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United States Nuclear Regulatory Commission
Protecting People and the Environment

NRC Update on Initiatives

"The future belongs to those who prepare for it."
— Ralph Waldo Emerson

Region IV TOP Workshop
Arlington, TX
February 13, 2018

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U.S. Nuclear Regulatory Commission

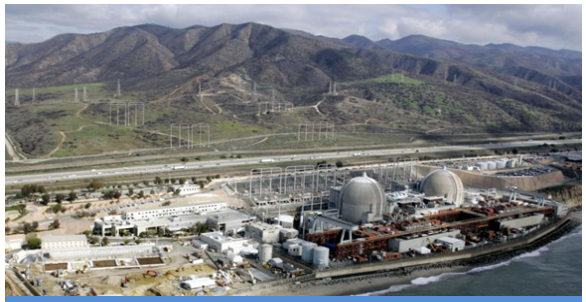
NRC Updates

- EP Rulemaking Activities
  - Decommissioning
  - Small Modular Reactor & Other New Technologies
- NUREG-0654/FEMA-REP-1 Revision 2
- EP Research
  - Study of ORO Intermediate Phase Capabilities and Practices
  - Study of Evacuation Time Estimates
  - Studies to Inform and Validate Technical Approach to EP

Decommissioning Sites

Kewaunee (Wisconsin)
October 2014

Crystal River 3 (Florida)
March 2015



San Onofre (California)
June 2015

Vermont Yankee (Vermont)
December 2015

Decommissioning Sites

Ft. Calhoun
Oct 24, 2016

Oyster Creek
October 2018

Palisades
Spring 2022

Indian Point
Unit 2 April 2020 Unit 3 April 2021

Pilgrim
May 2019

Decommissioning Rulemaking

- EP regulations do not address risk at permanently shutdown and defueled reactor sites
- Exemptions from regulations provide relief on a case-by-case basis
- Commission directed rulemaking to include consideration of a graded approach to EP (SRM SECY-14-0118)
- Rulemaking goals:
  - Maintain reasonable assurance
  - Maintain defense-in-depth
  - Provide regulatory certainty and clarity

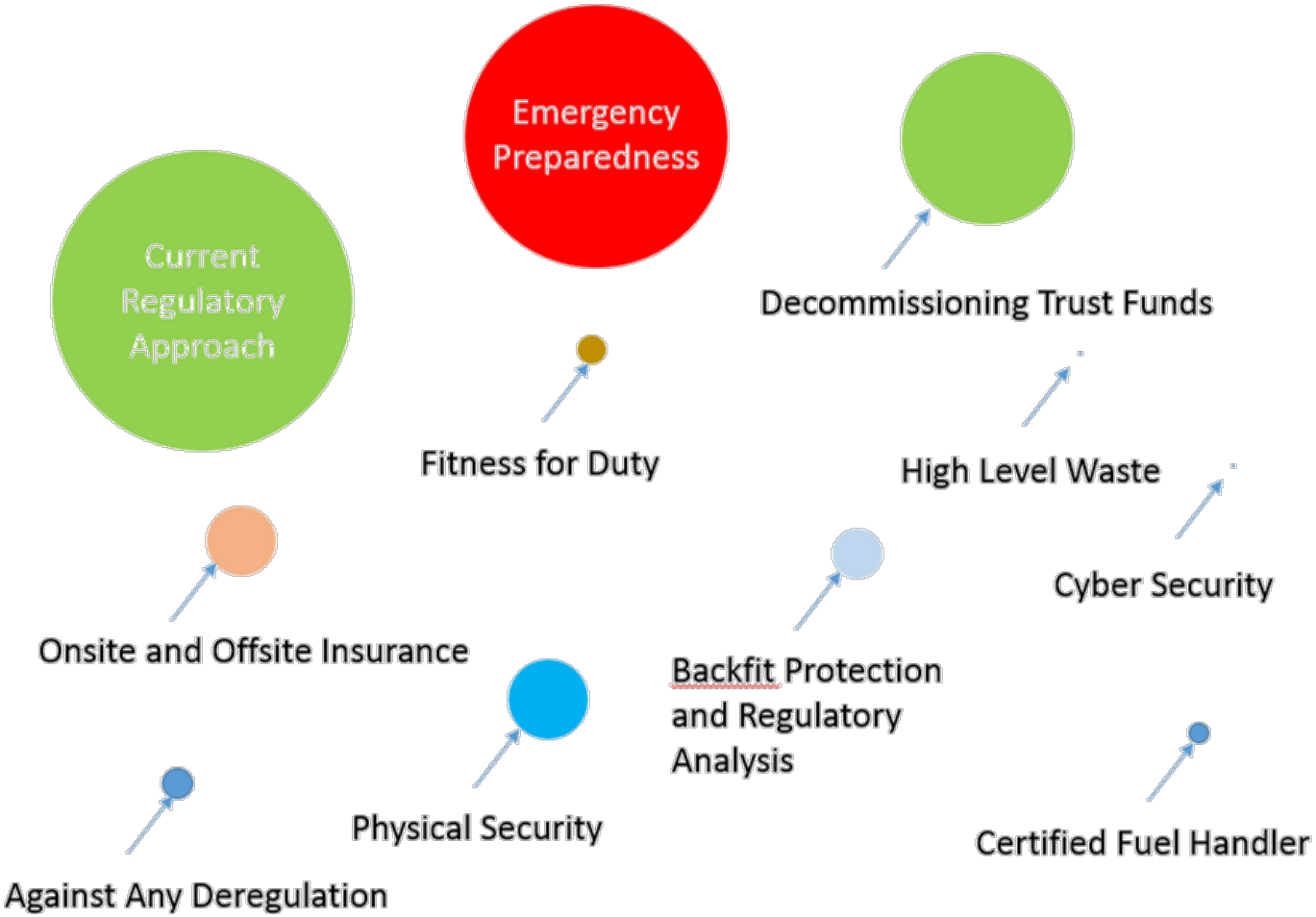
Advanced Notice of Proposed Rulemaking

Emergency Preparedness	Physical Security	Fitness for Duty
Requirements for Certified Fuel Handlers	Regulatory Approach for Decommissioning	Application of Backfitting Protection
Decommissioning Trust Funds	Offsite and Onsite Liability Protection	General Questions (e.g., Cumulative Effects of Regulation)

