

13.6 PHYSICAL SECURITY

13.6.1 Introduction

The early site permit (ESP) application for the Clinch River Nuclear (CRN) Site, submitted by Tennessee Valley Authority (TVA), describes the site characteristics applicable to security and provides information to demonstrate that security plans and measures can be developed in accordance with the applicable requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) 73.55, "Requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage," and 10 CFR 100.21(f). Within Chapter 1, "Introduction and General Description of the Plant," Chapter 2, "Site Characteristics," Chapter 3, "Design of Structures, Systems, Components, and Equipment," and Chapter 13, "Conduct of Operations," Section 13.6, "Physical Security," of the Site Safety Analysis Report (SSAR) contained in Part 2 of the ESP application, the applicant describes the characteristics of the proposed the CRN Site and the bounding parameters that establish the plant parameter envelope (PPE) within which a reactor design will be selected before applying for a combined license (COL) for construction and operation of one or two units.

The applicant's proposed the CRN Site is a tract of land adjacent to the Clinch River arm of the Watts Bar Reservoir, located west of the Oak Ridge Reservation, within the City of Oak Ridge, Tennessee. The CRN Site is approximately 935 acres within a 1200-acre property owned by the United States of America and managed by the TVA. Part 2, Chapter 1, of this ESP application provides a detailed description of the CRN Site.

13.6.2 Summary of Application

SSAR Chapters 1 and 2 provide information on the site's specific location, description, and PPE and contain various site maps and the CRN Site aerial photographs that depict site topography. The application also includes descriptions and depictions of the locations of existing industrial facilities, sewage treatment plants, pipelines, waterways, mining operations, highways, railroads, airports, airways, nearby power plants, and military facilities. In addition, the application provides descriptions and evaluations of potential hazards within the vicinity of the site (explosions, flammable vapor clouds, toxic chemicals, fires, liquid spills, radiological hazards, dam failures, etc.), which includes natural hazards, such as floods, ice, and seismic activity. SSAR Section 13.6 describes site characteristics to address the applicable regulatory requirements for the CRN Site to be such that adequate security plans and measures can be developed.

SSAR Chapter 2 provides CRN Site coordinates including a center-point reference location inside a 935-acre land mass at U.S. North American Datum 1983 (Decimal Degrees); longitude: 35.890889 North; latitude: 84.380927 West and at Universal Transverse Mercator Zone 16 North, North American Datum 1983 (Meters); 3,974,815.26 Northing and 736,407.14 Easting. SSAR Figure 1.2-1 "Clinch River Site location" and Figure 2.1-1 "Site Map" also depict a proposed Exclusion Area Boundary (EAB) of 1,200 acres owned by the United States and managed by TVA that encompasses the CRN Site. The CRN Site is located in Oak Ridge, Tennessee and is situated on the former Clinch River Breeder Reactor Project site within the EAB, which was cancelled in 1983. Because TVA only evaluated a number of small modular reactor (SMR) designs as discussed in SSAR Section 1.11, the power block area center-point location has not specifically been identified, but only as a proposed area location on a 28-acre land mass within a 94-acre land mass allocated for plant area. SSAR Figure 1.2-2, "Clinch River Nuclear Site Plant Areas" depicts the site location that includes the power block area in

relation to the overall plant area. SSAR Chapter 2 and the ER describe other manmade features such as a barge slip and intake structures.

13.6.3 Regulatory Basis

The provisions of 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” Subpart A, “Early Site Permits” establishes the requirements and procedures applicable to the U.S. Nuclear Regulatory Commission (NRC) issuance of an ESP for approval of a site for one or more nuclear power facilities separate from the filing of an application for a construction permit or a COL for the facility.

Provisions in 10 CFR 52.17, “Contents of applications; technical information,” set forth the requirements for the contents and technical information to be submitted in applications under this subpart:

- 10 CFR 52.17(a)(1)(x), as it relates to the requirement for submission of information to demonstrate that the site characteristics are such that adequate security plans and measures can be developed.

