

What is a Protective Action Measure?

- Any action that mitigates or decreases the absorption or effect of radiation.
 - Time
 - Distance
 - Shielding

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EPA Recommended Actions

Exposure Pathways and Protective Actions
These are examples of exposure routes and various protective actions. The phases are not set timeframes and protective actions may overlap more than one phase.

POTENTIAL EXPOSURE PATHWAYS	INCIDENT PHASES	PROTECTIVE ACTIONS
1. External radiation from facility	EARLY	1. Sheltering, evacuation, control of access
2. External radiation from plume		2. Sheltering, evacuation, control of access
3. Inhalation of activity in plume		3. Sheltering, administration of stable iodine, evacuation, control of access
4. Contamination of skin and clothes		4. Sheltering, evacuation, decontamination of persons
5. External radiation from ground deposition of activity	INTERMEDIATE	5. Evacuation, relocation, decontamination of land and property
6. Ingestion of contaminated food, water	LATE	6. Food and water controls
7. Inhalation of re-suspended activity		7. Relocation, decontamination of land and property

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Evacuation/Sheltering Model

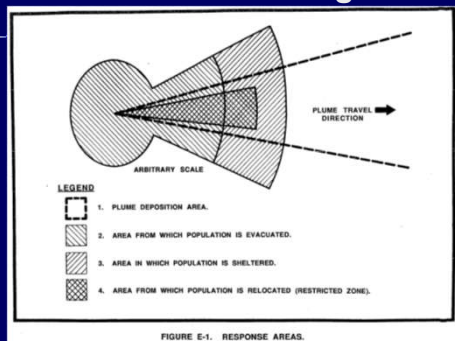
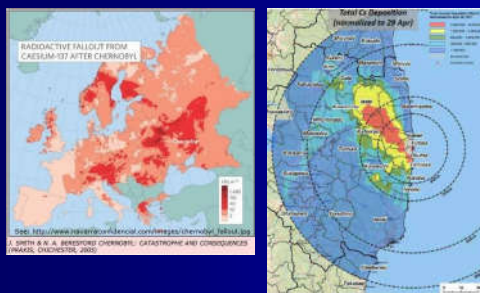


FIGURE E-1. RESPONSE AREAS.
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Which way is the wind blowing?

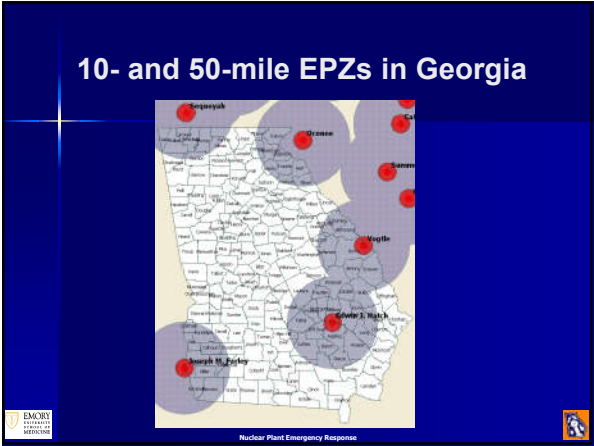


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Emergency Planning Zones

- 10-mile EPZ
 - Area of potential exposure to radioactive plume
 - Detailed plans mandated by law
- 50-mile EPZ
 - “Ingestion pathway” area
 - Contamination of food, water, soil

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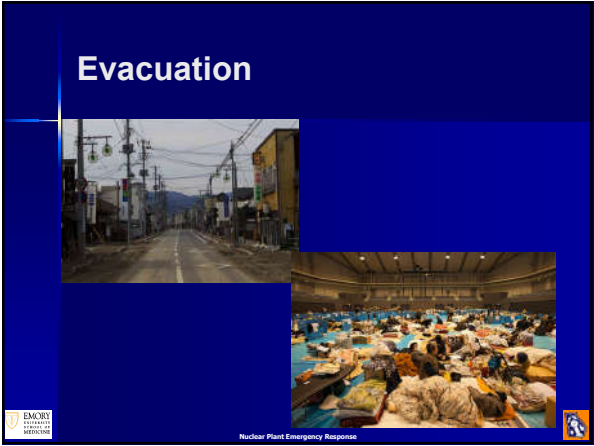


Time Phase	Protective Action	Limit (mSv)	Comments
Early	Evacuation or Sheltering	TED 10-50 Thyroid 50 – 250 Skin 500 – 2500	Evacuation should normally be initiated at 10 mSv. Sheltering may be the preferred protective action when it provides protection equal to or greater than evacuation.
	Administration of KI	250	Equivalent Dose to the thyroid from radioiodine. Requires approval of state medical officials.

