

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of)
)
SOUTHERN NUCLEAR OPERATING CO.) Docket No. 52-011-ESP
)
(Early Site Permit for Vogtle ESP Site))

NRC STAFF'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS
OF LAW CONCERNING UNCONTESTED MATTERS

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May 22, 2009

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I. BACKGROUND AND INTRODUCTION

1.1. These findings and rulings address all uncontested issues concerning the application for an early site permit (ESP) filed on August 14, 2006, by Southern Nuclear Operating Company ("Southern" or "Applicant"), on behalf of itself and the co-owners of the Vogtle Electric Generating Plant ("VEGP") site near Waynesboro, Georgia. The Applicant submitted an application pursuant to 10 C.F.R. Part 52, Subpart A, in which it requested an ESP for a site within the existing VEGP site ("Application"). This Atomic Safety and Licensing Board ("Board") addressed all outstanding contested issues in this proceeding in an earlier Memorandum and Order.

1.2. Following the Nuclear Regulatory Commission ("NRC")'s receipt of the Application¹ and the NRC's decision to docket the Application for review,² a notice of hearing

¹ See Southern Nuclear Operating Company; Notice of Receipt and Availability of an Application for an Early Site Permit for the Vogtle ESP Site, 71 Fed. Reg. 51,222 (Aug. 29, 2006).

² See Southern Nuclear Operating Company; Notice of Acceptance for Docketing of Application for Early Site Permit (ESP) for the Vogtle ESP Site, 71 Fed. Reg. 56,187 (Sept. 26, 2006).

and opportunity to petition for leave to intervene was published on October 12, 2006. 71 Fed. Reg. 60,195 (Oct. 12, 2006). The Notice of Hearing advised the Applicant and any person whose interest may be affected by the proceeding of their right to request a hearing. On December 11, 2006, several organizations filed a joint petition for leave to intervene, which contained several contentions challenging the Environmental Report (“ER”) filed as part of the Application. These organizations include the Center for a Sustainable Coast, Savannah Riverkeeper, Southern Alliance for Clean Energy, Atlanta Women’s Action for New Directions, and Blue Ridge Environmental Defense League (“Joint Intervenors”). The petitioners timely filed several contentions that they sought to litigate in this proceeding.

1.3. On December 15, 2006, this Board was established to rule on petitions for hearing and for leave to intervene and to preside over any adjudicatory proceeding that might be held in connection with the Application. 71 Fed. Reg. 77,071 (Dec. 22, 2006). The Board admitted two contentions initially, EC 1.2 and EC 1.3, and one late-filed contention, EC 6.0. A contested hearing on these contentions was held in Augusta, GA, on March 16-19, 2009. A more complete recitation of the background of the contested hearing is set forth in the Board’s Memorandum and Order ruling on contested environmental issues.

1.4. On August 15, 2007, the Applicant revised its Application to include a request for a limited work authorization (“LWA”).³ The LWA would allow the Applicant to undertake limited construction activities, including the placement of engineered backfill, placement of a concrete mudmat, a waterproofing membrane, a mechanically stabilized earth (“MSE”) retaining wall, and temporary drains. Notice of this request, including a supplementary notice of hearing and

³ Letter from J.A. “Buzz” Miller to U.S. NRC Document Control Desk, “Southern Nuclear Operating Company Vogtle Early Site Permit Application Supplement to Include Limited Work Authorization 2 Activities,” Aug. 15, 2007 (ML072330245).

opportunity to petition for leave to intervene, was published in the Federal Register on November 16, 2007. 72 Fed. Reg. 64,686 (Nov. 16, 2007).

1.5. In September 2007, the NRC staff published NUREG-1872, the “Draft Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant Site” (“DEIS”).⁴

1.6. In August 2008, the NRC staff published NUREG-1872, the “Final Environment Impact Statement for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant Site” (“FEIS”).⁵ Ex. NRC00001A, NRC00001B, NRC00001C, NRC00001D. On September 12, 2008, the NRC staff notified the Board and Parties of the availability of Errata to the FEIS.⁶ Ex. NRC00001E.⁷

1.7. On October 17, 2008, the Board issued a “Memorandum and Order (Providing Initial Questions and Potential Presentation Topics Associated with Mandatory Hearing on Environmental Matters)” including written questions on environmental topics. *Southern Nuclear*

⁴ The DEIS was made available to the Board and the parties to this proceeding on September 10, 2007. See Letter from J.M. Rund, Counsel for NRC Staff, to Administrative Judges (Sept. 10, 2007). See also Environmental Impacts Statements; Notice of Availability, 72 Fed. Reg. 52,557 (Sept. 14, 2007); Southern Nuclear Operating Company; Notice of Availability of the Draft Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle ESP Site and Associated Public Meeting, 72 Fed. Reg. 52,586 (Sept. 14, 2007).

⁵ The FEIS was made available to the parties and Board on August 14, 2008. See Letter from Patrick Moulding, Counsel for NRC Staff, to the Administrative Judges (Aug. 14, 2008). See also Southern Nuclear Operating Company; Notice of Availability of the Final Environmental Impact Statement (EIS) for an Early Site Permit (ESP) Application at the Vogtle Electric Generating Plant Site, 73 Fed. Reg. 49,496 (Aug. 21, 2008); Environmental Impacts Statements; Notice of Availability, 73 Fed. Reg. 49,667 (Aug. 22, 2008).

⁶ See Letter from Patrick Moulding, Counsel for NRC Staff, to the Administrative Judges (September 12, 2008). See also Southern Nuclear Operating Company; Notice of Availability of Errata Sheet for the Final Environmental Impact Statement (FEIS) for an Early Site Permit (ESP) Application at the Vogtle Electric Generating Plant Site, 73 Fed. Reg. 54,436 (Sept. 19, 2008).

⁷ Due to the size of the document, the FEIS and the accompanying Errata were entered into evidence in this proceeding as five related exhibits (NRC00001A-1E).

Operating Co. (Early Site Permit for Vogtle ESP Site), ML082910604 (unpublished order) (Oct. 17, 2008). Both the NRC staff and the Applicant provided written responses to these questions on November 7, 2008. See Ex. NRC000057; Ex. SNC000068.

1.8 On November 12, 2008, the NRC staff informed the Board and Applicant of the availability of the Advanced Safety Evaluation Report.⁸

1.9. Subsequently, on December 5, 2008, the Board issued a “Memorandum and Order (Providing Initial Questions and Potential Presentation Topics Associated with Mandatory Hearing on Safety Topics)” including written questions on safety topics. *Southern Nuclear Operating Co.* (Early Site Permit for Vogtle ESP Site), ML083400473 (unpublished order) (Dec. 5, 2008). Both the NRC staff and Applicant provided written responses to these questions on January 16, 2009. See Ex. NRC000058; Ex. SNC000069.

1.10 On December 31, 2008, the Board issued another Memorandum and Order in which it put forth an additional presentation topic. *Southern Nuclear Operating Co.* (Early Site Permit for Vogtle ESP Site), ML083660375 (unpublished order) (Dec. 31, 2008).

1.11. On February 5, 2009, the NRC staff informed the Board and Applicant of the availability of the Final Safety Evaluation Report (“FSER”).⁹

1.12. The Board convened the uncontested hearing in this proceeding on March 23-25, 2009, in Waynesboro, Georgia. Pursuant to the Board’s request, the Applicant and the NRC staff (for some topics, only the NRC staff) gave presentations on the following environmental and safety topics: Water Use Impacts; Radiological Impacts; Groundwater Impacts on Safety-

⁸ See Letter from Patrick Moulding, Counsel for NRC Staff, to the Administrative Judges (Nov. 12, 2008).

⁹ See Letter from Patrick Moulding, Counsel for NRC Staff, to the Administrative Judges (Feb. 5, 2009).

Related Structures; Environmental Impacts of Alternatives; LWA and Site Redress Plan; Site Emergency Plan; Seismic Evaluation; Severe Accident Mitigation Design Alternatives; Deferrals to COL; Permit Conditions; and AP1000 Design Certification Amendments. The Applicant and NRC staff submitted these presentations and other exhibits, including the FSER, the FEIS, and the written responses to the Board's questions, into evidence at the hearing.

1.13. These proposed findings of fact and conclusions of law present the Licensing Board's findings of fact with respect to the findings the Board has been directed to make by the Commission, and the Board's conclusions of law with respect thereto.

II. LEGAL STANDARDS

2.1. For an early site permit, which is considered a partial construction permit, the NRC must hold a hearing whether or not the issuance of the application is contested. Atomic Energy Act of 1954, as amended ("Act"), Section 189a., 42 U.S.C. § 2239(a); see 10 C.F.R. § 52.21.

2.2. In its Notice of Hearing, the Commission directed the Board to consider two safety issues and one environmental issue.¹⁰ 71 Fed. Reg. 60,195 (October 12, 2006). The safety issues were: (1) Whether the issuance of an ESP will be inimical to the common defense and security or to the health and safety of the public (Safety Issue 1); and (2) whether, taking into consideration the site criteria contained in 10 C.F.R. part 100, a reactor, or reactors, having characteristics that fall within the parameters for the site, can be constructed and operated

¹⁰ NRC caselaw emphasizes that the Board should make the findings as set forth in the Commission's Notices of Hearing. See *General Public Utilities Nuclear Corp.* (Three Mile Island Nuclear Station, Unit 1), ALAB-881, 26 NRC 465, 476 (1987) ("[T]he scope of the proceeding spelled out in the notice of hearing identifies the subject matter of the hearing[.]" (internal citations omitted)). Nevertheless, as the NRC staff noted in its opening statement, the findings required by the Notices of Hearing are analogous to the findings in 10 C.F.R. § 52.24, and the Board has sufficient information to make the findings in section 52.24 as well. Tr. at M-1684.

without undue risk to the health and safety of the public (Safety Issue 2). *Id.* The environmental issue was “[w]hether, in accordance with the requirements of subpart A of 10 C.F.R. Part 51, the ESP should be issued as proposed.” *Id.*

2.3. In addition, in accordance with 10 C.F.R. § 51.105(a), and as instructed in the initial Notice of Hearing, the Board must: (1) Determine whether the requirements of Section 102(2)(A), (C), and (E) of the National Environmental Policy Act of 1969 (“NEPA”) and subpart A of 10 C.F.R. Part 51 have been complied with in the proceeding; (2) independently consider the final balance among the conflicting factors contained in the record of the proceeding with a view to determining the appropriate action to be taken; and (3) determine, after considering reasonable alternatives, whether the ESP should be issued, denied, or appropriately conditioned to protect environmental values.

2.4. In conducting the hearing, the Commission directed that “[i]f the hearing is not a contested proceeding as defined in 10 C.F.R. § 2.4, the Board will determine without conducting a de novo review: Whether the application and the record of the proceeding contain sufficient information, and the review of the application by the Commission’s staff has been adequate to support a negative finding on Safety Issue 1 above, and an affirmative finding on Safety Issue 2 above, as proposed to be made by the Director, Office of Nuclear Reactor Regulation; and whether the review conducted by the Commission pursuant to NEPA has been adequate.” *Id.*

2.5. After the Applicant submitted its application for an LWA, the Commission issued a Supplementary Notice of Hearing that directed the Board to consider three more safety topics and one additional environmental topic. 72 Fed. Reg. 64,686 (November 16, 2007). The additional environmental topic is “[w]hether, in accordance with the requirements of subpart A of 10 C.F.R. Part 51, the ESP should authorize the Applicant to conduct the requested construction activities.” *Id.* The additional safety issues pursuant to the Atomic Energy Act of 1954, as amended, are:

1. whether the applicable standards and requirements of the Act, and the Commission's regulations applicable to the activities for which the Applicant seeks authorization have been met (Safety Issue 3);
2. whether the Applicant is technically qualified to engage in the activities authorized (Safety Issue 4); and
3. whether issuance of the ESP, granting the Applicant's requested authorization, will provide reasonable assurance of adequate protection to public health and safety and will not be inimical to the common defense and security (Safety Issue 5).

Id.

2.6. Additionally, the LWA Notice of Hearing stated that, in addition to complying with the provisions of the original notice of hearing, the Board will: (1) Determine whether the requirements of Section 102(2)(A), (C), and (E) of NEPA and subpart A of 10 C.F.R. Part 51 have been met, with respect to the activities to be authorized; (2) independently consider the balance among the conflicting factors with respect to the activities to be authorized which is contained in the record of the proceeding, with a view to determining the appropriate action to be taken; and (3) determine whether the redress plan submitted by the Applicant will adequately redress the activities to be authorized.

2.7. In response to certified questions from several Boards regarding how to conduct uncontested hearings, the Commission has noted that:

[W]hen considering safety and environmental matters not subject to the adversarial process – so-called “uncontested” issues – the boards should decide simply whether the safety and environmental record is “sufficient” to support license issuance. In other words, the boards should inquire whether the NRC Staff performed an adequate review and made findings with reasonable support in logic and fact.

Exelon Generation Co., LLC (Early Site Permit for Clinton ESP Site), CLI-05-17, 62 NRC 5, 39 (2005). With respect to NEPA considerations, the Commission stated that “licensing boards must reach their own independent determination on uncontested NEPA ‘baseline’ questions – *i.e.*, whether the NEPA process ‘has been complied with,’ what is the appropriate ‘final balance among conflicting factors,’ and whether the ‘construction permit should be issued, denied, or appropriately conditioned.” *Id.* at 45 [internal citations omitted].

III. FINDINGS OF FACT

3.1. Below we set forth: (1) an overview of the NRC staff’s safety review process, including associated Board questions and presentation topics, *see infra* Part III.A.1; (2) the Board’s findings with respect to the NRC staff’s safety review, *see infra* Part III.A.2; (3) an overview of the NRC staff’s environmental review process, including associated Board questions and presentation topics, *see infra* Part III.B.1, and (4) Board findings with respect to the NRC staff’s environmental review, including the “baseline” NEPA determinations required by the Commission’s notice of hearing, *see infra* Part III.B.2.

A. Review of Safety-Related Matters

1. Description of NRC Staff Review

3.2. In performing its safety analysis, as documented in the FSER, the NRC staff reviewed the information presented in the Vogtle application concerning the site’s meteorology, hydrology, geology and seismology, as well as the potential hazards to a nuclear power plant that could result from manmade facilities and activities on or in the vicinity of the site. The NRC staff also assessed the risks of potential accidents that could occur as a result of the operation of a nuclear plant at the site and evaluated whether the site would support adequate physical security measures for a nuclear power plant. The NRC staff also evaluated the Applicant’s quality assurance measures and reviewed the complete and integrated emergency plans that the Applicant would implement if the new reactor is eventually constructed at the ESP site. In

addition, the NRC staff reviewed the technical information presented in the application pertaining to the LWA activities being requested. Specifically, the NRC staff reviewed the Applicant's seismic design, seismic systems, and foundations as they relate to the LWA activities being requested. The NRC staff also evaluated the Applicant's fitness-for-duty program. We summarize these aspects of the NRC staff's review below, as well as the associated written responses and presentation topics requested by the Board as part of the uncontested hearing.

FSER Chapter 1, "Introduction and General Description"

3.3. In Chapter 1 of the FSER, the NRC staff provided a general description of the proposed site, which spans 3,169 acres and is located on a coastal plain bluff on the southwest side of the Savannah River in eastern Burke County, Georgia. Ex. NRC000056 at 1-2. The NRC staff described the two existing reactor units at the site, as well as the Department of Energy's Savannah River Site ("SRS"), located across the river, directly east of the proposed site. *Id.* at 1-2 to 1-3. Chapter 1 also identifies the agents and contractors who assisted in the development of the application,¹¹ and summarizes the major matters encompassed by the NRC staff's safety review of both the ESP and LWA applications. *Id.* at 1-3 to 1-5. The NRC staff identified nine permit conditions that it recommends be imposed if an ESP is issued, as well as certain inspections, tests, analyses, and acceptance criteria ("ITAAC"). *Id.* at 1-6 to 1-7, Appx. A.1, A.5. The NRC staff also identified five combined license ("COL") action items that would

¹¹ Southern submitted the application acting on behalf of itself and Georgia Power Company ("GPC"), Oglethorpe Power Corporation (an electric membership corporation), Municipal Electric Authority of Georgia, and the City of Dalton, Georgia, an incorporated municipality in the State of Georgia acting by and through its Board of Water, Light and Sinking Fund Commissioners. Ex. NRC000056 at 1-1.

need to be addressed by any future construction permit (“CP”) or COL applicant referencing the Vogtle ESP. *Id.* at 1-6, Appx. A.2.

3.4. Pursuant to the Board’s request for a hearing presentation on “Deferrals to COL,” the NRC staff presentation confirmed that no safety review required for the ESP or LWA was deferred to the COL stage. Ex. NRC000067 at 3.¹² The NRC staff found that all requirements applicable to the ESP and LWA had been met, subject to permit conditions and ITAAC. *Id.* In its hearing presentation, the NRC staff summarized the COL action items identified in the FSER (at Appendix A.2), noting that they are information requirements that would need to be addressed by a COL applicant referencing the ESP. *Id.* at 5-8.

3.5. In the FSER, the NRC staff described how, in contrast to previous ESP applications that relied on a “plant parameter envelope” representing a composite of several potential reactor designs, Southern specifically considered the AP1000 certified reactor design in its ESP and LWA application. Ex. NRC000056 at 1-3. The NRC staff emphasized in the FSER, however, that issuance of a Vogtle ESP does not constitute approval of future construction of the AP1000 certified design at the Vogtle site. If a CP or COL applicant references a Vogtle ESP in its application, the NRC staff’s CP or COL stage review would determine whether the reactor design that is ultimately selected by that applicant falls within the site characteristics and design parameters specified in the ESP. *Id.*; 10 C.F.R. § 52.79(b)(1). The NRC staff also explained that, while the LWA application references applicable design parameters of the AP1000 certified design, the NRC staff’s LWA review addresses only those aspects of the AP1000 design that are within the scope of that request. Ex. NRC000056 at 1-3.

¹² In support of its presentation on deferrals to the COL stage, the NRC staff introduced three witnesses: Mr. Mark N. Notich, Mr. Christian J. Araguas and Dr. Michael A. Smith. (The Curriculum Vitae of the NRC staff’s witnesses are in Exhibits NRC000072, NRC000074, and NRC000076, respectively.)

3.6. In conducting its review of the radiological safety and emergency planning aspects of the proposed nuclear power plant site, the NRC staff used the guidance in NRC Review Standard (RS)-002, "Processing Applications for Early Site Permits," Attachment 2, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" ("SRP"), and NUREG-0654/FEMA-REP-1, Supplement 2, "Criteria for Emergency Planning in an Early Site Permit Application."

FSER Chapter 2, "Site Characteristics"

3.7. In FSER Chapter 2, the NRC staff evaluated information relating to the site's geography and demography; nearby industrial, transportation, and military facilities; meteorology, hydrology, and seismology. The NRC staff's review and findings are summarized below.

Geography and Demography

3.8. With respect to geography and demography, the NRC staff reviewed the Applicant's description of the site location and the site area map, including the location of the proposed reactors relative to nearby highways, railroads, and waterways, political subdivisions, and prominent natural and manmade features. Ex. NRC000056 at § 2.1.1. The NRC staff also reviewed the location of the exclusion area boundary ("EAB") and the Applicant's authority and control over its exclusion area. *Id.* at § 2.1.2. Furthermore, the NRC staff reviewed the information concerning population distribution within a 50-mile radius as well as within the low population zone ("LPZ"). *Id.* at § 2.1.3.

3.9. The NRC staff found that the Applicant provided and substantiated, in sufficient detail, information concerning the site location and site description. *Id.* at 2-2 to 2-4. The NRC staff found that the Applicant appropriately described the exclusion area and its authority and methods of control over it. *Id.* at 2-5 to 2-7. Finally, the NRC staff found that the Applicant provided an acceptable description of current and projected population densities in and around

the site and that those densities met the guidelines of Regulatory Guide (“RG”) 4.7. *Id.* at 2-9 to 2-11. The NRC staff independently reviewed and confirmed the Applicant’s population projections. *Id.* The NRC staff determined that the site description and population data met the applicable requirements of 10 C.F.R. Part 52 and Part 100. *Id.* at 2-4, 2-7, 2-11.

3.10. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the descriptions of the proposed site, the exclusion area, and estimated population distribution.

Nearby Industrial, Transportation, and Military Facilities and Descriptions

3.11. The NRC staff also reviewed the application with respect to potential hazards from nearby industrial, transportation, and military facilities. *Id.* at § 2.2. The NRC staff considered whether the information in the application about facilities in the vicinity of the plant, including any hazardous materials, was sufficient to permit identification of possible hazards to the site. *Id.* at 2-12 to 2-17. The NRC staff also reviewed and evaluated potential accident sequences on and in the vicinity of the proposed ESP site to ensure that calculated risks are sufficiently low. *Id.* at 2-17 to 2-24. These included potential consequences of explosions on transportation routes near the proposed site, such as from trucks or railroad cars carrying hazardous chemicals, or from chemical storage areas or onsite storage tanks. *Id.* at 2-19 to 2-24.

3.12. The NRC staff found that the Applicant provided information about potential site hazards in accordance with RS-002 guidance, including with respect to roads, railroads, pipelines, and airports in the vicinity of the site. *Id.* at 2-13 to 2-17. The NRC staff determined that all potential hazards and potentially hazardous activities were identified. *Id.* at 2-17. The NRC staff reviewed the Applicant’s analysis of postulated accidents for various types, sources, and locations, and independently verified the Applicant’s evaluation. *Id.* at 2-17 to 2-24. The NRC staff identified two COL Action Items to ensure that potential impacts of onsite chemical

storage on control room habitability are considered at the CP or COL stage, depending on the eventual quantity of chemicals onsite and the control room design ultimately selected. *Id.* at 2-23. Based on its review, the NRC staff found that with respect to potential man-made hazards, the proposed site is acceptable and meets the relevant requirements of 10 C.F.R. Part 52 and Part 100. *Id.* at 2-24.

3.13. In its written questions for the uncontested hearing, the Board asked two questions concerning control of access to the exclusion area and monitoring of shipment-related hazards. The NRC staff explained that the Applicant had demonstrated control over the EAB consistent with applicable requirements, including with respect to the posting of signs, and also that while NRC monitoring of shipment-related hazards is not anticipated for an ESP consistent with NRC staff guidance, changes to those hazard levels might need to be evaluated consistent with 10 C.F.R. § 52.39. Ex. NRC000058 at 1-4.

3.14. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the descriptions of potential hazards from nearby industrial, transportation, and military facilities.

Site Meteorology

3.15. In Section 2.3 of the FSER, the NRC staff reviewed the application with respect to site meteorology. The NRC staff's review considered the application's description of regional and local climatological data, including climate extremes and severe weather occurrence relevant to the siting and design of proposed reactors. The NRC staff also reviewed the atmospheric dispersion characteristics of the site to determine whether radioactive effluents (from postulated accidental releases as well as routine operational releases) are within Commission guidelines.

3.16. Regarding regional climatology, the NRC staff reviewed the Applicant's description of climatic conditions and regional meteorological phenomena (both averages and

extremes) that could affect the design and operating bases of reactors at the proposed site. NRC000056 at § 2.3.1. This information included descriptions of the general climate, temperature and humidity extremes, as well as phenomena including extreme wind, tornadoes, tropical cyclones, precipitation extremes (including winter precipitation loads), and thunderstorms. *Id.* The NRC staff also reviewed the site characteristics proposed by the Applicant to reflect meteorological features. *Id.* Because of the Applicant's consideration of the AP1000 design, these site characteristics also included certain temperature site characteristics corresponding to site parameters in the AP1000 design control document ("DCD"). *Id.* at 2-38 to 2-39. Also, because the Applicant referenced a design with a passive containment cooling system, the NRC staff identified a COL Action Item to ensure that if the applicant at the COL stage selects an alternative design with an ultimate heat sink cooling tower, it would need to identify the appropriate meteorological site characteristics to evaluate the design of that tower. *Id.* at 2-36.

3.17. The NRC staff also reviewed the Applicant's description of local meteorology. *Id.* at § 2.3.2. The NRC staff's review included consideration of the site meteorology in terms of airflow, atmospheric stability, temperature, water vapor, precipitation, fog, and air quality. *Id.* at 2-47. The NRC staff reviewed the Applicant's topographical description of the site and its environs, as well as the potential for changes to the site's meteorological characteristics resulting from the construction and operation of the proposed facility. *Id.*

3.18. After independently verifying the data and data sources used by the Applicant, applying relevant NRC staff guidance (including RS-002 and RGs 1.23, 1.70, and 1.76), and considering responses to NRC staff Requests for Additional Information ("RAIs"), the NRC staff determined that the Applicant presented and substantiated information relative to the local and regional meteorological conditions and determined that the proposed site characteristics were acceptable. *Id.* at 2-41, 2-54. The NRC staff determined that the Applicant had provided the

local and regional meteorological information necessary to comply with 10 C.F.R. Part 52 and Part 100. *Id.*

3.19. In FSER Section 2.3.3, the NRC staff reviewed the onsite meteorological measurements program submitted with the ESP application. The development and implementation of this program is relevant to the NRC staff's evaluation of the Applicant's emergency plan, and is also necessary to demonstrate compliance at the COL stage with dose guidelines in 10 C.F.R. Part 50, Appendix I. *Id.* at 2-57. Accordingly, the NRC staff considered the Applicant's description of its meteorological instrumentation as well as hourly data from the five-year period of record that was submitted, and it evaluated whether the data were appropriate for characterizing atmospheric dispersion conditions. *Id.* at § 2.3.3. In evaluating the program, the NRC staff considered the potential influence of nearby plant structures on the meteorological measurement system. *Id.*

3.20. After independently considering the Applicant's instrumentation and data (including equipment calibration procedures), applying relevant NRC staff guidance (including RS-002 and RGs 1.23, 1.70, and 4.2), and considering responses to RAIs, the NRC staff determined that the Applicant successfully implemented an appropriate onsite meteorological measurements program and that the data provide an acceptable basis for estimating atmospheric dispersion for design basis accidents ("DBAs") and routine releases. *Id.* at 2-61 to 2-62. The NRC staff found that the application's five years of onsite data were representative of the site. The NRC staff further found that the adequacy of the onsite program was sufficient to support the NRC staff's evaluation in FSER Chapter 13 of the Applicant's proposed emergency plan. *Id.* at 2-62, 13-69, 13-70.

3.21. In FSER Section 2.3.4, the NRC staff evaluated the Applicant's description of short-term diffusion estimates for postulated accidental airborne releases of radioactive effluents to the EAB and the outer boundary of the LPZ. The Applicant used the PAVAN computer code

to estimate atmospheric dispersion (χ/Q) values at the EAB and at the outer boundary of the LPZ for potential accidental releases, consistent with the methodology outlined in RG 1.145. *Id.* at 2-67. The NRC staff agreed that the Applicant's use of a ground-level release assumption was conservative. *Id.* at 2-68. The NRC staff confirmed the Applicant's atmospheric dispersion estimates by running the PAVAN computer code and obtaining similar results. *Id.* at 2-69. Based on its confirmatory review and consideration of relevant NRC staff guidance (including RS-002 and RGs 1.23, 1.70, 1.111, 1.145, and 1.183) the NRC staff concluded that representative atmospheric transport and diffusion conditions were calculated at the EAB and the outer boundary of the LPZ as required by 10 C.F.R. Part 52 and 10 C.F.R. § 100.21(c)(2). *Id.* The NRC staff determined that the Applicant's proposed site characteristics for short-term atmospheric dispersion were acceptable. *Id.*

3.22. In FSER Section 2.3.5, the NRC staff evaluated the Applicant's description of long-term diffusion estimates for routine releases of radiological effluents to the atmosphere. This review was to verify that the Applicant used appropriate atmospheric dispersion models and meteorological data to calculate relative concentration and relative deposition for evaluation of routine airborne releases of radioactive material. *Id.* at 2-71. The Applicant used the NRC-sponsored computer code XOQDOQ to estimate atmospheric dispersion (χ/Q) and deposition (D/Q) values resulting from routine releases, consistent with RG 1.111. *Id.* at 2-73. Following its consideration of RAI responses concerning the site topography, the NRC staff concluded that the XOQDOQ modeling results are applicable to the site. *Id.* The NRC staff agreed that the Applicant's use of a ground-level release assumption was conservative, as discussed in RG 1.111, and acceptable. *Id.* at 2-74. The NRC staff confirmed the Applicant's χ/Q and D/Q values by running the computer code and obtaining the same results. *Id.* at 2-75. The NRC staff concluded that the Applicant provided meteorological data and an atmospheric dispersion model that are appropriate for the characteristics of the site and release points, and

that the Applicant calculated representative atmospheric transport and diffusion conditions. *Id.* Based on its confirmatory review and consideration of relevant NRC staff guidance (including RS-002 and RGs 1.23, 1.70, 1.109, 1.111, and 1.112) the NRC staff concluded that the Applicant provided the information required by 10 C.F.R. Parts 52 and 100. *Id.* at 2-75 to 2-76. The NRC staff determined that the Applicant's proposed site characteristics for long-term atmospheric dispersion were acceptable. *Id.*

3.23. In its written questions for the uncontested hearing, the Board asked several questions concerning meteorology, including with respect to meteorological data, weather influences on the AP1000 passive cooling system (PCS), meteorological parameters associated with the AP1000, and the NRC staff's review of the PAVAN computer model runs. The NRC staff explained that the Applicant's use of sources for climatic data and onsite data was consistent with RS-002 and RG 1.23. Ex. NRC000058 at 4-5. The NRC staff also reiterated that the PCS is designed to withstand the air temperature site parameters specified in the AP1000 DCD and that whether the AP1000-specific air temperature site characteristics described in the FSER are bounded by the design ultimately selected would be determined at the COL stage. *Id.* at 6-7. The NRC staff qualitatively reviewed all the inputs to the PAVAN model and found the inputs to be consistent with the site configuration and guidance provided in RG 1.145. *Id.* at 10.