The provisions in 10 CFR 73.55 set forth the requirements for power reactor licensees and applicants to establish and maintain a physical protection program, including a security organization, which will have as its objective to provide high assurance that activities involving special nuclear material are not harmful to the common defense and security and do not constitute an unreasonable risk to public health and safety.

The provisions in 10 CFR 100.21, “Non-seismic siting criteria,” set forth the requirements regarding non-seismic siting criteria for proposed commercial power reactor sites.

- 10 CFR 100.21(f), as it relates to the requirement that site characteristics to be such that adequate security plans and measures can be developed.

Acceptance criteria adequate to meet the above requirements include those set forth in:

1. Regulatory Guide (RG) 4.7, “General Site Suitability Criteria for Nuclear Power Stations,” Revision 2, April 1998, as it relates to the suitability criteria for a proposed site.
2. NUREG–0800, “Standard Review Plan (SRP) for the Review of Safety Analysis Reports for Nuclear Power Plants,” Chapter 13, Section 13.6.3, “Physical Security – Early Site Permit,” Revision 1; October 2010, as it relates to the review of physical security aspects of a permit application for a proposed site. The staff recently updated SRP Section 13.6.3 and published this guidance document in October 2016. The staff expects that the COL applicants will utilize the most updated regulatory guidance to provide the necessary updates in the COL application.

13.6.4 Technical Evaluation

In conducting the technical evaluation of the information contained in SSAR Chapter 13, Section 13.6 the staff also reviewed the pertinent information and figures contained in the following SSAR chapters and sections:

- Chapter 1, “Introduction and General Description of the Plant”; Section 1.1, “Introduction,” Section 1.2, “General Plant Description,”
- Chapter 2, “Site Characteristics,” Section 2.0, “Plant Parameter Envelope”; Section 2.1, “Geography and Demography,” Section 2.2, “Nearby Industrial, Transportation, and Military Facilities,” and Section 2.4, “Hydrologic Engineering,” and
- Chapter 3, “Design of Structures, Systems, Components, and Equipment”

In addition, the staff reviewed pertinent information and figures contained in the ER, Chapters 1 and 2, to confirm consistency of site characteristics information applicable to the review of physical security between the SSAR and the ER.

The staff review focused on: (1) whether the information in the application meets the requirements stated in 10 CFR 52.17(a)(1)(x) to demonstrate that the site is such that security plans and measures can be developed; (2) that the applicant has considered the applicable physical protection requirements stated in 10 CFR 73.55 in the selection of the site and its proposed layout; and (3) that the information in the application related to the site characteristics and potential hazards provided sufficient technical basis to demonstrate that the site characteristics and potential hazards do not present impediments to preclude the development of adequate security plans and measures consistent with 10 CFR 100.21(f).

13.6.4.1 Security Boundaries

In SSAR Section 13.6, the applicant states that the CRN Site is sufficiently large to implement the requirements of 10 CFR 73.55, including adequate distances between safety-related structures and the required security boundaries and consideration of land-based and waterborne vehicle bombs. Spatial separation is not limited because of natural topography of the CRN Site and planned structures for the site would not limit spatial separation.

Based on the information contained in the application, Part 2, Sections 1.2 and 2.1, and 13.6, the applicant identified a 94-acre plant area land mass, which includes a proposed location of the power block area within the 935-acre proposed for the CRN Site’s owner controlled area (OCA). The applicant concluded that the CRN land mass is sufficiently large enough to allow for the establishment of the security boundaries of the OCA, protected area (PA), vital area (VA), and PA perimeter isolation zones, with sufficient distance between these security boundaries and VAs, for the implementation of a physical protection program consistent with the requirements of 10 CFR 73.55. The applicant also stated in Chapter 2 that the actual design information selected for the CRN Site would be reviewed within a combined license application (COLA) to demonstrate that the design is bounded by the PPE.

The staff issued Request for Additional Information (RAI) 13.06.03-1 (Agency Documents Access and Management System (ADAMS) Accession No. ML17262B229), requesting that TVA confirm that once the specific design has been identified, a COL applicant would demonstrate that the chosen design is bounded by plant parameters identified in Chapter 2, Table 2.0-1, “Site Characteristics.” The staff considers the power block area specific coordinate as part of the ESPA review. Once the specific SMR design is identified the staff will review the selected design as part of the COL application to ensure the power block is bounded by the PPE as indicated in Chapter 2, Table 2.0-1.

