TENNESSEE VALLEY AUTHORITY

CLINCH RIVER NUCLEAR SITE

EARLY SITE PERMIT

Docket No. 52-047

Early Site Permit No. ESP-006

1. The U.S. Nuclear Regulatory Commission (the NRC, or the Commission) has found the following:

   A. The application for an early site permit (ESP) filed by Tennessee Valley Authority (TVA) meets the applicable standards and requirements of the Atomic Energy Act of 1954, as amended ("Act"), and the Commission's regulations.

   B. All required notifications to other agencies or bodies have been duly made.

   C. There is reasonable assurance that the permit holder will comply with the regulations in Title 10 of the *Code of Federal Regulations* (CFR) Chapter I and the health and safety of the public will not be endangered.

   D. There is reasonable assurance that the site is in conformity with the provisions of the Act and the Commission's regulations.

   E. TVA is technically qualified to engage in any activities authorized.

   F. Issuance of the ESP will not be inimical to the common defense and security or to the health and safety of the public.

   G. The issuance of this ESP, subject to the Environmental Protection Plan (EPP) and the conditions for the protection of the environment set forth herein, is in accordance with the National Environmental Policy Act of 1969, as amended, and with the applicable sections of 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

   H. The findings required by 10 CFR Part 51, Subpart A, "National Environmental Policy Act—Regulations Implementing Section 102(2)," have been made.

2. Based on the foregoing findings, and pursuant to Sections 103 and 185 of the Act and 10 CFR Part 52, the NRC hereby issues Early Site Permit No. ESP-006 to TVA for the Clinch River Nuclear Site (CRN Site) located on a tract of land adjacent to the Clinch River arm of the Watts Bar Reservoir, west of the Oak Ridge Reservation, within the City of Oak Ridge, Tennessee. The site is bounded on the east, south, and west by the Clinch River arm of the Watts Bar Reservoir and on the north by the Grassy Creek Habitat Protection Area. Communities located near the site include Kingston (approximately 6.8 miles [mi] west), Harriman (9.2 mi west-northwest), Lenoir City (approximately 8.8 mi southeast), and Knoxville (approximately 25.6 mi east-northeast). The CRN Site is approximately 935 acres within a 1200 acre property owned by the United States of America and managed by TVA. The PPE is based on construction and

operation at the CRN Site of two or more small modular reactors (SMRs) with a maximum rated thermal power for a single reactor core of 800 megawatts thermal (MWt). The combined nuclear generating capacity from the site is not to exceed 2420 MWt (800 megawatts electric (MWe)). A future set of reactor modules on the CRN Site is proposed to be built in the "power block area" location identified in TVA's application.

3. This ESP shall be deemed to contain and is subject to the conditions specified in the Commission's regulations in 10 CFR Chapter I; is subject to all applicable provisions of the Act and the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the following conditions specified or incorporated below:

   A. The characteristics of the CRN Site set forth in Appendix A to this ESP are hereby incorporated into this ESP.

   B. The bounding design parameter values set forth in Appendix B to this ESP are hereby incorporated into this ESP.

   C. The combined license (COL) action items set forth in Appendix C to this ESP are hereby incorporated into this ESP. These COL action items identify certain matters that an applicant submitting a construction permit (CP) or COL application that references this ESP shall address in the safety analysis report (SAR). These items constitute information requirements but are not the only acceptable set of information in the SAR. An applicant may depart from or omit these items, provided that it identifies and justifies the departure or omission in the SAR. In addition, these items do not relieve an applicant from any requirement in 10 CFR Chapter I that governs the application. After issuance of a CP or COL, these items are not requirements for the permit holder or licensee unless such items are included in a permit or license condition.

   D. The site characteristics and plant parameter envelope values considered in the environmental review of the application are set forth in Appendix D to this ESP and are hereby incorporated into this ESP.

   E. The EPP in Appendix E is hereby incorporated into this ESP.

   F. The following conditions apply:

      (1) Based on the regional government projections of industrial growth, the Metropolitan Knoxville Airport Authority has selected the Heritage Center Industrial Park, approximately 6 mi from the CRN Site, as the potential site for a general aviation airport. An applicant for a COL or CP referencing this ESP shall evaluate this planned airport, wherever it is to be located, for potential aircraft crash impact probability to determine whether or not it is a design basis event. If the aircraft crash is a design basis event, then the applicant shall demonstrate that the plant may nonetheless be safely operated.

      (2) An applicant for a COL or CP referencing this ESP shall evaluate and demonstrate compliance with NRC regulations regarding the potential effect onsite and offsite toxic chemicals may have on control room habitability. This evaluation shall account for the onsite storage of chemicals (to be identified in the COL or CP application) and the chemicals anhydrous ammonia, chlorine, and nitric acid transported offsite on Interstate Highway I-40, where the concentration

of these chemicals exceeds the respective IDLH (Immediately Dangerous to Life and Health) limit at the CRN Site power block area.

(3) An applicant for a COL or CP that references this ESP shall perform detailed geologic mapping of excavations for safety-related engineered structures; examine and evaluate geologic features discovered in those excavations; and notify the Director of the Office of Nuclear Reactor Regulation, or the Director's designee, once excavations for safety-related structures are open for examination by NRC staff.

(4) An applicant for a COL or a CP that references this ESP shall remove the material above El. 225.9 m (741 ft) NAVD 88 in areas where safety-related structures will be located to minimize the adverse effects of discontinuities, weathered and shear-fracture zones, and karst features on the stability of subsurface materials and foundations. The applicant shall also perform additional geotechnical investigations, in accordance with RG 1.132, at the excavation level to identify any potential geologic features that may adversely impact the stability of subsurface materials and foundations.

(5) An applicant for a COL or CP that references this ESP shall provide detailed information in the COL or CP application that demonstrates that the accident release source term information for the selected SMR design used in analyses to support the determination of the plume exposure pathway emergency planning zone (EPZ) size is bounded by the non-design-specific plant parameter source term information in the following Table 13.3-1, "Plant Parameter Accident Releases for Determining Emergency Planning Zone (EPZ) Size in Support of Emergency Planning Exemptions."

Table 13.3-1

Plant Parameter Accident Releases for Determining Emergency Planning Zone (EPZ) Size in Support of Emergency Planning Exemptions

Nuclide	4-Day Total Activity (Ci)	Nuclide	4-Day Total Activity (Ci)
Kr-85	3.29E+03	Ru-106	2.68E+00
Kr-85m	1.94E+03	Rh-103m	4.11E+00
Kr-87	1.10E+03	Rh-106	2.70E+00
Kr-88	3.04E+03	Nb-95	6.45E+01
Xe-133	1.74E+05	Co-58	7.88E-05
Xe-135	1.49E+04	Co-60	8.74E-04
Xe-135m	6.95E+02	Mo-99	6.16E+01
Cs-134	1.26E+02	Tc-99m	5.80E+01
Cs-136	2.82E+01	Nb-97	3.95E+00
Cs-137	8.88E+01	Nb-97m	4.61E-01
Rb-86	9.92E-01	Ce-141	1.31E+00
Rb-88	2.59E+03	Ce-143	1.09E+00
Ba-139	1.22E+01	Ce-144	1.10E+00
Ba-140	4.82E+01	Np-239	1.10E+01
Sr-89	2.20E+01	Pu-238	7.75E-03
Sr-90	7.46E+00	Pu-239	3.21E-04
Sr-91	2.05E+01	Pu-240	6.48E-04
Sr-92	1.27E+01	Pu-241	1.60E-01
Ba-137m	8.00E+01	Zr-95	6.34E-01
I-131	6.79E+02	Zr-97	5.64E-01
I-132	4.35E+02	Am-241	1.06E-04
I-133	9.72E+02	Cm-242	2.61E-02
I-134	2.08E+02	Cm-244	1.09E-02
I-135	6.59E+02	La-140	4.75E+00
Sb-127	1.51E+01	La-141	2.45E-02
Sb-129	1.23E+01	La-142	8.65E-01
Te-127	1.60E+01	Nd-147	6.82E+00
Te-127m	2.86E+00	Pr-143	3.10E-01
Te-129	1.75E+01	Y-90	5.05E-01
Te-129m	8.15E+00	Y-91	2.74E-01
Te-131m	2.22E+01	Y-92	7.46E+00
Te-132	1.78E+02	Y-93	2.90E-01
Te-131	1.09E+01	Y-91m	9.90E+00
Rh-105	2.90E+00	Pr-144	9.65E-01
Ru-103	4.13E+00	Pr-144m	1.72E-02
Ru-105	1.55E+00		

(6) An applicant for a COL or CP that references this ESP shall update the emergency plan to describe the on-shift personnel assigned to emergency plan implementing functions based on the chosen SMR technology and the number of proposed reactor units.

In addition, if a COL applicant references this ESP, the COL applicant shall propose a license condition for the COL holder to perform the following:

(i) No later than 18 months before the latest date set forth in the schedule submitted in accordance with 10 CFR 52.99(a) for completing the inspections, tests, and analyses in the Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC), the licensee shall have performed a detailed staffing analysis, in accordance with the latest NRC-endorsed revision of Nuclear Energy Institute (NEI) 10-05, "Assessment of On-Shift Emergency Response Organization Staffing and Capabilities."

(ii) No later than 180 days before the date scheduled for initial fuel loading set forth in the notification submitted in accordance with 10 CFR 52.103(a), the licensee shall have revised the emergency plan to incorporate any changes identified in the staffing analysis that are needed to bring staffing to the required levels.

If a CP applicant references this ESP, the CP applicant shall propose a permit condition for the operating license applicant to:

(i) Perform a detailed staffing analysis, in accordance with the latest NRC-endorsed revision of NEI 10-05, "Assessment of On-Shift Emergency Response Organization Staffing and Capabilities."

(ii) Revise the emergency plan to incorporate any changes identified in the staffing analysis that are needed to bring staffing to the required levels.

(7) If an applicant for a CP references this ESP, then references in the ESP SSAR to COL, COL applicant, or COL application will include and apply to a CP, CP applicant, and CP application, respectively, unless the context indicates otherwise.