3.24. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the descriptions of meteorology and meteorological site characteristics.

Site Hydrology

3.25. In Section 2.4 of the FSER, the NRC staff evaluated the hydrological setting of the Vogtle site and the data used in the Applicant's safety conclusions regarding hydrology. Ex. NRC000056 at 2-80. At the uncontested hearing, the Applicant and the NRC staff provided

presentations regarding the release and transport of radioactive liquid effluents under postulated accident conditions and on groundwater impacts on safety-related structures. Ex. SNCR00073; NRCR00060, NRC000061.¹³ To ensure that the site hydrological characteristics that could affect the safe design and siting of the proposed units meet the requirements set forth in 10 C.F.R. §§ 52.17(a) and 100.20(c), the NRC staff's review of the ESP and LWA application considered the basic hydrologic characteristics of the Vogtle site; the interface of the plant with the hydrosphere; its susceptibility to flooding from several mechanisms; ground and surface water use; the effect of low water conditions on the plant; the effect of accidental releases of radioactive effluents in ground and surface waters; the data that forms the basis of the Applicant's analysis and conclusions; and alternate conceptual models. Ex. NRC000056 at 2-86. The NRC staff also provided responses to questions proposed by the Board pertaining to its assessment of flooding causal mechanisms and use of historical data, evaluation of the hazards presented by formation of ice on safety-related structures, systems and components ("SSCs"), and the impacts expected from potential use of chelating agents. Ex. NRC000058 at 12-20.

Section 2.4.1, Hydrologic Description

3.26. In Section 2.4.1, the NRC staff reviewed the Applicant's description of the site hydrology, including surface and subsurface hydrologic characteristics of the site and region. Ex. NRC000056 at 2-83. The information provided included data on surface water users,

¹³ In support of its presentations on the release and transport of radioactive liquid effluents under postulated accident conditions and groundwater impacts on safety-related structures (Ex. NRC000060, NRC000061), the NRC staff introduced three witnesses: Dr Hosung Ahn, Dr. Charles T. Kincaid, and Mr. Christian J. Araguas. (The Curriculum Vitae of the NRC staff's witnesses are in Exhibits NRC000077, NRC000071, and NRC000074, respectively.) The Applicant's presentation (Ex. SNCR00073) was provided by Dr. Angelos N. Findikakis, whose Curriculum Vita is in Exhibit SNC000074.

hydrologic characteristics of streams, lakes, and shore regions, and all existing or proposed reservoirs and dams including tabulations of drainage areas, seismic and spillway design criteria, elevation-storage relationships, and short- and long-term storage allocations. *Id.* at 2-81. The NRC staff concluded that the hydrologic information provided by the Applicant conformed to the criteria established in 10 C.F.R. §§ 52.17(a), 100.20(c), and 100.21(d), and was sufficient for the NRC staff's review of hydrological causal mechanisms, water uses, and conceptual models related to the Vogtle ESP site. *Id.* at 2-83, 2-86.

Section 2.4.2, Floods

3.27. In Section 2.4.2, the NRC staff reviewed the types of flood-producing phenomena considered by the Applicant in establishing the flood design bases for safety-related plant features. *Id.* at 2-86. This included a determination of the flooding history of the Vogtle site and region, estimates of local intense precipitation, and an evaluation of the design-basis flood selected by the Applicant. *Id.* at 2-89. The NRC staff verified the information submitted by the Applicant by comparison to publications of the U.S. Geological Survey ("USGS"), the National Oceanic and Atmospheric Administration ("NOAA"), the U.S. Army Corps of Engineers ("USACE"), and applicable state and river basin authorities, and reviewed it for conformance with 10 C.F.R. Part 52 and Part 100, RS-002, and RG 1.59, Rev. 2. *Id.* at 2-88. The NRC staff's review considered the suitability of the Applicant's data for evaluation of the effect of local flooding on the site and drainage design, stream flooding, surges, seiches, tsunamis, seismically induced dam failures (breaches), flooding caused by landslides, and the effects of ice formation in water bodies. *Id.* at 2-86.

3.28. In its site safety analysis report ("SSAR"), the Applicant established a historical maximum stage of the Savannah River near the Vogtle site, estimated the local intense precipitation, and determined that the design-basis flood for the site is a flood generated by an upstream breach of dams with coincident wind setup and wave runup. *Id.* at 2-89. Based on its

independent analysis of the information provided by the Applicant, the NRC staff concluded that the identification and consideration of local intense precipitation, flooding causal mechanisms, and the controlling flooding mechanism met the applicable regulatory requirements and that the Applicant's proposed site characteristics related to local intense precipitation were acceptable. *Id.* at 2-92.

Section 2.4.3, Probable Maximum Flood (PMF) on Streams and Rivers

3.29. In Section 2.4.3 of the FSER, the NRC staff evaluated the design bases for flooding in streams and rivers and for site drainage. *Id.* at 2-92. This information was developed by the Applicant to determine the flood protection measures required for SSCs necessary to ensure the ability to shut down the reactor and maintain it in a safe shutdown condition. *Id.*

3.30. The NRC staff conducted independent estimates of the probable maximum precipitation (PMP) and probable maximum flood (PMF) for the Vogtle site and compared them to the Applicant's calculations. *Id.* at § 2.4.3.3.2. The NRC staff conservatively estimated the combined peak discharge in the Savannah River near the Vogtle site. *Id.* at 2-98. As an additional conservatism, the NRC staff estimated the peak PMF runoff from the drainage area downstream of the Thurmond Dam assuming that no losses occur during the PMP event and that all runoff was translated instantaneously to the Vogtle site. *Id.* Based on its review, the NRC staff concluded that the Vogtle site is dry with respect to floods in rivers and streams. *Id.* at 2-99. The NRC staff further concluded that the Applicant's analyses were acceptable in establishing the design bases for SSCs important to safety. *Id.*

3.31. In response to written questions from the Board, the NRC staff further described its calculation of the flooding causal and controlling mechanisms and the use of historical flood data. Ex. NRC000058 at 12-17. The NRC staff noted that historical precipitation data, along with theoretical methods for moisture maximization, transposition, and envelopment, were used

by NOAA to develop the PMP methodology, and that the PMP provided sufficient conservatism to account for historically-observed extreme precipitation events. *Id.* at 15. The PMP estimated by the NRC staff, based on the NOAA methodology, for the entire Savannah River Basin was then used to calculate the PMF assuming conservative hydrological conditions. *Id.* The NRC staff further explained that consideration of potential flooding mechanisms, such as from hurricanes or tsunamis, among others, led to its conclusion that a cascading dam failure scenario upstream of the Vogtle site would generate the highest flooding level and therefore constituted the design basis flood. *Id.* at 16. The design basis flood was then compared to the most extreme historical flood, plus an additional margin of conservatism, to ensure that the historical maximum flood was not more severe than the flood resulting from the hypothetical cascading dam failure. *Id.* The NRC staff, using conservative dam breach parameters, concluded that the hypothetical cascading dam failure would lead to a peak flood discharge near the Vogtle site which would be 6.6 times greater than the historical maximum flood and that such a difference was sufficient to account for uncertainty in the historical flood records. *Id.* at 17.

Section 2.4.4, Potential Dam Failures

3.32. In Section 2.4.4 of the FSER, the NRC staff evaluated the potential hazard to safety-related facilities resulting from failures of onsite, upstream, and downstream water control structures. Ex. NRC000056 at 2-99. The NRC staff's review considered: flood waves from severe breaching of an upstream dam, domino-type or cascading dam failures, dynamic effects of dam-failure induced flood waves on structures, loss of water supply at the plant due to failure of a downstream dam, effects of sediment deposition and erosion, failure of onsite water control or storage structures, and the potential effects of seismic and non-seismic information on the postulated design bases and how they relate to dam failures in the vicinity of the site and site region. *Id.* at 2-99 to 2-100. The NRC staff reviewed the information submitted by the Applicant

for conformance with 10 C.F.R. § 52.17 and Part 100, as well as the regulatory guidance in RG 1.70, Revision 3, RG 1.29, RG 1.59, Revision 2, and RG 1.102, Revision 1. *Id.* at 2-100.

3.33. The NRC staff independently reviewed the Applicant's estimate of floodwater height at the Vogtle site resulting from a domino-type failure of upstream dams, considering both steady and unsteady flows to compute the maximum stage and discharge in the Savannah River. *Id.* at 2-103. The NRC staff analyzed a dam-break scenario in which the maximum wave height and associated maximum wave runup were added to the peak flood wave elevation in accordance with applicable American Nuclear Society and American National Standards Institute criteria. *Id.* at 2-106. Based on this analysis, the NRC staff concluded that the Vogtle site would not flood during the postulated dam-break scenario including a domino-type cascading failure of multiple upstream dams and that the information submitted by the Applicant met the applicable regulatory requirements. *Id.* at 2-107. The NRC staff found the Applicant's proposed site characteristics concerning maximum flood elevation to be acceptable. *Id.*

Section 2.4.5, Probable Maximum Surge and Seiche Flooding

3.34. In Section 2.4.5 of the FSER, the NRC staff evaluated the probable maximum surge and seiche flooding associated with the probable maximum hurricane, probable maximum wind storm, seiche and resonance, wave runup, and effects of sediment erosion and deposition. Ex. NRC000056 at 2-109. The NRC staff reviewed the probable maximum hurricane storm surge estimated by the Applicant based on available hurricane data from the NOAA Coastal Services Center. *Id.* at 2-112. Based on this information, and the location of the Vogtle site in relation to the Savannah River estuary, the NRC staff concluded that the information provided by the Applicant met the applicable regulatory requirements and that the probable maximum surge and seiche would not affect the VEGP site. *Id.* at 2-113.

Section 2.4.6, Probable Maximum Tsunami Hazards

3.35. In Section 2.4.6 of the FSER, the NRC staff evaluated the hazards associated with the probable maximum tsunami. Ex. NRC000056 at 2-116. In its analysis, the NRC staff considered historical tsunami data, the probable maximum tsunami, tsunami propagation models, wave runup, inundation, and drawdown, hydrostatic and hydrodynamic forces, debris and water-borne projectiles, and the effects of sediment erosion and deposition. *Id.* It reviewed the information submitted by the Applicant for conformance with 10 C.F.R. Parts 52 and 100, as well as guidance in RG. 1.70, RG 1.29, RG 1.59, RG 1.102, and RG 1.125. *Id.* at 2-117.

3.36. The NRC staff noted that estimates of potential tsunamis impacts require an analysis of all potential distant and local tsunami generators, including volcanoes and areas of potential landslides as well as seismic characteristics for tsunami generators. *Id.* at 2-118. The NRC staff reviewed the information submitted by the Applicant and performed an independent analysis of the tsunami runup events reported in the general region of the Savannah River estuary as reported in the National Geophysical Data Center (“NGDC”) Tsunami Runup Database. *Id.* at 2-120. Based on its analysis of historical tsunami runup data, the NRC staff concluded that there was not enough historical data to assess the severity of runups near the Savannah River estuary; therefore, the NRC staff utilized a bounding approach to determine the potential effect of tsunamis on the Vogtle site. *Id.*

3.37. In determining the potential hazards to the Vogtle site from tsunamis, the NRC staff considered the distance of the site from the shoreline, the upriver distance of the site from the shoreline, and the elevation of the site relative to the shoreline. *Id.* at 2-122. Based on its analysis of historical data, the NRC staff concluded that all known tsunami runups on the Atlantic coast of the U.S. have been at least an order of magnitude less than the elevation of the Vogtle site and that a tsunami-induced bore traveling upstream to the Vogtle site would not occur. *Id.* at 2-124 and 2-125. The NRC staff further concluded that a tsunami causing a runup

of 200 feet mean sea level (“MSL”) more than 100 miles inland would be required in order to inundate the Vogtle site. *Id.* at 2-125. The NRC staff therefore found that a tsunami located at the mouth of the Savannah River would not affect the Vogtle site. *Id.*

Section 2.4.7, Ice Effects

3.38. In Section 2.4.7 of the FSER, the NRC staff evaluated the possibility for ice-induced hazards to affect safety-related facilities. Ex. NRC000056 at 2-126. In its analysis, the NRC staff reviewed historical ice accumulation, high and low water levels, ice sheet formation, ice-induced forces and blockages, and the potential for formation of frazil ice. *Id.* The NRC staff found that no ice jam events have been reported on the lower portion of the Savannah River near the Vogtle site, that the possibility of surface ice or ice floes near the site is reduced by the presence of dams and reservoirs upstream of the site, and that the ambient air temperature near the site would not support the formation of frazil ice. *Id.* at 2-128, 2-130 to 2-132. The NRC staff further found that the proposed units have no safety-related water requirement and that the formation of ice sheets, forces induced by ice, and blockages caused by ice would not affect the safety of the proposed units. *Id.* at 2-131. Based on its analysis, the NRC staff concluded that the Applicant submitted sufficient information pertaining to the identification and evaluation of ice effects at the proposed site and that the proposed site characteristic related to ice effects for the ESP application was acceptable. *Id.* at 2-132.

Section 2.4.8, Cooling Water Canals and Reservoirs

3.39. In Section 2.4.8 of the FSER, the NRC staff evaluated the Applicant’s hydraulic design basis for cooling water canals and reservoirs used to transport and impound water supplied to the safety-related SSCs. Ex. NRC000056 at 2-132. The NRC staff’s review also considered whether the applicant complied with the requirements of 10 C.F.R. Part 50, Appendix A, General Design Criterion (“GDC”) 44 as it relates to providing an ultimate heat sink (“UHS”) for normal operating and accident conditions. *Id.*

3.40. The NRC staff found that the proposed units would not rely on any external water source for safety-related cooling water other than the initial filling and occasional makeup water and that such water would come from deep, onsite groundwater wells. *Id.* at 2-134. The NRC staff further found that the proposed units will not use any safety-related canals or reservoirs and that the Applicant's site characterization related to canals and reservoirs is acceptable for the ESP application. *Id.* at 2-135.

Section 2.4.9, Channel Diversions

3.41. In Section 2.4.9 of the FSER, the NRC staff evaluated the possibility that plant and essential water supplies would be adversely affected by diversion of the stream channel away from the site and whether adequate alternate water supplies are available for support of safety-related equipment. *Id.* at 2-135. In its analysis, the NRC staff also reviewed historical channel diversions, regional topographic data for the river basin, ice causes, the possibility for flooding of the site due to channel diversion, human-induced channel diversion, and alternate sources of water. *Id.*

3.42. The NRC staff concluded that because the new units would not rely on any external source of safety-related water, diversion of the Savannah River away from the site would not result in an adverse effect on safety. *Id.* at 2-138. The NRC staff also concluded that the information submitted by the Applicant was sufficient for its review and that, based on topographic, morphologic and hydrological characteristics of the Savannah River, it was unlikely that diversion of the river towards the Vogtle site would cause onsite flooding. *Id.*

Section 2.4.10, Flooding Protection Requirements

3.43. In Section 2.4.10 of the FSER, the NRC staff considered the safety-related facilities exposed to flooding and the type of flooding protection required in site design or emergency procedures. *Id.* at 2-138. Consistent with the regulatory requirements of 10 C.F.R. Part 52 and 10 C.F.R. Part 100, and guidance in RS-002, the NRC staff evaluated the

topography and geology of the Savannah River Basin and its applicability to flooding damage, historical incidents of shore erosion and flooding damage, and the potential adverse effects of the loss of flooding protection. *Id.* at 2-139. As discussed in previous sections of the FSER, the NRC staff found that the design-basis flood elevation is below the proposed site grade and flooding protection is not required for the safety-related SSCs. *Id.* at 2-140.

Section 2.4.11, Low Water Considerations

3.44. In Section 2.4.11 of the FSER, the NRC staff discussed the natural events that may reduce or limit the available safety-related cooling water supply. *Id.* at 2-141. Consistent with 10 C.F.R. Parts 52 and 100, the NRC staff considered water use limits, low water conditions from drought or other phenomena and other site-related evaluation criteria. *Id.* Consistent with its guidance, the NRC staff analyzed the design of the primary water supply system as it related to low flow in rivers and streams and potential future water use and discharge limitations. *Id.* at 2-143. The NRC staff found that, other than initial filling and occasional makeup water requirements for two water storage tanks, low water conditions would not affect any safety-related SSCs. *Id.* at 2-143 to 2-144. The NRC staff concluded that the information submitted by the Applicant was sufficient to demonstrate compliance with applicable regulatory requirements and that the site characterization related to low water considerations to be included in the ESP was acceptable. *Id.* at 2-144.

Section 2.4.12, Ground Water

3.45. In Section 2.4.12 of the FSER, the NRC staff evaluated the hydrogeological characteristics of the site and described the effects of groundwater on the plant foundations and the reliability of safety-related water supply and dewatering systems. *Id.* at 2-144. The NRC staff reviewed the local and regional groundwater characteristics and use, the effects of plant foundations and other safety-related SSCs, and other site-related evaluation criteria. *Id.* These

criteria were evaluated for conformance with the requirements set forth in 10 C.F.R. Part 52 and 10 C.F.R. Part 100. *Id.* at 2-145.

3.46. The NRC staff noted that the proposed units are to be located on a topographic ridge, perpendicular to the Savannah River, which forms a boundary between two watersheds dominated by separate drainage systems to the northeast and southwest of the ridge. *Id.* at 2-144. The NRC staff also reviewed and confirmed data submitted by the Applicant regarding the aquifers, limestone, and confining unit underlying the Vogtle site, as well as the presence and locations of springs, seeps and local drainages. *Id.* at 2-148. Groundwater flow models were developed by the Applicant based on information obtained from onsite wells and piezometers, accounting for variations in surface slopes, vegetative cover, and land use, and with consideration that construction of the proposed facilities may alter site topography and recharge to the unconfined Water Table aquifer. *Id.* at 2-149 to 2-151.

3.47. The NRC staff conducted an independent analysis of the piezometric surface contour plots and confirmed the Applicant's description of regional and local hydrogeologic conditions by reviewing conceptual and numerical models documented by the USGS and State of Georgia, including independently determined values of hydraulic conductivity and transmissivity. *Id.* at 2-152 to 2-156. Based on this review, the NRC staff determined that, contrary to the information submitted by the Applicant, flow in the Water Table aquifer from the proposed powerblock area could be to the north-northwest (Mallard Pond) or to the south-southeast (Daniels Branch). *Id.* at § 2.4.12.3.2. Based on its analysis, the NRC staff also determined that an accidental release to groundwater would contaminate the Water Table aquifer, but that it was unlikely for contamination to reach the Tertiary aquifer due to the Blue Bluff Marl, which acts as a confining unit. *Id.* at 2-156.

3.48. In the FSER, the NRC staff evaluated the potential for groundwater to affect plant foundations and other safety-related SSCs, the reliability of groundwater resources and systems

used for safety-related systems, and the possible reliability of dewatering systems. *Id.* at 2-156. In response to the Board's request, both the Applicant and NRC staff also provided hearing presentations on the impact of groundwater on safety-related structures. Ex. NRC000061.¹⁴ In its hearing presentation, the NRC staff described its review of the pre- and post-construction site hydrology and the conservative nature of certain assumptions made in conceptual groundwater models. *Id.*

3.49. Specifically, the NRC staff assumed relatively high water recharge rates for the cooling tower and powerblock regions in its groundwater model, confirming that the post-construction water table is predicted to be below 165 feet MSL and thereby well below the foundations of safety-related SSCs at 180.5 ft MSL. *Id.* The NRC staff determined that the maximum observed groundwater elevation of 165 feet MSL will not contribute a buoyant force on the nuclear island structure. Ex. NRC000056 at 2-156. Further, the NRC staff found that a plant fitting within the bounding parameters provided in the permit application would not require groundwater for safety-related use, nor would it require a permanent dewatering system. *Id.* at 2-157.

3.50. Based on its analyses, the NRC staff concluded in the FSER that the Applicant submitted sufficient information to support the identification and evaluation of the effects of groundwater at the Vogtle site in conformance with the applicable regulatory requirements. *Id.* at 2-158. The NRC staff also concluded that the proposed hydrology-related site characteristic was acceptable for inclusion in the ESP for the proposed site. *Id.*

¹⁴ In support of its presentation on groundwater impacts to safety-related structures (Ex. NRC000061), the NRC staff introduced three witnesses: Dr. Hosung Ahn, Dr. Charles T. Kincaid, and Mr. Christian J. Araguas. (The Curriculum Vitae of the NRC staff's witnesses are in Exhibits NRC000077, NRC000071, and NRC000074, respectively.) The Applicant's presentation (Ex. SNCR00073) was provided by Dr. Angelos N. Findikakis, whose Curriculum Vita is in Exhibit SNC000074.

Section 2.4.13, Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters

3.51. In Section 2.4.13 of the FSER, the NRC staff evaluated the hydrogeological characteristics of the site and how accidental releases of radioactive liquid effluents in ground and surface water might affect existing uses and known and likely future uses of ground and surface water resources. *Id.* The NRC staff reviewed the information provided by the Applicant for conformance with the requirements of 10 C.F.R. Parts 52 and 100, as well as the guidance in RS-002, RG 1.113, Revision 1, and RG 4.4. *Id.* at 2-159. In meeting these criteria, the Applicant described the radionuclide transport characteristics of the groundwater environment with respect to existing and future users, the transport characteristics of the surface water environment for conditions which reflect worst-case release mechanisms and source terms, and submitted models to analyze the flow and dispersion of contaminants in groundwater and surface water. *Id.* at 2-160.

3.52. Also in Section 2.4.13, the NRC staff identified a COL Action Item requiring a COL or CP applicant to ensure that no chelating agents will be comingled with radioactive waste liquids and that such agents will not be used to mitigate an accidental release. *Id.* at 2-173, A-5. The NRC staff noted that, alternatively, the COL or CP applicant could obtain new distribution coefficients, which include chelating agents, and incorporate these values into its analysis of the radionuclide transport characteristics of the site. *Id.* at 2-173.

3.53. The NRC staff reviewed alternate conceptual models for groundwater and surface water transport, site characteristics that affect radionuclide transport, potential contamination pathways, and the analyses of contaminant transport, including pathways in the Water Table aquifer discharging into both Mallard Pond and Daniels Branch with points of compliance at the site boundary, and in the Tertiary aquifer with discharge to the Savannah River. *Id.* at 2-170 to 2-171. The NRC staff concluded that the most plausible pathway for

groundwater transport of radionuclides was to the north, with discharge into Mallard Pond. *Id.* at 2-165 to 2-166. The NRC staff also reviewed other groundwater pathways in the Water Table aquifer, concluding that drainage to Daniels Branch was plausible but unlikely and that drainage to the Savannah River or south of the Vogtle Units 1 and 2 cooling towers is implausible. *Id.* at 2-167. The NRC staff also concluded that transport into the Tertiary aquifer with drainage to the Savannah River was plausible but unlikely. The NRC staff analyzed all pathways identified as plausible, even those determined to be unlikely. *Id.* at 2-165 to 2-173.

3.54. Based on its analyses, the NRC staff concluded that the information submitted by the Applicant met the applicable regulatory requirements in 10 C.F.R. Parts 52 and 100. *Id.* at 2-173 to 2-174. The NRC staff further found that a release of radioactive liquid effluent to either surface water or groundwater can meet the requirements of 10 C.F.R. Part 20. *Id.* at 2-173.

3.55. In response to written questions from the Board, the NRC staff described the consideration of chelating agents in its contaminant transport analysis. Ex. NRC000058 at 18. The NRC staff noted that chelating agents had been used at the Vogtle site, there is limited water chemistry monitoring data from which to exclude the possibility of their presence in the subsurface, and the Applicant acknowledged that chelating agents may be used in the future. *Id.* at 19. Accordingly, as noted above, the NRC staff developed an associated COL Action Item.

3.56. Also, in response to the Board's request, the NRC staff prepared a presentation detailing its analysis of release and transport of radioactive effluent under postulated accident conditions. Ex. NRCR000060 at 1-21 (safety). The NRC staff described the relevant site hydrology, the site characteristics that impact transport, and the evaluation of post-construction transport pathways. *Id.* The presentation illustrated how the NRC staff's review and independent confirmatory analysis appropriately evaluated the Applicant's groundwater model to ensure conservatism. *Id.* In response to the Board's questions at the uncontested hearing,

the NRC staff demonstrated how its review had challenged the concept of a single groundwater transport pathway, considered alternate conceptual models, and confirmed the results. Tr. at M-1821 to M-1852.

2.4.14, Site Characteristics

3.57. In Section 2.4.14, the NRC staff listed site characteristics and bounding parameters recommended for inclusion in the ESP for the Vogtle site. Ex. NRC000056 at 2-174 to 2-177. These parameters include the site boundary, the highest groundwater elevation, the maximum flood elevation, wind runup, local intense precipitation, and plant grade elevation. *Id.*

3.58. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the descriptions of hydrology and hydrological site characteristics.

Site Geology, Seismology, and Geotechnical Engineering

3.59. In Section 2.5 of the FSER, the NRC staff reviewed the application with respect to site geology, seismology, and geotechnical engineering. In response to the Board's request for a presentation on the NRC staff's seismic evaluation, the NRC staff described its review of seismic matters as relevant to both the ESP and LWA request. Ex. NRC000065.¹⁵ As noted earlier, the LWA would allow the Applicant to undertake limited construction activities, including the placement of engineered backfill, placement of a concrete mudmat, a waterproofing membrane, an MSE retaining wall, and temporary drains. *Id.* at 40. The NRC staff's review of

¹⁵ In support of its presentation on the seismic evaluation, the NRC staff introduced nine witnesses: Mr. Christian J. Araguas, Ms. Laurel M. Bauer, Dr. Carl J. Costantino, Ms. Sarah H. Gonzalez, Dr. John S. Ma, Mr. Mark N. Notich, Dr. Gerry L. Stirewalt, Mr. Bret A. Tegeler, and Dr. Weijun Wang. (The Curriculum Vitae of the NRC staff's witnesses are in Exhibits NRC000074, NRC000081, NRC000085, NRC000082, NRC000086, NRC000072, NRC000083, NRC000087, NRC000084, respectively.) The Applicant's presentation (Ex. SNC000091) was provided by Mr. Donald P. Moore, whose Curriculum Vita is in Exhibit SNC000097.

the ESP and LWA application considered the application's basic geologic and seismic information; vibratory ground motion; surface faulting; the stability of subsurface materials and foundations; the stability of slopes; and embankments and dams.

Section 2.5.1, Basic Geologic and Seismic Information

3.60. In Section 2.5.1 of the FSER, the NRC staff reviewed basic geologic and seismic information in the application, including the Applicant's surface and subsurface geologic, seismic, and geotechnical investigations. Ex. NRC000056 at 2-209. In its review, the NRC staff focused in particular on whether the Applicant had demonstrated that the Pen Branch fault beneath the Vogtle site is a capable fault. *Id.* at 2-213; 2-229 to 2-233. The NRC staff also evaluated whether the Applicant had appropriately updated the Electric Power Research Institute ("EPRI") source model for the Charleston seismic source, which dominates the ground motion hazard at the site, in light of new information on source geometry and earthquake recurrence rate. *Id.* at 2-220 to 2-222; 2-226; 2-235. The NRC staff obtained the assistance of the USGS and visited the site to confirm the Applicant's interpretations, assumptions, and conclusions. *Id.* at 2-209.

3.61. The NRC staff determined that the data and analyses provided by the Applicant provided an adequate basis to conclude that no capable tectonic faults exist in the plant site area that have the potential to generate surface or near-surface fault displacement. *Id.* The NRC staff concluded that the Applicant had identified and appropriately characterized all seismic sources significant for determining the safe shutdown earthquake ("SSE") for the site, in accordance with the guidance in RG 1.70, 1.165, and Section 2.5.1 of the SRP. *Id.* at 2-235. The NRC staff found that the Applicant presented a thorough review of the literature on regional geology. *Id.* at 2-235. Based on that literature review and the Applicant's geologic, geophysical, and geotechnical investigations of the site vicinity and site area, the NRC staff concluded that the Applicant properly characterized regional and site lithology, stratigraphy,

geologic and tectonic history, and structural geology, as well as subsurface soils and rock units at the site. *Id.* at 2-235 to 2-236. The NRC staff also determined that the effects of human activity will not compromise the site's safety. *Id.* at 2-236.

3.62. Accordingly, the NRC staff concluded that the Applicant provided a thorough and accurate characterization of the geologic and seismic characteristics of the site, in accordance with 10 C.F.R. §§ 52.17(a)(1)(vi), 100.23(c), and 100.23(d). *Id.* at 2-236.

Section 2.5.2, Vibratory Ground Motion

3.63. In Section 2.5.2, the NRC staff reviewed the application with respect to the ground motion response spectra ("GMRS") at the site from potential earthquakes in the area. The NRC staff determined that the Applicant provided a thorough characterization of the seismic sources surrounding the site as required by 10 C.F.R. § 100.23. *Id.* at 2-326. The NRC staff reviewed the Applicant's development of a current earthquake catalog for the site and its use of the EPRI historical earthquake catalog. Considering the Applicant's evaluation of multiple areas and its determination that seismicity rates in the region have not increased since the period covered by the EPRI catalog, the NRC staff found that the Applicant's use of the EPRI seismicity rates is appropriate for assessment of the site seismic hazard. *Id.* at § 2.5.2.4.1; 2-268.