Federal Register (80 FR 72358), November 19, 2015

ANPR Areas of Interest

Diameter of circle shows relative number of comments submitted by topic



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Illustrative Milestones

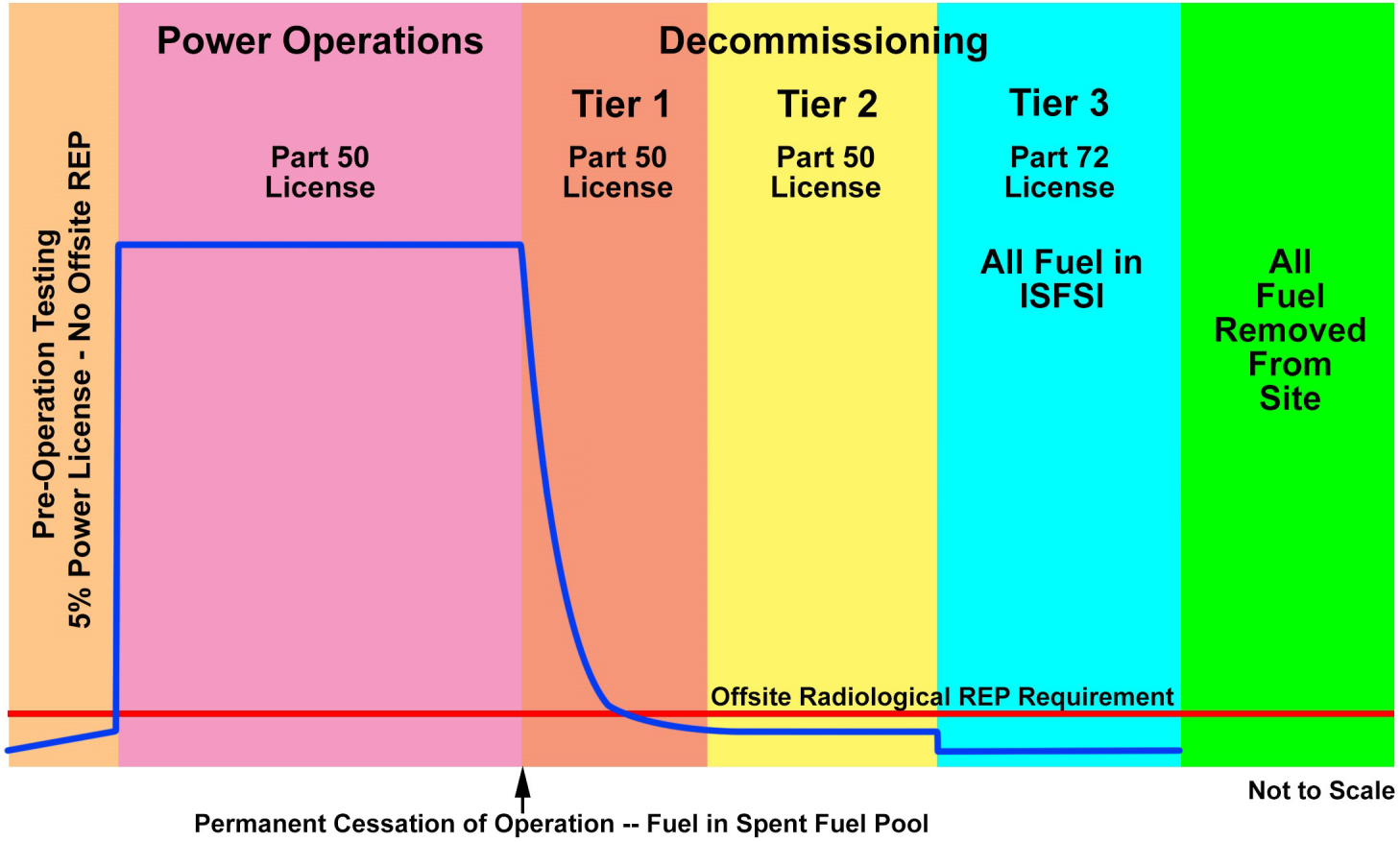


Figure Illustrates the Phases of Plant Operation and the Need for Offsite REP

Decommissioning Levels

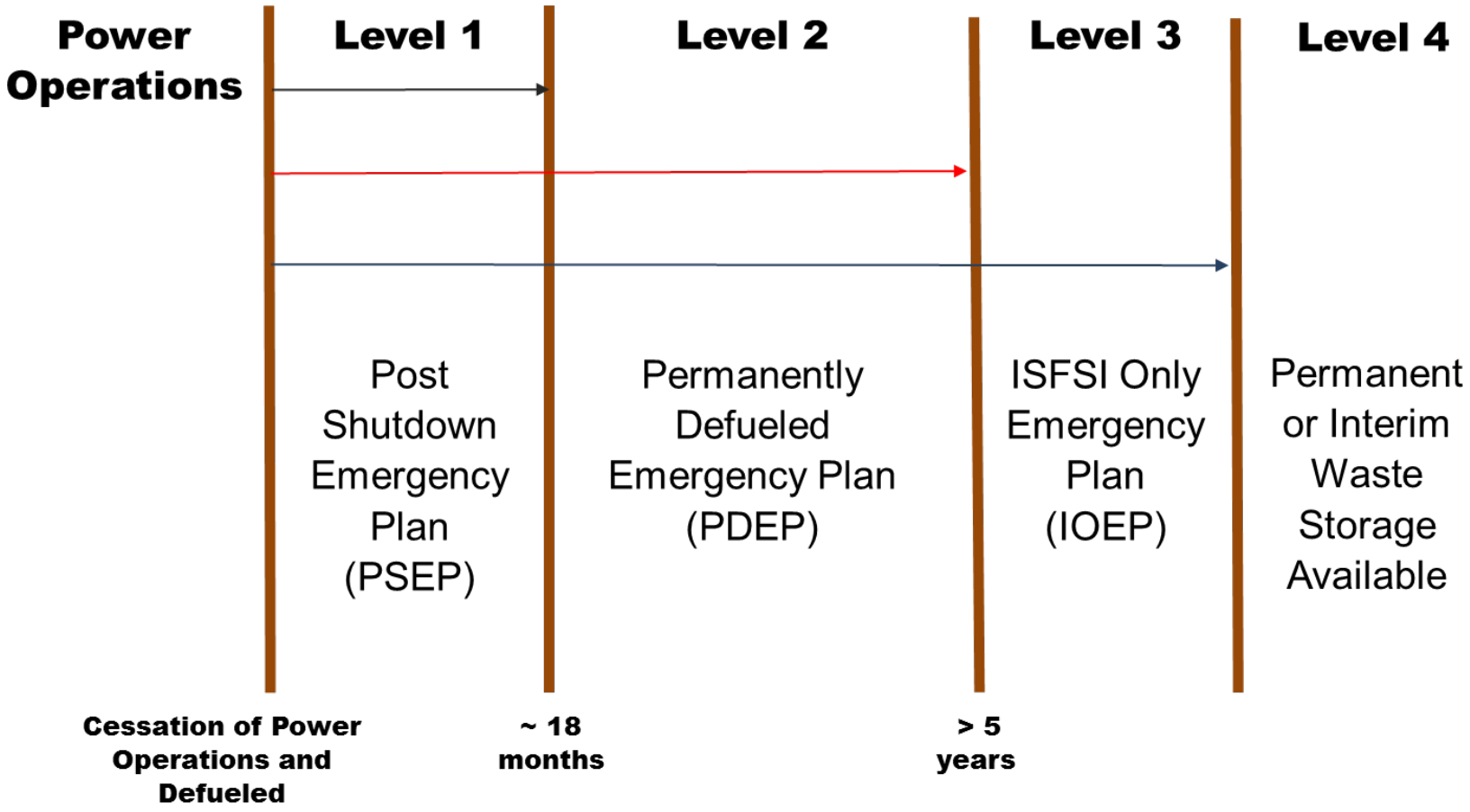
Level 1 — Permanent cessation of operations and all fuel in spent fuel pool

Level 2 — Spent fuel has sufficiently decayed (10 hour adiabatic heatup time)

Level 3 — All fuel is in dry cask storage

Level 4 — All fuel removed from site

Decommissioning EP Levels



EP Planning Basis

- The overall objective of EP is to provide dose savings for a ***spectrum of accidents*** that could produce ***offsite doses in excess of PAGs***
