



TVA Clinch River SMR Project Early Site Permit Application

December 6th, 2018

Advisory Committee on Reactor Safeguards
Full Committee Meeting

Acknowledgement and Disclaimer

Acknowledgment: "This material is based upon work supported by the Department of Energy under Award Number DE-NE0008336."

Disclaimer: "This presentation was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof."

Presentation Outline

- Clinch River Nuclear Site – Overview
 - Dan Stout
- Early Site Permit Application – Overview
 - Ray Schiele
- Emergency Preparedness
 - Archie Manoharan

Clinch River Nuclear Site - Overview

Dan Stout

Director, Nuclear Technology & Innovation

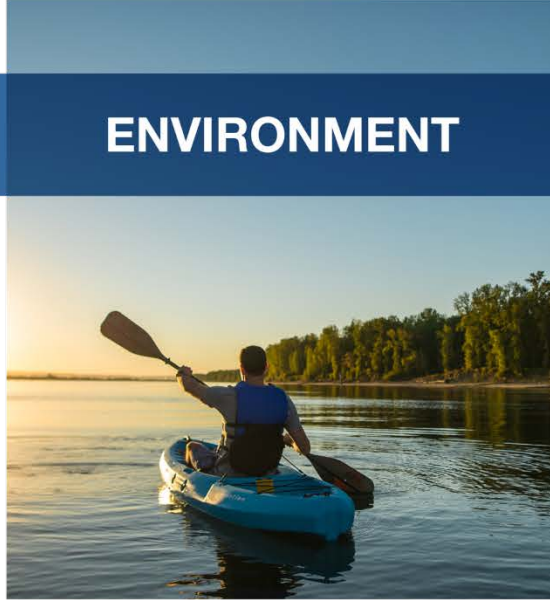
TVA's Mission

ENERGY



Provide *affordable, reliable* power.

ENVIRONMENT



Steward the Valley's *natural resources*.

ECONOMIC DEVELOPMENT



Partner for *economic growth*.

TVA Clinch River Site Site



- Access to 500 KV and 161 KV transmission
- Neighbor to DOE, an interested customer
- Basic Infrastructure
- Abundant and skilled workforce
- Strong community support
- TVA owned/controlled

Early Site Permit Application (ESPA)

An Early Site Permit assesses site suitability for potential construction and operation of a nuclear power plant.

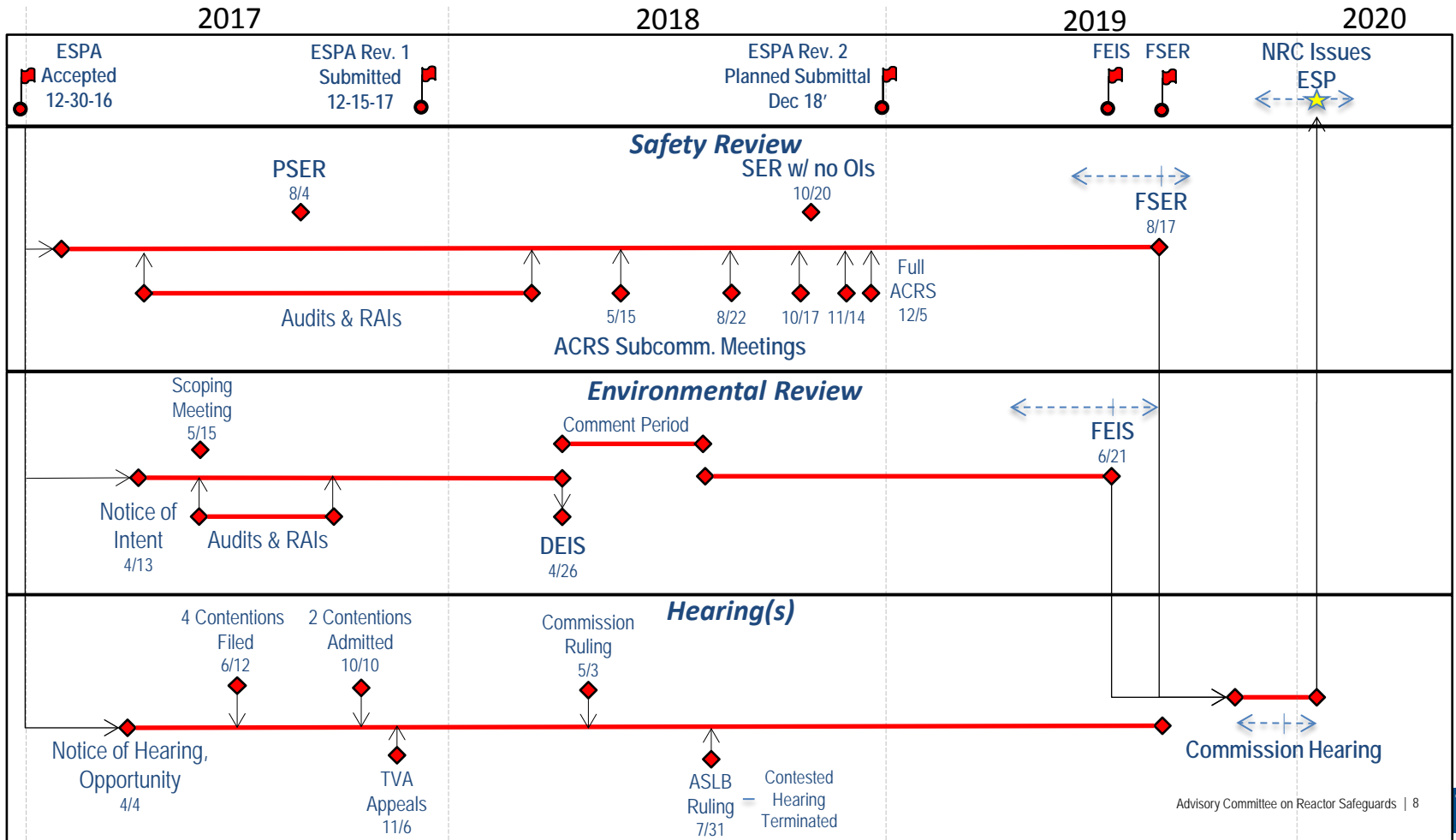
Application includes:

- Site Safety Analysis Report to address impacts of the environment on the plant
- Environmental Report
- Emergency Plans (Part 5A and Part 5B)
- Exemptions (Part 6)

ESPA based on a “plant parameter envelope” (PPE)

- Composite of reactor and engineered parameters from four U.S. light-water SMR designs with unique design features that bound the safety and environmental impact of plant construction and operation
- Developed based on NEI 10-01 guidance with margin added to specific parameters
- Assumes two or more SMR units of a single design
- Up to 800MWt for a single unit with a combined nuclear generating capacity not exceeding 2420 MWt (800 MWe)

NRC Review of ESPA



ESPA Summary

- NRC Commenced Review in FY 17'
- Contains more than 8000 Pages
- Supported by over 80,000 pages in referenced documents
- Efficient Use of Audits
- Few Requests for Additional Information (RAIs)
- Frequent, Clear, and Candid Communication

Early Site Permit- Overview

Ray Schiele

Licensing Manager

Application Organization

Part 1 – Administrative Information

Part 2 – Site Safety Analysis Report

- Chapter 1 – Introduction and General Description
- Chapter 2 – Site Characteristics
- Chapter 3 – Aircraft Hazards
- Chapter 11 – Radioactive Waste Management
- Chapter 13 – Emergency Planning
- Chapter 15 – Transient and Accident Analysis
- Chapter 17 – Quality Assurance

Part 3 – Environmental Report

Part 4 – Limited Work Authorization – Not Used

Part 5 – Emergency Plan

Part 6 – Exemptions and Departures

Part 7 – Withheld Information

Part 8 – Enclosures

ESPA Development

Regulatory bases for the SSAR:

- NRC Regulations—10 CFR 20, 10 CFR 50, 10 CFR 52, and 10 CFR 100
- NUREG-0800, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition
- NRC Regulatory Guide 1.206, Combined License Applications for Nuclear Power Plants (LWR Edition)
- RS-002, Processing Applications for Early Site Permits

Regulatory bases for the ER:

- National Environmental Policy Act,
- NRC Regulations—10 CFR 51 and 10 CFR 52,
- NRC Regulatory Guide 4.2, Preparation of Environmental Reports for Nuclear Power Stations,
- NRC Regulatory Guide 4.7, General Site Suitability Criteria for Nuclear Power Stations,
- NUREG-1555, Federal, regional, state and local environmental statutes, as applicable, and
- RS-002, Processing Applications for Early Site Permits.

