February 6, 2009

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

NRC STAFF REBUTTAL TESTIMONY OF DR. MICHAEL T. MASNIK, ANNE R. KUNTZLEMAN, REBEKAH H. KRIEG, JILL S. CAVERLY, AND LANCE W. VAIL CONCERNING ENVIRONMENTAL CONTENTION EC 1.2

Q1. Please state your name.

A1(a). (MTM) My name is Dr. Michael T. Masnik (MTM).

A1(b). (ARK) My name is Anne "Nancy" R. Kuntzleman (ARK).

A1(c). (RHK) My name is Rebekah H. Krieg (RHK).

A1(d). (JSC) My name is Jill S. Caverly (JSC).

A1(e). (LWV) My name is Lance W. Vail (LWV).

Q2. Have you previously submitted testimony concerning Contention EC 1.2 in this proceeding?

A2. (All) Yes. My direct testimony is provided in "NRC Staff Testimony of Dr. Michael T. Masnik, Anne R. Kuntzleman, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 1.2." (Jan. 9, 2009; as corrected and refiled February 2, 2009) (hereinafter "Staff EC 1.2 Direct Testimony"). A statement of my professional qualifications was attached to that filing.

I. General Questions

Q3. Are you familiar with the direct testimony submitted by the Joint Intervenors concerning EC 1.2, "Revised Pre-Filed Direct Testimony of Shawn P. Young in Support of EC 1.2" (Feb. 2, 2009) ("Young EC 1.2 Testimony") and "Revised Prefiled Direct Testimony of Barry W. Sulkin in Support of EC 1.2" (Feb. 2, 2009) ("Sulkin EC 1.2 Testimony")?

A3. (All) Yes.

Q4. Have any statements in the Joint Intervenors' testimony led you to believe that revisions to your direct testimony are necessary? If so, please explain.

A4. (LWV) Yes. In its ESP analysis, the Staff used a combined water withdrawal for Units 1 and 2 of 90 cubic feet per second (cfs). This value for the "normal" withdrawal of 90 cfs was based on the Applicant's Plant Parameters for VEGP Units 1 and 2 (Table 2.9-1 of Southern's Environmental Report (ER)). Exhibit SNC000001 at 2.9-2. Based on water balance considerations, the water withdrawal was assumed to be the sum of the Blowdown flow rate and the River water consumptive use listed in Table 2.9-1 of the ER. *Id.* Since the Staff interpreted this Table to reflect bounding conditions, the Staff believed that it would be conservative to use 90 cfs as both the average and the maximum withdrawal rate.

As noted by the Joint Intervenors, however, the Staff analysis in the Final Supplemental Environmental Impact Statement (FSEIS) for the renewal of the Units 1 and 2 licenses uses actual water use values at Units 1 and 2 in 2006, including values higher than 90 cfs. Sulkin EC 1.2 Testimony at A22. Subsequently, in identifying the reason for this discrepancy, the Staff has determined that in the license renewal analysis, the Staff instead based its estimate for normal withdrawals on withdrawal data reported by Southern to the State of Georgia pursuant to the Monthly Surface Water Withdrawal Report requirements of Permit No. 017-0191-05. Exhibit NRC000051; Exhibit JTI000022 at 4-13, 4-14. Based on the data record used in the FSEIS, the

reported withdrawal for Units 1 and 2 on the majority of days is 98 cfs, which the Staff believes represents the typical daily withdrawal rate of Units 1 and 2. Exhibit NRC000051. Occasionally, and typically only for a day at a time, the records show that the Units 1 and 2 withdrawal rates increase. *Id.* These increases occur to manage water quality or to adjust cooling basin storage. In the data that Southern reported to the State of Georgia Environmental Protection Division for the year of 2006, the maximum flow withdrawal for any specific day was reported as 136 cfs. *Id.* The maximum average flow for any calendar month during that period was approximately 104 cfs. *Id.*

The Staff acknowledges the inconsistency between the ESP FEIS and the license renewal FSEIS. Rather than the parameter value of 90 cfs, the maximum monthly average withdrawal value of 104 cfs derived from the data would be an appropriate, though still conservative, basis for evaluating cumulative impacts analysis with respect to the ESP application. Over the long term, considering outages, this monthly average number would be lower than 104 cfs; however, the Staff believes it is conservative to neglect these decreases in average withdrawal rate in determining cumulative impacts.

Therefore, based on the revised withdrawal rate of 104 cfs, the Staff has reconsidered the effect of the Unit 1 and 2 withdrawals on the water withdrawal percentages presented and considered in the FEIS. These values are presented in a table attached as Exhibit NRC000052.

As shown in that table, the Staff compared the effect of changing the water withdrawal rate from 90 cfs to 98 cfs (typical daily withdrawal) and to 104 cfs (maximum monthly average). Use of the 136 cfs value (the maximum daily withdrawal observed in the license renewal FSEIS data), however, is not an appropriate basis for a NEPA analysis, since such a withdrawal rate would occur only occasionally and would be for a short duration. *Id.* Nonetheless, to provide context for its determination that the significance of the revised withdrawal rates for Unit 1 and 2 is minor, the Staff computed the fractional withdrawal of the average daily discharge (8830 cfs)

in the Savannah River at the VEGP site that would occur under the highly unlikely conditions of Units 1 and 2 withdrawing at the 136 cfs rate and Units 3 and 4 withdrawing at the maximum rate of 129 cfs. Using these conditions would result in a combined withdrawal of 3.0 percent of the mean annual flow, compared to a combined withdrawal of 2.5 percent when instead using 90 cfs for Units 1 and 2. Even if the percentage of withdrawal is computed based on the more conservative mean annual flow from the short-term flow record at the Waynesboro, GA gauge (6691 cfs), for the case of Units 1 and 2 withdrawing at the 136 cfs rate and Units 3 and 4 withdrawing at the maximum rate of 129 cfs, the value would be 3.8 percent. The percentage withdrawn when using 104 cfs rather than 90 cfs for Units 1 and 2 is 2.6 percent of river flow, for a total difference of 0.1 percent, which is an insignificant change. A 0.1 percent difference is at least an order of magnitude less than any hydrological impact that could be detected. Therefore, as indicated in this table, the Staff determined that the revised withdrawal rates for Units 1 and 2 result in only a small change to the percentage of river flow cumulatively withdrawn by the two existing and two proposed Vogtle Units over the entire range of flows considered.

Given this reassessment of the appropriate Units 1 and 2 withdrawal rates to use for this NEPA analysis, the Staff also decided to confirm the consumptive water loss values previously assumed for Units 1 and 2. In the FEIS, the Staff assumed a consumptive water use rate of 67 cfs for Units 1 and 2. Exhibit NRC000001 at 7-5. The ESP application provides estimates for reject heat load of either Unit 3 or Unit 4 as 2212 MW and average combined consumptive loss as 62 cfs. The reject heat load was assumed to be the difference between the net thermal generation and the electrical generation. The recent power uprate license amendment for Units 1 and 2 indicates that these values are 3625 MWt and 1250 MWe respectively, for an estimated reject heat load of 2375 MW. Exhibit NRC000053 at Cover Page and p.26 of Safety Evaluation Report. Scaling of the evaporation rates for Units 1 and 2 based on the reject heat load of 2375

MW per unit, and assuming the same consumptive loss to reject heat load ratio as for Units 3 and 4, results in an estimate of combined consumptive use rate of 67 cfs for Units 1 and 2. Accordingly, the Staff believes that this confirms that the Staff's use of the 67 cfs consumptive use rate for Units 1 and 2 in its existing analysis remains reasonable.

Q5. Would the percentage changes due to the differences between Revision 15 and Revision 16 of the AP1000 DCD discussed in the Staff's direct testimony (Q62) be impacted by the Staff's revision of the water withdrawal rate for Units 1 and 2 to 104 cfs?

A5. (LWV) No. The percentage changes between Revision 15 and Revision 16 discussed in A62 of the Staff's direct testimony are determined by the presumed river flow and the withdrawals for Units 3 and 4, not the withdrawals by Units 1 and 2. Therefore, those percentage differences would not change as a result of any changes to the withdrawal rates used for Units 1 and 2. However, in Exhibit NRC000052 the Staff has provided the cumulative water withdrawal percentages associated with both Revision 15 and Revision 16.

Q6. Has the Staff considered the significance of the above responses for the Staff's analysis of impacts to aquatic biota? If so, please explain.

A6. (MTM, RHK) Yes. In light of the changes described above in water withdrawal rates for Units 1 and 2, the Staff has considered the significance of this change for the Staff's conclusions regarding cumulative impingement and entrainment impacts for all four units at the normal flow, the Drought Level 3 flows (3800 cfs) and extremely low-flows (3000 cfs and 2000 cfs).

Based on the Unit 1 and 2 maximum observed monthly average withdrawal rate of approximately 104 cfs, and normal withdrawal rates for Units 3 and 4 (83 cfs for AP1000 DCD Revision 15), the combined water withdrawals for Units 1 through 4 would be 2.1% of the average daily discharge flows (8830 cfs) of the Savannah River and 4.9% at Drought Level 3 (3800 cfs) flows, rather than 4.6% as stated in Staff EC 1.2 Direct Testimony at A48. With the

changes in withdrawal rates associated with AP1000 DCD Revision 16, the combined water withdrawals would increase by 0.1% for both the average daily discharge flows and the Drought Level 3 flows. Exhibit NRC000052.

The increase for the Drought Level 3 (3800 cfs) flows of 0.3% (0.4% when considering the DCD Revision 16 withdrawal for Units 3 and 4) would not change the Staff's conclusion in its direct testimony that the impacts of impingement and entrainment would be minor as a result of the cumulative withdrawals for all four units because these increases are small in comparison to the withdrawal rates that are being evaluated. Moreover, as stated in the Staff's EC 1.2 Direct Testimony at A48, the Staff did not rely solely on the percent water withdrawal values to assess the cumulative impacts associated with impingement and entrainment. The Staff's conclusions are based on a number of factors, including the use of closed-cycle cooling; the design, location and planned operation of the proposed intake including conformance with the US EPA National requirements for intake design; the characteristics of the watercourse in the immediate vicinity of the intake location; the river hydrology; the distribution, abundance, and life history data of species inhabiting the Savannah River near VEGP; the results of the SRS studies of impingement and entrainment completed in the 1980s; and the preliminary results of the impingement and entrainment sampling program for VEGP Units 1 and 2.

