## ClinchRiverESPHFNPEm Resource

**From:** Schiele, Raymond Joseph <rjschiele@tva.gov>
**Sent:** Friday, May 11, 2018 5:16 PM
**To:** Nguyen, Quynh
**Cc:** Fetter, Allen; Stout, Daniel Paul
**Subject:** [External_Sender] Slide Deck for TVA ACRS Presentation on May 15
**Attachments:** ACRS Presentation_5-15-18 (6).pptx

Quynh,

Please find attached the slide deck for the May 15 ACRS presentation. Please let me know if you have any questions or concerns.

Thanks!

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Clinch River Nuclear
Small Modular Reactor Project
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**From:** Schiele, Raymond Joseph

**Created By:** rjschiele@tva.gov

**Recipients:**
"Fetter, Allen" <Allen.Fetter@nrc.gov>
Tracking Status: None
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# Clinch River
# Early Site Permit
## SSAR Sections 2.1, 2.2, 3.5.1.6, & Ch.15

Advisory Committee on Reactor Safeguards
Subcommittee Meeting

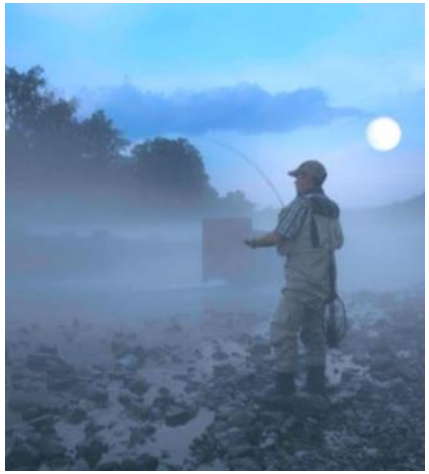
**Presented by**
**Ray Schiele, Licensing Manager**

