Radiation Protection in Homeland Security

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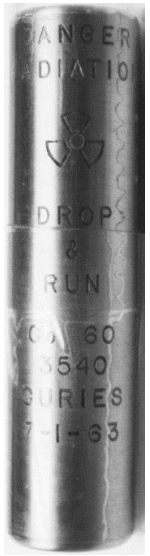
Homeland Security: Threat Response

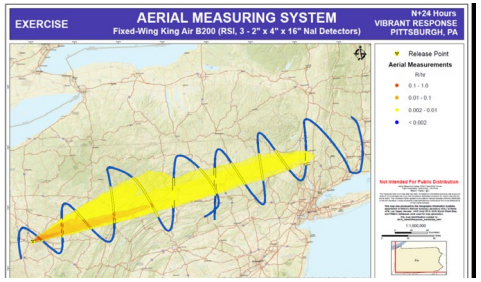
Left of Boom

Right of Boom



- Prevent/Protect (PRND)
  - Weapons production
  - NNSA
  - STA
  - National Labs
  - STC
  - LLEA

- Consequence Management
  - FRMAC
  - EPA
  - Transportation EP
  - ROSS



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the Unacceptable

Stolen Troxler Guage

- December 30 1300 hrs

Left of Boom

Right of Boo

August 2018 I-95 SB Bridgeport

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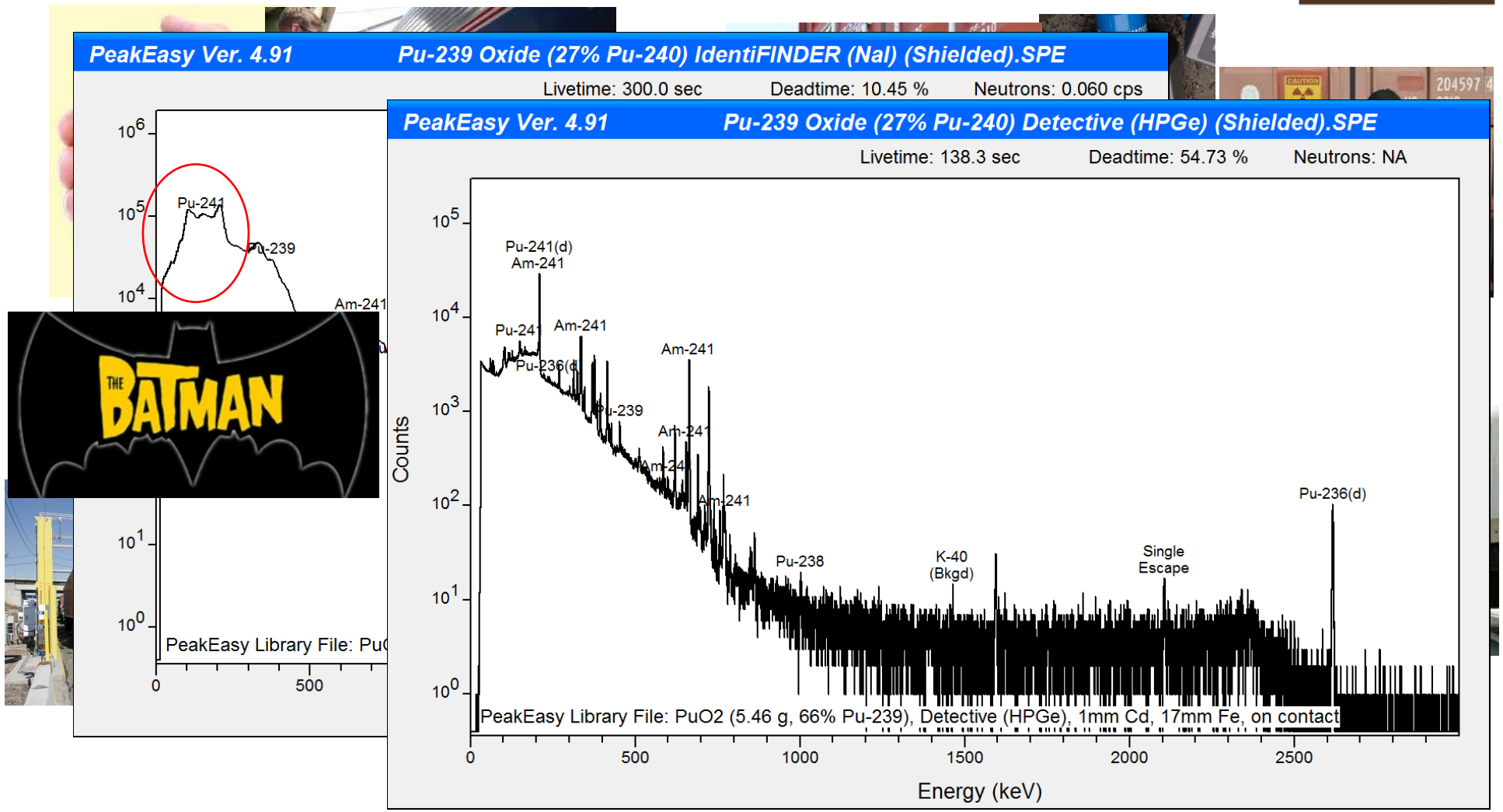
PRND: Intercepting Rad Material



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Consequence Management

- What just happened?
- Public Protective Actions?
- Responder Protective Actions?
- Initial public message?
- What help do you need?

0-6
State/Local
RAP
CST

6-12
AMS
CMAC
REAC/TS
CERFP

12 – 24
CMRT
EPA
HRF

24 – 48
Advisory Team
Other Agencies

FRMAC
Established

CMHT
NARAC
Advisory Team
REAC/TS

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

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Consequences

Characteristics of different R/N Events

Dirty Bomb Event

- No Notice
- All Material Released early
- 1 rem area might be "a few blocks"
- Hazard comes from both breathing contaminants and direct radiation shine

Nuclear Power Plant Incident

- Often early warning of release (like a kettle boiling)
- Release occurs over time (like a smoke stack, often in "puffs")
- Evacuation effective at reducing future exposures to releases, but must be timed to avoid "puff" release

Nuclear Detonation

- No Notice
- All Material Released at once
- 1 rem area can be 100 miles (10kT)
- Hazard is "direct shine" from fallout
- Highest hazard early (more than half the energy released in the 1st hour)

Transportation or Orphan Source

- Generally no noticed or discovered after the exposure occurs
- Scene control (immediate area) often sufficient for public safety

- Generally localized, though a few cases of more widespread effected when source is breached.