In a letter, (CNL-17-090 response to staff RAI, dated October 19, 2017, ADAMS Accession No. ML17295A000), TVA indicated that should TVA apply for a COL referencing the ESP, the actual design selected would be reviewed as part of the COLA to demonstrate that the design would be bounded by the PPE, and differences would be reviewed to confirm that the design selected would not invalidate the proposed location of the power block area. TVA further confirmed that the land mass corresponding to the selection of any specific reactor design technology discussed in Chapter 2 of the CRN ESP would be sufficiently large to allow for the establishment of the security boundaries of the OCA, PA, VA, and PA perimeter isolation zones, with sufficient distance between these security boundaries and VAs for the implementation of a physical protection program consistent with the requirements of 10 CFR 73.55 (See also 10 CFR 52.17).

Based on the above response, the staff finds that the information contained in the application is consistent with the requirements of 10 CFR 52.17(a)(1)(x) and provides a sufficient basis to conclude that site characteristics regarding the establishment of security boundaries are such that adequate security plans and measures can be developed.

13.6.4.2 Site Characteristics

In SSAR Chapters 1 and 2, the applicant describes and depicts the site characteristics and potential nearby hazards. Specifically, SSAR Figure 1.2-1 depicts and identifies features of the overall layout of the site, the proposed EAB as well as existing facilities and structures and other manmade features, such as a barge unloading facility, intake structures, and existing 500 kV power line corridor and 161 kV power line corridor which will be relocated away from the plant area. In addition, SSAR Chapter 2 provides the CRN Site coordinates including a center-point reference location inside a 935-acre land mass at U.S. North American Datum 1983 (Decimal Degrees); longitude: 35.890889 North; latitude: 84.380927 West and at Universal Transverse Mercator Zone 16 North, North American Datum 1983 (Meters); 3,974,815.26 Northing and 736,407.14 Easting. SSAR Figure 1.2-1 and Figure 2.1-1 also depict a proposed EAB of 1,200 acres owned by the United States and managed by TVA that encompasses the CRN Site. Along with the proposed power block location, SSAR Figure 3.1-2 depicts several large permanent and temporary cleared areas to support the construction activities which include switchyard and cooling tower areas. A designated area for a future Independent Spent Fuel Storage Installation facility is also identified.

In SSAR Section 13.6, the applicant states that the characteristics of the new plant footprint meet the applicable requirements of 10 CFR 100.21(f) and 10 CFR 73.55. The applicant also indicates that a COL applicant will address site-specific design features of the selected SMR technology that details site specific security, engineering designed features and monitoring equipment, and security methods for screening station operating personnel.

The staff issued RAI 13.06.03-4 (ADAMS Accession No. ML17262B229), requesting that the applicant confirm that subsequent COL applicant(s) who select any specific reactor design technology as discussed in Chapter 2 of the application will meet the PPE parameters and follow the requirements of 10 CFR 73.55 and 10 CFR 100.21(f). The following provide criteria for meeting the regulations addressing physical protection of licensed activities in nuclear power reactors against radiological sabotage: NRC RG 4.7, General Site Suitability Criteria for Nuclear Stations; U.S. Nuclear Energy Institute 03-12, Template for Security Plan and Training and Qualification Plan; and EA-03-086, Revised Design Basis Threat Order for site specific security, engineering designed features and monitoring equipment, and security methods for screening station operating personnel.

In a letter, (CNL-17-090 response to staff RAI, dated October 19, 2017, ADAMS Accession No. ML17295A000), TVA indicated that should TVA apply for a COL referencing the ESP, TVA would review the actual design selected for the CRN Site COLA to demonstrate that the design would be bounded by the PPE, and differences would be reviewed for acceptability in the COLA. This review would confirm that selection of any specific reactor design technology discussed in Chapter 2 would not impact the development of the security plan such as site specific security, engineering designed features and monitoring equipment, and security methods for screening station operating personnel.

