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United States Nuclear Regulatory Commission
Protecting People and the Environment

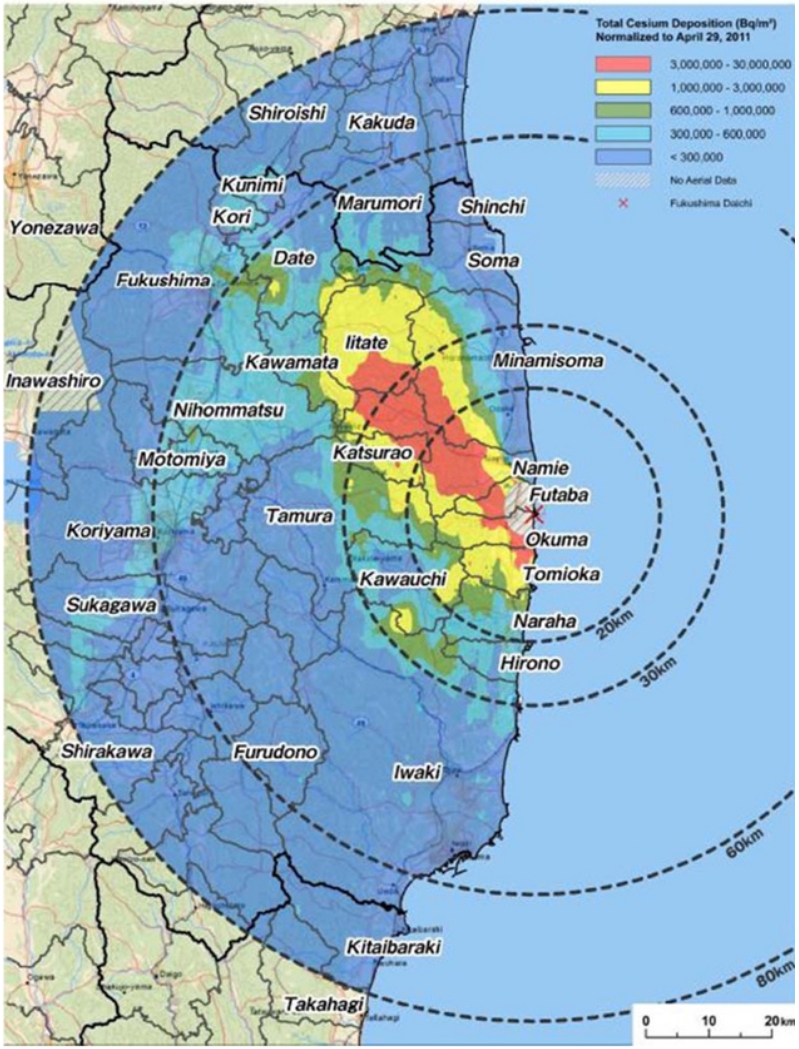
EP, HP, and Me

Baltimore-Washington Health Physics Society
Annual Meeting
May 10, 2019

Todd Smith, PhD
Emergency Preparedness Specialist
U.S. Nuclear Regulatory Commission