Source FRMAC Assessment Manual, Volume 1 Appendix C – Table 2-2, April 2010

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Population Monitoring



Sheltering in Place

- Stay inside, close windows and vents
- Provides shielding from radiation
- Decreases inhalation of particles



How to Shelter in Place?

- Get inside and stay inside a stable building
 - If you are outside, get inside.
 - If you are inside, stay inside.
 - If you are in a car, get inside the nearest stable building.
 - You will be safest in a basement or inside (interior) rooms with few or no windows.
 - Turn off any fans, air conditioners, and heating systems that bring in air from the outside.

KI – Role in a NPP Accident

- Supplement to other protective measures
 - Shelter in place
 - Evacuation
 - Food, milk, and water restrictions
- Sole purpose is to reduce dose to the thyroid gland from radioiodine (primarily I-131)
- Administration needs to be guided by local health authorities.



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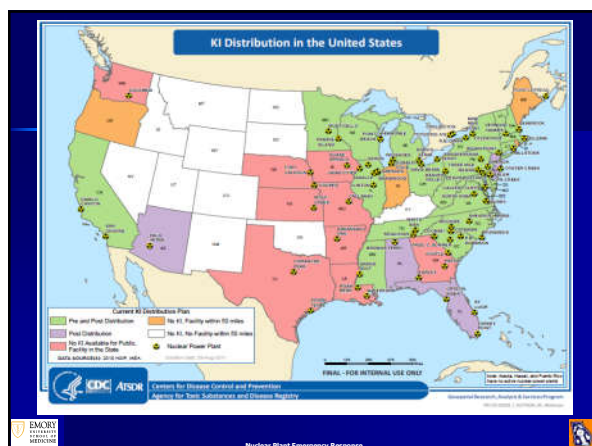
State KI Distribution

- Varies by state
 - Pre-event distribution
 - Post-event distribution
 - Pre- and post-event distribution
 - Distribution to emergency workers
 - Not provided



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Fukushima and KI

- Population wanted to feel safe and empowered
- Much time and energy was spent on messaging to discourage use of KI
- Some in the US wanted KI!



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Time Phase	Protective Action	Limit (mSv)	Comments
1 st Year	Relocation	TED 20	Or 1000 mSv skin dose
	Apply dose reduction techniques	<20	Should be taken to reduce doses to ALARA. (Scrubbing and/or flushing hard surfaces, soaking or plowing soil, minor removal of soil from areas of concentration, limiting outdoor time, etc.)
2 nd Year	Relocation	5	Any single year after the 1 st .
50 years	Relocation	50	Total for 50 years (including the first and second years).



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Ingestion Protective Actions

Animals	Move to shelter and/or corral, provide protected feed and water.
All foods	Isolate by temporary embargo until survey and initial sampling is completed. Determine whether condemnation or other disposition is appropriate.
Milk	Hold for decay or divert to other products involving adequate decay during processing (e.g. cheese, butter, dry milk solids, or evaporated milk).
Fruits and Vegetables	Wash, brush, scrub, or peel to remove surface contamination. Preserve by canning, freezing, dehydration, or storage to permit decay.
Grains	Process by milling and polishing to remove surface contamination.



Source: FRMAC Assessment Manual, Volume 1 Appendix C - Table 2-3, April 2010

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Recovery



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Consequence Assessment

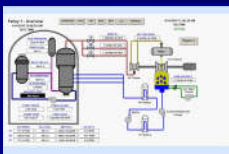
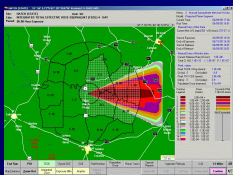
- What radioactive material(s) is/are present?
- Where is the radioactive material?
- How much is there?
- What are the pathways to humans?
- What are the likely doses?
- What can be done to minimize doses (i.e. protective actions)?

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Consequence Assessment (Emergency Phase)

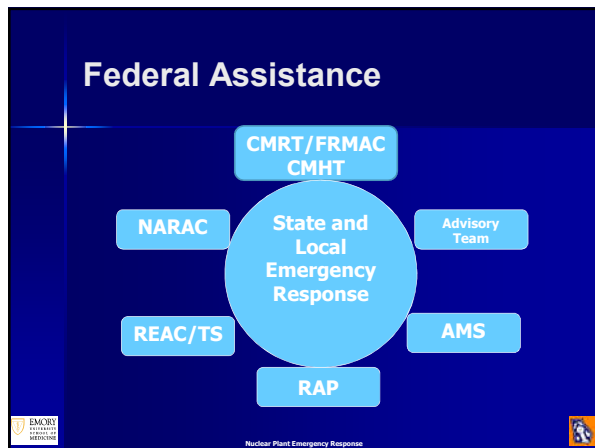
- Plant status
- Field monitoring
 - direct radiation
 - air samples

- Atmospheric dispersion estimates
- Utility liaison
- Recommendations to Governor, local officials

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National Atmospheric Release Advisory Center (NARAC)

- Predictive plots
 - What?
 - Where?
 - How much?
- General guidance

The map displays a grey plume originating from a point on the left and spreading towards the right over a landscape with roads and water bodies.

