UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

LBP-09-07

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before the Licensing Board:

G. Paul Bollwerk, III, Chairman
Nicholas G. Trikouros
Dr. James F. Jackson

In the Matter of	Docket No. 52-011-ESP
SOUTHERN NUCLEAR OPERATING CO.	ASLBP No. 07-850-01-ESP-BD01
(Early Site Permit for Vogtle ESP Site)	June 22, 2009

FIRST PARTIAL INITIAL DECISION
(Contested Proceeding)

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I. INTRODUCTION

1.1 On August 15, 2006, Southern Nuclear Operating Company (SNC) filed an application with the Nuclear Regulatory Commission (NRC) for an early site permit (ESP) under 10 C.F.R. Part 52 for two additional reactors utilizing the Westinghouse Electric Company AP1000 certified design at the existing Vogtle Electric Generating Plant (VEGP) site near Waynesboro, Georgia. This Partial Initial Decision presents the Licensing Board's findings of fact and conclusions of law relative to three admitted environmental contentions (ECs) proffered by Joint Intervenors[1] -- EC 1.2, Environmental Report Fails to Identify and Consider Cooling System Impacts on Aquatic Resources; EC 1.3, Environmental Report Dry Cooling System Alternatives Discussion Fails to Address Aquatic Species Impacts; and EC 6.0, Final

[1] Joint Intervenors 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.

Environmental Impact Statement Fails to Provide Adequate Discussion of Impacts Associated with Dredging the Savannah River Federal Navigation Channel -- challenging the adequacy of the environmental report (ER) contained in the SNC ESP application and/or the draft or final environmental impact statement (DEIS or FEIS) prepared by the NRC staff.

1.2 For the reasons set forth below, in the face of Joint Intervenors challenges to the ER, DEIS, and FEIS as reflected in contentions EC 1.2, EC 1.3, and EC 6.0, the Board finds that the staff and/or SNC have carried their respective burdens of proof to demonstrate the adequacy of the ER, DEIS, and FEIS in accordance with 10 C.F.R. Part 51. The Board thus concludes that Joint Intervenors three contentions cannot be sustained and enters a ruling on the merits of each contention in favor of the staff and SNC.

II. PROCEDURAL BACKGROUND

A. Contentions EC 1.2 and EC 1.3

2.1 Following the August 2006 submission of SNC's Vogtle ESP application and in response to the Commission's October 5, 2006 notice of hearing and opportunity to petition for leave to intervene, 71 Fed. Reg. 60,195 (Oct. 12, 2006), on December 11, 2006, Joint Intervenors (then Joint Petitioners) filed a request for hearing and petition to intervene. See Petition for Intervention (Dec. 11, 2006) [hereinafter Intervention Petition]. Thereafter, on December 15, 2006, this Atomic Safety and Licensing Board was established to adjudicate the Vogtle ESP proceeding. See 71 Fed. Reg. 77,071 (Dec. 22, 2006).

2.2 In its December 18, 2006 initial prehearing order, among other things, the Board indicated that it would treat the three designated subparts of the first of Joint Intervenors contentions as three separate contentions. The Board also requested that Joint Intervenors designate each of their contentions as being in one or more of the following subject matter

categories: (1) Administrative, (2) Site Safety Analysis, (3) Environmental, (4) Site Redress, (5) Emergency Planning, or (6) Miscellaneous. See Licensing Board Memorandum and Order (Initial Prehearing Order) (Dec. 18, 2006) at 1-2 (unpublished). Joint Intervenors filed a supplemental pleading designating all of their then-seven contentions as environmental contentions.[2] See J[oi]nt Supplement to Petition for Intervention (Dec. 27, 2006).

2.3 As set forth in these initial pleadings, the second and third portions of Joint Intervenors original contention 1, re-designated as contentions EC 1.2 and EC 1.3 pursuant to the Board's initial prehearing order, read as follows:

> EC 1.2: The ER fails to identify and consider direct, indirect, and cumulative impacts of the proposed cooling system intake and discharge structures on aquatic resources.
>
> EC 1.3: The ER fails to satisfy 10 C.F.R. § 51.45(b)(3) because it fails to address impacts to aquatic species in its discussion of alternatives. In particular, the ER's discussion of the no-action alternative and of alternative cooling technologies fails to consider environmental and economic benefits of avoiding construction of the proposed cooling system.

LBP-07-3, 65 NRC 237, 258-59 (2007).

2.4 After a one-day prehearing conference held on February 13, 2007, in Waynesboro, Georgia, during which Joint Intervenors, SNC, and the staff presented oral argument concerning the admissibility of each of Joint Intervenors initially-proffered contentions, including National Environmental Policy Act (NEPA)-associated contentions EC 1.2 and EC 1.3 at issue here, the Board issued a March 12, 2007 memorandum and order ruling on Joint Intervenors standing and the admissibility of their contentions. See id. at 237. The Board concluded that each of the Joint Intervenors had established its standing, and admitted narrower versions of contentions EC 1.2 and EC 1.3 that specified the impacts relevant to

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[2] As will be discussed in section II.B infra, Joint Intervenors contention EC 6.0 was not one of Joint Intervenors initially proffered contentions.

EC 1.2, i.e., the impacts of the to-be-built intake/discharge structures for proposed Vogtle Units 3 and 4, as they relate to possible impingement/entrainment, chemical discharges, and thermal discharges, and omitted the portion of EC 1.3, as proffered by Joint Intervenors, that challenged the SNC discussion of the no-action alternative. As admitted, the contentions stated:

> ENVIRONMENTAL CONTENTION (EC) 1.2 - ER FAILS TO IDENTIFY AND CONSIDER COOLING SYSTEM IMPACTS ON AQUATIC RESOURCES
>
> The ER fails to identify and consider direct, indirect, and cumulative impingement/entrainment and chemical and thermal effluent discharge impacts of the proposed cooling system intake and discharge structures on aquatic resources.
>
> EC 1.3 - ER DRY COOLING SYSTEM ALTERNATIVES DISCUSSION FAILS TO ADDRESS AQUATIC SPECIES IMPACTS
>
> The ER fails to satisfy 10 C.F.R. § 51.45(b)(3) because its analysis of the dry cooling alternative is inadequate to address the appropriateness of a dry cooling system given the presence of extremely sensitive biological resources.

Id. at 280. Additionally, the Board noted that although contention EC 1.1 concerning the adequacy of the ER relative to aquatic baseline information was not admissible, litigation regarding the merits of contention EC 1.2 might involve "the question of the adequacy of the baseline information provided by SNC relative to the portion of the Savannah River that encompasses the project area associated with the intake/discharge structures for both the existing and proposed Vogtle facilities." Id. at 259.

2.5 In accord with an initial schedule established by the Board permitting the submission of summary disposition motions after both the issuance of the staff draft and final EISs, see Licensing Board Memorandum and Order (Prehearing Conference and Initial Scheduling Order) (May 5, 2007) app. A, at 1-2 (unpublished), with the September 10, 2007

issuance of the DEIS, SNC filed seeking summary disposition of EC 1.2 and EC 1.3 in its favor on the merits, a request that the staff endorsed. See LBP-08-2, 67 NRC 54, 61 (2008); LBP-08-3, 67 NRC 85, 92 (2008). Moreover, in the face of Joint Intervernors response asserting that summary disposition was inappropriate, SNC and the staff responded with motions to strike, in part, Joint Intervenors responses, on the grounds the responses sought improperly to expand the scope of the contentions. Joint Intervenors opposed these motions. See LBP-08-2, 67 NRC at 62; LBP-08-3, 67 NRC at 93.

2.6 On January 15, 2008, the Board issued separate decisions regarding each of the summary disposition motions. In ruling on the motions, the Board found that the contentions at issue, which had not been amended following the DEIS, were contentions of inadequacy rather than omission, so that Joint Intervenors failure to amend their contentions was not dispositive of the issue. See LBP-08-2, 67 NRC at 63-65; LBP-08-3, 67 NRC at 94-96. Additionally, the Board found that the motions to strike were really mislabeled reply pleadings regarding the scope of the contentions that the applicant and the staff should have sought leave to file. The Board indicated, however, that it would consider whether the information provided by the parties was within the scope of EC 1.2 and EC 1.3 as part of its consideration of the SNC dispositive motions. See LBP-08-2, 67 NRC at 66-67; LBP-08-3, 67 NRC at 96-98.

2.7 With regard to contention EC 1.2, the Board was called upon to assess whether a genuine issue as to any material fact still existed on the subjects of (1) the adequacy of the aquatic baseline discussion in the vicinity of the Vogtle facility; (2) impingement and entrainment impacts; (3) thermal impacts; and (4) chemical impacts. Although the Board had rejected EC 1.1, which asserted that the baseline aquatic population for the area around the Vogtle facility had not been adequately assessed because of a lack of site-specific field studies or data, it also noted that the scope of the baseline for a particular project is a functional concept and

could, in the context of the purported deficiencies in the environmental impact analysis associated with contention EC 1.2, be litigated in the proceeding relative to the portion of the Savannah River that encompasses both the existing and proposed Vogtle facilities. See LBP-08-2, 67 NRC at 68-69. In connection with the summary disposition request, applicant SNC and the staff both asserted that the DEIS provided information on aquatic species that was sufficient to address any concern that the SNC ER discussion of the baseline aquatic environment was inadequate. See id. at 69-70. The Board concluded that Joint Intervenors, via the affidavit of Dr. Shawn Young, had established that there was still a dispute as to genuine issues of material fact regarding the adequacy of the baseline information relating to cooling system impacts. See id. at 71-73.

2.8 SNC and the staff also claimed that the DEIS analysis of impingement/entrainment was adequate to address concerns about the potential impacts, including minimum expected river water flow conditions, while Joint Intervenors declared this was inadequate as evidenced by the staff's use of a uniform drift distribution assumption in evaluating fish eggs and larval fish, the checking of screening baskets only several times a year, and the failure to include water withdrawals by current and projected future upstream sites relative to the flow of the river. See id. at 73-75. The Board found that material factual disputes still existed relative to larval fish mobility, screen basket cleanings, and the appropriate minimum river level flow figures. See id. at 76-77. The Board also found, however, that it would not consider further the issue raised by Joint Intervenors regarding the impacts of cumulative withdrawals other than those relating to the existing and proposed Vogtle facilities. See id. at 78.

2.9 Regarding thermal impacts, SNC and the staff claimed that the DEIS analysis was adequate to the degree it made conservative assumptions about river flow conditions and

provided a cumulative impact analysis that combined the existing and proposed thermal plumes. See id. at 79-80. Joint Intervenors disagreed, citing concerns about minimal river flow numbers, higher facility maximum withdrawals, and use of the uniform drift distribution assumption. See id. at 80. The Board found that genuine factual disputes regarding water flow rates and the use of the uniform drift distribution assumption existed such that summary disposition was inappropriate. See id. With regard to chemical impacts, however, Joint Intervenors having conceded that the DEIS discussion of the impact of chemicals on aquatic life was adequate, the Board granted the SNC motion and dismissed this aspect of the contention as moot. See id. at 81-82.

2.10 Concerning contention EC 1.3, in denying SNC's summary disposition motion, the Board found that a number of disputed material factual issues remained, including

> the type of turbines that can be used; the adequacy of current dry cooling system design for use in facilities like the proposed Vogtle plants; the impact of the climate in the vicinity of the VEGP on the efficacy of wet and dry system cooling; and the potential financial, environmental, and/or performance impacts upon facility design, construction, and/or operation of using a dry rather than a wet cooling system.

LBP-08-3, 67 NRC at 101. Additionally, the Board rejected as outside the scope of contention EC 1.3 Joint Intervenors claims regarding a wet-dry hybrid cooling system alternative, which the Board found they first raised in response to the summary disposition motion. See id. at 102-03.

2.11 Subsequently, in August 2008, the staff issued its FEIS. Although the Board's July 2008 revised general schedule provided for submission of another summary disposition motion regarding any admitted contentions following issuance of the FEIS, see Licensing Board Memorandum and Order (Revised General Schedule) (July 14, 2008) app. A, at 3 n.2 (unpublished) [hereinafter July 14, 2008 Scheduling Order], none of the parties chose to file such a motion.

B. Contention EC 6.0

2.12 Pursuant to the Board's July 2008 revised general schedule that also permitted new contentions to be filed after issuance of the staff's FEIS, see July 14, 2008 Scheduling Order app. A, at 2, on September 23, 2008, Joint Intervenors filed a motion to admit a new contention,[3] see Joint Intervenors' Motion to Admit New Contention (Sept. 23, 2008). The new contention, EC 6.0, read as follows:

> The discussion of potential impacts associated with dredging and use of the Savannah River Federal navigation channel is inadequate and fails to comply with NEPA because it relies on the Army Corps of Engineers (the "Corps") to analyze these impacts in the future. As a result, the staff's conclusion that impacts would be moderate runs counter to the evidence in the hearing record. Additionally, the FEIS wholly fails to address impacts of navigation on the Corps' upstream reservoir operations, an important aspect of the problem.

See Licensing Board Memorandum and Order (Ruling on Motion to Admit New Contention) (Oct. 24, 2008) at 3 (unpublished). Additionally, the motion contained eight items of foundational support for the contention:

1. The FEIS contains substantially different data and conclusions from the SNC ER or the staff's DEIS.

2. Using the federal navigation channel to barge components to the VEGP site is necessary for construction of Units 3 and 4.

3. Environmental impacts stemming from the use of the federal navigation channel are direct impacts of the proposed construction of Units 3 and 4 that must be addressed in the FEIS.

4. The staff's conclusion, as set forth in the "Cumulative Impacts" chapter of the FEIS, that the large-scale dredging from Savannah Harbor to the VEGP site could have moderate impacts is inadequately supported.

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[3] The deadline provided in the July 2008 revised general schedule was actually September 22, but due to technical difficulties later excused by the Board, Joint Intervenors did not successfully file their motion until September 23. See Licensing Board Memorandum and Order (Ruling on Motion to Admit New Contention) (Oct. 24, 2008) at 4, 8-9 (unpublished).

5. Dredging the federal navigation channel has potentially significant impacts on the environment.

6. The staff abdicated its duty independently to assess potential impacts of dredging in the FEIS.

7. Navigation requires release of significant amounts of water from upstream reservoirs, which is not addressed in the FEIS.

8. The NRC staff failed to consult with the United States Army Corps of Engineers (USACE), as required by NEPA.

See id. at 3-4.

2.13 In an October 24, 2008 memorandum and order, the Board admitted contention EC 6.0 as supported by foundational support items 4, 5, and 7. See id. at 16-17. The contention as admitted states:

> EC 6.0 - FINAL ENVIRONMENTAL IMPACT STATEMENT (FEIS) FAILS TO PROVIDE ADEQUATE DISCUSSION OF IMPACTS ASSOCIATED WITH DREDGING THE SAVANNAH RIVER FEDERAL NAVIGATION CHANNEL
>
> Because Army Corps of Engineers (Corps) dredging of the Savannah River Federal navigation channel has potentially significant impacts on the environment, the NRC staff's conclusion, as set forth in the "Cumulative Impacts" chapter of the FEIS, that such impacts would be moderate is inadequately supported. Additionally, the FEIS fails to address adequately the impacts of the Corps' upstream reservoir operations as they support navigation, an important aspect of the problem.

Id. at 20.

C. Evidentiary Hearing on Contentions EC 1.2, EC 1.3, and EC 6.0

2.14 Thereafter, in preparation for the 10 C.F.R. Part 2, Subpart L informal evidentiary hearing on these three environmental contentions, Joint Intervenors, SNC, and the staff filed initial position statements and prefiled direct testimony on January 9, 2009. In response to Joint Intervenors prefiled direct testimony, SNC and the staff filed motions in limine seeking to strike parts of the prefiled testimony of certain witnesses and associated exhibits. See Licensing

Board Memorandum and Order (Ruling on In Limine Motions) (Jan. 26, 2009) (unpublished). The Board granted the in limine motions in part and struck portions of Joint Intervenors prefiled direct testimony and exhibits as being outside the scope of the contentions as admitted. See id. at 2-7.

2.15 On February 6, 2009, the parties filed their response statements and prefiled rebuttal testimony regarding the three contentions. On February 11, 2009, SNC and the staff filed in limine motions seeking to exclude portions of Joint Intervenors prefiled rebuttal testimony and associated exhibits. See Licensing Board Memorandum and Order (Ruling on In Limine Motions) (Feb. 23, 2009) (unpublished). The Board ruled on this second round of in limine motions in a February 23, 2009 memorandum and order, striking certain portions of Joint Intervenors rebuttal testimony and exhibits, but declining to strike portions of the EC 1.3 testimony concerning North Anna Unit 3 (a proposed wet-dry hybrid nuclear unit cooling system) to the extent it was used to support Joint Intervenors claim that dry cooling is feasible, as well as declining to strike portions of the EC 6.0 testimony concerning dredge spoil disposal. See id. at 3-6. In accordance with the Board's rulings on the motions in limine, Board administrative directives for the hearing, and on the parties' own initiative, the parties submitted revised testimony and both revised and new exhibits. See, e.g., NRC Staff Resubmission of Prefiled Direct Testimony and Corrected Exhibit NRC000009 (Feb. 2, 2009); Joint Intervenors' Re-revised Initial Position Statement, Pre-filed Direct Testimony, Exhibits and Exhibit List (Feb. 13, 2009); Notice of Revised Testimony and Exhibit (Mar. 6, 2009); [SNC] Submission of Revised Testimony and Exhibits (Mar. 11, 2009). The final versions of the parties' pre-filed testimony were bound into the transcript as if read. See, e.g., Tr. at 577, 610-11.

2.16 Finally, in accordance with a March 6, 2009 memorandum and order in which the Board instructed the parties to file any remaining corrections to prefiled testimony and exhibits

no later than March 11, 2009, see Licensing Board Memorandum and Order (Additional Matters Related to Contested and Mandatory Hearings) (Mar. 6, 2009) at 1-2 (unpublished), on March 11, 2009, SNC filed revised versions of the testimony of two of its witnesses as well as a number of exhibits. See [SNC]'s Submission of Revised Testimony and Exhibits (Mar. 11, 2009). However, additional revisions to testimony and exhibits were made shortly before and during the evidentiary hearing. See Tr. at 633.

2.17 Pursuant to the general schedule set forth in a November 13, 2008 memorandum and order, see Licensing Board Memorandum and Order (Revised General Schedule) (Nov. 13, 2008) (unpublished), on March 16-19, 2009, the Board held evidentiary hearings in Augusta, Georgia, on contentions EC 1.2, EC 1.3, and EC 6.0. See Tr. at 506-1660. Subsequent to the hearing, in a March 30, 2009 memorandum and order, the Board granted an unopposed motion by SNC to admit a new exhibit, SNC000098, that had been identified for the record at the evidentiary hearing but had not been entered into evidence. See Licensing Board Memorandum and Order (Post-Hearing Administrative Items) (Mar. 30, 2009) at 1 (unpublished). Additionally, in an April 8, 2009 memorandum and order adopting certain corrections to the March 2009 hearing transcripts, the Board closed the evidentiary record for the contested portion of this proceeding as of that date. See Licensing Board Memorandum and Order (Transcript Corrections; Closing the Record of Contested Proceeding) (Apr. 8, 2009) at 1–2 (unpublished).

2.18 Pursuant to 10 C.F.R. § 2.1209 and the general schedule set forth in Appendix A to the Board's November 13 order, on April 24, 2009, Joint Intervenors, SNC, and the staff filed with the Board their proposed findings of fact and conclusions of law regarding those environmental contentions. See Joint Intervenor's Proposed Findings of Fact and Conclusions of Law (Apr. 24, 2009) [hereinafter Joint Intervenor Proposed Findings]; [SNC] Proposed

Findings of Fact and Conclusions of Law Regarding Environmental Contentions (Apr. 24, 2009) [hereinafter SNC Proposed Findings]; NRC Staff's Proposed Findings of Fact and Conclusions of Law Concerning Contested Environmental Matters (Apr. 24, 2009) [hereinafter Staff Proposed Findings]. Each party similarly filed reply findings of fact and conclusions of law on May 8, 2009. See Joint Intervenors' Reply to NRC Staff's and [SNC] Proposed Findings of Fact and Conclusions of Law Concerning Contested Matters (May 8, 2009) [hereinafter Joint Intervenors Reply Findings]; [SNC] Reply Findings of Fact and Conclusions of Law Regarding Environmental Contentions (May 8, 2009) [hereinafter SNC Reply Findings]; NRC Staff's Reply Findings of Fact and Conclusions of Law Concerning Contested Environmental Matters (May 8, 2009) [hereinafter Staff Reply Findings].

III. APPLICABLE LEGAL STANDARDS

3.1 The contentions at issue here -- EC 1.2, EC 1.3, and EC 6.0 -- arise under the National Environmental Policy Act of 1969 and the NRC regulations implementing the agency's responsibilities pursuant to the Act. See 42 U.S.C. § 4321 et seq.; 10 C.F.R. Part 51. Together, this statute and the corresponding agency regulations govern the applicant's and the staff's roles in considering the environmental effects of a proposed ESP licensing action under 10 C.F.R. Part 52, Subpart A. Additionally, the Council on Environmental Quality (CEQ) has implemented regulations that provide guidance on agency compliance with NEPA, see 40 C.F.R. Part 1500, that, while not binding on the NRC when the agency has not expressly adopted them, are entitled to considerable deference. See Limerick Ecology Action, Inc. v. NRC, 869 F.2d 719, 725, 743 (3d Cir. 1989).

A. NEPA Requirements

3.2 NEPA requires federal agencies to take a "hard look" at the environmental impacts of a proposed action, as well as reasonable alternatives to that action. See Louisiana Energy Servs., L.P. (Claiborne Enrichment Center), CLI-98-3, 47 NRC 77, 87-88 (1998). This "hard look" is, however, subject to a "rule of reason" in that consideration of environmental impacts need not address every impact that could possibly result, but rather only those that are reasonably foreseeable or have some likelihood of occurring. See, e.g., Long Island Lighting Co. (Shoreham Nuclear Power Station, Unit 1), ALAB-156, 6 AEC 831, 836 (1973). Agencies are given broad discretion in determining how thoroughly to analyze a particular subject, see Claiborne, CLI-98-3, 47 NRC at 103, and may decline to examine issues the agency in good faith considers "remote and speculative" or "inconsequentially small," Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), ALAB-919, 30 NRC 29, 44 (1989) (citing Limerick Ecology Action, 869 F.2d at 739). To that end, when reviewing a license application filed by a private applicant, as opposed to a federally-sponsored project, an agency may give substantial weight to the stated preferences of the applicant with regard to issues such as site selection and facility design. See Claiborne, CLI-98-3, 47 NRC at 104; Hydro Resources, Inc. (P.O. Box 15910, Rio Rancho, NM 87174), CLI-01-4, 53 NRC 31, 55 (2001).

3.3 Additionally, CEQ regulations state that an EIS must address both direct and indirect effects of an action. See 40 C.F.R. §§ 1502.16, 1508.8. Direct effects are those caused by the federal action, and occurring at the same time and place as that action, while indirect effects are those caused by the action at a later time or more distant place, yet are still reasonably foreseeable. See id. § 1508.8. But if effects are remote or speculative, the EIS need not discuss them. See Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519, 551 (1978).

3.4 Finally, in the context of an NRC adjudicatory proceeding, even if an EIS prepared by the staff is found to be inadequate in certain respects, the Board's findings, as well as the adjudicatory record, "become, in effect, part of the FEIS." Hydro Resources, CLI-01-4, 53 NRC at 53. Thus, the Board's ultimate NEPA judgments can be made on the basis of the entire adjudicatory record in addition to the staff's FEIS. See Louisiana Energy Servs., L.P., LBP-05-13, 61 NRC 385, 404 (2005), aff'd, CLI-06-22, 64 NRC 37 (2006), petition for review denied sub nom., Nuclear Infor. & Res. Serv. v. NRC, 509 F.3d 562 (D.C. Cir. 2007).

B. 10 C.F.R. Part 51 Requirements

3.5 Under the NRC's Part 51 regulations, an applicant for an early site permit must submit with its application an ER. See 10 C.F.R. § 51.50(b). The ER must "contain a description of the proposed action, a statement of its purposes, [and] a description of the environment affected," id. at § 51.45(b), and it must discuss:

> (1) The impact[s] of the proposed action on the environment . . . in proportion to their significance;
> (2) Any adverse environmental effects which cannot be avoided should the proposal be implemented;
> (3) Alternatives to the proposed action . . . ;
> (4) The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity; and
> (5) Any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Id. § 51.45(b)(1)-(5).

3.6 Relative to item 3 above, NEPA requires an agency to provide a detailed statement of reasonable alternatives to a proposed action. 42 U.S.C. § 4332(2)(C)(iii); see also Claiborne, CLI-98-3, 47 NRC at 104. The alternatives discussion, however, need not include "every possible alternative, but every reasonable alternative." Long Island Lighting Co. (Shoreham Nuclear Power Station, Unit 1), CLI-91-2, 33 NRC 61, 71 (1999). Reasonable

alternatives do not include alternatives that are "impractical[;] . . . that present unique problems; or that cause extraordinary costs." Private Fuel Storage, LLC (Independent Spent Fuel Storage Installation), LBP-03-30, 58 NRC 454, 479 (2003) (citing Airport Neighbors Alliance v. United States, 90 F.3d 426, 432 (10th Cir. 1996), Communities, Inc. v. Busey, 956 F.2d 619, 627 (6th Cir. 1992)). Alternatives that need not be considered include those that are technologically unproven, see Kelley v. Selin, 42 F.3d 1501, 1521 (6th Cir.) (upholding NRC decision not to consider additional alternative spent fuel storage technologies that were "neither sufficiently demonstrated nor practicable for use" for the application in question), cert. denied, 515 U.S. 1159 (1995); NRDC v. Morton, 458 F.2d 827, 837 (D.C. Cir. 1972) (approving exclusion from alternatives discussion of alternative energy sources that "will be dependent on [future] environmental safeguards and [technological] developments"); Busey, 956 F.2d at 627 (upholding rejection of alternatives that "presented severe engineering requirements" or were "imprudent for reasons including their high cost, safety hazards, [and] operational difficulties").

3.7 The agency's NEPA regulations also require that the NRC staff prepare an environmental impact statement in connection with the issuance of an ESP. See 10 C.F.R. § 51.20(b)(1). The staff must first prepare a DEIS, see id. § 51.70, which addresses, among other topics, "the matters specified in [section] 51.45." Id. § 51.71(a). Though the DEIS may rely in part on the ER, the regulations require the staff to "independently evaluate and be responsible for the reliability of all information used in the [DEIS]." Id. § 51.70(b). The DEIS is then distributed for public comment and, based on the comments received, a review of information provided by the applicant, and supplemental independent information and analysis, the staff prepares and issues an FEIS. See id. §§ 51.73, 51.91.

3.8 When the staff makes its conclusions in the DEIS and FEIS regarding the environmental impacts of a proposed action or alternative actions, the staff uses as guidance a

standard scheme to categorize or quantify the impacts. See, e.g., 10 C.F.R. Part 51, app. B, Table B-1 n.3. This standard was created using the approach outlined in section 1508.27 of the CEQ regulations, which requires agencies to consider both the context and intensity of impacts. See 40 C.F.R. § 1508.27. The NRC has established three levels of impacts -- SMALL, MODERATE, and LARGE -- that are defined as follows:

> SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE - Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> LARGE - Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

See Exh. NRC00001A, at 1-4 ([NRO, NRC], NUREG-1872, [FEIS for an [ESP] at the Vogtle Electric Generating Plant Site (Aug. 2008) (Sections 1.0-4.0)) [hereinafter FEIS 1A]; see also Exh. NRC000010, at 4.7-1 (Office of Nuclear Regulatory Research, NRC, NUREG-1555, Environmental Standard Review Plan (2007)) (stating with regard to cumulative impacts that "[t]he information should include a characterization of cumulative impacts using NRC's SMALL, MODERATE, LARGE terminology (see the Introduction)") [hereinafter 2007 ESRP].

3.9 In addition, although the staff is generally required independently to evaluate and substantiate all information contained in the DEIS, an agency may rely on an EIS prepared by another federal agency if such reliance will aid in the presentation of issues, eliminate repetition, or reduce the length of an EIS. See 10 C.F.R. Part 51, app. A, § 1(b). This principle may extend to conclusions by other agencies set forth in other contexts in which they have analyzed an issue extensively. See New England Coalition on Nuclear Pollution v. NRC, 582 F.2d 87, 98 (1st Cir. 1978) (NRC can accept as conclusive Environmental Protection Agency (EPA) adjudicatory findings concerning thermal discharge aquatic impacts). Thus, the staff is able to

adopt the underlying scientific data and inferences from the other agency's analysis without independent review, so long as it exercises independent judgment with respect to conclusions about the environmental impacts of the current proposed agency action. See id.; Philadelphia Elec. Co. (Limerick Generating Station, Units 1 and 2), LBP-82-43A, 15 NRC 1423, 1467-68 (1982).

3.10 Finally, in the context of licensing board adjudication of NEPA-related contentions, intervenors are required to file contentions in the first instance based on the applicant's ER. See 10 C.F.R. § 2.309(f)(2). Where, however, as is the case here, the staff has prepared a DEIS or FEIS by the time the contentions come before a licensing board on the merits, such contentions are appropriately treated as challenges to the EIS. See Claiborne, CLI-98-3, 47 NRC at 84 (approving Board decision to treat intervenor contentions addressing ER as challenges to FEIS).

C. Burden of Proof in NEPA Context

3.11 Although, as the proponent of the agency action at issue, an applicant generally has the burden of proof in a licensing proceeding, see 10 C.F.R. § 2.325, when NEPA contentions are involved, the burden shifts to the staff, because the NRC, not an applicant, has the burden of complying with NEPA. See, e.g., Duke Power Co. (Catawba Nuclear Station, Units 1 and 2), CLI-83-19, 17 NRC 1041, 1049 (1983). Nonetheless, because "the Staff, as a practical matter, relies heavily upon the Applicant's ER in preparing the EIS, should the Applicant become a proponent of a particular challenged position set forth in the EIS, the Applicant, as such a proponent, also has the burden on that matter." Louisiana Energy Servs., L.P. (Claiborne Enrichment Center), LBP-96-25, 44 NRC 331, 339 (1996) (citing Pub. Serv. Co. of New Hampshire (Seabrook Station, Units 1 and 2), ALAB-471, 7 NRC 477, 489 n.8 (1978)), rev'd on other grounds, CLI-97-15, 46 NRC 294 (1997).

IV. FACTUAL FINDINGS AND LEGAL CONCLUSIONS

A. Contention EC 1.2

1. Witnesses and Evidence Presented

4.1 SNC, the staff, and Joint Intervenors each presented witnesses in connection with EC 1.2 during the March 2009 evidentiary hearing in support of their respective positions on the adequacy of the FEIS discussion and analysis of the direct, indirect, and cumulative impingement/entrainment and thermal effluent discharge impacts of the proposed Vogtle Units 3 and 4 cooling system intake and discharge structures on aquatic resources. Each of these witnesses presented written direct and rebuttal testimony, with supporting exhibits, and gave oral testimony at the evidentiary hearing. See Tr. at 582-947; see also [SNC] Testimony of Anthony Dodd and Matt Montz Concerning EC 1.2 (fol. Tr. at 587) [hereinafter Dodd/Montz EC 1.2 Direct Testimony]; [SNC] Rebuttal Testimony of Tony Dodd and Matt Montz Concerning EC 1.2 (fol. Tr. at 589) [hereinafter Dodd/Montz EC 1.2 Rebuttal Testimony]; [SNC] Testimony of Dr. Charles Coutant Concerning EC 1.2 (fol. Tr. at 604) [hereinafter Coutant EC 1.2 Direct Testimony]; [SNC] Rebuttal Testimony of Dr. Charles C. Coutant on [EC] 1.2 (fol. Tr. at 605) [hereinafter Coutant EC 1.2 Rebuttal Testimony]; [SNC] Testimony of Thomas Moorer Concerning EC 1.2 (fol Tr. at 610) [hereinafter Moorer EC 1.2 Direct Testimony]; [SNC] Rebuttal Testimony of Tom Moorer Concerning EC 1.2 (fol. Tr. at 612) [hereinafter Moorer EC 1.2 Rebuttal Testimony]; NRC Staff 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 (fol. Tr. at 743) [hereinafter Staff EC 1.2 Direct Testimony]; 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 (fol Tr.

at 744) [hereinafter Staff EC 1.2 Rebuttal Testimony]; Re-revised Pre-filed Direct Testimony of Shawn P. Young in Support of EC 1.2 (fol. Tr. at 814) [hereinafter Young EC 1.2 Direct Testimony]; Revised Prefiled Rebuttal Testimony of Dr. Shawn Young Concerning Contention EC 1.2 (fol. Tr. at 815) [hereinafter Young EC 1.2 Rebuttal Testimony]; Revised Prefiled Direct Testimony of Barry W. Sulkin in Support of EC 1.2 (fol. Tr. at 816) [hereinafter Sulkin EC 1.2 Direct Testimony]; Revised Prefiled Rebuttal Testimony of Barry W. Sulkin Concerning Contention EC 1.2 (fol. Tr. at 817) [hereinafter Sulkin EC 1.2 Rebuttal Testimony].

a. SNC

4.2 For its part, SNC presented four witnesses regarding EC 1.2: (1) Anthony R. Dodd, Georgia Power Company Environmental Specialist; (2) Matthew T. Montz, SNC Environmental Specialist, (3) Dr. Charles C. Coutant, a private consultant to SNC on aquatic ecology and fisheries biology matters; and (4) Thomas C. Moorer, SNC Project Manager-Environmental. See Tr. at 583-738.

4.3 Mr. Dodd received a Bachelor of Science degree in Marine Biology from Troy University and has over twenty-five years of experience in the environmental field, specializing in aquatic biology. Prior to joining Georgia Power Company, he worked for seven years as a Senior Biologist for Geosyntec Consultants, Inc., during which he conducted and supervised fisheries-related investigations in freshwater and estuarine environments throughout various parts of the southeastern United States. Mr. Dodd is a licensed state and federal permit holder for the collection of protected freshwater fish species, and has experience in fish collection methodologies, including hydroacoustics sampling, species identification, and quality control

and quality assurance measures. See Dodd/Montz EC 1.2 Direct Testimony at 2; Exh. SNC000002 (Anthony R. Dodd Curriculum Vitae (CV)).[4]

4.4 Mr. Montz earned a Bachelor of Science degree in Biology and a Master of Science degree in Environmental Management from Samford University. He has over twelve years of experience in the field of environmental biology. Prior to joining SNC, Mr. Montz worked for seven years as an environmental specialist for Southern Company Services, Earth Science and Environmental Engineering, managing aquatic environmental monitoring programs and working in the areas of water chemistry, benthic macro invertebrate studies, and effluent toxicity testing. He also has conducted assessments of water quality conditions of southern estuaries and rivers to determine the impacts associated with the withdrawal and discharge of cooling water at seven electric generating facilities in Mississippi and Florida, and has participated in field collection of air, water, and soil samples, as well as the evaluation of those samples for possible environmental impacts. See Dodd/Montz EC 1.2 Direct Testimony at 3; Exh. SNC000003 (Matthew T. Montz CV).

4.5 Dr. Coutant obtained undergraduate and Master's degrees in biology, as well as a Ph.D. in biology (with a focus on ecology), from Lehigh University. He is a retired Distinguished Research Staff Member of the Oak Ridge National Laboratory, where his

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[4] As entered into the record and reflected in the agency's ADAMS-associated electronic hearing docket, the official exhibit number for each evidentiary item reflects a three-alpha character identifier (i.e, SNC, NRC, JTI), followed by six alpha and/or numeric characters to reflect its number and whether it was revised subsequent to its original submission as a prefiled exhibit (e.g., admitted exhibit SNCR00005 is a revised version of prefiled exhibit SNC000005); followed by a two-character alpha or numeric identifier that will be used in this case to distinguish between an exhibit utilized in the contested portion of this proceeding (i.e., 00) as opposed to the mandatory/uncontested portion of the proceed (i.e. MA); followed by the designation BD01, which indicates that this Licensing Board (i.e., BD01) was involved in its identification and/or admission. Accordingly, the official designation for this exhibit is SNC000002-00-BD01. For the sake of simplicity, however, we will refer to all exhibits admitted in the contested portion of this proceeding by their initial nine character designation only.

activities included conducting research on thermal effects and entrainment and impingement effects on aquatic life, preparing NEPA EISs for nuclear power plants, and serving on task forces to develop biological criteria for environmentally benign siting, design, and operation of power station cooling-water facilities. Dr. Coutant currently serves as a private consultant in the areas of aquatic ecology and fisheries biology. See Coutant EC 1.2 Direct Testimony at 1-4; Exh. SNC000012 (Dr. Charles C. Coutant CV).