FEMA

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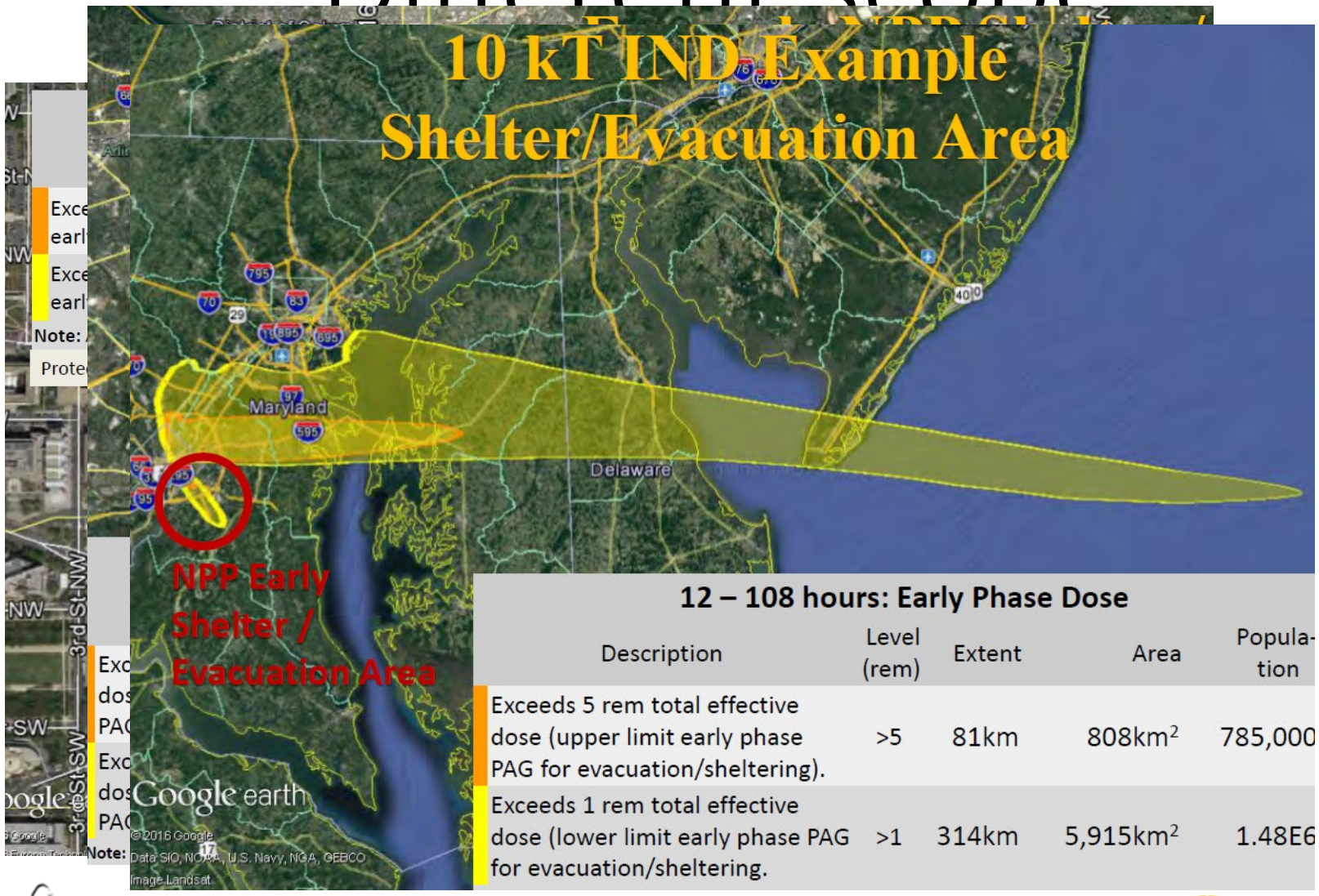
Different scope



12 – 108 hours: Early Phase Dose

Description	Level (rem)	Extent	Area	Popula-tion
Exceeds 5 rem total effective dose (upper limit early phase PAG for evacuation/sheltering).	>5	81km	808km^2	785,000
Exceeds 1 rem total effective dose (lower limit early phase PAG for evacuation/sheltering.	>1	314km	5,915km^2	1.48E6

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ROSS

Radiological Operations Support Specialist

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Who is ROSS, and why is he in my EOC?

- During Radiological Incidents:
  SME DEMAND >> SME RESOURCES
- Radiological Operations Support Specialist (ROSS)
  - State/Local SME (FEMA-typed) asset
    - Work for you – do not represent federal agency
  - Translate between local and federal response organizations
    - Can gather, organize, synthesize, document, and distribute incident and resource information for the purpose of improving situational awareness at all levels of an incident management (IM) situation.
  - Technical Interpreter
    - Provides the expertise necessary to clearly explain the implications of modeling, measurement, and analysis methods as well as, health risks and hazards existing during a radiological incident.
  - Prepared for diverse radiological events - NPP, RDD, IND, Nuc Det

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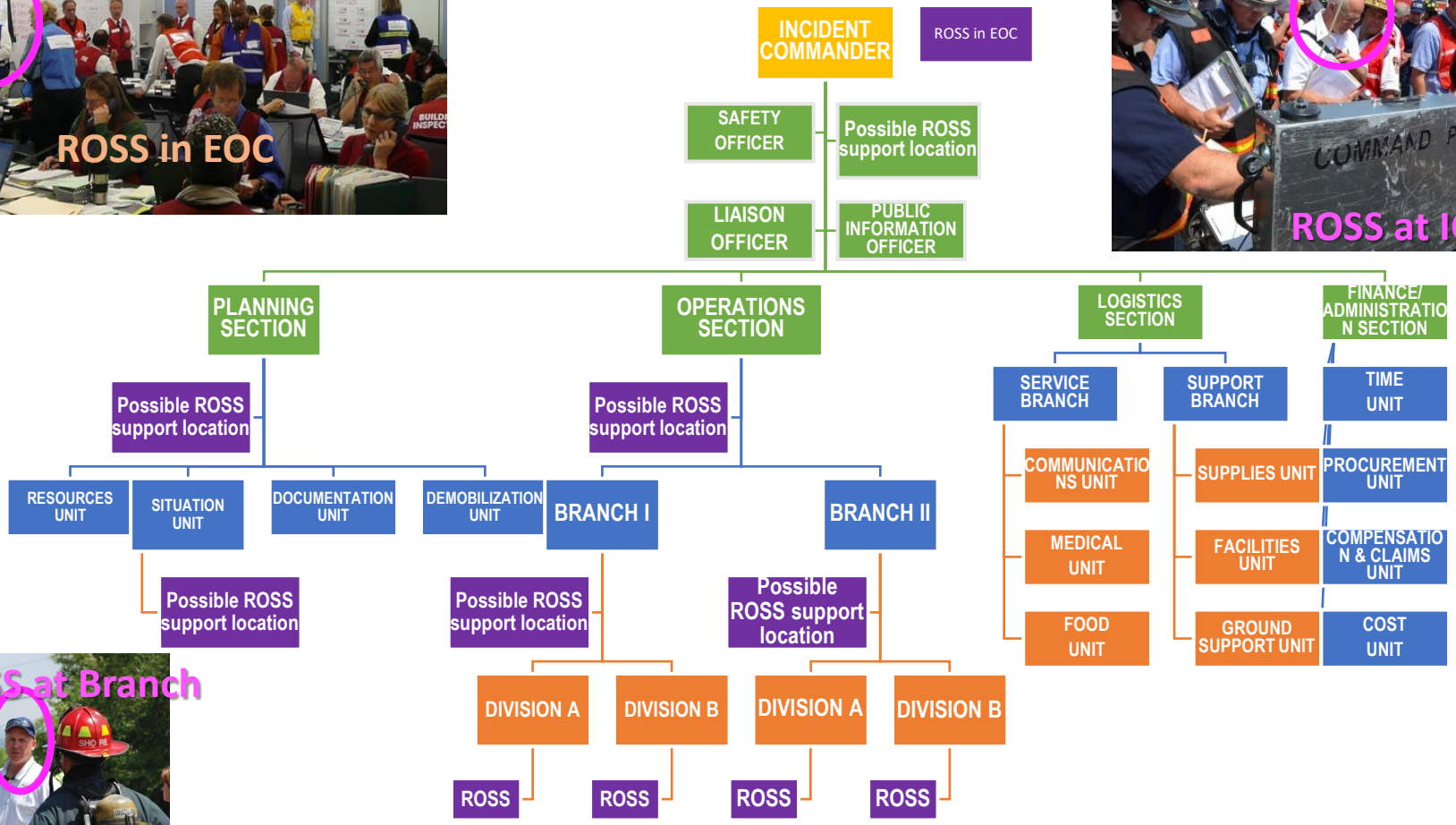
Many ROSS May Be Needed