ESPA NRC Interactions

- Pre-Environmental Report Visit March 2013
- PPE Development September 2014
- Pre-application Site Visit October 2014
- Alternative Sites Visit June 2015
- ESPA Readiness Review August 2015
- Hydrology and Health Physics Audit April 2017
- Seismic/Geotechnical Audit May 2017
- Environmental and Meteorology Audit May 2017
- QA Inspection April 2018
- Meteorology and Health Physics Audit May 2018

ASER/ACRS Committee Timeline

- 1st Set ASERs Issued April 2018
- ACRS Subcommittee Meeting May 2018
 - SSAR Sections 2.1, 2.2, 3.5.1.6, 15.0.3
- ASER – SSAR 13.3 Issued July 2018
- ACRS Subcommittee Meeting August 2018
 - SSAR Section 13.3
- ASER – SSAR 2.5 Issued September 2018
- ACRS Subcommittee Meeting October 2018
 - SSAR Section 2.5
- 2nd Set ASERs Issued October 2018
- ACRS Subcommittee Meeting November 2018
 - SSAR Sections 2.3, 2.4, 11.2/11.3, 17.0
- ACRS Full Committee Meeting December 2018

Emergency Preparedness

Archie Manoharan

Licensing Engineer

ESPA – Emergency Preparedness Approach

Emergency Planning (EP) Information Layout – 3 Areas

- Part 2, SSAR, Section 13.3, Emergency Preparedness
 - Plume exposure pathway (PEP) emergency planning size (EPZ) sizing methodology
- Part 5, Emergency Plan
 - Two major features (Onsite) Emergency Plans
 - Part 5A – Site Boundary EPZ Emergency Plan
 - Part 5B – 2-Mile EPZ Emergency Plan
- Part 6, Exemptions and Departures
 - 2 sets of exemption requests
 - Exemption requests for a PEP EPZ at Site Boundary
 - Exemption requests for a 2-mile PEP EPZ

The final EPZ size for the Clinch River Site will be determined at COLA stage

PEP EPZ Sizing Methodology

- Takes SMR design and safety advancements into consideration
- Dose-based, consequence-oriented approach to determine an appropriate EPZ size
- Consistent with the NUREG-0396 sizing rationale – spectrum of accidents are addressed
- **Approach has the same dose criteria as NUREG-0396 – 1 rem total effective dose equivalent (TEDE)**

Technical Criteria - PEP EPZ should:

- **Criterion A** – encompass those areas in which projected dose from **design basis accidents** (DBAs) could exceed the U.S. Environmental Protection Agency (EPA) early phase protective action guide (PAG)
- **Criterion B** – encompass those areas in which consequences of **less severe core melt accidents** could exceed the EPA early phase PAG
- **Criterion C** – be of sufficient size to provide for substantial reduction in early health effects in the event of **more severe core melt accidents**

PEP EPZ Sizing Methodology

- Step 1 - Accident scenario selection
 - DBA from Chapter 15
 - Design and site specific Probabilistic Risk Assessment (PRA) for severe accident scenarios
 - Considers – all modes, internal & external events, applicable fuel handling, spent fuel pool, and multi-module accidents
 - Sequences with mean core damage frequency (CDF) greater than $1E-8$ per reactor-year (rx-yr)
 - **Criterion B: Less severe core melt scenarios – Mean CDF greater than $1E-6$ per rx-yr, intact containment**
 - **Criterion C: More severe core melt scenarios – Mean CDF greater than $1E-7$ per rx-yr, containment bypass or failure**
- Step 2 - Determine source term releases from selected accidents
- Step 3 - Calculate dose consequences at distance
- Step 4 - Compare the dose at distance to EPA early phase PAG

COL applicant would perform an analysis using the PEP EPZ size methodology, with site- and design-specific input, to justify the PEP EPZ size for the COLA

PEP EPZ Sizing Methodology – Example Analysis

Criteria A & B: DBA and less severe accidents

- Dose consequences do not exceed the early phase EPA PAG – 1 rem total effective dose equivalent (TEDE)

Criterion C: More severe accidents

- Calculate distance at which conditional probability to exceed 200 rem whole body exceeds $1E-3$ per rx-yr
- Verify the PEP EPZ is of sufficient size to provide for substantial reduction in early health effects

Design-Specific Example Analysis – Evaluates NuScale Power Plant at Clinch River Site

| 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 met the required screening criteria. | |

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 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 reactor
- 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

- Exemptions for a PEP EPZ established at the **Site Boundary**
 - Deviate from 10-mile PEP EPZ
 - Various elements of a formal offsite emergency plan
 - Evacuation time estimates
 - Certain elements of offsite notifications and exercises
- Exemptions for an approximate **2-mile PEP EPZ**
 - Deviate from 10-mile PEP EPZ

Emergency Preparedness Approach – Summary

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

