guidance with ICRP 60= Dosimetry.

Briefing Product for Public Officials
Produced: 21 Jul 2015 17:25 UTC
Check for updates

Technical Details: FRMAC Home Team 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

EXERCISE EXERCISE EXERCISE page 1 of 3


EXERCISE EXERCISE EXERCISE

Set 1: Exercise
(34.40304,-80.15844)
NPP Release at 21 Jul 2015 16:17 UTC

#1 Predicted Evacuation and Sheltering Areas
Dose to the thyroid primarily due to inhalation of radioiodine is the greatest concern
Projected Total Thyroid Dose - Applicable prior to start of release

Evacuation/sheltering warranted, unless additional unusually hazardous circumstances exist (exceeds 25 rem (250 mSv) for adult). Est. Population: 80 Area: 2.7 km2 Extent: 3.7 km

Evacuation/sheltering normally initiated (5 to 25 rem (50 to 250 mSv) predicted for adult). Est. Population: 1160 Area: 17.5 km2 Extent: 10.5 km

Notes:
•Prompt evacuation and/or sheltering reduces radiation dose and cancer risk. Sheltering in-place may be more protective than evacuation while the radioactive cloud is present.
•Administration of Potassium Iodide (KI) may be warranted. See Predicted Areas Warranting Administration of Potassium Iodide (KI).
•Protective actions are only based on dose that can be avoided.

Assumptions:
•Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.
•Prediction shows total dose over four days beginning at the start of the release (0 to 96 hrs).
•Predicted dose assumes adult receives maximum dose without protective actions or mitigations, who inhales contamination from the radioactive cloud and dose from inhalation of resuspended dust.
•Based on 1992 EPA PAG Manual (ICRP 2326/30 dosimetry).

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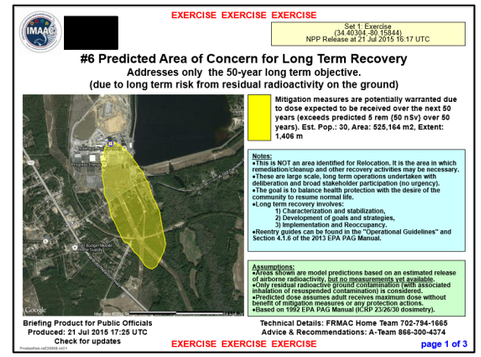
Technical Details: FRMAC Home Team 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

EXERCISE EXERCISE EXERCISE page 1 of 3

Intermediate Phase (days to months)

5. Predicted EPA/DHS Relocation Areas (BP#5)
6. Predicted area of concern for long term recovery (BP#6)


EXERCISE EXERCISE EXERCISE

Set 1: Exercise
(34.40304,-80.15844)
NPP Release at 21 Jul 2015 16:17 UTC

#6 Predicted Area of Concern for Long Term Recovery
Addresses only the 50-year long term objective.
(due to long term risk from residual radioactivity on the ground)

Mitigation measures are potentially warranted due to dose expected to be received over the next 50 years (exceeds predicted 5 rem (50 mSv) over 50 years). Est. Pop.: 30, Area: 525,164 m2, Extent: 1,406 m

Notes:
•This is NOT an area identified for Relocation. It is the area in which remediation/cleanup and other recovery activities may be necessary.
•These are large scale, long term operations undertaken with deliberation and broad stakeholder participation (no urgency).
•The goal is to balance health protection with the desire of the community to resume normal life.
•Long term recovery involves:
1) Characterization and stabilization,
2) Development of goals and strategies,
3) Implementation and Reoccupancy.
•Reentry guides can be found in the "Operational Guidelines" and Section 4.1.6 of the 2013 EPA PAG Manual.

Assumptions:
•Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.
•Only residual radioactive ground contamination (with inadvertent inhalation of resuspended Contamination) is considered.
•Predicted dose assumes adult receives maximum dose without benefit of mitigation measures or any protection actions.
•Based on 1992 EPA PAG Manual (ICRP 2326/30 dosimetry).

Briefing Product for Public Officials
Produced: 21 Jul 2015 17:25 UTC
Check for updates

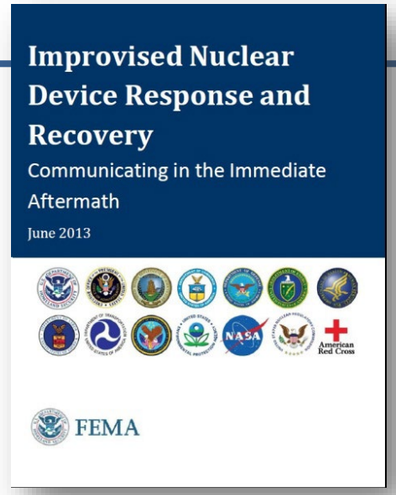
Technical Details: FRMAC Home Team 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

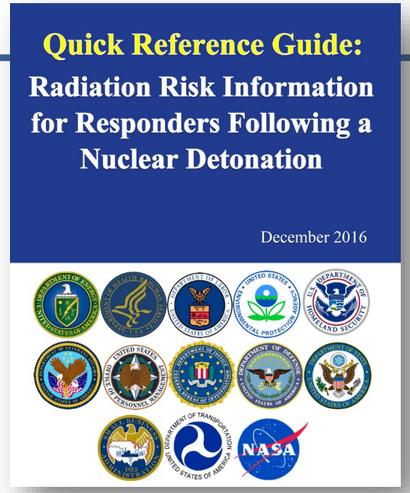
EXERCISE EXERCISE EXERCISE page 1 of 3

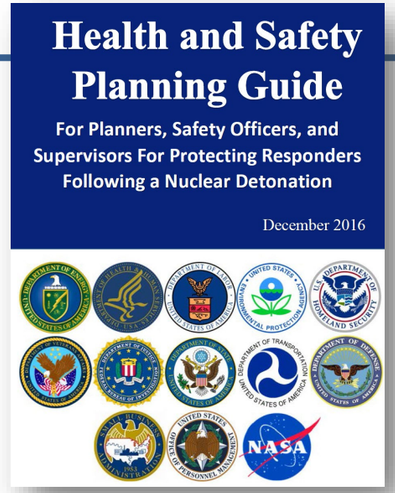
Late Phase (days to years)