In the FEIS and as described in its direct testimony, the Staff also assessed the cumulative impacts from entrainment and impingement losses at all four VEGP units at very-low flow rates of 3000 and 2000 cfs. Staff EC 1.2 Direct Testimony at A50. As a result of the changes in the withdrawal rates for Units 1 and 2, the Staff has considered the significance of this change for the Staff's conclusions regarding the cumulative impingement and entrainment impacts for all four units assuming normal withdrawals for Units 3 and 4 using the DCD Revision 15 withdrawal rate (83 cfs) and the maximum observed monthly average withdrawal rate from Units 1 and 2 (104 cfs). Using these values would result in the withdrawal of 6.2% of the river

flow at 3000 cfs and 9.4% at 2000 cfs (rather than 5.8% and 8.7% as given in Staff EC 1.2 Direct Testimony at A50). Exhibit NRC000052. With the changes in withdrawal rates associated with DCD Revision 16, the combined water withdrawals increase to 6.4% of the river flow at 3000 cfs and 9.5% of the river flow at 2000 cfs. *Id.* These increases in the cumulative withdrawal rate for all four units of 0.4% (3000 cfs) and 0.7% (2000 cfs) for DCD Revision 15 - or 0.5% and 0.7% for DCD Revision 16 - do not change the Staff's conclusions in the FEIS and described in its direct testimony. That is because these increases are small in comparison to the withdrawal rates that are being evaluated. Moreover, as stated in the FEIS and in the direct testimony, such very-low flows are expected to be temporary, on the order of days or weeks, rather than months. Exhibit NRC000001 at 7-24; Staff EC 1.2 Direct Testimony at A50. In addition, the Staff did not rely solely on the percent water withdrawal values to assess the cumulative impacts associated with impingement and entrainment at these very-low flows. Other factors include the use of closed-cycle cooling, the location, design, and planned operation of the intake structure, and the life history characteristics of "important species".

In addition, under very-low flow conditions, Southern could be directed by the State resource agencies to reduce power or cease power operations (actions which would reduce water withdrawals significantly) for reasons including increased impingement rates, or to protect aquatic biota during a critical spawning period for an important species when fish eggs and larvae would be present. *Id.*

II. Description of Aquatic Species and Habitat

Q7. Dr. Young asserts that "[t]he FEIS does not contain sufficient data to analyze the construction and operation impacts on fish species located in the Middle, Lower, and estuarine Savannah River." Young EC 1.2 Testimony at A12. Does the Staff agree with this assertion?

A7. (RHK) No. As discussed in its direct testimony, the Staff stated that it followed the guidance of the Environmental Standard Review Plan ("ESRP") Section 2.4.2 by providing a brief description of the aquatic ecological features of the site and vicinity that includes an "emphasis on the communities of the ecosystem that will be potentially affected by project construction, operation and maintenance." Staff EC 1.2 Direct Testimony at A6; Exhibit NRC000009 at 2.4.2-6, 2.4.2-7. This discussion of fish species and habitats within the Savannah River was included in Section 2.7.2.1 of the FEIS. Exhibit NRC000001 at 2-74, 2-76 to 2-86 and 2-88 to 2-93. In addition, following the guidance in ESRP 5.3.1.2, the Staff discussed the effects of plant operations, including entrainment, impingement, and discharge impacts in Sections 5.4.2.2 through 5.4.2.5 of the FEIS. Exhibit NRC000010 at 5.3.1.2-8, 5.3.1.2-9; Exhibit NRC000001 at 5-29 to 5-37. In its direct testimony, the Staff described the basis for its analysis and the sources of information used to support the FEIS analysis. Staff EC 1.2 Direct Testimony at A5, A9, A11, A19, A22, A29, A33 and A55. As further explained in the Staff's direct testimony, the Staff's data collection and analysis followed the appropriate ESRP guidelines for the description of aquatic resources and assessment of impacts due to entrainment, impingement, and thermal discharge. Staff EC 1.2 Direct Testimony at A6, A7, A20, A21, A27, A28, and A54. The Staff believes that because it followed the ESRP guidance regarding information needs, analysis, and the amount of information to be presented in the FEIS, the Staff ensured that it had presented adequate site-specific information in the FEIS and used the appropriate information in the analysis for determining the impacts to the aquatic biota of the Savannah River.

Q8. Dr. Young refers to six fish species that "are experiencing population decline and considered most imperiled and/or most important to Savannah River fisheries" and he asserts that "[i]n order to accurately evaluate the construction and operation impacts, the causes of the

population decline must be articulated." Young EC 1.2 Testimony at A12. Does the Staff agree with this assertion?

A8. (RHK) No. Dr. Young states that in order to accurately evaluate impacts, the causes of population decline to species (specifically the six species identified and described in the FEIS on pages 2-81 through 2-91) must be articulated. Young EC 1.2 Testimony at A12. However, the purpose of the FEIS is to present the Staff's analysis, "which considers and weighs the environmental impacts of the proposed action at the VEGP site, including the environmental impacts associated with construction and operation of reactors at the site...and the mitigation measures available for reducing or avoiding adverse environmental effects." Exhibit NRC000001 at 1-4. The impact from the operation of the facility is based on the potential for the facility to affect the species via means such as entrainment, impingement, and thermal discharges. Any potential impacts from the facility may exacerbate previous population declines depending on the magnitude of the impact. However, the potential impact of a facility using closed-cycle cooling on fish species does not generally depend on the cause or causes of the population declines of those species.

Nevertheless, in the interest of providing background information related to the species that inhabit the Savannah River in the vicinity of the VEGP site, the Staff does describe the reasons for population decline in several of the important fish species. For example, the FEIS states that data on the number of eels caught per unit of effort (in eastern rivers) indicate large localized declines in rivers across the Atlantic coast. *Id.* at 2-82. The FEIS describes several possible causes for the decline including overfishing, seaweed harvesting in the Sargasso Sea, loss of adult habitat in rivers and estuaries from dams, dredging and wetland destruction, and migration past dams and water intakes. *Id.* at 2-83. Further, the FEIS states that the population of striped bass drastically declined in the 1980's throughout the species' range on the Atlantic coast and refers to sources positing that the Savannah River harbor modifications resulted in

habitat alterations in the estuarine spawning grounds and contributed to the decline of the fishery in the Savannah River. *Id.* at 2-84. Additionally, the FEIS notes that population estimates indicate that the population of adult shortnose sturgeon is increasing but that juveniles are still rare, likely due to a recruitment bottleneck in the early life stages and in part because of water-quality degradation in the nursery habitat in the lower Savannah River. *Id.* at 2-91. Regarding the robust redhorse, the Staff has monitored the work of the Robust Redhorse Conservation Committee that was formed, in part, to investigate the species. Exhibit NRC000001 at 2-89; Exhibit NRC000015; Exhibit NRC000016.

Dr. Young's testimony mentions six fish species that are located in the Middle, Lower and estuarine Savannah River and that are mentioned on FEIS pages 2-81 through 2-91; he then states that "the FEIS lacks adequate discussion of the other fish species that may be at risk of population decline, as a result of construction and operation of Units 3 and 4." Young EC 1.2 Testimony at A12. However, Dr. Young does not name these "other fish species," nor does he describe what specific factors should be considered in the assessment of these "other fish species." As described in its direct testimony and in the FEIS, the Staff followed the guidance provided in the Environmental Standard Review Plan 2.4.2 to identify which species meet the definitions of "important," including those that are commercially important, recreationally valuable, rare (i.e. threatened or endangered), or important to the structure and function of the aquatic ecosystem; the Staff limited its detailed assessment to those species. Staff EC 1.2 Direct Testimony at A10; Exhibit NRC000001 at 2-81; Exhibit NRC000009 at 2.4.2-7.

Q9. Dr. Young argues that the surveys conducted by the Academy of Natural Sciences of Philadelphia ("ANSP") "are not an adequate indicator" of impacts on fish species and that the FEIS's reliance on the ANSP research does not provide sufficient data to substantiate conclusions regarding the impact of Units 3 and 4 on fish species. Young EC 1.2 Testimony at

A13. Do you agree with Dr. Young's characterization of how ANSP studies and data were used in the FEIS analysis?

A9. (RHK) No. As stated in the Staff's direct testimony at A9, the Staff used the ANSP studies to provide an understanding of the river ecology and the current species of fish and molluscs present in the vicinity of the VEGP site, as well as to demonstrate that the Savannah River has been studied extensively upstream and downstream of the VEGP site and at different seasons throughout the year. Staff EC 1.2 Direct Testimony at A9. The Staff also used the ANSP studies to provide an overall indication of the impacts of the SRS facilities and the existing VEGP Units 1 and 2 on the health of the Savannah River. *Id.* The ANSP studies were not the source of information for life history, migration timing or population numbers. The sources used for life history, migration timing and population numbers are clearly referenced in the appropriate sections of the FEIS. Exhibit NRC000001 at 2-81 to 2-93. For example, the Staff's description of the life history and spawning migration of the American Shad relies on background information from five different sources, none of which were the ANSP studies. *Id.* at 2-82

Dr. Young states that "several parts of the existing – albeit outdated – ANSP research, including ichthyoplankton surveys, were performed on a limited basis, only a few times per year, and during alternating years." Young EC 1.2 Testimony at A13. The Staff has reexamined the ANSP studies and notes that no data or results of ichthyoplankton studies are included in any of the three ANSP reports cited in the FEIS (ANSP 2001, ANSP 2003 or ANSP 2005). Exhibits NRC000002; NRC000003; NRC000004. Because the ANSP studies did not include ichthyoplankton survey data, the Staff in the FEIS relied on other studies to provide information on ichthyoplankton density and distribution. The Staff's direct testimony states that "[b]ecause neither Marcy et al. nor the ANSP study directly addressed the concentrations of fish larvae and

eggs in the Savannah River, the Staff relied on the studies performed by the SRS in the mid-1980s." Staff EC 1.2 Direct Testimony at A15.

As a result, Dr. Young's testimony inaccurately characterizes the contents of the ANSP studies and how the Staff considered those studies in the FEIS.

