

Technical Session W14—Innovation in New Light-Water-Reactor Reviews
“Evaluation of Emergency Preparedness
Requirements for Small Modular Reactors:
Clinch River Early Site Permit Application”

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Regulatory Requirements

- Current emergency preparedness (EP) regulations are based on the accidents and associated source terms for large light-water reactors:
 - NUREG-0396, “Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light Water Nuclear Power Plants,” issued December 1978
- Title 10 of the *Code of Federal Regulations* (10 CFR) 50.33(g) and 50.47(c): Establish requirement for plume exposure pathway and ingestion pathway emergency planning zones (EPZs) consisting of an area about 10 miles and 50 miles in radius, respectively
- 10 CFR 50.47(b): Establish requirement for onsite and offsite emergency response plans, which must meet specified planning standards

Evaluation Against Existing Regulations

Challenge:

- How to evaluate emergency plan requirements, based on a proposed small modular reactor (SMR) design, as part of the Clinch River early site permit (ESP) application (ESPA)?

Issues:

- No existing U.S. Nuclear Regulatory Commission (NRC)-approved SMR design certification
- Existing EP regulations do not consider safety advancements based on SMR design and reduced source term relative to existing large light-water reactors

What Is an Early Site Permit? (1/2)

- An NRC document that states the reviewed site is suitable for construction and operation of a nuclear power plant with specified design parameters
- An ESP does not allow construction or operation of a nuclear power reactor
- Can be referenced by a future combined license (COL) application (COLA)
- Issues resolved in an ESP need not be addressed again at the COL stage provided that chosen reactor design falls within what was analyzed at the ESP stage
- May contain specific permit conditions and COL action items, to be addressed at the COLA stage

What Is an Early Site Permit? (2/2)

- An ESPA must identify physical characteristics of the proposed site, such as egress limitations from the area surrounding the site, that could pose a significant impediment to the development of emergency plans [10 CFR 52.17(b)(1)]
- The ESPA may propose either major features of the emergency plans or complete and integrated emergency plans, in accordance with the pertinent standards of 10 CFR 50.47 and the requirements of Appendix E to 10 CFR Part 50

Plant Parameter Envelope (PPE) Concept

As part of the Clinch River nuclear site ESPA, Tennessee Valley Authority (TVA) is proposing:

1. Plant parameter envelope developed considering the following proposed reactor designs:
 - BWXT mPower SMR: 530 megawatts thermal (MWt) / 180 megawatts electric (MWe)
 - NuScale SMR: 160 MWt / 50 MWe
 - Holtec SMR-160: 525 MWt / 160 MWe
 - Westinghouse SMR: 800 MWt / 225 MWe

Based on construction and operation of two or more SMRs with a maximum nuclear generating capacity of 2,420 MWt (800 MWe)

Proposed EPZ Sizing Methodology

As part of the Clinch River nuclear site ESPA, TVA is proposing: (Cont'd)

2. Plume exposure pathway (PEP) EPZ sizing methodology (consistent with NUREG-0396 sizing rationale):
 - PEP EPZ should encompass those areas in which projected dose from design-basis accidents could exceed the U.S. Environmental Protection Agency (EPA) early phase protective action guide (PAG)
 - PEP EPZ should encompass those areas in which the consequences of less severe core melt accidents could exceed the EPA early phase PAG
 - PEP EPZ should be of sufficient size to provide for substantial reduction in early health effects in the event of more severe core melt accidents

Proposed Exemption Requests

As part of the Clinch River nuclear site ESPA, TVA is proposing: (Cont'd)

3. Two sets of exemption requests:

- Supporting a site boundary PEP EPZ and a 2-mile PEP EPZ
- 10 CFR 50.33(g) and 10 CFR 50.47(c)
 - Two requests for exemption from the 10-mile PEP EPZ requirement (both requests)
- 10 CFR 50.47 and Appendix E to 10 CFR Part 50
 - Twenty-three requests for exemption from requirements associated with offsite emergency planning (site boundary PEP EPZ only)

Proposed Major Features Plans

As part of the Clinch River nuclear site ESPA, TVA is proposing: (Cont'd)

4. Two major features emergency plans:

- Proposed 2-mile PEP EPZ scope:
 - Exemptions: 10 CFR 50.33(g) and 10 CFR 50.47(c)(2) for a 10-mile PEP EPZ
 - Onsite and offsite radiological emergency preparedness (REP) plans still required
 - Federal Emergency Management Agency (FEMA) consultation/review on offsite REP plans
- Proposed site boundary PEP EPZ scope:
 - Exemptions: 10 CFR 50.33(g), 10 CFR 50.47(c)(2), and some of 10 CFR 50.47(b) and Appendix E
 - Only onsite emergency plan required
 - Offsite support via State/local comprehensive emergency management plan (i.e., “all-hazard” concept)
 - Limited FEMA consultation/review (offsite contacts and arrangements)

Approval Acquired at ESP Phase

Upon issuance of the ESP, the applicant acquires approval, with conditions to be demonstrated at the COLA phase, for the following:

- PEP sizing methodology
- Two major features emergency plans (site boundary and 2-mile PEP EPZs)
- 25 requested exemptions

COLA Phase

- A COLA that incorporates the ESP by reference MUST:
 1. Apply the SMR sizing methodology to the chosen SMR technology to demonstrate whether the site boundary or 2-mile PEP EPZ is supported
 2. Provide a complete and integrated emergency plan:
 - Onsite emergency plan only for site boundary PEP EPZ
 - Both onsite and offsite emergency plans for 2-mile PEP EPZ
 3. Address all COL action items and permit conditions
- If sizing methodology does not support a site boundary of 2-mile PEP EPZ, then applicant would either retain 10-mile PEP EPZ or justify PEP EPZ >2 miles but <10 miles

Summary

- Establishes a methodology under the exemption request process, which aligns EP requirements that considers safety advancements and reduced source term based on a proposed SMR design
- NRC staff's evaluation of EP exemptions for the TVA Clinch River nuclear site ESPA is consistent with the draft proposed rule for SMRs/other new technologies (ONTs)
 - Staff provided the draft rule to the Commission on October 12, 2018, and made it public on October 31, 2018 (ADAMS Package Accession No. ML18134A086)

Acronyms

10 CFR	Title 10 of the <i>Code of Federal Regulations</i>	MWe	Megawatts Electric
BWXT	BWX Technologies	MWt	Megawatts Thermal
COL	Combined License	NRC	U.S. Nuclear Regulatory Commission
COLA	Combined License Application	ONTs	Other New Technologies
EP	Emergency Preparedness	PAG	Protective Action Guide
EPA	U.S. Environmental Protection Agency	PEP	Plume Exposure Pathway
EPZ	Emergency Planning Zone	PPE	Plant Parameter Envelope
ESP	Early Site Permit	REP	Radiological Emergency Preparedness
ESPA	Early Site Permit Application	SMR	Small Modular Reactor
FEMA	Federal Emergency Management Agency	TVA	Tennessee Valley Authority