3.64. In its evaluation of the seismic ground motion hazard, the NRC staff focused in particular on the Applicant's updated description of the Charleston source zone. *Id.* at § 2.5.2.4.2. The NRC staff evaluated the Applicant's treatment of liquefaction features discovered since the EPRI study from historic and prehistoric earthquakes. The NRC staff explained that in response to the NRC staff's concerns that the Application provided insufficient paleoliquefaction evidence to rule out the possibility of large inland earthquakes, the Applicant presented evidence of observed liquefaction features characteristic of a localized Charleston source, which the NRC staff found sufficient to resolve the concern. Ex. NRC000065 at 13.

Also, in response to the NRC staff evaluation regarding the hazard curves developed by one of the EPRI Earth Science Teams to characterize the regional hazard, the Applicant demonstrated that the contribution of that team's analysis to the total seismic hazard at the site is insignificant. *Id.* at 16. After considering the Applicant's weighting of the EPRI seismic zones that contribute to the seismic hazard at the ESP site, the NRC staff concluded that the Applicant's update of the 1986 EPRI probabilistic seismic hazards analysis ("PSHA") sources adequately characterizes the regional seismic hazard. Ex. NRC000056 at § 2.5.2.4.2.

3.65. The NRC staff also reviewed the inputs and results to the Applicant's PSHA. The NRC staff found that the Applicant adequately addressed the uncertainties in the characterization of seismic sources through a PSHA that follows the guidance in RGs 1.165 and 1.208. *Id.* at 2-326. The NRC staff concluded that the controlling earthquakes and associated ground motion derived from the Applicant's PSHA are consistent with the seismogenic region surrounding the site. *Id.*

3.66. Furthermore, the NRC staff found that the Applicant's GMRS adequately represent the regional and local seismic hazards and accurately include the effects of the local ESP subsurface properties. *Id.* Based on its review, including a confirmatory analysis of the GMRS, the NRC staff determined that the Applicant followed the guidance in RG 1.208 to develop the horizontal and vertical GMRS and that they are acceptable. *Id.* at § 2.5.2.4.6. Therefore, the NRC staff agreed with the Applicant's GMRS site characteristic. *Id.* at 2-323. The NRC staff noted that the GMRS site characteristic is not bounded by the AP1000 certified design response spectrum. *Id.* n.11; Ex. NRC000065 at 20. However, the NRC staff found the site GMRS value to be within the range of values that new reactor designs generally are engineered to withstand, and to be consistent with the NRC staff's determination that the ESP site is suitable from a geologic and seismologic perspective. *Id.* The NRC staff explained that

whether the reactor design ultimately chosen for the site bounds the GMRS site characteristic will be determined at the COL stage. *Id.*

3.67. Accordingly, the NRC staff concluded that the proposed ESP site is suitable with respect to the vibratory ground motion criteria for new nuclear power plants and meets the applicable requirements of 10 C.F.R. § 100.23. *Id.* at 2-326.

Section 2.5.3, Surface Faulting

3.68. In Section 2.5.3, the NRC staff evaluated the potential for tectonic and nontectonic surface and near-surface deformation at the ESP site. The NRC staff reviewed the Applicant's descriptions of previous studies and data collected within the site area, as well as on the investigations performed to image the Pen Branch fault at the site using seismic reflection and to look for evidence of surface faulting in the site vicinity using field and aerial reconnaissance. *Id.* at 2-334. The NRC staff also reviewed the Applicant's descriptions of the four bedrock faults mapped within the site area and the distribution of epicenters of recorded earthquakes that have occurred in the site vicinity. *Id.* at §§ 2.5.3.3.2 to 2.5.3.3.5. The NRC staff agreed with the Applicant's conclusions that none of the four faults is a capable tectonic feature (or linked with a capable regional tectonic structure) and that there are no zones of Quaternary deformation that required a detailed investigation. *Id.* at 2-337, 2-338. In response to NRC staff concerns that injected sand dikes observed in the site area could be associated with seismically-induced liquefaction, the Applicant presented field evidence to demonstrate that the dikes were likely not tectonic in origin, which the NRC staff found acceptable. *Id.* at 2-339 to 2-343; Ex. NRC000065 at 21.

3.69. Accordingly, the NRC staff concluded that the Applicant provided a thorough and accurate characterization of surface and near-surface faulting and nontectonic deformation and provided an adequate basis to conclude that these do not present a hazard for the site area. Ex. NRC000056 at 2-343.

Section 2.5.4, Stability of Subsurface Materials and Foundations

3.70. In Section 2.5.4, the NRC staff evaluated the stability of subsurface materials and foundations at the site. In doing so, it reviewed information obtained from investigations and field and laboratory testing that the Applicant performed specifically in order to support the LWA portions of the application. *Id.* at 2-344. As described in the FSER and as the NRC staff explained in its hearing presentation, although the NRC staff determined that the Applicant did not initially provide enough field and laboratory tests to reliably determine subsurface soil index properties, the additional investigations performed in support of the LWA request closed a number of open items that had been identified by the NRC staff, as well as twelve COL Action Items. *Id.* at § 2.5.4.3; Ex. NRC000065 at 23, 24. Based on the additional information, in particular the inclusion of several additional borings, which followed the guidance in RG 1.132 and 1.138, the NRC staff agreed that the Applicant conducted sufficient field and laboratory tests to adequately determine the static and dynamic properties of the site. Ex. NRC000056 at 2-390.

3.71. The NRC staff also initially found that the shear-wave velocity measurements in the Application were not sufficient to justify the proposed site characteristics. However, the Applicant obtained additional data to justify its characterization of the shear wave velocity in the Upper Sand Stratum layer at the site and support its decision to remove that stratum. *Id.* at 2-401 to 2-405; Ex. NRC000065 at 25. The NRC staff also reviewed the Applicant's evaluation of static and dynamic bearing capacity, and found that the Applicant used widely accepted equations and factors for its evaluation, and that both the static and dynamic bearing capacity values are within the margins specified in the AP1000 certified design. Ex. NRC000056 at 2-411 to 2-412.

3.72. The NRC staff focused on the adequacy of the Applicant's geophysical investigations to determine soil and rock dynamic properties. The NRC staff concluded that the

Applicant's investigations were adequate because the exploration program followed the guidelines in RG 1.132, including testing performed under an approved quality program in accordance with approved industry standards and practices. *Id.* at § 2.5.4.3.4.

3.73. The NRC staff also considered the Applicant's intended use of engineered backfill and its significance for the seismic response evaluation of the site. *Id.* at 2-416. The NRC staff reviewed the Applicant's description of the extent of the excavations, the backfill design and sources, quality control and ITAAC, groundwater control, and retaining wall plans. *Id.* at 2-417. The NRC staff also reviewed the Applicant's proposed ITAAC that would verify compliance with the compaction and shear wave velocity of the installed backfill. The NRC staff determined that the Applicant provided assurance that during construction activities, if the Applicant meets its soils specification and follows its backfill placement and compaction procedures, the applicable soil density and shear wave velocity requirements will be met as specified in the backfill ITAAC. *Id.* at 2-421 to 2-431. The NRC staff agreed that the description of the excavation and backfill plans at the site is acceptable and that the backfill ITAAC is appropriate, finding that the specified compaction is the accepted industry standard and that the minimum shear wave velocity specified is as required by the AP1000 DCD. *Id.* at 2-431.

3.74. Furthermore, the NRC staff evaluated how the Applicant developed the base shear wave velocity profile and modeled soil modulus reduction and damping, including how it derived its soil shear modulus degradation and damping curves. *Id.* at § 2.5.4.3.7. The NRC staff concluded that the Applicant adequately determined the properties of the soil and rock underlying the proposed new units with respect to dynamic loading, for both the ESP application and LWA request. *Id.* at 2-436.

3.75. With respect to liquefaction potential, the NRC staff evaluated the Applicant's conclusion that liquefaction would occur only in the Upper Sand Stratum. *Id.* at § 2.5.4.3.8. The NRC staff concluded that the data support the Applicant's demonstration that the Blue Bluff Marl

is not susceptible to liquefaction. *Id.* at 2-438. In agreeing that the site characteristic for liquefaction should be defined as negligible, the NRC staff recognized that the Upper Sand Stratum at the site is susceptible to liquefaction, and that the Applicant intended to either remove and replace or improve those soils; the NRC staff therefore proposed a permit condition that the ESP holder either remove and replace, or improve, the soils directly above the Blue Bluff Marl for soil under or adjacent to Seismic Category 1 structures, to eliminate any liquefaction potential. *Id.* at 2-438. Furthermore, with respect to static stability, the NRC staff examined the Applicant's bearing and settlement analysis and audited its seismic calculations and margins of safety. *Id.* at § 2.5.4.3.10. The NRC staff concluded that the Applicant provided sufficient information with respect to the static and dynamic stability of the site to satisfy the applicable criteria of 10 C.F.R. Parts 50 and 100. *Id.* at 2-442.

3.76. Based on its review of the engineering properties of materials at the ESP site, the assessment of bearing capacity, liquefaction potential, and settlement, as well as the development of a shear wave velocity profile through the site, the NRC staff agreed that the Applicant met the requirements of 10 C.F.R. § 100.23 in having adequately demonstrated the overall static and dynamic stability of the site, identified the soil and rock engineering properties through testing, and characterized the soil subsurface profile. *Id.* at 2-446. With respect to the LWA request, the NRC staff concluded that the applicant adequately demonstrated that it met the applicable LWA requirements associated with the stability of subsurface materials and foundations for the requested LWA activities at the Vogtle site. *Id.* at 2-446 to 2-447.

Section 2.5.5, Stability of Slopes; Section 2.5.6, Embankments and Dams

3.77. In Section 2.5.5, the NRC staff determined that because there are no safety-related permanent slopes, no analysis of slope stability was necessary. *Id.* at 2-448. In Section 2.5.6, the NRC staff considered existing and potential new embankments and dams at the ESP site. The NRC staff found that the Applicant had demonstrated that no embankments or dams

are needed for flood protection at the ESP site under possible flood and dam breach conditions because of the proposed finished grade elevation. *Id.* at 2-449.

3.78. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the descriptions of geology, seismology, and geotechnical engineering, and the proposed site characteristics and ITAAC.

3.79. In summary, based on the above, we find that the NRC staff had a reasonable basis for its conclusions in Chapter 2, and that the record is sufficient with respect to the description of the site and the identification of site characteristics.

FSER Chapter 3, "Site Safety Assessment"

3.80. Chapter 3 of the FSER analyzes the site safety analysis. Ex. NRC000056 at 3-1. In its initial ESP Application, the Applicant only submitted Section 3.5.1.6, "Aircraft Hazards," for review. When the Applicant amended its Application to add the LWA request, it also submitted Sections 3.7, "Seismic Design" and 3.8.5, "Foundations." These are the only sections of Chapter 3 of the FSER necessary for the review of the Applicant's ESP and LWA requests.

3.81. In Section 3.5.1.6 of the FSER, the NRC staff evaluated the potential hazards to the Vogtle ESP site associated with aircraft. *Id.* The NRC staff reviewed this information in conformance with RS-002, Section 3.5.1.6, to ensure that the Applicant's analysis met the requirements of 10 C.F.R. §§ 52.17, 100.20(b), and 100.21(e). *Id.* The NRC staff independently verified the Applicant's assessment of aircraft hazards at the site and concluded that the estimated probability of an accident having the potential for radiological consequences in excess of the exposure criteria found in 10 C.F.R. Part 100 is less than about 10^{-7} per year. *Id.* at 3-4. Based on this finding, the NRC staff concluded that aircraft hazards do not present an undue risk to the safe operation of nuclear units at the proposed ESP site. *Id.* at 3-4. Further, in response to a Board question regarding the time period used for calculating the potential aircraft hazard associated with the Augusta Airport, the NRC staff explained that it

followed RS-002 and NUREG-0800 to calculate the aircraft hazard through the year 2070, the expected operating life of the plants. Ex. NRC000058 at 21-23.

3.82. FSER Sections 3.7.1, "Seismic Design Parameters," 3.7.2, "Seismic System Analysis," and 3.8.5, "Foundations," address the Applicant's LWA request to install a mudmat with an embedded waterproof membrane. In accordance with the SRP, the NRC staff evaluated the Applicant's (1) seismic analysis and design, including (a) the design ground motion, (b) the foundation input response spectra, and (c) the supporting media for seismic design, and (2) applicable seismic system analyses, including (a) the foundation stability of the nuclear island (NI) against sliding and overturning, (b) the maximum dynamic bearing pressures developed beneath the foundation basemat, and (c) the horizontal seismic shear stresses developed between the basemat and the top of the mudmat, between the two halves of the mudmat through the waterproofing membrane, and between the bottom of the mudmat and the foundation soils.

3.83. As discussed in more detail in FSER Section 2.5, the Application identified that the Vogtle site-specific ground motion response spectra exceeded the AP1000, Revision 15, values at certain frequency ranges. Ex. NRC000056 at 3-9. Consequently, the Applicant performed a site-specific analysis to justify the adequacy of the mudmat, the waterproofing membrane, and the NI structure stability. *Id.* The NRC staff performed a detailed review of this analysis in Section 3.7.2 of the FSER in accordance with Section 3.7.2 of the SRP, RG 1.60, and RG 1.92. *Id.* at 3-12. Further, as part of its review of the Applicant's waterproof membrane in FSER Section 3.8.5, "Foundations," the NRC staff reviewed an ITAAC proposed by the Applicant. Ex. NRC000056 at 3-19. The NRC staff determined that this ITAAC is necessary to confirm that the waterproofing membrane can provide a coefficient of friction of 0.7 to prevent sliding of the upper portion of the mudmat from the lower portion of the mudmat during an SSE. *Id.* at 3-19, 3-21. During the uncontested hearing, both the Applicant and NRC staff provided an

overview of the LWA and the reasoning for the acceptance of the ground motion response spectra exceedences and the need for the ITAAC. Ex. SNC000091; Ex. NRC000065.

3.84. After conducting its review, the NRC staff found in FSER Section 3.7 that, with respect to the LWA request, the Applicant met the applicable requirements of 10 C.F.R. Part 50, Appendix A (GDC 2), and 10 C.F.R. Part 50, Appendix S, in that the Applicant's evaluation accounted for the SSI effects and the expected duration of the vibratory ground motion. In Section 3.8, the NRC staff found that the Applicant met the applicable requirements of 10 C.F.R. § 52.80(a), 10 C.F.R. Part 50, Appendix A (GDC 1 and 2), and 10 C.F.R. Part 50, Appendix B in that the Applicant adequately demonstrated: (1) that the Application contains the proposed ITAAC sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and NRC regulations; and (2) that the NI mudmat and waterproofing membrane are designed to resist an SSE event. *Id.* at 3-23.

3.85. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the site safety assessment, including the relevant requirements and ITAAC for the requested LWA activities.

FSER Chapter 11, "Radiological Effluent Release
Dose Consequences from Normal Operations"

3.86. In FSER Chapter 11, the NRC staff evaluated the dose consequences of both gaseous and liquid radiological effluents which are or may be released during normal plant operations, including anticipated operational occurrences. The NRC staff reviewed the information provided by the Applicant for conformance with the requirements of 10 C.F.R. §§ 52.17(a) and 100.21(c). Ex. NRC000056 at 11-1. The NRC staff determined that the Applicant provided adequate information to give reasonable assurance that it will control and

maintain radioactive gaseous and liquid effluents from the proposed facility within the regulatory limits specified in 10 C.F.R. Part 20, as well as maintain radiological effluents at as low as reasonably achievable (“ALARA”) levels, in accordance with Appendix I to 10 C.F.R. Part 50. *Id.* at 11-7. In its review, the NRC staff considered guidance in RG 1.109 and RG 1.111. *Id.* at 11-1 to 11-2.

Gaseous Effluents

3.87. In Section 11.3.1 of the FSER, the NRC staff reviewed the release of gaseous radiological effluents. The NRC staff’s review considered the Applicant’s description of the exposure pathways by which radiation and radioactive effluents could be transmitted to individuals living near the plant, including the use of radiological exposure models based on RG 1.109 and the GASPAR II computer program. The NRC staff also reviewed the atmospheric dispersion characteristics of the site to determine whether radioactive effluents (from routine operational releases) are within Commission guidelines.

3.88. With respect to gaseous pathway doses, the Applicant considered doses to the maximally exposed individual (“MEI”) at the nearest site boundary, residence, and from garden vegetables and meat animals. *Id.* at 11-3. Based on the gaseous radioactive effluent releases from Table 11.3-3 of the AP1000 DCD, the Applicant estimated site boundary doses for noble gas plume immersion, ground shine from deposited radioactive iodine and particulate radionuclides, and inhalation of radio-iodine and particulate radionuclides, as well as plume and ground plane exposure. *Id.* at 11-4.

3.89. The NRC staff independently reviewed and confirmed the Applicant’s MEI dose estimations using the GASPAR II code. *Id.* at 11-3. The NRC staff determined that the Applicant provided bounding assessments for gaseous effluents and demonstrated its ability to comply with the applicable requirements of 10 C.F.R. Part 20 and Appendix I to 10 C.F.R. Part 50. *Id.* at 11-4.

Liquid Effluents

3.90. In Section 11.3.2 of the FSER, the NRC staff reviewed the dose estimates calculated for releases of liquid radiological effluents. Liquid radiological effluents will be released through a newly constructed discharge structure into the Savannah River. *Id.* at 11-5. The dose estimates were calculated based on radiological source terms obtained from the AP1000 DCD. *Id.*

3.91. The Applicant calculated dose estimates for drinking water consumption, fish ingestion, shoreline exposure, and recreational use utilizing radiological exposure models based on RG 1.109 and the LADTAP II computer program. *Id.* at 11-5. The NRC staff independently reviewed and confirmed the Applicant's MEI dose estimations. Because the Applicant assumed that the Savannah River water served as a source of drinking water (which it does not for 100 miles downstream of the Vogtle site), assumed a low estimate of annual average river flow, and ignored dilution from plant discharge water, the NRC staff determined that the Applicant's estimates provided bounding assessments for liquid effluents. *Id.* at 11-6. The NRC staff also determined that the Applicant had demonstrated its ability to comply with the applicable requirements of 10 C.F.R. Part 20 and Appendix I to 10 C.F.R. Part 50. *Id.* at 11-6.

3.92. In response to Board questions, the NRC staff explained that use of a short transit time (0.1 hour) to calculate doses for an MEI who uses the river near the plant is a conservative approach that results in the inclusion of short-lived radionuclides and higher radionuclide concentrations in dose calculations. Ex. NRC000058 at 23. The NRC staff also explained that use of a 16-hour transit time to calculate a population dose estimate was reasonable because this amount of time is required for a liquid effluent release to travel half the fifty-mile radius downstream of the Vogtle site and provides an estimated radionuclide decay which is central to the entire affected population. *Id.* at 23-24. The NRC staff further explained that, because the agency's predictive dose models simulate radionuclide buildup from effluent

discharges over many years, use of long-term average annual river flows was reasonable even in light of recent drought conditions. *Id.* at 25-26.

3.93. The Board also requested an explanation for the release estimates for radioactive iodine and cesium from Units 3 and 4 which were significantly higher than the amounts being released from Units 1 and 2. The NRC staff stated that the iodine and cesium effluent releases predicted by the Applicant were obtained from the AP1000 DCD, which used a predictive licensing model that tends to over-estimate actual release concentrations for iodine and cesium. *Id.* at 24-25. The NRC staff stated that this conservative approach provides a margin of safety for isotopes of iodine and cesium. *Id.*

3.94. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the descriptions of gaseous and liquid radiological effluent release dose consequences from normal reactor operations.

FSEER Chapter 13, "Conduct of Operations"

3.95. For this ESP and LWA request, Chapter 13 of the FSEER includes Section 13.3, "Emergency Planning"; Section 13.6, "Physical Security"; and Section 13.7, "Fitness for Duty."

3.96. With respect to emergency planning, the regulations allow ESP applicants to either identify physical characteristics of a site that could pose a significant impediment to the development of emergency plans, to propose major features of an emergency plan, or to provide a complete and integrated emergency plan. 10 C.F.R. § 52.17(b). The Applicant chose to submit a complete and integrated emergency plan; this is the first complete and integrated emergency plan that has been reviewed by the NRC staff under the new Part 52 regulations. *Tr.* at M-2130. An ESP that contains complete and integrated emergency plans cannot be issued unless the NRC makes a finding that "the emergency plans provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency." 10 C.F.R. § 50.47(a)(1)(iii). The NRC must base its finding, in part, on

a review of the Federal Emergency Management Agency (“FEMA”) findings and determinations as to whether State and local emergency plans are adequate and whether there is reasonable assurance that they can be implemented. 10 C.F.R. § 50.47(a)(2).

3.97. Section 13.3 of the FSER discusses both the NRC staff’s review of the onsite emergency preparedness plans and the results of FEMA’s review of the offsite plans. The FSER also includes a discussion of seven license conditions and several ITAAC. In response to the Board’s request, the Applicant and NRC staff provided presentations at the uncontested hearing on the key elements of the site emergency plan. Ex. SNC000083; NRC000064.¹⁶

13.3.1 Significant Impediments to the Development of Emergency Plans

3.98. In accordance with 10 C.F.R. § 52.17(b)(1), the Applicant identified and the NRC staff reviewed physical characteristics unique to the proposed site, such as egress limitations from the area surrounding the site, that could pose a significant impediment to the development of emergency plans. Ex. NRC000056 at 13-3. To support this portion of its Application, Southern developed “Evacuation Time Estimates for the Vogtle Electric Generating Plant Plume Exposure Pathway Emergency Planning Zone” (“ETE”). *Id.* at 13-5 to 13-6. After reviewing the ETE, the NRC staff found that no physical characteristics unique to the proposed ESP site pose a significant impediment to the development of emergency plans. *Id.* at 13-6. Thus, the NRC staff found that the Applicant met the relevant requirements of 10 C.F.R. §§ 52.17(b)(1) and 52.18. *Id.*

¹⁶ In support of its presentation on the site emergency plan, the NRC staff introduced two witnesses: Mr. Bruce J. Musico and Mr. Christian J. Araguas, whose Curriculum Vitae are in Exhibits NRC000080 and NRC000074, respectively. The Applicant’s presentation (Ex. SNC000084) was provided by Mr. Theodore E. Amundson, whose Curriculum Vita is in Exhibit SNC000084.

13.3.2 Contacts and Arrangements with Local, State, and Federal Agencies

3.99. In accordance with Section 52.17(b)(4), an Applicant proposing complete and integrated emergency plans must make good faith efforts to obtain from local, State, and Federal governmental agencies with emergency planning responsibilities certifications that (1) the proposed emergency plans are practicable; (2) these agencies are committed to participating in any further development of the plans, including any required field demonstrations; and, (3) these agencies are committed to executing their responsibilities under the plans in the event of an emergency. Ex. NRC000056 at 13-7. The NRC staff reviewed the Applicant's submittals using the guidance contained in RS-002 and Supplement 2 to NUREG-0654/FEMA-REP-1. The NRC staff found that the Applicant provided the required certifications. On this basis, the NRC staff found that the Application met 10 C.F.R. § 52.17(b)(4). *Id.* at 13-8.

13.3.3 Complete and Integrated Emergency Plans

3.100. As a result of submitting a complete and integrated emergency plan, the Applicant put forth information to demonstrate that it met the requirements in Sections 52.17(b); 52.18; 50.47 and Appendix E to 10 C.F.R. Part 50. *Id.* These sections were prepared using the guidance contained in NUREG-0654/FEMA-REP-1, NEI 99-01, NEI 07-01, and Supplement 2 to NUREG-0654/FEMA-REP-1. *Id.* The NRC staff reviewed this portion of the emergency plan with assistance from FEMA. Further, a complete and integrated emergency plan must include proposed ITAAC. 10 C.F.R. § 52.17(b)(3). As part of its review, the NRC staff analyzed the Application to ensure it met the following standards¹⁷ from 10 C.F.R. § 50.47 and NUREG-0654/FEMA-REP-1: 1) Assignment of Responsibility (Organization Control), 2) Onsite Emergency Organization, 3) Emergency Response Support & Resources, 4) Emergency

¹⁷ The standards stated below are shorthand summaries for the full text of the standards.

Classification System, 5) Notification Methods & Procedures, 6) Emergency Communications, 7) Public Education & Information, 8) Emergency Facilities & Equipment, 9) Accident Assessment, 10) Protective Response, 11) Radiological Exposure Control, 12) Medical & Public Health Support, 13) Recovery & Reentry (Post-Accident Operations), 14) Exercises & Drills, 15) Radiological Emergency Response Training, and, 16) Responsibility for Planning Effort (Emergency Plans). *Id.* at § 13.3.3.2.

3.101. As part of its review of these standards, the NRC staff identified seven permit conditions, and also reviewed the Applicant's ITAAC. Ex. NRC000056 at 13-121 to 13-147. The first six conditions deal with the Applicant's emergency action level ("EAL") scheme. *Id.* The first two conditions¹⁸ require the Applicant to revise its EAL scheme to be in conformance with the final NRC-endorsed revision of NEI-07-01. *Id.* The third and fourth permit conditions require any Applicant referencing this ESP to account for any changes to the EAL scheme reflected in the completed and certified AP1000 design. *Id.* The fifth and sixth conditions require a COL Applicant referencing this ESP to conform its EAL scheme based on the in-plant conditions and instrumentation, and to discuss and agree on the final scheme with State and local governmental authorities. *Id.*

3.102. The seventh permit condition deals with the Applicant's proposed common Technical Support Center ("TSC") for Units 3 and 4. In Section 13.3 of the FSER, the NRC staff approved the Applicant's use of a common TSC with a walking distance of more than two minutes from the control rooms. *Id.* at 13-58 through 13-61.¹⁹ While the NRC staff approved

¹⁸ The first six conditions are discussed in pairs, because there was one identically worded condition for both Unit 3 and Unit 4.

¹⁹ The NRC staff also discussed reasons for this acceptance and the need for the permit condition in response to a written question from the Board. Ex. NRC000058 at 40-46.

the location of the TSC, a permit condition is required because the certified design for the AP1000 lists the TSC as a Tier 1 structure, and does not provide for a centralized TSC. Subsequent proposed revisions to the AP1000 certified design would define the TSC as a Tier 2* structure. Thus, depending on the treatment of the TSC as a Tier 1 or Tier 2* structure any certified AP1000 design eventually adopted by any COL applicant referencing this ESP, it may be necessary for the COL applicant to seek an exemption or departure from the certified design to use the approved common TSC. Ex. NRC000064 at 13-17. At the hearing, the NRC staff and Applicant presentations addressed why a common TSC with a more than 2-minute walking time from the control room is acceptable for the Vogtle site. *Id.* at 22-23; Ex. SNC000083.

3.103. In addition to its consideration of the testimony presented at the uncontested hearing and the evaluation in the FSER, the Board asked twelve written questions regarding the review in Chapter 13; the NRC staff answered each of these questions and the Applicant provided a supplemental response to a subset of the questions. See Ex. NRC000058; Ex. SNC000069. In these answers, the NRC staff described: (1) its treatment of each unit in a multi-unit site; (2) its review of the Applicant's ETE; (2) the purpose of ITAAC 1.1; (3) how and by whom decisions for event downgrading and termination are made; (4) the review of communications between control rooms; (5) the lack of a system comparable to the emergency response data system between control rooms; (6) the treatment of cell phones in the emergency plan; (7) the meaning of the license condition regarding TSC location; (8) the review of non-radiological hazards in the TSC; (9) the need for portable radiation monitors; (10) the use of the MIDRAC code and its capabilities; (11) the effect of precipitation effects on the offsite dose calculations; and (12) whether the emergency plan implementing procedures will take into account the different reactor types at the Vogtle site. Ex. NRC000058 at 26-59.

13.3.4 Conclusions

3.104. After reviewing the Applicant's complete and integrated emergency plans, the NRC staff concluded that, provided the permit conditions are adequately addressed, and the ITAAC are met, the VEGP onsite emergency plan establishes an adequate planning basis for an acceptable state of onsite emergency preparedness, and there is reasonable assurance that the plan can be implemented. Ex. NRC000056 at 13-120. Further, FEMA concluded that the offsite State and local emergency plans are adequate to cope with an incident at VEGP and there is reasonable assurance that these plans can be implemented. *Id.* In accordance with Section 52.17(b)(3), the Applicant's emergency plan included the proposed ITAAC that are necessary and sufficient to provide reasonable assurance that if the ITAAC acceptance criteria are met, VEGP Units 3 and 4 will have been constructed and will operate in conformity with its license. *Id.* Thus, the NRC staff concluded that the overall state of onsite and offsite emergency preparedness, when fully implemented, will meet all applicable regulations. *Id.* Consequently, in conformance with Section 50.47(a), the NRC staff concluded that, subject to the required conditions and limitations of the full-power license and satisfactory completion of the ITAAC, there is reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency at the VEGP site, and that emergency preparedness at Vogtle Units 3 and 4 is adequate to support full-power operations.

3.105. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to emergency planning, including the basis for the proposed emergency planning ITAAC.

13.6 Physical Security

3.106. The NRC staff reviewed the Applicant's physical security to determine whether site characteristics are such that adequate security plans and measures can be developed in accordance with the relevant sections of Part 52, Part 73, and Part 100. *Id.* at 13-148 to

13-151. In the course of a site visit to the ESP site, the NRC staff identified a rail spur entering the site. *Id.* at 13-151. The Applicant stated that this rail spur will be accounted for in accordance with existing regulations in the Physical Security Plan filed with its COL application. *Id.* The NRC staff made this COL Action Item 13.6-1 to ensure that any COL applicant referencing this ESP provides the specific access control measures to address the existing rail spur. *Id.*

3.107. The NRC staff examined pedestrian, vehicle, and water approaches, including nearby railroad lines, as well as terrain features regarding their potential to affect the establishment of adequate security plans and measures. *Id.* at 13-149. On the basis of this review, the NRC staff concluded that the ESP site characteristics will allow an applicant for a COL or CP to develop adequate security plans and measures for a reactor or reactors that it might construct and operate on the ESP site. *Id.* at 13-151.