III. Analysis of Impacts From Intake Structure

Q10. Dr. Young states that "[d]ata for early life history of fish that inhabit the Savannah River near Plant Vogtle, or pass by Plant Vogtle as part of the community drift, is of paramount importance when analyzing entrainment." Young EC 1.2 Testimony at A14. Does the Staff agree with this statement?

A10. (RHK) No. Such data are useful, but are not of "paramount" importance when analyzing entrainment. Dr. Young bases his claim on statements such as "[t]he early life stages of fish are the most susceptible to entrainment because they have limited capacity for avoidance." Young EC 1.2 Testimony at A14. However, as explained in direct testimony, the Staff assumed that fish eggs and larvae have no independent mobility, and that if they enter the hydraulic zone of influence they will be entrained and will suffer mortality. Staff EC 1.2 Direct Testimony at A31. The Staff's analysis, therefore, is conservative relative to Dr. Young's concern because it does not account for the ability of larvae to avoid entrainment. As described elsewhere in its direct testimony, the Staff did consider relevant life history information for important fish species, such as whether the species are pelagic or demersal spawners, the distribution of eggs and larvae within the water column, the concentration of ichthyoplankton in different within-river habitats, and the fecundity of the species. *Id.* at A12, A30, and A33. The Staff also determined the observed spawning areas for the "important species." *Id.* at A33. These factors are, in most cases, more important than the capacity for avoidance of entrainment in the overall assessment of entrainment impacts. Additionally, other factors such as the

location and design of the intake structure and the proportion of river flow entrained through the cooling system must also be considered. The supporting basis for the conclusions regarding entrainment impacts for each important species, including relevant life history factors, is described in the Staff's direct testimony. *Id.* at A33.

Q11. According to Dr. Young, "[t]he FEIS at page 5-30 states that 'species and life stages evaluated in various studies could endure a velocity of 1 ft/sec'." Young EC 1.2 Testimony at A15. Dr. Young then argues that "many of the endangered or important fish of the Savannah River cannot endure that water intake velocity." *Id.* Does the Staff agree that any of the "important" species identified in the FEIS cannot endure the water intake velocity anticipated at the proposed new units?

A11. (MTM) The FEIS on page 5-30 states that "EPA [not the NRC Staff] determined that species and life stages evaluated in various studies could endure a velocity of 1.0 ft/sec…" Exhibit NRC000001 at 5-30. In that context, the Staff was referring to an organism's ability or inability to avoid impingement. Nevertheless, the Staff recognizes that certain individual organisms, particularly the early life stages of many species, including the identified "important species," are incapable of overcoming an intake velocity of 1.0 ft/sec or even less. Those individual organisms that are entrained will likely transit the intake structure, enter the cooling water system, and experience 100 percent mortality. *Id.* at 5-30. Organisms affected could include the larval stages of both the robust redhorse and the shortnose sturgeon. However, other factors, such as the use of closed-cycle cooling, the design, location and operation of the intake structure, the location of the site on the Savannah River, and the river hydrology, as well as consideration of life history information (i.e., fecundity, spawning sites, spawning period), also affect the number of individuals lost due to entrainment. Exhibit NRC000001 at 5-30 to 5-32; Staff EC 1.2 Direct Testimony at Section II.C.

Therefore, the Staff agrees that at least some individual organisms, particularly those in early developmental stages (egg, larvae, and post-larvae, and in some cases juvenile fish), and including those from species identified as "important species," will not be able to overcome the through-screen intake velocity and will be entrained and lost from the fishery. However, the susceptibility of these early life stages for almost all species to entrainment due to the lack of or limited motility is fully consistent with the Staff's analysis in the FEIS. It is the consideration of the other abiotic and biotic factors identified above and the results of past field studies described in the FEIS that leads the Staff to conclude that the number of individuals lost will be sufficiently small that there will be no detectable changes in fish populations attributable to the operation of VEGP Units 3 and 4. Exhibit NRC000001 at 5-30 to 5-33; Staff EC 1.2 Direct Testimony at II.C. This conclusion is supported by the results of the Applicant's entrainment study conducted during 2008. Staff EC 1.2 Direct Testimony at A34.

Q12. Dr. Young argues that "[i]t is not reasonable to assume that the drift community near Plant Vogtle is uniformly distributed." Young EC 1.2 Testimony at A16. He subsequently argues that "[w]hen the drift community is not uniformly distributed, entrainment will not correspond directly with the percent of flow withdrawn." *Id.* at A17. Do you agree with these arguments?

A12. (MTM) The assumption of uniform distribution was made in the original FES for Units 1 and 2. Exhibit NRC000014 at 5-17. The Staff's use of a uniform distribution model is also consistent with ESRP guidance. Exhibit NRC000010 at 5.3.1.2-6. The Staff refers to the assumption of uniform distribution of drift organisms on pg 5-31 of the FEIS and states that it is a conservative assumption. Exhibit NRC000001 at 5-31. Dr. Young is critical of the Staff's assumption that entrainment is proportional to water withdrawals because of the use of the uniform distribution assumption. Young EC 1.2 Testimony at A17. Dr. Young cites the results of sampling by JTI000006 (Wiltz, 1983), JTI000007 (Nichols, 1983) and JTI000004 (Paller,

1995) to support the assumption that the drift community is non-uniformly distributed in the Savannah River. Young EC 1.2 Testimony at A16. The Staff does not dispute the results of these field studies; however, due to the temporal and spatial variation in densities and the generally higher concentrations of drift near the surface or the bottom of rivers, the Staff finds the use of a uniform-distribution model is conservative for the assessment of entrainment impact at this facility. The Staff believes this assumption is conservative with respect to impacts at the Vogtle site in particular primarily due to the design of the intake structure. The intake design includes a skimmer wall extending from the water surface downward and a weir wall extending upward from the river bottom. The effect of these two walls is to preferentially remove water from the middle of the water column where the density of drift organisms is generally lower than near the surface or bottom.

Thus for reasons already detailed in the Staff's direct testimony, the Staff considers the uniform distribution assumption to be appropriate and conservative, especially because it would likely result in an overestimation of organisms lost for most species. Staff EC 1.2 Direct Testimony at A28. Also, as described in the Staff's direct testimony, the preliminary results of Southern's entrainment study show that the densities of organisms in the intake canal are significantly lower than the densities in the Savannah River. Staff EC 1.2 Direct Testimony at A29; Exhibit NRC000030 at 20-25, 29-34.

The assumption that entrainment is proportional to the percent of river flow withdrawn is not only intuitive but is also consistent with EPA analysis as presented in its Phase I regulations for cooling water intake structures. In the statement of considerations for the final rulemaking (and specifically in section V. Basis for the Final Regulation), EPA states that "…entrainment impacts of cooling water intake structures are closely linked to the amount of water passing through the intake structure." Exhibit NRC000035 at 65,277. As described above in response to Question 9, and previously in the Staff's direct testimony, although the Staff's consideration of

water withdrawals assumes proportional entrainment, the percentage withdrawn was not the only relevant consideration in reaching impact conclusions. Staff EC 1.2 Direct Testimony at A43, A44. The Staff also considered biotic and abiotic factors, as well as past and recent field studies in the Savannah River, to arrive at its assessment of impact.

Q13. According to Dr. Young, "[t]he FEIS fails to provide any baseline data regarding species composition, abundance, and distribution to support its conclusions." Young EC 1.2 Testimony at A18. Young further argues that the FEIS "fails to take into account Paller's 1995 study of the horizontal distribution of American shad eggs in the drift near Plant Vogtle." *Id.* Do you agree with this characterization of the FEIS analysis? And would the results of the analysis have been different if the Paller 1995 study had been taken into account?

A13. (RHK) No, the Staff does not agree with the statement that "the FEIS fails to provide any baseline data regarding species composition, abundance, and distribution to support its conclusions." This information is provided in the FEIS at 2-76 to 2-86 and 2-88 to 2-93. Exhibit NRC000001. Information specific to the American shad populations is provided specifically at page 2-82. *Id.*

In regard to the results of the Paller 1995 study, this study provides an analysis of drifting American shad eggs at two transects located in the Savannah River at approximately rkm 250. Exhibit JTI000004 at 3. The study area for Paller (1995) was located approximately 6 kilometers upstream of the proposed VEGP intake structure (approximately rkm 244).

While the data in Paller (1995) is appropriate for illustrating generally that the assumption of "uniform distribution" is not realistic (as explained in Staff EC 1.2 Direct Testimony at A30), it is not an appropriate set of data to extrapolate specifically to ichthyoplankton entrainment at the location of the proposed VEGP site because of its distance from the proposed VEGP site, and the differences in habitat and current at the two locations. The Staff agrees that for facilities that are using once-through cooling, where "[w]ithdrawal rates

formerly reached as high as approximately 18% of the total river flow during the spring spawning months, primarily to satisfy the need for nuclear reactor cooling water," the assessment of entrainment impact at different locations can be a useful tool for determining the placement of intake structures. Exhibit JTI000004 at 3. This is because the removal of up to 18% of the ichthyoplankton from a river such as the Savannah River would be a much greater impact than was evaluated by the Staff for the closed-cycle cooling system of the proposed VEGP Units 3 and 4. The smaller water withdrawal rates of a closed-cycle cooling system such as the proposed VEGP Units 3 and 4, in a river the size of the Savannah River, result in a smaller impact to the aquatic biota. Thus, given these factors and available information (including Southern's interim report on its entrainment monitoring program for VEGP Units 1 and 2), data from further site-specific assessments are not necessary to obtain an impact determination of SMALL. Staff EC 1.2 Direct Testimony at A33 and A34; Exhibit NRC000030.

Q14. According to Dr. Young, "…on page 2-82 of the FEIS, the Staff illogically relies on oxbow population data, which is not relevant to its analysis of the mainstream ichthyoplankton community." Young EC 1.2 Testimony at A18. Do you agree with this characterization of the FEIS analysis?

A14. (RHK) No. The FEIS includes a statement that "Specht (1987) reported that American shad were the dominant taxa in the ichthyoplankton assemblage (primarily as eggs) in the river. They were not as abundant in the oxbows, creeks or intake canals on the Savannah River Site indicating that the primary location for spawning was the river." Exhibit NRC000001 at 2-82; Exhibit NRC000011 at V-478. The Staff is not relying on oxbow data for assessment of impacts to American shad, but instead is simply stating that the data indicate that American shad are more prevalent in the main river than in oxbows. Earlier in the FEIS, it was pointed out that Specht (1987) found higher larval densities in the oxbows than in the main river, but the

oxbow communities were dominated by gizzard shad and threadfin shad, while the main river was dominated by American shad." Exhibit NRC000001 at 2-81; Exhibit NRC000011 at V-472.