May 15, 2018

# TVA's Mission

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

Energy

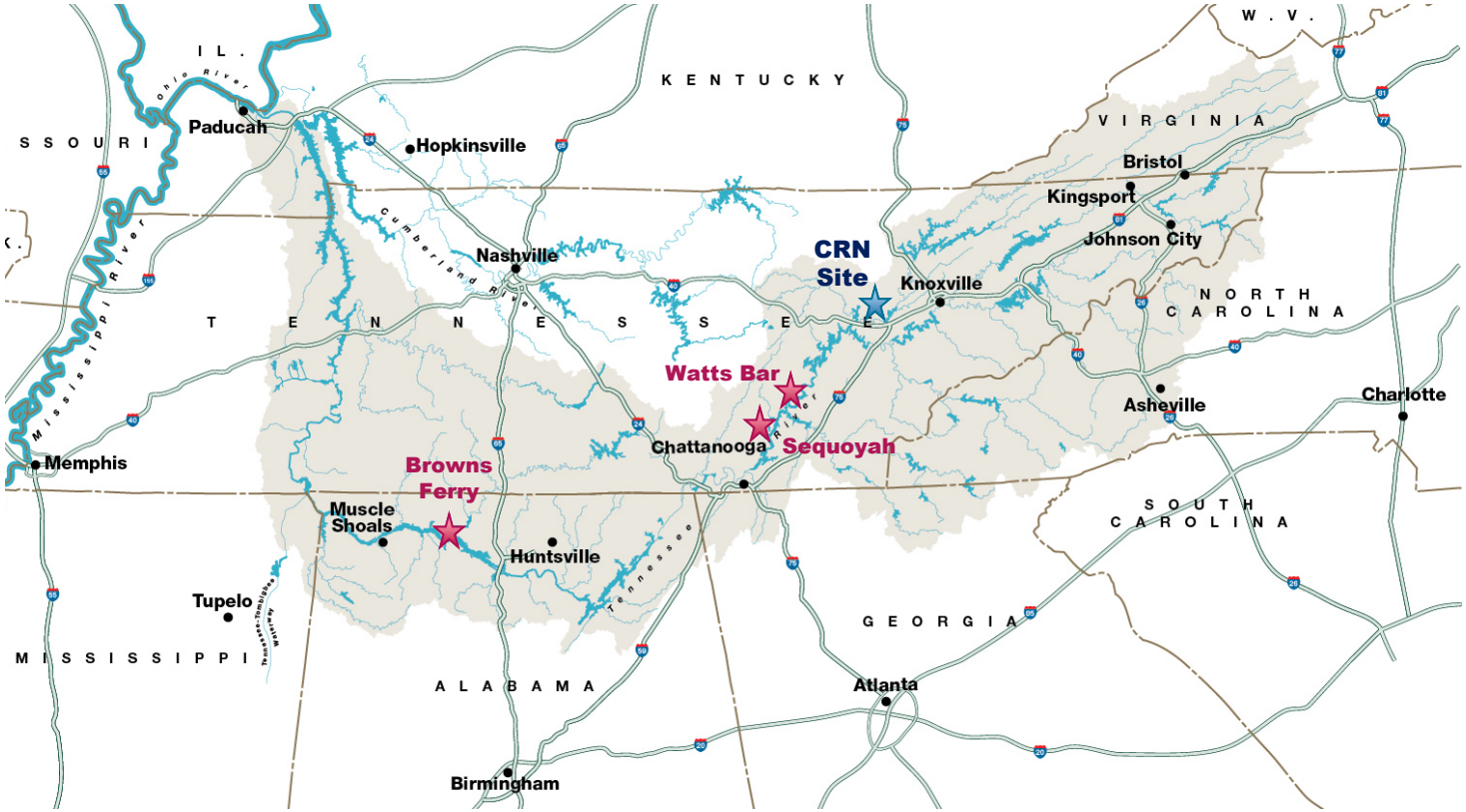


Environment

Economic Development

Partner with **154** local power companies, to serve **9 million people** and **700,000 businesses** in parts of **seven states.** Directly serve **56** large industries and federal installations.

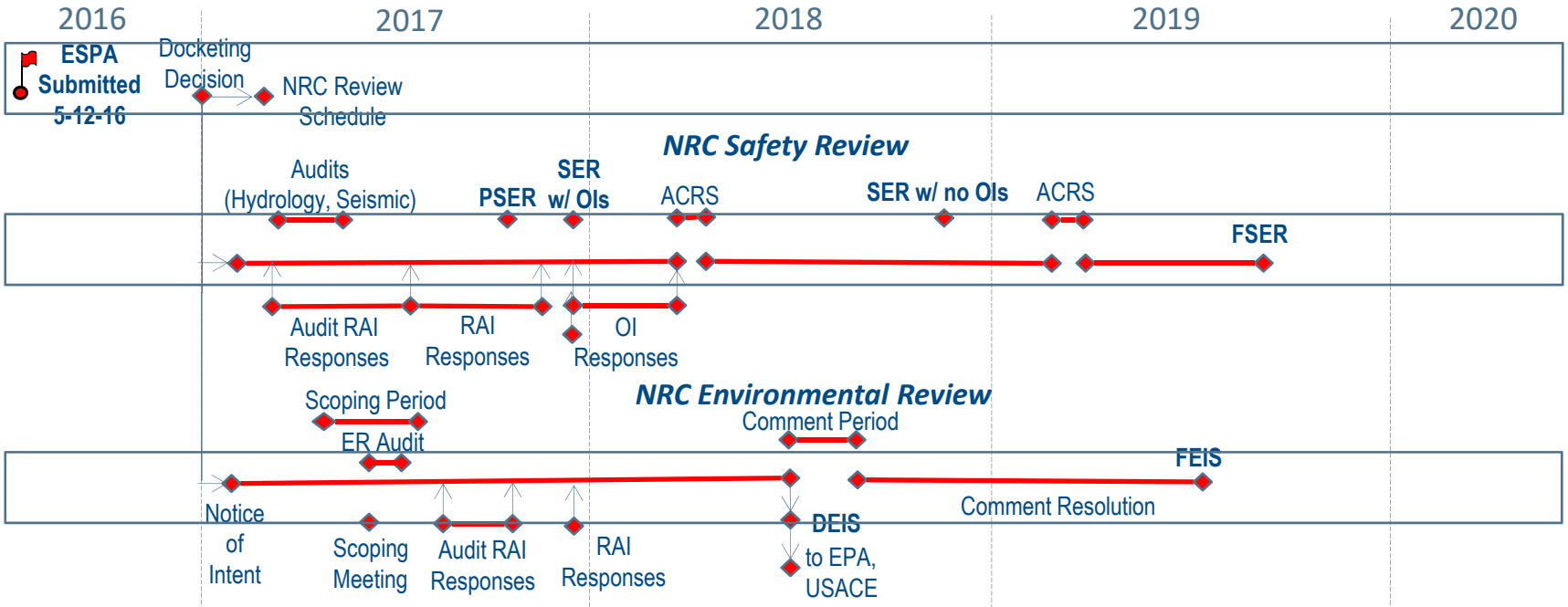
# TVA's Nuclear Fleet



# Early Site Permit Application Development

| | |
|---|---|
| TVA decides to pursue ESPA | 2014 |
| Site Characterization | 2010 - 2015 |
| ESPA Submitted to NRC | May 2016 |
| NRC accepts ESPA for review | December 2016 |
| NRC performs Audits | March-May 2017 |
| ESPA Rev. 1 Submitted | December 2017 |
| RAIs | 2017-2018 |

# ESPA Project Update – Licensing Process




TVA Business Sensitive

# Chapter 2 – Section 2.1

# Geography & Demography

# Section 2.1 – Geography & Demography

**The proposed CRN site location encompasses 935 acres of land adjacent to the Clinch River arm of the Watts Bar Reservoir, within the City of Oak Ridge, Roane County, Tennessee.**

