

Generic Framework for Small Modular Reactor (SMR) Emergency Preparedness

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NUCLEAR ENERGY INSTITUTE

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Agenda

- Need for SMRs
- Why an updated Emergency Preparedness (EP) framework for SMRs is warranted
- SMR Emergency Planning Zone (EPZ)
- Process for developing an appropriate EP framework for SMRs
- Proposed path forward

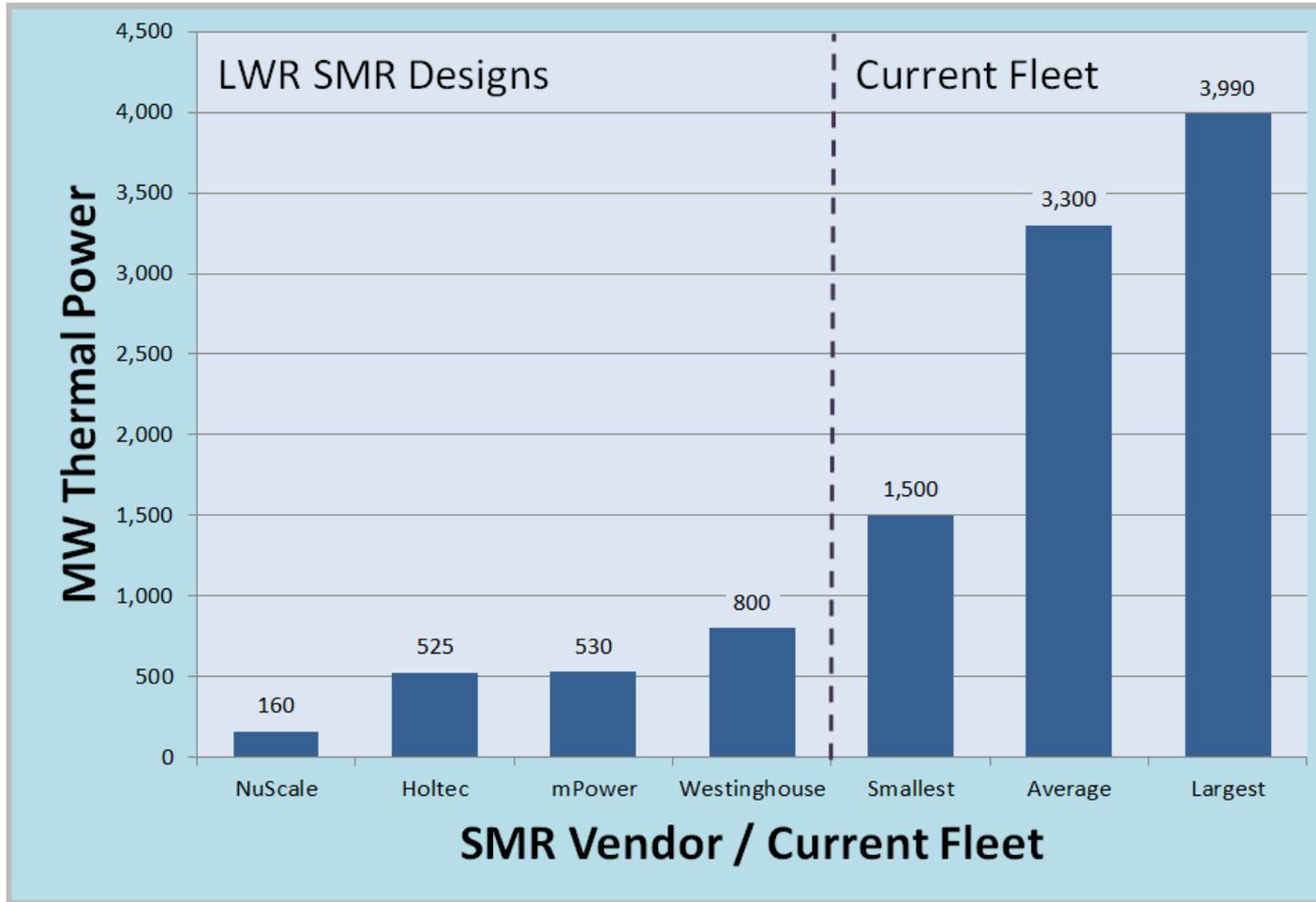
Need for SMRs

- Source of safe, reliable and carbon-free base-load electricity for domestic and foreign markets
- Replacement option for retiring coal plants, and complements natural gas plants and renewable energy sources (fuel diversity)
 - Energy Information Administration forecasts a need for 350 gigawatts of new US electric capacity by 2040 (28% growth)
- Ability to add capacity increments with demand