In evaluating the placement and location of the cooling water intake structure ("CWIS") in the river, the Staff reiterated the finding by Specht (1987) that larvae densities in the oxbows suggest that they may be important spawning areas. Exhibit NRC000001 at 5-31. Specht (1987) stated that "although approximately half of all the larvae collected in the 1985 study were collected in the oxbows, only 15% of the samples were collected there, which suggests that oxbows may be important spawning areas." Exhibit NRC000011 at V-478. The Staff is thus acknowledging that the location of the CWIS is in an area of the water body away from areas of high productivity to minimize impingement and entrainment. However, the Staff does not use this observation as a determining factor for the impact of the proposed VEGP units on the environment; rather, the Staff viewed the location of the CWIS as one factor that was considered in the analysis of entrainment, along with the small percentage of water withdrawn from the river, the design of the cooling intake canal and structure, the typically high fecundity of most species inhabiting rivers, and the high natural mortality rates of eggs and larvae. Exhibit NRC000001 at 5-32.

Q15. Dr. Young asserts that ichthyoplankton-net collection is the "most effective method to determine current ichthyoplankton species composition, distribution, and vulnerability to entrainment in the vicinity of the VEGP site[.]" Young EC 1.2 Testimony at A19. Are such studies necessary for adequate analysis of environmental impacts in the FEIS?

A15. (MTM) No, such studies are not always necessary for an adequate analysis of environmental impacts. The Staff agrees with Dr. Young that under most situations, the use of ichthyoplankton nets is an effective method of collecting the early life stages of most fish species. Southern's interim report on its impingement and entrainment assessment describes the sampling technique used to collect ichthyoplankton samples from the Savannah River and

the VEGP Units 1 and 2 intake canal. Exhibit NRC000030 at 13-15. The Applicant employed an ichthyoplankton net in the Savannah River and an entrainment pump system in the intake canal.

An understanding of the facility operation, the site and its waterbodies, and the biota inhabiting those waterbodies is necessary to determine the need for and design of an ichthyoplankton monitoring program. Assessing the level of impact to a fishery due to entrainment first requires an understanding of the operation of the cooling water system. For example, the EPA in its final rulemaking regarding cooling water intake structures makes the argument that the scientific literature and the EPA record "contains ample evidence to support the proposition that reducing flow and capacity reduces impingement and entrainment." Exhibit NRC000035 at 65,300. Intuitively, removing several gallons of water from a river will not affect the fishery. However, removing 50 percent of the flow of a river and causing the complete mortality of the entrained organisms certainly could have an adverse effect. So one of the first questions to ask in assessing the potential for impact is what percentage of the river flow is being removed by the facility. If it is a very small percentage of the river flow, if the facility is not located in a biologically unique area, and if there is no direct interaction with important species, sampling to assess entrainment losses may not be required. However, while not required for all impact analyses, the Staff recognizes that it is always preferable to have recent collections from the water source to supplement and, if appropriate, confirm the assessment.

VEGP Units 3 and 4 will withdraw only a few percent of the flow of the Savannah River, the units will utilize closed-cycle cooling, and the intake will likely comply with EPA requirements. The site is not located in a biologically unique stretch of the river. Past sampling of all life stages of fishes had been conducted in the Middle Savannah River and already available information provides a reasonable understanding of the indigenous biota. Life history data does not reveal a close association between the operation of the new units and "important

species." Accordingly, additional site-specific sampling was not necessary to enable the Staff to determine impacts. Nevertheless, subsequent to the Staff's analysis of impact due to entrainment, the Applicant did conduct an ichthyoplankton sampling program, employing the sampling gear identified by Dr. Young as being appropriate. Exhibit NRC000030 at 20-25. The results of the sampling program were consistent with the Staff's conclusions about impacts.

Q16. Dr. Young criticizes the Hydraulic Zone of Influence study conducted by the Applicant, stating that "[t]he Hydraulic Zone Influence [sic] study lacks sufficient data and analysis because the study was conducted while operation [of Units 1 and 2] was only at 56% capacity during a limited range of flows." Young EC 1.2 Testimony at A23. Is this an appropriate characterization of the study?

A16. (MTM) Although the Staff did not rely on the Applicant's hydraulic zone of influence study for its conclusions in the FEIS, the Staff did include a discussion of the study in its testimony and explained why the study provides additional support for the Staff's conclusions on the impact to fish populations from entrainment. Staff EC 1.2 Direct Testimony at A34. Dr. Young, in his testimony, states that the "study lacks sufficient data and analysis because the study was conducted while operation was only at 56% capacity during a limited range of flows." Young EC 1.2 Testimony at A23. Dr. Young goes on to state that "the modeling should also include the impact at full capacity under different flows." *Id.* The purpose of the Applicant's study was to define the hydraulically affected zone from which planktonic organisms and organisms with limited motility would be subject to entrainment. The Staff acknowledges that changing the pumping rate and the river flow rates would affect the hydraulic zone of influence in the Savannah River. For the following reasons, however, the study does provide useful information on the potential for entrainment of organisms in the Savannah River drifting by the site, and this information supports the Staff's assessment of impact for the proposed VEGP Units 3 and 4.

As noted recently in the Final Supplemental EIS (FSEIS) for the application for the renewal of the licenses for Units 1 and 2, the maximum observed average monthly withdrawal rate in 2006 was 104 cfs. Exhibit JTI000022 at 4-13. Also as described above in response to Question 4, the typical daily withdrawal rate for VEGP Units 1 and 2 is 98 cfs. Exhibit NRC000051. The hydraulic zone of influence study conducted on May 7, 2008, reported an intake withdrawal rate of 110 cfs. Exhibit NRC000031 at 2. This is a conservative number relative to both the maximum observed average monthly withdrawal rate in 2006 (104 cfs) and the typical daily withdrawal rate (98 cfs) as explained above in A4. Although the Applicant reported that the intake flow on the day of the measurements was 56 percent of intake "capacity" (three of the four intake pumps operating), this fact is consistent with the normal operation of the intake structure and does not detract from the applicability of the study. The intake full pump design capacity is 196 cfs, double the typical daily withdrawal rate of 98 cfs. Exhibit NRC000031 at 2; Exhibit NRC000051. However, intakes are designed with considerable excess capacity to allow for maintenance and replacement of pumps and other equipment while the plant is in operation and the intake is withdrawing water. Because of the likely infrequency and temporary nature of withdrawals at the maximum pumping rate, it is the normal withdrawal rate that is important in assessing the hydraulic zone of influence. The Applicant's study was conducted on a day when the withdrawal rate was significantly larger than the typical daily withdrawal rate or even the maximum observed average monthly withdrawal rate for 2006, so the conditions under which the study was conducted were conservative. Accordingly, conducting the study at a time when withdrawals were even higher would not result in a more reasonable and realistic assessment of impact.

At the time of the study, the flow on the Savannah River was reported at 4,482 cfs. Historically, lower flows have been reported and may occur in the future. Lower flows would result in lower river stage and presumably an increase in the hydraulic zone of influence. In the

Applicant's study, the area of hydraulic influence at a withdrawal rate of 110 cfs and a river flow of 4,482 cfs was determined to be 0.14 acres in the Savannah River and extended about one-sixth of the way across the river in the vicinity of the VEGP site. Exhibit NRC000031 at 2. In the FEIS, the Staff assessed impacts at the average-daily streamflow of 8830 cfs, and also down to the Drought Level 3 flow of 3800 cfs and the very-low flow levels of 3000 and 2000 cfs. For practical reasons, the Applicant was unable to measure the hydraulic zone of influence under all of the river flow conditions evaluated in the FEIS (average-daily, Drought Level 3 and very-low flows). It is the Staff's opinion that, although lower flows would result in an increase in the hydraulic zone of influence, the increase would not extend all the way across the river, and also would be less likely to occur in the spring and early summer during the spawning season when flows in the river have been historically higher. Therefore, as stated in the Staff's direct testimony, this information provides additional support for the Staff's conclusions in the FEIS, because it demonstrates that only a fraction of the Savannah River is influenced by the kinds of water withdrawals associated with the closed-cycle cooling system for Units 1 and 2. Staff EC 1.2 Direct Testimony at A34.

Q17. Dr. Young states that "[t]he FEIS lacks sufficient data and analysis to support its conclusion that the fish and shellfish located in the vicinity of the VEGP site are adapted to survival in varying flow regimes and velocities[.]" Young EC 1.2 Testimony at A20. Is additional explanation or analysis necessary in the FEIS to support the view that fish are able to tolerate variations in flow that might be created by the operation of two additional units at the VEGP site?

A17. (MTM) The Staff stated in the FEIS that "aquatic organisms inhabiting rivers and streams flowing into the Atlantic are preadapted to tolerate large variations in water flow. Periodic droughts have historically occurred in rivers in the southeastern United States, and species occurring in the river, although periodically stressed, persist." Exhibit NRC000001 at

E-75. The Staff again addressed this issue in its testimony, where the Staff stated that fish found in southeastern rivers that drain to the Atlantic are preadapted to tolerate large variations in flow. Staff EC1.2 Direct Testimony at A14, A23. In support of this assertion, one only has to look at the historic 1930 high flow of the Savannah River at Augusta estimated at 350,000 cfs and compare that to the historic low river flows of 1500 to 1000 cfs. Exhibit NRC000041. That represents a 233- to 350-fold variation in flow, and yet the fish have persisted in the river. The Staff, as stated in its direct testimony, is unaware of any species having been extirpated from the middle Savannah River for any reason, including very-low river flows, since scientific collecting in the river began. Staff EC1.2 Direct Testimony at A14.

Dr. Young states that while fish and shellfish can adapt to natural variability, "human-induced variability produces different results." Young EC 1.2 Testimony at A20. I reviewed Young's Exhibits 16 through 19 and found that none of the papers cited addresses impacts related to impingement, entrainment or thermal effects due to water withdrawals or discharges. Three of the studies (JTI000016, JTI000018 and JTI000019) focus on large scale modification of the aquatic environment such as impoundments, while the fourth study (JTI000017) develops a hypothetical extinction rate for aquatic species. That paper (JTI000017) relates the loss of aquatic species to habitat deterioration in general.