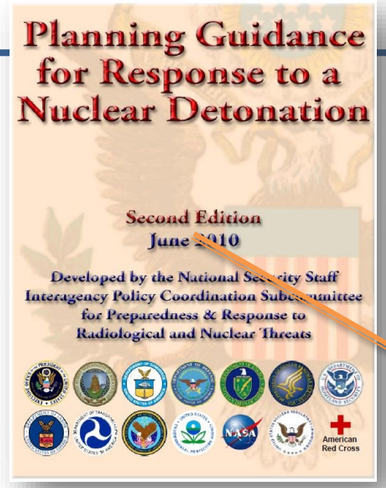
7. Predicted Areas of Concern for Agricultural Products (BP#7)

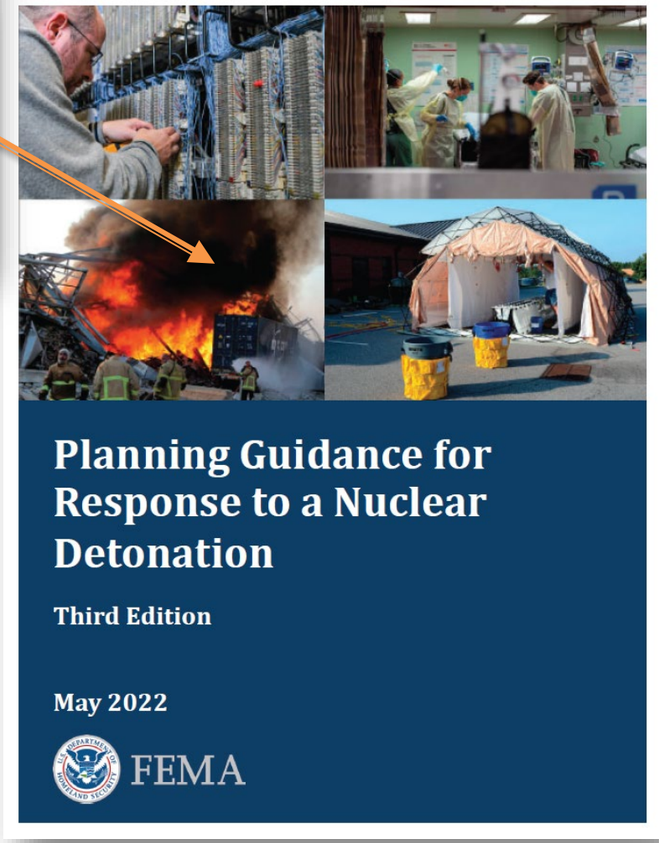
Guidance for Response to a Nuclear Detonation

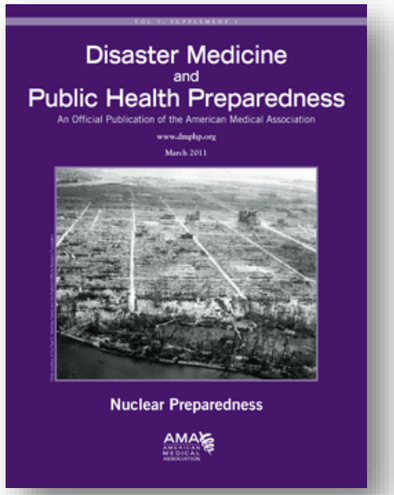


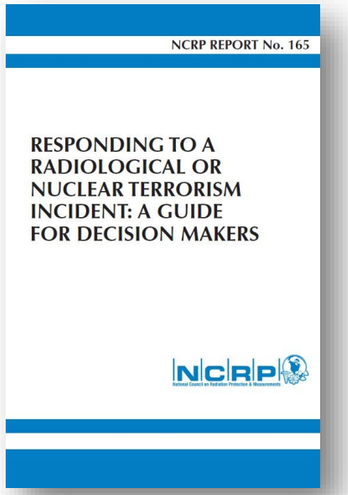












Guidance Overview

- Describes considerations, planning factors, and available resources, to craft a successful response plan for nuclear detonations.
- Focuses on the first 24-72 hours after a detonation, when early actions can save many lives, but majority of federal support has yet to arrive.

Primary Audiences

- Planners: Fire response, emergency medical service, HAZMAT response, utility service, public works emergency, transportation, public health, medical provider (e.g., hospitals)
- Mass care providers (e.g., American Red Cross)
- Local & regional private sector industries capable of supporting immediate response
- Other organizations that represent disciplines that conduct emergency response activities.

Third Edition Updates

- Guidance for a wider range of nuclear detonations, including larger detonations and air bursts
- Incorporates more than 10 years of new research, best practices, and response resources
- Includes a new chapter on the Integrated Public Alert & Warning System (IPAWS), which enables officials to send warnings and key messages during response

Document Structure

Chapters 3-7 are designed to be pulled-out and, when combined with Chapters 1 and 2, form stand-alone guidance documents.

For example, if a planner is only responsible for early medical care, covered by Chapter 4, they would only need Chapters 1, 2, and 4.

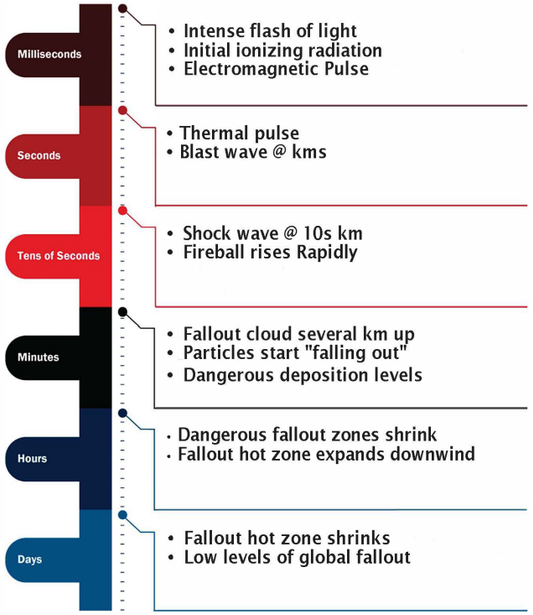
Chapter	Writing Lead
1: Nuclear Detonation Impacts	Technical Team (DOE led)
2: A Zoned Approach	Technical Team (DOE led)
3: Shelter & Evacuation	Technical Team (DOE led)
4: Acute Medical Care	HHS/ASPR
5: Population Monitoring	CDC
6: Communications and Public Preparedness	EPA
7: Alerts, Warning, Notifications, and FEMA's IPAWS	FEMA