4.6 Mr. Moorer has a Bachelor of Science degree in Environmental Science from Auburn University and a Bachelor of Science degree in Civil/Environmental Engineering from the University of Alabama. He has over thirty years experience in utility environmental management, including over eighteen years in the nuclear area and fifteen years experience regarding NEPA matters. As Project Manager-Environmental for SNC, Mr. Moorer was responsible for developing the ER and all supporting activities for SNC's ESP application for Vogtle Units 3 and 4. See Moorer EC 1.2 Direct Testimony at 1-2; Exh. SNC000014 (Thomas C. Moorer CV).

b. NRC Staff

4.7 The NRC staff presented five witnesses in support of its position regarding EC 1.2: (1) Dr. Michael T. Masnik, Senior Aquatic Biologist in the NRC's Division of Site and Environmental Reviews/NRC Office of New Reactors (DSER/NRO/NRC); (2) Anne R. Kuntzleman, DSER/NRO/NRC Aquatic Biologist; (3) Rebekah H. Krieg, Senior Research Scientist, Ecology Group, Environmental Sustainability Division/Energy and Environment Directorate of the Pacific Northwest National Laboratory ((ESD/EED/PNNL); (4) Dr. Christopher B. Cook, Senior Hydrologist, DSER/NRO/NRC; and (5) Lance W. Vail, Senior Research Engineer in the Hydrology Group, ESD/EED/PNNL. See Tr. at 738-810.

4.8 Dr. Masnik has a Bachelor of Science degree in Conservation from Cornell University and a Master of Science degree and Ph.D. in Zoology from Virginia Polytechnic Institute and State University. He has over thirty years of experience with NRC and its predecessor, the Atomic Energy Commission, in the environmental aspects of nuclear power plant operation and decommissioning, including participating in NEPA reviews for the construction and operation of new reactors. His specialty early in his agency tenure was in evaluating the impacts of cooling water system designs and intake structures on fish and shellfish. As a NRO Senior Aquatic Biologist, Dr. Masnik was the lead technical reviewer for the NRC on aquatic resource issues associated with the Vogtle ESP application. See Staff EC 1.2 Direct Testimony at 1 & unnumbered attach. 3 (Michael T. Masnik Statement of Professional Qualifications (SPQ)).

4.9 Ms. Kuntzleman received a Bachelor of Science degree in Biology from Pennsylvania State University, a Master of Science degree in Education from Temple University, and a Master of Science in Biology from the University of Michigan. Her professional experience includes more than ten years as an aquatic ecologist for environmental consulting firms, and more than eighteen years as a senior biologist with the Department of the Navy, Engineering Field Activity Northeast (EFANE). She was an NRC technical reviewer for the aquatic and terrestrial resources issues associated with the SNC ESP application for Vogtle Units 3 and 4 and provided technical oversight to the PNNL reviewers during the preparation of FEIS sections 2.7.2 (Aquatic Ecology), 4.4 (Ecological Impacts from Construction), 5.4 (Ecological Impacts from Operation), and 7.5 (Cumulative Impacts - Aquatic Ecosystem). See Staff EC 1.2 Direct Testimony at 1, 3 & unnumbered attach. 1 (Anne R. Kuntzleman SPQ).

4.10 Ms. Krieg has a Bachelor of Science degree in Biology from Washington State University and a Master of Science in Fisheries and Oceanographic Sciences from the

University of Washington. At PNNL, she has been involved in technical reviews of the environmental aspects of new nuclear plant applications and license renewals. Ms. Krieg, who was a technical reviewer for PNNL's contract with NRC on aquatic resource issues associated with the Vogtle ESP application, prepared the descriptive information contained in FEIS section 2.7.2 and performed the review of the impact to aquatic organisms due to interactions with the proposed station intake and discharge structures as presented in FEIS sections 4.4.2 (Aquatic Impacts), 5.4, and 7.5. See Staff EC 1.2 Direct Testimony at 2-3 & unnumbered attach. 4 (Rebekah H. Krieg Resume).

4.11 Dr. Cook has a Bachelor of Science in Civil Engineering from Colorado State University and a Master of Science and Ph.D. in Civil and Environmental Engineering from the University of California at Davis. His experience over the past two years at NRC and for seven years at PNNL includes conducting hydrologic safety and environmental reviews for new plant applications. As a Senior Research Engineer at PNNL, Dr. Cook was the lead technical reviewer for PNNL's contract with the NRC on hydrological alterations, water use, and water quality issues associated with the DEIS for the Vogtle ESP application. Likewise, while at NRC he has been a technical reviewer on these same issues relative to the Vogtle ESP. See Staff EC 1.2 Direct Testimony at 2-3 & unnumbered attach. 5 (Dr. Christopher B. Cook SPQ).

4.12 Mr. Vail obtained a Bachelor of Science in Environmental Resources Engineering from Humboldt State University and a Master of Science in Civil Engineering from Montana State University. He has done research in a number of areas related to water resources and is currently involved in water-related safety and environmental reviews for nuclear power plant ESPs. As a Senior Research Engineer at PNNL, Mr. Vail was a technical reviewer for PNNL's contract with NRC on hydrological alterations, water use, and water quality issues associated

with the Vogtle ESP application. See Staff EC 1.2 Direct Testimony at 2, 4 & unnumbered attach. 2 (Lance W. Vail SPQ).

c. Joint Intervenors

4.13 Finally, in connection with EC 1.2, Joint Intervenors provided the testimony of two witnesses: (1) Dr. Shawn P. Young, Research Faculty of Fisheries Biology at the University of Idaho, Moscow, Idaho, and a member of the Adjunct Faculty at Clemson University; and (2) Barry W. Sulkin, a private consultant to Joint Intervenors on water-related environmental matters. See Tr. at 810-947.

4.14 Dr. Young has a Bachelor of Science in Environmental Studies from Northland College and a Master of Science in Aquaculture, Fisheries, and Wildlife Biology and a Ph.D. in Fisheries and Wildlife Biology from Clemson University. He has eleven years of research experience in the effects of human activities on fisheries and aquatic ecosystems, including six years of experience studying fisheries in the Savannah River Basin. See Young EC 1.2 Direct Testimony at 1-2; Exh. JTI000042 (Shawn P. Young CV).

4.15 Mr. Sulkin has a Bachelor of Arts in Environmental Science from the University of Virginia and a Master of Science in Environmental Engineering from Vanderbilt University. He has more than thirty years experience in water quality monitoring and permit compliance, first serving with the Tennessee Department of Environment and Conservation and then, for the last eighteen years, as a private consultant on water quality issues, regulatory assistance, National Pollutant Discharge Elimination System (NPDES) permits, stream surveys, and environmental investigations. See Sulkin EC 1.2 Direct Testimony at 1-3; Exh. JTI000043 (Barry W. Sulkin CV).

4.16 Based on the foregoing, and the respective background and experience of the proffered witnesses, the Board finds that each of these witnesses is qualified to testify as an

expert witness relative to the subject of the adequacy of the FEIS discussion and analysis of the direct, indirect, and cumulative impingement/entrainment/thermal discharge impacts of the proposed Vogtle Units 3 and 4 cooling system intake and discharge structures on aquatic resources.

2. Wet Cooling System for Vogtle Units 3 and 4

4.17 The focus of this contention (as well as EC 1.3) is on the aquatic impacts associated with the cooling water system for proposed Vogtle Units 3 and 4. In that regard, to dissipate the waste heat that is a byproduct of normal nuclear power plant operation, each of the proposed Vogtle units would need to dispel up to 7.55×10^9 Btu/hr (british thermal units per hour) of waste heat. To do so, these units (as is the case with existing Vogtle Units 1 and 2) would employ a closed-cycle wet cooling water system to transfer heat from the main condenser, the turbine building closed-cycle cooling water heat exchangers, and the condenser vacuum pump seal water heat exchangers by utilizing one natural draft cooling tower per unit. In contrast to the mechanical draft cooling towers used for the service water system, in which fans are used to facilitate heat transfer, in a natural draft cooling tower, excess heat in the cooling water is transferred to the atmosphere by evaporative and conductive cooling. The cooled water is collected at the bottom of the cooling tower and returned to the condenser. After passing through the condenser, the heated water is pumped back to the cooling tower to begin another cycle. See Exh. NRC00001A, at 3-5 to -7 ([NRO, NRC], NUREG-1872, [FEIS for an [ESP] at the Vogtle Electric Generating Plant Site (Aug. 2008) (Sections 1.0-4.0)) [hereinafter FEIS 1A].[5]

[5] In accord with 10 C.F.R. § 2.337(g)(2)(iv), the staff introduced its FEIS into evidence in its entirety as exhibits NRC00001A through NRC00001E. See Prefiled Direct Testimony of Mark D. Notich Sponsoring NUREG-1872 into Hearing Record (fol. Tr. at 577).

4.18 Notwithstanding the "closed-cycle" nature of this arrangement, some water is lost from the system through evaporation, and a much lesser amount is lost by a process called drift. Drift is the result of small droplets of water being carried from the tower by the convecting air. Moreover, to limit the increased concentration of dissolved solids in the cooling water system caused by the heat dissipation evaporation process, a portion of the water in the otherwise closed system would be continuously discharged from the system as "blowdown." This blowdown, after being retained for a brief period in a sump to allow dechlorination, would be discharged back into the Savannah River through an outlet common to both new units. As a consequence, "makeup" water would be pumped from the Savannah River into the cooling water system for Vogtle Units 3 and 4 by means of a common intake structure to replace the water lost via evaporation, blowdown, and drift.[6] See id. at 3-6 to -7.

4.19 It is the extent of the impact upon Savannah River aquatic resources, via entrainment/impingement when makeup water is withdrawn from the river to replace this lost water, along with the potential impact of the thermal discharge associated with returning system blowdown to the river, that are at the heart of this contention (as well as EC 1.3).

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[6] According to the FEIS, assuming two operating reactor units utilizing revision 15 to the AP1000 certified design, for normal operation the make-up water rate flow would be 2348.47 liters per second (L/s) (37,224 gallons per minute (gpm)), the consumptive water use rate (evaporation and drift) would be 1761.73 L/s (27,924 gpm), and the blowdown rate would be 586.74 L/s (9300 gpm). See FEIS 1A, at 3-6 to -7. The FEIS also noted that the bounding or maximum make-up water flow rate would be 3645.60 L/s (57,784 gpm), the maximum consumptive water use rate would be 1823.56 L/s (28,904 gpm), and the maximum blowdown rate would be 1822.04 L/s (28,880 gpm), and that these figures would change somewhat under pending revision 16 to the AP1000 certified design, for which the staff provided an impacts analysis in FEIS sections 5.3.3.1 and 7.3.1.1. See id. at 3-7; see also supra section IV.A.4.b.

3. FEIS Discussion Relative to Contention EC 1.2

4.20 The discussion in the Vogtle FEIS that is relevant to the aquatic impact matters that are the focus of EC 1.2 is found in section 2.7.2.1 (Aquatic Ecology/Communities of the VEGP Site), which discusses the communities on and near the VEGP site and includes the species composition of molluscs and fish in the Savannah River. Noting that the VEGP site is at river mile (RM) 150.9, the FEIS also includes a short description of the habitat types in the middle reach of the Savannah River (defined as occurring from the Fall Line at RM 220 downstream to the mouth of Brier Creek (RM 97)). The FEIS discusses the results of studies related to diatoms, aquatic insects, molluscs, and fish, including threatened and endangered species. See FEIS 1A, at 2-18, 2-74 to -93.

4.21 In FEIS section 5.4.2.2 (Aquatic Impacts/Savannah River), the staff evaluated the impacts to aquatic resources from impingement and entrainment from the proposed Vogtle Units 3 and 4 operations and determined that (1) impingement caused by operation of the proposed Units 3 and 4 would have a minor impact on fish populations inhabiting the Savannah River; and (2) the impacts to the fish populations of the Savannah River from entrainment due to the operation of the proposed Units 3 and 4 would be minor. See Exh. NRC00001B, at 5-29 to -33 ([NRO, NRC], NUREG-1872, [FEIS for an [ESP] at the Vogtle Electric Generating Plant Site (Aug. 2008) (Sections 5.0-11.0)) [hereinafter FEIS 1B]; Staff EC 1.2 Direct Testimony at 37. Also, in FEIS section 7.5.2 (Aquatic Ecosystems/Operations) the staff evaluated the cumulative impacts to aquatic resources from impingement and entrainment from existing Vogtle Units 1 and 2 in combination with Units 3 and 4. The staff concluded that the cumulative impacts from entrainment would be minor, and that the cumulative losses from impingement are unlikely to impact Savannah River fish populations adversely. See FEIS 1B, at 7-21 to -25.

4.22 Finally, the staff evaluated the thermal impacts to aquatic resources from the operation of proposed Vogtle Units 3 and 4, as well as the cumulative impacts of Units 1 and 2 in combination with Units 3 and 4, in FEIS sections 5.4.2.3 (Aquatic Thermal Impacts), 5.4.2.9 (Summary of Aquatic Impacts), and 7.5.2 (Operations). The staff concluded that the thermal impacts would be minor and the cumulative thermal impacts would not negatively impact aquatic organisms. See id. at 5-33 to -34, 5-38 to -39, 7-23.

4. Overarching Legal/Technical Issues Relating to Contention EC 1.2

4.23 Although the adequacy of the FEIS analyses of the impingement/entrainment/thermal discharge impacts arising from proposed Vogtle Units 3 and 4 are the central controversy before the Board in connection with EC 1.2, as framed by Joint Intervenors and litigated by the parties, additional issues came to the forefront that became part and parcel of Joint Intervenors challenge under this issue statement. As we discuss in more detail below, these included (1) how the aquatic environment in the Vogtle environs should be characterized in terms of the fish and other creatures that inhabit the Savannah River; (2) what river flows should be used in assessing the impingement/entrainment/thermal discharge impacts at issue; and (3) the degree to which there is what Joint Intervenors have labeled a "lower baseline" for certain of the aquatic creatures in the VEGP environs such that they should be accorded "special creature status."

a. Characterization of the Aquatic Environment

4.24 As was noted above, see supra p. 4, in ruling on Joint Intervenors contention EC 1.1, the Board rejected their assertion that they had framed a litigable contention by challenging the SNC ER on the basis of the applicant's failure to include

> a site-specific description of the Plant Vogtle aquatic environs that is based on recent field studies or a quantative analysis of the circumstances regarding aquatic species assemblage, migration by anadromous (i.e., moving from the sea to rivers to breed) and

> diadromous (i.e., migrating between salt and freshwater) species, or habitat utilization within the proposed intake and discharge sites and/or the project area,

finding that they had failed to demonstrate with any references to any relevant agency rule, regulatory guide, or standard licensing review plan, "that suggest site specific studies are generally required." LBP-07-3, 65 NRC at 255-57. At the same time, in admitting contention EC 1.2, the Board indicated that "its merits may involve the question of the adequacy of the baseline information provided by SNC relative to the portion of the Savannah River that encompasses the project area associated with the intake/discharge structures for both the existing and proposed Vogtle facilities." Id. at 259. In the context of this contention, relative to the subsequent staff issuance of its FEIS, Joint Intervenors have continued to press their concern about the adequacy of the environmental analysis information base utilized to make the impingement/entrainment/thermal discharge impact determinations found in that staff environmental impacts report, both generally and more specifically with respect to what Joint Intervenors now label "Special Status Species." See Joint Intervenor Proposed Findings at 10-11; Joint Intervenors Reply Findings at 3-4.

i. NRC Regulations and Regulatory Guidance

4.25 Section 51.70 of Title 10 of the Code of Federal Regulations indicates that in analyzing alternatives and impacts, an agency NEPA statement "will identify any methodologies used and sources relied upon, and will be supported by evidence that the necessary environmental analyses have been made." Relative to the question of the information needed to fulfill this requirement, the guidance provided in chapter 2, section 2.2 of Regulatory Guide 4.2 identifies the information needed by the staff in the preparation of its assessment of the potential environmental effects of the proposed nuclear facility, stating that "the applicant should describe the flora and fauna in the vicinity of the site, their habitats, and their distribution.

This initial inventory will reveal certain organisms which, because of their importance to the community, should be given special attention." Exh. NRC000007 at 2-3 (NRC, NUREG-0099, Regulatory Guide 4.2, Preparation of Environmental Reports for Nuclear Power Stations (rev. 2 1976)).

4.26 Guidance in this regard also is provided in section 2.4.2 of NUREG-1555, the staff's ESRP, that "directs the staff's description of the aquatic environment and biota at and in the vicinity of the site and other areas likely to be impacted by the construction, maintenance, or operation of the proposed project." Exh. NRCR00009, at 2.4.2-1 (Office of Nuclear Reactor Regulation, NRC, NUREG-1555, Environmental Standard Review Plan (1999)) [hereinafter 1999 ESRP]. According to the ESRP, the scope of the staff's review

> should include the spatial and temporal distribution, abundance, and other structural and functional attributes of biotic assemblages on which the proposed action could have an impact. The review should also identify any "important" . . . or irreplaceable aquatic natural resources and the location of sanctuaries and preserves that might be impacted by the proposed actions.

Id. The ESRP also explains that "[t]he depth and extent of the input to the EIS should be governed by the kinds of aquatic ecological resources that could be affected by plant construction or operation and by the nature and magnitude of the expected impacts to these resources." Id. at 2.4.2-6. Furthermore, the ESRP states that:

> [t]he input should be brief and should contain the following information:
>
> - [T]he principal aquatic ecological features of the site and vicinity . . . with emphasis on the communities of the ecosystem that will be potentially affected by project construction, operation, or maintenance. This information should be based on an analysis of at least one full year of data to reflect seasonal variations in aquatic populations. Thus, the extent of discussion of various biotic components should be in proportion to the estimated severity of impacts and should be adequate to support the assessment of ESRP Chapters 4.0 [(Environmental

> Impacts of Construction)] and 5.0 [(Environmental Impacts of Station Operation)].
>
> • [D]escriptions of environmental or man-induced stresses to aquatic biota at the existing site and vicinity.
>
> * * * * *
>
> • [A] discussion of "important" aquatic species that may be affected by plant or transmission corridor construction or operation. Estimates of their abundance should be provided where appropriate. Special habitat and forage needs should be emphasized, if the proposed project would potentially disrupt these.
>
> • [A] summary of consultations with appropriate Federal, State, regional, local, and affected Native American tribal agencies, including the U.S. Fish and Wildlife Service (through the regional director), and the director of the State fish and wildlife agency.

Id. at 2.4.2-6 to -7; see also 2007 ESRP, at 5.3.1.2-1 (in assessing potential plant intake system impacts on aquatic ecosystems, per ESRP section 2.4.2, obtain description of aquatic ecology in vicinity of the site, especially resources potentially affected by cooling-water intake system). Additionally, the staff defines "important" species as species that are (1) "rare" species that are federally listed or proposed/candidates to be listed as threatened or endangered; (2) state listed as threatened, endangered, or of concern; (3) commercially or recreationally valuable or essential to the maintenance and survival of species that are rare and commercially or recreationally valuable; (4) critical to the structure and function of the aquatic ecosystem;[7] or (5) biological indicators of the aquatic environment. See 1999 ESRP at 2.4.2-7 (Table 2.4.2-1).

[7] Although Table 2.4.2-1 refers to the "terrestrial" ecosystem and environment (apparently having been copied from section 2.4.1, Terrestrial Ecology), in the context of the aquatic ecology section in which it is located (i.e., section 2.4.2), it clearly seems intended to encompass the aquatic ecosystem and environment.

ii. Documents Staff Used to Characterize Environment

4.27 Previously, in ruling on the admissibility of EC 1.1, we indicated that in the context of the agency's existing regulatory framework "the appropriate scope of the baseline for a project is a functional concept: an applicant must provide enough information and in sufficient detail to allow for an evaluation of important impacts." LBP-07-3, 65 NRC at 257. This approach is wholly consistent with the staff guidance set forth above, which indicates that the FEIS discussion should be proportional to the estimated severity of impacts and be adequate to support the impact assessments needed. As a consequence, we cannot endorse Joint Intervenors continuing assertion that an extensive assessment of the aquatic community in the vicinity of the facility, including additional detailed field studies, designed specifically to evaluate the impacts of the new intake and discharge structures is the only way to provide the necessary NEPA evaluation data, see Joint Intervenors Reply Findings at 2-3, at least in the absence of a showing that the information upon which the staff did rely was deficient in some material way.

4.28 Relative to the information that was used by the staff, the staff testified that it relied upon a range of sources of information to characterize the Savannah River in the vicinity of the site, which it asserts was both adequate and appropriately comprehensive to enable the staff's evaluation of environmental impacts. These included five major information sources or source groupings, as well as specific reports that addressed individual species.

4.29 The staff relied on the 2005 publication "Fishes of the Middle Savannah River Basin," authored by Barton C. Marcy, Jr., and four others, as the basis for a general description of the environment, and specifically to identify the fish species that are present in the stretch of the Savannah River adjacent to the site as given in FEIS section 2.7.2.1. Although not prepared as an impact assessment study, this volume does contain habitat characterizations, family descriptions, species accounts, habitat and species photographs, and a taxonomic identification

key, based on data obtained from an area from RM 97 to RM 221, for which the VEGP site, located at RM 150 to RM 152, is roughly in the midpoint. Also, the authors of this book based their records of distribution in the Middle Savannah River Basin (MSRB) and species life history information on more than 120 years of data collection from the MSRB and fifty years from the Department of Energy's Savannah River Site (SRS), which is just across the river from the VEGP site. See Staff EC 1.2 Direct Testimony at 14-15; see also NRC Exh. NRC000006 (excerpts from Barton C. Marcy, Jr., et al., Fishes of the Middle Savannah River Basin (2005)) [hereinafter Marcy Savannah River Fishes].

4.30 Also utilized by the Staff as a source of information for the FEIS to describe the aquatic species composition and habitat in the Savannah River was a series of reports that were developed by the Academy of Natural Sciences in Philadelphia (ANSP). The three reports referred to in the FEIS, which were published in 2001, 2003, and 2005, were based on ANSP efforts going back to 1951 to conduct biological and water quality studies in the Savannah River between RM 122 and RM 160 for the purpose of assessing potential effects of SRS contaminants and warm-water discharges on the aquatic communities in the river. Components of the ANSP study included basic water chemistry, diatoms, other attached algae, aquatic macrophytes (mosses and rooted aquatic plants), protozoa, aquatic insects, non-insect macroinvertebrates, and fish. Until 1997, the ANSP conducted two types of surveys, quadrennial comprehensive surveys, which included all the components mentioned above, and annual cursory surveys, which included a reduced component set, typically attached algae, insects and fish, and were carried out annually with four sampling periods per year. During years with comprehensive surveys, the comprehensive surveys substituted for two of the usual cursory sampling periods. Moreover, as part of the ANSP studies, sampling stations were added at RM 151.2 and 149.8 in 1985 to assess and distinguish the potential impacts of the

VEGP site. Cursory-type surveys occurred at the VEGP site until 1997. From 1997-2000, the ANSP conducted an annual survey in the early fall at four sampling stations. For this period, aspects of the VEGP site surveys were combined into a single, comprehensive study that included fish species. Sampling at one of the original Vogtle stations continued through 2001, although those particular samples were archived and not analyzed. See Staff EC 1.2 Direct Testimony at 15-16; Exh. NRC000003, at ii, 199 (The Academy of Natural Sciences, Report No. 03-08F, 2001 Savannah River Biological Surveys for Westinghouse Savannah River Company (Aug. 2003)) [hereinafter 2001 ANSP Study].

4.31 According to the staff, it used the ANSP studies, which demonstrate that the Savannah River has been studied extensively upstream and downstream of the VEGP site and at different seasons throughout the year, to provide an understanding of the river ecology and the current species of fish and molluscs present in the vicinity of the VEGP site. And in that regard, the staff noted in FEIS section 2.7.2.1 that the ANSP 2001 study data indicated that (1) species richness for fish was significantly higher at the sampling location farthest downstream (Station 6, which would be in the direction of the VEGP) than at the farthest sampling location upstream of the SRS (Station 1); and (2) neither species diversity, nor densities of common species of fish, differed significantly between stations. See id. at 16-17; see also FEIS 1A, at 2-81; 2001 ANSP Study at i, ii, v, x, xi, 2-3, 12-16, 199-200. In this regard, the ANSP characterized its sampling program as being "one of the most comprehensive ecological datasets available for any of the world's rivers." 2001 ANSP Study at v.

4.32 A third source of information for staff EIS preparation was two overlapping studies conducted by the SRS describing the ichthyoplankton distribution, which were discussed in FEIS section 2.7.2.1. See Vogtle FEIS 1A, at 2-81; see also Exh. NRC000011, at V-241 to -335 & V-454 to -536 (5 W.L. Specht, Comprehensive Cooling Water Study (Oct.

1987)); Exh. NRC000012, at xii to xvii & 3-1 to 5-9 (Michael H. Paller, et al., Distribution and Abundance of Ichthyoplankton in the Mid-Reaches of the Savannah River and Selected Tributaries (Mar. 1986)) [hereinafter Paller Ichthyoplankton Distribution]. Although twenty or more years old, these studies, which involved a stretch of the river along the southwestern edge of the SRS directly across the river from the VEGP site, were included in the FEIS because they occurred at the same location and showed similar species distributions. See Staff EC 1.2 Direct Testimony at 17.

4.33 A fourth source of information used by the staff became available only after the DEIS was published, when the staff received notice from the United States Fish and Wildlife Service (USFWS) that a study had been performed for USFWS based on data collected in a late 2006 survey of freshwater mussels in the Savannah River between RM 22.8 and RM 203. See Exh. NRC000005, at 2 (The Catena Group, Freshwater Mussel Surveys, The Savannah River from Augusta to Savannah: South Carolina & Georgia (2007)) [hereinafter Catena Group Mussel Surveys]. As the most recent study of the freshwater mussels in the river that has been conducted, the staff used this study to update information in FEIS section 2.7.2.1, including the number of important species identified during the survey and their locations. See Staff EC 1.2 Direct Testimony at 18; Vogtle FEIS 1A, at 2-76, 2-87, & 2-88.

4.34 A fifth set of information was used to provide general background or used in the development of descriptions of specific species and their life histories. This set included the 1985 final environmental statement (FES) for the operating license for Vogtle Units 1 and 2 and a variety of comprehensive studies on specific topics, which were used for developing Vogtle Units 3 and 4 FEIS descriptions of aquatic species and their life history. See Vogtle FEIS 1A, at 2-88, 2-89; see also Exh. NRC000013 (David H. Bennett and Robert W. McFarlane, The Fishes of the Savannah River Plant: National Environmental Research Park (Aug. 1983));

Exh. NRC000014 (Office of Nuclear Reactor Regulation, [NRC], Final Environmental Statement Related to the Operation of [VEGP], Units 1 and 2 (Mar. 1985));[8] Exh. NRC000015 (3 A. S. Hendricks, The Conservation and Restoration of the Robust Redhorse, Moxostoma robustum (May 2002)); Exh. NRC000016 (Mike Nichols, Conservation Strategy for Robust Redhorse (Moxostoma robustum) (2003)) [hereinafter Robust Redhorse Conservation Strategy]; Exh. NRC000017 (Timothy B. Grabowski & J. Jeffery Isely, Seasonal and Diel Movements and Habitat Use of Robust Redhorses in the Lower Savannah River, Georgia and South Carolina (2006)). According to the staff, these sources and studies were among the most recent, reliable, and authoritative studies of which the staff was aware. See Staff EC 1.2 Direct Testimony at 18.

iii. Adequacy of Staff Information Used in Characterizing the Aquatic Environment Generally

4.35 In accord with its own guidance on fulfilling its EIS-preparation responsibilities, the staff must have information sufficient to allow it to describe accurately the principal aquatic ecological features of the VEGP site and its environs, as well as the ecosystem communities that potentially will be affected by construction, operation, or maintenance of the proposed Vogtle facilities, with detail that is both proportional to the estimated severity of the impacts and adequate to support the required impacts assessment. It also must have sufficient information to permit it to identify and discuss "important" aquatic species that may be affected by the project. Joint Intervenors challenges to the adequacy of the information used by the staff in establishing the baseline for such an assessment of impingement/entrainment/thermal impacts in this instance mirror these two categories. One concern relates to the sufficiency of the information available to the staff to assess generally the Savannah River aquatic environment

[8] See infra note 53 and accompanying text regarding the admission of this exhibit.

as it is relevant to the staff's impacts determination. The other involves the sufficiency of that information in connection with what the staff refers to as "important" species, and what Joint Intervenors now call "special status species." We look first to their claim regarding the general sufficiency of the information.

4.36 Of particular concern to Joint Intervenors are the Marcy, et al., and ANSP studies referenced above. Acknowledging that these studies "are not irrelevant," Joint Intervenors Reply Findings at 2, Joint Intervenors nonetheless find them wanting. With respect to the Marcy, et al., study, Joint Intervenors focus on the staff's recognition that this study was "'not developed to provide an impact assessment.'" Joint Intervenors Reply Findings at 3 n.4 (quoting Staff EC 1.2 Direct Testimony at 15); see Young EC 1.2 Rebuttal Testimony at 7. The ANSP studies, on the other hand, are questioned because they employed sampling techniques over several days in the fall of each year, thereby purportedly "'miss[ing] a dominant portion of the fish-population moving through the vicinity and then also their early life history'" to the degree that larval and juvenile fish are most likely to be detected in the spring and early summer following spawning season. Joint Intervenors Reply Findings at 3 (quoting Tr. at 877 (Young)).

4.37 We, however, are unable to agree with the claim that these studies, and the staff's reliance upon them, are lacking as a basis for an adequate NEPA assessment. Relative to the ANSP studies, as the staff pointed out, they were used to furnish an overall understanding of the Savannah River ecology and the current fish and mollusc species present in the general vicinity of the VEGP site,[9] as well as an overall indication of the past SRS and

[9] Citing the "highly variable" habitat conditions on the river, Dr. Young also expresses concern about the ANSP studies relative to the river locations that were the subject of the sampling effort, i.e., at a distance some ten miles from the VEGP site, and the fact that the most recent ANSP study is from 2001. Young EC 1.2 Rebuttal Testimony at 5-6; see also Young EC 1.2 Direct Testimony at 5. This, however, is simply a variation on Dr. Young's overarching concern that only a contemporary, long-term, site-specific study can be adequate for

(continued...)

VEGP site impacts on the river, not as the source for life history, migration timing, or population numbers, which was garnered from other sources as the information was relevant to the "important species" the staff found merited extended EIS discussion.[10] See Staff EC 1.2 Rebuttal Testimony at 11. Nor do we find disqualifying the fact that Marcy, et al., (or other studies utilized by the staff) were not prepared to support a NEPA assessment. Looking to the applicable provisions of the staff FEIS cited above, see supra section II.A.4.a.ii, we see nothing on its face, and Joint Intervenors have provided us with nothing specific, that indicates the staff's reliance on this existing written information, in lieu of a site-specific study, has resulted in a factually inaccurate discussion of the Savannah River aquatic environment. To be sure, we have statements by Dr. Young on behalf of Joint Intervenors questioning, as a general matter, whether these materials have "the level of specificity needed for an impacts analysis." Young EC 1.2 Rebuttal Testimony at 7. We also have statements from Dr. Coutant on behalf of SNC indicating that the information utilized by the staff contains "an abundance of information" that provides "an adequate basis in my opinion to estimate what is out there or what should be out there with which to do an analysis." Tr. at 677-78.

4.38 We are not unsympathetic that, as an aquatic ecologist, Dr. Young would want the utmost site-specific information available to aid him when he is assessing the nature of a

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[9](...continued)
environmental impact assessment purposes.

[10] So too, Dr. Young in the context of his concerns about the ANSP study, suggests that the FEIS discussion includes "only the most abundant and common species," without sufficient attention to "the uncommon and rare," Young EC 1.2 Rebuttal Testimony at 5-6, albeit without acknowledging that the staff's "important" species approach to EIS analysis clearly is intended to encompass both. See FEIS 1A, at 2-81. Moreover, Dr. Young provides no insight into what those neglected species might be. Acknowledging that the FEIS provides information regarding the six "most imperiled and/or most important" Savannah River fisheries, he also suggests that the FEIS lacks a discussion of other "at risk" fish species, albeit without identifying what those might be. Young EC 1.2 Direct Testimony at 4.

particular aquatic environment. See Tr. at 882. Nonetheless, the materials relied upon by the staff in this proceeding in defining the aquatic environment associated with the Savannah River in the vicinity of the VEGP site have been shown by a preponderance of the evidence not to be materially deficient to the extent that it would adversely impact the staff's impingement/entrainment/thermal impacts analysis. As a result, whatever might be the case in some other instance relative to the age and sufficiency/relevance of the baseline reference materials involved, we find no basis here for entering a ruling that NEPA required the preparation of a contemporaneous, site-specific aquatic impacts field survey as support for this ESP application.[11]

iv. Adequacy of Staff Determinations Regarding Listing/Discussing "Important/Protected" Species

4.39 In addition to their concern about the adequacy of the information available to provide an overall assessment of the Savannah River aquatic environment, Joint Intervenors have articulated a similar concern relative to the "important" species that the staff must, consistent with its NEPA guidance, assess in the context of making an impacts determination

[11] This is not to say that the simple citation of existing studies and other information materials will, in all instances, establish the sufficiency of an ER or EIS in the face of a sufficiently supported challenge beyond one that merely asserts any discussion about the relevant aquatic environment has been omitted. Nor should this determination be considered as a basis for discounting the usefulness of contemporaneous aquatic studies such as were done by SNC in this instance, which can provide material aid to the staff in completing its NEPA responsibilities (and useful background for the public in reviewing the staff's efforts), particularly in the face of an information database that is less recent or incomplete.

We also think it is worth noting in this regard that, as this litigation illustrates, one of the results of the approach, however reasonable, under which "[t]he depth and extent of the input to the EIS should be governed by the kinds of aquatic ecological resources that could be affected by plant construction or operation and by the nature and magnitude of the expected impacts to these resources," 1999 ESPR at 2.4.2-6, is that saying less about SMALL impacts, in the face of a concerted challenge by a dedicated intervenor with qualified experts, may result in having to provide extensive supporting detail to defend both the input to, and the sufficiency of, the analysis.

regarding impingement/entrainment/thermal discharge. In particular, Joint Intervenors question the adequacy of the information baseline relative to the robust redhorse and various mussel species.[12]

4.40 In connection with the robust redhorse, a Georgia state-listed endangered species, see FEIS 1A, at 2-88, a principal concern of Joint Intervenors is the lack of a larval or juvenile life history, with the exception of its reported swimming speed of 0.25 to 0.4 feet per second (fps). See Joint Intervenors Proposed Findings at 16. This may well reflect, as Dr. Masnik noted for the staff, that "the early life history of this species is not well-known," Tr. at 778, but in any event hardly seems critical given the staff's presumption that because they are incapable of overcoming an intake velocity of 1.0 fps, 100 percent of such early forms will be entrained if they transit the intake structure. See Staff EC 1.2 Rebuttal Testimony at 13.

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[12] Albeit not raised in Joint Intervenors findings of fact, during the hearing Dr. Young suggested that there were several other deficiencies indicating that the FEIS informational baseline is inadequate. In particular, he cited the failure to refer to certain reference materials regarding the striped bass and the American shad, see Tr. at 944-46 (referencing Exh. JTI000015 (U.S. Fish and Wildlife Service, U.S. Department of the Interior ([FWS/DOI]) & Coastal Ecology Group, USACE, Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic) Striped Bass (Oct. 1983)); Exh.JTI000011 (FWS/DOI, Habitat Suitability Index Models and Instream Flow Suitability Curves: American Shad (June 1985)), which were designated in the FEIS as recreationally and commercially important species, respectively. In addition to the procedural problem, given the direction in 10 C.F.R. Part 2, Subpart L to file proposed findings, see 10 C.F.R. § 2.1209 (each party "shall" file written post-hearing proposed findings of fact and conclusions of law on the contentions addressed in an oral hearing), that this failure to raise the matter in their findings submissions (notwithstanding any discussion in their section 2.1207 initial or responsive written statements of position) seemingly waives these items as grounds for their EC 1.2 challenge to the FEIS, see Statement of Policy on Conduct of Licensing Proceedings, CLI-81-8, 13 NRC 452, 457 (1981), we find these matters without substance as well. In both instances, given the discussions in the FEIS regarding these species, see FEIS 1A, at 2-82 to -85, we do not perceive the failure to include these documents (which are of the same age as some of the FEIS reference materials criticized by Joint Intervenors as not being current) among the reference materials cited by the staff as having any substantive impact on the FEIS impacts analysis.