3.108. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to physical security.

13.7 Fitness for Duty Program

3.109. The Applicant updated its Application on March 28, 2008, to include a fitness for duty ("FFD") program during LWA construction. *Id.* at 13-152. On July 9, 2008, the Applicant updated its FFD program to incorporate changes to comply with the NRC's revised FFD rule that was issued on March 31, 2008. The NRC staff reviewed the FFD program to ensure it met the requirements of 10 C.F.R. § 26.4(e) and 10 C.F.R. Part 26, Subpart K. This evaluation included review of the persons to whom the FFD program applied, written policy and procedures, drug and alcohol testing, fitness monitoring, behavioral observation, sanctions, review process, audits, recordkeeping and reporting, and suitability and fitness evaluations. After reviewing the Applicant's FFD program for LWA construction, the NRC staff found that it

met the requirements of Part 26. *Id.* at 13-159. Consequently, the NRC staff found the Applicant's FFD program acceptable.

3.110. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the fitness-for-duty program.

3.111. Accordingly, we find that the NRC staff had a reasonable basis for its conclusions in Chapter 13, and that the record is sufficient with respect to the conduct of operations.

FSER Chapter 15, "Accident Analysis"

3.112. In Chapter 15 of the FSER, the NRC staff evaluated the Applicant's assessment of the radiological consequences resulting from DBAs. Ex. NRC000056 at 15-1. The NRC staff reviewed the information provided by the Applicant for conformance with the requirements of 10 C.F.R. §§ 50.34, 52.17(a) and 10 C.F.R. Part 100, as well as the guidance found in RG 1.145, RG 1.183, RS-002 and NUREG-0800. *Id.* The Applicant's radiological dose evaluations were based on a release of fission products from an AP1000 reactor located on the ESP footprint. *Id.* at 15-2.

3.113. Using the source term from the AP1000 DCD and site-specific atmospheric dispersion (χ/Q) values, the Applicant performed radiological consequence analyses for the following DBAs: (1) pressurized water reactor ("PWR") main steamline break, (2) PWR feedwater system pipe break, (3) reactor coolant pump shaft seizure (locked rotor), (4) reactor coolant pump shaft break, (5) PWR rod cluster control assembly ejection accident, (6) failure of small lines carrying primary coolant outside containment, (7) steam generator tube rupture, (8) loss-of-coolant accident, and (9) fuel handling accident. *Id.* at 15-1. Because these DBAs are identical to those analyzed for the AP1000 reactor design which were evaluated based on guidance in NUREG-0800 and RG 1.183, the NRC staff found the selection of DBAs acceptable for evaluating compliance of the proposed ESP site with the dose consequence factors specified in 10 C.F.R. § 52.17(a)(1). *Id.* at 15-2.

3.114. The radiological dose consequences were calculated for an individual located at any point on the EAB for a two-hour period following a postulated fission product release, and for an individual located on the outer boundary of the LPZ who is exposed to the radioactive cloud resulting from the postulated fission product release. *Id.* In accordance with 10 C.F.R. §§ 50.34(a)(1) and 52.17(a)(1), the radiological doses calculated based on these scenarios are limited to 25 rem [roentgen equivalent man] total effective dose equivalent (“TEDE”). *Id.*

3.115. The Applicant derived its site-specific χ/Q values using the atmospheric dispersion computer code PAVAN. *Id.* at 15-4. The NRC staff reviewed the calculation of these site-specific short-term χ/Q values in accordance with Section 2.3.4 of RS-002 (as discussed in Section 2.3.4 of the FSER) and found them to be acceptable. *Id.* at 15-3. The NRC staff also reviewed and found acceptable the references and methodology used by the Applicant to determine timing and release rates of fission product source terms. *Id.* at 15-5. The NRC staff noted that the Applicant’s site-specific χ/Q values were lower than those postulated for the AP1000 DCD, and that decreased χ/Q values are associated with lower radiological doses. *Id.* at 15-4. The NRC staff noted that the analysis of DBAs identical to those analyzed in the AP1000 DCD, using lower, site-specific, χ/Q values, yielded radiological dose consequences which were less than the dose consequences approved in the AP1000 DCD and met the requirements of 10 C.F.R. § 52.17. *Id.* at 15-5.

3.116. The NRC staff concluded that the proposed distances to the EAB and the LPZ outer boundary of the proposed ESP site, combined with the fission product releases provided by the Applicant, provide reasonable assurance that the radiological dose consequences of the postulated DBAs are within the limits set forth in 10 C.F.R. §§ 50.34(a)(1) and 52.17(a)(1). *Id.* at 15-6. The NRC staff also concluded that, based on the postulated DBAs, the proposed ESP site is suitable for power reactors with source term characteristics bounded by the AP1000 DCD

without undue risk to the health and safety of the public, and that the Applicant complied with the relevant requirements of 10 C.F.R. § 52.17 and 10 C.F.R. Part 100. *Id.*

3.117. Throughout its analysis of radiological dose consequences from DBAs, the NRC staff noted that the Applicant's ESP referenced the AP1000 design. *Id.* at 15-5. The NRC staff also stated that guidance in RG 1.206 specifically permits an applicant to demonstrate compliance with the regulatory radiological consequence evaluation criteria by demonstrating that its site-specific χ/Q values are bounded by those analyzed in the approval of the certified design. *Id.* As a result, the NRC staff imposed Permit Condition 9 to address situations in which an applicant might propose use of the ESP location in a COL or CP application that does not reference a certified design. *Id.* In such a scenario, the applicant would still be required to demonstrate that its source term is bounded by the source term values included in the ESP. *Id.*

3.118. In its response to Board questions, the NRC staff confirmed that its calculations regarding dose consequences from DBAs are based on the certified AP1000 design, DCD Revision 15, issued on January 27, 2006. Ex. NRC000058 at 60. The NRC staff further explained that release rates of specific radioactive isotopes are not assumed to be constant throughout a given DBA, but that the amount of radioactivity released for each isotope is integrated over the stated time period used to calculate the dose consequences. *Id.* The NRC staff explained the conservative nature of the atmospheric dispersion factors used by the Applicant in its DBA analyses, noting that the site-specific χ/Q values are averaged over the same time-period as the release rates, and are not expected to be exceeded more than 5 % of the time. *Id.* at 61. The NRC staff noted that the Applicant followed guidance in RG 1.145, RG 1.183 and SRP 15.0.1, which are referenced in RS-002 regarding generation of χ/Q values. *Id.*

3.119. Also in response to Board questions, the NRC staff explained that, in accordance with RG 1.145, the Applicant assumed a ground-level release of radioactivity, which usually results in higher ground-level concentrations at downwind receptors at relatively flat sites similar

to the Vogtle ESP site. *Id.* at 62. The NRC staff noted that, as a further conservatism, the Applicant assumed short downwind distances to the EAB, which results in higher χ/Q values and higher dose consequence calculations. *Id.*

3.120. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to radiological consequence analysis for DBAs.

FSER Chapter 17, "Quality Assurance Program Description"

3.121. In Chapter 17 of the FSER, the NRC staff analyzed the Applicant's quality assurance program description ("QAPD") to ensure it met the requirements of Part 50 Appendix B and Section 52.17(a)(xi). Ex. NRC000056 at 17-1. The NRC staff used Section 17.5 of the SRP to evaluate the Applicant's QAPD. *Id.* The Applicant's QAPD incorporates the standard content and format of Nuclear Energy Institute ("NEI") Report 06-14A "Quality Assurance Program Description." *Id.* While this document covers a variety of applications, the evaluation in the FSER only covers those activities described in the Application necessary for the ESP and LWA.

3.122. The NRC staff's review of the Applicant's QAPD included reviewing the following topics: (1) organization; (2) quality assurance program; (3) design control; (4) procurement document control; (5) instructions, procedures, and drawings; (6) document control; (7) control of purchased material, equipment, and services; (8) identification and control of materials, parts, and components; (9) control of special processes; (10) inspection; (11) test control; (12) control of measuring and test equipment; (13) handling, storage, and shipping; (14) inspection, test, and operating status; (15) nonconforming materials, parts, or components; (16) corrective action; (17) quality assurance records; (18) quality assurance audits; and (19) non-safety-related SSC quality assurance control. *Id.* at § 17.3.

3.123. In its QAPD, the Applicant made several regulatory commitments that the NRC staff reviewed. *Id.* at 17-12. The Applicant committed to follow RG 1.26, Revision 4, with the exception of Criteria C.1, C.1.a, C.1.b, and C.3. *Id.* The NRC staff found this approach acceptable for the same reasons noted in NUREG-1793, “Final Safety Evaluation Report related to Certification of the AP1000 Standard Design” and Supplement 1 to NUREG-1793. *Id.* The Applicant also committed to following RG 1.29, Revision 3, with the exception of Criteria C.1.d, C.1.g, and C.1.n. *Id.* The NRC staff found this approach acceptable for the same reasons as documented in NUREG-1793 and Supplement 1 to NUREG-1793. *Id.* The Applicant also committed to following the American Society of Mechanical Engineers Standard NQA-1-1994, “Quality Assurance Requirements for Nuclear Facility Applications,” Parts I and II, and NIRMA technical guides. *Id.* at 17-13.

3.124. After reviewing this information against the requirements in appendix B to Part 50, and the guidance of Section 17.5 of the SRP, the NRC staff found that the QAPD: (1) provides adequate guidance for an applicant to describe the authority and responsibility of management and supervisory personnel, performance/verification personnel, and self-assessment personnel; (2) provides adequate guidance for an applicant to provide for organizations and persons to perform verification and self-assessment functions with the authority and independence to conduct their activities without undue influence from those directly responsible for costs and schedules; (3) provides adequate guidance for an applicant to apply the QAPD to activities and items that are important to safety; and, (4) provides adequate guidance for establishing controls that, when properly implemented, comply with the requirements of 10 C.F.R. Part 52, Part 50 Appendix B, Part 21, and Section 50.55(e). *Id.* On the basis of these findings, the NRC staff concluded that the QAPD can be used by the Applicant for the ESP and activities authorized by the LWA. *Id.*

3.125. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the quality assurance program description.

FSER Chapter 18, "Review by the Advisory Committee on Reactor Safeguards"

3.126. In Chapter 18, the NRC staff explained that the Advisory Committee on Reactor Safeguards (ACRS) had completed its review of the ESP and LWA application, as well as its review of the NRC staff's safety evaluation report. *Id.* at 18-1. In its final letter report, dated December 22, 2008, the ACRS stated that the application for an ESP and LWA for the VEGP ESP site was adequate, and found that the NRC staff's review of the application was adequate. *Id.* The ACRS concluded that the ESP and the LWA should be granted. *Id.*

FSER Chapter 19, "Conclusions"

3.127. In Chapter 19 of the FSER, the NRC staff concluded that the VEGP ESP site characteristics comply with the requirements of 10 C.F.R. Part 100, "Reactor Site Criteria," subject to limitations and conditions proposed by the NRC staff in the FSER for inclusion in any ESP that might be issued. The NRC staff concluded that, taking into consideration the site criteria contained in 10 C.F.R. Part 100, two reactors having characteristics that fall within the parameters for the site, and which meet the terms and conditions proposed by the NRC staff in the FSER, can be constructed and operated without undue risk to the health and safety of the public. The NRC staff also found that the proposed ITAAC for emergency planning are necessary and sufficient, within the scope of the ESP, to provide reasonable assurance that the facility has been constructed and will be operated in conformity with the license, the provisions of the Atomic Energy Act, and the Commission's rules and regulations. The NRC staff also concluded that issuance of the requested ESP will not be inimical to the common defense and security or to the health and safety of the public.

3.128. Likewise, the NRC staff concluded that the VEGP LWA request meets the applicable standards and requirements of the Act and the Commission's regulations and that reasonable assurance has been established such that there is adequate protection to public health and safety, and that issuance of the LWA will also not be inimical to the common defense and security. The NRC staff also found that the proposed ITAAC for an LWA are necessary and sufficient, within the scope of the LWA, to provide reasonable assurance that the facility has been constructed and will be operated in conformity with the license, the provisions of the Atomic Energy Act, and the Commission's rules and regulations.

Additional Safety and Procedural Matters

3.129. As described above, the NRC staff identified several safety-related permit conditions that it recommends the Commission impose, should an ESP and LWA be issued. At the hearing, the NRC staff addressed the basis for these permit conditions in several presentations, including a summary presentation focusing specifically on permit conditions. Exs. NRC000064; NRC000065; NRC000068.²⁰ Based on our consideration of the FSER and these presentations, the Board agrees with the NRC staff that these permit conditions are appropriate.

3.130. The Board also asked the NRC staff at hearing to provide a presentation on the impacts, if any, of the AP1000 design certification revisions 16 and 17 on the ESP application. In its presentation, the NRC staff noted that the application and the FSER for the ESP and LWA are based on the AP1000 certified design (Revision 15). Ex. NRC000069 at 3, 5.²¹ As already

²⁰ In support of its presentation on permit conditions, the NRC staff introduced one witness: Mr. Christian Araguas, whose Curriculum Vita is in Exhibit NRC000074.

²¹ In support of its presentation on AP1000 design certification revisions, the NRC staff introduced four witnesses: Mr. James V. Ramsdell, Jr., Mr. Bret A. Tegeler, Mr. Christian J. Araguas and Mr. Mark N. (continued. . .)

noted above in the FSER, the NRC staff emphasized that the granting of an ESP that references a certified design does not indicate approval of the site for that specific design. *Id.* at 3. The NRC staff stated that changes in the design in Revisions 16 and 17 thus are not considered in the NRC staff's ESP or LWA safety review, and that at the COL stage, the COL applicant must demonstrate that the design chosen fits within the site characteristics and bounding parameters included in the ESP. *Id.* at 6. Similarly, any incompatibilities between the design information approved in an LWA and the design information submitted in a COL application would need to be reviewed by the NRC staff at the COL stage. *Id.* at 7. Furthermore, the NRC staff indicated that any activities undertaken under an LWA are undertaken entirely at the risk of the applicant, namely that the COL or CP may not be approved or that the design ultimately selected is incompatible with the LWA construction. *Id.*

3.131. The Applicant and NRC staff also submitted a joint exhibit and stipulation confirming that required notifications to other agencies and bodies regarding the application had been duly made and describing the Applicant's technical qualifications to engage in any activities authorized by the ESP and LWA. Ex. SNC000099. This exhibit included a description of the Applicant's experience with the operation of several existing nuclear power plants, as well as the technical qualifications of the Applicant's contractors in the design and construction of nuclear facilities. *Id.* Based on our consideration of the record, the Board finds that the required notifications have been made and that the Applicant is technically qualified to engage in the LWA activities requested.

(. . .continued)

Notich. (The Curriculum Vitae of the NRC staff's witnesses are in Exhibits NRC000075, NRC000087, NRC000074, and NRC000072, respectively.)

2. Licensing Board Findings on Safety Matters

Based on the above, and pursuant to the Commission's notice of hearing, the Board finds the following with respect to the ESP:

3.132. The issuance of an ESP will not be inimical to the common defense and security or to the health and safety of the public;

3.133. Taking into consideration the site criteria contained in 10 C.F.R. Part 100, a reactor, or reactors, having characteristics that fall within the parameters for the site, can be constructed and operated without undue risk to the health and safety of the public.

With respect to the LWA:

3.134. The applicable standards and requirements of the Act, and the Commission's regulations applicable to the activities for which the Applicant seeks authorization have been met;

3.135. The Applicant is technically qualified to engage in the activities authorized; and

3.136. Issuance of the ESP, granting the Applicant's requested authorization, will provide reasonable assurance of adequate protection to public health and safety and will not be inimical to the common defense and security.

B. Review of Environmental Matters

1. Description of NRC Staff Review

3.137. The NRC staff's environmental review as documented in the FEIS focuses on the environmental effects of construction and operation of two AP1000 reactors. The FEIS includes an analysis of land-use impacts, water-related impacts, meteorological and air quality impacts, terrestrial ecology impacts, aquatic ecology impacts, socio-economic impacts, historical and cultural resources impacts, and environmental justice. The FEIS also analyzes potential cumulative impacts of the proposed action, when considered in combination with past, present,

and reasonably foreseeable future actions. The NRC staff analysis also includes an evaluation of alternatives to the proposed action, including an analysis of alternative sites to determine whether there is an obviously superior alternative to the proposed site. Additionally, the FEIS includes a discussion on need for power and energy alternatives, as well as a discussion of benefits and costs of the proposed action. We summarize these aspects of the NRC staff's review below, as well as the associated questions and presentation topics requested by the Board as part of the uncontested hearing.

FEIS Chapter 1, "Introduction"

3.138. In Chapter 1 of the FEIS, the NRC staff described the procedural background for its environmental review, including an explanation of the purpose of an ESP, the chronology of the NRC staff environmental review, and the structure of the FEIS. Ex. NRC00001A at 1-1 to 1-7. In its environmental review, the NRC staff used the guidance in RS-002, in the SRP, and in NUREG-1555, the Environmental Standard Review Plan ("ESRP"). *Id.* at 1-3. In accordance with 10 C.F.R. Part 51, the NRC staff evaluated impacts by applying the significance levels – SMALL, MODERATE, or LARGE – that have been established by the NRC using Council on Environmental Quality guidance. *Id.* at 1-4. In the FEIS, the NRC staff described the proposed action, as well as the purpose and need for it. *Id.* at 1-1 to 1-5. The NRC staff described its obligation to consider alternatives to the proposed action, its consideration of environmental approvals and consultations associated with the application, and the NRC staff's contacts with appropriate Federal, State, Tribal, and local agencies to identify environmental issues of concern relating to site suitability. *Id.* at 1-5 to 1-6. Based on the above, we find that the NRC staff's description of these considerations was adequate.

FEIS Chapter 2, "Affected Environment"

3.139. In Chapter 2 of the FEIS, the NRC staff described the environment that would potentially be affected by the proposed action. The chapter described various aspects of the

proposed site pertaining to the environmental impact analysis, such as the site and vicinity's land-related issues, meteorology and air quality, geology, radiological environment, water, ecology, socioeconomics, historic and cultural resources, and environmental justice.

3.140. The NRC staff described the location of the proposed site in rural Burke County, GA including its location relative to nearby counties, cities, and towns, and to nearby transportation routes. Ex. NRC00001A at 2-1. The NRC staff described the vicinity of the site, including the site's acreage and boundary, the presence of the existing Vogtle Units 1 and 2, other onsite facilities, the nearby SRS, nearby road and rail spurs, and the site's general topography and land uses. *Id.* at § 2.2. The NRC staff also described the transmission line system (including the associated rights-of-way) supporting the existing units. *Id.* at 2-6. Furthermore, the NRC staff identified the Georgia and South Carolina counties within a 50-mile radius of the site, and described the land use within the three counties in Georgia within which 79% of the current Vogtle employees reside. *Id.* at 2-6 to 2-7. Based on the above, we find that the NRC staff's description of land use at the site and in the site vicinity was adequate for its environmental impact analysis.

3.141. In Sections 2.3 and 2.4 of the FEIS, the NRC staff described the meteorology, air quality, and geology of the site. From data sources including the National Weather Service and onsite meteorological data collection, the NRC staff characterized the climate of the site and region, predominant wind direction patterns and speeds, atmospheric stability and moisture (including precipitation and humidity), temperature, and severe weather conditions. *Id.* at 2-7 to 2-12. The NRC staff described air quality in the site vicinity, noting that all of the counties within the site's Air Quality Control Region are designated as in attainment or unclassified for all criteria pollutants for which National Ambient Air Quality Standards ("NAAQS") have been established. *Id.* at 2-12. The NRC staff also described the meteorological monitoring program for the existing units, which would be the monitoring program for the proposed site as well. *Id.*

at 2-13. The NRC staff found that the present monitoring system provides adequate data to represent onsite meteorological conditions and provides an acceptable basis for estimating atmospheric dispersion for design-basis accidents and routine releases. *Id.* In response to the Board's written questions, the NRC staff explained that the data period used for onsite meteorological data and for generating atmospheric dispersion characteristics was representative of the site and consistent with the criteria of RG 1.23. Ex. NRC000057 at 1-4. The NRC staff also determined that, based on NRC staff guidance in ESRP Section 6.4, the proposed new cooling towers would not likely affect operational meteorological monitoring. *Id.* at 4-6.

3.142. With respect to geology, the NRC staff briefly described the geologic features of the site and vicinity but noted that a detailed description of the geological, seismological, and geotechnical conditions at the site was provided in the Applicant's SSAR and assessed in the FSER. Ex. NRC00001A at 2-14. In its presentation at the uncontested hearing on seismic considerations, the NRC staff explained that pursuant to NRC staff guidance in the ESRP, the NRC staff did not consider the site's seismic suitability or the SSE in the FEIS, but rather referred to the detailed consideration in the FSER. Ex. NRC000065. Based on the above, we find that the NRC staff's description of the site meteorology, air quality, and geology was adequate for its environmental impact analysis.

3.143. Section 2.5 of the FEIS discusses the radiological environment. A radiological environmental monitoring program ("REMP") has been conducted around the VEGP site since operations of Units 1 and 2 began in 1987. Ex. NRC00001A at 2-16. The REMP includes the following pathways: direct radiation, atmospheric, aquatic and terrestrial environments, and groundwater and surface water. *Id.* The NRC staff reviewed four years of REMP data, from 2001 through 2004. *Id.* at 2-16. For these four years, the maximum annual dose to a member of the public was less than 0.001 millisieverts (mSv), which is a small fraction of the limits

specified by the environmental radiation standards in 10 C.F.R. Part 20, 10 C.F.R. Part 50 Appendix I, and 40 C.F.R. 190. In addition, the NRC staff found that exposures or concentrations in air, water, and vegetation at locations near the plant perimeter are comparable to, if not statistically indiscernible from, those at distances greater than 10 miles away. *Id.* Thus, the maximum exposure to a member of the public resulting from operation of Units 1 and 2 is a small fraction of the exposure measured at the control locations and much smaller than the variability of measured exposure values. *Id.* at 2-17. The NRC staff also noted that the State of Georgia had found that elevated levels of tritium in the unconfined aquifer in Georgia originated from the Savannah River Site, are well below the drinking water standard, and are not a public health threat. *Id.* Based on the above, we find that the NRC staff's description of the site radiological environment was adequate for its environmental impact analysis.

3.144. In Section 2.6 of the FEIS, the NRC staff described the hydrological processes governing the movement and distribution of water in the vicinity of the site. The NRC staff identified the dominant hydrological feature of the proposed site as the Savannah River, and described features of the river and the associated watershed. Ex. NRC00001A at § 2.6.1.1. The NRC staff described the upstream dams and reservoirs operated by the USACE to regulate flows on the river, including the J. Strom Thurmond Dam, which controls flows past the Vogtle site. *Id.* The NRC staff also described the USACE drought contingency plan and discussed relevant Savannah River water temperature data. *Id.* at 2-19 to 2-20. In response to Board questions, the NRC staff stated that it found no indication of an increasing water temperature trend. Ex. NRC000057 at 6-7.

3.145. The Board requested a presentation at the uncontested hearing on water use impacts associated with the operation of the existing and proposed Vogtle units, including cumulative surface and groundwater impacts. In its presentation, the NRC staff described long-term Savannah River discharges to illustrate patterns of flow in the river. Ex. NRC000059 at

6-7.²² The NRC staff also illustrated patterns of conservation pool elevations reflecting the USACE's reservoir management operations, as well as the river's hydrograph and precipitation record. *Id.* at 12-13, 15. In response to the Board's questions at the hearing, the NRC staff stated that it did not consider the recent drought conditions or rainfall patterns to be indicative of a long term trend of concern. *Tr.* at M-1703 to M-1705, 1709-1711, 1717-1726.

3.146. With respect to groundwater, the NRC staff in the FEIS identified the groundwater aquifers in the region and in the vicinity of the site, including the Water Table aquifer, the Tertiary aquifer, and the Cretaceous aquifer. *Ex.* NRC00001A at § 2.6.1.2. The NRC staff described key hydraulic properties of these aquifers, including transmissivity, storage coefficient, and effective porosity. *Id.* at 2-27 to 2-29. The NRC staff further discussed interactions between the site surface and groundwater, and between aquifers, such as the potential for local communication between the Water Table aquifer and the Tertiary aquifer. *Id.* at 2-29 to 2-31. In doing so, the NRC staff considered data from several sources, including models by the USGS. *Id.* at § 2.6.1. In response to the Board's written questions concerning possible groundwater movement from the proposed powerblock toward the onsite Mallard Pond, the NRC staff explained that such a groundwater gradient does not, in itself, require groundwater monitoring in this region in the absence of an anticipated release; however, it noted that the Applicant had developed a monitoring plan for Units 1 and 2, which includes monitoring wells that surround the operating units and would detect releases moving toward Mallard Pond drainage as well as other potential receptor locations. *Ex.* NRC000057 at 9-11.

²² In support of its presentation on water use impacts, the NRC staff introduced four witnesses: Mr. Lance W. Vail, Dr. Charles Kincaid, Dr. Christopher B. Cook, and Mr. Mark D. Notich. (The Curriculum Vitae of the NRC staff's witnesses are in Exhibits NRC000073, NRC000071, NRC000070, and NRC000072, respectively.)

In the FEIS the NRC staff also discussed applicable hydrological monitoring programs, including surface water data collected by the USGS at the Waynesboro gauge located at the Vogtle site and onsite monitoring in accordance with National Pollutant Discharge Elimination System (“NPDES”) permit criteria. Ex. NRC00001A at § 2.6.1.3.

3.147. The NRC staff discussed water use in the site vicinity, including withdrawals and consumptive use of surface water and groundwater. *Id.* at § 2.6.2. In its hearing presentation on water use, the NRC staff illustrated the water withdrawals and consumptive water use of various water users in the site vicinity, including by the existing and proposed Vogtle units, the SRS’s D-Area Powerhouse operated by South Carolina Electric and Gas (“SCE&G”), the Urquhart station operated by SCE&G, and other municipal water users. Ex. NRC000059 at 8-9; Tr. at M-1712 to M-1715. The NRC staff also discussed surface water quality, including thermal and chemical monitoring programs, noting that the data sources did not show any indication of degradation or impairment of water quality at the site. Ex. NRC00001A at §§ 2.6.3.1, 2.6.3.3, 2.6.3.4. In response to the Board’s written questions, the NRC staff explained that the monitoring of the existing units’ discharge plume does not include temperature measurements. Ex. NRC000057 at 14.

3.148. The NRC staff also described groundwater quality, noting consideration by Federal and State authorities of regional saltwater intrusion and tritium pollution. Ex. NRC00001A at §§ 2.6.3.2. In response to Board questions and in its hearing presentation on water use, the NRC staff described the evidence supporting its assertion that the primary pathway for tritium pollution of the Water Table aquifer is through recharge of the aquifer by atmospheric deposition of tritium released from the SRS. Ex. NRC000057 at 12-13; Ex. NRC000059 at 19; Tr. at M-1731 to M-1735.

3.149. Based on the above, we find that the NRC staff’s description of the site hydrology and water resources was adequate for its environmental impact analysis.

3.150. In Section 2.7 of the FEIS, the NRC staff described the terrestrial and aquatic ecology of the site and vicinity that may be affected by the design, siting, construction, operation, and maintenance of the proposed new units at the Vogtle site. The NRC staff identified terrestrial ecological resources by describing relevant species composition as well as important features such as wildlife sanctuaries and natural areas that might be impacted by the proposed action. Ex. NRC00001A at § 2.7.1. The NRC staff also identified wildlife species in the vicinity, including game species, state-listed species, and Federally-listed threatened and endangered species. *Id.* at §§ 2.7.1.1, 2.7.1.2.

3.151. The NRC staff also described the aquatic environment and biota in the vicinity of the site that may be affected by the construction, operation, and maintenance of the proposed new units at the Vogtle site. *Id.* at § 2.7.2. The NRC staff identified aquatic communities on the site and in the site vicinity, including algae and aquatic macrophytes, diatoms, aquatic insects, mollusks, and fish. *Id.* at § 2.7.2.1. In doing so, the NRC staff identified important species, including commercially important fisheries, recreationally important fish, state-listed species, and Federally-listed threatened and endangered species. *Id.* at §§ 2.7.2.1, 2.7.2.2. The NRC staff noted that in the site vicinity, no critical habitat has been designated by the U.S. Fish and Wildlife Service (“FWS”), nor has Essential Fish Habitat been identified by the National Marine Fisheries Service (“NMFS”). *Id.* at 2-85.

3.152. Based on the above, and as described in more detail in our ruling on contested environmental matters, we find that the NRC staff’s description of ecological resources was adequate for its environmental impact analysis.

3.153. In Section 2.8 of the FEIS, the NRC staff described the socioeconomic baseline of the region surrounding the site that forms the basis for assessing social and economic impacts from the construction and operation of the proposed new units at the Vogtle site. First, the NRC staff described population demographics of the area, including resident and transient

populations, and migrant labor. Ex. NRC00001A at § 2.8.1. The NRC staff noted that the Vogtle site is located in a rural setting surrounded by a region of low population density, and described the closest towns and metropolitan areas within a 20-mile and 50-mile radius of the site. *Id.* at 2-97.

3.154. The NRC staff also described the characteristics of the community surrounding the site that may be affected by the construction, operation, and maintenance of the proposed new units at the Vogtle site. *Id.* at § 2.8.2. The NRC staff identified principal economic centers in the site vicinity, including the cities of Augusta, Martinez, Evans and Waynesboro. *Id.* at § 2.8.2.1. The NRC staff identified the largest employers in the region and described local and state sales and property taxes, regional transportation networks including interstate and state highways and railways, recreational areas, housing, public services (including water and wastewater), and local primary and secondary schools and colleges. *Id.* at §§ 2.8.2.1 to 2.8.2.7. The NRC staff noted that the region is adequately supported by police, fire, and medical services. *Id.* at 2-111.