Based on the above response, the staff finds:

- The information contained in the application is consistent with the requirements stated in 10 CFR 52.17(a)(1)(x) and along with the applicant's response to the staff RAI provide sufficient basis to conclude that site characteristics regarding the installation of physical protection equipment and the implementation of a physical protection program are such that adequate security plans and measures can be developed.
- The site characteristics and topographical features would not pose an impediment to the implementation of a physical protection program. The proposed power block location inside the 94-acre land mass is of sufficient size for the installation of intrusion detection and assessment equipment, physical barriers, vehicle checkpoints and search areas (sally ports), and will accommodate the implementation of a physical protection program consistent with the requirements of 10 CFR 73.55 and 10 CFR 100.21(f).

13.6.4.3 Approaches

In SSAR Section 2.2, "Nearby Industrial, Transportation, and Military Facilities," the applicant describes hazardous materials, railways, highways and routes, airports, nearby power plants, pipelines information, and waterways that could impact the facilities and activities within the 5-mile (mi) vicinity of the CRN Site. These characteristics were analyzed as to meet the guidance in NUREG-0800, SRP for the Review of Safety Analysis Reports for Nuclear Power Plants: Light Water Reactor (LWR) Edition.

13.6.4.3.1 Locations and Routes

The approximate 935-acre of the CRN Site is located in the City of Oak Ridge, Tennessee (TN). The southern portion of the site, containing the power block area, is located on a peninsula bounded by the Clinch River arm of the Watts Bar Reservoir on the western, southern, and eastern sides.

The northern portion of the CRN Site is bounded on the north by the Grassy Creek Habitat Protection Area and to the east by the U.S. Department of Energy's Oak Ridge Reservation and Management Area. The applicant evaluated potential hazard facilities and routes within the 5-mile vicinity of the CRN Site, and airports within 10-mile of the site along with significant facilities at a greater distance in accordance with RG 1.206, "Combined License Applications for Nuclear Power Plant LWR Edition," RG 1.91, "Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants," RG 4.7, "General Site Suitability Criteria for Nuclear Power Stations," RG 1.78, "Evaluating the Habitability of a Nuclear Power Plant Control

Room During a Postulated Hazardous Chemical Release,” and relevant sections of 10 CFR Parts 50, 52, and 100.

The evaluation performed by the applicant identified five industrial facilities, Clinch River arm of Watts Bar Reservoir, one major highway, four major roads, Heritage Railroad Corporation Railway and two natural gas pipelines that are significant enough to be considered. These include:

Industrial Facilities

- Oak Ridge National Laboratory
- TVA Kingston Fossil Plant
- Oak Ridge Water Treatment Plant (WTP)
- TVA Bull Run Fossil Plant
- Hallsdale Powell Utility District Melton Hill WTP

Transport Routes

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

13.6.4.3.2 SSAR - Nearby Transportation Routes/Pipelines

The NRC evaluation below focuses on the impacts of industrial facilities, transport routes and airways as well as chemical hazards. Section 2.2.3.1.1.3, “Nearby Transportation Routes/Pipelines,” indicates that there are two natural gas transmission pipelines within the vicinity of the CRN Site. The closest approach from the nearest natural gas transmission pipeline, East Tennessee Natural Gas Pipeline 1 (6-inch), to the edge of the CRN Site power block area is approximately 1.1 mi (5,800 ft) and the closest approach from the East Tennessee Natural Gas Pipeline 2 (22-inch) to the edge of the power block area is approximately 3 mi (15,800 ft). The applicant indicated that a natural gas pipeline explosion occurring in the vicinity of the release point would be in an unconfined environment. The worst case scenario had considered the immediate detonation of natural gas content in the pipeline to be capable of supporting an explosion. The scenario assumed that the pipe had burst open, leaving the full cross-sectional area of the pipe completely exposed to the air. It was also assumed that the ignition source existed at the break point. The safe distance to 1 psi overpressure was calculated by determining the mass of natural gas released using TNT mass equivalent methodology as described in Subsection 2.2.3.1.1. Due to the nature of a high pressure release through a pipeline, upon a complete pipeline rupture, the initial release rate of the gas (lb/s) will be very large and quickly drop to a fraction of the initial release rate in an unconfined environment. As a result, detonation of natural gas in an unconfined environment would not have an adverse impact on structures beyond the safe distance and therefore would not be credible. However, ignition of a natural gas release near the release point could result in a less damaging deflagration explosion or jet fire.