Aerial Measuring Results

Joint US / Japan Survey Data



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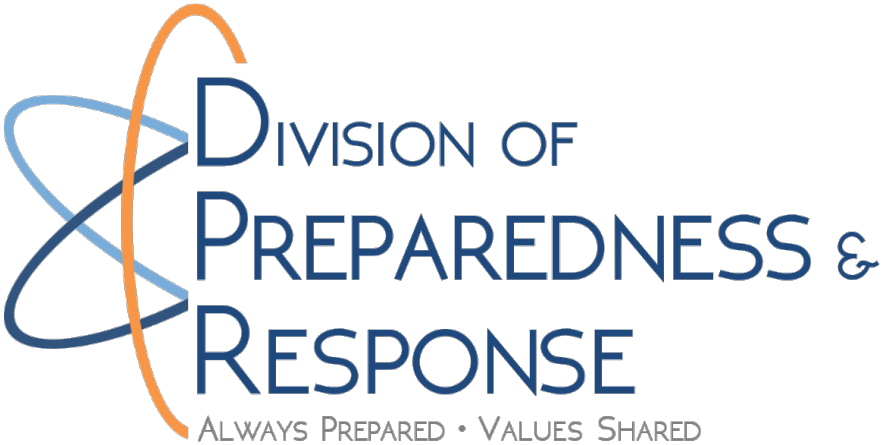
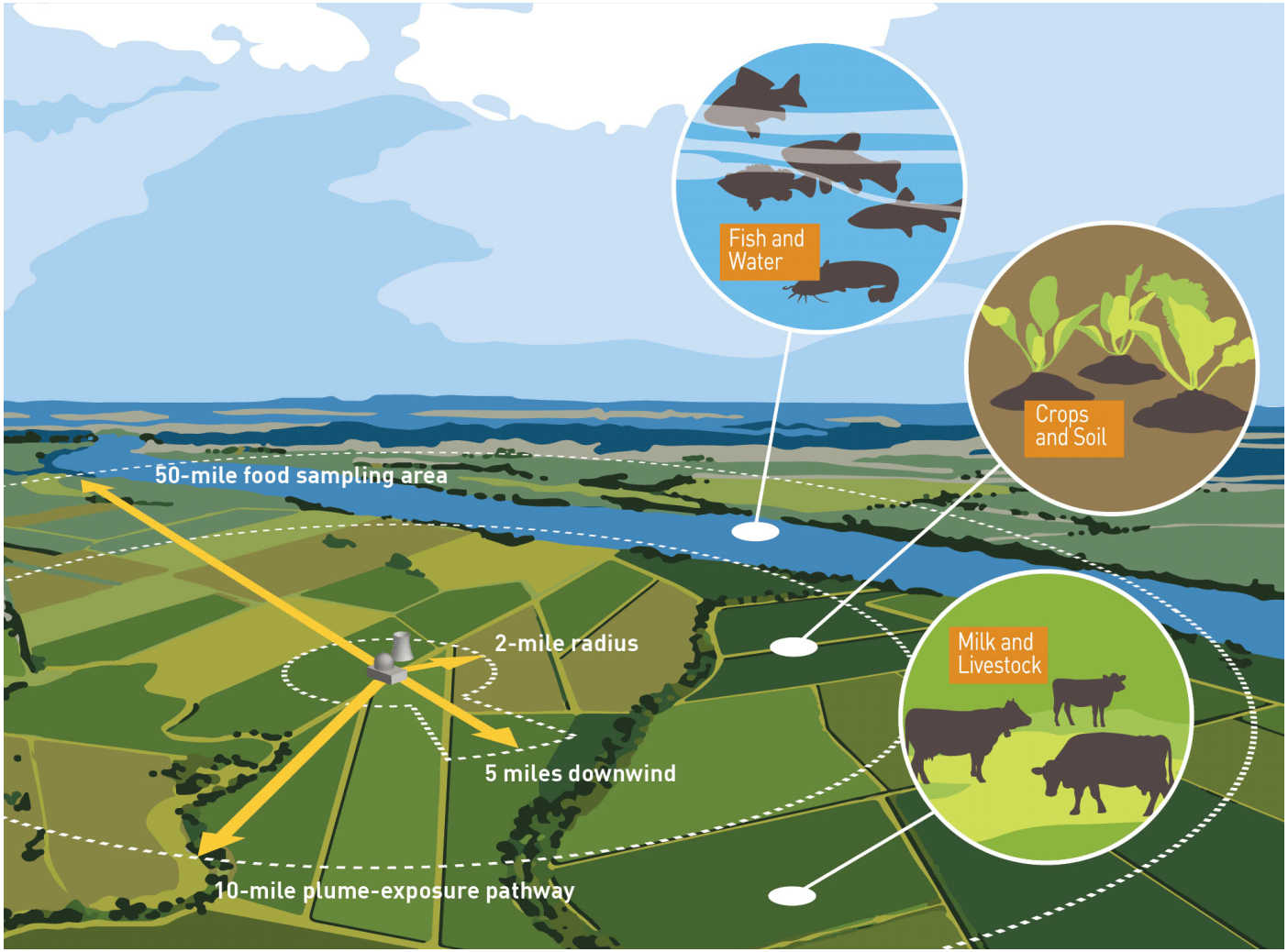
What is Emergency Preparedness?

Emergency preparedness is a state of readiness to respond to a potential hazard to protect the **health and safety of the public**.