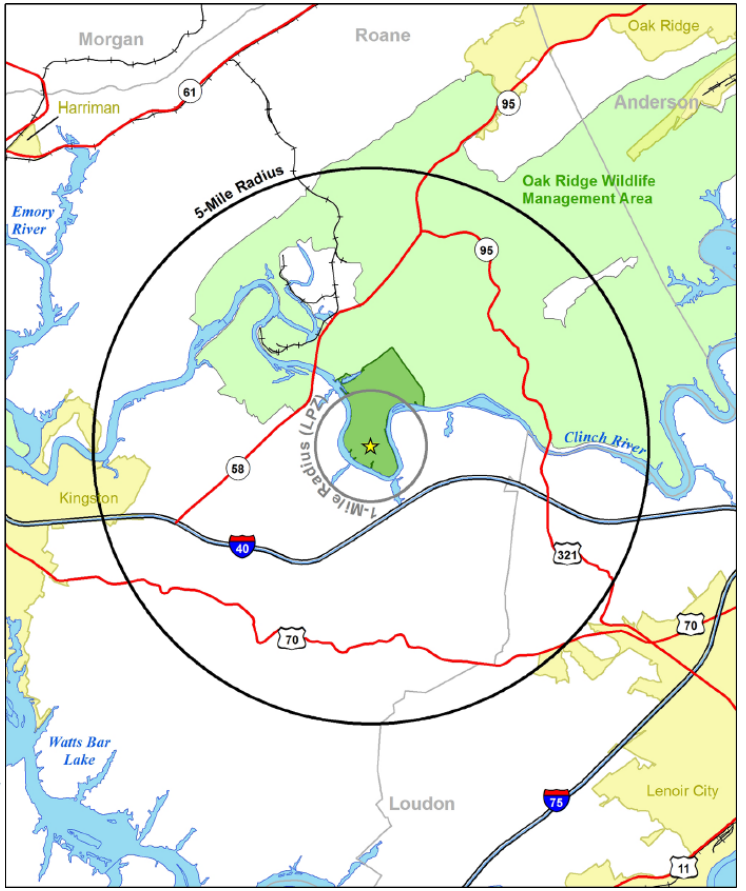
- Borders DOE Oak Ridge Reservation
- 6.8 miles East of Kingston, TN
- 9.2 miles East-Southeast of Harriman, TN
- 8.8 miles Northwest of Lenoir City, TN
- 25.6 miles West-Southwest of Knoxville, TN

**The land is owned by the United States of America and managed by TVA as the agent of the federal government.**

# Section 2.1 – Geography & Demography

**Population Distribution**

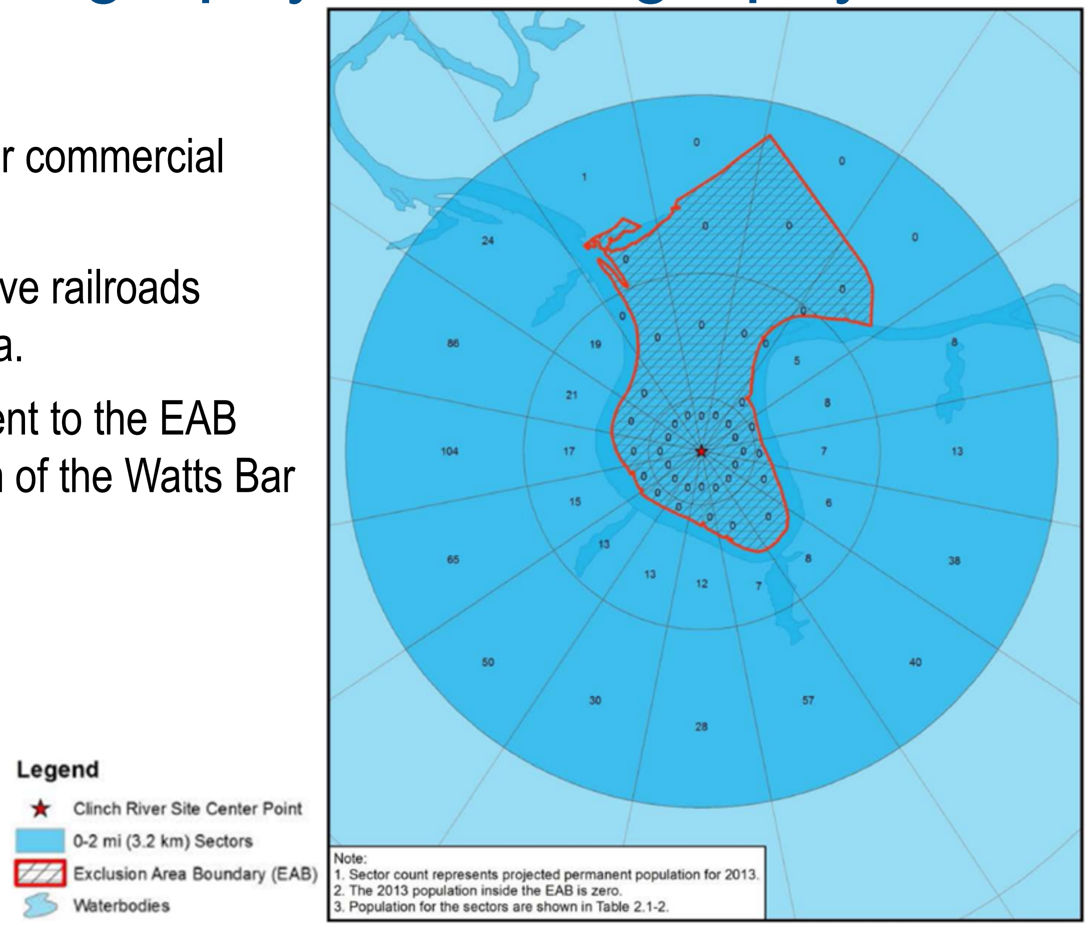
- The low-population zone (LPZ) is defined as a 1 mi radius from the site center point.
- There are no hospitals, prisons, or jails within the LPZ
- There are no transient population events or attractions within this area.