Chapter 1: Nuclear Detonation Impacts

Chapter 1 provides a high-level description of the features that make a nuclear incident **unique.**

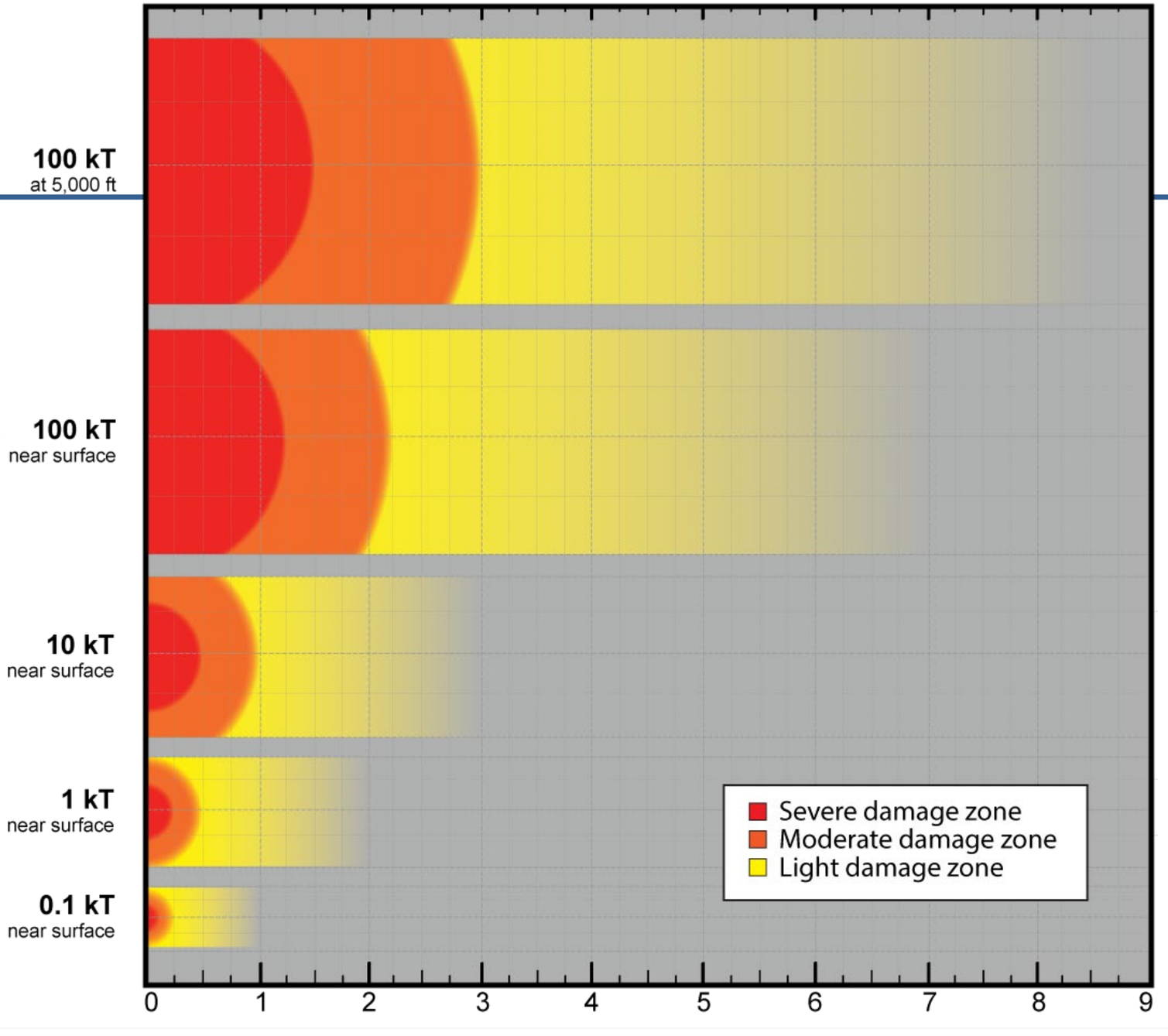
While these subjects are technical, descriptions are tailored for a non-technical audience.

- Blast Effects
- Prompt Thermal Effects and Fire
- Eye Injuries
- Initial and Residual Radiation
- Height of Burst (HOB) Considerations
- Radiation Zones
- Radiation Injuries and Fallout Health Impacts
- Electromagnetic Pulse (EMP) affects