- Planning basis elements consider ***distance***, ***timing***, ***materials***
- **EPZs** are areas for which planning is needed to assure that ***prompt*** and effective actions can be taken to protect the public in the event of an accident
- After permanent cessation of operations:

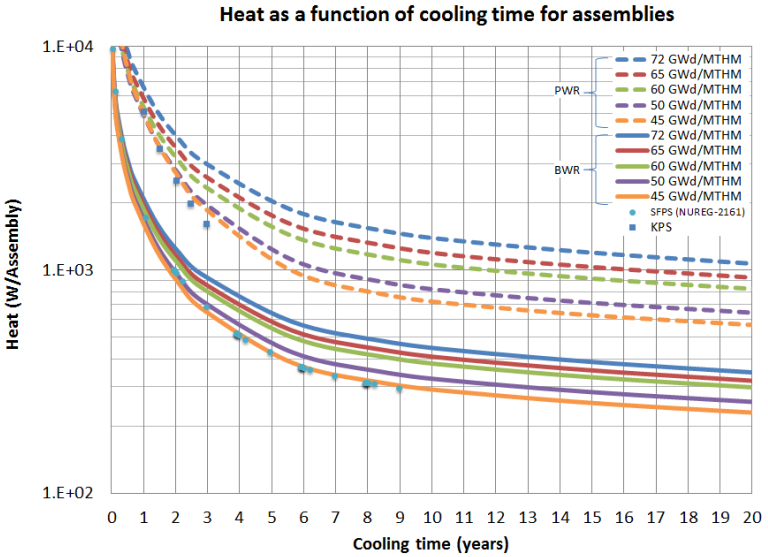
The spectrum of accidents are fewer

DBAs will not exceed EPA PAGs offsite

At least 10 hours available before release occurs

Research to Support Rulemaking

- **NUREG-1738**, "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants"
- **NUREG-2161**, "Consequence Study of a Beyond-Design-Basis Earthquake Affecting the Spent Fuel Pool for a U.S. Mark I Boiling Water Reactor"
- **Supporting Research Studies**
  (ADAMS ML16110A416)
  - Analysis of Mitigative Actions
  - Spent Fuel Decay Time
  - Dose Rate of Accidental Radiological Release from Spent Fuel Pool