Emergency Planning Zones



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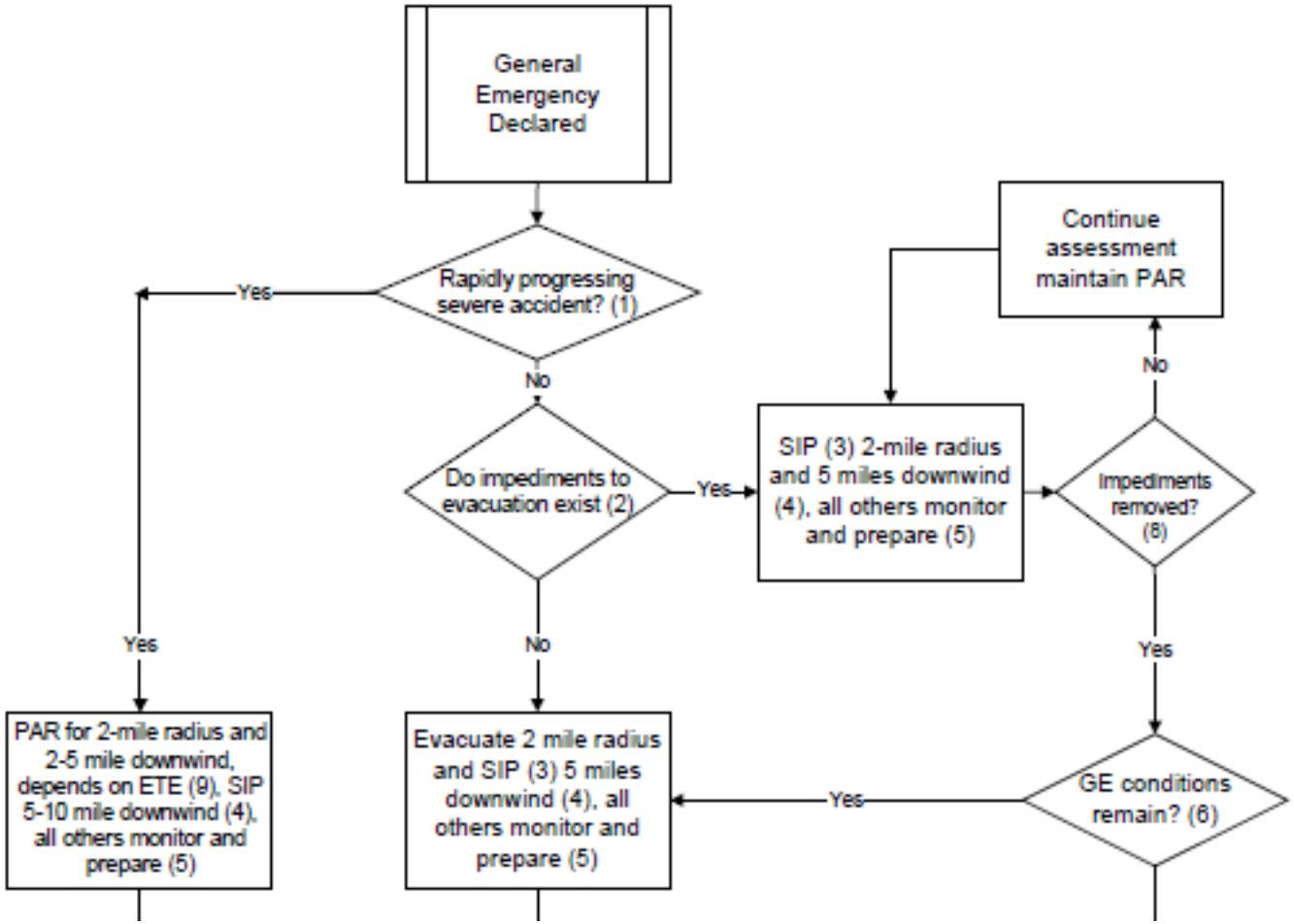
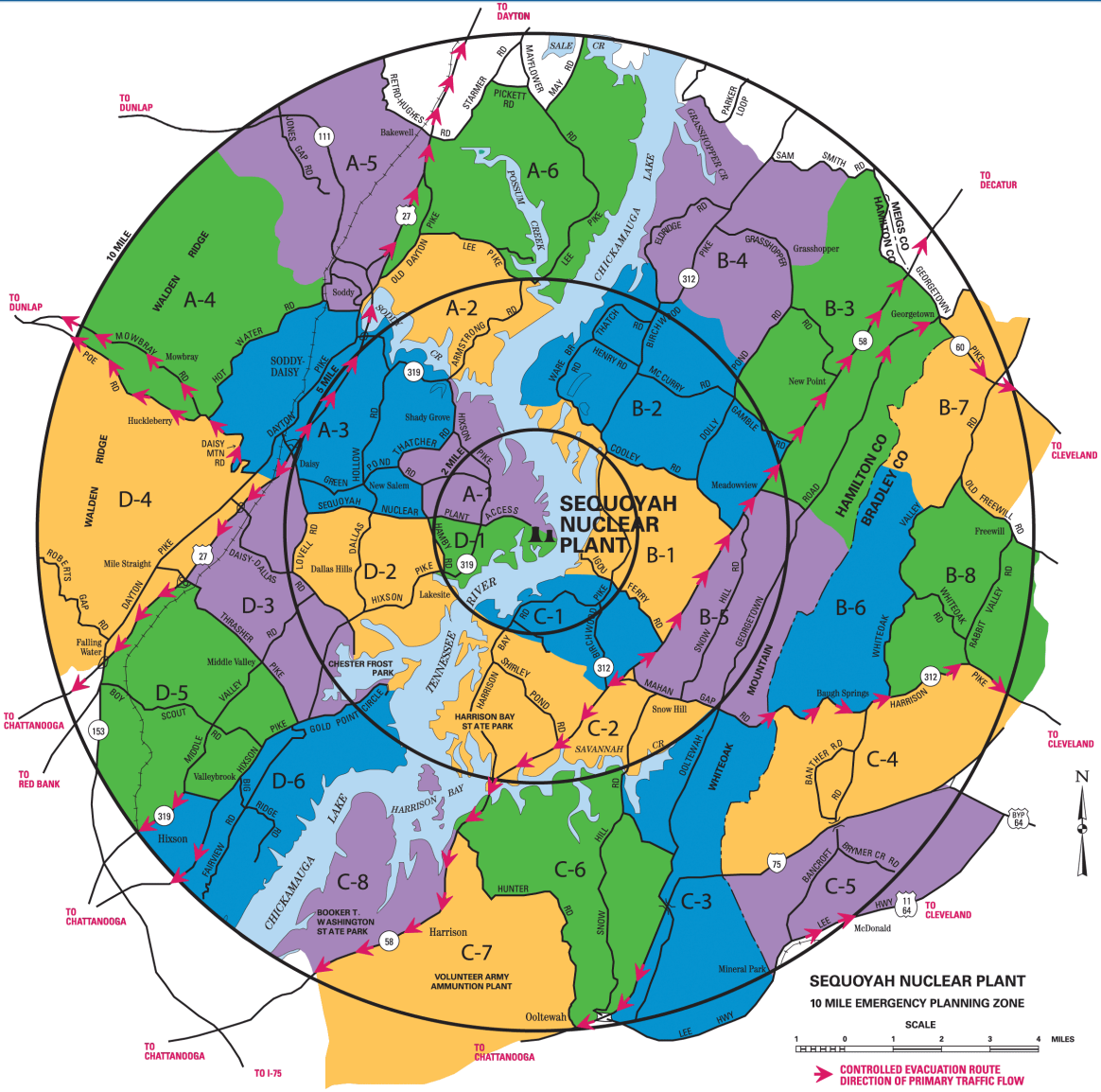
Protective Action Strategy





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PAGs, PARs, PADs

PAGs – Protective Action Guide (PAG) is the projected dose from unplanned release at which a specific protective action to reduce or avoid dose is recommended

- Used as guidance for triggering appropriate protective actions to minimize dose
- Balances the benefit of dose reduction against the risks of implementing the action

PARs – Licensees are required to make a protective action recommendation (PAR)

PADs – The offsite response organization then considers the PAR and makes a protective action decision (PAD)

NRC Reflections on Fukushima

"My commitment to prevent such accidents is even more personal. I believe that we must adopt a mindset of continually challenging ourselves to ask questions… If we are not successful, we…will breach the public trust."