The Staff interprets Dr. Young's EC 1.2 Testimony at A20 as implying that organisms can adapt to the natural variation in water flow in a river but that somehow man-induced variability produces different results, presumably ones detrimental to populations of fish and shellfish. However, none of the references cited in Dr. Young's testimony discusses the distinction between the effects of human-induced variation versus natural variation on aquatic organisms. *Id.* at A20.

The Staff recognizes that impoundments can profoundly change the flow regime of a river, which can in turn affect species distribution and abundance. Flow variation in rivers and

streams draining the Atlantic coast is considered necessary and important to maintain a healthy riverine fishery. Fisheries management professionals have advocated the return to more normative flows in the free flowing sections of impounded rivers. The release of water during fish spawning periods has been a widely used technique that has had some success in managing fish populations. In fact, resource agencies have instituted periodic planned releases to benefit downstream biota in a number of river basins. There is no indication that fish or shellfish are able to discern the difference in the source of these flow pulses – whether man-made or naturally occurring. The desire to restore more normative flows in the Savannah River has resulted in the USACE initiating a program to periodically release high-flow pulses on the order of 15,900 cfs to 30,000 cfs to the Savannah River. Exhibit NRC000054 at 13. It is believed that such high-flow pulses benefit fish spawning, inundate low-lying floodplain areas that can be utilized by aquatic species, and flush oxbow lakes. *Id.*

Similarly, the Staff's direct testimony presented the results of a study that concluded that very large reductions in flows, far in excess of those expected from consumption of water due to the additional VEGP units, need to occur on a river the size of the Savannah before fish populations are extirpated or even adversely affected. Staff EC 1.2 Direct Testimony at A14; Exhibit NRC000027. Additionally, the Staff's direct testimony demonstrated that the day-to-day variation of river flow of the Savannah River in the vicinity of the site is often greater than the proposed Units 3 and 4 water consumption rate. Staff EC 1.2 Direct Testimony at A14; Exhibit NRC000041. Any variation in river flow attributable to the future operation of VEGP Units 3 and 4 would be minor compared to upstream releases from Thurmond Dam along with natural variation in river flow between the dam and the VEGP site.

The Staff reaffirms its conclusion that the small contribution in flow reduction due to the consumption of water (62 cfs) by operation of two additional units will have no detectable effect on the Savannah River fishery. Exhibit NRC000001 at 7-5. Furthermore, the fact that flow

variations in excess of several hundredfold have occurred in the past in the Savannah River, and fish species persist in the river, supports the premise that fish are preadapted to tolerate wide variations in river flow. For the reasons discussed above and in my direct testimony, I do not believe that additional data or analysis in the FEIS is necessary to support the conclusion that the fish are able to tolerate variations in flow resulting from the operation of two additional units at the VEGP site.

IV. Flow Considerations and Water Withdrawals

Q18. Dr. Young states that the "FEIS fails to consider a sufficient range of flows" and considers only flows of 8830 cfs, 4200 cfs, 4000 cfs, and 3800 cfs. Young EC 1.2 Testimony at A24. Is that correct?

A18. (MTM, LWV) The Staff disputes Dr. Young's assertion that the range of flows considered in the FEIS was insufficient. The range of flows considered in the draft EIS (8830 cfs to 3800 cfs) was indeed appropriate for a NEPA analysis because it reflected reasonably anticipated flow conditions, even during drought conditions. However, the Staff decided, based on comments to the DEIS associated with the ongoing drought, to include two lower flows (3000 cfs and 2000 cfs) in the final EIS to provide additional conservative context. Exhibit NRC000001 at 5-9. Thus, contrary to Dr. Young's claim, the Staff considered a sufficient range of flows in the FEIS, including flows lower than 3800 cfs. For example, the Staff evaluated impingement and entrainment losses at the Savannah River under average-daily and Drought Level 3 flow conditions (*Id.* at 5-30 and 5-31) and at very-low flows of 3000 cfs and 2000 cfs. *Id.* at 5-38 and 7-24 and 7-25. The Staff's direct testimony described how the Staff evaluated impacts to aquatic biota at a variety of streamflows including the average-daily discharge (8830 cfs), Drought Level 3 (3800 cfs), 3000 cfs and 2000 cfs. Staff EC 1.2 Direct Testimony at A38, A41, A45, A48, A50, A59, and A60.

Q19. Dr. Young asserts that "the level is below Drought Level 3, the lowest level considered" and that "the area is experiencing extreme drought conditions not contemplated by the FEIS." Young EC 1.2 Testimony at A24. Is that correct?

A19. (LWV) No. The Savannah River Basin has drifted between Drought Level 2 and Drought Level 3 for the past few months. The Savannah River Basin has never reached Drought Level 4. The Staff determined that it was appropriate to base its NEPA analysis of impacts of operation under low flow conditions on Drought Level 3, which has never been exceeded. In any event, as explained above in response to Question 18, the flows under the current drought conditions are still bounded by the flows of 3000 cfs and 2000 cfs analyzed in the FEIS.

Q20. Mr. Sulkin also asserts that "actual Savannah River discharge has consistently been below 3,800 cfs since November 2007, and was recently reduced to 3,100 cfs." Sulkin EC 1.2 Testimony at A14. In Exhibit JTI000021, he also lists "3100 cfs" as "Current Flow." Do you know what Mr. Sulkin means by "actual Savannah River discharge"?

A20. (LWV) Mr. Sulkin appears to be referring to flows at Thurmond Dam. However, as the Staff explains in its direct testimony, while the Staff used Thurmond Dam releases in the FEIS as a method of estimating flows at the site, tributaries and groundwater do contribute to the Savannah River between Thurmond Dam and VEGP site. Staff EC 1.2 Direct Testimony at A37. The Staff's direct testimony presented recent flow data from the gauge at Waynesboro, GA that indicated flows past the site were consistently higher than the releases at the Dam. Exhibit NRC000041. The relationship between the Waynesboro gauge flows and the Thurmond Dam releases is also illustrated in the graph presented as Exhibit NRC000026. Therefore, the Staff believes its analysis in the FEIS using a streamflow of 3800 cfs for low flow conditions is appropriate and thereby provides conservative estimates of what fractional withdrawals and consumptive use of the Savannah River flows will be at the VEGP site. In any event, as

explained previously, the flows under the current drought conditions would be bounded by the flows of 3000 cfs and 2000 cfs analyzed in the FEIS.

Q21. Dr. Young also states that the "FEIS fails to consider a sufficient range of flows in its analysis of water intake percentages and their affect [sic] on entrainment and impingement[.]" Young EC 1.2 Testimony at A21. Dr. Young asserts that the FEIS "lacks sufficient analysis of entrainment and impingement during low flows, even though low flows are reasonably likely to occur" and that the FEIS "should, at the very least, include analysis of flows ranging from normal to Drought Level 4." *Id.* Did the Staff analysis of impingement and entrainment include consideration of flows lower than 3800 cfs, and does the Staff disagree that the analysis should include Drought Level 4 flows?

A21. (MTM) Yes. As explained in A18 above, the Staff considered a range of flows in its assessment of impacts due to impingement and entrainment. The Staff evaluated impingement and entrainment losses at the Savannah River under average and Drought Level 3 flow conditions (Exhibit NRC000001 at 5-30, 5-31) and at very-low flows of 2000 cfs and 3000 cfs. *Id.* at 5-38, 7-24 and 7-25. The Staff's direct testimony described how the Staff evaluated impacts to aquatic biota at a variety of river flows, including the average-daily discharge flow (8830 cfs), Drought Level 3 (3800 cfs), and very-low flows of 3000 cfs and 2000 cfs. Staff EC 1.2 Direct Testimony at A38, A41, A45, A48, A50, A59, and A60. The Staff also described how it evaluated the changes in flows related to the cooling system operation associated with changes between Revision 15 and Revision 16 of the AP1000 DCD. *Id.* at A62.

With respect to evaluating impacts to aquatic biota at Drought Level 4, the Staff determined that without explicit flow levels (and given the likelihood that any such flow levels would likely change based on the ongoing development of the Draft Drought Contingency Plan) and because Drought Level 4 would be an extremely rare event, it was still conservative to base its low-flow analysis in the FEIS on Drought Level 3 flows (3800 cfs). Exhibit NRC000001 at

E-44; Staff EC 1.2 Direct Testimony at A38. Therefore, the Staff did not assess the impact to aquatic biota at Drought Level 4.

Q22. In his testimony, Mr. Sulkin calculates "withdrawal and consumption use rates" using a range of flows including 957 cfs, which he defines as "Drought Level 4, the hypothetical unimpaired minimum flow if there were no dams or reservoirs[.]" Sulkin EC 1.2 Testimony at A15. He mentions that this value was reported in NUREG-1437, Supplement 34, in connection with the renewal of the Vogtle Units 1 and 2 licenses. *Id.* at A16. Would it be reasonable to analyze a "hypothetical minimum" 957 cfs flow rate as part of the Staff's analysis in the FEIS?

A22. (JSC, LWV) No. The 957 cfs flow value mentioned in the license renewal FSEIS was described as "the hypothetical minimum flow during the most extreme drought[.]" Exhibit JTI000022 at 4-13. Such extreme conditions are considered as part of the safety analysis for the site, but not as a representative scenario for an environmental analysis. (Low river water is not a safety consideration for the proposed ESP units because the AP1000 design relies on a passive cooling design.) Safety analyses rely on extremely conservative bases, rather than on representative conditions. Such extreme design bases for safety reviews are not appropriate for a NEPA review.

Q23. Mr. Sulkin states that it "may be reasonable to use 2,000 cfs as a lower bound for estimating potential future flow at the Vogtle site, but the FEIS should be consistent in calculating flow percentages for all of the different withdrawal and use scenarios and flows." Sulkin EC 1.2 Testimony at A25. Did the FEIS identify flow percentages for the relevant range of uses (e.g., the likely water withdrawals of the four Vogtle Units) and flows?