# Section 2.1 – Geography & Demography

**Exclusion Area Boundary**

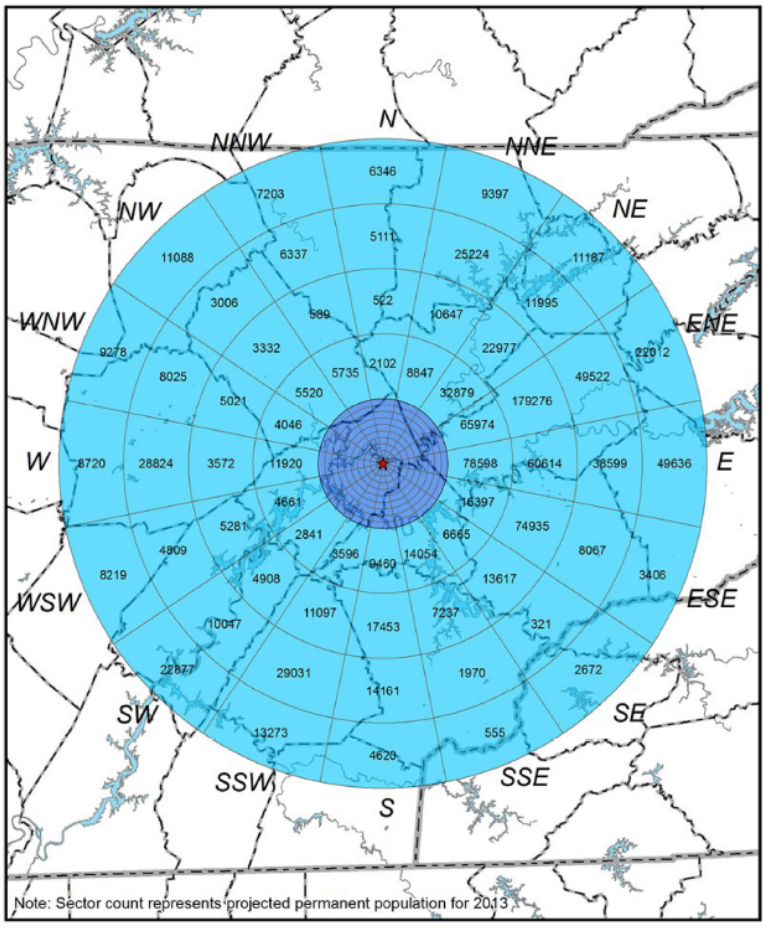
- There are no residences or commercial activities within the EAB.
- No public highways or active railroads traverse the exclusion area.
- Barge traffic occurs adjacent to the EAB along the Clinch River arm of the Watts Bar Reservoir.



# Section 2.1 – Geography & Demography

**Population Distribution**

- The population distribution surrounding the site, up to a 50-mi radius, estimated based upon the most recent 2010 USCB decennial census data.
- Transient population is projected to 40 years beyond the 2027 commencement of operation date for the last unit.