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Decommissioning Rulemaking

- Implementation of a graded approach to EP
  - Minimize licensing actions
  - Regulatory standards commensurate with radiological risk
  - Consistent with approved EP exemptions but based on considerations of EP as a separate layer of defense-in-depth
- Emergency Plan Change Process
  - Transition to Levels
  - Changes within Levels
  - Changes in FSAR
  - Changes in EAL Classifications and Scheme(s)
- Draft Regulatory Guide to accompany proposed rule

Decommissioning Rule Schedule

- Advance Notice of Proposed Rulemaking
  - November 19, 2015
- Draft Regulatory Basis
  - March 15, 2017
- Final Regulatory Basis
  - November 2017
- Proposed Rule/Draft Regulatory Guidance
  - Provide to Commission in May 2018
- Final Rule/Final Regulatory Guidance
  - Goal: Provide to Commission CY2019

The Future of EP

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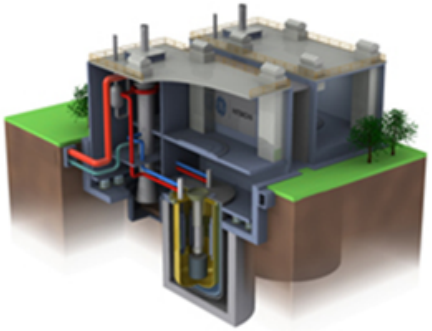
EP for SMRs & ONT

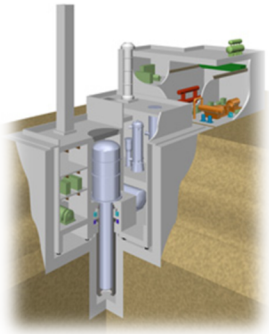
- Rulemaking to develop a clear set of rules and guidance for small modular reactors (SMRs) and other new technologies (ONT)

Technology Neutral

Risk-Informed, Performance Based

Principle of dose-at-distance and consequence-oriented approach to determine EPZ size





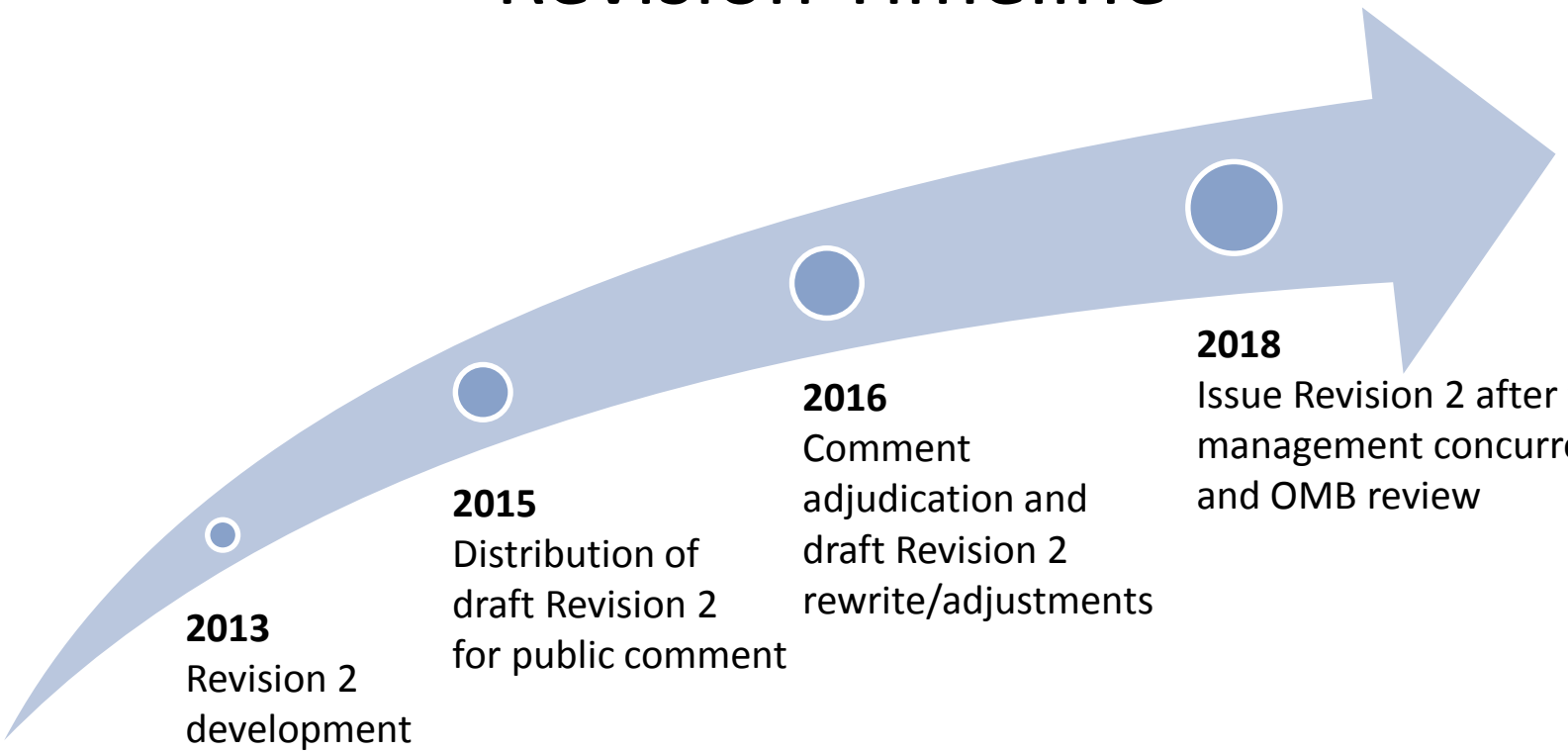
SMR & ONT Rulemaking

- Rule would consider
  - Event classification and mitigation
  - Protective actions
  - Communications
  - Command and control
  - Staffing
  - Radiological assessment
- Guidance
  - General information (non-design specific)
  - Design specific guidance would be developed after rulemaking