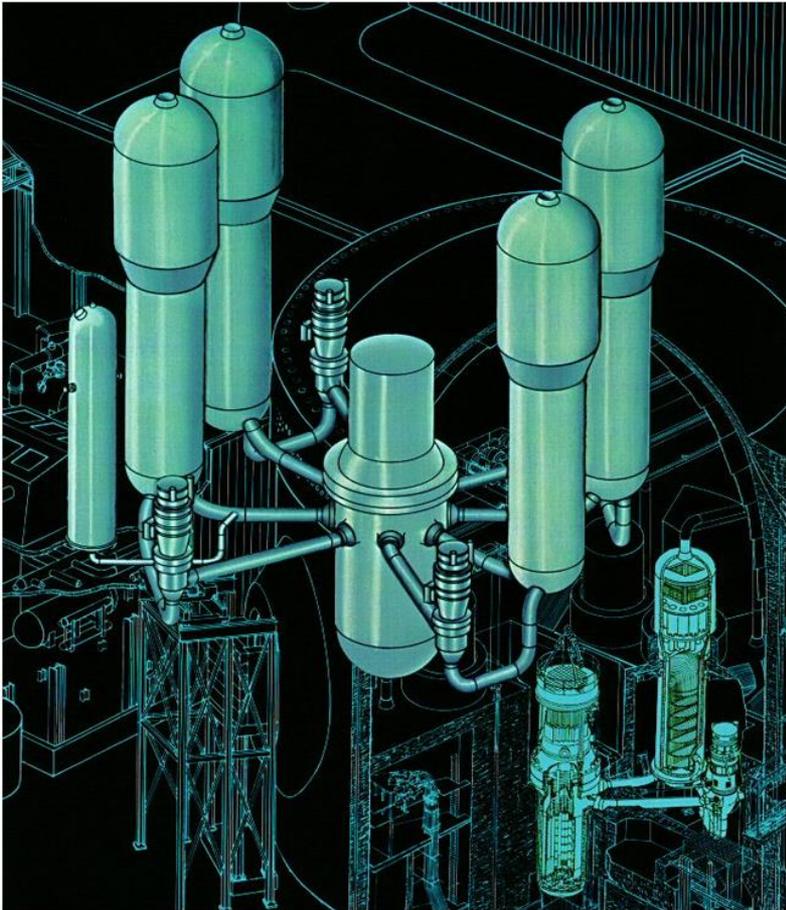
Need Updated EP Framework for SMRs (1/2)

- SMRs differ from current reactor designs
 - Smaller cores and source terms
 - Simplified integral designs (e.g., no large piping)
 - Reduction in potential accident sequences
 - Slower accident progression/longer coping times
 - Passive plant response by design
- SMR designs significantly reduce the risk of a radiological release and offsite consequences

Smaller Cores/Source Terms



Simplified Integral Designs



From this . . .

to this . . .