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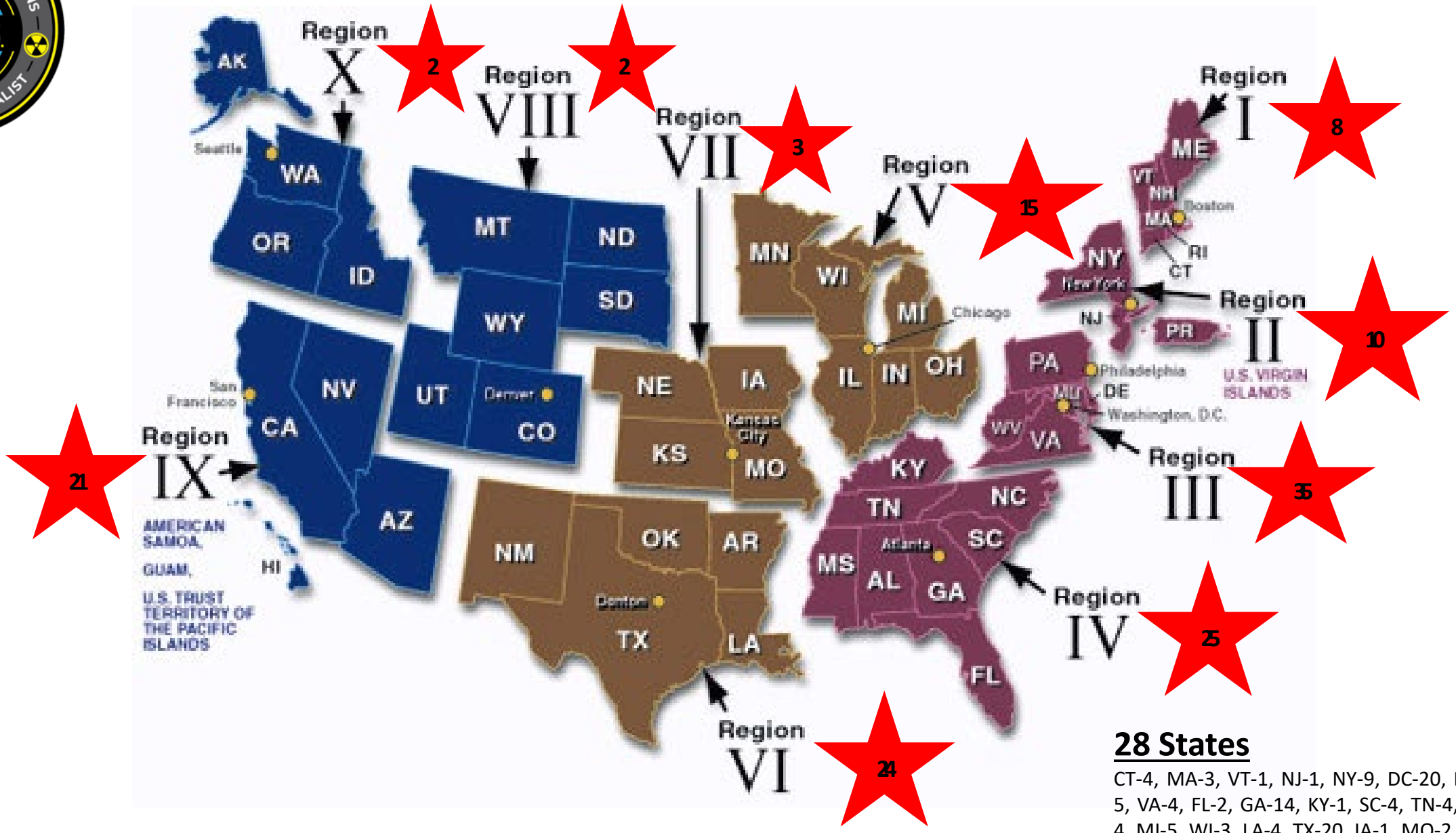

28 States

CT-4, MA-3, VT-1, NJ-1, NY-9, DC-20, MD-6, PA-5, VA-4, FL-2, GA-14, KY-1, SC-4, TN-4, IL-3, OH-4, MI-5, WI-3, LA-4, TX-20, IA-1, MO-2, SD-2, AZ-13, CA-5, NV-3, ID-1, OR-1

How can I become a ROSS?

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Planning Guidance for Response to a Nuclear Detonation

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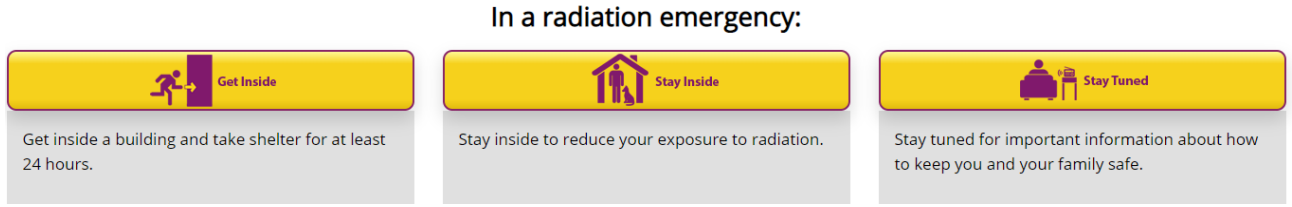
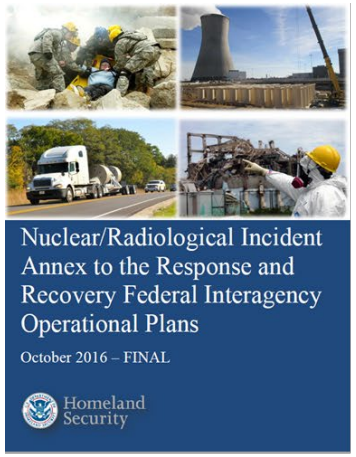
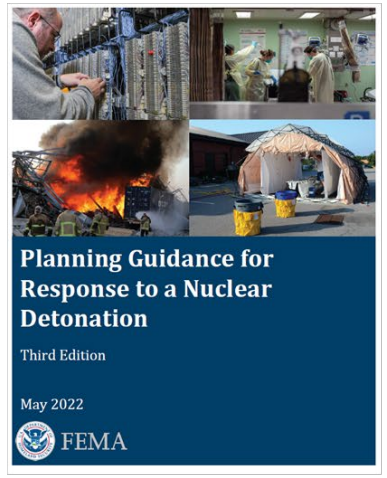
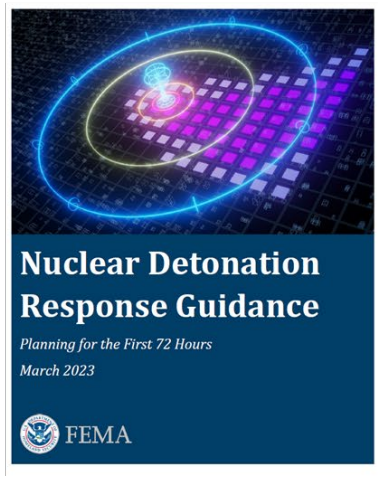
Response



- We have national response plans and protocols
- Local actions in the first hours can save lives
- Break the nuclear power plant paradigm
- We have trained ROSS to support decision makers







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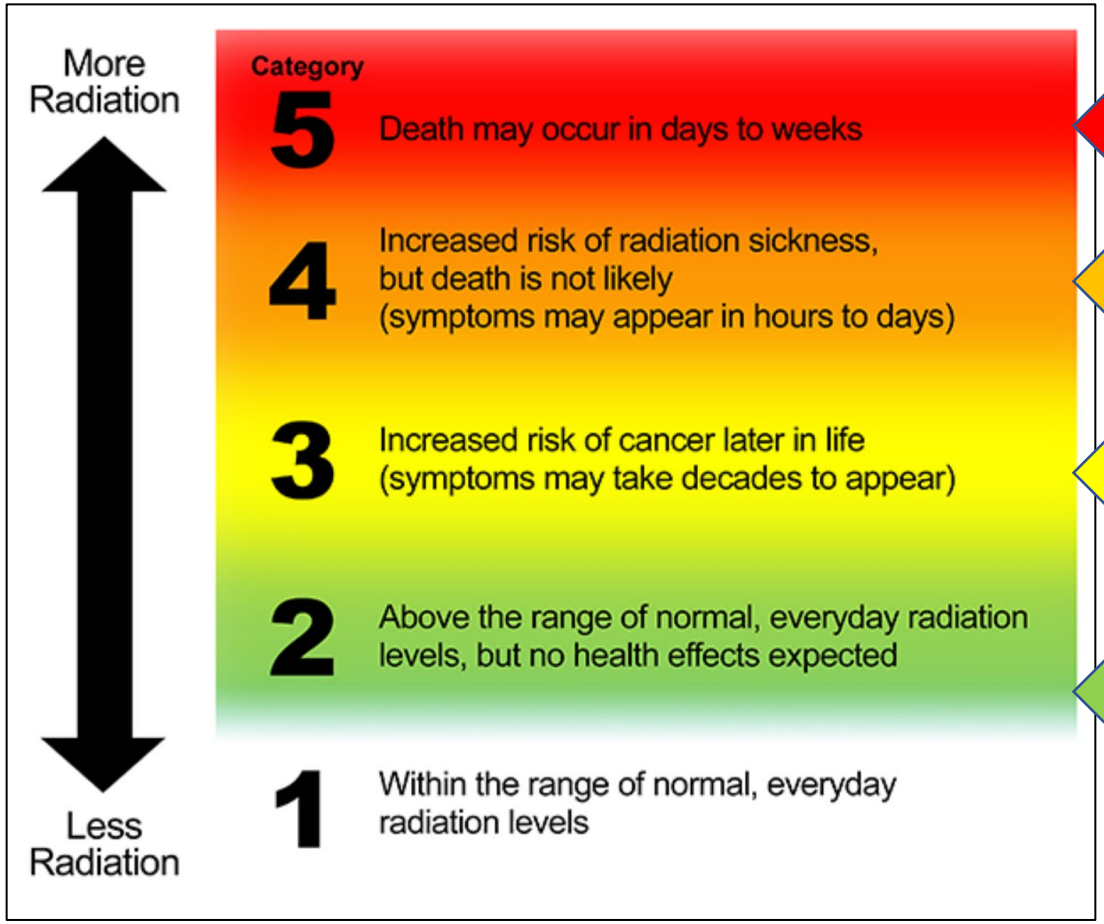
Review - Rad Hazard Scale