Cynthia D. Pederson

"We must ensure that both the regulator and industry are prepared for the unexpected."

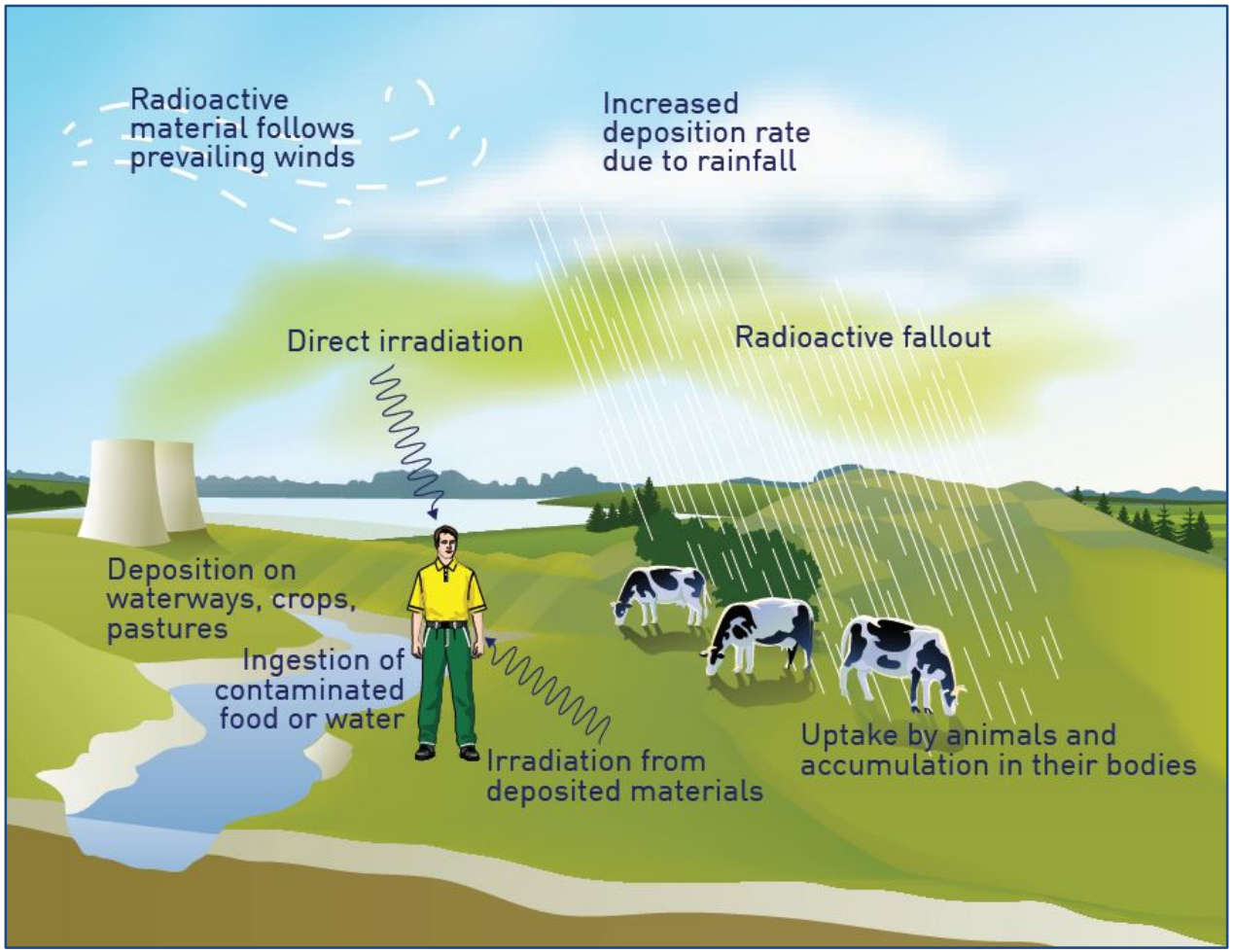
Marc L. Dapas

"We need to remember that well intended regulatory actions might lead to significant unintended effects. We need to be careful that our processes promote enhancements to safety and security and that they do not introduce unnecessary, artificial, or hidden barriers."

James T. Wiggins

NRC Research in Emergency Preparedness

Why is Health Physics Important to EP?