4.41 Also evidencing a failure to provide sufficient baseline information, according to Joint Intervenors, was the FEIS discussion of mussels. While noting that no mussel survey was conducted in connection with the SNC application, Joint Intervenors do recognize that the FEIS included a discussion of Georgia state-listed mussels as identified in a 2007 survey by The Catena Group on behalf of the federal Fish and Wildlife Service. They also assert, however, that the failure of the FEIS to identify the host fish species to which larval mussels attach is a deficiency that both establishes the need for further baseline information and is fatal to any finding that the impingement/entrainment/thermal impacts will be SMALL given there is no specific finding of the impacts that would be visited on those host fish and, concomitantly, upon the mussel larvae that they host. See Joint Intervenors Findings of Fact at 18-20. At first blush, this point seems to have some merit, particularly given that some mussel host fish apparently have yet to be identified. See Catena Group Mussel Surveys, at 27 (several Savannah River Basin mussel species fish hosts still unknown; laboratory and field research needed as understanding life cycles critical component of species conservation). Ultimately, however, we find this argument unpersuasive in the context of this FEIS. The staff FEIS assessment was that the impingement/entrainment/thermal impacts on all affected fish species would be minor or SMALL. See FEIS 1B, at 5-29 to -34; Staff EC 1.2 Direct Testimony at 37, 46, 58; Staff EC 1.2 Rebuttal Testimony at 37 (using the terms minor and small). Assuming that assessment is true, which we discuss in more detail below, it is not apparent, at least in the absence of some specific showing that Joint Intervenors have not made in this instance, how impingement/entrainment/thermal impacts on host fish that will be small can have a significantly different impact upon that fish's ability to perform its usual biological functions, whether that is hosting a mussel larva or being a food chain predator or nutrition source. Consequently, we

cannot find this purported host fish information deficiency to be one that compels either additional information gathering efforts or a revision to the staff's FEIS impact assessment.

b. Use of River Flows in Assessing Impingement/Entrainment/Thermal Impacts

4.42 Although not the subject of any of Joint Intervenors proposed legal/factual findings, see supra note 12, in the prefiled testimony of both Dr. Young and Mr. Sulkin, see Young EC 1.2 Direct Testimony at 9-10; Sulkin EC 1.2 Direct Testimony at 4-15; Sulkin Rebuttal Testimony at 1-7, they do take issue with what they describe as the failure of the staff in the FEIS to consider an appropriate range of Savannah River flows in evaluating the aquatic resource impacts from the Vogtle Units 3 and 4 intake and discharge structures. At issue are possible low flow conditions, which at very reduced levels persisting over a long period of time potentially could have adverse impacts with respect to impingement/entrainment losses and thermal pollution. See Staff EC 1.2 Direct Testimony at 66-67, 87-88. In questioning this staff assessment, Joint Intervenors challenged the two staff assessment benchmarks associated with river flow: river flow level/discharge, as measured in cubic feet per second (cfs), and reactor unit water use withdrawal as a percentage of the river flow/discharge.

4.43 Acknowledging that (1) the intake of cooling system makeup water during the operation of the proposed Units 3 and 4 will result in a reduction of the amount of water downstream from the VEGP site; and (2) the reduction would be proportionally greater in low flow circumstances, such as the drought of record that the Savannah River Basin has been experiencing since 2006, in the FEIS the staff assessed the impact of low-flow conditions. As the basis for this analysis, the staff chose to rely upon the level of releases from the J. Strom Thurmond Dam reservoir, located some seventy miles north of the VEPG site, as they are tied to the drought levels -- from 1, the least severe, to 4, the most severe -- at which that reservoir's pool is maintained consistent with the existing draft USACE Drought Contingency

Plan under which, as the drought level increases, pool preservation requires a reduction in the dam discharge flow resulting in a lower flow downstream. See Staff EC 1.2 Direct Testimony at 61-62; FEIS 1B, at 5-7 to -8. Using these reservoir discharge flow rates, as well as figures computed to reflect the river water withdrawals that would occur during normal and maximum operation of proposed Vogtle Units 3 and 4 and normal operation of existing units 1 and 2, the staff then calculated the percentage of river flow that would be withdrawn (i.e., the amount taken out of the river as makeup water) and consumptively used (i.e., the amount withdrawn offset by what is returned to the river as blowdown) by the proposed new units both alone and in combination with existing Units 1 and 2. See FEIS 1B, at 5-7 to -9, 7-6 to -7. This percentage, in turn, was assessed in comparison to the figure of five percent of annual average flow used by EPA as a threshold under 40 C.F.R. § 125.84(b)(3)(i) for riverine system withdrawals. See Staff EC 1.2 Direct Testimony at 77.

4.44 In connection with the issue of river flow discharge, notwithstanding Dr. Young's protestations that flows lower than 3800 cfs were not considered, see Young EC 1.2 Direct Testimony at 11, the FEIS does consider flows of 3000 and 2000 cfs, as well as 8830, 4200, 4000, and 3800 cfs, the last of which is considered the Drought Level 3 condition under the existing draft USACE Drought Contingency Plan. See FEIS 1B, at 5-9 to -10, 7-4 to -7. Although at the lowest flow rate of 2000 cfs or less, withdrawals would exceed the EPA five percent withdrawal figure, in the FEIS the staff concluded that there will be a SMALL impact from normal operation of Units 3 and 4 alone, or in combination with Units 1 and 2, at all the aforementioned flow levels, finding with respect to the very low-flow scenarios

of 3000 and 2000 cfs that they are likely to be so rare and temporary as to not destabilize the water supply.[13] See FEIS at 5-10, 7-7.

4.45 In their prefiled and trial testimony, Joint Intervenors witnesses posit a series of concerns regarding this river flow information. Initially, Mr. Sulkin challenges the relevance of what he refers to as the staff's "surrogate method" of referencing the EPA five percent standard as part of its FEIS assessment, asserting the figure is a performance standard relative to what is technologically achievable that says nothing about the potential impacts of withdrawals less than five percent. Additionally, he questions the staff's figures used to represent withdrawals and consumptive use in relation to both existing Units 1 and 2 as well as proposed Units 3 and 4, asserting that they failed to account for higher withdrawal figures used in conjunction with the recent staff FEIS regarding the operating license renewal for Vogtle Units 1 and 2, as well as higher withdrawal and consumption figures for Units 3 and 4 based on the pending revision 16 to the design certification document (DCD) for the AP1000 certified design. Once properly calculated, he contends, they showed that the EPA five percent figure had been exceeded in several instances. Also in this regard, noting that recent weather has brought Drought Level 3 to pass, both Dr. Young and Mr. Sulkin assert there should be an impacts assessment of Drought Level 4, which Mr. Sulkin indicates, based on figures used in the Units 1 and 2 license renewal FEIS, would be at a flow level of 957 cfs. See Sulkin EC 1.2 Direct Testimony at 4-15; Sulkin EC 1.2 Rebuttal Testimony at 1-7; Young EC 1.2 Direct Testimony at 10-11; Tr. at 918-40; Exh. JTI000021 (Savannah River Discharge Tables) [hereinafter Joint Intervenors Discharge Tables].

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[13] Furthermore, the 3000 and 2000 cfs low-flow scenarios represent "snap-shots" of low flow periods, while the EPA five percent withdrawal figure is referenced to the average flow over the course of a year. See infra nn. 14-15 and accompanying text.

4.46 The staff has posed various defenses to these claims. In connection with the use of the EPA five percent standard, noting that the figure was used in the context of a percentage of annual mean flow, the staff asserts that the record of the rulemaking associated with that figure indicates that, rather than providing a demarcation threshold for NEPA impact level changes, this percentage reflects an EPA judgment about one of a combination of requirements, including intake design and construction technologies intended to reduce impingement and entrainment, that will provide adequate protection to aquatic biota in a waterbody. In the case of the Vogtle Units 3 and 4 assessment, the staff declares, this five percent figure was not the controlling factor in its NEPA impacts assessment, but rather one among a number of factors, including design, location, and planned operation of the intake structure; the site location and uniqueness of the site vicinity habitat; site hydrology; applicable important species life history data; and past and recent field studies in the vicinity of the VEGP site. Moveover, in response to Mr. Sulkin's concerns about the accuracy of the figures provided in the FEIS, the staff provided revised figures they assert account for both the license renewal FEIS information and the DCD revision 16 data cited by Mr. Sulkin. See Staff EC 1.2 Rebuttal Testimony at 2-7, 31-36; Exh. NRC000052, at unnumbered page 1 (Tables Showing Cumulative Withdrawals of All Four Vogtle Units as Percentage of River Flow) [hereinafter Staff Revised Withdrawal Tables]. They also argue that Joint Intervenors concerns about withdrawal percentages exceeding the five percent threshold for the two existing and two proposed units at the VEGP site in combination relative to (1) the maximum, rather than normal operation, withdrawal rate for the four units; or (2) river flows below Drought Level 3 fail to recognize the infrequent, short-term nature of the former and the unrepresentative nature of the latter in terms of likely conditions. See Staff EC 1.2 Rebuttal Testimony at 31-36.

4.47 While putting somewhat more stock in the non-EPA flow percentage elements of the staff's impact assessment, which are discussed in sections IV.A.5.c, IV.A.6.c, IV.A.7.b below, as a decisional basis for that NEPA determination, we nonetheless find nothing in the staff's river flow analysis that renders this an element fatal to the staff's impacts analysis. Certainly, if the five percent mark is utilized, as EPA seemed to contemplate, in conjunction with mean annual flow, which in the case of the VEGP site is in the neighborhood of either 6991 cfs, per a recently installed Waynesboro gauge located near the facility,[14] see id. at 4, or the 8830 cfs figure from the FEIS, see FEIS at 5-8 to -9, 7-4 to -5, the normal cumulative withdrawals of all four plants under the staff's revised figures fall well below the five percent figure,[15] see Staff Revised Withdrawal Tables at unnumbered page 1. Even when considered relative to the Thurmond Dam release figures utilized in the FEIS, which appear to be conservative relative to what likely is actually flowing past the VEGP site, see supra note 14, the cumulative withdrawals associated with normal operations, which we consider the appropriate

[14] Although there was some dispute regarding the utility of the information from this gauge because it was not utilized by staff in its FEIS analysis given it had been in place only since January 2005, see Staff EC 1.2 Direct Testimony at 65; Sulkin EC 1.2 Rebuttal Testimony at 3, see also Exh. NRC000026 (Waynesboro-Thurmond Discharge Graph); Exh. NRC000041 (Table Comparing Thurmond Dam Discharge with Waynesboro, Georgia United States Geological Survey Gauge), we consider it persuasive evidence that the flows at the VEGP site generally are higher than those at Thurmond Dam, a likely consequence of inflow from tributaries and groundwater between the dam and the Waynesboro gauge location. See Tr. at 800-01.

[15] At the hearing, Joint Intervenors witness Mr. Sulkin agreed that the EPA five percent guideline is indeed properly referenced to the annual average flow, and not to postulated lower flows such as 3100 cfs. See Tr. at 920-24. So while both the staff and Joint Intervenors calculated withdrawal percentages for a range of postulated flow rates, the record supports the conclusion that based on the annual average flow, even under recent drought conditions, the withdrawal fraction projected for Vogtle Units 3 and 4 would not exceed the EPA five percent guideline. See FEIS 1A, at 5-8 to -9.

reference point for this purpose,[16] exceed the five percent figure only below Drought Level 3. This, however, is low-flow territory that is likely to be entered very infrequently,[17] and then only under the watchful eye of Georgia State environmental resources officials with authority, as exists currently relative to Units 1 and 2, to order water withdrawal rates (along with power production) to be significantly reduced or curtailed entirely to protect aquatic biota in appropriate circumstances, see Staff EC 1.2 Direct Testimony at 79; Tr. at 797; Exh. NRC00001C, at H-12 ([NRO, NRC], NUREG-1872, [FEIS for an [ESP] at the [VEGP] Plant Site (Aug. 2008) (Apps. A-J) (prior to operating authorization, SNC required to obtain revision of existing Georgia Department of Natural Resources (GDNR) permit authorizing Savannah River water withdrawal for cooling makeup and in-plant use) [hereinafter FEIS 1C]. Consequently, on the record before us, we are unable to conclude that any aspect of the staff's flow analysis provides a basis for overturning or substantially revising the staff's impact assessment findings.[18]

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[16] The possibility exists for "maximum" withdrawals by the existing and the proposed units, either singularly or in combination with any or all of the other units, so as to produce withdrawals in excess of what is generated by normal operation and so possibly exceed the five percent EPA threshold in pre-Drought Level 3 conditions. See Joint Intervenors Discharge Tables, at 2 (Table 4). Nonetheless, as was noted by the staff, because these maximum withdrawal events generally are associated with cooling tower water chemistry control activities rather than changes in consumptive water use, maximum withdrawals (as well as maximum blowdowns that return larger volumes of water to the river) are likely to be rare, one-unit events that would not provide the basis for an increase in the staff's impact assessment of SMALL. See Staff EC 1.2 Direct Testimony at 79.

[17] Certainly this is the case relative to Drought Level 4, a scenario that Mr. Sulkin suggested needed to be assessed, as well as the absolute "worst case" scenario in which the water level in the reservoir pool is so low that USACE is unable to allow any Thurmond Dam discharge, see Tr. at 938-39.

[18] On the matter of water flows, while not mentioned in Joint Intervenors proposed findings, see supra note 12, in his testimony Dr. Young also raised an issue about the degree to which the FEIS dealt adequately with the question of aquatic species pre-adaption to large variations in flows, given it did not distinguish between the impacts of natural and human-induced variability. In support of this proposition, Dr. Young cited several scientific articles he asserted establish that human-induced variability, combined with related

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c. "Lower Baseline" for "Special Status Species"

4.48 In their proposed factual findings and legal conclusions, Joint Intervenors also suggest that in the context of this contention it should be recognized that what they refer to as "special status species," i.e., species that are threatened, endangered, or of concern under state or federal law, "are considered 'rare' and therefore vulnerable to unacceptable impacts from construction and operation of nuclear power plants. In other words, special status species have a low baseline, whether caused by natural occurrences or human activities." Joint

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[18](...continued)
anthropogenic stressors such as entrainment mortality, is a primary cause of decreased freshwater biodiversity, and declared that the Thurmond Reservoir is one cause of the native species decline because it eliminates extremely low flows. See Young EC 1.2 Direct Testimony at 9; Young EC 1.2 Rebuttal Testimony at 7. Although it seems apparent that flow variability is an important factor in maintaining a healthy and diverse aquatic riverine ecology, see Staff EC 1.3 Rebuttal Testimony at 23-24, the articles cited by Dr. Young, which concern either the impacts of impoundments and other large-scale aquatic environment modifications, see Exh. JTI000016, at 912 (Caryn C. Vaughn & Christopher M. Taylor, Impoundments and the Decline of Freshwater Mussels: A Case Study of an Extinction Gradient, 13 Conservation Biology 912 (Aug. 1999)); Exh. JTI000018, at 183 (P.J. Cosgrove & L.C. Hastie, Conservation of Threatened Freshwater Pearl Mussel Populations: River Management, Mussel Translocation and Conflict Resolution, 99 Biological Conservation 183 (2001)); Exh. JTI000019, at 475 (James B. Layzer & Edwin M. Scott, Jr., Restoration and Colonization of Freshwater Mussels and Fish in a Southeastern United States Tailwater, 22 River Res. & Applications 475 (2006)), or a hypothetical aquatic species extinction rate based on general habitat deterioration, see Exh. JTI000017, at 1220 (Anthony Ricciardi & Joseph B. Rasmussen, Extinction Rates of North American Freshwater Fauna, 13 Conservation Biology 1220 (Oct. 1999)), provide no basis for concluding that these events, in combination with entrainment/impingement/thermal impacts such as those involved for Vogtle Units 3 and 4, create a situation in which species cannot adapt so as to constitute a primary cause of decreased Savannah River biodiversity. This is particularly so in light of the existing daily flow fluctuations in the VEGP facility vicinity, including recent drought-related low-flow conditions and periodic high-flow releases per a USACE-initiated river management program; the relatively minor impact the Vogtle 3 and 4 units will have on the overall river level; and a staff-cited study that concluded very large flow reductions, far in excess of those expected for the additional Vogtle facilities, need to occur in a river the size of the Savannah River before fish populations will be affected. See Staff EC 1.2 Rebuttal Testimony at 22-25 (citing Exh. NRC000054, at 13 (Brian D. Richter & Gregory A. Thomas, Restoring Environmental Flows by Modifying Dam Operations, 12 Ecology & Soc'y 12 (2007)); Exh. NRC000027, at 447 (Mary C. Freeman & Paula A. Marcinek, Fish Assemblage Responses to Water Withdrawals and Water Supply Reservoirs in Piedmont Streams, 38 Envtl. Mgmt. 435 (2006)).

Intervenors Proposed Findings at 11. Both SNC and the staff contest this approach, asserting that Joint Intervenors have not shown how the purported "rarity" or "low baseline" attributed to these species has any relevance vis a vis the adequacy of the staff's impingement/entrainment/thermal impact assessments. See SNC Reply Findings at 4-6; Staff Reply Findings at 7.

4.49 We find that we cannot accept these "special status species" or "low baseline" characterizations either. Initially, we note that we are unaware of any case law that indicates the mere existence of an endangered/threatened species in the area of a proposed project necessarily mandates a finding that the species is, by reason of its protected status, automatically "vulnerable" to that project. To be sure, the presence of what the staff denotes as "important" creatures in the vicinity of a proposed project merits close scrutiny (1) to identify any potential interactions between the project and those species, as well as the potential impacts of those interactions relative to the species; and (2) if impacts can occur, to assess whether those impacts will be SMALL, MODERATE, or LARGE by reason of measures that can, or cannot, mitigate or eliminate those impacts. Clearly, this is not the same as a declaring such a species per se "vulnerable" to a proposed project.

4.50 It should be added that the process that occurred in this proceeding reflects this approach. We explore in the sections that follow below the details of how the staff carried out its analysis relative to the potential impacts of impingement/entrainment/thermal discharge on important species, but note here one example of the assessment process, as it was properly undertaken in this instance, that seems to belie, if not run directly counter to, the Joint Intervenors attempt necessarily to equate "rare" with "vulnerable." Relative to one of the important species implicated here -- the shortnose sturgeon -- the staff, acting in accord with its NEPA/Endangered Species Act (ESA) consultation responsibilities, requested and obtained

from the National Marine Fisheries Service (NMFS), as the designated authority for the shortnose sturgeon, see Testimony of Dr. Charles C. Coutant on Behalf of [SNC] Concerning [EC] 1.3 (fol. Tr. at 951) at 10 [hereinafter Coutant EC 1.3 Direct Testimony],[19] that organization's assessment of the impact of the proposed action of issuing an ESP for Vogtle Units 3 and 4 upon that species.[20] That letter states "[t]here is no designated critical habitat in or near the project area" and "this proposed action is not likely to adversely affect shortnose sturgeon." Exh. SNC000022, at 3-4 (Letter to William Burton, NRC, from Roy E. Crabtree, Ph.D., Regional Administrator, NMFS (Aug. 11, 2008)) [hereinafter NMFS Consultation Letter]. Thus, while the status of a species as "important" because of its relative rarity wins it particular scrutiny in the context of an impacts assessment associated with a project, that does not mean that species vulnerability to that project must be assumed in assessing the NEPA implications of the project, regardless of the factual circumstances involved.[21] See also Tr. at 1048-49 (Dr.

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[19] In citing this testimony relating to contention EC 1.3, we note, as is apparent from our discussion in section IV.B.5.a below, that the matter of the "special status species" at issue under contention EC 1.2 is not dissimilar from the matter of the "extremely sensitive biological resource" that is at issue relative to contention EC 1.3.

[20] Such an assessment was not sought for the robust redhorse, the other fish species whose previously assumed extinction makes it of interest here, because the redhorse is a state-designated species that has not been named as endangered under the federal ESA. See Countant EC 1.3 Direct Testimony at 10.

[21] By the same token, although Dr. Young in his testimony maintains that the staff's FEIS is deficient because it has failed to document the causes of population decline in the Savannah River for at least six fish species that have resulted in this low baseline, see Young EC 1.2 Direct Testimony at 4, we are unable to find this concern to be meritorious. Putting aside his ostensible failure specifically to identify all the species, it is not apparent how the potential impingement/entrainment/thermal impacts of implementing a to-be-built closed-cycle cooling system would depend generally on the past cause or causes of the population decline of a particular species. Nor, given our conclusion for the reasons discussed in this section, that the preponderance of the evidence supports the staff's impacts assessment of SMALL, can we conclude that the facility would contribute a significant added source of mortality so as to make such an analysis potentially relevant. Moreover, as the staff pointed out, in the FEIS it provided information regarding the causes of decline for several important species, specifically eels

(continued...)

Coutant testifies that operation of federal hydropower system and commercial fishing is permitted in areas occupied by endangered salmon).

4.51 With the foregoing general items in mind, we look next to the adequacy of the staff's NEPA assessment of the impacts of impingement/entrainment/thermal discharge in the context of Joint Intervenors challenges to the staff's findings, beginning with impingement.

5. Impingement Impacts

a. Impingement Defined

4.52 Relative to the sufficiency of the staff's impingement impacts analysis that is at issue under this contention, we note initially that, as was discussed in section IV.A.2 above, proposed Vogtle Units 3 and 4 would employ a closed-cycle wet cooling system to dissipate the waste heat that is a byproduct of normal power generation. Notwithstanding the "closed-cycle" nature of this system, some water is lost via evaporation, blowdown, and drift. To replace this water loss, makeup water would be pumped from the Savannah River into the cooling water system for Units 3 and 4 through an intake structure common to both units. See FEIS 1A, at 3-6, 3-8; Staff EC 1.2 Direct Testimony at 33. Traveling screens, typically of 3/8 inch mesh, would be located in the intake structure to prevent debris and large organisms from entering the intake pumps. See FEIS 1A, at 3-8 to 3-9; Staff EC 1.2 Direct Testimony at 32. "Impingement"

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[21](...continued)
(overfishing, seaweed harvesting, loss of adult habitat because of dams, dredging and wetland destruction, and migration past dams and water intakes), and striped bass (Savannah River harbor modifications), and noted recruitment problems with juvenile shortnose sturgeon associated with nursery habitat water quality degradation. See Staff EC 1.2 Rebuttal Testimony at 9-10. We also fail to see the relevance of this concern relative to the robust redhorse, given that the apparent reasons for that species survival challenges, including water quality degradation, overharvesting in the late 1800s, introduction of non-native species, sedimentation from poor land use practices, development of hydropower facilities, and the presumed low number of wild individuals as opposed to introduced individuals, see Robust Redhorse Conservation Strategy at 8-10, bear no relationship to the impacts of a closed-cycle cooling system.

occurs when aquatic organisms, most typically fish, macroinvertebrates, shellfish, and aquatic macrophytes, collide with and are trapped against these cooling system intake screens by the force of the water drawn into the system. This ultimately can result in the starvation, exhaustion, asphyxiation, and descaling of an aquatic species. See FEIS 1B, at 5-29 to 5-30; Staff EC 1.2 Direct Testimony at 32.

b. RG/ESRP Guidance re Assessment of Impingement Impacts

4.53 Regulatory guidance associated with the staff's NEPA assessment of the potential impacts of any impingement that may be attendant to a license application for a proposed facility is found in ESRP Section 5.3.1.2, Aquatic Ecosystems. This ESRP provision states that the scope of the review should include an analysis of the effects of impingement in sufficient detail to allow the reviewer to predict potential impacts on "important species" and to evaluate the potential significance of such impacts. 1999 ESRP at 5.3.1.2-1. According to this guidance, this determination involves the evaluation both of station-related factors that influence impingement loss rates as well as life history data for the various species present that would provide information indicating their susceptibility to impingement. The reviewer is to determine, based on the cooling system being employed (e.g., closed-cycle or once-through), the system intake design, and the life history data if the effects of impingement on "important species" would be destabilizing or noticeably alter population levels. See id. at 5.3.1.2-5 to -7. The ESRP directs that the reviewer also draw on the experience of comparable, currently operating power stations to assist in the impact prediction. See id. at 5.3.1.2-6. The ESRP further states that "[i]n the most practical terms, the reviewer's final evaluation is determined through professional judgment based on the pertinent data and analyses." Id. at 5.3.1.2-5. If, according to the staff, "the reviewer determines that the effects of impingement would not be detectable or

noticeably alter population levels, then the reviewer is to state that conclusion and the review is completed." See Staff EC 1.2 Direct Testimony at 36.

c. Adequacy of Staff Impingement Assessment and Conclusions

4.54 According to the staff, its conclusion in section 5.4.2.9 of the FEIS that impacts due to impingement on the intake screens to fish and shellfish populations in the vicinity of the site would be minor was based on six factors: (1) the planned low through-screen intake velocity of less than 0.5 fps at the minimum river water level of seventy-eight feet; (2) the applicant's use of closed-cycle cooling, which reduces river water withdrawal substantially; (3) a calculated intake canal flow velocity toward the intake screens of about 0.1 feet per second; (4) an evaluation of life history, distribution, and abundance data of aquatic species, including "important species" inhabiting the Middle Savannah River; (5) the past absence of significant impingement episodes at the existing intake of Vogtle Units 1 and 2 and information collected during NRC site visits; and (6) the results of the SRS impingement study. See id. at 35.

4.55 With one exception, Joint Intervenors have mounted no challenge to the staff's FEIS impingement findings in their proposed legal and factual findings. The exception relates to statements in the 1998 NMFS recovery plan for the shortnose sturgeon that make mention of impingement events involving the sturgeon and power plants, including the Salem nuclear power plant in New Jersey. See Joint Intervenors Proposed Findings at 12-13 & nn.53-54 (citing Exh. JTI000026, at 53, 55 (NMFS, U.S. Dep't of Commerce, Final Recovery Plan for the Shortnose Sturgeon *Acipenser brevirostrum* (Dec. 1998) [hereinafter NMFS Recovery Plan]); see also Young EC 1.2 Rebuttal Testimony at 8. While the NMFS plan cited by Joint Intervenors does reference impingement episodes involving the sturgeon, it says nothing about any shortnose sturgeon impingement situation at the Vogtle facility. Indeed, these Joint Intervenor-framed NMFS concerns about sturgeon impingement are entirely gainsayed by that

agency's stated assessment that Vogtle Units 3 and 4 will have no significant impact relative to the shortnose sturgeon. See supra section IV.A.4.c. We thus are unable to find that the NMFS recovery plan provides any basis for revising the staff's impingement impact assessment finding.

4.56 In addition, Joint Intervenors witness Dr. Young raised questions, although not reiterated in their proposed findings, see supra note 12, regarding the adequacy of the baseline data and the range of river flows supporting the staff's assessment, see Young EC 1.2 Direct Testimony at 4, 9. We previously have addressed these items in sections IV.A.4.a, IV.A.4.b above, and find they provide no basis for modifying the staff's finding of minor impacts from impingement.

d. Role/Adequacy of SNC Impingement Study

i. Description of SNC Impingement Study

4.57 Separate from the staff's impingement impact assessment efforts, beginning in March 2008 SNC began a study of the impingement associated with the operation of its existing Vogtle Units 1 and 2, with the intent to infer an impingement rate for the similarly designed intake structure for proposed Units 3 and 4. See Exh. SNCR00004, at 3, 5 (Interim Report of Fish Impingement at the Plant Vogtle Electric Generating Plant (Jan. 2009)) [hereinafter SNC Impingement Study]. The impingement study, conducted at SNC's request and under its direction by Georgia Power Company, "was designed as a 12-month study encompassing twice per month sampling" of the material collected from the traveling screen screen-wash system for Vogtle Units 1 and 2. Id. at 3. The traveling screens, which continually rotate at a rate of approximately five feet per minute, collect debris that is then washed by water spray into the trash basket. The screen wash water is then returned to the intake structure. See id. at 7-8.

4.58 Each sampling event consisted of a twenty-four-hour period divided equally into two twelve-hour samples: a day sample and a night sample. Prior to a sampling event, the screens were rotated for a full rotation cycle. Then an insert net was positioned in the system to catch material washed off the screens. After each of the traveling screens was rotated and washed over the course of the twelve-hour sample, the net was manually removed. See id. at 9-10.

4.59 Fish and shellfish were separated from other debris and then sorted by species. Samples either were preserved in formalin and transported to an offsite laboratory or were processed onsite. The weight and length of each organism was recorded during processing. From this data, the estimated impingement rate for a time period was calculated by multiplying the average impingement rate per day times the number of days within that time period (approximately two weeks). The study participants also collected data on the sampling events for quality control purposes in accordance with Georgia Power Environmental Laboratory procedures, as well as data on intake water flow rates, ambient water temperature, ambient air temperatures, river stage and discharge, and precipitation. See id. at 10-12.

4.60 Prior to the March 2009 evidentiary hearing in this proceeding, SNC submitted the interim report of its impingement study, which represented data from twenty out of twenty-four collection periods (i.e., a ten-month interval). See id. at 10, 13. The study was expected to be completed at the end of February 2009. See id. at 3. From March 2008 to December 2008, a total of 157 organisms representing twenty-one species had been collected, none of which were protected species. See id. at 13. The total impinged biomass collected in the sampling process was 865.2 grams (1.9 pounds). See id. at 14. SNC witness Mr. Dodd, who participated in the design, implementation, and analysis of the study, see Dodd/Montz EC 1.2 Direct Testimony at 5, used this information to extrapolate the ten-month data to a total

365-day impingement rate of 2421 fish at an approximate weight of 30.1 pounds of biomass, see Tr. at 633. SNC thus concluded that "Plant Vogtle's Unit 1 & 2 ten-month impingement mortality effect on the fish population of the Savannah River is likely[ ] highly insignificant even when considering the addition of a second similar intake structure for Vogtle Units 3 & 4." Dodd/Montz EC 1.2 Direct Testimony at 8; see also SNC Impingement Study at 17.

ii. Adequacy of SNC Impingement Study

4.61 Joint Intervenors raised no specific concerns about the SNC impingement study in their proposed findings and conclusions, see supra note 12, but in his prefiled testimony, Dr. Young noted that the study did not include a full year's worth of data. See Young EC 1.2 Rebuttal at 8. While this point is certainly worthy of consideration given the staff's ESRP guidance, see 1999 ESRP at 2.4.2-6, as we review the matter in this particular instance, given the study by all appearances was well-planned and executed, we do not find that its ten-month duration at the time it was submitted for the record constitutes a material deficiency significant enough to lead us to discount it in its entirety.[22] Certainly, nothing on the record contradicts the results of the Units 1 and 2 impingement study, which fully supports the staff finding that the aquatic environment impacts of impingement from Vogtle Units 3 and 4, both alone and in concert with Units 1 and 2, are likely to be minor.

[22] Our determination in this regard should not be taken as downplaying or questioning the importance of the staff's ESRP guidance indicating that a study such as that conducted by SNC needs to include one year's worth of data to reflect seasonal variations in aquatic populations. An applicant that submits a study that does not meet this guidance does so at its peril, creating the real risk that it may expend considerable monetary and personnel resources without purpose.

6. Entrainment Impacts

a. Entrainment Defined

4.62 Also at issue under this contention is the sufficiency of the staff's findings that entrainment of aquatic species via the common makeup water intake for proposed Vogtle Units 3 and 4 would have only minor impacts on the aquatic environment. "Entrainment" occurs when aquatic organisms are carried into the cooling system. In contrast to impinged aquatic organisms, aquatic organisms that become entrained are normally relatively small benthic (bottom organisms), planktonic (surface organisms), and nektonic (water column organisms) forms, including the early life stages of fish and shellfish that often serve as prey for larger organisms. Because of their small size, these organisms generally are not impeded by the intake screens that result in species impingement, but entrainment nonetheless is most often lethal due to the mechanical, thermal, and toxic stresses that the organisms are exposed to as they pass through the cooling system. See FEIS 1B, at 5-30; Staff EC 1.2 Direct Testimony at 33.

b. RG/ESRP Guidance re Assessment of Entrainment Impacts

4.63 In assessing entrainment impacts, in addition to the guidance described in section IV.A.5.b above relative to impingement, as it is pertinent here the ESRP indicates that the reviewer is to determine initially if the facility "is being located at a site close to an existing nuclear facility." 2007 ESRP at 5.3.1.2-6. If it is, then the ESRP specifies that the reviewer should "[d]etermine whether the applicant has a current [National Pollutant Discharge Elimination System (NPDES)] permit with a Clean Water Act Section 316(b) determination, if appropriate, or equivalent State permits and supporting documentation." Id. If no section 316(b) determination is available, the ESRP instructs the reviewer to "[i]dentify the 'important' aquatic organisms and their life stages susceptible to . . . entrainment." Id.

at 5.3.1.2-6 to -7. Following the determination that "important" aquatic species are present and susceptible to entrainment, the reviewer is instructed to "[e]stimate the levels of susceptibility in either qualitative or quantitative terms, or both" and to "estimate the survival rates for those species entrapped, impinged or entrained by relying on experience at other stations." Id. at 5.3.1.2-7. ESRP section 5.3.1.2 also instructs the reviewer to "[a]ssume 100% mortality for all entrained biota." Id. at 5.3.1.2-8.

c. Adequacy of Staff Entrainment Assessment and Conclusions

4.64 Although the proposed Vogtle Units 3 and 4 are adjacent to the existing Units 1 and 2 that are closed-cycle cooling systems and have an NPDES permit, the existing units do not have a Clean Water Act section 316(b) determination. Because there was no specific entrainment data available from the adjacent VEGP Units 1 and 2 at the time of preparation of the FEIS and because those units did not have a section 316(b) determination, in accord with the ESRP guidance the Staff estimated the levels of susceptibility to entrainment of aquatic organisms that would be impacted. See Staff EC 1.2 Direct Testimony at 48; FEIS 1B, at 5-30 to -32. As was the case with its impingement analysis, having identified "important" species present that would be susceptible to entrainment, including the shortnose sturgeon and the robust redhorse by reason of their respective federal and state endangered species designations, the staff continued with its analysis under ESRP section 5.3.1.2, ultimately concluding that, even assuming 100 percent of the organisms entrained in the cooling water

system for proposed Units 3 and 4 (as well as existing Units 1 and 2) would not survive,[23] the impacts from entrainment would be minor. See FEIS 1B, at 5-32.

4.65 A number of factors are cited by the staff as the basis for this determination. Noting that the amount of water withdrawn from the source waterbody greatly influences the degree to which entrainment affects aquatic biota, factors cited by the staff as important support for its conclusion included SNC's use of a closed-cycle cooling system, the design and location of the cooling intake canal and structure, including its placement along a straighter portion of the river (as opposed to near an oxbow where larval densities are significantly greater), and the use of a weir wall and skimmer wall at the mouth of the intake. See Staff EC 1.2 Direct Testimony at 46, 48-55; Staff EC 1.2 Rebuttal Testimony at 18. The staff also considered previous sampling data, the high fertility of most species inhabiting rivers, and the high natural mortality rates of eggs and larvae. See Staff EC 1.2 Direct Testimony at 46. Also of significance to the staff are previous sampling relating to SRS operations, which it concluded indicated that historic operations of the SRS intake did not have a discernable impact on fish species in the Savannah River despite water withdrawals much greater than those anticipated for Vogtle Units 3 and 4, and the 1985 FES associated with the licensing of Vogtle Units 1 and 2, which assumed a uniform distribution of drift organisms and found entrainment would have an insignificant effect on drift organisms. See id. at 50-52. Moreover, with respect to important species, as described

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[23] Notwithstanding this presumption of 100 percent mortality, in his testimony Dr. Young challenges the adequacy of the FEIS regarding entrainment on the basis that there is not enough life histories information to identify which species would be entrained. See Young EC 1.2 Direct Testimony at 5. From our perspective, the FEIS discussion described in the staff's testimony, see Staff EC 1.2 Direct Testimony at 56-58, resolves this concern. The 100 percent mortality presumption also appears to resolve Dr. Young's related concern about the inability of some larval fish to overcome the predicted water intake velocity. See Young EC 1.2 Direct Testimony at 6. Of course, as the staff points out, see Staff EC 1.2 Rebuttal Testimony at 6, the relevance of this concern is not apparent since it provides nothing, in the context of Joint Intervenors challenge to the adequacy of the staff's entrainment impact analysis, that addresses the central issue of the number of larval fish that might be entrained.

in section IV.A.4.c above, of import to the staff is the NMFS concurrence with the staff's conclusions regarding impacts to the shortnose sturgeon, including the staff's assumptions related to the potential loss of shortnose sturgeon eggs and larvae. See id. at 59.

4.66 Also of importance to the staff, as was discussed in section IV.A.4.b above, is the question of the impact of river flow rates on entrainment and the EPA five percent withdrawal factor. While observing that entrainment impacts (and possibly impingement impacts) could increase under very-low-flow conditions, the staff determined that such flows and subsequent losses would be temporary and are unlikely to have any persistent long-term impacts on populations of aquatic organisms in the Savannah River. See id. at 73-74.