Suggested Dose Guide

- 2 Gy (200 Rad)
- 1 Gy (100 Rad)
- 20 mSV (2 rem)
- Location Specific

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Prompt Effects

- Optical
- EMP
- Blast and Overpressure
- Thermal radiation (Heat)
- Ionizing Radiation

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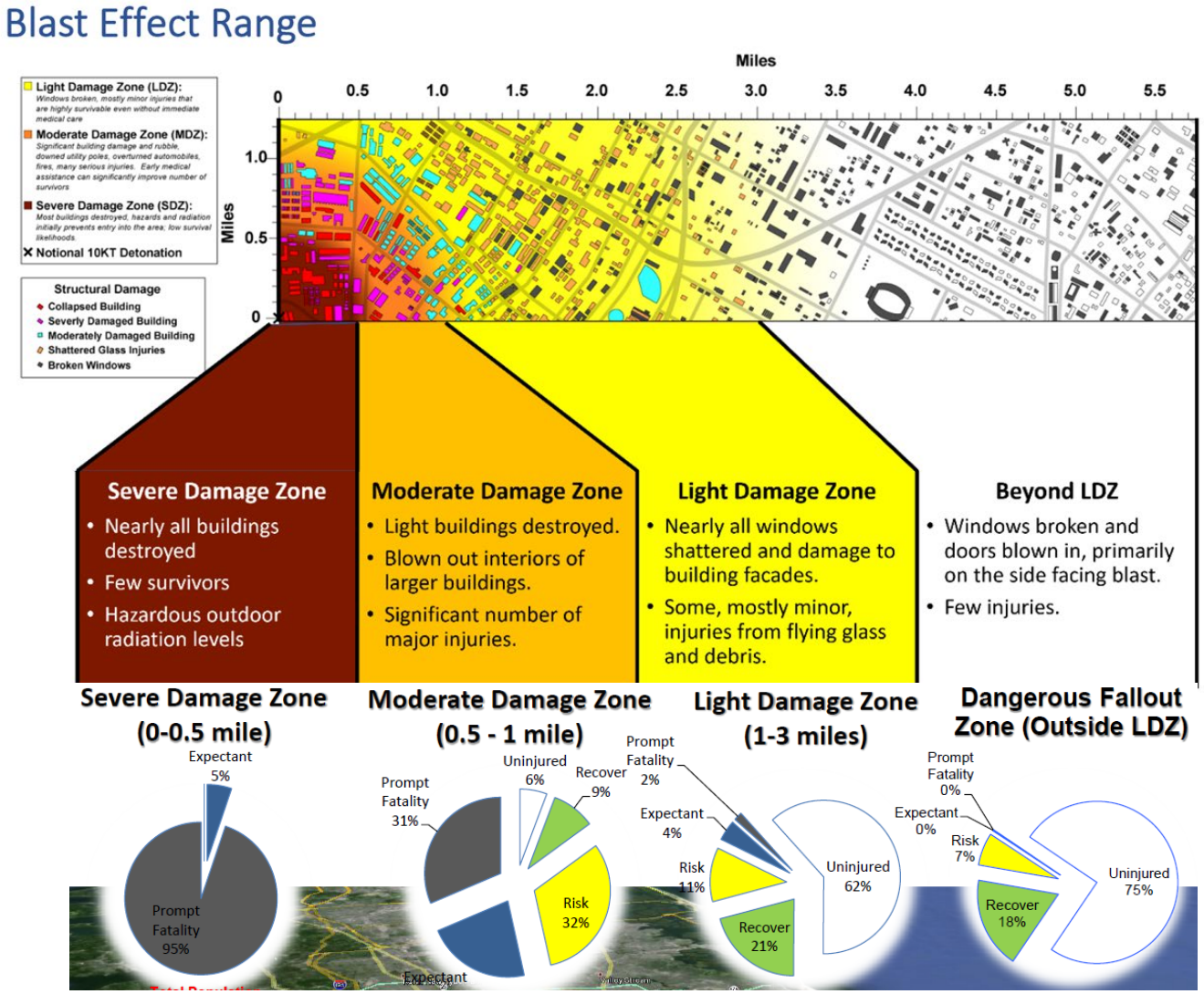
Damage Zones



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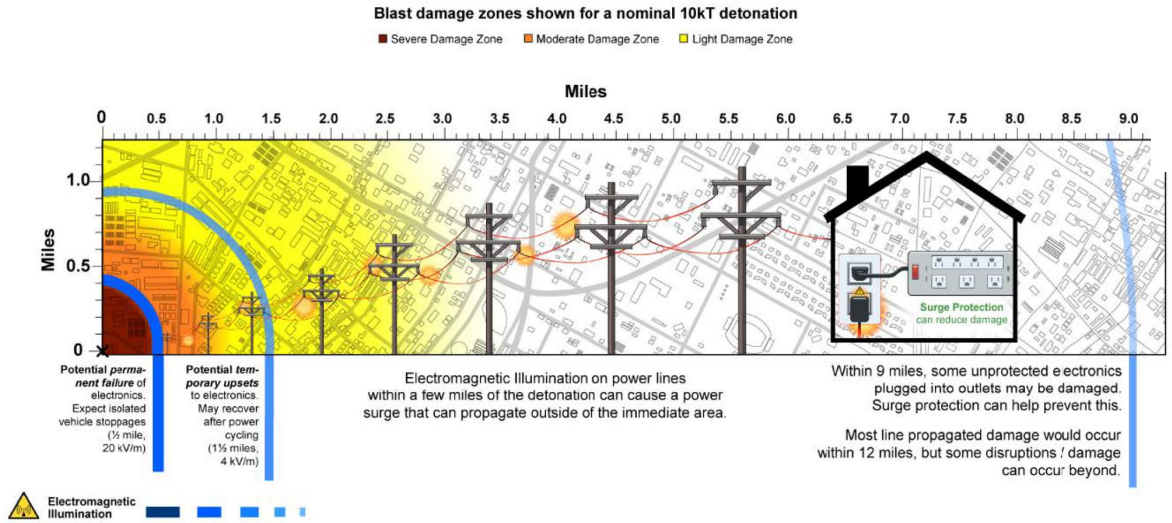
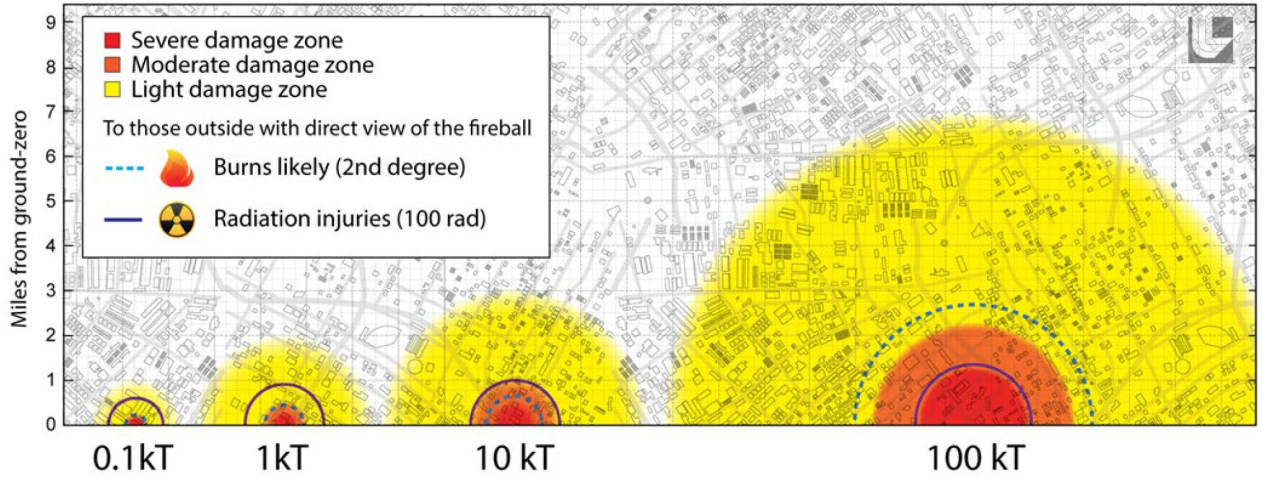
Prompt Effect in Hazard Zones





