

# **Emergency Planning for Small Modular Reactors/Other New Technologies**

**National Radiological Emergency Preparedness Conference  
April 2019**

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# Purpose

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- To present NRC's basis for its risk informed emergency planning zone (EPZ) sizing for small modular reactors and other new technologies (SMR/ONT)

# What is changing and why?

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- EPZ size and other radiological emergency preparedness (REP) Program capabilities should be proportional to the risk without undue regulatory burden on licensees
- Performance-based emergency preparedness (EP) and scalable EPZ size commensurate with risk
- Ingestion planning capabilities rather than defined zone
- New designs/technologies are including “EP by design” to meet the expectations of the Commission Policy Statement on Advanced Reactors, issued in 2008
- NRC as a matter of long standing principle has licensed facilities such as research and test reactors, reactors at low power operation, and fuel facilities with EPZs that do not require an off-site REP program

# NRC Authorities

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- Atomic Energy Act of 1954, as amended:
  - Grants the authority to the NRC to set standards for offsite emergency preparedness
  - Empowered the NRC to establish by rule or order, and to enforce, such standards to govern possession and use of regulated nuclear materials as “the Commission may deem necessary or desirable in order to protect health and safety and minimize danger to life or property”
  - The U.S. Supreme Court has expressly held that, while States retain authority over “questions of need, reliability, cost, and other related State concerns,” Federal preemption under the Atomic Energy Act grants final authority to the NRC to set standards for offsite emergency preparedness and radiological safety
- Ensures regulatory stability and predictability

# Reasonable Assurance/Adequate Protection

- Reasonable assurance is the determination that licensee on- and offsite plans; and State, local, and Tribal, plans and preparedness are adequate to protect public health and safety in the event of a radiological emergency at a nuclear power plants
- FEMA evaluates offsite planning and preparedness and reports findings/determination to NRC
- NRC evaluates onsite emergency planning and preparedness and considering FEMA's evaluation makes the overall determination of reasonable assurance

# What Is NOT Offsite Radiological Emergency Preparedness?

- Emergency planning and implementation of measures within the site boundary rests with the licensee and includes response to fire events, medical emergencies, and security events
- If the NRC determines no need for offsite radiological emergency plans, then FEMA findings and determinations are not needed to support licensing decisions

# EPA PAGs and EPZs

- EPZ size is based on doses not exceeding the U.S. Environmental Protection Agency (EPA) protective action guides (PAGs)
- 1975 EPA PAG manual did not consider planning zone size
- 1978 NUREG-0396/EPA-520 EPA & NRC task force established emergency planning zones
  - “that the objective of emergency response plans should be to provide dose savings for a spectrum of accidents that could produce offsite doses in excess of the PAGs.”
- The 1992 and 2017 revisions to the PAG manual support the EPZ –PAG and offsite EP relationship



# Commission Policy Statement on Advanced Reactors

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- “the Commission expects, as a minimum, at least the same degree of protection of the environment and public health and safety and the common defense and security that is required for current generation light-water reactors (LWRs)... the Commission expects that advanced reactors will provide **enhanced** margins of safety and/or use **simplified, inherent, passive, or other innovative means** to accomplish their safety and security functions.” (emphasis added)

# NRC Objectives for EP for SMR/ONT

- Continue to provide reasonable assurance of adequate protection
- Promote regulatory stability, predictability, and clarity
- Reduce requests for exemptions from EP requirements
- Recognize technology advancements embedded in design features
  - Incorporate lessons learned, e.g. TMI-Unit 2 accident
  - Credit safety enhancements in evolutionary and passive systems
  - Credit features of SMR/ONT design with respect to accidents:
    - slower transient response times
    - Smaller/slower release of fission products

# NRC Safety Goals

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- NRC issued the Safety Goal Policy Statement which specified two qualitative safety goals and two quantitative health objectives (QHOs) which establish goals to limit radiological risk to an acceptable level
- These safety goals apply to current fleet of reactors as well as SMRs/ONTs

# Qualitative Safety Goals

- Individual members of the public should be provided a level of protection from consequences of nuclear power plant (NPP) operations such that the individuals bear no significant additional risk to life and health
- Societal risks to life and health from NPPs should be comparable to or less than the risks of generating electricity by viable competing technologies and should not be a significant addition to other societal risks
- The next slide provides comparison of mortality for nuclear power and other electricity generating technologies

# Qualitative Safety Goals

## How safe is your kilowatt?

<b>Energy Source</b>	<b>Mortality Rate (deaths/trillionkWhr)</b>
Coal – global average	100,000 (41% global electricity)
Coal – U.S.	10,000 (32% U.S. electricity)
Oil	36,000 (33% energy, 8% electricity)
Natural Gas	4,000 (22% global electricity)
Biofuel/Biomass	24,000 (21% global energy)
Solar (rooftop)	440 (< 1% global electricity)
Wind	150 (2% global electricity)
Hydro – global average	1,400 (16% global electricity)
Hydro – U.S.	5 (6% U.S. electricity)
Nuclear – global average	90 (11% global electricity)
Nuclear – U.S.	0.1 (19% U.S. electricity)

<https://www.statista.com/statistics/494425/death-rate-worldwide-by-energy-source/>

# Quantitative Health Objectives

- The risk to an average individual in the vicinity of a nuclear power plant of prompt fatalities that might result from reactor accidents should not exceed one-tenth of one percent (0.1 percent) of the sum of prompt fatality risks resulting from other accidents to which members of the U.S. population are generally exposed
- The risk to the population in the area near a nuclear power plant of cancer fatalities that might result from nuclear power plant operation should not exceed one-tenth of one percent (0.1 percent) of the sum of cancer fatality risks resulting from other causes.

# NRC Safety Policy and Reasonable Assurance

- NRC safety policy expresses the Commission's views on the acceptable level of risks to public health and safety and on the safety-cost tradeoffs in regulatory decision making
- Reasonable assurance of adequate protection of public health and safety is defined by the totality of Commission's health and safety regulations themselves
- When applicant/licensee demonstrates compliance with NRC regulations, it follows that there is reasonable assurance of adequate protection of public health and safety
- Requiring measures to further reduce risk would constitute an undue regulatory burden

# What If ?

- Concerns that an event could happen that could lead to doses in excess of the EPA PAGs off site in a community with no formal REP
  - Any nuclear power plant with site boundary EPZ will have very low risk of offsite health impacts (acute or stochastic)
- If an accident occurs, what is needed to protect public health and safety?
  - Implementation of protective measures such as evacuation/sheltering
  - Evacuation/sheltering are not nuclear issues but occur routinely in response to “no notice” life-threatening events
- At NRC-licensed facilities with low offsite radiological hazard, risk can be addressed by all-hazards planning



# Learning from Past Disasters

- Evacuations from hazards that are immediately dangerous to life and health occur routinely and most typically without extensive preplanning;
  - World Trade Center bombings: the evacuation of lower Manhattan,
  - Freight train derailments (trains carrying hazardous materials) e.g. Mississauga, Ontario, Graniteville, SC
  - Wildfires, flooding, storms/hurricanes occur routinely in the US

# Changes

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Reactor technology is changing,  
EP is evolving,  
the NRC's mission to protect the health and  
safety of the public remains unchanged