The staff issued RAI 13.06.03-2 (ADAMS Accession No. ML17262B229), requesting that the applicant discuss how such an event, specifically the pressure induced by an explosion and the heat flux induced by a jet fire, was considered in the future development of the security plan.

In a letter, (CNL-17-090 response to staff RAI, dated October 19, 2017, ADAMS Accession No. ML17295A000), TVA indicated that SSAR Section 2.2.2.3 and Table 2.2-4 provide a description of the pipelines, sizes, age, operating pressure, depth of burial, and product carried. SSAR Section 2.2.2.3 identifies various isolation valves located along the pipeline route, which can be reached and operated within one-hour of notification. The worst-case scenarios, which considered the delayed ignition (detonation) of the released natural gas, with a one-hour maximum release, were presented in SSAR Sections 2.2.3.1.2.3, 2.2.3.1.3.3, and 2.2.3.1.4.

TVA indicated that the largest calculated safe distance of flammable vapor clouds (delayed ignition) deflagration and detonation and jet fire for the East Tennessee Natural Gas Pipeline 1 is 1,575 ft, which is less than the distance to the CRN Site power block area of 5,800 ft, and the largest calculated safe distance for the East Tennessee Natural Gas Pipeline 2 is 4,572 ft, which is less than the distance to the CRN Site power block area of 15,800 ft (Table 2.2-10). Based on the maximum safe distance information, the ability to access and operate those isolation valves provided by TVA and a review of SSAR reference sections and tables, the staff concludes that gas pipeline explosions would not impact safety-related structures, or prohibit the development of site security plans and measures in accordance with 10 CFR 52.17(a)(1)(x), 10 CFR 100.21(f), and the requirements of 10 CFR 73.55.

The staff also issued RAI 13.06.03-3 (ADAMS Accession No. ML17262B229), requesting that the applicant discuss transportation routes for ORNL, an assessment of products and materials being transported along the I-40 corridor, and the potential impact on the development of a site specific security plan.

In responding to the staff RAI, TVA indicated that SSAR Section 2.2.2.5 identified I-40 as a bounding transport route in the vicinity of the CRN Site. I-40 corridor, located approximately one mile from the site power block area, is the most significant and closest highway to the CRN Site. The route is evaluated as a potential transport route for supplies shipped to ORNL and for the potential effects of chemical accidents as part of design-basis events for plant design parameters. The route uses for shipping and receiving supplies at the plant may vary, and unless a material is prohibited on a route, there are no restrictions that would prevent the delivery from taking another nearby available route.

The chemicals stored at ORNL are presented in Table 2.2-2 of the SSAR. The disposition of hazards associated with these chemicals is summarized in Table 2.2-5 and the subsequent analysis of these chemicals is addressed in SSAR Section 2.2.3. Analysis of accidents involving chemicals, liquid fuels, and gaseous fuels were considered for facilities and activities within the vicinity of the CRN Site, where such materials are processed, stored, used, or transported in quantity. The effects of explosions were analyzed for structural response to blast pressures. The effects of blast pressure from explosions located at nearby facilities and transportation routes to the CRN Site power block area boundary were included in SSAR Section 2.2.3 and addressed whether the explosion would have an adverse effect on safety-related plant structures located within the CRN Site power block area, which could affect plant operation or prevent safe shutdown of the plant.

In a letter, (CNL-17-090 response to staff RAI, dated October 19, 2017, ADAMS Accession No. ML17295A000), TVA provided additional clarification discussions of the transportation routes in Section 2.2.2.2.2. These clarifications were, subsequently, incorporated in Revision 1 of the CRN ESP application (ADAMS Accession No. ML18005A067). Based on additional information provided by the applicant and the review of relevant SSAR sections, the staff finds

that potential accidents involving explosions and flammable vapor clouds from materials transported along the I-40 route would not adversely affect the safe operation or shutdown of units located within the CRN Site, or impact the development of the site security plan.