MACCS

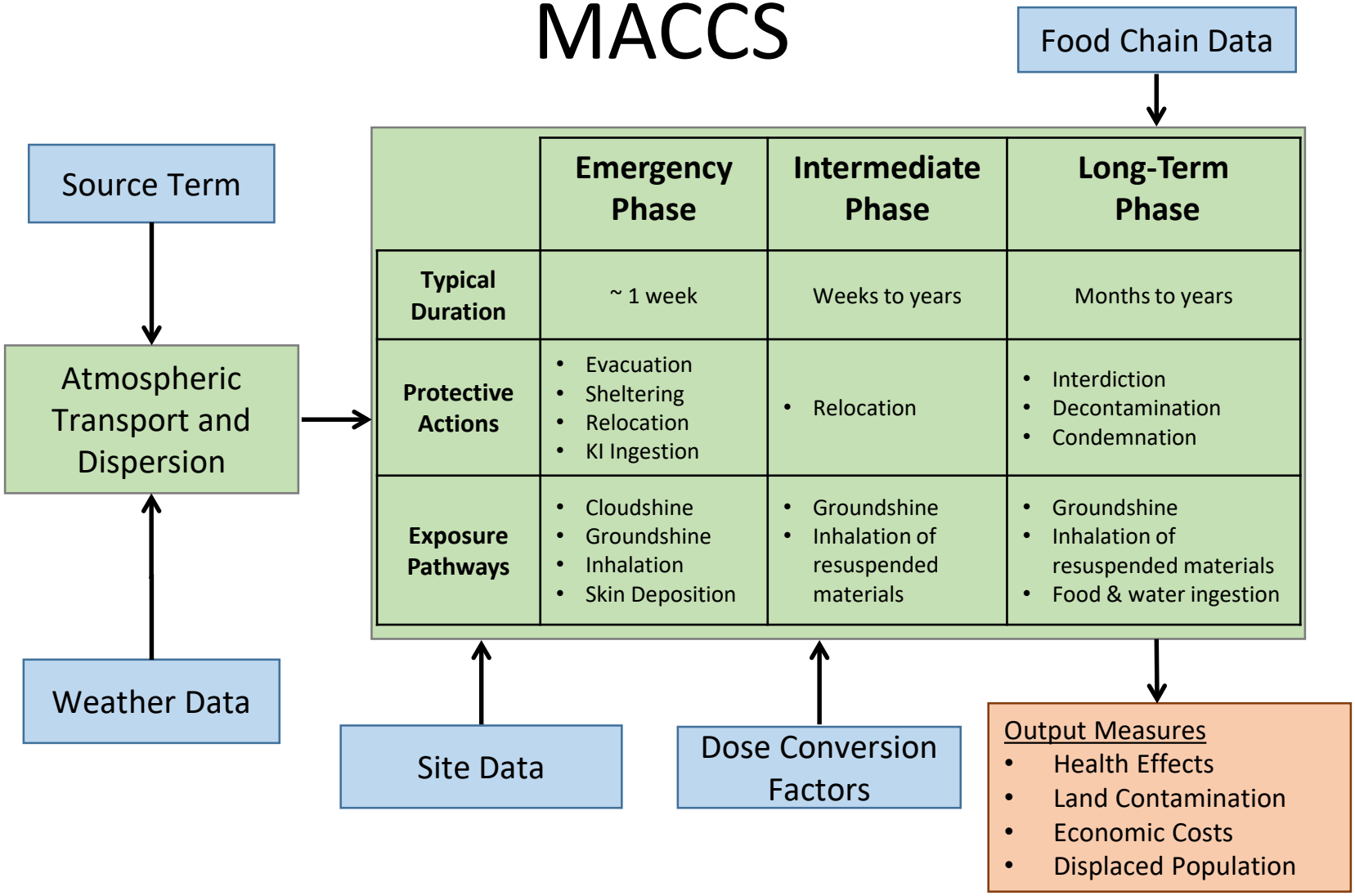
What is MACCS?

- MELCOR Accident Consequence Code System
- Probabilistic analysis tool for developing realistic estimates of consequences of nuclear power plant incidents
- Developed by NRC and Sandia National Laboratory
- Extensive use by NRC and domestic and international organizations

How is MACCS used?