4. Exemptions

A. The exemptions for the Site Boundary EPZ Emergency Plan 5A that are described below are granted for the following reasons: As discussed in Section 13.3 of the final safety evaluation report (FSER), the exemptions are authorized by law, will not present an undue risk to the public health and safety, and are consistent with the common defense and security. Also, special circumstances are present under 10 CFR 50.12(a)(2)(ii) because application of the regulations in the particular circumstances is not necessary to achieve the underlying purpose of the rule. The NRC is granting exemptions from the regulatory text below that is struck out; the regulatory text that is not struck out continues to apply. These exemptions may be used by a COL or CP applicant referencing this ESP only if (a) the condition in Section 3.F.(5) of this permit is satisfied, and (b) the COL or CP applicant performs an analysis in accordance with the methodology in SSAR Section 13.3 that meets all criteria in SSAR Section 13.3 for a site boundary plume exposure pathway EPZ.

(1) Exemptions from regulations in 10 CFR 50.33(g), 50.47(b), and 50.47(c)(2):

(i) 10 CFR 50.33(g): If the application is for an operating license or combined license for a nuclear power reactor, or if the application is for an early site permit and contains plans for coping with emergencies under § 52.17(b)(2)(ii) of this chapter, the applicant shall submit radiological emergency response plans of State and local governmental entities in the United States that are wholly or partially within the plume exposure pathway emergency planning zone (EPZ), as well as the plans of State governments wholly or partially within the ingestion pathway EPZ. If the application is for an early site permit that, under 10 CFR 52.17(b)(2)(i), proposes major features of the emergency plans describing the EPZs, then the descriptions of the EPZs must meet the requirements of this paragraph. Generally, ~~the plume exposure pathway EPZ for nuclear power reactors shall consist of an area about 10 miles (16 km) in radius and~~ the ingestion pathway EPZ shall consist of an area about 50 miles (80 km) in radius. The exact size and configuration of the EPZs surrounding a particular nuclear power reactor shall be determined in relation to the local emergency response needs and capabilities as they are affected by such conditions as demography, topography, land characteristics, access routes, and jurisdictional boundaries. The size of the EPZs also may be determined on a case-by-case basis for gas-cooled reactors and for reactors with an authorized power level less than 250 MW thermal. The plans for the ingestion pathway shall focus on such actions as are appropriate to protect the food ingestion pathway.

(ii) 10 CFR 50.47(b): The onsite ~~and, except as provided in paragraph (d) of this section, offsite~~ emergency response plans for nuclear power reactors must meet the following standards:

(iii) 10 CFR 50.47(b)(4): A standard emergency classification and action level scheme, the bases of which include facility system and effluent parameters, is in use by the nuclear facility licensee~~, and State and local response plans call for reliance on information provided by facility licensees for determinations of minimum initial offsite response measures~~.

(iv) 10 CFR 50.47(b)(5): Procedures have been established for notification, by the licensee, of State and local response organizations and for notification of emergency personnel by all organizations; the content of initial and follow-up messages to response organizations ~~and the public~~ has been established~~; and means to provide early notification and clear instruction to the populace within the plume exposure pathway Emergency Planning Zone have been established~~.

(v) 10 CFR 50.47(b)(6): Provisions exist for prompt communications among principal response organizations to emergency personnel ~~and to the public~~.

(vi) 10 CFR 50.47(b)(9): Adequate methods, systems, and equipment for assessing and monitoring actual or potential ~~offsite~~ consequences of a

radiological emergency condition are in use.

(vii) 10 CFR 50.47(b)(10): A range of protective actions has been developed for the plume exposure pathway EPZ for emergency workers and the public. ~~In developing this range of actions, consideration has been given to evacuation, sheltering, and, as a supplement to these, the prophylactic use of potassium iodide (KI), as appropriate. Evacuation time estimates have been developed by applicants and licensees. Licensees shall update the evacuation time estimates on a periodic basis.~~ Guidelines for the choice of ~~protective actions during an emergency, consistent with Federal guidance, are developed and in place, and~~ protective actions for the ingestion exposure pathway EPZ appropriate to the locale have been developed.

(viii) 10 CFR 50.47(c)(2): Generally, ~~the plume exposure pathway EPZ for nuclear power plants shall consist of an area about 10 miles (16 km) in radius and~~ the ingestion pathway EPZ shall consist of an area about 50 miles (80 km) in radius. The exact size and configuration of the EPZs surrounding a particular nuclear power reactor shall be determined in relation to local emergency response needs and capabilities as they are affected by such conditions as demography, topography, land characteristics, access routes, and jurisdictional boundaries. The size of the EPZs also may be determined on a case-by-case basis for gas cooled nuclear reactors and for reactors with an authorized power level less than 250 MW thermal. The plans for the ingestion pathway shall focus on such actions as are appropriate to protect the food ingestion pathway.

(2) Exemptions from regulations in Appendix E to 10 CFR Part 50:

(i) IV.2. ~~This nuclear power reactor license applicant shall also provide an analysis of the time required to evacuate various sectors and distances within the plume exposure pathway EPZ for transient and permanent populations, using the most recent U.S. Census Bureau data as of the date the applicant submits its application to the NRC.~~

(ii) IV.3. ~~Nuclear power reactor licensees shall use NRC approved evacuation time estimates (ETEs) and updates to the ETEs in the formulation of protective action recommendations and shall provide the ETEs and ETE updates to State and local governmental authorities for use in developing offsite protective action strategies.~~

(iii) IV.4. ~~Within 365 days of the later of the date of the availability of the most recent decennial census data from the U.S. Census Bureau or December 23, 2011, nuclear power reactor licensees shall develop an ETE analysis using this decennial data and submit it under § 50.4 to the NRC. These licensees shall submit this ETE analysis to the NRC at least 180 days before using it to form protective action recommendations and providing it to State and local governmental authorities for use in developing offsite protective action strategies.~~

(iv) IV.5. ~~During the years between decennial censuses, nuclear power reactor~~

~~licensees shall estimate EPZ permanent resident population changes once a year, but no later than 365 days from the date of the previous estimate, using the most recent U.S. Census Bureau annual resident population estimate and State/local government population data, if available. These licensees shall maintain these estimates so that they are available for NRC inspection during the period between decennial censuses and shall submit these estimates to the NRC with any updated ETE analysis.~~

(v) IV.6. ~~If at any time during the decennial period, the EPZ permanent resident population increases such that it causes the longest ETE value for the 2-mile zone or 5-mile zone, including all affected Emergency Response Planning Areas, or for the entire 10-mile EPZ to increase by 25 percent or 30 minutes, whichever is less, from the nuclear power reactor licensee's currently NRC approved or updated ETE, the licensee shall update the ETE analysis to reflect the impact of that population increase. The licensee shall submit the updated ETE analysis to the NRC under § 50.4 no later than 365 days after the licensee's determination that the criteria for updating the ETE have been met and at least 180 days before using it to form protective action recommendations and providing it to State and local governmental authorities for use in developing offsite protective action strategies.~~

(vi) IV.7. ~~After an applicant for a combined license under part 52 of this chapter receives its license, the licensee shall conduct at least one review of any changes in the population of its EPZ at least 365 days prior to its scheduled fuel load. The licensee shall estimate EPZ permanent resident population changes using the most recent U.S. Census Bureau annual resident population estimate and State/local government population data, if available. If the EPZ permanent resident population increases such that it causes the longest ETE value for the 2-mile zone or 5-mile zone, including all affected Emergency Response Planning Areas, or for the entire 10-mile EPZ, to increase by 25 percent or 30 minutes, whichever is less, from the licensee's currently approved ETE, the licensee shall update the ETE analysis to reflect the impact of that population increase. The licensee shall submit the updated ETE analysis to the NRC for review under § 50.4 of this chapter no later than 365 days before the licensee's scheduled fuel load.~~

(vii) IV.D.1. Administrative and physical means for notifying local, State, and Federal officials and agencies ~~and agreements reached with these officials and agencies for the prompt notification of the public and for public evacuation or other protective measures, should they become necessary,~~ shall be described. This description shall include identification ~~of the appropriate officials, by title and agency,~~ of the State and local government agencies within the EPZs.

(viii) IV.D.3. A licensee shall have the capability to notify responsible State and local governmental agencies within 15 minutes after declaring an emergency. ~~The licensee shall demonstrate that the appropriate governmental authorities have the capability to make a public alerting and notification decision promptly on being informed by the licensee of an emergency condition. Prior to initial operation greater than 5 percent of rated thermal power of the first~~

~~reactor at a site, each nuclear power reactor licensee shall demonstrate that administrative and physical means have been established for alerting and providing prompt instructions to the public within the plume exposure pathway EPZ. The design objective of the prompt public alert and notification system shall be to have the capability to essentially complete the initial alerting and initiate notification of the public within the plume exposure pathway EPZ within about 15 minutes. The use of this alerting and notification capability will range from immediate alerting and notification of the public (within 15 minutes of the time that State and local officials are notified that a situation exists requiring urgent action) to the more likely events where there is substantial time available for the appropriate governmental authorities to make a judgment whether or not to activate the public alert and notification system. The alerting and notification capability shall additionally include administrative and physical means for a backup method of public alerting and notification capable of being used in the event the primary method of alerting and notification is unavailable during an emergency to alert or notify all or portions of the plume exposure pathway EPZ population. The backup method shall have the capability to alert and notify the public within the plume exposure pathway EPZ, but does no need to meet the 15-minute design objective for the primary prompt public alert and notification system. When there is a decision to activate the alert and notification system, the appropriate governmental authorities will determine whether to activate the entire alert and notification system simultaneously or in a graduated or staged manner. The responsibility for activating such a public alert and notification system shall remain with the appropriate governmental authorities.~~

(ix) IV.D.4. ~~If FEMA has approved a nuclear power reactor site's alert and notification design report, including the backup alert and notification capability, as of December 23, 2011, then the backup alert and notification capability requirements in Section IV.D.3 must be implemented by December 24, 2012. If the alert and notification design report does not include a backup alert and notification capability or needs revision to ensure adequate backup alert and notification capability, then a revision of the alert and notification design report must be submitted to FEMA for review by June 24, 2013, and the FEMA-approved backup alert and notification means must be implemented within 365 days after FEMA approval. However, the total time period to implement a FEMA-approved backup alert and notification means must not exceed June 22, 2015.~~

(x) IV.F.2. The plan shall describe provisions for the conduct of emergency preparedness exercises as follows: Exercises shall test the adequacy of timing and content of implementing procedures and methods, test emergency equipment and communications networks, ~~test the public alert and notification system,~~ and ensure that emergency organization personnel are familiar with their duties.