3.155. Based on the above, we find that the NRC staff's descriptions of population demographics and socioeconomic resources were adequate for its environmental impact analysis.

3.156. In FEIS Section 2.9, the NRC staff described the historic and cultural resources that may be impacted by land-disturbing activities associated with construction and operation of the new units. First, the NRC staff described the cultural background of the area in and around the Vogtle ESP site. *Id.* at 2-113. The NRC staff noted the prehistoric occupation of the area beginning prior to 7800 B.C., with European colonization beginning in the early 1700s. *Id.* at 2-113 to 2-114.

3.157. The NRC staff identified historic and cultural resources at the Vogtle site and associated transmission lines using information from the ER, an archaeological assessment

conducted in conjunction with an FES prepared for units 1 and 2 in the 1970s, a transmission right-of-way study conducted in 2007, records at the Georgia Archaeological Site File, and by conducting a tour of the Vogtle site. *Id.* at 2-114. The NRC staff identified 26 National Register-eligible archaeological sites and 14 buildings located within 10 miles of the Vogtle site. *Id.* Seventeen new archaeological sites were located on the Vogtle site. *Id.* at 2-114 to 2-115. Although the NRC staff did not conduct an analysis of cultural or historic resources for new transmission line rights-of-way that may be constructed to connect the new units with the existing electrical grid due to the uncertainty of their locations, it did review a report including information on recorded archaeological sites and historic buildings located within potential rights-of-way considered by the Georgia Power Company (“GPC”). *Id.* at 2-116.

3.158. Finally, the NRC staff initiated consultations with the Advisory Council on Historic Preservation, the Georgia State Historic Preservation Office (“SHPO”) and the Alabama SHPO. *Id.* The NRC staff also conducted a public scoping meeting in Waynesboro, GA to elicit comments or concerns regarding potential impacts to historic and cultural resources. *Id.* The Georgia SHPO expressed concerns related to new archaeological sites identified in the DEIS for which the Georgia SHPO had no record. *Id.* As discussed in Section 4.6, the Applicant and Georgia SHPO have consulted regarding protective actions to be taken at these sites. *Id.* at 4-57.

3.159. Based on the above, we find that the NRC staff’s description of historic and cultural resources was adequate for its evaluation of environmental impacts.

3.160. In Section 2.10 of the FEIS, the NRC staff described the demographic and geographic characteristics of the proposed site and surrounding communities, in order to develop a baseline for consideration of potential environmental justice effects. First, the NRC staff examined the geographic distribution of minority and low-income populations within 50 miles of the Vogtle site, utilizing 2000 Census data. *Id.* at § 2.10.1. The NRC staff then

interviewed community leaders of minority groups and provided them with advance notice of public meetings and hearings. *Id.* at 2-121. The NRC staff gathered data on mortality statistics and determined that the age-adjusted mortality rate for cancer-related deaths of the Black/African-American population in Burke County is slightly lower than mortality rates for the State of Georgia and the 11 counties within a 50-mile radius of the site. *Id.* The NRC staff determined that there is no evidence in the health and mortality statistics of any environmental conditions that make the Black/African-American population exceptionally vulnerable in Burke County. *Id.* at 2-122. The NRC staff also determined that there were no significant concentrations of migrant workers within the analytical area. *Id.* at § 2.10.4.

3.161. The NRC staff concluded that low-income and minority populations exceed the percentage criteria established for preparing environmental justice analyses. Accordingly, the NRC staff identified and analyzed several special socioeconomic and health circumstances and potential pathways for disproportionate health and environmental impacts in Sections 4.8, 4.9, 5.8 and 5.9. *Id.* at 2-121.

3.162. Based on the above, we find that the NRC staff's description and evaluation of low-income and minority populations was adequate to form the basis for its environmental justice impact analysis.

3.163. In Section 2.11 of the FEIS, the NRC staff reviewed the possibility that other Federal projects might impact issuance of an ESP. The NRC staff determined that no other Federal activities or projects are associated with the proposed ESP for the Vogtle site. Ex. NRC00001A at 2-123. During its review, the NRC staff consulted with the FWS and the NMFS, and it provided relevant correspondence in Appendix F to the FEIS. *Id.* at 2-123 to 2-124.

3.164. Based on the above, we find that the NRC staff's description of the affected environment was adequate to form the basis for its environmental impact analysis.

FEIS Chapter 3, "Site Layout and Plant Description"

3.165. In Chapter 3 of the FEIS, the NRC staff identified aspects of the site design relevant to assessing environmental impacts. The NRC staff described the layout of the site and the existing facilities, the anticipated plant design, and the power transmission system. The NRC staff described basic features and parameters of the plant design provided by Southern, including plant water consumption and treatment, the proposed cooling system, the radioactive waste-management system,²³ and nonradioactive waste systems. Ex. NRC00001A at § 3.2. In Chapter 3, the NRC staff also described the power transmission system connecting the site to the regional power grid, as well as the new transmission line that would be constructed to handle the power generated by the proposed new units. *Id.* at § 3.3.

3.166. In the FEIS, the NRC staff evaluated plant parameter values that are based on the AP1000 certified design. However, because Westinghouse submitted a revision to the certified AP1000 design, which is undergoing NRC staff review separate from the ESP application, Southern's comments on the DEIS also described certain changes to the parameter values of the certified design. *Id.* at 3-3 to 3-4. Accordingly, the NRC staff evaluated those changes in the FEIS. *Id.* The NRC staff also provided a presentation on this topic at the hearing with respect to the environmental review. Ex. NRC000069.²⁴ The NRC staff explained

²³ Based in part on the NRC staff description of the anticipated radioactive waste-management system, the Board asked the NRC staff to provide a presentation on any environmental topics that were considered deferred to the COL stage. In its hearing presentation, the NRC staff explained that no required environmental review for the ESP had been deferred to the COL stage, and that its reference in Chapter 3 to "deferring analysis" of the radioactive waste-management system had only been intended to convey that final design information may change at the COL stage, which may constitute new and significant information for the COL environmental review. Ex. NRC000067 at 10; Tr. at M-2194 to M-2196.

²⁴ As noted earlier, in support of its presentation on AP1000 design certification revisions, the NRC staff introduced four witnesses, including Mr. Mark Notich, the NRC staff's environmental project manager.

that at the COL stage when a final design is selected and referenced, an applicant would need to demonstrate that the design that is ultimately selected falls within the design parameters evaluated in the ESP FEIS; changes from the design parameter values evaluated in the ESP FEIS would be considered during the COL application review as new and potentially significant information. Ex. NRC00001A at 3-4; Ex. NRC000069 at 13; Tr. at M-2383 to M-2384.

FEIS Chapter 4, "Construction Impacts at the Proposed Site"

3.167. In Chapter 4 of the FEIS, the NRC staff examined the environmental issues associated with potential site-preparation activities and construction of proposed Units 3 and 4 at the Vogtle site.

3.168. In Section 4.1 of the FEIS, the NRC staff provided information regarding land-use impacts associated with site-preparation activities and construction of proposed units 3 and 4 at the Vogtle site. Ex. NRC00001A at 4-2. The NRC staff described ground-disturbing impacts occurring within the Vogtle site, including the construction of permanent facilities affecting 324 acres, temporary facilities and spoils storage affecting 232 acres, and a borrow area utilizing 31 acres. *Id.* Potential impacts analyzed by the NRC staff also included construction of three roads, relocation of a transmission line, relocation of an existing landfill, and clearing and removal of trees. *Id.* The NRC staff also considered impacts to wetlands and waterways existing onsite, including those from construction of the cooling water intake and discharge structures. *Id.* The NRC staff indicated that few off-site land-use impacts would be expected as a result of the construction activities, and it concluded that the overall land-use impacts of construction would be small. *Id.*

3.169. The NRC staff also indicated that a new transmission line has been proposed to serve the new units transmission line rights-of-way and offsite areas. The proposed transmission line was described as being approximately 150 feet wide and 60 miles long, requiring approximately 390 towers, and passing west of Fort Gordon then north to the

Thomson substation located west of Augusta, Georgia. *Id.* at 4-3 to 4-4. The NRC staff concluded that the land-use impacts of constructing the new transmission line would be moderate primarily because of the length of the line and because the precise route for the new line has not been determined. *Id.* at 4-5.

3.170. Based on the above analysis, the Board finds the NRC staff's conclusion regarding land-use impacts to be reasonable.

3.171. In Section 4.2 of the FEIS, the NRC staff described the impacts of construction on local meteorology and air quality. The NRC staff determined that construction would result in temporary impacts to local air quality as a result of emissions and construction-related traffic, but found that the overall impact would be temporary and limited in magnitude, particularly in light of Southern's dust-control and traffic-management plans and associated mitigation measures. *Id.* at 4-5 to 4-7. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the descriptions of the construction-related impacts to air quality.

Water-Related Impacts

3.172. In Section 4.3 of the FEIS, the NRC staff described construction-related impacts on water. The NRC staff identified authorizations Southern would need to obtain prior to initiating construction, including from the USACE and from the State of Georgia. *Id.* at 4-7 to 4-8. The NRC staff described potential effects from dewatering of the foundation excavations, as well as from construction of an intake canal and placement of the discharge pipe, construction of a barge slip, and small-scale dredging adjacent to the Vogtle site for those construction activities. *Id.* at § 4.3.1. The NRC staff determined that impacts of hydrological alterations resulting from these construction activities would be localized and temporary, and also that the aforementioned permit processes would likely include measures to minimize impacts. *Id.* at 4-9.

3.173. With respect to water use, the NRC staff stated that Southern generally does not plan to use surface water during construction. *Id.* at 4-10. The NRC staff then estimated drawdown due to groundwater withdrawal during construction. The NRC staff found that the water-use impacts from construction would be small, because the changes would be small relative to the confining head in the Cretaceous aquifer, because the existing water-use permit has adequate capacity, because of the deep aquifer baseflow, and because impacts would be localized and temporary and the recovery rapid. *Id.* at § 4.3.2. For similar reasons, including implementation of best management practices (“BMPs”) required by the necessary permits, the NRC staff determined that impacts on water quality would be small. *Id.* at 4-13.

3.174. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the descriptions of the construction-related impacts to water.

Ecological Impacts

3.175. In Section 4.4 of the FEIS, the NRC staff analyzed construction-related impacts on ecology. With respect to terrestrial impacts, the NRC staff reviewed potential impacts including loss of habitat and wetlands, noise, traffic mortality, and avian collisions. *Id.* at § 4.4.1. The NRC staff considered that Southern would implement construction mitigation practices at the site and within transmission line rights-of-way, including BMPs. *Id.* The NRC staff determined that impacts on wildlife habitat within the site (including permanent and temporary losses of upland hardwood forest and bottomland forested wetlands) would be minimal. *Id.* at 4-24. The NRC staff determined that onsite impacts to wildlife populations, including state-listed species, would be minimal, and the Applicant would consult with the Georgia Department of Natural Resources (“GDNR”) to ensure that any species of concern would be protected during construction. *Id.* With respect to the impacts in the vicinity of the transmission line, the NRC staff determined that impacts would likely be small, but stated that due to uncertainty regarding

both the actual route and the distribution of State-protected species along and within the right-of-way, impacts could be moderate. *Id.*

3.176. With respect to impacts to aquatic ecology, the NRC staff considered the impacts from the construction of the intake and discharge structures and a new barge facility, and the associated loss of habitat, both temporary and permanent. *Id.* at § 4.4.2. The NRC staff also evaluated impacts to ponds and streams onsite, as well as from construction of the transmission line. *Id.* at §§ 4.4.2.2, 4.4.2.3. The NRC staff considered the Applicant's time-of-year limitations on the construction, steps to minimize turbidity during the excavation process, and use of BMPs and environmental controls. *Id.* at § 4.4.2. The NRC staff noted that the amount of benthic habitat, open water, shoreline, and benthic fauna that would be lost is a small fraction of the total present in this area of the Savannah River. *Id.* at 4-28. The NRC staff determined that while fish may leave the vicinity of the construction area temporarily during those activities, they would be expected to return and, moreover, none of the species of interest (such as the robust redhorse) is known to spawn specifically in the areas where construction would occur. *Id.* Given the small area of disruption relative to the benthic habitat at this location, the NRC staff found that impact to state-listed mussel species would be minor. *Id.* at 4-30. Thus the NRC staff found that the impacts from the proposed construction activities, including potential dredging at the barge slip and from the Federal navigation channel to the proposed barge slip, would be small, and any impacts would be temporary and largely mitigable. *Id.* at 4-30.

3.177. Finally, with respect to Federally-listed threatened and endangered species (aquatic and terrestrial), the NRC staff considered potential impacts from both onsite construction and construction of the proposed transmission line, and also prepared biological assessments as appropriate. *Id.* at § 4.4.3. The NRC staff evaluated potential impacts to the red-cockaded woodpecker, wood stork, flatwoods salamander, American alligator, Canby's dropwort, smooth coneflower, relict trillium, Georgia aster, and shortnose sturgeon. *Id.* Based

on information including the threatened and endangered species surveys, historical records, life history information, and known species locations, the NRC staff determined that construction-related impacts to these species would be small. *Id.* at 4-36, 4-37. However, with respect to impacts from the placement of the transmission line, the NRC staff noted that without adequate surveys, consultation, and appropriate mitigation, impacts to terrestrial threatened and endangered species could be moderate. *Id.* at 4-36.

3.178. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the descriptions of the construction-related impacts to terrestrial ecology, to aquatic ecology, and to threatened and endangered species.

3.179. In Section 4.5 of the FEIS, the NRC staff evaluated the potential socioeconomic impacts to individual communities, the surrounding region, and minority and low-income populations from the construction of the proposed new units at the Vogtle site. The NRC staff described physical, demographic, and economic impacts, as well as those involving infrastructure and community services. In its analysis, the NRC staff considered the entire region within a 50-mile radius of the site when evaluating socioeconomic impacts; however, the primary region of interest for physical impacts was limited to a 10-mile radius. *Id.* at 4-38. The scope of the review with regard to social and economic impacts also encompasses the entire 50-mile region around the site; however, it primarily focuses on the impacts to Burke, Richmond, and Columbia Counties, which are the counties where most of the in-migrating construction workforce would likely reside. *Id.* at 4-38, 4-43. The NRC staff found *de minimis* impacts on counties outside the 50-mile radius based on commuter patterns and the distribution of residential communities in the area. *Id.* at 4-38.

3.180. The NRC staff evaluated the effects of temporary and localized physical impacts related to construction of the proposed units such as noise, odors, vehicle exhaust, and dust.

Id. at § 4.5.1. The NRC staff assessed the effect of these impacts on workers and the local public, buildings, roads, and aesthetics. *Id.* Due to strict control of blasting and other shock-producing activities, the NRC staff did not consider vibration and shock impacts. *Id.* at 4-38. First, the NRC staff noted that, due to the rural nature of the surrounding area, most offsite physical construction impacts would be at annoyance or nuisance levels. *Id.* at 4-39. The NRC staff stated that the persons most vulnerable to noise, dust, and gaseous emissions include construction workers and other onsite personnel and that those persons would receive adequate training and personal protective equipment to minimize the risk of potentially harmful exposure. *Id.* a 4-39.

3.181. The NRC staff also noted that Burke County is part of the Augusta-Aiken Interstate Air Quality Control Region, which is classified as in attainment of the NAAQSs set forth in 40 C.F.R. § 81.114 for all criteria pollutants. *Id.* The NRC staff noted that emissions of fugitive dust and particulate matter generated during earth-moving and material-handling activities may cause temporary and minor effects on local ambient air quality but noted that such effects would be minimized by use of mitigation measures such as water suppression and paving, and that odors from exhaust emissions would dissipate onsite. *Id.* at 4-39 to 4-40.

3.182. Next, the NRC staff noted that construction activities would have no effect on offsite buildings and that onsite buildings are designed to withstand possible impacts, including shock and vibration, from onsite construction activities. *Id.* at 4-40.

3.183. The NRC staff also considered the impact of construction activities on public roads and railways that would be used to transport construction materials and equipment. *Id.* at 4-41. The NRC staff noted that impacts to the surrounding region would be minimized by avoiding routes that could adversely affect sensitive areas such as residential neighborhoods, hospitals, schools and retirement communities and by restricting delivery times to daylight hours when possible and by repairing or upgrading any damaged transportation routes. *Id.*

3.184. The NRC staff also described the aesthetic impacts of construction of the proposed units, noting that approximately 555 acres would be cleared and excavated, with clearing and grading of approximately 22.5 acres of river shoreline. *Id.* Due to the temporary nature of construction activities, the NRC staff indicated that the physical impacts would be small. *Id.* at 4-42. However, the NRC staff noted that the aesthetic impacts of construction of the proposed new transmission line would likely be moderate. *Id.*

3.185. Based on its analysis the NRC staff concluded that the overall physical impact of construction would be small. *Id.*

3.186. As noted above, the NRC staff also considered the demographic impacts resulting from construction of the proposed new units. *Id.* at 4-42; § 4.5.2. The NRC staff considered the impacts of an in-migrating workforce and their dependents of approximately 5500 people. *Id.* at 4-43. The residential distribution of this workforce was assumed to mirror that of the current operations workforce for approximation of commuting patterns. *Id.* The NRC staff determined that the impact of such in-migrating workers on the surrounding community would be small if they chose to relocate to more populated counties, but would be moderate in Burke County depending on where these workers chose to reside. *Id.*

3.187. The NRC staff also evaluated the social and economic impacts of construction of the proposed new units. *Id.* at 4-43; § 4.5.3. The NRC staff noted that new indirect jobs would likely be created in the local area to support the approximately 2500 new workers engaged in construction. *Id.* at 4-44. The overall economic impact from personal and corporate income taxes, sales and use taxes, and property taxes was determined to be moderate and beneficial in Burke County and small in the surrounding region. *Id.* at 4-46.

3.188. Construction impacts on regional infrastructure and community services were also determined to be generally small, with a potential for moderate impacts to rural regions if a large portion of the in-migrating workers relocates to these areas. *Id.* at § 4.5.4. The NRC staff

reached this conclusion by evaluating impacts to transportation including rail and waterways, housing, public services including water supply, police, fire and medical facilities, social services, and educational facilities. *Id.*

3.189. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the analysis of potential impacts of construction on socioeconomic resources.

3.190. In FEIS Section 4.6, the NRC staff described the historic and cultural resources that may be impacted by land-disturbing activities associated with construction and operation of the new units. The NRC staff identified one archaeological site that would be impacted by construction of a water pipeline. *Id.* at 4-57. A Phase I archaeological survey of this location indicated that the site might yield significant information on prehistory for the area. *Id.* The NRC staff described the results of additional investigations at this location conducted in February 2008. The NRC staff indicated that the Georgia SHPO made a determination that construction of the water pipeline would not adversely affect this archaeological site and that the Georgia SHPO and the Applicant intended to enter into a memorandum of understanding (“MOU”) to preserve the balance of the site from disturbance and to allow further archaeological investigations. *Id.* Based on the potential impacts to known archaeological sites, the mitigation measures to be taken by the Applicant, and the NRC staff’s cultural resource analysis and consultation, the NRC staff concluded that the potential construction impacts on historic and cultural resources would be moderate. *Id.* at 4-58.

3.191. Finally, the NRC staff indicated that the Applicant had agreed to implement procedures to establish measures to be taken in the event any archaeological or historical materials are discovered during construction of the proposed units. *Id.* The NRC staff further indicated that construction workers would be given cultural resource training and that ongoing

consultation between the Applicant and the Georgia SHPO may result in a requirement that cultural resource monitoring take place during construction of the proposed units. *Id.*

3.192. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the analysis of potential construction impacts to historic and cultural resources.

3.193. In Section 4.7 of the FEIS, the NRC staff described the potential for disproportionate environmental impacts from construction of the proposed units on the health or welfare of minority and low-income populations (environmental justice impacts). The NRC staff analyzed environmental justice impacts by considering health and environmental impacts, socioeconomic impacts and impacts to subsistence and special conditions. The NRC staff determined the impact of each potential pathway for individuals within the identified region utilizing 2000 Census data. *Id.* at § 2.10.

3.194. The NRC staff identified the potential pathways for effects to human health and welfare, analyzing four primary sources of potential impacts including soil, water, air, and noise. *Id.* at § 4.7.1. In the FEIS, the NRC staff noted that construction activities within the Vogtle site represent the largest source of soil-related environmental impacts, but that the effects are largely localized and have little migratory ability. *Id.* at 4-58. Additionally, the NRC staff noted that BMPs and construction strategies would mitigate the potential soil-related effects. The NRC staff also interviewed community leaders regarding potential soil disruption within communities hosting in-migrating workers. *Id.* at 4-59. The NRC staff concluded that soil-related environmental impacts during construction would pose little or no impacts on populations within the region of interest. *Id.*

3.195. The NRC staff then analyzed water-related impacts including erosion-related surface water degradation and the introduction of anthropogenic substances into surface and groundwater. *Id.* The NRC staff concluded that there would be no water-related impacts on

minority and low-income populations due to the elimination of surface water impacts due to on-site BMPs, isolation of the Cretaceous and Tertiary aquifers beneath the proposed site, and the expectation that construction-related impacts to the water table aquifer would be mitigated at a distance equal to that of the nearest person to the proposed site. *Id.*

3.196. Next, the NRC staff analyzed air-related impacts from motor vehicle exhaust and construction dust. The NRC staff indicated that, based on the findings in Section 4.2 of the FEIS, the negative environmental impacts from construction-related air quality degradation would be small, localized and short-lived. *Id.* The NRC staff concluded that there would be no disproportionate and adverse impacts on minority and low-income populations due to air quality changes. *Id.*

3.197. The NRC staff also analyzed noise-related impacts associated with construction of the two proposed units. *Id.* at 4-60. The NRC staff found that the loudest construction noise would register 60-80 decibels at a distance of 400 feet from the source. Based on this noise level and the greater than half-mile distance to the site EAB in all directions, the NRC staff concluded that impacts from the noise of construction activities would be small and would not require mitigation. *Id.*

3.198. The NRC staff next considered the socioeconomic impacts of construction of the proposed new units, including an increase in traffic during the construction phase. *Id.* For reasons described in FEIS Section 4.5, the NRC staff concluded that there were no disproportionate adverse impacts to low-income and minority populations due to changes in traffic and other community services. *Id.*

3.199. Finally, the NRC staff assessed the potential impacts to populations of particular interest or unusual circumstances, such as minority communities exceptionally dependent on subsistence resources or identifiable in compact locations. *Id.* at 4-60. The NRC staff noted the presence of subsistence fishing practices along the Savannah River adjacent to the proposed

site and identified mercury as the primary contaminant of concern for the Savannah River. *Id.* The NRC staff determined that there were no disproportionate adverse impacts on this subsistence activity as mercury and other heavy metals are not considered to be by-products of the proposed construction activities. *Id.* The NRC staff indicated that, based on the “scattered” nature of the primary minority and low-income populations, there were no environmental justice effects to consider with respect to densely populated minority or low-income peoples. *Id.* at 4-61.

3.200. Based on the preceding analysis, the NRC staff concluded that the impacts of construction of the proposed units on minority and low-income populations in the region of interest would be small. *Id.* The NRC staff also found that there would likely be beneficial impacts to these communities due to increased income and tax revenues. *Id.*

3.201. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to health and environmental impacts, socioeconomic impacts, and impacts to subsistence and special conditions related to low-income and minority populations.

3.202. In Section 4.8 of the FEIS, the NRC staff analyzed non-radiological health impacts to workers at the site and to the local population from fugitive dust, occupational injuries, noise, and transportation of materials and personnel. The NRC staff noted that Southern’s operational controls, compliance with applicable Federal, State, and local emission requirements, and the distance of the public from the construction site all would mitigate impacts from dust and exhaust emissions. Ex. NRC00001A at 4-62. The NRC staff found that occupational injury and fatality risks are reduced by adherence to NRC and Occupational Safety and Health Administration (“OSHA”) safety standards, and it also evaluated U.S. Bureau of Labor Statistics (“USBLS”) statistics to estimate potential injury rates. *Id.* at 4-62 to 4-63. The NRC staff also found that injury and fatality rates at nuclear reactor facilities have historically

been lower than average U.S. industrial rates. *Id.* at 4-62. Accordingly, the NRC staff determined that each of these impacts would be small. *Id.* at 4-62 to 4-63.

3.203. With respect to noise, the NRC staff considered the temporary nature of the construction activities and the location of the site, as well as mitigation measures such as time-of-day restrictions. *Id.* at § 4.8.1.3. Regarding transportation impacts, the NRC staff considered estimates of the Applicant's construction materials, shipments, workers, and representative accident and injury rates, and found only a small increase relative to the current traffic fatality risks in the area surrounding the proposed site. *Id.* at § 4.8.2. The NRC staff concluded that these impacts would be small. *Id.* at 4-66.

3.204. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the descriptions of the non-radiological health impacts of construction.

3.205. In Section 4.9 of the FEIS, the NRC staff analyzed the radiation health impacts due to construction. The sources of radiation exposure for construction workers include direct radiation exposure, exposure from liquid radioactive waste discharges, and exposure from gaseous radioactive effluents from the existing VEGP Units 1 and 2 during the site-preparation and construction phase. *Id.* at 4-66 to 4-67. For the purposes of this section, the NRC staff assumed construction workers to be members of the public; therefore, the dose estimates were compared to the dose limits for the public in 10 C.F.R. Part 20, Subpart D. *Id.* at 4-67.

3.206. The Applicant identified two sources of direct radiation exposure from the VEGP site: (1) the current reactor buildings for VEGP Units 1 and 2; and (2) the planned Independent Spent Fuel Storage Installation ("ISFSI"). *Id.* In addition, the planned VEGP Unit 3 was identified as a direct source of radiation exposure to VEGP Unit 4 construction workers. *Id.* In order to measure the radiation from the operating units, the Applicant used fenceline thermoluminescent dosimeters ("TLDs") and environmental TLDs. *Id.* The results from the

environmental TLDs were not significantly different from control locations and showed no increase in environmental gamma radiation levels resulting from plant operations at the VEGP site. *Id.* The Applicant used the fenceline TLDs to estimate the dose to Unit 4 workers from Unit 3 operation, concluding that a construction worker present for 2080 hours per year would receive an annual dose of 0.251 mSv. *Id.* at 4-68.

3.207. The VEGP site releases gaseous effluents via the common station heating, ventilating, and air conditioning stack; the condenser air injector; the steam packing exhaust system; the Radwaste Processing Facility; and the Dry Active Waste Building. *Id.* The Applicant estimated the annual TEDE from gaseous effluents, adjusted to the expected occupancy of a construction worker, to be 0.0121 mSv. *Id.* The NRC staff's review of annual effluent release reports for the past four years showed this dose to be typical. *Id.* The dose to construction workers from gaseous effluent releases would be negligible compared to the dose from direct radiation exposure. *Id.* Similarly, the Applicant found radiation exposure from liquid effluents to be negligible, and the NRC staff, after reviewing the radioactive effluent release reports, found the Applicant's results to be typical. *Id.* Accordingly, the dose to construction workers from the liquid effluent releases would be negligible compared to the dose from direct radiation exposure. *Id.*

3.208. The Applicant estimated the total annual dose for site preparation workers, assuming an occupancy of 2000 hours per year, to be approximately 0.241 mSv. *Id.* at 4-69. Adjusting this dose for the expected occupancy of a construction worker (2080 hr/yr) and assuming a 100 percent plant capacity factor yields an annual dose of 0.263 mSv, which is less than the 1 mSv annual exposure limit for an individual member of the public. *Id.*; 10 C.F.R. § 20.1301. The maximum estimated annual collective dose to site preparation workers is 0.92 person-Sv. Ex. NRC00001A at 4-69.

3.209. The NRC staff found that, after reviewing the Applicant's estimate of dose to site-preparation workers during construction, the doses were well within the NRC's annual exposure limits. *Id.* Assuming that the proposed location of VEGP Units 3 and 4 does not change, the NRC staff concluded that the impacts of radiological exposures to site-preparation workers would be small. *Id.*

3.210. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the description of the radiological health impacts of construction.

3.211. In Section 4.10 of the FEIS, the NRC staff described measures and controls which would be employed during site-preparation and construction activities in order to limit adverse environmental impacts. Ex. NRC00001A at 4-69. These measures include compliance with applicable state, federal, and local laws regarding solid waste management, erosion or sediment control, air emissions, noise control, stormwater management, spill response, and cleanup and management of hazardous materials as well as continued compliance with permits and licenses for the existing units and incorporation of environmental requirements into construction contracts. *Id.* at 4-69, 4-70.

3.212. Specific mitigation measures and controls were provided in Table 4-6. *Id.* at 4-70. Measures and controls proposed by the Applicant consider impacts to the site and site vicinity as well as those associated with the transmission line right-of-way. *Id.* The proposed measures address impacts to air quality, historic properties, cultural resources, water-use, water quality, aquatic ecosystems, socioeconomic impacts, and non-radiological health impacts. *Id.* at Table 4-6. Specific measures included such actions as limiting onsite vegetation removal, developing a dust mitigation plan prior to the start of construction, contacting appropriate regulatory agencies in the event a potential historic, cultural, or paleontological resource is discovered, installing stormwater drainage at construction sites, implementing erosion and

sediment control plans prior to construction, providing appropriate training to construction workers to reduce the risk of exposure to noise, dust, and exhaust emissions, staggering work shifts and erecting traffic congestion signs, and providing onsite first-aid. *Id.*

3.213. In Section 4.11 of the FEIS, the NRC staff described the site redress plan that was submitted as part of the Applicant's ESP application. *Id.* at 4-72. The Applicant and NRC staff also provided hearing presentations on the requested LWA activities, their impacts, and the activities that would be implemented under the site redress plan to mitigate those impacts. Ex. SNC000077; NRC000063.²⁵

3.214. In the FEIS, the NRC staff noted that the site redress plan is intended to ensure that the Vogtle site is returned to an environmentally stable and aesthetically acceptable condition if the proposed new units are not fully developed to generate nuclear power. *Id.* The NRC staff also noted that, in accordance with 10 C.F.R. § 50.10(g), implementation of the redress plan would begin within 18 months of any action triggering the need for redress, such as termination of construction, withdrawal or denial of the ESP or COL application, or revocation of the LWA. *Id.* at 4-74.

