Clinch River
Early Site Permit
Part 2,SSAR Section 13.3, Part 5, & Part 6

Advisory Committee on Reactor Safeguards
Committee Meeting

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Acknowledgement and Disclaimer

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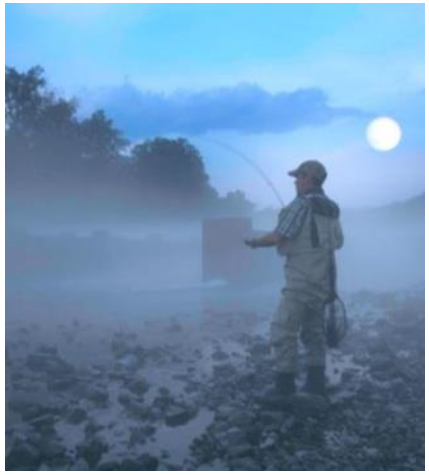
TVA's Mission

Serving the people of the Tennessee Valley to make life better.

Energy

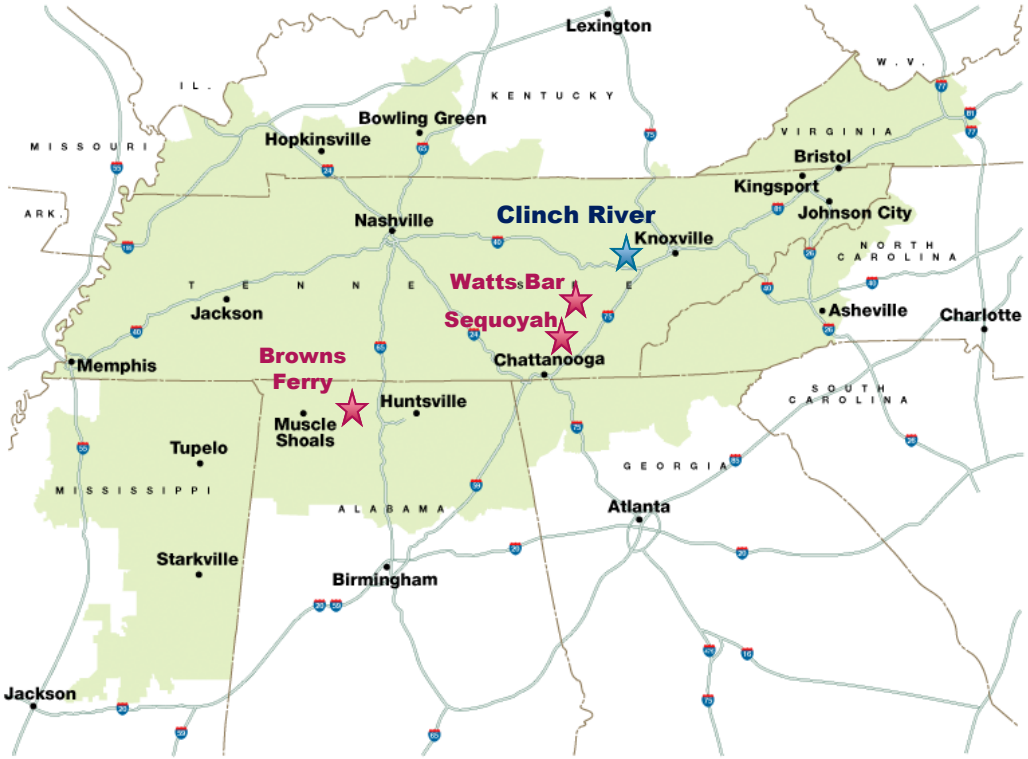


Environment

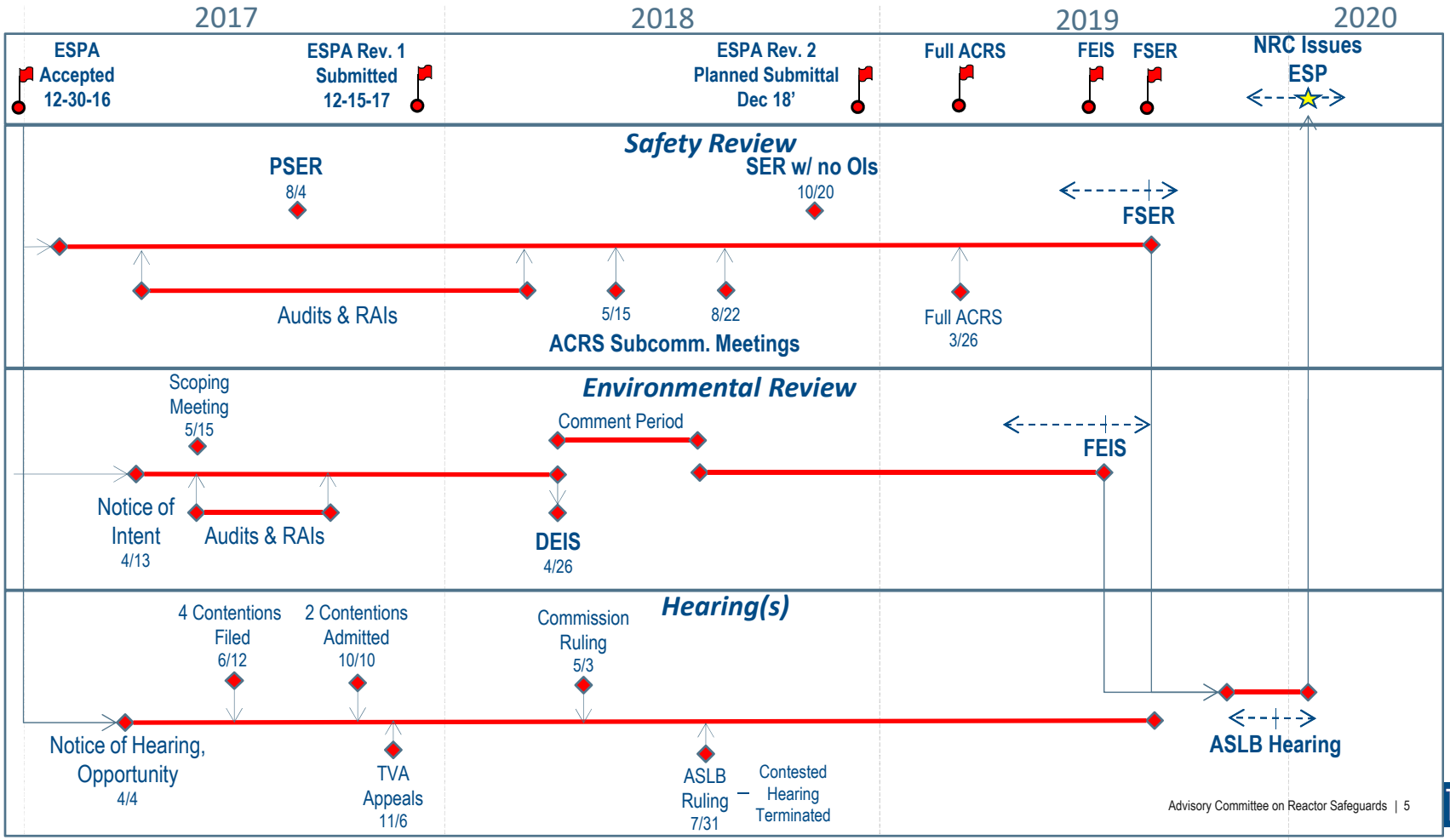
Economic Development

Partner with **154** local power companies, to serve more than **9 million** customers in parts of **seven states**. Directly serve **54** large industries and federal installations.

TVA's Nuclear Fleet



NRC Review of ESPA



ESPA – Emergency Preparedness Development

The ESPA considered information from four light water small modular reactor (SMR) designs:

- NuScale (160 megawatts thermal (MWt), 50 megawatts electrical (MWe))
- SMR-160 Holtec (525 MWt, 160 MWe)
- mPower (530 MWt, 180 MWe)
- Westinghouse (800 MWt, 225 MWe)

Combined nuclear generating capacity for the Clinch River Site not to exceed 2420 MWt (800 MWe)

Need for Scalable Emergency Planning Zone (EPZ):

- NUREG-0396 introduced the concept of a 10-mile EPZ 40 years ago
- NUREG-0396 considered large light water reactors (LWRs)

Based on SMR design information:

- TVA developed a dose-based, consequence-oriented approach to determine an appropriate EPZ size for a SMR
  - approach has the same dose criteria as NUREG-0396
  - takes into consideration SMR design and safety advancements
- Two emergency plans were proposed and developed
  - all four designs are expected to be able to meet the dose criteria for 2-mile EPZ
  - at least one design is expected to be able to meet the does criteria for Site Boundary EPZ
- Exemption requests that allow for review of major features of emergency plans other than 10-mile EPZ