4.67 The staff also testified that the SNC 2008 study concerning the hydraulic zone of influence (HZI) at Vogtle Units 1 and 2 further confirmed the staff entrainment analysis. That study indicated that at a river flow of 4482 cfs and a water withdrawal rate of 110 cfs for Units 1 and 2, the Units 1 and 2 intake structure had an area of hydraulic influence of 1.10 acres, of which 0.14 acres extended into the Savannah River and only about 1/6th of the way across the river in the vicinity of the VEGP site. See Staff EC 1.2 Direct Testimony at 60; Exh. NRC000031, encl. 1, at 2 (Letter from J. A. "Buzz" Miller, Senior Vice President, SNC Nuclear Development to NRC Document Control Desk encl. 1 (May 27, 2008) (Impingement and Entrainment Monitoring Update at Plant Vogtle)) [hereinafter Attachment to May 27, 2008 Letter]. As was reflected in the SNC testimony regarding this study, the river flow at the time of the study was representative of average river flows past the site even during a period of drought in the Savannah River, both units were operating at or near 100 percent of their generating capacity, and the cooling water intake structure was operating in its normal pumping configuration. See Dodd/Montz EC 1.2 Direct Testimony at 14-16; Dodd/Montz EC 1.2 Rebuttal Testimony at 3-4. The staff likewise testified that the SNC study was conducted on a day when

the water withdrawal rate for Units 1 and 2 was significantly greater than the typical daily withdrawal rate, or even the maximum observed average monthly withdrawal rate for 2006, so that the conditions under which the study was conducted were conservative for assessing the hydraulic zone of influence. See Staff EC 1.2 Rebuttal Testimony at 20-21. The staff concluded that this study provided additional support for the staff's FEIS conclusion that the proposed Vogtle Units 3 and 4 intake structure would affect only a fraction of the river, comparable to that of Units 1 and 2, so that the vast majority of organisms moving up or down the river would not be adversely affected by the influence of the intake structures. See Staff EC 1.2 Direct Testimony at 60-61.

4.68 Finally, the staff testified that it had become aware of relevant additional sampling data available since the FEIS was issued, one source of which was the SNC entrainment study discussed in section IV.A.6.d below. As the staff noted, the study provided an estimate of an average daily entrainment rate of 1230 organisms (eggs and larva),[24] whereas the estimated daily source water drift abundance was 312,039 organisms. See Staff EC 1.2 Direct Testimony at 59; Exh. SNCR00005, at 23 (Entrainment Assessment at the Plant Vogtle Electric Generating Plant (Oct. 2008)) [hereinafter SNC Entrainment Study]. This suggests that only about one-third of one percent of the organisms in the river's drift community were being entrained. According to the staff, this SNC study information demonstrates that eggs and larvae are several times more numerous in samples from the Savannah River than in samples from the Units 1 and 2 intake canal. The staff also pointed out that the projected entrainment rate

[24] In its direct testimony, the staff cites to SNC's interim report that listed the daily rate as 1302 organisms. See Staff EC 1.2 Direct Testimony at 25 (citing Exh. NRC000030 at 25 (Draft Interim Report of Fish Impingement and Entrainment Assessment at the Plant Vogtle Electric Generating Plant) (Sept. 2008)). On March 6, 2009, SNC notified the Board that it was specifically revising this number from 1302 to 1230. See Notice of Revised Testimony and Exhibit (Mar. 6, 2009) at 1-2.

of 1230 organisms per day was very small compared to the projected entrainment rates of 64,000 organisms per day in 1984, and 71,000 organisms per day in 1985, when the SRS was operating three nuclear production reactors with once-through cooling, as well as a coal plant, that nonetheless did not appear to have an impact on the fishery despite being a much higher rate than has been projected for Vogtle. See Staff EC 1.2 Direct Testimony at 59-60. All this information, according to the staff, supports its conclusion that the impacts of entrainment for Vogtle Units 3 and 4 would be minor. See id. at 60.

4.69 In contesting this staff determination that the entrainment impacts of proposed Vogtle Units 3 and 4 would be minor, Joint Intervenors have made a variety of arguments, some that are outlined in their proposed findings of fact and conclusions of law, and some that are found only in the testimony of their supporting witness Dr. Young. We examine their concerns below.

i. Adequacy of Entrainment Assessment Regarding Shortnose Sturgeon

4.70 In their proposed findings and conclusions, relative to the shortnose sturgeon, a federally designated endangered species, Joint Intervenors assert that, based on (1) the NMFS sturgeon recovery plan that indicates shortnose sturgeon fish and larvae are sometimes impinged/entrained in the various areas they inhabit in the Eastern United States, including the Savannah River; and (2) a 1980s SRS study indicating that shortnose sturgeon larvae were found near the Vogtle Units 1 and 2 facility,[25] it must be assumed there will be some entrainment of these sturgeon by Units 3 and 4. See Joint Intervenors Proposed Findings

[25] Although Joint Intervenors proposed findings suggest that the authors of these surveys "concluded that some sturgeon could be entrained by the [SRS] cooling water intake," Joint Intervenors Proposed Findings at 13, we think a fair reading of the cited pages of the survey supports only a finding that probably two of the seven larval sturgeon found were shortnose sturgeon and they were taken in the river as part of a source water survey in locations that might have brought them into contact with the SRS intake.

at 12-14 (citing NMFS Recovery Plan at 53, 55; Paller Ichthyoplankton Distribution, at 3-112 to -113). Further, notwithstanding the fact that the SRS production reactors have not operated since the early 1990s,[26] Joint Intervenors contend that the effects of the high entrainment rates from the SRS facility's cooling water intake over the years, in combination with the continued operation of Vogtle Units 1 and 2, are still being felt to the extent that the shortnose sturgeon population in the river, for which "'the adult population is increasing, but juveniles are still rare,'" is suffering from a "depleted baseline population" from which it has not recovered. Id. at 13 (quoting FEIS 1A, at 2–90 to -91). As a consequence, entrainment of even a small number of shortnose sturgeon eggs and larvae will be "clearly noticeable and sufficient to destabilize" the species such that the staff's entrainment impacts assessment for proposed Vogtle Units 3 and 4 should have been characterized as LARGE. Id. at 13-15.

4.71 Based on the record in this proceeding, we are unable to endorse Joint Intervenors position in this regard. As is generally the case with the other aquatic species that inhabit the environs in the vicinity of the Vogtle facility, see Staff EC 1.2 Rebuttal Testimony at 14 (agreeing that some individual organisms, particularly those in early developmental stages, will be entrained and lost from the fishery), we certainly are not in a position to say that no shortnose sturgeon larvae will be entrained (or adult sturgeon impinged) as a result of the operation of Units 3 and 4. On the other hand, the record before us supports the staff's finding of minor impacts such that there will be no detectable changes in fish populations attributable to operation of Vogtle Units 3 and 4. Just as we are not willing to assume that this endangered species is per se vulnerable to this project, see section IV.A.4.c above, we also are not

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[26] As Dr. Young noted, the SRS production reactors have been decommissioned. See Tr. at 934. As is outlined in the history of the SRS production reactors that is found on the SRS website, of which the Board takes judicial notice, see 10 C.F.R. § 2.337(f), the last SRS production reactor, the K-reactor, was placed in cold-standby condition in 1993. See [SRS] History Highlights, http://www.srs.gov/general/about/history1.htm (last visited June 19, 2009).

persuaded that, in the face of the NMFS assessment and the apparent increase in adult members of the population, see FEIS 1A, at 2-90 to -91, that the possible entrainment of some small number of sturgeon larvae or eggs will constitute a LARGE impact.

4.72 In making this determination, we should not be read to derogate the importance, which the staff recognized, see Tr. at 1079-81, of any instance in which a facility's operation results in the taking of a member of an endangered species. That is a serious issue. At the same time, we cannot accept the largely unsupported proposition Joint Intervenors espouse in the face of an evidentiary record showing that (1) recognized, reasonably effective measures, including the intake facility's location relative to the river and its design using a weir wall and skimmer wall, will be put in place to forestall such a taking, see Coutant EC 1.2 Direct Testimony at 14-17; Staff EC 1.2 Direct Testimony at 48, 52, 54; Tr. at 699-702, 787-88, 838; (2) the ongoing operation of Vogtle Units 1 and 2, as well as the reasonably contemporaneous entrainment survey by SNC, have provided no indication of any shortnose sturgeon takings, Staff EC 1.2 Direct Testimony at 35, 60; Tr. 631, 705-06; (3) any entrainment impacts by the SRS facility occurred using a different, more intrusive intake system that, in any event, has not been operating for some fifteen years, see Staff EC 1.2 Direct Testimony at 52; and (4) the spawning locations and the egg attachment/larval drift habits of the shortnose sturgeon do not lend themselves to ready interaction with the existing and proposed Vogtle units intake facilities, see FEIS 1A, at 2-89 to -93; FEIS 1B, at 5-41 to -42; Exh. NRC000046, at 179-80 (Alan M. Richmond & Boyd Kynard, Ontogenetic Behavior of Shortnose Sturgeon, *Acipenser brevirostrum,* [1995] 1 Copeia 172)); NRC Staff Testimony of Dr. Michael T. Masnik, Rebekah H. Krieg, Dr. Christopher B. Cook, and Lance W. Vail Concerning [EC] 1.3 (fol. Tr. at 1062) at 15-16 [hereinafter Staff EC 1.3 Direct Testimony]; Tr. at 668-69, 702-03, 767-68. As a

consequence, we see no basis for revising the staff's impact assessment of SMALL relative to its findings associated with the shortnose sturgeon.

ii. Adequacy of Entrainment Assessment Regarding Robust Redhorse

4.73 The other endangered species at issue relative to this contention is the Georgia state-designated robust redhorse. In their proposed findings, Joint Intervenors claim that the staff assessment regarding this species is deficient because it fails to provide sufficient information about the life history of the larval or juvenile robust redhorse. See Joint Intervenors Proposed Findings at 16; Joint Intervenors Reply Findings at 3. Additionally, they assert that the sampling conducted under the SNC entrainment study, while purportedly failing to encounter any robust redhorse specimens in either the source water or intake area samples, did produce unidentified taxa that consisted of twenty percent unidentified members of the catastomid (sucker) family, a classification group that includes the robust redhorse. See Joint Intervenors Proposed Findings at 17 (citing Dodd/Montz EC 1.2 Direct Testimony at 12); Joint Intervenors Reply Findings at 6. According to Joint Intervenors, the fact that the entrained catastomids were post-yolk-sack-larvae, in conjunction with the SNC failure to conduct genetic testing on this taxa to the species level, undermines any significance that might be attributed to the supposed failure of SNC to find any robust redhorse as part of its entrainment study. See Joint Intervenors Proposed Findings at 17; Joint Intervenors Reply Findings at 6.

4.74 Although testimony before the Board suggests that any lack of detailed life history information about this species, in particular its larval stage, could be attributable to its relative rarity, see Tr. at 778, the life history that is provided, which shows a species that does not spawn in the immediate vicinity of the VEGP site and tends to stay in the main channel rather than move toward the shore, see FEIS 1A, at 2-88, FEIS 1B, at 5-36, see also Exh. NRC000017, at 1148, 1152 (Timothy B. Grabowski & J. Jeffery Isely, Seasonal and Diel

Movements and Habitat Use of Robust Redhorses in the Lower Savannah River, Georgia and South Carolina, 135 Transactions of the Am. Fisheries Soc'y 1145 (2006)), when taken in conjunction with the other factors the staff relied upon relative to its entrainment determination, including intake facility location/design and low intake velocities, does not suggest anything about the possibility of entrainment of this fish that would run contrary to the staff's assessment finding of SMALL. Nor do we find Joint Intervenors reliance on the undifferentiated entrainment taxa to be persuasive evidence that a different assessment is merited. Besides the fact that there are eight other catastomid species known to be present in the Middle Savannah River about which we have no information regarding the yolk-sack status of their larvae, see Marcy Savannah River Fishes at 9, but among which the spotted sucker (Minytrema melanops) appears to be the most common in the Vogtle vicinity, see Exh. NRC000002, at 222 (The Academy of Natural Sciences, Report No. 01-16F, 2000 Savannah River Biological Surveys for Westinghouse Savannah River Company (Sept. 2001)); 2001 ANSP Study at 215, the testing done by SNC was state-of-the-art analysis that went as far as practical for egg and larva identification for this type of survey, see Tr. at 630-31.

iii. Adequacy of Entrainment Assessment of American Shad

4.75 While not included in Joint Intervenors findings of fact, see supra note 12, in his testimony Dr. Young raised questions about the FEIS treatment of entrainment relative to the American shad, see Young EC 1.2 Direct Testimony at 8, one of the species the staff identified as commercially important, see FEIS IA at 2-81 to -82. In this regard, Dr. Young challenges the adequacy of the baseline data provided, in particular asserting that the staff's reliance on the demersal nature of shad eggs as concentrated along the bottom of the water column is inadequate given the 1995 SRS study by M. H. Paller, et al., regarding the horizontal distribution of American shad eggs in the drift near the VEGP site, which Dr. Young asserts showed an

abundance of shad eggs toward the western/Georgian bank and supports the proposition that site-specific ichthyoplankton distribution studies near existing or proposed water intakes are important to permit the sensitive resolution of spatial patterns. See Young EC 1.2 Direct Testimony at 8 (citing Exh. JTI000004, at 2 (M.H. Paller, et al., Statistical Methods for Detecting Ichthyoplankton Density Patterns That Influence Entrainment Mortality (1995))). While, as the staff points out, see Staff EC 1.2 Rebuttal Testimony at 16-17, the 1995 Paller report may be seen as supportive of the general proposition that the assumption of uniform distribution, which we discuss in more detail in section IV.A.6.d.iv below, is not realistic, the report's significance here as a basis for extrapolating American shad entrainment impacts relative to Vogtle facility impacts is tempered both by the distance of the Paller test sites some 3.5 miles upriver from the proposed intake structure and the fact that the report assesses the SRS once-through cooling system, which clearly would have larger entrainment impacts than the closed system employed for the Vogtle facilities given the substantial difference in water withdrawal rates.[27]

d. Role/Adequacy of SNC Entrainment Study

i. Description of SNC Entrainment Study

4.76 As was the case with the impingement study discussed in section IV.A.5.d above, in an effort to characterize the current entrainment rate at the Vogtle Units 1 and 2 makeup water intake structure and use that information to infer an entrainment rate for the similarly designed intake structure for proposed Units 3 and 4, again at the request and under the direction of SNC, Georgia Power Company conducted an entrainment study. This study

[27] In this context, Dr. Young also maintains that staff reliance in its FEIS on the lack of American shad egg distribution in river oxbows was not relevant to the staff's impacts analysis, see Young EC 1.2 Direct Testimony at 8, but as the staff notes, this was merely a way of emphasizing the point that, unlike some other species that tend to have greater egg/larval concentrations in oxbows, creeks, or intake canals that are off the main river channel, American shad spawning, and the eggs that result, stay in the main channel so as to be more likely to pass by the VEGP site, see Staff EC 1.2 Rebuttal Testimony at 17.

began in mid-March 2008 and concluded in late July 2008 based on the SNC assessment that this period represented the most biologically productive time period of the year for fish, when the occurrence of planktonic (drift) fish eggs and larvae is most prevalent in the Middle Savannah River. See SNC Entrainment Study at 5-7, 11.

4.77 Relative to the entrainment study, to provide a basis for comparison relative to what was found via the survey of existing documentary information, SNC conducted sampling of the source water in the Savannah River at the VEGP site as well as in the intake canal upstream of the intake pumps for the cooling system make-up water. Samples from both source water and canal water were collected at six-hour intervals and then composited into one twelve-hour "day" and one twelve-hour "night" sample. See Dodd/Montz EC 1.2 Direct Testimony at 8-10; SNC Entrainment Study at 11.

4.78 The river source water was sampled at two locations, one about 300 feet upstream of the present intake for Units 1 and 2, and the other another 0.3 mile upstream at the location of the proposed intake for Units 3 and 4. Each sampling location included a center-channel station and stations about thirty feet from each shore. Paired 500-micron mesh size plankton nets were towed in the river current behind an anchored boat, starting near the river bottom and progressing every five to ten minutes to the surface at one-meter intervals. Relevant environmental conditions, such as river stage and temperature, were recorded for each sampling event. Egg and larvae densities were calculated from the sample counts and the amount of water filtered through the plankton net. Total water column sample time averaged about twenty minutes per station event, while the mean target sample volume for the background samples was approximately 100 cubic meters of water. See Dodd/Montz EC 1.2 Direct Testimony at 9; Coutant EC 1.2 Direct Testimony at 24-25; SNC Entrainment

Study at 12-14, 17. No protected species were collected from the source water. See SNC Entrainment Study at 18.

4.79 The Vogtle Units 1 and 2 intake canal was also sampled March through July, essentially simultaneously with the river sampling. A pump collection system (water pumped from the canal was filtered through a plankton net) was needed there because the velocities in the canal were too low to permit use of the plankton nets. A total of thirty-six ichthyoplankton samples were collected during the study period. Comparison of pump and net collections taken simultaneously in the river indicated that both methods were comparable when viewed in terms of types and numbers of organisms caught per unit volume of water, although there were significantly fewer organisms in the canal water than in the river, and the taxa were different. See Dodd/Montz EC 1.2 Direct Testimony at 9; Coutant EC 1.2 Direct Testimony at 25; SNC Entrainment Study at 21. SNC utilized the data gathered during these sampling events, in conjunction with certain assumptions about the representative nature of the semi-monthly samples, see Dodd/Montz EC 1.2 Direct Testimony at 10-11, to calculate an annual entrainment rate that it ultimately declares shows the entrainment impacts of the new units are SMALL, see Coutant EC 1.2 Direct Testimony at 26. In this regard, as was pointed out in section IV.A.6.c above, the SNC study projected that less than one percent of the drift population in the river would be entrained. See SNC Entrainment Study at 23 (comparing estimated daily entrainment rate of 1230 organisms with estimated daily source water drift abundance of 312,039 organisms). Moreover, no protected species were collected inside the intake canal. See SNC Entrainment Study at 21.

ii. Adequacy of SNC Entrainment Study

4.80 Although Joint Intervenors apparently agree that the plankton net sampling method as utilized for river source water was an effective sampling technique, see Young

EC 1.2 Direct Testimony at 8-9; Tr. at 851, 853, 867, they nonetheless challenge the SNC entrainment study on several other accounts. In their proposed reply findings, Joint Intervenors raise concerns about the timing (biweekly March-July 2008) and number (20) of sampling events relative to the purported "critically depleted baseline populations" of the shortnose sturgeon and robust redhorse populations, which they assert was inadequate to test the impacts of the closed cooling system on these two species so as to validate that these species were not entrained by the Vogtle Units 1 and 2 structure. See Joint Intervenors Reply Findings at 6. In addition, although not raised in Joint Intervenors findings, see supra note 12, Dr. Young expresses concerns in his testimony, as he did relative to the SNC impingement study, about the entrainment study lacking one year of data, see Young EC 1.2 Rebuttal Testimony at 8, as well as contests its accuracy based on (1) a change in survey location from the mouth of the intake canal to the middle of the canal, which would result in undercounting of eggs that were withdrawn from the river and died, but were not counted because they never reached the middle of the canal; (2) the explanation provided by Mr. Dodd and Mr. Montz for not observing any eggs in the entrainment samples, which they attribute to "settling out" in the water column between the mouth of the intake canal and the head of the intake structure due to sediment catchment, but which Dr. Young asserts should have resulted in higher entrainment results because eggs of species like the American shad would likely die; and (3) the taking of significantly fewer samples at the site of the proposed Units 3 and 4 intake, thereby creating an unequal data set. See Young EC 1.2 Rebuttal Testimony at 3-4.

4.81 Relative to the matter of the number and timing/duration of the entrainment sampling events, we are unable to agree with Joint Intervenors that these items are fatal to the efficacy of the survey in this context. The timing/duration matches the period in which an event critical to measuring the impacts of entrainment -- the spawning and egg/larval drift season --

occurs relative to the Savannah River aquatic community. See Dodd/Montz EC 1.2 Direct Testimony at 8. Nor do we find the disagreement over the number of sampling events to be of substance in this instance. As was the case with timing/duration, although the SNC testimony indicates what was done rested on a scientifically sound sampling basis, see Dodd/Montz EC 1.2 Rebuttal Testimony at 2-3; Coutant EC 1.2 Rebuttal Testimony at 5-6, Joint Intervenors would have preferred more. But the basis upon which they assert this is needed, i.e., the purported critically depleted population, is not one for which the evidentiary record provides support. See supra section IV.A.4.c.

4.82 On the matter of the study data not covering a year, as a practical matter, the purpose for which the one-year collection guidance was established seems to have been fulfilled in this instance. As ESRP indicates, 1999 ESRP at 2.4.2-6, the one-year sampling regimen is intended to ensure that the data "reflect[s] seasonal variations in aquatic populations." While this makes perfect sense as a general matter, relative to entrainment impacts, the critical period is March through June, see Staff EC 1.2 Direct Testimony at 56, which, as we noted above, see supra section IV.A.6.d.i, is the period SNC targeted the study to encompass. Under the circumstances, we see no cause for refusing to consider this study on that basis alone.

4.83 With respect to the intake canal survey location change and egg sampling, it turns out these concerns have a common theme, as both depend on the definition of what is an entrainment for the purpose of a NEPA impacts analysis. SNC witness Mr. Dodd explained that the location change after the first sampling session to move the sampling station closer to the cooling water system intake was done principally to account for the presence of eddies at the mouth of the intake canal that were perceived to be impacting the scientific/technical objectivity of the sampling in terms of it being representative of aquatic material that is actually entrained,

i.e., that is subject to the plant's cooling system, as opposed to material that simply goes into the intake canal. See Tr. at 624-27. By the same token, the "settling out" explanation for the lack of eggs in the entrainment water samples, as compared with the abundance found in the study's source water samples, appears not to be an SNC concern because it does not consider such material to have been "entrained," given it would only be in the intake canal without being subjected to the cooling water system. See Tr. at 628-30. Dr. Young, however, has a different perspective, since he considers an assessable entrainment to be any egg mortality that arises as a result of leaving the source water flow and entering the intake canal, whether it occurs in the intake canal because of sediment catchment or because the egg actually enters the cooling water system. See Tr. at 838-42.

4.84 The SNC decision to move the sampling station to avoid the eddies' impact on the scientific validity of its survey was a determination based on sound technical judgment. At the same time, we think Dr. Young's point about consideration of intake canal "settled out" eggs as part of an entrainment impact assessment has some merit as an analytical matter, given the intake canal that can induce this effect is created, like the cooling system itself, to support Vogtle facility operation.

4.85 That being said, we nonetheless conclude, based on the record before us, that such a possible impact does not invalidate the staff's NEPA assessment in this instance. Dr. Young's egg mortality concern was directed principally to the American shad, whose eggs he identified would suffer mortality in such a sediment catchment situation. See Tr. at 839. Given the fecundity of that species, see Tr. at 727-28, 735 (9.3 million American shad eggs would be produced in a year in the river that potentially could be drifting past the Vogtle facilities), and the demersal characteristics of American shad eggs that causes them to stay near the bottom, see FEIS 1A, at 2-82; Staff EC 1.2 Direct Testimony at 54; Exh. NRC000036, at 63 (McFarlane, et

al., Impingement and Entrainment of Fishes at the Savannah River Plant (Feb. 1978)); Dodd/Montz EC 1.2 Rebuttal Testimony at 6, the SNC position attributing the lack of entrained shad eggs identified by the SNC study to the design characteristics of the intake canal, as opposed to pre-intake egg mortality caused by "settling out," has more persuasive support in the evidentiary record.

4.86 Finally, as to Dr. Young's criticism of the adequacy of the source water portion of the SNC entrainment survey as having taken fewer samples from the river near the location for the proposed Units 3 and 4 intake structure (approximately eleven percent) than from the river near the current site of the Units 1 and 2 intake canal (approximately eighty-nine percent), see SNC Entrainment Study at 18, under the circumstances here, as outlined in the record, in which the stretch of river bank in which this structure will reside is uniformly unremarkable in terms of features that might have a particular effect on the assessment of the egg/larval drift, see Staff EC 1.2 Rebuttal Testimony at 19 (site not located in biologically unique stretch of river), we find this concern without substance.

iii. Adequacy of SNC HZI Survey

4.87 Although not challenged in Joint Intervenors proposed findings, see supra note 12, Dr. Young also raised questions in his prefiled testimony about the adequacy of the SNC HZI survey, which was conducted to provide a better understanding of the area of the river influenced by the withdrawal of water into the cooling system. See Dodd/Montz EC 1.2 Direct Testimony at 14. Specifically, Dr. Young asserted that this study lacked sufficient data and analysis because it was conducted while Units 1 and 2 were operating at fifty-six percent of capacity during a limited range of river flows, instead of at full capacity and during different flows to ensure differing water intakes were modeled (e.g., operation at 100 percent capacity will require more water withdrawal) thereby increasing the HZI and the accompanying increased

intake velocities further into the river channel. See Young EC 1.2 Direct Testimony at 10; Young EC 1.2 Rebuttal Testimony at 4. Before assessing this concern, we provide a brief explanation of the survey methodology and its results.

(1) Description of HZI Survey

4.88 As a complement to SNC's 2008 impingement and entrainment surveys, on May 7, 2008, SNC personnel performed an HZI survey at the intake structure for Vogtle Units 1 and 2. The purpose of the survey was to measure the extent of the HZI by "measuring and recording deviations in the magnitude, direction, and velocity of river flow." Dodd/Montz EC 1.2 Direct Testimony at 14. The idea is to map-out what portion of the river is impacted or influenced by the flow of water into the intake canal. See id. at 15 (HZI boundary determined where water velocities and vectors are not influenced by VEGP intake structure).

4.89 SNC personnel used a boat-based Acoustic Doppler Current Profiler (ADCP) to collect river flow data. They navigated a boat parallel to the Savannah River shoreline, collecting information at eleven transects, which were established at ten-foot intervals beginning at the intake canal and extending into the Savannah River at mid-channel. When the measurements indicated that the water velocities and vectors were unrelated to the intake structure, the boundary of the HZI was established. See id. at 15.

4.90 During the survey, three intake pumps were operating, as compared to the use of two intake pumps in typical operations, and the intake flow was 110 cfs.[28] The average flow of

[28] This number represents 56 percent of the full capacity of the intake structure flow, but it is typical, slightly higher even, than flows during normal operations at Vogtle. See Dodd/Montz EC 1.2 Rebuttal Testimony at 4; Staff EC 1.2 Rebuttal Testimony at 21. The intake structure for Vogtle Units 1 and 2 is designed to take almost double the capacity of what is typically used. See Dodd/Montz EC 1.2 Rebuttal Testimony at 4; Staff EC 1.2 Rebuttal Testimony at 21; Attachment to May 27, 2008 Letter at 2.

the river was 4482 cfs. The average flow of the river was measured both before and after the survey, with measured flows varying by less than two percent. See id. at 15.

4.91 Based on the measurements, SNC concluded that the HZI for Vogtle Units 1 and 2 "occupied an area of 1.10 acres, which includes the entire VEGP intake canal and a small portion of the Savannah River." Id. at 15-16. The small portion of the Savannah River amounted to "a distance of approximately fifty feet from the mouth of the intake canal (or about 13 percent of the total distance across the river channel and proximal to the mouth of the canal)." Id. at 16; see also Attachment to May 27, 2008 Letter at 2, 4.

(2) Adequacy of HZI Survey

4.92 Relative to Dr. Young's challenge to the HZI survey, as Mr. Dodd and Mr. Montz indicated, see Dodd/Montz EC 1.2 Rebuttal Testimony at 3-4, when the HZI determination was conducted at Plant Vogtle, Unit 1 was operating at 100 percent of its generating capacity, while Unit 2 was operating at 98.1 percent of its generating capacity, and the cooling water intake structure was operating in its normal pumping configuration. Of the four pumps that are available to the cooling water system, during normal operation (i.e., plant at full load) of the intake structure, one pump operates for each unit (two pumps total), a third pump operates intermittently as needed to adjust cooling tower basin water levels and for waste dilution, and a fourth pump is kept in standby should one of the other three pumps require maintenance. According to Messrs. Dodd and Montz, the fifty-six percent capacity to which Dr. Young referred was simply the ratio of the daily withdrawal rate reported by Plant Vogtle for Units 1 and 2 (71.24 million gallons per day (MGD)) for May 7, 2008, to the theoretical limit of all four pumps operating at full design capacity (127 MGD). Regardless of this figure, however, they maintained that on the day the HZI determination was conducted, the plant was operating three of the four cooling water intake pumps, which is the normal mode of operation at full power

generation. Given this unrebutted testimony, the sufficiency and relevance of which the staff fully supports, see Staff EC 1.2 Direct Testimony at 60-61; Staff EC 1.2 Rebuttal Testimony at 21, we see no basis for crediting Dr. Young's concern in this regard.

4.93 Regarding Dr. Young's assertion that an insufficient range of flows were analyzed, Messrs. Dodd and Montz maintain that the HZI survery was conducted during a period of prolonged drought that was, at a minimum, representative of average river flows during 2008 under normal cooling water withdrawal rates. According to these SNC witnesses, Savannah River flows averaged 4482 cfs on the day the HZI determination was conducted, while for 2008, the average daily flow in the Savannah River at Plant Vogtle was approximately 4950 cfs, which can be contrasted with the average daily flow in the Savannah River from January 22, 2005, to December 31, 2008, which was 7173 cfs, or about 44.7 percent greater than the 2008 average flow. See Dodd/Montz EC 1.2 Rebuttal Testimony at 4 (citing USGS, http://waterdata.usgs.gov/nwis/ and Exh. SNC000053 (Daily Average Discharge USGS021973269 Savannah River Near Waynesboro, Georgia) (calculation based on tables and charts reflecting daily average discharge at USGS gauge 021973269, on the Savannah River near Waynesboro, Georgia)). Given this unrebutted testimony, which the staff again fully supported, see Staff EC 1.2 Direct Testimony at 60-61; Staff EC 1.2 Rebuttal Testimony at 21-22, as well as our discussion in section IV.A.4.b above regarding the adequacy of the SNC consideration of low-river flows as they impact its various surveys and which roughly correspond to the flow figures extant at the time of the HZI survey, we find no basis for Dr. Young's concerns about the adequacy of the HZI survey in this regard either.

4.94 Consequently, we conclude that the SNC HZI information further supports the FEIS determination that entrainment impacts will be small because only a relatively small

portion of the river would be influenced by water withdrawals from the intake structure for the cooling water system.

iv. Propriety of Staff Use of Uniform Drift Distribution (UDD) in Assessing Entrainment Impacts

4.95 As another part of their challenge to the FEIS entrainment assessment, albeit not as part of their proposed findings, see supra note 12, Joint Intervenors contested the staff's assumption in the FEIS that the drift community near the VEGP site is uniformly distributed, which assumption the staff indicated was based on its review of the 1985 FES for Vogtle Units 1 and 2 that concluded, using a uniform drift distribution (UDD) assumption, that those units would have an insignificant entrainment impact on drift organisms. See Young EC 1.2 Direct Testimony at 6-7 (citing FEIS 1B, at 5-31). For the reasons outlined below we find that the use of this analytical tool in the entrainment analysis for proposed Vogtle Units 3 and 4 was reasonable.

(1) UDD Defined

4.96 Field surveys of drifting aquatic organisms generally show that the distribution of organisms is spatially and temporally variable. See Coutant EC 1.2 Direct Testimony at 43, Young EC 1.2 Direct Testimony at 7. The UDD is a simplifying assumption under which an analyst takes a high-end estimate of the number of organisms in the free-floating drift community in a water sample, which includes entrainable life stages such as eggs and larvae, and assumes that estimate to be the density of organisms in any given sample. See Coutant EC 1.2 Direct Testimony at 41-43. Thus, drift organisms are assumed to be evenly spread out throughout the water column "such that any x% of the water will contain x% of the drift community within it," and "the drift from all species would be entrained equally." Moorer EC 1.2 Direct Testimony at 9.

(2) Adequacy of Staff Data/Analysis Supporting Employing UDD

4.97 Joint Intervenors witness Dr. Young challenges the staff's use of the UDD on the basis that drift distributions in general and the drift distribution in the Savannah River in particular are, in fact, nonuniform. See Young EC 1.2 Direct Testimony at 7; Tr. at 842-43. We agree with SNC and the staff, however, that the UDD was appropriate for estimating entrainment impacts at the VEGP site because it is both commonly used and conservative. See SNC Proposed Findings at 33-34; Staff Proposed Findings at 38-39.

4.98 In support of the position that UDD is a commonly used assumption, staff witnesses noted that both relevant EPA regulations and the original FES associated with the Vogtle Units 1 and 2 10 C.F.R. Part 50 operating license also assume a UDD. See Staff EC 1.2 Direct Testimony at 53, 55-56. Further, SNC witness Dr. Coutant noted that in the NEPA analysis context, the details of distribution only become important if a MODERATE or LARGE impact is predicted using the UDD. See Coutant EC 1.2 Direct Testimony at 41. For their part, Joint Intervenors presented no evidence of any instance in which a more in-depth distribution analysis was being used where only a SMALL impact was predicted.

4.99 SNC and staff witnesses also presented evidence showing that the UDD is a conservative assumption for estimating entrainment impacts at the VEGP site. First, some species spawn in nests so that their eggs do not regularly enter the drift community. See Tr. at 667-68. Second, the eggs and larvae of some fish species, including sturgeon, tend to sink to the bottom of the water column, and SRS studies showed that egg concentrations are generally higher near the bottom of the river. See Staff EC 1.2 Direct Testimony at 53-54, Tr. at 668-69. Because the proposed intake structure for Vogtle Units 3 and 4 includes a weir wall and skimmer wall that would result in water from the middle of the water column preferentially entering the intake canal, the entrainment impact on species at the top or bottom of the water

column would tend to be lower than the impact predicted using the UDD. See Staff EC 1.2 Direct Testimony at 53-54; Coutant EC 1.2 Direct Testimony at 45-46. Finally, the results of SNC's 2008 entrainment study show that organism density was in fact much lower in the Vogtle Units 1 and 2 intake canal than in the source water. See Coutant EC 1.2 Direct Testimony at 43. Joint Intervenors again produced no evidence to rebut this argument that the UDD results in conservative entrainment estimates.

4.100 We thus conclude that the use of the UDD in the analysis of entrainment impacts for proposed Vogtle Units 3 and 4 was appropriate.

7. Thermal Impacts

4.101 We next turn to the portion of this contention under which Joint Intervenors have questioned the adequacy of the staff's assessment of the impacts of thermal emissions from proposed Vogtle Units 3 and 4. As was noted earlier, see supra section IV.A.2, as is the case with existing Units 1 and 2, as part of their cooling water system, cooling tower blowdown from the Vogtle Units 3 and 4 would be discharged back into the Savannah River through an outlet common to both new units. The discharge outfall for the new facilities would lie some 400 feet downstream from the outfall for the existing facilities, also on the western (Georgia) bank of the river. The heated blowdown water would enter the river from a single submerged pipe three feet from the river bottom angled seventy degrees from the shoreline (albeit pointing toward the center of the channel) and slightly downstream. The GDNR has classified the Savannah River at the VEGP site for fishing water use, so that the water quality standards for temperature are twofold: (1) the heated blowdown is not to exceed 90 degrees Fahrenheit (°F); and (2) at no time is the temperature of the river water receiving the heated blowdown to be increased by more than 5°F above the intake temperature after allowing for a reasonable and limited mixing zone that would not create an objectionable or damaging pollution condition. This defines two

mixing zones, the first being a zone that exceeds 5°F and the second being a zone that exceeds 90°F. See FEIS 1A, at 2-43; FEIS 1B, at 5-17 to -19; Staff EC 1.2 Direct Testimony at 85.

a. RG/ESRP Guidance

4.102 ESRP guidance regarding the cumulative impact analysis for aquatic resources from discharge of heated cooling water associated with nuclear unit operation indicates that the NRC staff's review should include "the analysis of alterations to the receiving water body resulting from plant thermal . . . discharges in sufficient detail to predict and determine the nature and extent of potential impacts on aquatic ecosystems." 1999 ESRP at 5.3.2.2-1. The ESRP also states that "the staff's analysis may be provided by referencing the aquatic biota descriptions of ESRP 2.4.2 and describing in brief detail the effects on biota that are 'important' and susceptible to thermal . . . impact." Id. at 5.3.2.2-10.

b. Adequacy of Plume Assessment

4.103 According to the staff, its conclusions regarding thermal impacts were based on the discharge temperature, the size of the plume that emerges from the discharge pipe, the design and the location of the discharge structure, and the width of the river at the location of the VEGP site. See Staff EC 1.2 Direct Testimony at 84. The central focus of the staff's thermal impacts assessment is the interaction between the heated water in the discharge plume and the aquatic species in the river. Of particular import in this regard is the size and shape of the thermal plume that will be created when the blowdown discharge enters the river and creates a mixing zone in which the cooler river water absorbs the heat from the blowdown. Within the mixing zone or plume, the water temperature may exceed the ambient river temperature by more than 5°F. See FEIS 1A, at 2-43; FEIS 1B, at 5-17. The size of the plume

thus is defined as that region where the temperature of the mixture exceeds the ambient river temperature by more than 5°F. See FEIS 1B, 5-33.