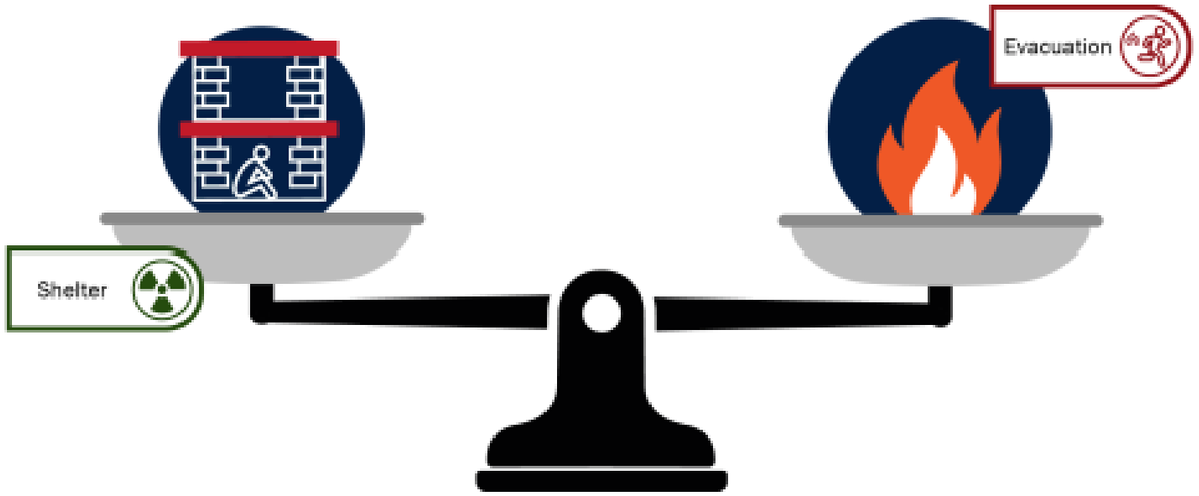
Expanded number of Yields and HOBs

- 100 kT Air burst, 5000 ft
- 100 kT Air burst, 1000 ft
- 100 kT Ground burst
- 10 kT Ground burst
- 1.0 kT Ground burst
- 0.1 kT Ground burst



Fires

Fires can seriously complicate protective actions because they may warrant evacuations when fallout is present.

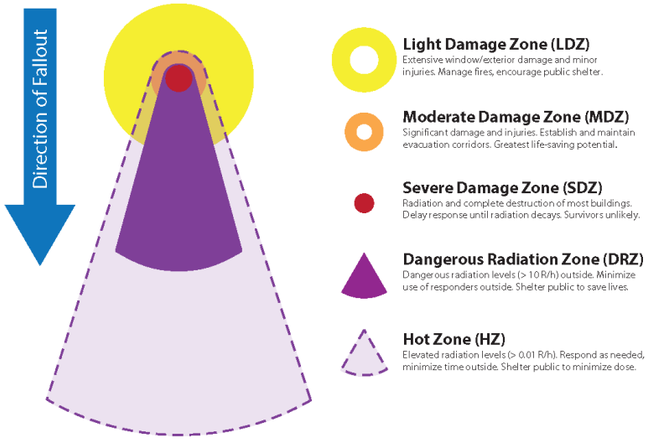


- Air burst nuclear detonations increase the amount of nuclear induced fires within a few miles of point of detonation.
- Large urban fires can be a significant threat to survivors in damage zones and evacuation may be required to save lives.
- Air bursts and yields greater than 10 kT thermal pulse can ignite fires and cause lethal burns to those in line-of-sight to the fireball.

Chapter 2: A Zoned Approach

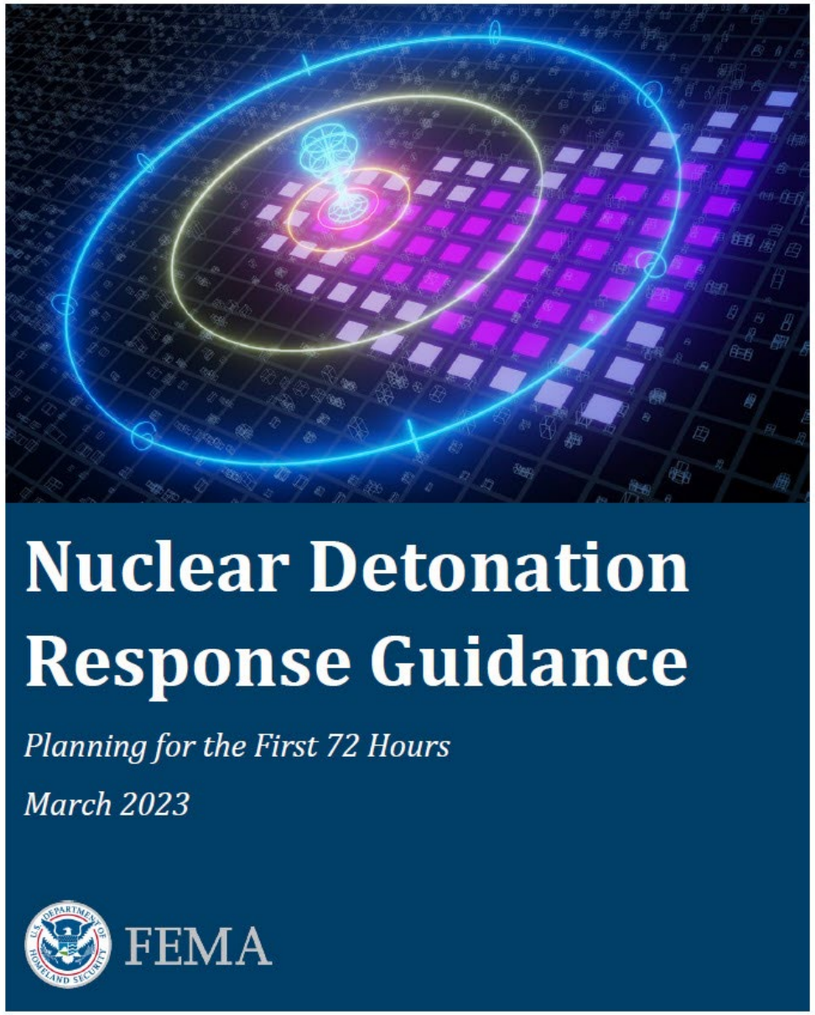
- An adaptable, zoned approach to prioritize response activities and coordinate collective allocation of scarce resources among jurisdictions, states, and regional organizations.
- Provides flexibility to responders who must process an overwhelming amount of incident information and rapidly generate prioritized response actions.