(xi) IV.F.2.a. A[n] ~~full participation~~ exercise which tests as much of the licensee~~, State, and local~~ emergency plans as is reasonably achievable ~~without mandatory public participation~~ shall be conducted for each site at which a power reactor is located. Nuclear power reactor licensees shall submit exercise scenarios under § 50.4 at least 60 days before use in a[n] ~~full~~

~~participation~~ exercise required by this paragraph 2.a.

(xii) IV.F.2.a.(i) For an operating license issued under this part, this exercise must be conducted within two years before the issuance of the first operating license for full power (one authorizing operation above 5 percent of rated power) of the first reactor and shall include participation by ~~each State and local government within the plume exposure pathway EPZ and~~ each state within the ingestion exposure pathway EPZ. If the ~~full participation~~ exercise is conducted more than 1 year prior to issuance of an operating licensee for full power, an exercise which tests the licensee's onsite emergency plans must be conducted within one year before issuance of an operating license for full power. ~~This exercise need not have State or local government participation.~~

(xiii) IV.F.2.a.(ii) For a combined license issued under part 52 of this chapter, this exercise must be conducted within two years of the scheduled date for initial loading of fuel. If the first ~~full participation~~ exercise is conducted more than one year before the scheduled date for initial loading of fuel, an exercise which tests the licensee's onsite emergency plans must be conducted within one year before the scheduled date for initial loading of fuel. ~~This exercise need not have State or local government participation. If FEMA identifies one or more deficiencies in the state of offsite emergency preparedness as the result of the first full participation exercise, or i~~[I]f the Commission finds that the state of emergency preparedness does not provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency, the provisions of § 50.54(gg) apply.

(xiv) IV.F 2.a.(iii) For a combined license issued under part 52 of this chapter, if the applicant currently has an operating reactor at the site, an exercise~~, either full or partial participation,~~ shall be conducted for each subsequent reactor constructed on the site. This exercise may be incorporated in the exercise requirements of Sections IV.F.2.b. and c. in this appendix. ~~If FEMA identifies one or more deficiencies in the state of offsite emergency preparedness as the result of this exercise for the new reactor, or i~~[I]f the Commission finds that the state of emergency preparedness does not provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency, the provisions of § 50.54(gg) apply.

(xv) IV.F.2.b. Each licensee at each site shall conduct a subsequent exercise of its onsite emergency plan every 2 years. Nuclear power reactor licensees shall submit exercise scenarios under § 50.4 at least 60 days before use in an exercise required by this paragraph 2.b. ~~The exercise may be included in the full participation biennial exercise required by paragraph 2.c. of this section.~~ In addition, the licensee shall take actions necessary to ensure that adequate emergency response capabilities are maintained during the interval between biennial exercises by conducting drills, including at least one drill involving a combination of some of the principal functional areas of the licensee's onsite emergency response capabilities. The principal functional areas of emergency response include activities such as management and coordination of emergency response, accident assessment, event classification, notification of offsite authorities, assessment of the onsite ~~and offsite~~ impact of radiological releases, ~~protective action recommendation~~

~~development, protective action decision making,~~ plant system repair and mitigative action implementation. During these drills, activation of all of the licensee's emergency response facilities (Technical Support Center (TSC), Operations Support Center (OSC), and the Emergency Operations Facility (EOF)) would not be necessary, licensees would have the opportunity to consider accident management strategies, supervised instruction would be permitted, operating staff in all participating facilities would have the opportunity to resolve problems (success paths) rather than have controllers intervene, and the drills may focus on the onsite exercise training objectives.

(xvi) IV.F.2.c. ~~Offsite plans for each site shall be exercised biennially with full participation by each offsite authority having a role under the radiological response plan. Where the offsite authority has a role under a radiological response plan for more than one site, it shall fully participate in one exercise every two years and shall, at least, partially participate in other offsite plan exercises in this period. If two different licensees each have licensed facilities located either on the same site or on adjacent, contiguous sites, and share most of the elements defining co-located licensees, then each licensee shall~~:

~~(1) Conduct an exercise biennially of its onsite emergency plan;~~

~~(2) Participate quadrennially in an offsite biennial full or partial participation exercise;~~

~~(3) Conduct emergency preparedness activities and interactions in the years between its participation in the offsite full or partial participation exercise with offsite authorities, to test and maintain interface among the affected State and local authorities and the licensee. Co-located licensees shall also participate in emergency preparedness activities and interaction with offsite authorities for the period between exercises~~;

~~(4) Conduct a hostile action exercise of its onsite emergency plan in each exercise cycle~~; ~~and~~

~~(5) Participate in an offsite biennial full or partial participation hostile action exercise in alternating exercise cycles~~.

(xvii) IV.F.2.d. Each State with responsibility for nuclear power reactor emergency preparedness should fully participate in the ingestion pathway portion of exercises at least once every exercise cycle. In States with more than one nuclear power reactor plume exposure pathway EPZ, the State should rotate this participation from site to site. ~~Each State with responsibility for nuclear power reactor emergency preparedness should fully participate in a hostile action exercise at least once every cycle and should fully participate in one hostile action exercise by December 31, 2015. States with more than one nuclear power reactor plume exposure pathway EPZ should rotate this participation from site to site.~~

B. The exemptions for the 2-Mile EPZ Emergency Plan 5B that are described below are granted for the following reasons: As discussed in Section 13.3 of the FSER, the exemptions are authorized by law, will not present an undue risk to the public health and

safety, and are consistent with the common defense and security. Also, special circumstances are present under 10 CFR 50.12(a)(2)(ii) because application of the regulations in the particular circumstances is not necessary to achieve the underlying purpose of the rule. The NRC is granting exemptions from the regulatory text below that is struck out; the regulatory text that is not struck out continues to apply. These exemptions may be used by a COL or CP applicant referencing this ESP only if (a) the condition in Section 3.F.(5) of this permit is satisfied, and (b) the COL or CP applicant performs an analysis in accordance with the methodology in SSAR Section 13.3 that meets all criteria in SSAR Section 13.3 for a 2-Mile plume exposure pathway EPZ.

(1) Exemptions from regulations in 10 CFR 50.33(g) and 50.47(c)(2):

(i) 10 CFR 50.33(g): If the application is for an operating license or combined license for a nuclear power reactor, or if the application is for an early site permit and contains plans for coping with emergencies under § 52.17(b)(2)(ii) of this chapter, the applicant shall submit radiological emergency response plans of State and local governmental entities in the United States that are wholly or partially within the plume exposure pathway emergency planning zone (EPZ), as well as the plans of State governments wholly or partially within the ingestion pathway EPZ. If the application is for an early site permit that, under 10 CFR 52.17(b)(2)(i), proposes major features of the emergency plans describing the EPZs, then the descriptions of the EPZs must meet the requirements of this paragraph. Generally, ~~the plume exposure pathway EPZ for nuclear power reactors shall consist of an area about 10 miles (16 km) in radius and~~ the ingestion pathway EPZ shall consist of an area about 50 miles (80 km) in radius. The exact size and configuration of the EPZs surrounding a particular nuclear power reactor shall be determined in relation to the local emergency response needs and capabilities as they are affected by such conditions as demography, topography, land characteristics, access routes, and jurisdictional boundaries. The size of the EPZs also may be determined on a case-by-case basis for gas-cooled reactors and for reactors with an authorized power level less than 250 MW thermal. The plans for the ingestion pathway shall focus on such actions as are appropriate to protect the food ingestion pathway.

(ii) 10 CFR 50.47(c)(2): Generally, ~~the plume exposure pathway EPZ for nuclear power plants shall consist of an area about 10 miles (16 km) in radius and~~ the ingestion pathway EPZ shall consist of an area about 50 miles (80 km) in radius. The exact size and configuration of the EPZs surrounding a particular nuclear power reactor shall be determined in relation to local emergency response needs and capabilities as they are affected by such conditions as demography, topography, land characteristics, access routes, and jurisdictional boundaries. The size of the EPZs also may be determined on a case-by-case basis for gas cooled nuclear reactors and for reactors with an authorized power level less than 250 MW thermal. The plans for the ingestion pathway shall focus on such actions as are appropriate to protect the food ingestion pathway.

5. An applicant for a COL or CP application referencing this ESP shall develop an EPP for construction and operation of the proposed plant and include the EPP in the application. The portion of the EPP directed to operation shall include any environmental conditions

derived in accordance with 10 CFR 50.36b, “Environmental conditions.”

6. The holders of this ESP are subject to the requirements of 10 CFR Part 21, “Reporting of Defects and Noncompliance,” as of the date of issuance of this ESP.