3.215. In reviewing the Applicant's site redress plan, the NRC staff considered the construction activities that would be performed as part of the LWA proposed by the Applicant. *Id.* LWA activities requested by the Applicant include such actions as driving of piles, subsurface preparation, placement of engineered backfill, concrete or permanent retaining walls

²⁵ In support of its presentation on the limited work authorization and site redress plan, the NRC staff introduced three witnesses: Mr. Christian J. Araguas, Mr. Mark D. Notich, and Dr. Michael R. Sackschewsky. (The Curriculum Vitae of the NRC staff's witnesses are in Exhibits NRC000074, NRC000072, and NRC000079, respectively.) The Applicant's presentation (Ex. SNC000077) was provided by Mr. Dale L. Fulton, whose Curriculum Vita is in Exhibit SNC000078.

within an excavation, and installation of mudmats, a waterproof membrane and the formwork for the nuclear island base slab. *Id.* at 4-73.

3.216. As prerequisites to these LWA activities, the NRC staff noted that the Applicant is required to submit specific site information that would allow for an assessment of the performance of site redress actions. *Id.* at 4-72. This information serves as a baseline for redressing the site and includes documentation of existing site conditions including photographs, surveys, and a listing of existing facilities and structures. In addition, the Applicant is required to obtain an agreement between the site's co-owners and the Applicant to allow implementation of LWA activities, and the necessary permits to perform preconstruction activities and LWA activities such as NPDES, wetlands, stormwater, and local building permits. *Id.* at 4-73.

3.217. The NRC staff noted that the environmental impacts of LWA activities allowed pursuant to 10 C.F.R. § 50.10(d) and (e) are bounded by the environmental impacts of construction activities and would be of shorter duration. *Id.* at 4-74. The NRC staff also indicated that site redress activities would implement various measures to mitigate adverse impacts. *Id.* Further, the NRC staff stated that the Applicant's site redress plan addressed approaches to accomplish the objective of reversing, mitigating, or stabilizing the environmental impacts while preserving the site's potential for future industrial use. *Id.* Based on its review of the Applicant's proposed LWA activities and site redress plan, the NRC staff concluded that the LWA activities would not result in significant adverse environmental impacts that could not be redressed. *Id.* at 4-74.

3.218. In Table 4-7 in FEIS Section 4.12, the NRC staff provided a summary of the environmental impact levels anticipated from construction of the proposed units and based on the preceding analyses. *Id.* at 4-75.

3.219. Based on the above information, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to impacts of construction of the proposed units at the Vogtle site.

FEIS Chapter 5, "Station Operational Impacts at the Proposed Site"

3.220. In Chapter 5, the NRC staff examined environmental issues associated with operation of the proposed new units at the VEGP site for an initial 40-year period. Ex. NRC00001B at 5-1.

3.221. In Section 5.1 of the FEIS, the NRC staff examined the land-use impacts associated with operation of the proposed units 3 and 4 at the Vogtle site. *Id.* at 5-2. The NRC staff's analysis considered impacts to the site and site vicinity as well as those associated with the construction of a planned transmission line. *Id.*

3.222. The NRC staff noted that potential off-site land-use impacts include conversion of land to housing developments, increased retail development to serve plant workers, and additional growth and land conversion associated with improved infrastructure. *Id.* The NRC staff indicated that the surrounding counties have comprehensive land-use plans to assist in management of any future growth. *Id.* Based on this information, the NRC staff concluded that land-use impacts to the site and vicinity associated with operation of the two new units would be small. *Id.*

3.223. The NRC staff also indicated that land use impacts would likely result during construction of a new transmission line proposed to serve the proposed new units. *Id.* Because the GPC provides easements to allow agricultural activities beneath powerlines, the NRC staff concluded that the land-use impacts of operating the new transmission line would be small. *Id.*

3.224. Based on the above analysis, we find that the NRC staff had a reasonable basis for its conclusions and that the record is sufficient with regards to land-use impacts from operation.

3.225. In Section 5.2 of the FEIS, the NRC staff described the impacts of operation on local meteorology and air quality. Based on estimates using the Seasonal and Annual Cooling Tower Impacts code and consideration of the heat and moisture plumes from the existing cooling towers, as well as the anticipated infrequent use of standby diesel generators and auxiliary power systems (and the Federal and State requirements for pollutants from those systems) the NRC staff found no significant air quality impacts from the cooling towers and power systems. *Id.* at 5-3 to 5-4. The NRC staff also found that based on analysis in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants," air quality impacts from new transmission lines to serve the new units would be expected to be small. *Id.* at 5-4.

3.226. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the descriptions of the air quality impacts of operation.

Water-Related Impacts

3.227. In Section 5.3 of the FEIS, the NRC staff evaluated water-related impacts to the surrounding environment from operation of the new units. The NRC staff described the regulation of water use and water quality by the USACE and state authorities, and identified the water-related permits and certifications that Southern would need to obtain. *Id.* at 5-5. The NRC staff presented the expected normal and maximum surface-water withdrawal and discharge rates for the new units, as well as the use of groundwater to makeup water lost by the service water system and to satisfy operational demands for demineralized, potable, and fire protection water systems. *Id.* at §§ 5.3.1, 5.3.2. The NRC staff also explained how these numbers would be affected by changes between Revision 15 and Revision 16 of the AP1000 DCD, and what effect these changes would have on the NRC staff's conclusions regarding impact levels. *Id.* at 5-6 to 5-7, 5-17. The NRC staff described how the surface water

withdrawal and consumptive use rates compared to the flows in the Savannah River under average conditions (8830 cubic feet per second (cfs)) as well as under low-flow conditions (down to 3800 cfs) pursuant to the USACE's Drought Contingency Plan. *Id.* at § 5.3.2.1. Furthermore, to provide additional context in light of then-ongoing drought conditions, the NRC staff described impacts under even lower flows (3000 and 2000 cfs). *Id.* at 5-9. The NRC staff found that water-use impacts would be small even under these unlikely very-low-flow conditions and considering the changes associated with Revision 16 of the DCD. *Id.* at 5-10.

3.228. The NRC staff evaluated the drawdown resulting from groundwater use during the operation of the new units. *Id.* at § 5.3.2.2. The NRC staff determined that groundwater would be withdrawn primarily from the Cretaceous aquifer. *Id.* at 5-10. Based on the anticipated demand relative to the baseflow of the deep aquifer, and analysis of drawdown at well locations of different proximity to the facility boundary using data from the USGS and the Final Safety Analysis Report ("FSAR") for the existing Vogtle units, the NRC staff found that the groundwater resource use at the rates necessary for the proposed units could be sustained for the life of the facility, and that groundwater-use impacts would be small. *Id.* at § 5.3.2.2. The NRC staff also noted that because changes between Revision 15 and Revision 16 of the AP1000 DCD would expect to result in a decrease in the groundwater demand, the NRC staff determined that its conclusions regarding groundwater use would not change. *Id.* at 5-17.

3.229. In response to Board questions, the NRC staff stated that, considering conservative estimates of cumulative drawdown, a flow reversal from the Tertiary aquifer to the Cretaceous aquifer could occur locally at the VEGP site, especially at the location of production wells. Ex. NRC000057 at 16-17. However, the NRC staff stated that reversal of the gradient would not impact the conclusions in the FEIS regarding potential contamination of the Cretaceous aquifer because there is no known significant contamination in the Tertiary aquifer,

(and none is expected from future VEGP operation) to be drawn through the confining zone and into the VEGP wells completed in the Cretaceous aquifer. *Id.*

3.230. With respect to water quality impacts, the NRC staff described the discharge plume that would result from the proposed outfall. *Id.* at § 5.3.3.1. To determine bounding water temperature impacts to the Savannah River, the NRC staff examined variable effluent and river discharge conditions. *Id.* The NRC staff performed an independent assessment of the extent of the 5°F-above-ambient mixing zone, assuming conservative river conditions (minimum river temperatures, maximum discharge temperatures, and combining the total effluent from all four Vogtle units into a single discharge pipe). *Id.* The NRC staff found that the maximum downstream extent of the mixing zone was 97 feet, while the maximum width was 15 feet, at a point where the Savannah River would be approximately 312 feet wide. *Id.* The NRC staff determined that under very-low-flow conditions (2000 cfs), the mixing zone would approximately double in areal extent. Ex. NRC00001E; Ex. NRC000057 at 18-19. Based on the small size of the discharge plume and relatively high levels of dilution at the mixing zone boundary, the NRC staff determined that water-quality impacts of the effluent plume from the Vogtle units would be small and localized. Ex. NRC00001B at 5-20. The NRC staff found no potential impacts on groundwater quality from the proposed units. *Id.* at 5-21.

3.231. Based on the above, and as discussed more fully in our ruling on contested environmental matters, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the descriptions of the water-related impacts of operation.

Ecological Impacts

3.232. In Section 5.4 of the FEIS, the NRC staff analyzed potential impacts to ecological resources from operation of the two new units, transmission line operation, and transmission line right-of-way maintenance. First, with respect to terrestrial impacts, the NRC staff reviewed

potential impacts including from vapor plumes and drift, noise, effects on birds from electromagnetic fields (“EMF”) and collisions with cooling towers and transmission lines, and transmission line maintenance. *Id.* at § 5.4.1. The NRC staff considered cooling tower drift from the existing and proposed towers, as well as the evaluation in NUREG-1437, and found that impacts to vegetation from fogging, icing, and deposition would be minimal. *Id.* at § 5.4.1.1. The NRC staff determined that, given the location of the site and the absence of reported excessive bird-impact events from the existing units, bird collisions associated with operation of the new units and transmission line would be minimal. *Id.* at §§ 5.4.1.2, 5.4.1.6.

3.233. With respect to noise, the NRC staff determined that impacts would be negligible given the large expanses of open habitat available into which wildlife species could move and acclimation of species to noise levels from the existing units. *Id.* at § 5.4.1.3.

3.234. The NRC staff also evaluated potential impacts to shoreline habitat and determined that changes in river stage from operational water withdrawals would be small even under very-low-flow conditions and maximum withdrawals by the new units. *Id.* at § 5.4.1.4. The NRC staff concluded that impacts to shoreline habitat would be minor even under these conditions. *Id.* The NRC staff noted that increased water consumption rates associated with the changes from Revision 15 to Revision 16 of the AP1000 would not alter that conclusion. *Id.*

3.235. The NRC staff also considered impacts on terrestrial ecology, floodplains, and wetlands from transmission line right-of-way management and determined, based on the analysis in NUREG-1437 and assuming BMPs are followed, that impacts would be negligible. *Id.* at §§ 5.4.1.5, 5.4.1.8. The NRC staff found no evidence of potential EMF effects on flora and fauna. *Id.* at § 5.4.1.7. Moreover, the NRC staff determined that although impacts from right-of-way maintenance are not known due to uncertainty of the final routing of the transmission line, impacts to terrestrial State-listed species from the above factors would likely be minimal based

on the Applicant's past performance and established maintenance practices and procedures.

Id. at §§ 5.4.1.9, 5.4.1.10.

3.236. With respect to impacts to aquatic ecology, the NRC staff considered the impacts of operation on the aquatic ecosystem in the Savannah River, onsite streams and ponds, and water courses crossed by the transmission line rights-of-way. *Id.* at § 5.4.2. The majority of this analysis is addressed more fully in our ruling on contested environmental matters. First, the NRC staff determined that use of a stormwater system like that currently used for the Vogtle site would result in minimal impacts to onsite streams and ponds. *Id.* at § 5.4.2.1. With respect to the Savannah River, the NRC staff evaluated impacts from potential impingement and entrainment of aquatic species due to water intake and consumption. *Id.* at § 5.4.2.2. The NRC staff described a number of factors – including the design and location of the intake structure and the amount of water withdrawn – as influencing the degree to which impingement and entrainment affect aquatic biota, and determined that these impacts would be minor. *Id.*

3.237. The NRC staff also discussed thermal impacts to aquatic resources resulting from the proposed new units' effluent discharge to the Savannah River. The NRC staff considered acute and chronic thermal impacts, cold shock, and the effect of elevated temperatures on aquatic invasive or nuisance organisms. *Id.* at § 5.4.2.3. The NRC staff found that given the small size of the mixing zone, the volume of the effluent discharge relative to the flow of the river, the fact that Vogtle will be a multiple-unit plant, and that no large growths of invasive microorganisms are anticipated, such impacts would be minor. *Id.* The NRC staff considered impacts related to chemical treatment of the cooling water, and after evaluating the anticipated chemicals and concentrations, the estimated in-river dilution, and the NPDES permit required from GDNR that would specify discharge limits, the NRC staff determined that impacts from the chemical discharges to the Savannah River would be minimal. *Id.* at § 5.4.2.4. The NRC staff also found that while some scouring of the river bottom is anticipated from the

discharge pipe, impacts would be to a very small fraction of the benthic habitat of the river and thus impact on benthic organisms would be minimal. *Id.* at § 5.4.2.5. The NRC staff also discussed impacts to State-listed species (including the robust redhorse) from entrainment, impingement, thermal, and chemical discharges, and after describing considerations specific to those species, the NRC staff determined that the impacts to these species would be minor. *Id.* at § 5.4.2.6.

3.238. For additional conservatism, the NRC staff also considered impacts to aquatic biota at very-low-flow rates (3000 and 2000 cfs). *Id.* at § 5.4.2.9. The NRC staff found that the potential increase in entrainment percentage and impingement mortality were unlikely to have any persistent long term impacts on populations in the river because the low flow conditions would likely be temporary and the characteristics of the river in the site vicinity are not biologically unique. *Id.* The NRC likewise found with respect to thermal and chemical impacts that given the small amount of water discharged relative to the river flow and the resulting dilution of the discharge plume, impacts would not be significantly different than those analyzed for operation at Drought Level 3. *Id.* The NRC staff also evaluated the significance of the change in water use from Revision 15 to Revision 16 of the AP1000 DCD and determined that because these would result in only minor increases in the water use, it would not alter the NRC staff's impact assessment even under low-flow and very-low-flow conditions. *Id.*

3.239. The NRC staff also examined the impacts of maintenance activities along the transmission line right-of-way. Based on GPC's practices and procedures, and the fact that no Federal or State-listed aquatic organisms are anticipated to be in the right-of-way, the NRC staff concluded that these maintenance activities would not adversely affect aquatic resources. *Id.* at § 5.4.2.7.

3.240. Finally, the NRC staff considered impacts from plant operation and the proposed transmission line with respect to Federally-listed threatened and endangered species (aquatic

and terrestrial). *Id.* at § 5.4.3. The NRC staff evaluated potential impacts to the red-cockaded woodpecker, wood stork, flatwoods salamander, American alligator, Canby's dropwort, smooth coneflower, relict trillium, Georgia aster, and shortnose sturgeon. *Id.* The NRC staff considered species habitat and known locations and determined that impacts to terrestrial species from operation would be small, and that impacts from the proposed transmission line would also be small, although any mitigative actions or BMPs would be dependent on the species and exact location of the transmission line right-of-way. *Id.* at § 5.4.3.1. With respect to impacts to the shortnose sturgeon, the NRC staff considered impacts from entrainment, impingement, and thermal and chemical discharges. The NRC staff also prepared a Biological Assessment that it forwarded to NOAA for review pursuant to the Endangered Species Act. *Id.* at § 5.4.3.2. Based on factors including the design and operation of the intake, the size of the thermal mixing zone, the dilution of chemicals, and the species' life history information, the NRC staff found that impacts to the shortnose sturgeon would be small. *Id.* The NRC staff likewise found that no adverse impacts would be expected from maintenance of the sites transmission lines, because they do not cross the Savannah River. *Id.* Furthermore, the NRC staff determined that long-term adverse impacts would not be likely even under very-low-flow conditions (3000 and 2000 cfs), and that its impact analysis would not significantly differ in connection with the potential small increases in river withdrawals associated with Revision 16 of the AP1000 DCD. *Id.*

3.241. Based on the above, and as discussed further in our ruling on contested environmental matters, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the descriptions of the impacts of operation of the new units to terrestrial ecology, to aquatic ecology, and to threatened and endangered species.

Socioeconomic Impacts

3.242. In Section 5.5, the NRC staff analyzed the potential socioeconomic impacts from operating the proposed new reactors at the Vogtle site and from the demands of the operating workforce on the surrounding region, including individual communities, and minority and low-income populations. Ex. NRC00001B at 5-42. The assessment included physical, demographic, economic, and infrastructure impacts. *Id.* at 5-43 to 5-51.

3.243. The NRC staff considered physical impacts resulting from noise, odors, exhausts, thermal emissions, and visual intrusions associated with operation of the proposed new reactors on the surrounding community, the plant, and specific segments of the population. *Id.* at 5-43. The NRC staff noted that air quality impacts to workers and the local public would likely result from periodic testing and operation of the site's standby diesel generators and auxiliary power systems, commuter vehicle dust and exhaust, odors from operations, and operations-based noise, but that such impacts would be mitigated and have only a small impact. *Id.*

3.244. The NRC staff noted that operational impacts to buildings and roads would also have small impacts and not require mitigation. *Id.* at 5-44. The NRC staff determined that aesthetic impacts related to the new cooling towers would be small, while the aesthetic impact of the proposed transmission line would be moderate. *Id.* at 5-44, 5-45.

3.245. The NRC staff also evaluated the demographic impacts associated with operation of the proposed units. *Id.* at 5-45. The NRC staff stated that the distribution of new operational workers and their families would likely resemble that of the current plant employees and that such demographic changes would likely have a small impact on the surrounding region. *Id.* at 5-45 to 5-46.

3.246. Based on the NRC staff's evaluation, economic impacts to the community from operation of the proposed units include increases in operational workforce jobs, tax revenues,

and population. *Id.* at 5-46. The NRC staff indicated that such impacts could be moderate in Burke County and small in the surrounding region. *Id.* at 5-47.

3.247. The NRC staff's evaluation of the impacts to infrastructure and community services included consideration of transportation, housing, public services, and education. *Id.* at 5-49. The NRC staff estimated that the operational workforce would include an additional 812 persons. *Id.* Based on interviews with public officials in the surrounding area concerning the availability of services and anticipated additional tax revenues, the NRC staff determined that the beneficial impacts of operation of the proposed units would be moderate within Burke County and small in the surrounding region. *Id.* at 5-53. The NRC staff found that the estimated operational workforce would have a small effect on the transportation network and a small effect on public services and infrastructure. *Id.* The NRC staff further determined that the additional property tax revenues within Burke County would likely be beneficial and large. *Id.*

3.248. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the socioeconomic impacts of operation of the proposed units.

Historic and Cultural Resources Impacts

3.249. In Section 5.6, the NRC staff analyzed the potential impacts to historic and cultural resources associated with operation of the proposed new reactors at the Vogtle site. *Id.* at 5-53. Included in this analysis were potential effects on archaeological sites, historic buildings, and traditional places important to local populations. *Id.* The NRC staff indicated that any new ground-disturbing activities associated with operation of the new units would follow procedures established to evaluate whether additional archaeological review is necessary and that mitigation might be warranted should an unexpected discovery occur. *Id.* at 5-54. The NRC staff concluded that no significant impacts to historic and cultural resources were expected during operation of the new units; therefore, the impacts from operations would be small. *Id.*

3.250. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the impacts of operation of the proposed units on historic and cultural resources.

Environmental Justice

3.251. In Section 5.7 of the FEIS, the NRC staff described the potential for disproportionate environmental impacts on minority and low-income populations associated with operation of the proposed new reactors at the Vogtle site. *Id.* at 5-54. The NRC staff analyzed environmental justice impacts by considering health and environmental impacts, socioeconomic impacts and impacts to subsistence and special conditions. *Id.*

3.252. The NRC staff identified the potential pathways for effects to human health and welfare, analyzing four primary sources of potential impacts including soil, water, and air. *Id.* at 5-55 to 5-56. In doing so, the NRC staff drew on its impacts analysis from other sections of Chapter 5. The NRC staff noted that normal operational dose assessments presented in Section 5.9 were well below regulatory guidelines in Appendix I of 10 C.F.R. Part 50 and the regulatory standards of 10 C.F.R. Part 20. *Id.* at 5-55. The NRC staff explained that there would be no operations-related environmental impacts to soils and therefore, there would be no significant adverse health impacts to the public and only minimal health impacts on minority and low-income members of the public. *Id.*

3.253. The NRC staff also considered the operational impacts to surface and groundwater resources. *Id.* The NRC staff considered the impacts to water associated with the use of biocides, anti-scaling compounds and dispersants. *Id.* The NRC staff found that impacts to aquatic biota associated with these compounds would be negligible due to the low concentrations used and the amount of dilution expected once the water reached the Savannah River. *Id.* The NRC staff also noted that the consumptive loss of river flow during normal plant operation, even under drought conditions, was too small to affect recreational activities on the

river. *Id.* The NRC staff also considered the impact of three groundwater wells, and two potential new wells, withdrawing water from the Cretaceous aquifer to support the two existing reactor units, as well as the two proposed units, under normal operating conditions. *Id.* at 5-55 to 5-56. The NRC staff determined that the proposed well locations and pumping rates for the two proposed units would create an increased drawdown in the Cretaceous aquifer of approximately 6.5 feet after 30 years of operation. *Id.* at 5-56. Based on this information, the NRC staff concluded that there would be no operations-related environmental effects requiring mitigation and no disproportionate adverse impacts on minority and low-income populations. *Id.* at 5-56.

3.254. The NRC staff also evaluated the potential impacts of gaseous effluent doses from all four units. *Id.* The NRC staff found that these doses would be well within the regulatory limits of 40 C.F.R. 190, and that the potential air impacts would be small. Thus, it concluded that there would be no disproportionate and adverse impacts to minority or low-income populations. *Id.*

3.255. Based on the above, the Board finds that the NRC staff's analysis and conclusion that the health and environmental impacts of operation of the two proposed reactors would have no disproportionate adverse impacts on minority and low-income populations are reasonable.

3.256. The NRC staff also evaluated the socioeconomic impacts of operation of the two proposed units. *Id.* at 5-56. The NRC staff concluded that such impacts would diminish after reductions in the construction workforce following completion of the reactors, with possible additional impacts resulting from in-migration of a permanent operational workforce. *Id.* The NRC staff found that such additional impacts would be offset by the region's capacity to absorb the influx of temporary or permanent workers and by the positive impacts of additional income and local taxes. *Id.*

3.257. Also as part of the environmental justice analysis, the NRC staff analyzed the operational impacts of the proposed reactors on subsistence and special conditions. *Id.* As discussed in Section 4.7 of the FEIS, subsistence living for low-income and minority populations in the region involves consumption of locally-caught fish. *Id.* at 4-60. The NRC staff noted that some fish species in the Savannah River can carry potentially harmful levels of radioactive contamination. *Id.* at 5-57. The NRC staff stated that addition of the proposed new reactors is not expected to significantly increase levels of radioactive contamination in the Savannah River and that there was no reason to believe that subsistence consumption of fish species from the Savannah River would present a health problem for minority and low-income populations. *Id.*; Ex. NRC000057 at 19-20.

3.258. The NRC staff also evaluated impacts of the proposed reactors on high density communities. Ex. NRC00001B at 5-57. Because the NRC staff found only scattered populations of minority and low-income persons, the NRC staff determined that there were no environmental justice effects on these communities to consider with respect to operation of the proposed reactors. *Id.* Based on the above analysis, the NRC staff concluded that the impacts of plant operations on environmental justice would be small due to the lack of environmental pathways, health characteristics or other special conditions of the minority and low-income population that would lead to adverse and disproportionate impacts. *Id.*

3.259. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the environmental justice impacts of operation of the proposed new units.

Non-Radiological Health Impacts

3.260. In Section 5.8 of the FEIS, the NRC staff evaluated non-radiological health impacts to the public and workers from operation of the new units, including from the cooling systems, noise generated by operations, acute and chronic impacts of EMF, and transportation

of workers to and from the units. With respect to thermophilic microorganisms, the NRC staff considered the historical low incidence of primary amoebic meningoencephalitis in Georgia, the small expected temperature increase in the Savannah River from operation of the new units, and the relative absence of swimming or other activities in the vicinity of the existing and proposed discharge structures, and determined that human health impacts would be small. *Id.* at § 5.8.1. The NRC staff also considered the postulated noise levels for cooling towers and diesel generators at the site, and concluded that given the distance to the plant boundaries, noise impacts would be small. *Id.* at § 5.8.2.

3.261. With respect to EMF-related impacts, the NRC staff found that design of the new transmission lines to meet National Electric Safety Code standards would result in small impacts from acute effects of EMF, and that the potential for chronic effects is not sufficient for the NRC staff to consider the potential impacts as significant. *Id.* at §§ 5.8.3, 5.8.4. The NRC staff considered the low historic occupational health risks for nuclear reactor facilities, as well as the anticipated adherence to NRC and OSHA safety standards, and found that occupational non-radiological health risks to workers would be small. *Id.* at § 5.8.5. Finally, considering anticipated transportation of operations personnel to and from the Vogtle site, in combination with traffic accident statistics, the NRC staff found only a small increase relative to the current traffic fatality risk in the area around the site. *Id.* at § 5.8.6. Accordingly, the NRC staff concluded that potential non-radiological health impacts from operations would be small. *Id.* at 5-63.

3.262. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the descriptions of the non-radiological health impacts of operation.

Radiological Impacts of Normal Operations

3.263. Section 5.9 of the FEIS addressed the radiological impacts of normal operations of the proposed new units, including a discussion of the estimated radiation dose to a member of the public and to the biota inhabiting the area around the VEGP site. *Id.* at 5-63. Estimated doses to workers at the proposed units were also discussed. *Id.* The radiological impacts from plant operation were determined using the AP1000 reactor design with expected direct radiation and liquid and gaseous radiological effluent rates in the evaluation. *Id.* Pursuant to the Board's request, the Applicant and NRC staff also provided a hearing presentation reviewing radiological sources, pathways, and doses to the public from both routine operation and potential accidents for the proposed VEGP Units 3 and 4. Exs. SNC000070; NRCR00060.²⁶

3.264. In Section 5.9.1 of the FEIS, the NRC staff reviewed the Applicant's proposed exposure pathways. The Applicant considered the exposure pathways that could cause the highest calculated radiological dose based on the use of the environment by residents located around the site. Ex. NRC00001B at 5-63 to 5-64. The Applicant evaluated several exposure pathways from the liquid effluent release pathway and the gaseous effluent release pathway. *Id.* at 5-64. The Applicant calculated population doses using the same exposure pathways as used for the individual dose assessment, with the addition of the cow milk ingestion pathway. *Id.* The Applicant stated that direct radiation from the reactor buildings and the planned ISFSI would be the primary sources of direct radiation exposure to the public. *Id.*

²⁶ In support of its presentation on radiological impacts evaluated in the environmental review, the NRC staff introduced three witnesses: Mr. James V. Ramsdell, Jr., Dr. Michael A. Smith, and Mr. Mark Notich. (The Curriculum Vitae of the NRC staff's witnesses are in Exhibits NRC000075, NRC000076, and NRC000072, respectively.) The Applicant's presentation (Ex. SNC000070) was provided by Mr. Philip Young, whose Curriculum Vita is in Exhibit SNC000071.

3.265. The NRC staff reviewed the exposure pathways for the public and biota identified by the Applicant and based on a documentation review, a tour of the environs, and interviews with Southern's staff and contractors during a site visit found them to be appropriate. *Id.* at 5-66.

3.266. In Section 5.9.2 of the FEIS, the NRC staff reviewed the Applicant's analysis of the radiation doses to members of the public. The Applicant calculated the dose to the MEI and the population living within a fifty-mile radius of the site from both the liquid and gaseous release pathways. *Id.* at 5-67.

3.267. The liquid pathways were calculated using the LADTAP II computer program. As the NRC staff explained at the uncontested hearing, the LADTAP II code was developed specifically for calculating doses from routine releases of liquid reactor effluents, it has been approved by the NRC, and it has been benchmarked against similar computer codes and has given reasonable results. Ex. NRCR00060 at 37.²⁷ The NRC staff performed an independent evaluation of the liquid pathway doses using input parameters from the ER and found results similar to the Applicant's. Ex. NRC00001B at 5-67. The NRC staff also found that all of the input parameters used by the Applicant were appropriate. *Id.* In response to a Board question regarding why the Applicant's annual radiological effluent release reports showed that the highest liquid pathway releases occurred in 2001, the NRC staff noted that the 2001 releases were within limits and the NRC staff, while acknowledging that it did not know why the year 2001 had the highest readings, provided plausible reasons why the 2001 data was higher than other years. Ex. NRC000057 at 20-21.

²⁷ The citation corresponds to slide number 15 in the environmental portion of the NRC staff's presentation.