Presentation Outline

Part 2, Site Safety Analysis Report (SSAR), Section 13.3, Emergency Preparedness:

- 13.3.1 Physical Characteristics
- 13.3.2 Emergency Plan (Refers to Part 5 of the ESPA)
- 13.3.3 Emergency Planning Zones
- 13.3.4 Evacuation Time Estimates (Supports Part 5B)
- 13.3.5 Contacts and Agreements

Part 5, Emergency Plan:

- Part 5A Emergency Plan Site Boundary EPZ
- Part 5B Emergency Plan 2-Mile EPZ

Part 6, Exemptions and Departures

- Exemption Requests for a Plume Exposure Pathway (PEP) EPZ at Site Boundary
- Exemption Requests for an approximate 2-mile PEP EPZ

Key NRC Interactions Related to Emergency Preparedness

Two audits were conducted to review the emergency preparedness information in the ESPA

- First audit – November 2017 through February 2018
  - Example analysis completed by TVA to demonstrate feasibility that dose criteria can be met at Clinch River Site Boundary (RAI-8885)
- Second audit – April 2018
  - EPZ Plant Parameter Approach (RAI-9206)

Requests for Additional Information (RAIs)

- RAI-8885 – demonstrate that dose criteria can be met at Site Boundary EPZ
- RAI-9206 – discuss how EPZ methodology was implemented in the example analysis and the EPZ plant parameter approach developed

Part 2, SSAR,
Chapter 13 – Section 13.3
Emergency Preparedness

Section 13.3.1 – Physical Characteristics

Site Description

DOE Oak Ridge Reservation borders the North-East sides

6.8 miles East of Kingston, TN

8.8 miles Northwest of Lenoir City, TN

9.2 miles East-Southeast of Harriman, TN (not shown)

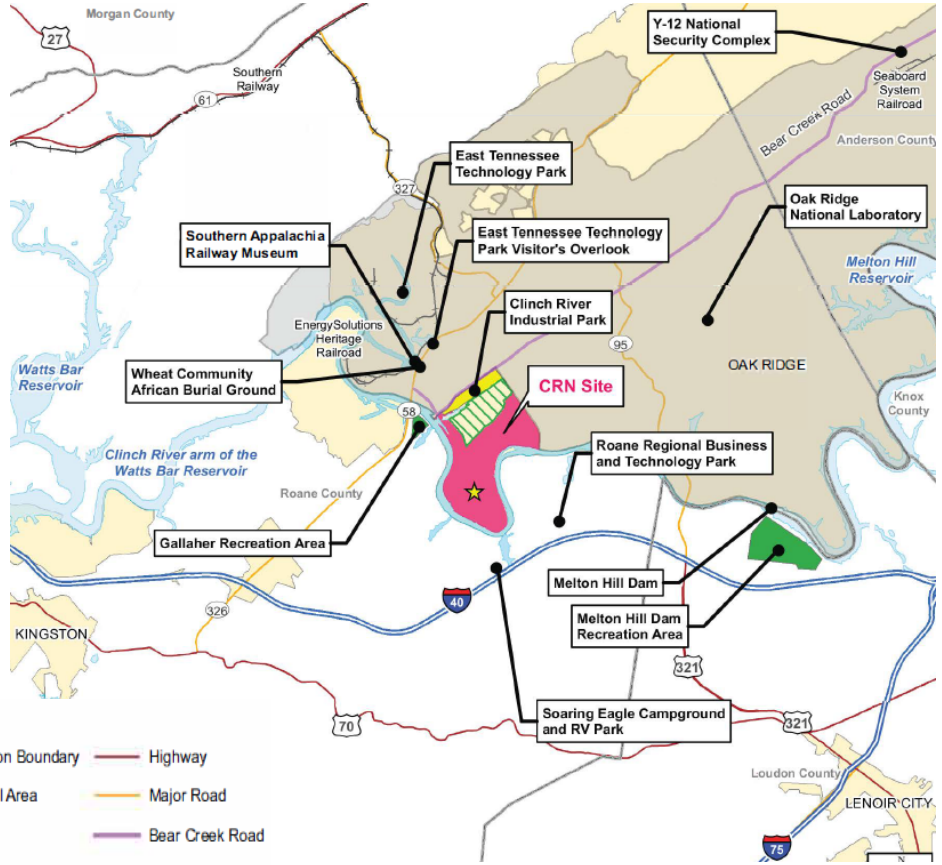
25.6 miles West-Southwest of Knoxville, TN (not shown)

Area Population

U.S. Census 2010 data projected to 2015

856 permanent residents within 2-mile PEP EPZ

186,500 permanent residents within 15 miles



Section 13.3.3 – Emergency Planning Zones

The methodology uses a dose-based, consequence-oriented approach for determining the appropriate size of the PEP EPZ consistent with the NUREG-0396 approach with a dose criteria of the Environmental Protection Agency (EPA) early phase Protective Action Guides (PAGs).