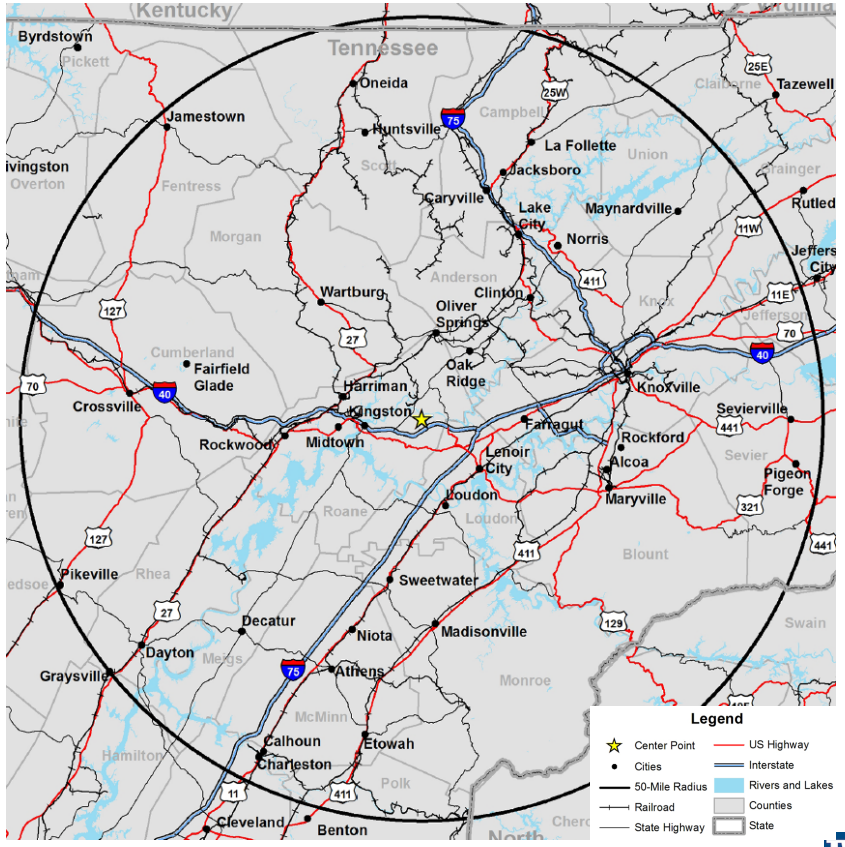

**Legend**

- Clinch River Site Center Point
- 0-10 mi (16km) Sectors
- 10 mi (16 km) - 50 mi (80 km) Sectors
- County Boundary
- State Boundary
- Waterways

# Section 2.1 – Geography & Demography

**Population Center**

- Distance to population center boundary (greater than 25,000 people) complies with 10 CFR 100.3 guidance.
- USCB census-delineated urban areas are used to identify population centers and are based largely on population density.



# Section 2.1 – Geography & Demography

**Population Density**

Population densities, per Regulatory Guide 4.7, *General Site Suitability Criteria for Nuclear Power Stations*, were calculated for the 50-mi region for the projected start of construction date (2021), the projected commencement of operation date for the last unit (2027), and the end of operation date (2067).

- The total projected permanent population for 2021 and 2027 is approximately 1,305,000 and 1,377,000, respectively.
- The total projected transient population for 2021 and 2027 is approximately 638,000 and 674,000, respectively.
- The 2021 and 2027 total projected population for the 50-mi region is approximately 1.94 million and 2.05 million, respectively.
- The 2021and 2027 total population density is 247 people per $mi^2$ and 261 people per $mi^2$, respectively. These projected population densities are less than the 500 people per $mi^2$ recommended by Regulatory Guide 4.7.