7. This ESP is effective as of [date of issuance] and shall expire at midnight on [20 years from date of issuance].

For The Nuclear Regulatory Commission

Frederick D. Brown, Director
Office of New Reactors

Appendices:
Appendix A – Characteristics of the CRN ESP Site
Appendix B – Bounding Design Parameters
Appendix C – Combined License Action Items
Appendix D – Site Characteristics and Plant Parameter Envelope Values Considered in the Environmental Review of the Application
Appendix E – Environmental Protection Plan (Nonradiological)

APPENDIX A

CHARACTERISTICS OF THE CRN SITE

Characteristic/Parameter	Site-Specific Value[a]	Description
Geography and Demography		
Exclusion Area Boundary (EAB)	Clinch River Property Boundary	The area surrounding the reactors, in which the reactor licensee has the authority to determine all activities, including exclusion or removal of personnel and property from the area.
Low Population Zone	1 mi from CRN Site center point	The area immediately surrounding the exclusion area which contains residents, the total number and density of which are such that there is a reasonable probability that appropriate protective measures could be taken in their behalf in the event of a serious accident.
Population Center Distance	4.8 mi (southeast)	The distance from the site center point to the nearest boundary of a densely populated center containing more than about 25,000 residents.
Meteorology and Hydrology		
Winter Precipitation		
Normal Winter Precipitation Event	21.9 psf	The maximum ground-level weight (lb/ft^2) of the 1) 100-year return snowpack (snow cover), 2) historical snowpack (snow cover), 3) 100-year return 2-day snowfall event, or 4) historical maximum 2-day snowfall event.
Extreme Frozen Winter Precipitation Event	21.9 psf	The maximum ground-level weight (lb/ft^2) of the 1) 100-year return 2-day snowfall event or 2) historical maximum 2-day snowfall event.
Extreme Liquid Winter Precipitation Event (48-hour Probable Maximum Winter Precipitation (PMWP))	23.5 in	The extreme liquid winter precipitation event is defined as the theoretically greatest ground-level depth of precipitation (in inches of water) for a 48-hour period that is physically possible over a 25.9 square kilometer (10 square mile) area at a particular geographical location during those months with the historically highest snowpacks.
Potential for Frazil Ice in Ultimate Heat Sink (UHS) Water Storage Facility	N/A	Potential for accumulated ice formation in the UHS Water Storage Facility in a turbulent flow condition.
Maximum Rainfall Rate	18.8 in/hr 6 in/5-minutes	PMP for 1-hour and for 5-minute durations at the site estimated from Hydro-Meteorological Report HMR-52.

(SRI/CEII)

Characteristic/Parameter	Site-Specific Value[(a)]	Description
Maximum Flood (or Tsunami)	[[ ]] ft NGVD29 ([[ ]] ft NAVD88) – Still water [[ ]] ft – wind-wave [[ ]] ft NGVD29 ([[ ]] ft NAVD88) – Combined	Predicted maximum flood level (including wave run-up) from external events, not including local PMP.
Maximum Ground Water	816.1 ft NAVD88	Maximum groundwater level under deep foundation structures in power block area.
Basic Wind Speed	96.3 mph for a 3-second gust	Wind velocity at 33 ft above ground for Exposure Category C associated with a 100-year return period in the site area.
Historical Maximum Wind Speed	87 mph for a 3-second gust 73 mph fastest mile	The resulting windspeed for nominal 3-second peak-gust values at a height of 33 ft in flat open terrain.
Design-Basis Hurricane Windspeed	130 mph for a 3-second gust	Wind velocity at 33 ft above ground associated with the most severe hurricane wind that has been historically observed in the site region.
Tornado		
Maximum Pressure Drop	1.2 psi	Decrease in ambient pressure from normal atmospheric pressure at the site due to passage of a tornado having a probability of occurrence of 10^{-7} per year.
Maximum Rotational Speed	184 mph	Rotation component of maximum wind speed at the site due to passage of a tornado having a probability of occurrence of 10^{-7} per year.
Maximum Translational Speed	46 mph	Translation component of maximum wind speed at the site due to the movement across the ground of a tornado having a probability of occurrence of 10^{-7} per year.
Maximum Wind Speed	230 mph	Sum of the maximum rotational and translational wind speed components at the site due to passage of a tornado having a probability of occurrence of 10^{-7} per year.
Radius of Maximum Rotational Speed	150 ft	Distance from the center of the tornado at which the maximum rotational wind speed occurs at site due to passage of a tornado having a probability of occurrence of 10^{-7} per year.

Characteristic/Parameter	Site-Specific Value[a]	Description
Rate of Pressure Drop	0.5 psi/s	Maximum rate of pressure drop at site due to passage of a tornado having a probability of occurrence of 10^{-7} per year.
Site Characteristic Ambient Air Temperatures		Site characteristic wet bulb and dry bulb temperatures associated with the listed exceedance values and the 100-year return period.
Maximum Dry Bulb Temperature with Maximum Wet Bulb Temperature		The maximum dry-bulb temperature that has existed at the site for 2 hours or more combined with the maximum wet-bulb temperature that exists in that population of dry-bulb temperatures.
95% Annual Exceedance	30°F Dry Bulb	
5% Annual Exceedance	85°F Dry Bulb 71.8°F Coincident Wet Bulb	
2% Annual Exceedance	90°F Dry Bulb 73.7°F Coincident Wet Bulb	
1% Annual Exceedance	92°F Dry Bulb 74.2°F Coincident Wet Bulb	
0.4% Annual Exceedance	95°F Dry Bulb 74.9°F Coincident Wet Bulb	
0% Annual Exceedance	105°F Dry Bulb 74.6°F Coincident Wet Bulb	
100-Year Return Period	107°F Dry Bulb 73.1°F Coincident Wet Bulb	
Maximum Non-Coincident Wet Bulb Temperature		The maximum historic wet-bulb temperature recorded for 2 or more hours.
2% Annual Exceedance	75.7°F	
1% Annual Exceedance	76.7°F	
0.4% Annual Exceedance	77.6°F	
0% Annual Exceedance	81.7°F	
100-Year Return Period	83.6°F	
Minimum Dry Bulb Temperature		
2% Annual Exceedance	25°F	
1% Annual Exceedance	21°F	
0.4% Annual Exceedance	16°F	
0% Annual Exceedance	-9°F	
100-Year Return Period	-9.9°F	

Characteristic/Parameter	Site-Specific Value[a]	Description
Atmospheric Dispersion (X/Q) (Accident) 0-2 hr @ EAB 0-8 hr @ LPZ 8-24 hr @ LPZ 1-4 day @ LPZ 4-30 day @ LPZ	 4.96×10^{-3} s/m^3 3.10×10^{-4} s/m^3 2.26×10^{-4} s/m^3 1.14×10^{-4} s/m^3 4.30×10^{-5} s/m^3	Atmospheric dispersion coefficients used in the design safety analyses to estimate dose consequences of accident airborne releases.
Atmospheric Dispersion (X/Q) (Annual Average)	Refer to SSAR Table 2.3.5-10	Atmospheric dispersion coefficient used in the safety analysis for the dose consequences of normal airborne releases.
Gaseous Releases		
Dose Consequences Normal Post-Accident	 10 CFR Part 20, App. B 10 CFR Part 50, App. I 10 CFR 52.17(a)(1)(ix)	 Estimated design radiological dose consequences due to gaseous releases from normal operation of the plant. Estimated design radiological dose consequences due to gaseous releases from postulated accidents.
Minimum Distance from Release Point to EAB	1100 ft	Minimum lateral distance from the effluent release boundary to the EAB.
Liquid Releases		
Dose Consequences Normal Post-Accident	 10 CFR Part 20, App. B 10 CFR Part 50, App. I 10 CFR Part 20, App. B DC/COL-ISG-013	 Estimated design radiological dose consequences due to liquid effluent releases from normal operation of the plant. Estimated design radiological dose consequences due to liquid effluent releases from postulated accidents.
Geology, Seismology, and Geotechnical Engineering		
Ground Motion Response Spectra	SSAR Figure 2.5.2-78	The design response spectra used to establish a plant's seismic design.
Capable Tectonic Structures or Sources	None	The assumption made in a plant design about the presence of capable faults or earthquake sources in the vicinity of the plant site (e.g., no fault displacement potential within the investigative area).
Soil Properties Liquefaction	 None	 Liquefaction potential at the site.

Characteristic/Parameter	Site-Specific Value[(a)]	Description
Minimum Bearing Capacity (Static)	110 ksf	Allowable load-bearing capacity of layer supporting plant structures.
Minimum Shear Wave Velocity	4650 fps	Propagation velocity of shear waves through foundation materials.
Dynamic Bearing Capacity	110 ksf	Capacity of the foundation soil/rock to resist loads imposed by the structures in the event of an earthquake.
Minimum Soil Angle of Internal Friction	36°	Minimum value of the internal friction angle of foundation soils, fill soils, or excavation slopes that would provide a safe design of the plant through soil structure interaction analyses including sliding along the base.

(a) Values shown are for a single unit, but would be the same value for each additional unit.