The methodology is consistent with the NUREG-0396 approach:

- a spectrum of accidents are addressed
- Dose criteria is the same
- **PEP EPZ boundary ensures protection from dose levels above 1 rem total effective dose equivalent (TEDE) limit established in the EPA PAG**

Four light water SMR designs were considered which significantly differ from the large LWRs:

- smaller cores
- lower source terms
- reduced accident consequences
- reduced likelihood of accidents
- slower accident progression allows more time for mitigating actions

Section 13.3.3 – Emergency Planning Zones

Technical criteria for determining the PEP EPZ size uses the existing emergency preparedness regulatory framework and dose saving criteria established in NUREG-0396

- Consistent with the NUREG-0396 sizing rationale, the technical criteria for determining the PEP EPZ size:
  - A. Encompass those areas in which projected dose from design basis accidents (DBAs) could exceed the EPA early phase PAGs.
  - B. Encompass those areas in which consequences of less severe core melt accidents could exceed the EPA early phase PAGs.
  - C. Be of sufficient size to provide for substantial reduction in early severe health effects in the event of more severe core melt accidents.

Section 13.3.3 – Emergency Planning Zones

Criteria A and B: PEP EPZ encompasses those areas in which the plume exposure doses from DBAs and less severe core melt accidents could exceed the EPA early phase PAG

- Areas outside the PEP EPZ would meet the EPA early phase PAG dose limit of less than 1 rem TEDE.
- The methodology for verifying dose consequences beyond the PEP EPZ do not exceed the EPA early phase PAG levels includes:
  - Step 1 - Selecting appropriate accident scenarios *(accident scenarios with mean core damage frequency (CDF) greater than 1E-6 per reactor-year (rx-yr))*
  - Step 2 - Determining source terms for selected accident scenarios
  - Step 3 - Calculating the dose consequences for selected accident scenarios
  - Step 4 - Comparing the dose consequences for selected accident scenarios with the EPA early phase PAG

Section 13.3.3 – Emergency Planning Zones

Criteria C: PEP EPZ be of sufficient size to provide for substantial reduction in early severe health effects in the event of more severe core melt accidents

Methodology for verifying that areas outside the PEP EPZ meet the limits for substantial reduction in early health effects:

- Step 1 - Selecting appropriate accident scenarios *(accident scenarios with mean CDF greater than 1E-7 per rx-yr)*
- Step 2 - Determine source terms for selected accident scenarios
- Step 3 - Calculate the dose consequences for selected accident scenarios at the PEP EPZ boundary
- Step 4 - Calculate the distance at which the conditional probability to exceed 200 rem (whole body) exceeds 1E-3 per rx-yr
- Step 5 - Compare that distance with the PEP EPZ