# Chapter 2 – Section 2.2

# Nearby Industrial, Transportation, and Military Facilities

# Section 2.2 – Nearby Industrial, Transportation, and Military Facilities

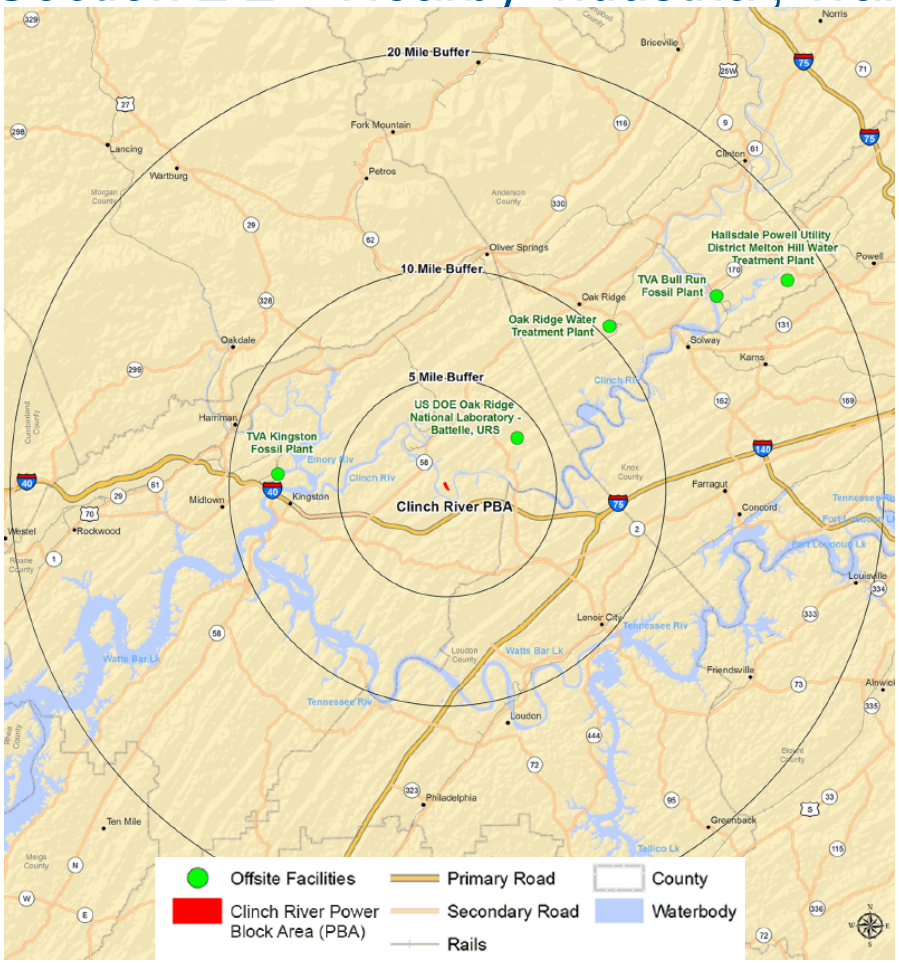
**Locations and Routes**

- Potential hazard facilities and routes within the 5-mile vicinity of the CRN Site identified in accordance with RG 1.206, RG 1.91, RG 4.7, and RG 1.78.
  - Identified all facilities and activities within 5 miles
  - Identified potentially significant facilities and activities beyond 5 miles.
- 1 navigable waterway, 1 major highway, 4 major roads, 1 minor rail line, and 2 natural gas pipelines identified within 5 miles.
- Additional industrial facilities were identified beyond 10 miles that were significant enough to be considered for further review.
- No identified roads, railways or navigable waterways at distances greater than 10 miles that are significant potential hazards.

**Description of Products and Materials**

- Identified chemicals used, produced, or transported by each facility/activity.

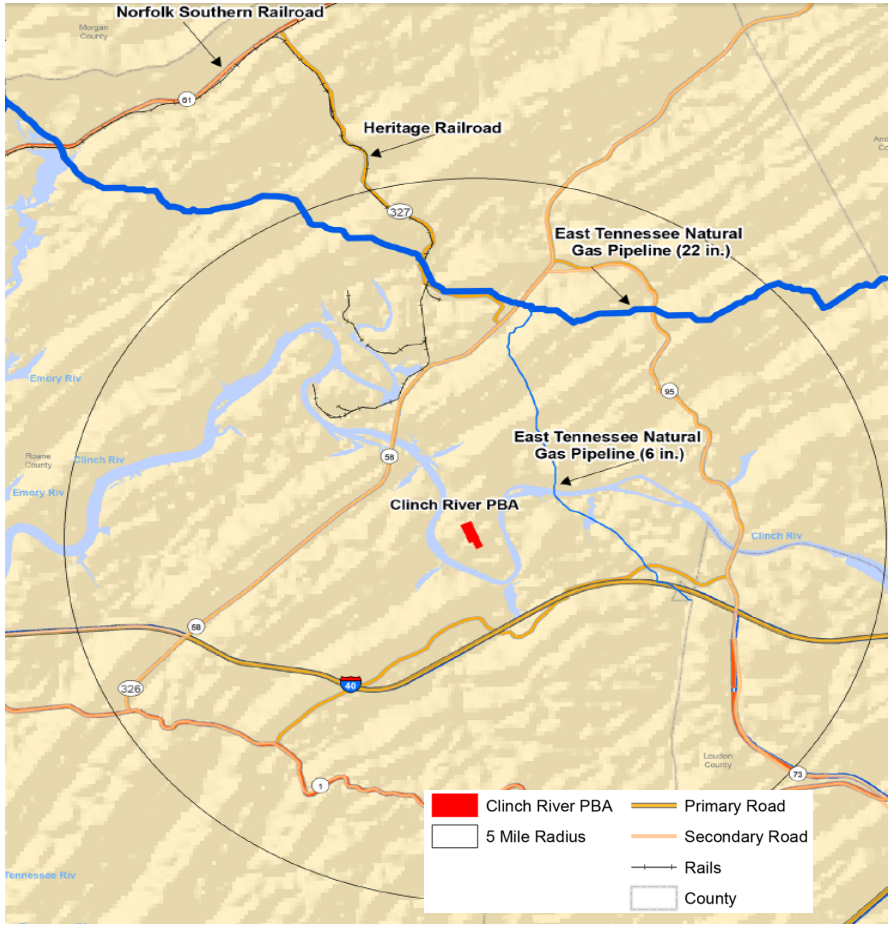
# Section 2.2 – Nearby Industrial, Transportation, and Military Facilities




## Industrial Facilities

- ORNL (Battelle and URS)
- TVA Kingston Fossil Plant
- Oak Ridge WTP
- TVA Bull Run Fossil Plant
- Hallsdale Powell Utility District Melton Hill WTP