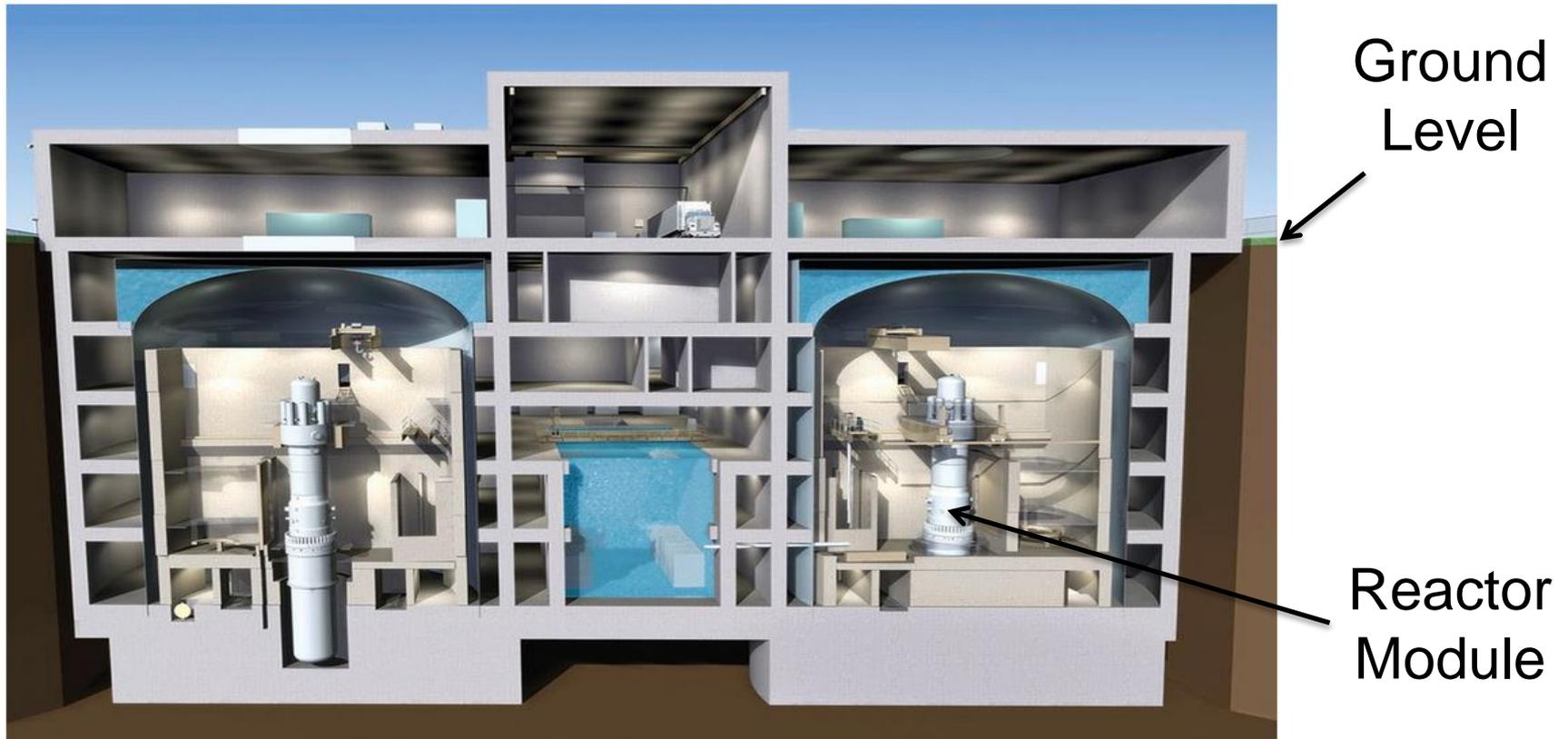
NuScale Module

Drawings not to same scale

Slow Accident Progression/Long Coping

- The **Holtec** SMR plant “is designed to remain passively cooled indefinitely, without requiring any operator activity”
- For **mPower** SMR, “No safety-related emergency AC power required” – “14-day ‘coping time’ under station blackout”
- “The **NuScale** Power Module can safely shut down and self-cool indefinitely with no AC or DC power, no additional water, and no operator action”
- **Westinghouse** SMR has “Passive safety features designed to ... keep it cool without human intervention or AC power for seven days”

And robust protection against threats



Generation mPower

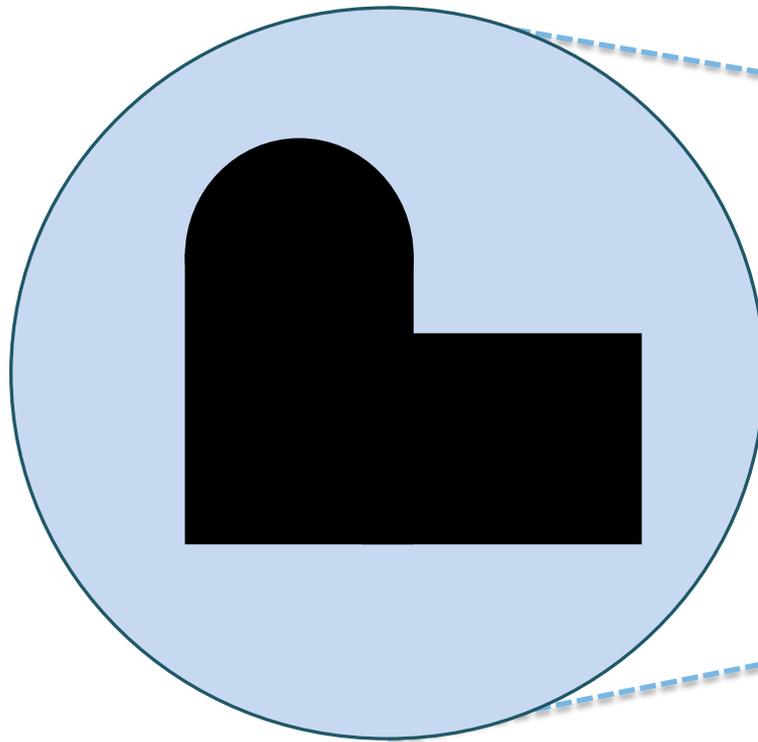
Need Updated EP Framework for SMRs (2/2)