4.104 To determine the extent of this plume, the staff utilized the CORMIX numerical model, an EPA-supported standard computer code for determining regulatory mixing zones from continuous point source discharges, such as are involved for the Vogtle units. Further, to ensure conservatism in this calculation, the staff used a series of inputs designed to maximize the size of the thermal plume, i.e., Drought Level 3 low river discharge (3800 cfs); largest outfall discharge (both Units 1 and 2 and Units 3 and 4 blowdown from the same pipe at 90.5 cfs); and lowest ambient stream temperature (41°F), so as to provide the largest temperature difference between the temperature coming out of the blowdown discharge pipe and the river water. The resulting CORMIX-calculated plume, with a length of ninety-seven feet and a width of fifteen feet, would, after leaving the discharge pipe, be oriented roughly parallel to the river bank as the plume curves downstream with the river flow. See Staff EC 1.2 Direct Testimony at 85; FEIS 1B, at 5-18 to -19, 5-33.

4.105 In addition, the staff evaluated the extent of the mixing zone of the 90°F isotherm, which is only 1°F below the maximum effluent discharge temperature. The same assumptions were made for this analysis except that the maximum rather than the minimum measured ambient river temperature at Shell Bluff Landing (81°F) was used to maximize the size of the mixing zone. The results generated by CORMIX indicated that the maximum downstream extent of the 90°F isotherm would occur at a distance of 0.9 meters (m) (3 feet (ft)) downstream of the outfall pipe. Because of the proximity of the 90°F isotherm to the pipe terminus, the plume had not yet been significantly influenced by the river flow rate, and the lateral extent of the isotherm was greater than the downstream extent. The maximum lateral

extent of the 90°F isotherm from the outfall pipe terminus toward the river centerline was 2.21 m (7 ft). See FEIS 1B, at 5-18, 5-19.

4.106 The staff also made an assessment of the larger 5°F isotherm zone using very low-flow conditions, which would tend to increase the "above 5°F of ambient" mixing zone. With the caveat that it considered each very low-flow scenario an extremely rare, short duration event that would be most unlikely during the spring and early summer spawning periods when there is considerable up and down river traffic of organisms, the staff calculated the plumes for river flows of 3000 cfs and 2000 cfs. In the latter instance, the result was a plume with approximately double the areal extent. See Staff EC 1.2 Direct Testimony at 87-88.

4.107 In both instances, however, the staff concluded that the impacts of the thermal plume on aquatic resources would be SMALL. Given that the river is 312 feet wide at the discharge point, the staff concluded that the 5°F isotherm would occupy between five and ten percent of the river cross section, thereby avoiding any thermal blockage that would impede the movement of fish or otherwise prevent them from acting on their natural instinct to avoid unhealthy waters. Nor did the staff consider "cold shock" a factor of concern. This condition, which occurs when an otherwise warm body of water cools suddenly because a heat source, such as the reactor blowdown from Units 3 and 4, is abruptly curtailed, would not be a major concern, according to the staff, in light of the small size of the plume and the likelihood of the continued operation of Units 1 and 2. So too, the staff found no significant impact for eggs/larvae floating in the water given they would only be a small percentage of the total number of organisms passing through the site and given the small size of the plume, which the staff asserted some could transit without being impacted. Finally, relative to the low-flow and

very low-flow conditions,[29] the staff again noted that Georgia state environmental authorities could intercede to curtail or halt facility operation if the situation warranted. See id. at 86-88.

4.108 In addition to the staff's CORMIX plume size analysis, SNC provided for the record an additional plume analysis generated by mapping the physical size and temperature characteristics of the VEGP thermal discharge plume under what it asserted were typical cooling tower operations with Units 1 and 2 in operation during a period of stable river flow/stage conditions. As described in the testimony of SNC witnesses Dodd and Montz, the inputs from on-the-water surveys conducted using an ADCP, which provides broad-band acoustic echo information, and a Hydrolab Surveyor, which is a multi-array water quality analyzer instrument that records water temperature, were electronically synthesized with a 3-D computer model to illustrate graphically the spatial effects of the hydraulics and temperature characteristics of the Units 1 and 2 thermal plume. The data indicated that the thermal discharge plume occupied a small zone (approximately 100 feet long by 75 feet wide) located immediately downstream of the discharge pipe/outfall. See Dodd/Montz EC 1.2 Direct Testimony; see also Exh. SNC000011, at unnumbered pages 1-4 (Images from Thermal Study depicting river water temperature).

4.109 Although again not the subject of Joint Intervenors proposed legal and factual findings, see supra note 12, some aspects of the staff's thermal impacts assessment were challenged in Dr. Young's prefiled testimony. Initially, he questions whether the plume modeling was adequate given the possibility of lower river flows, which would increase the chance of channel confinement and concomitant vulnerability to thermal stress and mortality. He also

[29] Also in connection with these low flow scenarios, the staff assessed the impact of the AP1000 DCD revision 16 change on the maximum withdrawal figures used to compute consumptive use rates and found that these changes would have no impact on blowdown flow rates or any thermal impacts assessment. See Staff EC 1.2 Direct Testimony at 91.

challenges the purported failure of the FEIS to consider "all possible river conditions" by focusing on conservative conditions and asserts there is a general lack of analysis of potential thermal impacts on vulnerable aquatic creatures life history stages, and a particular lack of analysis of the impact of elevated temperatures on the earlier life stages of such species as the American shad, blueback herring, shortnose sturgeon, and striped bass. Along these same lines, he contests the sufficiency of the SNC plume study as not accounting for ichthyoplankton drift distribution in the plume and not including additional seasons other than summer. See Young EC 1.2 Direct Testimony at 10-12; Young EC 1.2 Rebuttal Testimony at 4.

4.110 We are unable to agree that Dr. Young's claims outweigh the showing of the staff and SNC, as supported in the record, relative to the adequacy of the staff's thermal impacts findings of SMALL. While it is true that the very low-flow conditions about which Dr. Young expresses a concern will expand the warm water plume somewhat, it does not appear that, even if doubled, its size and orientation would result in the sort of thermal barrier that would not allow fish to avoid waters they might find unhealthy. By the same token, the interaction between such a plume and fish eggs/larvae,[30] while causing some losses, is not likely to have a substantial impact on the relevant ecosystem. Assuming they would come into contact with the plume area,[31] some demersal (i.e., sinking) or semi-pelagic (staying in the water column to some extent) eggs/larvae, such as the eggs of the American shad, may very well drift under the more bouyant plume area, while others, such as those of the shortnose sturgeon and striped

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[30] Dr. Young's suggestion to the contrary notwithstanding, see Young EC 1.2 Rebuttal Testimony at 5, because ichthyoplankton drift tends to be concentrated in the spring and early summer time frame, see Coutant EC 1.2 Direct Testimony at 37, Coutant EC 1.2 Rebuttal Testimony at 11, we consider the likelihood of eggs/larvae encountering a very low-flow enlarged plume to be low as well.

[31] For instance, the degree to which eggs/larvae of the shortnose sturgeon or the striped bass even come in the vicinity of the VEGP site is not readily apparent. See Coutant EC 1.2 Rebuttal Testimony at 10.

bass will not be affected because the water temperature of the river and the plume are, at the time of spawning and egg drift in the spring and early summer, not likely to be in the fatal range. See FEIS 1A, at 2-82; Staff EC 1.2 Direct Testimony at 54; Dodd/Montz EC 1.2 Rebuttal Testimony at 5-6; Coutant EC 1.2 Rebuttal Testimony at 8-10. Moreover, for those eggs/larvae moving through the plume at a time when the temperature differential might be unhealthy, by reason of the average stream velocity of 1.5 fps, they are likely to spend less than two minutes in the plume, a period during which eggs/larvae of a species like the blueback hearing and striped bass should not be permanently harmed. See Dodd/Montz EC 1.2 Rebuttal Testimony at 5; Coutant EC 1.2 Rebuttal Testimony at 9-10. These points also address the asserted need for additional analysis relative to particular life histories and for the SNC study to extend to additional seasons other than spring for fish. See Staff EC 1.2 Rebuttal Testimony at 41-43. Thus, we find that the record before us supports the staff's conclusion that the thermal impacts associated with proposed Vogtle Units 3 and 4, both alone and in concert with existing Units 1 and 2, will be SMALL.

8. Adequacy of Cumulative Impacts Analysis

4.111 Finally, in their proposed findings, Joint Intervenors contend that the staff failed to assess adequately the cumulative impacts of Vogtle Units 3 and 4 to the extent it has not assessed or has downplayed the present effects of past actions that have depleted the baseline population of "important species" to the point they are threatened with extinction. According to Joint Intervenors, by asserting that the impacts of proposed Vogtle Units 3 and 4 will be small because the impacts of existing Vogtle Units 1 and 2 have been small, the staff has failed to account for the possibility that individually minor but collectively significant actions are taking place over a period of time. See Joint Intervenors Proposed Findings at 21; Joint Intervenors Reply Findings at 4. In addition, Joint Intervenors maintain, the staff's reliance on the purported

small impacts of a closed-cycle cooling system, as opposed to a once-through cooling system, in the face of SNC testimony identifying three once-through cooling system power stations operating on the Savannah River, makes it likely these three facilities have significant adverse impacts on aquatic species that are totally ignored by the FEIS. See Joint Intervenors Reply Findings at 4-5.

4.112 These claims are essentially a reframing of Joint Intervenors arguments regarding the "low baseline" and "special species" status of certain aquatic creatures, which now seeks to emphasize the possibility that, notwithstanding the staff's findings of minor impacts relative to impingement and entrainment, which we have concluded are supported by the preponderance of the evidence here, those impacts might be "'the straw that breaks the back of the environmental camel,'" Joint Intervenors' Revised Response Statement and Pre-Filed Rebuttal Testimony (March 2, 2009) at 15 (quoting Hanly v. Kleindienst, 471 F.2d 823, 831 (2d Cir. 1972)), such that the proposed VEGP facility, despite its low impacts, must be shelved until, presumably, other facilities currently operating along the river have decreased their impacts to the point that this project no longer would retain its "back-breaking" characteristics.

4.113 Putting aside the issue of whether, as Joint Intervenors now use the term "cumulative," these assertions are within the scope of this contention,[32] in assessing this

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[32] Not every impact to which Joint Intervenors might seek to attach that label is necessarily within the contention's scope. In admitting this contention we found Joint Intervenors had provided sufficient supporting information, in the form of an affidavit from Dr. Young, to support consideration under this contention of "asserted deficiencies concerning the ER impact discussion regarding the intake/discharge structure for the two new proposed facilities -- impingement/entrainment, . . . and thermal discharges, including cumulative impacts from these items associated with the existing Vogtle facilities." LBP-07-3, 65 NRC at 258. As this language denotes, per the supporting material provided by Joint Intervenors, see Intervention Petition at 12-13 (ER does not adequately address the cumulative impacts on aquatic resources of the new cooling system facilities, combined with the current impacts of the existing intake and discharge); id. Exh. 1.3, at 3 ("An additional two units, especially in conjunction with operation of existing units, have the potential for large cumulative impacts on

(continued...)

challenge we think it worth noting that the existing nature of the environment here is not without significance. Joint Intervenors have cited the majority opinion of the United States Court of Appeals for the Second Circuit in Hanley v. Kleindienst for the proposition that an EIS must be attuned to the "camel's back" problem. In that opinion, however, the majority also noted that

> [w]here conduct conforms to existing uses, its adverse consequences will usually be less significant than when it represents a radical change. Absent some showing that an entire neighborhood is in the process of redevelopment, its existing environment, though frequently below an ideal standard, represents a norm that cannot be ignored. For instance, one more highway in an area honeycombed with roads usually has less of an adverse impact than if it were constructed through a roadless public park.

Hanley, 471 F.2d at 831. Thus the fact that, as the staff recognized in the FEIS, see FEIS 1A, at 2-33, there are various existing facilities making withdrawals from the river does not, under the NEPA rule of reason, automatically compel an extensive analysis of how each facility withdrawing water upstream of the proposed Vogtle Units 3 and 4 interacts with the Savannah River environment.

4.114 Even more specifically, however, on the basis of the record before us, it appears Joint Intervenors seek to have us make a finding that is the environmental impact equivalent of the whole being more than the sum of its parts. Notwithstanding the ongoing river water

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[32](...continued)
the Savannah River fish assemblage.") (Declaration of Shawn Paul Young, Ph.D), the cumulative impacts we found subject to consideration under this contention were those associated with the cumulative effects of the existing and proposed Vogtle facilities.

So too, in ruling on the SNC summary disposition request relative to EC 1.2, in connection with Joint Intervenor arguments that material factual disputes existed relative to the effect of river flow levels on impingement and entrainment impacts because the then-DEIS did not include a discussion of the cumulative impacts of water withdrawals from various facilities upstream of the VEGP facility, including the D-Area powerhouse, Urquhurt Station, the Augusta Channel, the Augusta International Paper Mill, and the City of Augusta, the Board declined to permit further litigation on this aspect of the river flow issue as outside the scope of the contention. See LBP-08-2, 67 NRC at 77-78.

withdrawals of the various facilities about which Joint Intervenors have expressed a concern, and which the staff recognized in its cumulative impacts analysis, see FEIS 1B, at 7-21, as we noted in section IV.A.4.c above, the record does not support their assertion that some kind of special species/low baseline designation is appropriate here relative to any of the aquatic species at issue, including those considered rare.[33] Moreover, even with these various facilities

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[33] Nor, on the record before us, are we able to agree with Joint Intervenors apparent suggestion that SRS impingement and entrainment impacts were, and continue to be, a primary source of very significant negative impacts for the Savannah River environs at issue here so that the SRS facility, in combination with the existing VEGP facility and the additional "straw" afforded by the proposed new units, will result in serious environmental damage. Although likewise not pursued in Joint Intervenors proposed findings, see supra note 12, in his testimony Dr. Young takes issue with statements in the record by SNC witness Mr. Moorer regarding the adequacy of the SRS studies as they concluded that, despite the SRS facility's large once-through cooling intake flows, impacts from entrainment (and impingement) were small and did not result in quantifiable fishery or aquatic community impacts. See Young EC 1.2 Rebuttal Testimony at 2; see also id. at 4 (challenging Dr. Coutant statement about lack of link between nuclear facilities on Savannah River and negative impacts on river fisheries). As the discussion on this point during the evidentiary hearing indicates, see Tr. at 898-902, the conclusions Dr. Young appears to draw from the language of an exhibit co-authored by one of the scientists who was also involved in the SRS studies about the significant extent of the negative impacts on the fish population from entrainment from the SRS and Vogtle facilities do not seem wholly consistent with the statements in the exhibit so as to provide sufficient support for Dr. Young's assertion. The exhibit provides in pertinent part:

> Historically, the largest sources of entrainment in the MSRB have been the reactor cooling water intakes for the SRS (9.8% of Savannah River flow) and the Plant Vogtle nuclear power station (4.2% of river flow; Wiltz 1981; DOE 1990).
>
> **SAVANNAH RIVER SITE** Historically, the SRS has affected populations of commercially and recreationally important fish species in the river primarily through impingement and entrainment losses of fish eggs, larvae, and adults during intake of cooling water (McFarlane et al. 1978). The overall rates of impingement at the SRS intakes were low relative to those of other cooling-water intake facilities in the Southeast (DOE 1988). Cessation of reactor operations and the concomitant lack of need for cooling water withdrawals from the Savannah River reduced entrainment impacts substantially.

Marcy Savannah River Fishes at 16.

operating, as a general matter the prospectus for the large river population associated with recreational fishing indicates that population is relatively healthy, see Exh. SNC000097, at unnumbered pages 1-2 (2009 Fishing Prospects for the Savannah River, http://www.gofishgeorgia.com/); see also Tr. at 934 (Dr. Young states that prospectus at gofishgeorgia.com, which is "looking good," is indicator of species rebounding from earlier declines).

4.115 Thus, whether viewed in terms of rare or populous species, we are unable to find on this record that there has been “a stone left unturned” such that the NEPA cumulative impacts analysis in this instance is deficient in assessing whether the proposed new units will provide the proverbial “straw” about which Joint Intervenors are concerned.

9. Summary of Findings Regarding Contention EC 1.2

4.116 Although Joint Intervenors have provided a variety of challenges to the staff’s FEIS findings regarding impingement/entrainment/thermal impacts for Vogtle Units 3 and 4, ultimately we find them unavailing. The preponderance of the evidence does not support their assertion that the staff’s reliance upon existing information regarding the much-studied Middle Savannah River Basin was inadequate and required, instead, an extensive site-specific study. Nor do we find their overarching concerns about the adequacy of the river flow data used by the staff in making its impingement/entrainment/thermal impacts assessment in light of the recent drought conditions to be supported by the record, particularly given their strong reliance upon very-low flow conditions that are unlikely to occur or be of any extended duration. So too, their assertion that otherwise protected species should be given an additional designation as “special status species” is untoward and unsupported as a legal or factual matter. Also lacking support in the face of the extensive record provided by the staff and SNC are their challenges to the staff’s finding of a SMALL impact relative to impingement/entrainment/thermal discharge

impacts, particularly in light of the recent SNC studies that have provided significant data on each of these subjects that fully support the staff's impact analysis and conclusions. Finally, we see no basis for a ruling in Joint Intervenors favor on the question of the adequacy of the staff's analysis of the cumulative impacts associated with impingement/entrainment/thermal discharge given that Joint Intervenors concerns rest in large measure upon a view of the ecological health of the Savannah River that fails to account for or recognize that cooling water needs of the former SRS production reactors, albeit substantial, have not been a factor impacting the river for a number of years.

4.117 As such, a judgment on the merits regarding contention EC 1.2 is entered in favor of the staff and SNC.

B. Contention EC 1.3

1. Witnesses and Evidence Presented

4.118 SNC, the staff, and Joint Intervenors each presented witnesses in connection with EC 1.3 during the March 2009 evidentiary hearing in support of their respective positions on the adequacy of the FEIS discussion and analysis of the alternative of implementing a dry cooling system for proposed Vogtle Units 3 and 4. Each of these witnesses presented written direct and/or rebuttal testimony, with supporting exhibits, and gave oral testimony at the evidentiary hearing. See Tr. at 947-1284; Coutant EC 1.3 Direct Testimony; Testimony of James W. Cuchens on Behalf of [SNC] Concerning [EC] 1.3 (fol. Tr. at 955) [hereinafter Cuchens EC 1.3 Direct Testimony]; Rebuttal Testimony of James W. Cuchens on Behalf of [SNC] Concerning [EC] 1.3 (fol. Tr. at 957) [hereinafter Cuchens EC 1.3 Rebuttal Testimony]; Testimony of Thomas C. Moorer on Behalf of [SNC] Concerning [EC] 1.3 (fol. Tr. at 966) [hereinafter Moorer EC 1.3 Direct Testimony]; Rebuttal Testimony of Charles R. Pierce on Behalf of [SNC] Concerning [EC] 1.3 (fol. Tr. at 971) [hereinafter Pierce EC 1.3 Rebuttal

Testimony]; Staff EC 1.3 Direct Testimony; NRC Staff Rebuttal Testimony of Lance W. Vail Concerning [EC] 1.3 (fol. Tr. at 1064) [hereinafter Staff EC 1.3 Rebuttal Testimony]; Revised Prefiled Direct Testimony of William Powers in Support of EC 1.3 (fol. Tr. at 1096) [hereinafter Powers EC 1.3 Direct Testimony]; Revised Prefiled Rebuttal Testimony of William Powers Concerning [EC] 1.3 (fol. Tr. at 1098) [hereinafter Powers EC 1.3 Rebuttal Testimony]; Revised Prefiled Direct Testimony of Barry W. Sulkin in Support of EC 1.3 (fol Tr. at 1100) [hereinafter Sulkin EC 1.3 Direct Testimony]; Pre-filed Rebuttal Testimony of Shawn P. Young Concerning [EC] 1.3 (fol. Tr. at 1102) [hereinafter Young EC 1.3 Rebuttal Testimony].

a. SNC

4.119 SNC presented four witnesses regarding EC 1.3: (1) Dr. Charles C. Coutant, a private consultant to SNC on aquatic ecology and fisheries biology matters; (2) James W. Cuchens, Principal Engineer, Southern Company Generation Engineering and Construction Services; (3) Thomas C. Moorer, SNC Project Manager-Environmental; and (4) Charles R. Pierce, SNC Licensing Manager. See Tr. at 947-1060, 1199-1285.

4.120 Mr. Cuchens, who has a Bachelor of Science in Mechanical Engineering from Mississippi State University, holds professional engineering licenses in four states. He has thirty-five years of engineering experience with Southern Company and has been involved in all phases of power plant design and construction, including the design of various types of cooling cycles, including closed loop, once-through, and/or cooling ponds serving nuclear, fossil fuel, and cogeneration units. Mr. Cuchens specifically studied the feasibility of dry cooling technology for proposed Vogtle Units 3 and 4. See Cuchens EC 1.3 Direct Testimony at 1-3; Exh. SNC000023 (James W. Cuchens CV).

4.121 Mr. Pierce has a Bachelor of Science and a Master of Science in Mechanical Engineering from Mississippi State University. An SNC engineer for twenty-eight years, Mr.

Pierce has managed license renewal projects for nuclear facilities and was involved in the development and licensing of the Westinghouse AP1000 standard design. See Pierce EC 1.3 Rebuttal Testimony at 1-2; Exh. SNC000058 (CV of Charles R. Pierce).

4.122 The qualifications of Dr. Coutant and Mr. Moorer have been previously discussed by the Board above in connection with its ruling on contention EC 1.2 regarding impingement/entrainment/thermal impacts on aquatic resources. See supra section IV.A.1.a.

b. Staff

4.123 The staff presented four witnesses in support of its position regarding EC 1.3: (1) Dr. Michael T. Masnik, Senior Aquatic Biologist, DSER/NRO/NRC; (2) Rebekah H. Krieg, Senior Research Scientist, Ecology Group, ESD/EED/PNNL; (3) Dr. Christopher B. Cook, Senior Hydrologist, DSER/NRO/NRC; and (4) Lance W. Vail, Senior Research Engineer in the Hydrology Group, ESD/EED/PNNL. See Tr. at 1060-84.

4.124 The qualifications of all four of these witness have been previously discussed by the Board above in connection with its ruling on contention EC 1.2 regarding impingement/entrainment/thermal impacts on aquatic resources. See supra section IV.A.1.b.

c. Joint Intervenors

4.125 With respect to EC 1.3, Joint Intervenors provided the testimony of three witnesses: (1) William Powers, principal of Powers Engineering; (2) Barry W. Sulkin, a private consultant to Joint Intervenors on water-related environmental matters; and (3) Dr. Shawn P. Young, Research Faculty of Fisheries Biology at the University of Idaho Moscow, Idaho, and a member of the Adjunct Faculty at Clemson University. See Tr. at 1084-1194, 1199-1285.

4.126 Mr. Powers has a Bachelor of Science in Mechanical Engineering from Duke University and a Master of Public Health in Environmental Sciences from the University of North Carolina and is a registered professional engineer in the state of California. He has over

twenty-five years of experience serving as a lead engineer and project manager for power generation, permitting, technical assessments, and emissions control projects. He has also published and presented on the subject of air cooling of power plants. See Powers EC 1.3 Direct Testimony at 1-3; Exh. JTIR00044 (Bill Powers, P.E., CV).

4.127 The qualifications of Mr. Sulkin and Dr. Young have been previously discussed by the Board above in connection with its ruling on contention EC 1.2 regarding impingement/entrainment/thermal impacts on aquatic resources. See supra section IV.A.1.c.

4.128 Based on the foregoing, and the respective background and experience of the proffered witnesses, the Board finds that each of these witnesses is qualified to testify as an expert witness relative to the subject of the analysis of dry cooling as an alternative to the proposed Vogtle Units 3 and 4 closed-cycle wet cooling system.

2. Dry Cooling System

4.129 In section IV.A.2 above, we described in general the way in which the closed-cycle wet cooling system for the proposed Vogtle Units 3 and 4 would operate. More specifically, in a closed-cycle wet cooling system, the steam leaving the turbine is condensed using a steam surface condenser. This is a large heat exchanger filled with tubes that have cold water flowing through them. The cold water in the tubes absorbs the heat from the steam, causing the steam to condense back into liquid form for recirculation in the steam generator. See Cuchens EC 1.3 Direct Testimony at 3-4; Exh. SNCR00024, at 3-4 (Jim Cuchens, Feasibility of Air-Cooled Condenser Cooling System for the Standardized AP1000 Nuclear Plant (Jan. 9, 2009)) [hereinafter SNC Air-Cooled Feasibility Study]. At the same time, the now-heated water in the condenser tubes is pumped to a cooling tower, where it discharges its heat to the atmosphere largely through evaporation. See id. The cooling tower can be either mechanical draft, which uses fans to force air through the tower to cool the water, or natural

draft, which uses the physical properties of warm and cold air to create a natural flow of air through the tower, much like the effect of the chimney on a fireplace. See SNC Air-Cooled Feasibility Study at 7. The remaining cool water is then collected and pumped back through the condenser tubes in the steam surface condenser. See id. at 4.

4.130 This can be contrasted with an alternative facility cooling system, i.e., a dry system that uses air instead of water as the main heat transfer medium for the steam coming out of the turbine. With an air-cooled condensing (ACC) system, the steam leaving the turbine is piped through large ducts outside of the turbine building to an ACC, where it is condensed into water inside large, metal-finned tubes that have air flowing across their outside surface. While the heat is thus rejected directly to the atmosphere, the water is drained into a large tank from which it is pumped back into the plant to again create steam. See SNC Air-Cooled Feasibility Study at 3, 12. An ACC, somewhat like a wet system with a mechanical draft cooling tower, uses fans to force air across the finned tubes to achieve optimum heat transfer, see SNC Air-Cooled Feasibility Study at 12.

4.131 Another dry cooling system alternative is indirect dry cooling, of which two examples, the HELLER system, see Exh. JTIR00038 (Andras Balogh & Zoltan Szabo, The Advanced HELLER System Technical Features & Characteristics (June 2005)) [hereinafter Heller System Features], and the cooling towers at the Kendal plant in South Africa, see Exh. SNC000098, at 2 (J.W. Cuchens, Kogan Creek Project Dry Cooling Technology Investigation Final Report (May 1999) [hereinafter Kogan Creek Investigation], were described in this proceeding. In both designs, steam leaving the turbine is condensed using cooling water (or a glycol solution, see Tr. at 1241) in a condenser and not cooled directly by air, see Heller System Features at 3; Kogan Creek Investigation at 2. The cooling water is then pumped to a cooling tower and cooled using air flowing over finned tube bundles in the tower. See Heller System

Features at 3; Kogan Creek Investigation at 2. The Kendal plant uses a natural draft cooling tower, while the HELLER system can use either a natural or a mechanical draft tower. See Heller System Features at 7-8; Kogan Creek Investigation at 2. Indirect dry cooling systems with natural draft air cooling towers have smaller parasitic loads (i.e., the energy expenditure required to run the cooling system) than a direct dry cooling system. See Tr. at 1232-33.

4.132 The focus of this contention is the extent to which a dry cooling system is an appropriate alternative to the wet cooling system proposed for Vogtle Units 3 and 4.

3. FEIS Discussion Relative to Contention EC 1.3

4.133 The EC 1.3-related discussion in the Vogtle FEIS relative to a dry cooling system as an alternative to a wet cooling system is found in section 9.3 (System Design Alternatives). There the staff noted that although the use of dry cooling would eliminate aquatic impingement/entrainment/thermal impacts, this alternative system had significant disadvantages. Citing an EPA rulemaking (which also was a significant factor in our admission of this contention, see section IV.B.5.a below) that considered, among other things, whether to adopt dry cooling as the best technology available for minimizing adverse environmental impacts, the staff concluded that dry cooling involved additional expenses that made it less cost effective. See FEIS 1B, at 9-26 (citing National Pollutant Discharge Elimination System: Regulations Addressing Cooling Water Intake Structures for New Facilities, 66 Fed. Reg. 65,256 (Dec. 18, 2001)). Also, according to the staff, because of the increased power usage to move large amounts of air though a heat exchanger, dry cooling would involve higher fuel use and spent fuel transportation and storage impacts along with elevated noise levels and increased land use impacts associated with an ACC. See id. at 9-26 to -27. These disadvantages, when considered in conjunction with the staff's conclusion that the aquatic impacts of the proposed wet cooling system would be SMALL, led the staff to conclude that a

dry cooling system would not be preferable to the wet cooling system being proposed for Vogtle Units 3 and 4.

4. NRC Regulations and Regulatory Guidance

4.134 Contention EC 1.3 as initially admitted challenged the SNC ER as failing to adequately address the dry cooling alternative as required by 10 C.F.R. § 51.45(b)(3). Because NEPA-based challenges raised prior to the issuance of a DEIS become, in effect, challenges to the DEIS and, subsequently, the FEIS as those documents are issued, see supra section III.B, the Board considers contention EC 1.3 to be a challenge to the adequacy of the FEIS dry cooling discussion. The Board also concludes, however, that section 51.45(b)(3) remains the applicable standard in that section 51.90 instructs the staff to prepare the FEIS "in accordance with the [DEIS-related] requirements in §§ 51.70(b) and 51.71," and section 51.71, in turn, instructs the staff to address in the DEIS matters an applicant is instructed to address in the ER under section 51.45. See 10 C.F.R. §§ 51.90, 51.71(a). Thus, the Board must decide whether the FEIS discussion of the dry cooling alternative is "sufficiently complete to aid the Commission in developing and exploring, pursuant to section 102(2)(E) of NEPA, 'appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources.'" Id. § 51.45(b)(3). And in that regard, staff witnesses testified that in determining the level of detail in which to analyze dry cooling as an alternative, they followed ESRP section 9.4.1, which states "[t]he depth of the analysis should be governed by the nature and magnitude of proposed heat dissipation system impacts . . . ." 2007 ESRP at 9.4.1-5; see Staff EC 1.3 Direct Testimony at 9-11.

5. Adequacy of Assessment of Dry Cooling System As an Alternative

4.135 Because the staff found the impacts from the proposed closed-cycle wet cooling system to be SMALL, pursuant to ESRP section 9.4.1, the staff indicated it did not conduct a

more detailed analysis of dry cooling. See Staff EC 1.3 Direct Testimony at 10-11. Joint Intervenors do not challenge the staff's reliance on this ESRP guidance, but instead argue that even under ESRP section 9.4.1 the staff should have analyzed dry cooling in more detail because its SMALL impacts conclusion was unjustified. See Joint Intervenors Proposed Findings at 28-30; Joint Intervenors Reply Findings at 7-8.

4.136 Having found the staff reasonably concluded that impacts from the proposed wet cooling system would be SMALL, see section IV.A.9 above, we also find that it appropriately followed its own NEPA guidance in providing a more limited discussion of the dry cooling alternative than it would have if the impacts had been MODERATE or LARGE. The FEIS assessment of system design alternatives does discuss the environmental impacts of dry cooling, albeit qualitatively, and compares them to the impacts of the proposed wet cooling system before concluding that dry cooling would not be preferable, see FEIS 1B, at 9-26 to -27, in accordance with section 51.45(b)(3).[34] Even if that were not the case, however, for the reasons outlined below, the preponderance of the evidence before the Board supports the conclusion that the FEIS discussion, as supplemented by the information now before the Board as a result of the evidentiary hearing, establishes that (1) the agency's NEPA obligations in connection with the adequacy of the discussion of dry cooling have been satisfied; and (2) the staff's conclusion that the dry cooling alternative is not the preferable alternative relative to proposed Vogtle Units 3 and 4 is a reasonable determination.

a. Extremely Sensitive Biological Resources

4.137 As was noted above, see supra section IV.B.3, the FEIS cites EPA's extensive rulemaking analysis of cooling technologies and conclusion that dry cooling is not the best

[34] 10 C.F.R. § 51.45(b)(3) states that "[t]o the extent practicable, the environmental impacts of the proposal and the alternatives should be presented in comparative form."

available cooling technology for a national requirement as support for not finding dry cooling to be preferable to closed-cycle wet cooling for proposed Vogtle Units 3 and 4.[35] See FEIS 1B, at 9-26. As was also discussed above, see supra section III.B, the staff has the discretion to rely on the data and inferences from this EPA analysis. At the same time, as we noted in our order admitting contention EC 1.3, EPA stated in that rule that dry cooling might be appropriate for some facilities if, for example, they would rely on bodies of water with "'extremely sensitive biological resources.'" LBP-07-3, 65 NRC at 260 (quoting 66 Fed. Reg. at 65,282); see also LBP-08-3, 67 NRC at 91 (summary disposition ruling regarding EC 1.3). Thus, further NRC analysis of dry cooling might be necessary despite EPA's analysis if proposed Vogtle Units 3 and 4 were to fall into the category of facilities affecting extremely sensitive biological resources (ESBRs).

4.138 As staff witness Dr. Masnik noted, see Tr. at 1066-67, EPA did not define ESBRs; instead, it merely listed as examples "endangered species" and "specially protected areas," 66 Fed. Reg. at 65,282. We agree with the staff, however, that its definition of "important species" likely encompasses any ESBRs that might be affected by proposed Vogtle Units 3 and 4.

[35] The statement of considerations accompanying the EPA rule includes an analysis of dry cooling implementation as a national strategy based on a nearly zero intake flow and rejects dry cooling as the national minimum requirement because (1) dry cooling technology carries costs that are sufficient to pose a barrier to entry into the marketplace for some facilities; (2) dry cooling has some detrimental effect on energy production by reducing energy efficiency of steam turbines; (3) dry cooling may pose unfair competitive disadvantages by region and climate; and (4) dry cooling technologies pose significant engineering feasibility problems. EPA also indicated the cost is estimated at more than three times the cost of wet cooling. See 66 Fed. Reg. at 65,282.

4.139 Joint Intervenors appear to argue that the presence of ESBRs in the vicinity of the VEGP site should, by itself, trigger a more detailed analysis of dry cooling.[36] See Joint Intervenors Reply Findings at 11. But EPA stated only that dry cooling "may be the appropriate cooling technology for some facilities" and that "[t]his could be the case" when ESBRs are present. 66 Fed. Reg. at 65,282 (emphasis added). At a minimum, the mere presence of ESBRs in the vicinity of a project does not equate to dry cooling being the appropriate cooling technology for that project. Nor do we think it reasonable that the possibility that dry cooling may be appropriate by reason of the presence of ESBRs should necessarily trigger a detailed analysis of the dry cooling alternative if it can be shown that any impacts of a wet cooling system to ESBRs are likely to be minor. Otherwise, the presence of a single specimen of an endangered species near a proposed power plant could trigger an in-depth study of dry cooling even if the plant would have only an insignificant effect on the specimen, and even less on the species. We therefore agree with the staff and SNC that some impact to ESBRs greater than SMALL must be involved to trigger the requirement of a more detailed analysis.[37] Thus, because the information in the FEIS properly shows the proposed wet cooling system for Vogtle Units 3 and 4 will have no more than SMALL impacts on important species,[38] see supra

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[36] Joint Intervenors also appeared to maintain, perhaps in the alternative, that a more detailed discussion was necessary because the staff's SMALL impacts conclusion was unfounded. See Tr. at 1112, 1175.

[37] SNC asserts that the definition of ESBRs includes a further requirement that the proposed non-dry cooling system pose "significant risks" to the species or area in question. See Coutant EC 1.3 Direct Testimony at 4; see also Tr. at 1046-47. We do not find it necessary to determine whether the characterization is appropriate, however, as we conclude that some level of impact on ESBRs beyond SMALL must be present to trigger a more detailed discussion of dry cooling than was provided in the FEIS.

[38] As we noted in sections IV.A.4.c and IV.A.5.c above, the staff's analysis of impacts is further supported with regard to the shortnose sturgeon by NMFS, which the staff consulted pursuant to the Endangered Species Act and which stated that proposed Vogtle Units 3 and 4

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section IVA.9, we find that the staff's reliance on EPA's analysis of dry cooling was reasonable and that the FEIS therefore contained sufficient information to support a finding that dry cooling would not be a preferable alternative to wet cooling at the VEGP site.

b. Dry Cooling as a Feasible Alternative

4.140 In addition, SNC asserts that NEPA does not require a more detailed analysis of dry cooling as an alternative because it is not feasible for a large nuclear power plant at the VEGP site and is therefore not a "reasonable" alternative that must be discussed under NEPA. See SNC Proposed Findings at 55-56. The feasibility argument centers on the high level of risk associated with implementing a dry cooling technology that is unproven for an application of the size and geographical location of the Vogtle Units 3 and 4 AP1000 reactors. Given the various implementation risks discussed below, the preponderance of the evidence before us leads us to conclude the use of dry cooling is not a feasible alternative for an AP1000 reactor at the VEGP site.

i. Technical Background

4.141 To generate electricity, a pressurized water nuclear reactor (such as the AP1000) heats water into steam in the steam generators. The steam is then passed to a turbine. The turbine turns a generator to create electricity, while the steam is condensed back into water and returned to the steam generator to repeat the cycle. See Cuchens EC 1.3 Direct Testimony at 3-4; SNC Air-Cooled Feasibility Study at 3.