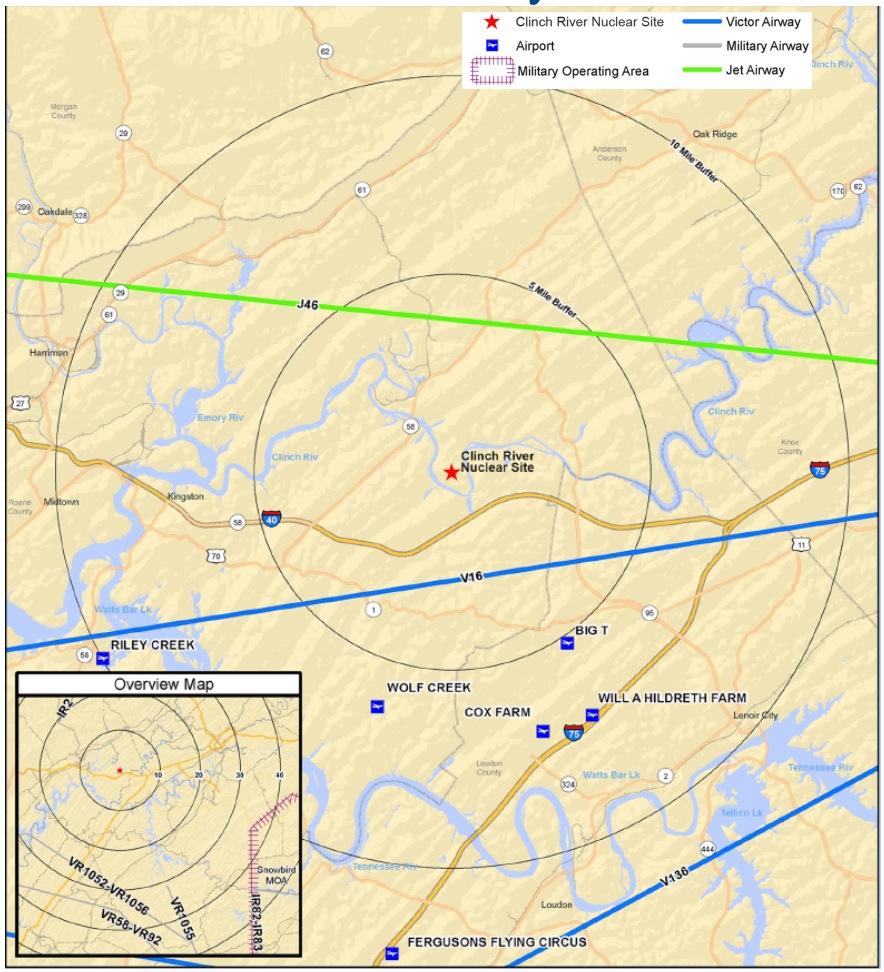
# Section 2.2 – Nearby Industrial, Transportation, and Military Facilities




## Transport Routes/Natural Gas Pipelines

- Clinch River arm of Watts Bar Reservoir
- I-40
- TN 1/US11-70, and TN 58, TN 95, and TN 327
- Heritage Railroad Corporation Railway
- East Tennessee Natural Gas Pipeline 1 (6 inch) and Pipeline 2 (22 inch)

# Section 2.2 – Nearby Industrial, Transportation, and Military Facilities




## Airports and Airways

- Big T
- Wolf Creek
- Cox Farm
- Will A Hildreth Farm
- Riley Creek
- Federal Airways V16 and J46

# Section 2.2 – Evaluation of Potential Accidents

**Determination of Potential Accidents**

- RG 1.206 states that design-basis events, internal and external to the CRN Site, are defined as those accidents that have a probability of occurrence on the order of magnitude of 10-7 per year or greater with potential consequences serious enough to affect the safety of the plant to the extent that the guidelines in 10 CFR 100 could be exceeded.

- The following accident categories are considered in selecting design-basis events:
  - Chemical Releases: Explosions, flammable vapor clouds (delayed ignition), toxic chemicals, or fires.
  - Collisions with the intake structure.
  - Aircraft hazards.
  - Liquid spills.

# Section 2.2 – Evaluation of Potential Accidents

The following locations were analyzed for postulated accidents within the accident categories considered in selecting design-basis events:

**Nearby Storage Facilities**

- ORNL (Batelle and URS) (located 3.8 mi from the CRN Site power block area)
- TVA Kingston Fossil Plant (located 7.6 mi from the CRN Site power block area)
- Oak Ridge WTP (located 10.3 mi from the CRN Site power block area)
- TVA Bull Run Fossil Plant (located 15 mi from the CRN Site power block area)
- Hallsdale Powell Utility District Melton Hill WTP (located 18.2 mi from the CRN Site power block area)

**Nearby Transportation Routes**

- East Tennessee Natural Gas Pipelines 1 and 2
- I-40
- Federal Airways V16 and J46

# Section 2.2 – Evaluation of Potential Accidents

**Effects of Design Basis Events**

- Evaluations were performed of the potential hazards nearby to the CRN Site. These evaluations concluded that potential accidents involving explosions, flammable vapor clouds, collisions with intake structures, and liquid spills do not pose a threat to the CRN Site.
- Evaluation of the potential effect of toxic chemical releases from nearby industrial and transportation routes concluded that, except for anhydrous ammonia and chlorine potentially transported along I-40, the distance to the toxic endpoints are less than the distance to the CRN Site power block area. A main control room habitability analysis will be performed at the time of COLA for the transport of anhydrous ammonia and chlorine on I-40.
- The effects of chemical releases from onsite chemical storage will be evaluated in the COLA because plant features such as the control room habitability system design and location of safety-related structures must be considered to determine there is no adverse effect from these hazards.