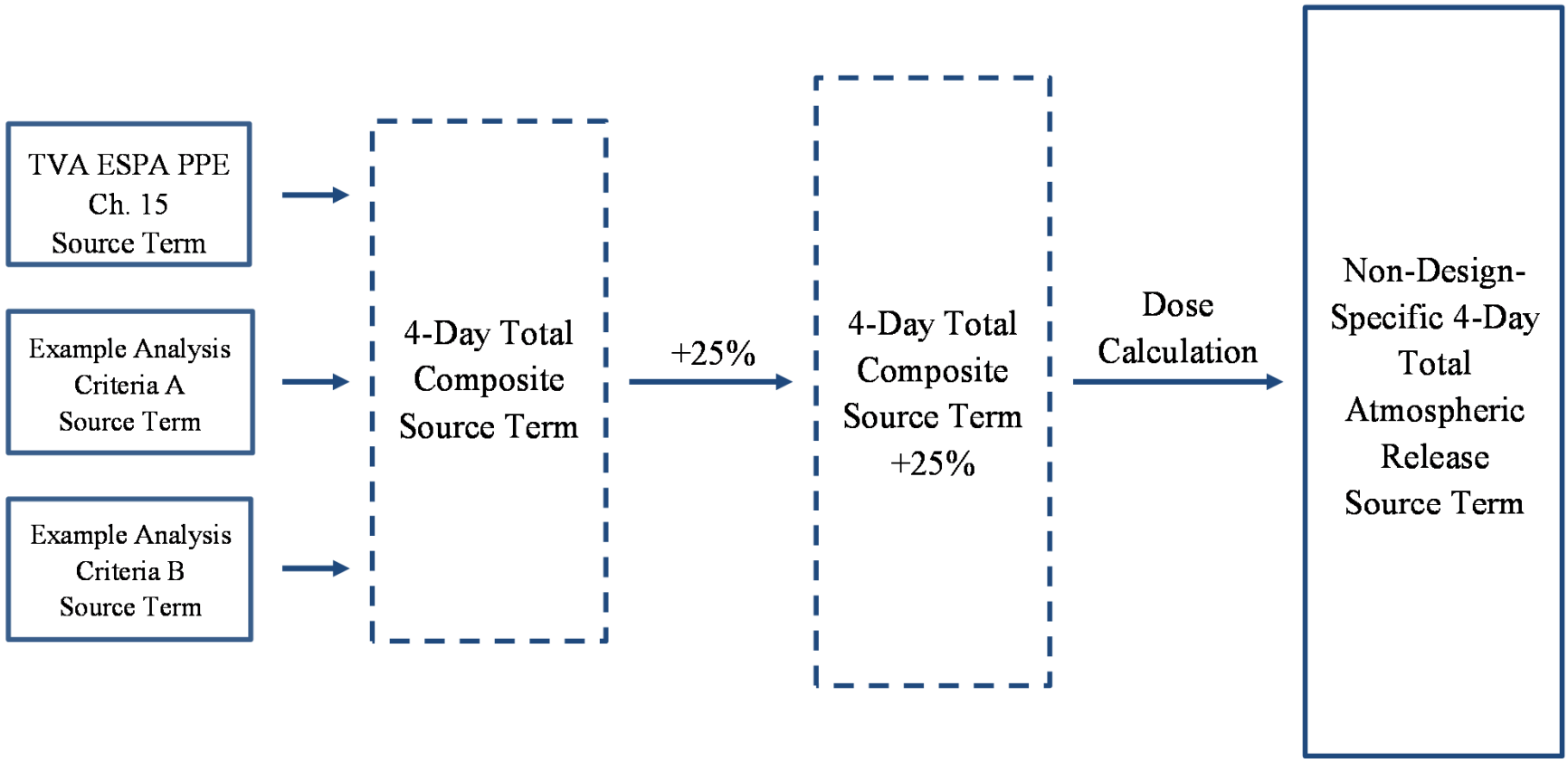
Design Specific Example Analysis – Site Boundary PEP EPZ

- Evaluates NuScale Power Plant at the Clinch River Site
- Implements the dose-based methodology described in SSAR Section 13.3
- Demonstrates that Site Boundary EPZ is possible
- Doses at Site Boundary are much less than the EPA early phase PAG

Criteria	Site Boundary Dose TEDE (rem)	EPA Early Phase PAG Limit TEDE (rem)
A: Design Basis Accidents	**0.104**	1
B: Less Severe Core Melt Accidents	**0.158**	1

C: Reduction in Early Severe Health Effects	No accident scenarios with mean CDF greater than 1E-7 per rx-yr.

EPZ Plant Parameter Approach



Section 13.3.5 – Contacts and Agreements

Letters of Support

- Letters of support from the State of Tennessee, Anderson County, Roane County, and the City of Oak Ridge were submitted in support of the ESPA.
- 10 CFR 52.17(b)(4) requires that the applicant make good-faith efforts to obtain certifications from local, State, and Federal governmental agencies with EP responsibilities.

Letters of Agreements and Certification Letters

- Certification letters and letters of agreements will be pursued during the combined license application (COLA) process.
- TVA will maintain agreements with surrounding emergency response organizations.
- **TVA would continue to work with State and local support organizations to establish an emergency preparedness at Clinch River commensurate with the potential consequences to public health and safety**

Part 5 – Emergency Plan

Part 5 – Emergency Plan

Part 5 of the ESPA contains the major features of two distinct Emergency Plans for Clinch River Site in accordance with 10 CFR 52.17(b)(2)(i).