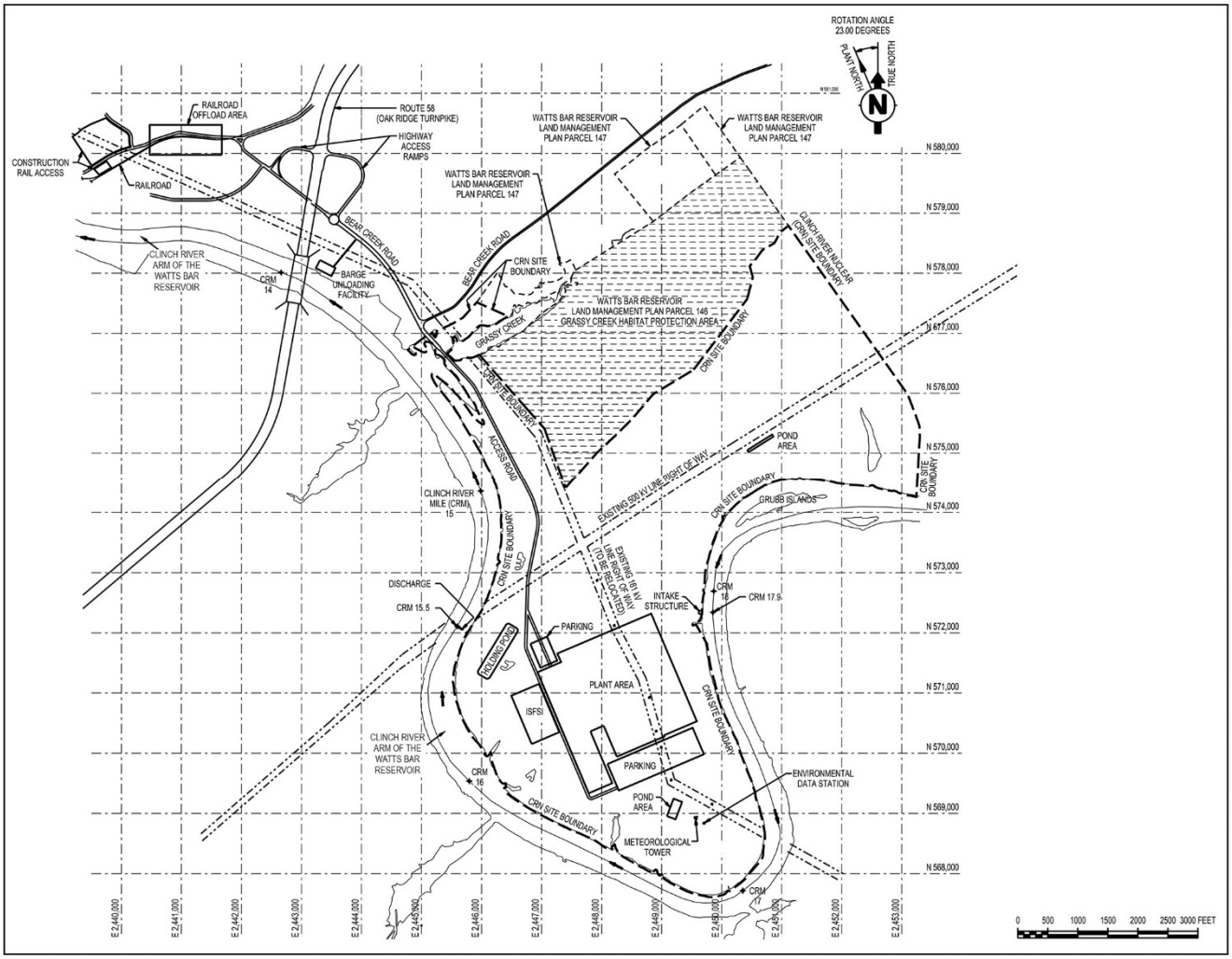
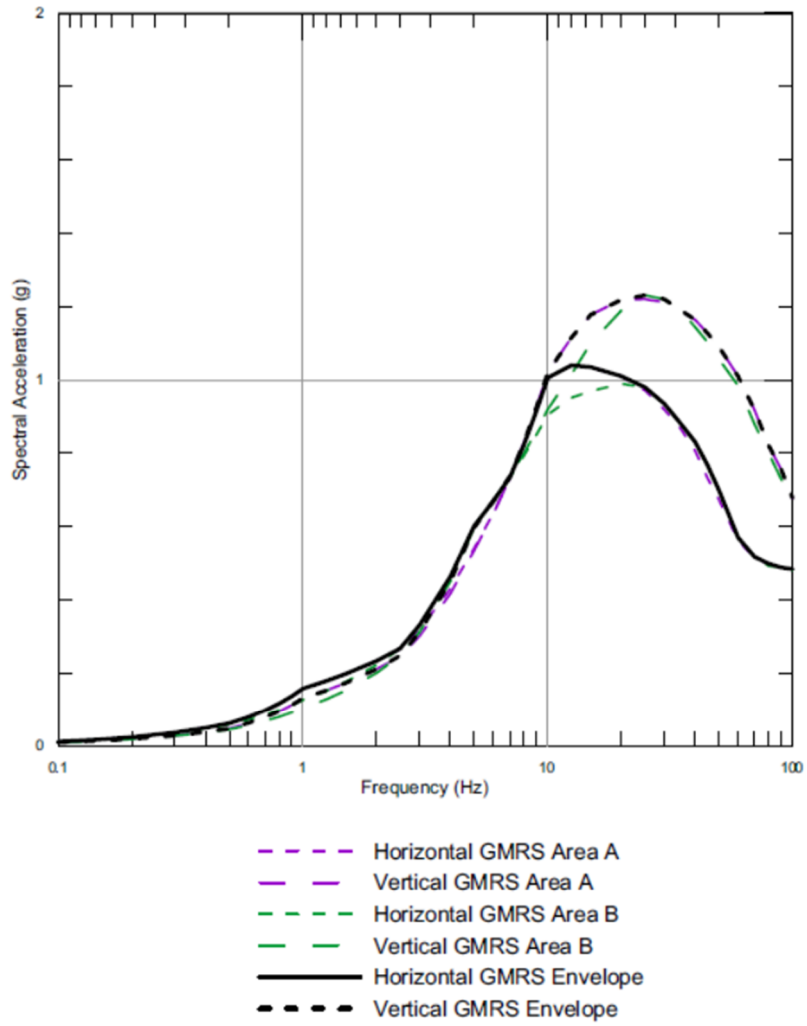


Figure A.3-1 – CRN Site Boundary
(Reproduced from SSAR Revision 1, Figure 1.2-1)



Note: Location shown on Figure 2.5.2-2.
GMRS = Ground Motion Response Spectra

Figure A.3-2 – Plots of the horizontal and vertical GMRS
(Reproduced from SSAR Revision 1, Figure 2.5.2-78)

APPENDIX B

BOUNDING DESIGN PARAMETERS

Characteristic/ Parameter	Bounding Value[a]	Description
Structure Height	160 ft	The height from finished grade to the top of the tallest power block structure, excluding stacks and cooling towers.
Structure Foundation Embedment	138 ft	The depth from finished grade to the bottom of the basemat for the most deeply embedded power block structure.
Plant Megawatts Thermal	800 MWt (reactor core) (805 MWt including reactor coolant pump) [2,420 MWt]	The maximum thermal power generated by one unit and the maximum thermal power for the site.
Minimum Site Grade	821 ft NAVD88	Minimum finished ground elevation in the power block area.
Condenser/Heat Exchanger Design Duty	[5,593 MBTU/hr]	Design value for the waste heat rejected to the circulating water system across the condensers.
Gaseous Releases		
Source Term (Accident)	Refer to SSAR Table 2.0-3	Bounding design basis accident atmospheric release by post-accident interval.
Source Term (Normal)	Refer to SSAR Table 2.0-4	Annual activity, by radionuclide, contained in routine plant airborne effluent streams.
Release Point Elevation		
Accident	Ground level	The elevation above finished grade of the release point for releases due to an accident.
Normal	Ground level	The elevation above finished grade of the release point for normal effluent releases.
Liquid Releases		
Accidental Release	Refer to SSAR Table 2.0-5	The assumed activity, by radionuclide, contained in accidental liquid radwaste release.
Source Term (Normal)	Refer to SSAR Table 2.0-6	Annual activity, by isotope, contained in routine plant liquid effluent streams.

(a) Values shown are for a single unit, but would be the same value for each additional unit. Bracketed numbers represent the value for multiple units at the site.

APPENDIX C

COMBINED LICENSE ACTION ITEMS

COL Action Item	COL Action Items
2.3 COL Action Item Numbers	**Section 2.3, Meteorology – COL Action Items**
2.3-1	An applicant for a COL or a CP referencing this ESP should verify the cooling-tower plume characteristics described in the ESP. Future COL or CP applications referencing this ESP should also include an evaluation of the cooling-tower plume impacts on the switchyard, as designed, and any impacts on safety-related air intakes and the adjacent cooling tower.
2.3-2	An applicant for a COL or a CP referencing this ESP should verify that the onsite meteorological measurement system, including the instrument tower, expected at the site prior to operation, is as described in site safety analysis report (SSAR) Section 2.3.3. Any differences in instrumentation, exposure, or siting should be identified and discussed to demonstrate that the meteorological measurements program continues to meet the guidance provided in Regulatory Guide (RG) 1.23.
2.3-3	An applicant for a COL or a CP referencing this ESP should clarify whether the operational phase of the onsite meteorological measurements program will include wind data averaging on the basis of scalar or vector averages.
2.3-4	An applicant for a COL or a CP referencing this ESP should identify and justify the wind speed and direction averaging approach(es) (either vector or scalar) used in the COL or CP application: • for modeling accident-related Control Room and Technical Support Center (TSC) atmospheric dispersion; and • for use during the operational phase to support emergency planning.
2.4 COL Action Item Numbers	**Section 2.4, Hydrology – COL Action Items**
2.4-1	An applicant for a COL or CP that references this ESP should design the site grading to provide flooding protection to safety-related structures at the CRN Site based on a comprehensive flood water routing analysis for a local intense precipitation (LIP) event.
2.4-2	An applicant for a COL or CP referencing this this ESP should address whether the local flood elevation exceeds the site grade elevation and whether the local flood elevation justifies flood protection measures to prevent flooding of any safety-related structures, systems and components (SSCs). If so, the applicant should address necessary flooding protection for safety-related SSCs based on the flooding event and associated effects.
2.4-3	An applicant for a COL or CP that references this ESP should establish, as part of its plan to minimize contamination in accordance with 10 CFR 20.1406, a baseline for background radionuclide concentrations.