- 5 Hazard Zones
  - 3 Blast Damage Zones
  - 2 Radiation Zones

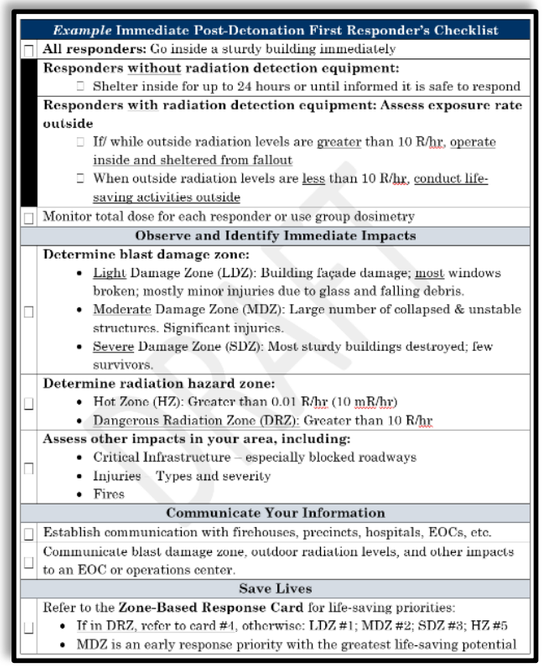


- Emergency Worker Safety
- Critical Infrastructure Decontamination
- Radioactive Waste Management

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

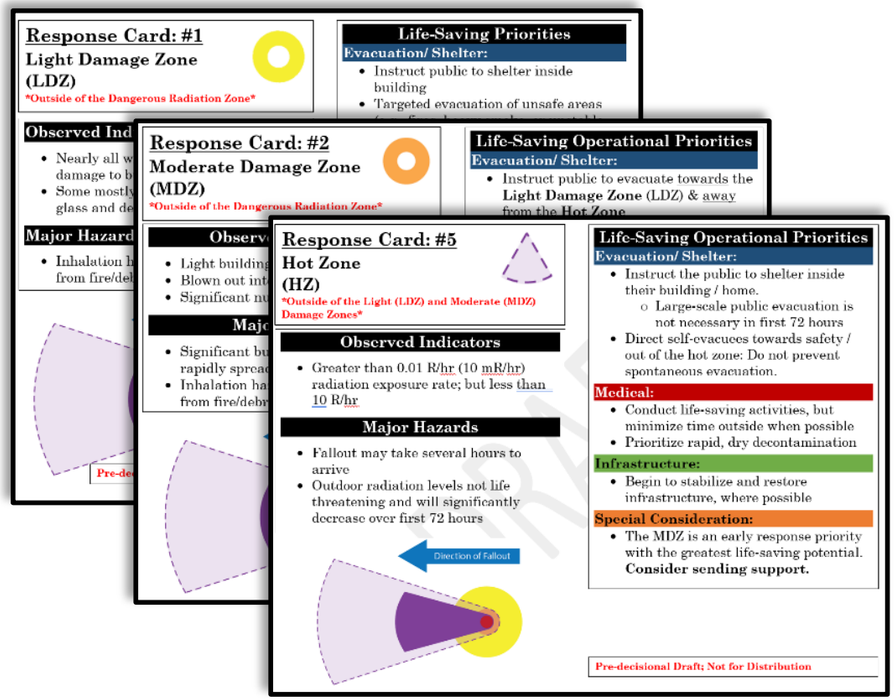
Communicate Your Information

- ☐ 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

Chapter 3: Shelter & Evacuation

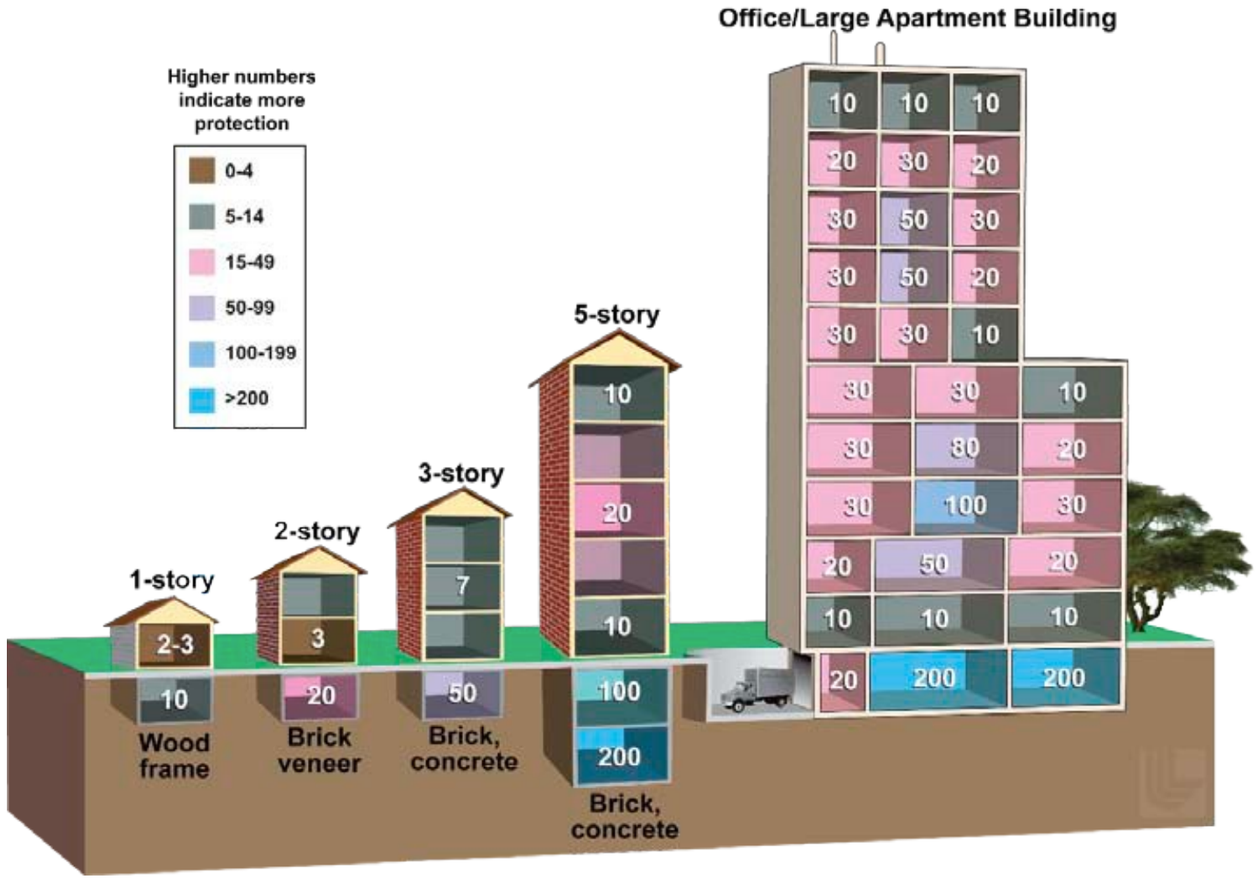
Sheltering is one of the most, if not **the most**, important protective action.