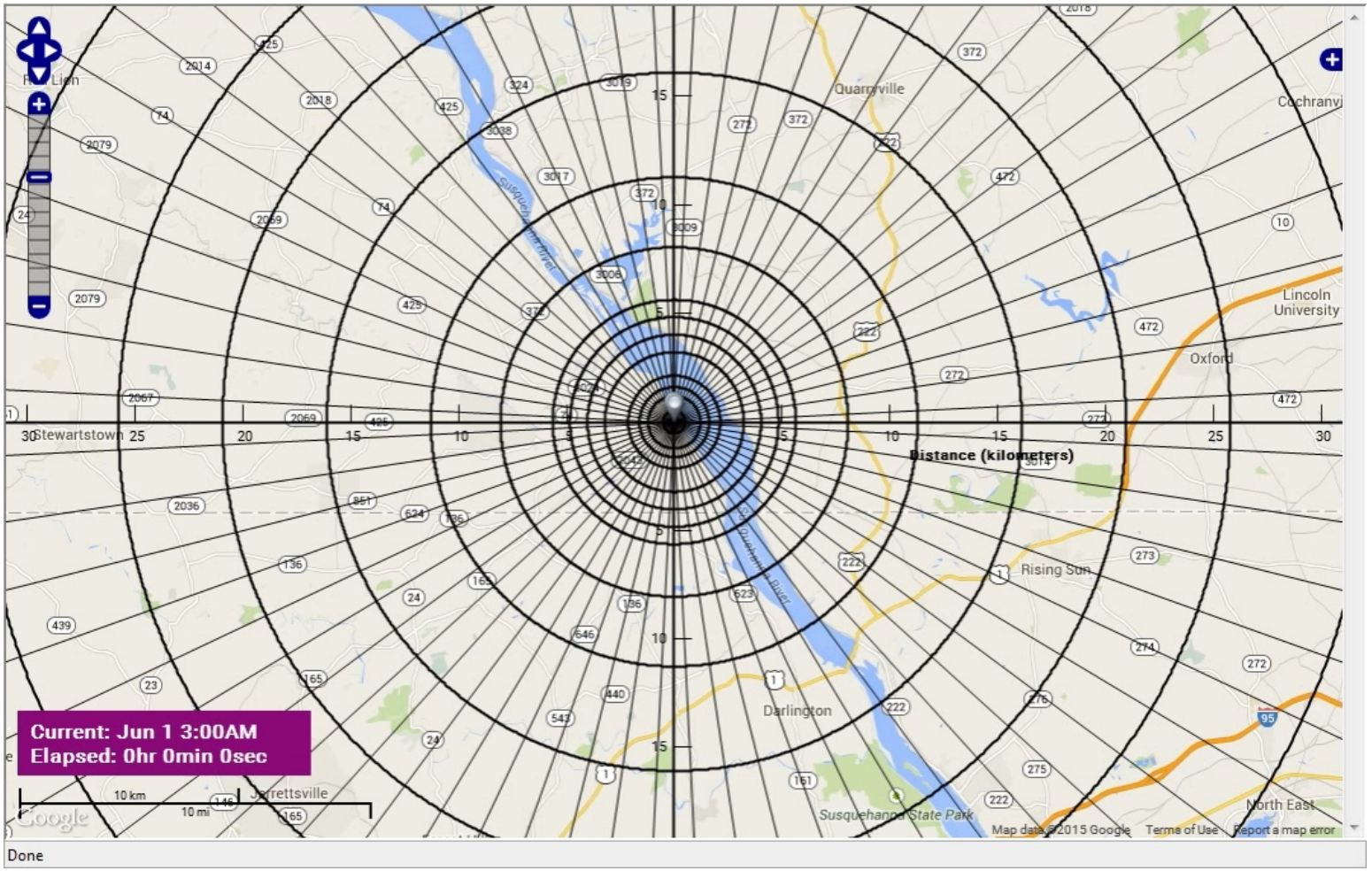
- Cost-benefit analysis
- Level 3 Probabilistic Risk Assessment (PRA)
- Consequence studies
- Risk-informed decision-making

MACCS



	Emergency Phase	Intermediate Phase	Long-Term Phase
Typical Duration	~ 1 week	Weeks to years	Months to years
Protective Actions	• Evacuation • Sheltering • Relocation • KI Ingestion	• Relocation	• Interdiction • Decontamination • Condemnation
Exposure Pathways	• Cloudshine • Groundshine • Inhalation • Skin Deposition	• Groundshine • Inhalation of resuspended materials	• Groundshine • Inhalation of resuspended materials • Food & water ingestion

Example Gaussian Plume Segment Transport



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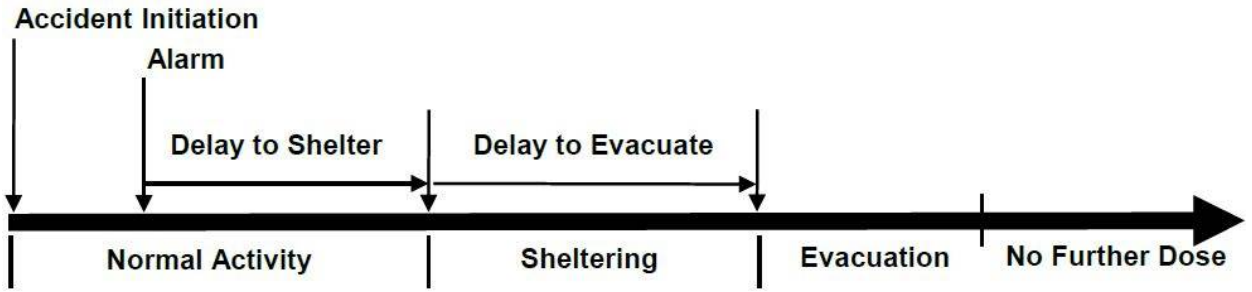
MACCS

Emergency Phase Modeling

- Protective actions (evacuation, sheltering, relocation, KI)
- Cohort timeline (general population, schools, special facilities, evacuation tail, shadow evacuees, non-evacuees)



How parameters are informed

- Evacuation time estimate (ETE) studies and traffic simulation codes
- MACCS modeling best practices
- Discussions with state and local authorities