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Radiological Assistance Program (RAP)

The map shows the United States divided into eight regions, each with a number and a star: 1 (Northeast, purple), 2 (Mid-Atlantic, pink), 3 (Southeast, orange), 4 (South, orange), 5 (Midwest, green), 6 (West, yellow), 7 (Northwest, yellow), and 8 (Alaska, blue).

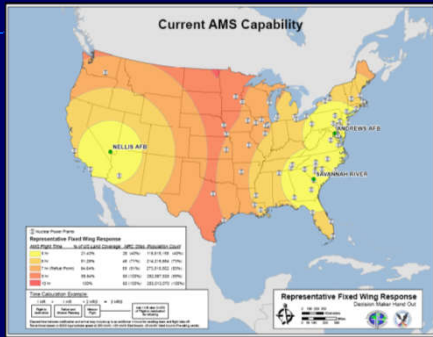
- 4-6 hour response
- Assist with field monitoring / characterization

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Aerial Measuring System (AMS)




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Federal Radiological Monitoring and Assessment Center (FRMAC)

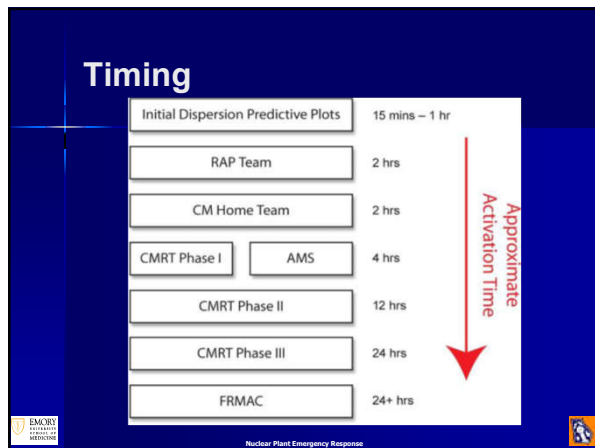
- Phased deployment
 - CMRT Phase I (25 technical and management personnel)
 - CMRT Phase II (38 support personnel)
 - Augmentation / FRMAC (42+ personnel)
- Initially DOE-only, later inter-agency
- CMHT coordinates while assets in route

 **DOE**
DEPARTMENT OF ENERGY
WASHINGTON, DC 20585-1204



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Federal Radiological Monitoring and Assessment Center (FRMAC)

- Field measurements and AMS data
- Field samples and laboratory analysis

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Common Operating Picture

- What?
- Where?
- How much?

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



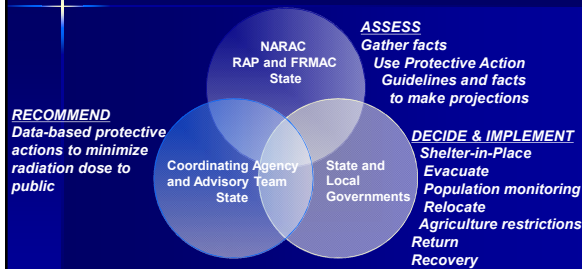
- Multi-agency
- Provide guidance to state and local ERO
 - Health and safety advice
 - Application of PAGs
 - Minimization of agricultural losses
 - Disposition of contaminated items



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Different Roles - One Team



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How Would the Public Respond?

- *"The first thing I would want to do is grab my kids."*
- *"As a mother, your first thought is, 'I've got to go get my kids'."*
- *"[I'd] gather my family."*

CDC Radiation Emergency Communications Research
<http://www.emergency.cdc.gov/radiation/audience.asp>





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Effective Communication Can:


- Decrease illness, injury, and death
- Facilitate response and recovery efforts
- Avoid misallocation of limited resources
- Reduce rumors
- Minimize medically unnecessary self-referrals to hospitals and other critical facilities

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Questions or Comments?

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Summary Points

- Protective action measures depend on situation, may change over time
- Sheltering in place excellent protection for some situations, but may prove to be impractical for reactor accidents
- KI availability varies by state
- Many agencies (federal, state, and local) will be involved – coordination is key to success
- Proper public messaging is vital

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