2.4-4	An applicant for a COL or CP referencing this ESP should verify that the calculated dose to members of the public from a postulated accidental liquid radionuclide effluent release to the groundwater from a chosen reactor design at the CRN Site is bounded by the dose evaluated in the CRN Site ESP application (ESPA) as reviewed by the NRC staff. The applicant should evaluate discrepancies and justify any changes made to address differences in the source term for the reactor design used to calculate the dose for a COL or CP application.
2.5 COL Action Item Numbers	**Section 2.5, Site Geologic Features – COL Action Items**
2.5-1	An applicant for a COL or CP referencing this ESP, upon selection of a final technology and site location, should conduct further evaluation of the shear-fracture zones and weathered fracture zones at the CRN Site.
2.5-2	Upon selection of a final technology and site location, an applicant for a COL or CP referencing this ESP, should reevaluate the potential for karstic cavity impacts, within the zone of influence of the foundation under all design loading conditions, and on foundation stabilities for safety-related structures. The evaluation should be performed using a method that can adequately model foundation performance under actual site geologic conditions and specific loading conditions. In the evaluation, detailed information should be provided to address the site subsurface geologic characteristics, foundation dimension and embedment depth, the lateral location of the foundation with respect to the bedding planes and shear-fracture zones, location and dimension of voids, the shear strength at the bedding planes and shear-fracture zones, the in situ stresses around the foundations, and proper subsurface material properties to be used. The analysis should also take into account undetected cavities that could adversely affect foundation performance and include details related to the expected size of such a potential cavity.
2.5-3	An applicant for a COL or CP referencing this this ESP should conduct additional surface geophysical surveys during excavation to detect cavities below the foundation elevation that could adversely affect foundation performance. In addition, the applicant should perform confirmatory drilling or borehole testing during excavation to characterize any geophysical anomalies detected. Finally, if needed, the applicant should develop a grouting program based on the information obtained from the geologic mapping, geophysical surveys, and specific analyses, to mitigate the effect of voids or cavities on foundation performance at and below the foundation levels of safety-related structures. If a grouting program is needed, the associated ITAAC should be specified.
	Section 2.5, Properties of Subsurface Materials – COL Action Items
2.5-4	Reserved
2.5-5	An applicant for a COL or CP referencing this ESP should perform additional testing to determine rock mass properties and to further characterize the rock

	shear strength along the bedding planes with discontinuities and fracture zones in areas where the safety-related structures will be located.
	Section 2.5, Excavation and Backfill – COL Action Items
2.5-6	An applicant for a COL or CP referencing this ESP should provide specific details regarding the lateral and vertical extent of the excavation consistent with the selected reactor technology.
2.5-7	An applicant for a COL or CP referencing this ESP should specify excavation procedures and methods that will not have adverse impacts on the integrity of the foundation subsurface materials. The applicant should design proper excavation support and evaluate the stability of excavation slopes. The applicant should develop a monitoring plan that includes detailed instrumentation and data collection to monitor slope movement and heave of subsurface materials due to excavation, changes in pore pressures of soil underneath the foundation, and displacement of the foundation during and after construction.
2.5-8	An applicant for a COL or CP referencing this ESP should provide the detailed design of backfill materials including identification of sources and quantity requirements, backfill material property and placement specifications, applicable industry standards, and related ITAAC. The in-place backfill hydraulic characteristics, such as permeability and porosity, should be consistent with those specified in the SSAR. If differences exist, then their effect on the site conceptual model and site characterization, as described in the SSAR, should be evaluated.
	Section 2.5, Groundwater Conditions – COL Action Items
2.5-9	An applicant for a COL or CP referencing this ESP should provide the detailed design of dewatering and groundwater control during excavation and construction, including a monitoring plan, and provide an evaluation of the impact of dewatering on the stability of foundations.
2.5-10	An applicant for a COL or CP referencing this ESP should provide the detailed design for foundation protection based on the chemical characteristics of the groundwater and foundation and fills materials at the site consistent with the applicable industrial standards.
	Section 2.5, Response of Soil and Rock to Dynamic Loading – COL Action Items
2.5-11	An applicant for a COL or CP referencing this ESP should develop seismic wave velocity profiles for the locations where the safety-related structures will be built, based on sufficient detailed site investigation data and with consideration of uncertainties and variability. The applicant should determine the appropriate damping and shear modulus reduction properties for soil and rock for in situ subsurface materials at the CRN Site based on test data and/or justifiable generic curves.

	Section 2.5, Static and Dynamic Stability – COL Action Items
2.5-12	An applicant for a COL or CP referencing this ESP should evaluate the foundation bearing capacity for safety-related structures, based on the selected plant structure and foundation designs and actual geologic conditions at the CRN Site under anticipated maximum static and dynamic loadings.
2.5-13	An applicant for a COL or CP referencing this ESP should evaluate the foundation settlement and heave for safety-related structures, based on the selected plant structure and foundation designs, and actual geologic conditions at the CRN Site under anticipated excavation depth and maximum static and dynamic loadings.
2.5-14	An applicant for a COL or CP referencing this ESP should evaluate the maximum lateral earth pressure and its distribution along foundation and structure walls below ground. The total lateral earth pressure should include pressures contributed from static soil pressure, hydrostatic pressure, surcharge-induced (equipment and adjacent structures) pressure and seismic lateral earth pressure at the CRN Site under anticipated maximum static and dynamic loadings.
2.5-15	An applicant for a COL or CP referencing this ESP should identify and reevaluate geotechnical engineering-related design criteria to meet applicable industrial standards and NRC regulations.
	Section 2.5, Techniques to Improve Subsurface Conditions – COL Action Items
2.5-16	An applicant for a COL or CP referencing this ESP should evaluate subsurface conditions in the influence zone of foundations for safety-related structures when karst or other geologic hazard features are discovered. The applicant should determine remediation methods after evaluating the presence of geologic hazard features based on the results of adequate and more detailed geophysical testing at the site.
2.5-17	An applicant for a COL or CP that references this ESP should perform a slope stability analysis of any safety-related slopes, including dams and dikes, consistent with the selected reactor technology.
11.2.3 & 11.3.3 COL Action Item Number	**Sections 11.2.3 and 11.3.3, Radioactive Waste Management – COL Action Item**
11-1	An applicant for a COL or CP referencing this ESP should verify that the calculated doses to members of the public from normal gaseous and liquid effluent releases for a chosen reactor design at the CRN Site are bounded by the doses evaluated in this ESPA as reviewed by the NRC staff. The applicant should evaluate discrepancies and justify any changes made to address differences in the source term for the reactor design used to calculate the doses for a COL or CP application.

13.3 COL Action Item Numbers	Section 13.3, Emergency Planning - COL Action Items
13.3-1	An applicant for a COL or CP that references this ESP should identify the chosen SMR technology for the CRN Site, including the applicable ESP major features emergency plan, or, if appropriate, a new emergency plan for NRC review. In addition, if the accident dose consequences of the chosen SMR technology support the site boundary plume exposure pathway (PEP) EPZ, the applicant will inform the offsite response organizations regarding establishment of the PEP EPZ at the site boundary. The applicant should update the major features emergency plan to reflect the chosen SMR technology, and incorporate it into a complete and integrated emergency plan. In addition, the applicant should provide detailed information that shows the ability of the chosen SMR technology to meet the applicable PEP EPZ, as described in ESPA, Part 2, Section 13.3.3, "Emergency Planning Zones."
13.3-2	An applicant for a COL or CP that references this ESP should submit to the NRC up-to-date letters of agreement or memoranda of understanding with offsite support organizations, which address the concept of operations in support of their respective emergency response roles associated with the chosen plant design, including hostile actions at the CRN Site, consistent with applicable requirements and guidance, including 10 CFR 52.79(a)(22)(i) and (ii) and 10 CFR 50.47(b), (c).
13.3-3	An applicant for a COL or CP that references this ESP should update the emergency plan to describe on-shift emergency response organization staffing in support of the chosen SMR technology for the CRN Site, including the capability for Tennessee Valley Authority's (TVA's) onsite and offsite emergency response organization positions to be staffed and emergency response facilities activated, consistent with the applicable requirements and guidance.
13.3-4	An applicant for a COL or CP that references this ESP should update the emergency plan to describe the emergency classification and action level scheme applicable to the chosen SMR technology for the CRN Site, consistent with the applicable requirements and guidance.
13.3-5	An applicant for a COL or CP that references this ESP, including the Part 5B Emergency Plan (2-Mile Emergency Planning Zone [EPZ]), should update the emergency plan to describe the chosen Alert and Notification System (ANS) network(s), which reflects the assessment of the various technologies by TVA and the affected State and local agencies, and meets the applicable requirements and guidance.
13.3-6	An applicant for a COL or CP that references this ESP should update the emergency plan to describe the CRN Site Emergency Communications Equipment, including all required communications and data links, associated with the chosen SMR technology, consistent with the applicable regulations and guidance.
13.3-7	An applicant for a COL or CP that references this ESP should update the emergency plan to describe the location, function, and capabilities of the Joint

	Information Center (JIC), consistent with the applicable regulations and guidance.
13.3-8	An applicant for a COL or CP that references this ESP should update the emergency plan to describe onsite monitoring systems and equipment, including the installed Radiation Monitoring System, consistent with the applicable regulations and guidance.
13.3-9	An applicant for a COL or CP that references this ESP should update the emergency plan to describe how the criteria in Section 2 of NUREG-0696 and Section 8 of Supplement 1 to NUREG-0737 are met for the TSC, including the emergency classification requiring activation and the time frame for designated personnel to report to the TSC and achieve full functional operation.
13.3-10	An applicant for a COL or CP that references this ESP should update the emergency plan to describe the location of the Operations Support Center (OSC) and communications capabilities consistent with Section 3.3 of NUREG-0696.
13.3-11	An applicant for a COL or CP that references this ESP should update the emergency plan to describe the location, function, and capabilities of the Local Recovery Center (LRC). In addition, the applicant should describe how the LRC meets the applicable requirements in Sections IV.E.8.b and IV.E.8.d of Appendix E to 10 CFR Part 50, and the criteria in Sections IV.D and IV.I of NSIR/DPR-ISG-01.
13.3-12	An applicant for a COL or CP that references this ESP should update the emergency plan to describe the capability of the Central Emergency Control Center (CECC) to support response to events occurring simultaneously at the CRN Site and at one or more of the other TVA nuclear power reactor sites that are served by the CECC. The CECC description should address, as a minimum, the following considerations, consistent with the applicable regulations and guidance. a) The facility's location and size. b) The prescribed activation time for the facility. c) Whether the facility would be able to fulfill its intended required emergency response functions. d) The anticipated staffing (including response time) and training of licensee emergency response personnel at the facility. e) The facility's communication capabilities and data systems. f) The availability in the facility of the radiation monitoring system and Safety Parameter Display System (SPDS) plant parameter variables, including those identified in NRC RG 1.97, Revision 4, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants" (or other applicable guidance). g) The facility's capacity for accommodating a multi-site event. h) Impact on the NRC and/or State and local response organizations.
13.3-13	An applicant for a COL or CP that references this ESP should update the emergency plan to describe the radiation monitoring and other systems and equipment, including potential major release points from the plant, associated with the chosen SMR technology that support accident assessment activities.