# Chapter 3 – Section 3.5.1.6
# Aircraft Hazards

# Section 3.5.1.6 – Aircraft Hazards

- NUREG-0800 establishes that the risks as the result of aircraft hazards should be sufficiently low, in that each requires that aircraft accidents that could lead to radiological consequences in excess of the exposure guidelines of 10 CFR 50.34(a)(1) with a probability of occurrence greater than an order of magnitude of 10-7 per year should be considered in the design of the plant.

- Utilizing proximity criteria, TVA performed a screening analysis to establish whether the probability of aircraft accidents for the proposed CRN Site is considered to be less than an order of magnitude of 10-7 per year by inspection.

# Section 3.5.1.6 – Aircraft Hazards

**Criterion 1:**
The plant-to-airport distance, D, is between 5 and 10 statute miles, and the projected annual number of operations is less than 500 D2, or the plant-to-airport distance, D, is greater than 10 statute miles, and the projected annual number of operations is less than 1000 D2.

- Five small privately-owned airports are located between 5 and 10 statute mi of the CRN Site and two small privately-owned airports are within 10 to15 statute mi of the CRN Site.
- The airport projected number of operations, based on available data, is less than the significance factor (i.e., the allowable annual number of operations) called for by criterion 1.
- The results of this evaluation, summarized in SSAR Table 2.2-7 of the ESPA, indicate that the proximity screening criterion 1 is met for each evaluated airport; therefore, no nearby airports need further evaluation.

# Section 3.5.1.6 – Aircraft Hazards

**Criterion 2:**
The plant is at least 5 statute miles from the nearest edge of military training routes, including low-level training routes, except for those associated with usage greater than 1000 flights per year, or where activities (such as practice bombing) may create an unusual stress situation.

- The CRN Site is located about 19.2 statute mi from the centerline of military training route IR2 this training route or approximately 13.4 statute mi from the edge of the training route.
- The closest military operation area (MOA) is the Snowbird MOA located approximately 36 mi from the CRN Site
- Given this separation distance between the CRN Site and the nearest military training route (greater than 5 mi from the nearest edge of a military training route), along with the distance to the nearest MOA, criterion 2 is met.

# Section 3.5.1.6 – Aircraft Hazards

**Criterion 3:**
The plant is at least 2 statute miles beyond the nearest edge of a Federal airway, holding pattern, or approach pattern.

- There are two Federal airways, one victor (V) and one jet (J) route (V16 and J46, respectively) whose nearest edge lies within 2 statute mi of the CRN Site.
- Thus, due to the proximity of Federal airways V16 and J46, the proposed CRN Site does not meet proximity screening criterion 3.
- A detailed aircraft hazards analysis was performed and the expected rate of occurrence of potential exposures resulting in radiological dose has been shown to be on the order of magnitude of 10-6 per year and the realistic probability has been shown to be lower, based on qualitative arguments.

# Chapter 15
# Transient and Accident Analysis

# Chapter 15 – Transient and Accident Analysis

**Accident Selection**

- NEI 10-01, *Industry Guidance for Developing a Plant Parameter Envelope in Support of an Early Site Permit* recommends that accident analyses model the time-dependent transport of radionuclides out of the reactor core through several pathways, each with different time-dependent removal mechanisms for radionuclides.
  - For the purposes of evaluating offsite post-accident doses, the vendor analysis with the highest resultant post-accident dose was selected for use in the CRN Site-specific dose analysis.
- Each of the four small modular PWR designs under consideration for the CRN Site is expected to include advanced design features that would further minimize accident consequences.
- TVA anticipates that the consequences of a LOCA will be less than those for large PWR designs and that no events of greater consequence will be identified.
- The COLA will verify that the accident doses provided in this ESPA are bounding or provides an evaluation of accident radiological consequences.

# Chapter 15 – Transient and Accident Analysis

**Source Terms**

- The PPE LOCA source term is based on a design that uses standard light-water reactor fuel, which is representative of the SMR designs under consideration, and assumes a core power level for a single unit at 800 MW thermal.
- To assess reasonableness, a comparison of the PPE LOCA source term to that of the AP1000 design was performed.
  - The activity release associated with the worst 2-hour time period of the scaled-down AP1000 is approximately 25 percent greater than that for the surrogate plant (as provided in the PPE).
  - The activity release for the 30-day duration of the LOCA is approximately equivalent to that of the surrogate plant and is also considered reasonable.

# Chapter 15 – Transient and Accident Analysis

**Evaluation Methodology and Conclusions**

- SMR Doses for a LOCA are evaluated at the EAB and LPZ boundary.
- Doses are calculated using the ratio of the X/Q methodology.

  The evaluation uses the following parameters:

  - Short-term 95$^{th}$ percentile accident atmospheric dispersion factors (X/Qs) for the CRN Site.
  - Bounding vendor-provided LOCA doses.
  - X/Q values associated with the bounding vendor-provided LOCA doses.
- The resulting accident doses are expressed as total effective dose equivalent (TEDE), consistent with 10 CFR 52.17. All site LOCA doses meet the 25 rem TEDE limit specified in 10 CFR 52.17