3.268. The gaseous pathway doses to the MEI were calculated using the GASPAR II computer program at the nearest residence and at the exclusion area boundary. Ex. NRC00001B at 5-67. The GASPAR II code was also used to calculate annual population doses. *Id.* As the NRC staff explained at the uncontested hearing, the GASPAR II program was developed specifically for calculating doses from routine releases of gaseous reactor effluents, it has been approved for use by the NRC, and it has been benchmarked against similar computer codes and has given reasonable results. Ex. NRCR00060 at 40.²⁸ The NRC staff performed an independent evaluation of the gaseous pathway doses to both the MEI and to the population. Ex. NRC00001B at 5-68. While the NRC staff's results for the MEI were similar to the Applicant's, the NRC staff's calculation of the dose to the population was 20 percent higher than that calculated by the Applicant. *Id.* This difference was due to the fact that the NRC staff calculated the population dose using population predictions for the year 2013 as directed by Section 5.4.1 of the ESRP, while the Applicant used census data from the year 2000. *Id.* at 5-69.

3.269. Section 5.9.3 of the FEIS analyzed the impacts to members of the public from radiological releases and direct radiation from two new units at the VEGP site. *Id.* This section addressed dose from operations to the MEI located at the VEGP site, and the collective dose to the population within fifty miles around the VEGP site. *Id.*

3.270. The Applicant estimated that the total body and organ dose estimates to the MEI from liquid and gaseous effluents for two new units would be within the design objectives of 10 C.F.R. Part 50, Appendix I. *Id.* Further, estimates from combined liquid and gaseous effluents

²⁸ This corresponds to slide number 18 in the environmental portion of the NRC staff's presentation.

to the MEI at the nearest residence from the new units are well within the regulatory standards of 40 C.F.R. Part 190. *Id.* at 5-70. In addition, the Applicant found that the combined dose from the two operating units and the proposed two new units would be well within the 40 C.F.R. Part 190 standards, 10 C.F.R. Part 20 standards, and the 10 C.F.R. Part 50, Appendix I design objectives. *Id.*

3.271. In analyzing the population dose, the Applicant estimated the collective total body dose within a 50-mile radius of the VEGP site to be 0.01837 person Sv/yr. *Id.* The collective dose was estimated using the GASPAR II computer code and was attributed to the gaseous and liquid effluent pathway. *Id.* at 5-71. The NRC staff's independent evaluation resulted in results that are 20 percent higher than the Applicant's, again due to the different population estimates used. *Id.* The NRC staff relied on studies by the National Research Council and National Cancer Institute to support its conclusion that the risk to the public from cumulative radiation exposure is very small. *Id.*

3.272. After evaluating the health impacts to members of the public from routine gaseous and liquid radiological effluent released from the new VEGP site, the NRC staff concluded that there would be no observable health impacts to the public from normal operation of the new units, and the health impacts would be small. *Id.* at 5-71 to 5-72.

3.273. Section 5.9.4 of the FEIS analyzed the occupational doses to workers. The Applicant estimated that the occupational doses from advanced reactor designs, including the AP1000, will be slightly less than the annual occupational doses for current light-water reactors. *Id.* at 5-72. As noted in NUREG-0713, "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities," the average annual collective dose per operating PWR in the United States was 0.83 person Sv/yr for the time period of 2001 – 2006. Further, the licensee of a new plant would need to maintain individual doses to workers within 0.05 Sv annually as specified in 10 C.F.R. § 20.1201 and incorporate ALARA. *Id.* Based on this

information, the NRC staff concluded that the health impacts from occupational radiation exposure would be small. *Id.* In response to a Board question, the NRC staff also provided the average and maximum individual occupational doses during the year 2005 for the existing Vogtle units. Ex. NRC000057 at 21.

3.274. Section 5.9.5 of the FEIS analyzed the impacts to biota other than members of the public due to operation of two new units at the VEGP site. Ex. NRC00001B at 5-72. The Applicant estimated doses to representative biota species, including the following important biota species for the VEGP site and the corresponding surrogate species: (1) various mussel and mollusk species – invertebrates, (2) darter, shiner, catfish, sunfish, perch, eels, largemouth bass, striped bass – fish, (3) white-tailed deer, raccoon, gray squirrel, Eastern cottontail, coyotes, gray fox, and pocket gopher – raccoon and muskrat, (4) wood duck – duck, and (5) wood stork – heron. *Id.* The NRC conducted an independent evaluation including consideration of surrogate species that included invertebrates and algae and found similar results to those reported by the Applicant. *Id.* at 5-72 to 5-73.

3.275. The Applicant used the LADTAP II computer code to calculate doses to the biota from the liquid effluent pathway. *Id.* at 5-73. The NRC staff explained in the FEIS that liquid pathway doses were higher for biota compared to man because of considerations for bioaccumulation of radionuclides, ingestion of aquatic plants, ingestion of invertebrates, and increased time spent in water and shoreline compared to man. *Id.* Gaseous effluents would contribute to the total body dose of the terrestrial surrogate species. *Id.* The dose calculated for the MEI from gaseous effluent was also applicable to terrestrial surrogate species, with two modifications. *Id.* One modification was increasing the ground deposition factors by a factor of two because terrestrial animals are closer to the ground than the MEI, and the second was to disable the vegetation intake pathway for muskrat and heron because these species are not known to consume vegetation. *Id.*

3.276. The NRC staff found that the radiological impact on biota from the routine operation of the proposed Units 3 and 4 at the VEGP site would be small. *Id.* at 5-75. The dose to all biota was well below the radiation standards in 40 C.F.R. Part 190. *Id.* at 5-74. The NRC staff noted that while these standards apply to members of the public, not biota, they are useful for comparative purposes. *Id.* In addition, the NRC staff found that the cumulative effects of the existing VEGP units and the new units result in dose rates far less than those specified as protective by the International Atomic Energy Agency and National Council on Radiation Protection and Measurement studies. *Id.*

3.277. Section 5.9.6 of the FEIS reviewed the Applicant's radiological monitoring program. A radiological environmental monitoring program ("REMP") has been in place since operations began at the VEGP site in 1987. *Id.* at 5-75. To the greatest extent practical, the REMP for the ESP program would utilize the procedures and sampling locations used by the existing VEGP site. *Id.* The NRC staff reviewed the documentation for the existing REMP, the Vogtle Offsite Dose Calculation Manual, and recent monitoring reports from VEGP and the SRS and determined that the current operational monitoring program is adequate to establish the radiological baseline for comparison with the expected impacts on the environment related to the construction and operation of the proposed new units at the VEGP site. *Id.*

3.278. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to radiological impacts of normal operations.

3.279. In Section 5.10 of the FEIS, the NRC staff considered the environmental impacts of postulated accidents. The consequence estimates were based on the AP1000 certified design as set forth in 10 C.F.R. Part 52, Appendix D. *Id.* at 5-75. This section of the FEIS discussed (1) the types of radioactive materials, (2) the paths to the environment, (3) the

relationship between radiation dose and health effects, and (4) the environmental impacts of reactor accidents, both DBAs and severe accidents. *Id.* at 5-76.

3.280. The review of DBAs focused on the certified AP1000 reactor at the VEGP site. *Id.* at 5-77. Because this is a certified design, the potential DBAs are well established, and the source terms for the reactor and methods for evaluation potential accidents are based on guidance in RG 1.183. *Id.* The NRC staff noted that RG 1.145 sets forth acceptable methods for calculating χ/Q values for DBAs from site meteorological data. *Id.* The NRC staff reviewed the Applicant's χ/Q values, and the method used by the Applicant to calculate them, and found that they were acceptable for use in evaluating potential environmental consequences of postulated DBAs at the Vogtle site. *Id.* at 5-78. Further, because the DBAs analyzed by the Applicant were the same as those considered in the design certification for the AP1000, the NRC staff found them to be appropriate. *Id.* In all cases, the Applicant's dose calculations were considerably smaller than the doses used as safety criteria; therefore, the NRC staff concluded that with respect to DBAs the VEGP site is environmentally suitable for operation of two new AP1000 reactors. *Id.* at 5-79. Consequently, the NRC staff found the environmental consequences of a DBA at the VEGP site would be of small significance. *Id.* at 5-80. The NRC staff noted in this section that Westinghouse has submitted an amendment to the AP1000 reactor design that contains a change in source term and that the NRC staff is reviewing that request independently of its ESP review; it noted that the information in that submission indicates that doses from postulated accidents would decrease. *Id.*

3.281. In its ER, the Applicant considered three pathways for the potential consequences from a severe accident: (1) the atmospheric pathway, in which radioactive material is released to the air, (2) the surface-water pathway, in which airborne radioactive material falls out on open bodies of water, and (3) the groundwater pathway, in which groundwater is contaminated by a basemat melt-through with subsequent contamination of

surface water by groundwater. *Id.* at 5-80. The Applicant based its evaluation of the potential environmental consequences for the atmospheric and surface-water pathways on the results of the MACCS2 computer code run using AP1000 source term information and site specific meteorological, population, and land-use data. *Id.* The NRC staff reviewed input and output files for the MACCS2 computer runs, and ran confirmatory calculations and concurred with the Applicant's results. *Id.* For some potential pathways, the Applicant relied on the GEIS. *Id.*

3.282. Three types of severe accident consequences were assessed: (1) human health, (2) economic costs, and (3) land area affected by contamination. *Id.* at 5-81. The NRC staff summarized these consequences in Tables 5.15 through 5.17 of the FEIS. *Id.* at 5-83 to 5-85. The NRC staff evaluated the ER and conducted its own confirmatory analysis using the MACCS2 code. *Id.* at 5-89. The results of both the Applicant's analysis and the NRC analysis indicated that the environmental risks associated with severe accidents if an AP1000 reactor were to be located at the VEGP site would be small compared to the risks associated with operation of current-generation reactors. *Id.* These risks are well below the NRC safety goals; therefore, the NRC staff concluded that the probability-weighted consequences of severe accidents at the VEGP site would be of small significance for an AP1000 reactor at the Vogtle site. *Id.*

3.283. In Section 5.10.3 of the FEIS, the NRC staff discussed Severe Accident Mitigation Alternatives ("SAMAs"). The NRC staff also presented a presentation on this topic during the uncontested hearing. Ex. NRC000066.²⁹ The purpose of the evaluation of SAMAs is to determine whether there are severe accident mitigation design alternatives ("SAMDAs") or

²⁹ In support of its presentation on Severe Accident Mitigation Design Alternatives, the NRC staff introduced two witnesses: Mr. James V. Ramsdell, Jr., and Mr. Mark N. Notich, whose Curriculum Vitae are in Exhibits NRC000075 and NRC000072, respectively.

procedural modifications or training activities that can be justified to reduce the risk of severe accidents. Ex. NRC000001B at 5-90. The evaluation of SAMDAs was performed as part of the design certification review for the AP1000; thus, it was not repeated in the FEIS. *Id.* The Applicant assessed fifteen SAMDAs that were considered in the AP1000 certified design using site-specific information and found none of them to be cost beneficial. *Id.* The NRC staff's review focused on whether the Vogtle site-specific values used by the Applicant are within the site parameters specified in the AP1000 DCD. Ex. NRC000066 at 8. Based on a review of its previous evaluation of generic SAMDAs for the AP1000 rulemaking and the Applicant's analysis, the NRC staff concluded that there are no cost beneficial SAMDAs. Ex. NRC00001B at 5-90.

3.284. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the environmental impacts of postulated accidents.

3.285. In Section 5.11 of the FEIS, the NRC described the general measures and controls on which it relied in its evaluation of impacts during operation of the new units, including those that would be required of the Applicant by applicable permits and authorizations. *Id.* at 5-91 to 5-92. In Section 5.12, the NRC staff summarized the impacts from the operation of two new AP1000 units at the VEGP site. *Id.* at § 5.12.

3.286. Based on the above information, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to impacts of operation of the proposed units at the Vogtle site.

FEIS Chapter 6, "Fuel Cycle, Transportation, and Decommissioning"

3.287. In Chapter 6 of the FEIS, the NRC staff analyzed the environmental impacts from the uranium fuel cycle, solid waste management, transportation of radioactive material, and decommissioning of two new nuclear reactors at the Vogtle site. NRC00001B at 6-1.

3.288. The NRC staff evaluated the environmental impacts of uranium fuel cycle and solid waste for the AP1000 reactor design against the environmental data set forth in 10 C.F.R. § 51.51(a) (Table S-3) that are listed in Table 6-1 of the FEIS. *Id.* The NRC staff scaled the reference reactor in Table S-3 to compare with the proposed new units at the Vogtle site and determined that the fuel cycle impacts for the new units at Vogtle would be approximately three times the values established in Table S-3. *Id.* at 6-6. The NRC staff considered the impacts associated with land and water use, effects related to fossil fuel use, chemical effluents, radiological effluents, and radiological wastes associated with provision, utilization, and ultimate disposition of fuel for nuclear power reactors, and also discussed why contemporary fuel cycle impacts are below those identified in Table S-3. *Id.* at 6-6 to 6-14. The NRC staff found that the environmental impacts from the fuel cycle would be small. *Id.*

3.289. The NRC staff also evaluated transportation impacts, including an assessment of the impacts from normal operating and accident conditions from shipment of unirradiated fuel to the VEGP site, shipment of spent fuel to a monitored retrievable storage facility or permanent repository, and shipment of low-level radioactive waste and mixed waste to offsite disposal facilities. *Id.* at 6-14. With respect to the transportation of unirradiated fuel, the NRC staff calculated the radiological dose impacts using the RADTRAN 5 computer code. *Id.* at 6-18. The NRC staff determined that the dose estimates were bounded by the conditions specified in 10 C.F.R. § 51.52 (Table S-4). *Id.* at 6-19 to 6-20. The NRC staff determined that the risks to the public would be small compared to the effects expected to occur due to exposure to natural radiation sources. *Id.* at 6-20. Likewise, the NRC staff analyzed doses to the MEI from unirradiated fuel shipments to, and spent fuel and radioactive shipments from, the Vogtle site. *Id.* at 6-20 to 6-22. The NRC staff also evaluated radiological impacts of traffic accidents during transportation of unirradiated fuel and found that they would be smaller than those in Table S-4, in part due to reductions in traffic accident rates. *Id.* at 6-22. Additionally, the NRC staff

calculated non-radiological impacts from unirradiated fuel shipments and spent fuel shipments, such as traffic accidents, using representative accident, injury, and fatality rates from published sources. *Id.* at 6-22 to 6-23, 6-33 to 6-34.

3.290. The NRC staff also considered the environmental impacts of transportation of spent fuel from the Vogtle site to an offsite disposal repository, using the proposed site at Yucca Mountain, Nevada, as a surrogate destination. *Id.* at 6-23. The NRC staff's analysis was based on shipment of spent fuel by truck in shipping casks that are similar to current cask designs, and it used conservative assumptions consistent with those in NUREG-1437. *Id.* at 6-24. The NRC staff also considered the use of current cask designs to be conservative, as such casks are currently designed for transportation of short-cooled spent fuel and future designs are expected to have higher cargo capacities of longer-cooled fuel, with fewer shipments. *Id.* at 6-24.

3.291. The NRC staff evaluated the environmental impacts of transportation of the spent fuel under normal conditions, with radiation exposures calculated to residents of the transportation corridors, persons in vehicles traveling on the same route as the spent fuel shipment, persons at vehicle stops for food and rest along the same route as the spent fuel shipment, and transportation crew workers. *Id.* at 6-26 to 6-28. Radiation doses for the total shipping distance were estimated using the RADTRAN 5 code, and they included population distributions obtained from the TRAGIS computer code for the Vogtle-to-Yucca Mountain route. *Id.* at 6-25. Based on the RADTRAN 5 model results, the NRC staff estimated risks to the public from routine radiation exposure and concluded that the impacts are small compared to the effects on the same population from exposure to natural radiation sources. *Id.* at 6-30. For the radiological impacts of both normal and accident conditions, the NRC staff considered the effects of increased fuel enrichment and fuel irradiation levels associated with changes between Revision 15 and Revision 16 of the AP1000 DCD, and found that this would have no impact on the NRC staff's conclusions. *Id.* at 6-30, 6-33.

3.292. The NRC staff also used the RADTRAN 5 code and determined that the impacts of transportation of spent fuel under accident conditions would also be small, in part because of the robustness of the shipping casks. *Id.* at § 6.2.2.2. The NRC staff also evaluated the potential environmental impacts of transportation of radioactive waste from the Vogtle site. *Id.* at 6-34. The NRC staff noted that such waste shipments would conform with packaging, shipping, and weight limits set forth in 10 C.F.R. § 51.52, and that the waste volumes and shipments would be expected to be less than for the reference reactor that was the basis for Table S-4. *Id.* at 6-34 to 6-35.

3.293. The NRC staff concluded that the impacts under normal and accident conditions of transporting fuel and wastes to and from the Vogtle site would be small and consistent with the impacts presented in Table S-4. *Id.* at 6-36.

3.294. The NRC staff indicated that the Applicant was not required to submit information regarding decommissioning of the proposed reactors as part of the ESP application. *Id.* at 6-36 to 6-37. However, the NRC staff concluded that regulatory requirements regarding completion of decommissioning activities are expected to limit impacts from these activities to small. *Id.* at 6-37

3.295. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the impacts of fuel cycle, transportation, and decommissioning activities related to the proposed reactors.

FEIS Chapter 7, "Cumulative Impacts"

3.296. In Chapter 7 of the FEIS, the NRC staff considered potential cumulative impacts that could occur as a result of the construction and operation of the proposed new units. In this review, the NRC staff considered the impacts of the proposed action in combination with other past, present, and reasonably foreseeable future actions in the vicinity of the site that would affect the same resources impacted by the proposed units. Ex. NRC00001B at 7-1. As

explained in the FEIS, these would include individually minor but collectively significant actions taking place over a period of time. *Id.*

3.297. In Section 7.1, the NRC staff reviewed the cumulative impacts of the construction of the two new units and a new transmission line on land use. Ex. NRC00001B at 7-2. The NRC staff considered land-use impacts at the Vogtle site as well as those resulting from possible additional growth and land conversions to accommodate new workers and services. *Id.* Based, in part, on the assumption that the construction and operations workforces would be drawn from a relatively large geographic area and that impacts from the new transmission line would be subject to mitigation measures employed by GPC, the NRC staff concluded that the cumulative impacts from these activities would be small. *Id.* Based on the above information, we find that the NRC staff had a reasonable basis for its conclusions and that the record is sufficient with respect to analysis of cumulative land use impacts.

3.298. In Section 7.2, the NRC staff considered cumulative impacts to air quality. The NRC staff identified permitted air emission sources in the vicinity, including Plant Wilson (combustion turbine plant) and the SRS, as well as the proposed mixed-oxide fuel ("MOX") facility at the SRS. *Id.* at 7-2, 7-3. The NRC staff identified the potential air emissions from those facilities as well as the estimated small air quality impacts from the Vogtle site and again noted that the Vogtle site is located in an area that is in attainment for all criteria pollutants. *Id.* The NRC staff concluded that the cumulative impacts to air quality would be small. *Id.* In response to a Board question, the NRC staff explained that this conclusion does assume simultaneous operation and construction of the identified facilities, and that the applicable permits for the existing facilities (as well as ones that would be issued in the future for proposed facilities like the MOX facility) are intended to keep the area in attainment with respect to the NAAQS criteria air pollutants. Ex. NRC000057 at 22-23. Based on the above, we find that the

NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the descriptions of the cumulative impacts to air quality.

3.299. In Section 7.3, the NRC staff considered cumulative impacts to water use and water quality. As explained in the FEIS and in the NRC staff's hearing presentation on water use impacts, the NRC staff considered the impacts of the proposed units in combination with the existing Vogtle units, the SRS, and other water users in the region. Ex. NRC00001B at 7-3; NRC000059 at 8-9. With respect to water use impacts, the NRC staff examined cumulative impacts to both surface water and groundwater. Ex. NRC00001B at § 7.3.1. As stated in the FEIS, the NRC staff described combined surface water withdrawal rates and consumptive use by both the existing and proposed Vogtle units, as a percentage of Savannah River discharge. *Id.* at § 7.3.1.1. As clarified in its contested hearing testimony, the NRC staff considered normal withdrawal rates from the proposed units, in combination with the highest observed monthly average withdrawals by the existing units, and stated that this reflected appropriately conservative values for the purpose of cumulative impacts analysis (rather than the highly unlikely scenario of all units withdrawing at the maximum rate).³⁰

3.300. The NRC staff considered these values over a range of river flows, from average flows to low flows. The NRC staff also identified water withdrawals and consumptive use by other water users in the vicinity of the Vogtle site, including the D-Area Powerhouse and the SCE&G Urquhart station, and calculated the combined water use of these and the four Vogtle units. Ex. NRC000059 at 8-9; Tr. at M-1712 to M-1715. After considering the Vogtle site withdrawals and consumptive use compared to the river flow (even under drought conditions),

³⁰ "NRC Staff Rebuttal Testimony of Dr. Michael T. Masnik, Anne R. Kuntzleman, Rebekah H. Krieg, Dr. Christopher B. Cook, and Lance W. Vail Concerning Environmental Contention EC 1.2," Post Tr. 744 at 2-5; Tr. at 790-791.

and the consumptive use of nearby water users, the NRC staff concluded that the combined surface water use impacts to the Savannah River would be minor. Ex. NRC00001B at 7-5. For additional context, the NRC staff considered cumulative impacts from the four Vogtle units at very-low-flows (3000 and 2000 cfs), and found that while the percentage of water withdrawn and consumptively used would increase, impacts would still be minor, as such extreme low flow conditions at the Vogtle site would be extremely rare and temporary. *Id.* at 7-6. Similarly, the NRC staff determined that its impact analysis would not significantly differ in connection with the potential small increases in river withdrawals associated with Revision 16 of the AP1000 DCD, including at those very-low flows. *Id.*

3.301. In response to Board questions, the NRC staff explained that flows lower than 3800 cfs at the site would be considered extreme events, so the evaluation of very-low flows would provide bounding values for impacts to surface waters that would occur in only extremely rare instances. Ex. NRC000057 at 23-24. The flow rates of 3000 and 2000 cfs that the NRC staff analyzed were not explicitly Drought Level 4 flows, but the NRC staff's attempt to provide additional conservative context for its analysis, given the then-ongoing drought conditions and reservoir-release changes contemplated by the USACE. *Id.* at 26. The NRC staff explained that its analysis was not intended to suggest that these very-low flows would be typical or even anticipated conditions at the site. *Id.* at 27. The NRC staff also stated that its consideration of flows from average flows to Drought Level 3 flows is representative of a range of conditions consistent with a NEPA review. *Id.* at 28. The NRC staff used releases from the upstream Thurmond Dam as a surrogate for flows past the site, and stated that USGS data (including from the Waynesboro gauge at the Vogtle site) confirm that this is a conservative estimate of what flow will be at the site because water inflows between Thurmond Dam and the site generally exceed consumptive loss from upstream users such as the Urquhart station and the D-Area Powerhouse, even during low-flow conditions. *Id.* at 28-30. The NRC staff explained

that the flow rates it evaluated thus account for consumptive use by upstream water users. *Id.* at 31, 32.

3.302. The NRC staff also considered cumulative groundwater use impacts, taking into account the four Vogtle units as well as existing and future groundwater users in the vicinity. Ex. NRC00001B at § 7.3.1.2. Based on the projected relatively low drawdown of normal operation, the temporary drawdowns of maximum operation, and the presence of a groundwater resource sufficient to sustain the incremental increase and future increase in groundwater use, the NRC staff concluded that cumulative impacts would be small. *Id.* at 7-10. The NRC staff also noted that because changes between Revision 15 and Revision 16 of the AP1000 DCD would expect to result in a decrease in the groundwater demand, the NRC staff determined that its conclusions regarding cumulative groundwater use would not change. *Id.*

3.303. With respect to surface water quality, the NRC staff noted that downstream responses to saltwater intrusion in the groundwater aquifer may lead to increased use of surface water to meet water needs, but that the cumulative water use of the Vogtle units was not large compared to the total Savannah River discharge. *Id.* at 7-10 to 7-11. With respect to thermal impacts, the NRC staff noted that its analysis in Chapter 5 considered combined discharge impacts from all four Vogtle units and that the resulting mixing zone was still very small compared to the size of the river. *Id.* at 7-11 to 7-12. The NRC staff explained that as discussed in Chapter 5, the NRC staff also analyzed these impacts at very-low flow rates (3000 and 2000 cfs) and determined that the impacts were not significantly different under these conditions than under the Drought Level 3 flows analyzed. *Id.* at 7-12.

3.304. Concerning groundwater quality, the NRC staff examined the impacts from saltwater intrusion issues in Georgia, the observed tritium in the unconfined aquifer, and the potential for SRS contamination to impact groundwater quality at the Vogtle site. *Id.* The NRC staff found that the quality of water withdrawn from groundwater wells in Burke County is not

affected by saltwater intrusion and the proposed project would not contribute to the saltwater intrusion that is occurring. *Id.* at 7-12 to 7-13. The NRC staff also determined from USGS and State of Georgia information that tritium contamination in the unconfined aquifer is likely due to atmospheric deposition of tritium released from the SRS and the proposed project will not contribute to the tritium contamination. *Id.* at 7-13. Finally, based on its review of site hydrogeology and of groundwater contamination and management practices at the SRS, the NRC staff determined that existing and proposed use of groundwater at the Vogtle site does not appear to contribute to migration of the SRS contamination. *Id.* at 7-13 to 7-15. Accordingly, the NRC staff concluded that cumulative impacts to groundwater quality would be small. *Id.* at 7-15.

3.305. Based on the above, and as discussed more fully in our ruling on contested environmental matters, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the descriptions of the cumulative water use and water quality impacts.

3.306. In Section 7.4, the NRC staff considered cumulative impacts to the terrestrial ecosystem. The NRC staff found that the habitats that would be disturbed at the site are common in the region and are not considered critical habitat, and that the wetlands that would be disturbed represent only a small portion of those available in the site vicinity. *Id.* at 7-16. The NRC staff considered terrestrial effects from generating stations and non-power generating plants in the vicinity, as well as from the SRS, including air emissions, chemical discharge and deposition. *Id.* at 7-16 to 7-17. The NRC staff found that the Vogtle plant would present little additional impact from airborne releases and that habitat loss or alteration would be confined primarily to the site. *Id.* at 7-17. Thus these impacts, even in combination with effects associated with other facilities in the region, would not destabilize the terrestrial resource. *Id.* The NRC staff also determined that cooling tower salt deposition from all four units would be

negligible and that there are no other significant sources of cooling tower drift in the site vicinity. *Id.* at 7-17 to 7-18.

3.307. With respect to transmission line rights-of-way, the NRC staff noted that if the actual route is similar to the hypothetical route considered by Southern and GPC, impacts would be negligible, but if the route differs, impacts could be greater or smaller. *Id.* at 7-18. The NRC staff also indicated that the GPC would site the line in accordance with Georgia state regulations and in consultation with FWS and GDNR regarding impacts to special habitats and threatened and endangered species. *Id.* at 7-19. The NRC staff identified no other actions that could significantly affect wildlife and wildlife habitat in ways similar to the transmission line operation and maintenance and thus found that cumulative adverse impacts of this type would be minor. *Id.*

3.308. Accordingly, the NRC staff determined that cumulative terrestrial impacts, including from transmission line operation and maintenance, would be small. *Id.* Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to cumulative terrestrial ecosystem impacts.

3.309. In Section 7.5, the NRC staff evaluated cumulative impacts to the aquatic ecosystem. The NRC staff considered impacts to the Savannah River from potential sources including the proposed and existing Vogtle units, activities at the SRS, urban development and recreational activities, and natural environmental stressors. *Id.* at 7-19 to 7-20. With respect to construction, the NRC staff found that the construction of the existing Vogtle units did not affect the river observably or significantly from an aquatic ecological perspective. *Id.* at 7-20. The NRC staff found that activities related to construction of the intake and discharge structures and barge slip for the proposed units would likewise have impacts that are minimal and temporary and can largely be mitigated. *Id.*

3.310. The NRC staff also described the possible impacts of potential dredging of the Savannah River Federal navigation channel (“FNC”), noting that because the channel has not been maintained for navigation, areas of the channel would likely need to be dredged to allow barge traffic at normal river flow. *Id.* at 7-20. However, the NRC staff stated that any such dredging project is incompletely defined, the amount of material to be removed is unknown, and the locations of the dredged material disposal areas have not been identified. *Id.* The NRC staff also stated that the USACE, which has the responsibility for maintaining the FNC, would have to conduct a NEPA assessment prior to any authorization for dredging. *Id.* Nevertheless, the NRC staff described impacts to aquatic biota that could occur if dredging were undertaken, and also noted that use of BMPs, time of year restrictions, relocation of benthic organisms, and restrictions on equipment type could ameliorate many of the impacts. *Id.* The NRC staff concluded that cumulative impacts from the construction including dredging of the navigation channel could be moderate, depending on the type of mitigation. *Id.*

3.311. With respect to cumulative impacts of operations, the NRC staff considered the possibility of stressors contributing to cumulative impacts to the river, including water consumption, drought, entrainment and impingement at intake structures of other facilities, thermal effects from cooling water discharges, chemical contaminants, environmental changes associated with changes in regional water use, fishing pressures, and habitat modification and loss. *Id.* at 7-21. In its evaluation, the NRC staff examined the potential effects on the ecosystem from cumulative water use at the Vogtle site relative to the Savannah River discharge, including during drought conditions. *Id.* at § 7.5.2. The NRC staff also identified that several facilities withdraw from or discharge into the Savannah River in the vicinity of the site. *Id.* at 7-21; Ex. NRC000059 at 8, 9. In response to a Board question, the NRC staff described further how it had considered other major water users in its cumulative impacts analysis, and explained how that analysis - including data from studies at the SRS, the temporary nature of

very-low-flow conditions, the generally higher river flows at times when concentrations of ichthyoplankton in the river are high, characteristics of fish species, and the availability of multiple spawning sites - all supported the NRC staff determination that cumulative impacts to aquatic biota would be small even under very-low-flow conditions. Ex. NRC000057 at 33-39.