	The emergency plan should also identify the specific monitoring capability for the radiological parameters identified in NRC RG 1.97, Revision 4, (or other applicable guidance), and the dose assessment and projection modeling system.
13.3-14	An applicant for a COL or CP that references this ESP should update the emergency plan to describe the new meteorological tower and meteorological monitoring program at the CRN Site, in accordance with NRC RG 1.23, Revision 1, “Meteorological Monitoring Programs for Nuclear Power Plants.” The emergency plan should also describe the specific design instrumentation, and capabilities to provide required meteorological information in support of the new reactor(s) at the CRN Site.
13.3-15	An applicant for a COL or CP that references this ESP should update the emergency plan to describe the location of the onsite personnel decontamination facility.
13.3-16	An applicant for a COL or CP that references this ESP should update the emergency plan to describe the frequency for communications testing, and for the conduct of hostile action exercises, consistent with the applicable regulations and guidance.

APPENDIX D

SITE CHARACTERISTICS AND PLANT PARAMETER ENVELOPE VALUES CONSIDERED IN THE ENVIRONMENTAL REVIEW OF THE APPLICATION

The early site permit (ESP) site characteristics and plant parameter envelope (PPE) values are from Tables 3.1-1 and 3.1-2 of the applicant's Early Site Permit Application (Revision 2): Part 3, Environmental Report, unless otherwise specified. These characteristics and parameters were used by the Nuclear Regulatory Commission (NRC) staff in its independent evaluation of the environmental impacts of the surrogate reactors and are tabulated in Tables I-1 and I-2 of the FEIS as well as below. Any mention of figures or tables in Tables I-1 or I-2 refer to figures or tables in the Environmental Report. In some cases, as noted, the staff substituted values based on its own analysis.

Table D.1. Clinch River Nuclear Environmental Site Characteristics

PPE Section[a]	Definition	Parameter Type	PPE Value	ER Section
9. Unit Vent/Airborne Effluent Release Point				
9.1 Atmospheric Dispersion (X/Q) (Accident)				
9.1.1 0-2 hr @ EAB	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases in the limiting two-hour interval.	Site	5.58E-04 s/m^3	7.1
9.1.2 0-8 hr @ low population zone (LPZ)	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases in the first eight hours.	Site	4.27E-05s/m^3	7.1
9.1.3 8-24 hr @ LPZ	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases between hours 8 and 24 after the accident.	Site	3.80E-05 s/m^3	7.1
9.1.4 1-4 day @ LPZ	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases between the first day and the fourth day after the accident.	Site	2.94E-05 s/m^3	7.1
9.1.5 4-30 day @ LPZ	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases between day four until the end of the first 30 days after the accident.	Site	2.04E-05 s/m^3	7.1
9.3 Calculated Dose Consequences				
9.3.1 Normal	The design radiological dose consequences due to airborne releases from normal operation of the plant.	Site	10 CFR Part 20, 10 CFR Part 50 Appendix I	5.4[b], 7.2[b]
9.3.2 Post-Accident	The design radiological dose consequences due to airborne releases from postulated accidents.	Site	10 CFR 52.17(a)(1)(ix), 10 CFR 100.20	5.4[b], 7.2[b]

(a) The numbering of the PPE listing is not meant to be sequential and was compiled from, and is consistent with, the list developed by industry and refined for this early site permit application.
(b) Information used in the development of the impacts described in the section, but not referenced specifically in the text.

Table D.2. Clinch River Nuclear Site-Related Design Parameters

PPE Section[a]	Definition	Parameter Type	PPE Value	ER Section
1. Structure				
1.1 Building Characteristics				
1.1.1 Height (w/o Stack and Cooling Towers)	The height from finished grade to the top of the tallest power-block structure, excluding cooling towers (excludes stairway towers, elevator, etc.).	Rx	160 ft	2.5.2, 3.1, 4.4, 5.8
1.1.2 Foundation Embedment	The depth from finished grade to the bottom of the basemat or the most deeply embedded power-block structure (excavation depth is the same elevation as embedment depth).	Rx	138 ft	3.1
3. Normal Plant Heat Sink				
3.1 Condenser				
3.1.2 Condenser/Heat Exchanger Duty	Design value for the waste heat rejected to the circulating water system across the condensers.	Eng	5593 MBTU/hr for site	3.4
3.2 Non-Safety Related Service Water Systems				
3.2.3 Miscellaneous Plant Water Uses Intake	The maximum, and normal, water intake of the plant neglecting cooling-tower makeup, potable/sanitary water users, and liquid radwaste treatment.	Eng	Maximum: 5,100 gpm; normal: 1,345 gpm See Figure 3.3-1	3.4
3.2.4 Miscellaneous Plant Water Uses Discharge	The maximum, and normal, water discharge of the plant neglecting cooling-tower makeup, potable/sanitary water users, and liquid radwaste treatment.	Eng	Maximum: 4,200 gpm; normal: 445 gpm See Figure 3.3-1	3.4
3.3 Mechanical Draft Cooling Towers				
3.3.1 Acreage	The land required for cooling towers, including support facilities such as equipment sheds, basins, canals, or shoreline buffer areas.	Eng	See Figure 3.1-1	3.4, 5.3
3.3.3 Blowdown Constituents and Concentrations	The maximum expected concentrations for anticipated constituents in the cooling-water systems blowdown to the receiving waterbody.	Eng	Table 3.6-1 (values for site)	3.6
3.3.4 Blowdown Flow Rate	The normal (and maximum) flow rate of the blowdown stream from the cooling-water systems to the receiving waterbody for closed system designs.	Eng	Maximum: (2 COC) 12,800 gpm, Expected: (4 COC) 4270 gpm See Figure 3.3-1	3.4

Table D.2. (cont'd)

PPE Section[a]	Definition	Parameter Type	PPE Value	ER Section
3.3.5 Blowdown Temperature	The maximum expected blowdown temperature at the point of discharge to the receiving waterbody.	Eng	90 F	3.4
3.3.6 Cycles of Concentration	The ratio of total dissolved solids in the cooling-water blowdown streams to the total dissolved solids in the makeup water streams.	Eng	Maximum: 4; minimum: 2	3.4, 5.3
3.3.7 Evaporation Rate	The expected (and maximum) rate at which water is lost by evaporation from the cooling-water systems.	Eng	12,800 gpm (expected and maximum) - values for site	3.4
3.3.8 Height	The vertical height above finished grade of mechanical draft cooling towers associated with the cooling-water systems.	Eng	65 ft	3.4, 5.3, 5.8
3.3.9 Makeup Flow Rate	The expected (and maximum) rate of removal of water from a natural source to replace water losses from closed cooling-water system.	Eng	17,078 gpm (expected), 25,608 gpm (maximum)	3.4
3.3.10 Noise	The maximum expected sound level produced by operation of cooling towers, measured at 1,000 ft from the noise source.	Eng	<70 dba	5.3, 5.8, 9.3
3.3.11 Cooling-Tower Temperature Range	The temperature difference between the cooling water entering and leaving the towers.	Eng	18 F	3.4
3.3.12 Cooling-Water Flow Rate	The total cooling-water flow rate through the condenser/heat exchangers.	Eng	755,000 gpm	3.4, 5.3
3.3.14 Maximum Consumption of Raw Water	The expected maximum short-term consumptive use of water by the cooling-water systems (evaporation and drift losses).	Eng	12,808 gpm	3.4
3.3.16 Stored Water Volume	The quantity of water stored in cooling-water system impoundments, basins, tanks and/or ponds.	Eng	5 million gal	3.4
3.3.17 Drift	Rate of water lost from the tower as liquid droplets entrained in the vapor exhaust air stream.	Eng	8 gpm	3.4
5. Potable Water/Sanitary Waste System				
5.1 Discharge to Site Water Bodies				
5.1.1 Flow Rate (Potable/Sanitary Normal)	The expected (normal) effluent flow rate from the potable/sanitary system to the receiving waterbody.	Rx	50 gpm	3.4, 3.6, 5.5
5.1.2 Flow Rate (Potable/Sanitary Maximum)	The maximum effluent flow rate from the potable/sanitary system to the receiving waterbody.	Rx	100 gpm	3.4, 3.6, 5.5

Table D.2. (cont'd)

PPE Section[a]	Definition	Parameter Type	PPE Value	ER Section
9.5 Source Term				
9.5.1 Gaseous (Normal)	The expected annual activity, by radionuclide, contained in routine plant airborne effluent streams, excluding tritium.	Rx	Table 3.5-3	3.5
10. Liquid Radwaste System				
10.2 Release Point				
10.2.1 Flow Rate	The discharge (including minimum dilution flow, if any) flow rate of liquid potentially radioactive effluent streams from plant systems to the receiving waterbody.	Eng	900 gpm - expected normal and maximum -	3.4
10.3 Source Term				
10.3.1 Liquid	The annual activity, by radionuclide, contained in routine plant liquid effluent streams, excluding tritium.	Rx	Table 3.5-1 ([value per site)	3.5
11. Solid Radwaste System				
11.2 Solid Radwaste				
11.2.1 Activity	The annual activity, by radionuclide, contained in solid radioactive wastes generated during routine plant operations.	Rx	Table 3.5-5 (site value)	3.5
11.2.3 Volume	The expected volume of solid radioactive wastes generated during routine plant operations.	Rx	5,000 cubic ft/yr (site value)	3.5, 3.8, 5.7, 7.4
13. Auxiliary Boiler System				
13.1 Exhaust Elevation	The height above finished plant grade at which the flue gas effluents are released to the environment.	Eng	Plant Grade	3.6
13.2 Flue Gas Effluents	The expected combustion products and anticipated quantities released to the environment due to operation of the auxiliary boilers.	Eng	Table 3.6-2	3.6
14. Standby Power System				
14.1 Diesel				
14.1.2 Diesel Exhaust Elevation	The elevation above finished grade of the release point for standby diesel exhaust releases.	Eng	25 ft	3.6
14.1.3 Diesel Flue Gas Effluents	The expected combustion products and anticipated quantities released to the environment due to operation of the emergency standby diesel generators.	Eng	Table 3.6-3 (value per site)	3.6