SMR & ONT Rulemaking Schedule

- Draft Regulatory Basis
  - April, 2017
- Final Regulatory Basis
  - November 2017 (ML17206A265)
- ACRS Subcommittee meeting
  - August 2018
- ACRS full meeting
  - October 2018
- Commission Submission
  - October 2019
- Proposed Rule/Draft Regulatory Guidance
  - January 2019

NUREG-0654/FEMA-REP-1 Revision Timeline



NRC Research in Emergency Preparedness

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

Outcome

NUREG/CR report to be published by March 2018

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

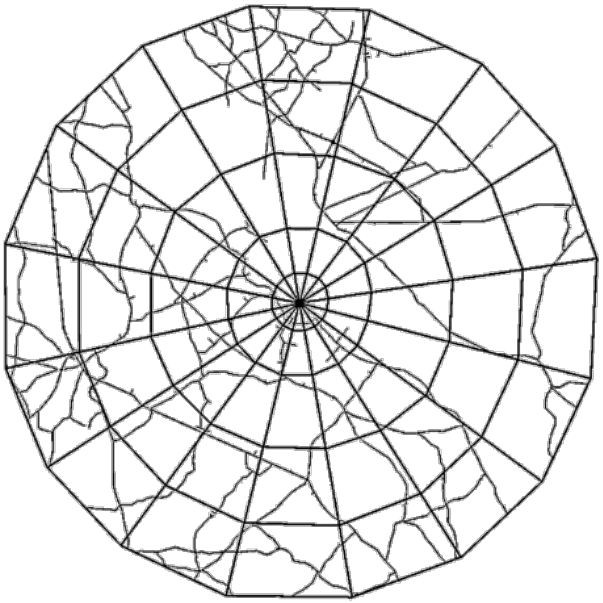
- Shadow evacuation analysis
- Distance of evacuation travel
- Manual traffic control
- Determination of variable importance

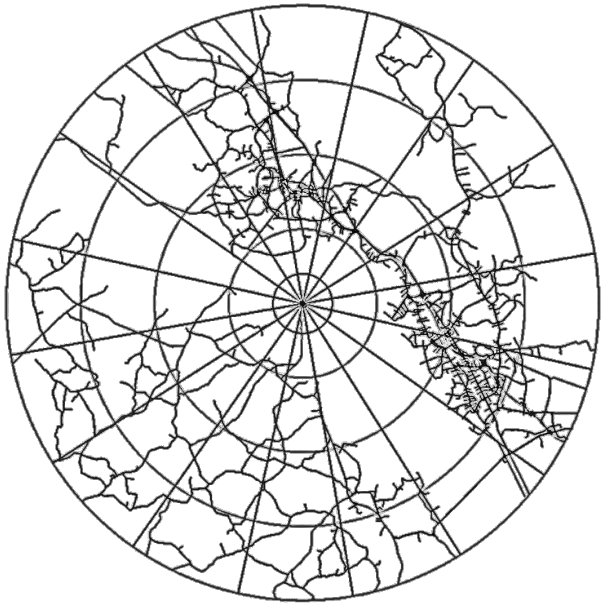
Outcome

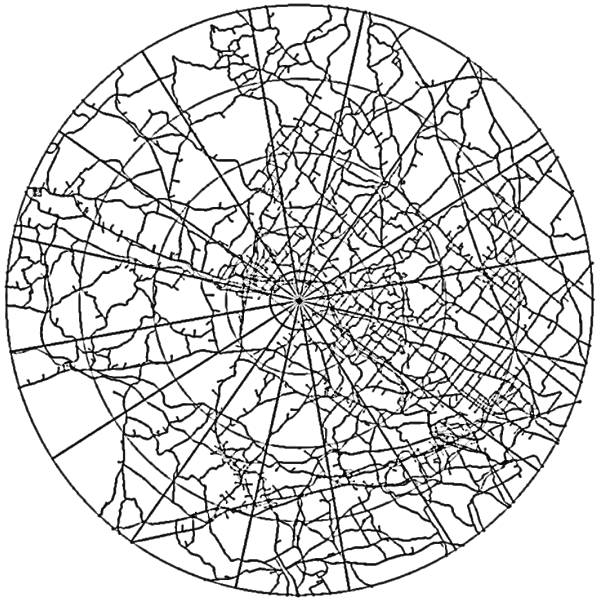
- NUREG/CR report published late 2018
- NUREG/CR-7002 update prior to 2020 census