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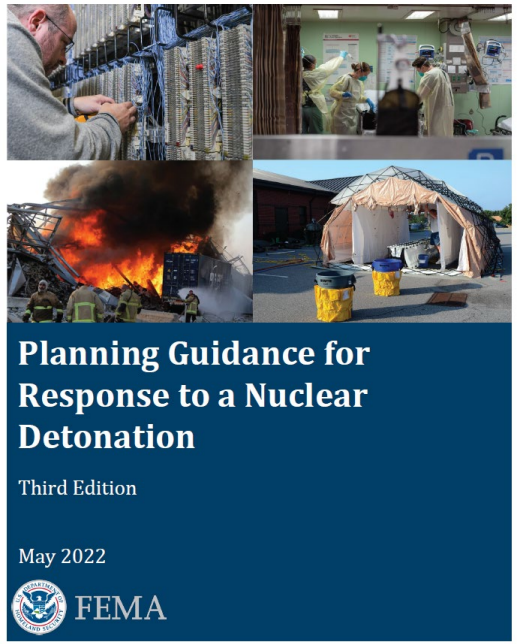
5 Key Response Zones



Fallout Zones
(Approximate for a 10kT)

Dangerous Fallout Zone (DFZ)
- *Bounded by radiation levels of 10R/hr*
- *Acute Radiation Injury possible within the DFZ*
- *Could reach 10-20 miles downwind*
- *The decay of the radiation causes this zone to shrink after about 1 hour*

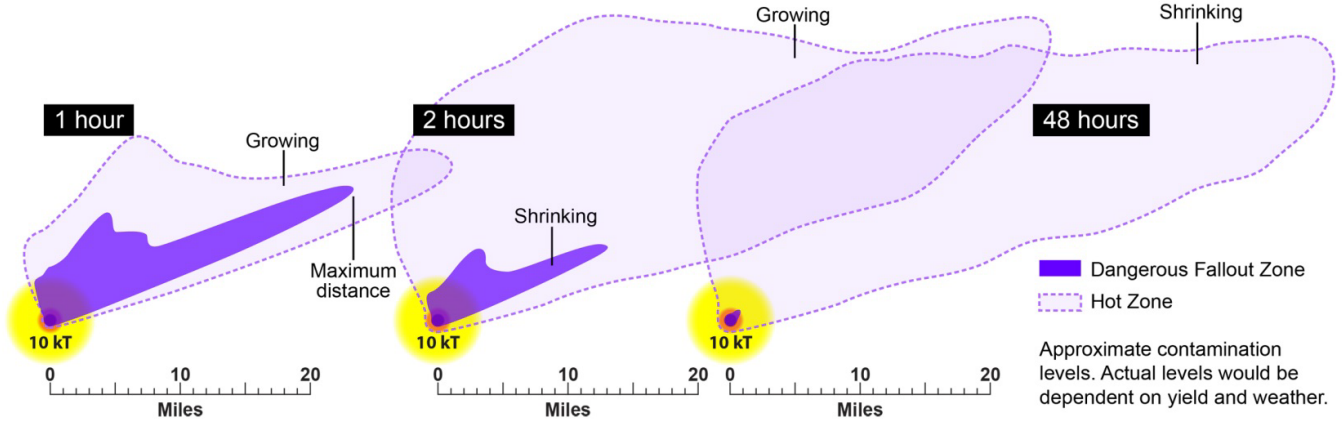
Hot Zone
- *Bounded by radiation levels of 0.01 R/h (10 mR/h)*
- *Acute radiation effects unlikely, however steps should be taken to control exposure*
- *For a 10 KT detonation, the Hot Zone could extend in a number of directions for 100s of miles*
- *The decay of the radiation causes this zone to shrink after about 12-24 hours*
- *After ~ 1 week the Hot Zone will be the size of the maximum extent of the DFZ (10-20 miles)*

Blast Zones
(Approximate for a 10kT)

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

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

Light Damage Zone
(1- to 3-mile radius)
Windows broken, mostly minor injuries that are highly survivable even without immediate medical care.



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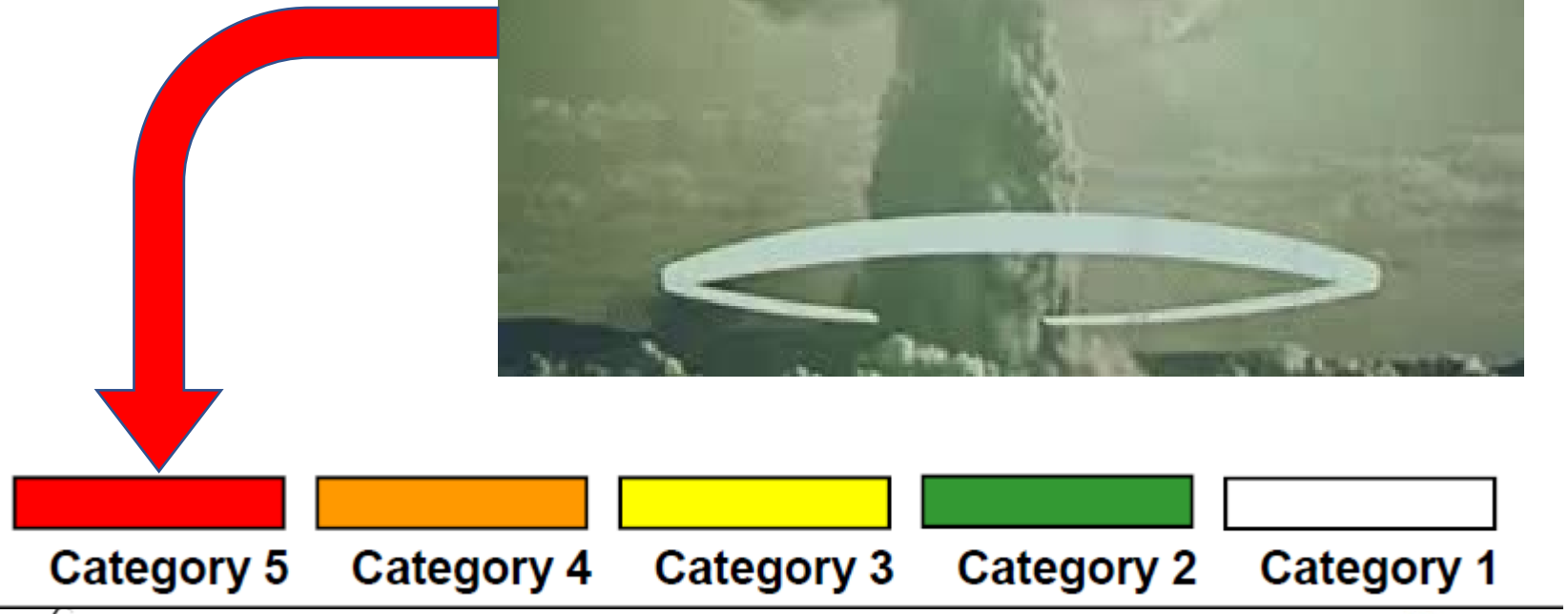
Delayed Fallout Effects