Table D.2. (cont'd)

PPE Section[a]	Definition	Parameter Type	PPE Value	ER Section
14.2 Gas Turbine				
14.2.2 Gas-Turbine Exhaust Elevation	The elevation above finished grade of the release point for standby gas turbine exhaust releases.	Eng	50 ft	3.6
14.2.3 Gas-Turbine Flue Gas Effluents	The expected combustion products and anticipated quantities released to the environment due to operation of the emergency standby gas-turbine generators.	Eng	Table 3.6-4	3.6
15. Plant Layout Considerations				
15.1 Access Routes				
15.1.1 Heavy-Haul Routes	The land usage required for permanent heavy-haul routes to support normal operations and refueling.	Eng	5 ac	3.9
15.2 Acreage to Support Plant Operations	The land area required to provide space for plant facilities.	Eng	See Figure 3.1-1	3.7
16. Plant Operations Considerations				
16.1 Megawatts Thermal	The thermal power generated by one unit (may be the total of several modules). Specify both core thermal power and reactor coolant pump (RCP) thermal power if there are RCPs in the design. The total thermal power for the site.	Rx	800 MW(t) (core for single unit), 805 MW(t) (core for single unit + RCP), 2,420 MW(t) total for site	5.7, 7.4
16.2 Plant Design Life	The operational life for which the plant is designed.	Rx	60 years	3.2
16.3 Plant Population				
16.3.1 Operation	The estimated number of total permanent staff to support operations of the plant.	Eng	500 (value per site)	3.10,5.8, 9.3
16.3.2 Refueling/Major Maintenance	The estimated additional number of temporary staff required to conduct refueling and major maintenance activities.	Eng	1,000	5.8, 9.3
16.4 Station Capacity Factor	The percentage of time that a plant is capable of providing power to the grid.	Eng	Maximum: 98%; minimum: 90%	5.7, 7.4
16.6 Megawatts Electrical (at 100% power with 85ºF circulating water)	Best estimate of MW(e) generator output.	Eng	800 MW(e) (value for site)	3.2, 5.7, 5.9, 7.4, 9.4, 10.1

Table D.2. (cont'd)

PPE Section[a]	Definition	Parameter Type	PPE Value	ER Section
17. Construction				
17.2 Acreage				
17.2.1 Laydown Areas	The land area required to provide space for construction support facilities. Provide a list of what buildings and/or areas and the associated acreage for each.	Eng	See Figure 3.1-1	3.7
17.3 Construction				
17.3.1 Noise	The maximum expected sound level due to construction activities, measured at 50 ft from the noise source.	Eng	101 dB at 50 ft	3.9
17.4 Plant Population				
17.4.1 Construction	Maximum number of people onsite during construction.	Eng	2,200 (value per site)	3.10
18. Miscellaneous Items				
18.0.1 Fuel Characteristics	What is the form of the reactor fuel and the burnup (GWd/MTU)	Rx	UO_2, 51 GWD/MTU	5.7, 7.4
18.0.2 Fuel assemblies	Provide the number of fuel assemblies per core and the weight (in MTU) of each assembly.	Rx	Number of fuel assemblies: 96 weight of each assembly: 0.304 MTU	3.8, 5.7, 7.4
18.0.4 Refueling	Provide the refueling frequency, average number of assemblies per refueling, and fuel pool capacity (in fuel assemblies).	Rx	Frequency: 2 years, assemblies per refueling: 96, capacity: up to 1,800 fuel assemblies[b]	3.8, 5.7, 5.8
18.0.5 Irradiated fuel transportation	Provide the weight of irradiated fuel per spent fuel shipping cask (MTU).	Rx	21.2 MTU	5.7
18.1 Maximum Fuel Enrichment	Concentration (weight percent fraction) of U-235 in the fuel uranium.	Rx	<5% U-235	3.2, 5.7, 7.4
18.2 Maximum Average Assembly Burnup	Maximum assembly average burnup at end of assembly life.	Rx	51 GWD/MTU	3.2, 5.7, 7.4
18.3 Peak fuel rod exposure at end of life	Peak fuel rod exposure at end of life.	Rx	62 GWD/MTU	3.2
18.7 Clad Material	Fuel rod clad material.	Rx	Zirc Alloy (Zircaloy)	5.7

(a) The numbering of the PPE listing is not meant to be sequential and was compiled from, and is consistent with, the list developed by industry and refined for this early site permit application.
(b) The fuel pool capacity PPE value was set by the NRC based on information provided by TVA (TVA 2018-TN5830).
Notes: RX = Reactor Parameter; Eng = Owner Engineered Parameter; COC = Cycles of Concentration.

APPENDIX E

ENVIRONMENTAL PROTECTION PLAN

(NONRADIOLOGICAL)

1.0 Objective of the Environmental Protection Plan

The Environmental Protection Plan (EPP) objective is to ensure compliance with Biological Opinions issued pursuant to the Endangered Species Act of 1973, as amended (ESA), and to ensure that the Commission is kept informed of other environmental matters. The EPP is intended to be consistent with Federal, state, and local requirements for environmental protection.

2.0 Environmental Protection Issues

In the Final Environmental Impact Statement (FEIS) dated April 2019, the staff considered the environmental impacts associated with the issuance of an early site permit (ESP), including consideration of the impacts of construction and operation of a new nuclear plant at the CRN Site. This EPP applies to the permit holder's actions affecting the environmental resources evaluated in the FEIS and the permit holder's actions that may affect any newly discovered environmental resources.

2.1 Aquatic Resources Issues

Federal agencies other than the U.S. Nuclear Regulatory Commission (NRC), such as the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (USACE), have jurisdiction to regulate aquatic resources under the Federal Water Pollution Control Act (Clean Water Act or CWA) and the Rivers and Harbors Appropriation Act of 1899 (RHA). Nothing within this EPP shall be construed to place additional requirements on the regulation of aquatic resources except the imposition of the requirements in a Biological Opinion under the ESA (see Section 2.3).

2.2 Terrestrial Resources Issues

Several statutes govern the regulation of terrestrial resources. For example, the U.S. Fish and Wildlife Service (FWS) regulate matters involving migratory birds and their nests in accordance with the Migratory Bird Treaty Act. Activities affecting migratory birds or their nests may require permits under the Migratory Bird Treaty Act. The FWS also regulates matters involving the protection and taking of bald and golden eagles in accordance with the Bald and Golden Eagle Protection Acts.

2.3 Endangered Species Act of 1973

The NRC may be required to protect some aquatic resources and terrestrial resources in accordance with the ESA. If a Biological Opinion has been issued to the NRC in accordance with ESA Section 7 prior to the issuance of a construction permit or combined license referencing the ESP, the permit holder shall comply with the Terms and Conditions set forth in the Incidental Take Statement of such a Biological Opinion. If any Federally listed species or critical habitat occurs in an area affected by construction that

was not previously identified as occurring in such areas, including species and critical habitat that were not previously Federally listed, the permit holder shall inform the NRC within four hours of discovery. Similarly, the permit holder shall inform the NRC within four hours of discovery of any take, as defined in the ESA, of a Federally listed species or destruction or adverse modification of critical habitat. These notifications shall be made to the NRC Operations Center via the Emergency Notification System. The permit holder shall provide any necessary information to the NRC if the NRC initiates consultation under the ESA.

Unusual ESA-Related Event - The permit holder shall inform the NRC of any onsite mortality, injury, or unusual occurrence of any species protected by the ESA within four hours of discovery, followed by a written report in accordance with Section 4.1. Such incidents shall be reported regardless of causal relation to construction.

3.0 Consistency Requirements

The permit holder shall notify the NRC of proposed changes to permits or certifications concerning aquatic or terrestrial resources by providing the NRC with a copy of the proposed change at the same time it is submitted to the permitting agency. The permit holder shall provide the NRC with a copy of the application for renewal of permits or certifications at the same time the application is submitted to the permitting agency.

Changes to or renewals of these permits or certifications shall be reported to the NRC within 30 days following the later of the date the change or renewal is approved or the date the change becomes effective. If a permit or certification, in part or in its entirety, is appealed and stayed, the NRC shall be notified within 30 days following the date the stay is granted.

4.0 Administrative Procedures

4.1 Plant Reporting Requirements: Non-routine Reports

A written report shall be submitted to the NRC within 30 days of occurrence of any unusual ESA-related event described in Section 2.3 of this EPP. The report shall (a) describe, analyze, and evaluate the event, including extent and magnitude of the impact and plant operating characteristics at the time of the event; (b) describe the probable cause of the event; (c) indicate the action taken to correct the reported event; (d) indicate the corrective action taken to preclude repetition of the event and to prevent similar occurrences involving similar components or systems; and (e) indicate the agencies notified and their preliminary responses.

4.2 Review and Audit

The permit holder shall provide for review and audit of compliance with Section 2.3 of the EPP. The audits shall be conducted independently of the individual or groups responsible for performing the specific activity. A description of the organizational structure utilized to achieve the independent review and audit function and results of the audit activities shall be maintained and made available for inspection.

4.3 Records Retention

Records required by this EPP shall be made and retained in a manner convenient for review and inspection. These records shall be made available to the NRC on request. The records, data, and logs relating to this EPP shall be retained for five years or, where applicable, in accordance with the requirements of other agencies.

4.4 Changes in Environmental Protection Plan

A request for a change in the EPP shall include an assessment of the environmental impact of the proposed change and a supporting justification. Implementation of such changes in the EPP shall not commence prior to NRC approval of the proposed changes in the form of a license amendment incorporating the appropriate revision to the EPP.

The permit holder shall request a license amendment to incorporate the requirements of any Terms and Conditions set forth in the Incidental Take Statement of Biological Opinions issued subsequent to the effective date of this EPP.