- Portions of current EP requirements and guidance should be updated for SMRs
 - Maintain a consistent level of defense-in-depth for the protection of public health and safety
 - Appropriate allocation of resources (e.g., NRC and FEMA) commensurate with enhanced safety
- SMR EP framework should be technology-neutral, dose-based, consequence-oriented, and risk-informed

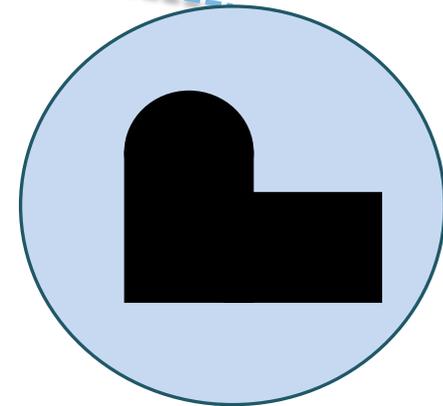
Maintain Same Level of Protection

Current U.S. Reactor Fleet

SMR Designs



Prescriptive 10-mile EPZ



Scalable EPZ Size

NRC staff considering SMR EP policy for several years

- SECY-11-0152 (Oct. 28, 2011)
 - NRC staff to develop a technology-neutral, dose-based, consequence-oriented EP framework for SMRs
 - Concluded that a dose/distance rationale based on EPA PAGs is appropriate for SMRs
- SECY-14-0095 (Aug. 28, 2014)
 - NRO ready to conduct safety and environmental reviews for all types of light-water SMRs
 - Staff preparing a notation vote paper for the Commission with SMR EP policy recommendations; paper scheduled for completion in 2015

Emergency Planning Zones

- Current requirements (reactors >250 MWt)
 - About 10 miles for plume exposure pathway (EPZ)
 - About 50 miles for ingestion exposure pathway (IPZ)
 - Exact size and configuration determined by local response needs and capabilities
- NRC precedents exist for appropriate EPZ size alternatives
 - Reactors such as La Crosse BWR, Big Rock Point and Fort Saint Vrain
 - Decommissioning reactor sites

SMR Emergency Planning Zones (1/3)

- SECY 11-0152 discusses the NRC staff's intent to develop a technology-neutral, dose-based, consequence-oriented EP framework for SMRs
 - Scalable EPZs
 - Dose limits based on EPA protective action guidelines (PAGs)
 - Apply principles of dose savings to determine EPZ size

SMR Emergency Planning Zones (2/3)

- NEI has proposed a methodology supporting a scalable EPZ determination (December 2013 White Paper)
- Dose-based acceptance criteria consistent with existing EP framework for large light-water reactors*
 - Design basis accidents: <1 Rem TEDE
 - More probable less severe accidents: <1 Rem TEDE
 - Less probable more severe accidents: <200 Rem acute dose
 - Applications will address specific implementation of dose criteria in a risk informed, defense-in-depth manner

*Acceptance criteria are derived from the technical basis for the existing 10 mile EPZ

SMR Emergency Planning Zones (3/3)

- SMR vendors will develop design-specific implementation for determining appropriately sized EPZs
- License applicants will determine appropriate EPZ size based on design and site characteristics
- Need to assess rest of existing EP framework and identify potential changes for SMRs

EP Planning Standards for SMRs

- Assess how the 16 EP planning standards from 10 CFR 50.47(b) should be implemented for SMRs
 - 1) Organization
 - 2) On-site Staffing
 - 3) Assistance Resources
 - 4) Emergency Action Level
 - 5) Procedures
 - 6) Communications
 - 7) Public Notifications
 - 8) Emergency Facilities
 - 9) Assessment and Monitoring
 - 10) Protective Actions
 - 11) Exposure Guidelines
 - 12) Medical Services
 - 13) Recovery Plans
 - 14) Periodic Exercises
 - 15) Training
 - 16) EP Plan Development

Process to Develop SMR EP Framework

- Review EP-related regulations and key guidance
 - NRC (10 CFR) and FEMA (44 CFR)
- Identify elements that should be updated to reflect enhanced safety of SMR designs
- Meet with NRC and FEMA staff to discuss proposed changes
- Determine most effective timing/mechanism(s) to implement changes (e.g., revised guidance, exemptions, rulemaking, etc.)