A23. (LWV) The FEIS did calculate flow percentages consistently for the range of conditions that the Staff considered to be representative of likely flow conditions and likely operating conditions. The Staff does not believe that 2,000 cfs is a representative flow condition. The Staff included some lower flows (3000 cfs and 2000 cfs) in the FEIS in response

to comments to the DEIS associated with the drought. However, particularly in light of the data confirming that there is generally net inflow between the Thurmond Dam and the VEGP site, the Staff believes that 3800 cfs is representative of low flow conditions in the Savannah River at the VEGP site. *See* Exhibit NRC000041; Staff EC 1.2 Direct Testimony at A35 to A37. As mentioned in A22, the 957 cfs flow value that Mr. Sulkin listed in JTI000021 is entirely inappropriate for a NEPA analysis, as it represents a worst-case scenario. Mr. Sulkin also refers to 3100 cfs as the current flow in JTI000021. As the Staff explained above in A20, Mr. Sulkin appears to be referring to the current release from Thurmond Dam; while the Staff has used this methodology, the flows currently being measured at the VEGP site indicate that use of the Dam flows is a conservative approach. Finally, with respect to the operating conditions that are appropriate to consider in assessing the cumulative withdrawals for all four Vogtle Units, as described in A4, the Staff has revised its estimates of the Unit 1 and 2 contribution to cumulative withdrawals based on the Joint Intervenors' testimony. However, in doing so the Staff explained why it is still not appropriate to assume maximum withdrawals by all four units as a basis for determining cumulative impacts.

Q24. Mr. Sulkin also argues that the Staff consideration of withdrawal percentages "does not capture the time dimension – the frequency of extremely low flows and their duration." Sulkin EC 1.2 Testimony at A25. Is it necessary for the FEIS to specify the likely frequency and duration of extremely low flows?

A24. (LWV) No. The Staff determined the impacts under steady low flow conditions (3800 cfs) to be SMALL. As the Staff mentions in its direct testimony, the streamflow values used in the FEIS assumed releases at Thurmond Dam, but flows are likely to be higher at the VEGP site as a result of runoff between Thurmond Dam and the VEGP site and, therefore, withdrawals from the proposed Vogtle units would result in even smaller impacts than those analyzed for 3800 cfs. Staff EC 1.2 Direct Testimony at A37. Furthermore, in response to

comments on the DEIS associated with the ongoing drought, the Staff provided additional conservative context by considering flows of 3000 and 2000 cfs. While droughts may exist over extended periods of time, the Staff still does not believe that flows of 3000 cfs and 2000 cfs are representative of anticipated drought conditions, whereas 3800 cfs is a better representation of such conditions. The Staff thus did not consider it necessary to elaborate on the expected frequency of flow departures from this conservative condition. However, in the unlikely event that 3000 cfs or 2000 cfs flows were to ever occur at the VEGP site, the Staff believes that such flows would be of short duration.

Q25. Mr. Sulkin describes water withdrawals using primarily Revision 16 to the AP1000 Design Control Document (DCD). Sulkin EC 1.2 Testimony at A17 to A20; Exhibit JTI000021. In the FEIS, did the Staff describe changes in water use percentages associated with the differences between Revision 15 and Revision 16?

A25. (LWV) Yes. The Staff discussed the differences between Revision 15 and Revision 16 of the DCD in the FEIS. Exhibit NRC000001 at 5-10, 7-6, 7-7, 7-10, 7-12 and 7 Errata. The Staff also presents values for the differences between Revision 15 and Revision 16 based on the revised water withdrawal estimates for Units 1 and 2 described in A4 of this testimony. Similarly, as Mr. Sulkin points out in his testimony regarding his independent assessment, there is little difference in withdrawal percentages associated with the differences between Revision 15 and Revision 16 of the AP1000 DCD. Sulkin EC 1.2 Testimony at A19.

Q26. Mr. Sulkin asserts that "[t]here is no scientific or regulatory basis for setting the threshold of significance for withdrawals at 5% of the total flow." Sulkin EC 1.2 Testimony at A11. Did the Staff set or rely on a 5% "threshold of significance" for water withdrawals in reaching its conclusions with respect to entrainment in the FEIS?

A26. (MTM) The Staff did not use the phrase "threshold of significance" in its analysis in either the DEIS or the FEIS. The phrase appears in the FEIS in a comment by the Georgia

Water Coalition on the DEIS. Exhibit NRC000001 at E-33. The Staff does not believe that there is a threshold of significance with respect to impact to the fishery related to water withdrawals in excess of the five percent limit required by 40 CFR § 125.84(b)(3)(i). The Staff did consider the proportional flow requirements of the EPA's Phase I regulations. Exhibit NRC000001 at 5-30; Staff EC 1.2 Direct Testimony at A28. In the Staff's direct testimony, the Staff specifically stated that "the Staff considered the US EPA requirements implementing section 316(b) of the Federal Water Pollution Control Act…," which include the five percent annual mean flow withdrawal requirement for intake structures located in freshwater rivers and streams. Staff EC 1.2 Direct Testimony at A14. The Staff's conclusion regarding the level of impact related to entrainment losses is based on an evaluation of several factors, including the design, location, and planned operation of the intake structure; the site location and the uniqueness of the habitat in the vicinity of the site; the site hydrology; the applicable life history data for "important species"; and nearby past and recent field studies. Staff EC 1.2 Direct Testimony at A28; Exhibit NRC000001 at 5-30 to 5-33. The Staff's conclusions are not based solely on whether or not the intake would in fact meet the EPA requirements. *See* Exhibit NRC000001 at 5-30 to 5-33. In the FEIS, the Staff was merely pointing out that EPA had established these requirements and that the intake structure for the new Vogtle units will likely be consistent with the requirements. Exhibit NRC000001 at 5-30; Staff EC 1.2 Direct Testimony at A28. Presumably, the EPA regulations are protective of the aquatic environment.

Although the Staff did not rely on the EPA requirement to arrive at the level of significance for entrainment impacts at Vogtle, some background on how the EPA arrived at the five percent value is helpful. In the EPA's description of the basis for the requirement that a facility located on a freshwater stream or river withdraw no more than five percent of the annual mean flow, EPA makes the argument that the scientific literature and its rulemaking record "contain[s] ample evidence to support the proposition that reducing flow and capacity reduces

impingement and entrainment." Exhibit NRC000035 at 65,300. EPA further states that "[t]he 5 percent value mean annual flow [sic] reflects an estimate that this would entrain approximately 5 percent of the river or stream's organisms and a policy judgment that such a degree of entrainment reflects an inappropriately located facility." Exhibit NRC000035 at 65,301. The proposed rule for new facilities published in the Federal Register on August 10, 2000, provides additional insight into why the EPA chose five percent of the annual mean flow as the limit for withdrawals from rivers and streams. 65 Fed. Reg. 49,060 (Exhibit NRC000055). In the supplemental information to the proposed Phase I rule, EPA states that

> The five percent requirement would establish a maximum level for entrainment effects that, in all areas within 50 meters of the littoral zone, would be further reduced by additional requirements (such as requirements to reduce cooling water withdrawals, and additional design and construction technologies to further reduce impingement and entrainment). EPA estimates that the combination of these requirements (and the design intake velocity limitation for reducing impingement in almost all waterbody types) should result in protection of greater than 99 percent of the aquatic community from impingement and entrainment.

Exhibit NRC000055 at 49,085. EPA states that the combination of requirements "provide[s] the minimum level of protection for designated uses that reflect the goals in section 101(a) of the CWA, i.e. 'protection and propagation of fish and shellfish and wildlife and recreation in and on the water.'" *Id.* The Staff believes that EPA in its rulemaking was not establishing a uniform threshold at which the significance level of impacts changes from SMALL to MODERATE or LARGE, but rather was defining the combination of requirements, including limiting the withdrawal rate from rivers and streams, that will provide adequate protection to aquatic biota inhabiting the waterbody.

In any event, as stated above, the Staff did not rely on the 5 percent requirement to conclude that the impact of entrainment on the Savannah River fishery would be SMALL. The Staff's analysis is presented in section 5.4.2.2 of the FEIS and section II.C of the Staff's direct testimony. Exhibit NRC000001 at 5-30 to 5-33; Staff EC 1.2 Direct Testimony. The Staff's

testimony stated that the normal water withdrawal of the two proposed units would be approximately 1.2 percent of the annual mean flow, which was conservatively derived from the Waynesboro, GA gauge using a limited record during an extended drought. Staff EC1.2 Direct Testimony at A43. Therefore, assuming entrainment losses are proportional to withdrawal rate (see A12 above) and that the five percent value established by EPA in concert with other requirements would result in protection of greater than 99 percent of the aquatic community, then a withdrawal rate of 1.2 percent, approximately a four-fold decrease in EPA's proportional flow withdrawal requirement, would result in even less entrainment mortality. This conclusion is consistent with the Staff's testimony and the FEIS.

Q27. Mr. Sulkin states that the "FEIS obscures the fact that several scenarios result in withdrawals that exceed the 5% threshold of significance." Sulkin EC 1.2 Testimony at A11. He also asserts that the presentation of the Staff's calculations in the FEIS is problematic. *Id.* at A14. Did the FEIS identify circumstances under which withdrawals would exceed 5% of the river flow? Please explain the Staff's approach, including how it presented the flows and associated withdrawals in the FEIS.

A27. (LWV) The Staff intentionally limited the values listed in the tables of the FEIS to the range of flows (mean annual flow of 8830 cfs to Drought Level 3 of 3800 cfs) that Staff considered representative of likely conditions consistent with the objectives of NEPA analysis. Exhibit NRC000001 at 5-9. Based on comments to the DEIS, the Staff added additional text to describe impacts at lower flows, flows that the Staff nevertheless considers unrepresentative of future flow conditions. The Staff did not include the values in the FEIS tables (3000 cfs and 2000 cfs) because the Staff believes they are not representative of likely conditions. The Staff did not obscure this information but instead provided additional context for the reader beyond what the Staff believes is necessary under NEPA. The Staff explicitly acknowledges that withdrawal percentages in excess of 5% can occur at low flows and high withdrawals. However,

as discussed further in A26 above, the Staff does not make its impact determination based solely on the 5% criteria and the Staff believes these conditions are overly conservative for highlighting in a NEPA analysis.