Part 5A

- Describes major features of an Emergency Plan for a PEP EPZ consisting of the area encompassed by the Site Boundary.

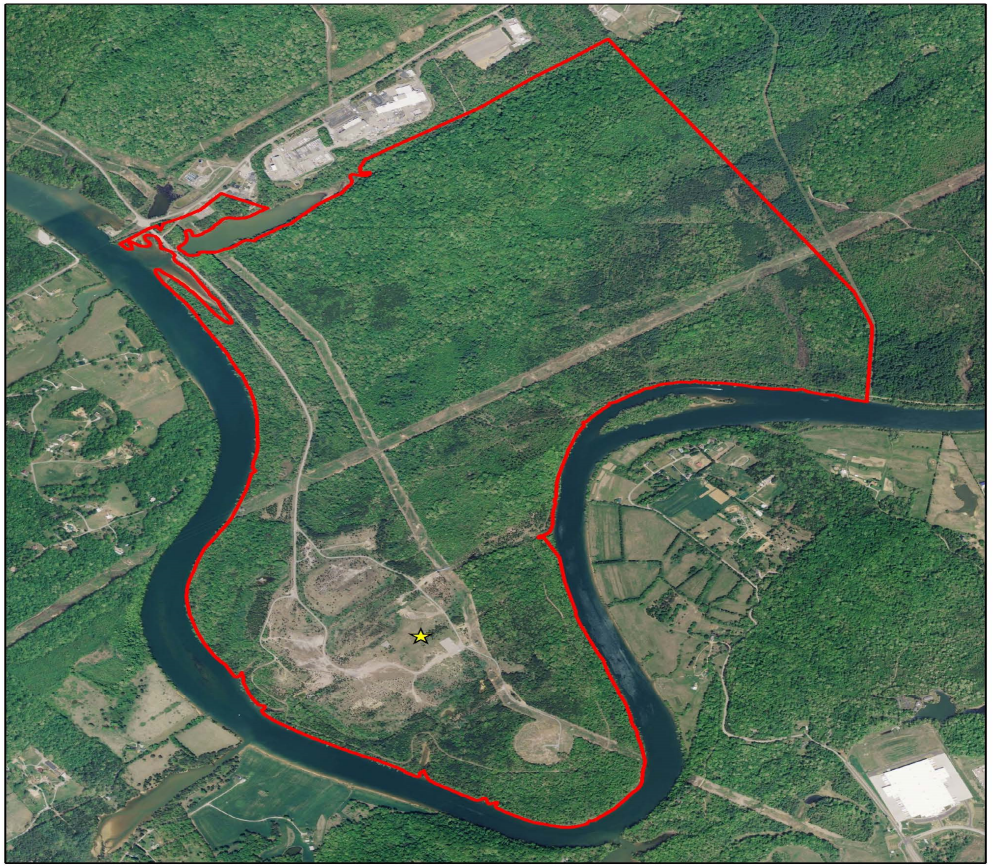
Part 5B

- Describes major features of an Emergency Plan for a PEP EPZ consisting of an area approximately two miles in radius surrounding the Clinch River Site.

Both plans address the 16 planning standards in NUREG–0654, Section II, which reflects the requirements in 10 CFR 50.47(b)(1) through 10 CFR 50.47(b)(16) and Appendix E to 10 CFR Part 50 considering the requested exemptions described in Part 6 of the ESPA