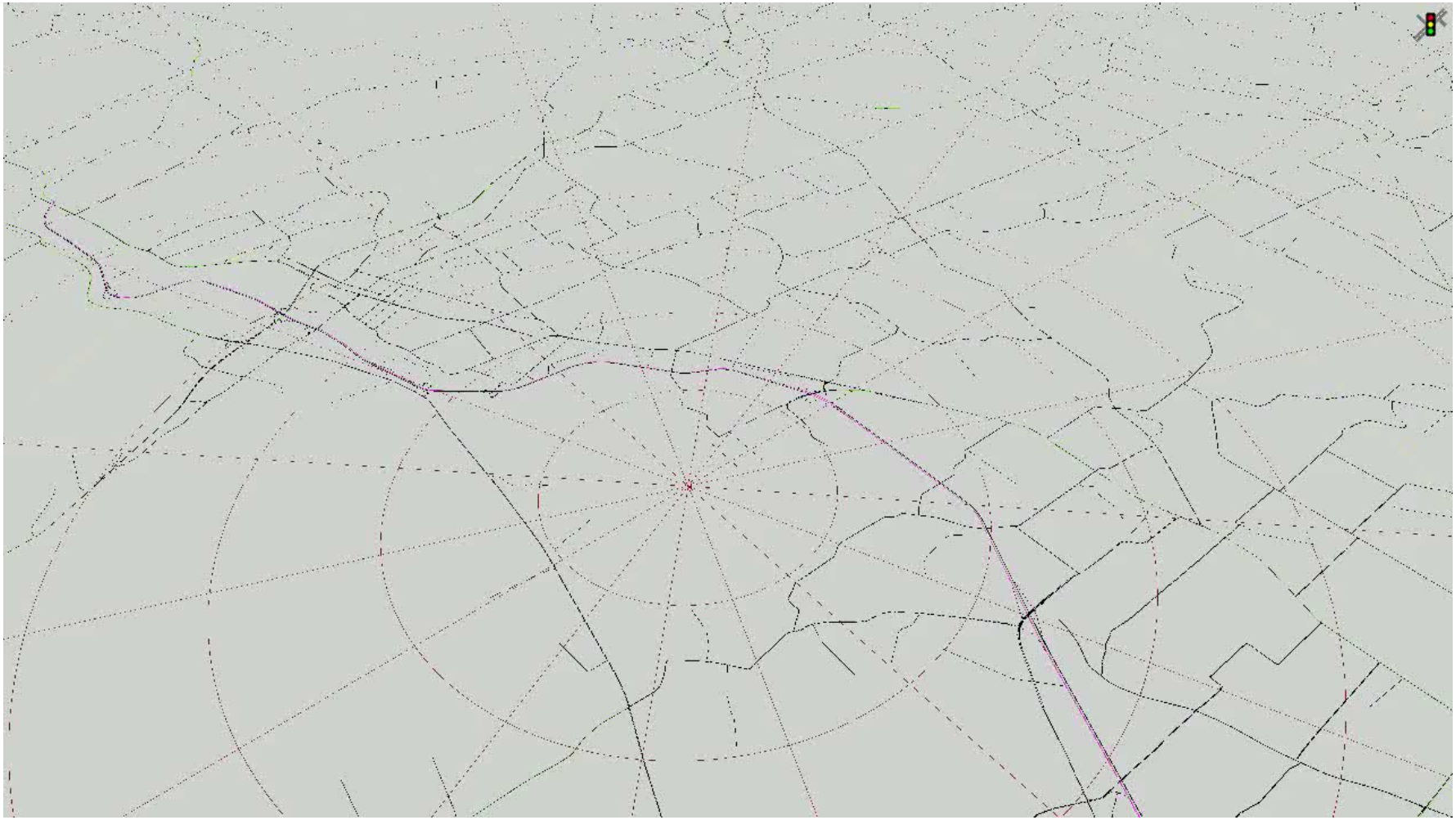
ETE Study

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

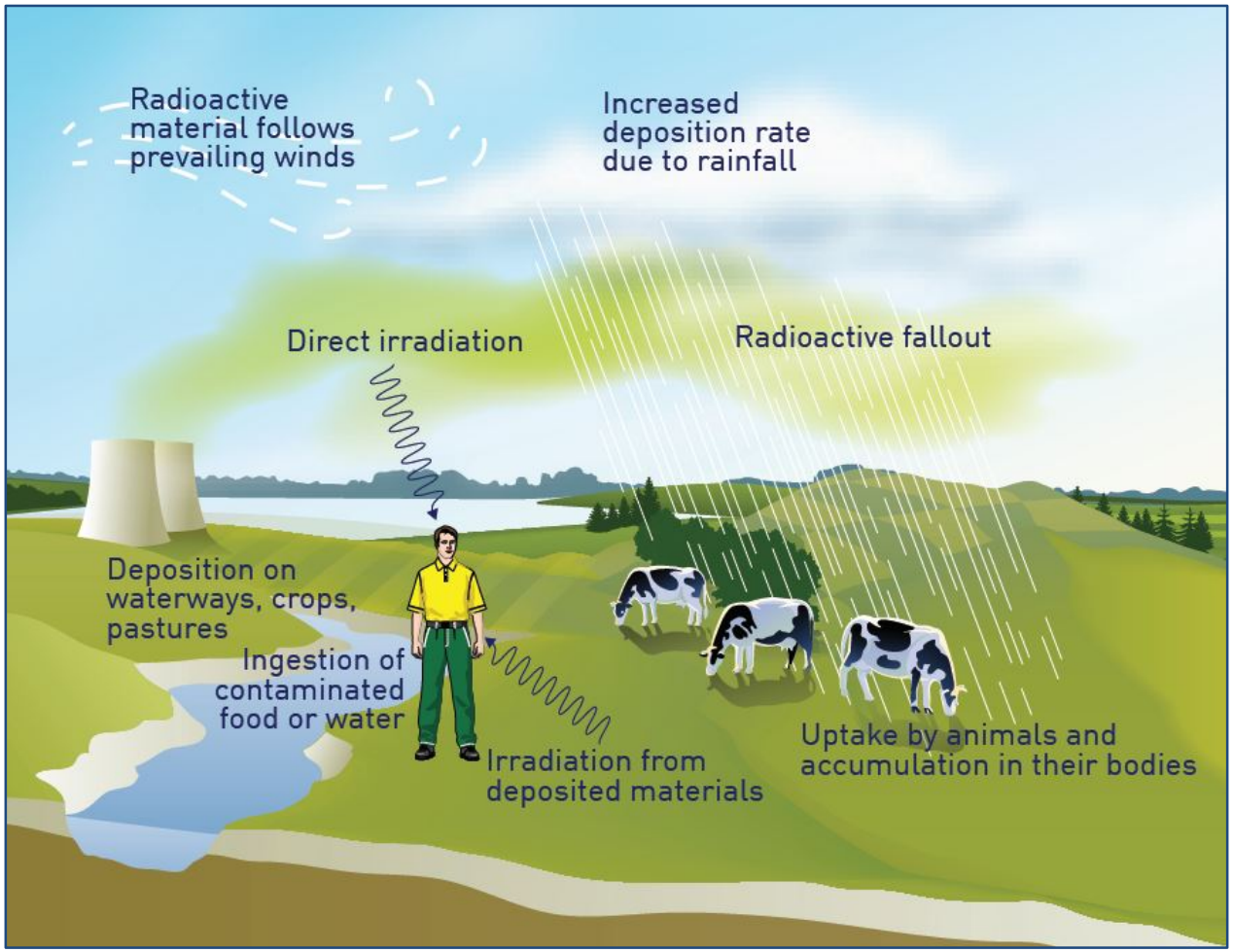