4.142 According to SNC witness Mr. Cuchens, during the steam condenser cooling process, as steam condenses back into liquid water, it takes up significantly less space or

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[38](...continued)
are "not likely to adversely affect shortnose sturgeon." NMFS Consultation Letter at 4. Though Joint Intervenors apparently discount the NMFS letter, they do so on the basis of construction impacts, see Joint Intervenors Reply Findings at 12, which are not associated with the facility cooling system operational impacts question that is the focus of contention EC 1.3.

volume, which creates a vacuum inside the steam condenser and/or turbine exhaust that is referred to as backpressure. See Cuchens EC 1.3 Direct Testimony at 5. The turbine specified in the AP1000 DCD is a standard-backpressure turbine (sometimes referred to as a low-backpressure turbine) that is designed to operate at an average backpressure of 2.92 inches (") of mercury absolute pressure (HgA) at the design inlet cold water temperature of 91ºF, see SNC Air-Cooled Feasibility Study at 6; Exh. SNC000028, at 10.2-18 (AP1000 DCD (Rev. 17) § 10.2) [hereinafter AP1000 DCD Rev. 17], though it can operate at backpressures within a range of 1.0" HgA to 5.0" HgA, see Cuchens EC 1.3 Direct Testimony at 6-7. At backpressures above 5.0" HgA, but below the standard-backpressure turbine's trip point of 6.0" HgA, the turbine cannot operate continuously. See SNC Air-Cooled Feasibility Study at 6. At 6.0" HgA, the turbine is set to trip offline to prevent damage to the turbine. See id. Thus, a standard-backpressure turbine cannot function reliably at higher backpressures. A turbine trip can also lead to a reactor scram, which is a rapid shutdown of the reactor, that increases the risk of a safety challenge to the reactor. See Tr. at 1039-40. On the other hand, high-backpressure turbines operate at an average backpressure of 8.0" HgA or higher, see Powers EC 1.3 Direct Testimony at 5, thus minimizing the potential for a reactor scram and turbine trip at relatively high backpressures, see Cuchens EC 1.3 Rebuttal Testimony at 5; Tr. at 985, 1039-40.

4.143 The backpressure experienced in an ACC-cooled unit depends largely on the Initial Temperature Difference (ITD), which is the difference between the temperature of the outside air (ambient temperature) and the temperature of the steam condensing within the tube bundles. See Cuchens EC 1.3 Direct Testimony at 7; SNC Air-Cooled Feasibility Study at 13; see also Powers EC 1.3 Direct Testimony at 5. At a given ITD, the higher the ambient temperature in which an air-cooled turbine operates, the higher the steam saturation

temperature and, therefore, the higher the backpressures on the turbine. See Cuchens Direct Testimony at 7; SNC Air-Cooled Feasibility Study at 13. According to uncontroverted testimony by Mr. Cuchens, current state-of-the-art ACCs are designed with an ITD of 40º F, and a few have an ITD as low as 35º F, but no currently existing ACC has an ITD lower than 35º F. Id.

4.144 Just as a wet cooling system can operate with either a standard-backpressure or a high-backpressure turbine, a dry cooling system can also be paired with either a standard-backpressure turbine or a high-backpressure turbine under the proper conditions.

ii. Feasibility of a High-backpressure Turbine at Vogtle

4.145 Although Joint Intervenors appear to have abandoned the notion that an ACC with the AP1000 standard-backpressure turbine is a reasonable alternative in this situation,[39]

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[39] Even if Joint Intervenors had continued to press that argument, however, we would find that the combination of a standard AP1000 turbine and an ACC would not be feasible at the VEGP site. The standard AP1000 turbine is a standard-backpressure turbine. See SNC Air-Cooled Feasibility Study at 5-6 (normal operating backpressure for AP1000 turbine is between 1.0" and 5.0" HgA). SNC witness James Cuchens nonetheless stated that a high-backpressure turbine would be a "necessity" for an air-cooled system at the VEGP site, Tr. at 1203, and Joint Intervenors witness William Powers confirmed that a high-backpressure turbine would be the "most likely" scenario, Tr. at 1202. This certainly seems correct, for as Mr. Cuchens pointed out, and Mr. Powers did not dispute, at the design temperature for the Vogtle site of 95°F, a state-of-the-art ACC (with an ITD of 35°F) would produce a backpressure of 4.5" HgA, just 0.5" below the alarm point for the standard turbine. See Cuchens EC 1.3 Direct Testimony at 8; Tr. at 982-83 (Cuchens); Tr. at 1120-21 (Powers). Higher ambient air temperatures, wind influences, and normally expected fouling of the ACC would lead to further backpressure increases. See Tr. at 983 (Cuchens: "very difficult" to maintain the five inches in very high temperature period); Tr. at 984 (Cuchens: "fouling itself can incur back pressures additive to half of an inch to one inch"); Tr. at 995 (Cuchens: "So 4.5 represents 95 degrees in a perfect calm, a very perfect calm day, no wind influence, no recirculation influence, no fouling influences."). Also in this regard, Mr. Cuchens testified regarding and produced trip reports indicating that, for example, particularly in its early years wind effects substantially impacted performance and caused load swings and unit trips at Matimba, an ACC-cooled South African coal plant consisting of six 665 megawatt electric (MWe) units. See Tr. at 1268-69; Kogan Creek Investigation at 3-4, 12. Although Mr. Powers argued that wind effects could be mitigated with wind skirts like the ones implemented at Matimba, see Tr. at 1277, as Mr. Cuchens testified, the ACC for Vogtle Units 3 and 4 would likely be designed differently from Matimba, because the AP1000 design is more open so that the ACC would be exposed on all sides so as to require protection on all sides, thereby needing a wind skirt design that has not previously

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they continue to assert that a high-backpressure turbine coupled with an ACC would be feasible for the proposed Vogtle Units 3 and 4. See Joint Intervenors Proposed Findings at 22-23. High-backpressure turbines have never been used with large nuclear reactor units, however. See Tr. at 1170 ("Judge Trikouros: So there is experience out there with high backpressure turbines, but they are not nuclear? Mr. Powers: That is correct."); Tr. at 1217 ("Judge Trikouros: Are you aware of a high backpressure turbine in use in a commercial nuclear power plant regardless of the specific cooling system applied at the plant? Mr. Powers: No. . . . Mr. Cuchens: No."). As Mr. Cuchens stated, and Mr. Powers did not contradict, there are no existing high-backpressure turbines capable of handling the 8.4 million pounds per hour steam flow from an 1154 megawatt electric (MWe) AP1000 nuclear unit such as are planned for Vogtle Units 3 and 4. See Cuchens EC 1.3 Direct Testimony at 9; SNC Air-Cooled Feasibility Study at 17; Tr. at 1212. The largest currently-operating high-backpressure turbines that either party mentioned are in the mid-600 MWe South African plants, which are not triple-exhaust turbines. See Tr. at 978. Mr. Powers does appear to rely on North Anna Unit 4, which is to utilize an Economic Simplified Boiling Water Reactor (ESBWR) certified design as proposed in the North Anna ESP application, see Exh. JTI000051 at 1.2-50 (excerpts from General Electric

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[39](...continued)
been implemented. See Tr. at 1282-83. For his part, Mr. Powers, albeit asserting that "a manufacturer has to meet site conditions," Tr. at 1120, did not indicate how the effects of fouling might be mitigated.

The record before us thus indicates that to utilize an ACC with the standard AP1000 DCD, a high-backpressure turbine would likely be required so as to avoid operating at or near the alarm setpoints, see Tr. at 980-84, 999-1000, that bring the safety and reliability challenges posed by the higher likelihood of standard-backpressure turbine trips and reactor scrams, see Tr. at 1039, 1203-04. Accordingly, it seems clear that the combination of an ACC with a triple-exhaust, standard-backpressure turbine is neither "sufficiently demonstrated nor practicable for use" in this instance so as to be a viable NEPA alternative. Kelley v. Selin, 42 F.3d at 1521. Further, we note that because an indirect dry cooling system would have the same ITD limitations as an ACC, see Tr. at 1242, it also would not be a feasible alternative for use in combination with a standard-backpressure turbine.

(GE)-Hitachi Nuclear Energy, ESBWR [DCD] Tier 2, chap. 1, §§ 1.1 to 1.11 (rev. 4 Sept. 2007)), as an example of a large nuclear unit with a completely dry cooling system and possibly a high backpressure turbine, see Tr. at 1211, 1215. When asked, however, Mr. Powers admitted that to his knowledge ESBWR designer GE had not built a prototype of such a turbine.[40] See Tr. at 1215. Moreover, since no combined license (COL) application has been filed for North Anna Unit 4, we do not know if the facility will attempt to use a high backpressure turbine to implement the completely dry cooling system Dominion apparently committed to relative to the ESP.

4.146 Mr. Powers also suggested that the standard-backpressure turbine for the AP1000 might be modified to become a high-backpressure turbine by removing the last-stage bucket, i.e., the last set of turbine blades. See Tr. at 1159. However, as Mr. Cuchens noted, modification of a standard-backpressure turbine to a high-backpressure turbine has "never been done for a unit the size of AP-1000 ever before," and no modifications of this nature have been made for a triple-exhaust turbine. Tr. at 1206. When queried, Mr. Powers agreed that the largest existing high-backpressure turbines that are "modifications of a standard turbine by the

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[40] Joint Intervenors assertion that this proceeding, like the North Anna Unit 4 proceeding, concerns an ESP application does not strengthen their argument in this regard. See Joint Intervenors Reply Findings at 9. Given the NRC did not make a feasibility determination regarding the facility cooling system in granting this ESP, see Tr. at 1254-55, this hardly supports the feasibility finding necessary to require an applicant proposing a different cooling system to discuss dry cooling as an alternative.

Similarly, Joint Intervenors earlier references to a potential wet/dry hybrid cooling system for North Anna Unit 3, see Powers EC 1.3 Rebuttal Testimony at 5, which they did not pursue in their proposed findings, see supra note 12, also are unavailing. As Mr. Pierce and Mr. Cuchens pointed out, North Anna 3 would use a standard-backpressure turbine, see Tr. at 1212, and would be completely dry-cooled only under favorable (i.e., cool) weather conditions. See Tr. at 988-89; Exh. SNC000096 at 2-173 (Dominion, North Anna 3 [COL] Application, Part 2: Final Safety Analysis Report (rev. 1 Dec. 2008)) ("Maximum Water Conservation (MWC) -- The dry cooling tower and hybrid cooling tower operate in series with a provision for cold weather bypass"). North Anna 3 therefore does not show that dry cooling would be feasible as a full-time cooling system with the turbine type being utilized at the VEGP site.

removal of the last stage bucket" are those at South Africa's Matimba plant, "at just under 700 megawatts." Tr. at 1209. Again, however, as Mr. Cuchens indicated, these are not triple-exhaust turbines. See Tr. at 978.

4.147 Given that (1) a high-backpressure turbine capable of handling the steam flow from an AP1000 nuclear unit does not currently exist; and (2) modification of a large triple-exhaust turbine like the AP1000 standard-backpressure turbine to a high-backpressure turbine has never been done, it seems apparent that the use of an ACC and high-backpressure turbine in this instance poses a significant implementation risk such that it is neither "sufficiently demonstrated nor practicable for use" so as to be a viable NEPA alternative. Kelley v. Selin, 42 F.3d at 1521.

c. Dry Cooling as a Preferable Alternative

4.148 Additionally, for the reasons set forth below, we find that the extensive hearing record before us, as it supplements the information in the FEIS, fully supports the staff's conclusion that dry cooling is not preferable to closed-cycle wet cooling towers for Vogtle Units 3 and 4. To be sure, staff witnesses admitted that dry cooling would largely eliminate impacts on aquatic biota. See NRC Staff EC 1.3 Direct Testimony at 7-8. Nonetheless, the record contains ample evidence that dry cooling would require significant modifications to the standard AP1000 design, reduce power output, cost more to design, implement, and maintain, require more land, and delay the licensing and construction process for these proposed facilities. Particularly when combined with the SMALL environmental impact of the closed-cycle wet cooling system, as established by the record regarding the staff's conclusion concerning impingement/entrainment/thermal impacts on the aquatic environment (including ESBRs), as supplemented by the SNC impingement and entrainment studies, see supra sections IV.A.4 to .8, and the technological challenges of implementing a first-of-a-kind dry cooling system in a

large nuclear plant that makes implementation here infeasible,[41] see supra section IV.B.5.b, it is clear that the preponderance of the evidence associated with these factors supports a finding that, as the staff found in its FEIS, the dry cooling alternative is not the preferable alternative.[42]

i. Need for Modifications to AP1000 DCD Standard Design

4.149 SNC maintains that significant modifications to the AP1000 standard design would be needed to accommodate an ACC with or without a high-backpressure turbine. See Tr. at 1000-01. SNC presented essentially unrebutted evidence that changes would be necessary to the turbine building, turbine pedestal, feed water heaters and associated piping, and steam surface condensers. See Cuchens EC 1.3 Direct Testimony at 26-28; Cuchens EC 1.3 Rebuttal Testimony at 5-6; Pierce EC 1.3 Rebuttal Testimony at 5; SNC Air-Cooled Feasibility Study at 26; Tr. at 1004-1006, 1263-1264. Mr. Cuchens particularly emphasized that the need to construct large steam ducts to carry steam from the turbine building to the ACC modules would impact areas with a significant amount of structural steel, thus requiring a re-design of the turbine building structure as well as the relocation of major equipment from its AP1000 DCD-specified locations to make room for the ducts. See Tr. at 1004-05; Exh. SNCR00026 at unnumbered slide 26 (James W. Cuchens, Dry Cooling Presentation). On the other hand, Joint Intervenors, who do not address the impact of turbine building modifications at all in their proposed findings, see supra note 12, failed to provide adequate

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[41] Although technical infeasibility, set forth in the previous section, provides a separate basis of support for why the FEIS did not need to analyze the dry cooling alternative in further detail, the same facts supporting a finding that dry cooling is not feasible also support a finding that it is not a preferable alternative if a fuller analysis is performed.

[42] Under NEPA, once "the adverse environmental effects of the proposed action are adequately identified and evaluated, the agency is not constrained by NEPA from deciding that other values outweigh the environmental costs," Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 351 (1989), so that the agency's NEPA obligations are satisfied once the record contains sufficient support and analysis regarding the dry cooling alternative to explain its determination for not finding dry cooling to be preferable.

evidence to rebut SNC's evidence that the modifications would be significant. For example, though Mr. Powers suggested that the steam ducts could be customized to accommodate the structural steel, see Tr. at 1156, he also stated that an additional detailed study would need to be made of the standard design to determine whether the building or the ducts should be modified, see id., and he admitted that he himself had not reviewed the building plans, see Tr. at 1159. So too, while not prepared to discuss the extent of modifications identified by Mr. Cuchens, Mr. Powers did agree that changes to the standardized design could increase costs. See Tr. at 1161.

4.150 Additionally, Mr. Pierce suggested that modifications to the turbine would require modifications to the standard AP1000 design. If, for example, SNC were to employ a high-backpressure turbine that does not retain the Tier I characteristics of one high-pressure turbine, three low-pressure stages, and a condenser, an exemption from the certified design would be required. See Tr. at 1016-17. Indeed, Joint Intervenors appear to concede that certain portions of the DCD would need to be re-analyzed in light of the modification of the standard-backpressure turbine to a high-backpressure turbine. See Joint Intervenors Proposed Findings at 23.

ii. Cost Factors

(1) Energy Penalty

4.151 The parties appear to agree that an ACC-cooled system at the VEGP site would produce less net electricity than the proposed wet-cooled system due to a combination of efficiency losses from operating at a higher backpressure and the parasitic load (i.e., electrical generation usage) differences that exist between operating wet systems and ACCs. Mr. Cuchens' analysis of dry cooling for proposed Vogtle Units 3 and 4 concluded that the parasitic load difference between a 4.5" HgA ACC and a wet cooling tower would be 9-15 MWe,

depending on whether a mechanical draft or a natural draft wet tower were chosen for comparison. See SNC Air-Cooled Feasibility Study at 26. This difference is evidenced in a comparison of the energy requirements of the ACC fans with the circulating water pumps in a wet cooling tower and, for a mechanical wet cooling tower, the fans in the wet tower. See id. Mr. Powers appeared to agree that the difference between an ACC and a mechanical wet tower would be 9 MWe.[43] See Tr. at 1147-48. As Mr. Powers noted, there would be no parasitic load from fans in a natural draft dry cooling system.[44] See Tr. at 1233. Thus, there might or might not be a parasitic load difference between wet and dry cooling systems, depending on whether one compares mechanical (i.e., fan-assisted) or natural draft systems.

4.152 Dry cooling systems do, however, appear to be less efficient than wet cooling systems and would, therefore, result in a lower power output regardless of parasitic load. Mr. Cuchens calculated that, at the VEGP site design temperature of 95º F, the backpressure difference between one of the proposed Vogtle units and a facility with an ACC with a 35º F ITD would lead to a reduction in power output of approximately 55 MWe in a standard-backpressure AP1000 turbine. See SNC Air-Cooled Feasibility Study at 15. Mr. Cuchens did not provide an output differential for a high-backpressure turbine because, as no high-backpressure turbines currently exist for applications such as the AP1000 nuclear reactor, no efficiency curves exist of the type he relied on to reach his 55 MWe figure for the standard-backpressure turbine. See Tr. at 1231. But as both Mr. Cuchens and Mr. Powers noted, conversion of a

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[43] Mr. Powers correctly indicated that to be done fairly, the cost comparison has to be done on a consistent basis, i.e., wet mechanical v. dry mechanical and wet natural draft v. dry natural draft. See Tr. at 1232-33.

[44] Mr. Powers further stated that the natural draft dry tower would have a parasitic load advantage over a natural draft wet tower because the dry tower would not require circulating water pumps. See id. However, in the context of indirect dry cooling towers, which rely on circulating water or glycol, rather than air, as a cooling medium, see supra section IV.B.2, we think it unlikely that the parasitic load from the pumps could be eliminated for the dry towers.

standard-backpressure turbine to a corresponding high-backpressure turbine would also result in some performance degradation because the modified turbine would no longer be able to extract as much energy from the steam passing over it. See Tr. at 1205, 1208 (Powers); Tr. at 1206-07 (Cuchens). Mr. Powers argued that the difference for a standard-backpressure turbine would be much smaller than the figure Mr. Cuchens gave, but did not provide his own figure for an ACC at the design temperature, instead stating that the total output differential between a dry-cooled plant and a wet-cooled plant under average conditions would be 15-20 MWe. See Powers EC 1.3 Direct Testimony at 9; Tr. at 1096. He also stated that a natural draft dry-cooled system, which in his opinion would actually have a lower parasitic load than a natural draft wet-cooled system, would experience a total performance penalty of four percent at 95º F with a yearly average of about two percent. See Tr. at 1233-34.

4.153 Overall, the information in the record supports a finding that a dry-cooled system will be less efficient than a wet-cooled system, particularly at or above the design temperature for the VEGP site, leading to less energy production, especially on hot days.[45]

(2) Capital Costs

4.154 It is also undisputed that a dry cooling system would cost more to build than would the proposed wet natural draft towers. Witnesses for SNC and Joint Intervenors appeared to agree that an ACC would cost around $200 million more per reactor unit than would a natural draft wet cooling tower system. See Cuchens EC 1.3 Direct Testimony at 22, Tr. at 1151 (Powers). Additionally, both parties appear to agree that modifications taking the facility design away from the standard AP1000 design, which would require additional

[45] To the degree Joint Intervenors have criticized the staff's failure to calculate the efficiency penalty associated with dry cooling, see Joint Intervenors Proposed Findings at 26, any significance to such an omission is now irrelevant as the hearing record and this opinion supplement the FEIS. See supra section III.A.

design/engineering/operational/safety analyses, would further increase capital costs. See Cuchens EC 1.3 Direct Testimony at 28-29; Pierce EC 1.3 Rebuttal Testimony, at 6; Tr. at 1161 (Powers); Tr. at 1243-44 (Pierce). In this regard, Mr. Pierce indicated that the capital cost differential between using natural draft wet towers and using ACCs would increase significantly, beyond the $200 million dollar figure identified above, if a high-backpressure turbine were used in place of the standard AP1000 turbine. See Tr. at 1279 (Pierce: "So look at a dry cooling system with a high backpressure turbine . . . and now so you're looking at several hundred million dollars at this point."). Thus, although the exact re-design costs are unknown at this point, the parties' testimony clearly indicated they could be quite significant.

(3) Maintenance Costs

4.155 The parties dispute as well the extent to which maintenance requirements would be greater for an air-cooled system than for the proposed wet cooling system. SNC witness Mr. Cuchens stated that the metal structure of the ACC, which makes it subject to corrosion, and the greater number of moving parts in an ACC would lead to a greater need for maintenance. See Tr. at 1008-09. In contrast, Joint Intervernors witness Mr. Powers argues that fans in an ACC, "operating in clean, ambient air" would not be subject to a significant amount of fouling and would therefore not require a significant amount of maintenance. See Tr. at 1250-51. Mr. Powers, however, did not offer any testimony to contradict SNC's evidence that actual experience with ACCs indicates that a significant amount of maintenance was required. See Tr. at 1246-47, 1250-51; Kogan Creek Investigation at 3-4. Accordingly, we find that maintenance costs would likely be higher for an ACC than for a wet cooling system.[46]

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[46] In the context of maintenance requirements, the parties did not specifically discuss natural draft dry cooling towers. Nonetheless, given the evidence in the record indicating that capital costs for natural draft dry towers are two to three times higher than for ACCs, see Kogan Creek Investigation at 10, we consider it likely the increased capital costs for a natural draft dry

(continued...)

iii. Land Use Impacts

4.156 SNC and Joint Intervenors both indicated that ACCs would occupy more land than the proposed wet cooling towers. SNC witness Thomas Moorer estimated an area of 248.9 acres for a 324-cell ACC, see Moorer EC 1.3 Direct Testimony at 4, but noted that a 202-cell ACC (the size that would achieve a 35ºF ITD) would occupy about two thirds of that area, see Tr. at 1057, which would translate to approximately 166 acres. Mr. Powers, testifying for Joint Intervenors, suggested that the 202-cell ACC would occupy about sixty percent of the area of a 324-cell ACC, see Powers EC 1.3 Rebuttal Testimony at 4-5, or just under 150 acres, but Joint Intervenors now appear to concede that an ACC would require an area of approximately two-thirds of the expanse originally estimated by Mr. Moorer. See Joint Intervenors Proposed Findings at 27. By both parties' estimates, however, an ACC would require more than twice the amount of land the proposed Vogtle Units 3 and 4 wet cooling towers would occupy. See Moorer EC 1.3 Direct Testimony at 5 (wet towers would occupy seventy acres). Thus, land use impacts would necessarily seem to be greater with an ACC than with the proposed wet cooling system.[47]

iv. Schedule Impacts

4.157 Finally, depending on the extent of modifications necessary to the AP1000 standard design to accommodate dry cooling, see section IV.B.5.c.i above, portions of the site safety analysis report might need to be reconsidered before proposed Vogtle Units 3 and 4

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[46](...continued)
tower would outweigh the lower maintenance costs.

[47] Although neither party addressed natural draft dry towers in this context in their proposed findings, SNC witness Mr. Cuchens stated that natural draft dry towers would require an amount of land between the amount required for wet towers and the amount required for an ACC. See Tr. at 1058-59. Thus, natural draft dry cooling towers would also likely have greater land use impacts than the proposed Vogtle Units 3 and 4 natural draft wet towers.

could be licensed as dry-cooled units. See Pierce EC 1.3 Rebuttal at 5-6; Tr. at 1018-23. For example, Mr. Pierce testified that a design analysis would need to be done of the effect of a dry cooling system on the plant's ability to accommodate the full range of design basis events, such as a full-load rejection. See Tr. at 1017-19. Although this topic was only discussed qualitatively by the parties, implementing dry cooling at proposed Vogtle Units 3 and 4 no doubt would lead to delays in the licensing process and incur additional analysis costs. See id. at 1255.

4.158 Thus, the evidentiary support for the various factors outlined above establishes by a preponderance that impacts associated with the design/construction/operational changes from the AP1000 standard design that will result by implementing a dry-cooling system in lieu of the planned wet cooling system, as well as those arising from increased costs, expanded land use, and scheduling delays, render dry-cooling as not being preferable to wet cooling in this instance.

6. Summary of Findings Regarding Contention EC 1.3

4.159 In summary, the Board finds that the discussion of the dry-cooling alternative in the staff FEIS, as supplemented by the record in this proceeding, satisfies the NRC's NEPA obligations. Because the staff reasonably concluded that aquatic impacts in general, and impacts to ESBRs in particular, would be SMALL, the staff reasonably relied on the ESRP assessment guidance and EPA's cooling technology rulemaking in arriving at a finding that dry cooling not to be a preferable alternative. In this regard, we disagree with Joint Intervenors assertion that the mere presence of ESBRs in the vicinity of the VEGP site mandates a detailed analysis of dry cooling, and we find the staff's reliance on EPA's analysis to be reasonable absent any indication that the impact of the proposed new reactors on ESBRs would be more than minor.

4.160 Additionally, dry cooling need not be explored in more detail for the VEGP site under NEPA because, in this instance, the preponderance of the evidence establishes it is not technologically feasible and is therefore not a "reasonable" alternative for NEPA purposes. The high-backpressure turbine, although apparently now championed by Joint Intervenors because it would minimize the safety and reliability problems that are likely to be caused by using dry cooling in conjunction with a standard-backpressure AP1000 turbine, is an unproven technology for large nuclear plants such as the proposed Vogtle units.

4.161 Finally, the preponderance of the evidence in the record of this proceeding, which supplements the FEIS, further demonstrates that dry cooling is not a preferable alternative to a closed-cycle wet cooling system in this instance because it would require substantial modifications going away from the standard AP1000 design, cost significantly more, require more land, and likely would delay construction and operation of the new reactors.

4.162 Accordingly, a judgment on the merits regarding contention EC 1.3 is entered in favor of the staff and SNC.

C. Contention EC 6.0

1. Scope of Contention EC 6.0

4.163 As discussed in section II.B above, Joint Intervenors contention EC 6.0 as submitted was broader than what was admitted by the Licensing Board. The Board found that certain foundational support proffered for the contention did not meet the requirements for contention admissibility under 10 C.F.R. § 2.309(f). The contention as admitted reflects Joint Intervenors concerns that the discussion regarding federal navigation channel dredging was inadequate to support the staff's finding that the impacts of dredging could be MODERATE. Specifically, it includes Joint Intervenors allegations -- as discussed in the declarations of their two expert witnesses, Dr. Donald Hayes and Dr. Shawn Young -- that the FEIS should contain

more information about the extent and duration of any dredging, the impacts on water quality, the disposal of any dredged material, and the impacts on aquatic biota as a result of any dredging. In addition, it includes Joint Intervenors claim that the FEIS should have contained a discussion of environmental impacts from any releases that the USACE might make from upstream reservoirs to accommodate barge transportation.

4.164 There were references in the testimony proffered during the evidentiary phase of this proceeding that mentioned the potential for transportation of construction components by rail or highway. See Tr. at 1319-20. However, to the extent that Joint Intervenors now claim that the staff's FEIS should have analyzed the impacts associated with other modes of transportation for construction components, see Joint Intervenors Proposed Findings at 31-32; Joint Intervenors Reply Findings at 18-20, these issues are not properly within the scope of EC 6.0 because these issues were not raised in the contention admissibility phase. Alternative modes of transportation will be discussed here only to illustrate the other options besides barging that SNC has relative to construction component transportation.

2. Witnesses and Evidence Presented

4.165 SNC, the staff, and Joint Intervenors presented witnesses in support of their respective positions on contention EC 6.0, providing written direct and rebuttal testimony, with supporting exhibits, as well as oral testimony at the evidentiary hearing. See Tr. at 1287-1382, 1475-1631; [SNC] Testimony of Jeffrey Neubert, Benjamin Smith, and David Scott Concerning EC 6.0 (fol. Tr. at 1290) [hereinafter Neubert/Smith/Scott EC 6.0 Direct Testimony]; [SNC] Testimony of Thomas Moorer Concerning EC 6.0 (fol. Tr. at 1291) [hereinafter Moorer EC 6.0 Direct Testimony]; [SNC] Testimony of Dr. Charles Coutant Concerning EC 6.0 (fol. Tr. at 1292) [hereinafter Coutant EC 6.0 Direct Testimony]; [SNC] Rebuttal Testimony of Dr. Charles C. Coutant on [EC] 6.0 (fol. Tr. at 1293) [hereinafter Coutant

EC 6.0 Rebuttal Testimony]; NRC Staff Testimony of Mark D. Notich, Anne R. Kuntzleman, Rebekah H. Krieg, Dr. Christopher B. Cook, and Lance W. Vail Concerning Environmental Contention EC 6.0 (fol. Tr. at 1477) [hereinafter Staff EC 6.0 Direct Testimony]; NRC Staff Rebuttal Testimony of Anne R. Kuntzleman Concerning Environmental Contention EC 6.0 (fol. Tr. at 1479) [hereinafter Staff EC 6.0 Rebuttal Testimony]; Revised Pre-filed Direct Testimony of Shawn P. Young in Support of EC 6.0 (fol. Tr. at 1569) [hereinafter Young EC 6.0 Direct Testimony]; Rebuttal Testimony of Dr. Shawn P. Young Concerning Contention EC 6.0 (fol. Tr. at 1570) [hereinafter Young EC 6.0 Rebuttal Testimony]; Revised Pre-filed Direct Testimony of Donald F. Hayes in Support of EC 6.0 (fol. Tr. at 1572) [hereinafter Hayes EC 6.0 Direct Testimony]; Prefiled Rebuttal Testimony of Dr. Donald [Hayes] Concerning Contention EC 6.0 (fol. Tr. at 1573) [hereinafter Hayes EC 6.0 Rebuttal Testimony]. USACE representatives who appeared at the request of the staff, provided direct testimony and oral testimony at the evidentiary hearing. See Tr. at 1383-1467; [USACE] Testimony of William G. Bailey, Carol L. Bernstein, Lyle J. Maciejewski, and Stanley L. Simpson Concerning Environmental Contention EC 6.0 (fol. Tr. at 1385) [hereinafter USACE EC 6.0 Direct Testimony].

a. SNC Witnesses

4.166 SNC presented five witnesses: (1) Dr. Charles C. Coutant, a consultant for SNC in the areas of aquatic ecology and fisheries biology; (2) Thomas C. Moorer, SNC's Project Manager for Environmental Support; (3) Jeffrey L. Neubert, Director of Logistics for Nuclear Power for Westinghouse Electric Company; (4) Captain H. David Scott, Owner, President, and Principal Surveyor of Southeastern Marine Surveying Company; and (5) Benjamin B. Smith, Operations Manager for Stevens Towing Company. See Tr. at 1287-1382.

4.167 Dr. Coutant's and Mr. Moorer's expert qualifications have been previously discussed in connection with contention EC 1.2. See supra section IV.A.1.a.

4.168 Mr. Neubert earned a Bachelor of Science degree in Engineering Mechanics from Pennsylvania State University and an Executive Masters of Business Administration from University of Pittsburgh. He has over thirty-five years of experience in logistics management, including teaching university-level courses on transportation management, logistics management, and supply chain management. Mr. Neubert is currently employed as the Director of Logistics for Nuclear Power at Westinghouse Electric Company, where, earlier in his career, he was involved in the delivery of major components to over forty nuclear power plant construction sites, including Vogtle Units 1 and 2. See Neubert/Smith/Scott EC 6.0 Direct Testimony at 1-2.

4.169 Captain Scott earned a Bachelor of Science in Nautical Science from Maine Maritime Academy. He has over thirty years of experience in the shipping trade and maritime industry, holds licenses and certifications for piloting vessels on oceans and on the Savannah River, and for the past twenty-six years has served as the Owner, President, and Principal Surveyor of Southeastern Marine Surveying Company. See Neubert/Smith/Scott EC 6.0 Direct Testimony at 1, 3.

4.170 Mr. Smith earned a Bachelor of Arts in History from The University of the South, Sewanee, Tennessee, and a Masters of Business Administration from the Citadel. He has over twenty years of experience planning and supervising all inland and offshore operations for a barge transportation company with a fleet of nine tug boats and twenty-five barges. He has supervised operations on all of the navigable rivers in the Southeast, including the Savannah River, delivering large manufactured pieces, transformers, generators, turbines, and chemical plant vessels. Mr. Smith is versed in shallow water tug and barge operations and the practices and techniques required for deliveries of difficult project cargo. He is currently employed as the

Operations Manager at Stevens Towing Company, Inc. See Neubert/Smith/Scott EC 6.0 Direct Testimony at 1-3.

b. Staff Witnesses

4.171 The staff presented five witnesses: (1) Dr. Christopher B. Cook, Senior Hydrologist, DSER/NRO/NRC; (2) Rebekah H. Krieg, Senior Research Scientist in the Ecology Group, ESD/EED/PNNL; (3) Anne R. Kuntzleman, Aquatic Biologist, DSER/NRO/NRC; (4) Mark D. Notich, Senior Project Manager, DSER/NRO/NRC; and (5) Lance W. Vail, Senior Research Engineer in the Hydrology Group, ESD/EED/PNNL. See Tr. at 1475-1566.

4.172 The qualifications of Dr. Cook, Ms. Krieg, Ms. Kuntzleman, and Mr. Vail have been previously discussed by the Board in connection with contention EC 1.2. See supra section IV.A.1.b.

4.173 Mr. Notich earned a Bachelor of Science in Agricultural Chemistry from the University of Maryland. He has over thirty years experience with the preparation of environmental assessments and environmental impact statements. Mr. Notich currently is employed as a Senior Project Manager, DSER/NRO/NRC. In this capacity he served as the NRC Project Manager for the environmental review of the Vogtle ESP application. See Staff EC 6.0 Direct Testimony at 1 & unnumbered attach. 6 (Mark D. Notich SPQ).

c. USACE Witnesses

4.174 Pursuant to the staff's request and an authorization by the USACE Savannah District to address topics within USACE's authority, see USACE EC 6.0 Direct Testimony at 3, four USACE witnesses also appeared: (1) William G. Bailey; (2) Carol L. Bernstein; (3) Lyle J. Maciejewski; and (4) Stanley L. Simpson. See Tr. at 1383-1466.

4.175 Mr. Bailey earned a Bachelor of Science in Forestry from Syracuse University, a Bachelor of Science in Biology from SUNY College of Environmental Science and Forestry, and

a Master of Science in Civil Engineering from North Carolina State University. He is currently employed with USACE as Chief of the Savannah Planning Unit, Savannah-Mobile Regional Planning Center (Environmental Resources, Plan Formulation, and Economics), Mobile District. He manages the Savannah District Unit's planning program, which evaluates the environmental impacts and economic feasibility of new projects and the environmental compliance of existing projects. In this capacity Mr. Bailey provides advice and direction and reviews the work of environmental staff. See USACE EC 6.0 Direct Testimony at 1-2 & unnumbered attach. 2 (William George Bailey SPQ); Tr. at 1390-91.

4.176 Ms. Bernstein earned a Bachelor of Science in Renewable Natural Resources from the University of Arizona and a Master of Science in Interdisciplinary Environmental Sciences Studies from Johns Hopkins University. She is currently employed with USACE as Chief of the Coastal Branch, Regulatory Division, Savannah District. The Regulatory Division has full responsibility for planning, programming, administering, and enforcing the Regulatory Program, including permit evaluation, enforcement, noncompliance, and mitigation under the Rivers and Harbors Act and the Clean Water Act. In her capacity as Chief of the Coastal Branch in the Regulatory Division she manages and executes the regulatory program for the southern half of Georgia and supervises eighteen interdisciplinary staff, including two section chiefs and one field office. See USACE EC 6.0 Direct Testimony at 1-2 & unnumbered attach. 4 (Carol L. Bernstein SPQ); Tr. at 1390.

4.177 Mr. Maciejewski earned both a Bachelors and a Masters degree in Civil Engineering from the South Dakota School of Mines and Technology. He is currently employed with USACE as Operations Project Manager in the Navigations Branch, Operations Division, Savannah District. In this capacity he budgets, schedules work, coordinates, monitors funding, and serves as technical point of contact with internal and external customers for work involving

maintenance dredging of the Savannah Harbor and river basin. See USACE EC 6.0 Direct Testimony at 1-2 & unnumbered attach. 6 (Lyle Maciejewski SPQ); Tr. at 1389.

4.178 Mr. Simpson earned a Bachelor of Science in Civil Engineering from Clemson University. He is currently employed with USACE as the Savannah District Water Control Manager, Engineering Division, Wilmington District. In his capacity as the Water Control Manager, Mr. Simpson is involved in the day-to-day operations of water management in the Savannah River Basin, establishing rules in the Water Control Manuals, and developing the Drought Contingency Plan. He manages water resources, prepares periodic reports and data-calls on Water Control activities and the Water Control Data System, and provides technical support to other USACE divisions. His work involves daily communication with USACE personnel and entities both within and outside the USACE. See USACE EC 6.0 Direct Testimony at 1-3 & unnumbered attach. 8 (Stanley L. Simpson SPQ); Tr. at 1392-93.

d. Joint Intervenors Witnesses

4.179 Joint Intervenors presented two witnesses for contention EC 6.0: Dr. Donald Hayes, a civil engineering professor and professional engineer, and Dr. Shawn P. Young, a fisheries biologist. See Tr. at 1567-1631.