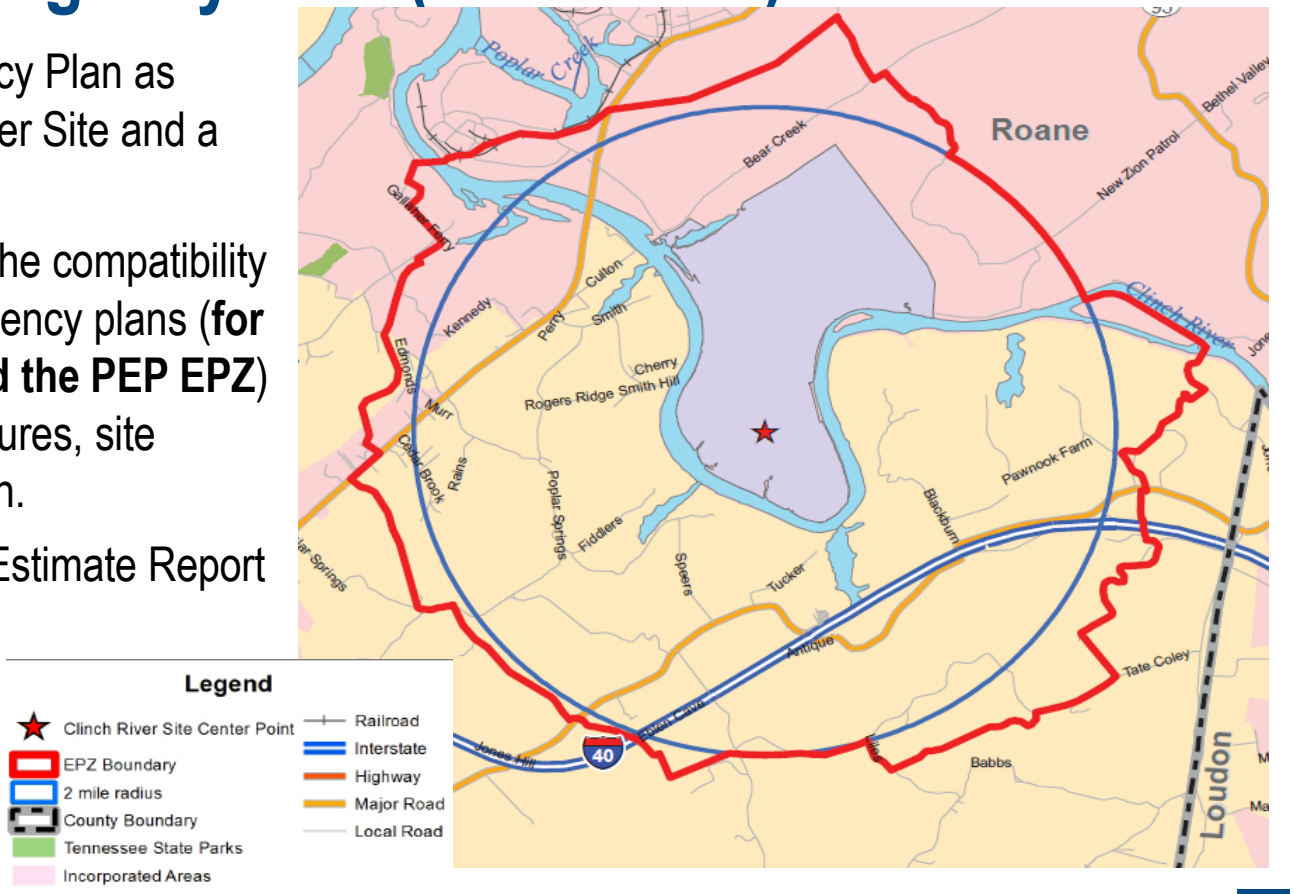
Part 5A – Emergency Plan (Site Boundary EPZ)

- TVA Generic Emergency Plan as modified for Clinch River Site and an appendix with Site-Specific information
- Actions necessary to safeguard onsite personnel (within the site boundary) and minimize damage to property
- Information to ensure the compatibility of the proposed emergency plans (**for onsite areas**) with facility design features, site layout, and site location



Part 5B – Emergency Plan (2-Mile EPZ)

- TVA Generic Emergency Plan as modified for Clinch River Site and a Site-specific appendix
- Information to ensure the compatibility of the proposed emergency plans (**for both onsite areas and the PEP EPZ**) with facility design features, site layout, and site location.
- Site Evacuation Time Estimate Report



Part 5B – Evacuation Time Estimate

- Analysis of evacuation times is one method to identify any significant impediments to the development of emergency plans at the Site
- Provides TVA, State and local governments with site-specific information needed for protective action decision making
- Evacuation Time Estimates (ETE) analyses for Clinch River Site were completed in accordance with the guidance provided in NUREG/CR-7002, Criteria for Development of Evacuation Time Estimate Studies
- These analyses did not identify any physical characteristics unique to the Clinch River Site that could pose a significant impediment to the development of emergency plans

Part 6 – Exemptions and Departures

Part 6 – Exemptions and Departures

Pursuant to 10 CFR 52.7, Specific Exemptions, which is governed by 10 CFR 50.12, Specific Exemptions, TVA requested exemptions from the following emergency preparedness requirements for the Clinch River Site:

- Certain standards in 10 CFR 50.47(b) regarding onsite and offsite emergency response plans for nuclear power reactors
- Certain requirements of 10 CFR 50.33(g) and 10 CFR 50.47(c)(2) to establish PEP EPZ for nuclear power plants
- Certain requirements of 10 CFR Part 50, Appendix E, which establish the elements that make up the content of emergency plans