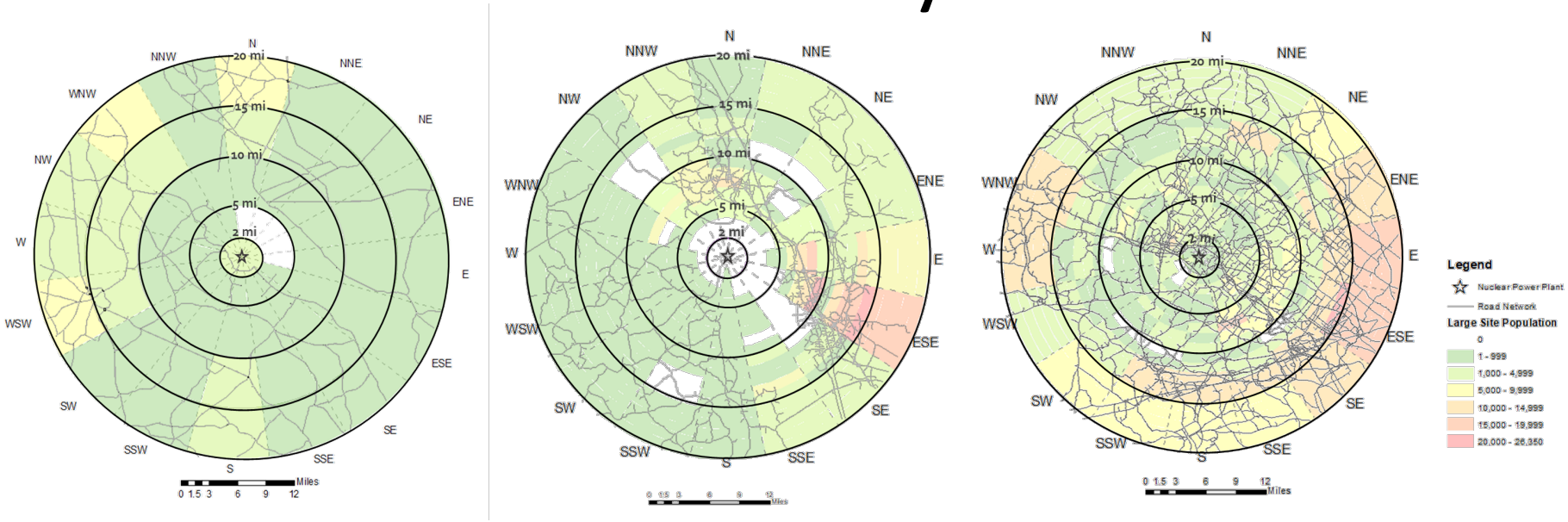
Evacuation Time Estimate (ETE) Study

Applied research study to examine topics associated with the modeling and simulation of evacuations and independent verification of the NRC's methodology for ETE development.

Study Areas

- Shadow evacuation analysis
- Distance of evacuation travel
- Manual traffic control
- Determination of variable importance

ETE Study



Model Comparison	EPZ POPULATION	MODEL EPZ POPULATION		MODEL STATS		
	0-10 MILE	0-10 MILE	20% SHADOW	INTER-SECTIONS	MILES OF ROAD	LINKS/ CONNECTORS
SMALL	0 – 50,000	7500	3000	174	1196	376/863
MEDIUM	50,000 – 200,000	200,000	30,000	449	3313	2645/3846
LARGE	> 200,000	325,000	60,000	974	3712	10605/14719

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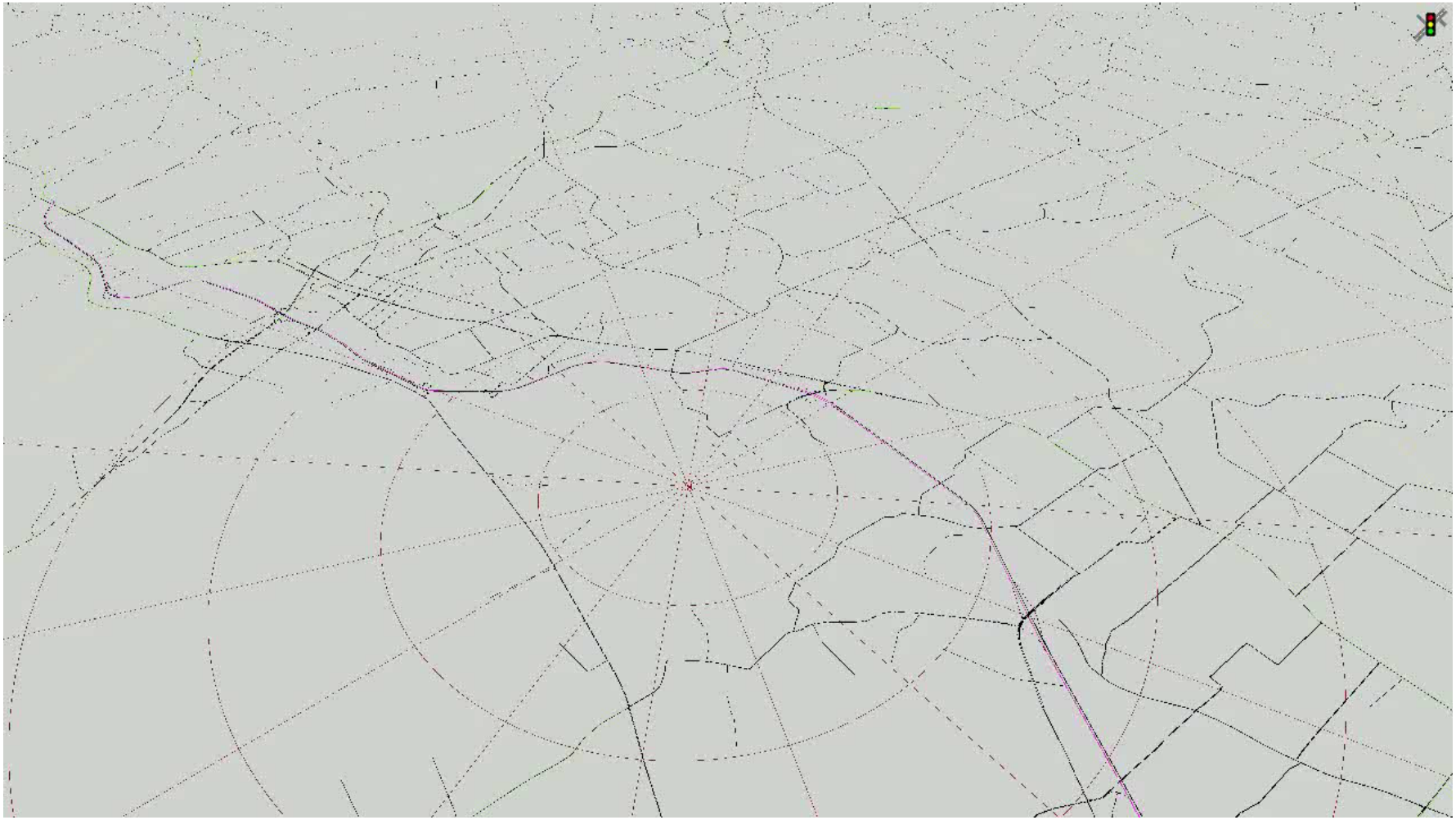