Q28. Mr. Sulkin states that the "5% threshold is not compelled by any statute or regulation." Sulkin EC 1.2 Testimony at A12. Is this assertion consistent with the Staff's understanding of the 5 percent withdrawal requirement as set forth in 40 CFR 125.84? In light of Mr. Sulkin's assertions, please explain under what conditions the 5 percent withdrawal requirement applies and whether the FEIS properly considered it.

A28. (MTM) The Staff believes that the 5 percent withdrawal requirement is compelled by EPA regulations at 40 CFR § 125.84(b)(3)(i). As stated in the Staff's direct testimony, the EPA established national technology-based performance requirements in its December 18, 2001 rulemaking. Exhibit NRC000035 at 65,256; Staff EC 1.2 Direct Testimony at A22. EPA's regulations at 40 CFR 125.84(b)(3)(i) state "[f]or cooling water intake structures located in a freshwater river or stream, the total design intake flow must be no greater than five (5) percent of the source water annual mean flow;…". The 5 percent withdrawal requirement applies to owners or operators of a new facility that have withdrawals of equal to or greater than 10 million gallons per day ("MGD"). As stated in Staff testimony, the proposed VEGP Units 3 and 4 would withdraw approximately 54 MGD. Staff EC 1.2 Direct Testimony at A22.

In response A26 above, the Staff stated that it based its conclusion regarding the level of impact related to entrainment losses on an assessment of impact, not on whether or not the design, location and proposed operation of the intake met the EPA requirements. *See also* Exhibit NRC000001 at 5-30 to 5-33. The Staff in the FEIS and its testimony merely was pointing out that the intake structure for the new Vogtle units will likely be consistent with the EPA regulations and that the EPA regulations were presumably protective of the aquatic environment. *Id.*; Staff EC 1.2 Direct Testimony at A22.

Q29. Mr. Sulkin states that with respect to the 5 percent proportional withdrawal requirement, the Staff failed to assess the condition in which 1) all four reactors are operating in their maximum capacity mode and 2) one or more of the reactors is operating in the maximum water withdrawal mode while the remainder are in normal mode. Sulkin EC 1.2 Testimony at A21. Does the Staff agree that the scenarios raised by Mr. Sulkin must be considered in the Staff's environmental analysis?

A29. (MTM) In its direct testimony, the Staff stated that "[n]ormal withdrawals are most representative of the combined flows of all four units operating. Because maximum withdrawal[s] are rare, it is unlikely that maximum withdrawal rates would occur at more than one unit at any time. Maximum withdrawals (and maximum blowdowns) are primarily associated with activities to control the water chemistry in the cooling tower and are not associated with changes in consumptive water use. Furthermore, such periods are partially offset by periods when one of the units is experiencing an outage." Staff EC 1.2 Direct Testimony at A51. Therefore, the Staff concluded that it was unreasonable to assess cumulative impact to aquatic biota under the conditions of all four VEGP units operating simultaneously at their maximum withdrawal rates.

The Staff acknowledges that there could be periods in which one or more units are withdrawing at or near their maximum rates. However, as described in response to Question 4 above, such conditions would be infrequent and of short duration. As explained further in A4, the Staff has reconsidered the withdrawal rates for Units 1 and 2 for its cumulative impacts analysis and determined that using higher withdrawal rates for Units 1 and 2 (104 cfs) in its assessment of cumulative impact would be more appropriate. Nevertheless, the Staff evaluated that change in the Units 1 and 2 withdrawal value and, because it resulted in only a small change in the total percentage of water withdrawn, concluded that the change was not

significant for its impact conclusions. The Staff also noted that withdrawals would still meet the EPA 5% withdrawal requirement (see A4 above), even assuming higher withdrawals from the two existing (136 cfs) and two proposed (129 cfs) Units and assuming a conservative annual mean flow (6691 cfs). Furthermore, as explained in response to Question 6 above, the station water withdrawal rate from the river is only one of several factors taken into consideration by the staff in assessing impact. The Staff concludes that the impact due to entrainment on the Savannah River fishery, even with infrequent and temporary use of maximum pumping rates by the Vogtle units, would have no detectable effect on fish populations inhabiting the river.

Q30. Mr. Sulkin asserts that "short term maximum withdrawal conditions can result in significant cumulative impacts on water resources and aquatic species." Sulkin EC 1.2 Testimony at A21. Is the Staff aware of the basis for this statement?

A30. (MTM) The Sulkin testimony offers no explanation of the assertion that short term maximum withdrawal conditions can result in significant cumulative impacts on water resources and aquatic effects. The Staff acknowledges that increasing the withdrawal rate for one or more units could result in some increased mortality to aquatic organisms but, as explained in the response to Q29 above, such maximum withdrawals would be infrequent and would be of short duration. Therefore, the Staff believes that such transients would have no lasting effect on aquatic populations inhabiting the Savannah River.

V. Thermal Impacts

Q31. Dr. Young states that reduced river flow "places more of the drift community at danger of thermal impacts due to river channel confinement" and that low flow reduces "the ability for the heat to be dissipated across time and space." Young EC 1.2 Testimony at A26. Does the Staff's analysis in the FEIS account for these considerations?

A31. (ARK) Yes. The Staff's direct testimony and Section 5.4.1.4 of the FEIS discuss the relationship between river flow and habitat availability in the Savannah River. Staff EC 1.2 Direct Testimony at A14; Exhibit NRC000001 at 5-25, 5-26. The Staff considered the flow-habitat relationship and its potential to affect the availability of suitable habitat, specifically the potential impact to aquatic organisms due to the reduction in flow resulting from the consumptive use of the river water. The Staff determined the reduction in river stage would be negligible, even at river flow rates of 3000 cfs and 2000 cfs, and any impacts to downstream shoreline habitat would result principally from the extremely low river flows, not the consumptive use. Exhibit NRC000001 at 5-25, 5-26.

A59 and A60 of the Staff's direct testimony discuss thermal impacts to aquatic resources from VEGP Units 3 and 4 operations under Drought Level 3 (3800 cfs) and very-low (less than 3800 cfs) river flows, respectively. Staff EC 1.2 Direct Testimony at A59, A60. The Staff concluded that due to the small plume size and resultant short duration of plume transit, only a small percentage of fish eggs and larvae would be lost, resulting in minor and undetectable impact to fish populations. *Id.* At a very-low river flow of 2000 cfs, the mixing zone plume would approximately double in areal extent; however, the lateral extent of plume relative to river width at these flow rates would still be small. *Id.* at A58. The Staff determined that even a doubling in its area would not represent a significant impact to water quality in the river. Exhibit NRC000001 at Errata 7. The Staff believes the very-low flow conditions would be rare and of only temporary duration, and unlikely to occur during the spring and early summer spawning period. In the FEIS the Staff reviewed the potential for thermal impacts to the aquatic environment in the vicinity of the VEGP site and concluded that impacts to aquatic organisms from thermal discharges from the proposed VEGP Units 3 and 4 would be minor. *Id.* at 5-34.

Q32. Dr. Young states that "[t]he FEIS fails to consider *all possible* river conditions and rather, focuses on *conservative* river conditions. The FEIS lacks analysis under elevated

temperatures." Young EC 1.2 Testimony at A27 (emphasis added). Is it necessary to consider "all possible" river conditions when evaluating thermal stress at the VEGP site?

A32. (ARK, LWV) No, it is not necessary to consider "all possible" river conditions when evaluating thermal stress at the VEGP site, particularly when the Staff's initial analysis, developed with conservative inputs, resulted in a thermal plume with a very small areal extent. The Staff examined an appropriate range of variable effluent and river discharge conditions considering the VEGP location (deep river channel with steep banks). For a bounding analysis with the largest plume (5°F above ambient isotherm), the Staff employed conservative inputs for key parameters for the CORMIX assessment considering a Drought Level 3 flow of 3800 cfs. This analysis is explained in Staff EC 1.2 Direct Testimony at A57; the resulting plume length and width were 97 ft and 15 ft, respectively. Exhibit NRC000001 at 5-18. Note that the largest plume, assuming fixed river and effluent discharge rates, occurs when the temperature difference is the greatest between the ambient river and the discharging effluent. Therefore, the maximum temperature difference occurs when the ambient river temperature is at a minimum (e.g. mid-winter). *Id.* Thus, as the ambient river temperature increases, the plume size decreases.

For additional conservatism, the Staff considered thermal impacts under flows of 3000 and 2000 cfs and analyzed how the thermal plume and associated impacts would change under such very-low flows. Staff EC 1.2 Direct Testimony at A58; Exhibit NRC000001 at Errata 7. As stated in the FEIS, the plume at 2000 cfs would be approximately twice the areal extent of the plume at 3800 cfs. Exhibit NRC000001 at Errata 7.

In its direct testimony, the Staff describes how it followed guidance in ESRP Section 5.3.2.2 directing its description, quantification, and assessment of potential thermal stresses to aquatic organisms (A54), what information it used to make its conclusions regarding thermal impacts (A55), and why it was not necessary to include thermal tolerance data on various

species and their life stages to predict thermal impacts (A56). Staff EC 1.2 Direct Testimony at A54, A55, and A56.

The Staff's direct testimony details how the Staff evaluated thermal impacts to aquatic biota at Drought Level 3 (3800 cfs) (A59) and at very-low river flows, namely down to 2000 cfs (A60). Staff EC 1.2 Direct Testimony at A59, A60. The FEIS concluded that impacts to the aquatic ecosystem from the thermal discharge from the proposed VEGP Units 3 and 4 are likely to be minor based upon the size of the thermal plume relative to the size of the Savannah River at the Drought Level 3 flow of 3800 cfs. Exhibit NRC000001 at 5-38. The Staff also concluded that given the small size of the plume at Drought Level 3, even doubling the area under the very-low flow conditions would not represent a significant impact to water quality in the river. Staff EC 1.2 Direct Testimony at A60; Exhibit NRC000001 at Errata 7. The FEIS stated that "the effects on aquatic biota in the river from the thermal … discharges from VEGP Units 3 and 4 at the 3000 and 2000 cfs river flow rates, even at maximum withdrawal rates, would not result in impacts to aquatic biota that are significantly different from those analyzed for VEGP operation at Drought Level 3." Exhibit NRC000001 at 5-39.