13.6.4.3.3 SSAR - Airports, Aircraft, and Airway Hazards

Section 2.2.2.7, "Airports, Aircraft, and Airway Hazards" indicates that there are five small privately-owned airports (Big T, Wolf Creek, Cox Farm, Will A Hildreth Farm, and Riley Creek) located between 5 and 10 statute miles of the CRN Site. These airports have no Federal Aviation Administration (FAA) Terminal Area Forecast (TAF) data available due to their size and low number of operations; however, their projected number of operations, based on locally available data, is less than the significance factor (i.e., the allowable annual number of operations) as specified in Criterion 1 of SRP Section 3.5.1.6 of NUREG-0800 in which the probability of aircraft accidents resulting in radiological consequences greater than the 10 CFR Part 100 exposure guidelines is less than an order of magnitude of 10^{-7} per year.

The applicant also indicated that two small privately-owned airports, Oliver Springs and Fergusons Flying Circus, are within 10 to 15 statute miles of the CRN Site. No FAA TAF data was available due to their size and low number of operations. However, based on locally available data for these airports, the projected number of operations for each airport is less than the significance factor (i.e., the allowable annual number of operations) as specified in Criterion 1 of SRP Section 3.5.1.6 of NUREG-0800. Airports located at distances greater than 15 statute miles were also evaluated to ensure that they meet the significance factor specified in Criterion 1 of SRP Section 3.5.1.6 of NUREG-0800. SSAR Table 2.2-7 documents the proximity screening results of these airports.

The applicant also evaluated the probability of aircraft accidents at the CRN Site to determine if the site met proximity screening Criterion 2, as specified in SRP Section 3.5.1.6 of NUREG-800. The applicant identified that the CRN Site is located about 19.2 statute miles from the centerline of the closest military training route. The closest military operation area (MOA) is the Snowbird MOA located approximately 36 miles from the CRN Site. The primary users of the Snowbird MOA were Air National Guard units, which have since been relocated or converted from fighter aircraft to other missions due to high terrain for the eastern part of the country and altitude allocated to accommodate civil overflights, which limit the area's flexibility and utility for military operations. Given this separation distance between the CRN Site and the nearest military training route (greater than 5 miles from the nearest edge of a military training route), along with the distance to the nearest MOA, the applicant concluded that Criterion 2 of SRP Section 3.5.1.6 of NUREG-0800 was met.

There are two Federal airways (V16 and J46) with the nearest edge located within 2 statute miles of the CRN Site. As required by Section 3.5.1.6 of NUREG-0800, the applicant conducted a detailed review of aircraft hazards to determine the accident probability rate. The analysis result is detailed in SSAR Section 2.2.2.7, and shown to be on the order of magnitude of 10^{-6} per year and the realistic probability has been shown to be lower. The applicant discussed aircraft hazards and assessment results in SSAR Section 3, "Design of Structures, Systems, Components, and Equipment," and concluded that the risk to plant safety from aircraft hazards is sufficiently low. Detailed discussion of aircraft impacts and staff regulatory assessment is discussed in Section 2.3.5.6. of this SE.

Based on the above discussion, the staff finds that the information contained in the application is consistent with the requirements of 10 CFR 52.17(a)(1)(x) and provides a sufficient basis to conclude that site characteristics regarding the establishment of security boundaries are such that adequate security plans and measures can be developed.

13.6.5 Conclusion

As described above and based on its review of additional clarification of referenced SSAR sections and tables, and response to staff RAIs, the staff concludes that the applicant provided sufficient technical basis to demonstrate that the site characteristics and potential hazards do not present impediments that would preclude the development of adequate security plans and measures. The staff also concludes that the CRN Site is such that adequate security plans and measures can be developed consistent with the requirements in 10 CFR 52.17(a)(1)(x) and 10 CFR 100.21(f).