ORO Study

The NRC seeks to better understand offsite response organization (ORO) capabilities and practices for protective actions in the intermediate phase of emergency response to a nuclear power plant (NPP) incident

Study Areas

- Identification of radiological hot spots
- Relaxation of evacuation and relocation orders
- Food condemnation or embargo
- Drinking water safety
- Beyond the 10-mile emergency planning zone (EPZ)
- Notable observations

MACCS

Potential use of ORO Study Results

ORO Study Topics	Related MACCS Model
Identification of Radiological Hot Spots	Early Phase Relocation Models
Beyond the 10-Mile EPZ	Early Phase
Relaxation of Evacuation and Relocation Orders	Intermediate Phase Relocation and Habitability Assessment
Food Condemnation or Embargo	Long-term Phase Agricultural Restrictions
Water	Long-term Phase Societal Dose Assessment

EP Research

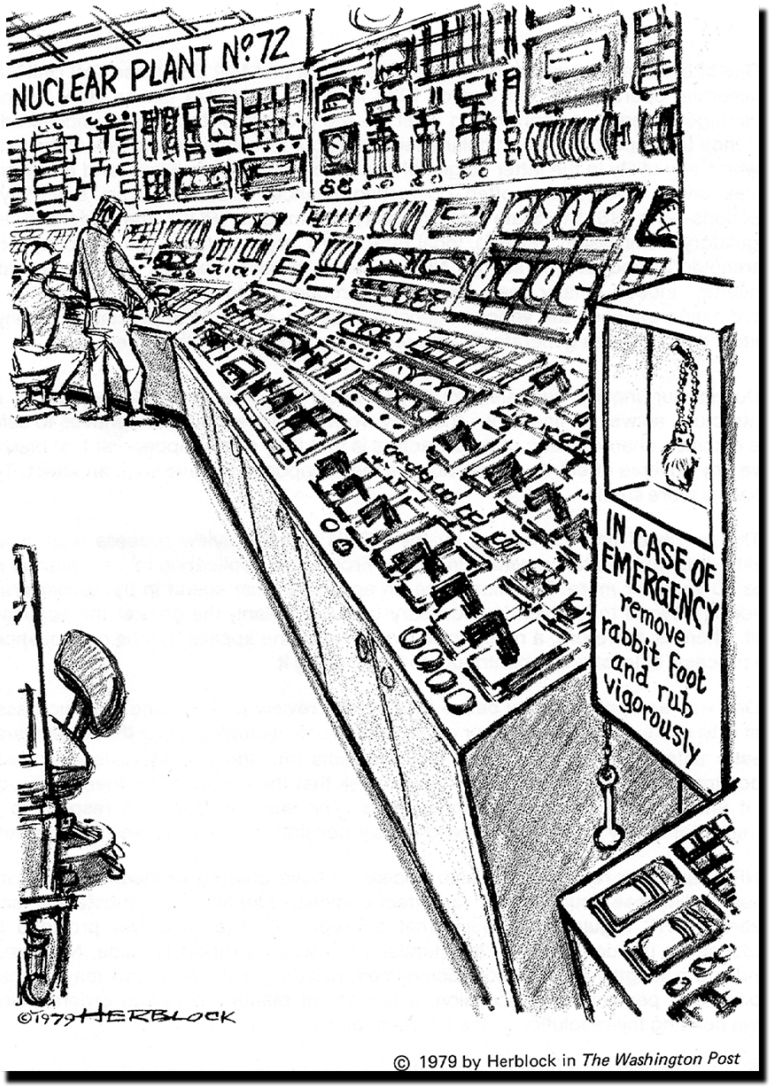
The NRC is conducting a number of research studies to inform emergency preparedness regulations or guidance and to assess the impact of EP in reducing consequences

Consequence Studies

- Sequoyah SOARCA (includes seismic impact to EP)
- Level 3 Probabilistic Risk Assessment

Studies to Inform Regulations or Guidance

- EPZ size methodology of NUREG-0396
- Non-radiological impacts of evacuations
- Technical basis for protective action recommendations (PARs)


NUCLEAR PLANT Nº 72
IN CASE OF EMERGENCY remove rabbit foot and rub vigorously
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Reactor technology is advancing,
EP and HP are evolving,
but the NRC's mission to protect the health and safety of the public remains unchanged