Because the conservative and cumulative conditions evaluated by the Staff resulted in such a small plume, it was not necessary to look at a wider range of conditions in order to be able to make a reasonable determination of thermal impacts. The Staff's conclusion that impacts to the aquatic ecosystem from the thermal discharge would be minor is also confirmed by the National Marine Fisheries Service's (NMFS) response to the Staff's January 2008 Biological Assessment, which was received after publication of the FEIS. Exhibit SNC000022. The NMFS stated that "[t]he potential effect from thermal discharge will be insignificant[.]" *Id.* at 4.

Q33. Dr. Young states that "[t]he FEIS does not provide sufficient data and analysis of thermal stress and mortality for the fish species located in the Middle, Lower, and estuarine

Savannah River." Young EC 1.2 Testimony at A27. Dr. Young also states that "[h]igh water temperature kills the early life history stages of several highly-valued fish found near VEGP, and most likely also causes mortality in many less-studied and less-desired Savannah River fish species"; he presents examples of several fish species that he says "suffer mortality" at particular temperatures, and he describes effects of water temperature changes on early stages of striped bass. *Id.* Does the Staff agree with this assessment, and does the Staff analysis in the FEIS account for the studies cited with respect to mortality of individual species?

A33. (ARK) The Staff does not agree with Dr. Young's assessment. The Staff followed the guidance provided in ESRP Section 5.3.2.2, "Aquatic Ecosystems" (2000) (Exhibit NRC000009) and considered the areal extent of the thermal plume, the effects of the thermal plume on "important" aquatic biota, as well as the current National Pollutant Discharge Elimination System (NPDES) permit for the VEGP Units 1 and 2. The Staff determined that thermal tolerance data on various species and their life stages was not necessary to predict impacts for the following reasons.

First, as described in my direct testimony and in the FEIS, the Staff considered the physical and thermal characteristics of the plume in relation to the receiving water body. Staff EC 1.2 Direct Testimony at A54. At the location of the discharge outfall, at a Drought Level 3 flow rate (3800 cfs), the Savannah River is approximately 312 feet wide, with an average depth of 8.2 feet, and a cross-sectional average velocity of 1.50 ft/s. The local water depth near the outfall, which is located near the deepest point in the cross section, is 10.0 feet. Exhibit NRC000001 at 5-17. Assuming conservative river conditions (e.g., minimum river temperatures, maximum discharge temperatures), the maximum width of the 5°F isotherm would be 15 feet while the length would be 97 feet downstream of the outfall pipe. *Id.* at 5-33. Based on these calculations, the Staff determined that the size of the thermal plume would be small (about 5% of the river cross section) in comparison to the width of the Savannah River at

the VEGP site. The Staff also considered thermal impacts at a very-low flow (2000 cfs). *Id.* at Errata 7. Under this scenario, which would be an extremely rare event, the mixing zone plume would approximately double in areal extent and would not represent a significant impact to water quality in the river. *Id.* As described in the Staff's direct testimony, such very-low flow conditions are expected to be temporary and, based on the historical record of flows since the construction of the upstream impoundments, would be more unlikely during the spring and early summer spawning period when most river-running species are moving up and down river. Staff EC 1.2 Direct Testimony at A60. Additionally, that testimony explains that should low flow rates result in an unacceptable thermal impact or should the Applicant exceed its mixing zone requirements, Southern could be directed by the State resource agencies to reduce power or cease power operations. *Id.*

Next, the Staff, in following the guidance of ESRP 5.3.2.2, considered "[i]f 'important' aquatic species are present and are susceptible to heat shock resulting from plant-cooling-system discharges to the receiving water bodies such that the effects will be detectable or may destabilize or noticeably alter population levels[.]" Exhibit NRC000009 at 5.3.2.2-6. The Staff concluded that given the small size of the plume relative to the river, the thermal plume would not create a barrier to the up- or down-stream migration of important fish species, including the robust redhorse and the shortnose sturgeon. Exhibit NRC000001 at 5-36, 5-42. And, as my colleague Dr. Masnik stated in the Staff's direct testimony, "[f]ish actively avoid areas of unhealthy water temperatures, provided there is an escape route." Staff EC 1.2 Direct Testimony at A59. The Staff acknowledges in that testimony that there may be some mortality of eggs and larvae as they pass through the plume; however, this would be only a small percentage of the total number of organisms passing the site, resulting in minor and undetectable impact to fish populations. *Id.* at A56, A59. In addition, due to the short transit

time within the plume due to the small area it encompasses, there would be some survival of eggs and larvae, thereby reducing the thermal impact to fish populations. *Id.* at A59.

The Staff concluded that since the areal extent of the thermal plume would be so small and the transit time through the plume would be so short, fish populations would remain stable even if some eggs and larvae would be affected by the thermal plume. *Id.* at A56. The Staff determined that cooling-system discharge impacts on aquatic biota from the proposed VEGP Units 3 and 4 would be minor. Exhibit NRC000001 at 5-34. Therefore, in accordance with the ESRP guidance and based upon the Staff's analysis of cooling-system discharge impacts, the Staff determined that a review of additional thermal tolerance and mortality data for various fish species and their life stages in the Middle, Lower, and estuarine Savannah River was not necessary to predict thermal impacts. Staff EC 1.2 Direct Testimony at A56.

Finally, as my colleague Dr. Masnik explained in the Staff's direct testimony, VEGP Units 1 and 2 are in compliance with the current NPDES permit (GA0026786) issued by the State of Georgia, and the Staff anticipates that Units 3 and 4 would also comply with State requirements. *Id.* at A61. Additionally, the FEIS states there have been no fish kills related to the thermal discharge reported from the site. Exhibit NRC000001 at 2-93, 5-33.

For these reasons, the Staff's analysis in the FEIS already appropriately accounts for the temperature effects on individual species.

Q34. Dr. Young asserts that the FEIS does not provide a comprehensive analysis of potential thermal impacts on vulnerable life history stages of fish species. Young EC 1.2 Testimony at A28. He argues that "[f]ish thermal tolerance and mobility changes across life history stages," that "[e]ggs have no mobility and reduced thermal tolerance during embryonic development," and that the FEIS does not present "data detailing spatial distribution of ichthyoplankton drift in the vicinity of the thermal plume[.]" *Id.* Does the Staff's analysis account for these concerns?

A34. (ARK) Yes, the Staff's analysis does account for the potential impacts to the vulnerable life history stages of fish species. As my colleague Ms. Krieg explained in the Staff's direct testimony, the Staff evaluated the discharge temperature, plume size as estimated by CORMIX code, design and location of discharge structure, and the width and bathymetry of the river at the discharge site. Staff EC 1.2 Direct Testimony at A55. The Staff also considered river velocity. Exhibit NRC000001 at 5-17. Following the guidance at ESRP 5.3.2.2 (Exhibit NRC000009 at 5.3.2.2-7, 5.3.2.2-8), the Staff considered the small areal extent of the thermal plume relative to the cross section of the Savannah River and the relatively short transit time of eggs and larvae within the plume. Staff EC 1.2 Direct Testimony at A56, A59. Due to these considerations, a comprehensive analysis of ichthyoplankton drift in the vicinity of the thermal plume is not warranted.

Q35. Does this conclude your testimony?

A35. (ALL) Yes.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

AFFIDAVIT OF MICHAEL T. MASNIK CONCERNING
PREFILED REBUTTAL TESTIMONY ON ENVIRONMENTAL CONTENTION 1.2

I, Michael T. Masnik, do declare under penalty of perjury that my statements in *NRC Staff Rebuttal Testimony of Dr. Michael T. Masnik, Anne R. Kuntzleman, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 1.2*, are true and correct to the best of my knowledge, information, and belief.

Executed in Accord with
10 C.F.R. § 2.304(d)

_____
Michael T. Masnik

Executed at Rockville, Maryland
This 6th day of February, 2009

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

AFFIDAVIT OF ANNE R. KUNTZLEMAN CONCERNING PREFILED REBUTTAL TESTIMONY ON ENVIRONMENTAL CONTENTIONS 1.2 AND 6.0

I, Anne R. Kuntzleman, do declare under penalty of perjury that my statements in *NRC Staff Rebuttal Testimony of Dr. Michael T. Masnik, Anne R. Kuntzleman, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 1.2*, and in *NRC Staff Rebuttal Testimony of Anne R. Kuntzleman Concerning Environmental Contention EC 6.0,* are true and correct to the best of my knowledge, information, and belief.

Executed in Accord with
10 C.F.R. § 2.304(d)

_____
Anne R. Kuntzleman

Executed at Rockville, Maryland
This 6th day of February, 2009

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

AFFIDAVIT OF REBEKAH HARTY KRIEG CONCERNING
PREFILED REBUTTAL TESTIMONY ON ENVIRONMENTAL CONTENTION 1.2.

I, Rebekah Harty Krieg, do declare under penalty of perjury that my statements in *NRC Staff Rebuttal Testimony of Dr. Michael T. Masnik, Anne R. Kuntzleman, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 1.2*, are true and correct to the best of my knowledge, information, and belief.

Executed in Accord with
10 C.F.R. § 2.304(d)

_____
Rebekah Harty Krieg

Executed at Richland, Washington
This 6th day of February, 2009

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

AFFIDAVIT OF JILL S. CAVERLY CONCERNING PREFILED
REBUTTAL TESTIMONY ON ENVIRONMENTAL CONTENTIONS 1.2

I, Jill S. Caverly, do declare under penalty of perjury that my statements in *NRC Staff Rebuttal Testimony of Dr. Michael T. Masnik, Anne R. Kuntzleman, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 1.2*, are true and correct to the best of my knowledge, information, and belief.

Executed in Accord with
10 C.F.R. § 2.304(d)

_____
Jill S. Caverly

Executed at Rockville, Maryland
This 6th day of February, 2009

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

AFFIDAVIT OF LANCE W. VAIL CONCERNING PREFILED
REBUTTAL TESTIMONY ON ENVIRONMENTAL CONTENTIONS 1.2 AND 1.3

I, Lance W. Vail, do declare under penalty of perjury that my statements in *NRC Staff Rebuttal Testimony of Dr. Michael T. Masnik, Anne R. Kuntzleman, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 1.2*, and in *NRC Staff Rebuttal Testimony of Lance W. Vail Concerning Environmental Contention EC 1.3*, are true and correct to the best of my knowledge, information, and belief.

Executed in Accord with
10 C.F.R. § 2.304(d)

_____
Lance W. Vail

Executed at Richland, Washington
This 6th day of February, 2009