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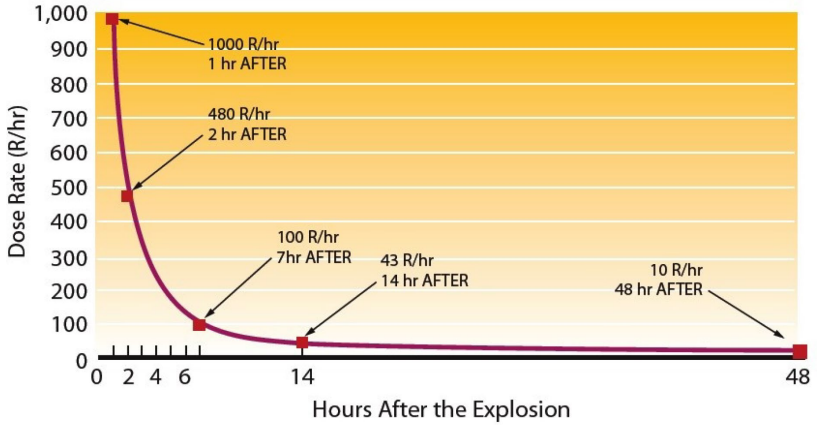
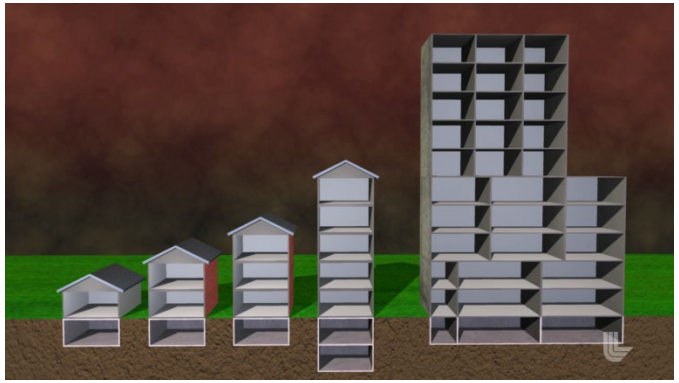
Key Fallout Considerations

- ***Fallout Decays Rapidly*** (releasing more than half of its energy in the first hour)
- The primary hazard from fallout is being is exposure to penetrating radiation from the particles
- Dangerous levels of fallout is readily visible as it falls
- Plot v. Plume
- Fallout is not a significant inhalation hazard
- The radiation penetrates through windows and walls, but exposure decreases with distance and intervening materials.





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Category 5

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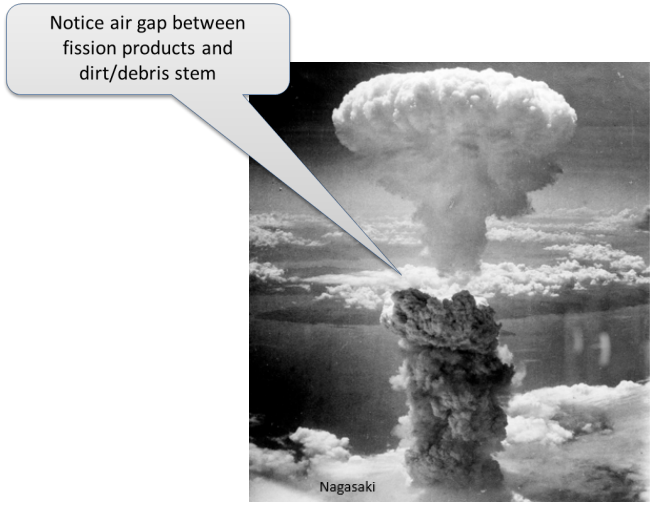
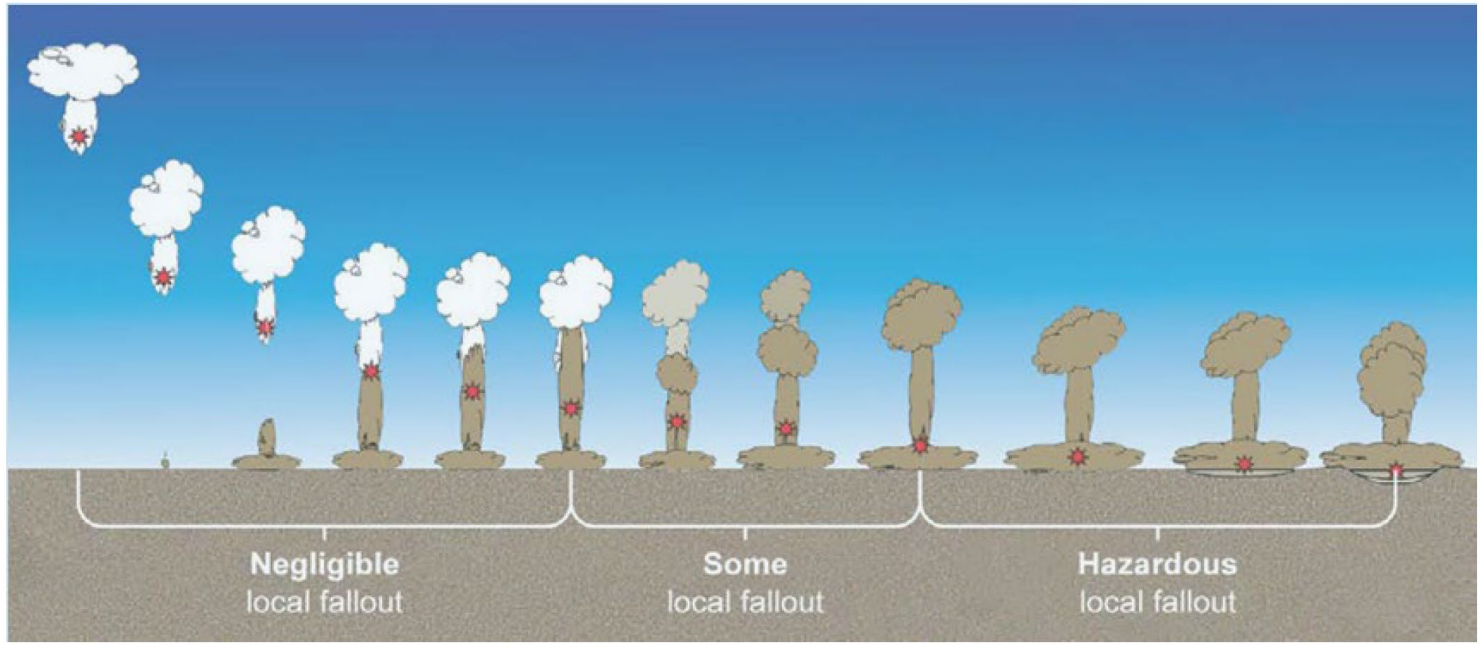
Fallout Depends on Yield and HOB





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Break the NPP Paradigm

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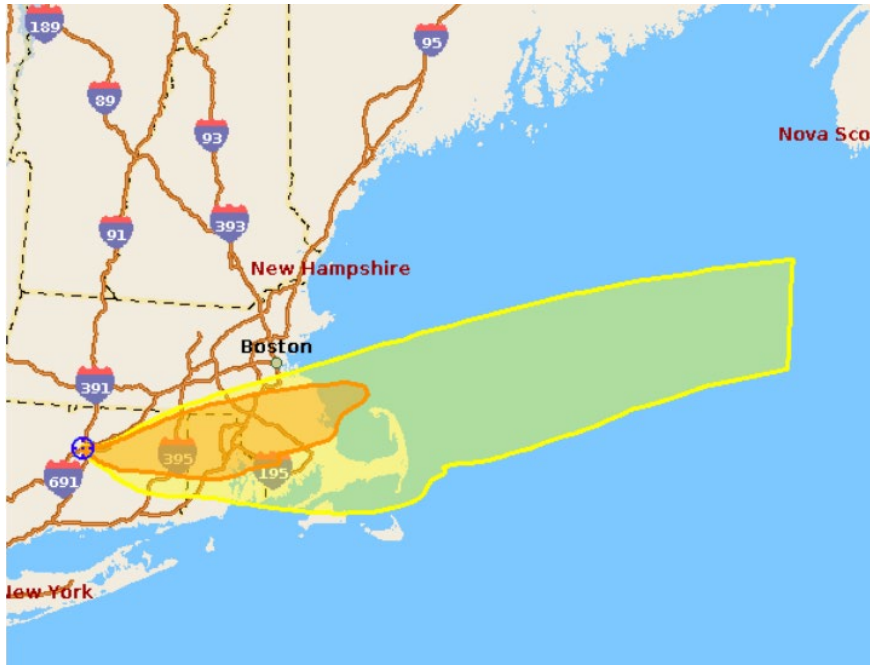
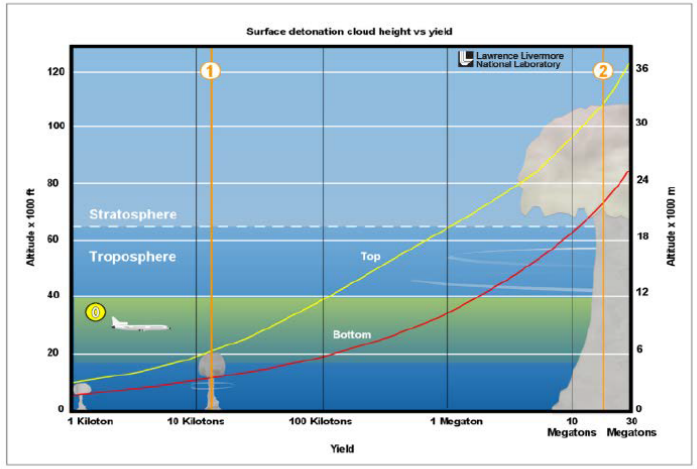
Higher and Further