- Timely Messaging
- Adequate Shelter
- Sheltering Guidance
- Situational Awareness
- Evacuation Guidance
- Self-Evacuation
- Contamination Concerns

Sheltering and evacuation can reduce the number of people exposed to life-threatening situations, such as high levels of radiation, medical emergencies, and fires.

Adequate Shelter

- **Radiation:** The best radiation protection is underground (e.g., basements, subway tunnels, underground parking garages) or in the center of large, heavy buildings.
- **Blast:** Underground areas or the center of building that have heavy construction (concrete, brick, or cement) to mitigate blast effects.
- **Dust & Smoke:** Close windows and doors to minimize the amount of outdoor air being drawn into the building. Make sure to maintain enough ventilation to ensure adequate indoor air quality.



When planning evacuations, planners must consider

- Responder and evacuee risks, including radiation exposure along the evacuation route
- The threat of fires or hazardous material exposure in the area
- Transportation resources (e.g., vehicles, public transit, rail, air, water)
- Ease of access and egress (including infrastructure damage to roads, bridges, and tunnels)
- Evacuation support resources
- Impact of self-evacuating populations

Chapter 4: Acute Medical Care

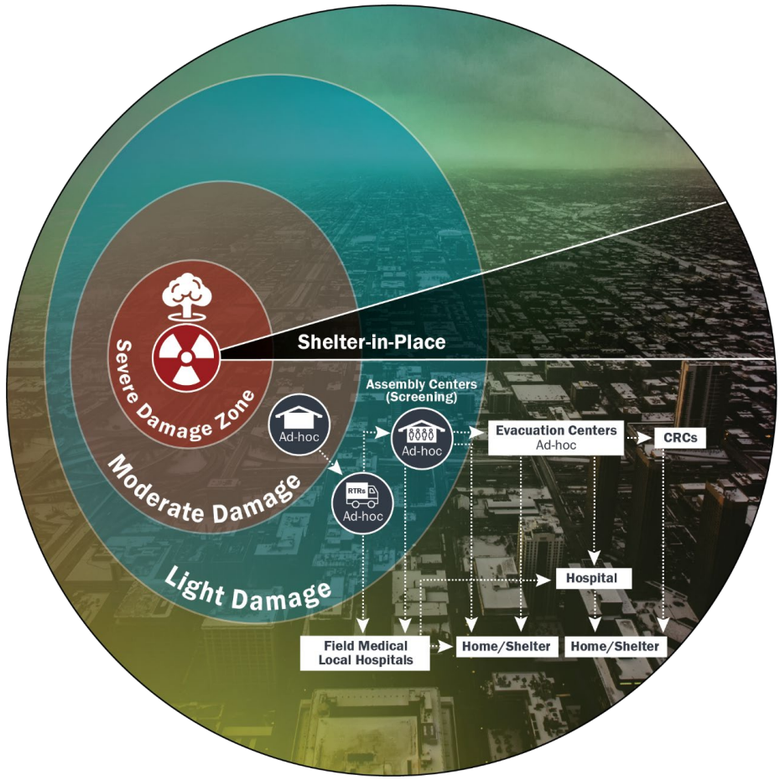
The large number of casualties caused by a nuclear detonation will overwhelm local medical systems.

- Injuries: Identification, Triage, and Treatment
  - Mechanical trauma
  - Thermal burn injuries
  - Radiation injuries
  - Hematopoietic acute radiation syndrome
  - Microbial Infections
  - Psychosocial and behavioral healthcare
- Initial Mass Casualty Triage in Scarce Resource Environments
  - Resource scarcity
  - Triage
  - Medical Countermeasures (MCMs) in the Strategic National Stockpile (SNS)
- Radiation Triage, Treatment, and Transportation (RTR) system
- Fatality Management

Chapter 5: Population Monitoring

Population monitoring: assessing the impact population's exposure to radiation or contamination through interview and screening with equipment (if available).

- Contamination considerations
- Screening for contamination
  - External
  - Internal
  - Self-decontamination
- Community Reception Centers and Mass Care Shelter Operations
- Long-Term Registry and Follow-up



Chapter 6: Communications and Public Preparedness

Communications strategies for all nuclear detonation scenarios have the same baseline criteria – **immediate, clear, and instructive messages** for public health and safety are the priority.

- Pre-Incident Communications Planning
  - Community Preparedness and Awareness
  - Audience Assessment and Preparation
  - Interjurisdictional Relationships and MOUs
- Immediate Response Communications Priorities
  - Safety Instruction Dissemination
  - Communications Infrastructure
  - Worldwide Media Interest
  - Intraorganizational Communication Challenges
  - Loss of Life Messaging

Pre-Incident Communications Planning

- Plan and execute nuclear detonation preparedness education campaigns related to other hazards and harness teachable moments.
- Determine your audience and develop tailored messaging/communications.
- Develop interjurisdictional relationships and Memorandums of Understanding (MOUs)

Without pre-incident knowledge, key messaging, and preparedness steps, people will likely follow the instinct to run from danger, potentially exposing themselves to fatal doses of radiation that could be avoided by sheltering.