4.180 Dr. Hayes earned both a Bachelor of Science and a Master of Science in Civil Engineering from Mississippi State University and a Ph.D. in Civil Engineering with emphases in Environmental Engineering and Water Resources Planning and Management from Colorado State University. He is currently employed as the Director of the Institute for Coastal Ecology and Engineering and is an Endowed Professor of Civil Engineering at the University of Louisiana at Lafayette. He is a registered Professional Engineer in the State of Mississippi and a Board Certified Environmental Engineer by the American Academy of Environmental Engineers. Dr. Hayes has over twenty-seven years of experience as an engineer, much of it

related to dredging and associated impacts. He also serves on the Board of Directors of the Western Dredging Association. See Hayes EC 6.0 Direct Testimony at 1-2; Exh. JTIR20041, at unnumbered page 1 (Declaration of Donald Hayes (Sept. 21, 2008)); see also Exh. JTIR00045 (CV of Donald Hayes).

4.181 Dr. Young's background and expert qualifications are discussed in connection with EC 1.2 in section IV.A.1.c supra.

4.182 Based on the foregoing, and the respective background and experience of the witnesses, the Board finds that each of these witnesses is qualified to testify as an expert witness relative to the analysis of likely impacts from any dredging of the Savannah River federal navigation channel necessary for construction of proposed Vogtle Units 3 and 4.

3. Factual Background for Contention EC 6.0

4.183 SNC has stated that "the optimal and desired method of delivery of heavy components to the Plant Vogtle Units 3 [and] 4 construction site [is] via barge." Neubert/Smith/Scott EC 6.0 Direct Testimony at 3. This is because, in SNC's estimation, barge delivery is "the most efficient and cost-effective method of delivery," id. at 4, considering that these components likely will be manufactured overseas and will arrive in the United States via ship, and, as SNC witness Mr. Neubert explained, traveling as far as possible by water with such components is generally preferred. See Tr. at 1340-41. SNC plans to transport only the heavy components (such as the reactor vessel and steam generators) via barge, with the other construction components likely being transported by rail or highway. See Tr. at 1319-20. SNC currently estimates thirty to sixty barge shipments for the heavy components. See Tr. at 1322.

4.184 The proposed barge shipments will travel through a portion of the Savannah River downstream from the VEGP site known as the federal navigation channel, which is under USACE jurisdiction. See FEIS 1A, at 4-27. USACE has the authority to maintain the channel to

a depth of nine feet by a width of ninety feet to enable river navigation, but has not maintained the channel since 1979. See id.; Tr. at 1338, 1463.

4.185 Because of this gap in maintenance dredging, federal and state authorities and citizens groups provided comments on the staff's DEIS that indicated the staff should consider the impacts of potential dredging of the channel in the staff's environmental review process. See FEIS 1C, at E-55 to -57. This resulted in the staff's inclusion of a brief discussion in the Cumulative Impacts section of the FEIS and a staff conclusion that any impacts from dredging could be MODERATE. See id. at E-58; FEIS 1B, at 7-20 to -21.The adequacy of the staff's analysis and the purported lack of reasoning behind the staff's conclusion were subsequently challenged by Joint Intervenors and became one of the subjects of this contention. The other aspect of the contention concerns the staff's decision not to include a discussion of any water releases from upstream reservoirs that Joint Intervenors allege will be made to otherwise support the navigation of SNC barges through the federal navigation channel.

4.186 As an initial matter, it is useful to outline the SNC options relative to use of the federal navigation channel and the process that would follow a decision to pursue any one of the options. SNC has three options if it plans to use the federal navigation channel for the transportation of construction components to the Vogtle site: (1) proceed without dredging, relying on the flow of the Savannah River to enable barging; (2) request that the USACE perform maintenance dredging of the federal navigation channel pursuant to its authority; or (3) request a permit from USACE for SNC to perform its own dredging of the federal navigation channel. See Tr. at 1346-47.

a. Barging Without Dredging

4.187 If SNC makes the determination that it will transport at least some of the construction components by barge, but decides that it will not pursue dredging of the federal

navigation channel and, instead, will rely on the flow of the Savannah River, SNC will be limited in its use of the channel to periods of time when the flow is sufficient to accommodate barging of its components. Witnesses from USACE and the staff acknowledged that one of the barge shipments on the Savannah River within the past ten years, a Chem Nuclear shipment of contaminated reactor vessels to Barnwell, South Carolina (which involved the transport of a 700-ton payload on a 200 by 40-foot barge with a draft of about 5.5 feet), required a flow of about 10,000 cubic feet per second. USACE EC 6.0 Direct Testimony at 5; Staff EC 6.0 Direct Testimony at 9; Tr. at 1438-40. According to USACE, this shipment was roughly equivalent to what would be required to ship a steam generator, the largest component that will be transported to the VEGP site for proposed Units 3 and 4.[48] See Tr. at 1439-40. According to SNC witnesses, a flow of 10,000 cubic feet per second would be in excess of what is needed to ship a steam generator.[49] See Tr. at 1327-28.

4.188 As of the date of the evidentiary hearing, given that the Savannah River has been in drought condition, the river flow was at a level where barging of large industrial components would not be feasible without dredging. See USACE EC 6.0 Direct Testimony at 5. The flow of the river as of January 5, 2009, was 3790 cfs based on data from the United States Geological Survey Augusta gauge. See Neubert/Smith/Scott EC 6.0 Direct Testimony at 9. USACE witness Mr. Simpson indicated, however, that the river flow could change in a relatively short period of time following precipitation, which could involve a transition from a drought to a

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[48] Compare USACE EC 6.0 Direct Testimony at 5, and Tr. at 1439-40, with Neubert/Smith/Scott EC 6.0 Direct Testimony at 5.

[49] Although SNC witnesses indicated that the Chem Nuclear shipment had a somewhat higher payload that required a greater barge draft, see Tr. at 1327-28, this does not diminish the relevance of their testimony regarding the sufficiency of a 10,000 cfs flow for the Vogtle steam generators. If sufficient for what might have been a somewhat larger load, such a 10,000 cfs flow would be more than enough for a (relatively) lighter component.

flood. Mr. Simpson testified that the transition out of the 1998 to 2003 drought occurred in about two to three months. See Tr. at 1442-43.

4.189 Although SNC will not need USACE permission for navigation prior to a barge shipment that can be accomplished without dredging (or, indeed under either of the two dredging scenarios delineated in section IV.C.3 above once the channel has been adequately dredged), if SNC wants USACE to release water from the reservoirs upstream from the VEGP site, this must be coordinated with USACE. See id. If drought conditions were not present, as they were at the time of the hearing, USACE would attempt to accommodate such a request, and "would release as little [water] as [necessary] . . . to provide that service." Tr. at 1445. The amount of water necessary is determined ahead of time by the pilot who will be handling the trip or by USACE's review of its gauges at various locations on the river, although USACE does not have the duty to ascertain the status of the navigation channel. See Tr. at 1444-46.

4.190 The Chem Nuclear barge shipment discussed above involved a release by USACE and serves as an example of what is required for a release. See Tr. at 1441. USACE "had to water up the river about a week in advance," and "keep it watered up while they transport[ed] their barge up, off-load[ed] it, turn[ed] it around and ship[ped] it back," which took roughly a two-week period. Tr. at 1439. This has occurred about three or four times in the last twenty years. See id. In other instances, when there is enough water stored in the flood control pools, water can be released for the duration required for a barge shipment without requiring USACE "to do anything out of the ordinary." Tr. at 1441. In these instances, USACE stores water in its flood control pools after a "high storm event, high inflow event" and then "release[s] it at a non-damaging rate rather than just passing the storm on through." Tr. at 1441-42. Additionally, in the past, when USACE knew ahead of time that a shipment was planned,

USACE stored water in the flood control pools to provide enough water for the shipment. See Tr. at 1440.

4.191 Prior to making such a release, USACE will consider environmental concerns that might be identified by resource agencies. See Tr. at 1451. For example, relative to a release, USACE witness Mr. Simpson explained that "[w]e have concerns about the way we make the release, the time that we make the release[, or i]f it's a spawning season or that time of year." Tr. at 1447. This would be done in accordance with USACE's current authority and likely would not require a new NEPA analysis. See Tr. at 1451-52. Nonetheless, because of the drought, USACE is currently operating pursuant to its Drought Contingency Plan, under which it will not release water from its reservoirs to facilitate barge shipments. See id.

b. Request for USACE to Conduct Maintenance Dredging

4.192 Alternatively, assuming SNC decides that it will transport at least some of the construction components by barge, it might choose to request that USACE conduct maintenance dredging pursuant to USACE's current authority to dredge the federal navigation channel. SNC indicated that this would be the preferred option if dredging were determined to be necessary. See Tr. at 1315-16, 1373.

4.193 At the evidentiary hearing, USACE described in detail the steps that would need to be taken to resume maintenance dredging of the channel. USACE has the authority to perform maintenance dredging of the federal navigation channel to enable transportation. See FEIS 1A, at 4-27. USACE has been authorized to maintain the channel to a depth of nine feet and a width of ninety feet. See id. The last time USACE dredged the channel, however, was in 1979, approximately thirty years ago. See id. Since that time, sediment has settled in the channel, and trees and snags, or woody debris, have accumulated, changing the depth and width of the channel. Based on a survey commissioned by SNC and performed in July 2008,

SNC estimates that a total of 36,500 cubic yards of dredged material and 277 snags and trees would need to be removed from the 110-mile stretch of river between the mouth of the Savannah River and the VEGP facility to enable barge transportation on a barge 220 feet in length by 55 feet in width carrying 730 tons of cargo with a 5.5 foot draft. See Neubert/Smith/Scott EC 6.0 Direct Testimony at 5; Tr. at 1321. USACE stated that it does not have the funds to review the survey commissioned by SNC, although it acknowledged that it was aware of the SNC survey. See Tr. at 1457.

4.194 Although USACE has the authority to dredge the federal navigation channel, it currently does not have the funds to resume maintenance dredging. See Tr. at 1411, 1452-53; USACE EC 6.0 Direct Testimony at 9. To request funds, USACE would need to develop a budget request that would be submitted at the district level, then the regional level, and then the national level as the President's budget proposal to Congress. See Tr. at 1409-10. At each level, proposed projects are ranked against each other and are in competition for funding with other projects. See Tr. at 1410. The budget "process typically takes [eighteen] months." Id. To give an idea of how far in advance the process is initiated, USACE will soon begin work on its budget for fiscal year 2011, which begins in October 2010. See Tr. at 1419.

4.195 USACE witness Mr. Maciejewski explained, however, that funds are normally requested when there are at least two users of the channel. See Tr. at 1461; see also Tr. at 1448-49. Accordingly, with SNC being considered one user, it normally would require another user also to request that the channel be dredged before USACE will consider dredging. See Tr. at 1448. Mr. Maciejewski also stated that he believed USACE had made funding requests to dredge the channel since 1979, but that they were out-competed by other projects. See Tr. at 1461-63.

4.196 An alternative to initiating a funding request would be if Congress directed the USACE to resume maintenance dredging and appropriated the funds. Tr. at 1419-20.

4.197 Aside from the initial funding needed for conducting the maintenance dredging, because the channel has not been maintained since 1979, the USACE might be required to perform an environmental assessment (EA) or an EIS prior to resuming maintenance, which likely will require additional funds as well as additional time to complete the environmental review process. See Tr. at 1453-54; see also Tr. at 1398 (stating EIS process takes approximately two years to complete). The environmental review process in this instance is similar to that for permit applications, see infra section IV.C.3.c, in which public comment is elicited on the proposed project, members of the public have an opportunity to request a hearing or otherwise participate in the review process, and an EA or an EIS is produced. See Tr. at 1412-15.

4.198 Furthermore, because this is an "older project," an additional time consideration for maintenance dredging likely would be the necessary review of any "real estate actions," or anything having to do with real estate, to ensure that USACE and its dredging contractor have access to disposal sites, parking for workers, and storage for supplies. See Tr. at 1455-56. Mr. Maciejewski stated that this process "might be quite time intensive." Tr. at 1456.

c. Request for a Permit for SNC to Perform Dredging

4.199 Finally, assuming SNC were to decide that it will transport at least some of the construction components by barge, it might choose to apply for a permit from USACE for SNC to perform the federal navigation channel dredging. If that is the case, SNC would need to provide USACE with a complete application and be prepared to provide any additional information USACE requires, such as sediment testing. See Tr. at 1393-94. In addition, SNC would need to ensure that any other project for which a permit would be required that is

sufficiently related to the dredging request is also included in its application at that time. This is because USACE regulations prohibit segmentation, or deliberate attempts to submit piecemeal requests to make a project appear smaller than it is. See Tr. at 1402-03. Because SNC plans to dredge parts of the river for a barge slip and the intake and discharge structures for its Vogtle Units 3 and 4 cooling system, for which USACE anticipates SNC will apply for a permit in winter 2009, see USACE EC 6.0 Direct Testimony at 7, these projects likely would have to be included with any project to dredge the channel in one complete application to avoid segmentation, and this process could delay permit issuance. See Tr. at 1346, 1348, 1402-03; USACE EC 6.0 Direct Testimony at 7. For this reason, the permit option likely is the least desirable for SNC. See Tr. at 1314-16, 1348.

4.200 USACE described the permit application process in detail during the evidentiary hearing. Once an application for a dredging permit is received, it is reviewed for completeness and a public notice is issued with a thirty-day period for comment on the proposed project. See Tr. at 1394, 1397. The comment period might be extended up to ninety days at the request of other federal and state agencies that wish to provide comments. See Tr. at 1397. USACE then performs a NEPA analysis of the proposed project. Over the course of its review, USACE might seek additional information from the applicant in order for it to make its permit decision. See Tr. at 1399. If USACE issues an EA with a "Finding of No Significant Impact," it will proceed to a permit decision without an additional comment period. See Tr. at 1398. If it determines that an EIS is necessary, either from the EA process or at the outset of its review of the application, an additional public involvement process ensues, which can take approximately two years to complete. See id. The need to produce an EIS could also add additional time to the permit decision process because the Regulatory Division that handles permitting typically is not funded to conduct its EIS process. See Tr. at 1421. USACE witness Ms. Bernstein explained that the

Regulatory Division "ha[s] to go to headquarters and ask for that funding usually a year ahead . . . to give them a heads up and say, 'we've got this coming down, and put us in the budget for this EIS for this project.'" Id. She also indicated that the applicant will pay for the EIS. See id.

4.201 For certain projects, any member of the public may request a public hearing, although these are not often held. At a public hearing, the District Engineer presides and testimony is taken in the presence of a court reporter. More often USACE will hold a workshop, or request that the applicant hold a workshop, which is a less formal forum for allowing public participation than the public hearing. See Tr. at 1400.

4.202 If issued, the permit likely would contain specific information about the areas authorized for dredging, the method of dredging, and the disposal areas, but would allow for some flexibility for the permit holder to "adaptively manage" the project. Tr. at 1404, 1406. The permit might also contain certain conditions, if, after its environmental review, USACE determines them to be necessary. See Tr. at 1404-05; USACE EC 6.0 Direct Testimony at 7-8. For example, USACE could place restrictions on dredging where cultural resources are found, restrict the time of year dredging is conducted, limit the type of dredge, or limit the disposal area. See Tr. at 1404-05. Generally the permit would be valid for five years, with an opportunity to request an extension. See Tr. at 1403. USACE will also conduct a compliance inspection at some point after the permit is issued and work begins on the project. See Tr. at 1405.

d. Barging Not Used for Transportation

4.203 The three options discussed above all assume that SNC will decide to barge at least some of the construction components for Vogtle Units 3 and 4. After reviewing its options, however, SNC could forego barging altogether and decide to transport its components solely by rail or by truck. See Tr. at 1315. SNC witness Mr. Neubert testified that in his employment for

Westinghouse Electric Company he was required to analyze "at least two viable delivery methods for every component that goes into the AP1000," Tr. at 1320, and stated that "[w]e are absolutely certain that we will be able to deliver all the components to the site even without the barge delivery for Vogtle." Tr. at 1321.

4. Staff's FEIS Methodology Regarding Dredging-Related Impacts

4.204 After receiving comments on the DEIS from federal and state resource agencies as well as members of the public regarding the possibility of dredging, the staff determined that the potential impacts associated with dredging were "worthy of mention," Tr. at 1497, in the Cumulative Impacts section of the FEIS. Staff EC 6.0 Direct Testimony at 5-6, 11. The staff, pursuant to the definition of cumulative impacts provided in CEQ regulations and the staff's environmental review guidance document, "determined this was the appropriate section for the discussion of dredging because the action of dredging the Federal navigation channel in the Savannah River is not under the NRC's jurisdiction and would require a separate review under [NEPA]." Id. at 11-12.

4.205 At the time the staff incorporated this analysis into the FEIS, little information was available as to what SNC's plans were in terms of transporting its components via barge and any dredging of the river that would be required to enable transportation. See id. at 7-8, 10; Staff EC 6.0 Rebuttal Testimony at 3-4; FEIS 1A, at 4-27. The staff held informal discussions with SNC and with members of the USACE both prior to and after issuance of the DEIS. See Staff EC 6.0 Direct Testimony at 7-8. In these discussions, SNC "stated that the Corps had a mandate to maintain the Federal navigation channel," while members of the USACE "stated that while the Corps had authorization for maintaining the Federal navigation channel, the channel had not been maintained for decades and Congress would need to provide funding before maintenance dredging could resume." Id. at 8. USACE officials also indicated in these

discussions that SNC had not made any formal request for dredging the federal navigation channel. See id. at 8. Based on these discussions, the staff "did not believe that dredging for the Federal navigation channel was expected to occur." Id. at 7; see also id. at 8 ("[T]he staff determined that it was unlikely that dredging of the Federal navigation channel would occur and certainly not within any short-term time frame.").

4.206 The staff also assumed that there would be other options that SNC could pursue. The staff, based on informal conversations with USACE, "believe[d] that large components could be barged during periods of naturally occurring high flow" without dredging. Id. at 8. Moreover, the staff assumed that there were other available transportation options besides barging -- road and rail transportation, for example. See id. at 7.

4.207 Because of the limited information available to the staff and the uncertainty over whether (1) the AP1000 components would be barged; and, if so, (2) the channel would need to be dredged to enable barging, the staff performed a qualitative analysis of the impacts of the dredging project. See Staff EC 6.0 Rebuttal Testimony at 3. The staff emphasized that "[w]ithout project-specific information for such a potentially large-scale dredging project (one that indeed may change in scope after review by the resource and regulatory agencies or not occur at all), the Staff could not conduct a meaningful quantitative assessment." Id. at 3; see also id. at 4. Despite the limited information available, "based on the [s]taff's familiarity with previous dredging projects, the [s]taff determined that a qualitative analysis to identify the types of potential environmental impacts likely to occur with such a project was appropriate." Id. at 3.

4.208 To perform the qualitative analysis, the staff drew upon the experience of Ms. Kuntzleman, who for almost twenty years served as a biologist for the Department of the Navy, Engineering Field Activity Northeast, where she "worked on very complex, controversial, and environmentally sensitive dredging projects" located throughout the northeast. Staff

EC 6.0 Direct Testimony at 13-14. The staff also relied on its understanding of USACE's environmental review process and the types of considerations that USACE would take into account regarding either resuming maintenance dredging or approving a permit for SNC to perform the dredging, with the understanding that dredging will have to comply with state water quality standards. See id. at 16-18.

4.209 Given that there was a limited amount of information available regarding the possibility of dredging the channel, the staff had to assume certain conditions in order to perform its analysis. Although "[t]here were orders of magnitude of possible volumes of dredging," Tr. at 1546, the staff assumed that the channel would be dredged to a depth of nine feet and a width of ninety feet, see Tr. at 1487, 1546, and that "depending on the level of water flow, most areas of the Federal navigation channel above rkm 56 (RM 35) would likely need to be dredged to allow barge traffic during normal river flow." FEIS 1A, at 4-27.

4.210 In the FEIS and in its testimony provided at the evidentiary hearing, the staff outlined the types of impacts that might result from dredging the federal navigation channel or disposing of the dredged material and mitigating measures to minimize such impacts. See FEIS 1B, at 7-20; Staff EC 6.0 Direct Testimony at 13-15, 20-21.

a. Types of Impacts on Aquatic Biota

4.211 In terms of the potential impacts on aquatic biota as a result of dredging or disposing of dredged material, the staff stated that dredging the federal navigation channel "would likely have an effect on aquatic organisms for most trophic levels." Staff EC 6.0 Direct Testimony at 13. Based on "the general types of potential adverse environmental effects [Ms. Kuntzleman] ha[s] evaluated with previous dredging projects," Staff EC 6.0 Direct Testimony at 14, dredging could result in a "destruction of benthic habitat, disruption of spawning

migrations, . . . and the direct (e.g., toxicological) and indirect (e.g., habitat alteration) effects on fish and their prey species." Staff EC 6.0 Direct Testimony at 14. The staff elaborated that

> [m]aintenance dredging may result in adverse effects to benthic habitat either by direct removal of the benthic substrate by the dredging operation itself, or via disposal of the dredged material onto the benthic habitat at the disposal site. Various fish species can also lose a source of forage from removal of benthic macroinvertebrates within the dredged area. Sediment disturbance can also impact fish spawning, egg and larval development, and juvenile survivorship.

Id. at 15.

b. Types of Impacts on Water Quality

4.212 In terms of potential impacts on water quality from dredging and disposal of dredged material, the staff stated that

> [w]ater quality impacts . . . include physical, chemical, and biological impacts. Physical impairment of the water column occurs from changes in dissolved oxygen, pH, oxidation-reduction state, and turbidity with a resultant decrease in light penetration. Chemical impairment is caused by release of various chemical contaminants that may occur within the sediment. Biological impairment can occur when introduction of dredged material into the water column kills submerged aquatic vegetation and macroalgae (either through direct smothering or via impaired light penetration) leading to higher rates of bacterial decomposition and a resultant increase in bacterial oxygen demand.

Id.

c. Disposal of Dredged Material

4.213 According to the staff, the amount of dredged material and the locations for, and method of, disposing of dredged material could not be identified based on the limited information available regarding SNC's plans to transport the heavy components to the VEGP site. See FEIS 1A, at 4-27; FEIS 1B, at 7-20; Tr. at 1534-35. The staff, however, did take into account the potential impacts of dredged material disposal when discussing the impacts to aquatic biota and water quality that are outlined above. See Staff EC 6.0 Direct Testimony

at 15. The staff also noted at the hearing that USACE likely would use upland disposal locations rather than the in-water placement method that was employed in 1979 when the channel was last maintained. See Tr. at 1535. The staff indicated that the eventual review of the upland dredge disposal locations, would "get down to a level of detail" of evaluating "the access road into the disposal site" as well as the disposal areas "to make sure there were no wetlands or endangered species there." Tr. at 1536.

d. Mitigation Measures

4.214 Based on the staff's understanding of typical USACE environmental review practice, the staff believed that any adverse environmental impacts as a result of dredging or disposal of dredged material would be mitigated or minimized through appropriate steps taken by USACE. See Staff EC 6.0 Direct Testimony at 17. Regarding impacts to aquatic biota, the staff assumed that after consultation with "Federal resource agencies, including the U.S. Fish and Wildlife Service . . . and National Marine Fisheries Service" and coordination with state regulatory and resource agencies over "where the dredging and dredged material disposal would occur," biota at risk would be identified. Id. The agencies would then "determine the time of the year the areas proposed for maintenance dredging would be used by important species (e.g., birds, fish, macroinvertebrates) for breeding, foraging, rearing, or migration." Id. Accordingly, USACE "would likely be required to avoid dredging activities during peak reproductive and migratory activities, and seasonal restrictions (or environmental windows) would be established by the Federal and state resource agencies for the project." Id.

4.215 If there are endangered mussel species present in a proposed dredging area, relocation of mussels might be a last resort option; otherwise, every effort likely would be made "to minimize the amount of dredging in that area." Tr. at 1535-36; see also Staff EC 6.0 Direct Testimony at 22. Relocation of mussels is a last resort option because the success of

relocation depends on the experience level of the person conducting the relocation, the time of year, and the weather conditions. See Tr. at 1536.

4.216 With regard to mitigation of potential water quality impacts, the staff explained that "if dredging were conducted, by employing best management practices, impacts to water quality would be minimized and the water quality of the Savannah River would return to pre-project conditions." Staff EC 6.0 Direct Testimony at 21. These best management practices include

> selection of the proper dredge type and/or size, use of a sealed or environmental bucket for mechanical dredging, deployment of silt curtain containments, use of sheet pile enclosures, management of barge overflow, and control of sediment loss from bucket to barge as well as from the barge to the upland offloading location.

Id. Time-of-year restrictions on dredging could also reduce water quality impacts, see id., as could any water quality restrictions that are put in place by the states of Georgia and South Carolina under the Clean Water Act, see id. at 18. For example, "Georgia and South Carolina likely would require implementation of a water quality monitoring plan, and violation of state water quality standards would not be permitted to occur beyond a designated mixing zone." Id.

4.217 The staff cautioned that these mitigation measures were discussed "as examples only and not as specific recommendations . . . because there was (and is) no formal request or permit application to dredge the Federal navigation channel before the Corps for its review." Id. at 20.

e. Staff's Conclusion Regarding Cumulative Impacts of Dredging

4.218 After making the above observations regarding potential impacts to aquatic biota, water quality, and possible mitigation measures, the staff concluded "that the cumulative impacts to aquatic organisms in the region from the construction including dredging of a navigation channel could be MODERATE, depending on the type of mitigation." FEIS 1B,

at 7-20. As we noted previously, "MODERATE" is defined as "[e]nvironmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource." FEIS 1A, at 1-4. In the staff's view, this was a conservative assessment of the potential impacts given the staff's "anticipat[ion] that the Federal and state regulatory and resource agencies responsible for reviewing the dredging project would require project-specific mitigation measures to ensure that the cumulative impacts to aquatic organisms in the region would not be LARGE," Staff EC 6.0 Direct Testimony at 18-19; see also id. at 22, 24, which is defined as "clearly noticeable" environmental effects that "are sufficient to destabilize important attributes of the resource." FEIS 1A, at 1-4. Instead, according to the staff, it was likely that the impacts could be "up to" MODERATE, and even could be SMALL, but the selection of MODERATE represented a range of possibilities without more specific information. Tr. at 1525-26. In making its MODERATE finding, the staff noted that "these impacts would be evaluated in more detail in the NEPA analysis that would need to be conducted by the USACE." FEIS 1B, at 7-21.

5. Parties' Arguments Regarding Dredging-Related Impacts

4.219 The staff and SNC both argue that because it is speculative whether the channel will need to be dredged, a cumulative impacts analysis of dredging is not required under NEPA to be included in the staff's FEIS. See Staff Proposed Findings at 83; SNC Proposed Findings at 92. Alternatively, both argue that even assuming such an analysis were required, the staff's review is sufficient to satisfy NEPA requirements because USACE will ultimately identify potential impacts and potential mitigation measures that will ensure any impacts are not greater than MODERATE. See Staff Proposed Findings at 84, 96-100; SNC Proposed Findings at 92-93.

4.220 Joint Intervenors maintain that dredging is not speculative. To the contrary, Joint Intervenors conclude that SNC has planned to barge some of its components, that no dredging

of the federal navigation channel would occur but for SNC's barging needs, and that the NRC staff thus is required to provide a direct impacts analysis of such dredging. See Joint Intervenors Reply Findings at 14-15. In the alternative, assuming that a direct impacts analysis is not required, Joint Intervenors argue that a cumulative impacts analysis is required, and that the staff's cumulative impacts analysis was insufficient to provide the "hard look" that NEPA requires. See id. at 14, 33-36. Joint Intervenors take issue with the staff's "cursory treatment" of the impacts of dredging based on the staff's assumption that dredging "'impacts would be evaluated in more detail'" by USACE. See JTI Proposed Findings at 36 (quoting FEIS 1B, at 7-21).

4.221 Specifically, Joint Intervenors challenge several aspects of the staff's analysis. First, Joint Intervenors demand a quantitative analysis of the impacts of dredging, with the staff required to provide a range of possibilities of potential impacts related to a range of possible volumes of dredged material. See Hayes EC 6.0 Direct Testimony at 6. Second, Joint Intervenors insist that site-specific studies should be provided with regard to the presence of aquatic biota in proposed dredging locations. See Young EC 6.0 Direct Testimony at 5; Young EC 6.0 Rebuttal Testimony at 4. Third, Joint Intervenors argue that sediment management should be explored, particularly the potential for contaminated sediments and any impacts associated with disposal of dredged material. See Hayes EC 6.0 Direct Testimony at 5-6.

6. Legal Background for EC 6.0

4.222 As discussed more fully in section III.A supra, NEPA imposes procedural restraints on an agency, calling for the agency to take a "hard look" at the environmental impacts of a proposed action, as well as reasonable alternatives to that action. See Claiborne, CLI-98-3, 47 NRC at 87-88. This "hard look" is, however, subject to a "rule of reason" in that the consideration of environmental impacts need not address every impact that could possibly

result, but rather only those that are reasonably foreseeable or have some likelihood of occurring. See, e.g., Shoreham, ALAB-156, 6 AEC at 836. Agencies are given broad discretion in determining how thoroughly to analyze a particular subject, see Claiborne, CLI-98-3, 47 NRC at 103, and may decline to examine issues the agency in good faith considers "remote and speculative" or "inconsequentially small," Vermont Yankee, ALAB-919, 30 NRC at 44 (citing Limerick Ecology Action, 869 F.2d at 739).

4.223 In implementing NEPA, the NRC uses the definitions provided in CEQ regulations. 10 C.F.R. § 51.14(b). The CEQ regulations state that an agency EIS must consider direct, indirect, and cumulative impacts of an action. See 40 C.F.R. § 1508.25. Direct impacts are those caused by the federal action, and occurring at the same time and place as that action, while indirect impacts are caused by the action at a later time or more distant place, yet are still reasonably foreseeable. See id. § 1508.8. Cumulative impacts are defined as:

> the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Id. § 1508.7. This definition is also provided in the NRC's ESRP, which as we have discussed previously, see section IV.A.4.a.i supra, is a guidance document the staff uses for its environmental review. See Staff EC 6.0 Direct Testimony at 12. If impacts are remote or speculative, the EIS need not discuss them. See Vermont Yankee, 435 U.S. at 551.

4.224 For impacts that are reasonably foreseeable, but for which the agency lacks complete information in its analysis, the agency must indicate that such information is lacking. See 40 C.F.R. § 1502.22. Significantly, the unavailability of information does not "halt all government action." Sierra Club v. Sigler, 695 F.2d 957, 970 (5th Cir. 1983). "This is

particularly true when information may become available at a later time and can still be used to influence the agency's decision." Id.

4.225 Joint Intervenors focus on the types of actions that an EIS must consider. They argue that dredging the Savannah River federal navigation channel is a connected action to the proposed ESP, and they therefore conclude that it must be addressed with a direct impacts analysis, or alternatively, a cumulative impacts analysis. Under section 1508.25 of the CEQ regulations, which defines the term "connected action," the types of impacts that are to be considered are outlined separately from the types of actions that are to be considered. See 40 C.F.R. § 1508.25. This indicates that each type of action and each type of impact has its own independent significance in the sense that a conclusion that something is a "connected action" does not necessarily inform the type of impacts analysis that is performed, whether direct, indirect, or cumulative. See id. § 1508.25 ("To determine the scope of environmental impact statements, agencies shall consider 3 types of actions, 3 types of alternatives, and 3 types of impacts."). That being the case, the Board rejects Joint Intervenors argument that a direct impacts analysis should have been performed in lieu of a cumulative impacts analysis.

4.226 Finally, with regard to the parties' arguments as to whether an analysis need be included in the FEIS at all based on the foreseeability of dredging the federal navigation channel -- i.e., the staff's and SNC's arguments that dredging is not reasonably foreseeable and an analysis need not be included, and Joint Intervenors argument that dredging is reasonably foreseeable and an analysis must be included -- the Board finds in these circumstances that it need not address these arguments, but will instead focus in the first instance on the sufficiency of the staff FEIS discussion that was provided regarding the impacts of any potential dredging.

7. Adequacy of Staff's Conclusion Regarding Cumulative Impacts of Dredging

4.227 Based on the staff's qualitative review discussed above, the Board finds that the staff's conclusion that the cumulative impacts as a result of dredging the federal navigation channel could be MODERATE is a reasonable, adequately supported, conservative conclusion given the limited information available regarding the nature and extent of any dredging.

4.228 As discussed above, the staff included the cumulative impacts analysis in the FEIS in response to comments received on the DEIS regarding possible dredging of the federal navigation channel. The staff was limited to a discussion of potential impacts and possible mitigation measures and an assumption that the channel would be dredged to a depth of nine feet and a width of ninety feet. As of the date of the evidentiary hearing and of this decision, as far as the Board is aware there has been no change in the amount of information available regarding SNC's intent with respect to dredging -- SNC has not made a formal request that USACE resume maintenance dredging, nor has SNC filed a permit application with USACE. See, e.g., USACE EC 6.0 Direct Testimony at 10. Nevertheless, the staff's analysis and MODERATE conclusion comport with SNC's testimony regarding the potential extent of dredging the federal navigation channel and any impacts associated with dredging as well as USACE's testimony regarding its eventual review of any dredging-related impacts. Thus, for the reasons outlined below, the evidentiary record amply supports the staff's conclusion that the cumulative impacts associated with dredging could be MODERATE.

a. Extent of Dredging

4.229 For the purposes of transporting the largest construction component -- one of the steam generators -- a barge measuring 220 feet in length and 55 feet in width would be required. See Neubert/Smith/Scott EC 6.0 Direct Testimony at 5. "The expected operational draft of a barge of this size loaded with one steam generator would be 5 1/2 feet." Id. With a

barge of these dimensions and this operating draft, and with the preliminary survey of the federal navigation channel that SNC commissioned, SNC determined that there were "[eight] locations along the Savannah River where a total of only approximately 36,500 cubic yards of dredged material would need to be removed." Id. at 4. This volume of dredged material assumes that the eight locations will be dredged to a depth of six feet, which will accommodate the barge draft and 1/2 foot of under-keel clearance. See id. at 8.

4.230 Joint Intervenors are concerned that SNC underestimated the depth necessary for safe navigation and therefore underestimated the volume of dredged material. See Hayes EC 6.0 Rebuttal Testimony at 3. Joint Intervenors suggest that "[a] dredging depth of [seven] feet or greater is probably more realistic." Id. The USACE could not confirm whether 36,500 cubic yards would be a realistic estimate of the volume of dredged material. See Tr. at 1426. Even assuming, however, that seven feet would have been more appropriate, this does not adversely affect the staff's MODERATE conclusion. If anything, because the staff assumed that the channel would be dredged to a depth of nine feet, this would serve to support the finding that the staff's MODERATE conclusion was conservative. See Tr. at 1546. Moreover, the amount of dredging required could be less, depending on the flow of the river at the time any dredging is conducted. Because SNC's survey was conducted when the river was in drought conditions with an assumed flow rate of about 3700 cfs, see Neubert/Smith/Scott EC 6.0 Direct Testimony at 8, SNC's estimated dredged material volume was itself a conservative estimate.

b. Impacts on Aquatic Biota and Water Quality from Dredging and Tree/Snag Removal

4.231 It is important to note, however, that despite the possibility that the volume of dredged material likely will be much smaller than what the staff originally assumed in preparing its FEIS, this does not answer the question of the impacts to aquatic biota in the eight

SNC-identified locations for dredging. See Tr. at 1547. As Joint Intervenors witness Dr. Young opined, "[e]ven if only one mile of river is dredged, the dredged areas may be hotspots of high abundance for benthic organisms," or the dredging "may change flow velocity or location of the thalweg which in turn may then cause changes in habitat." Young EC 6.0 Rebuttal Testimony at 1. As discussed below, SNC witnesses provided testimony that further supported the staff's conclusion in this regard -- establishing by a preponderance of the evidence that such impacts likely would not be greater than MODERATE.

i. Freshwater Mussels

4.232 In the interest of further understanding potential impacts to freshwater mussels, Joint Intervenors claim that "a thorough freshwater mussel survey for the entire affected area should be completed" including "a thorough discussion of each mussel species' life history." Young EC 6.0 Direct Testimony at 5. Studies proffered by SNC and the staff, however, indicate that the habitats identified for dredging are not favored habitats for mussels. The locations that SNC identified for dredging are primarily in the Savannah River shifting sand habitats. See Tr. at 1350. A study conducted on the Pee Dee River that involved a comprehensive survey of mussel habitats and "spent much more time on the shifting sand habitats that would be the subject of dredging here," id., concluded that "[m]uch of the habitat in the center of the channel . . . is of poor quality for freshwater mussels due to unstable, shifting sediment. The best mussel habitat in these rivers is often restricted to narrow troughs, usually within the thalweg [(the deepest part of the channel), Tr. at 1351,] adjacent to river banks." Exh. SNC000066, at 30 (Freshwater Mussel Surveys of the Pee Dee River Basin in South Carolina (Jan. 3, 2006)).