Yield Estimate	Height (ft)	Height (miles)	Height (km)
1,000 kT	> 58,000 ft	> 11 miles	> 18 km
100 kT	38,000 ft to 58,000 ft	7 miles to 11 miles	12 km to 18 km
10 kT	17,000 ft to 38,000 ft	3 miles to 7 miles	5 km to 12 km
1 kT	< 17,000	< 3 miles	< 5 km



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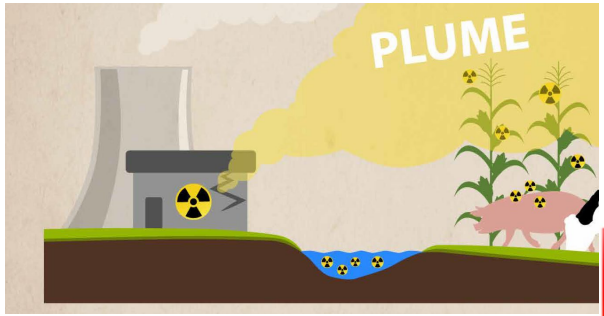
Immediate Health Risk v. Cancer Risk



Evacuation

Fallout

Get Inside
Stay nside

Evacuate

Reduces
risk to..

Category	
5	Death may occur in days to weeks
4	Increased risk of radiation sickness, but death is not likely (symptoms may appear in hours to days)
3	Increased risk of cancer later in life (symptoms may take decades to appear)
2	Above the range of normal, everyday radiation levels, but no health effects expected
1	Within the range of normal, everyday radiation levels

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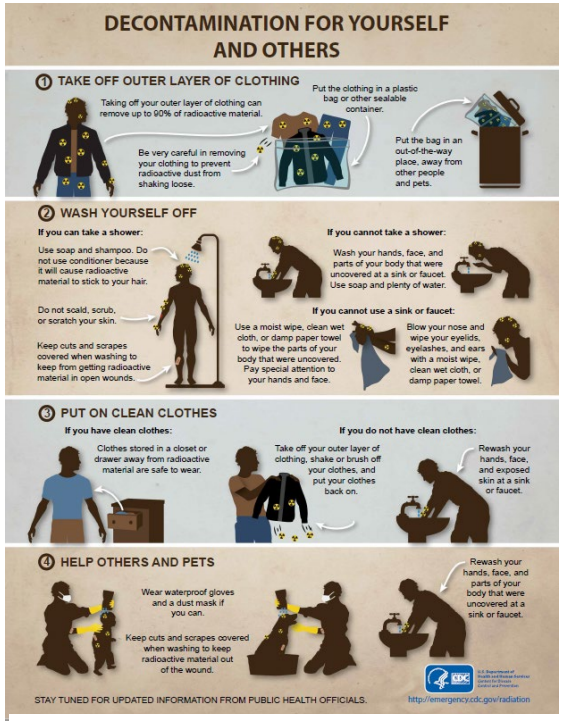
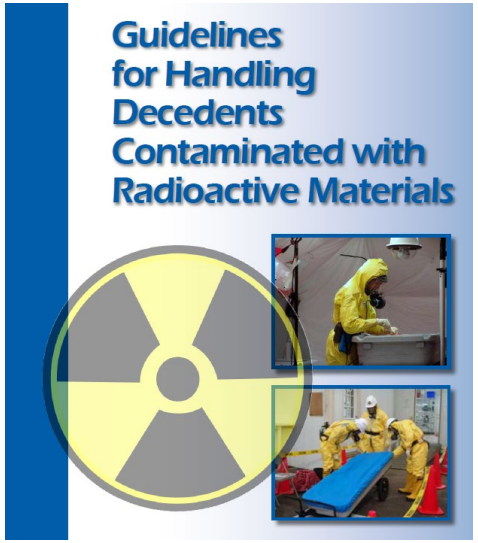
Break the NPP Paradigm

- Other actions for the Public
  - Self Decon
  - Contamination Screening Criteria
    - Severely Resource constrained: “walk by”
    - Resource constrained: 100,000 cpm
    - Nominal: 10,000 cpm
    - Millstone: > 200 cpm over background
  - Mental Health and Palliative Care
  - Disaster Mortuary Services (DMORT)





	Uninjured	Recover	At Risk	Expectant	Dead
Severe Damage Zone	6,415	7,716	6,526	22,680	74,904
Moderate Damage Zone	38,203	25,985	3,503	4,376	2,695
Light Damage Zone	229,502	51,625	6,477	23,171	0
Fallout Only Zone	630,946	3,439	8,812	4,127	0
Totals	905,067	88,765	25,319	54,354	77,599

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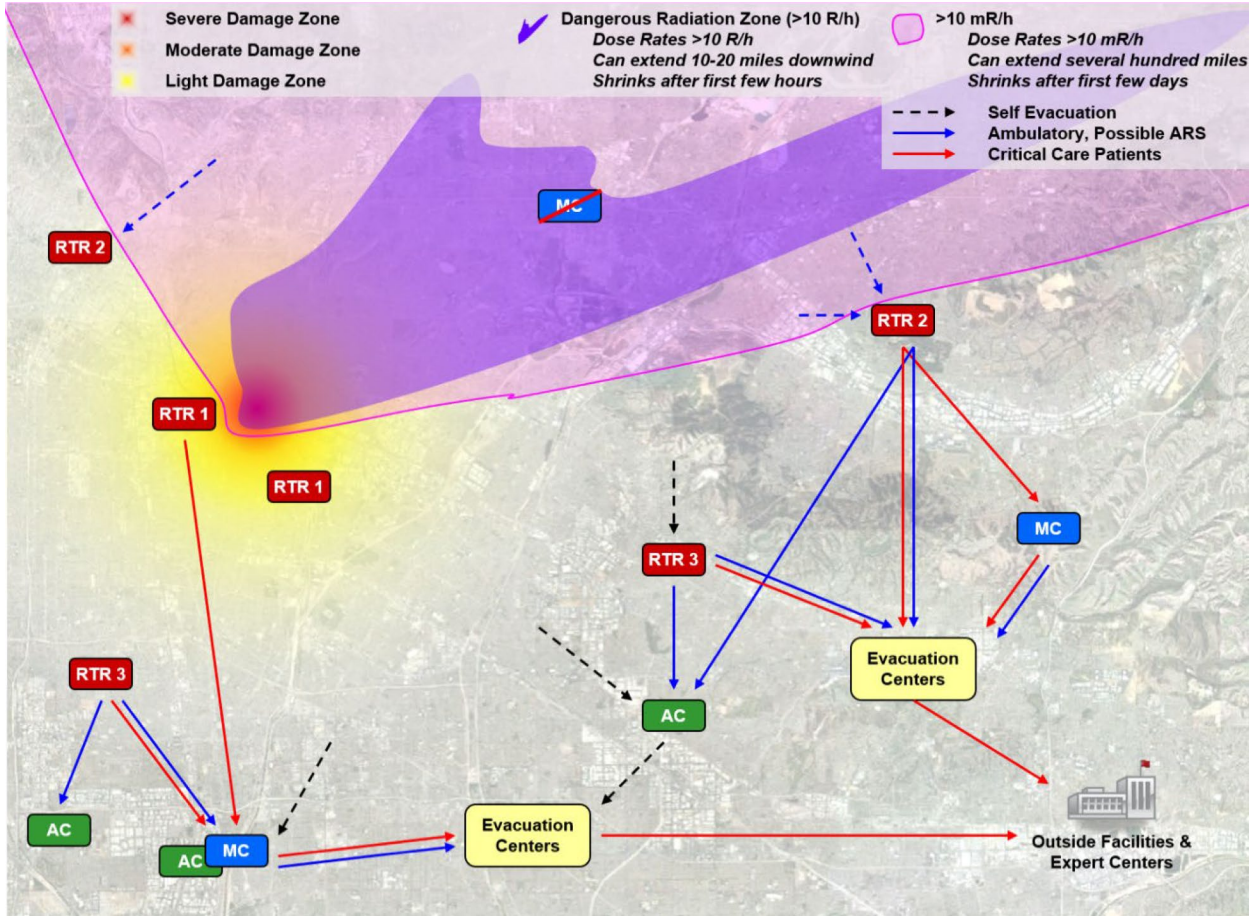
Triage