Chapter 7: Alerts, Warnings, Notifications (AWNs), and FEMA's IPAWS

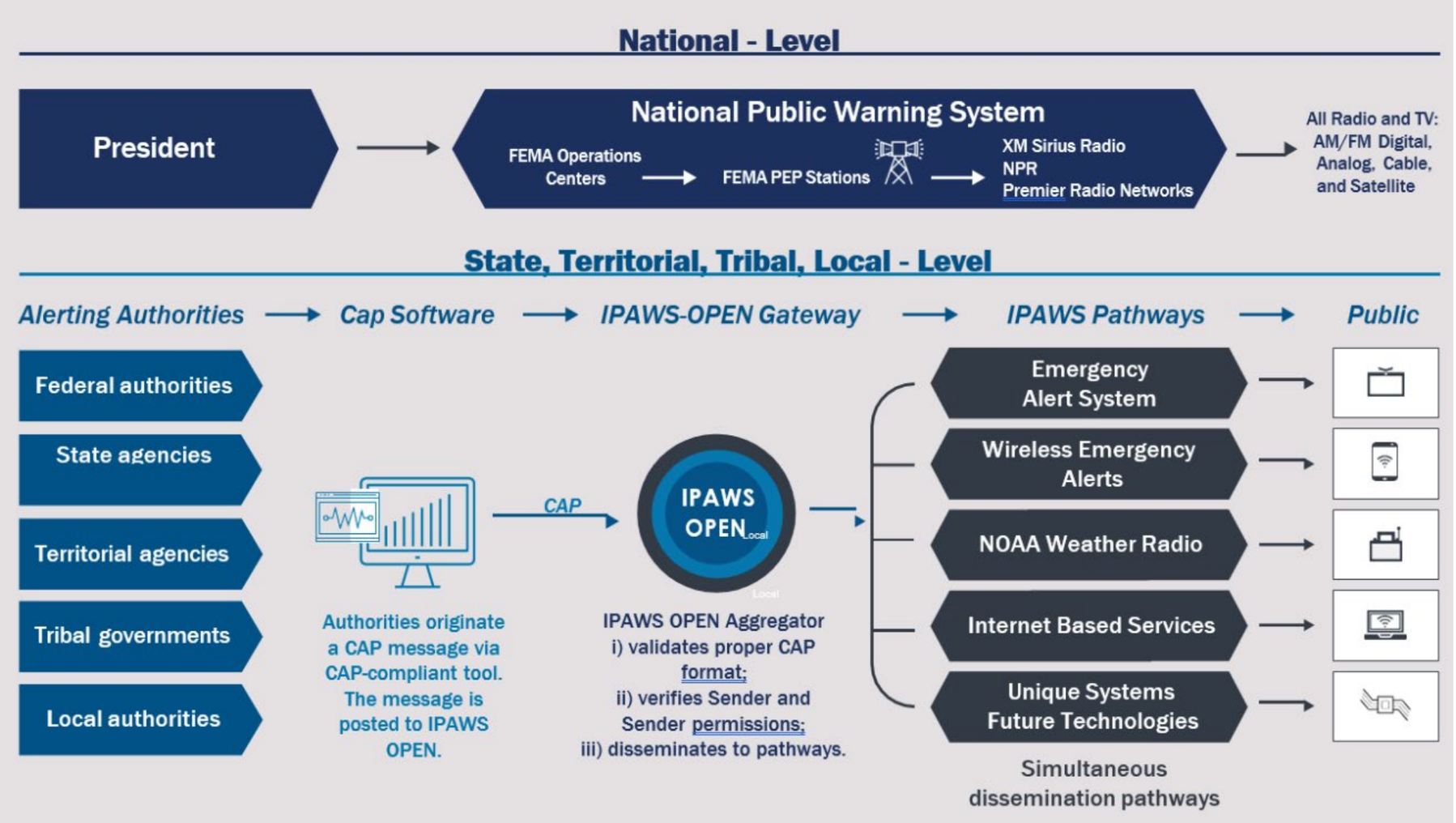
- Importance of AWNs
- Public Alerting Authorities
- Public Alert and Warning (A&W) Systems for Mass Notification
- Integrated IPAWS Components
- Public AWN in Operational Planning
- Community Lifelines and ESFs
- AWN Planning Factors for Low-Altitude Nuclear Detonation
- Planning for Post-Detonation AWNs

In the immediate aftermath of a nuclear detonation, instantaneous alerts, warnings, and notifications (AWNs) are necessary to tell people in the affected area how to avoid death and injury from radiation. Development of significantly improved AWN capabilities, such as FEMA's IPAWS, is helping to mitigate hazards and lessen the impact of all disasters, including nuclear detonation.

FEMA's Integrated Public Alert and Warning System (IPAWS)

The IPAWS is a national A&W infrastructure available for use by FSLTT public alerting authorities to send emergency alerts to citizens. Includes:

- Emergency Alert System (EAS)
- Wireless Emergency Alerts (WEA)
- National Oceanic and Atmospheric Administration (NOAA) Weather Radio All Hazards (NWR)
- other public alerting systems



Recent Developments in Response Planning

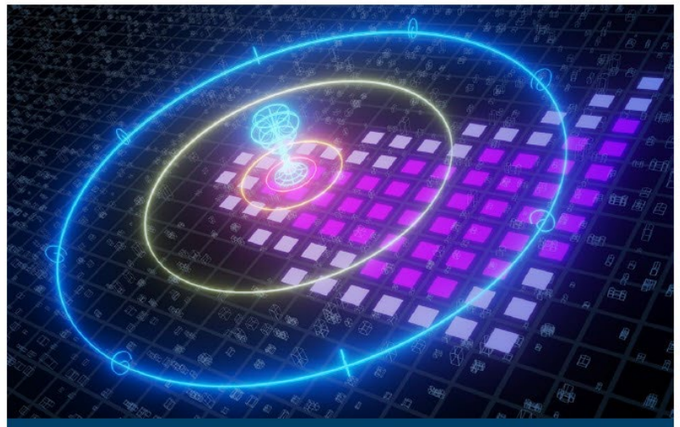
Planning Guidance for Response to a Nuclear Detonation