How does the NRC use this research?



MACCS

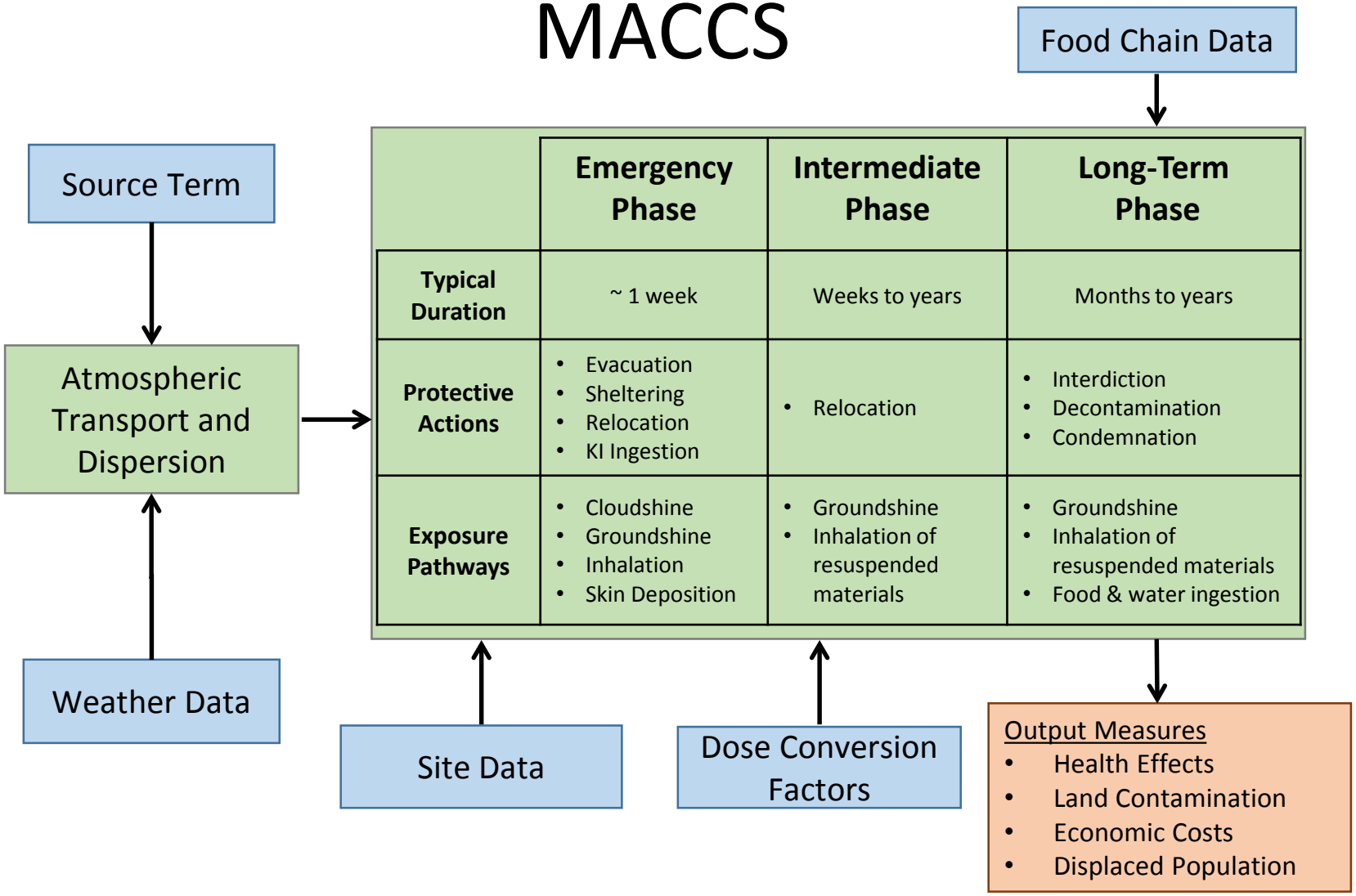
What is MACCS?

- 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?