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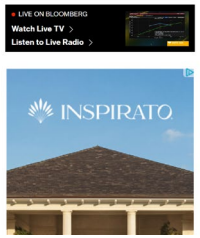
Medical Countermeasure

- *Searches for "does iodide help in nuclear war" have risen more than 1,000% over the past seven days [from March 2 to March 9], according to Google.*
- **But…Potassium Iodine (KI) is *NOT* effective following a nuclear detonation**

Pills That Blunt Radiation's Health Danger Post 100% Price Surge

Consumers worried about atomic risks from Russia's invasion of Ukraine are rushing to buy tablets that can reduce the effects of nuclear-radiation exposure.



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Potassium Iodide Runs Low as Americans Seek It Out

By Jonathan D. Rockoff

Updated March 15, 2011 12:01 am ET

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ARS Medical Counter Measures

- FDA has granted approvals to four products for the treatment of humans acutely exposed to myelosuppressive doses of radiation - hematopoietic acute radiation syndrome (H-ARS)
  - human granulocyte colony-stimulating factors (G-CSFs)
  - Based on efficacy studies in animals (under the Animal Rule)
  - Strategic National Stockpile (SNS)

Myeloid cytokine category	G-CSF recommendation
1	G-CSF indicated.
2	G-CSF indicated, lower priority than Category 1.
3	G-CSF not indicated.

G-CSF priority categories for "normal or good" resource availability

Radiation Dose* (Gy)	RADIATION ONLY or minimal trauma: Minimal trauma*	COMBINED INJURY Moderate or severe injury* + radiation** > 2 Gy: Moderate trauma*	COMBINED INJURY Moderate or severe injury* + radiation** > 2 Gy: Severe trauma*
>10 Gy Likely fatal	Expectant[3] Immediate[2]	Expectant[3]	Expectant[3]
>6-10 Gy Severe	Immediate[2]	Delayed[2]	Expectant[3]
≥2-6 Gy Moderate	Immediate[1]	Immediate[1]	Delayed[2]

G-CSF priority categories for "fair or poor" resource availability

Radiation Dose* (Gy)	RADIATION ONLY or minimal trauma: Minimal trauma* (Fair)	RADIATION ONLY or minimal trauma: Minimal trauma* (Poor)	COMBINED INJURY Moderate or severe injury* + radiation** > 2 Gy: Moderate trauma* (Fair and Poor)	COMBINED INJURY Moderate or severe injury* + radiation** > 2 Gy: Severe trauma* (Fair and Poor)
>10 Gy Likely fatal	Expectant[3]	Expectant[3]	Expectant[3]	Expectant[3]
>6-10 Gy Severe	Delayed[2]	Expectant[3]	Expectant[3]	Expectant[3]
≥2-6 Gy Moderate	Immediate[1]	Immediate[1]	Delayed[2]	Expectant[3]

NEUPOGEN® (FILGRASTIM)

leukine® sargramostim

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For Emergency Workers - Decision Doses

25 rem EPA guideline

5 rem Regulatory Limit

- *"A Decision Dose can be used by the incident commander as a tool to address the need to and the consequences of exposing emergency workers to higher doses to accomplish Mission Critical actions."* (EPA-400, PAG Manual

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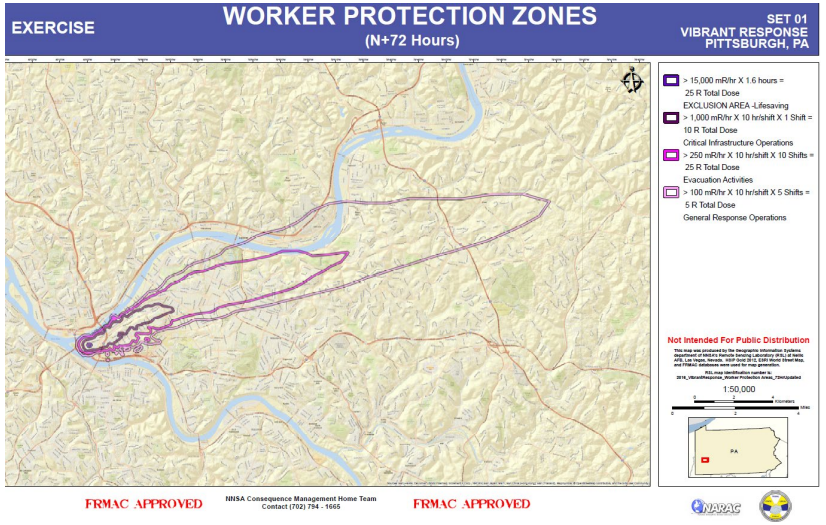
For Emergency Workers - Alternate Dosimetry Methods

Team Dosimetry

Time in Zone



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Questions?

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NUCLEAR WEAPON

What is a nuclear weapon?

A nuclear weapon is a device that uses a nuclear reaction to create an explosion. This explosion is much more powerful than that of conventional explosives (like TNT). When a nuclear weapon explodes, it gives off four types of energy: a blast wave, intense light, heat, and radiation. Nuclear weapons can be in the form of bombs or missiles.

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

What are the main dangers of a nuclear weapon?

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

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

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

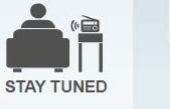
- Fallout on the outside of the body or clothes (external contamination) or on the inside of the body (internal contamination)
- Radiation sickness
- Contaminated food and water sources

What should I do to protect myself?

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

http://emergency.cdc.gov/radiation

WHERE TO GO IN A RADIATION EMERGENCY



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

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

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

Adapted from Ventura County Public Health, Ventura County, CA

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

http://emergency.cdc.gov/radiation

NERHC

Connecticut Department of Energy & Environmental Protection
RADIATION DIVISION

Top 20 radionuclides ranked by contribution to Adult Whole Body Dose (in mrem) for the period of 12-108 hours af
detonation.

Ra

Iodine specific analysis:

Radionuclide	Resuspension Inhalation	Groundshine	Total	Nuclide Dose %	% of Dose from Resuspension	"Ranking"
I-135	5.94E+00	1.35E+04	1.35E+04	13%	0.0%	3
I-133	5.57E+01	8.66E+03	8.72E+03	8%	0.6%	5
I-131	3.39E+01	6.29E+02	6.63E+02	1%	5.4%	17
I-134	1.57E-04	2.32E+00	2.32E+00	0%	0.0%	40
Total Iodine	**9.55E+01**	**2.28E+04**	**2.29E+04**	**21%**	**0.4%**	

Te-133m	1.09E+01	1.70E+03	1.71E+03	2%	92%	0.6%
Mn-56	3.24E-01	1.37E+03	1.37E+03	1%	93%	0.0%

So, while 21% of the Total Dose from the release comes from isotopes of Iodine, 96.6% of that is external dose. For the period of 12-108 hours after detonation, only 0.09% of the Total Dose is from inhalation of resuspended Iodine.

Ru-103	6.98E+00	4.24E+02	4.31E+02	0%	98%	1.6%
La-141	1.56E+01	4.11E+02	4.26E+02	0%	98%	3.7%
Te-131	2.03E+01	3.76E+02	3.96E+02	0%	99%	5.1%

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