Two Sets of Exemptions

Based on the dose-based EPZ methodology described in Section 13.3 and taking light water SMR designs into consideration, two sets of exemptions were developed:

- Exemptions for a PEP EPZ established at the Site Boundary (Part 5A)
- Exemptions for an approximate 2-mile PEP EPZ (Part 5B)

Part 6 – Exemptions and Departures

Requested exemptions – Table 1-1 Exemptions Requested from 10 CFR 50.33(g), 50.47(b), and 50.47 (c)(2) for the **Site Boundary PEP EPZ Emergency Plan**

Regulation	Requirement	Exemption Request
10 CFR 50.33(g) 10 CFR 50.47(c)(2)	10 mile PEP EPZ distance	Deviate from 10 mile PEP EPZ
10 CFR 50.47(b), b(4), b(5), b(6), b(9), b(10)	Various elements of a formal offsite emergency plan	Deviate from formal offsite radiological emergency plan requirements on the basis that there are no offsite radiological consequences from any credible event in excess of the criteria described in Section 13.3. **Note:** TVA's emergency plan will describe the capabilities to determine if a radiological release is occurring and promptly communicate that information to the offsite response organizations for their consideration.

Part 6 – Exemptions and Departures

Requested Exemptions – Table 1-2 Exemptions Requested from 10 CFR 50, Appendix E for the **Site Boundary PEP EPZ Emergency Plan**

Regulation	Requirement	Exemption Request
10 CFR 50, Appendix E, Section IV.2 – IV.7	Evacuation time estimates (ETEs)	Deviate from ETE requirements as no offsite consequences from any credible event in excess of the criteria provided in Section 13.3, formal offsite radiological emergency response plans with preplanned evacuation details are not necessary. Therefore, there is no need for ETEs.
10 CFR 50, Appendix E, Section IV.D.1, D.3, D. 4	Certain elements of offsite notifications	Deviate from certain offsite notification requirements as members of public would not be within the Site Boundary PEP EPZ. (**Note**: TVA is not seeking an exemption from the requirement to notify responsible State and local government agencies within 15 minutes after declaring an emergency.)
10 CFR 50, Appendix E, Section IV.F.2, F.2.a, F. 2.a.(i) – 2.a.(iii), F.2.b, F.2.c, F.2.d	Certain elements of offsite exercises	Deviate from certain offsite exercise requirements as no formal offsite radiological emergency response plans would be needed as no offsite consequences from any credible event in excess of the criteria provided in Section 13.3. (**Note**: TVA would continue to invite State and local support organizations to participate in the periodic drills and exercises conducted.)

Part 6 – Exemptions and Departures

Requested Exemptions – Table 1-3 Exemptions Requested from 10 CFR 50.33(g) and 50.47(c)(2) for the **2-Mile PEP EPZ Emergency Plan**

Regulation	Requirement	Exemption Request
10 CFR 50.33(g) 10 CFR 50.47(c)(2)	10 mile PEP EPZ distance	Deviate from 10 mile PEP EPZ

Part 6 – Exemptions and Departures

Technical Justification

- The criteria established in the methodology described in Section 13.3, provides for adequate protection of public health and safety by providing a EPZ that encompasses the areas in which the plume exposure doses could exceed the EPA early phase PAG, and for where there is a substantial reduction in risk of significant early health effects.

Special Circumstances Exist – Underlying Purpose of the Regulations Being Met

- Exemptions are Authorized by Law
- Exemptions Will not Present Undue Risk to Public Health And Safety
- Exemptions Are Consistent with the Common Defense and Security

Summary

	ESPA	COLA
PEP EPZ Methodology (Part 2, SSAR, Section 13.3)	Approval of the dose-based, consequence oriented methodology for determining the PEP EPZ size	Approval of design specific implementation of the methodology approved in the ESPA
EPZ Size (Part 6)	Approval to deviate from the current 10-mile PEP EPZ requirements based on the methodology to determine PEP EPZ size	Approval of design specific PEP EPZ size based on design specific implementation of the methodology
Emergency Plan (Part 5)	Approval of the major features of the Site Boundary and 2-mile emergency plans presented in Part 5	Approval of the remaining elements of either the Site Boundary or 2-mile emergency plans OR a new plan based on design specific PEP EPZ size using methodology