4.233 SNC witness Dr. Coutant testified, see Tr. at 1350-51, that this finding was consistent with the mussel survey conducted on the Savannah River that was cited by Joint Intervenors as "the most recent information available about the mussel species of the Savannah

River," Young EC 6.0 Rebuttal Testimony at 3. The Savannah River survey reached the same conclusion as the Pee Dee survey, i.e., that "[i]n general, mussels were most abundant in the thalweg at the base of the river bank, and rare or absent in the shifting sand dominated runs in the center of the channel." Exh. Catena Group Mussel Surveys at 5. Because mussel species were not likely to be found in the potential dredge areas, Dr. Coutant thus concluded that the impacts on mussel species as a result of dredging likely would be small. See Tr. at 1354.

4.234 Joint Intervenors assert that Dr. Coutant was incorrect to rely heavily on the Pee Dee River survey as opposed to the Savannah River survey because the dredging will take place on the Savannah River. See Young EC 6.0 Rebuttal Testimony at 3. The Savannah River survey, however, was not as comprehensive as the Pee Dee River survey and focused on the deep water habitats rather than those similar to the potential dredged areas identified by SNC. See Tr. at 1350. Because the Pee Dee River survey focused on areas similar to the potential dredge areas and both surveys reached the same conclusion, the Board finds Dr. Coutant was not incorrect to rely on the Pee Dee River survey.

4.235 Although Joint Intervenor witness Dr. Young initially disagreed with the SNC interpretation of the studies, explaining that several species of mussels were collected in an area that he believed to be a shifting sand habitat, see Tr. at 1599-1602, Dr. Young admitted that he was not able to discern the type of habitat where these species were observed. See Tr. at 1628.

4.236 Joint Intervenors are also concerned with the staff's mention of the possible relocation of freshwater mussels in the event they are present in dredging locations, noting that "[r]elocations of freshwater mussels have had variable success – with some relocation attempts resulting in 100% mortality." Young EC 6.0 Direct Testimony at 5; see also Tr. at 1608. The staff did not disagree with the risk involved in mussel relocation. This is the reason the staff

stated that the relocation of mussels would be a last resort option. The staff believed that in the first instance every effort likely would be made "to minimize the amount of dredging in [an] area [where mussel species are present]." Tr. at 1535-36; see also Staff EC 6.0 Direct Testimony at 22. Joint Intervenors did not otherwise dispute the staff's explanation of possible efforts to minimize adverse effects on freshwater mussels.

4.237 Therefore, contrary to Joint Intervenors claim that more thorough mussel surveys should be conducted relative to the staff's cumulative impacts analysis, see Young EC 6.0 Direct Testimony at 5, both the Savannah River and Pee Dee River surveys are sufficient to support the staff's finding that impacts will be MODERATE because they show that mussels are not likely to be found in the potential dredge areas. Joint Intervenors do not provide any evidence that would support a finding that, given the above evidentiary record supporting the staff's conclusion, impacts on freshwater mussels would be greater than MODERATE.

ii. Fish

4.238 Joint Intervenors witness Dr. Young stated that dredging might negatively impact other aquatic species such as the shortnose and Atlantic sturgeon, the robust redhorse, and the striped bass, and that more studies are necessary. See Young EC 6.0 Direct Testimony at 4; Young EC 6.0 Rebuttal Testimony at 4. In response to Joint Intervenors concerns, SNC witness Dr. Coutant prepared a report that concluded that the food web dynamics and spawning success of these species would not be significantly affected. See SNCR20051, at unnumbered pp. 11-12 (Analysis of Impacts of Navigation Channel Maintenance for Barge Delivery of Materials for Construction of Vogtle Units 3 and 4 on the Ecology of the Savannah River (Jan. 2, 2009, corrected Mar. 13, 2009)) [hereinafter Coutant Report]. In addition, he stated at the hearing that "[t]here obviously will be some change in turbidity" or "some increase in the silt that's put into the water" from dredging or snag removal, but "[t]hat kind of turbidity effect is very

brief. The siltation settles out very quickly and has no long term effect." Tr. at 1362. Further, Dr. Coutant stated that these species tend to be in deep water in the channel, whereas the dredging habitats are shallow by definition. See id. Therefore, he expected that these species "are not going to be unduly impacted." Id.

4.239 Although Dr. Young specifically took issue with Dr. Coutant's statement in his report that the robust redhorse has not been identified in the reach of the Savannah River where the dredging is proposed, see Young EC 6.0 Rebuttal Testimony at 4, Dr. Young did not challenge Dr. Coutant's conclusions regarding these fish species other than to allege that more studies are necessary. For the purposes of the staff's FEIS, however, more studies at this stage are not necessary. As Dr. Young acknowledged, site-specific studies likely will be conducted by USACE if dredging is pursued as an option. See Tr. at 1614-15. Dr. Coutant's report and testimony support the staff's finding that impacts to fish from dredging or snag removal could be MODERATE, with nothing provided by Joint Intervenors indicating that these impacts would be greater than MODERATE.

iii. Snag Removal

4.240 Joint Intervenors argue that the removal of trees and snags identified by SNC could negatively impact fish and mussel species. See Young EC 6.0 Rebuttal Testimony at 2-3. Joint Intervenors witness Dr. Young asserted that removal of trees from the main channel, even though it could positively impact shallow water species when the trees and snags are then deposited along the banks, could negatively impact main channel mussels and fish. See id. In particular, Dr. Young emphasized that woody debris provides a very important habitat to "a number of . . . species of concern or threatened or endangered species." Tr. at 1612. Dr. Young asserted that from "the number of trees that may have to be removed from the channel, . . . there's no way it would not affect these vulnerable species." Id. He also noted the

importance of reestablishment of these habitats, with a potential mitigation measure of replacing the snags after they have been removed. See Tr. at 1616-17.

4.241 SNC witness Dr. Coutant agreed that there is a potential impact on aquatic biota from snag removal. See Tr. at 1359. He stated that "if you have a large tree that falls in and its branches will catch smaller woody debris, th[en] it becomes a velocity barrier and fish will tend to hide behind it." Id. Dr. Coutant did not believe, however, that snag removal would have a significant impact. This is because he estimated that "only about a third" of these barriers that are present in the channel will be removed. Tr. at 1360. Not only would this leave the remaining two-thirds in place, but he indicated that the one-third being taken from the channel would be "moved to another spot out of the way of the barges" so that "ecological function is still going to occur." Id. In addition, Dr. Coutant stated that snags "tend[ ] to reappear quite quickly as you have a flooding cycle. . . . [, s]o this kind of habitat is reestablished very quickly." Tr. at 1360. SNC witness Mr. Moorer added that in his experience with USACE dredging, the USACE "do[es] not allow . . . dredging to occur during spawning periods, and they might have similar controls for snag removal as well," Tr. at 1361, further indicating that any impacts from snag removal likely will be limited.

4.242 Citing a study that he participated in, which indicated that woody debris provides important habitats for fish and mussel species, Joint Intervenors witness Dr. Young asserted that there likely would be a negative impact on species whose habitats are disrupted. See Tr. at 1611-14. As discussed above, the staff and SNC appear to agree that there will be some negative impacts from the removal of trees and snags. The important question, however, is whether these impacts will exceed the highest potential impact that the staff predicted could occur in the FEIS -- whether it would exceed a MODERATE impact. Joint Intervenors do not

provide any evidence to rebut the staff's and SNC's evidence establishing, by a preponderance of the evidence, that impacts from snag removal likely would not exceed MODERATE.

iv. Sediment Contamination

4.243 Joint Intervenors allege that the sediments that might be resuspended as a result of dredging might be contaminated, which could impact water quality, aquatic biota, see Tr. at 1588-89, 1598-99, 1609-10, and dredge disposal options, see Hayes EC 6.0 Direct Testimony at 10. SNC witness Dr. Coutant responded, however, that "there is good evidence . . . that these river sediments are not contaminated." Tr. at 1356. Dr. Coutant cited a "study of three representative sites in the reach of river that we're talking about for dredging[,] where sampling was done of the bottom sediments and the water quality[,] . . . . [that] indicated that all of the sediment concentrations of the materials you might consider as contaminating the water quality," Tr. at 1356, were in concentrations that fell below relevant standards. Tr. at 1356-1358. Based on this study, Dr. Coutant concluded that "I'm quite confident that the sediments in the river are not contaminated," and that the impacts associated with any potential risk of contamination "look like they'd be small." Tr. at 1357; see also Tr. at 1358.

4.244 Consistent with his conclusion that the sediments likely are not contaminated, Dr. Coutant explained that even though there are fish consumption advisories for the Savannah River, likely due to the presence of mercury in fish, "it doesn't necessarily mean that . . . mercury has come out of the sediments." Tr. at 1381. He elaborated that although "there is a potential source of mercury in the Savannah system and that's the Chlor-Alkali Plant . . . near Augusta, . . . the mercury levels . . . in the Savannah River are quite low." Tr. at 1380. Mercury concentration at these levels often can be attributed to "the general atmospheric deposition of mercury from coal burning and other activities that give that pretty consistent background of mercury level in the water," Tr. at 1380-81, which is then "taken up by organisms." Tr. at 1379.

Joint Intervenors did not dispute Dr. Coutant's testimony with respect to contamination. See Tr. at 1589.

4.245 Joint Intervenors witness Dr. Hayes explained that in citing fish consumption advisories and a paper concerning mercury contamination related to the Chlor-Alkali plant near Augusta, he merely wanted the issue of potential contamination to be considered in the environmental analysis. See Tr. at 1588-89. Likewise, Joint Intervenors witness Dr. Young cited his own experience studying fish with possible contamination, and asserted that this was an area of concern for him as a biologist. See Tr. at 1609-10. However, neither Dr. Hayes nor Dr. Young disputed Dr. Coutant's assertion that contamination in the sediment was not likely to be an issue. Thus, the preponderance of the evidence establishes that Joint Intervenors evidence is insufficient to rebut the staff's finding that the impacts from dredging likely would be no greater than MODERATE.

c. Disposal of Dredged Material

4.246 Joint Intervenors claim that the staff did not adequately address the management and disposal of dredged material. See Hayes EC 6.0 Direct Testimony at 5-6. When the staff wrote the FEIS it did not have any information on potential disposal areas, but it considered the disposal of dredged material in finding that the impacts could be MODERATE. See Staff EC 6.0 Direct Testimony at 15. This information was corroborated by testimony from SNC at the evidentiary hearing. Based on his experience with channel maintenance and dredging operations, SNC witness Mr. Moorer stated it was his opinion that the USACE will "use existing upland disposal areas or move the material to heavily eroded areas to replenish sand lost to hurricane or heavy wave damage" rather than a "within bank" disposal program that the USACE previously used for channel maintenance. Moorer EC 6.0 Direct Testimony at 4-5. In addition,

Dr. Coutant stated in his report that these disposal options are "feasible because of the relatively small amount of material involved." Coutant Report at 4.

4.247 Joint Intervenors appeared to agree that given the small amount of material anticipated, disposal would be manageable. After learning of SNC's estimated dredge volume of approximately 36,500 cubic yards of material, Joint Intervenors witness Dr. Hayes characterized the dredging project as a "very small to modest" project that "can be managed fairly readily." Tr. at 1586. He was therefore "not particularly concerned whether [the volume is] 36,000 or 40,000, or 30,000." Id. Instead he would be concerned if that number changed by an order of magnitude, from 36,000 to 360,000. If that were the case, "things [would] change very dramatically" because more material would need to be managed and placement areas for dredged material would need to be assessed for environmental impacts. Id. However, Dr. Hayes acknowledged that USACE or SNC, whichever would be paying for the dredging, would eventually perform a survey to better estimate the volume of dredged material before beginning work on any dredging project. See Tr. at 1596-97.

4.248 As discussed above with respect to the extent of dredging, the staff assumed that the channel would be dredged to the greatest USACE-authorized extent of nine by ninety feet, and with this amount determined that construction impacts, including those related to the disposal of dredged material, would not be greater than MODERATE. There was otherwise no evidence that contradicted the staff's MODERATE finding in terms of impacts from dredge disposal. Furthermore, although there is limited information available with regard to dredge disposal, the staff, SNC, USACE, and Joint Intervenors all agreed that this is an area that will be addressed if and when dredging is pursued as an option. See Tr. at 1536 (staff); Moorer EC 6.0 Direct Testimony at 4-5 (SNC); Tr. at 1404-06 (USACE); Tr. at 1596-97 (Joint Intervenors).

d. Mitigation Measures

4.249 The staff's analysis and conclusion are consistent with the USACE testimony regarding USACE's eventual review of any dredging project and identification of mitigation measures. As discussed above, in making its FEIS finding, the staff relied on the types of impacts that USACE likely would evaluate and the types of actions or conditions on dredging that USACE would consider to mitigate those impacts. USACE indicated that it will be required under NEPA to perform an environmental review of an application for a permit submitted by SNC and likely will be required to perform an environmental review prior to resuming maintenance dredging. See Tr. at 1394-98, 1434-35; USACE EC 6.0 Direct Testimony at 6-7. Witnesses for the USACE also confirmed that in both cases, compliance with water quality standards will be required prior to any dredging. See USACE EC 6.0 Direct Testimony at 6-7. This further supports a finding that dredging-related impacts likely will not be greater than MODERATE.

4.250 Witnesses for Joint Intervenors and SNC appear to be in agreement that the environmental impacts will be bounded by USACE's more in-depth review. Dr. Coutant and Mr. Moorer, both witnesses for SNC, testified that based on their experience with environmental review, impacts on mussels, impacts from sediment contamination, and impacts from snag removal will be explored in greater detail by USACE if and when SNC makes a formal request for USACE maintenance dredging or a dredging permit. See Tr. at 1355, 1357, 1361. USACE might place time of year restrictions on dredging so as not to interfere with spawning, for example. See Tr. at 1361. Dr. Hayes, a witness for Joint Intervenors, stated that in terms of the USACE process, he did not really have anything "to say that is really contradictory to what has already been said by the Corps of Engineers or the NRC panel." Tr. at 1593. Dr. Hayes added that if SNC were to request a permit, then SNC would perform the assessment that he had

expected to see in the staff's FEIS, which USACE would then use as part of the permitting process. Id. Joint Intervenors witness Dr. Young also acknowledged areas where the USACE likely would perform an in-depth review. See Tr. at 1614-15.

4.251 Based on the foregoing, the Board agrees with the undisputed evidence that any impacts associated with dredging the navigation channel likely would not exceed MODERATE, and finds that the staff's conclusion in this regard was reasonable and is supported by the preponderance of the evidence before the Board.

8. Adequacy of Staff's FEIS Methodology Regarding Impacts of Upstream Reservoir Operations

4.252 The FEIS does not contain an analysis of the impacts of upstream reservoir operations for transportation of construction components on the Savannah River. This is because, after discussions with USACE, "the [s]taff assumed reservoir operations would not be altered solely for the purpose of navigation." Staff EC 6.0 Direct Testimony at 6. "Accordingly the staff did not consider it reasonably foreseeable that there would be impacts to the upstream reservoirs associated with releases for navigation, in connection with either the NRC's action or the potential dredging of the Federal navigation channel." Id.

a. Parties' Arguments Regarding Impacts of Upstream Reservoir Operations

4.253 The staff argues that because the USACE will not be making any releases from upstream reservoirs outside of its ordinary flood control plan operations, it is not "reasonably foreseeable that there would be impacts to the upstream reservoirs associated with releases for navigation." Id. SNC likewise argues that such an analysis was not required to be included in the FEIS because it was not reasonably foreseeable that USACE would make additional water releases to support navigation outside of its ordinary operations. See SNC Proposed Findings at 46-47.

4.254 Joint Intervenors, on the other hand, assert that because the impacts of water releases from upstream reservoirs are unaddressed, this is a violation of the staff's responsibilities under NEPA. Joint Intervenors insist that an analysis of impacts from water releases must be conducted before an ESP is issued. See Joint Intervenors Proposed Findings at 42-43.

b. Adequacy of Staff's Decision Not to Address Impacts of Upstream Reservoir Operations

4.255 The Board finds that the preponderance of the evidence establishes that it is not reasonably foreseeable that USACE would release water from upstream reservoirs to support barge transportation of SNC's construction components on the Savannah River outside of its normal operations. Accordingly, the staff's decision not to address these impacts was reasonable because it was not required under NEPA to include this information in the FEIS.

4.256 As discussed in section IV.C.3.a above, one of SNC's options if it decides to transport at least some of its construction components by barge, but decides not to dredge the federal navigation channel to enable barging, is to choose to coordinate with USACE a release of water from upstream reservoirs.

4.257 The staff assumed that USACE would not be making any releases to support barge transportation for SNC's construction components outside of USACE's normal flood control operations. This was confirmed in testimony from USACE. Although USACE has released water outside of its normal flood control operations a few times in the last twenty years, it more likely would do so incident to its normal flood control operations. Moreover, SNC has unequivocally stated that it "does not plan to request any extra or special releases from upstream reservoirs to support navigation. Operations in accordance with existing Corps procedures is all that is expected." Moorer EC 6.0 Direct Testimony at 7. Indeed, without such a request, USACE will not make any special releases.

4.258 Under NEPA, the staff is required to include an analysis of only those impacts that are reasonably foreseeable or have some likelihood of occurring. See, e.g., Shoreham, ALAB-156, 6 AEC at 836. Because there is nothing in the record to indicate that USACE will make any releases outside of its normal water control operations to support barging of construction components -- and there is overwhelming evidence to the contrary, i.e., that USACE will not make any releases outside of its normal water control operations -- it is not reasonably foreseeable that such releases will be made. Accordingly, the staff's decision not to include an analysis of the impacts of such releases was reasonable.

9. Joint Intervenors Likely Will Have Another Opportunity to Raise Their Concerns

4.259 In reaching this decision regarding Joint Intervenors contention EC 6.0 and finding reasonable the staff's FEIS conclusion that the cumulative impacts from dredging the federal navigation channel could be MODERATE, the Board also notes that Joint Intervenors are not necessarily foreclosed from raising their concerns if and when a decision is made to dredge the federal navigation channel.

4.260 If the ESP has not been issued and new and significant information is obtained with respect to dredging the channel, the staff will issue a supplemental EIS in this proceeding. See Tr. at 1547. Also, in accord with its review of the SNC COL application for Vogtle Units 3 and 4 (which is the subject of a contested proceeding before a separate licensing board, albeit one that contains the same membership as this Board), the staff will issue a supplemental EIS that will address any new and significant information identified by SNC. See Tr. at 1547-48; see also Tr. at M-2387 to M-2388.[50] For both proceedings, the draft supplemental EIS will be

[50] Although this is a citation to the transcript of the mandatory hearing for this proceeding, to which Joint Intervenors were not a party, it is noted here merely as providing further confirmation of the testimony regarding the NEPA procedural process that was given in the contested hearing.

published in the Federal Register, and the public, including Joint Intervenors, will be given an opportunity to provide comments on the draft. See Tr. at 1548-49. A final supplemental EIS then will be issued incorporating the staff's responses to those comments. See Tr. at 1548. In the event SNC determines that there is no new and significant information and the staff agrees, a draft supplemental EIS will be issued with a statement to that effect and the public will have an opportunity to comment on that determination. See Tr. at M-2389-90. Joint Intervenors also may be able to submit a contention challenging any analysis of planned dredging. See, e.g., 10 C.F.R. § 52.39(c); Virginia Elec. & Power Co. (Combined License Application for North Anna Unit 3), LBP-08-15, 68 NRC 294, 309 (2008).

4.261 Alternatively, Joint Intervenors might be able to raise their concerns in a USACE proceeding if and when an environmental review process for any dredging is initiated. As discussed in section IV.C.3. above, USACE allows public participation through comment on proposed projects, the opportunity to request a hearing on a proposed project, attendance at informal meetings with USACE, and the opportunity to comment on any draft EIS that will be issued.[51]

10. Summary of Findings Regarding Contention EC 6.0

4.262 The staff's review process and discussion of potential dredging-related impacts satisfied its obligation under NEPA and Commission regulations to take the requisite "hard look" at the environmental impacts of such dredging. Although from initial discussions with USACE and SNC the staff determined that dredging was unlikely, it responded to comments on the DEIS by including this information. See 10 C.F.R. § 51.91(a)(1). The staff also properly noted

[51] Relative to the possibility of future USACE water releases to permit barging without dredging, the record indicates that USACE would not undergo an environmental review process if it were making releases within its normal flood control operations. See Tr. at 1451-52. Nothing on the record before us suggests that any release necessary to accommodate the components at issue here would lie outside those parameters. See supra section IV.C.8.

in the FEIS the areas in which it did not have enough information to make a more thorough analysis. See 40 C.F.R. § 1502.22 (providing that any agency should make clear when information is incomplete or lacking).[52]

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[52] In response to SNC's proposed findings, Joint Intervenors assert in their reply findings that 40 C.F.R. § 1502.22 cannot be relied upon to justify the limited information available in the FEIS. They argue that the standard in 40 C.F.R. § 1502.22(a) has not been met because the overall costs of obtaining information regarding dredging impacts are not exorbitant "[i]n light of the $7 billion costs of each proposed Unit." Joint Intervenors Reply Findings at 35-36. Arguing in the alternative, Joint Intervenors maintain that even if the staff were excused from obtaining the information under 40 C.F.R. § 1502.22(a), the standards in 40 C.F.R. § 1502.22(b) have not been met. According to Joint Intervenors, neither the FEIS, nor the record as a whole, contains the additional explanation required to be included under 40 C.F.R. § 1502.22(b) when the information cannot be obtained. Id. at 36.

Contrary to Joint Intervenors assertion, the staff was not required under 40 C.F.R. § 1502.22(a) to obtain additional information regarding dredging-related impacts. Based on the information that the staff had at the time, with a potentially wide-ranging dredging project encompassing over 100 miles of river dredged to a depth of nine feet and a width of ninety feet, a quantitative study of environmental impacts, indeed, the type of study that Joint Intervenors demand, see Joint Intervenors Reply Findings at 32, likely would be exorbitant. Compare Hayes EC 6.0 Direct Testimony at 6 ("[A]bout 116 miles of river channel . . . will need to be dredged. For a 90 foot wide channel, the requisite dredging activities could disturb 140 acres or more of benthic habitat and result in about two million cubic yards of sediment to be dredged per foot of deepening required. . . . Despite the lack of specific data, the FEIS could provide a range of estimates for sediment volume and dredging duration based upon some reasonable assumptions and ranges of conditions."), with Staff EC 6.0 Rebuttal Testimony at 3 ("[A] large-scale dredging project [potentially such as this one] does involve a comprehensive environmental analysis that would call for substantial ecological, geotechnical, chemical, and physical information."), and id. at 4 ("Without a pending plan or dredging application before the Corps, the Staff was severely constrained during preparation of the FEIS. . . . Any quantitative evaluation by the Staff would have been a highly speculative effort, since the range of postulated dredging quantities alone would encompass several orders of magnitude."). Although the survey conducted by SNC provided additional information that indicated the extent of dredging could be much less than originally thought, this information cannot be known for certain until SNC, if it decides to do so, applies for a permit with USACE or requests that USACE resume maintenance dredging, thereby initiating USACE's environmental review process.

Because the costs of obtaining additional information likely would be exorbitant, the question becomes whether 40 C.F.R. § 1502.22(b) has been satisfied. Looking at the FEIS, as now supplemented by this decision, the additional explanation required under 40 C.F.R. § 1502.22(b) has been provided. The staff stated numerous times in the FEIS and in testimony that certain information is unavailable to perform the quantitative or site-specific analysis of

(continued...)

4.263 Moreover, the preponderance of the evidence presented at the hearing, as it supplements the staff's FEIS, supports the staff's finding that the cumulative impacts from dredging could be MODERATE. Although Joint Intervenors raised issues that indicated there might be negative impacts from dredging and snag removal, nothing described by Joint Intervenors indicated that any of these impacts would be greater than MODERATE. Joint Intervenors arguments amount ultimately to an assertion that more information is needed regarding the scope of the dredging project and that more studies are necessary to understand the environmental impacts of dredging. NEPA's hard look requirement is subject to a rule of reason, however, and extensive studies of every conceivable impact need not be addressed. See Shoreham, ALAB-156, 6 AEC at 836. The staff provided a reasonable analysis of the potential dredging-related impacts and a reasonable explanation for why they determined that such impacts could be MODERATE. This is all that NEPA requires.

4.264 Furthermore, if SNC determines that dredging will be necessary to transport heavy construction components to the VEGP site and it decides either to request that USACE resume maintenance dredging or to request a permit, more information likely will be provided and more studies likely will be conducted, and this information likely will be incorporated into

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[52](...continued)
dredging impacts that USACE would eventually perform, satisfying 40 C.F.R. § 1502.22(b)(1). See, e.g., FEIS 1B, at 7-20 to -21. As all parties to the proceeding and USACE stated both in prefiled and oral testimony, this information, when available, is relevant to determining if, when, where, and how any dredging and any mitigating measures will be conducted, satisfying 40 C.F.R. § 1502.22(b)(2). See generally Tr. at 1287-1631. In addition to what was included in the FEIS, the testimony provided at the hearing satisfies 40 C.F.R. § 1502.22(b)(3), with experts in the field from all three parties explaining, and with SNC and Joint Intervenors referencing particular scientific studies, the types of impacts that could occur. See, e.g., Tr. at 1349-52, 1588-89, 1599-1602, 1611-12; Staff EC 6.0 Direct Testimony at 14-15. And, finally, the staff's conclusion that the impacts could be MODERATE, with the Board's finding that this was a reasonable conclusion, satisfies 40 C.F.R. § 1502.22(b)(4) in that it is the agency's evaluation of the potential dredging impacts and the potential methods of mitigating those impacts based on a review of the evidence presented by qualified expert witnesses with relevant experience.

any environmental review document produced by USACE. That this information is not available now should not "halt government action" in this instance, Sigler, 695 F.2d at 970, particularly when it would become available with USACE's eventual environmental review and could still be used to inform a USACE decision or the staff's NEPA decision relating to this SNC ESP application, or the pending SNC COL application for Vogtle Units 3 and 4, depending on the timing of its availability.

4.265 The Board therefore concludes that the staff's FEIS finding that cumulative impacts from dredging the federal navigation channel could be MODERATE is adequately supported. Moreover, the staff was not required to include an analysis of the impacts of releases from upstream reservoirs because such releases were not reasonably foreseeable. Accordingly, a judgment on the merits regarding Joint Intervenors contention EC 6.0 is entered in favor of the staff and SNC.

V. SUMMARY FINDINGS OF FACT AND CONCLUSIONS OF LAW

5.1 With respect to contention EC 1.2, the Board rules that (1) the staff's reliance on the extensive body of existing scientific and technical information regarding the Middle Savannah River Basin in reaching its FEIS conclusions regarding impingement/entrainment/thermal impacts for Vogtle Units 3 and 4, met the NEPA requirement to take a "hard look" at those impacts, notwithstanding Joint Intervenors assertion that a contemporary site-specific assessment was necessary; and (2) the staff's conclusion that impingement/entrainment/thermal impacts associated with the operation of Vogtle Units 3 and 4, including cumulative impacts, would be SMALL was fully supported by the record, including the additional information provided by applicant SNC as a result of several recent scientific surveys

it undertook in connection with its currently operating Vogtle Units 1 and 2 facility. As such, a judgment on the merits regarding contention EC 1.2 is entered in favor of the staff and SNC.

5.2 With respect to contention EC 1.3, the Board finds that (1) the lack of significant impacts on ESBRs from the proposed closed-cycle wet cooling towers justifies the FEIS's limited discussion of dry cooling and reliance on EPA's prior findings; (2) in the context of the proposed Vogtle facilities, implementing a dry cooling system is technically infeasible so that it is not a reasonable alternative in the context of NEPA and, therefore, does not need to be analyzed further to satisfy NRC's NEPA obligations; and (3) the record now contains sufficient evidence on dry cooling to support a conclusion that dry cooling would not be preferable to the proposed wet cooling system at the Vogtle site. We thus conclude that the agency's NEPA obligations relative to the discussion of design alternatives have been satisfied with regard to dry cooling, and contention EC 1.3 is resolved on the merits in favor of the staff and SNC.

5.3 With respect to contention EC 6.0, the Board concludes that (1) the staff's review process and discussion of potential dredging-related impacts satisfied its obligation under NEPA and Commission regulations to take a hard look at the environmental impacts of such dredging, given the information that it had when the FEIS was issued; (2) the preponderance of the evidence presented at the hearing supports the staff's finding that the cumulative impacts from dredging could be MODERATE; (3) if SNC determines that dredging will be necessary to transport heavy construction components to the VEGP site and it decides either to request that USACE resume maintenance dredging or to request a permit, more information likely will be provided and more studies likely will be conducted, and this information likely will be incorporated into any environmental review document produced by USACE, which would become available and inform a USACE decision on the dredging or the staff's NEPA decision relating to this SNC ESP application, or the pending SNC COL application for Vogtle Units 3

and 4, depending on the timing of its availability. The Board also finds that the staff was not required to include an analysis of the impacts of releases from upstream reservoirs outside of USACE's normal flood control operations as such releases are not reasonably foreseeable. As a consequence, a judgment on the merits regarding Joint Intervenors contention EC 6.0 is entered in favor of the staff and SNC.

6.1 Pursuant to 10 C.F.R. § 2.1210, it is this twenty-second day of June 2009, ORDERED, that:

A. In accord with 10 C.F.R. §§ 2.319(m), 2.332(b), (1) the record of this proceeding is reopened; (2) exhibit NRCR00014 is admitted into evidence; (3) exhibit NRC000014 is stricken from the evidentiary record of this proceeding; and (4) the record of this proceeding is closed.[53]

B. Joint Intervenors contentions EC 1.2, EC 1.3, and EC 6.0 are resolved on the merits in favor of the staff and applicant SNC, and the contested portion of the Vogtle Units 3 and 4 ESP proceeding before this Board is terminated.

C. In accordance with 10 C.F.R. § 2.1210, this partial initial decision will constitute a final decision of the Commission forty (40) days from the date of issuance (or the

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[53] During its post-hearing review of the record, the Board discovered that two different documents were prefiled in this proceeding with the exhibit number NRC000014: the 1974 FES for the Vogtle Units 1-4 construction permit and the 1985 FES for the Vogtle Units 1 and 2 operating license. Although the 1974 FES was marked and admitted into evidence at the evidentiary hearing, it is apparent that the staff intended to submit the 1985 FES, see NRC Staff Revised Exhibit List and Corrected Exhibit NRC000014 (Jan. 16, 2009) at 2; Tr. at 750-51, and that the parties have referred to the 1985 FES and not the 1974 FES in their proposed findings. Accordingly, the 1974 FES, exhibit NRC000014-00-BD01 as admitted at the evidentiary hearing, see Tr. at 765, is being stricken, and NUREG-1087, [FES] related to the operation of Vogtle Electric Generating Plant, Units 1 and 2, dated March 1985, is being admitted into evidence as exhibit NRCR00014-00-BD01 and is being placed into the record of this proceeding.

first agency business day following that date if it is a Saturday, Sunday, or federal holiday, see 10 C.F.R. § 2.306(a)), i.e., on Monday, August 3, 2009, unless a petition for review is filed in accordance with 10 C.F.R. § 2.1212, or the Commission directs otherwise. Any party wishing to file a petition for review on the grounds specified in 10 C.F.R. § 2.341(b)(4) must do so within fifteen (15) days after service of this partial initial decision. The filing of a petition for review is mandatory for a party to have exhausted its administrative remedies before seeking judicial review. Within ten (10) days after service of a petition for review, parties to the proceeding may file an answer supporting or opposing Commission review. Any petition for review and any answer shall conform to the requirements of 10 C.F.R. § 2.341(b)(2)-(3).

6.2 Although this ruling resolves all contested matters before the Licensing Board in connection with the August 2006 application of SNC for an ESP for its proposed Vogtle Units 3 and 4, staff issuance of a 10 C.F.R. Part 52 ESP relative to those facilities must abide, among

other things, the issuance by this Board of its partial initial decision regarding the uncontested, mandatory hearing portion of this proceeding.

THE ATOMIC SAFETY
AND LICENSING BOARD[54]

/RA/
G. Paul Bollwerk, III
CHAIRMAN

/RA/
Nicholas G. Trikouros
ADMINISTRATIVE JUDGE

/RA/
James F. Jackson
ADMINISTRATIVE JUDGE

Rockville, Maryland

June 22, 2009

[54] Copies of this partial initial decision were sent this date by the agency's E-Filing system to counsel for (1) applicant SNC; (2) Joint Intervenors; and (3) the staff.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

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

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing FIRST PARTIAL INITIAL DECISION (Contested Proceeding) (LBP-09-07) have been served upon the following persons by Electronic Information Exchange.

Office of Commission Appellate Adjudication
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
E-mail: ocaamail@nrc.gov

U.S. Nuclear Regulatory Commission
Office of the Secretary of the Commission
Mail Stop O-16C1
Washington, DC 20555-0001
Hearing Docket
E-mail: hearingdocket@nrc.gov

U.S. Nuclear Regulatory Commission
Atomic Safety and Licensing Board Panel
Mail Stop T-3 F23
Washington, DC 20555-0001

Administrative Judge
G. Paul Bollwerk, III, Chair
E-mail: gpb@nrc.gov

Administrative Judge
Nicholas G. Trikouros
E-mail: ngt@nrc.gov

U.S. Nuclear Regulatory Commission
Office of the General Counsel
Mail Stop O-15D-21
Washington, DC 20555-0001
Kathryn L. Winsberg, Esq.
Ann P. Hodgdon, Esq.
Patrick A. Moulding, Esq.
Jody C. Martin, Esq.
Sarah A. Price, Esq.
Joseph Gilman, Paralegal
E-mail: klw@nrc.gov
ann.hodgdon@nrc.gov; patrick.moulding@nrc.gov,
jody.martin@nrc.gov; sap1@nrc.gov;
jsg1@nrc.gov

Administrative Judge
James Jackson
E-mail: jackson538@comcast.net

Emily Krause, Law Clerk
Wen Bu, Law Clerk
E-mail: eik1@nrc.gov
Wxb3@nrc.gov

Kenneth C. Hairston, Esq.
M. Stanford Blanton, Esq.
Peter D. LeJeune, Esq.
Leslie Garrett Allen, Esq.
Balch & Bingham LLP
1710 Sixth Avenue North
Birmingham, Alabama 35203-2014
E-mail: kchairston@balch.com;
sblanton@balch.com; plejeune@balch.com;
lgallen@balch.com

Moanica M. Caston, Esq.
Southern Nuclear Operating Company, Inc.
40 Inverness Center Parkway
P.O. Box 1295, Bin B-022
Birmingham, AL 35201-1295
E-mail: mcaston@southernco.com

C. Grady Moore, III, Esq.
Balch & Bingham, LLP
1901 6TH Avenue, Suite 2600
Birmingham, AL 35203
E-mail: gmoore@balch.com

Kathryn M. Sutton, Esq.
Steven P. Frantz, Esq.
Paul M. Bessette, Esq.
Mary Freeze, Admin. Assist.
Morgan, Lewis & Bockius, LLP
Co-Counsel for Southern Nuclear Operating Company, Inc.
1111 Pennsylvania Ave., NW
Washington, DC 20004
E-mail: ksutton@morganlewis.com
sfrantz@morganlewis.com
pbessette@morganlewis.com
mfreeze@morganlewis.com

Diane Curran, Esq.
Harmon, Curran, Spielberg &
Eisenberg, L.L.P.
1726 M Street, NW, Suite 600
Washington, DC 20036
E-mail: dcurran@harmoncurran.com

Lawrence D. Sanders, Esq.
Turner Environmental Law Clinic
Emory University School of Law
1301 Clifton Road
Atlanta, GA 30322
E-mail: lsande3@emory.edu

Pillsbury Winthrop Shaw Pittman, LLP
2300 N. Street, N.W.
Washington, DC 20037-1128
Robert B. Haemer, Esq.
Maria Webb, Paralegal
E-mail: David.Lewis@pillsbury.com; robert.haemer@pillsburylaw.com

Eckert Seamans Cherin & Mellott, LLC
600 Grant Street, 44th Floor
Pittsburgh, PA 15219
Counsel for Westinghouse Electric Company, LLC
Barton Z. Cowan
E-mail: teribart61@aol.com

Charles R. Pierce
Southern Company Services, Inc.
600 North 18th Street, BIN B056
Birmingham, AL 35291-0300
E-mail: crpierce@southernco.com

[Original signed by Christine M. Pierpoint]
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