Third Edition

May 2022

FEMA

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



Nuclear Detonation Response Guidance

Planning for the First 72 Hours

March 2023

FEMA

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

Nuclear Detonation Preparedness: Communicating in the Immediate Aftermath

April 2024

FEMA

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

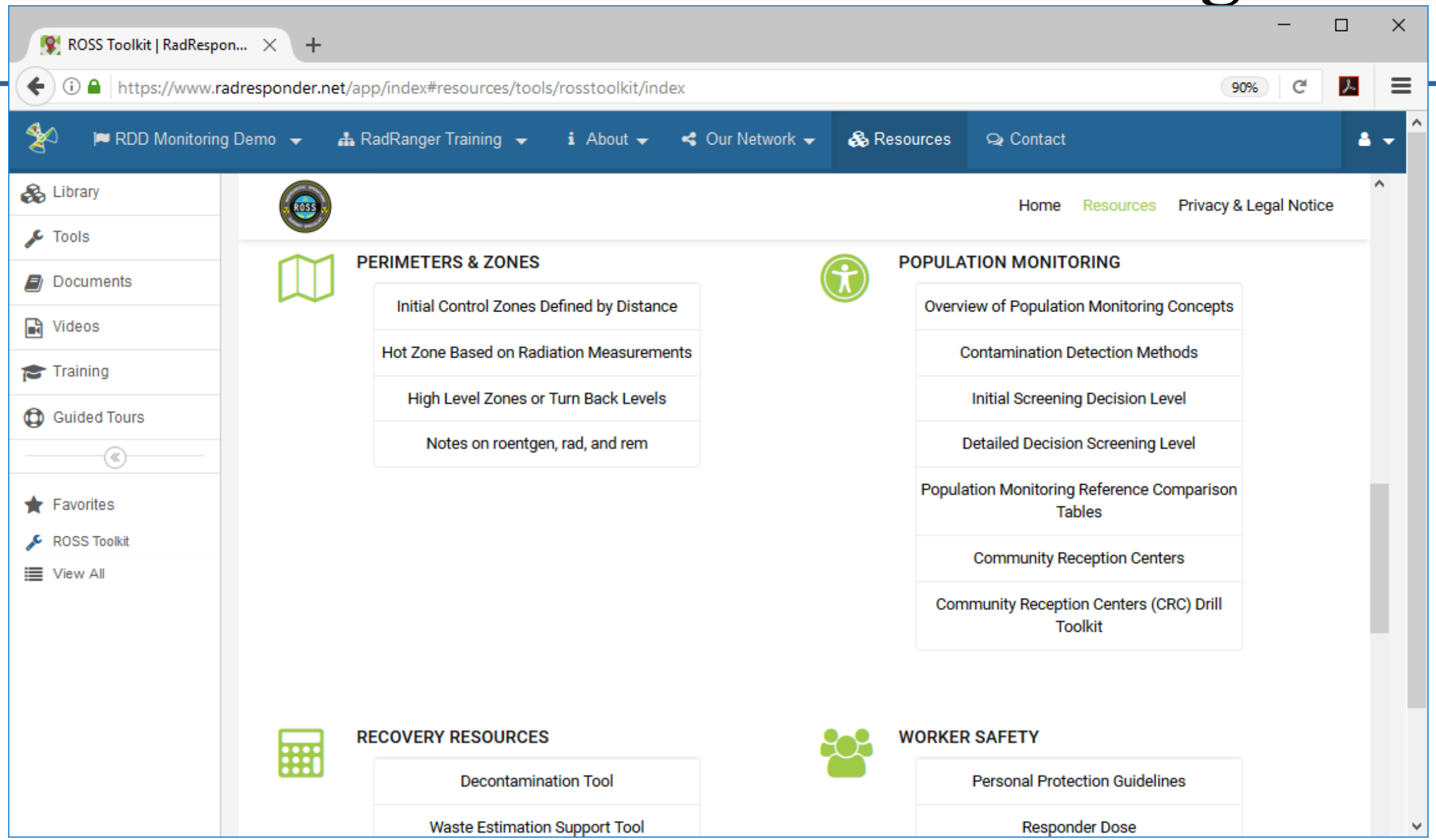
Radiological/Nuclear (R/N) Emergency Messages: Korean Language Version

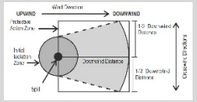
March 2024

FEMA EPA United States Environmental Protection Agency

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

ROSS Toolkit – Home Page



Reference	Applies to	Zone Name	Initial Zone Demarcation	Text from
DOT Emergency Response Guidebook (ERG)  *Click to Expand*	Transportation Incidents	Isolation Zone (note: for Uranium Hexafluoride, Guide 166, has additional isolation zone guidance.)	Immediate precautionary measure, isolate spill or leak area for at least 25 meters (75 feet) in all directions. For a large Spill consider 100m (330 feet) downwind For a "large quantity involved in a fire" consider 300 meters (1000 feet) in all directions.	As an immediate p measure, isolate s for at least 25 met all directions **Large Spill:** Consi downwind evacua 100 meters (330 f **Fire:** When a large material is involve consider an initial distance of 300 m in all directions.
IAEA Manual for First Responders to a Radiological Emergency, 2006  *Click to Expand*	Unshielded or damaged potentially dangerous source (outside)	Inner cordoned area (also called the "Hot Zone")	30m in all directions from the source	The actual boundar and security perime defined in the way easily recognizable secured. However, perimeter should b least as far from th indicated in Table radiological assess situation.
IAEA Manual for First Responders to a Radiological Emergency, 2006  *Click to Expand*	Major spill from a potentially dangerous source (outside)	Inner cordoned area (also called the "Hot Zone")	100m in all directions from the source	The actual boundar and security perime defined in the way easily recognizable secured. However, perimeter should b least as far from th indicated in Table radiological assess situation.

Discussion

Pros: The ERG is considered a primary reference for the HAZMAT community due to HAZWOPR training requirements and recommendations based on the ERG will have broad acceptance.

Cons: The recommendations are based on a transportation ***accident*** and takes into account the robust packaging and source controls required by DOT. *Because of this, these controls may not be suitable for intentional misuse of radioactive material.*

Pros: The IAEA 1st responder guidance is very similar to the ERG (30m instead of 25m) for damaged/unshielded source, except they added RDD guidance (below) and state their recommendations could be applied outside of the transportation accident scenario.

Cons: *Presumes accident not intentional exposure.* Presumed source sizes are still based on an examination of emergencies involving the largest amounts of radioactive material that could be encountered and on international guidance for transport.

Pros: The IAEA 1st responder guidance is the same as the ERG for the "Major Spill" category, except they state their recommendations could be applied outside of the transportation accident scenario.

Cons: *Presumes accident not intentional exposure.* Presumed source sizes are still based on an examination of emergencies involving the largest amounts of radioactive material that could be encountered and on international guidance for transport.

Remaining IAEA values match DOT ERG

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.