Example Update – 10 CFR 50.47(c)(2)

- Generally, the plume exposure pathway EPZ for nuclear power reactors shall consist of an area about 10 miles (16 km) in radius and the ingestion pathway EPZ shall consist of an area about 50 miles (80 km) in radius. The exact size and configuration of the EPZs surrounding a particular nuclear power reactor shall be determined in relation to local emergency response needs and capabilities as they are affected by such conditions as demography, topography, land characteristics, access routes, and jurisdictional boundaries. The size of the EPZs also may be determined on a case-by-case basis for gas-cooled nuclear reactors, small modular light water reactors with an authorized power level less than 900 MW thermal and other reactors with an authorized power level less than 250 MW thermal. The plans for the ingestion pathway shall focus on such actions as are appropriate to protect the food ingestion pathway.

Example Update – 44 CFR 350.9(c)(3)

- Each appropriate local government which has a site within its boundaries or is within the 10-mile plume exposure pathway emergency planning zone shall fully participate in a joint exercise with the licensee and the State at least every two years. For those local governments that have planning and preparedness responsibilities for more than one facility, the Regional Director may seek an exemption from this requirement by recommending alternative arrangements for approval by the Associate Director.

Example Update – PAR Guidance

- Assess compatibility of a scalable EPZ approach with existing PAR implementing guidance (i.e., NUREG-0654, Sup 3)
 - Rapidly progressing severe accident
 - Decision criteria beyond a site's EPZ boundary
 - Expected coordination with offsite area actions implemented through an “all hazards” plan

SMR EAL Guidance

- Prepare a “first draft” of an SMR EAL guidance document (similar to NEI 99-01/NEI 07-01)
 - Include material that could be generically applicable to all SMR designs (e.g., front-end material, and Category A, E and H EALs)
 - Identify vendor/design-specific information needed to complete the document (e.g., design-specific accident analysis information) - this would primarily address Category C, F and S EALs
 - Begin public meeting engagement with staff

SMR EAL Guidance

- Add to document as design information becomes available from SMR vendors
 - Continue public meeting engagement with staff
- Submit initial/updated guidance around time of each design certification submittal
 - E.g., Rev. 0 would have all EAL information for NuScale; Rev. 1 adds mPower, Rev. 2 adds Westinghouse and Rev. 3 adds Holtec

Emergency Response Staffing

- Emergency Response Organization (ERO) staffing
 - On-shift and augmented
 - Necessary functions
 - Timing requirements

Proposed Path Forward

NEI Work Products	2015				2016			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
EP Framework								
• Develop/Provide White Paper	***							
• Staff Engagement		***	***					
• Revise/Finalize White Paper			***					
PAR Guidance								
• Assess Current Guidance	***							
• Staff Engagement		***	***					
• Provide Recommended Changes			***					
Emergency Action Levels								
• Develop First Draft			***					
• Staff Engagement			***	***	***	***	***	***
• Add Design-Specific EALs					***	***	***	***
ERO Staffing Guidance								
• Develop Proposal					***			
• Staff Engagement						***	***	***
• Provide Recommended Changes								***
TVA ESP Submittal Timeframe								
NuScale DCA Timeframe								

NEI Project Managers

- Marcus Nichol
 - Overall SMR Lead
 - Scalable EPZ Methodology
- David Young
 - SMR EP Framework
 - Proposed EP Regulation/Guidance Changes
 - EALs, PARs, ERO Staffing, etc.

Summary

- There is a need and solid technical basis for an alternative EP framework for SMRs
- NEI plans to submit a white paper in 1Q15
 - Identify current EP framework elements that should be updated for SMRs along with proposed changes
- Need for continued NRC engagement
 - Timely feedback to inform applicant submittals
 - Defining path forward for implementing EP framework updates for SMRs

Acronyms

CEMP = Comprehensive Emergency Management Plan

CFR = Code of Federal Regulations

EAL = Emergency Action Levels

EP = Emergency Preparedness

EPZ = Emergency Planning Zone

ERO = Emergency Response Organization

FEMA = Federal Emergency Management Agency

IPZ = Ingestion Pathway Zone

NEI = Nuclear Energy Institute

NRC = Nuclear Regulatory Commission

ORO = Offsite Response Organizations

PAG = Protective Action Guidelines

PAR = Protective Action Recommendations

SMR = Small Modular Reactor

TEDE = Total Effective Dose Equivalent