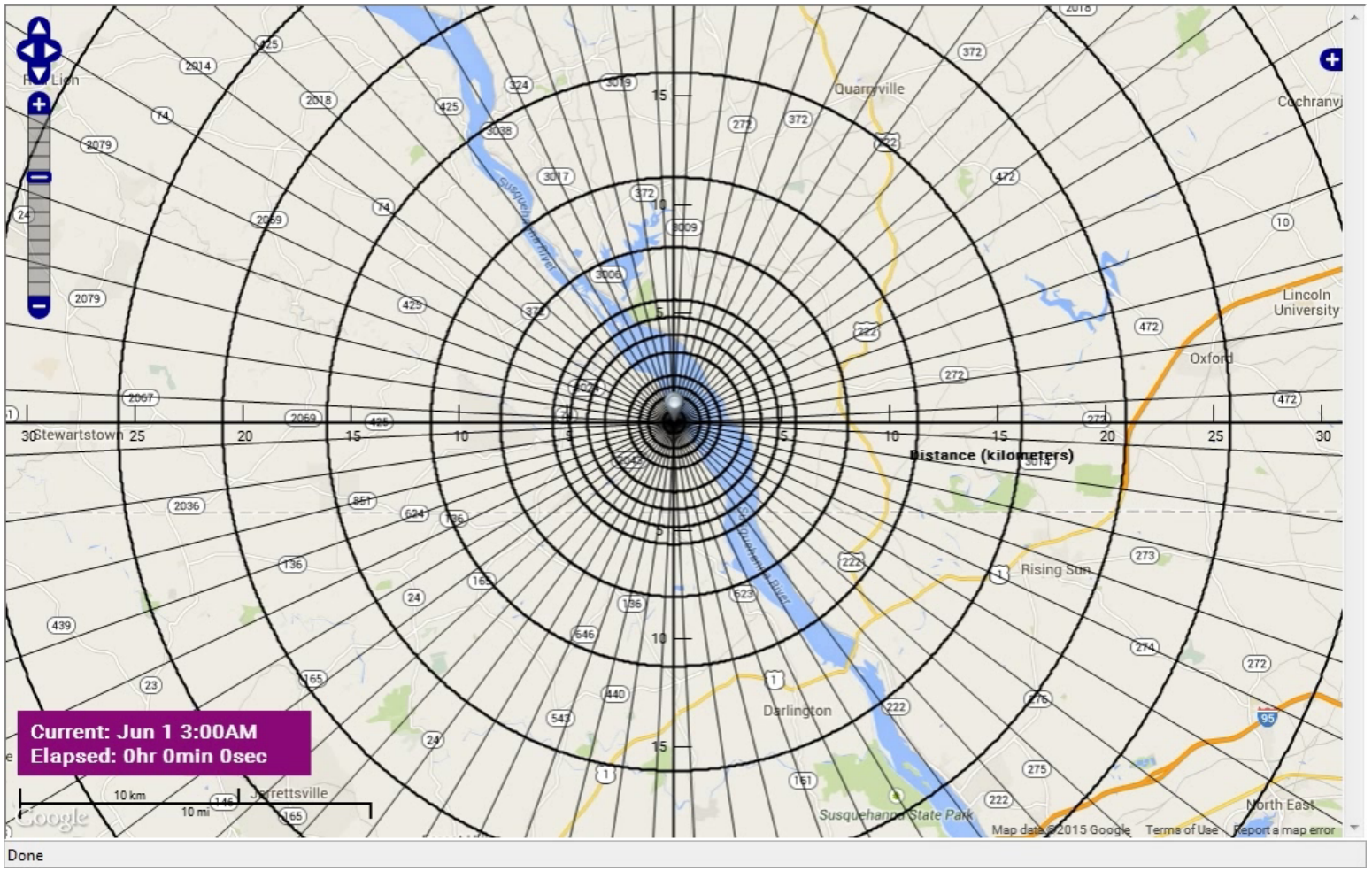
- Cost-benefit analysis
- Level 3 Probabilistic Risk Assessment (PRA)
- Consequence studies
- Risk-informed decision-making

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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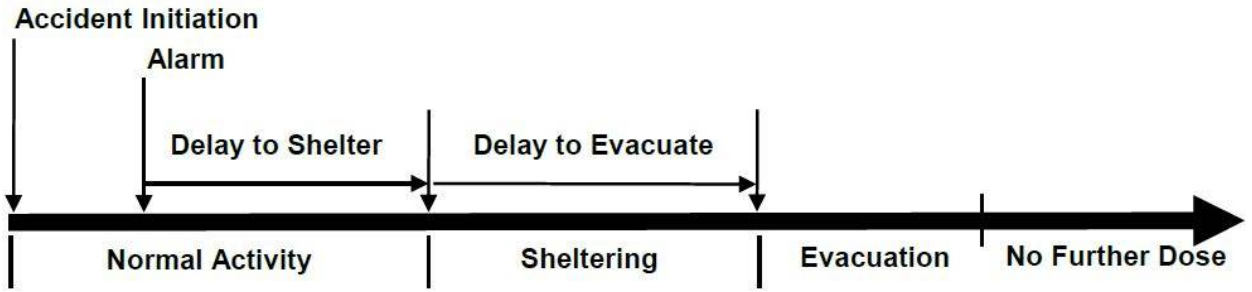
MACCS

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

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

Studies to Inform Regulations or Guidance

- EPZ Size Methodology of NUREG-0396
- Non-radiological impacts of evacuations
- MACCS model improvements

Consequence Studies

- Sequoyah SOARCA
- Level 3 PRA

Back to the Future

EP is evolving, but the NRC's mission to protect the health and safety of the public remains the same

- EP of the past informs the future
  - NUREG-0396 planning basis
- Guidance updates incorporate decades of experience
- Research enhances our understanding and informs and validates our technical approach

Contact Information

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