3.312. After considering a number of factors such as the design of the intake, the small percentage of water withdrawn, life history data for important species, past data from studies at the SRS, and the preliminary data from sampling at the existing units, the NRC staff determined that cumulative impacts from impingement and entrainment would be minor. Ex. NRC00001B at § 7.5.2. The NRC staff acknowledged that under very-low-flow conditions, the effects of the four Vogtle units in combination with potential losses at the SRS could have a localized detrimental effect, but determined that these flow conditions would likely be temporary and are unlikely to result in long term persistent impacts. *Id.* at 7-24. Likewise, the NRC staff found that given the small amount of water discharged relative to the river flow and the dilution of the discharge plume, cumulative effects on aquatic biota from the thermal and chemical discharges of the Vogtle units would be small, even under very-low-flow conditions. *Id.* at 7-23. The NRC staff also found that the changes associated with Revision 16 of the AP1000 DCD are small increases in water use that would not alter the impact assessment. *Id.* at 7-24 to 7-25.

3.313. Consequently, the NRC staff determined that potential cumulative impacts on aquatic resources would be minor. *Id.* at 7-25. Based on the above, and as explained in more detail in our ruling on contested environmental matters, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to cumulative impacts to the aquatic ecosystem.

3.314. In Section 7.6, the NRC staff evaluated the cumulative impacts of the proposed new reactors related to socioeconomics, historic and cultural resources and environmental justice. The NRC staff noted that the geographic area of the cumulative impacts analysis

associated with these issues varies depending on the impact analyzed. *Id.* at 7-26. For example, impacts may depend on tax jurisdiction or may be related to distance from the actual site. *Id.*

3.315. The NRC staff's analysis of cumulative socioeconomic impacts identified the potential for an increase in road congestion and noted that this impact is limited to the local area and may be mitigated with proper planning, car pool incentives, and minor road improvements. *Id.* In its evaluation of impacts to the socioeconomic infrastructure and housing, the NRC staff considered the effect of construction of the proposed units in combination with possible concurrent construction of the nearby SRS MOX facility. *Id.* The NRC staff noted that county planners for two local Georgia counties projected negligible impacts to housing, and determined that the cumulative effect would be small. *Id.* However, the NRC staff acknowledged that the impacts could be moderate should more workers settle in Burke County than expected. *Id.* The NRC staff also noted that there would likely be a large beneficial effect on tax revenues. *Id.*

3.316. Also in Section 7.6, the NRC staff considered the impact of construction of the additional reactor units on cultural resources, a non-renewable resource. *Id.* at 7-27. The NRC staff indicated that there were no past, present, or future actions with adverse cultural resource implications and concluded that the cumulative impact to cultural resources would be moderate. *Id.*

3.317. In its analysis of environmental justice impacts, the NRC staff identified no unusual resource dependencies or practices or environmental pathways through which minorities and low-income populations would be disproportionately impacted; the NRC staff thus considered cumulative environmental justice impacts to be small. *Id.* The NRC staff did note that if more workers settle in the local area than is currently anticipated, and if tax revenues do not increase accordingly, then reduced services or increased taxes may be expected to disproportionately affect county residents. *Id.*

3.318. Based on the above, the Board finds the NRC staff's evaluation of the cumulative impacts of the proposed construction on socioeconomics, historic and cultural resources, and environmental justice to be reasonable.

3.319. In Section 7.7, the NRC staff considered cumulative non-radiological health impacts. After considering the unlikelihood of increases in thermophilic microorganisms, the below-average rates of occupational injuries, and the small impacts to the public and workers from noise, dust emissions, acute EMF, and transportation, the NRC staff found that cumulative impacts on non-radiological health would be small. *Id.* The NRC staff noted that it had not come to a conclusion on chronic impacts of EMF but that available information would not cause the NRC staff to consider the impact as significant to the public. *Id.* Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to cumulative impacts to non-radiological health.

3.320. In Section 7.8, the NRC staff considered the cumulative radiological impacts of normal operations. The NRC staff explained that the radiological exposure limits and standards for the protection of the public and for occupational exposures have been developed assuming long-term exposures and, therefore, incorporate cumulative impacts. *Id.* For purposes of cumulative impacts, the NRC staff considered a 50-mile area, which includes the VEGP site, the existing VEGP Units 1 and 2, and DOE's SRS. *Id.* at 7-27 to 7-28. Other facilities included in the cumulative impacts analysis are the existing Chem-Nuclear site and the Starmet CMI facility, and the proposed MOX facility. *Id.* at 7-28. In order to be conservative, the NRC added together all MEI doses from these sites, even though the MEI for each site would be composed of different individuals, locations and periods of time. *Id.* at 7-29. This approach resulted in an estimated cumulative impact of about 2.9 millirem per year ("mrem/yr") for the MEI and about 30 person-rem per year for the population dose. *Id.* Therefore, the NRC staff concluded that the cumulative impacts of operating two new units, along with the existing units at VEGP and the

influence of the SRS, would be small. *Id.* Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to cumulative impacts to the radiological impacts of normal operations.

3.321. In Section 7.9, the NRC staff considered the cumulative impacts of severe accidents. In order to determine these cumulative impacts, the NRC staff added the population dose risks associated with adding two AP1000 reactors to the population risk of the two existing reactors. *Id.* The combined risk did not result in a significant increase in risk, and similar conclusions were obtained when other risks were evaluated. *Id.* Thus, the NRC staff concluded that the cumulative severe accident impacts associated with adding two AP1000 reactors to the VEGP site were small. *Id.*; Ex. NRCR00060 at 59-61.³¹ Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to cumulative impacts due to severe accidents.

3.322. In Section 7.10, the NRC staff considered the cumulative impacts of the production of additional fuel for the proposed new reactors, transportation of fuel to the site, transportation of spent fuel and wastes from the site and the environmental impacts of decommissioning. Ex. NRC00001B at 7-29. The NRC staff noted that the impacts from fuel production include mining and milling of the uranium ore, fuel fabrication resulting in conversion to fuel pellets, and disposition of the spent fuel in a waste repository. *Id.* The NRC staff provided a detailed discussion of the environmental impacts of fuel cycle activities for the proposed new units in Section 6.1 of the FEIS. *Id.* at 7-30. Based upon a comparison of the environmental impacts estimated for the two proposed new units with the environmental

³¹ This corresponds to slide numbers 35-39 in the environmental portion of the NRC staff's presentation.

considerations listed in 10 C.F.R. § 51.51, Table S-3, the NRC staff concluded that the cumulative fuel cycle impacts of operating the Vogtle site would be small. *Id.*

3.323. The NRC staff also evaluated the cumulative impacts of shipments of unirradiated fuel to the site and of spent fuel and waste from the site. *Id.* The NRC staff concluded that the normalized number of fuel and waste shipments would be within the criteria specified in Table S-4 and that the cumulative impacts of transportation would be small. *Id.* A detailed discussion of the environmental impacts of fuel and waste transportation for the proposed new units was included in Section 6.2 of the FEIS. *Id.*

3.324. The NRC staff stated that decommissioning of the proposed new units would be performed in compliance with regulatory requirements. *Id.* Based on the cumulative impact findings noted in Supplement 1 to NUREG-0586, *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, in which impacts related to decommissioning were found to be small, the NRC staff concluded that the impacts of decommissioning the two new reactors proposed for the Vogtle site would also be small. *Id.*

3.325. Based on the above analysis, the Board finds the NRC staff's conclusion regarding cumulative impacts related to fuel cycle, transportation, and decommissioning associated with the two proposed new reactors to be reasonable.

3.326. Given the above considerations, the NRC staff concluded that the potential cumulative impacts resulting from construction and operation are generally small, and that additional mitigation beyond the measures discussed in the FEIS is not warranted. *Id.* at 7-31.

3.327. Based on the above, and as discussed more fully in our ruling on contested environmental matters, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to cumulative impacts of construction and operation.

FEIS Chapter 8, "Need for Power"

3.328. Despite its not being required for an ESP application, Southern chose to include a need for power analysis in its ER. 10 C.F.R. § 51.50(b)(2). The NRC staff reviewed the Applicant's need for power analysis using guidance in Sections 8.0 through 8.4 of the ESRP. Ex. NRC00001B at 8-1. The Applicant's need for power analysis was based on an integrated resource plan ("IRP"), including a need for power analysis, which the GPC submitted to the Georgia Public Service Commission ("GPSC"). *Id.* at 8-5, 8-6. Ultimately, the GPSC approved this IRP. *Id.* at 8-7. The NRC staff explained that when a state public utility commission prepares or reviews a need for power analysis, the NRC staff's review is limited to whether this analysis is (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty. *Id.* at 8-1.

3.329. The NRC staff in the FEIS considered the GPSC's evaluation of the GPC's IRP and other energy forecasts to develop a conclusion about the need for power. *Id.* at 8-7. The GPSC approved a reserve margin for planning with 3 years, and a 15 percent margin for longer forecasts and approved planning that identifies the need for new generating resources beginning in 2010. *Id.* The GPSC determined that it is reasonable for the GPC to investigate the opportunity to build nuclear resources. *Id.* The NRC staff compared the GPC's projections in its IRP with data from the U.S. Department of Energy, Energy Information Administration's Annual Energy Outlook, population increases estimated by the U.S. Census Bureau, and projections from the South Eastern Reliability Council. *Id.* at 8-7 through 8-9.

3.330. After considering this information, the NRC staff found that the GPC submitted to the GPSC an IRP that contained a detailed review for the need for power in the state of Georgia and parts of the surrounding area. *Id.* at 8-10. The NRC staff determined that the GPC's IRP, including the need for power analysis is (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty. *Id.* Thus, the NRC staff accepted

the need for power evaluation contained in the IRP submitted to the GPSC. The NRC staff also concluded that the GPC's prediction of its future load demand is a reasonable basis for planning for 2007 to 2030 and that the GPC cannot expect to satisfy a significant portion of that demand load by additional electric purchases from neighboring producers. *Id.* Based on this analysis, the NRC staff concluded that there is a justified need for power in the region of interest. *Id.*

3.331. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the need for power analysis.

FEIS Chapter 9, "Environmental Impacts of Alternatives"

3.332. Chapter 9 of the FEIS described alternatives to the proposed action and discussed the environmental impacts of those actions. Additionally, Chapter 9 considered the no-action alternative and energy, system, and site alternatives. In accordance with Section 9.3 of the ESRP, the NRC staff's evaluation of alternative sites follows a two step process. Ex. NRC00001B at 9-1. First, the NRC staff looks at a full suite of environmental issues using reconnaissance level information to determine if any of the alternatives are environmentally preferable to the proposed site. *Id.* If there are no environmentally preferable sites, then the process is complete; but, if environmentally preferable sites are discovered, the NRC staff considers economic, technological, and institutional factors to determine if any of the sites are obviously superior to the proposed site. *Id.* At the uncontested hearing, both the NRC staff and Applicant provided presentations on the Applicant's alternatives analysis and the NRC staff's review.³² Exs. NRC000062; SNC000076.

³² In support of its presentation on the environmental impacts of alternatives, the NRC staff introduced four witnesses: Mr. Lance W. Vail, Mr. Paul L. Hendrickson, Dr. Christopher B. Cook, and Mr. Mark D. Notich. (The Curriculum Vitae of the NRC staff's witnesses are in Exhibits NRC000073, NRC000078, NRC000070, and NRC000072, respectively.) The Applicant's presentation (Ex. SNC000076) was provided by Mr. Thomas C. Moorer, whose Curriculum Vita is in Exhibit SNC000014.

9.1 *No-Action Alternative*

3.333. The no-action alternative refers to a scenario in which the NRC denies the ESP request. *Id.* at 9-2. Because under the no-action alternative the ESP would not be issued, the environmental impacts associated with the LWA would be avoided. *Id.* Further, because the FEIS analyzes impacts from construction and operation of two new nuclear units, the no-action alternative would eliminate all of the impacts of the NRC-approved activities discussed in the FEIS. *Id.* However, the no-action alternative would also accomplish none of the benefits from the ESP process. *Id.* Based on the above we find that the NRC staff had a reasonable basis for its conclusions and that the record is sufficient with regards to the analysis of the no-action alternative.

9.2 *Energy Alternatives*

3.334. The Applicant's objective in seeking an ESP is to secure a site for new baseload power generation. *Id.* at 9-2. For its analysis of alternatives, the Applicant assumed a bounding electrical output target value of 2234 megawatts electric ("MW(e)"). *Id.* at 9-3. The NRC staff used this same electrical output value in its analysis of energy alternatives. *Id.* The NRC staff's analysis, as documented in the FEIS, discussed energy alternatives not requiring new generating capacity, energy alternatives requiring new generating capacity, and a combination of energy alternatives. The NRC staff also compared the environmental impacts from new nuclear, coal-fired, and natural-gas-fired generating units at the VEGP site. *Id.* at 9-2.

3.335. The NRC staff analyzed four alternatives that would not require the Applicant to construct new generating capacity. These alternatives are to: (1) purchase the needed electric power from other suppliers; (2) reactivate retired power plants; (3) extend the operating life of existing power plants; and (4) implement conservation or demand-side management programs. *Id.* at 9-3; Ex. NRC000062 at 6-7.

3.336. The NRC staff also analyzed alternatives requiring new generating capacity. Specifically, the NRC staff in the FEIS analyzed the alternatives identified by the Applicant in its ER; namely, coal-fired and natural-gas-fired alternatives located at the VEGP site. *Id.* at 9-5. Further, the NRC staff analyzed a number of other alternatives in Section 9.2.3 of the FEIS. *Id.* at 9-16

3.337. In analyzing the coal-fired generation alternative, the NRC staff assumed construction of four pulverized coal-fired units, each with a new capacity of 530 MW(e) at the VEGP site, the construction of a required extra transmission line, and an operating life of 40 years. *Id.* at 9-6. The NRC staff also considered an integrated gasification combined cycle (“IGCC”) coal-fired plant, but the NRC staff found that this was not a reasonable alternative because: (1) IGCC plants are more expensive than comparable pulverized coal plants, (2) existing IGCC plants have considerably smaller capacity than the proposed 2234-MW(e) nuclear plant, (3) system reliability of existing IGCC plants has been lower than pulverized coal plants, (4) the existing IGCC plants have had an extended shakedown period, and (5) a lack of overall plant performance warranties for IGCC plans has hindered commercial financing. *Id.* For the coal-fired generation alternative, the NRC staff analyzed the construction and operation impacts of land use, air quality, water use and quality, ecology, waste management, socioeconomics, human health, historic and cultural resources, and environmental justice. *Id.* at 9-7 to 9-12.

3.338. In its analysis of the natural gas alternative, the NRC staff assumed construction and operation of a natural-gas-fired plant with a closed-cycle cooling system and cooling towers located at the VEGP site. *Id.* at 9-12. The NRC staff used the Applicant’s assumption of four units with a new capacity of 530 MW(e) per unit, and the construction of an additional transmission line in a new right-of-way. *Id.* The NRC staff analyzed the construction and operation impacts of land use, air quality, water use and quality, ecology, waste management,

socioeconomics, human health, historic and cultural resources, and environmental justice. *Id.* at 9-12 to 9-16.

3.339. The NRC staff also analyzed other alternatives that the Applicant determined were not reasonable. *Id.* at 9-16. As explained in the NRC staff's presentation at the uncontested hearing, after analyzing the following alternatives, the NRC staff agreed that none was a feasible baseload generation alternative: (1) oil-fired power generation was too expensive; (2) wind power is a small resource and has a low capacity factor; (3) solar power is suitable for water heating of photovoltaic but not for baseload, and it has a low capacity factor; (4) hydropower is a relatively small resource in the area and is expensive; (5) geothermal energy is not suitable for an eastern location, (6) wood waste plants are too small; (7) municipal solid waste plants are too small; (8) other biomass-derived fuels are too small; and (9) fuel cells are not economically or technologically feasible. Ex. NRC000062 at 12.

3.340. The NRC staff also compared a combination of alternatives to see if this combination would be environmentally preferable to the proposed units. To analyze the combination of alternatives, the NRC staff assessed the environmental impacts of three 530 MW(e) natural-gas-fired, combined-cycle generating units at the VEGP site using closed-cycle cooling with cooling towers, 60 MW of wind energy, 60 MW of hydropower, 100 MW from biomass sources including municipal solid waste, and 424 MW from conservation and demand-side management programs. Ex. NRC00001B at 9-23. The NRC staff explained in response to a written Board question that it found this combination of alternatives to be reasonable, and it explained its reasoning for assigning a value of 60 MW for wind energy. Ex. NRC000057 at 42-43.

3.341. As shown in Table 9-4 of the FEIS, the NRC staff compared the environmental impacts of nuclear, coal, natural gas and a combination of alternatives. *Id.* at 9-25. Based on this analysis, the NRC staff determined that from an environmental perspective none of the

viable energy alternatives is clearly preferable to construction of a new baseload nuclear power generation plant. *Id.* at 9-24. Consequently, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to analysis of energy alternatives.

9.3 System Design Alternatives

3.342. In this section of the FEIS, the NRC staff analyzed the environmental impacts of alternative heat dissipation systems. The proposed heat dissipation system is a closed-cycle wet cooling tower. Specifically, the NRC staff analyzed once-through systems, dry cooling towers and hybrid wet/dry cooling towers. *Id.* at 9-25 to 9-27. The NRC staff did not find a once-through cooling tower to be environmentally preferable to the proposed system because of the quantity of water that would have to be withdrawn from the Savannah River in a once-through system; this withdrawal rate could be greater than the flow of the river during drought periods. *Id.* at 9-26. The NRC staff also analyzed a hybrid wet/dry design. In analyzing the hybrid wet/dry alternative the NRC staff found a number of disadvantages of the dry cooling portion of the system, namely increased fuel use, spent fuel transport, spent fuel storage and land use as well as increased terrestrial impacts when compared to a wet cooling system. *Id.* at 9-27. Further, because the NRC staff found that the impacts from the proposed cooling system on aquatic resources were already small, the NRC staff found that a hybrid wet/dry system would not be environmentally preferable to the proposed wet tower system for VEGP. *Id.* For similar reasons, the NRC staff found that a dry cooling system was also not preferable. The basis for the NRC staff's conclusion regarding the dry cooling alternative is discussed in greater depth in our ruling on contested environmental matters. Ultimately, the NRC staff found that there was no preferable heat dissipation alternative to the proposed system. *Id.*

3.343. Based on the above, and taking into account our finding in the contested portion of this hearing, we find that the NRC staff's conclusions were reasonable and that the record is sufficient with respect to system design alternatives.

9.4 *Region of Interest and Alternative Site-Selection Process*

3.344. Applicants for an ESP must provide an evaluation of alternative sites to determine whether any obviously superior alternative exists to the site proposed. 10 C.F.R. § 52.17(a)(2). The NRC staff reviewed the Applicant's evaluation using the guidance in the ESRP. This section of the FEIS included a discussion of the Applicant's Region of Interest ("ROI") and its alternative site selection process. *Id.*

3.345. For its ROI, the Applicant selected its three-state service area, Alabama, Georgia and Mississippi. The Applicant's approach of designating its service area as its ROI is consistent with the ESRP. *Id.* at 9-28. Therefore, the NRC staff concluded that the Applicant's ROI was reasonable for consideration and analysis of potential ESP sites, and that the Applicant did not arbitrarily excluded desirable candidate ESP locations. *Id.*

3.346. In its site selection process, the Applicant determined that the advantages of co-locating new nuclear generating units with an existing power plant owned by the Applicant outweighed the potential advantages of other alternatives. *Id.* By using these criteria, the Applicant identified twelve potential sites with existing electric power generation facilities, and one greenfield site. *Id.* The Applicant then screened its thirteen potential sites to four candidate sites by eliminating existing plant sites with coal-fired power plants. *Id.* at 9-29. The remaining sites were Plant Farley, Plant Hatch and the VEGP site (all sites with existing nuclear units) and the Barton greenfield site. *Id.* Next, the Applicant performed an environmental analysis for each candidate site. The NRC staff reviewed the Applicant's methodology using the guidance provided in Section 9.3 of the ESRP. *Id.* In response to a written question from the Board, the NRC staff explained in more detail how it reviewed the Applicant's site selection process using

the guidance in the ESRP. Ex. NRC000057 at 45-47. In accordance with the guidance in the ESRP, the NRC staff found the Applicant's approach reasonable. Ex. NRC00001B at 9-28.

3.347. Based on the above, we find that the NRC staff's conclusions were reasonable and that the record is sufficient with respect to the Applicant's site selection process.

9.5 *Evaluation of Alternative Sites*

3.348. Section 9.5 of the FEIS examines the Applicant's three alternative sites in more detail: Plant Hatch, Plant Farley, and the Barton Greenfield site. The NRC staff visited each of these sites and, in accordance with Section 9.3 of the ESRP, collected and analyzed reconnaissance-level information. *Id.* at 9-30. In Section 9.6 of the FEIS, the NRC staff also analyzed environmental impacts that would not vary among sites; therefore, the NRC staff did not analyze these impacts individually for each site. *Id.* at 9-85. The impacts analyzed generically were some aspects of terrestrial impacts, some aspects of socioeconomics, non-radiological and radiological effects on member of the public, workforce, and biota, and postulated accidents. The NRC staff analyzed the following impacts either individually for each site or generically: (1) land-use impacts, (2) air quality, (3) water-related impacts, (4) ecological impacts, (5) socioeconomic impacts, (6) impacts to the community – social and economic, (7) impacts to the community – infrastructure and community, (8) public and social services and infrastructure, (9) historic and cultural resources, (10) environmental justice, (11) non-radiological health, and (12) radiological health.

3.349. The NRC staff's summary of the construction impacts of locating the Applicant's proposed nuclear units at each alternative site is contained in Table 9-7 of the FEIS. *Id.* at 9-93 to 9-94. The NRC staff's summary of the operational impacts is presented in Table 9-8 of the FEIS. *Id.* at 9-94 to 9-95. The NRC staff compared the alternate sites to the proposed site in Chapter 10 of the FEIS.

3.350. In addition to the ER and the FEIS, the Board has also considered presentations given by both the Applicant and NRC staff during the uncontested hearing, in which both parties described the alternatives analysis in more detail. Ex. NRC000062; Ex. SNC000076. Both the NRC staff and Applicant also responded to five questions posed by the Board regarding the analysis in Chapter 9. Ex. NRC000056; Ex. SNC000068. In response to those questions, the NRC staff explained why it used the Applicant's proposed output target value of 2234 MW(e) and the extent to which the analysis would be bounding for a smaller facility; why its choice of 60 MW for wind energy in the combination of alternatives analysis was reasonable; why cooling ponds and other similar options were not analyzed in more detail; the methodology the NRC staff used to determine that the Applicant's site selection process was reasonable; and why the NRC staff based its alternative sites analysis in part on the 7Q10 flows, the expected lowest average-daily flow for seven consecutive flows over a ten year period. Ex. NRC000057 at 39-49.

3.351. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the evaluation of alternative sites. FEIS Chapter 10, "Comparison of the Impacts of the Proposed Action and the Alternative Sites"

3.352. In Chapter 10, the NRC staff compared the proposed site with the alternative sites evaluated in Chapter 9. Consistent with NRC staff guidance in the ESRP, in order to determine if an obviously superior site had been identified, the NRC staff first considered whether the list of candidate sites included any environmentally preferred sites. The NRC staff found that the Applicant had reasonably identified candidate sites, evaluated the likely environmental impacts of construction and operation at those sites, and used a logical means of comparing sites that led to the Applicant's selection of the proposed site. *Id.* at 10-1 to 10-2.

3.353. Based on the NRC staff's independent review, the NRC staff compared the proposed site with the three alternative sites, noting that the impact levels for construction and

operation for most impact categories at the proposed and alternative sites is small. *Id.* at 10-4. The NRC staff determined that although there are some differences in the environmental impacts of construction and operation at the Vogtle site and the alternative sites, none of these differences was sufficient to determine that any of the alternative sites was environmentally preferable to the proposed site. *Id.* at 10-6. Accordingly, the NRC staff did not need to proceed to the second step of the process described in the NRC staff guidance, determining whether any environmentally preferable site was an obviously superior site. *Id.* at 10-7. In response to a written Board question, the NRC staff explained its independent review of the Applicant's alternative site analysis, including its visits to the proposed and alternative sites, consultation with Federal and State agencies, review of the Applicant's ER, literature reviews, consideration of EISs from the existing units at the Vogtle, Farley, and Hatch sites, issuance of RAIs to the Applicant, review of comments on the DEIS, and consideration of applicable NRC staff guidance. Ex. NRC000057 at 49-51. The NRC staff noted that based on its independent review, its impact characterizations sometimes differed from those of the Applicant. *Id.* at 50.

3.354. The NRC staff also compared the proposed action to the no-action alternative. The NRC staff acknowledged that were the ESP and LWA request denied, impacts of the NRC-approved construction activities would not occur, but also that denial of the application would prevent early resolution of safety and environmental issues for the site. Ex. NRC00001B at 10-7. The NRC staff also identified other paths that the Applicant could follow to satisfy its electric power generation needs, although those paths would have associated environmental impacts. *Id.* at 10-7 to 10-8.

3.355. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the comparison of the proposed site and the alternative sites.

FEIS Chapter 11, "Conclusions and Recommendations"

3.356. In Chapter 11 of the FEIS, the NRC staff presented its conclusions and recommendations concerning the environmental review of the Application. The NRC staff summarized the impacts of the proposed action and also described the extent to which there would be unavoidable environmental impacts if the proposal were implemented. The NRC staff summarized alternatives to the proposed action, including the no-action alternative, and addressed the relationship between short-term uses and long-term productivity of the human environment. Furthermore, the NRC staff described the extent to which there would be irreversible and irretrievable commitments of resources if the proposed action were undertaken.

3.357. The NRC staff then evaluated the benefit-cost balance of the proposed action. *Id.* at § 11.6. The NRC staff described societal benefits including price stability and longevity, energy security, and fuel diversity, as well as regional benefits such as tax revenues and benefits to regional productivity and community (infrastructure and employment). *Id.* at 11-12 to 11-14. The NRC staff identified costs, including internal costs to the Applicant associated with construction, operation, fuel, waste disposal, and decommissioning, and external costs such as the environmental and social costs described in Chapters 4 and 5 of the FEIS. *Id.* at 11-14 to 11-18. In response to a written Board question, the NRC staff explained its conclusion that the Applicant's estimates of overnight capital costs associated with construction of the proposed units were well within the range of other independent study estimates considered by the NRC staff. Ex. NRC000057 at 52-56. In that response, the NRC staff also explained that its analysis of the benefit-cost balance of the proposed Vogtle Units 3 and 4, presented in the Vogtle FEIS, is not affected by the Turkey Point cost estimates discussed in the Bellefonte COL proceeding. *Id.* The NRC staff concluded that on the basis of the assessments summarized in the FEIS, the construction and operation of the proposed units, with the mitigation measures identified by the NRC staff, would have accrued benefits that most likely would outweigh the economic,

environmental, and social costs associated with constructing and operating the new units at the site. Ex. NRC00001B at 11-19.

3.358. Accordingly, the NRC staff's recommendation related to the environmental aspects of the proposed action is that the ESP should be issued. *Id.* at 11-21. The NRC staff based its recommendation on the Applicant's ER, additional information provided by the Applicant, including in response to RAIs, consultation with Federal, State, Tribal, and local agencies, the NRC staff's own independent review, as well as its consideration of comments received during the public scoping and DEIS review, and the assessment provided in the FEIS. *Id.* at 11-21 to 11-22. The NRC staff also determined that there are no environmentally preferable or obviously superior sites. *Id.* at 11-22. Finally, the NRC staff concluded that the LWA activities described in the site redress plan would not result in any adverse significant impact that cannot be redressed. *Id.*

3.359. Based on the above, we find that the NRC staff had a reasonable basis for its conclusions, and that the record is sufficient with respect to the NRC staff's conclusion and recommendation regarding issuance of the ESP and LWA.

2. Licensing Board Findings on Environmental Matters

Based on the above, and pursuant to the Commission's notice of hearing, the Board finds the following with respect to the ESP:

3.360. The requirements of Section 102(2)(A), (C), and (E) of NEPA and subpart A of 10 C.F.R. Part 51 have been complied with in the proceeding;

3.361. The Board has independently considered the final balance among the conflicting factors contained in the record of the proceeding with a view to determining the appropriate action to be taken; and

3.362. The Board has determined, after considering reasonable alternatives, that the ESP should be issued and does not need to be conditioned to protect environmental values.

3.363. Therefore, the Board finds that in accordance with the requirements of subpart A of 10 C.F.R. Part 51, the ESP should be issued as proposed.

With respect to the LWA:

3.364. Based on the above considerations, the Board has determined that the requirements of Section 102(2)(A), (C), and (E) of NEPA and subpart A of 10 C.F.R. Part 51 have been met, with respect to the activities to be authorized;

3.365. The Board has independently considered the balance among the conflicting factors with respect to the activities to be authorized which is contained in the record of the proceeding, with a view to determining the appropriate action to be taken; and

3.366. The Board has determined that the redress plan submitted by the Applicant will adequately redress the activities to be authorized.

3.367. Accordingly, the Board finds that in accordance with the requirements of subpart A of 10 C.F.R. Part 51, the LWA should be authorized as proposed with the ESP.

Respectfully submitted,

/signed (electronically) by/

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Dated at Rockville, Maryland
This 22nd day of May, 2009

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of)
)
SOUTHERN NUCLEAR OPERATING CO.) Docket No. 52-011-ESP
)
(Early Site Permit for Vogtle ESP Site))

CERTIFICATE OF SERVICE

I hereby certify that copies of the "NRC STAFF'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW CONCERNING UNCONTESTED MATTERS" have been served upon the following persons by Electronic Information Exchange this 22nd day of May, 2009:

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